Table 6: Vibration levels around Letpadaung Project area

Location	Vibration levels (mm/s)						Safe level according to DIN 4150-3 (mm/s)[1]		
	Hot dry season			Wet season			MSB	RB	IB
	Mean	Max	Min	Mean	Max	Min			
Station 1	0.371	1.400	0.000	0.360	1.500	0.000	3	5	20
Station 2	0.510	3.000	0.100	0.515	3.000	0.100	3	5	20
Station 3	1.383	4.800	0.400	1.410	5.900	0.400	3	5	20
Station 4	0.298	0.800	0.100	0.294	0.700	0.100	3	5	20
Station 5	0.229	1.200	0.100	0.225	1.200	0.100	3	5	20
Station 6	0.958	4.500	0.200	0.990	4.500	0.200	3	5	20
Station 7	0.360	1.500	0.000	0.373	1.500	0.000	3	5	20
Station 8	0.329	1.400	0.100	0.338	1.500	0.100	3	5	20
Station 9	0.279	1.300	0.100	0.271	1.200	0.100	3	5	20
Station 10	0.233	1.100	0.100	0.223	1.200	0.100	3	5	20

Prepared by Knight Piésold.
Source: MWMCL
Notes:
(1) Safe level for frequency less than 10 Hz
(2) MSB = More sensitive buildings
(3) RB = Residential buildings
(4) IB = Industrial buildings. Commercial, Industrial or Similar
Legend:

x	Values greater than MSB standard
x	Values greater than RB standard
x	Values greater than IB standard

In order to assess the mean records obtained at stations close to roads (stations 1, 2, 3 and 5), it has been considered to compare them to standards established by the Federal Transit Administration (FTA) of the U.S. Department of Transit. Based on mean vibration level records, expressed in mm/s, the velocity level was determined in $Lv_{ref\ 1\ \mu inches}$ (VdB) units. The velocity level (L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref1:\frac{micro\ in.}{sec}} = 20 \times \log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is the RMS (Root Mean Square) of velocity amplitude, and v_{ref} is the reference velocity amplitude.

Table 7: General assessment of vibration levels recorded close to roads

Location	Vibration levels in VdB ref 1 micro inch/sec		General assessment according to FTA(1)		
	Season		Category		
	Hot dry	Wet	C1(2)	C2(3)	C3(4)
Station 1	**83.3**	**83.0**	65	72	75
Station 2	**86.1**	**86.1**	65	72	75
Station 3	**94.7**	**94.9**	65	72	75
Station 5	**79.1**	**78.9**	65	72	75

Prepared by Knight Piésold.
Notes:
(1) Standard values for frequent events are defined as more than 70 vibration events of the same source per day (FTA, 2006). Most rapid transit projects fall into this category.
(2) C1 = Category 1. Buildings where vibration would interfere with interior operations
(3) C2 = Category 2. Residences and buildings where people normally sleep
(4) C3 = Category 3. Institutional land use, mainly during daytime
Legend:

x	Values greater than C1 standard
x	Values greater than C2 standard
x	Values greater than C3 standard

According to results shown in Table 7, vibrations are clearly felt by inhabitants who are close to the referred stations. According to FTA criteria (2006), the area close to these stations is suitable for dwellings that present resistant structures rather than for sensitive buildings.

4.2 METEOROLOGICAL INFORMATION

In order to model air quality dispersion (AERMOD View v. 8.2) and noise propagation (Sound PLAN v. 7.2), weather data generated by the MM5 model[1] has been used. This model contains hourly ground-level and vertical data. This data comprises the period from January 2010 to December 2012 and is representative for an area of 144 km^2 (MM5 model grid area), which is where the Letpadaung Project lies. The information generated by the MM5 model is based on global reanalysis climate data provided by the National Center for Environmental Protection (NCEP). This information has a resolution of 2.5 degrees for the entire planet, with records for every 6 hours. Table 8 shows the characteristics of information generated by the MM5 model.

[1]Developed by Pennsylvania State University (PSU) and National Center for Atmospheric Research (NCAR). MM5 meteorological model is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation.

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Table 8: Surface & Upper air met data pre-processed from MM5 meteorological model

Met data information	
Met data type:	AERMET-Ready (Surface &Upper air data)
Star-End date:	Jan 01, 2010 – Dec 31, 2012
Latitude:	22.084864 N
Longitude:	95.090047 E
Datum:	WGS84
Site time zone	UTC/GMT UTC + 6 hour(s)
Place:	Letpadaung Project
Calculated pseudo met station parameters	
Anemometer height:	14 m
Station base elevation:	98 m
Upper air adjustment:	-6 hour(s)
MM5-Processed grid cell	
Grid cell center (Lat, Lon):	22.084864 N, 9.090047 E
Grid cell dimension:	12 km x 12 km
Information of MM5 model:	http://www.mmm.ucar.edu/mm5/mm5-home.html
Hourly surface met data (*.sam)	
Format:	SAMSON (surface met data for preprocessing by AERMET)
Output interval:	Hourly
File format description:	http://www.webmet.com/MetGuide/Samson.html
Upper air data (*.ua)	
Format:	TD-6201 – Fixed Length (upper air met data for pre-processing by AERMET).
Data reported:	UTC/GMT
Output interval:	00Z and 12Z
File format description:	http://www.webmet.com/MetGuide/TD6200.html

Prepared by Knight Piésold
Source: Lakes Environmental Software

The hourly surface parameters that have been pre-processed by AERMET are:

- Total cloud cover (tenths)
- Dry bulb temperature (ºC)
- Dew point temperature (ºC)
- Relative humidity (%)
- Station pressure (mb)
- Wind direction (deg)
- Wind speed (meter/second)
- Ceiling height (m): 77777 = unlimited ceiling height
- Hourly precipitation quantity (hundreds of inches)

Graph 1 shows the variations of each meteorological parameter throughout the period 2010-2012, where one can see each parameter's variation. It also allows distinguishing the dry[2] (November to April) and wet season (May to October). Considering the information period 2010-2012, one can observe that temperatures vary between 10 and 35 °C; relative humidity, between 40 and 100%; atmospheric pressure, between 985 and 1005 mbar; wind speed, between calms (0 m/s) and 9 m/s; cloud cover, between partly clear sky (2-5 tenths) and cloudy sky (6-10 tenths); and cloud altitude is higher during the dry season (3,000-9,000 m) and lower during the wet season (2,500 m approximately).

Regarding wind speed (Graph 2), one can see that 2 directions predominate: the northern winds (September to May) and the southern ones (June to September); this behaviour seems to be influenced by monsoons, due to transportation of moist air masses that come from the south and dry air masses from the north. With respect to precipitation, Graph 3 shows the variation of this parameter throughout the months between 2010 and 2012; one can make out that monthly cumulative precipitation is higher during July, reaching a maximum of 384.81 mm in 2012. Table 9 shows daily precipitation values throughout the assessment period (2010-2012).

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[2] The dry season is divided into a cold-dry period (November to February) and a warm-dry one (March to April).

Graph 1: Hourly surface met data from January 2010 to December 2012

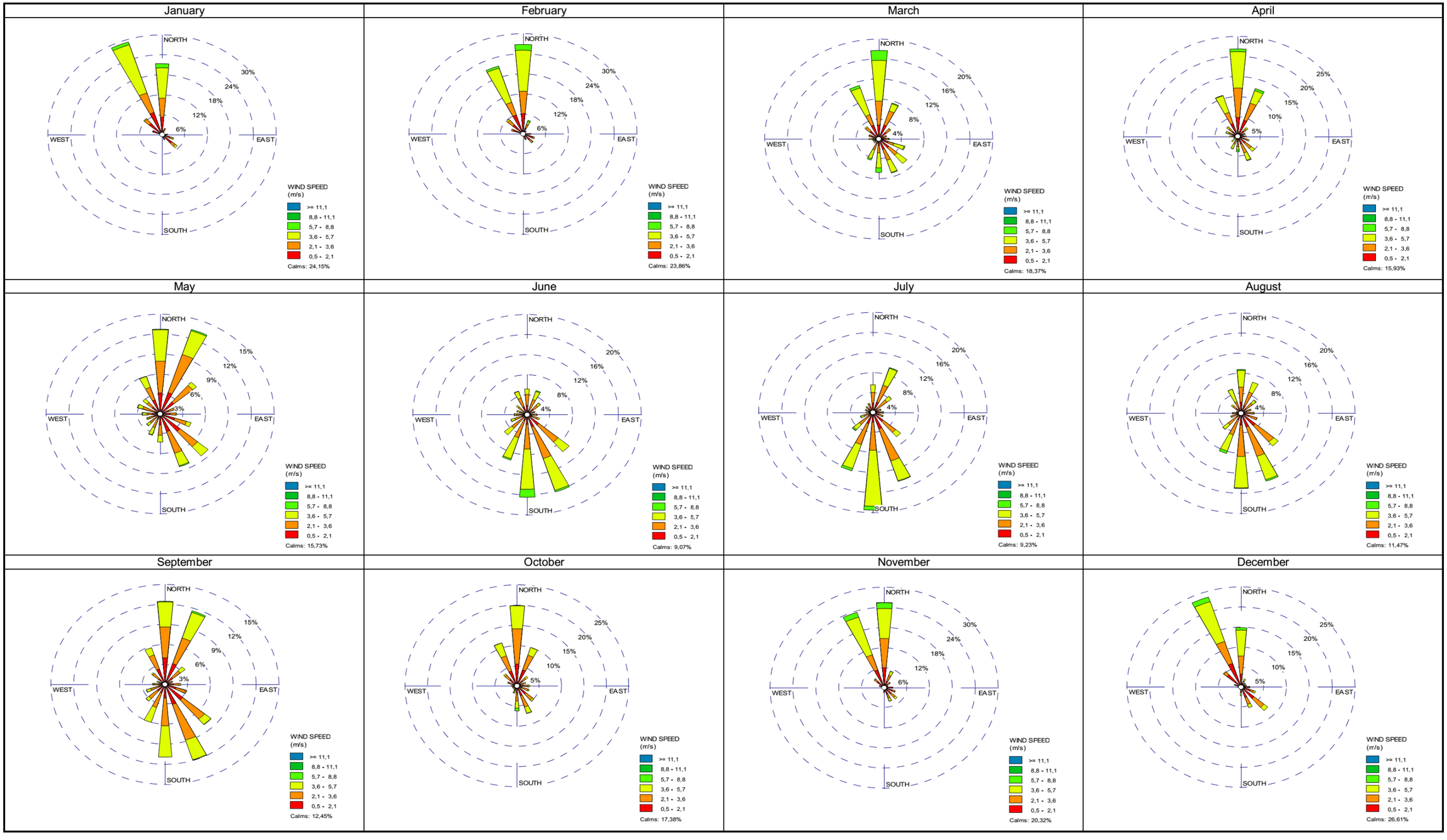
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Dry bulb temperature (°C)
40
35
30
25
20
15
10
5
Relative humidity (%)
120
100
80
60
40
20
Station pressure (mb)
1010
1005
1000
995
990
985
980
975
Wind speed (m/s)
10
9
8
7
6
5
4
3
2
1
0
Total cloud cover (tenths)
10
9
8
7
6
5
4
3
2
1
Ceiling height (m)
10000
9000
8000
7000
6000
5000
4000
3000
2000

Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

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Graph 2: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

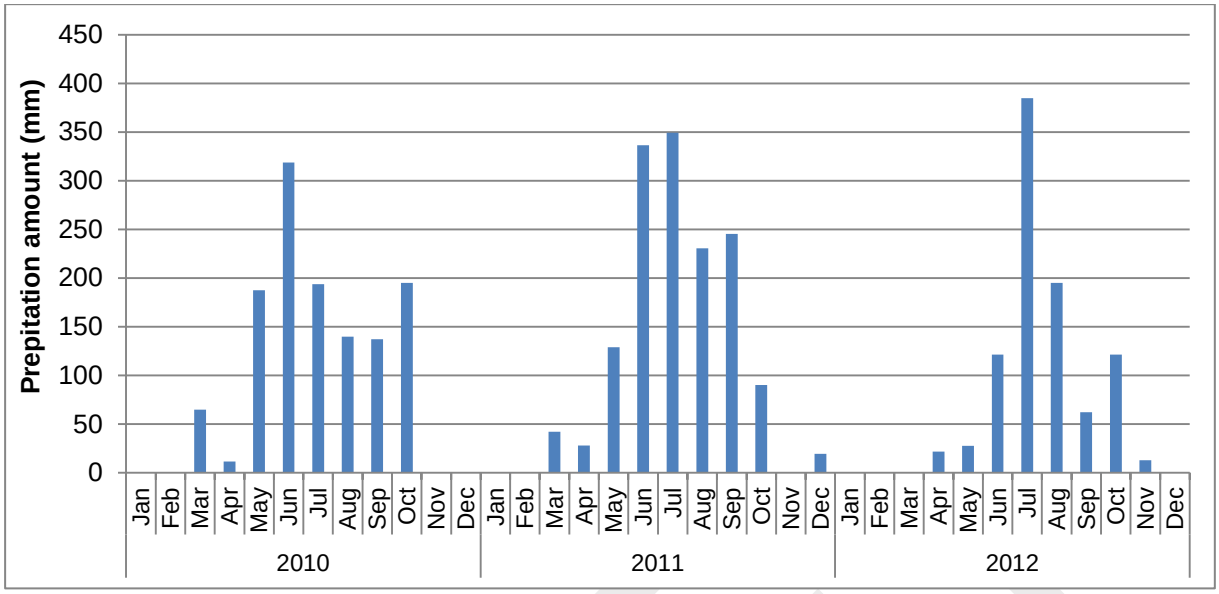
Table 9: Daily precipitation amount (mm) by year (2010 - 2012) - Letpadaung Project

Day	2010												2011												2012											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	2.79	0	0	13.46	1.524	0	0	0	0	0	0	0	0	0	32.5	5.08	1.02	0	0	0	0	0	0	0	0	9.65	13.7	2.54	7.37	0	0.76	1.27	0
2	0	0	0	0	0	0	12.45	2.794	4.826	0	0	0	0	0	0	0	0	0	3.05	5.84	0	0	0	0	0	0	0	0.51	0	7.11	2.29	7.87	0	0.25	0	0
3	0	0	0	0	3.302	0	3.556	28.45	61.47	2.032	0	0	0	0	0	0	0	0	1.02	0	0	3.81	0	0	0	0	0.51	0	0	8.38	2.29	0	0	0	0	0
4	0	0	0	0	0	0	0	57.66	2.286	3.048	0	0	0	0	0	0	0	0	3.3	7.11	0	1.02	0	0	0	0	0	0	0	1.02	3.56	31.8	27.7	0	0	0
5	0	0	0	0	0	0.254	3.81	1.27	1.016	0	0	0	0	0	0	0	0	0	7.11	5.84	12.7	0	0	0	0	0	0	3.56	0	0	1.78	0.51	2.03	3.3	0	0
6	0	0	0	0	0	2.794	0	1.524	0	12.45	0	0	0	0	0	0	2.29	4.57	2.54	2.29	14	16.5	0	0	0	0	0	0	0	0	2.79	10.7	1.52	0	0	0
7	0	0	0	0	0	0	0	5.588	0	7.874	0	0	0	0	0	0	0	2.79	0	16.8	20.6	7.62	0	0	0	0	0	0.51	0	0	5.33	12.2	14	28.7	0.25	0
8	0	0	0	0	0	0	0.508	0	0.762	13.72	0	0	0	0	0	0	0.25	24.6	0	37.1	14.2	6.6	0	0	0	0	0	2.54	0	0	4.83	1.27	5.59	4.06	4.32	0
9	0	0	0	0	0	40.13	0	0	7.62	25.4	0	0	0	0	0	0	0	24.9	0	20.6	0	0	0	0	0	0	0	7.62	0	5.33	8.13	4.32	3.56	3.56	2.29	0
10	0	0	0	0	0	2.286	0	0	0.508	6.35	0	0	0	0	0	0	0	0	0	32	20.3	0	0	0	0	0	0	0.51	0	3.56	2.54	8.64	0	22.6	0	0
11	0	0	0	0	0.254	44.96	9.398	0	0	19.3	0	0	0	0	0	0	0	0	0	2.29	0	0	0	0.76	0	0	0	2.54	0	0	2.03	15.5	0	52.8	0	0
12	0	0	0	0	0.254	27.94	0.254	0	0	0	0	0	0	0	0	0	0	0	4.57	8.64	0	0	0	0.76	0	0	0	1.02	0.51	1.52	3.05	15	0	0.76	0	0
13	0	0	0	0	0	7.366	5.08	0	7.874	0	0	0	0	0	0	0	0	0	0	13.7	10.7	0	0	0	0	0	0	0	0	0	2.54	7.37	0	0	0	0
14	0	0	0	0	0	5.842	1.27	1.524	1.778	2.54	0	0	0	0	0	0	0	5.59	0	1.52	6.6	0	0	0	0	0	0	0	0.51	0.25	4.83	2.54	0	0	0	0
15	0	0	0	0	0	23.62	2.54	0.254	0	11.68	0	0	0	0	0	0	0	24.9	0	0	12.7	0	0	0	0	0	0	0	0.25	0	26.2	4.83	0	0	0	0
16	0	0	0	0	2.032	11.43	0	1.016	4.318	0.762	0	0	0	0	0.76	0	0.25	9.14	15.5	1.02	22.1	4.83	0	0	0	0	0	0	0	1.52	0	0	0	0	0	0
17	0	0	0	0	0	22.1	0.254	0	0	1.27	0	0	0	0	0	0	0	13.2	2.29	0	42.7	14.2	0	0	0	0	0	0	0	1.52	2.29	0.76	0	4.57	0	0
18	0	0	0	0	0	2.794	0	0	1.27	0	0	0	0	0	0	0	4.32	64	2.29	0	5.33	25.7	0	0	0	0	0	0	0	6.35	4.83	0	0	0	3.3	0
19	0	0	0	0	8.636	35.31	0	6.858	26.16	2.54	0	0	0	0	0	0	0	3.3	24.1	3.81	2.03	0	0	0	0	0	0	0	0	0	6.86	5.84	0	0	0	0
20	0	0	0	0	36.07	1.27	5.334	2.54	0	6.858	0	0	0	0	0	0	1.27	41.7	102	0	0	6.86	0	0	0	0	0	0	0	30.5	0	24.9	0	0	0.51	0
21	0	0	0	7.62	11.68	2.54	0	0	0	0.762	0	0	0	0	0	14.2	0	0.25	87.1	0.76	56.4	0.25	0	0	0	0	0	0	0	0.76	0	9.14	0	0	0.76	0
22	0	0	0	0	1.016	0	0	0	0	22.61	0	0	0	0	0	0	0	1.27	19.1	10.2	5.08	0	0	0	0	0	0	0	0	2.03	0	1.52	0	0	0	0
23	0	0	0	0	3.556	5.334	3.048	0	0.508	24.13	0	0	0	0	0	0.25	0	0	0.51	0	0	0	0	0	0	0	0	0	0	9.65	3.81	1.27	0	0	0	0
24	0	0	0	0	39.37	25.91	0	1.778	7.62	4.572	0	0	0	0	0	0.76	0	0	33.8	0	0	0	0	0	0	0	0	0	0	7.87	4.06	0	0.25	0	0	0
25	0	0	0	1.02	29.97	38.35	0	10.16	0	0	0	0	0	0	0	9.91	0	3.05	26.4	0	0	0	0	0	0	0	0	0	0.25	4.32	9.4	7.11	0	0	0	0
26	0	0	0	0	4.318	0.508	0	2.032	8.89	0.254	0	0	0	0	3.81	1.02	0.51	30.7	9.4	1.78	0	0	0	0	0	0	0	0	0	4.32	13	0	4.57	0	0	0
27	0	0	3.3	0	12.95	10.41	2.286	0.508	0	0	0	0	0	0	2.03	0	5.84	9.65	0.25	27.4	0	0	0	9.4	0	0	0	0	0	4.83	62.2	0	0	0	0	0
28	0	0	23.6	0	5.08	7.62	13.46	4.318	0.254	0	0	0	0	0	19.6	1.78	4.57	16	0	1.78	0	2.79	0	8.38	0	0	0	2.79	0.76	0.25	29.5	2.29	1.02	0	0	0
29	0		19.8	0	3.302	0	88.9	3.556	0	0.508	0	0	0		4.06	0	21.3	20.1	0	5.59	0	0	0	0	0	0	0	0	0	0	106	5.84	0	0	0	0
30	0		8.13	0	22.86	0	22.1	5.08	0	26.42	0	0	0		11.7	0	34	4.06	0	8.38	0	0	0	0	0		0	0	13.7	6.6	57.4	6.6	1.78	0	0	0
31	0		9.91		2.794		6.096	1.27		0		0	0		0		54.1		0	15		0		0	0		0		1.78		10.9	0		0		0
Total	**0**	**0**	**64.8**	**11.4**	**187.5**	**318.8**	**193.8**	**139.7**	**137.2**	**195.1**	**0**	**0**	**0**	**0**	**41.9**	**27.9**	**129**	**336**	**349**	**230**	**245**	**90.2**	**0**	**19.3**	**0**	**0**	**0.51**	**21.6**	**27.4**	**121**	**385**	**195**	**62**	**121**	**12.7**	**0**

Prepared by Knight Piésold.

Source: Lakes Environmental Software.

Graph 3: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold
Source: MWMCL

As part of complementary information to estimate the inventory of emissions due to wind erosion, weather data shown in Table 10 was used. This weather data was recorded between July 1995 and April 2007 by the weather station located in the project area.

Table 10: Maximum wind speed (July 1995 to April 18, 2007)

Month	Year/ maximum wind speed[(1)]									Maximum
	1995	1996	1997	2001	2003	2004	2005	2006	2007	
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6

Prepared by Knight Piésold
Source: MWMCL
Notes:
[(1)] Weather station collapsed and broke into pieces due to strong wind (April 18, 2007, 16:35 hr).

4.3 AIR QUALITY DISPERSION MODELING

Air quality dispersion modelling took place for the project's construction and operation phases, taking into account the influence of changes caused by the dry and wet season (mainly wind speed variations due to monsoon influence).

Considering the project's extractive characteristics, dust emissions (PM_{10} and $PM_{2.5}$) have been inventoried; of these emissions, it was considered modelling PM_{10} emission dispersion, given that it is seen as an air quality impact indicator for extractive open pit mining activities (Vallero, 2008).

4.3.1 Particulate Matter Emission Inventory

Estimation of emission factors[3] (*EF*) for particulate matter ($PM_{10}$and $PM_{2.5}$), based on each assessed activity, was performed by applying standardized methods approved by the United States Environmental Protection Agency (USEPA), which are published in the AP-42 Guide, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources (USEPA, 1995-2011). Moreover, the parameters used for estimating the *EF* were based on the specific project characteristics for the construction and operation phases. These parameters were provided by MWMCL, while meteorological parameters were based on weather data generated by the MM5 model and weather station records about maximum wind speed:

- Total blast area (m^2)
- Relative humidity content of material (%)
- Material drop height from excavators (m)
- Fine particle content of material (%)
- Mean vehicle weight (Mg)
- Fines load on paved road surface (g/m^2)
- Mean wind speed in project area (m/s)
- Number of days and hours with precipitation above 0.254 mm

[3]According to USEPA, an emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity linked with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of material handled).

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- Sulphur content in diesel fuel[4]
- Vehicle fleet power in kW units

After estimating *EF* per activity, PM_{10} and $PM_{2.5}$ (units: kg/year and g/s) were estimated by applying the general emission estimation equation (USEPA, 1995-2011):

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where *E* is emission, *A* is activity rate, *EF* is emission factor, and *ER* is overall emission reduction efficiency in percent. Estimation of activity levels (A) was based on available project-related information for the construction and operation phases:

- Area of each component
- Number of drilling and blasting events per month
- Material volume obtained per blast
- Number of front loaders (loader and dozer), trucks (light and heavy) and vehicles (pickup trucks)
- Load capacity of loaders and trucks, in tons
- Tons of topsoil removed (tons/month)
- Machinery operation time per day (hours)
- Kilometres covered by machinery per day
- Monthly excavated material volume
- Material hauling by trucks (tons/month)
- Material unloading by trucks (tons/month)
- Length of paved and unpaved roads (km)
- Mean annual evaporation level in inches
- Frequency of hours watering unpaved roads
- Watering intensity on unpaved roads (gallons per square yard)
- Maximum monthly wind speed (m/s)
- Soil texture characteristics and fines content at surface (%)
- Waste rock dump sizes (m^2)

[4]A sulfur content value of 2,000 ppm has been assumed, based on information from the United Nations Environment Programme (UNEP) – Diesel Fuel Sulphur Levels: Global Status December 2012, available at: www.unep.org/transport/pcfv

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The construction phase includes activities that will be performed within the area comprising the mine, access roads, and the road close to the project site. Table 11 shows a list of activities that will be carried out during the construction phase.

Table 11: Activities during construction phase

Component	Activity
Mining area	Drilling Blasting Bulldozing (removing topsoil) Bulldozing (travel mode) Crawler dozer and grading Digging Loading trucks Unloading trucks in waste rock dumps Fuel consumption (diesel)
Unpaved roads	Travel of mining dump truck from digging area to waste rock dumps Travel of light trucks Fuel consumption (diesel)
Paved roads (highway near to mining area)	Travel of light vehicles Fuel consumption (diesel)

Prepared by Knight Piésold

The operation phase includes activities that will take place within the area comprising the pit, material haul roads, waste rock dumps, crushers and road close to project area. Table 12 shows a list of activities that will be performed during this phase.

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Table 12: Activities during operation phase

Component	Activity
Open pit	Drilling Blasting Earthmoving in blast area (loader, crawler dozer and ballgrader) Loading of dump trucks delivering ore and waste rock Loader travel in blast area Fuel consumption by equipment (trucks, dozer, and others) Haul truck travel in blast area to crushers (dust from wheeled) Haul truck travel in blast area to crushers (dust from exhaust)
Road from open pit to waste rock areas	Haul truck travel to waste rock storage area (dust from wheeled) Haul truck travel to waste rock storage area (dust from exhaust)
Waste rock storage areas (WRD1 and WRD2)	Haul truck unloading at waste rock areas Dozer activity in waste rock areas Wind erosion in WRDs, applied to maximum wind speed
Crushers semi-mobile	Unloading to each semi-mobile crusher Primary crushing (High-moisture ore) Material handling and transfer for each point (High-moisture ore)
Highway near to mining area	Light duty vehicles (dust from wheeled) Light duty vehicles (dust from exhaust)

Prepared by Knight Piésold

Construction Phase

During the construction phase, activities related to drilling and blasting, earthworks (topsoil removal, excavations and land grading), loading and unloading of materials by trucks, and light and heavy vehicle traffic on paved and unpaved roads will take place.

Table 13 shows the assessed activities and their emission factors, for which equations including a scaling factor representing a particle-size dependent emission magnitude have been used. Based on an activity-level assignment, emissions have been determined according to their source. Table 14 shows emissions according to source type.

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Table 13: Emission factors during construction phase

Activity	Description	Scaling Factors (k)		Emission factor equations by activity [1, 2, 3]		Emission factor (EF)			Reference [1]
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Drilling for blasting	-	0.52	0.03	EF = k*0.59	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
Blasting	-	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	0.10349	0.00597	kg/blast	AP-42 Blasting - Section 11.9
Earthmoving (overburden, removing topsoil)	Bulldozing (removing top soil)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	1.67006	1.83253	kg/hr	AP-42 Dozer equation - Section 11.9
	Bulldozing travel mode	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	3.00776	0.30078	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Crawler dozer and grading	0.25	0.025	EF = k*0.029	EF	0.00725	0.00073	kg/Mg	AP-42 Dozer equation - Section 11.9
	Excavator	0.75	0.017	$k*0.0029\ (d)^{0.7}/(M)^{0.3}$	$k*0.0046\ (d)^{1.1}/(M)^{0.3}$	0.00547	0.00012	kg/m^3	NERDDC (1988) & SPCC (1983), cited by NPI (2012)
	Fuel consumption - earthmoving	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]
Trucks loading	Digging area	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Loading equation - Section 13.2.4
Trucks unloading	Waste dump	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Unloading equation - Section 13.2.4
Material transport - roads	Unpaved roads - Mining dump truck	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.28337	0.12834	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Unpaved roads - Light trucks	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.65094	0.06509	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Paved roads	0.62	0.15	$EF = [k\ (sL)^{0.91}*(W)^{1.02}]*(1-1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.1
	Fuel consumption - light truck and light duty vehicles	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]
	Fuel consumption - Mining dump truck	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*0.473-S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor [2]

Prepared by Knight Piésold.

[1] Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).

[2] Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

[3] Symbols for equations:	Value	Description
A: Area per blast (m^2)	93.5	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	10	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	21.1	Moisture content of overburden, material handling by excavator and bulldozers.
M: Material moisture content (%)	17	Moisture content of overburden, material handling by loading and unloading.
d: drop height (m)	13.8	Excavator.
s: Material silt content (%)	10	Silt content of material on unpaved roads.
s: Material silt content (%)	50	Silt content of material overburden.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer
W: Mean vehicle weight (Mg)	113	Dump Truck (TR100, TEREX). Average weight between net weight and net load.
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Representative value, source: Table 13.2.1-3, Section 13.2.1 Paved Roads.
P: Precipitation with at least 0,254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0,254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 14: Construction phase – Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Mining area	116,354.3	3.6896	67,658.0	2.1454
Line	Paved roads – Highway	30,212.9	0.9580	11,170.1	0.3542
	Unpaved roads - Mining Dump truck	105,052.2	3.3312	40,190.2	1.2744
	Unpaved Roads - Light trucks	16,392.3	0.5198	4,637.8	0.1471
Total		268,011.6	8.4986	123,656.0	3.9211

Prepared by Knight Piésold.

Below, calculation of PM_{10} and $PM_{2.5}$ emissions is detailed for each activity.

Drilling and Blasting

Drilling and blasting activities are considered for extracting construction materials, rock removal and preparing the land for setting up facilities and/or building infrastructure. Calculation of particulate matter emissions due to drilling considers the number of drilling events to be performed, while the calculation corresponding to blasting events considers the number of blasting events to be conducted and the horizontal area removed by each blast. It is worth highlighting that no particulate matter emission reduction control measures have been considered for these activities. Table 15 shows emission estimation results for drilling and blasting activities. Equations considered for emission estimation are the following:

$$E = EF \times N$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor, and *N* is the number of drilling events performed per year.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is a scaling factor based on size of emitted particles, *N* is the number of blasting events per year, and *A* is the horizontal area removed by blasting (m^2). Total blasting area considered was 24,693.08 m^2 per year, while 22 blasting events equivalent to a volume of 180,000 m^3 were considered per month. Based on this information, a value of *A* = 93.5 m^2 per blast was determined.

Table 15: Construction phase - Drilling, blasting, earthmoving and handling

Activity	Installation/Sub activity	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
Drilling	Mining area	10,800	hole/yr	0.30680	0.01770	kg/hole	3 313.4	0.105	191.2	0.006
Blasting	Mining area	264	blast/yr	0.10349	0.00597	kg/blast	27.3	0.001	1.6	0.000
Bulldozing (removing top soil)	Mining area	29,200	hr/yr	1.67006	1.83253	kg/hr	48,765.9	1.546	53 509.8	1.697
Bulldozing travel mode	Mining area	3,650	VKT/yr	3.00776	0.30078	kg/VKT	10,978.3	0.348	1 097.8	0.035
Crawler dozer and grading	Mining area	3 600,000	Mg/yr	0.00725	0.00073	kg/Mg	26,100.0	0.828	2 610.0	0.083
Digging by excavator	Mining area	3 000,000	m^3/yr	0.00547	0.00012	kg/m^3	16,413.9	0.520	372.0	0.012
Loading trucks	Mining area	12 000,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	378.1	0.012	57.3	0.002
Unloading trucks	Waste Dump	9 600,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	302.5	0.010	45.8	0.001
Fuel consumption (diesel)	Drilling and blasting	16 060,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,916.4	0.092	2 828.9	0.090
	Bulldozing (loader, dozer, crawler and grader)	26 280,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	4,772.2	0.151	4 629.1	0.147
	Excavator in mining area	13 140,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,386.1	0.076	2 314.5	0.073
Total							**116,354**	**3.690**	**67,658**	**2.145**

Prepared by Knight Piésold.

Data input used to estimate activity rates:

Description	Value	Notes	Source
Number of hole by month	900	Depth of 10,350 m	Myanmar Wanbao Mining Copper Limited
Number of blast by month	22	Quantity = 180,000 m^3	Myanmar Wanbao Mining Copper Limited
Number of loader and dozer for bulldozing	10	Models: LW800K, ZL50G, MD32	Myanmar Wanbao Mining Copper Limited
Removing topsoil (tonnes/month)	300,000	2 Grader and 6 crawler dozer.	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Kilometer travelled per loader	1	km/day from 8:00 a.m. - 6:00 p.m.	Value estimated by extension area of the project.
Material handling	250,000	Volume of material in m^3/month for digging.	Myanmar Wanbao Mining Copper Limited
Material handling	1000,000	Material loading tonnes/month.	Myanmar Wanbao Mining Copper Limited
Material handling	800,000	Material unloading tonnes/month.	Myanmar Wanbao Mining Copper Limited

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Earthmoving

Estimation of particulate matter emission due to earthmoving activities comprises piling up and arranging materials, stripping, filling, machinery traffic, grading and excavation. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 15 shows emission results for the mentioned activities.

Equations considered for estimating emissions based on each activity are detailed below.

Bulldozing (Removing Topsoil)

Equations from USEPA's Guide AP-42, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation that determines PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation to calculate $PM_{2.5}$ emissions is the one below:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is the scaling factor based on size of emitted particles, *s* is fine particle content (%), *M* is the material's moisture content (%) and *T* is machinery operation time (hours). Values assigned are *s* = 50%, *M* = 21.1% and *T*= 29,200 h/year.

Bulldozing Travel Mode

Particulate matter emissions caused by earthmoving machinery travel were estimated through the following equations (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor in kg/VKT units, *VKT* is total kilometres covered by machinery per year (km/year), *k* is a scaling factor constant based on size of emitted particles in lb/VMT units, *s* is fine particle content (%), *W* is mean weight of all machinery (tons), and *P* is number of days with

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precipitation above 0.254 mm per year. Values assigned are *VKT* = 3,650 km/year, *s* = 50%, *M* = 21.1% and P= 110 days/year (Lakes Environmental, 2013).

Crawler Dozer and Grading

Particulate matter emissions generated by using machinery for grading and moving topsoil were estimated through the following equation (USEPA, 1995-2011):

$$E = A \times k \times EF$$

Where *E* is PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/Mg units, and *k* is scaling factor based on size of emitted particles. Values assigned are *EF* = 0.029 kg/Mg (Table 11.9-4, Section 11.9, AP-42, USEPA) and *A* = 3600,000 Mg/year equivalent to 300,000 tons/month.

Excavating

PM_{10} emissions generated by excavator use were estimated through the following equation:

$$E = k \times 0.0029 \times \frac{d^{0.7}}{M^{0.3}} \times V$$

While the equation that determines $PM_{2.5}$ emissions is as follows:

$$E = k \times 0.0046 \times \frac{d^{1.1}}{M^{0.3}} \times V$$

Where E are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *d* is material drop height (m), *M* is the material's moisture content (%), and *V* is material volume to be removed. Values assigned are *d* = 13.8 m, *M* = 21.1% and *V* = 3,000,000 m^3/year, equivalent to 250,000 m^3/month.

Loading and Unloading of Material

Activities related to loading and unloading of material take place in different project execution areas. Haul trucks are loaded with power shovels, while the material is directly unloaded at the work fronts and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 15 shows emission estimation results for the mentioned activities.

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Emissions due to loading and unloading of material were based on USEPA's Guide *AP-42*. It is worth pointing out that the same equation is used for estimating both activities' emissions:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *U* is mean wind speed (m/s), *M* is the material's moisture content (%), and *Q* is quantity of material that will be loaded or unloaded per year. Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 17% and *Q* = 12,000,000 Mg/yr (loading) and 9,600,000 Mg/yr (unloading).

Vehicle Traffic on Paved and Unpaved Roads

Considerations are that particulate matter emissions produced by vehicle traffic will have its origin in unpaved haul roads, as well as in light vehicle traffic on paved roads close to the project area. Table 16 shows particulate matter emission results.

Below, criteria considered for estimating emissions are detailed.

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Table 16: Construction phase - Material transporting

Activity	Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
Travel of mining dump truck on unpaved roads	Digging area to waste dump	105,495	Vehicles/yr	1 265,934	VKT/yr	1.28337	0.12834	kg/VKT	96	70 932	2.249	7,093	0.225
Travel of light trucks on unpaved roads	Mining area	37,960	Vehicles/yr	455,520	VKT/yr	0.65094	0.06509	kg/VKT	96	12 946	0.411	1,295	0.041
Travel of light duty vehicles on paved roads	Highway near to mining area	58,400	Vehicles/yr	876,000	VKT/yr	0.02844	0.00688	kg/VKT	-	24 910	0.790	6,027	0.191
Fuel consumption (diesel)	Digging area to waste dump	105,495	hr/yr	110 769,231	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	34 121	1.082	33,097	1.049
	Mining area	37,960	hr/yr	18 980,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	3 447	0.109	3,343	0.106
	Highway near to mining area	58,400	hr/yr	29 200,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	5 302	0.168	5,143	0.163
Total										**142 908**	**4.532**	**47 511**	**1.507**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	35	Route from digging area to waste dump. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Number of other trucks	13	Refuelling truck, light truck, truck with crane, and maintenance truck.	Myanmar Wanbao Mining Copper Limited
Number of light duty vehicle by hour	20	Weight vehicle between1.8 to 20 tonnes.	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	91	91 tonnes per dump truck. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Length of unpaved roads (km)	6	Digging area (open pit) to waste dumps, averaged value.	Value estimated by extension area of the project.
Length of paved roads (km)	15	Paved roads near to mining area.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	36	Vehicles per hour for dump truck	Value calculated.
Time between water application in hours (T)	3	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.2	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

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Dust Entrainment from Unpaved Roads

Different routes are considered for hauling material between work fronts and WRDs. Particulate matter emissions caused by hauling material on considered routes were based on Section 13.2.2, Unpaved Roads of USEPA's AP-42 Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by trucks per year (km/year), *k* is scaling factor constant based on size of emitted particles lb/VMT units, *s* is fine particle content (%), *W* is mean weight (tons) of heavy trucks or light vehicles, and *P* is number of days with precipitation above 0.254 mm per year. Values assigned were *VKT* = 1,265,934 km/year for heavy trucks and 455,520 km/year for light vehicles, *s* = 10%, *W* =113 Mg (heavy trucks) and 25 Mg (light vehicles) and P= 110 days/year (Lakes Environmental, 2013). Length of assigned road route was 6 km and includes the area between the excavation area and WRDs. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (TEREX T100).

On the other hand, as a mitigation measure on dirt roads that will be used for hauling material, road watering by tank trucks is considered. Efficiency percentage of emission reduction, *ER*, has been determined by applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Where *ER* is dust reduction efficiency of watering roads with tank trucks, *A* is annual evaporation level (inches), *D* is mean vehicle traffic per hour, *T* is time between two road watering events (hours), and *I* is watering intensity (gal/yd^2). Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 36 trucks/hour, *T* = 3 hours, *I* = 2.2 gal/yd^2. Using these values in the above dust emission reduction equation yields an *ER* value of 96%.

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Dust Entrainment from Paved Roads

Paved roads closest to the study area have been considered as possible routes for construction material transportation and light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1000}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by vehicles per year (km/year), *k* is scaling factor constant based on size of emitted particles in g/VKT units, *sL* is road surface fines load (g/m^2), *W* is mean vehicle weight (tons), and *P* is number of hours with precipitation over 0.254 mm per year. Values assigned are *VKT* = 876,000 km/year, *sL* = 2 g/m^2 (conservative value), *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons.

Fuel Consumption by Equipment and Vehicles

Emissions due to fuel consumption have been assumed to depend on percentage of sulfur in fuel, fuel type, machinery and vehicle power, load factor, and mean machinery and vehicle lifespan. Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to the following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Where $EF_{adj(PM)}$ is a sulfur content-adjusted emission factor, *AR* is the activity level (hp-hr/yr), EF_{ss} is zero-hour steady-state emission factor (g/hp-hr), *TAF* is transient adjustment factor (unitless), *DF* is deterioration factor (unitless), and S_{PMadj} is the emission factor's adjustment factor, which depends on fuel sulfur content (g/hp-hr).

Values assigned for determining emission factor are EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery) and 2.37 (heavy trucks), *DF* = 1.116, S_{PMadj} = 0.03438 (vehicles and machinery) and 0.040167 (heavy trucks).

Operation Phase

During the operation phase, activities related to drilling and blasting, earthmoving, material loading and unloading, heavy vehicle traffic on paved roads between the pit and the WRDs (haul roads), wind erosion of stockpiles at WRDs, unloading at semi-mobile crushers, materials crushing, ore handling, ore transfer to heap leach piles (HLPs), and vehicle traffic along paved roads will take place.

Table 17 shows assessed activities and their emission factors, for which equations that include a scaling factor representing emission magnitude based on particle size, have been used. According to activity level assignment, emissions were determined based on their source. Table 18 shows emissions based on source type.

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Table 17: Emission factors for mine operations

	Activity	Scaling factors (k)		Equations of emission factor by activity (1, 2, 3)		Emission factor (EF)			Reference (1)
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Open pit									
1	Drilling	0.52	0.03	$EF = k*0.59$	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
2	Blasting	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	3.61765	0.20871	kg/blast	AP-42 Blasting - Section 11.9
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	1.16153	kg/hr	AP-42 Dozer equation - Section 11.9
4	Loading of dump trucks delivering ore and waste rock	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Loading equation - Section 13.2.4
5	Loader travel in blast area	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.70659	0.07066	kg/VKT	AP-42 Travel on unpaved roads - Section 13
6	Fuel consumption by equipment (trucks, dozer, and others)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
7	Haul truck travel in blast area to crushers (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
8	Haul truck travel in blast area to crushers (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor (2)
Road from open pit to waste rock areas (waste road)									
9	Haul truck travel to waste rock storage area (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
10	Haul truck travel to waste rock storage area (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
Waste rock storage areas (WRD1 and WRD2)									
11	Haul truck unloading at waste rock areas	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Unloading equation - Section 13.2.4
12	Dozer activity in waste rock areas	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	2.31756	kg/hr	AP-42 Dozer equation - Section 11.9
13	Wind erosion in WRDs, applied to maximum wind speed.	0.5	0.075	$EF = k\sum_{1}^{N}P_i$ $P = 58(u^*-u_t^*)^2 + 25(u^*-u_t^*)$; $P = 0$ if $u^* \le u_t^*$	EF	0.014	0.0011	$g/m^2.hr$	AP-42 Industrial wind erosion - Section 13.2.
Crushers semi-mobile									
14	Unloading to each crusher semi-movil	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.0004	0.0001	kg/Mg	AP-42 Unloading equation - Section 13.2.4
15	Primary crushing (High-moisture ore)	-	0.2	$EF = 0.004$	k*EF	0.004	0.0008	kg/Mg	AP-42 Primary crushing - Section 11.24
16	Material handling and transfer for each point (High-moisture ore)	-	0.3	$EF = 0.002$	k*EF	0.002	0.0006	kg/Mg	AP-42 Material handling and transfer - Secti
Highway near to mining area									
17	Light duty vehicles (dust from wheeled)	0.62	0.15	$EF = [k(sL)^{0.91}*(W)^{1.02}]*(1\text{-}1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.
18	Light duty vehicles (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)

Prepared by Knight Piésold.

(1)Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).

(2) Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

(2) Symbols for equations:	Value	Description
A: Area per blast (m^2)	1,000	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	2.75	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	2.75	Moisture content of overburden, material handling by loading and unloading.
s: Material silt content (%)	10	Silt content in % by weight.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer and loader.
W: Mean vehicle weight (Mg)	153.1	Dump Truck TEREX (TR100, NTE260). Average weight (net weight and net load).
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Assumed as conservative value (AP-42, Table 13.2.1-3, Section 13.2.1 Paved Roads).
P: Precipitation with at least 0.254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0.254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv.
Horsepower by equipment	500	Representative value for earthmoving equipment and light vehicles (load factor = 0,59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 18: Operation phase - Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Open pit	157,889	5.0066	56,488	1,7912
Line	Open pit	202,039	6.4066	57,178	1,8131
Line	Open pit to WRD#1	46,949	1.4887	4,746	0,1505
Line	Open pit to WRD#2	4,107	0.1302	436	0,0138
Area	WRD#1	28,884	0.9159	15,118	0,4794
Area	WRD#2	2,512	0.0796	1,315	0,0417
Area	WRD#1 - wind erosion	22,241	0.7053	1,668	0,0529
Area	WRD#2 - wind erosion	1,820	0.0577	136	0,0043
Area	Crushed ore #1	14,862	0.4713	2,906	0,0922
Area	Crushed ore #2	14,862	0.4713	2,906	0,0922
Area	Transfer #1	13,500	0.4281	4,050	0,1284
Area	Transfer #2	13,500	0.4281	4,050	0,1284
Line	Highway 1	25,069	0.7949	6,181	0,1960
Line	Highway 2	35,097	1.1129	8,653	0,2744
Total		583,333	18.4974	165,832	5.2585

Prepared by Knight Piésold.

Open Pit

In the pit area, considerations are that activities related to drilling, blasting, earthmoving, material loading, truck and machinery travel along roads, and fuel consumption will take place. Tables 19 and 20 show calculation results for particulate matter emissions from the pit.

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Table 19: Emission sources in open pit - Drilling, blasting, earthmoving and loading

Activity		Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
1	Drilling	13,416	hole/yr	0.30680	0.01770	kg/hole	4 116.0	0.131	237.5	0.008
2	Blasting	604	blast/yr	3.61765	0.20871	kg/blast	2 185.1	0.069	126.1	0.004
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	43,800	hr/yr	2.58945	1.16153	kg/hr	113 418.0	3.596	50 875.0	1.613
4	Loading of dump trucks delivering ore and waste rock	69 000,000	Mg/yr	0.00040	0.00006	kg/Mg	27 853.9	0.883	4 217.9	0.134
5	Loader travel in blast area	14,600	VKT/yr	0.70659	0.07066	kg/VKT	10 316.3	0.327	1 031.6	0.033
6	Fuel consumption by equipment (trucks, dozer, and others)	21 900,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	3 976.9	0.126	3 857.6	0.122
Total							**157,889**	**5.007**	**56,488**	**1.791**

Prepared by Knight Piésold.
Source: Myanmar Wanbao Mining Copper Limited.
Parameters used:

Description	Value	Notes
Number of hole by month	1,118	Total depth of 19 000 m (17 m per hole)
Number of blast by year	604	Quantity = 3.5 million tonne/month
Number of loader	5	Model: LW800K, ZL50G (XCMG).
Number of dozer	5	Model: MD32 (Inner Mongolia)
Number of crawler dozer	3	Model: CAT D9R and D475A-EO (KOMATSU).
Number of ballgrader.	2	Model: 14M (CAT).
Kilometre travelled per loader in blast area	1	km/day from 8:00 a.m. - 6:00 p.m.
Material handling in kt (kilo tonne by year)	69,000	Mining plan for year 5 (ore and waste rock).
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.

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Table 20: Emission sources in open pit - Haul truck travel in open pit

Activity		Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
7	Haul truck travel in blast area to crushers (dust from wheeled)	Blast area	559,964	Vehicles/yr	1 119,928	VKT/yr	1.47112	0.14711	kg/VKT	90	159.540	5.059	15,954	0.506
8	Haul truck travel in blast area to crushers (dust from exhaust)	Blast area	8	worked hrs/Veh-day	137 970,000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	42.499	1.348	41,224	1.307
Total											**202,039**	**6.407**	**57,178**	**1.813**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Haulage routes average per truck (km)	1	Material transport on unpaved roads in open pit.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	128	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

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Drilling and Blasting

During the operation phase, drilling and blasting activities are considered necessary for ore extraction. Calculation of particulate matter emissions due to drilling considers the number of drilling events, which was estimated based on information provided by MWMCL related to drilling depth for each blasting event (17 m per hole) and total drilling distance per month (19,000 m). Furthermore, for the calculation corresponding to blasting events, MWMCL information has been taken into account, which considers a total blasting area of 603,900 m^2 per year, equivalent to a quantity of 3.5 million tons per month. It is worth noting that no particulate matter emission reduction control measures have been considered for these activities. Table 19 shows emission results for the mentioned activities.

Equations considered for estimating emissions were the following:

$$E = EF \times N$$

Value assigned for emission calculation was for *N* = 13,412 holes/yr.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

According to information provided by MWMCL, total blasting area amounts to 603,900 m^2 per year and generates 3.5 million tons per month. Based on this information, the following values were determined: *A* = 1,000 m^2 per blast and *N* = 604 blasting events per year.

Earthmoving

Estimation of particulate matter emissions due to earthmoving activities comprises material stockpiling and arrangement, stripping, filling, machinery traffic, and grading. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 19 shows emission results for the mentioned activities.

Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation for calculating PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation used for calculating $PM_{2.5}$ emissions is as follows:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are *s* = 10%, *M* = 2.75% and *T*= 43,800 h/year.

Loading of Dump Trucks Delivering Ore and Waste Rock

Trucks are loaded with material at the pit. These materials are then transported to crusher or WRDs. Truck loading is performed by power shovels, while unloading takes place directly at semi-mobile crushers and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 19 shows emission results for material loading activities.

Material loading emissions were based on USEPA's *AP-42* Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 69,000 kt/yr (load).

Loader Travel in Blast Area

Equation considered for estimating front loader emissions within blasting area is the following:

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned are *VKT* = 14,600 km/year, *s* = 10%, *M* = 2.75% and P= 110 days/year (Lakes Environmental, 2013). Table 19 shows emission results for activities related to machinery traffic.

Fuel Consumption by Equipment

Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010), according to the following equations:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

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Values assigned for determining the emission factor are *NA* = 21,900,000 hp-hr/yr, EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), *DF* = 1.116, S_{PMadj}= 0.03438 (vehicles and machinery).

Haul Truck Travel in Blasting Area to Crushers

Particulate matter emissions caused by hauling material between blasting area and crushers were based on Section 13.2.2, Unpaved Roads, of USEPA's *AP-42* Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned were *VKT* = 1 119,928 km/year, *s* = 10%, *W* =153.1 Mg and P = 110 days/year (Lakes Environmental, 2013). Assigned road route length was 1 km. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (123 tons).

Emission estimation was also considered, due to the trucks' fuel consumption. This estimation was made by applying the equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

On the other hand, as a mitigation measure for dirt roads that will be used for hauling materials, road watering using tank trucks is considered. The efficiency percentage of emission reduction, *ER*, has been determined applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 128 trucks/hour, *T* = 2 hours, and *I* = 2.34 gal/yd^2. Applying these values in the above dust emission reduction equation one obtains *ER* = 90%. Emission estimation results are shown in Table 20.

Road from Open Pit to Waste Rock Areas

Roads that go from the pit boundary to waste rock dumps 1 and 2 (WRDs) generate emissions due to re-suspension of particulate matter from unpaved road surface, as well as particulate matter emissions due to the trucks' fuel combustion. These emission sources have been estimated using the following equations:

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

As control measure, it has been considered to water the roads using tank trucks. Emission reduction efficiency has been determined through the equation below:

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 72 trucks/hour, *T* = 2 hours (8:00-10:00 a.m., 3:00-5:00 p.m.), and *I* = 2.34 gal/yd^2. Inserting these values in the above dust emission reduction equation yields *ER* = 95%.

Table 21 shows calculation results for particulate matter emissions generated along the route between pit boundary and waste rock dumps (WRDs).

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Table 21: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

Activity		Line sources	Length	Data (conservative value)		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			km	Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
9	Haul truck travel to waste rock storage area (dust from wheeled)	Open pit to WRD #1	1	291 181	Veh/yr	582 362	VKT/yr	1.47112	0.14711	kg/VKT	95	46 891	1.487	4 689	0.149
		Open pit to WRD #2	1	25 320	Veh/yr	50 640	VKT/yr	1.47112	0.14711	kg/VKT	95	4 077	0.129	408	0.013
10	Haul truck travel to waste rock storage area (dust from exhaust)	Open pit to WRD #1	1	4	worked hrs/Veh-day	189 000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	58	0.002	56	0.002
		Open pit to WRD #2	1	2	worked hrs/Veh-day	94 500	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	29	0.001	28	0.001
Total												**51 056**	**1.619**	**5 182**	**0.164**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0.59)	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	39,000	Mining plan for year 5 (WRD 1 & 2).	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	72	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

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Waste Rock Storage Areas (WRD1 and WRD2)

At the waste rock dumps, activities related to material unloading, earthmoving, and wind erosion exposure will take place.

Below, details of the calculation conducted for estimating emissions are provided (Table 22).

Haul Truck Unloading at Waste Rock Areas

Material unloading activities consist of directly unloading trucks at areas where waste rock dumps are located (WRDs). Table 22 shows emission results for material unloading activities. Calculation for estimating emissions generated by material unloading is based on USEPA's AP-42 Guide, applying the following mathematical expression:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are U = 2.41 m/s (Lakes Environmental, 2013), M = 2.75% and Q = 35,880 kt/yr (WRD1) and 3,120 kt/yr (WRD2).

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Table 22: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
11	Haul truck unloading at waste rock areas	WRD #1	35 880,000	Mg/yr	0.00040	0.00006	kg/Mg	14,484.0	0.4593	2,193.3	0.0695
		WRD #2	3 120,000	Mg/yr	0.00040	0.00006	kg/Mg	1,259.5	0.0399	190.7	0.0060
12	Dozer activity in waste rock areas	WRD #1	5,373	hr/yr	2.58945	2.31756	kg/hr	13,912.6	0.4412	12,451.8	0.3948
		WRD #2	467	hr/yr	2.58945	2.31756	kg/hr	1,209.8	0.0384	1,082.8	0.0343
	Dozer activity in waste rock areas (dust from exhaust)	WRD #1	2 686,400	hp-hr/yr	0.18159	0.17614	g/hp-hr	487.8	0.0155	473.2	0.0150
		WRD #2	233,600	hp-hr/yr	0.18159	0.17614	g/hp-hr	42.4	0.0013	41.1	0.0013
Total								**31 396**	**0,9956**	**16 433**	**0.5211**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Number of dozer	4	Model: MD32 (Inner Mongolia)	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	4	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

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Dozer Activity in Waste Rock Areas

Machinery linked to this type of activity for earthmoving is caterpillar tractors and graders. Table 22 shows emission results for the mentioned activities. Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) have been considered.

Calculation of PM_{10} emissions is based on the following expression:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the expression below has been used for calculating $PM_{2.5}$ emissions:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are s = 10%, *M* = 2.75% and *T*= 5,373 hr/year (WRD1) and 467 hr/year (WRD2).

Moreover, emissions generated by fuel consumption have been estimated through the following equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Values assigned for determining emission factor are *NA* = 2 686,400 hp-hr/yr (WRD1) and 233,600 hp-hr/yr (WRD2), EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), and *DF* = 1.116, and S_{PMadj}= 0.03438 (vehicles and machinery).

Wind Erosion in WRDs

Estimation of emissions caused by wind erosion has been determined based on monthly weather data recorded by the weather station located in the study area between July 1995 and April 2007. Based on this information, friction velocity values have been determined, which are influenced by roughness height of the surface to be eroded. The procedure for calculating particulate matter emissions was based on USEPA's AP-42 Guide, Section 13.2.5, Industrial Wind Erosion.

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Friction velocity has been estimated using the following equation (USEPA, 1995-2011):

$$u(z) = \frac{u^*}{0{,}4} \ln \frac{z}{z_o} (z > z_o)$$

Where *u* is wind speed, *u** is friction velocity, *z* is height above test surface, and z_o is roughness length. Upon calculating friction velocity, erosion potential was determined based on exposed surface (fine material) by applying the following expression (USEPA, 1995-2011):

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 0 \text{ for } u^* \leq u_t^*$$

Where *P* is erosion potential in g/m^2, and u_t^* is threshold friction velocity, which depends on the type of exposed material. A value of 0.58 m/s was considered for u_t^*, which represents fine material for *s* = 10%. Furthermore, based on a frequency distribution analysis of weather data generated by the MM5 model, it was determined that wind speeds above 5.7 m/s present a frequency of 2.4% (Lakes Environmental, 2013). Table 23 shows calculation results for monthly erosion potential based on wind speed frequency.

Subsequently, emissions were estimated by applying the following equation:

$$E = k \times \sum_{i=1}^{N} P_i \times A$$

Where *N* is number of perturbations, P_i is potential erosion corresponding to maximum speed for period *i* between perturbations, and *A* is surface area that presents wind-erodible material. It should be pointed out that according to hourly weather data generated by MM5 model, maximum mean wind speeds correspond to 8.8 m/s; hence, it is estimated that wind speed perturbations above 11 m/s occur for time periods of less than 1 hour. Table 24 shows calculation results for emissions due to wind erosion events at waste rock dumps.

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Table 23: Erosion potential emission factors

Month	Maximum wind speed (January 1995 to 18-Apr-2007) [1]									Max - u (m/s)	Friction velocity u* (m/s)	Erosion potential - P (g/m^2)	Emission factor $g/(m^2.hr)$	
	1995	1996	1997	2001	2003	2004	2005	2006	2007			PM	EF - PM_{10}	EF - $PM_{2,5}$
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6	0.29	0.00	0.00	0.00
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8	0.36	0.00	0.00	0.00
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1	0.43	0.00	0.00	0.00
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3	0.54	0.00	0.00	0.00
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6	0.61	0.82	0.01	0.00
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2	0.54	0.00	0.00	0.00
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1	0.48	0.00	0.00	0.00
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6	0.40	0.00	0.00	0.00
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8	0.62	1.17	0.01	0.00
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0	0.32	0.00	0.00	0.00
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2	0.33	0.00	0.00	0.00
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6	0.35	0.00	0.00	0.00

Prepared by Knight Piésold.

Notes:

[1] Weather station was fall down and damaged into pieces by strong wind (18 April 2007, 16:35 hr).

Parameters	Value	Units	Source
Threshold friction velocity - u_t* (m/s)	0.58	m/s	AP-42, Table 13.2.5-1 (Tyler sieve No. 32)
Roughness height for open terrain (m)	0.005	m	AP-42, Industrial wind erosion.
Scaling factor k ≤ 10 µm	0.5	-	AP-42, Table 13.2.5-2
Scaling factor k ≤ 2,5 µm	0.075	-	AP-42, Table 13.2.5-3
Hourly wind class frequency distribution > 5,7 m/s	2.4	%	Lakes environmental (2013).

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Table 24: Wind erosion emissions in Waste Rock Dumps (WRDs)

Month	Emission factor g/(m^2.hr)		Emissions (g/s)				Scaling factor
			WRD #1		WRD #2		
	EF - PM_{10}	EF - $PM_{2,5}$	PM_{10}	$PM_{2,5}$	PM_{10}	$PM_{2,5}$	
Jan	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0
May	0.0098	0.0007	0.290	0.022	0.024	0.002	0.4
Jun	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0
Sep	0.0140	0.0011	0.416	0.031	0.034	0.003	0.6
Oct	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0
Total			**0.705**	**0.053**	**0.058**	**0.004**	**1**

Prepared by Knight Piésold.

Assumptions:

Control efficiency for water spray assumed to be 50% (NPI, 2012).

2.4% of time that wind speed is greater than 5.7 m/s (Lakes Environmental, 2013).

Disturbed area for WRDs assumed to be 10% of silt content, due to soil texture analysis (Gravel Clay Silty Sandy) according to Knight Piésold (2000).

Parameters	Value	Disturbed area	Units
Total area of WRD #1 - 92.44%	2 132,700	213,270	m^2
Total area of WRD #2 - 17.45%	174,500	17,450	m^2
Total area - 100%	2 307,200	230,720	m^2

Semi-Mobile Crushers

Considerations are that activities related to material unloading, material crushing and transfer from conveyor belt to heap leach piles will take place at crusher area. Table 25 shows calculation results for particulate matter emissions resulting from the mentioned activities.

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Table 25: Emission sources at semi-mobile crushers - Unloading, Crushing and Material Handling

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
14	Unloading to each crusher semi-movil	Crushed ore #1	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
		Crushed ore #2	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
15	Crushing ore and wet suppression systems (spray nozzles)	Crushed ore #1	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
		Crushed ore #2	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
16	Material handling and transfer for each point	Transfer #1	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
		Transfer #2	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
Total								**56,725**	**1.7987**	**13,913**	**0.4412**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	30,000	Mining plan for ore (year 5).	Myanmar Wanbao Mining Copper Limited
Controlled emissions by wet suppression systems (spray nozzles)	77.5	Percentage (controlled EF by wet suppression/uncontrolled EF)	AP-42, Section 11.19.2, Table 11.19.2-1.

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Unloading of Material

Materials will be directly unloaded from trucks at areas where crushers are located. Emissions generated by unloading material were based on USEPA's AP-42 Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 30,000 kt/yr. Moreover, application of water-spraying systems (spray nozzles) has been considered as emission reduction measure. These systems achieve emission reduction (*ER*) efficiency close to 77.5% (USEPA AP-42, Section 11.19.2, Table 11.19.2-1).

Primary Crushing

Estimation of emissions caused by crushing material was based on the following equation:

$$E = k \times 0.004 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned for calculating emissions are *Q* = 30,000 kt/yr and *ER* = 77.5%.

Material Handling and Transfer (Conveyors)

Estimation of emissions due to ore transfer to conveyor belt was based on following equation:

$$E = N \times k \times 0.002 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Where *N* is number of transfer points. Values assigned to each parameter were *N* = 2, *Q* = 30,000 kt/yr and *ER* = 77.5%.

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Highway near to Mining Area

Paved roads closest to the study area have been considered as possible routes for light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1{,}000}$$

Values assigned are *VKT* = 2,102,400 km/year, *sL* = 2 g/m^2, *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons. Furthermore, emissions due to fuel consumption have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Table 26 shows calculation results for particulate matter emissions produced by the mentioned activities.

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Table 26: Emission sources on road close to mining area

Activity		Line sources	No. of vehicle passes/year	Length [(1)]	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
				km	Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
17	Light duty vehicles (dust from wheeled)	Highway 1	58,400	15	876,000	VKT/yr	0.02844	0.00688	kg/VKT	24,910	0.790	6,027	0.191
		Highway 2	58,400	21	1 226,400	VKT/yr	0.02844	0.00688	kg/VKT	34,875	1.106	8,437	0.268
18	Light duty vehicles (dust from exhaust)	Highway 1	58,400	15	876,000	VKT/yr	0.18159	0.17614	g/hp-hr	159	0.005	154	0,005
		Highway 2	58,400	21	1 226,400	VKT/yr	0.18159	0.17614	g/hp-hr	223	0.007	216	0,007
Total										**60,167**	**1.908**	**14,834**	**0.470**

Prepared by Knight Piésold.

[(1)] Length of paved roads until boundary environmental baseline area.

Parameters used:

Description	Value	Notes	Source
Nº of light duty vehicle by hour	20	Representative value.	Myanmar Wanbao Mining Copper Limited
Average daily traffic (ADT)	160	Assumed equivalent to 34 vehicles.	-
Horsepower of equipment	187.7	Value for light duty vehicle (load factor = 0.59).	Myanmar Wanbao Mining Copper Limited

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4.3.2 AERMOD Model Configuration

Assessment of emission sources corresponding to different activities during the construction and operation phases has been performed using the AERMOD model, which can simulate atmospheric dispersion of particle and gas emissions from one or several sources on flat and complex terrain. To this effect, hourly weather data is used (surface and altitude data), as well as the ground's geophysical characteristics, together determining parameters that characterize the atmospheric stability of the area of interest and are included in the equations governing the model (Cimorelli *et al.*, 2005). Parameters included in dispersion calculations have been determined by AERMOD pre-processors (AERMET for meteorological and ground parameters, and AERMAP for parameters related to terrain relief).

Surface and altitude weather data obtained as results from MM5 meteorological model (Lakes Environmental, 2013) has been entered in AERMET meteorological pre-processor. Regarding topographic information, it corresponds to the end of the construction phase and year 5 of the operation phase (Stage I).

Sectors and Surface Parameters for Letpadaung Project Area

Among the setup options represented by ground characteristics, the AERMET processor requires surface parameters such as Albedo, Bowen ratio[5] (H/λE), and roughness length (m). These parameters are considered in AERMET's processing since they influence atmospheric turbulence characterization and, hence, pollutant dispersion (Cimorelli *et al.*, 2005).

With regard to the Letpadaung Project, surface parameter information entered in AERMET's pre-processor comes from NASA reanalysis satellite data generated by the Giovanni[6] Interactive Visualization and Analysis project - GES DISC (Goddard Earth Sciences, Data and Information Services Center). Downloaded information corresponds to the period between January 2010 and December 2012; the selected area comprises southeast (SE) and northwest coordinates (NW): latitude (22.06379, 22.10488) and longitude (95.0636, 95.112749). Table 27 shows mean values throughout the months entered in AERMET's pre-processor, which were determined

[5] The Bowen ratio is used to describe the type of heat transfer. It is calculated by the equation $B = H/\lambda E$; where H is sensible hating and λE is latent heating.
[6] Retrieved in http://disc.sci.gsfc.nasa.gov/giovanni

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based on information downloaded from the Giovanni project – GES DISC (Appendix A and Table 28).

Table 27: Mean surface parameters for Letpadaung Project area

Month	Albedo	Bowen ratio	Roughness length (m)
January	0.175	0.646	0.618
February	0.178	1.383	0.525
March	0.175	3.254	0.391
April	0.169	1.434	0.316
May	0.166	0.649	0.342
June	0.165	0.099	0.422
July	0.164	0.065	0.497
August	0.163	0.051	0.540
September	0.159	0.043	0.569
October	0.160	0.079	0.609
November	0.166	0.189	0.641
December	0.167	0.307	0.646

Prepared by Knight Piésold
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences, Data and Information Services Center.

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Table 28: Surface parameters for Letpadaung Project

Year	Month	Roughness length (m)		Latent heat flux (λE) from land (W/m^2)	Sensible heat flux (H) from land (W/m^2)	Bowen ratio (H/λE)	Surface albedo (fraction)
		Sensible heat	Momentum				
2010	January	0.6	0.635	50.5	45.2	0.89	0.175
	February	0.482	0.567	35.9	69.6	1.94	0.178
	March	0.322	0.46	14.9	90.7	6.10	0.175
	April	0.237	0.394	30.5	84.2	2.76	0.168
	May	0.267	0.418	83.9	52.0	0.62	0.165
	June	0.357	0.486	131.6	12.5	0.09	0.165
	July	0.447	0.546	130.3	8.4	0.06	0.164
	August	0.501	0.579	129.2	6.2	0.05	0.164
	September	0.537	0.601	107.6	5.4	0.05	0.16
	October	0.587	0.63	95.5	4.0	0.04	0.157
	November	0.629	0.652	98.5	20.0	0.20	0.167
	December	0.636	0.656	69.8	21.5	0.31	0.167
2011	January	0.6	0.635	66.7	32.7	0.49	0.176
	February	0.482	0.567	56.4	58.1	1.03	0.178
	March	0.323	0.46	59.4	58.1	0.98	0.174
	April	0.238	0.394	88.7	37.1	0.42	0.169
	May	0.267	0.418	125.2	22.6	0.18	0.167
	June	0.357	0.486	135.6	11.5	0.08	0.165
	July	0.448	0.546	134.7	7.2	0.05	0.165
	August	0.501	0.579	130.3	7.0	0.05	0.163
	September	0.537	0.601	117.2	6.0	0.05	0.16
	October	0.587	0.63	105.4	9.8	0.09	0.161
	November	0.629	0.652	95.2	21.0	0.22	0.168
	December	0.636	0.656	72.6	20.3	0.28	0.166
2012	January	0.6	0.636	64.1	35.4	0.55	0.175
	February	0.482	0.567	49.6	58.6	1.18	0.179
	March	0.322	0.46	31.4	84.3	2.68	0.175
	April	0.238	0.394	56.3	63.2	1.12	0.169
	May	0.266	0.418	62.1	71.2	1.15	0.166
	June	0.357	0.486	130.3	15.3	0.12	0.166
	July	0.447	0.546	141.7	10.9	0.08	0.164
	August	0.501	0.579	130.3	6.6	0.05	0.163
	September	0.537	0.601	98.1	2.5	0.03	0.158
	October	0.587	0.63	108.1	11.1	0.10	0.163
	November	0.629	0.652	89.6	12.7	0.14	0.163
	December	0.637	0.656	69.9	23.4	0.34	0.169

Prepared by Knight Piésold.
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences. Data and Information Services Center.

Notes:
The MERRA is a NASA reanalysis for the satellite era using a major new version (V5) of the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS). The MERRA focuses on historical analyses of the hydrological cycle on a broad range of weather and climate time scales. This MERRA Instance of Giovanni focuses on visualizing and analysing the MERRA hourly 2D data from the MERRA HISTORY COLLECTIONS. All data used here are at GEOS-5 native resolution of 2/3 longitude by 1/2 latitude degrees.
Selected time period: Jan 2010 - Dec 2012
Selected area for averaging: Lat (22.06379. 22.10488). Lon (95.0636. 95.112749).

Receptor Locations

Points for which the model calculates concentration level contributions resulting from emissions generated by the different assessed activities are called receptors.

PM_{10} dispersion modeling used a total of 9 discrete receptors located within the study area; of which 8 correspond to air quality sampling sites, while 1 is located in the city of Monywa (Table 29).

Table 29: Discrete Cartesian receptors of air quality modeling

Location	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	715,252.18	2,442,082.56	127
Station 2	719,251.74	2,438,468.46	80
Station 3	713,421.56	2,444,860.13	90
Station 4	715,622.86	2,448,138.15	78
Station 5	709,895.01	2,450,963.14	83
Station 6	711,883.05	2,440,896.18	120
Station 7	707,251.93	2,438,634.96	149
Station 8	705,617.76	2,442,419.11	175
Monywa	720,911.88	2,446,350.66	81

Prepared by Knight Piésold.

Moreover, a Cartesian receptor grid was set up, comprising an area of 216 km^2 (Table 30), which considers the final range of PM_{10} dispersion generated by construction activities. Figure 2 shows the receptor grid entered in the model corresponding to the project's construction phase.

Table 30: Uniform Cartesian grid receptor network – Construction phase

Description	X Axis	Y Axis	Units
Origin (SW corner) (X, Y)	705,529.84	2,437,860.72	UTM WGS84 (m)
No. of points	65	55	-
Spacing (Dx, Dy)	250	250	m
Length	16	13.5	km
Number of receptors	3,575		-

Prepared by Knight Piésold.

In relation to the operation phase, a nested receptor grid comprising an area of 506.25 km^2 (22.5 km x 22.5 km) has been set up, shown in Table 31. Figure 3 shows the receptor grid considered for the project's operation phase.

Table 31: Nested receptor grids – Operation phase

Bounding box		
Origin (SW corner) (X, Y)	714,759.58 m	2,441,933.91 m
Size (Width, Height)	2,500 m	2,500 m
Receptor spacing	150 m	
Number of receptors	1,804	
Nested grids		
Number of nested grid	**Distance from Bounding Box**	**Receptor spacing**
1	2,500 m	300 m
2	5,000 m	500 m
3	20,000 m	2,000 m

Prepared by Knight Piésold.

4.4 NOISE AND VIBRATION MODELLING

Noise level propagation during construction and operation activities was determined with the computer simulation program SoundPLAN, version 7.2, which includes physical variables and acoustic characteristics of sound sources. Regarding the determination of projections of vibrations caused by activities (blasting, machinery and vehicle traffic) towards the location of sensitive receptors, mathematical formulations proposed by Devine (1962; quoted by López Jimeno *et al.*, 2003) and the Federal Transit Administration (FTA) of the U.S. Department of Transit (2006) have been used.

4.4.1 Noise Modelling Input

Modelling methodology is based on ISO 9613 standard, which uses divergent attenuation principles along with extra attenuation caused by obstacles and air attenuation. The model's input variables are the sound powers of noise sources for each considered phase. The exclusive contribution generated by assessed project sources was modelled; this contribution was based on information related to the sources' spatial geometry.

Temperature was set at 25°C and relative humidity at 80%, which are considered meteorological values that are representative for the study area. Also, wind speed has been assumed to vary between 1 and 5 m/s, according to what is established in ISO 9613, Part 2, and the noise propagation direction is towards the receptors.

During the construction and operation phases (Stage 1), activities will take place that are categorized into stationary, linear, and impulsive (blasting), depending on the noise sources.

Noise Emission Inventory

Stationary and Linear Sources in Mining Area

The noise emission characteristics in L_{AeqT} dB(A) of each piece of machinery are based on values published by the British Standard (BS 5228) "Update of Noise database for prediction of noise on construction and open sites" (contained in Annex C) (DEFRA; 2005, 2008). Table 32 shows global acoustic powers assigned to each piece of machinery that will be used, determined through the equation that relates a stationary noise emission source to a specific distance [L_{AeqT} in dB(A)] and acoustic power (Lw), which applies for an obstacle-free ground-level propagation direction:

$$Lw = Lp + 20\log(r) + 8$$

Where Lw is projected acoustic power, Lp is sound pressure level in L_{Aeq} dB(A), and r is the distance between receptor and source.

Upon assigning powers to each piece of machinery, the global acoustic power level representing a noise emission area was determined, for which the following mathematical expression was used:

$$L_T = 10\log\sum_i^n 10^{\frac{L_i}{10}}$$

Where L_T is the sum of all sound radiation sources, n is the number of sources, and L_i are each source's noise levels, expressed in dB(A).

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Table 32: Acoustic power (Lw) in dB(A) of equipment used during construction and operation phases - Stationary sources

Scenario	Operating Route	Designation[1]	Model[1]	Amount[1]	Engine power (kW)	Operation weight (tons)	Octave band sound pressure levels @ 10 m (Hz)[2]								A-weighted sound pressure level, LAeq, dB @ 10 m[2]	Acoustic power level
							63	125	250	500	1k	2k	4k	8k		
Construction & Operation (Stage I)	Blasting Zone	Hole Pumping Truck	PP-150	1	199	17	77	83	82	84	85	85	84	79	91	119
		Hole Stemming Machine	ZL50F-II	2	162	17	77	83	82	84	85	85	84	79	91	119
	Drilling Area	Drilling Rig	T35	1	142	15.1	83	84	79	85	82	79	75	71	87	115
		Drilling Rig	ROC L6 (25)	2	287	21.7	94	95	90	91	87	85	80	73	92	120
		Drilling Rig	HCR1500-20 II	1	261	17.3	77	83	82	84	85	85	84	79	91	119
	Digging Area	Excavator	EX1900-6BH	1	810	383	82	78	82	81	81	78	72	64	85	113
		Excavator	EX1200-6LD	2	567	223	82	78	82	81	81	78	72	64	86	114
		Excavator	PC2000-8	5	728	204.1	89	92	83	81	82	78	73	65	86	114
	Mining Area	Excavator	XE370C	1	184	36.6	81	80	80	83	82	79	76	73	86	114
		Loader	LW800K	2	250	28.5	91	81	73	71	71	72	62	59	77	105
		Loader	ZL50G	3	162	16	86	82	77	74	70	66	62	55	76	104
		Dozer	MD32	5	235	45	89	90	81	73	74	70	68	64	80	108
		Roller	W2601	2	174	18	80	75	77	72	67	62	54	46	73	101
		Crawler Dozer	CAT D9R	6	350	48	80	84	76	77	79	81	69	59	85	113
		Ballgrader	14M	2	221	25	88	87	83	79	84	78	74	65	86	114
		Refuelling Truck	ND5318GJYZ(20T)	2	235	20	91	81	76	77	73	72	70	62	79	107
		Light Truck	BJ1138VJPHG	2	140	13.2	84	81	74	73	72	68	61	53	76	104
		Truck with Crane	ND1250A50J	2	235	13.6	85	73	67	71	72	69	63	56	76	104
		Fire-Fighting Truck	ND1310D35J	2	235	20	85	80	77	72	74	70	65	58	78	106
		Maintenance Truck	ND1160A45J	2	235	10	85	73	67	71	72	69	63	56	76	104
		Sprinkler Truck	TR50W	3	392	45	92	91	86	85	84	85	77	77	90	118
		AN Mixing-Loading Truck	NCHA-15	2	247	15	85	73	67	71	72	69	63	56	76	104
		Heavy ANFO Mixing-Loading Truck	NCHZ-15	2	447	15	88	93	84	84	83	81	79	69	88	116
	Digging area to WRD	Mining Dump Truck	TR100	35	783	113	89	94	89	85	83	81	76	71	89	117
Operation (Stage I)	Digging Area	Excavator (front shovel)	PC4000	2	1,400	391	91	86	80	81	80	78	77	70	85	113
	Drilling Area	Rotary Rig	DML	5	460	27.2	86	92	85	88	84	83	78	77	90	118
	Mining Area	Crawler Dozer	D475A-EO	1	728	108.4	80	84	76	77	79	81	69	59	85	113
	Digging area to WRD and Leaching Pad	Mining Dump Truck	NTE260	10	1,865	236	97	95	91	91	86	84	79	75	92	120
	Crushing area	Tracked Semi-Mobile Crusher	--	2	310	90	91	91	88	87	85	83	78	68	90	118

Prepared by Knight Piésold
[1] Source: Mining Plan according to Myanmar Wanbao Mining Copper Limited
[2] Sound levels according to DEFRA (2005, 2008)

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Linear Sources on Paved Roads

During construction and operation phases, noise generation due to vehicle traffic on roads close to project has been considered. For this reason, in a conservative approach a flow of 20 light vehicles and 14 heavy vehicles has been considered per hour, equivalent to 816 vehicles per day during 24 hours. For this linear source, it has been considered to set up the model by applying the noise propagation method based on the German RLS 90 standard[7], which considers that noise emission on a road corresponds to a point located 25 m from the centerline (called LM25) and 4 m above ground level. Thus, the speeds considered are a maximum vehicle speed of 48 km/h and a speed of 40 km/h when vehicles pass built-up areas.

Subsequently, the RLS 90 method calculates sound propagation from the emission line using the LM25 value.

Blasting

Modelling methodology is based on sound field propagation standard ISO 9613, Part I & II, "Attenuation of sound during propagation outdoors", which uses divergent attenuation principles along with extra attenuation caused by obstacles and attenuation due to air effects. The used software is SoundPLAN, version 7.2, which includes all physical variables related to the noise sources' geomorphology and sound power.

Table 33 shows the octave frequency band spectrum (Hz) that corresponds to noise emission for a surface blasting event. This information is representative for blasting activities in mining projects and has been used as part of the environmental impact assessments conducted by Knight Piésold for open pit mining projects (Knight Piésold; 2010, 2011).

Table 33: Acoustic power (Lw) in dB(C) for blasting events

Source	Central Frequency in Octave Bands (Hz)								Lw in dB(C)
	63	125	250	500	1k	2k	4k	8k	
Surface blast	144.0	137.0	133.0	129.0	124.0	116.0	110.0	107.0	145.0

Prepared by Knight Piésold
Source: Data measured by Control Acústico Ltda for blasting events in northern Chile during 2003

[7]German Noise Classification System

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Acoustic power shown in Table 33 is related to SEL (Sound Exposure Level), a parameter that represents the total energy produced by a single noise event with a duration of 1 second, a time period considered representative for blasting events (Afeni & Osasan, 2009).

Receptor Locations

The SoundPLAN v. 7.2 model receptors were set up considering a calculation area that comprises the noise sampling stations, whose locations are shown in Table 34.

Table 34: Discrete Cartesian receptors of noise quality modeling

Description	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	713,421.56	2,444,860.13	91
Station 2	716,226.37	2,444,500.06	81
Station 3	719,184.44	2,443,299.27	79
Station 4	719,251.74	2,438,468.46	78
Station 5	717,231.75	2,445,136.04	81
Station 6	715,622.86	2,448,138.15	82
Station 7	709,895.01	2,450,963.14	89
Station 8	711,883.05	2,440,896.18	120
Station 9	707,251.93	2,438,634.96	148
Station 10	705,617.76	2,442,419.11	81

Prepared by Knight Piésold

4.4.2 Vibration Modeling Input

The main activities of interest capable of generating major impact due to vibrations during the construction and operation phases are blasting events, truck and construction machinery traffic (drills, vibratory roller, grader, bulldozer). Such activities have been assessed in this study by applying mathematical models that project vibration at a given point, for which available formulations related to each activity were revised.

Blasting

In order to forecast vibrations produced by blasting, the mathematical formulation proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) for representing vibration behaviour in open pit mining operations was proposed.

$$PPV = K \times \left(\frac{d}{W^{1/2}}\right)^{-\alpha}$$

Where *PPV* is particle peak velocity (mm/s), *W* is explosive charge weight (kg), *d* is the distance between detonation area and receptor of interest (m), *K* is velocity factor, and α is attenuation factor. It is worth mentioning that the values *K* and α are variables that have been statistically determined and depend on the soil's geological conditions. Thus, the mean factors considered were the theory-based *K* = 357 and α = 2.07, which had been proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) and determined from field measurements and theoretical calculations based on studied soil type.

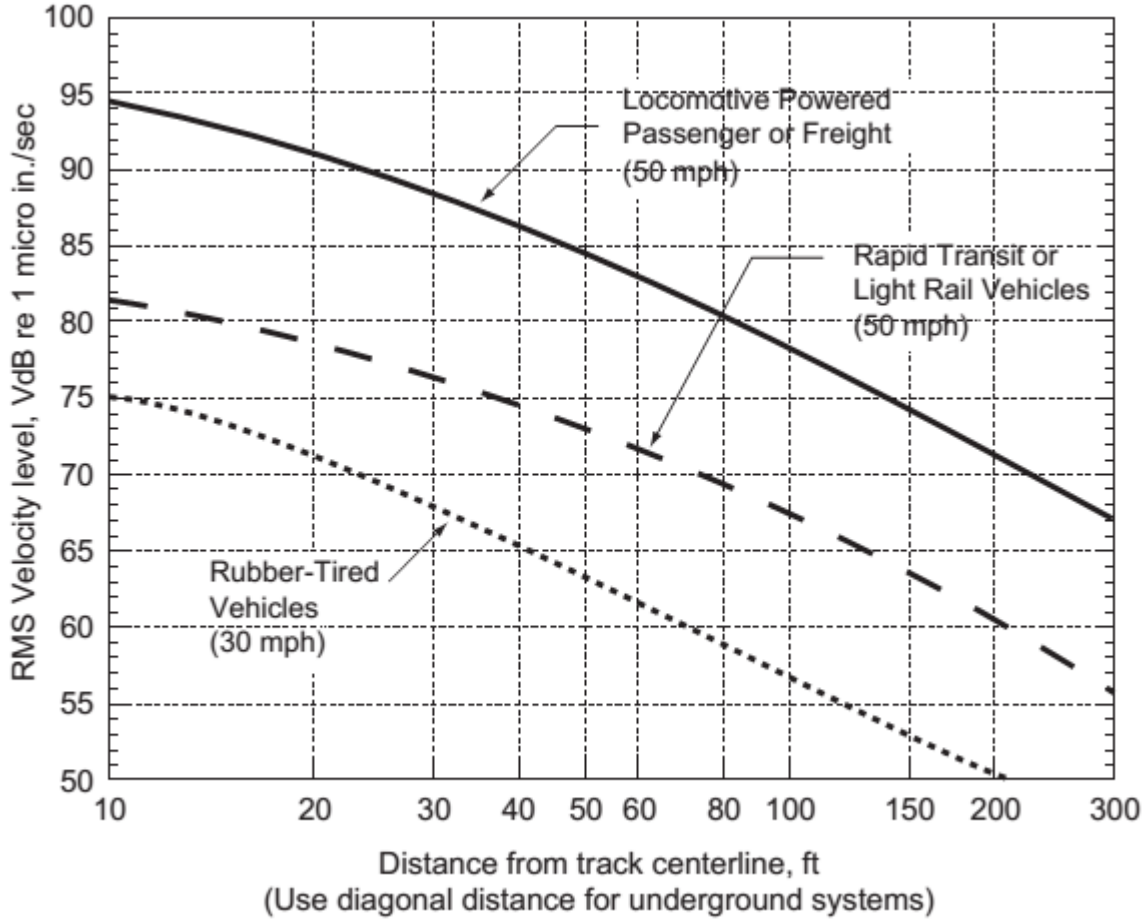
Regarding this study, it has been considered to use between 600 and 1,200 kg of explosive charge for each blasting event during the project's construction and operation phases. It should be pointed out that when an explosive charge is detonated, a pressure wave that displaces particles surrounding the detonation area is generated. The elasticity of the transmitted wave is directly proportional to the particle's velocity. The same amount of explosive charge detonated and measured at a fixed distance does not necessarily produce the same vibration magnitude if performed at different sites. In general, blast-induced vibrations take very short time according to the short duration of typical production blast at less than 2 seconds (Kuzu, 2008; Afeni & Osasan, 2009). Human reactions to blast-induced vibration start at particle velocities of generally about 10 mm/s (Siskind *et al.*, 1980 as cited in Kuzu, 2008).

Truck Traffic

Vibrations generated by truck traffic within the study area have been estimated by using criteria proposed by the Federal Transit Administration (FTA) of the U.S. Department of Transit in 2006, which are based on maximum vibration levels for one-time events. According to Graph 4, maximum vibration level values expected at each receptor are estimated, based on the distance between the track's centerline and the receptor. In this case, it corresponds to the graph's lower dotted curve (rubber-tired vehicles).

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Graph 4: Generalized ground surface vibration curves



Source: FTA (2006)

The velocity level (RMS L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref1:\frac{micro\ in.}{sec}} = 20\log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is RMS (Root Mean Square) of velocity amplitude, and v_{ref} is reference velocity amplitude. Projections of vibration levels Lv at a distance (D) have been estimated through the following mathematical expression (FTA, 2006):

$$L_v(D) = L_v(25\ ft) - 30\log\left(\frac{D}{25}\right)$$

According to the FTA (2006), background vibrations in residential areas are usually 50 VdB or less, far below the human perception threshold, which is around 65 VdB. Larger vibrations that exceed 70 VdB generate significant responses, such as a reaction of discomfort.

According to the abovementioned, it has been considered to assess vibrations generated by truck traffic based on the FTA criterion shown in Table 35.

Table 35: Ground-borne vibration (GBV) impact criteria for general assessment

Land Use Category	GBV Impact levels (VdB ref. 1 micro-inch/sec)	
	Frequent events(1)	Infrequent events(2)
Category 1:Buildings where vibration would interfere with interior operations	65 VdB	65 VdB
Category 2: Dwellings and buildings where people normally sleep	72 VdB	80 VdB
Category 3: Institutional land primarily with daytime use	75 VdB	83 VdB

Source FTA (2006)
Notes:
(1) "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
(2) "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

In this case, receptors located within the project area correspond mainly to dwellings, which is why the criterion for Category 2 will be applied.

Construction Machinery

For the case of construction machinery, the FTA criterion establishes a maximum of 100 VdB for fragile buildings, or 95 VdB for fragile historical buildings.

Vibration level sources[8] corresponding to equipment used during the construction phase vary between 86 L_v (front loader) and 94 L_v (vibratory roller), for which from a conservative point of view a value of 94 L_v was chosen. Furthermore, for modelling the vibrations of vehicles travelling close to the roads, a maximum speed of 48 km/h has been considered (30 mph).

[8] RMS velocity in decibels (VdB) ref 1 micro-inch/second at 25 ft

5. MODELING RESULTS

The results produced by the AERMOD View v. 8.2 and SoundPLAN v. 7.2 modelling systems allowed quantifying the impact produced by project activities. Moreover, these results have been added to the information provided by baseline sampling related to air and noise quality.

5.1 PARTICULATE MATTER CONCENTRATIONS - PM_{10}

5.1.1 Construction Phase

In Figures 4 and 5 one can see the impact of dispersion of PM_{10} emissions generated by construction activities. Table 36 shows the results generated by the model (PM_{10} impacts) at each receptor depending on sampling station location. These results were added to the background concentrations obtained during baseline sampling. Hence, total PM_{10} concentration results that do not exceed international standards established by the WHO were obtained.

Table 36: Impact analysis of PM_{10} concentration – Construction phase

Receptor	Impacts of PM_{10} ($\mu g/m^3$)		Background concentration of PM_{10} ($\mu g/m^3$)(1)		Total PM_{10} ($\mu g/m^3$)	
	Annual	24 hours(2)	Annual	24 hours(2)	Annual	24 hours(2)
Station 1	1.5	13.3	11.3	14.3	12.8	27.6
Station 2	0.3	11.4	7.7	12.65	8	24.05
Station 3	2.2	21.4	7.8	11.4	10	32.8
Station 4	0.4	12.8	14.3	17.6	14.7	30.4
Station 5	0.2	3.7	20.0	22.3	20.2	26
Station 6	0.2	5.1	7.1	9.5	7.3	14.6
Station 7	0.1	1.8	15.0	19.2	15.1	21
Station 8	0.1	1.9	7.4	10.4	7.5	12.3
Monywa	0.2	11.9	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.1.2 Operation Phase

In Figures 6 and 7 one can see the impact of dispersion of PM_{10} emissions generated by mine operation activities. Table 37 shows the results provided by the model (PM_{10} impacts) for each receptor depending on sampling station location. These results have been added to the background concentrations obtained during

baseline sampling. Thus, total PM_{10} concentration results that do not exceed international standards established by the WHO have been obtained.

Table 37: Impact analysis of PM_{10} concentration – Operation phase

Receptor	Impacts of PM_{10} ($\mu g/m^3$)		Background concentration of PM_{10} ($\mu g/m^3$)[(1)]		Total PM_{10} ($\mu g/m^3$)	
	Annual	24 hours[(2)]	Annual	24 hours[(2)]	Annual	24 hours[(2)]
Station 1	2.3	33.3	11.3	14.3	13.6	47.6
Station 2	1.2	15.6	7.7	12.65	8.9	28.3
Station 3	2.7	29.3	7.8	11.4	10.5	40.7
Station 4	1.0	14.4	14.3	17.6	15.3	32.0
Station 5	0.8	19.2	20.0	22.3	20.8	41.5
Station 6	0.4	10.3	7.1	9.5	7.5	19.8
Station 7	0.1	6.6	15.0	19.2	15.1	25.8
Station 8	0.2	6.1	7.4	10.4	7.6	16.5
Monywa	0.3	6.1	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.2 NOISE AND VIBRATIONS

5.2.1 Noise

This section shows results provided by SoundPLAN v. 7.2 noise modelling system related to noise propagation in the study area and noise levels at receptors. It is worth mentioning that the shown noise levels represent an exclusive contribution generated by noise sources considered by the project.

Construction Phase

Figure 8 shows propagation of noise generated by noise sources considered during the construction phase. Tables 38 and 39 show projected noise levels at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC. Subsequently, the total noise of the evaluated stations was determined by the energetic sum of noise generated by the project and the background noise, applying the following mathematical expression:

$$L_T = 10 \log \sum_i^n 10^{\frac{L_i}{10}}$$

According to the results of total noise, for all sampling stations the noise background increment is lower than 10.2 dB (A). The largest increases of noise were observed for station 1 and 2, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Table 38: Assessment of noise modelling results for construction phase – Daytime

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.2	67.5	52.4	67.6	65 (4)
Station 2	49	42.8	72.9	49.9	73.0	65 (4)
Station 3	29.2	44.7	59.9	44.9	59.9	55 (5)
Station 4	16	46.6	66.5	46.6	66.5	55 (5)
Station 5	31.6	43.9	75.4	44.1	75.4	65 (4)
Station 6	20.7	43.8	63.8	43.9	63.8	55 (5)
Station 7	4.4	45.0	85.5	45.0	85.5	55 (5)
Station 8	35.5	42.2	67.9	43.0	67.9	55 (5)
Station 9	0	42.3	67.8	42.3	67.8	55 (5)
Station 10	1	41.3	60.0	41.3	60.0	55 (5)

Prepared by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 65 dB(A) according to OECD.
(5) Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

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Table 39: Assessment of noise modelling results for construction phase – Night-time

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 (4)
Station 2	49	42.4	68.9	49.9	68.9	55 (4)
Station 3	23.7	46.3	67.9	46.4	67.9	45 (5)
Station 4	16	44.0	74.6	44.0	74.6	45 (5)
Station 5	27.7	44.6	66.7	44.7	66.7	55 (4)
Station 6	16.5	44.4	74.0	44.4	74.0	45 (5)
Station 7	4.4	44.2	72.5	44.2	72.5	45 (5)
Station 8	35.5	42.0	68.7	42.9	68.7	45 (5)
Station 9	0	42.2	67.0	42.2	67.0	45 (5)
Station 10	1	41.5	67.6	41.5	67.6	45 (5)

Elaborated by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 55 dB(A) according to OECD.
(5) Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

Table 40 shows noise levels projected at receptors due to blasting events within the mine area, which do not exceed reference values according to the North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901"., which in Section 901.109 establishes a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Furthermore, Figure 9 shows the propagation of noise produced by blasting events in the study area in LeqT units in dB(C) for T = 24 hours.

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Table 40: Assessment of noise modelling results for construction phase - Blasting events

Location	Sound Exposure level (SEL) for 1 second[(1)]	Standard - SEL in dB(C)	
		Class A	Class B
Station 1	85.2	107.0	112.0
Station 2	104.8	107.0	112.0
Station 3	99.8	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	103.6	107.0	112.0
Station 6	95.7	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
[(1)]Values determined based on values in L_{eqT} units in dB(C), where T = 1 hour.

Operation Phase

Figure 10 shows propagation of noise generated by noise sources considered during the operation phase. Tables 41 and 42 show noise levels projected at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC.

According to the results of total noise, for all sampling stations, the noise background increment is lower than 11.3 dB (A). The largest increases of noise were observed for station 1, 2 and 5, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

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Table 41: Assessment of noise modeling results for operation phase – Daytime

Location	Predicted Noise Level dB(A) [1]	Background noise dB(A) [2]		Total noise [3]		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	53.2	42.2	67.5	53.5	67.6	65 [4]
Station 2	51.7	42.8	72.9	52.2	73.0	65 [4]
Station 3	48.4	44.7	59.9	50.0	60.2	55 [5]
Station 4	16.5	46.6	66.5	46.6	66.5	55 [5]
Station 5	52.1	43.9	75.4	52.7	75.4	65 [4]
Station 6	16.5	43.8	63.8	43.9	63.8	55 [5]
Station 7	4.4	45.0	85.5	45.0	85.5	55 [5]
Station 8	43.2	42.2	67.9	45.7	67.9	55 [5]
Station 9	Not perceptible	42.3	67.8	42.3	67.8	55 [5]
Station 10	1	41.3	60.0	41.3	60.0	55 [5]

Elaborated by Knight Piésold.
Notes:
[1] Results from noise modeling using SoundPLAN v. 7.2
[2] Results from noise quality sampling for environmental baseline.
[3] Total noise = background noise + predicted noise level.
[4] Acceptable standard for Leq < 65 dB(A) according to OECD.
[5] Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

Table 42: Assessment of noise modeling results for operation phase – Night-time

Location	Predicted Noise Level dB(A) [1]	Background noise dB(A) [2]		Total noise [3]		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 [4]
Station 2	49	42.4	68.9	49.9	68.9	55 [4]
Station 3	45	46.3	67.9	48.7	67.9	45 [5]
Station 4	16	44.0	74.6	44.0	74.6	45 [5]
Station 5	28.5	44.6	66.7	44.7	66.7	55 [4]
Station 6	16.5	44.4	74.0	44.4	74.0	45 [5]
Station 7	4.4	44.2	72.5	44.2	72.5	45 [5]
Station 8	35.5	42.0	68.7	42.9	68.7	45 [5]
Station 9	Not perceptible	42.2	67.0	42.2	67.0	45 [5]
Station 10	1	41.5	67.6	41.5	67.6	45 [5]

Elaborated by Knight Piésold.
Notes:
[1] Results from noise modeling using SoundPLAN v. 7.2
[2] Results from noise quality sampling for environmental baseline.
[3] Total noise = background noise + predicted noise level.
[4] Acceptable standard for Leq < 55 dB(A) according to OECD.
[5] Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

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Table 43 shows noise levels projected at receptors due to blasting events in mine area, which do not exceed reference values according to North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901," which establishes in Section 901.109 a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Moreover, Figure 11 shows the propagation of noise produced by blasting events in the study area in L_{eqT} units in dB(C) for T = 24 hours.

Table 43: Assessment of noise modelling results for operation phase - Blasting events

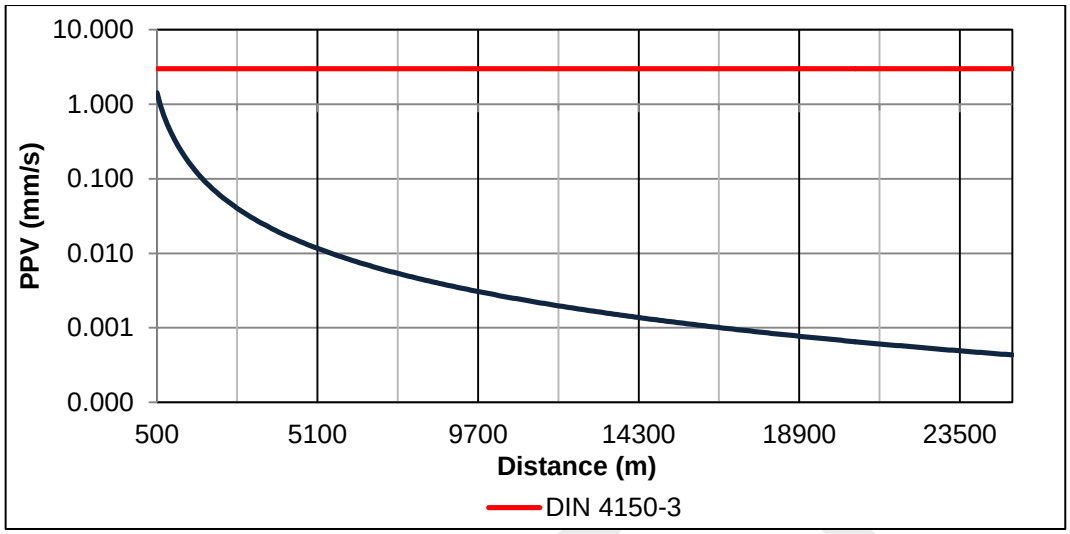
Location	Sound Exposure level (SEL) for 1 second (1)	Standard - SEL in dB(C)	
		Class A	Class B
Station 1	93.5	107.0	112.0
Station 2	94.0	107.0	112.0
Station 3	83.5	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	102.4	107.0	112.0
Station 6	95.8	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
(1) Values determined based on values in LeqT units in dB(C), where T = 1 hour.

5.2.2 Vibrations

Graph 5 shows PPV values for distances ranging from 0.5 km to 250 km, considering a blasting event. These PPV values were calculated by applying the mathematical expression proposed by Devine (1962; quoted by López Jimeno *et al.*, 1987). Furthermore, it shows a 3 mm/s protection standard corresponding to sensitive buildings based on German DIN standard No. 4150-3 (DIN = Deutsches Institut für Normung). According to Kuzu (2008), human reactions due to vibrations caused by blasting events start at particle peak velocities close to 10 mm/s. For this reason, the 3 mm/s standard proposed by the DIN 4150-3 standard is considered the most demanding one.

Graph 5: Prediction of blast-induced vibration level



Prepared by Knight Piésold

Table 44 shows modelling results for vibrations caused by blasting events at nearby sensitive receptors. These vibrations do not exceed safety limits suggested by German DIN standard No. 4150-3.

Table 44: Modelling results of vibrations caused by blasting at receptor sites

Location	Distance from blasting area to receptor (km)	PPV (mm/s)	Safe level according to DIN 4150-3 (mm/s)
Station 1	2.5	0.0508	3
Station 2	1.13	0.2629	3
Station 3	2.67	0.0443	3
Station 4	5.03	0.0120	3
Station 5	1.96	0.0841	3
Station 6	4.71	0.0137	3
Station 7	9.39	0.0033	3
Station 8	3.67	0.0229	3
Station 9	8.84	0.0037	3
Station 10	9.54	0.0032	3

Prepared by Knight Piésold

Vibrations caused by vehicle traffic along paved roads do not exceed the FTA's allowed limit of 65 VdB. Table 45 shows results for vibration levels projected at the distance where dwellings are located with regard to the vehicle's route.

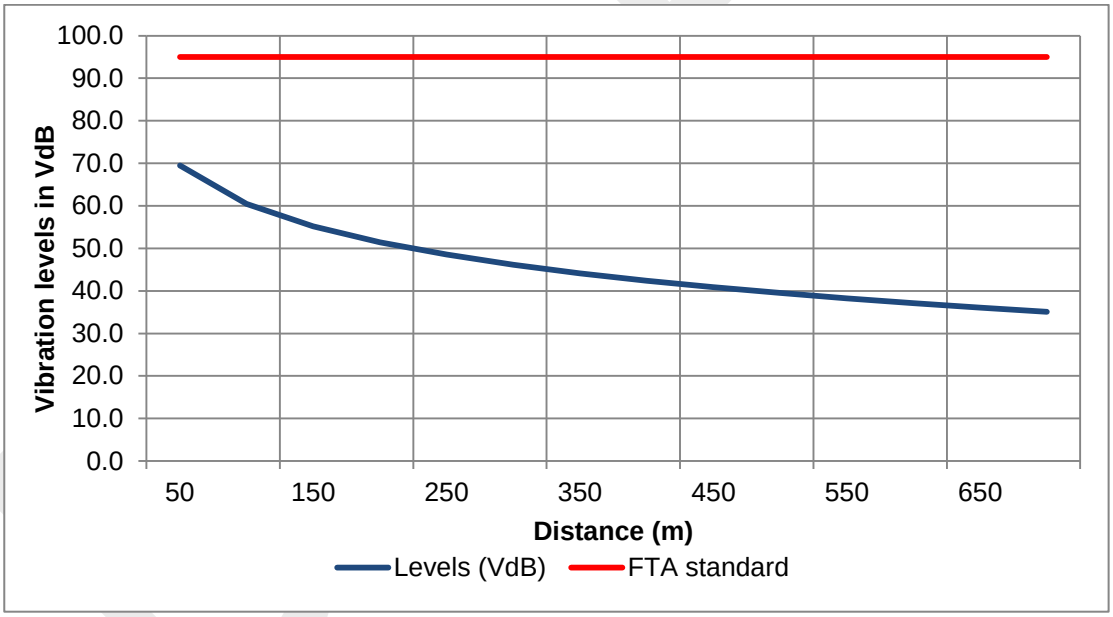
Table 45: Modeling results of vibrations caused by vehicles on road close to receptor sites

Location	Distance from track centerline (m)	Lv (ref 1 micro-inches/s) (VdB)	FTA Standard Category I
1	14	64	65 VdB
2	16	63	
3	199	26	
5	22	59	

Prepared by Knight Piésold

Regarding activities resulting from heavy machinery operation during the construction phase, Graph 6 shows Lv values projected at a specific distance. According to the results, the vibration levels generated by machinery do not exceed the limit of 95 VdB recommended by the FTA for sensitive structures.

Graph 6: Modelling results of vibrations caused by construction equipment at receptor sites



Prepared by Knight Piésold

6. CONCLUSIONS

Inventories of particulate matter (PM_{10} and $PM_{2.5}$), noise and vibrations were developed for construction and operation phases. According to results, it is evident that operation phase generates more dust and noise than construction phase.

According to results provided by computer programs Aermod View 8.2 and SoundPLAN 7.2, the impact caused by emissions of particulate matter, noise and vibrations during the construction and operation phases does not exceed environmental quality standards established by the IFC/WHO and OECD. The sites that present the highest concentrations of particulate matter, as well as the highest noise and vibration levels are within project area facilities, such as the pit and the waste rock dumps.

Regarding the impact on air quality, during the construction phase Station 3 (air quality) is the one receiving the highest contributions of PM_{10} concentration (21.4 $\mu g/m^3$ for mean maximum 24-hour value and 2.2 $\mu g/m^3$ for mean maximum annual value) resulting from dispersion of particulate matter. Furthermore, during the operation phase, stations 1 and 3 receive larger PM_{10} concentration contributions, which range from 29.3 to 33.3 $\mu g/m^3$ (mean maximum 24-hour value) and from 2.3 to 2.7 $\mu g/m^3$ (mean maximum annual value).

With regard to impact on noise quality, one can see that during the construction and operation phases the stations 1, 2, 3, 5 and 8 are the ones receiving the largest noise contributions, due to the proximity of these stations to vehicle traffic on the roads surrounding the project area.

Finally, vibrations caused by project activities during its various phases comply with standards established by DIN standard 4150-3 and by FTA criteria.

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7. RECOMMENDATIONS

Regarding the impact on air quality, it is recommended to permanently monitor PM_{10} and $PM_{2.5}$ at stations 1 and 3 during the project's construction and operation phases, as part of the environmental monitoring plan.

Regarding the impact on noise quality due to the proximity of urban areas and roads surrounding the project area, it can be reduce to some extent by adopting mitigation measures such the implementation of noise barriers and suitable traffic management. According to FTA (2006), Section 6.8.1 Noise Mitigation Measures, noise barriers are effective in mitigating noise when they break the line-of-sight between source and receiver. Where the barrier is very close to the transit vehicle or where the vehicles travel between sets of parallel barriers, barrier effectiveness can be increased by as much as 5 decibels by applying sound-absorbing material to the inner surface of the barrier (FTA, 2006). The normal minimum requirement is a surface density of 4 pounds per square foot (FTA, 2006).

Finally, it is recommended to permanently monitor noise and vibration at stations 1, 2, 3, 5 and 8 during the project's construction and operation phases considering a quarterly frequency, as part of the environmental monitoring plan to verify the mitigation actions implemented.

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APPENDIX A

Merra Monthly History Data Collections – Giovanni Project

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APPENDIX B

Maximun 24 hour mean concentrations for PM_{10} impacts during dry-cold, dry-hot and wet seasons

APPENDIX C

Baseline Studies - Flora

Knight Piésold CONSULTING

BASELINE SURVEY ON FLORA OF LETPADAUNG COPPER MINE PROJECT AREA

Cool Dry Season

(February, 2013)

Environment Myanmar Cooperative Co. Ltd. (EMC)

2013

Flora

Methodology

Data collection

A Global Positioning System was used to navigate and mark coordinates between sample plots around the mining area. In order to obtain essential ecological data for predicting flora of scrubs, 2x2m quadrats (total 75) were laid down and observed. In each plot every plant species were listed and counted. For the tree species 10x10m quadrats (total 10) were subjectively chosen and observed. In each sample plot every living tree of girth at breast height (gbh) ≥10cm was measured, listed and counted. Care has been taken to cover different elevation, slope, aspects, drainage and density gradients to study overall spectrum of species diversity. In addition all trees, shrubs, and herbs around the Lepadaung taung area were recorded and listed. The families were identified by using key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994). Specimen identification was performed with the use of literatures by Backer *et a*l., 1963, and Kress *et al*. 2003 and confirmed at Herbarium in Department of Botany, University of Yangon.

Data analysis

Quantitative analysis of scrub species, density, relative density, frequency, and relative frequency were calculated. For the tree species their relative values of frequency, density and basal area were calculated and summed to get Importance Value Index. Diversity statistics applied to the data, generated in this study were calculated using the software package; Species Diversity & Richness IV (SDR) for window 2007.

Result (1) Scrub species in Letpadaung area

Frequency and Relative Frequency

Among the scrub species, Blepharis boerhaviefolia Pers., has highest relative frequency value (12.40%), *Melhania hamiltoniana* Wall. takes second highest relatively frequency value (10.54%), and *Atalantia monophylla* A. DC. possesses third relatively frequency value (8.88%) see table (1), figure (1). These species are most frequently occurred in belt transect (1).

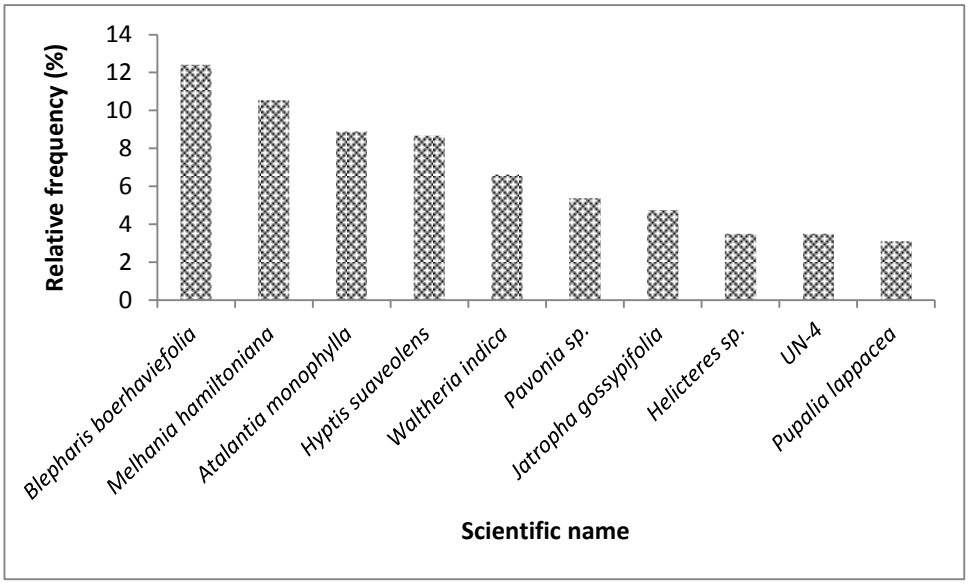


Figure (1) Relative frequency of scrubs in belt transect (1)

Table (1) Ranking of frequency and relative frequency of scrub species

No.	Scientific name	Frequency	Relative frequency (%)
1	*Blepharis boerhaviefolia* Pers.	0.80	12.40
2	*Melhania hamiltoniana* Wall.	0.68	10.54
3	*Atalantia monophylla* A. DC.	0.57	8.88
4	*Hyptis suaveolens* (L.) Poit.	0.56	8.68
5	*Waltheria indica* L.	0.43	6.61
6	*Pavonia* sp.	0.35	5.37
7	*Jatropha gossypifolia* L.	0.31	4.75
8	*Helicteres* sp.	0.23	3.51
9	UN-4	0.23	3.51
10	*Pupalia lappacea* Moq.	0.20	3.10
11	*Atylosia scarabaeoides* Benth.	0.19	2.89
12	*Abutilon indicum* (L.) Sweet	0.17	2.69
13	*Cocculus villosus* DC.	0.17	2.69
14	*Capparis zeylanica* L.	0.15	2.27
15	*Indigofera* sp.	0.13	2.07
16	*Grewia humilis* Wall.	0.12	1.86
17	UN-3	0.12	1.86
18	*Azadirachta indica* A. Juss.	0.11	1.65
19	*Capparis glauca* Wall.	0.11	1.65
20	*Cymbopogon* sp.	0.09	1.45
21	*Ehretia rigida* (Thunb.) Druce	0.09	1.45
22	*Ziziphus oenoplia* Mill.	0.08	1.24
23	*Hymenopramis brachiata* Wall.	0.05	0.83
24	*Tridax procumbens* L.	0.05	0.83
25	UN-2	0.05	0.83
26	*Desmodium triflorum* (L.) DC.	0.04	0.62
27	*Euphorbia antiquarum* L.	0.04	0.62
28	*Ipomoea* sp.	0.04	0.62
29	*Leptadenia* sp.	0.04	0.62
30	*Phyllanthus* sp.	0.04	0.62
31	*Streptocaulon tomentosum* Wight & Arn.	0.04	0.62
32	*Acacia catechu* Willd.	0.01	0.21
33	*Acacia pennata* (L.) Willd.	0.01	0.21
34	*Acalypha* sp.	0.01	0.21
35	*Achyranthes aspera* L.	0.01	0.21
36	*Barleria prionitis* L.	0.01	0.21
37	*Capparis* sp.	0.01	0.21
38	*Cardiospermum corindum* L.	0.01	0.21
39	*Gardenia* sp.	0.01	0.21
40	*Hesperethusa crenulata* (Roxb.) Roem.	0.01	0.21
41	*Leptadenia reticulata* Wight & Arn.	0.01	0.21
42	*Phyllanthus simplex* Retz.	0.01	0.21
43	*Prosopis juliflora* DC.	0.01	0.21
44	*Tectona hamiltoniana* Wall.	0.01	0.21

Density and Relative Density of Belt transect (1)

In belt transect (1) *Hyptis suaveolens* (L.) Poit. has highest relative density value (33.89%), *Blepharis boerhaviefolia* takes second highest relatively density value (20. 15%), and *Melhania hamiltoniana* Wall. holds third relatively density value (14.81%) see table (2), figure (2). The *Hyptis suaveolens* (L.) Poit. was most densely found in the study area.

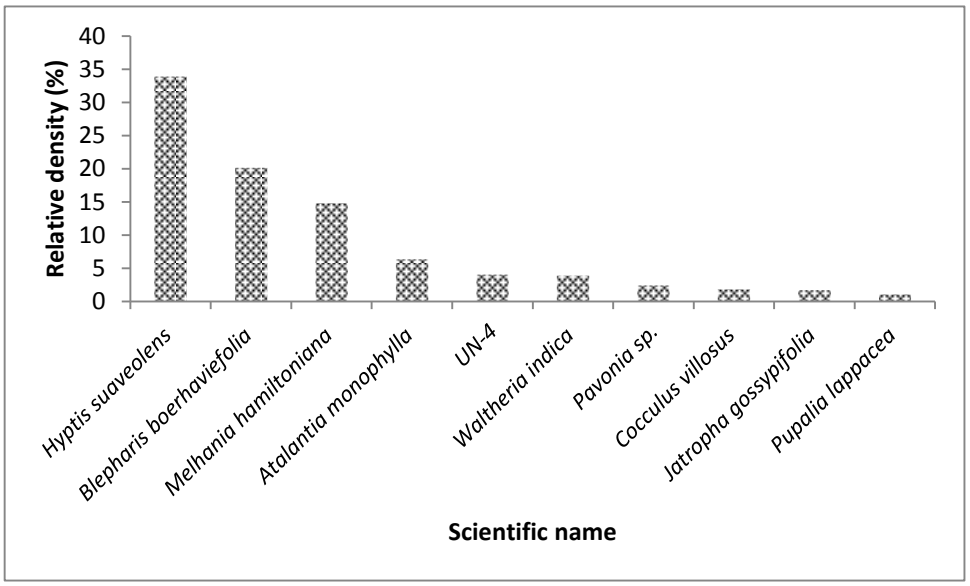


Figure (2) Relative density of scrubs

Table (2) Ranking of density and relative density of scrub species

No.	Scientific name	Density	Relative density (%)
1	*Hyptis suaveolens* (L.) Poit.	12.36	33.89
2	*Blepharis boerhaviefolia* Pers.	7.35	20.15
3	*Melhania hamiltoniana* Wall.	5.40	14.81
4	*Atalantia monophylla* A. DC.	2.32	6.36
5	UN-4	1.48	4.06
6	*Waltheria indica* L.	1.43	3.91
7	*Pavonia* sp.	0.88	2.41
8	*Cocculus villosus* DC.	0.68	1.86
9	*Jatropha gossypifolia* L.	0.63	1.72
10	*Pupalia lappacea* Moq.	0.40	1.10
11	*Atylosia scarabaeoides* Benth.	0.39	1.06
12	*Helicteres* sp.	0.37	1.02
13	*Abutilon indicum* (L.) Sweet	0.36	0.99
14	*Cymbopogon* sp.	0.33	0.91
15	*Indigofera* sp.	0.29	0.80
16	*Capparis zeylanica* L.	0.20	0.55
17	*Grewia humilis* Wall.	0.17	0.48
18	UN-3	0.16	0.44
19	*Capparis glauca* Wall.	0.15	0.40
20	*Azadirachta indica* A. Juss.	0.13	0.37
21	*Ehretia rigida* (Thunb.) Druce	0.11	0.29
22	*Tridax procumbens* L.	0.09	0.26
23	*Ipomoea* sp.	0.08	0.22
24	*Ziziphus oenoplia* Mill.	0.08	0.22
25	UN-2	0.08	0.22
26	*Desmodium triflorum* (L.) DC.	0.07	0.18
27	*Hymenopramis brachiata* Wall.	0.07	0.18
28	*Euphorbia antiquarum* L.	0.05	0.15
29	*Leptadenia* sp.	0.05	0.15
30	*Phyllanthus* sp.	0.05	0.15
31	*Streptocaulon tomentosum* Wight & Arn.	0.05	0.15
32	*Acacia pennata* (L.) Willd.	0.03	0.07
33	*Hesperethusa crenulata* (Roxb.) Roem.	0.03	0.07
34	*Acacia catechu* Willd.	0.01	0.04
35	*Acalypha* sp.	0.01	0.04
36	*Achyranthes aspera* L.	0.01	0.04
37	*Barleria prionitis* L.	0.01	0.04
38	*Capparis* sp.	0.01	0.04
39	*Cardiospermum corindum* L.	0.01	0.04
40	*Gardenia* sp.	0.01	0.04
41	*Leptadenia reticulata* Wight & Arn.	0.01	0.04
42	*Phyllanthus simplex* Retz.	0.01	0.04
43	*Prosopis juliflora* DC.	0.01	0.04
44	*Tectona hamiltoniana* Wall.	0.01	0.04

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 88.64% of the total number of species was in lower frequency classes, A and B, while 11.36% was observed only in higher frequency class C and D (Table 3, Figure 3). No species was found in highest frequency class (E). It indicates that the scrubs in study area is floristically heterogeneous, according to Lamprecht (1989). The species which fall in higher frequency class D was *Blepharis boerhaviefolia* Pers. This species can be considered as the most common species in the study area.

Table (3) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	35	79.55
B	21-40%	4	9.09
C	41-60%	3	6.82
D	61-80%	2	4.55
E	81-100%	0	0.00

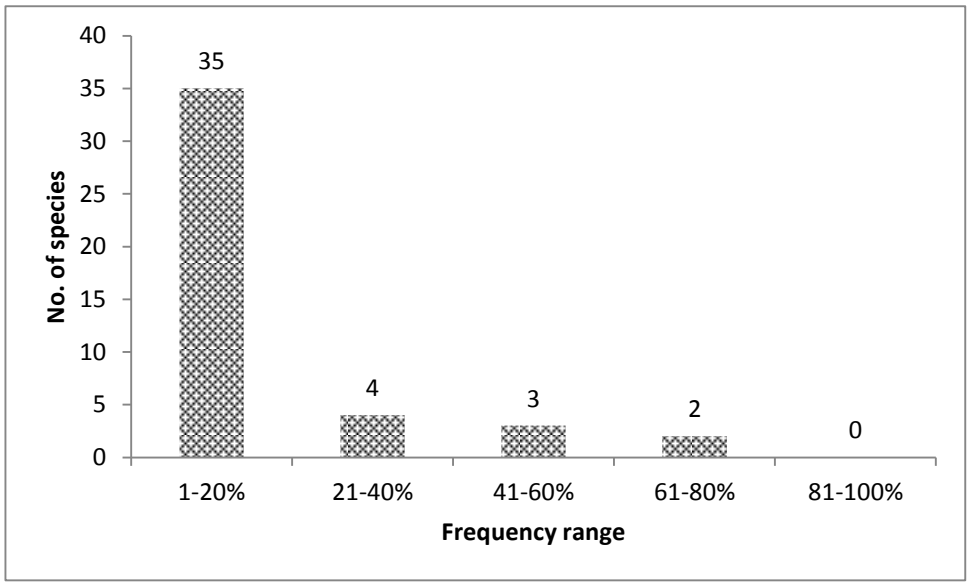


Figure (3) Scrub species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the scrub species was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (4) and (5). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (4) Scrub species diversity in study area

Sample	H	Variance H	Simpson (D)	Fisher's Alpha	Brillouin (D)
Q-1	1.41	0.01669	2.673	3.301	1.263
Q-2	1.723	0.03327	4.667	4.47	1.402
Q-3	1.482	0.01851	2.8	3.416	1.318
Q-4	1.786	0.01439	3.992	3.753	1.604
Q-5	1.798	0.02131	4.195	4.134	1.557
Q-6	1.269	0.01215	2.429	2.918	1.156
Q-7	1.838	0.01016	5.561	3.3	1.64
Q-8	1.717	0.01017	4.624	2.412	1.542
Q-9	1.419	0.01188	3.457	1.726	1.27
Q-10	1.216	0.03193	2.725	2.297	1.01
Q-11	0.9158	0.03139	1.961	1.297	0.7649
Q-12	1.735	0.0115	7.037	2.906	1.401
Q-13	1.782	0.03505	5.676	4.717	1.4
Q-14	1.546	0.02535	4.065	2.872	1.29
Q-15	1.539	0.01805	3.698	2.714	1.344
Q-16	1.81	0.03365	8.273	5.571	1.345
Q-17	1.54	0.05799	5.077	4.775	1.117
Q-18	1.806	0.03416	5.833	4.717	1.419
Q-19	0.466	0.02202	1.447	0.5884	0.3837
Q-20	1.332	0.02113	3.375	1.805	1.122
Q-21	1.236	0.03734	3.054	2.212	0.9871
Q-22	1.333	0.01138	4.444	1.712	1.077
Q-23	1.352	0.03902	7	3.879	0.9208
Q-24	1.787	0.01792	6.794	3.544	1.442
Q-25	1.792	0.04753	8.25	7.029	1.285
Q-26	1.146	0.01692	2.425	1.392	1.017
Q-27	0.921	0.01759	1.649	2.42	0.8153
Q-28	0.8559	0.01786	1.637	1.53	0.7604
Q-29	1.004	0.01984	1.967	1.669	0.885
Q-30	1.328	0.02488	3.016	2.114	1.129
Q-31	1.15	0.01715	2.464	1.426	1.017
Q-32	1.324	0.01941	2.541	2.382	1.173
Q-33	1.246	0.01836	2.102	2.795	1.114
Q-34	0.7921	0.01726	1.516	1.782	0.6998
Q-35	0.9806	0.01862	1.98	1.679	0.8663
Q-36	1.603	0.02249	3.777	3.343	1.378
Q-37	1.246	0.02008	2.725	1.54	1.083
Q-38	1.67	0.02292	3.848	3.343	1.436
Q-39	1.368	0.01595	3.436	1.957	1.192
Q-40	0.4473	0.01011	1.299	0.6354	0.4031

Sample	H	Variance H	Simpson (D)	Fisher's Alpha	Brillouin (D)
Q-41	1.214	0.03387	2.455	2.18	1.014
Q-42	1.661	0.02983	5.25	3.677	1.323
Q-43	1.534	0.03329	4.857	3.305	1.197
Q-44	1.626	0.04067	6	4.322	1.207
Q-45	1.494	0.02454	5.353	2.782	1.152
Q-46	1.186	0.02061	3.326	1.594	0.9678
Q-47	0.9433	0.03163	2.813	1.453	0.7139
Q-48	0.7595	0.05808	1.897	1.359	0.5641
Q-49	1.633	0.02117	4.559	2.816	1.372
Q-50	1.208	0.04212	2.377	2.343	0.9865
Q-51	1.344	0.04604	2.518	3.424	1.092
Q-52	1.816	0.02601	5.221	4.164	1.502
Q-53	1.431	0.01855	4.419	2.14	1.168
Q-54	1.457	0.06471	3.255	4.208	1.106
Q-55	1.336	0.03752	2.696	2.765	1.105
Q-56	1.46	0.04979	3.254	3.544	1.15
Q-57	1.619	0.01155	5.273	2.297	1.373
Q-58	1.037	0.07045	2.143	2.496	0.7798
Q-59	0.8982	0.02215	2.528	1.171	0.7205
Q-60	1.599	0.0226	3.832	2.967	1.369
Q-61	0.5623	0.02233	1.692	0.6852	0.4495
Q-62	0.8877	0.03181	2.444	1.284	0.6903
Q-63	0.9003	0.0592	2.545	1.743	0.6405
Q-64	1.895	0.01533	9.714	4.451	1.468
Q-65	1.415	0.02194	4.275	2.212	1.145
Q-66	1.498	0.04261	4.121	3.305	1.16
Q-67	1.38	0.0143	3.551	1.616	1.198
Q-68	1.326	0.04051	2.669	2.872	1.087
Q-69	1.852	0.03185	5.603	4.876	1.489
Q-70	1.542	0.02688	4.565	2.807	1.244
Q-71	1.168	0.05206	3.462	2.471	0.8525
Q-72	1.779	0.02041	6.417	3.544	1.432
Q-73	1.443	0.01342	3.47	2.095	1.287
Q-74	1.257	0.01155	2.758	1.856	1.143
Q-75	1.402	0.03103	4.375	2.626	1.09
All Sample Index	2.207		5.368	7.452	2.176
Jackknife Std Error	0.07111		0.5425	0.6729	0.06916

Table (5) Scrub species evenness in study area

Sample	Shannon Maximum	Shannon Minimium	Simpson evenness (E)	Brillouin (E)
Q-1	2.398	0.6101	0.243	0.5768
Q-2	2.197	1.163	0.5185	0.7767
Q-3	2.398	0.6516	0.2546	0.6063
Q-4	2.485	0.6765	0.3326	0.7107
Q-5	2.398	0.8928	0.3814	0.7405
Q-6	2.398	0.466	0.2209	0.5175
Q-7	2.303	0.7064	0.5561	0.7967
Q-8	2.079	0.558	0.578	0.8202
Q-9	1.792	0.4575	0.5761	0.7839
Q-10	1.792	0.7372	0.4541	0.6635
Q-11	1.386	0.4709	0.4902	0.6374
Q-12	1.792	0.9647	1.173	0.9723
Q-13	2.079	1.285	0.7095	0.8561
Q-14	1.946	0.8588	0.5808	0.7865
Q-15	2.079	0.6881	0.4623	0.7317
Q-16	1.946	1.451	1.182	0.9261
Q-17	1.792	1.35	0.8462	0.8471
Q-18	2.079	1.285	0.7292	0.8679
Q-19	0.6931	0.2237	0.7234	0.6458
Q-20	1.609	0.6249	0.675	0.8182
Q-21	1.609	0.8065	0.6107	0.7551
Q-22	1.386	0.6886	1.111	0.9591
Q-23	1.386	1.154	1.75	1
Q-24	1.946	1.075	0.9706	0.9186
Q-25	1.946	1.589	1.179	0.9335
Q-26	1.609	0.3959	0.4849	0.6985
Q-27	2.197	0.4563	0.1833	0.401
Q-28	1.792	0.3485	0.2728	0.4585
Q-29	1.792	0.4266	0.3278	0.5427
Q-30	1.792	0.6543	0.5027	0.7289
Q-31	1.609	0.416	0.4929	0.702
Q-32	2.079	0.5446	0.3177	0.623
Q-33	2.303	0.5128	0.2102	0.5252
Q-34	1.946	0.3677	0.2166	0.387
Q-35	1.792	0.4324	0.3299	0.532
Q-36	2.197	0.8237	0.4197	0.7199
Q-37	1.609	0.4824	0.545	0.7607
Q-38	2.197	0.8237	0.4275	0.7501
Q-39	1.792	0.5779	0.5727	0.7562

Sample	Shannon Maximum	Shannon Minimium	Simpson evenness (E)	Brillouin (E)
Q-40	1.099	0.1478	0.433	0.3892
Q-41	1.792	0.6849	0.4092	0.6591
Q-42	1.946	1.11	0.75	0.8463
Q-43	1.792	1.079	0.8095	0.853
Q-44	1.792	1.285	1	0.9069
Q-45	1.609	0.9944	1.071	0.9305
Q-46	1.386	0.6337	0.8315	0.8512
Q-47	1.099	0.639	0.9375	0.8557
Q-48	1.099	0.6002	0.6322	0.6633
Q-49	1.946	0.8381	0.6513	0.8336
Q-50	1.792	0.7566	0.3962	0.6517
Q-51	2.079	0.951	0.3147	0.6225
Q-52	2.197	1.082	0.5801	0.8218
Q-53	1.609	0.7777	0.8837	0.8833
Q-54	1.946	1.234	0.465	0.7332
Q-55	1.946	0.8185	0.3851	0.6686
Q-56	1.946	1.075	0.4648	0.7326
Q-57	1.792	0.7372	0.8788	0.902
Q-58	1.609	0.9089	0.4286	0.6138
Q-59	1.099	0.5091	0.8426	0.811
Q-60	2.079	0.7893	0.479	0.759
Q-61	0.6931	0.2868	0.8462	0.7898
Q-62	1.099	0.5661	0.8148	0.7925
Q-63	1.099	0.7356	0.8485	0.8097
Q-64	1.946	1.282	1.388	0.984
Q-65	1.609	0.8065	0.855	0.8758
Q-66	1.792	1.079	0.6869	0.8268
Q-67	1.609	0.5253	0.7101	0.8502
Q-68	1.946	0.8588	0.3812	0.6627
Q-69	2.197	1.257	0.6226	0.8371
Q-70	1.792	0.9321	0.7609	0.8571
Q-71	1.386	0.9404	0.8654	0.8412
Q-72	1.946	1.075	0.9167	0.9122
Q-73	1.946	0.5251	0.4957	0.7336
Q-74	1.946	0.4048	0.394	0.6369
Q-75	1.609	0.9496	0.875	0.8632
All Sample Index	3.784	0.14	0.122	0.5821
Jackknife Std Error	0.07486	0.01477	0.01542	0.02089

Result (2) Forest Tree in Letpadaung taung area

Important Value Index (IVI)

In the ten sampling plots, total number of tree species was 16 species. Ranking of ecological significance by IVI of tree species in the study area were given in table (6). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 114.51%, the second most dominant species is *Acasia* sp. (IVI=35.43%) and *Dalbergia paniculata* Roxb. (IVI = 32.45%) is third (figure-4). The number of species greater than 10% IVI value was seven species. Those species could be considered as ecological indicator species of study area.

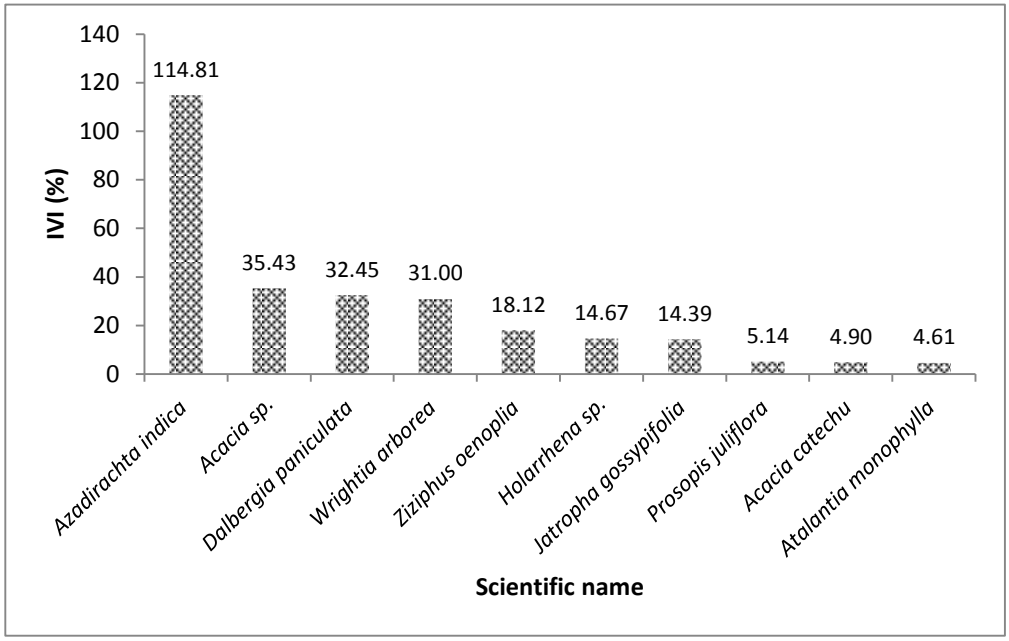


Figure (4) Important Value Index of top ten species in the Letpadaung taung area

Table (6) Ranking of Important Value Index (IVI) in the Letpadaung taung area

No.	Scientific name	RD (%)	RF (%)	RDm (%)	IVI (%)
1	*Azadirachta indica* A. Juss.	44.79	25.00	45.03	114.81
2	*Acacia* sp.	3.68	6.25	25.50	35.43
3	*Dalbergia paniculata* Roxb.	14.72	6.25	11.48	32.45
4	*Wrightia arborea* (Dennst.) Mabb.	15.95	9.38	5.68	31.00
5	*Ziziphus oenoplia* Mill.	4.29	12.50	1.32	18.12
6	*Holarrhena* sp.	7.98	3.13	3.57	14.67
7	*Jatropha gossypifolia* L.	3.07	9.38	1.95	14.39
8	*Prosopis juliflora* DC.	0.61	3.13	1.40	5.14
9	*Acacia catechu* Willd.	0.61	3.13	1.16	4.90
10	*Atalantia monophylla* A. DC.	0.61	3.13	0.87	4.61
11	*Goniothalamus* sp.	0.61	3.13	0.55	4.29
12	*Hymenopramis brachiata* Wall.	0.61	3.13	0.48	4.22
13	*Tectona hamiltoniana* Wall.	0.61	3.13	0.38	4.12
14	Un-1	0.61	3.13	0.33	4.07
15	*Gardinia* sp.	0.61	3.13	0.15	3.89
16	*Boscia variabilis* Collett & Hemsl.	0.61	3.13	0.15	3.88
Total		100.00	100.00	100.00	300.00

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 93.75% of the total number of species was in lower frequency classes, A and B, while low value was observed only in highest frequency class D (Table 7, Figure 5). It indicates that the forest area is floristically heterogeneous, according to Lamprecht (1989). The species which fall in highest frequency class D was

Azadirachta indica A. Juss.. This species can be considered as the most common species in the study area.

Table (7) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	12	75.00
B	21-40%	3	18.75
C	41-60%	0	0.00
D	61-80%	1	6.25
E	81-100%	0	0.00

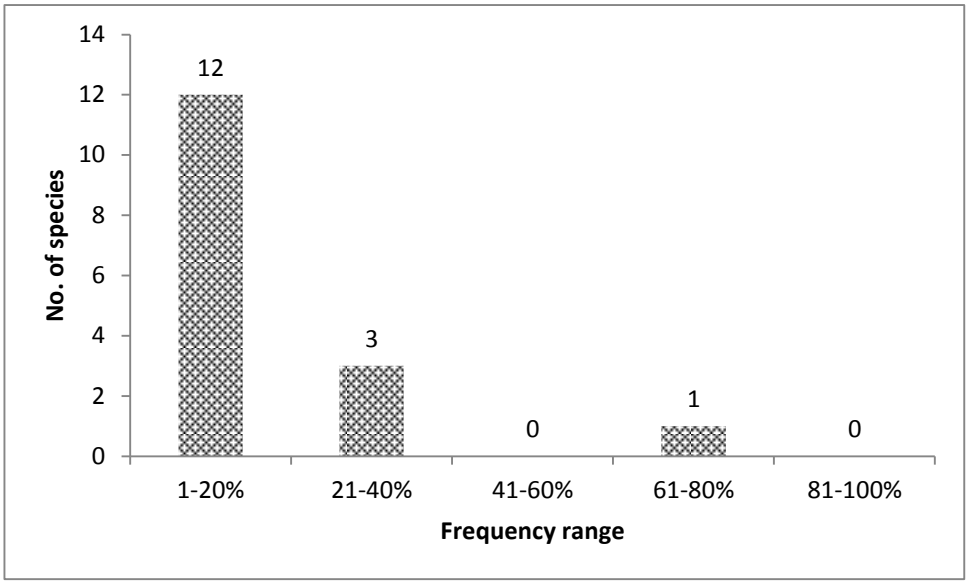


Figure (5) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (8) and (9). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (8) Diversity indices in the Letpadaung taung area

Sample	Shannon Wiener H	Variance H	Simpson (D)	Fisher's Alpha	Brillouin (D)
Pl-1	0.656	0.0518	1.625	1.171	0.4997
Pl-2	0	0	1	0.428	-6.43E-09
Pl-3	1.04	0.09253	6	5.453	0.6212
Pl-4	0.4101	0.06636	1.4	0.9356	0.278
Pl-5	0.7775	0.03222	1.967	1.09	0.6245
Pl-6	0.5297	0.01661	1.577	0.5753	0.4459
Pl-7	1.212	0.01495	3.083	1.596	1.054
Pl-8	0.6238	0.04405	1.445	1.37	0.4898
Pl-9	1.059	0.02595	2.52	1.772	0.8888
Pl-10	0.9372	0.06784	2.108	1.974	0.6967
All Sample Index	1.781		3.902	3.53	1.701
Jackknife Std Error	0.08453		0.5461	0.7428	0.0932

Table (9) Evenness indices in the Letpadaung taung area

Sample	Shannon Maximum	Shannon Minimium	Simpson evenness (E)	Brillouin (E)
Pl-1	1.099	0.5091	0.5417	0.5624
Pl-2	0	0	1	0
Pl-3	1.099	1.04	2	1
Pl-4	0.6931	0.4101	0.7	0.5473
Pl-5	1.099	0.4634	0.6557	0.6882
Pl-6	0.6931	0.2146	0.7887	0.7437
Pl-7	1.609	0.5138	0.6166	0.7452
Pl-8	1.386	0.5141	0.3613	0.413
Pl-9	1.609	0.6082	0.504	0.6451
Pl-10	1.386	0.7937	0.527	0.647
All Sample Index	2.773	0.3112	0.2439	0.6383
Jackknife Std Error	0	0.2118	0.03413	0.03129

Forest structure

Stem density of ≥10cm was 1630 ha^{-1} and basal area was 3.74 m^2/ha in the study area Table (10). Among the 10sample plots studies,16 tree species were recorded, 9 species were found only one individual and these were considered as unique species. List of recorded species along the tracking are showed in appendix-1.

The 3 most abundance species in terms of basal area occupied 82.01% of the total, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 45.03%, followed by *Acasia* sp. 25.50%, and *Dalbergia paniculata* Roxb. 11.48% of the total basal area table (11), figure (6).

Table (10) Consolidated detail of species inventory in the study area

Description	Results
No. of sampling point	10
No. of tree species	16
Density (stem/ha)	1630
Basal area (m^2/ha)	3.74
Total no. of unique species	9

Table (11) Ranking of relative basal area by species in the study area

No.	Scientific name	Stem/ha	Basal area (m^2/ha)	Basal area (%)
1	*Azadirachta indica* A. Juss.	730	1.68	45.03
2	*Acacia* sp.	60	0.95	25.50
3	*Dalbergia paniculata* Roxb.	240	0.43	11.48
4	*Wrightia arborea* (Dennst.) Mabb.	260	0.21	5.68
5	*Holarrhena* sp.	130	0.13	3.57
6	*Jatropha gossypifolia* L.	50	0.07	1.95
7	*Prosopis juliflora* DC.	10	0.05	1.40
8	*Ziziphus oenoplia* Mill.	70	0.05	1.32
9	*Acacia catechu* Willd.	10	0.04	1.16
10	*Atalantia monophylla* A. DC.	10	0.03	0.87
11	*Goniothalamus* sp.	10	0.02	0.55
12	*Hymenopramis brachiata* Wall.	10	0.02	0.48
13	*Tectona hamiltoniana* Wall.	10	0.01	0.38
14	UN	10	0.01	0.33
15	*Gardinia* sp.	10	0.01	0.15
16	*Boscia variabilis* Collett & Hemsl.	10	0.01	0.15
Total		1630	3.74	100.00

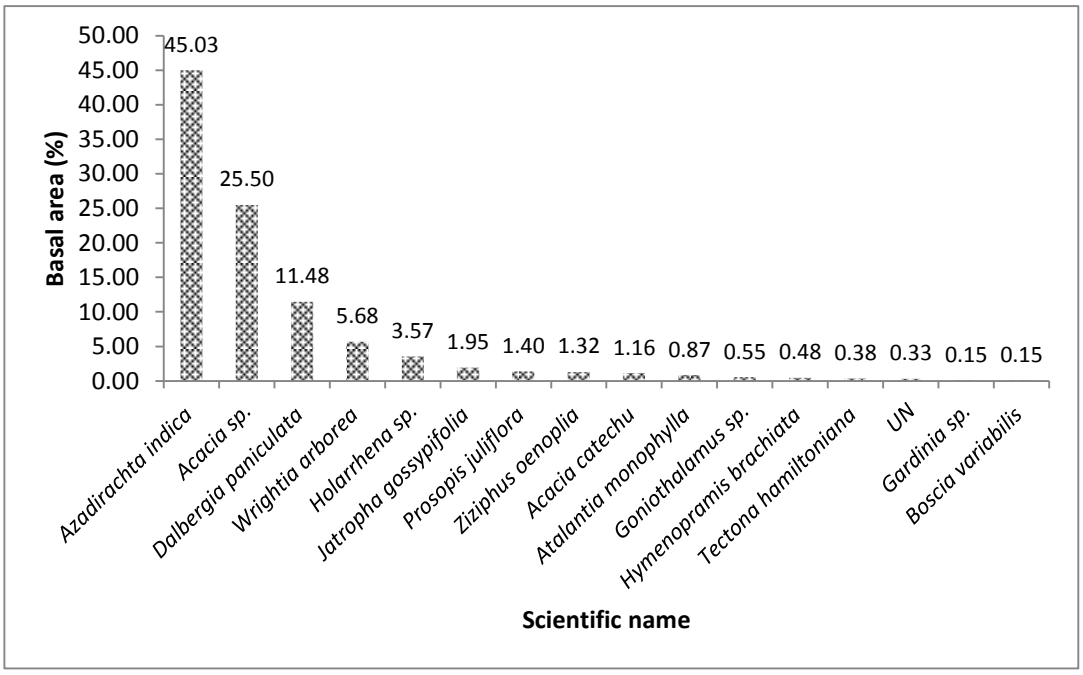


Figure (6) Relative basal area by species in the study area

Discussion and conclusion

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A total of 90 species representing 71 genera and 38 families were listed in the Letpadaung taung area (appendix-1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 114.81%, the second most dominant species is *Acacia sp.* (IVI = 35.43%) and *Dalbergia paniculata* Roxb. (IVI= 32.45%) is third. The number of species greater than 10% IVI value was seven species. Those species could be considered as ecological indicator species of Letpadaung taung area.

Scrub and tree species distribution by frequency classes in study area showed that high percent of the total number of species was in lower frequency classes, A and B, while low percent was observed only in higher frequency class C and D. It indicates that the forest of study area is floristically heterogeneous. The value of diversity indices and evenness indices for scrubs and tree species were very low in study area.

Stem density of ≥10cm was 1630 ha^{-1} and basal area was 3.74 m^2/ha in the study area. Among the 10sample plots studies, 16 tree species were recorded, 9 species were found only one individual and these were considered as unique species. The 3 most abundance species in terms of basal area occupied 82.01% of the total, of which *Azadirachta indica* A. Juss.was the most dominant species in the study area with 45.03%, followed by *Acasia* sp. 25.50%, and *Dalbergia paniculata* Roxb. 11.48% of the total basal area. The plant species that listed and recorded in recently study were checked with IUCN red list of threaten species. But no species were found in IUCN red list.

Recommendation

1. To balance the forest ecosystem services lost by project development, buffer zone should be implemented around the project area
2. Re-vegetation program should be included in buffer zone. High IVI value species should be considered priority species for plantation which could tolerate and grow well in that climate.
3. Annual monitoring and measuring growth performance should be conducted to evaluate the re-vegetation site since the action not only maintain the forest but also support the biodiversity of ecosystem.

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Flora (Hot Dry Season)

Methodology

Data collection

A Global Positioning System was used to navigate and mark coordinates between sample plots around the mining area. In order to obtain essential ecological data for predicting flora of trees, 4 sample plots (each sample plot was 15mx 15m) were subjectively laid down and observed. To account overall species diversity four subplots 1mx 1m were divided in four corners and study for herbs in the plot (fig. 1). In each sample plot every living tree of girth at breast height (gbh) ≥10cm was measured, listed and counted. Care has been taken to cover different elevation, slope, aspects, drainage and density gradients to study overall spectrum of species diversity. In addition all trees, shrubs, and herbs around the Lepadaung taung area were recorded and listed. The families were identified by using key to the families of the flowering plants, issued by Department of Botany, Yangon University (1994). Specimen identification was performed with the use of literatures by Backer *et a*l., 1963, and Kress *et al*. 2003 and confirmed at Herbarium in Department of Botany, University of Yangon.

Data analysis

Quantitative analysis of tree species their relative values of frequency, density and basal area were calculated and summed to get Importance Value Index. For the herb species, density, relative density, frequency, and relative frequency were calculated. Diversity statistics applied to the data, generated in this study were calculated using the software package; Species Diversity & Richness IV (SDR) for window 2007.

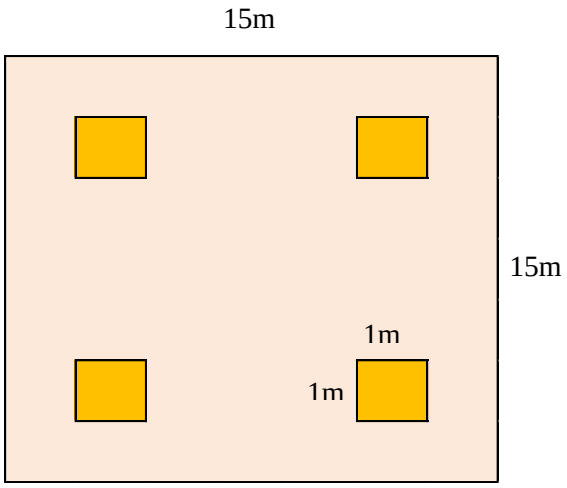


Figure (1) Lay out design of sample plot

Result (1) Forest Tree in Letpadaung taung area

Important Value Index (IVI)

In the ten sampling plots, total number of tree species was 14 species. Ranking of ecological significance by IVI of tree species in the study area were given in table (1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 54.47%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI=53.41%) and *Tectona hamiltoniana* Wall. (IVI = 34.65%) is third (figure-2). The number of species greater than 10% IVI value was eight species. Those species could be considered as ecological indicator species of study area.

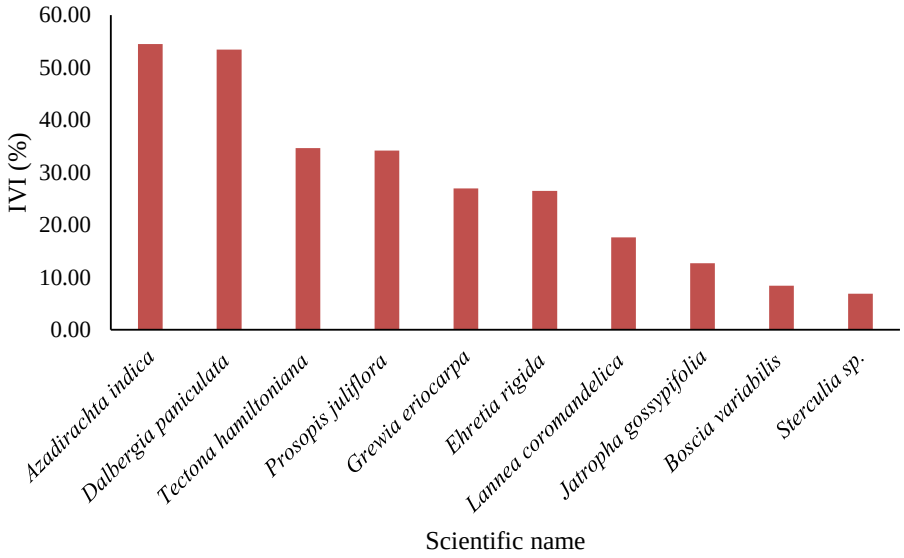


Figure (2) Important Value Index of top ten species in the Letpadaung taung area

Table (1) Ranking of Important Value Index (IVI) in the Letpadaung taung area

No.	Scientific name	RD (%)	RF (%)	R.Dm (%)	IVI (%)
1	*Azadirachta indica* A. Juss.	21.19	12.50	20.78	54.47
2	*Dalbergia paniculata* Roxb.	25.42	8.33	19.65	53.41
3	*Tectona hamiltoniana* Wall.	14.41	12.50	7.75	34.65
4	*Prosopis juliflora* DC.	6.78	4.17	23.24	34.19
5	*Grewia eriocarpa* Juss.	6.78	16.67	3.48	26.92
6	*Ehretia rigida* (Thunb.) Druce	11.86	8.33	6.27	26.46
7	*Lannea coromandelica* (Houtt.) Merr.	0.85	4.17	12.61	17.62
8	*Jatropha gossypifolia* L.	3.39	8.33	0.95	12.67
9	*Boscia variabilis* Collett & Hemsl.	3.39	4.17	0.80	8.36
10	*Sterculia* sp.	0.85	4.17	1.84	6.86
11	*Acacia* sp.	0.85	4.17	1.38	6.39
12	*Bridelia* sp.	1.69	4.17	0.40	6.27
13	*Ziziphus oenoplia* Mill.	1.69	4.17	0.37	6.23
14	*Hymenopramis brachiata* Wall.	0.85	4.17	0.48	5.50
Total		100.00	100.00	100.00	300.00

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 57.14% of the total number of species was in lower frequency classes, B, while 42.86% was observed only in highest frequency class C, D, and E (Table 2, Figure 3). The species which fall in highest frequency class E was *Grewia eriocarpa* Juss.. This species can be considered as the most common species in the study area.

Table (2) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	0	0.00
B	21-40%	8	57.14
C	41-60%	3	21.43
D	61-80%	2	14
E	81-100%	1	7.14

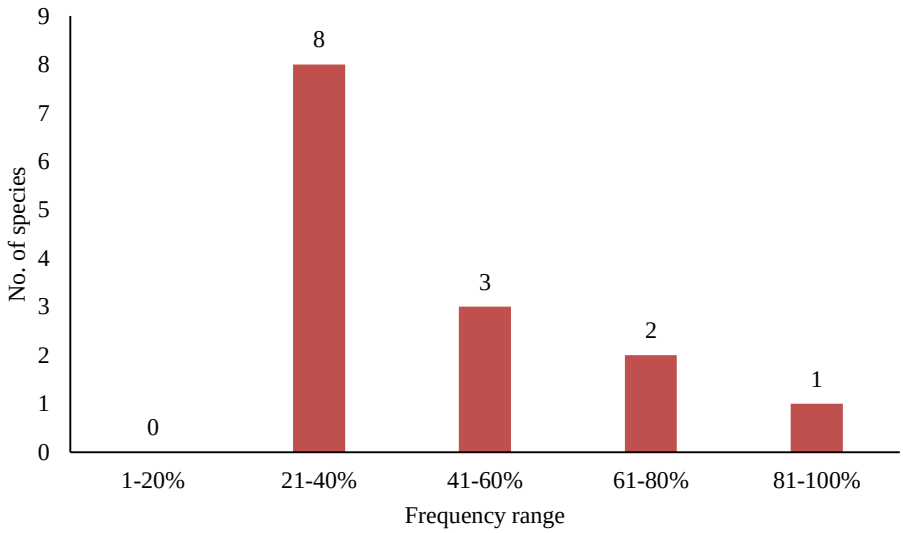


Figure (3) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Simpson (E), and Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (3) and (4). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (3) Diversity indices in the Letpadaung taung area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.197	3.31	2.458	1.043	1.841
Q2	0.5783	1.783	1.478	0.4483	1.057
Q3	1.852	6.371	5.667	1.549	3.997
Q4	1.539	4.66	4.667	1.244	2.807
All Sample Index	2.103		6.689	1.932	4.133
Jackknife Std Error	0.1326		0.8236	0.1297	1.051

Table (4) Evenness indices in the Letpadaung taung area

Sample	Shannon maximum	Shannon minimium	Simpson E	Brillion E
Q1	1.792	0.5187	0.4097	0.653
Q2	1.099	0.4438	0.4928	0.4898
Q3	2.197	1.035	0.6296	0.8392
Q4	1.792	0.9321	0.7778	0.8571
All Sample Index	2.639	0.6294	0.4778	0.7953
Jackknife Std Error	0.1856	0.1904	0.07786	0.03634

Forest structure

Stem density of ≥10cm was 1311 ha^{-1} and basal area was 6.22 m^2/ha in the study area Table (5). Among the 4 sample plots studies, 14 tree species were recorded, 4 species were found only one individual and these were considered as unique species. List of recorded species along the tracking are showed in appendix-1.

The 3 most abundance species in terms of basal area occupied 63.70% of the total, of which *Prosopis juliflora* DC. was the most dominant species in the study area with 23.25%, followed by *Azadirachta indica* A. Juss. 20.79%, and *Dalbergia paniculata* Roxb. 19.66% of the total basal area table (6), figure (4).

Table (5) Consolidated detail of species inventory in the study area

Description	Results
No. of sampling point	10
No. of tree species	12
Density (stem/ha)	810
Basal area (m^2/ha)	9.24

Table (6) Ranking of relative basal area by species in the study area

No.	Scientific name	Stem/ha	Basa area (m^2/ha)	Basal area (%)
1	*Prosopis juliflora*	89	1.45	23.25
2	*Azadirachta indica*	278	1.29	20.79
3	*Dalbergia paniculata*	333	1.22	19.66
4	*Lannea coromandelica*	11	0.78	12.61
5	*Tectona hamiltoniana*	189	0.48	7.75
6	*Ehretia rigida*	156	0.39	6.27
7	*Grewia eriocarpa*	89	0.22	3.48
8	*Sterculia* sp.	11	0.11	1.84
9	*Acacia* sp.	11	0.09	1.38
10	*Jatropha gossypifolia*	44	0.06	0.95
11	*Boscia variabilis*	44	0.05	0.80
12	*Hymenopramis brachiata*	11	0.03	0.48
13	*Bridelia* sp.	22	0.03	0.40
14	*Ziziphus oenoplia*	22	0.02	0.37
Total		1311	6.22	100

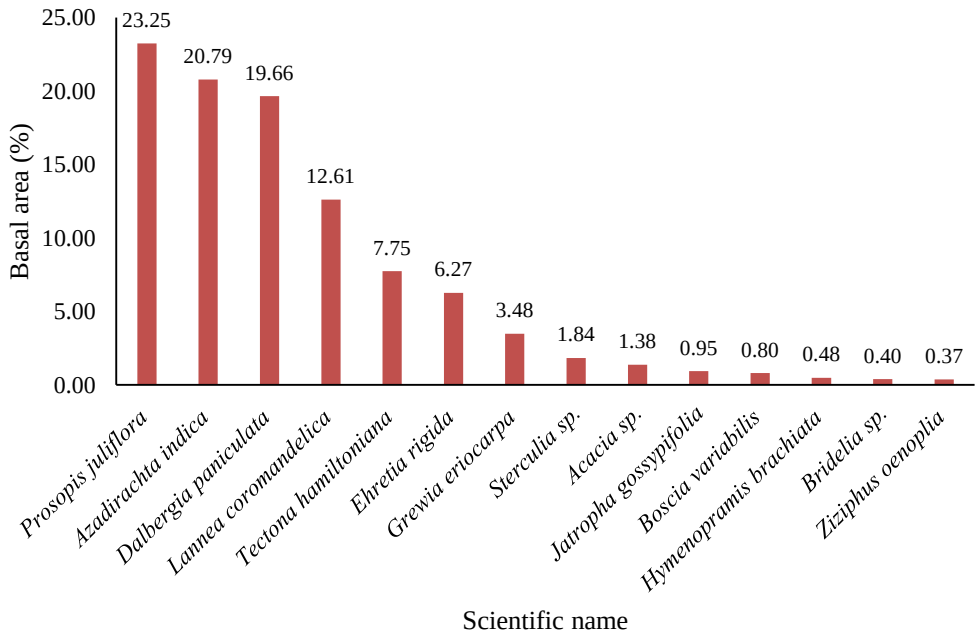


Figure (4) Relative basal area by species in the study area

Result (2) Herb species in Letpadaung taung area

Frequency and Relative Frequency

Hibiscus sp. has highest relative frequency value (11.27%), UN-1 takes second highest relatively frequency value (9.86%), and *Azadirachta indica* A. Juss. and *Blepharis boerhaviefolia* Pers. possess third relatively frequency value (8.45%) see table (7), figure (5). These species are most frequently occurred in the study area.

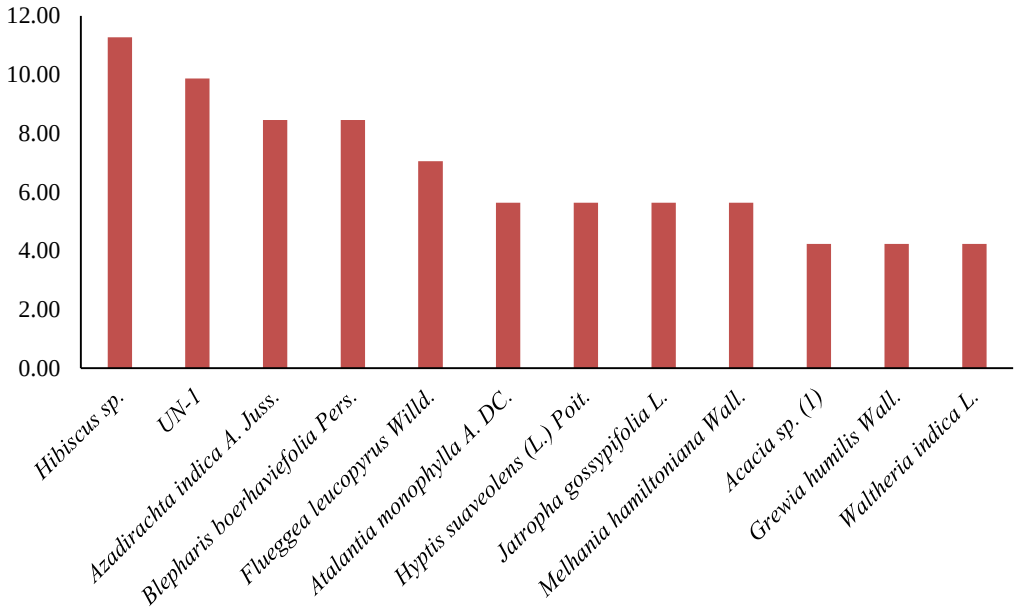


Figure (5) Relative frequency of top ten species

Table (7) Ranking of frequency and relative frequency of herb species

No.	Scientific Name	Frequency	Relative frequency (%)
1	*Hibiscus* sp.	0.50	11.27
2	UN-1	0.44	9.86
3	*Azadirachta indica* A. Juss.	0.38	8.45
4	*Blepharis boerhaviefolia* Pers.	0.38	8.45
5	*Flueggea leucopyrus* Willd.	0.31	7.04
6	*Atalantia monophylla* A. DC.	0.25	5.63
7	*Hyptis suaveolens* (L.) Poit.	0.25	5.63
8	*Jatropha gossypifolia* L.	0.25	5.63
9	*Melhania hamiltoniana* Wall.	0.25	5.63
10	*Acacia* sp. (1)	0.19	4.23
11	*Grewia humilis* Wall.	0.19	4.23
12	*Waltheria indica* L.	0.19	4.23
13	*Bridelia* sp.	0.13	2.82
14	*Capparis zeylanica* L.	0.13	2.82
15	*Cocculus villosus* DC.	0.13	2.82
16	*Cyperus* sp.	0.13	2.82
17	*Ehretia rigida* (Thunb.) Druce	0.13	2.82
18	*Poa annua* L.	0.06	1.41
19	*Tephrosia purpurea* Pers.	0.06	1.41
20	UN-2	0.06	1.41
21	*Ziziphus oenoplia* Mill.	0.06	1.41

Density and Relative Density of Belt transect

Hyptis suaveolens (L.) Poit. has highest relative density value (88.87%), UN-1 takes second highest relatively density value (3.57%), and *Hibiscus* sp. holds third relatively density value (1.19%) see table (8), figure (6). The *Hyptis suaveolens* (L.) Poit. was most densely found in the study area.

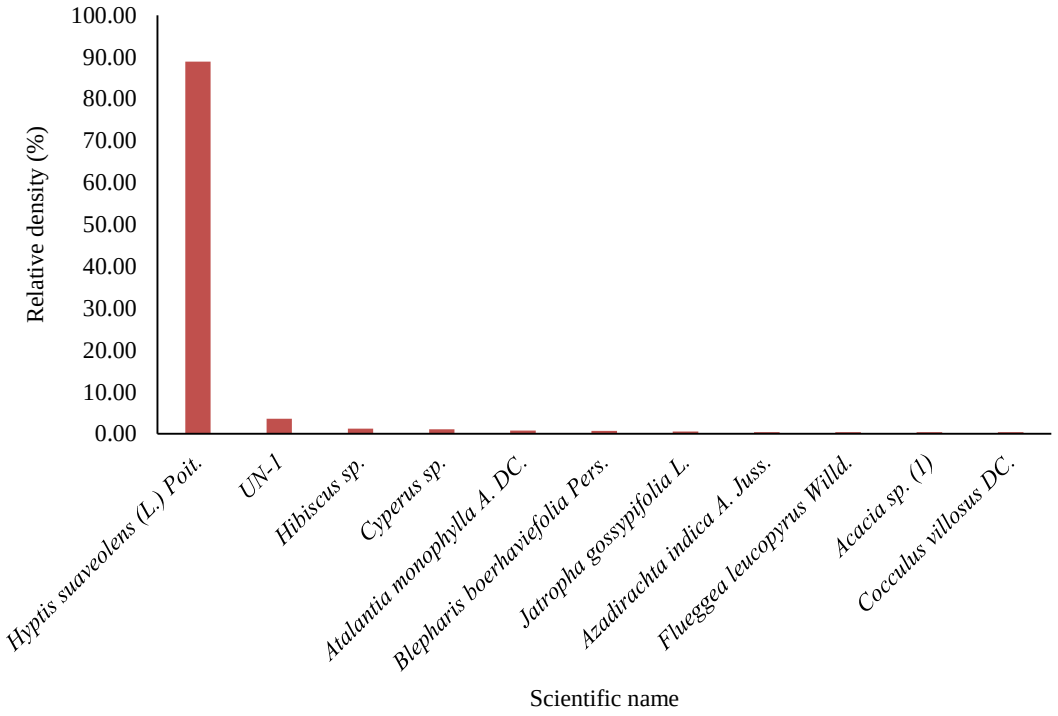


Figure (6) Relative density of herb species

Table (8) Ranking of d and relative density of herb species

No.	Scientific Name	Density	Relative Density (%)
1	*Hyptis suaveolens* (L.) Poit.	93.31	88.87
2	UN-1	3.75	3.57
3	*Hibiscus* sp.	1.25	1.19
4	*Cyperus* sp.	1.13	1.07
5	*Atalantia monophylla* A. DC.	0.81	0.77
6	*Blepharis boerhaviefolia* Pers.	0.75	0.71
7	*Jatropha gossypifolia* L.	0.56	0.54
8	*Azadirachta indica* A. Juss.	0.44	0.42
9	*Flueggea leucopyrus* Willd.	0.44	0.42
10	*Acacia* sp. (1)	0.38	0.36
11	*Cocculus villosus* DC.	0.38	0.36
12	*Melhania hamiltoniana* Wall.	0.31	0.30
13	*Grewia humilis* Wall.	0.25	0.24
14	*Bridelia* sp.	0.19	0.18
15	*Capparis zeylanica* L.	0.19	0.18
16	*Ehretia rigida* (Thunb.) Druce	0.19	0.18
17	*Poa annua* L.	0.19	0.18
18	*Tephrosia purpurea* Pers.	0.19	0.18
19	*Waltheria indica* L.	0.19	0.18
20	UN-2	0.06	0.06
21	*Ziziphus oenoplia* Mill.	0.06	0.06

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 90.48% of the total number of herb species was in lower frequency classes, A and B, while 9.52% was observed only in higher frequency class C (Table 9, Figure 7). It indicates that the herb species in study area is floristically heterogeneous, according to Lamprecht (1989).

Table (9) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	12	57.14
B	21-40%	7	33.33
C	41-60%	2	9.52
D	61-80%	0	0
E	81-100%	0	0

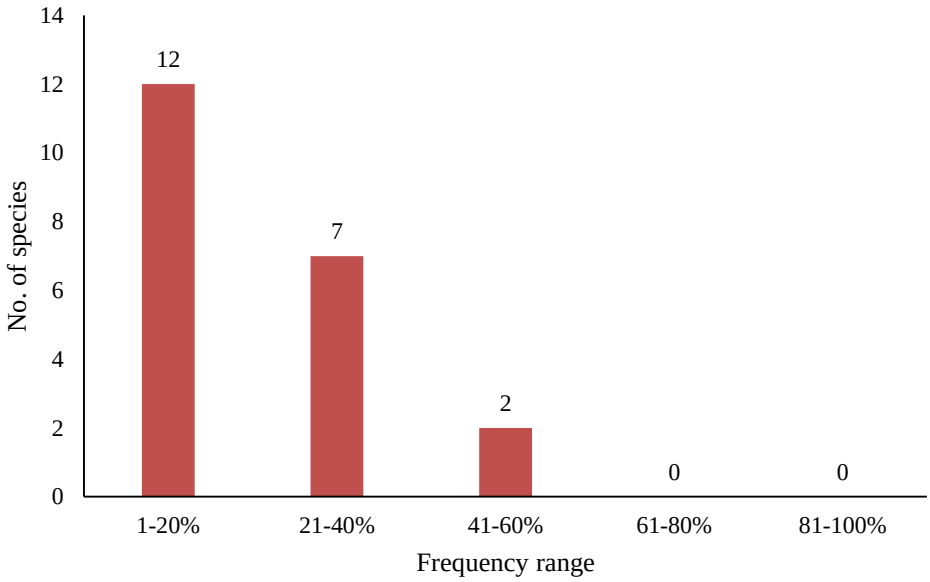


Figure (7) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the herb species was analyzed using the Shannon Wiener index (H), Simpsons index (D), Brillouin (D), Fisher's Alpha, Shannon maximum and minimum evenness (E), Simpson (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (10) and (11). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (10) Species diversity in the study area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.206	3.341	2.731	1.003	1.84
Q2	1.894	6.644	13.75	1.339	8.286
Q3	1.494	4.456	7	1.015	5.705
Q4	0.6005	1.823	1.531	0.4996	0.8897
Q5	0.6931	2	2	0.3466	2.00E+06
Q6	0	1	1	-1.01E-09	0.7959
Q7	0.6931	2	2	0.3466	2.00E+06
Q8	0.9503	2.586	3.333	0.5991	3.167
Q9	1.414	4.114	4.583	1.03	3.538
Q10	1.223	3.397	3.477	0.9977	1.594
Q11	1.586	4.883	5.571	1.175	4.322
Q12	1.16	3.191	2.553	0.8863	2.496
Q13	0.1813	1.199	1.067	0.1695	0.9218
Q14	0.2118	1.236	1.078	0.1958	0.9748
Q15	0.2085	1.232	1.075	0.1801	1.17
Q16	0.09952	1.105	1.031	0.0844	0.876
All Sample Index	0.6204		1.264	0.599	3.384
Jackknife Std Error	0.2487		0.1774	0.2376	0.3135

Table (11) Species evenness in the study area

Sample	Shannon maximum	Shanno	Simpson E	Brillion E
Q1	1.609	0.643	0.5462	0.7343
Q2	1.946	1.666	1.964	1
Q3	1.609	1.386	1.4	0.9524
Q4	1.099	0.334	0.5102	0.5206
Q5	0.6931	0.693	1	1
Q6	0	0	1	0
Q7	0.6931	0.693	1	1
Q8	1.099	0.95	1.111	0.8808
Q9	1.609	1.16	0.9167	0.8756
Q10	1.386	0.634	0.8693	0.8776
Q11	1.792	1.285	0.9286	0.8835
Q12	1.609	0.909	0.5106	0.6977
Q13	1.792	0.06	0.1779	0.09595
Q14	1.792	0.077	0.1797	0.1113
Q15	1.792	0.159	0.1792	0.1042
Q16	1.609	0.1	0.2062	0.05381
All Sample Index	3.045	0.1	0.06017	0.1991
Jackknife Std Error	0.08182	0.047	0.01221	0.08405

Discussion and conclusion

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A total of 71 species representing 60 genera and 33 families were listed in the Letpadaung taung area (appendix-1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 54.47%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI = 53.41%) and *Tectona hamiltoniana* Wall. (IVI= 34.65%) is third. The number of species greater than 10% IVI value was eight species. Those species could be considered as ecological indicator species of Letpadaung taung area.

Herb species distribution by frequency classes in study area showed that high percent of the total number of species was in lower frequency classes, A and B, while low percent was observed only in higher frequency class C. It indicates that the herb species of study area is floristically heterogeneous. The value of diversity indices and evenness indices for herb and tree species were very low in study area.

Stem density of ≥10cm was 1311 ha^{-1} and basal area was 6.22 m^2/ha in the study area. Among the 4 sample plots studies, 14 tree species were recorded, 4 species were found only one individual and these were considered as unique species. The 3 most abundance species in terms of basal area occupied 63.70% of the total, of which *Prosopis juliflora* DC. was the most dominant species in the study area with 23.25%, followed by *Azadirachta indica* A. Juss. 20.79%, and *Dalbergia paniculata* Roxb. 19.66% of the total basal area. The plant species that listed and recorded in recently study were checked with IUCN red list of threaten species. But no species were found in IUCN red list.

Recommendation

1. To balance the forest ecosystem services lost by project development, buffer zone should be implemented around the project area
2. Re-vegetation program should be included in buffer zone. High IVI value species should be considered priority species for plantation which could tolerate and grow well in that climate.
3. Annual monitoring and measuring growth performance should be conducted to evaluate the re-vegetation site since the action not only maintain the forest but also support the biodiversity of ecosystem.

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Baseline Flora Wet Season

Methodology

Data collection

In order to obtain essential ecological data for predicting flora of trees, 4 permanent plots (each sample plot was 15mx 15m) in different sites were subjectively laid down and observed. To account overall species diversity four subplots 1mx 1m were divided in four corners and study for herbs in the plot (fig. 1). After plot set up enumeration was conducted. Within each sub-plot, every living tree with a minimum girth at breast height (gbh) of 10cm was mapped to the nearest 0.1m and its coordinates were recorded using different symbols, each tree was labeled with a number. The trees were permanently marked with a uniquely numbered aluminum tag.

Tags were attached to the tree with nylon fishing line using a slip-knot system to allow the sling to increase its size as the tree grows. Only in the case of very large trees, is the tag nailed to the tree. The point of measurement is marked by a permanent marker pen at 1.3m above the ground (or above any buttresses; the size of a tree at the point of measurement will then still be referred to as the gbh, i.e. this term is equivalent to a reference height) and trees are measured for gbh to the nearest mm over the paint mark.

Botanical specimens are taken – except for very common and in the field reliably identified species. The families were identified by using a key to the families of the flowering plants, issued by the Department of Botany, Yangon University (1994). Specimen identification was performed with the use of the following references: Backer *et a*l., (1963, 1965, 1968), Hooker, Sir J.D. Vol.(I-VII), (1897) and Hundley, H.G. and Chit Ko Ko (1961).

Data analysis

Quantitative analysis of tree species their relative values of frequency, density and basal area were calculated and summed to get Importance Value Index. For the herb species, density, relative density, frequency, and relative frequency were calculated. Diversity statistics applied to the data, generated in this study were calculated using the software package; Species Diversity & Richness IV (SDR) for window 2007.

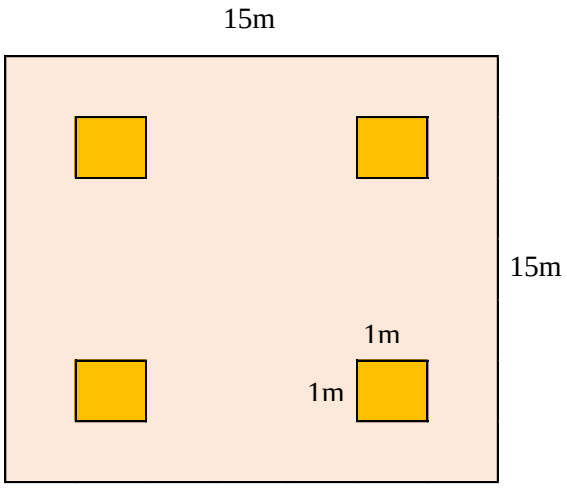


Figure (1) Lay out design of sample plot

Result (1) Forest Tree in Letpadaung taung area

Important Value Index (IVI)

In the ten sampling plots, total number of tree species was 16 species. Ranking of ecological significance by IVI of tree species in the study area were given in table (1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 66.83%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI=44.22%) and *Prosopis juliflora* DC. (IVI = 31.60%) is third (figure-2). The number of species greater than 10% IVI value was ten species. Those species could be considered as ecological indicator species of study area.

Table (1) Ranking of Important Value Index (IVI) in the Letpadaung taung area

No.	Scientifics name	RD (%)	RF (%)	R.Dm (%)	IVI (%)
1	*Azadirachta indica* A. Juss.	31.97	11.11	23.74	66.83
2	*Dalbergia paniculata* Roxb.	18.37	7.41	18.45	44.22
3	*Prosopis juliflora* DC.	5.44	3.70	22.45	31.60
4	*Tectona hamiltoniana* Wall.	10.88	11.11	6.53	28.53
5	*Ehretia rigida* (Thunb.) Druce	8.84	7.41	6.65	22.90
6	*Grewia eriocarpa* Juss.	4.08	11.11	3.18	18.37
7	*Lannea coromandelica* (Houtt.) Merr.	0.68	3.70	11.69	16.08
8	*Ziziphus oenoplia* Mill.	5.44	7.41	1.31	14.16
9	*Boscia variabilis* Collett & Hemsl.	4.76	7.41	1.18	13.35
10	*Jatropha gossypifolia* L.	3.40	7.41	1.12	11.93
11	*Sterculia* sp.	0.68	3.70	1.74	6.13
12	*Hymenopramis brachiata* Wall.	1.36	3.70	1.03	6.09
13	*Bridelia* sp.	1.36	3.70	0.43	5.50
14	*Wrightia arborea* (Dennst.) Mabb.	1.36	3.70	0.25	5.31
15	*Grewia humilis* Wall.	0.68	3.70	0.16	4.55
16	*Holarrhena pubescens* Wall. ex. G. Don	0.68	3.70	0.07	4.46
Total		100.00	100.00	100.00	300.00

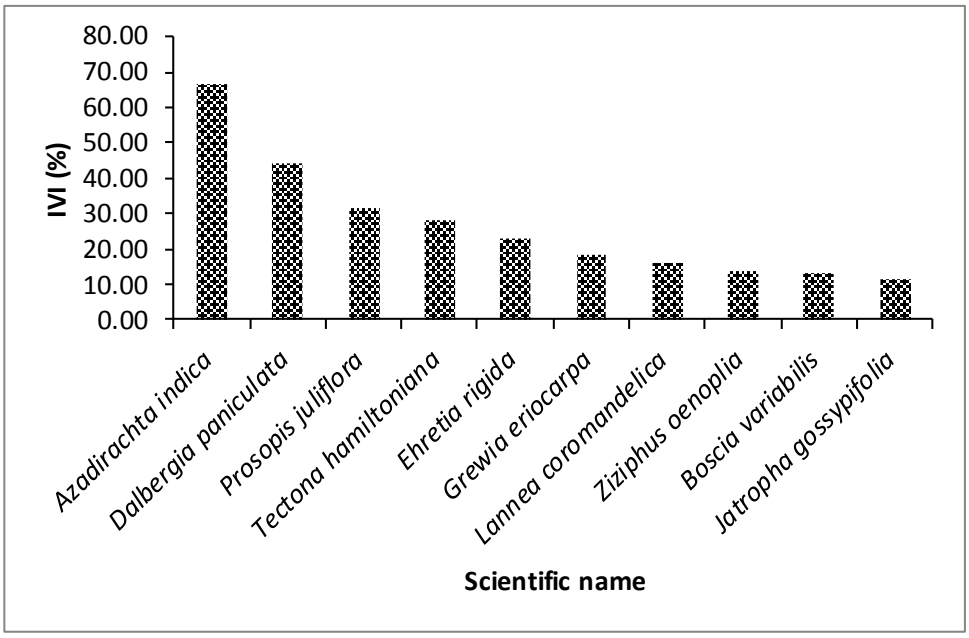


Figure (2) Important Value Index of top ten species in the Letpadaung taung area

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 50% of the total number of species was in lower frequency classes B, while 50% was observed only in highest frequency class C and D, (Table 2, Figure 3). The species which fall in higher frequency class D was *Azadirachta indica* A. Juss., *Grewia eriocarpa* Juss., and *Tectona hamiltoniana* Wall.. Those species can be considered as the most common species in the study area.

Table (2) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	0	0.00
B	21-40%	8	50.00
C	41-60%	5	31.25
D	61-80%	3	19
E	81-100%	0	0

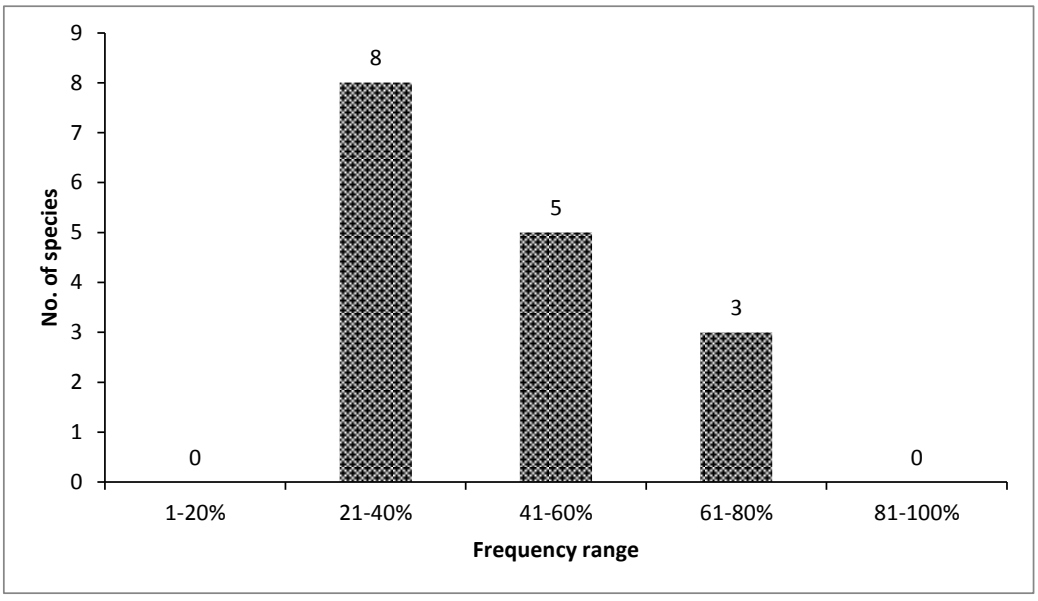


Figure (3) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analyzed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Simpson (E), and Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (3) and (4). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (3) Diversity indices in the Letpadaung taung area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.313	3.718	2.791	1.144	1.877
Q2	0.8996	2.459	1.81	0.7779	1.438
Q3	1.847	6.338	5.667	1.551	3.922
Q4	1.639	5.151	4.865	1.322	3.426
All Sample Index	2.15		6.185	1.988	4.566
Jackknife Std Error	0.17		1.979	0.1621	0.7267

Table (4) Evenness indices in the Letpadaung taung area

Sample	Shannon maximum	Shannon minimium	Simpson E	Brillion E
Q1	1.792	0.5369	0.4651	0.7193
Q2	1.609	0.4232	0.362	0.5376
Q3	2.197	1.013	0.6296	0.836
Q4	1.946	1.041	0.6951	0.8376
All Sample Index	2.773	0.6059	0.3866	0.7726
Jackknife Std Error	0.08766	0.1271	0.155	0.07758

Forest structure

Stem density of ≥10cm was 1633 ha^{-1} and basal area was 6.76 m^2/ha in the study area Table (5). Among the 4 sample plots studies, 16 tree species were recorded, 4 species were found only one individual and these were considered as unique species. List of recorded species along the tracking are showed in appendix-1.

The 3 most abundance species in terms of basal area occupied 64.65% of the total, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 23.74%, followed by *Prosopis juliflora* DC. 22.45%, and *Dalbergia paniculata* Roxb. 18.45% of the total basal area table (5), figure (4).

Table (5) Ranking of relative basal area by species in the study area

No.	Scientifics name	Stem/ha	Basal area m^2/ha)	Basal area (%)
1	*Azadirachta indica* A. Juss.	522	1.61	23.74
2	*Prosopis juliflora* DC.	89	1.52	22.45
3	*Dalbergia paniculata* Roxb.	300	1.25	18.45
4	*Lannea coromandelica* (Houtt.) Merr.	11	0.79	11.69
5	*Ehretia rigida* (Thunb.) Druce	144	0.45	6.65
6	*Tectona hamiltoniana* Wall.	178	0.44	6.53
7	*Grewia eriocarpa* Juss.	67	0.22	3.18
8	*Sterculia* sp.	11	0.12	1.74
9	*Ziziphus oenoplia* Mill.	89	0.09	1.31
10	*Boscia variabilis* Collett & Hemsl.	78	0.08	1.18
11	*Jatropha gossypifolia* L.	56	0.08	1.12
12	*Hymenopramis brachiata* Wall.	22	0.07	1.03
13	*Bridelia* sp.	22	0.03	0.43
14	*Wrightia arborea* (Dennst.) Mabb.	22	0.02	0.25
15	*Grewia humilis* Wall.	11	0.01	0.16
16	*Holarrhena pubescens* Wall. ex. G. Don	11	0.00	0.07
Total		1633	6.76	100

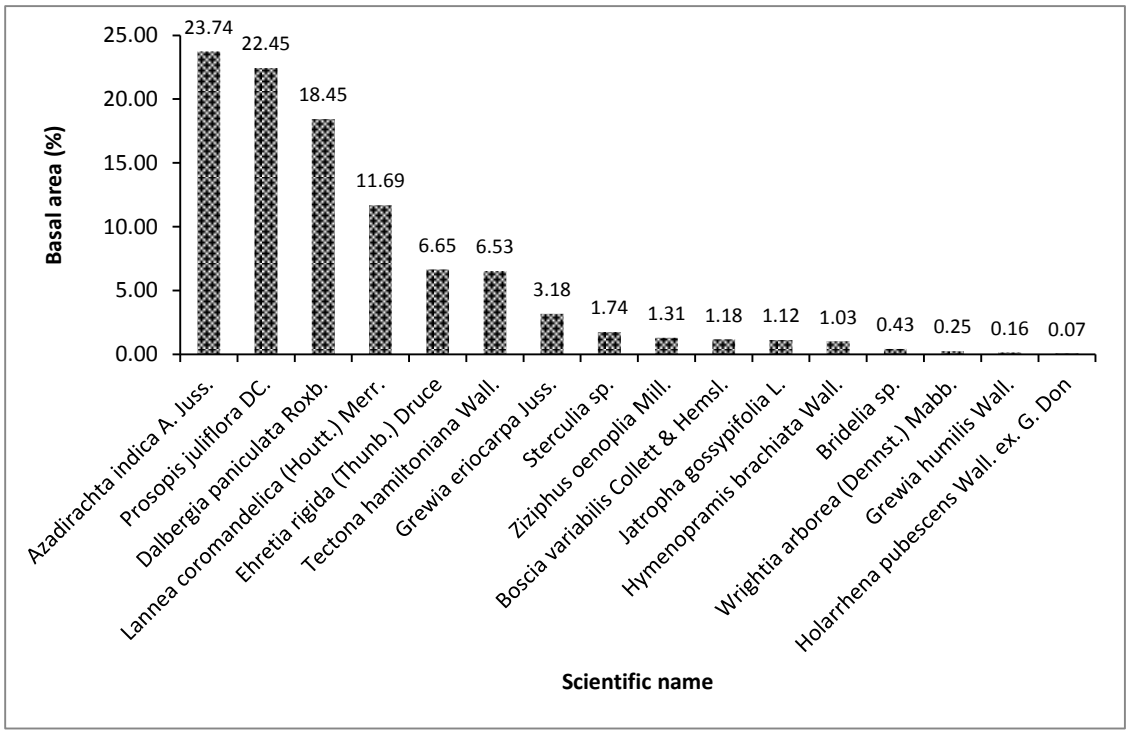


Figure (4) Relative basal area by species in the study area

Result (2) Herb species in Letpadaung taung area

Frequency and Relative Frequency

Rhynchosia sp. has highest relative frequency value (15.24%), *Blepharis boerhaviefolia* Pers. takes second highest relatively frequency value (11.43%), and *Hyptis suaveolens* (L.) Poit. possesses third relatively frequency value (7.62%) see table (6), figure (5). These species are most frequently occurred in the study area.

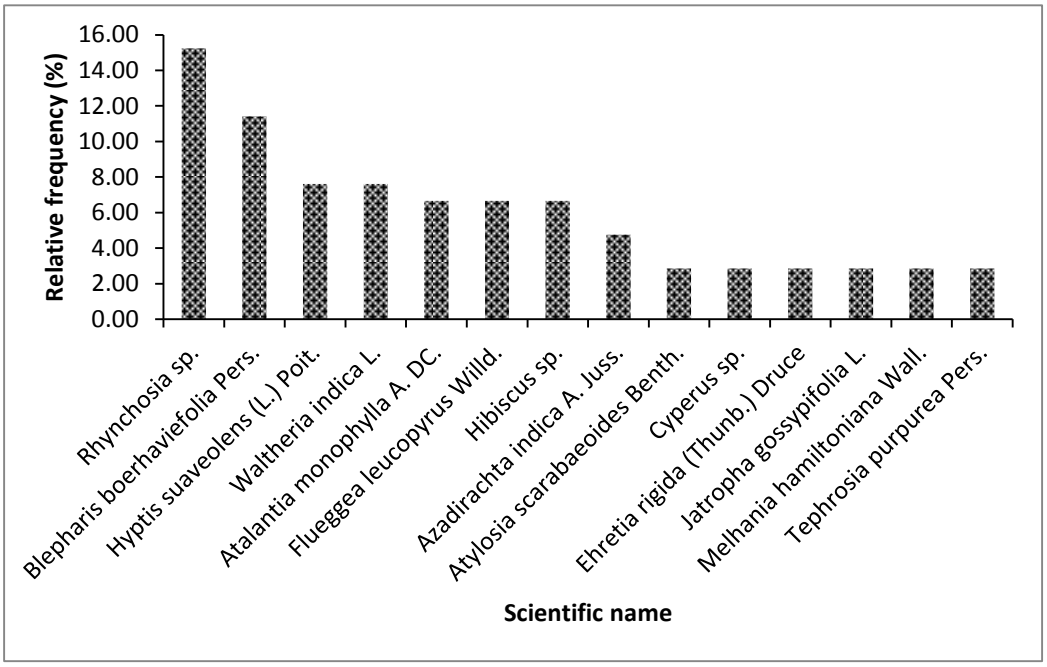


Figure (5) Relative frequency of top ten species

Table (6) Ranking of frequency and relative frequency of herb species

No.	Scientifics name	Frequency	Relative frequency (%)
1	*Rhynchosia* sp.	1.00	15.24
2	*Blepharis boerhaviefolia* Pers.	0.75	11.43
3	*Hyptis suaveolens* (L.) Poit.	0.50	7.62
4	*Waltheria indica* L.	0.50	7.62
5	*Atalantia monophylla* A. DC.	0.44	6.67
6	*Flueggea leucopyrus* Willd.	0.44	6.67
7	*Hibiscus* sp.	0.44	6.67
8	*Azadirachta indica* A. Juss.	0.31	4.76
9	*Atylosia scarabaeoides* Benth.	0.19	2.86
10	*Cyperus* sp.	0.19	2.86
11	*Ehretia rigida* (Thunb.) Druce	0.19	2.86
12	*Jatropha gossypifolia* L.	0.19	2.86
13	*Melhania hamiltoniana* Wall.	0.19	2.86
14	*Tephrosia purpurea* Pers.	0.19	2.86
15	*Bridelia* sp.	0.13	1.90
16	*Cocculus villosus* DC.	0.13	1.90
17	*Grewia humilis* Wall.	0.13	1.90
18	*Abutilon indicum* (L.) Sweet	0.06	0.95
19	*Holarrhena pubescens* Wall. ex. G. Don	0.06	0.95
20	*Ipomoea* sp.	0.06	0.95
21	*Leptadenia reticulata* Wight & Arn.	0.06	0.95
22	*Phyllanthus simplex* Retz.	0.06	0.95
23	*Phyllanthus* sp.	0.06	0.95
24	*Poa annua* L.	0.06	0.95
25	UN-1	0.06	0.95
26	UN-2	0.06	0.95
27	*Wrightia arborea* (Dennst.) Mabb.	0.06	0.95
28	*Ziziphus oenoplia* Mill.	0.06	0.95

Density and Relative Density of Belt transect

Hyptis suaveolens (L.) Poit. has highest relative density value (29.37%), Rhynchosia sp. takes second highest relatively density value (27.33%), and *Waltheria indica* L. holds third relatively density value (21.69%) see table (7), figure (6). The *Hyptis suaveolens* (L.) Poit. was most densely found in the study area.

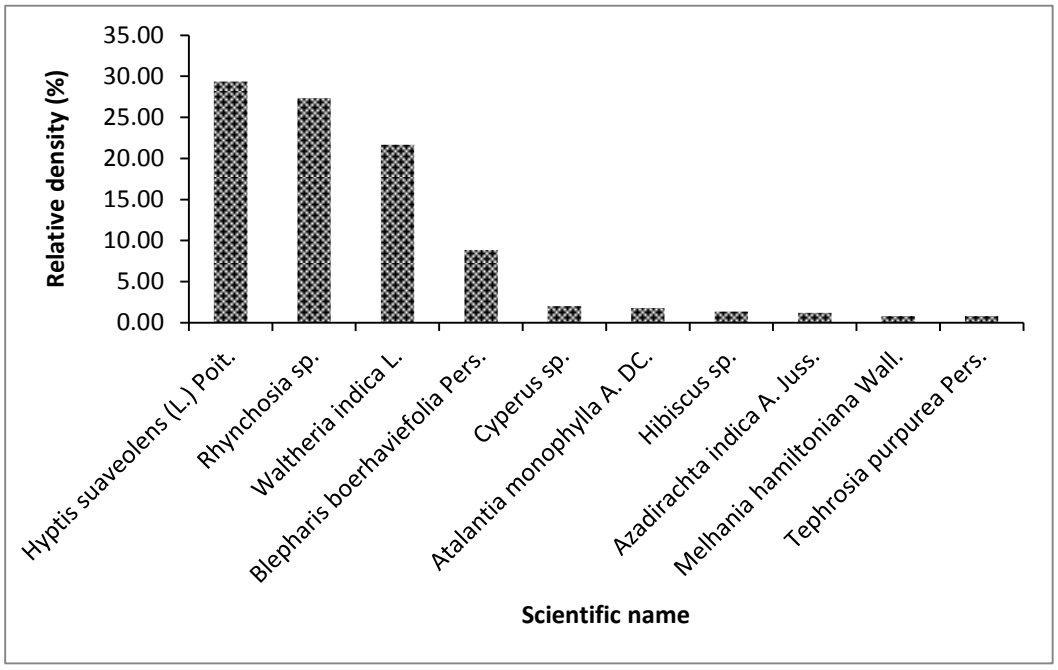


Figure (6) Relative density of herb species

Table (7) Ranking of d and relative density of herb species

No.	Scientifics name	Density	Relative density(%)
1	*Hyptis suaveolens* (L.) Poit.	24.38	29.37
2	*Rhynchosia* sp.	22.69	27.33
3	*Waltheria indica* L.	18.00	21.69
4	*Blepharis boerhaviefolia* Pers.	7.38	8.89
5	*Cyperus* sp.	1.69	2.03
6	*Atalantia monophylla* A. DC.	1.50	1.81
7	*Hibiscus* sp.	1.13	1.36
8	*Azadirachta indica* A. Juss.	1.00	1.20
9	*Melhania hamiltoniana* Wall.	0.69	0.83
10	*Tephrosia purpurea* Pers.	0.69	0.83
11	*Flueggea leucopyrus* Willd.	0.63	0.75
12	*Atylosia scarabaeoides* Benth.	0.44	0.53
13	*Jatropha gossypifolia* L.	0.44	0.53
14	*Poa annua* L.	0.44	0.53
15	*Ehretia rigida* (Thunb.) Druce	0.31	0.38
16	*Grewia humilis* Wall.	0.31	0.38
17	*Bridelia* sp.	0.25	0.30
18	*Cocculus villosus* DC.	0.19	0.23
19	*Phyllanthus simplex* Retz.	0.19	0.23
20	*Abutilon indicum* (L.) Sweet	0.13	0.15
21	UN-2	0.13	0.15
22	*Holarrhena pubescens* Wall. ex. G. Don	0.06	0.08
23	*Ipomoea* sp.	0.06	0.08
24	*Leptadenia reticulata* Wight & Arn.	0.06	0.08
25	*Phyllanthus* sp.	0.06	0.08
26	UN-1	0.06	0.08
27	*Wrightia arborea* (Dennst.) Mabb.	0.06	0.08
28	*Ziziphus oenoplia* Mill.	0.06	0.08

Species distribution by frequency classes

In order to clarify the homogeneity or heterogeneity of the floristic distribution in the study area, species distribution by frequency classes was examined. According to the outcome of frequency chart, 75% of the total number of herb species was in lower frequency classes, A while 25% was observed only in higher frequency class C, D, and E (Table 8, Figure 7). It indicates that the herb species in study area is floristically heterogeneous, according to Lamprecht (1989).

Table (8) Species distribution by frequency classes

Frequency Class	Frequency range	No. of species	% of total species frequency distribution
A	1-20%	21	75.00
B	21-40%	0	0.00
C	41-60%	5	17.86
D	61-80%	1	4
E	81-100%	1	4

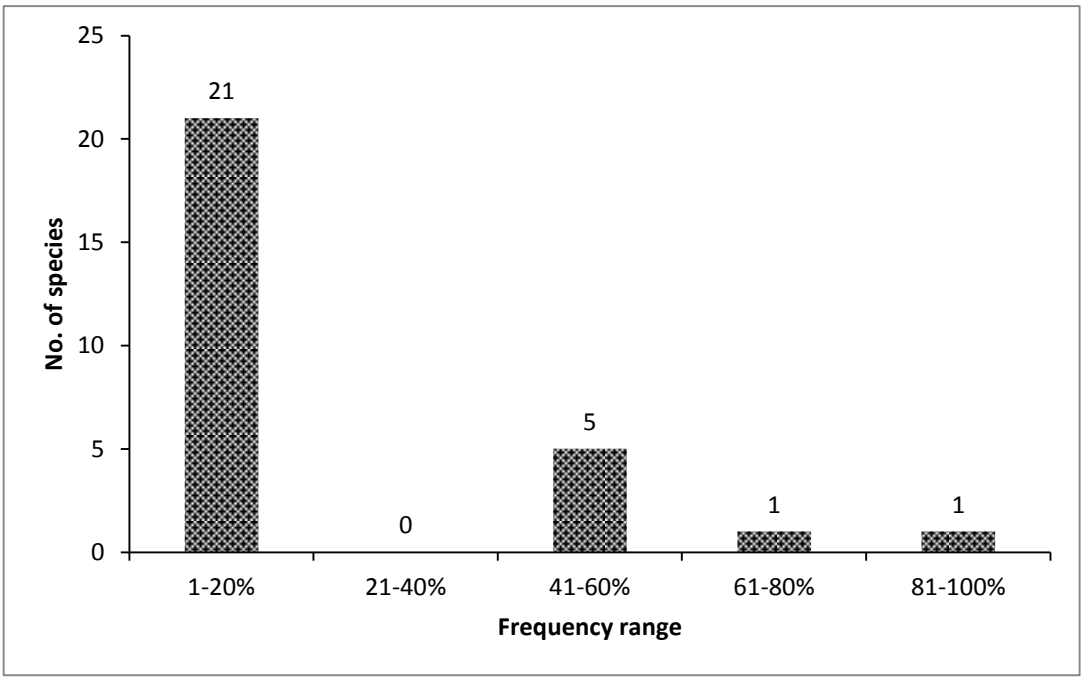


Figure (7) Species distribution by frequency classes

Diversity indices and evenness

Among the different measurement of species diversity indices, the floristic diversity of the herb species was analyzed using the Shannon Wiener index (H), Simpsons index (D), Brillouin (D), Fisher's Alpha, Shannon maximum and minimum evenness (E), Simpson (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals. The value of diversity indices and evenness indices of individual sample plot and all sample indices were shown in table (9) and (10). According to the result, the diversity indices of individual sample plot and all sample indexes are very low.

Table (9) Species diversity in the study area

Sample	Shannon Wiener (H)	Exp H	Simpson (D)	Brillouin D	Fisher's Alpha
Q1	1.505	4.506	3.62	1.392	2.029
Q2	1.654	5.228	4.315	1.399	3.189
Q3	0.8806	2.412	1.755	0.7388	1.576
Q4	1.267	3.551	3.083	1.105	1.558
Q5	1.061	2.89	2.382	1.018	1.156
Q6	1.328	3.774	3.016	1.262	1.259
Q7	1.053	2.867	2.581	0.8986	1.297
Q8	1.306	3.69	2.878	1.191	1.848
Q9	1.767	5.851	5.25	1.395	4.523
Q10	1.545	4.69	6.6	1.16	3.218
Q11	1.32	3.742	4.25	1.075	1.649
Q12	2.023	7.56	16.5	1.435	10.49
Q13	1.294	3.648	2.773	1.185	2.063
Q14	0.5828	1.791	1.57	0.5643	0.6709
Q15	1.277	3.587	2.486	1.203	2.009
Q16	1.908	6.738	6.068	1.682	3.513
All Sample Index	1.868		4.615	1.83	5.02
Jackknife Std Error	0.1363		0.5498	0.1279	0.6431

Table (10) Species evenness in the study area

Sample	Shannon maximum	Shanno	Simpson E	Brillion E
Q1	0.3806	2.079	0.4525	0.7179
Q2	0.871	2.079	0.5394	0.7885
Q3	0.5029	1.609	0.351	0.5214
Q4	0.4924	1.609	0.6167	0.7778
Q5	0.1527	1.792	0.397	0.5883
Q6	0.2032	1.792	0.5027	0.737
Q7	0.4709	1.386	0.6452	0.7488
Q8	0.4008	1.946	0.4111	0.6631
Q9	1.245	2.079	0.6562	0.8449
Q10	1.099	1.609	1.32	0.9717
Q11	0.6599	1.386	1.063	0.9522
Q12	1.814	2.079	2.063	1
Q13	0.3963	2.079	0.3466	0.6128
Q14	0.07539	1.386	0.3925	0.4166
Q15	0.2794	2.197	0.2762	0.5744
Q16	0.7831	2.303	0.6068	0.8266
All Sample Index	0.1663	3.332	0.1648	0.5588
Jackknife Std Error	0.03762	0.11	0.02506	0.04334

Discussion and conclusion

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A total of 117 species representing 94 genera and 44 families were listed in the Letpadaung taung area (appendix-1). The tree layer in the study area is dominated by *Azadirachta indica* A. Juss. with the highest IVI of 66.83%, the second most dominant species is *Dalbergia paniculata* Roxb. (IVI = 44.22%) and *Prosopis juliflora* DC. (IVI= 31.60%) is third. The number of species greater than 10% IVI value was ten species. Those species could be considered as ecological indicator species of Letpadaung taung area.

Herb species distribution by frequency classes in study area showed that high percent of the total number of species was in lowest frequency classes, A and while low percent was observed only in higher frequency class C, D, and E. It indicates that the herb species of study area is floristically heterogeneous. The value of diversity indices and evenness indices for herb and tree species were very low in study area.

Stem density of ≥10cm was 1633 ha^{-1} and basal area was 6.76 m^2/ha in the study area. Among the 4 sample plots studies, 16 tree species were recorded, 4 species were found only one individual and these were considered as unique species. The 3 most abundance species in terms of basal area occupied 64.65% of the total, of which *Azadirachta indica* A. Juss. was the most dominant species in the study area with 23.74%, followed by *Prosopis juliflora* DC. 22.45%, and *Dalbergia paniculata* Roxb. 18.45% of the total basal area. The plant species that listed and recorded in recently study were checked with IUCN red list of threaten species. But no species were found in IUCN red list.

Recommendation

1. To balance the forest ecosystem services lost by project development, buffer zone should be implemented around the project area
2. Re-vegetation program should be included in buffer zone. High IVI value species should be considered priority species for plantation which could tolerate and grow well in that climate.
3. Annual monitoring and measuring growth performance should be conducted to evaluate the re-vegetation site since the action not only maintain the forest but also support the biodiversity of ecosystem.

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APPENDIX D

Baseline Studies - Fauna

Knight Piésold CONSULTING

BASELINE STUDY - FAUNA



Letpadaung Copper Mine Project

LETPADAUNG COPPER MINE PROJECT

Baseline Study – Fauna

Prepared for: Myanmar Wanbao Mining Copper Limited

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Document Number/ Revision Number	Prepared by	Reviewed by	Date
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EXECUTIVE SUMMARY

Environment Myanmar Cooperative Company Limited (EMC) has undertaken a survey of the fauna within and around the site of the Letpadaung Copper Project for Myanmar Wanbao Mining Copper Limited (MWMCL). The survey was undertaken in three campaigns over the period from September 2012 until late June 2013 to take into account the seasonal variation and the effect on species abundance and diversity and habitat condition. .

The survey was undertaken through the use of fixed location points that were frequently revisited and observations recorded, transects that were inspected for tracks, scats and calls and wandering transects where observations were made, potential habitat inspected and evidence of presence/absence recorded. Identification was confirmed according to historic collections, recordings and identification specimens using local and international references.

Historical studies in the Project area indicated that the fauna composition was depauperate in numbers and that state could likely be attributed to the habitat condition in the area. Indeed the habitat condition has declined over the last 20 years as a result of the harvesting of vegetation for its resources and more substantial trees have been removed both from natural vegetation in the Letpadaung hills as well as plantations in the surrounding area. Thus much of the protection offered by those habitats is no longer available nor is the nesting, roosting or burrowing opportunities they provided.

Recordings were made of mammals, birds, reptiles, amphibians, butterflies and odonates. Statistical analysis of the recordings made suggested there was very little difference in species abundance and diversity across the seasons.

Two mammal species, Eld's Deer and the Myanmar Hare, were observed directly or reported in interviews as occurring in the Project area. Individuals of these species in the project would be considered to be under threat as their ability to move unhindered across open fields to other areas of protection is doubtful. It is considered that the provision of an offset for the lost habitat to accommodate the needs of these mammals and a possible capture/release programme should be considered for these species.

Other species of animal are less threatened due to their mobility (birds), ability to survive in small patches or ability to move to other sites away from the Letpadaung site inconspicuously will enable them to survive the habitat loss through disturbance of the site.

1 INTRODUCTION

1.1 Background

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of fauna in the project area of the Letpadaung Copper Project ("the Project"). The survey was undertaken in three campaigns over the period from September 2012 until late June 2013 to enable the evaluation of the fauna in the three seasons experienced in the Project area.

The proponent, MWMCL, aims to promote survey work that is uniform and of sufficient rigour to contribute to a more systematic inventory of the Myanmar and Salingyi district's fauna. This will result in a consolidated and readily accessible database of environmental information.

The Environmental and Social Impact Assessment (ESIA) is a systematic study and process to determine the impacts and effects of a project on the environment during its various phases of construction, commissioning, operation, and abandonment. As such, its objectives are to ensure that the project is sound and maximises the social and environmental standpoint benefit to be derived, and that any issues of concern relating to the biological, physical, or socio-economic environments or applicable national or international regulations or guidelines are recognised early and considered in the project design. This allows incorporation into the Project design of appropriate mitigation measures to avoid, eliminate or compensate for potential adverse effects (impacts), as well as including the costs of these measures into the project economics.

This study, the baseline fauna study, is designed to gather data and, through analysis of that data, identify any significant issues associated with the Project that have significance to the fauna living within the area. The study will propose management and monitoring options to mitigate any issues related to fauna that are identified, and provide the base information for inclusion in the ESIA.

1.2 The Project

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The Project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic centre of central Myanmar and 722 km north of Yangon. The Project is focused around Letpadaung Hill. The Project location within Myanmar is shown at Figure 1.1.

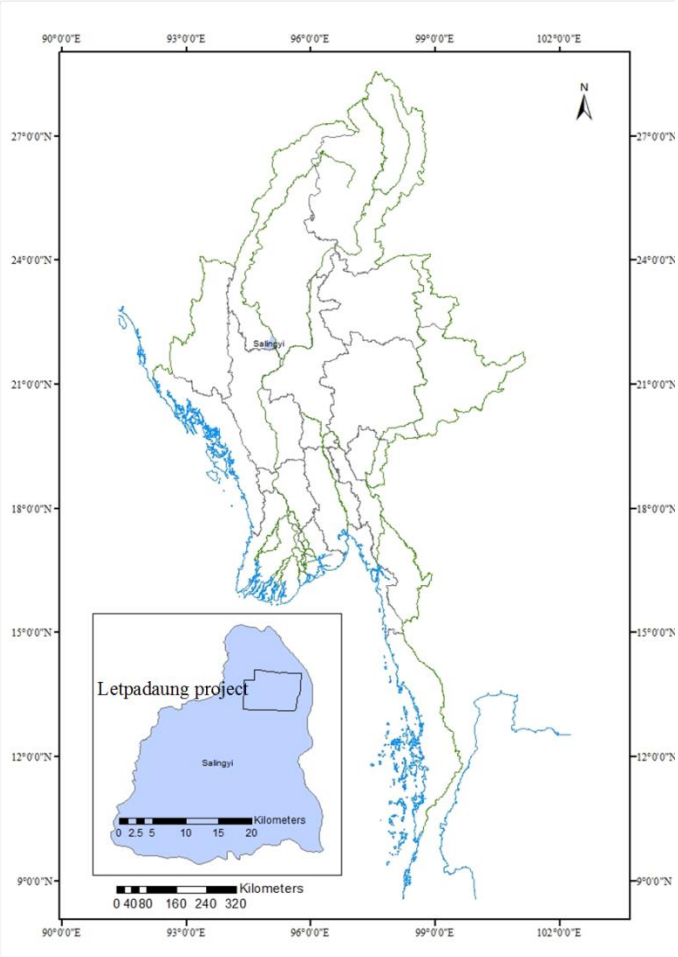


Figure 1.1: Site Locality Plan

Letpadaung Hill is situated in Salingyi Township, west of the Chindwin River, right across Monywa. In the vicinity area, Sabe Taung, Myayeik Taung, Kyae Sin Taung, and Phone Win Taung are located side by side on the west bank of Chindwin. Letpadaung Hill includes twelve small hills forming ridges and valleys. The hill is covered with scrub forest with dry zone plant species and stunted tree species. The Letpadaung hill is bounded by the Chindwin River on the east, where Nyaungbingyi port is one of the transportation routes between east bank and west bank of Chindwin River. It is also bounded by Nyaungbingyi-Gangaw Road and Taungbalu village, Kyawywar and Aungchansi villages on the north, Moegyobyin (south), Moegyobyin (central) and Moegyobyin (south) villages on the west, and Ton village, Phaunggadar village, and Seide-Zeedaw (new village) on the south. The Project location is shown in Figure 1.2.

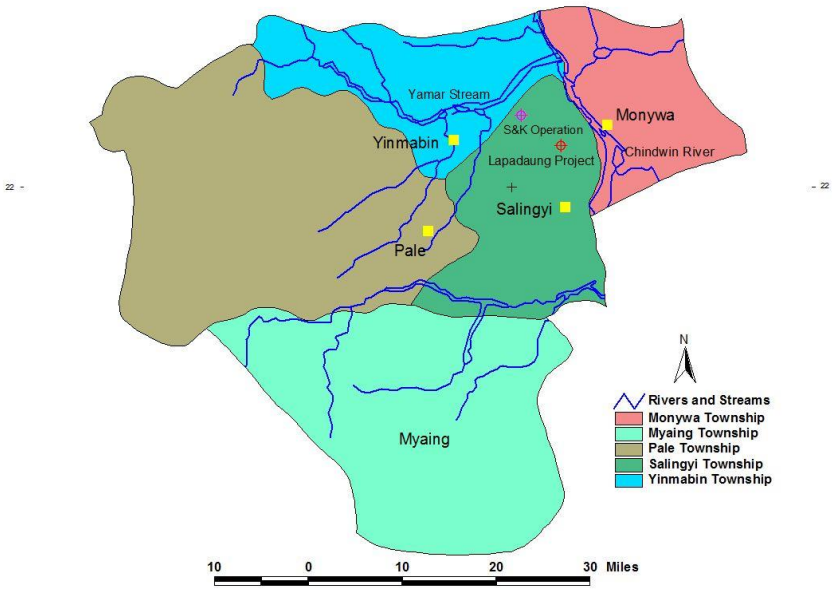


Figure 1.2: Project Location Plan

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung (which are mined by Myanmar Yang Tse Copper Ltd as the S&K operation) and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).[1] The Project area is shown in Figure 1.3.

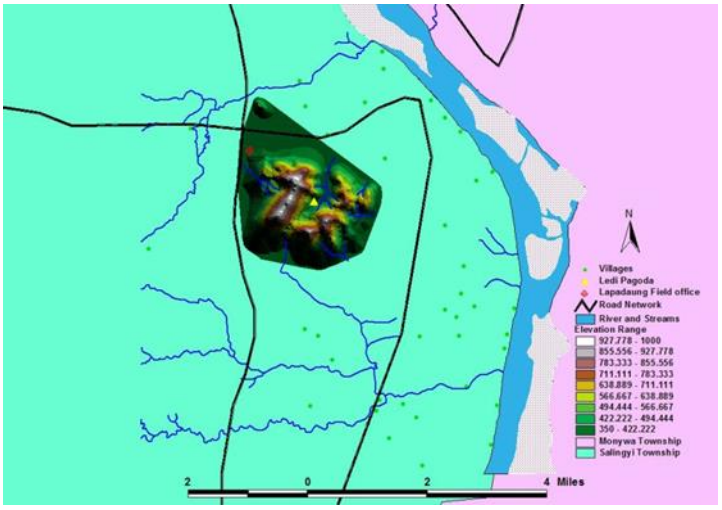


Figure 1.3: Site Location Plan

MWMCL proposes to mine and process copper bearing ore for a period of 30 years to produce 100,000 tonnes per annum of copper cathode. The ore will be mined by an open pit method and processed through a series of heap leach pads with the leachate being collected and processed in a solvent extraction – electro-winning plant to produce the copper cathode.

Certain fauna baseline data were collected at the mine site in support of the 1997 Environmental Impact Assessment (EIA) Feasibility Study Report for a project similar in nature to that being considered by MWMCL.

[1] China Nerin Engineering Co., Ltd, 2011; Myanmar Monywa Letpadaung Copper Project – Basic Design, Volume 1 - Specification; Prepared for Myanmar Wanbao Mining Copper Limited; June 2011.

The data collected in the 1997 report will also enable comparison of past and present conditions to be made to identify changes that have occurred/are occurring without a mine being in place at Letpadaung.[2]

1.3 This Document

This document has been prepared consistent with a terms of reference (TOR) provided to EMC by MWMCL (included at Appendix 1). The document comprises the following sections in response to the TOR:

- Section 1 – Introduction to the document;
- Section 2 – A description of the legal framework associated with fauna protection in Myanmar;
- Section 3 – Discussion of the TOR and variations made during field investigations. This section also describes the methodologies used in field studies and data analysis from observations made;
- Section 4 – Literature Review;
- Section 5 – Presentation of findings of field studies;
- Section 6 – Analysis of data gathered during the field studies and its implications;
- Section 7 – Discussion of the potential impacts arising from project implementation that will affect the baseline fauna in the Project area and possible mitigation strategies;
- Section 8 – Proposes recommendations for management of fauna on the site and provides a conclusion regarding the study findings in relation to local and regional knowledge of the fauna;
- Appendix – The appendix will include the Terms of Reference; and
- Figures – Figures will include site location plans and study location plan.

[2] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme Volume 1 - Report Final Draft , Letpadaung Copper Project, Myanmar for Ivanhoe Myanmar Holdings; Report No ME96-056-001; 17 February 1997; In Volume 8, Appendix 10, Feasibility Study Letpadaung Copper project, Monywa, Union of Myanmar commissioned by Ivanhoe Myanmar Holdings; Presented to No1 Mining Enterprise, Ministry of Mines, Government of the Union of Myanmar; Minproc Engineers Limited ACN 008 992 694; March 1997

2 LEGAL FRAMEWORK AND INDUSTRY GUIDELINES

The section describes the legal framework and policy context within which fauna is managed in Myanmar. It also describes the international treaties that are designed to protect fauna, to which Myanmar is a signatory.

Industry guidelines are also described which aspire to minimize the impact of the industries activities on fauna and biodiversity.

2.1 Legislation and Regulations

Myanmar has a long history of formal protected area management, dating back to the designation of a wildlife sanctuary near Mandalay. For most of the 20th Century, the Forest Act of 1902 and the Wildlife Protection Act of 1936 provided the legal basis for wildlife protection and protected area management in Myanmar.

In 1994, wildlife protection and protected area management regulations were overhauled with the passing of the Protection of Wildlife and Protected Areas Law. The objectives of this law included protecting wild animals and plants, conserve natural areas, and fulfill Myanmar's obligations under international agreements. The law recognised seven categories of protected area: scientific nature reserve; national park; marine national park; nature reserve; wildlife sanctuary; reserve of geophysical significance; and other nature reserve designated by the Minister.

Another piece of recent legislation related to biodiversity conservation is the Forest Act of 1992, which explicitly links forestry management with social and environmental considerations. The Forest Act is complemented by the 1995 National Forest Policy, which emphasises the need to integrate the goals of timber production, and wildlife and environmental conservation.

Myanmar is also a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed according to the degree of protection they need. The classes of listing include:

- Species threatened with extinction;
- Species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival; and
- Species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

A list describes those species covered by CITES and includes species of fauna from Myanmar.

2.2 Guidelines

The International Finance Corporation (IFC) has a Performance Standard 6 (PS6) – Biological Conservation and Sustainable Natural Resource Management which has been developed around the international Convention on Biological Diversity. The performance standard addresses the opportunities that exist for operations to avoid and mitigate threats to biodiversity.

The key requirements of PS6 in relation to fauna are:

- Assessment of impacts of the Project on fauna;
- Account for the differing values of stakeholders in that assessment;

- Consider the effects of habitat destruction and the potential for introduction of invasive alien species; and
- Use qualified and experienced external experts to assist in data collection and assessment.

PS6 also considers options for mitigation including:

- Restoring impacted areas with appropriate native species and consistent with local ecological conditions;
- Offsetting biodiversity losses through the creation of ecologically comparable area(s) elsewhere (comparable in size, quality and function) that is managed for biodiversity; and
- Financial or in-kind compensation to direct users of biodiversity.

3 TERMS OF REFERENCE

The objectives of this TOR (are to ensure that:

- There is clarity for MWMCL on the scale of the fauna and faunal assemblage survey appropriate for different areas;
- The fauna and faunal assemblage survey, analysis, interpretation and reporting undertaken for the ESIA is of a suitable quality and of consistent methodology to enable judgement of the impacts of the Project on fauna and faunal assemblages;
- The environment, in particular significant fauna and faunal assemblages, is identified and protected through good practice in the conduct and reporting of fauna and faunal assemblage surveys for the ESIA;
- Myanmar's knowledge base of fauna and faunal assemblages and biogeography are developed and enhanced over time at both the local and regional scale to the benefit of future decision making; and
- Survey data are capable of underpinning long-term observation and measurement for later compliance and audit purposes (especially as this pertains to completion criteria for the Project).

The timing of the survey was specified to consider the cool-dry, hot-dry and wet seasons and, as a result, fieldwork was undertaken during these three (3) periods to address the seasonal variations that are expected to occur.

The TOR also specified the area in which the fauna study should extend and included areas beyond the immediate Project site.

3.1 Variations to the TOR

During the study period, particularly in the cool-dry and hot-dry monitoring periods, it was difficult to implement a full scale capture and release program as access to the site and security of personnel, equipment and trapped fauna could not be assured, due to the dissatisfaction of the local community with the Project and the limitations on land access and disputed land compensation. As a result, modifications were made to the methodology used as described in Section 3.2 below.

3.2 Methodology Adopted in Surveys

3.2.1 Birds

Birds were observed with binoculars and identified with the aid of a field guide. As many factors can affect bird activity and behaviour, time of day, season and the weather were included as more important factors. Many birds are more active and vocal early in the morning. Selection of the bird watching season is also an important factor because bird's movements and migration are especially related to the seasonal food source and physical surroundings. Nocturnal birds were observed at dusk. Transect method; point count and opportunistic method were used to census the species richness. The survey was conducted to cover all kinds of vegetation and elevation ranges. Point counting involved walking to, and usually marking, a particular spot,

and then recording all bird contacts for a pre-determined period (15 minutes) before moving on to the next point. Birds were identified according to Smythies (1953)[3] Robson (2000)[4] and Robson (2005)[5].

3.2.2 Mammals

Distribution and presence of large mammals were examined by conducting track and sign surveys. Sighting of prey species, tracks, scats, droppings were undertaken as data gathering in the field. Voucher specimens of tracks were taken in the forms of plaster casts, photographs or tracings. Questionnaire surveys were conducted. The results of questioning each individual informant were treated as a distinct sample.

The tracks and signs of small mammals were observed along the proposed project area. Small mammal traps were set up in systematic randomization design and left to cover night and day hours and checked the trapped animals. The small mammal species were identified following after Tun Yin (1976)[6] and Francis (2001)[7]. Interview survey was made in villages around Letpadaung hills. The results of questioning each individual informant were treated as a distinct sample.

3.2.3 Reptiles and Amphibians

In the present study, methodology of the study on reptilian and amphibian species was based on active search and trapping method. Stratification of the habitat was relatively similar to that of mammal study. Reptilian and amphibian species were actively searched during the survey period. The collected specimens were preserved in 10% formalin for further identification in the laboratory. Reptiles were identified according to Win Maung and Win Ko Ko (2002)[8] and Das (2010)[9].

3.2.4 Butterflies and Odonates

Butterflies and odonates were caught using the hand net. The captured insects were immobilized quickly by pinching the underside of the thorax or immediately anesthetized by placing them in a killing bottle with chloroform, soaked cotton wool to prevent excessive flapping of the wings which lead to mechanical injuries. The anesthetized specimens were transferred into triangular paper envelopes. The dead specimens were mounted on setting board. The dead specimens need to be pinned and spread before their muscles become rigid. Since the butterflies are small and not fleshy, they can be dry-preserved. These specimens were photographed. Dead specimens were also kept in an insect box. Identification of the butterfly species was followed after Bingham (1905 and 1907)[10] and Talbot (1939 and 1947)[11].

[3] Smythies, B.E (1953). The Birds of Burma, London: Oliver and Boyd. Survey of India.
[4] Robson, C (2000). A Field Guide to the Birds of South East Asia, UK: New Holland Publisher
[5] Robson, C (2005). Birds of South-East Asia: Thailand Peninsular, Malaysia, Singapore, Vietnam, Cambodia, Laos, Myanmar
[6] Tun Yin,(1976) Wild Mammals of Myanmar. Nyunt Printing Press, Forest Department, Myanmar. Pp.329
[7] Francis, C.M.(2001) Mammals of South-East Asia including Thailand, Malaysia, Singapore, Myanmar, Laos, Cambodia, *Vietnam, Java, Sumatra, Bali, and Borneo
[8]
[9] Das, I. (2010)A Field Guide to the Reptiles of Thailand and South-East Asia
[10] Bingham, C. T. (1905). The fauna of British India including Ceylon and Burma. Butterflies. Volume I. Taylor and Francis Company, London. 511pp. and
[11] Bingham, C.T. (1907). The fauna of British India including Ceylon and Burma. Butterflies. Volume II. Taylor and Francis Company, London. 480pp.

4 LITERATURE REVIEW

AATA (1996)[12] briefly describes the fauna of the Central Myanmar region and the fauna that may be present in the Monywa area. They note that of the 334 resident and migratory bird species likely to be found in the region only 45 common resident bird species are expected to be found in the Monywa area. The bird species, *Crypsirina cucualta* (Family Corvidae) is an endangered species.

Whilst a number of large mammals could be found in the Central Myanmar region, only the Thamin or Eld's Deer, *Cervus eldy*, is expected to be found in the Monywa area.

Muir Environmental (1997)[13] suggested that avifauna in the Project area represented only about 23% of the regional avifauna (based on the 38 species of bird observed in the Project area) which indicated the area does not support a large number or diversity of species. It also suggested the hills do not offer refuge to less common species.

The presence of omnivorous birds suggested that the limited habitats did not suit specialist species. However, nearly all birds observed had some agricultural significance either for their significance in pest control or their potential to harm either people or local agriculture.

Muir observed four (4) mammal species and received reports of another 4 being present in the Project area.

Frogs and reptiles were considered to be low in abundance and diversity and this characteristic may have accounted for the scarcity of raptors in the Project area.

In the wet season of 2003 and at the end of the hot-dry season in 2004, surveys by staff from the Department of Zoology at the University of Yangon, established the following information regarding bird and mammal species in the Project area.

Table 4.1: Bird Data 2003/2004 Surveys

Location	Species Wet Season	Species Hot-dry Season
Saddle	13	14
Lower slopes	9	11
Valley sides	3	3
Total	14	16

During the survey at the end of the hot-dry season, the Asian barred owlet *Glaucidium cuculoides* was recorded in the broad saddle of the two hills.

A survey of mammals was also undertaken over the same period. Eld's deer (Shwethamin) *Cervus eldi* thamin and the hare *Lepus peguensis* were recorded during both survey periods.

[12] AATA, 1996; Environmental Assessment – Monywa Copper Project, Volume 1;In Feasibility Study Sabetaung – Kyisintaung Copper Project, Monywa, Union of Myanmar – Volume 5 Appendices , prepared for Ivanhoe Myanmar Holdings Ltd by Mincorp Engineers and Constructors; AATA International Inc., Fort Collins, Colorado USA; March 1996

[13] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme – Volume 1 – Final Draft; Appendix 10, Volume 8 in Feasibility Study, Letpadaung Copper Project, Monywa, Union of Myanmar for Ivanhoe Myanmar Holdings Limited by Minproc Engineers Ltd; March 1997.

5 FIELD SURVEY RESULTS

5.1 Birds

5.1.1 Cool-Dry Season

A total of 19 bird species were recorded during the survey period (see Table 5.1). The recorded species belong to 13 Families of the Order Passeriformes.

The birds, Spotted Dove *Streptopelia chinensis*, Red-vented Bulbul *Pycnonotus cafer*, Indian Roller *Coracias benghalensis*, Chinese Francolin *Francolinus pintadeanus* and White Wagtail *Motacilla alba* were mostly common at the lower slopes and foothill areas.
The broad saddles between the hills, steeply sided valley and hill crest are normally inhabited by the Black-Shouldered Kite *Elanus caeruleus*, Shikra *Accipiter badius* and Mountain Tailor Bird *Orthotomus cuculatus*.

Common bird species which inhabit mainly foothill areas, lower slopes and flat areas are the Common Myna *Acridotheres tristis*, Pied bush chat *Saxicola caprata*, White throated babblers *Turdoides gularis* and Red vented bulbul *Pycnonotus cafer* (Plate 5.1).

Table 5.1: Bird species recorded during the cool-dry season survey.

Sr.No.	Scientific name	Common name	Family	IUCN Red List Status
1	*Passer montanus*	Tree Sparrow	Ploceidae	NL
2	*Streptopelia chinensis*	Spotted Dove		NL
3	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	NL
4	*P.blanfordi*	Streak-eared Bulbul		NL
5	*Coracias benghalensis*	Indian Roller	Coraciidae	NL
6	*Merops orientalis*	Green Bee-eater	Meropidae	NL
7	*Turdoides gularis*	White-throated Babbler	Timaliidae	NL
8	*Lanius collurioides*	Burmese Shrike		NL
9	*Accipiter badius*	Shikra		NL
10	*Acridotheres tristis*	Common Myna	Sturnidae	NL
11	*Sturnus burmanicus*	Vinous-breasted Starling		NL
12	*Upupa epops*	Hoopoe	Upupidae	NL
13	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL
14	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL
15	*Orthotomus cuculatus*	Mountain Tailorbird		NL
16	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL
17	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL
18	*Motacilla alba*	White Wagtail	Motacillidae	NL
19	*Elanus caeruleus*	Black-shouldered Kite	Accipitridae	NL

NL=Not Listed

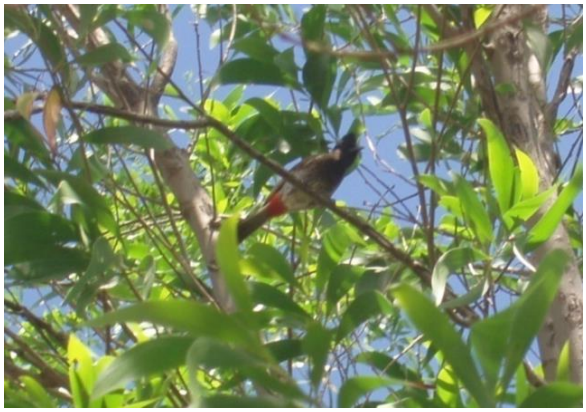


Plate 5.2: Red-vented Bulbul *Pycnonotus cafer*

5.1.2 Hot-Dry Season

A total of 18 bird species were recorded during the survey period (Table 5.2). The recorded species belong to 13 Families of the Order Passeriformes.

The Spotted Dove *Streptopelia chinensis*, Red-vented Bulbul *Pycnonotus cafer*, and Indian Roller *Coracias benghalensis*, were mostly common at the lower slopes and foothill areas.

The broad saddles between the hills, steeply sided valley and hill crest are normally inhabited by the Black-shouldered Kite *Elanus caeruleus*, Shikra *Accipiter badius* and Mountain Tailorbird *Orthotomus cuculatus*.

Common bird species which inhabit mainly foothill areas, lower slopes and flat areas are Common Myna *Acridotheres tristis*, Pied Bush Chat *Saxicola caprata*, White-throated Babblers *Turdoides gularis* and Red-vented Bulbul *Pycnonotus cafer* (Plate 5.2).

Table 5.2: Bird species recorded during the hot-dry season survey

Sr.No.	Scientific name	Common name	Family	IUCN Red List Status
1	*Passer montanus*	Tree Sparrow	Ploceidae	NL
2	*Streptopelia chinensis*	Spotted Dove	Ploceidae	NL
3	*Pycnonotus cafer*	Red-vented Bulbul	Pycnonotidae	NL
4	*P.blanfordi*	Streak-eared Bulbul	Pycnonotidae	NL
5	*Coracias benghalensis*	Indian Roller	Coraciidae	NL
6	*Merops orientalis*	Green Bee-eater	Meropidae	NL
7	*Turdoides gularis*	White-throated Babblers	Timaliidae	NL
8	*Accipiter badius*	Shikra		NL
9	*Acridotheres tristis*	Common Myna	Sturnidae	NL
10	*Sturnus burmanicus*	Vinous-breasted Starling		NL
11	*Upupa epops*	Hoopoe	Upupidae	NL
12	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL
13	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL
14	*Orthotomus cuculatus*	Mountain Tailorbird		NL
15	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL
16	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL
17	*Motacilla alba*	White Wagtail	Motacillidae	NL
18	*Elanus caeruleus*	Black-shouldered Kite	Accipitridae	NL

NL-Not Listed

5.1.3 Wet Season

A total of 18 bird species were recorded during the survey period (Table 5.3). The recorded species belong to 11 Families of the Order Passeriformes.

The broad saddles between the hills are inhabited by 7 bird species of 6 Families; 16 bird species recorded at the lower slopes, 11 species at the steeply sided valley of Letpadaung hill and 4 species at the hill crest.

Table 5.3: Bird species recorded during the wet season survey.

Sr. No.	Scientific name	Common name	Family	IUCN Red List/ Endemic Status	Remark
1	*Passer montanus*	Tree Sparrow	Ploceidae	NL	Observed
2	*Streptopelia chinensis*	Spotted Dove	Columbidae	NL	Observed
3	*Pycnonotus cafer*	Red Vented Bulbul	Pycnonotidae	NL	Observed
4	*Pycnonotus blanfordi*	Streak-eared Bulbul	Pycnonotidae	NL	Observed
5	*Coracias benghalensis*	Indian Roller	Coraciidae	NL	Observed
6	*Merops orientalis*	Green Bee-eater	Meropidae	NL	Observed
7	*Turdoides gularis*	White-throated Babblers	Timaliidae	Endemic	Observed
8	*Accipiter badius*	Shikra	Accipitridae	NL	Observed
9	*Acridotheres tristis*	Common Myna	Sturnidae	NL	Observed
10	*Sturnus burmanicus*	Vinous-breasted Starling	Sturnidae	NL	Observed
11	*Upupa epops*	Hoopoe	Upupidae	NL	Observed
12	*Turnix tanki*	Yellow-legged Buttonquail	Turnicidae	NL	Observed
13	*Orthotomus sutorius*	Common Tailorbird	Sylviidae	NL	Observed
14	*Orthotomus cuculatus*	Mountain Tailorbird	Sylviidae	NL	Observed
15	*Francolinus pintadeanus*	Chinese Francolin	Falconidae	NL	Observed
16	*Saxicola caprata*	Pied Bush Chat	Turdidae	NL	Observed
17	*Motacilla alba*	White Wagtail	Motacillidae	NL	Observed
18	*Mirafra microptera*	Burmese Bushlark	Alaudidae	Endemic	Observed

NL-Not Listed

5.2 Mammals

5.2.1 Cool-dry season

The Myanmar Hare *Lepus peguensis* was observed during the survey period (Table 5.4). Individuals were observed in foothill areas of the Letpadaung hills. Also scats of the hare were also observed as evidence. They have a large range, moving between scrubland and cultivated areas at the base of the Letpadaung hill. According to the interview survey and foot-prints observed, Eld's deer (Shwethamin) *Cervus eldii thamin* (*Rucervus eldii*) was listed as a frequent visitor to the Project area. Barking deer *Muntiacus muntjak* were also noted with track and sign evidence in the Project area.

Table 5.4: Mammals recorded during the cool-dry season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status
1	Lepus peguensis	Myanmar Hare	Leporidae	NL
2	Paradoxurus hermaphroditus	Common Palm Civet	Viverridae	NL
3	Muntiacus muntjak	Barking Deer	Cervidae	NL
4	Cervus eldi thamin	Eld's Deer	Cervidae	Endemic / Endangered

NL-Not Listed

5.2.2 Hot-dry season

Myanmar Hare *Lepus peguensis* was observed during the hot-dry season survey (Table 5.5). Individuals were observed in foothill areas of the Letpadaung hills. Additionally, Myanmar hare scat was also observed. They have a large range, moving between scrubland and cultivated areas at the base of the Letpadaung Hill. The foot-prints of Eld's Deer (Shwethamin) *Cervus eldii thamin* (*Rucervus eldii*) and that of the Barking Deer *Muntiacus muntjak* were not observed in the Project area. This may be due to scarcity of food sources and hiding places during the hot-dry season. Only two mammal species were recorded based on track and sign survey.

Table 5.5: Mammals recorded during the hot-dry season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status
1	*Lepus peguensis*	Myanmar Hare	Leporidae	NL
2	*Paradoxurus hermaphroditus*	Common Palm Civet	Viverridae	NL

NL-Not Listed

5.2.3 Wet season

Myanmar Hare *Lepus peguensis* was recorded during the survey period. Individuals were observed on the flatlands. They have large range, moving between scrubland and cultivated areas at the base of the Letpadaung hill. According to the interview survey, Eld's deer (Shwethamin) *Cervus eldi thamin* was listed as a frequent visitor to the Project area.

Table 5.6: Mammals recorded during the wet season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status	Remark
1	*Lepus peguensis*	Myanmar Hare	Leporidae	NL	Observed
2	*Paradoxurus hermaphroditus*	Common Palm Civet	Viverridae	NL	Scat
3	*Callosciurus pygerythrus*	Grey squirrel	Sciuridae	Lc	Observed
4	*Niviventer fulvscens*	White-belleyed Rat	Muridae	Lc	Observed

Lc - Least Concern, NL-Not Listed

5.3 Reptiles and Amphibians

5.3.1 Cool-dry season

A total of three reptile species, *Calotes versicolor*, *Mabuya multifasciata*, *Ptyas korros*, and one amphibian species, *Bufo melanostatus* were recorded for the cool dry season during the survey period (Table 5.7). The most common species among them was the Garden Fence Lizard *Calotes versicolar*. The Garden Fence Lizard is a very common species in the Project area. The Sun Skink *Mabuya multifasciata* was also observed as a common species in the Project area. As all recorded species are not included on the IUCN Red List, no threatened reptile and amphibian species are likely to occur in the Project area.

Table 5.7: Reptile and amphibian species recorded during the cool-dry season survey

Sr. No.	Species	Common name	Family	Taxonomic group
1	*Calotes versicolor*	Garden Fence Lizard	Agamidae	Reptile
2	*Mabuya multifasciata*	Many-lined Sun Skink	Scincidae	Reptile
3	*Ptyas korros*	Rat Snake	Colubridae	Reptile
4	*Bufo melanostatus*	Common Toad	Bufonidae	Amphibian

5.3.2 Hot-dry season

A total of three reptile species, *Calotes versicolor*, *Mabuya multifasciata*, *Ptyas korros*, and one amphibian species, *Bufo melanostatus* were recorded during the survey period (Table 5.8). The most common species observed was the Garden Fence Lizard *Calotes versicolar*, which is very common in and around the Project area. The Sun Skink *Mabuya multifasciata* was also observed as a common species in the Project area.

Table 5.8: Reptile and amphibian species recorded during the hot-dry season survey

Sr. No.	Species	Common name	Family	Taxonomic group
1	*Calotes versicolor*	Garden fence lizard	Agamidae	Reptile
2	*Mabuya multifasciata*	Many-lined sun skink	Scincidae	Reptile
3	*Ptyas korros*	rat snake	Colubridae	Reptile
4	*Bufo melanostatus*	Common toad	Bufonidae	Amphibian

5.3.3 Wet season

The wet season survey identified a range of reptile and amphibian species not observed during the dry season as shown in Table 5.9. This change is likely to be a result of an increase in food sources during this season and the development of environmental conditions that provided opportunity for observation of the species.

Table 5.9: Reptile and amphibian species recorded during the wet season survey

Sr. No.	Scientific name	Common name	Family	IUCN Status	Remark
1	*Bungarus fasciatus*	Banded krait	Elapidae	Lc	Interviewed
2	*Daboia russellii siamensis*	Russell's Viper	Viperidae	Lc	Interviewed
3	*Ptyas korros*	Indo-chinese Rat Snake	Colubridae	Lc	Interviewed
4	*Eutropis carinatus*	Common Sun Skink	Scincidae	Lc	Observed
5	*Calotes versicolor*	Garden Fence Lizard	Agamidae	Lc	Observed
6	*Calotes emma*	Tree Lizard	Agamidae	Lc	Observed
7	*Fejervarya l. limnocharis*	Paddy Frog	Dicroglossidae	Lc	Observed
8	*Polypedates leucomystax*	Common Tree Frog	Rhacophoridae	Lc	Interviewed
9	*Duttaphrynus melanostictus*	Common Toad	Bufonidae	Lc	Observed
10	*Kaloula pulchra*	Painted Bull Frog	Microhylidae	Lc	Interviewed
11	*Holobatrachus tigerinus*	Indian Bull Frog	Dicroglossidae	Lc	Interviewed

Lc = Least Concern

5.4 Butterflies and odonates

5.4.1 Cool-dry season

Seven butterfly species were recorded during the survey period (Table 5.10). The most common species among them were *Ixias marianne* and *Appias libythea* species. The lower slope and foothill habitats were found to have the highest diversity of butterfly species and the highest population density.

Regarding the odonate species, five species namely *Tholymis tillarga*, *Orthetrum sabina*, *Macrodiplax cora*, *Tramea basilaris* and *Ictinogomphus pertinax* were recorded (Table 5.11). Damselfly species were not observed in the Project area during the survey period.

No threatened species of butterfly or odonates were observed in the Project area.

Table 5.10: Butterfly species recorded during the cool-dry season survey

Sr. No.	Family	Species	Status
1	Papilionidae	*Graphium agamemnon*	Common
2	Pieridae	*Ixias marianne*	Very Common
3	Pieridae	*Catopsilia pomona*	Common
4	Pieridae	*Appias libythea*	Very Common
5	Danaidae	*Danaus chrysippus*	Common
6	Satyridae	*Mycalesis perseidoes*	Common
7	Lycaenidae	*Catochrysops rosimon*	Common

Table 5.11: Odonate species recorded during the cool-dry season survey

No.	Species	Common name	Family	Status
1	*Tholymis tillarga*	Evening Skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green Skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common Glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	Common Flangetail	Gomphidae	Common

5.4.2 Hot-dry season

The seven butterfly species recorded during the cool-dry season survey period (Table 5.12) were also observed during the hot-dry season. The most common species among them *were Ixias marianne* and *Appias libythea* species. Most of the butterfly species and the highest numbers were observed in the lower slope and foothill habitats.

Five odonate species, *Tholymis tillarga*, *Orthetrum sabina*, *Macrodiplax cora*, *Tramea basilaris* and *Ictinogomphus pertinax* were recorded as shown in Table 5.13. Damselfly species were not observed in the Project area during the survey period.

Table 5.12: Butterfly species recorded during the hot-dry season survey

Sr. No.	Family	Species	Status
1	Papilionidae	*Graphium agamemnon*	Common
2	Pieridae	*Ixias marianne*	Very Common
3	Pieridae	*Catopsilia pomona*	Common
4	Pieridae	*Appias libythea*	Very Common
5	Danaidae	*Danaus chrysippus*	Common
6	Satyridae	*Mycalesis perseidoes*	Common
7	Lycaenidae	*Catochrysops rosimon*	Common

Table 5.13: Odonate species recorded during the hot-dry season survey

No.	Species	Common name	Family	Status
1	*Tholymis tillarga*	Evening skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	Common Flangetail	Gomphidae	Common

5.4.3 Wet season

Twelve butterfly species were recorded during the survey period (Table 5.14). The most common species among them were *Eurema hecabe* and *Catopsilia pomona pomona* species. Most of the butterfly species and greatest numbers were observed in the lower slope habitat.

Table 5.14: Butterfly species recorded during the wet season survey

Sr. No.	Species	Family	Common Name	Status
1	*Papilio polytes romulus*	Papilionidae	Common Mormon	Common
2	*Papilio demolius*	Papilionidae	Lime Butterfly	Common
3	*Catopsilia pomona pomona*	Pieridae	Lemon Emigrant	Very Common
4	*Eurema hecabe*	Pieridae	Common Grass Yellow	Very Common
5	*Ixias pyrene verna*	Pieridae	Yellow Orange Tip	Uncommon
6	*Appias libythea olferna*	Pieridae	Striped Albatross	Very Common
7	*Danaus limniace limniace*	Danaidae	Blue Tiger	Uncommon
8	*Danaus chrysippus*	Danaidae	Plain Tiger	Common
9	*Danaus genutia genutia*	Danaidae	Common Tiger	Uncommon
10	*Junonia hierta*	Nymphalidae	Yellow Pansy	Common
11	*Junonia almana almana*	Nymphalidae	Peacock Pansy	Uncommon
12	*Junonia atlites*	Nymphalidae	The Gray Pansy	Common

Regarding the odonate species, five species namely *Tholymis tillarga*, *Orthetrum sabina*, *Macrodiplax cora*, *Tramea basilaris* and *Ictinogomphus pertinax* were recorded as shown in Table 5.15. Damselfly species were not observed in the Project area during the survey period.

Table 5.15: Odonate species recorded during the wet season survey

No.	Species	Common name	Family	Status
1	*Tholymis tillarga*	Evening skimmer	Libellulidae	Common
2	*Orthetrum sabina*	Green skimmer	Libellulidae	Common
3	*Macrodiplax cora*	Common glider	Libellulidae	Common
4	*Tramea basilaris*	Glider	Libellulidae	Common
5	*Ictinogomphus pertinax*	Common Flangetail	Gomphidae	Common

6 ANALYSIS OF DATA

6.1 Species Identified

It is considered that there were insufficient numbers of mammals, reptiles and amphibians observed to enable robust statistical analysis of the seasonal variation to be completed. However, the study team did note the large variation between dry and wet season numbers. However, this variation is considered to be strongly influenced by the methods of sampling available given the time and security constraints placed on the sampling methodology. For example, if night observations and the setting of traps were able to be utilized it is expected that species such as bats, nocturnal foraging species and species with energy constrained habits would have been observed.

The number of bird species observed did not display significant seasonal variations, as shown in Table 6.1, when subjected to statistical scrutiny. It is considered this lack of variation reflects the level of degradation within the environment. This degradation has reduced the overall environmental diversity which subsequently affects the ability of more specialized species to remain sustainable while their specialized resource requirements are diminished.

Table 6.1: Comparison of the recorded parameters among three seasons in avifauna studies

Item	Season			X2 test	Remark
	Cool dry	**Hot dry**	**Wet season**		
No. of bird species	19	18	18	p>0.05; X2=0.036; df=2	NS
Diversity (H') value	3.56	3.749	3.494	p>0.05; X2=0.182; df=2	NS

NS = Not significant

The number of species of butterfly recorded across the three seasons of survey showed no significant statistically variability. Given the tendency for the butterflies to be found on the lower slopes of the hills and the restricted habitat types present in those areas and the dependence on diversity of habitats, it is not unexpected that this level of variability is found.

Table 6.2: Comparison of the recorded parameters among three seasons in butterfly studies

Item	Season			X2 test	Remark
	Cool dry	Hot dry	Wet season		
No. of butterfly species	7	7	12	p>0.05; X2=1.923; df=2	NS
Diversity (H') value	1.537	2.095	3.299	p>0.05; X2=0.281; df=2	NS

6.2 Species diversity

6.2.1 Indices Used[14]

Among the different measurement of species diversity indices, the floristic diversity of the Letpadaung taung area was analysed using the Shannon Wiener index (H), Simpsons index (D), Fisher's Alpha, Brillouin (D), Shannon maximum and minimum evenness (E), Brillouin (E) because these indices do not only take taxa richness into account but also depend on the relative distribution of individuals.

The Shannon-Weiner index is a measure of the likelihood that the next individual will be the same species as the previous sample. It combines two quantifiable measures:

- The species richness (the number of species in the community); and
- Species evenness (how even are the numbers of individuals of each species).

For instance, say we have a sample of 100 fish containing only 2 species. We would say that the species are even if there were 50 of each species. Conversely, if there were 99 of 1 species and only 1 of the other, there would be no evenness. Given this second scenario, we would be pretty confident in our prediction that if we were to sample 1 more individual that it would be the same as the 99 in that sample. Conversely, in the previous scenario, we would have a 50/50 chance at predicting the next species sampled.

Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

Fisher's Alpha is a parametric index of diversity that assumes that the abundance of species follows the log series distribution.

The Brillouin index measures the diversity of a collection, as opposed to the Shannon index which measures a sample. Pielou (1975) recommends this index in all situations where a collection is made, sampling was non-random or the full composition of the community is known.

The value obtained rarely exceeds 4.5 and both the Brillouin and Shannon Indices tend to give similar comparative measures. This information measure should be used in favour of the Shannon index when the species differ in their capture rates.

Shannon maximum is simply the maximum value the Shannon-Wiener index could produce for the given data set and is given by ln(S), where S is the total number of species. The Shannon minimum is simply the minimum value the Shannon-Wiener index could produce for the given data set.

[14] As described at www.pisces-conservation.com/sdrhelp

The Bruillioun evenness index is an index based on Bruillouin's HB, it is not an estimate but an accurate statistic. This index reduces the sensitivity of the estimate to the species density.

6.2.2 Birds

6.2.2.1 COOL-DRY SEASON

Shannon diversity index value (H') was 3.560 and Simpson's Index value was 0.896; both of the index values showed the relatively high diversity of bird species in the Project area in thecool-dry season (Table 6.3). The number of equally common species was 16 and a total of 157 individuals were observed during the survey period. Evenness value (E') was noted as 0.500, which showed the evenly distribution of the birds in the Project area.

Table 6.3: Diversity and evenness of the bird species – cool-dry season

Index/Item	Value
Shannon Diversity H' (range)	3.560 (3.381-3.723)
Simpson's Index (1-D)	0.896 (0.876-0.0.913)
Brillouin's H	3.300 (3.135-3.449)
Evenness E'	0.500
Number of equally common species	16
No. of species	19
N	157

6.2.2.2 HOT-DRY SEASON

Shannon diversity index value (H') was 3.749 and Simpson's Index value was 0.921; both of the index values showed the relatively high diversity of bird species in the Project area in hot dry season (Table 6.4). Number of equally common species was 15 and a total of 92 individuals were observed during the survey period. Evenness value (E') was noted as 0.664, which showed the evenly distribution of the birds in the Project area.

Table 6.4: Diversity and evenness of the bird species – hot-dry season

Index/Item	Value
Shannon Diversity H' (range)	3.749(3.555-3.920)
Simpson's Index (1-D)	0.921(0.901-0.0.936)
Brillouin's H	3.357 (3.190-3.503)
Evenness E'	0.664
Number of equally common species	15
No. of species	18
N	92

6.2.2.3 WET SEASON

Shannon diversity index value (H') was 3.494 and Simpson's Index value was 0.905; both of the index values showed the relatively high diversity of bird species in the Project area in hot dry season (Table 6.5). Number of equally common species was 13 and a total of 67 individuals were observed during the survey period. Evenness value (E') was noted as 0.573, which showed the evenly distribution of the birds in the Project area.

Table 6.5: Diversity and evenness of the bird species – wet season

Index/Item	Value
Shannon Diversity H' (range)	3.494(3.231-3.718)
Simpson's Index (1-D)	0.905(0.875-0.926)
Brillouin's H	3.061(2.848-3.244)
Evenness E'	0.573
Number of equally common species	13
No. of species	18
N	67

6.2.3 Butterflies

6.2.3.1 COOL-DRY SEASON

Shannon's species diversity index (H') value of the butterfly species was 1.537 and Sampson's diversity index (1-D) value was 0.566. Both of the index values showed the moderate species diversity of butterflies during the cool dry season in the Project area (Table 6.6). Equally common species was 3 and evenness (E') value was 0.346 and these also show the relatively even distribution of the butterflies in the Project area.

Table 6.6: Diversity and evenness of the butterfly species – cool-dry season

Index/Item	Value
Shannon Diversity H' (range)	1.537 (1.335-1.734)
Simpson's Index (1-D)	0.566(0.503-0.0.623)
Brillouin's H	1.447 (1.258-1.633)
Evenness E'	0.346
Number of equally common species	3
No. of species	7
N	138

6.2.3.2 HOT-DRY SEASON

Shannon's species diversity index (H') value of the butterfly species was 2.095 and Sampson's diversity index (1-D) value was 0.705. Both of the index values showed the moderate species diversity of butterflies during hot dry season in the project area (Table 6.7). Equally common species was 5 and Evenness (E') value was 0.526, these also show the relatively even distribution of the butterflies in the Project area.

Table 6.7: Diversity and Evenness of the butterfly species – hot-dry season

Index/Item	Value
Shannon Diversity H' (range)	2.095 (1.776-2.378)
Simpson's Index (1-D)	0.705(0.606-0.0.782)
Brillouin's H	1.871 (1.582-2.130)
Evenness E'	0.526
Number of equally common species	5
No. of species	7
N	56

6.2.3.3 WET SEASON

Shannon's species diversity index (H') value of the butterfly species was 3.299 and Sampson's diversity index (1-D) value was 0.896. Both of the index values showed the high species diversity of butterflies during wet season in the project area (Table 6.8). Equally common species was 11 and evenness (E') value was 0.723, these also show the relatively even distribution of the butterflies in the Project area.

Table 6.8: Diversity and Evenness of the butterfly species – wet season

Index/Item	Value
Shannon Diversity H' (range)	3.299(3.151-3.422)
Simpson's Index (1-D)	0.896(0.875-0.910)
Brillouin's H	3.011(2.877-3.121)
Evenness E'	0.732
Number of equally common species	11
No. of species	12
N	93

6.3 Inter-Seasonal Comparison

6.3.1 Birds

The diversity and evenness of bird species remains constant across the seasons suggesting there is little migration of bird species into the area with seasonal changes. This is confirmed by a review of the species recorded and the statistical analysis of the results obtained.

The number of bird species recorded was only about 40% of the number expected to occur in the Monywa area which suggests the habitat condition in the area is degraded.

6.3.2 Butterflies and Odonates

It appears the diversity and evenness of distribution of butterflies and odonates improves during the wet season as both diversity and evenness indices rise in comparison to dry season statistics. However the improvement is not statistically significant.

7 IMPACTS AND MITIGATION

7.1 Impacts

The Project area appears to be undergoing a continuous decline in numbers of species present as time has progressed from studies undertaken in 1996/97 to 2003/04 and now into 2012/13. Across all fauna groups assessed there has been a decline in species diversity which is most likely linked to demands on ecosystem services that have increased as population in the areas around the Project area has risen. Indeed, the review of changes in flora and vegetation (and subsequently in fauna habitat) suggests that any mature forest or plantation in the area in 1997 has been harvested. Current studies suggest that seasonal harvesting of plants for traditional use, firewood and stockfeed reduces stocks of plant species and restricts the ability of habitats to mature and provide the diversity of resources needed to sustain the levels of fauna diversity that may otherwise be expected from studies such as those reported here.

The Project development is expected to further reduce opportunities for those fauna that move between the lower hills and adjacent farmed lands. Much of the areas currently cropped and grazed on the plains surrounding the Letpadaung hills will be used to accommodate the leaching, processing and infrastructure facilities used to process the ore mined in the hills. Remnant areas will be fragmented and offer little benefit as fauna habitat.

The future of any individuals of the Eld's Deer and Myanmar Hare in the Project area is highly threatened by the proposed habitat fragmentation and mining activities that will occur in the area. These mammals are unlikely to be able to migrate to another area of habitat successfully without a formal capture/release programme due to the lack of cover offered in the intervening lands.

During the Project operations, the progressive rehabilitation of disturbed areas will provide a habitat that is well resourced in regard to variety of food and evolving habitat. As a result, it is expected the diversity of species may gradually increase compared to that which is currently observed if the fauna behaviour replicates that in mining sites in other countries.

The proposed Project plan will fragment and remove about 70% of the current area of 'natural' vegetation on the Letpadaung hills. The impact of mining, such as dust noise and vibration will extend over the whole site. In addition, the increase in movements of light and heavy vehicles is likely to give rise to fatalities of fauna moving around or seeking to leave the site. This fragmentation is a long-term effect of mining as it will remain for the mine life and beyond as the core area, the open pit, will not be able to be revegetated at closure. Even when rehabilitated waste rock dumps are included in the total area of vegetation, the level of fragmentation will persist and the edge effects through an increased boundary between vegetated and cleared land will add to the residual impact on fauna.

The current fauna diversity and evenness is strongly influenced by local environmental pressures. The historical decrease in fauna abundance and diversity would be expected to continue without the impact of mining, albeit over many decades. The lack of specialized species amongst those identified, which are predominantly omnivorous species, is a clear indicator of the impact of current disturbance. Any reversal will need a change in the way the land around the Letpadaung hills is traditionally used.

Mining will accelerate the loss of habitat in the short term but has the potential to improve fauna diversity in the medium to long term, especially if site access is controlled after mine closure.

7.2 Mitigation

Prior to the further clearing of natural vegetation on the Project site, a formal capture and release programme for the Eld's Deer and Myanmar Hare should be undertaken. The captured animals should be released in an area of protected habitat for their long term conservation. Identification of this area, as an offset for the area to be cleared for mining and processing at the Project site, should be considered a condition of project approval by the Government.

During construction of the mine and clearing of 'natural' vegetation, fauna spotters should be used to allow the identification of fauna under threat from the clearing processes. These spotters should either collect and remove the fauna to a safe site or move them out of the way of any harm.

Staff should be trained to maintain a good line of site to enable fauna fatalities on Project roads to be avoided. This may require the enforcement of site speed limits and development of a presence/absence warning system where animal movement is frequent.

A key to the long term survival and use of the area by fauna is the progressive rehabilitation of disturbed areas and the assisted colonization by common fauna species. Generally, the establishment of 'natural' vegetation on disturbed areas will see a progressive re-colonization by fauna as cover and micro-habitats are developed.

Any increase in fauna diversity over the pre-mining conditions will require both an improved, undisturbed level of vegetation cover. To achieve this outcome, it may be necessary to provide plantations of plant material traditionally used by villages so that harvesting does not occur on rehabilitated lands. Initially these resources could be established in the visual buffers of vegetation established around the site.

8 CONCLUSION AND RECOMMENDATIONS

The following activities were completed in the conduct of this baseline survey:

- A review of previous studies conducted in the area;
- Surveys of fauna in the study area over the cool-dry, hot-dry and wet season;
- An analysis of the findings; and
- Identification of impacts that arise from mining the Letpadaung hills and possible their mitigation options.

No listed rare or endangered fauna species will be significantly affected by the Project although the Project will restrict the grazing areas for Eld's Deer and the Myanmar Hare.

The surveys did not identify any listed rare or endangered species. They did confirm earlier conclusions by AATA (1996) and Muir Environmental (1997) that the fauna in the area is depleted as a result of land clearing on the plains surrounding the hills and the heavy demand on the ecosystem services derived from the hills by the surrounding communities.

The number of species identified has declined over the period from 1996 to 2013 as shown from the collections made in surveys in 1996/97, 2003/04 and 2012/13. This decline is expected to continue due to the unconstrained use of the vegetated hills area by the ever growing surrounding communities.

The likely impact of the proposed copper mining project on the fauna is a further decrease in the diversity of fauna in the area, at a rate exceeding that currently occurring. However, the mining is also likely to provide a long term opportunity for existing habitat to recover (due to its isolation within the mine site) and the revegetation of disturbed land should lead to new areas of vegetation being created over the course of the mine life.

An issue will be the provision for ecosystem services lost. From the perspective of fauna populations, this loss will be relatively small and can be accommodated by buffer plantings in and around the mine site.

8.1 Recommendations

No provision is required to offset habitat loss or relocate rare or endangered species.

Management plans should be prepared and implemented to accommodate:

- Spotting of fauna and removal of animals found during clearing operations;
- Control of vehicle movements to minimize the loss of fauna through road kills; and
- The unlawful capture and removal of fauna by Project staff.

Monitoring of rehabilitation works undertaken on the site should include the monitoring of fauna using the rehabilitated areas as habitat. Rehabilitation works should include provision of habitat opportunities (old logs, retention of large trees and rock and stone cover) where they can be made available. Progressive improvement in levels of use by fauna should be examined through analysis of monitoring results.

APPENDIX 1

TERMS OF REFERENCE – FAUNA BASELINE STUDIES

APPENDIX E

Baseline Studies – Aquatic Ecology

Knight Piésold CONSULTING

BASELINE STUDY – AQUATIC FAUNA



Letpadaung Copper Mine Project

Baseline study – Aquatic Fauna

LETPADAUNG COPPER MINE PROJECT

LETPADAUNG COPPER MINE PROJECT

Baseline Study – Aquatic Fauna

Prepared for: Myanmar Wanbao Mining Copper Limited

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1 SPECIES PROPORTIONAL ABUNDANCE II
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EXECUTIVE SUMMARY

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of the aquatic life in the Project area of the Letpadaung Copper Mine Project ("the Project"). The work was undertaken over the hot-dry season, the cool-dry season and the wet season of 2013 to enable the evaluation of the aquatic fauna in the three seasons experienced in the Project area.

The survey was undertaken through the use of 8 sampling locations that were located upstream, downstream and parallel to the Project site. Identification was confirmed according to historic collections, recordings and identification specimens using local and international references.

During the surveys no threatened fish species were found in either the Chindwin River or Yamar Creek. All recorded fish species are considered to be common species and as such are not listed under the protected species list of Myanmar.

1 INTRODUCTION

1.1 Background

Environment Myanmar Cooperative Company Limited (EMC) was appointed by Myanmar Wanbao Mining Copper Limited (MWMCL) to undertake a baseline survey of the aquatic life in the Project area of the Letpadaung Copper Mine Project ("the Project"). The work was undertaken over the hot-dry season, the cool-dry season and the wet season of 2013 to enable the evaluation of the aquatic fauna in the three seasons experienced in the Project area.

The proponent, MWMCL, aims to promote survey work that is uniform and of sufficient rigour to contribute to a more systematic inventory of the Myanmar and Salingyi district's aquatic fauna. This will result in a consolidated and readily accessible database of environmental information.

The Environmental and Social Impact Assessment (ESIA) is a systematic study and process to determine the impacts and effects of a project on the environment during its various phases of construction, commissioning, operation, and closure. As such, its objectives are to ensure that the project is sound and maximizes the social and environmental standpoint benefit to be derived. This includes early recognition of any issues of concern relating to the biological, physical, or socio-economic environments or applicable national or international regulations or guidelines which can then be considered in the project design. This allows incorporation into the project design of appropriate mitigation measures to avoid, eliminate or compensate for potential adverse effects (impacts), as well as including the costs of these measures into the project economics.

This study, the baseline aquatic fauna study, is designed to gather data and through analysis of the data identify any significant issues associated with the Project relating to the aquatic ecosystem of the area. The study will propose management and monitoring options to mitigate any issues related to aquatic fauna that are identified, and provide the base information for inclusion in the ESIA.

1.2 The Project

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The Project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic center of central Myanmar and 722 km north of Yangon. The project is focused around Letpadaung Hill. The Project location within Myanmar is shown at Figure 1.1.

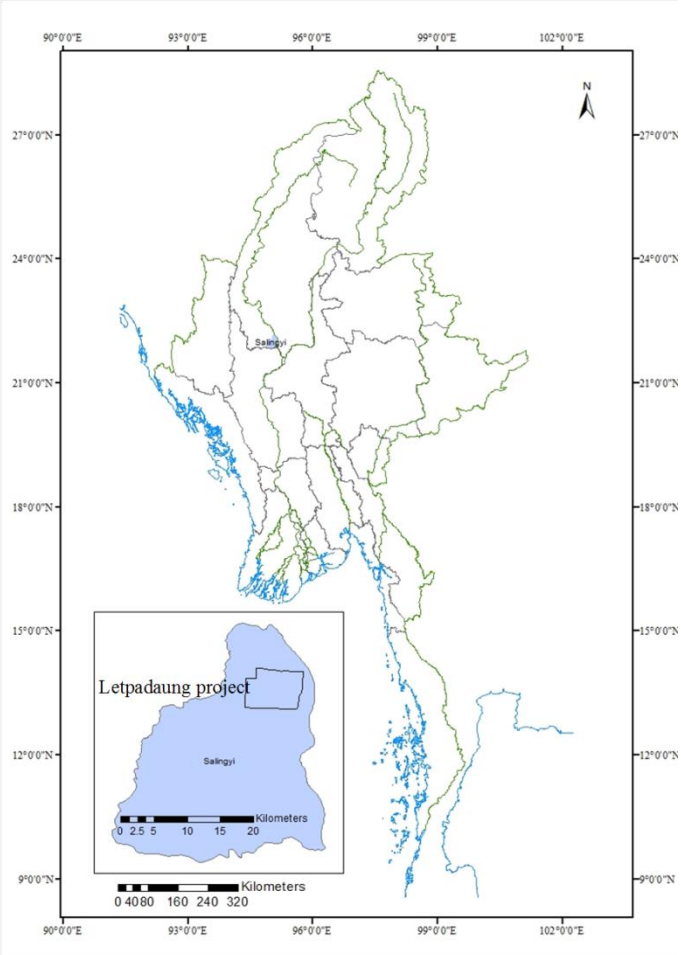


Figure 1.1: Site Locality Plan

Letpadaung Hill is situated in Salingyi Township, west of the Chindwin River, right across the river from Monywa. In the immediate area, Sabe Taung, Myayeik Taung, Kyae Sin Taung, and Phone Win Taung are located side by side on the west bank of Chindwin. Letpadaung Hill includes twelve small hills forming ridges and valleys. The hill is covered with the scrub forest with dry zone plant species and stunted tree species were observed. The Letpadaung hill is bounded by Chindwin River on the east, where Nyaungbingyi port is one of the transportation routes between the east bank and the west bank of the Chindwin River. It is also bounded by Nyaungbingyi-Gangaw Road and Taungbalu village, Kyawywar and Aungchansi villages on the north, Moegyobyin (south), Moegyobyin (central) and Moegyobyin (south) villages on the west, and Ton village, Phaunggadar village, and Seide-Zeedaw (new village) on the south. The Project location is shown in Figure 1.2.

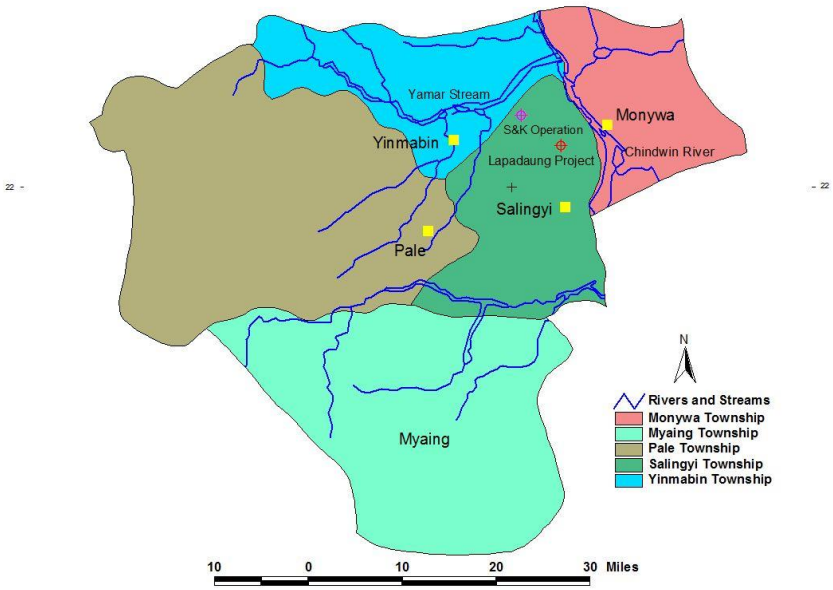


Figure 1.2: Project Location Plan

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung (which are mined by Myanmar Yang Tse Copper Ltd as the S&K operation) and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).[1] The project area is shown in Figure 1.3.

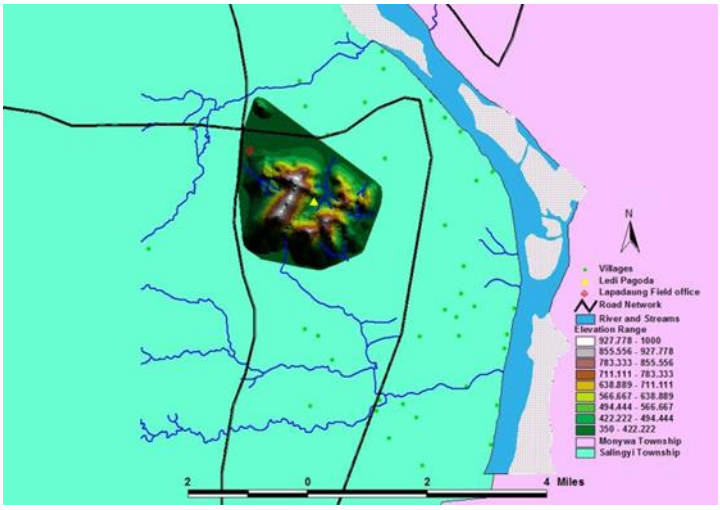


Figure 1.3: Site Location Plan

MWMCL proposes to mine and process copper bearing ore for a period of 30 years to produce 100,000 tonnes per annum of copper cathode. The ore will be mined by an open pit method and processed through a series of heap leach pads with the leachate being collected and processed in a solvent extraction – electro-winning plant to produce the copper cathode.

[1] China Nerin Engineering Co., Ltd, 2011; Myanmar Monywa Letpadaung Copper Project – Basic Design, Volume 1 - Specification; Prepared for Myanmar Wanbao Mining Copper Limited; June 2011.

Certain aquatic baseline data were collected from the aquatic habitats surrounding the mine site in support of the 1997 Environmental Impact Assessment (EIA) Feasibility Study Report for a project similar in nature to that being considered by MWMCL. The data collected in the 1997 report will also enable comparison of past and present conditions to be made to identify changes that have occurred/are occurring without a mine being in place at Letpadaung.[2]

1.3 This Document

This document has been prepared consistent with a terms of reference (TOR) provided to EMC by MWMCL (included at Appendix 2). The document comprises the following sections in response to the TOR:

- Section 1 – Introduction to the document;
- Section 2 – A description of the legal framework associated with flora and vegetation protection in Myanmar;
- Section 3 – Discussion of the TOR and variations made during field investigations. This section also describes the methodologies used in field studies and data analysis from observations made;
- Section 4 – Presentation of findings of field studies;
- Section 5 – Analysis of data gathered during the field studies and its implications;
- Section 6 – Discussion of the potential impacts arising from Project implementation that will affect the baseline aquatic condition in the Project area;
- Appendices – The appendices includes will include the Terms of Reference and species proportional abundance for each observation point utilised.
- Figures – Figures will include site location plans, study location plans and a site vegetation map.

[2] Muir Environmental, 1997; Environmental and Social Assessment and Management Programme Volume 1 - Report Final Draft , Letpadaung Copper Project, Myanmar for Ivanhoe Myanmar Holdings; Report No ME96-056-001; 17 February 1997; In Volume 8, Appendix 10, Feasibility Study Letpadaung Copper project, Monywa, Union of Myanmar commissioned by Ivanhoe Myanmar Holdings; Presented to No1 Mining Enterprise, Ministry of Mines, Government of the Union of Myanmar; Minproc Engineers Limited ACN 008 992 694; March 1997

2 LEGAL FRAMEWORK AND INDUSTRY GUIDELINES

The section describes the legal framework and policy context within which aquatic fauna is managed in Myanmar. It also describes the international treaties that are designed to protect aquatic fauna, to which Myanmar is a signatory.

Industry guidelines are also described which aspire to minimize the impact of the industries activities on aquatic fauna and biodiversity.

2.1 Legislation and Regulations

Myanmar has a long history of formal fishery management. The Fisheries Act of 1905 was the only legislation regulating fishery management and the fishing industry of Myanmar until amended in 1954, and was finally repealed by "Law relating to the fishing rights of foreign fishing vessels" in 1989. After that, the government promulgated three other fisheries laws, namely "Aquaculture fisheries law" in 1989, "Myanmar marine fisheries law" in 1990, and "Freshwater fisheries law in 1991. This law protects sexually mature adults and fingerlings of freshwater fish, specifying those species that it is forbidden to catch, export, kill or keep in captivity in the months of May, June, July and August without permission of the Director General of Department of Fishery (DoF). These prohibit trade in sexually mature adults and fingerlings of the freshwater prawns *Macrobrachium rosenbergii*, and *M. malcolnsonii*, which cannot be caught, exported, sold, killed or kept in captivity in the months of May, June and July, unless permitted by the Director General of the DoF. The regulation lists all the species of fish and mammals that are protected, including the dugong, whale, whale shark, dolphin, giant clam and turtle, and included in the list of endangered species in the Convention on International Trade of Endangered Species (CITES).

Myanmar is also a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed according to the degree of protection they need. The classes of listing include:

- Species threatened with extinction;
- Species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival; and
- Species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

A list describes those species covered by CITES and includes species of fauna from Myanmar.

2.2 Guidelines

The International Finance Corporation (IFC) has a Performance Standard 6 (PS6)– Biological Conservation and Sustainable Natural Resource Management which has been developed around the international Convention on Biological Diversity. The performance standard addresses the opportunities that exist for operations to avoid and mitigate threats to biodiversity.

PS6 suggests requirements to:

- Protect and conserve biodiversity in:
    - Habitats;

- Natural habitat;
- Modified habitat; and
- Critical habitat;
- Legally protected area, such as national parks, conservation reserves and designated forests; and
- Relation to invasive alien species;

Manage and use of renewable natural resources such as:

- Natural and plantation forests; and
- Freshwater and Marine Systems.

The key requirements of PS6 in relation to fauna are:

- Assessment of impacts of the project on the fauna;
- Account for the differing values of stakeholders in that assessment;
- Consider the effects of habitat destruction and the potential for introduction of invasive alien species; and
- Use qualified and experienced external experts to assist in data collection and assessment.

PS6 also considers options for mitigation including:

- Restoring impacted areas with appropriate native species and consistent with local ecological conditions;
- Offsetting biodiversity losses through the creation of ecologically comparable area(s) elsewhere (comparable in size, quality and function) that is managed for biodiversity; and
- Financial or in-kind compensation to direct users of biodiversity.

3 TERMS OF REFERENCE

The objectives of this Terms of Reference (TOR) (in Appendix 2) are to ensure that:

- There is clarity for MWMCL on the scale of the aquatic fauna assemblage survey appropriate for different areas;
- The aquatic fauna assemblage survey, analysis, interpretation and reporting undertaken for the ESIA is of a suitable quality and of consistent methodology to enable judgment of the impacts of the project on the aquatic fauna assemblage;
- The environment, in particular significant aquatic fauna assemblages, is identified and protected through good practice in the conduct and reporting of aquatic fauna assemblage surveys for the ESIA;
- Myanmar's knowledge base of fauna and faunal assemblages and biogeography are developed and enhanced over time at both the local and regional scale to the benefit of future decision making; and
- Survey data are capable of underpinning long-term observation and measurement for later compliance and audit purposes (especially as this pertains to completion criteria for the Project).

The timing of the survey was specified to consider the cool-dry, hot-dry and wet seasons and, as a result, fieldwork will be undertaken during these three (3) periods to address the seasonal variations that are expected to occur.

The TOR also specified the area in which the fauna study should extend and included areas beyond the immediate Project site.

3.1 Sampling Sites for Surveys

The upstream, downstream sites and a site parallel with the Project area of the Chindwin River were selected as sampling sites. Upstream and downstream sites of the Yamar creek in were also selected as sampling sites. The location of the sampling sites is shown in Figure 3.1

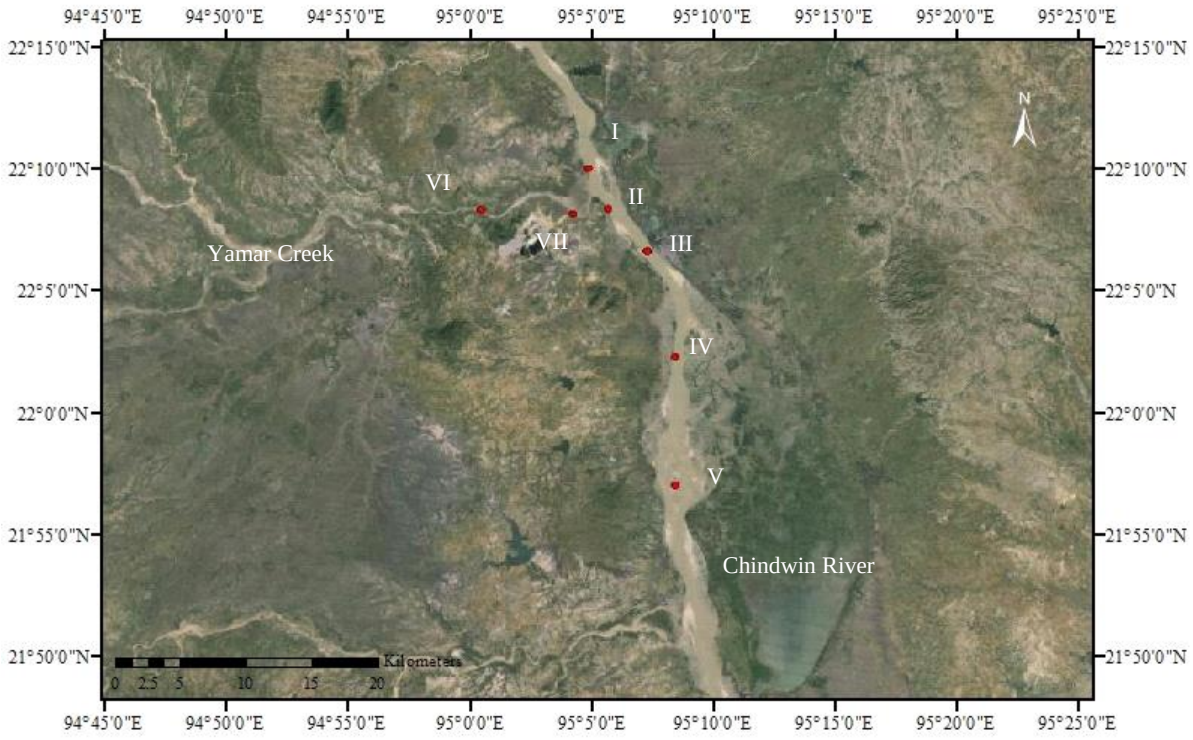


Figure 3.1: Sampling Site Locations

Table 3.1: Sampling Site Locations

Sampling station	Site	Coordinates			
		X (m)	Y (m)	Latitude	Longitude
I	CHR up 1	714537	2452844	22˚ 10' 4.80"	95˚ 04' 48.00"
II	CHR up 2	715987	2449834	22˚ 08' 27.60"	95˚ 05' 34.80"
III	CHR site 3	718764	2446648	22˚ 06' 43.20"	95˚ 07' 12.00"
IV	CHR down 1	720837	2438703	22˚ 02' 24.00"	95˚ 8' 20.40"
V	CHR down 2	720988	2428988	21˚ 57' 7.20"	95˚ 08' 24.00"
VI	YAM up	706994	2449619	22˚ 08' 24.00"	95˚ 00' 25.20"
VII	YAM down	713461	2449392	22˚ 08' 13.20"	95˚ 04' 8.40"

CHR – Chindwin River

YAM- Yamar Creek

3.2 Methodology Adopted in Surveys

3.2.1 Fish

Fish were collected with the help of the fishermen during the survey period. Fishing methods and gear were selected according to Munprasit et al. (1989)[3]. The cast nets, dip-net and traps were used in collecting the fish in the study sites. Traps were also used to get various types of fish, like surface dwellers and bottom

[3] Munprasit et al. (1989). Fishing Gear and Methods in Southeast Asia Malaysia Training Department Southeast Asian Fisheries Development Center. 324pp

dwellers. The fish were photographed soon after the collection and measurements were also taken for key characteristics. The fish were then preserved in 10% formalin solution for further identification in the laboratory. The fish were then identified according to Lagler (1956)[4], F.A.O (1974)[5], Jayaram (1981)[6], Day (1987)[7] and Carpenter and F.A.O (1997)[8]. Ecological methodology was followed after Welcomme (1979)[9] and Begon et al (1996)[10].

3.2.2 Zooplankton and Phytoplankton

Plankton sampling was conducted using a plankton net. Five sampling stations along the river were defined with equal interval. Plankton were collected using a motorboat. Plankton were sampled from surface layer and middle layer at each sampling station. The collected samples were fixed with Lugols Iodine solution for further identification in the laboratory. The plankton samples were then identified under a binocular microscope. Zooplankton species were collected and prepared according to Harris et. al (2000)[11].

3.2.3 Benthos

Benthos species were collected by digging, sieving, and dragging (using a drag-net). Twenty quadrats (2x2ft) were set up at the water's edge along the river, and dug using a small shovel and sieved. The benthos species were also collected by dragging along the water's edge using a drag-net. The collected benthos specimens were preserved in ethyl alcohol for further identification in the laboratory. The specimens were then identified under the binocular microscope in the laboratory.

[4] Lagler, K.C, Bardach, J.E. and Miller, R.R. (1962). The study of fish. Jon Wiley and son, Inc., Toppan Printing Co., Ltd. New York.545pp
[5] F.A.O (1974). Species identification sheets for fishery families from A to Z in four volumes.
[6] Jayaram, K.C. (1981). The freshwater fish of India, Pakistan, Bangladesh, Burma and Sri Lanka. Zoological
[7] Day, F. (1987). The fishes of India, being a natural history of the fish known to inhibit to seas and freshwaters of India, Burma and Ceylon. Vol. 1 & 2. New Delhi
[8] Carpenter and F.A.O (1997). Species identification field guide for fishery purpose. 49pp.
[9] Welcomme , R.L (1979). Fisheries ecology of floodplain rivers. Longman London and New York. 317pp.
[10] Begon, M., Harper, J.L., Townsend, C.R. (1996). Ecology: Individuals, Populations, and Communities. Blackwell Science Ltd. Oxford, London
[11] Harris , R.P., Wiebe, P.H., Lenz, J., Skjoldal, H.H., and Huntley, M. (2000). Zooplankton Methodology Manual. Printed in Great Britain by MPG BooksLtd, Bodmin, Cornwall

4 FIELD SURVEY RESULTS

4.1 Fish

4.1.1 Cool-Dry Season

A total of 21 fish species belonging to 12 families were recorded in Chindwin River and Yamar Creek during the study period in the cool-dry season. The recorded fish species mainly included species of the family Cyprinidae (Table 4.1).

Among the recorded fish species, the population sizes of *Glossogobius giuris* and *Labeo* sp. exceed those of the remaining recorded species.

Table 4.1: Fish species recorded during the cool-dry season, hot-dry season and wet season.

Sr. No.	Scientific name	Local name	Family	IUCN Red List Status
1	*Puntius chola*	Ngakhonema	Cyprinidae	NL
2	*Chela sardinella*	Yinbaungzar		NL
3	*Cirrhina mrigala*	Ngagyinbyu		NL
4	*Labeo calbasu*	Nganet pyah		NL
5	*Labeo angra*	Ngalu		NL
6	*Labeo rohita*	Ngagyin		NL
7	*Labeo boga*	Ngalu		NL
8	*Esomus altus*	Ngamautort		NL
9	*Rhinomugil corsula*	Ngazinlone	Mugilidae	NL
10	*Lepidocephalus thermalis*	Ngathaledoe	Cobitidae	NL
11	*Mastacembelus armatus*	Ngamwedoegyar	Mastacembelidae	NL
12	*Mastacembelus zebranus*	Ngamwedoebaygyar		NL
13	*Chanda ranga*	Ngazinzat	Channidae	NL
14	*Glossogobius giuris*	Kathaboe	Gobiidae	NL
15	*Mystus aor*	Nga-gyaung	Siluridae	NL
16	*Ompok bimaculatus*	Nganuthan		NL
17	*Silonia silondia*	Ngamyin	Schilbeidae	NL
18	*Mystus cavasius*	Ngazinyaingbyu	Bagridae	NL
19	*Notopterus notopterus*	Ngaphe	Notopteridae	NL
20	*Gudusia variegata*	Ngalabi	Clupeidae	NL
21	*Channa orientalis*	Ngayantgaungdoe	Channidae	NL

NL = Not Listed

4.1.2 Hot-Dry Season

A total of 21 fish species belonging to 12 families were recorded in Chindwin River and Yamar Creek during the survey in hot-dry season. The recorded fish species mainly included species of the family Cyprinidae (Table 4.1).

Among the recorded fish species, the species *Chanda ranga* and *Glossogobius giuris* were very common in all sampling sites. Although a small number of the species were not found in some sampling sites during the

survey period, it can be assumed that all recorded species exist in the studied segment since the fish were mobile species.

4.1.3 Wet Season

A total of 21 fish species belonging to 12 families were recorded in the Chindwin River and Yamar Creek during the survey in the wet season (Table 4.1). The members of the family Cyprinidae was largest in number and it was followed by those of the family Mastacembelidae and Siluridae. Among the recorded fish species, the species *Chanra ranga* and *Glossogobius giurus* were very common in all sampling sites.

4.2 Zooplankton

A total of 15 zooplankton species were recorded from the Chindwin River and Yamar Creek during the surveys in cool-dry, hot-dry and wet seasons (Table 4.2). Members of the Arthropod group predominate in zooplankton composition. Second-most common species were found from the Rotifer group. A small number of zooplankton species were absent at some of the sampling sites, but overall composition of the Chindwin River and Yamar Creek indicated the existence of all recorded zooplankton species.

Table 4.2: Species composition of Zooplankton in the Chindwin River and Yamar Creek.

Sr. No.	Species	Phylum	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
1	*Astramoeba radiosa*	Protozoa	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
2	*Spirostomum minus*	Protozoa	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
3	*Monostyla lunaris*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
4	*Monostyla bulla*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
5	*Brachionus diversicornis*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
6	*Brachionus havanaensis*	Rotifer	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
7	*Lecane ungulata*	Rotifer	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
8	*Daphnia sp*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
9	*Daphnia pulex*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
10	*Bosminopsis sp*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
11	*Chydorus sp*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
12	*Cyclops vicinus*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
13	*Stenocypris malcolmsoni*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
14	*Eucypris virens*	Arthropoda	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
15	*Entacythere donaldsonensis*	Arthropoda	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI

4.3 Phytoplankton

A total of 21 phytoplankton species were recorded from the Chindwin River and Yamar Creek during the surveys in cool-dry, hot-dry and wet seasons (Table 4.3). Members of the class Cyanophyceae predominate in phytoplankton composition. Members of the class Chlorophyceae were the second most abundant. A small number of phytoplankton species were absent at some of the sampling sites, but overall composition of the Chindwin River and Yamar Creek indicated the existence of all recorded phytoplankton species.

Table 4.3: Species composition of Phytoplankton in the Chindwin River and Yamar Creek.

Sr. No.	Species	Class	Station (Cool Dry Season)	Station (Hot Dry Season)	Station (Wet Season)
1	*Synedra affinis*	Chrysophyta	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
2	*Dinobryon divergens*	Chrysophyta	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
3	*Diatoma elongaum*	Bacillariophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
4	*Campsopogan caeruleus*	Rhodophyceae	I,II,III,IV,V,VI	I,II,III,IV,V,VI	I,II,III,IV,V,VI
5	*Staurastrum leptopus*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
6	*Mougeotia nummuloides*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
7	*Spirogyra protecta*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
8	*Spirogyra microspora*	Chlorophyceae	III,,VI,VII	III,,VI,VII	III,,VI,VII
9	*Spirogyra cylindrospora*	Chlorophyceae	III,,VI,VII	III,,VI,VII	III,,VI,VII
10	*Spiroyra prolifica*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
11	*Spirogyra azygospora*	Chlorophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
12	*Oscillatoria laete-virens*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
13	*Oscillatoria subbrevis*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
14	*Lyngbya martensiana*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
15	*Lyngbya truncicola*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
16	*Lyngbya contorta*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
17	*Phormidium ambiguum*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
18	*Planktothrix raciborskii*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
19	*Treubaria crassispina*	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
20	Synedra acus var. angustissima	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII
21	*Synedra acus* var. radians	Cyanophyceae	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII	I,II,III,IV,V,VI,VII

4.4 Benthos

Five benthos species; *Crocothemis servilia, Orthetrum glaucaum, Rhyothemis Phyllis, Tramea basilaris*, and *Ictinogomphus rapax* were recorded in Chindwin River; all of them are nymphs of dragonfly species. Six benthos species; *Crocothemis servilia, Orthetrum glaucaum, Rhyothemis Phyllis, Tramea basilaris,*and *Macrodiplax cora* and *Ictinogomphus rapax* were found in Yamar Creek. Similarly to the survey of the Chindwin River, all of the aforementioned species recorded were dragonfly nymphs.

5 ANALYSIS OF DATA

5.1 Species seasonal diversity

5.1.1 Fish

Shannon species diversity index (H') values of fishes were compared using binomial test between upstream and downstream sites of Chindwin River and Yamar Creek. The diversity index values were not significantly different between upstream and downstream sites in the three studied seasons (p=1.00; Binomial test; obs. prop.=0.50: NS) (Table 5.1, 5.2 and 5.3). The results showed that there was no significant difference in species diversity in relation to environmental conditions of upstream and downstream sites showing relatively similar aquatic habitat quality.

Table 5.1: Comparison of fish species diversity (H') values between upstream and downstream of Chindwin River and Yamar Creek in the cool-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.7984	3.7737	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6819	3.714	p=1.00; Binomial test; obs. prop.=0.50	NS

NS- non-significant

Table 5.2: Comparison of fish species diversity (H') values between upstream and downstream of Chindwin River and Yamar Creek in the hot-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.826	3.7754	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6924	3.6964	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.3: Comparison of fish species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the wet season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.829	3.7797	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.7353	3.6975	p=1.00; Binomial test; obs. prop.=0.50	NS

5.1.2 Zooplankton

Shannon species diversity index (H') values of zooplanktons were compared using binomial test between upstream and downstream sites of Chindwin River and Yamar Creek. The diversity index values were not significantly different between upstream and downstream sites in the three studied seasons (p=1.00; Binomial test; obs. prop.=0.50) (Table 5.4, 5.5 and 5.6). The results showed that there was no significant difference in species diversity in relation to environmental conditions indicating the relatively similar aquatic habitat quality of upstream and downstream sites.

Table 5.4: Comparison of zooplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the cold-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.5266	3.5029	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6181	2.897	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.5: Comparison of zooplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the hot-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.4748	3.6089	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.4993	2.9473	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.6: Comparison of zooplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the wet season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.4111	3.5859	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.3093	2.9624	p=1.00; Binomial test; obs. prop.=0.50	NS

5.1.3 Phytoplankton

Shannon species diversity index (H') values of phytoplankton were compared using binomial test between upstream and downstream sites of Chindwin River and Yamar Creek. The diversity index values were not significantly different between upstream and downstream sites in the three studied seasons (p=1.00; Binomial test; obs. prop.=0.50) (Table 5.7, 5.8 and 5.9). The results showed that there was no significant difference in

species diversity in relation to environmental conditions indicating the relatively similar aquatic habitat quality of upstream and downstream sites.

Table 5.7: Comparison of phytoplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the cold-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.8067	3.9603	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.7275	3.9126	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.8: Comparison of phytoplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the hot-dry season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.8337	3.8551	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.6197	3.9333	p=1.00; Binomial test; obs. prop.=0.50	NS

Table 5.9: Comparison of phytoplankton species diversity values between upstream and downstream of Chindwin River and Yamar Creek in the wet season.

Water body	Upstream	Downstream	Test	Remark
Chindwin	3.6479	3.9082	p=1.00; Binomial test; obs. prop.=0.50	NS
Yamar	3.4086	3.9504	p=1.00; Binomial test; obs. prop.=0.50	NS

5.1.4 Margalef's species richness and Shannon's Evenness

The Margalef's species richness index values show relatively similar values of upstream and downstream sites both in Chindwin River and Yamar Creek for fishes and planktons (Table 5.10, 5.11and 5.12). A significant difference was not found between upstream and downstream sites in all three seasons (p=1.00; Binomial test; obs. prop.=0.50; NS) (Table 5.10, 5.11 and 5.12). Evenness index values found for all sites in three seasons indicated the even distribution of the existing organisms along the river and creek.

Table 5.10: Margalef's species richness index values and Shannon Evenness values of fish.

Item		Cool dry season		Hot Dry Season		Wet Season	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Chindwin River	Margalef's Species Richness index	5.479	5.4261	5.457	5.4098	5.4224	5.3641
	Shannon Evenness (J')	0.865	0.859	0.871	0.86	0.872	0.861
Yamar Creek	Margalef's Species Richness index	5.5724	5.6429	5.5483	5.6515	5.5589	5.6264
	Shannon Evenness (J')	0.838	0.846	0.841	0.842	0.85	0.842
Differences between downstream and upstream sites- p=1.00; Binomial test; obs. prop.=0.50; NS							

Table 5.11: Margalef's species richness index values and Shannon Evenness values of zooplankton in three seasons

Item		Cool dry season		Hot dry season		Wet season	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Chindwin River	Margalef's Species Richness index	7.3153	6.8193	7.2754	6.7454	7.1641	6.6546
	Shannon Evenness (J')	0.903	0.897	0.889	0.924	0.873	0.918
Yamar Creek	Margalef's Species Richness index	7.0789	5.2851	7.129	5.3499	7.237	5.1829
	Shannon Evenness (J')	0.847	0.856	0.847	0.856	0.847	0.856
Differences between downstream and upstream sites- p=1.00; Binomial test; obs. prop.=0.50; NS							

Table 5.12: Margalef's species richness index values and Shannon Evenness values of phytoplankton in three seasons

Item		Cool dry season		Hot dry season		Wet season	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Chindwin River	Margalef's Species Richness index	9.4054	8.7677	9.3541	8.6726	9.2109	8.5559
	Shannon Evenness (J')	0.896	0.932	0.903	0.921	0.859	0.92
Yamar Creek	Margalef's Species Richness index	10.1128	10.0418	10.1843	10.1648	10.3386	9.8476
	Shannon Evenness (J')	0.849	0.905	0.824	0.91	0.776	0.914
Differences between downstream and upstream sites- p=1.00; Binomial test; obs. prop.=0.50; NS							

6 DISCUSSION AND MITIGATION MEASURES

During the surveys, no threatened fish species were found in either the Chindwin River or Yamar Creek. All recorded fish species are considered to be common species and as such are not listed under the protected species list of Myanmar. However, fishing activities are prohibited during the spawning season by the Fisheries Department; people associated with the Project should be informed of this restriction.

6.1 Species conservation

There is concern that toxic minerals and chemicals, particularly those resulting from acid rock drainage (ARD) from the waste rock dumps and the pit may make their way into the water bodies of the river and creek; particularly in the wet season. Bioaccumulation of the toxic minerals in aquatic organisms may cause harmful effect on the aquatic population and consequently it may cause adverse impacts on the people, which consume the aquatic organisms including fish.

ARD formation can result in soil and water contamination. ARD may easily occur because the ore and waste rocks contain high concentrations of sulphur. High ambient temperature and rain water greatly support the occurrence of ARD.

The Project will use the water from the river for the workers accommodation and for the processing operation. In pumping the water from the Chindwin River, fish eggs, larvae and fry may be incidentally included in the pumped water causing the fish population to decline. Fish are important for the local people, because some people generate their income by fishing, and fish make up an important part of the diet of the local community. It is therefore recommended that suitable devices and systems are used to reduce the intake of fish when water is being drawn from the Chindwin River.

Aquatic fauna including fish and plankton species should be regularly monitored in both the Chindwin River and Yamar creek during all phases of the Project including the construction phase, operation phase, and mine closure phase. The results of the monitoring should be analysed in order to identify any changes to the population dynamics of the aquatic fauna. Fish of both the Chindwin River and Yamar Creek can be used as indicator species in monitoring the direct and indirect impacts from the Project.

Regarding indirect impacts, the water bodies and aquatic fauna may be disturbed, and aquatic organisms may be overexploited by both the workers from the Letpadaung Project and the locals as well. Illegal fishing during spawning season and using illegal methods such as poisoning and use of explosive could occur.

It is recommended that MWMCL should release native fish fingerlings into the river and creek and into seasonal floodplains, to support the livelihood of the community.

6.2 Population change and decline

Population change and decline of aquatic species are related to changes of environment and habitat quality. Change of index values and proportional abundance of the aquatic community, specifically fish, zooplankton and phytoplankton can be used as indicators. Zooplankton and phytoplankton species are primary food sources of larger species like fish and prawns. As such, impacts on the plankton population may cause adverse impacts on the aquatic vertebrates like fish. In addition, pollution of the water bodies could result in the increase in the population of certain phytoplankton species as well as other species that are able to take advantage of the polluted water.

APPENDIX 1 –SPECIES PROPORTIONAL ABUNDANCE

1 SPECIES PROPORTIONAL ABUNDANCE

1.1 Fish Species

A total of 21 fish species were recorded in the upstream site of Chindwin River during the survey period in cool-dry season. The species *Chanda ranga* was found to have the highest proportional abundance (0.1765), followed by *Glossogobius giuris*, *Chela sardinella* and *Rhinomugil corsula* (Table 1.1). The species diversity (H') index value of Chindwin River upstream site in cool-dry season was 3.794, which showed that the fish species were in moderately diverse condition in the upstream site in cool dry season.

Table 1.1: Fish species abundance and diversity index values in Chindwin River upstream area in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Chanda ranga*	0.176510067	
2	*Glossogobius giuris*	0.146979866	
3	*Chela sardinella*	0.118568233	
4	*Rhinomugil corsula*	0.106487696	
5	*Labeo calbasu*	0.057270694	
6	*Labeo rohita*	0.051454139	
7	*Lepidocephalus thermalis*	0.049440716	
8	*Puntius chola*	0.046979866	
9	*Cirrhina mrigala*	0.035794183	
10	*Mystus cavasius*	0.035123043	
11	*Mastacembelus armatus*	0.029082774	
12	*Ompok bimaculatus*	0.026845638	
13	*Labeo angra*	0.021923937	
14	*Notopterus notopterus*	0.019463087	
15	*Mastacembelus zebranus*	0.017002237	
16	*Labeo boga*	0.014541387	
17	*Gudusia variegata*	0.012527964	
18	*Esomus altus*	0.010067114	
19	*Mystus aor*	0.008277405	
20	*Silonia silondia*	0.008053691	
21	*Channa orientalis*	0.007606264	
			3.798477361

A total of 21 fish species were recorded in the downstream site of Chindwin River during the survey period. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1545), followed by *Chanda ranga*, *Labeo rohita* and *Rhinomugil corsula* (Table 1.2). The species diversity (H') index value of Chindwin River downstream site in cool dry season was 3.7737, which showed that the fish species were in moderately diverse condition in the upstream site in cool-dry season.

Table 1.2: Fish species abundance and diversity index values in Chindwin River downstream site in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	Glossogobius giuris	0.154575433	
2	Chanda ranga	0.13911789	
3	Labeo rohita	0.134789777	
4	Rhinomugil corsula	0.126133553	
5	Chela sardinella	0.075638912	
6	Puntius chola	0.048433636	
7	Lepidocephalus thermalis	0.045342127	
8	Labeo calbasu	0.044723825	
9	Cirrhina mrigala	0.029472383	
10	Mystus cavasius	0.029472383	
11	Labeo angra	0.026793075	
12	Ompok bimaculatus	0.026380874	
13	Mastacembelus zebranus	0.024732069	
14	Notopterus notopterus	0.024732069	
15	Mastacembelus armatus	0.01793075	
16	Gudusia variegata	0.011129431	
17	Channa orientalis	0.009480627	
18	Labeo boga	0.009274526	
19	Silonia silondia	0.009274526	
20	Esomus altus	0.007419621	
21	Mystus aor	0.005152514	
			3.773695181

A total of 21 fish species were recorded in the upstream site of Yamar Creek during the survey period in cool-dry season. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1977), followed *by Chanda ranga*, *Labeo rohita* and *Rhinomugil corsula* (Table 1.3). The species diversity (H') index value of Yamar Creek upstream site in cool dry season was 3.6819, which showed that the fish species were in moderately diverse condition in the upstream site in cool-dry season.

Table 1.3: Fish species abundance and diversity index values in Yamar Creek upstream site in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.197785218	
2	*Chanda ranga*	0.161730621	
3	*Labeo rohita*	0.123100695	
4	*Rhinomugil corsula*	0.114859645	
5	*Lepidocephalus thermalis*	0.054081895	
6	*Puntius chola*	0.048673706	
7	*Chela sardinella*	0.043007984	
8	*Mastacembelus armatus*	0.034766933	

9	*Mystus cavasius*	0.032964203	
10	*Labeo calbasu*	0.031676539	
11	*Mastacembelus zebranus*	0.025753284	
12	*Ompok bimaculatus*	0.022405357	
13	*Notopterus notopterus*	0.019314963	
14	*Labeo angra*	0.017769766	
15	*Cirrhina mrigala*	0.017512233	
16	*Channa orientalis*	0.014164306	
17	*Gudusia variegata*	0.011073912	
18	*Esomus altus*	0.009013649	
19	*Silonia silondia*	0.009013649	
20	*Labeo boga*	0.005923255	
21	*Mystus aor*	0.00540819	
			3.681937336

A total of 21 fish species were recorded in the downstream site of Yamar Creek during the survey period. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1836), followed by *Chanda ranga*, *Rhinomugil corsula* and *Labeo rohita* (Table 1.4). The species diversity (H') index value of Yamar Creek downstream site in cool dry season was 3.714, which showed that the fish species were in moderately diverse condition in the upstream site in cool-dry season.

Table 1.4: Fish species abundance and diversity index values in Yamar Creek downstream in cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.183609366	
2	*Chanda ranga*	0.159908624	
3	*Rhinomugil corsula*	0.122215877	
4	*Labeo rohita*	0.089948601	
5	*Lepidocephalus thermalis*	0.067675614	
6	*Chela sardinella*	0.062821245	
7	*Puntius chola*	0.056253569	
8	*Mastacembelus armatus*	0.036550543	
9	*Ompok bimaculatus*	0.036550543	
10	*Labeo calbasu*	0.03597944	
11	*Mystus cavasius*	0.03597944	
12	*Notopterus notopterus*	0.019417476	
13	*Labeo angra*	0.017704169	
14	*Channa orientalis*	0.013135351	
15	*Cirrhina mrigala*	0.011993147	
16	*Esomus altus*	0.01027984	
17	*Gudusia variegata*	0.009994289	
18	*Silonia silondia*	0.009423187	
19	*Labeo boga*	0.007138778	
20	*Mystus aor*	0.007138778	
21	*Mastacembelus zebranus*	0.006282125	
			3.714065812

A total of 21 fish species were recorded in the upstream site of the Chindwin River during the survey period in hot-dry season. The species *Chanda ranga* was found to have the highest proportional abundance (0.1643), followed by *Glossogobius giuris* and *Chela sardinella* (Table 1.5). The species diversity (H') index value of Chindwin River upstream site in hot-dry season was 3.826, which showed that the fish species were moderately diverse condition in the upstream site.

Table 1.5: Fish species abundance and diversity index values in Chindwin River upstream site in hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Chanda ranga*	0.164359862	
2	*Glossogobius giuris*	0.150951557	
3	*Chela sardinella*	0.121107266	
4	*Rhinomugil corsula*	0.105752595	
5	*Puntius chola*	0.060553633	
6	*Labeo calbasu*	0.051903114	
7	*Labeo rohita*	0.045415225	
8	*Lepidocephalus thermalis*	0.045415225	
9	*Cirrhina mrigala*	0.036764706	
10	*Mystus cavasius*	0.036548443	
11	*Ompok bimaculatus*	0.024221453	
12	*Mastacembelus armatus*	0.023788927	
13	*Labeo angra*	0.021626298	
14	*Mastacembelus zebranus*	0.021193772	
15	*Notopterus notopterus*	0.021193772	
16	*Labeo boga*	0.018382353	
17	*Gudusia variegata*	0.014057093	
18	*Esomus altus*	0.012543253	
19	*Silonia silondia*	0.01016436	
20	*Mystus aor*	0.007569204	
21	*Channa orientalis*	0.006487889	
			3.826014963

A total of 21 fish species were recorded in the upstream site of Chindwin River downstream site during the survey period in hot-dry season. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.1566), followed by *Chanda ranga* and *Labeo rohita* (Table 1.6). The species diversity (H') index value of Chindwin River downstream site in hot dry season was 3.7759, which showed that the fish species were moderately diverse condition in the downstream site in hot-dry season.

Table 1.6: Fish species abundance and diversity index values in Chindwin River downstream area in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.156689434	
2	*Chanda ranga*	0.136601045	
3	*Labeo rohita*	0.135596625	
4	*Rhinomugil corsula*	0.124548011	
5	*Chela sardinella*	0.076335878	
6	*Puntius chola*	0.049216553	
7	*Lepidocephalus thermalis*	0.046203294	
8	*Labeo calbasu*	0.044194456	
9	*Cirrhina mrigala*	0.030936119	
10	*Mystus cavasius*	0.028726396	
11	*Ompok bimaculatus*	0.026918441	
12	*Notopterus notopterus*	0.024708718	
13	*Labeo angra*	0.024106067	
14	*Mastacembelus zebranus*	0.022097228	
15	*Mastacembelus armatus*	0.019686621	
16	*Labeo boga*	0.011249498	
17	*Gudusia variegata*	0.011249498	
18	*Silonia silondia*	0.009642427	
19	*Channa orientalis*	0.009441543	
20	*Esomus altus*	0.006830052	
21	*Mystus aor*	0.005022097	
			3.775881729

A total of 21 fish species were recorded in the upstream site of Yamar Creek during the survey period in hot-dry season. The species *Glossogobius giuris* was found to have the highest proportional abundance (0.197), followed by *Chanda ranga* and *Labeo rohita* (Table 1.7). The species diversity (H') index value of Yamar Creek upstream site in hot dry season was 3.6924, which showed that the fish species were in moderately diverse condition in the upstream site in hot-dry season.

Table 1.7: Fish species abundance and diversity index values in Yamar Creek upstream in hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.197018634	
2	*Chanda ranga*	0.162484472	
3	*Labeo rohita*	0.123726708	
4	*Rhinomugil corsula*	0.109565217	
5	*Lepidocephalus thermalis*	0.052670807	
6	*Puntius chola*	0.048447205	
7	*Chela sardinella*	0.044223602	
8	*Mastacembelus armatus*	0.036024845	
9	*Labeo calbasu*	0.032298137	
10	*Mystus cavasius*	0.032298137	

11	*Mastacembelus zebranus*	0.027329193	
12	*Ompok bimaculatus*	0.023602484	
13	*Cirrhina mrigala*	0.018881988	
14	*Labeo angra*	0.018881988	
15	*Notopterus notopterus*	0.018881988	
16	*Channa orientalis*	0.013416149	
17	*Gudusia variegata*	0.011428571	
18	*Silonia silondia*	0.009192547	
19	*Esomus altus*	0.007950311	
20	*Mystus aor*	0.006459627	
21	*Labeo boga*	0.005217391	
			3.692393222

A total of 21 fish species were recorded in the downstream site of Yamar Creek during the survey period in the hot-dry season. The species *Glossogobius giuris* was found with highest proportional abundance (0.1879) and that was followed by those of *Chanda ranga* and *Rhinomugil corsula* (Table 1.8). The species diversity (H') index value of Yamar Creek downstream site in hot dry season was 3.6964, which showed that the fish species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.8: Fish species abundance and diversity index values in Yamar Creek downstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.187915583	
2	*Chanda ranga*	0.157849089	
3	*Rhinomugil corsula*	0.126047991	
4	*Labeo rohita*	0.092512287	
5	*Lepidocephalus thermalis*	0.07082972	
6	*Chela sardinella*	0.060711188	
7	*Puntius chola*	0.052327262	
8	*Mastacembelus armatus*	0.037583117	
9	*Ompok bimaculatus*	0.037583117	
10	*Mystus cavasius*	0.03555941	
11	*Labeo calbasu*	0.029777392	
12	*Notopterus notopterus*	0.020237063	
13	*Labeo angra*	0.01618965	
14	*Cirrhina mrigala*	0.012431339	
15	*Channa orientalis*	0.012431339	
16	*Esomus altus*	0.00982943	
17	*Silonia silondia*	0.00982943	
18	*Gudusia variegata*	0.00982943	
19	*Mastacembelus zebranus*	0.007227522	
20	*Labeo boga*	0.006649321	
21	*Mystus aor*	0.006649321	
			3.696353394

A total of 21 fish species were recorded in the upstream site of Chindwin River upstream site during the survey period in the wet season. The species *Chanda ranga* was found with highest proportional abundance (0.1598) and that was followed by those of *Glossogobius giuris* and *Chela sardinella* (Table 1.9). The species diversity (H') index value of Chindwin River upstream site in wet season was 3.829, which showed that the fish species were in moderately diverse condition in the upstream site.

Table 1.9: Fish species abundance and diversity index values in Chindwin River upstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Chanda ranga*	0.159836066	
2	*Glossogobius giuris*	0.153688525	
3	*Chela sardinella*	0.116803279	
4	*Rhinomugil corsula*	0.114754098	
5	*Puntius chola*	0.06147541	
6	*Labeo calbasu*	0.047131148	
7	*Labeo rohita*	0.047131148	
8	*Lepidocephalus thermalis*	0.047131148	
9	*Cirrhina mrigala*	0.034836066	
10	*Mystus cavasius*	0.032786885	
11	*Mastacembelus armatus*	0.024590164	
12	*Labeo angra*	0.022540984	
13	*Mastacembelus zebranus*	0.022540984	
14	*Ompok bimaculatus*	0.022540984	
15	*Notopterus notopterus*	0.020491803	
16	*Labeo boga*	0.018442623	
17	*Gudusia variegata*	0.014344262	
18	*Esomus altus*	0.012295082	
19	*Silonia silondia*	0.010245902	
20	*Mystus aor*	0.008196721	
21	*Channa orientalis*	0.008196721	
			3.829038482

A total of 21 fish species were recorded in the downstream site of Chindwin River during the survey period in the wet season. The species *Glossogobius giuris* was found with highest proportional abundance (0.1513) and that was followed by those of *Chanda ranga*, *Labeo rohita* and *Rhinomugil corsula* (Table 1.10). The species diversity (H') index value of Chindwin River downstream site in cool dry season was 3.7797, which showed that the fish species were in moderately diverse condition in the upstream site in the wet season.

Table 1.10: Fish species abundance and diversity index value in Chindwin River downstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.151345291	
2	*Chanda ranga*	0.147047833	
3	*Labeo rohita*	0.130792227	
4	*Rhinomugil corsula*	0.116405082	
5	*Chela sardinella*	0.087817638	

6	*Puntius chola*	0.052316891	
7	*Lepidocephalus thermalis*	0.044843049	
8	*Labeo calbasu*	0.039237668	
9	*Cirrhina mrigala*	0.033632287	
10	*Mystus cavasius*	0.028026906	
11	*Labeo angra*	0.024289985	
12	*Mastacembelus zebranus*	0.022421525	
13	*Ompok bimaculatus*	0.022421525	
14	*Notopterus notopterus*	0.022421525	
15	*Mastacembelus armatus*	0.020553064	
16	*Labeo boga*	0.012518685	
17	*Gudusia variegata*	0.011210762	
18	*Channa orientalis*	0.010089686	
19	*Silonia silondia*	0.008594918	
20	*Esomus altus*	0.008408072	
21	*Mystus aor*	0.005605381	
			3.779659813

A total of 21 fish species were recorded in the upstream site of Yamar Creek during the survey period in the wet season. The species *Glossogobius giuris* was found with highest proportional abundance (0.1792) and that was followed by those of *Chanda ranga* and *Labeo rohita* (Table 1.11). The species diversity (H') index value of Yamar Creek upstream site in wet season was 3.7353, which showed that the fish species were in moderately diverse condition in the upstream site in the wet season.

Table 1.11: Fish species abundance and diversity index values in Yamar Creek upstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.179247665	
2	*Chanda ranga*	0.159555668	
3	*Labeo rohita*	0.12623075	
4	*Rhinomugil corsula*	0.109063368	
5	*Chela sardinella*	0.053016915	
6	*Lepidocephalus thermalis*	0.053016915	
7	*Puntius chola*	0.04544307	
8	*Mastacembelus armatus*	0.037869225	
9	*Mystus cavasius*	0.03534461	
10	*Labeo calbasu*	0.03029538	
11	*Mastacembelus zebranus*	0.03029538	
12	*Ompok bimaculatus*	0.027770765	
13	*Cirrhina mrigala*	0.022721535	
14	*Labeo angra*	0.02019692	
15	*Notopterus notopterus*	0.02019692	
16	*Gudusia variegata*	0.012623075	
17	*Silonia silondia*	0.009088614	
18	*Esomus altus*	0.008583691	
19	*Channa orientalis*	0.008583691	
20	*Labeo boga*	0.005806614	
21	*Mystus aor*	0.00504923	
			3.7353051

A total of 21 fish species were recorded in the downstream site of Yamar Creek during the survey period in the wet season. The species *Glossogobius giuris* was found with highest proportional abundance (0.189) and that was followed by those of *Chanda ranga* and *Rhinomugil corsula* (Table 1.12). The species diversity (H') index value of Yamar Creek downstream site in wet season was 3.6975, which showed that the fish species were in moderately diverse condition in the downstream site in the wet season.

Table 1.12: Fish species abundance and diversity index values in Yamar Creek downstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Glossogobius giuris*	0.189015891	
2	*Chanda ranga*	0.161137441	
3	*Rhinomugil corsula*	0.127125732	
4	*Labeo rohita*	0.09478673	
5	*Lepidocephalus thermalis*	0.066350711	
6	*Chela sardinella*	0.064120435	
7	*Puntius chola*	0.047393365	
8	*Mystus cavasius*	0.036241985	
9	*Mastacembelus armatus*	0.03345414	
10	*Ompok bimaculatus*	0.03345414	
11	*Labeo calbasu*	0.027320881	
12	*Notopterus notopterus*	0.01672707	
13	*Esomus altus*	0.015611932	
14	*Gudusia variegata*	0.015611932	
15	*Cirrhina mrigala*	0.013939225	
16	*Labeo angra*	0.013939225	
17	*Silonia silondia*	0.012545302	
18	*Channa orientalis*	0.010036242	
19	*Labeo boga*	0.009478673	
20	*Mastacembelus zebranus*	0.008363535	
21	*Mystus aor*	0.003345414	
			3.697526027

1.2 Zooplankton Species

A total of 15 zooplankton species were recorded in the upstream site of Chindwin River during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1951) and that was followed by those of *Chydorus sp*, *Brachionus havanaensis* and *Eucypris virens* (Table 1.13). The species diversity (H') index value of Chindwin River upstream site in the cool-dry season was 3.5266, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.13: Zooplankton species and Shannon diversity index values of Chindwin River upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.195121951	
2	*Chydorus sp*	0.134146341	
3	*Brachionus havanaensis*	0.134146341	
4	*Eucypris virens*	0.085365854	
5	*Monostyla lunaris*	0.085365854	
6	*Spirostomum minus*	0.06097561	
7	*Stenocypris malcolmsoni*	0.06097561	
8	*Brachionus diversicornis*	0.048780488	
9	*Daphnia sp*	0.048780488	
10	*Cyclops vicinus*	0.036585366	
11	*Monostyla bulla*	0.036585366	
12	*Entacythere donaldsonensis*	0.024390244	
13	*Lecane ungulata*	0.024390244	
14	*Bosminopsis sp*	0.012195122	
15	*Daphnia pulex*	0.012195122	
			3.526582243

A total of 15 zooplankton species were recorded in the downstream site of Chindwin River during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1946) and that was followed by those of *Monostyla lunaris*, *Spirostomum minus* and *Daphnia pulex* (Table 1.14). The species diversity (H') index value of Chindwin River downstream site in the cool-dry season was 3.5029, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the cool-dry season.

Table 1.14: Zooplankton species and Shannon diversity index values of Chindwin River downstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.194690265	
2	*Monostyla lunaris*	0.132743363	
3	*Spirostomum minus*	0.115044248	
4	*Daphnia pulex*	0.115044248	
5	*Brachionus diversicornis*	0.097345133	
6	*Brachionus havanaensis*	0.07079646	
7	*Entacythere donaldsonensis*	0.053097345	
8	*Stenocypris malcolmsoni*	0.044247788	
9	*Lecane ungulata*	0.03539823	
10	*Eucypris virens*	0.03539823	
11	*Bosminopsis sp*	0.03539823	
12	*Cyclops vicinus*	0.026548673	
13	*Daphnia sp*	0.017699115	
14	*Chydorus sp*	0.017699115	
15	*Monostyla bulla*	0.008849558	
			3.502919334

A total of 15 zooplankton species were recorded in the upstream site of Yamar Creek during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1684) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Daphnia sp* (Table 1.15). The species diversity (H') index value of Yamar Creek upstream site in the cool-dry season was 3.6181, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.15: Zooplankton species and Shannon diversity index values of Yamar Creek upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.168421053	
2	*Eucypris virens*	0.147368421	
3	*Entacythere donaldsonensis*	0.136842105	
4	*Daphnia sp*	0.073684211	
5	*Monostyla bulla*	0.063157895	
6	*Lecane ungulata*	0.063157895	
7	*Monostyla lunaris*	0.052631579	
8	*Bosminopsis sp*	0.052631579	
9	*Stenocypris malcolmsoni*	0.052631579	
10	*Brachionus havanaensis*	0.042105263	
11	*Cyclops vicinus*	0.042105263	
12	*Spirostomum minus*	0.031578947	
13	*Daphnia pulex*	0.031578947	
14	*Brachionus diversicornis*	0.021052632	
15	*Chydorus sp*	0.021052632	
			3.618082807

A total of 11 zooplankton species were recorded in the downstream site of Yamar Creek during the survey period in the cool-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.3205) and that was followed by those of *Daphnia sp*, *Cyclops vicinus* and *Spirostomum minus* (Table 1.16). The species diversity (H') index value of Yamar Creek downstream site in the cool-dry season was 2.897, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the cool-dry season although it was relatively low when compared to other sites.

Table 1.16: Zooplankton species and Shannon diversity index values of Yamar Creek downstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.320512821	
2	*Daphnia sp*	0.179487179	
3	*Cyclops vicinus*	0.153846154	
4	*Spirostomum minus*	0.076923077	
5	*Monostyla bulla*	0.064102564	
6	*Lecane ungulata*	0.051282051	
7	*Eucycpris virens*	0.051282051	
8	*Daphnis pulex*	0.038461538	
9	*Bosminopsis sp*	0.025641026	
10	*Brachionus diversicornis*	0.025641026	
11	*Monostyla lunaris*	0.012820513	
			2.897027518

A total of 15 zooplankton species were recorded in the upstream site of Chindwin River during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2023) and that was followed by those of *Brachionus havanaensis*, *Chydorus sp* and *Eucypris virens* (Table 1.17). The species diversity (H') index value of Chindwin River upstream site in the hot-dry season was 3.4748, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.17: Zooplankton species and Shannon diversity index values of Chindwin River upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.202380952	
2	*Brachionus havanaensis*	0.166666667	
3	*Chydorus sp*	0.142857143	
4	*Eucypris virens*	0.071428571	
5	*Spirostomum minus*	0.071428571	
6	*Monostyla lunaris*	0.05952381	
7	*Stenocypris malcolmsoni*	0.05952381	

8	*Entacythere donaldsonensis*	0.035714286	
9	*Brachionus diversicornis*	0.035714286	
10	*Lecane ungulata*	0.035714286	
11	*Bosminopsis sp*	0.035714286	
12	*Cyclops vicinus*	0.023809524	
13	*Daphnia sp*	0.023809524	
14	*Daphnia pulex*	0.023809524	
15	*Monostyla bulla*	0.011904762	
			3.474843992

A total of 15 zooplankton species were recorded in the downstream site of Chindwin River during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1764) and that was followed by those of *Spirostomum minus*, *Monostyla lunaris* and *Daphnia pulex* (Table 1.18). The species diversity (H') index value of Chindwin River downstream site in the hot-dry season was 3.6089, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.18: Zooplankton species and Shannon diversity index values of Chindwin River downstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.176470588	
2	*Spirostomum minus*	0.12605042	
3	*Monostyla lunaris*	0.109243697	
4	*Daphnia pulex*	0.100840336	
5	*Brachionus diversicornis*	0.100840336	
6	*Brachionus havanaensis*	0.058823529	
7	*Eucypris virens*	0.058823529	
8	*Lecane ungulata*	0.050420168	
9	*Cyclops vicinus*	0.042016807	
10	*Bosminopsis sp*	0.042016807	
11	*Daphnia sp*	0.033613445	
12	*Stenocypris malcolmsoni*	0.033613445	
13	*Entacythere donaldsonensis*	0.033613445	
14	*Monostyla bulla*	0.016806723	
15	*Chydorus sp*	0.016806723	
			3.60894494

A total of 15 zooplankton species were recorded in the upstream site of Yamar Creek during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2065) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Monostyla bulla* (Table 1.19). The species diversity (H') index value of Yamar Creek upstream site in the hot-dry season was 3.4993, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.19: Zooplankton species and Shannon diversity index values of Yamar Creek upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.206521739	
2	*Eucypris virens*	0.163043478	
3	*Entacythere donaldsonensis*	0.130434783	
4	*Monostyla bulla*	0.076086957	
5	*Daphnia sp*	0.065217391	
6	*Spirostomum minus*	0.054347826	
7	*Lecane ungulata*	0.054347826	
8	*Monostyla lunaris*	0.043478261	
9	*Bosminopsis sp*	0.043478261	
10	*Stenocypris malcolmsoni*	0.043478261	
11	*Brachionus diversicornis*	0.032608696	
12	*Cyclops vicinus*	0.032608696	
13	*Brachionus havanaensis*	0.02173913	
14	*Daphnia pulex*	0.02173913	
15	*Chydorus sp*	0.010869565	
			3.499389705

A total of 11 zooplankton species were recorded in the downstream site of Yamar Creek during the survey period in the hot-dry season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2837) and that was followed by those of *Cyclops vicinus*, *Daphnia sp* and *Spirostomum minus* (Table 1.20). The species diversity (H') index value of Yamar Creek downstream site in the hot-dry season was 2.9473, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.20: Zooplankton species and Shannon diversity index values of Yamar Creek downstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.283783784	
2	*Cyclops vicinus*	0.175675676	
3	*Daphnia sp*	0.162162162	
4	*Spirostomum minus*	0.121621622	
5	*Monostyla bulla*	0.054054054	
6	*Brachionus diversicornis*	0.054054054	
7	*Lecane ungulata*	0.040540541	
8	*Bosminopsis sp*	0.040540541	
9	*Monostyla lunaris*	0.027027027	
10	*Daphnis pulex*	0.027027027	
11	*Eucycpris virens*	0.013513514	
			2.947250227

A total of 15 zooplankton species were recorded in the upstream site of Chindwin River during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2444) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Cyclops vicinus* (Table 1.21). The species diversity (H') index value of Chindwin River upstream site in the wet season was 3.4111, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.21: Zooplankton species and Shannon diversity index values of Chindwin River upstream in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.244444444	
2	*Eucypris virens*	0.155555556	
3	*Entacythere donaldsonensis*	0.144444444	
4	*Cyclops vicinus*	0.066666667	
5	*Spirostomum minus*	0.055555556	
6	*Brachionus diversicornis*	0.055555556	
7	*Monostyla lunaris*	0.044444444	
8	*Lecane ungulata*	0.044444444	
9	*Monostyla bulla*	0.033333333	
10	*Daphnia sp*	0.033333333	
11	*Bosminopsis sp*	0.033333333	
12	*Stenocypris malcolmsoni*	0.033333333	
13	*Daphnia pulex*	0.022222222	
14	*Chydorus sp*	0.022222222	
15	*Brachionus havanaensis*	0.011111111	
			3.411133243

A total of 15 zooplankton species were recorded in the downstream site of Chindwin River during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.1968) and that was followed by those of *Spirostomum minus*, *Daphnia sp* and *Lecane ungulata* (Table 1.22). The species diversity (H') index value of Chindwin River downstream site in the wet season was 3.5859, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.22: Zooplankton species and Shannon diversity index values of Chindwin River downstream site in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.196850394	
2	*Spirostomum minus*	0.11023622	
3	*Daphnia sp*	0.102362205	
4	*Lecane ungulata*	0.094488189	
5	*Brachionus havanaensis*	0.086614173	

6	*Daphnia pulex*	0.086614173	
7	*Monostyla lunaris*	0.062992126	
8	*Eucypris virens*	0.05511811	
9	*Brachionus diversicornis*	0.047244094	
10	*Stenocypris malcolmsoni*	0.039370079	
11	*Monostyla bulla*	0.031496063	
12	*Cyclops vicinus*	0.031496063	
13	*Chydorus sp*	0.023622047	
14	*Bosminopsis sp*	0.015748031	
15	*Entacythere donaldsonensis*	0.015748031	
			3.585866395

A total of 15 zooplankton species were recorded in the upstream site of Yamar Creek during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.2325) and that was followed by those of *Eucypris virens*, *Entacythere donaldsonensis* and *Monostyla lunaris* (Table 1.23). The species diversity (H') index value of Yamar Creek upstream site in the wet season was 3.3093, which showed that the zooplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.23: Zooplankton species and Shannon diversity index values of Yamar Creek upstream site in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.23255814	
2	*Eucypris virens*	0.186046512	
3	*Entacythere donaldsonensis*	0.174418605	
4	*Monostyla lunaris*	0.069767442	
5	*Spirostomum minus*	0.046511628	
6	*Brachionus diversicornis*	0.046511628	
7	*Cyclops vicinus*	0.046511628	
8	*Lecane ungulata*	0.034883721	
9	*Chydorus sp*	0.034883721	
10	*Monostyla bulla*	0.023255814	
11	*Brachionus havanaensis*	0.023255814	
12	*Daphnia sp*	0.023255814	
13	*Bosminopsis sp*	0.023255814	
14	*Stenocypris malcolmsoni*	0.023255814	
15	*Daphnia pulex*	0.011627907	
			3.309270908

A total of 11 zooplankton species were recorded in the downstream site of Yamar Creek during the survey period in the wet season. The species *Astramoeba radiosa* was found with highest proportional abundance (0.3411) and that was followed by those of *Spirostomum minus*, *Monostyla lunaris* and *Monostyla bulla* (Table 1.24). The species diversity (H') index value of Yamar Creek downstream site in the wet season was

2.9624, which showed that the zooplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.24: Zooplankton species and Shannon diversity index values of Yamar Creek downstream site in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Astramoeba radiosa*	0.341176471	
2	*Spirostomum minus*	0.141176471	
3	*Monostyla lunaris*	0.082352941	
4	*Monostyla bulla*	0.035294118	
5	*Lecane ungulata*	0.058823529	
6	*Daphnia sp*	0.047058824	
7	*Bosminopsis sp*	0.023529412	
8	*Cyclops vicinus*	0.129411765	
9	*Daphnis pulex*	0.035294118	
10	*Eucycpris virens*	0.070588235	
11	*Brachionus diversicornis*	0.035294118	
			2.962446123

1.3 Phytoplankton Species

A total of 19 phytoplankton species were recorded in the upstream site of Chindwin River during the survey period in the cool-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.2456) and that was followed by those of *Synedra acus var. angustissima*, *Spirogyra protecta* and *Mougeotia nummuloides* (Table 1.25). The species diversity (H') index value of Chindwin River upstream site in the cool-dry season was 3.8067, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.25: Phytoplankton species and Shannon diversity index values of Chindwin River upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.245614035	
2	*Synedra acus var. angustissima*	0.114035088	
3	*Spirogyra protecta*	0.061403509	
4	*Mougeotia nummuloides*	0.061403509	
5	*Lyngbya contorta*	0.052631579	
6	*Oscillatoria subbrevis*	0.052631579	
7	*Staurastrum leptopus*	0.043859649	
8	*Campsopogan caeruleus*	0.043859649	
9	*Planktothrix raciborskii*	0.043859649	
10	*Lyngbya martensiana*	0.043859649	
11	*Phormidium ambiguum*	0.035087719	
12	*Oscillatoria laete-virens*	0.035087719	
13	*Treubaria crassispina*	0.035087719	

14	*Spiroyra prolifica*	0.035087719	
15	*Diatoma elongaum*	0.026315789	
16	*Dinobryon divergens*	0.026315789	
17	*Synedra acus var. radians*	0.01754386	
18	*Spirogyra azygospora*	0.01754386	
19	*Lyngbya truncicola*	0.00877193	
			3.806727646

A total of 19 phytoplankton species were recorded in the downstream site of Chindwin River during the survey period in the cool-dry season. The species *Synedra affinis* had the highest proportional abundance (0.1729) and that was followed by those of *Oscillatoria laetevirens*, *Lyngbya martensiana* and *Staurastrum leptopus* (Table 1.26). The species diversity (H') index value of Chindwin River downstream site in the cool-dry season was 3.9603, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the cool-dry season.

Table 1.26: Phytoplankton species and Shannon diversity index values of Chindwin River downstream in the cool-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.172932331	
2	*Oscillatoria laetevirens*	0.090225564	
3	*Lyngbya martensiana*	0.082706767	
4	*Staurastrum leptopus*	0.067669173	
5	*Dinobryon divergens*	0.060150376	
6	*Planktothrix raciborskii*	0.060150376	
7	*Oscillatoria subbrevis*	0.060150376	
8	*Spirogyra protecta*	0.052631579	
9	*Mougeotia nummuloides*	0.052631579	
10	*Lyngbya contorta*	0.052631579	
11	*Diatoma elongaum*	0.052631579	
12	*Phormidium ambiguum*	0.045112782	
13	*Spiroyra prolifica*	0.037593985	
14	Synedra acus var. angustissima	0.022556391	
15	*Treubaria crassispina*	0.022556391	
16	*Spirogyra azygospora*	0.022556391	
17	Synedra acus var. radians	0.015037594	
18	*Lyngbya truncicola*	0.015037594	
19	*Campsopogan caeruleus*	0.015037594	
			3.960285717

A total of 21 phytoplankton species were recorded in the upstream site of Yamar Creek during the survey period in the cool-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.2734) and that was followed by those of Synedra acus var. radians, *Diatoma elongaum* and *Oscillatoria laetevirens* (Table 1.27). The species diversity (H') index value of Yamar Creek upstream site in the cool-dry

season was 3.7275, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the cool-dry season.

Table 1.27: Phytoplankton species and Shannon diversity index values of Yamar Creek upstream in the cool-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.273381295	
2	Synedra acus var. radians	0.129496403	
3	*Diatoma elongaum*	0.086330935	
4	*Oscillatoria laete-virens*	0.057553957	
5	*Spiroyra prolifica*	0.050359712	
6	*Lyngbya martensiana*	0.050359712	
7	*Mougeotia nummuloides*	0.043165468	
8	*Campsopogan caeruleus*	0.035971223	
9	*Spirogyra microspora*	0.035971223	
10	*Lyngbya contorta*	0.035971223	
11	*Dinobryon divergens*	0.028776978	
12	*Spirogyra azygospora*	0.028776978	
13	*Staurastrum leptopus*	0.021582734	
14	*Spirogyra protecta*	0.021582734	
15	*Phormidium ambiguum*	0.021582734	
16	*Spirogyra cylindrospora*	0.014388489	
17	*Oscillatoria subbrevis*	0.014388489	
18	*Lyngbya truncicola*	0.014388489	
19	*Planktothrix raciborskii*	0.014388489	
20	Synedra acus var. angustissima	0.014388489	
21	*Treubaria crassispina*	0.007194245	
			3.727532631

A total of 21 phytoplankton species were recorded in the downstream site of Yamar Creek during the survey period in the cool-dry season. The species *Synedra affinis* was found with the highest proportional abundance (0.1503) and that was followed by those of Synedra acus var. angustissima, *Spirogyra microspora* and *Planktothrix raciborskii* (Table 1.28). The species diversity (H') index value of Yamar Creek downstream site in the cool-dry season was 3.9126, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the cool-dry season.

Table 1.28: Phytoplankton species and Shannon diversity index values of Yamar Creek downstream in the cool-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.150326797	
2	Synedra acus var. angustissima	0.137254902	
3	*Spirogyra microspora*	0.111111111	
4	*Planktothrix raciborskii*	0.08496732	

5	*Spirogyra protecta*	0.071895425	
6	*Oscillatoria laete-virens*	0.071895425	
7	*Lyngbya martensiana*	0.045751634	
8	*Rhizoclonium hieroglyphicum*	0.039215686	
9	*Spirogyra azygospora*	0.039215686	
10	*Dinobryon divergens*	0.032679739	
11	*Lyngbya contorta*	0.032679739	
12	Synedra acus var. radians	0.032679739	
13	*Spiroyra prolifica*	0.026143791	
14	*Lyngbya truncicola*	0.026143791	
15	*Diatoma elongaum*	0.019607843	
16	*Ulothrix tenerrima*	0.019607843	
17	*Phormidium ambiguum*	0.019607843	
18	*Staurastrum leptopus*	0.013071895	
19	*Spirogyra cylindrospora*	0.013071895	
20	Treubaria crassispina	0.013071895	
			3.912647388

A total of 19 phytoplankton species were recorded in the upstream site of Chindwin River during the survey period in the hot-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.2424) and that was followed by those of *Synedra acus var. angustissima*, *Planktothrix raciborskii* and *Campsopogan caeruleus* (Table 1.29). The species diversity (H') index value of Chindwin River upstream site in the hot-dry season was 3.8337, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.29: Phytoplankton species and Shannon diversity index values of Chindwin River upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.242424242	
2	*Synedra acus var. angustissima*	0.106060606	
3	*Planktothrix raciborskii*	0.068181818	
4	*Campsopogan caeruleus*	0.060606061	
5	*Lyngbya contorta*	0.053030303	
6	*Spiroyra prolifica*	0.053030303	
7	*Synedra acus var. radians*	0.045454545	
8	*Spirogyra protecta*	0.045454545	
9	*Mougeotia nummuloides*	0.045454545	
10	*Lyngbya martensiana*	0.045454545	
11	*Dinobryon divergens*	0.037878788	
12	*Diatoma elongaum*	0.03030303	
13	*Spirogyra azygospora*	0.03030303	
14	*Oscillatoria subbrevis*	0.03030303	
15	*Phormidium ambiguum*	0.022727273	
16	*Oscillatoria laete-virens*	0.022727273	
17	*Staurastrum leptopus*	0.022727273	
18	*Treubaria crassispina*	0.022727273	

19	*Lyngbya truncicola*	0.015151515	
			3.83376114

A total of 19 phytoplankton species were recorded in the downstream site of Chindwin River during the survey period in the hot-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.1926) and that was followed by those of *Oscillatoria laetevirens*, *Lyngbya martensiana* and *Dinobryon divergens* (Table 1.30). The species diversity (H') index value of Chindwin River downstream site in the hot-dry season was 3.8551, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.30: Phytoplankton species and Shannon diversity index values of Chindwin River downstream in the hot-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.192592593	
2	*Oscillatoria laete-virens*	0.081481481	
3	*Lyngbya martensiana*	0.074074074	
4	*Dinobryon divergens*	0.066666667	
5	*Spirogyra protecta*	0.059259259	
6	*Staurastrum leptopus*	0.059259259	
7	*Diatoma elongaum*	0.059259259	
8	*Oscillatoria subbrevis*	0.059259259	
9	*Planktothrix raciborskii*	0.051851852	
10	*Mougeotia nummuloides*	0.044444444	
11	*Lyngbya contorta*	0.044444444	
12	*Spiroyra prolifica*	0.044444444	
13	*Treubaria crassispina*	0.02962963	
14	*Phormidium ambiguum*	0.02962963	
15	Synedra acus var. radians	0.022222222	
16	*Campsopogan caeruleus*	0.022222222	
17	Synedra acus var. angustissima	0.014814815	
18	*Spirogyra azygospora*	0.014814815	
19	*Lyngbya truncicola*	0.007407407	
			3.855076207

A total of 21 phytoplankton species were recorded in the upstream site of Yamar Creek during the survey period in the hot-dry season. The species *Synedra affinis* was found with highest proportional abundance (0.24) and that was followed by those of *Synedra acus var. angustissima*, Synedra acus var. radians and *Diatoma elongaum* (Table 1.31). The species diversity (H') index value of Yamar Creek upstream site in the hot-dry season was 3.6197, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the hot-dry season.

Table 1.31: Phytoplankton species and Shannon diversity index values of Yamar Creek upstream in the hot-dry season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.24	
2	Synedra acus var. angustissima	0.153333333	
3	Synedra acus var. radians	0.146666667	
4	*Diatoma elongaum*	0.086666667	
5	*Lyngbya martensiana*	0.053333333	
6	*Oscillatoria laete-virens*	0.033333333	
7	*Lyngbya contorta*	0.033333333	
8	*Campsopogan caeruleus*	0.026666667	
9	*Spirogyra microspora*	0.026666667	
10	*Planktothrix raciborskii*	0.026666667	
11	*Dinobryon divergens*	0.02	
12	*Mougeotia nummuloides*	0.02	
13	*Spirogyra azygospora*	0.02	
14	*Oscillatoria subbrevis*	0.02	
15	*Lyngbya truncicola*	0.02	
16	*Staurastrum leptopus*	0.013333333	
17	*Spirogyra protecta*	0.013333333	
18	*Spiroyra prolifica*	0.013333333	
19	*Phormidium ambiguum*	0.013333333	
20	*Treubaria crassispina*	0.013333333	
21	*Spirogyra cylindrospora*	0.006666667	
			3.619710988

A total of 20 phytoplankton species were recorded in the downstream site of Yamar Creek during the survey period in the hot-dry season. The species Synedra acus var. angustissima was found with highest proportional abundance (0.1517) and that was followed by those of *Synedra affinis*, *Spirogyra microspora* and *Spirogyra protecta* (Table 1.32). The species diversity (H') index value of Yamar Creek downstream site in the hot-dry season was 3.9333, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the hot-dry season.

Table 1.32: Phytoplankton species and Shannon diversity index values of Yamar Creek downstream in the hot-dry season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	Synedra acus var. angustissima	0.151724138	
2	*Synedra affinis*	0.137931034	
3	*Spirogyra microspora*	0.103448276	
4	*Spirogyra protecta*	0.082758621	
5	*Oscillatoria laete-virens*	0.068965517	
6	*Planktothrix raciborskii*	0.068965517	
7	Synedra acus var. radians	0.048275862	
8	*Diatoma elongaum*	0.04137931	
9	*Lyngbya martensiana*	0.04137931	
10	*Staurastrum leptopus*	0.034482759	

11	*Spirogyra azygospora*	0.034482759	
12	*Dinobryon divergens*	0.027586207	
13	*Spiroyra prolifica*	0.027586207	
14	*Lyngbya contorta*	0.027586207	
15	*Spirogyra cylindrospora*	0.020689655	
16	*Lyngbya truncicola*	0.020689655	
17	Treubaria crassispina	0.020689655	
18	*Rhizoclonium hieroglyphicum*	0.013793103	
19	*Ulothrix tenerrima*	0.013793103	
20	*Phormidium ambiguum*	0.013793103	
			3.933271116

A total of 19 phytoplankton species were recorded in the upstream site of Chindwin River during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.2984) and that was followed by those of *Diatoma elongaum*, *Synedra acus var. angustissima, Phormidium ambiguum* and *Synedra acus var. radians* (Table 1.33). The species diversity (H') index value of Chindwin River upstream site in the wet season was 3.6479, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.33: Phytoplankton species and Shannon diversity index values of Chindwin River upstream area in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.298387097	
2	*Diatoma elongaum*	0.088709677	
3	*Synedra acus var. angustissima*	0.072580645	
4	*Phormidium ambiguum*	0.064516129	
5	*Synedra acus var. radians*	0.064516129	
6	*Oscillatoria laete-virens*	0.056451613	
7	*Spirogyra azygospora*	0.048387097	
8	*Staurastrum leptopus*	0.040322581	
9	*Lyngbya contorta*	0.040322581	
10	*Campsopogan caeruleus*	0.032258065	
11	*Lyngbya truncicola*	0.032258065	
12	*Treubaria crassispina*	0.032258065	
13	*Dinobryon divergens*	0.024193548	
14	*Spirogyra protecta*	0.024193548	
15	*Planktothrix raciborskii*	0.024193548	
16	*Mougeotia nummuloides*	0.016129032	
17	*Spiroyra prolifica*	0.016129032	
18	*Lyngbya martensiana*	0.016129032	
19	*Oscillatoria subbrevis*	0.008064516	
			3.647921712

A total of 19 phytoplankton species were recorded in the downstream site of Chindwin River during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.1926) and that was followed by those of *Spirogyra protecta*, Synedra acus var. angustissima and Synedra

acus var. radians (Table 1.34). The species diversity (H') index value of Chindwin River downstream site in the wet season was 3.9082, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.34: Phytoplankton species and Shannon diversity index values of Chindwin River downstream in the wet season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.192592593	
2	*Spirogyra protecta*	0.081481481	
3	*Synedra acus* var. angustissima	0.081481481	
4	*Synedra acus* var. radians	0.074074074	
5	*Mougeotia nummuloides*	0.066666667	
6	*Dinobryon divergens*	0.059259259	
7	*Oscillatoria laete-virens*	0.059259259	
8	*Treubaria crassispina*	0.059259259	
9	*Lyngbya contorta*	0.051851852	
10	*Staurastrum leptopus*	0.044444444	
11	*Spirogyra azygospora*	0.044444444	
12	*Lyngbya truncicola*	0.044444444	
13	*Spiroyra prolifica*	0.02962963	
14	*Planktothrix raciborskii*	0.02962963	
15	*Campsopogan caeruleus*	0.022222222	
16	*Phormidium ambiguum*	0.022222222	
17	*Diatoma elongaum*	0.014814815	
18	*Oscillatoria subbrevis*	0.014814815	
19	*Lyngbya martensiana*	0.007407407	
			3.90823694

A total of 21 phytoplankton species were recorded in the upstream site of Yamar Creek during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.2727) and that was followed by those of *Synedra acus var. angustissima*, Synedra acus var. radians and *Diatoma elongaum* (Table 1.35). The species diversity (H') index value of Yamar Creek upstream site in the wet season was 3.4086, which showed that the phytoplankton species were in moderately diverse condition in the upstream site in the wet season.

Table 1.35: Phytoplankton species and Shannon diversity index values of Yamar Creek upstream area in the wet season

Sr. No.	Species	Proportional abundance Pi	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.272727273	
2	Synedra acus var. angustissima	0.204545455	
3	Synedra acus var. radians	0.136363636	
4	*Diatoma elongaum*	0.068181818	
5	*Oscillatoria subbrevis*	0.039772727	
6	*Spiroyra prolifica*	0.034090909	
7	*Planktothrix raciborskii*	0.034090909	
8	*Mougeotia nummuloides*	0.022727273	

9	*Oscillatoria laete-virens*	0.022727273	
10	*Lyngbya contorta*	0.022727273	
11	*Campsopogan caeruleus*	0.017045455	
12	*Spirogyra microspora*	0.017045455	
13	*Lyngbya martensiana*	0.017045455	
14	*Treubaria crassispina*	0.017045455	
15	*Dinobryon divergens*	0.011363636	
16	*Staurastrum leptopus*	0.011363636	
17	*Spirogyra cylindrospora*	0.011363636	
18	*Spirogyra azygospora*	0.011363636	
19	*Lyngbya truncicola*	0.011363636	
20	*Phormidium ambiguum*	0.011363636	
21	*Spirogyra protecta*	0.005681818	
			3.408609263

A total of 20 phytoplankton species were recorded in the downstream site of Yamar Creek during the survey period in the wet season. The species *Synedra affinis* was found with highest proportional abundance (0.1317) and that was followed by those of Synedra acus var. angustissima, *Spirogyra protecta* and *Treubaria crassispina* (Table 1.36). The species diversity (H') index value of Yamar Creek downstream site in the wet season was 3.9504, which showed that the phytoplankton species were in moderately diverse condition in the downstream site in the wet season.

Table 1.36: Phytoplankton species and Shannon diversity index values of Yamar Creek downstream site in the wet season

Sr. No.	Species	Proportional abundance(Pi)	Shannon Diversity Index Value ∑si=1(Pi)(Log2 Pi)
1	*Synedra affinis*	0.131736527	
2	Synedra acus var. angustissima	0.125748503	
3	*Spirogyra protecta*	0.089820359	
4	Treubaria crassispina	0.089820359	
5	*Spirogyra microspora*	0.071856287	
6	*Planktothrix raciborskii*	0.071856287	
7	*Oscillatoria laete-virens*	0.065868263	
8	Synedra acus var. radians	0.053892216	
9	*Diatoma elongaum*	0.041916168	
10	*Staurastrum leptopus*	0.041916168	
11	*Spiroyra prolifica*	0.041916168	
12	*Rhizoclonium hieroglyphicum*	0.035928144	
13	*Spirogyra cylindrospora*	0.02994012	
14	*Lyngbya martensiana*	0.02994012	
15	*Dinobryon divergens*	0.017964072	
16	*Ulothrix tenerrima*	0.017964072	
17	*Spirogyra azygospora*	0.011976048	
18	*Lyngbya truncicola*	0.011976048	
19	*Lyngbya contorta*	0.011976048	
20	*Phormidium ambiguum*	0.005988024	
			3.95036096

APPENDIX 2 – TERMS OF REFERENCE FOR AQUATIC SURVEYS

APPENDIX F

Baseline Study – Socio Economic

Prepared by EMC

Knight Piésold CONSULTING

Socio-Economic Aspects of the Letpadaung copper mining project

General aspect

The villages that are closed to the project site were studied for their socio-economic status and to get their opinions towards the project. Almost all of the studied villages are from potential project affected areas. Most of the villages which are more closed to the project site are small in household number and population size (Table 1). The data were recorded based on the information given by the Heads of the villages, which may vary from the secondary data. A total of 215 interviewees from 15 villages were used in the interview survey. Out of the total interviewees, 90 are males and 125 are females.

Table 1 Household numbers of the potentially project affected villages

No.	Village	Township	Distric	No. HH	Population
1	Phaung Kar (N)	Sarlingyi	Monywa	200	1200
2	Taung Pa Lu	Sarlingyi	Monywa	170	867
3	Kyaw Ywa	Sarlingyi	Monywa	110	650
4	Wet Hmae	Sarlingyi	Monywa	52	250
5	Kan Taw	Sarlingyi	Monywa	97	582
6	Wet Hmae (New)	Sarlingyi	Monywa	62	350
7	Sel Tal	Sarlingyi	Monywa	30	180
8	Zee Taw (New)	Sarlingyi	Monywa	67	350
9	Phaung Kar (Mid)	Sarlingyi	Monywa	157	628
10	Phaung Kar (S)	Sarlingyi	Monywa	67	450
11	Moe Gyo Pyin (S)	Sarlingyi	Monywa	160	700
12	Moe Gyo Pyin (Mid)	Sarlingyi	Monywa	110	550
13	Doon Taw	Sarlingyi	Monywa	325	1600
14	Kan Kone	Sarlingyi	Monywa	3881	656
15	Hta Naung Kone	Sarlingyi	Monywa	575	115
	Total			6063	9128

Majority of the people in the project area are farmers (43%) (Fig.1) and followed by waged labor and others. Most of the waged laborers are noted as seasonal workers employed during the cultivation seasons of rice, sesame, beams and peas. Some of the waged laborers work in other sectors operated in Monywa city. Two per cent of the respondents are found as government staff.

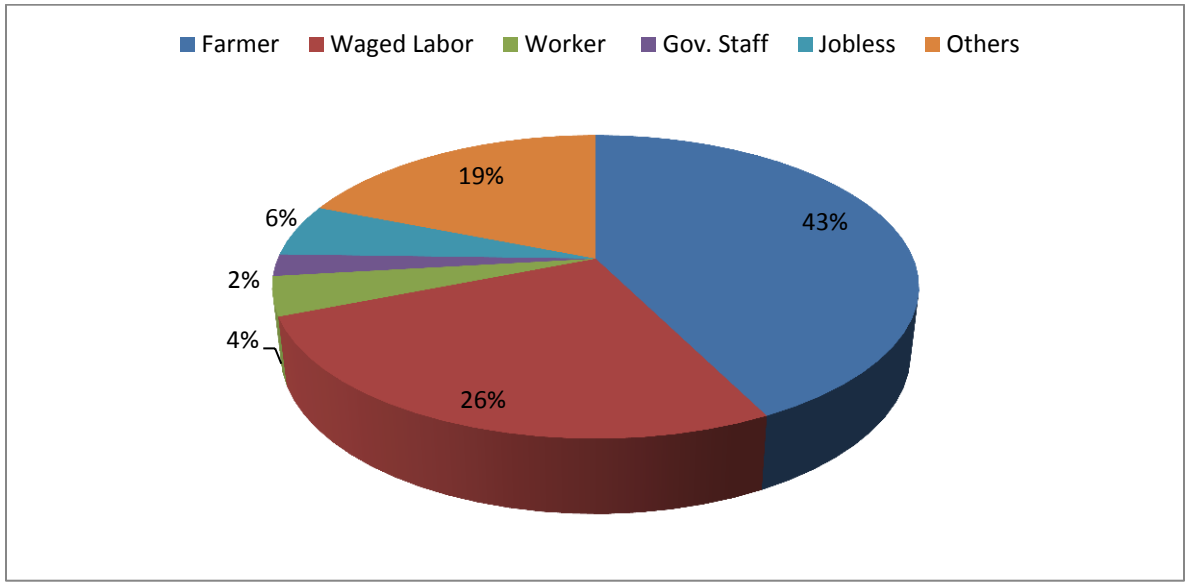


Fig. 1 proportions of occupation among the respondents

Level of Education

Level of education is an important factor for the community in all aspects like improvement of livelihood, health, sanitation, conceptual thinking and personal behavior etc.. Based on the interview survey, 5 categories can be as education levels; Illiterate, Primary and monastic school level, Middle school level, High school level and graduate levels. The results showed that 71.6 per cent of the total respondents had primary or Monastic school level education, 11.6 per cent is high school level, 9.8 per cent is middle school level, and 1.9 per cent is illiterate (Fig.2). Among the respondents, 5.1 per cent are found as graduates from different Universities.

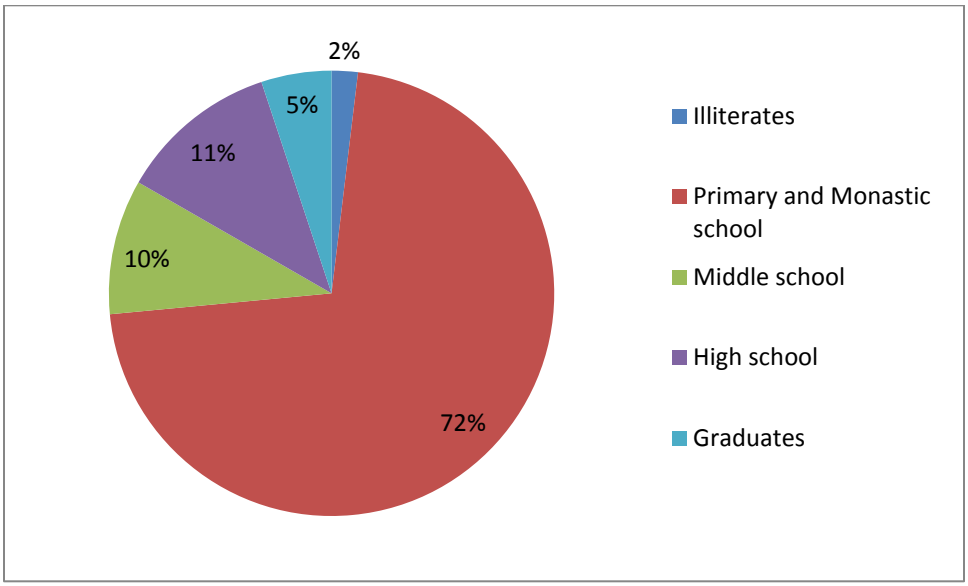


Fig.2 Education levels of the respondents

Health problems and Treatment

In the studied community, most people suffer from hypertension and second most is general sickness due to bacterial infection and gastro-intestinal diseases because of the limited knowledge in health and poor sanitation facilities. Some villages have rural health clinic which are opened in weekly basis. Most of the sickness recorded from the health assistance and

midwifes are common cold, cough, headache, and dizziness. Pregnant women and children are also paid attention by the mobile government health service team. Eighty percent of the respondents also said that medical mobile team from Yantse and Wanpaung projects also visit the villages to give necessary assistance for health (Fig 3). Most villagers mainly depend on the private drug store and private health clinic to solve their health problems. If they suffer serious illness, they are admitted to Monywa hospital or private clinics located in Monywa city. Sometimes the villagers visit the Township Hospital located in Mine Town of the Yantse copper mine project, which was established since the time of Government-Yugoslav joint mining project.

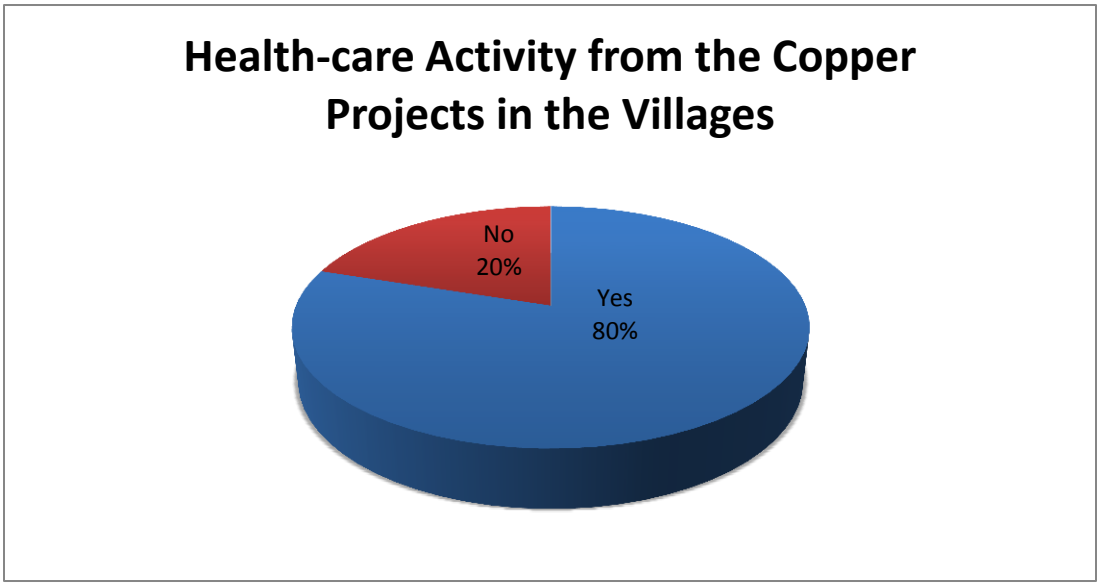


Fig. 3 Health-care activity from the copper projects, Yantse and Wanpaung

Solid waste and waste water system

In the nearby project area, solid waste management is not focused by the people due to inadequate knowledge. The villages have not access to the improved sanitation facilities. Only a few numbers of the houses have fly-proof toilet system showing the lack of improved sanitation system within the community.

Drinking water system

Source of the water and drinking water systems is mainly from the rain-fed weir/dam and shallow wells (Fig.4). A few numbers of tube-well are also observed in some villages. Some villages like Phaunga, and Mogyobyin depend on rain water which is kept in Phaunga weir and sub-earthen pond near the villages. There are three weirs at southern part of the project site, which keep the rain water during wet season and the kept rain water is used both for cultivation and for daily usage of the villagers.

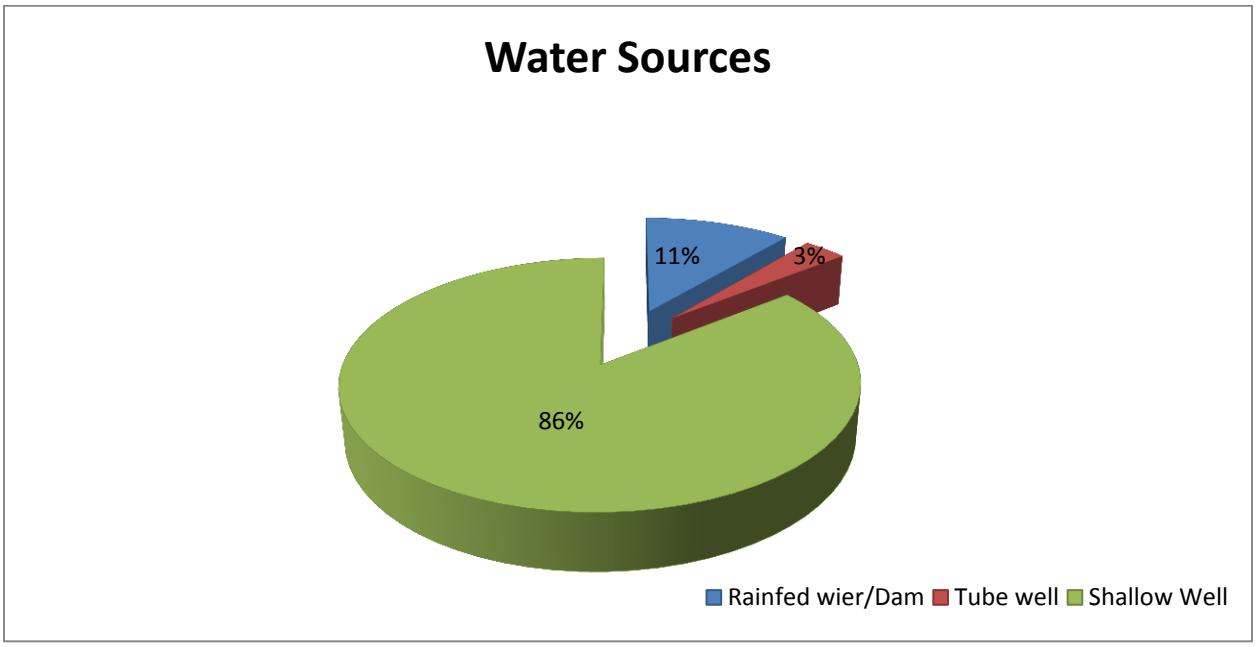


Fig.4 Used water sources of the community

Ethnicity and Religion

Most of the villagers in the community are Bamar, and thay all believe in Theravada Buddhism. At least a Monastery is established in every village. A meditation center exists near the project site and one historical temple and monastery exist within the Letpadaung project site. Tradition and culture of the community are closely related to the Buddhism and the attitude and concept on the current life are based on the religion and education level of the people.

Basic Infrastructure and Social Facilities

Taungbalu, Kyawywar and some villages have access to electricity in the area, but some villages like Moegyobyin have no access to electricity. Although there is an access to electricity, some households cannot afford to use the electricity due to the constraint of their insufficient income. Around 11 per cent of the households have own shallow wells, which is used for general house work and for drinking. But most of the shallow wells have water shortage in hot dry season. Some shallow wells of the villages, e.g Taungbalu village, which are closed to the Letpadaung project site cannot provide good quality water because the aquifer may be connected to the underground mineral sources of the Letpadaung hills. In this case the villagers use the water from the tube-wells which exist closely to the seasonal flooded lake and the tube well has relatively large depth in meters.

Resources in the project area

The important natural resources that people utilize are mainly from the Letpadaung hills, which provide fuel wood, and vegetables from natural vegetation, medicinal plants and herbs and grass as cattle feed. During wet season, some families generate the income by seasonal fisheries. Some villagers also hunt the small animal like Myanmar hare at the Letpadaung hills. Bamboo

shoots, mushroom and some medicinal herbs form the Letpadaung hills are collected by the villagers for their consumption and also for the local market to generate family income.

Existing Socio-Economic Conditions

The villages located closed to the Letpadaung copper project were focused in the interview survey. The people from these villages are project affected people (PAPs), which have also right to give their view, opinion, and comments on the project since major development project like copper mining project has to perform in sustainable manner balancing the economy, environment and social security.

To understand their existing situation, attitudes and opinion towards the project are examined by interview survey and using questionnaires. The questionnaires cover the basic information, economy, education, occupation, perception and health.

Basic information

Almost all of the people from the surveyed villages are Bamar nationality. They speak Myanmar language as mother language and Buddhism is their religion in the whole community. The household has relatively large family size, varied from 4 to 9 persons. More than half of them are within an average of 4-6 size. The ratio of males to females shows the female bias ratio.

A total of 131 respondents are in the age group of over 40 years while the rest of them are under 40 years of age. The youngest respondent is 17 and the oldest respondents are over 70 of age. As the ages of the respondents varied, the education levels were also in different levels.

In terms of education, most of the interviewees finished primary school and monastic education. A few numbers of the people have higher education level and very few number of the people are illiterates.

Housing condition

Types of house are 1-storey house constructed with mixed bamboo and palm leaves (House/Home Type 1), 2-storey house constructed with wood and roofed with GI sheets (House/Home Type 2) and 2-storey house constructed with brick and wood and roofed with GI sheets (House/Home Type 3) (Fig. 5), where the house yards are different even in a single village. Average house size is 20'x50', 30'x60' and 40'x60'. Most of their houses are constructed by wood, bamboo and palm leaves. A few numbers of houses are constructed using brick. Banana, mangoes, papaya, lemon and guava trees are normally grown in the yards.

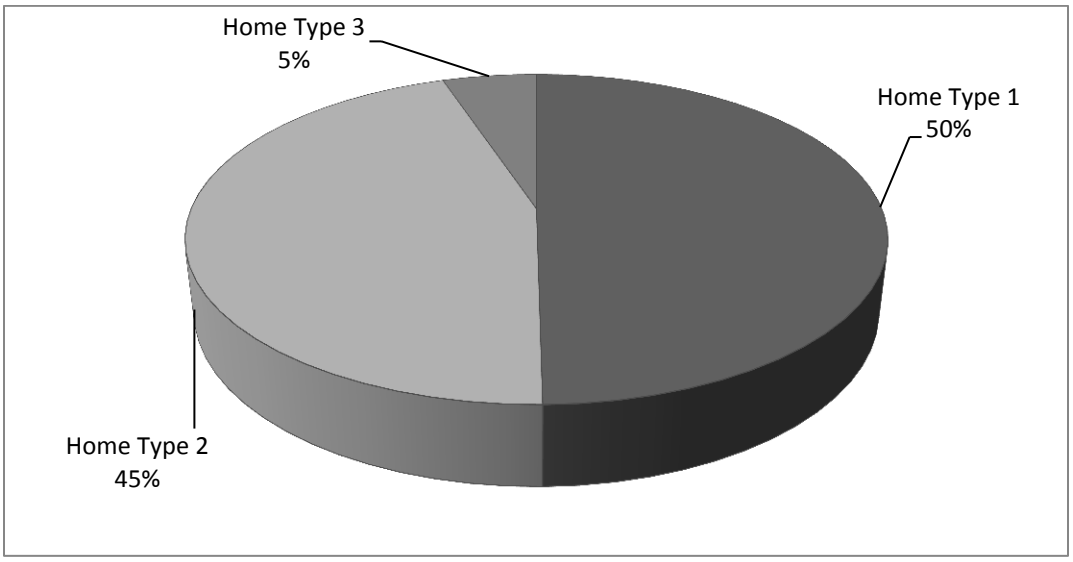


Fig. 5 Proportions of the three different house types

Most of the respondents said they have drinking water problem in the community. Water shortage problem mainly occurs in hot dry season. More than 90 to 99 percent of the households of the villages have toilets, but only 80 per cent of the toilets are improved or fly-proof toilets. Most of the families own bicycles, motorcycles, and almost all families have radio units.

Economic conditions of the household

Occupation and sources of income

Most of the villagers are relying on the agriculture; where most of the agricultural lands are lost due to the copper mine project because most of the lands are located around the Letpadaung copper mining project. The sizes of agricultural lands of the locals are different in size normally from 0.5 to 4 hectares. Cultivated crops include rice, sesame, peas, beams, sunflower, and vegetable like cabbage and chili.

Economic conditions

Agriculture is major concern of the main occupation of the people living around the project site and in all project affected villages. Some villages have livestock breeding like goats and sheep. The range of total annual income is about 12-30 lakh kyats per household (one lakh=100,000 kyats) (Fig. 8), while the average expenses are nearly the same as the income rate, which shows their poverty and living status. An average land holding size is 0.5-4 hectares per farmer.

Beside cultivation, the people work for daily wages in various sectors in the area, which also include agriculture. Some people raise the cattle like cows, sheep and goats. Cattle are also used in land preparation of the farms. For family consumption, some families breed chickens, and pigs.

In wet season, some villagers earn their living harvesting the fishes in the flooded areas of the Chindwin River and in some creeks like Yama and other small creeks. A few numbers of the peoples are found as government workers and some are employed by the Yantse copper mining project and Wanpaung copper mining project (Fig. 1).

Income Level

Income level is different from place to place and from village to village (Fig. 6). Findings of the interview survey show that monthly income of respondents ranges from 1-3 lakhs of kyats in the studied villages (Fig. 7).

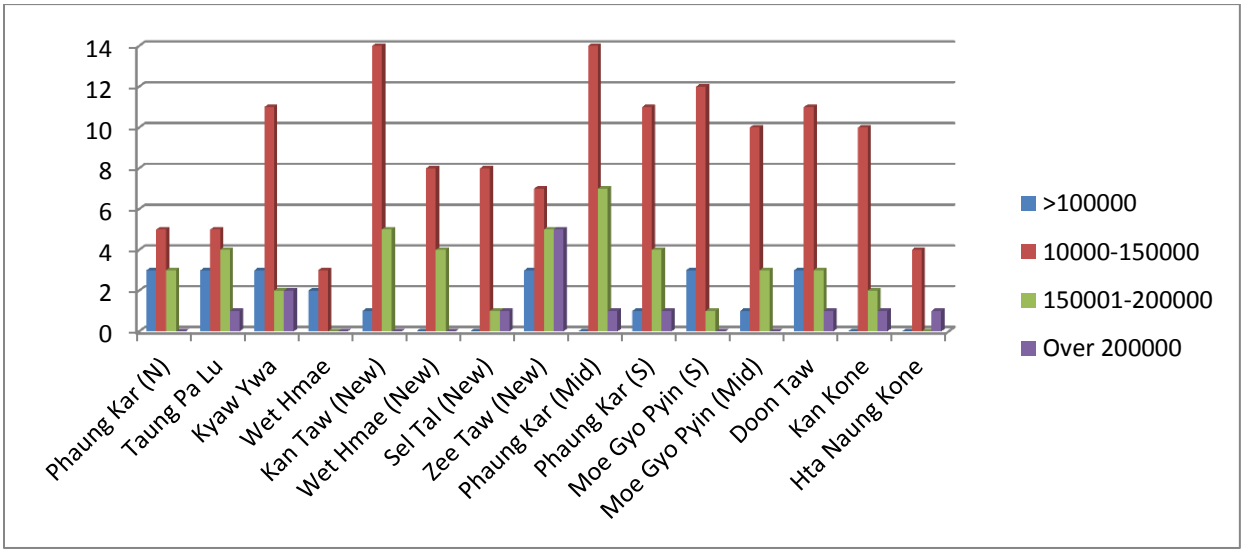


Fig.6 Monthly income levels of the surveyed villages

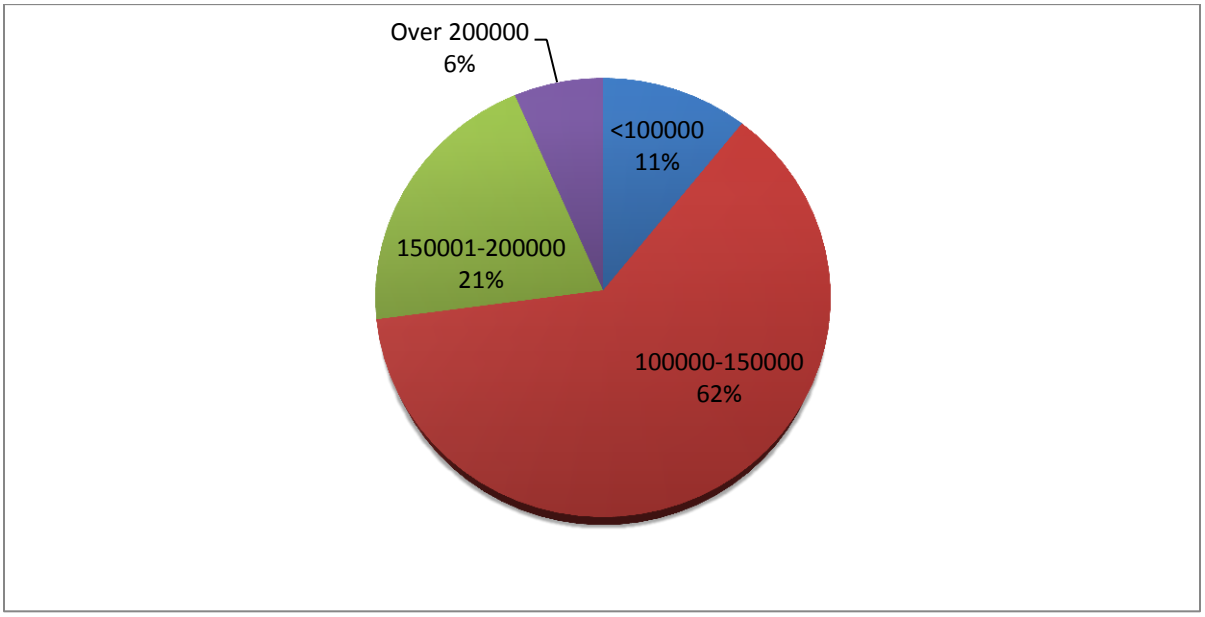


Fig.7 Proportions of groups of monthly income ranges

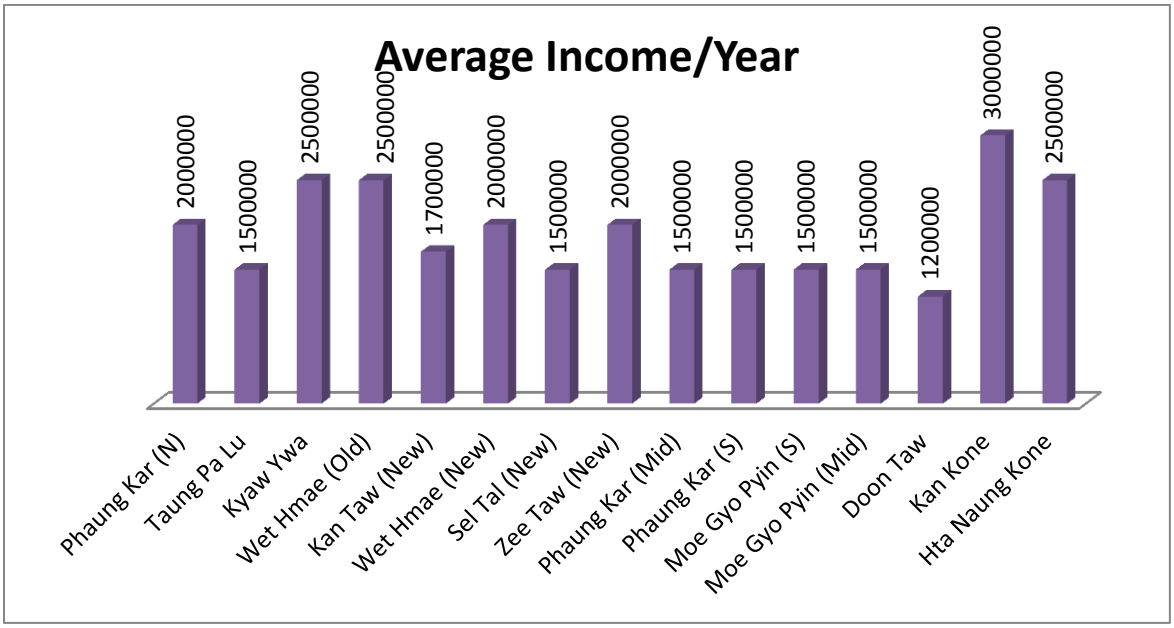


Fig.8 Annual income levels of the surveyed villages

Expenditure

Almost all respondents said that their incomes are not adequate for the livelihood of the families and they are living with many constraints in daily life.

Sufficiency of Income

They use almost all of their monthly income and some families have to borrow the money in some cases like in health problems. Therefore some people are living in debt waiting the better job opportunity.

Satisfaction with existing living conditions

Most of the people said that they have to be satisfied with the present conditions although they are trying to improve the livelihood and infrastructure as their best. But they are worried with the unforeseen adverse impacts of the Letpadaung copper mining project.

Opinions towards the project development

Fifty two per cent of the people from the surveyed villages, particularly from the villages which are closed to the project site, do not like the project because they are worried on the adverse impacts of the project related to soil contamination, air pollution and noise and dust problems (Fig.9). The villagers from Kyawywa village make complaint on the dust problems; they said the wind carry the dusts from Letpadaung mining site to Kyawywa. The farmers, who lost their land due to the copper mining project, seriously disagree with the copper mining project. The villagers, who live in village which is relatively far from Letpadaung copper mining project like Htanaunggone village, said that they have no comments and would like to stay in neutral line. Forty six per cent of the respondents stay in neutral line (Fig. 9). Some families of the surveyed villages rely on the Letpadaung hill because they collect the vegetables and medicinal plants and send to the markets for their family incomes; they also collect the bamboo shoots, mushrooms and other edible herbs for family consumption. These factors are also why they don't like the copper mining project, which give indirect negative impacts on their families.

The common opinion on the Letpadaung copper mining project is that if the project has to be anyway constructed and operated, they expect the jobs from the project and if available jobs are not adequate for the locals, government and Wanpaung company should create other possible job opportunities for the locals, and Chinese workers should be replaced with Myanmar people. The villagers are also worried from the likely shortage of water sources in the long term operation of the copper mining project, and wish government and the Wanpaung to take precaution measures for the social security of the community.

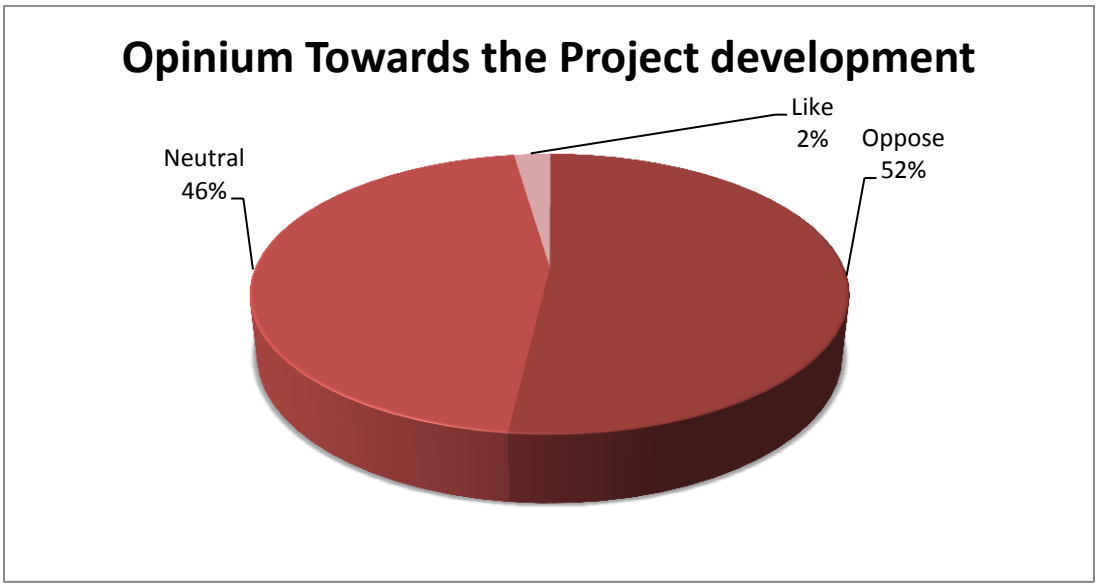


Fig. 8 Proportions of the respondents showing their opinion towards the project

Recommendation and Mitigation measures

The findings reveal possible problems of direct and indirect impacts on the community of the Letpadaung project. Direct impacts are concerned with the loss of farmland, potential noise, dust and air pollution problems. Revegetation plan should be undertaken to establish the buffer zone to prevent the impacts like noise and dust. Soil and water conservation are also important issues among the local people. Long-term plan should be drawn for the access to improved water within the community.

Indirect impacts are concerned with natural resources available from Letpadaung hills, which play important role for the livelihood of some local families, who extract the vegetables, medicinal plants and other edible herbs for family consumption and also family income. More job opportunity should be created for these families. Effective Coporate Social Responsibility (CSR) programme should be extended in the community.

To compensate the loss of natural vegetation of Letpadaung hills and to conserve the ground water, nearby watershed areas and watershed hills like Khamauk-taung, Kyadwin-taung, Hninsi-taung, Phowun-taung and other hill rages should be managed by revegetation.

APPENDIX G

Socio Economic Survey Data Sheets

To be provided by EMC

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APPENDIX H

Health Table

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Appendix H Table 1: Disease prevalence in the villages near the Project area (number or presentations in para).

Village Tract	Village Name	Viral Infections	Hypertension	Arthritis	Gastric Diseases	Skin complaints	Respiratory Diseases	Vitamin Deficiency	Eye Diseases	Dental Diseases	Female Issues
Moe Gyoe Pyin	Moe Gyoe Pyin No	7.5 (48)	13.8 (88)	7.4 (47)	3.4 (22)	3.4 (22)	2.0 (13)	1.4 (9)	0.78 (5)	0.78 (5)	0.78 (5)
	Moe Gyoe Pyin So	1.4 (10)	4.1 (29)	1.1 (8)	2.1 (15)	0.86 (6)	1.0 (7)	2.9 (20)	1.1 (8)	0.0 (0)	0.14 (1)
	War Dan	41.5 (263)	15.8 (100)	10.4 (66)	16.1 (102)	7.6 (48)	5.7 (36)	4.7 (30)	1.6 (10)	4.4 (28)	2.5 (16)
	Phaung Kar No	15.8 (99)	20.1 (126)	15.1 (95)	5.4 (34)	5.3 (33)	1.6 (10)	5.1 (32)	3.2 (20)	1.9 (12)	1.1 (7)
	Phaung Kar Ce	7.1 (85)	2.3 (27)	3.1 (37)	2.8 (33)	1.5 (18)	1.1 (13)	0.33 (4)	1.7 (20)	1.6 (19)	0.33 (4)
	Phaung Kar So	1.3 (6)	4.2 (19)	2.2 (10)	0.44 (2)	0.0 (0)	1.1 (5)	2.0 (9)	0.89 (4)	0.0 (0)	0.44 (2)
Doon Taw	Doon Taw	30.9 (495)	6.6 (105)	7.9 (122)	6.3 (100)	6.1 (98)	6.1 (98)	2.3 (36)	1.6 (26)	1.4 (23)	10.0 (16)
	Ywar Thar Ywar	82.8 (318)	19.0 (73)	25.3 (97)	18.8 (72)	15.1 (58)	7.3 (28)	7.6 (29)	4.9 (19)	8.1 (31)	5.2 (20)
Shwe Pan Khaing	Shwe Pan Khaing	14.0 (118)	16.8 (142)	7.8 (66)	5.1 (43)	3.6 (30)	3.7 (31)	3.8 (32)	3.3 (28)	1.8 (15)	2.1 (18)
	Tal Pin Kan	32.3 (140)	27.9 (121)	16.2 (70)	18.5 (80)	9.7 (42)	8.1 (35)	5.3 (23)	6.7 (29)	4.4 (19)	6.2 (27)
	The' Taw Gyi	8.7 (32)	26.1 (96)	10.1 (37)	6.5 (24)	6.0 (22)	2.2 (8)	3.0 (11)	2.7 (10)	1.6 (6)	3.0 (11)
Taung Palu	Taung Palu	15.5 (134)	7.2 (62)	3.2 (28)	5.8 (50)	1.6 (14)	5.2 (45)	1.4 (12)	1.0 (9)	1.4 (12)	1.6 (16)

Village Tract	Village Name	Viral Infections	Hypertension	Arthritis	Gastric Diseases	Skin complaints	Respiratory Diseases	Vitamin Deficiency	Eye Diseases	Dental Diseases	Female Issues
	Kyaw Ywar	3.8 (25)	4.0 (26)	1.1 (7)	2.0 (13)	0.92 (6)	0.77 (5)	0.31 (2)	0.46 (3)	1.2 (8)	0.15 (1)
Paung Ga Da	Phaung Kadar S.	9.6 (93)	10.8 (104)	9.1 (88)	5.8 (56)	2.5 (24)	2.8 (27)	1.9 (18)	3.1 (30)	1.5 (14)	1.1 (11)
	Kyaut Phyu Dine	2.9 (16)	10.1 (55)	1.8 (10)	3.5 (19)	2.0 (11)	0.9 (5)	1.5 (8)	1.1 (6)	0.37 (2)	0.91 (5)
	Zee Taw & Sei Te'	4.3 (23)	5.3 (28)	2.6 (14)	5.3 (28)	1.9 (10)	1.5 (8)	2.8 (15)	1.5 (8)	1.7 (9)	0.0 (0)
Latpataung	Shwe Hlay	15.4 (41)	12.1 (32)	10.6 (28)	4.9 (13)	17.0 (45)	7.5 (20)	3.4 (9)	3.0 (8)	1.1 (3)	0.75 (2)
Ywar Shwe	Ywar Shay	4.2 (61)	8.1 (117)	4.6 (66)	1.9 (28)	1.0 (15)	0.55 (8)	0.55 (8)	1.0 (14)	0.55 (8)	0.75 (11)
	Palaung	7.9 (76)	9.2 (88)	6.4 (61)	2.6 (25)	3.7 (35)	1.3 (12)	2.0 (19)	2.2 (21)	1.4 (13)	0.31 (3)
	Wet Hmay	7.4 (26)	4.6 (16)	0.57 (2)	0.57 (2)	0.0 (0)	3.4 (12)	0.57 (2)	2.0 (7)	0.0 (0)	0.57 (2)
	Kan Daw	1.7 (10)	4.0 (23)	1.5 (9)	0.69 (4)	1.0 (6)	2.7 (16)	1.0 (6)	0.5 (3)	0.69 (4)	0.0 (0)
Ton	Lei Ti	0.71 (4)	1.6 (9)	1.8 (10)	0.5 (3)	0.89 (5)	0.36 (2)	0.36 (2)	0.5 (3)	0.0 (0)	0.18 (1)
Nyaung Pin Gyi	Nyaung Pin Gyi	4.7 (73)	8.1 (125)	3.9 (60)	1.0 (16)	1.3 (20)	0.9 (14)	0.7 (11)	1.0 (16)	0.59 (9)	0.45 (7)
	Yone Pin Yoe	3.4 (25)	4.1 (30)	4.3 (31)	1.5 (11)	0.55 (4)	0.55 (4)	0.55 (4)	0.55 (4)	0.41 (3)	2.5 (16)
	Aung Chan See	3.7 (25)	10.3 (69)	3.9 (26)	0.15 (1)	0.15 (1)	1.2 (8)	0.0 (0)	0.75 (5)	0.45 (3)	0.30 (2)

APPENDIX I

Preliminary Waste Dump Design

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT



WASTE ROCK DUMPS
PRELIMINARY DESIGN

PREPARED FOR:

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Knight Piésold
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MYANMAR WANBAO MINING COPPER LTD (MWMCL)

LETPADAUNG COPPER PROJECT

WASTE ROCK DUMPS

PRELIMINARY DESIGN

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EXECUTIVE SUMMARY

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake preliminary design of the above-surface waste rock dumps for the proposed Letpadaung Copper Project. The Letpadaung Copper Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit.
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

Knight Piésold (KP) conducted a review of the waste rock dump development plan proposed by MWMCL, while considering the acid generating potential of the rock mass to estimate the potential for acid rock drainage and metal leaching from the dumps. Specific aspects addressed in this report include the following:

- Site characteristics including setting, climate and seismicity;
- Geotechnical conditions at the waste dumps;
- Waste characterization methodology and results;
- Principals of surface and storm water management, including rock drains, diversion channels, water collection and sediment control measures;
- Layout and design features of the waste dumps, including the incorporation of PAF waste within the dumps;
- Waste dump stability;
- Operation and monitoring considerations;
- Reclamation and closure.

Note that this report only considers the above-ground disposal of waste rock. In-pit disposal is addressed separately by MWMCL.

The main conclusions of the work are:

i. Geotechnical conditions in the proposed waste dump areas are poorly understood due to a lack of site investigation. Preliminary stability analyses

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using available data have not shown any significant issues under static loading conditions, but further investigation is needed to confirm design assumptions.

ii. Simplified pseudostatic analyses show that stability during Operational Basis Earthquake (OBE) and Safety Evaluation Earthquake (SEE) seismic events is marginal. These loading cases need to be analysed in more detail using more advance methodologies such as FLAC or PLAXIS software.

iii. Data on the physical and geochemical properties of the waste are limited and further investigation of the open pit area is needed to confirm design assumptions.

iv. The available data suggest a significant acid-generating and metal leaching potential for a large proportion of the waste that will be produced. The PAF and metal leaching waste will need to be encapsulated during operations with intermediate and final engineered covers comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The final encapsulation material will need to be covered by a store and release cover constructed from benign waste or borrow material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the low permeability cover.

v. The data collected to date on composition of waste suggests a high proportion of PAF and metal leaching and a small quantity of NAF will be generated. This may result in a shortfall of materials for encapsulation of wastes and for construction of the closure cover system. A materials balance based on up-to-date site investigation is urgently needed as materials may need to be borrowed from the footprints of the heap leach pads and/or the waste rock dumps prior to construction.

vi. There are some uncertainties regarding the ability to store the total amount of waste within the footprints currently designated when the recommendations of this report are considered and a more appropriate bulk density is adopted for waste dump design. Optimisation of storage volumes and necessary footprint areas is urgently needed.

vii. Assessments suggest the current design profile of 1V:2.5H local slopes and 1V:2.9H slopes will be geotechnically stable but that consideration needs to be given to flattening these slopes in order to reduce overall life of mine costs as

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construction of the cover system and rehabilitation costs will increase significantly for local slopes steeper than 1V:3H.

The waste dump design now needs to be progressed to detailed design. In order to achieve this we make the following recommendations:

i. Undertake site investigations in the WRD foundation areas to assess geotechnical properties.

ii. Update the stability analyses with the new data and undertake a more detailed analysis of performance under SEE loading conditions using FLAC or PLAXIS software.

iii. Undertake site investigations around the site to identify construction material resources and prepare a materials balance for the site.

iv. Additional geochemical assessment should be conducted to better quantify the amount of potentially acid-generating and/or metal-leaching material which will be encountered during the first year(s) of operations to allow detailed waste management planning.

v. Undertake kinetic testing of waste rock samples to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.

vi. Agreement on the final land use of the WRD areas after closure to facilitate construction of the dumps consistent with the agreed end land use to reduce closure costs.

vii. Complete an optimisation of the WRD design that incorporates encapsulation of PAF and metal leaching waste, addresses issues with final land use, appropriate slope angles and potential construction materials shortfall, and provides a suitable footprint layout within the site constraints.

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1. INTRODUCTION

1.1 LOCATION AND PROJECT DESCRIPTION

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake preliminary design of the above-surface waste rock dumps for the proposed Letpadaung Copper Project. The Letpadaung Copper Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit; and
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

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1.2 SCOPE

The overall site general arrangement plan, including locations, footprints and volumetric determinations of the proposed waste rock dumps, has been prepared by MWMCL. The preliminary layout for the dumps is shown on Figure 1.1.

Knight Piésold (KP) conducted a review of the waste rock dump development plan proposed by MWMCL, while considering the acid generating potential of the rock mass to estimate the potential for acid rock drainage and metal leaching from the dumps. Specific aspects addressed in this report include the following:

- Site characteristics including setting, climate and seismicity;
- Geotechnical conditions at the waste dumps;
- Waste characterisation methodology and results;
- Principles of surface and storm water management, including rock drains, diversion channels, water collection and sediment control measures;
- Layout and design features of the waste dumps, including the incorporation of PAF waste within the dumps;
- Waste dump stability;
- Operation and monitoring considerations; and

- Reclamation and closure.

As a preliminary design, this report considers the main design principles to address physical and chemical stability and makes recommendations for further work considered necessary to complete a detailed design. Incorporation of these design features into the overall waste dump design with optimisation for stored volume is the responsibility of MWMCL.

Note that this report only considers the above-ground disposal of waste rock. In-pit disposal is addressed separately by MWMCL.

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2. SITE CONDITIONS

2.1 CLIMATE

2.1.1 General

A complete baseline design climatology study (KP Ref. PE13-00538, included as Appendix A) was conducted prior to the preparation of this report in order to define the preliminary hydrologic basis for on-going and future design work. The following sub-sections outline key results from this previously released document. For additional details, please refer to Appendix A.

2.1.2 Data Sources

Four different sources of historic climate data were used to derive baseline design climate estimates:

- Daily historic data spanning the period (1961-2013) from the Monywa Township climate station, located 5.6 km northeast of Letpadaung Hill, was employed for deriving precipitation estimates;
- Monthly historic pan evaporation data spanning the period (2000-2013) from the Yangtse climate station, located 7.6 km northwest of Letpadaung Hill at the Sabetaung and Kysintaung (S&K) operations site was employed for deriving evaporation estimates;
- Daily temperature data spanning the period (1981-2012) from the World Meteorological Organization (WMO) climate station number 48037, located 4.7 km northeast of Letpadaung Hill was used for determining temperature normal; and
- Hourly wind speed, wind direction and precipitation data spanning the period (2010-2012) derived from the MM5 (5th generation Mesoscale Model) and SAMSON hourly surface meteorological datasets at a sampling location 0.9 km northwest of Letpadaung Hill was used for characterisation of prevailing wind normals and in developing precipitation temporal distributions.

2.1.3 Precipitation

The historic precipitation dataset was aggregated on annual and monthly time scales and used to compute sampling statistics to define normal precipitation patterns at Letpadaung Hill. The resulting normal pattern of monthly precipitation is presented in Table 2.1.

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Table 2.1: Monthly precipitation statistics – Monywa Township (1961-2013)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)	Average # of Rain Days*1
Jan	2	0	6	0	31	0
Feb	3	0	15	0	102	0
Mar	5	1	14	0	96	1
Apr	26	21	22	0	100	4
May	102	94	70	12	386	9
Jun	100	72	79	0	342	9
Jul	67	59	43	2	182	8
Aug	121	103	80	0	356	10
Sep	166	150	89	47	496	11
Oct	142	136	95	15	513	10
Nov	33	12	44	0	186	3
Dec	6	0	17	0	85	1

*1 Incomplete data from 1995 (Jan – Jun), 1999 (Jan – Apr) and 2013 (Jun – Dec) were excluded from this analysis.

Annual average precipitation is 774 mm, normally occurring over 65 rain days each year. The wet season lasts for six months, from May through the end of October. The wettest month of the year is September (166 mm on average) and the driest is January (1.9 mm on average).

Intensity / Frequency / Duration (IDF) relationships were determined from the dataset. The results are provided in Table 2.2.

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Table 2.2: Letpadaung intensity / frequency / duration results

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm							
	2	5	10	20	50	100	200	500
5 min	157	205	235	262	295	319	341	369
10 min	128	167	192	214	241	260	279	302
15 min	109	142	163	182	205	221	237	256
30 min	76	99	114	127	143	154	165	178
1 h	49	63	72	81	91	98	105	114
2 h	29	38	43	48	55	59	63	68
3 h	21	28	32	35	40	43	46	50
6 h	12	16	18	20	23	24	26	28
12 h	7	9	10	11	13	14	15	16
18 h	5	6	7	8	9	10	10	11
24 h	4	5	6	6	7	8	8	9
48 h	2	3	3	4	5	5	6	6
72 h	2	2	3	3	4	4	5	6

2.1.4 Evaporation

The historic evaporation dataset was aggregated on annual and monthly time scales and used to compute sampling statistics. The resulting normal pattern of monthly evaporation is presented in Table 2.3.

Table 2.3: Monthly pan evaporation statistics – MYTCL climate station (2000-2006)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)
Jan	123	121	5	119	134
Feb	149	151	13	130	166
Mar	210	213	14	188	224
Apr	228	236	21	191	248
May	202	205	43	118	256
Jun	203	187	36	165	270
Jul	172	174	12	153	187
Aug	184	175	38	133	248
Sep	160	150	27	128	208
Oct	145	148	27	102	184
Nov	125	130	17	102	146
Dec	117	112	12	98	131

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Annual average lake evaporation is estimated at 1,412 mm, which assumes a pan coefficient of 0.7 applied to calculated annual average pan evaporation (2,017 mm).

2.1.5 Comparison of Precipitation and Evaporation

Average monthly values of precipitation and pan evaporation were compared to determine if the site is expected to run under annual water surplus or deficit conditions. The comparison is provided in Table 2.4.

Table 2.4: Comparison of monthly average precipitation and evaporation

Month	Ave. Precipitation (mm)	Ave. Pan Evaporation (mm)	Ave. Lake[*1] Evaporation (mm)	Precip. minus Pan Evap. (mm)
Jan	2	123	86	-121
Feb	3	149	105	-146
Mar	5	210	147	-205
Apr	26	228	160	-202
May	102	202	142	-100
Jun	100	203	142	-103
Jul	67	172	121	-105
Aug	121	184	129	-63
Sep	166	160	112	6
Oct	142	145	101	-3
Nov	33	125	87	-92
Dec	6	117	82	-111
Totals	773	2,017	1,412	-1,344

*1 Assumed pan coefficient = 0.7.

As Table 2.4 clearly shows, the Letpadaung site is expected to run a strong water deficit on average. The only month where a positive balance is indicated is September.

2.1.6 Temperature

The historic temperature dataset was aggregated on annual and monthly time scales and used to compute sampling statistics. The resulting normal pattern of monthly average temperature is provided in Table 2.5.

Table 2.5: Monthly average temperature statistics – WMO 48037 station (1981-2012)

Month	Average (°C)	Median (°C)	Std. Dev. (°C)	Min. (°C)	Max. (°C)
Jan	21.9	21.9	1.9	18.4	28.0
Feb	24.0	23.6	2.3	21.1	32.9
Mar	28.1	28.0	2.3	23.1	35.5
Apr	30.9	30.9	1.4	25.9	33.1
May	31.0	31.0	1.4	28.1	33.8
Jun	30.6	30.5	1.1	27.8	32.9
Jul	30.5	30.8	1.2	26.8	32.5
Aug	29.9	29.8	1.0	28.4	32.1
Sep	29.3	29.3	0.7	27.8	30.4
Oct	28.0	28.0	0.7	26.5	29.8
Nov	25.1	25.3	1.1	23.0	27.6
Dec	22.2	22.0	1.9	18.4	28.0

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2.1.7 Wind

The wind speed and direction dataset was analysed statistically using WindRose Pro 3.01 software to produce a series of wind rose plots for the Letpadaung site.

Winds generally blow from the North (0°) to North by Northwest (337.5°) at an average speed of 3.0 m/s, with a maximum speed of 9.2 m/s. These correspond to Beaufort scale readings of 2 “light breeze” to 5 “fresh breeze”. The direction the wind blows from tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Available data indicates that high wind storms are unlikely at the Letpadaung site.

Seasonal variability was also considered. The dataset was divided into the Wet (May through October) and Dry (November through April) Seasons. During the Wet Season, winds generally blow along the North / South cardinal directions, with the preponderance of statistical data suggesting that winds blow from the South (180°) to South by Southeast (157.5°). In the Dry Season, the wind blows predominantly from the North (0°) to North by Northwest (337.5°).

2.2 SURFACE WATER

2.2.1 Water Source

The Chindwin River lies approximately 3 km east of the Letpadaung deposit, with a maximum flow rate of 24,850 m^3/s and an average flow rate of 3,860 m^3/s. The river depth ranges from 1.5 to 10.25 m with an average depth over the year of 5 m. The 20-year flood water level is RL75.1 m and 100-year flood water level is RL75.65 m.

2.2.2 Water Quality

Water quality in the Chindwin River changes over the course of the year. Table 2.6 presents a series of water quality indicators monitored during various months over the year 2000.

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Table 2.6: Water quality monitoring data – Chindwin River (Muir, 1997)

Month	Temp. (°C)	Total Dissolved Solids (mg/l)	Total Suspended Solids (mg/l)	Total Hardness (mg/l)	Dissolved Oxygen (mg/l)	$CaCO_3$ (mg/l)	Sulphate (mg/l)	Ca (mg/l)	Mg (mg/l)
Feb	22.6	146.7	70	90	3.8	107.4	9.2	18.5	10.7
May	34.5	186	11.9	93	-	113	4.8	18.5	11.3
Jun	29	399	1,438	-	4.2	51.6	6.0	21	-
Aug	30.6	98	404	58	3.5	43	2.0	11.6	7
Nov	28.4	79	528	43	3.3	57	10	10.3	4.2
Dec	21	117	190	85	4.6	90	2.4	19.1	9

The results indicate that the indices are generally stable (except water turbidity which increases markedly in the rainy season) and meet the surface water standard of class IV water[1], and as such can be used for common industrial purposes.

2.3 GEOLOGY

The Project comprises four copper deposits distributed in a north-west direction among which Sabetaung, Sabetaung South and Kyisintaung are located in close proximity to one another. The Letpadaung deposit is located 7 km to the southeast of the Sabetaung deposit, and is the largest one of the four deposits (Figure 2.1).

The Project is located along an Inner Volcanic Arc within the Central Myanmar Subsidence Belt in Late Tertiary pyroclastics and late stage andesite dacite on the western flood plain of the Chindwin River. The deposits are high sulphidation copper deposits formed by weathering, leaching and supergene enrichment of porphyry copper ores. Mineralisation is hosted by dykes and sills of porphyritic biotite andesite and minor dacite, by minor rhyolite dykes and by the folded Upper Pegu Group. The predominant copper sulphides are chalcocite, and digenite with subordinate covellite invariably accompanied by pyrite. Mineralization extends downwards from the base of oxidation to a depth which locally exceeds 540 m at Letpadaung. The Letpadaung deposit is overlain by a barren leached cap that is locally 200 m thick and forms hills rising to 185 to 249 m above the plain[2].

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[1] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.
[2] Mitchell. A.H.G.. Win Myint, Kyi Lynn, Yint Thein Htay, Maw oo, and Thein Zaw (2008) The Monywas Copper Deposits, Myanmar: Chalccite-covellite Veins and Breccia Dykes in Late Miocene Epithermal System. Proceedings of the International Symposia on Geoscience Resources and Environments of Asian Terranes (GREST 2008), 4th IGCP 516, and 5th APSEG: Nov 24-26 2008, Bangkok, Thailand.

At the Letpadaung deposit there are numerous faults predominantly striking northeast and northwest (Figure 2.2). Mineralisation and hydrothermal alteration is significantly controlled by faulting[3]. The main faults are the Chindwin Basic Fault (F1), the Monastery Fault (F2), and secondary interconnecting faults f1, f2, f3 and f4. The Monastery Fault (F1) bounds the north eastern margin of the Letpadaung deposit and is the main ore-controlling structure. The Monastery Fault (F2) runs sub parallel to the Chindwin Basic Fault (F1) about 1.3 km to the southwest. The faults have the same hanging wall and footwall lithology with no obvious fracture zones but some sections show signs of compression fractures with significant hydrothermal alteration.

2.4 HYDROGEOLOGY AND GROUNDWATER QUALITY

2.4.1 Pre-Mining

Proposed Waste Rock Dumps 1, 2 and 3 will be located on the Chindwin River alluvial plain. The Quaternary alluvial deposits form an aquifer that is in hydraulic contact with the Chindwin River. The aquifer comprises river alluvium of medium to fine sand, sand gravel and clay. The upper part is clay, with a thickness of 4 to 6 m; the lower part is a medium to fine sand, sand gravel and cobble gravel, with a thickness of 12.1 to 50.1 m (25.7 m on average). It has high permeability and aquifer storage properties. The permeability ranges between 18.4 m/d and 43.6 m/d, with an average of 23.6 m/d (i.e. very high permeability). On the alluvial plain the depth to groundwater in the dry season ranges between 0.65 m to 19.12 m, with an average of 4.86 m. If it is continuous the upper clay layer may protect the aquifer from contamination, otherwise the shallow depth to groundwater may make it vulnerable to contamination.

Groundwater level data given in MWMCL (2011)[4] have been combined with baseline monitoring data from monitor bores installed around the heap leach pads to generate indicative groundwater level contours. The groundwater contours indicate pre-mining groundwater flow radiating out from the Letpadaung Hill and broadly from the southwest towards the north-east and the Chindwin River. The groundwater flow direction indicates that prior to mining groundwater is providing base flow to the Chindwin River.

MWMCL summarised the pre-mining surface water and groundwater quality as follows:

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[3] MWMCL, April 2011. Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.
[4] MWMCL, April 2011. Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.

- Surface Water: (Chindwin River): Water chemistry type: HCO_3-Na-Mg; salinity: about 500 mg/L; total hardness: about 160 mg/L; total alkalinity: 300 mg/L; pH: about 8;
- Quaternary Aquifer: Water chemistry type: $HCO_3 \cdot SO_4 \cdot Cl$—Ca·Mg·Na; salinity: 390 to 2,350 mg/L; total hardness: 150 to 940 mg/L; total alkalinity: 590 to 780 mg/L; pH: 7.2 to 7.4; and
- Andesite-Dacite Rock Fissure Weak Aquifer: Water chemistry type $HCO_3 \cdot SO_4 \cdot Cl$- Ca·Na·Mg; salinity: 960 to 1,878 mg/L; total hardness: 340 to 421 mg/L; total alkalinity: 20 to 144 mg/L; pH: 3.30 to 8.30. Trace metals (As, Cr, Cu, Fe and Mn) occur at higher than guideline values.

Groundwater in the alluvium is shown by Coffey[5] to contain brackish to saline (2,600 to 2,700 mg/L TDS), pH neutral, NaCl dominated water near to the mine site and is said to contain fresher water close to the Chindwin River and in association with the floodway. A sharp increase in salinity after pumping at bore LWB01 located at the foot of Letpadaung hill is consistent with a fresh water layer or lens over saline water with the freshwater lens being depleted by pumping.

Coffey also indicate the presence of strontium within the alluvium and volcanics at concentrations of between 1 and 3 mg/L.

Baseline groundwater chemistry for December 2011 (end of wet season) and February 2013 (end of dry season) collected from monitor bores around the proposed Heap Leach Pads 1 and 2 are summarised as follows:

- The groundwater samples are neutral to slightly basic ranging between pH 6.9 and 8.7 with an average value of 7.8;
- Total dissolved solids (TDS) concentrations range between fresh to saline, 1,016 mg/L to 19,386 mg/L TDS with an average value of 4,368 mg/L TDS; and
- TDS, hardness, sulphate, lead and manganese values occur above the guideline values.

In summary, the baseline groundwater chemistry beneath the Waste Rock Dumps is likely to be saline, slightly alkaline and may contain heavy metals and possibly strontium above guideline values.

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[5] Letpadaung Copper Project Feasibility Study – Water Management and Environmental Monitoring, Coffey Partners Int. Pty Ltd, Report G7024/4-A, dated February 1997.

2.4.2 Operational Phase

If continuous, the upper Quaternary clay layer may hydraulically isolate and protect the aquifer from contaminated seepage emanating from the waste rock dumps; otherwise the shallow depth to groundwater may make it vulnerable to contamination.

Mining below the groundwater table will result in a localised steepening and reversal of the groundwater flow direction towards the Letpadaung pit. Based on the current pit design the main eastern ramp will intersect the high permeability Quaternary alluvium which will result in higher groundwater inflows to the pit and a steepening and reversal of the groundwater flow direction towards the pit that will extend under the south of Waste Rock Dump 1, Waste Rock Dump 2 and Waste Rock Dump 3. It is possible that not all groundwater flowing beneath the waste rock dumps will be captured by the pit dewatering operation and that some groundwater may continue to flow northeast towards the Chindwin River. The villages of Nyaungbingyi, Gadogone and Palaung to the east of the Letpadaung deposit may have water bores/wells and are potentially at risk from changes in groundwater quality that may result from the seepage from the waste rock dumps.

2.4.3 Post Mine Closure

Following mine closure the dewatering system will be decommissioned and the Letpadaung Pit will be allowed to fill from direct rainfall, runoff from pit walls, groundwater inflows, and surface water inflows from the upslope catchment areas which will include potentially contaminated contact water from the waste rock dumps.

The pit lake water is likely be brackish to saline water affected by acid rock drainage resulting in low pH and high dissolved metals (Fe and Cu) concentrations; and the accumulation of metals and salts in the water due to evaporation. Water quality from Sabetaung Pit bore (GW050) was shown by Coffey[6] to be low pH (pH 3.2) of moderately high salinity (TDS 4,050 mg/L) and very high copper concentrations (550 mg/L). The main hydraulic contact between the pit and the regional groundwater flow is likely to be where the pit cuts the alluvium at the eastern pit wall/ramp area. Pit in flows and lake levels are likely to be strongly influenced by inflows from the alluvium in the eastern wall. Whilst the pit lake will act as a groundwater sink as a result of evaporation it is possible that not all groundwater flowing beneath the waste rock dumps will be captured by the pit and that some groundwater may flow northeast towards the Chindwin River.

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[6] Coffey, 1997. Letpadaung Copper Project Feasibility Study – Water Management and Environmental Monitoring. Report G7024/4-A, dated February 1997.

2.5 SEISMICITY

The project area is located in an earthquake active area. A search of the USGS database earthquake lists 406 earthquakes that have been recorded between 1973 and 2013, within 200 km of the Letpadaung site including one M7.0 and M6.8, and 44 events at magnitudes between M5.0 and M5.9. The most recent earthquake was a M4.7 event that occurred on the 20th July 2013, about 70 km south-west from Letpadaung. The closest earthquakes in proximity of the site were a M4.0 event that occurred approximately 3.6 km from the site and a M4.1 that was approximately 9.1 km of the site.

A seismic hazard assessment has been undertaken. Existing seismic and tectonic information and historical data, including earthquake catalogues and technical publications have been collected and reviewed. Preliminary seismic ground motion parameters for the project area have also been determined.

The computer program EZ-FRISK was used to develop a seismic hazard model for Letpadaung. The seismic hazard analysis module available with EZ-FRISK includes a database provided by Risk Engineering Inc. of faults and areal seismic sources pertinent to the study area.

Seismic sources defined in the hazard model include Sagaing Fault, which is the closest fault located approximately 96 km east of Letpadaung. The Sagaing Fault is an active strike-slip fault that separates the Burma plate extending west of the Sagaing Fault to the Bay of Bengal and the Shan-Thai block that contains the Eastern Highlands Belt extending east. Other faults and areal seismic sources defined in the EZ-FRISK seismic source zone and within 500 km of Letpadaung are listed in Table 2.7.

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Table 2.7: EZ-FRISK seismic source zones

Source	Deterministic distance (km)	Fault Magnitude	Mechanism	Site Lies to
Sagaing SE	95.88	7.6	Strike-Slip	West
Kabaw SE	105.57	7.75	Strike-Slip	East
Arakan Trench Arakan Trench	325.66 331.2	7.25 7.5	Reverse Strike-Slip	North North-East
Myanmar Margin	372.98	6.75	Strike-Slip	North-West
Mae Saraing	393.28	6.8	Strike-Slip	North-West
Mae Chan	495.73	7.3	Strike-Slip	North-West

For shallow crustal earthquakes a set of five ground motion attenuation models, known as the Next Generation Attenuation (NGA) relations were used (Earthquake Spectra, 2008). These include the ground motion relationships of Abrahamson and Silva, Boore and Atkinson, Campbell and Bozorgnia, Chiou and Youngs These ground motion attenuation relationships are applicable to shallow crustal earthquakes in western North American and similar tectonic regions of the world. The reported peak ground accelerations for shallow crustal earthquakes are average values calculated using the four attenuation relationships (equal weighting). Appropriate NGA attenuation relationships for normal faulting have been used in the probabilistic and deterministic analyses.

Table 2.8 lists the annual return periods for several events, probability of exceedance depending on anticipated mine life, and peak ground accelerations for the Letpadaung Copper Project based on the NGA relations.

Table 2.8: Summary of probabilistic hazard analysis

Return Period (Years)	Probability of Exceedance (%)				Median Peak Ground Acceleration (PGA)
	Design Life = 10 years	Design Life = 15 years	Design Life = 20 years	Design Life = 25 years	
50	18	26	33	39	0.027
100	10	14	18	22	0.043
200	4.9	7	10	12	0.059
500	1.98	3.0	4	5	0.083
1000	1.0	1.5	2	2	0.101
2500	0.40	0.60	1	1	0.124
5000	0.20	0.30	0	0	0.145
10000	0.10	0.15	0.2	0	0.170
20000	0.05	0.07	0.1	0.1	0.199

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3. GEOTECHNICAL CONDITIONS

Geotechnical investigation in the areas of the proposed waste dumps is very limited and it is recommended that further investigation and laboratory tests be undertaken in advance of any further design development.

From the available information it is determined that Waste Rock Dumps 1, 2 and 3 overlie Quaternary alluvial deposits that comprise top organic soil, fill, clay silty sand, gravelly sand. The upper part is silty clay with sand, with a thickness of 0.3 to 9.5 m; the lower part is a medium to fine sand, sandy gravel and cobble gravel, with a thickness of 0.4 m to 23.45 m. MWMCL[7] groundwater investigation hole LS007 located adjacent to the south western corner of Waste Rock Dump 1 encountered alluvium to 25 m over highly weathered base rock with a groundwater level of at 2.2 m below ground level (mbgl). Borehole LS008 located adjacent to the north western corner of Waste Rock Dump 1 encountered alluvium to 13 m over highly weathered base rock with a groundwater level of at 5.2 mbgl. The average ground water level in Waste Rock Dump 1 area is about 2.83 mbgl. The upper Quaternary clay layer has the potential to form a low permeability base and hydraulically isolate and protect the alluvial sands and gravels aquifer from contaminated seepage emanating from the waste rock dumps.

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[7] MWMCL, April 2011. Hydrogeology, Engineering Geology and Mineral Supplements Survey Report of Monywa Letpadaung Copper Mine, Sagaing Division, Burma.

4. WASTE CHARACTERISATION

4.1 GENERAL

An assessment of the likely geochemistry of the waste was undertaken previously as is reported in KP Report PE701-00077/16. A copy of that report is included in Appendix B. The following sections present a summary of the findings and implications for design.

Physical characterisation of the waste is taken from the Nerin Basic Design Report[8].

4.2 BACKGROUND

The project is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap is present above the main ore zone of between 10 and 200 m thick. Previous geochemical investigations at the project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold selected 150 samples of waste rock for the study which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

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4.3 GEOCHEMICAL ANALYSIS RESULTS

The concentration of sulfur in the waste rock was elevated, although not all of this sulfur was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur which was present as reactive sulfide minerals was still very high averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

[8] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.

Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming. There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material.

Three types of waste rock will need to be managed during the mine life. These are:

i. PAF (with or without high leachable metal concentrations)

ii. NAF with high leachable metals

iii. NAF with low leachable metals.

Additional characterisation of the waste rock at the project will be required prior to bulk mining and throughout the life of the operation. Operational testing will include net acid generation testing on closely spaced grade control or blast hole samples for every mining bench. The extent of the testing is such that establishment of a site laboratory to conduct both geochemical and geotechnical testing will be required.

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4.4 IMPLICATIONS FOR DESIGN AND OPERATION

The geo-chemical characteristics of the waste rock should be considered an extreme risk to the integrity of the natural environment around the Project site. The waste will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all waste dump areas;
- Placement of layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps;
- Full encapsulation of all waste with a suitable compacted soil liner;
- Cover of the soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material; and
- Water management structures around all waste dump areas to collect potentially contaminated waters.

In addition, the potentially acid generating waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height; and
- Installation of interim covers.

4.5 PHYSICAL CHARACTERISTICS

To date there has been no testing of mine waste samples to determine physical characteristics so engineering parameters can only be inferred from field observations and inspection of core from a few representative boreholes. The degree of weathering, and hence material strength and grading vary with depth.

A shear strength of the waste rock of 2.01 t/m^3 has been provided by Myanmar Wanbao Mining Copper Limited (MWMCL). It is our opinion that this value seems on the upper bound based our past experience on adjacent and similar sites. However, for stability analysis, this represents the worst case scenario and it was adopted for the analysis. The shear strength parameters for the waste rock were assumed based on typical values obtained in the literature such as Breitenbach[9] and Leps[10]. As seen, it is stress dependent, decreasing with the increase of overburden pressure, which is more realistic to reflect the waste rock shearing behaviour in such high embankments than a single constant value. The basic geotechnical parameters for waste rock are listed in Table 4.1.

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Table 4.1: Geotechnical parameters for waste rock

Average bulk density (t/m^3)	Cohesion c' (kPa)	Angle of friction Φ' (°)
2.01	0	Φ = 42° to 32° for σ'n = 100 to 3000 kPa

[9] Breitenback, A.J., AB Engineering Inc., Littleton, Colorado, USA, *"Improvement in Slope Stability Performance of Lined Heap Leach Pads from Design to Operation and Closure"*, 2004.

[10] Leps, T.M., Journal of the Soil Mechanics and Foundations Division, Proceeding of the American Society of Civil Engineers, *"Review of Shearing Strength of Rockfill"*,. 1970.

5. DESIGN BASIS

5.1 GENERAL

The principal objective of the waste dump design is to provide waste rock storage while ensuring protection of the environment during operations and post closure. The waste dump design has taken the following requirements into account:

- Permanent and secure storage of all waste rock within engineered facilities;
- Waste dump placement and development scheduling to minimize equipment requirements, achieve stable slopes at closure and reduce closure measures;
- Control of drainage and runoff from the waste dumps during operations to the maximum practical extent;
- Collection of sediment from the waste dumps to the maximum practical extent;
- Treatment (if required) and discharge of excess drainage and runoff from the waste dumps; and
- Monitoring for all aspects of the waste dumps to the maximum practical extent to ensure performance goals are achieved and design objectives are met.

Construction will be scheduled to ensure that there is always sufficient waste rock storage capacity available. The designs provide flow and drainage control measures to safely pass the design storm event to the environment during both operations and at closure.

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5.2 GENERAL DESIGN STANDARDS

For the design of the waste rock dumps, the Chinese Code for Waste Dump Design of Nonferrous Metal Mines[11] was adopted as the minimum standard. Reference was also made to international guidelines and standards in order to ensure that good practice is considered in all aspects of the design. The guidance included:

- Environmental, Health and Safety Guidelines for Mining, IFC/World Bank Group, 10th December 2007;
- Management of Tailings and Waste-Rock in Mining Activities, European Commission Reference Document on Best Available Techniques, January 2009;
- British Columbia Ministry of Energy and Mines (August 1998). Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia;

[11] Code for Waste Dump Design of Nonferrous Metal Mines, National Standard of the People's Republic of China. GB 50421-2007.

- Environment Australia (1998). Best practice Environmental Management in Mining – Landform Design for Rehabilitation;
- Australian Government, Department of Industry, Tourism and Resources (October 2006). Mine Rehabilitation;
- Australian Government, Department of Industry, Tourism and Resources (February 2007). Managing Acid and Metalliferous Drainage;
- Hollingsworth ID (2010). Mine Landform Design Using Natural Analogues. Ph.D. thesis submitted to the Faculty of Agriculture, Food and Natural Resources, University of Sydney;
- IFC (July 2004). IFC Environmental, Health and Safety Guidelines for Precious Metal Mining (Draft); and
- IFC (December 2007). IFC Environmental, Health and Safety Guidelines for Mining.

For project-specific input data such as mine waste tonnages, the China Nerin Engineering (June 2011) Basic Design Report was used as the main source of information.

5.3 HAZARD ASSESSMENT

The principal failure mechanism considered was global slope instability leading to movement of waste outside of the waste dump footprint. A preliminary assessment was made of the potential impact of this on:

- Population (Mine staff and local population);
- Infrastructure (Mine and public); and
- Environment.

The main impacts could be as follows:

<u>WRD 1</u>

i. Population at risk who live around the mine site perimeter in towns, villages or isolated settlements.

ii. Instability of open pit wall placing workers at risk and affecting mining operations.

iii. Debris deposited in the river/canal potentially blocking flows.

iv. Debris deposited on public road.

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v. Damage to Waste Water Storage Reservoir (North) potentially allowing release of contaminated water to the environment.

vi. Damage to the site flood protection bund.

vii. Damage to site access roads and surface water management infrastructure

WRD 2

i. Population at risk who live around the mine site perimeter in towns, villages or isolated settlements.

ii. Debris deposited on public road.

iii. Damage to site access roads and surface water management infrastructure.

WRD 3

i. Instability of open pit wall placing workers at risk and affecting mining operations.

ii. Damage to Waste Water Storage Reservoirs potentially allowing release of contaminated water to the environment.

iii. Damage to site access roads and surface water management infrastructure.

iv. Risk to explosives storage area.

Failure of a waste rock dump would place population at risk, affect private and public infrastructure as well as potentially causing environmental damage if debris reaches watercourses. As such, the design of the dumps should provide for adequate factors of safety for stability under operating and closure conditions as well as provide for appropriate offset distances from critical locations such as houses, rivers or public infrastructure.

Waste rock dumps in excess of 10 Mm^3 in volume are classified as a design Grade I[12].

5.4 DESIGN CRITERIA

The Waste Rock Dump design criteria are summarised in Table 5.1.

For seismic design criteria it was assumed that the minimum offset distances, as listed in Table 5.1, would be adopted in order to reduce the risk to and impact on population and infrastructure in the event of waste dump instability. The Operational Basis Earthquake (OBE) was selected as a 100 year ARI event as instability during the mine

[12] Code for Waste Dump Design of Nonferrous Metal Mines, National Standard of the People's Republic of China. GB 50421-2007.

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operation would impact the waste dumps but presents a low risk to population or infrastructure due to the significant offset distances. Damage could be easily repaired through earthworks operations to restabilise the slopes. The Safety Evaluation Earthquake (SEE) is used to assess longer-term stability which includes post-closure when population and/or infrastructure may be placed closer to the WRDs and therefore a 10,000 year ARI event was selected.

Table 5.1: Waste rock dump design criteria

Item	Criteria	Source
Mine Production	Mine Life – 31 years Ore – 954 Mt Waste – 946 Mt	Nerin[13]
Waste Rock Production	WRD 1 – 335 Mt (Yr 1 to 20) WRD 2 – 195 Mt (Yr 1 to 20) WRD 3 – 157 Mt (Yr 7 to 20) Total Above Ground – 687 Mt	MWMCL
Design Grade	For WRD >10 Mm^3 in volume – Grade I	NSPRC[14]
WRD Offset Distances	The minimum offset distances from the WRD toe shall be: • Public infrastructure including railways, roads and rivers – 1.0 to 1.5 x WRD height • Mine infrastructure – 0.75 x WRD height • Open Pit – 30 m or greater as determined by pit stability assessment. • Residential areas, towns and industrial sites - >2.0 x WRD height	 NSPRC NSPRC NSPRC NSPRC
Static Stability	The minimum factors of safety to be as follows: • Local Slope (Operations) – 1.0 • Local Slope (Closure) – 1.3 • Global Stability (Operations) – 1.3 • Global Stability (Closure) – 1.5	 KP assessed KP assessed KP assessed KP assessed
Seismic Stability	Operations – 1.3 for 1 in 100 yr ARI = 0.04g Closure – 1.1 for SEE = 0.17g	KP assessed KP assessed
Hydraulic Design	Surface water management systems (Operations) – 25 yr ARI event. Surface water management systems (Closure) – 100 yr ARI event.	NSPRC KP assessed

[13] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.
[14] Code for Waste Dump Design of Nonferrous Metal Mines, National Standard of the People's Republic of China. GB 50421-2007.

6. WASTE ROCK DUMP STABILITY

6.1 GENERAL

Stability of the WRDs was assessed for three main criteria namely:

1. Static stability.
2. Stability under seismic loading.
3. Long-term stability of the rehabilitated surface against soil loss.

6.2 GROUND MODEL AND DESIGN PARAMETERS

As available geotechnical information for the waste dump stability analysis is very limited. The sub soil profiles of the three waste dumps were assumed based on the geotechnical investigation report completed by Southwest Nonferrous Kunming Design Institute (西南有色昆明勘测设计院) in 2012[15]. The report indicates that the subsurface materials are very variable. For the stability analyses, assumed average subsurface material profiles are as follows:

- 7 m of silty clay / clayey silt overlying;
- 23 m of silty sand with clay overlying;
- 20 m of residual soil/extremely weathered rock overlying;
- Highly to moderately weathered rock.

The average ground water depth of 2.83 m was adopted for WRD 1 and average ground water depth of 6.65 m was used for WRD 2 and 3.

Based on Standard Penetration Test (SPT) values and descriptions in the geotechnical report, the average subsurface material shear strength parameters were assessed and are summarised Table 6.1. The density and shear strength of waste rock are discussed in Section 4.5.

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[15] Southwest Nonferrous Kunming Design Institute (西南有色昆明勘测设计院)(2012) “Geotechnical and geohydrological investigation report for proposed waste dumps and embankments at Letpadaung Copper Mine”, Myanmar.

Table 6.1: Estimated geotechnical design parameters for waste rock dump analysis

Material	γ (kN/m^3)	c' (kPa)	Φ' (°)	Undrained shear strength
Waste Rock	20.0	Φ = 42° to 32° for σ'_n = 100 to 3000 kPa		
Silty clay / clayey silt	19.3	10	28	Minimum 75kPa ,0.30σ'_v
Silty sand with clay	20.8	3	32	
Sand	21.0	3	33	

6.3 WASTE DUMP GEOMETRY

The current design for operations provided by MWMCL is that waste rock dumps will be constructed as a series of lifts with 5.4 m wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 22° and overall angles of 19°. Waste dump geometry used in the analyses is summarised in Table 6.2.

Table 6.2: Waste dump geometry

	WRD1	WRD2	WRD3
Total height(m)	150	75	125
Bench slope angle	22°	22°	22°
Overall slope angle	19°	19°	19°
Bench width (m)	5.4	5.4	5.4

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6.4 STATIC AND SEISMIC STABILITY

"SLOPE/W", developed by GEO-SLOPE International Ltd. in Canada[16], was used for the stability analysis. It is a limit equilibrium program based on the rigid-plastic theory for material shearing behaviour. The slope stability analysis was performed using the modified Morgenstern-Price method.

Seismic stability analyses were completed using a pseudo-static method. This is a simplified seismic analysis that represents the effects of an earthquake event by applying constant horizontal and/or vertical accelerations on the potential sliding mass. The accelerations are associated with a design earthquake and expressed as seismic coefficients. The pseudo-static assessment presented herein uses the Hynes-Griffin and Franklin formulation[17]. In addition to the seismic coefficient detailed above, the

[16] GEO-SLOPE International Ltd., *"SLOPE/W"*, 2007.
[17] Hynes-Griffin, M. E. and Franklin, A. G., Department of the Army Waterways Experiment Station, Corps of Engineers, *"Rationalizing the Seismic Coefficient Method"*, July 1984.

formulation utilises reduction of undrained shear strength to 80% of the static shear strength values.

The following seismic parameters were selected:

- Operating Base Earthquake (OBE) (100 year ARI event): pga = 0.04g; and
- Standard Evaluation Earthquake (SEE) (10,000 year ARI event): pga = 0.17g.

Both local and global stability were assessed for WRD1, WRD2 and WRD3 embankment under static and seismic loading conditions. A summary of stability analysis for all WRD's are presented in Table 6.3. A detailed report of the stability assessment is provided in Appendix C.

Table 6.3: Stability assessment results for all waste rock dump embankments

Embankment	Loading Condition	Failure Mode	Factor of Safety
WRD1	Static	Global	2.0
		Local (lower part)	2.2
		Local (upper part)	2.5
	OBE	Global	1.2
		Local (lower part)	1.3
		Local (upper part)	1.9
	SEE	Global	1.0
		Local (lower part)	1.1
		Local (upper part)	1.6
WRD2	Static	Global	2.2
		Local (lower part)	2.2
		Local (upper part)	2.5
	OBE	Global	1.2
		Local (lower part)	1.3
		Local (upper part)	1.7
	SEE	Global	1.0
		Local (lower part)	1.1
		Local (upper part)	1.4
WRD3	Static	Global	2.1
		Local (lower part)	2.2
		Local (upper part)	2.5
	OBE	Global	1.2
		Local (lower part)	1.4
		Local (upper part)	1.9
	SEE	Global	1.0
		Local (lower part)	1.1
		Local (upper part)	1.6

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The assessment results indicate that the factors of safety for static loading cases meet the minimum stability requirement as discussed in Section 5.4.

For the seismic assessment, the analyses suggest that the stability is marginal during OBE and SEE events where factors of safety of 1.2 and 1.0 were determined respectively. The pseudo-static analysis method is generally considered to be a conservative approach for stability analysis and it is likely that slopes will be stable but this needs to be confirmed by analysis with more sophisticated approaches, such as FLAC or PLAXIS software, in the next design stage.

6.5 SOIL EROSION ASSESSMENT

6.5.1 Methodology

The methodology employed for estimating long-term soil erosion rates is the Revised Universal Soil Loss Equation (RUSLE) as originally derived by Renard et. al[18] and subsequently adapted for conditions on the Australian continent[19]. There is no specific adaptation for Myanmar. Consideration was given to the prevailing climates in Australian and Myanmar in terms of total precipitation and annual rainfall distribution and it was considered that the climates were sufficiently similar to apply the adapted method for this preliminary assessment of soil loss.

RUSLE takes the form of a simple linear equation:

$$Y_J = R_J \cdot K \cdot L \cdot S \cdot C_J \cdot P$$

where:

Y_J = average soil loss rate for a given month (t / (ha·mo));

R_J = rainfall erosivity factor for a given month ((MJ·mm) / (ha·h·mo));

K = soil erodibility factor ((t·ha·h) / (ha·MJ·mm));

L = slope length factor (dimensionless);

S = slope steepness factor (dimensionless);

C_J = ground cover factor for a given month (dimensionless);

P = conservation practice factor (dimensionless); and

J = currently selected month (Jan = 1, Feb = 2 … Dec = 12).

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[18] Renard, K.G. et al. *"Predicting Soil Erosion by Water – A Guide to Conservation Planning with the Revised Universal Soil Loss Equation RUSLE"*, U.S. Department of Agriculture, 2010. Washington, DC. USA.

[19] CSIRO Land and Water. *"Prediction of Sheet and Rill Erosion Over the Australian Continent, Incorporating Monthly Soil Loss Distribution",* CSIRO Technical Report 13/01, 2001. Canberra, Australia

It was assumed that the topsoil properties were as follows:

- P_{125} = 50 to 75%;
- Bulk unit weight = 1.3 t/m^3;
- Organic carbon content = 0%;
- Bare soil / minimal vegetation.

The calculations included a sensitivity analysis on slope angle and rainfall patterns. Both 1V:2.5H and 1V:3.5H local slopes were considered with a slope height of 12.5 m i.e. slope lengths of 33.7 and 45.5 m respectively. From available historical data, the likely erosion during the driest and wettest years was calculated as well as that for years with total annual rainfall that represented the 25th centile, median and 75th centile of the available data.

6.5.2 Results

The results of the analyses are presented in Table 6.4.

Table 6.4: Estimated annual soil erosion

Scenario	Slope Length	Slope Angle	Estimated Annual Soil Loss per meter of WRD slope area (t/m^2) for given Historical Rainfall Scenario				
			Driest Year (1982)	25th % Year (1997)	Median Year (1989)	75th % Year (1963)	Wettest Year (1973)
	(m)	(°)	411 mm	610 mm	722 mm	896 mm	1,370 mm
Scenario 1 (2.5 H:1V)	33.7	21.8	0.012	0.020	0.032	0.042	0.068
Scenario 2 (3.5 H:1V)	45.5	15.9	0.011	0.018	0.029	0.038	0.062

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The results show that average soil loss would be approximately 30 kg per m^2 per year. There is approximately 10% difference in the magnitude of soil loss between the two slope angles assessed.

6.6 CONCLUSIONS

From the assessment of the WRD stability, the following conclusions are reached:

i. The proposed operational geometry of 1V:2.5H local slopes and 1V:2.9H global slopes has adequate factor of safety for global stability under static loading conditions.

ii. Pseudo-static analyses suggest that stability is marginal under OBE and SEE loading conditions. These loading cases should be analysed in more detail using FLAC or PLAXIS software.

iii. Erosion of soil cover is expected to be relatively high immediately after placement prior to full revegetation. In more detailed design of the closure cover system, consideration needs to be given to protection of this valuable resource in order to achieve a stable closure landform.

iv. Whilst geotechnically stable, the proposed local slope angles are relatively steep which will make placement of compacted soil liners and other earthwork capping to the WRD slopes more difficult and costly than if flatter slopes are utilised. Slopes steeper than approximately 1V:3H will require cover to be placed using benched fill rather than direct placement onto the surface.

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7. WASTE ROCK MANAGEMENT AND ENCAPSULATION

7.1 OBJECTIVES

As discussed above, the geochemistry of the waste rock is such that there is a significant risk of acid generation and/or metal leaching. Waste which poses a risk to the environment must be encapsulated within the waste dumps to:

1. Reduce oxygen ingress.
2. Reduce water ingress.
3. Protect shallow groundwater.
4. Protect surface water.

7.2 WASTE ZONE IDENTIFICATION

Testing will need to be conducted on grade control or blast hole samples to define the acid formation and metal leaching potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF/metal leaching and NAF waste zones. The waste zones will then be marked out in the field by the survey team to identify the different waste blocks. This is commonly achieved through coloured tape and pegs defining the boundaries of the different material types.

7.3 SELECTIVE HANDING

Material will need to be selectively handled to allow separation of PAF/metal leaching and NAF waste so that the waste can be placed into the correct areas of the waste dump. This can be achieved through a simple method of signage in the excavators and trucks. The conventional method is for a coloured sign to be displayed on the excavators and shovels to indicate the type of material being excavated. As the truck is being loaded it should also change the sign displayed on the dashboard of the truck to match that of the excavator and then haul the material to the designated areas for correct disposal of the type of waste or stockpiling/crushing of ore. This system allows spotters and supervisor within the pit and the waste dump area to visually check that the material is being correctly loaded and dumped in the designated areas.

7.4 WASTE PLACEMENT METHODS FOR PAF MATERIAL

The reduction of oxidation rates within the dump is critical to reducing the rate of acid generation and the potential long term water treatment liabilities. As such, it is essential that the waste placement method used for the PAF material reduces the potential for preferential oxygen flow paths.

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This should be achieved through the placement of waste in lifts of no greater than 3 m to 5 m in height to reduce the segregation of material into coarse and fine fractions. The trucks should be routed over the entire surface of the dump to provide compaction to the waste which will reduce the voids ratio and hence the amount of contained oxygen. Compaction trials on 3 m lifts have shown that trucks of 100 tonnes or greater can produce effective compaction down to the base of lifts at these heights.

PAF waste should not be placed directly onto the natural ground as this interface is typically a preferred flow path for water, and water flowing through the waste will transport oxidation products rapidly out of the dump. Therefore, PAF waste should not be placed within 3 m of the base of the waste dump, with a layer of benign (i.e. non leachable) NAF waste placed prior to PAF placement. The base of the dumps will also need to be tested to determine the in-situ permeability and, if required, the base will need to be engineered to reduce the permeability prior to waste placement.

It should be noted that PAF low grade ore shall be treated in the same manner as PAF waste and stored in compacted encapsulation cells if not placed directly on a heap leach pad and processed immediately following excavation from the pit.

7.5 NAF WASTE PLACEMENT

Based on the acid formation potential estimates for the deposit, approximately 30% of the waste (or 300 Mt) is likely to be non-acid forming. There are no specific controls relating to the placement of NAF waste in respect to acid generation, however, as the majority of NAF waste is expected to be leachable, the material will need to be encapsulated.

7.6 ENCAPSULATION OF WASTE

All waste rock that has the potential to generate acid of metal leachate will require encapsulation to further reduce the rate at which oxygen can enter the dump and to reduce the amount of meteoric water flowing through the waste.

The rate of oxygen transport through soils is directly dependant on the grain size and degree of saturation of the material. Materials with a high degree of saturation have high water content in the void spaces. Oxygen diffuses through water 10,000 times slower than it diffuses through air, so the presence of water in the void spaces effectively reduces the potential for oxygen to pass through the encapsulation material. Material placed with a degree of saturation of 90% reduces the rate of oxygen diffusion by approximately 3 orders of magnitude compared to material placed dry.

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As such, the encapsulation material used should be a fine grained material (silt or clay) which should be heavily moisture conditioned and compacted. Suitable borrow sources for encapsulation material will need to be defined and the geotechnical properties of these material determined. Based on the scale of the Letpadaung project, the borrow requirements are significant and work on defining these sources is required prior to bulk mining commencing.

The encapsulation material will need to be constructed with a high moisture content and consequently a high degree of saturation. However, it is critical that the material is not allowed to desiccate, as this will reduce the degree of saturation and can also lead to desiccation cracking, resulting in pathways for the oxygen to enter the dump. Therefore, the encapsulation material should be covered with benign (i.e. non-acid generating, non-enriched and non-leachable) waste to form a store and release cover. A store and release cover acts to absorb water during higher rainfall periods (i.e. the wet season at Letpadaung) and then slowly releases the moisture over the extended dry periods, preventing desiccation of the encapsulation material and protecting it from erosion.

Detailed geotechnical and water flux testing of the proposed encapsulation and cover materials is required, together with modelling of the climatic conditions, to allow detailed encapsulation and cover design. However, based on projects in similar climates, it is estimated that the encapsulation materials will require a true width of approximately 2 m, and the cover materials will require a thickness of approximately 1.5 to 2.0 m.

Depending on the results of the kinetic testing which has been recommended for the project, there may be a requirement for interim covers to be installed prior to the waste dump achieving its final profile. These covers are intended to limit oxygen and meteoric water ingress into the dump prior to installation of the final cover system. Based on a visual assessment of the waste during the site visit conducted by KP, the waste rock itself does not appear to be suitable for this purpose and additional borrow material will be required.

Cells should be sized to accommodate 4 to 6 weeks production of PAF material. The procedure for encapsulating the waste is presented on Figures 7.1 to 7.4 inclusive.

7.7 INTERNAL DRAINAGE

Internal drainage will need to be installed at the upstream toe of the encapsulation zone to collect internal drainage water and direct this to the water storage facility. These internal drains will have to allow water to flow out of the system, but will need to

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be engineered to prevent oxygen from entering the drainage system. This can be achieved through the inclusion of U-bends in the water pipes to act as a seal.

7.8 AS-BUILT RECORDS

Once waste rock is assigned as PAF or NAF, its quantity and dumping location should be recorded on a layout plan. An inventory of material quantities and accurate as-built surveys should be maintained.

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8. SURFACE WATER MANAGEMENT

8.1 GENERAL

Careful surface water management for the WRDs will be necessary to limit uncontrolled water flow into the open pit, reduce erosion, and to prevent release of contaminated drainage from the site. Some surface water run-off needs to be collected and stored to supplement process water supplies and the infrastructure needs to direct the necessary flows to the process reservoirs.

The most significant cause of erosion and sediment transport from the project areas is anticipated to be uncontrolled surface water runoff. Accordingly, a key component of the surface water management needs to comprise a system of channels to collect and divert surface water, in a controlled manner, away from exposed overburden and ore surfaces. These structures will, during the active mine life; replace the natural drainage existing within the disturbed areas which will be lost upon commencement of project development.

The channel network can be subdivided into diversion structures and collection structures. The diversion structures comprise channels located along the uphill side of mine components that are designed to direct surface runoff away from the component. The collection structures are located along the downstream side of mine components and are designed to collect the surface water runoff from each component and route the flow into a sedimentation basin for the removal of sediment contained within the flow.

Depending upon the velocity of the peak flows within each channel section, a liner may be required to prevent erosion and degradation of the channel. However the design should seek to reduce the amount of lined channels, both to reduce costs and to minimise the long-term maintenance requirements, by configuring the channels to produce lower velocities that can be accommodated by either exposed soil or vegetated channels whenever possible.

8.2 DESIGN APPROACH

The potential occurrence of soil or waste erosion and subsequent transport by surface water runoff from project areas can be reduced through the incorporation of proper water management into the mine plan. It is anticipated that ongoing incorporation of water management measures will be required until the successful re-establishment of a vegetative cover over the disturbed project areas, when the vegetation will provide the required erosion protection.

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Water management measures should comprise a network of ditches, channels, sedimentation basins and discharge structures designed to reduce the potential for erosion of soil and waste dump materials and to remove eroded sediment from surface water prior to discharge from disturbed project areas. A series of perimeter diversion ditches will also be installed around the WRDs to intercept expected surface flows up to the design event and direct them into collection ponds.

A preliminary surface water layout plan has been prepared as part of the overall surface water management report (KP Report PE701-00022/18) a copy of which is provided in Appendix D. The general principles adopted are:

i. Diversion channels to be used to reduce the amount of upstream flow which reaches the WRD toe.

ii. Benches and WRD profile to be used to convey run-off around the outside of the WRDs to a selected number of rock chutes at key locations.

iii. Rock chutes will provide an erosion-protected channel for flows off the dumps and into carrier channels.

iv. Carrier channels to convey flows to ponds for sedimentation and potential use of the water in the process.

v. In some locations, pumped systems may be employed where gravity systems are not practical.

vi. Flows from WRD No 1 will be directed to Waste Water Reservoir (North).

vii. Surface water from WRD No 2 will flow to a collection pond along the southern edge of the dump. If below water quality threshold values, the water can be released to adjacent watercourses. If above threshold then an outlet channel from the pond will convey run-off to the Waste Water Reservoirs.

viii. Flows from WRD No 1 will be directed to the Waste Water Reservoirs.

8.3 SURFACE WATER RUNOFF DESIGN FLOWS

The following extreme rainfall event return periods are recommended for component design:

- The 1 in 25 year for operational measures; and
- The 1 in 100 year for closure measures.

The peak surface water runoff flow reporting to each component is to be determined by the Engineer using the Rational Method. This is an empirical-deterministic approach

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that has been successfully applied worldwide to estimate peak surface water runoff flows resulting from extreme rainfall events. It is particularly suitable for urban runoff or small rural catchments with high rates of runoff. The Rational Method equation takes the form:

$$Q_P = 0.00278 * C * I * A \text{ (metric)}$$

Where:

- 'Q_P' is the peak flow in m^3/s;
- 'C' is a dimensionless runoff coefficient representative of the catchment;
- 'i' is the effective rainfall intensity in mm/hour; and
- 'A' is the catchment area in ha.

The run-off coefficient accounts for the anticipated disturbed surface conditions and numerous shallow depressions in the mining and disturbed surfaces, as well as the vegetative cover. An appropriate coefficient should be selected for each design element that reflects the surface conditions and design storm event.

8.4 SEDIMENT CONTROL MEASURES

Good international management practices have been applied to comply with project sediment discharge guidelines (as stated in the project environmental management plan). Good management practices typically require engineered structures to mitigate erosion and reduce sediment loads:

The sediment control measures have to be designed to remove sediment particles eroded from disturbed project areas during pre-development, mining and reclamation activities. The measures should comprise sediment barriers, traps, sedimentation basins and sediment control dams (SCDs) located downstream of the disturbed areas. The sediment barriers and traps consist of structures located within the surface water runoff collection and diversion, and control channels and are intended to remove coarser fraction, (i.e. sand and larger particles) from the runoff flows, in addition to reducing peak flow velocities within the channels.

The sedimentation basins and dams should be located at the downstream terminus of the runoff collection channels and should be designed to ensure compliance with project environmental commitments.

Further details of erosion and sediment control measures are provided in KP Report PE701-00022/21 Erosion and Sediment Control Guidelines, Rev A dated 22nd July 2013. A summary of principal components is provided below.

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8.5 SEDIMENT BARRIERS AND TRAPS

Sediment barriers consist of brushwood barriers, silt fences, check dams, sediment weirs and rock filter dams which will be constructed within the surface water diversion and collection channels. The barriers locally reduce flow velocities within these channels thereby allowing suspended sediment to settle. Due to the limited length of channel affected by each sediment barrier, these measures are only effective for coarser sediment particle size, typically coarse sand and larger particles.

The reduction in runoff collection and diversion channel flow velocities caused by the sediment barriers will also assist in the stabilisation of the channel liner(s) from erosional forces and may actually reduce channel liner requirements for erosion protection.

Sediment traps comprise a local deepening and/or widening within the diversion or collection channels creating a local reduction in the flow velocity. This causes the coarser fraction of any suspended sediment to be deposited into the trap. Sediment traps are to be incorporated into the shorter-term drainage and collection ditches located within active areas. This will trap and retain the coarse sediment fraction within the area it is derived from, and will reduce the overall sediment loading on the longer-term perimeter erosion control measures, leading to a reduction in operation and maintenance costs.

It is not anticipated that any formal design will be required for sizing or locating of sedimentation barriers and traps to meet any specific particle size retention requirements. It is expected that those will be sized to fit within and pass the design flow of the existing channel or ditch configuration in which they will be installed and act largely as shorter-term measure.

8.6 SEDIMENTATION BASINS

Sedimentation basins should be used to augment SCDs. Sedimentation basins should be located downstream of active project areas and are therefore considered to be longer-term structures.

It should be noted that there is a practical limit for gravity settlement of suspended particles. A portion of the fine sediment (typical less than 0.02 mm in size) will be trapped by vegetation within the receiving environment, particularly the Environmental Buffer Zones. However a significant amount of the finer portion will be discharged from the project. Discharge of the finer portion of the sediment will need to be compared with baseline conditions as well as regulatory requirements. During heavy rainfalls, the main

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receiving river and its tributaries experience natural sediment loads which should be established prior to the commencement of the project and used as baseline data.

The basins should be designed with an allowance of up to 2 metres of sediment storage capacity. The frequency of sediment removal for the basins will depend upon the efficiency of the upstream sediment barriers and traps, actual rainfall peak flow velocities and the rate of sediment erosion.

Maintaining the basins in a drained state, except during runoff events, allows the sediment to dry and consolidate within the basin, thereby reducing the sediment storage requirements. The sand filter material should be cleaned or replaced periodically, as necessary, to prevent plugging of the drain. In addition, this design approach eliminates the need for an internal filter zone within the containment embankment and reduces failure risks and consequences as compared with a basin designed to remain flooded. It will also eliminate a standing water body in which mosquitoes can breed.

An overflow spillway should be incorporated into each sedimentation basin to allow peak design flows associated with a 1 in 50 year recurrence interval storm event to be safely passed. The overflow spillways should incorporate a pervious zone constructed with clean rock filled gabion baskets designed to drain all impounded water from the basin and allow the settled sediment to de-water after a storm event. Settled sediment is prevented from passing through the pervious base by incorporating a non-woven geotextile over the upstream entrance of the pervious base.

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9. CONCEPTUAL CLOSURE PLAN

9.7 GENERAL

The waste rock dumps (WRDs) will be constructed during operations to provide structures which are safe and stable whilst also providing landforms that are appropriate for rehabilitation and the final land use. Due to the significant quantities of PAF waste that will be produced from the pit, the dumps will be constructed to encapsulate the PAF waste concurrent with mining and also allow progressive rehabilitation of the dumps.

It is noted that geochemistry evaluations have not yet been fully completed and therefore the concepts presented herewith are based on the available data which suggest a significant potential for acid generation and metals leaching.

9.8 POST-CLOSURE LAND-USE

Whilst there will be a large area of revegetated land on closure, the elevation of the WRDs compared to the surrounding topography combined with minimal flat areas and low rainfall experienced in the area are unlikely to make the WRDs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

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9.9 DECOMMISSIONING AND RECLAMATION

The waste rock dumps will be constructed as a series of lifts with seven metre wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 1V:2.5H and overall angles of 1V:2.9H. Some reprofiling may be required to reduce slope angles to enable effective rehabilitation and for the slopes to be grazed by animals. This will be confirmed during detailed design. The outer walls will be finished with a cover system (described below).

The top of the waste rock dump will be shaped to shed water to drainage channels located on the final top surface that direct flows to drop drains. The benches of the waste rock dump will be graded to direct water also to the drop drains. The drop drains will be lined with heavy fresh benign NAF rock with drain stop boards constructed every five metres down the slope to control the flow speed of the water down the slope. At the base of each drop drain an energy dissipater and sediment trap with the capacity to hold runoff from a 1 in 10 year storm of 1 hour duration will be constructed to control flows and contain runoff prior to release to the general site surface water management system.

After all the batter slopes have been covered, they should be seeded/planted with a mixture of local grass seed and the seeds or plants of shrubs with a maximum height of 1 m that are local to the area.

The rehabilitation of waste rock dump batters should occur progressively during the mining process, after each berm is established and the outer walls shaped, to enable the success of the rehabilitation techniques to be reviewed and refined. This will allow a fully developed and assured method of revegetation and batter treatment, as well as drainage structures, to be developed and minimise the level of maintenance required after closure works are complete.

9.10 COVER SYSTEM

Cover systems are an integral design component for the successful reclamation and closure of the Project. At the surface of the cover system, direct precipitation will either run off the cover, be removed through evapotranspiration or infiltrate into the active zone. Water that infiltrates is typically stored in the active zone and can exfiltrate to the surface and evaporate. A portion of the water that infiltrates can also percolate into the underlying waste, which is intended to be reduced by the placement of the cover system. The objectives of the cover systems considered for the Project include:

- Physical stabilization to provide dust and erosion control, particularly wind and water erosion of waste materials, and to act as a barrier to prevent direct contact of the waste by flora and fauna
- Chemical stabilization through control of oxygen or water ingress; and contaminant release control through reduced infiltration, and
- Meeting land use objectives and other societal values by providing a growth medium for establishment of sustainable vegetation; and reclaiming the area for post-closure land uses.

A combination of cover system efficiency and saturation conditions can help to reduce oxygen ingress and the subsequent oxidization of waste materials which typically results in ARD production.

The proposed cover system concept aims to maximize use of the climate, cover material characteristics, cover material availability, hydrogeologic setting and waste material physical properties to minimize potential effects related to the waste material chemical properties.

In consideration of the anticipated chemistry of the waste rock combined with the varying proximity of the waste materials to watercourses that are used for domestic,

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drinking, irrigation and livestock watering uses, a low Infiltration cover system (50-90 % reduction of net infiltration) is proposed for the WRDs in order to reduce the risk of acid generation in the waste dumps and the associated release of low-pH leachate to the environment. Release of solubilised heavy metals will also be reduced.

A low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-8} m/s would be required to construct a cover system capable of reducing net infiltration to approximately 50 to 90% of the infiltration rate expected for a bare surface. Considering the characteristics and availability of materials on site, the cover system would be constructed from a minimum 1 m thick compacted low permeability soil layer, overlain by a 2 m thick gravelly store and release layer, and finished with a re-vegetated subsoil/topsoil layer some 400 mm thick comprising 250 mm of subsoil over which 150 mm of topsoil is place. A typical section through the cover system is provided on Figure 9.1.

Additionally, prior to placement of the cover system, some localised grading may be required to promote positive surface drainage thereby minimizing the likelihood of standing water and saturation of the materials in the cover system. Sloped areas must be protected from surface erosion through re-vegetation and development of drainage structures, to reduce infiltration and to prevent breakthrough of flow into the underlying tailings.

It is anticipated that the low permeability materials and the store and release layer will be sourced from overburden strip from the mine pit during operations. Alternatively borrow areas may need to be established if insufficient material is available locally and/or mine scheduling isn't compatible with the waste dump construction.

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9.11 WATER MANAGEMENT

A surface water management system will be progressively established concurrent to waste dump development. Major flowpaths are shown on Figure 9.2. Provision is made in the design for separate systems to manage non-contaminated contact water and potentially contaminated contact water. Non-contaminated contact water will be suitable for release into watercourses downstream of the site following basic settling to reduce suspended sediment loads. Potentially contaminated contact water will be directed initially to the mine pit dewatering system and, once the pit is decommissioned, the water will flow to the pit lake to prevent release of the potentially-contaminated water to the wider environment.

Runoff and drainage water from the waste dumps will be analysed during the closure phase to determine the water quality characteristics. It is anticipated that the surface

runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated, while seepage from the waste rock may be of poorer quality. If water treatment is found to be necessary, a suitably designed passive water treatment wetland system will be designed to enable improvement of water quality to be undertaken prior to release into the environment.

9.12 REHABILITATION

The construction of the closure cover system will provide a landform suitable for revegetation with native plants with a maximum grown height of 1 m. Seeding and planting across the finished surface will provide long-term erosion protection.

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10. WASTE ROCK MANAGEMENT PLAN

10.1 OBJECTIVES

A Waste Rock Management Plan should be developed prior to development of the site. The objectives of the Management Plan are to:

- Establish Standard Operating Procedures (SOPs) for MWMCL WRD activities;
- Define MWMCL requirements and procedures to guide the Project Management Team and Project contractors;
- Define plans/measures for impact mitigation;
- Define roles and responsibilities; and
- Define monitoring and reporting procedures.

10.2 ROLES AND RESPONSIBILITIES

The project team is ultimately responsible for the following key tasks, roles and actions relating to hazardous waste as outlined in the RACI presented in Table 10.1.

Table 10.1: Roles and Responsibilities – Waste Rock

Activity Description	Senior Management Team	MWMCL Mine Planning Team	Contractors Team	Contractors Team	MWMCL Environment Team
Develop appropriate WRD designs	I	R	C/A	C/A	C/A
Construct and install appropriate WRDs	I	C/A	R	C/A	C/A
Develop WRD management plans	I	R	C/A	I	C/A
Introduce WRD management strategies to the workforce	I	C/A	R	I	I
Monitor WRD management across the project	I	I	R	C/A	C/A
Record and report WRD incidents and training of personnel	I	I	R	C/A	I
Develop a tracking system for incidents related to WRDs	R	I	C/A	I	C/A

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R = Responsible / Accountable: The person(s) who is ultimately answerable for the execution and results of the activity.

A = Assisting / Attending: The person(s) who assists in the execution of the task and/or attends a meeting.

C = Consulted: The person(s) to be consulted during the decision making process. A two-way communication.

I = Informed: The person(s) who need to be informed after a decision is made or action taken. A one-way communication.

Overall responsibility for the implementation of this Management Plan shall rest with the MWMCL Environment Manager who shall report on progress to the MWMCL General Manager.

10.3 MANAGEMENT ACTIONS

Actions expected from management are as follows:

1. Environmental induction and toolbox meetings will include WRD management and awareness.
2. WRDs will be appropriately designed, constructed and installed.
3. Personnel working with WRDs will be trained to ensure safe handling, transfer, and disposal.
4. Damage to WRD containment and monitoring structures will be inspected immediately and repairs undertaken.
5. Promotion of progressive rehabilitation of WRDs.

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11. INSTRUMENTATION AND MONITORING

11.1 INSTRUMENTATION

Instrumentation will be installed prior to WRD construction and progressively through construction, closure and rehabilitation. Instrumentation will include:

i. Survey pins at regular intervals around the WRD perimeter at each bench height to monitor for slope movement.

ii. Piezometers at regular intervals to monitor phreatic surfaces within the dumps.

iii. Monitoring standpipes upstream and downstream of the WRDs to monitor groundwater quality.

iv. V-notch weirs or similar on surface water channels to monitor flow rates.

v. Thermistors at regular intervals to monitor dump temperature.

vi. Air sampling points to measure oxygen concentrations in the materials.

11.2 MONITORING

As part of the WRD construction and operation, extensive monitoring will be undertaken to ensure the WRD design intention is met. This monitoring will comprise three basic types. These are:

- Operation monitoring

  This will include items such as surface water management infrastructure and adherence to the dumping plan. This level of monitoring is directed at ensuring that the facility is operating smoothly.

- Compliance monitoring

  This includes items such as checking survey pins for movement, monitoring bores for contamination, etc. This monitoring is required to ensure that the project is meeting all its commitments in regard to a safe and secure operation.

- Performance monitoring

  Regular surveys of the waste rock dumps and reconciliation of the volumes against tipping records will be necessary to maintain ‘as-built’ plans and to provide updates on densities achieved within the dumps. The data generated will be used to refine the tipping schedule and develop the final waste dump heights.

The monitoring programme for the facility is summarised in Table 11.1 and further details on compliance monitoring are provided in Section 11.3.

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Table 11.1: Monitoring programme

Area	Monitoring Requirement	Frequency	Method
Section 1:	Operation monitoring		
Surface Water Management	Visual inspection of run-off collection ditches and ponds	Daily	Manual
WRD Construction	Visual integrity assessment of facility	Daily	Manual
	Visual assessment of adherence to dumping plan.	Daily	Manual
Section 2:	Compliance Monitoring		
WRDs	Survey pins - basic	Monthly	Manual
	Survey - comprehensive	Quarterly or immediately after seismic event	Manual
	Materials testing of encapsulation layers	Daily	Manual
	General inspection by suitably qualified engineer	Annual	Manual
Monitoring Bores	Water level	Monthly	Manual
	Water quality – basic	Monthly	Manual
	Water quality – comprehensive	Quarterly	Manual
Piezometers	Water level	Monthly	Manual
Thermistors	WRD temperature	Monthly	Manual
Air Sampling Points	Oxygen concentrations	Monthly	Manual
Surface Water	Flow rates	Weekly	Manual
	Water quality	Monthly	Manual
Section 3:	Performance Monitoring		
Climatic	Precipitation	Daily	Automatic
	Evaporation	Daily	Automatic
	Maximum - minimum temperatures	Daily	Automatic
	Wind direction and speed	Daily	Automatic
Waste	Waste rock (tonnes)	Daily	Manual
	Waste volume by survey	Quarterly	Manual
Technical Audit	Independent geotechnical engineer.	Annually	Manual

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11.3 COMPLIANCE MONITORING

11.3.1 Survey Pins

Survey pins will be installed at regular intervals around the WRD perimeter. As the WRDs are raised, additional survey pins will be added to the benches and slopes. Each pin will be monitored for movement at regular intervals as outlined in the monitoring programme.

Any displacement which is considered excessive or ongoing may indicate stability problems and will require investigation by a qualified geotechnical engineer. Remedial

action will be undertaken if required based on the conclusions drawn from such an investigation.

11.3.2 Geotechnical Monitoring of Encapsulation

Significant resources will need to be assigned to the encapsulation of the PAF waste at the project and, as such, a geotechnical monitoring program will be required to ensure that the material is being placed to the design specification. This will require geotechnical testing of the material during placement to ensure that the material has an appropriate grain size and that it has been compacted to a suitable density. Also, most importantly, the geotechnical testing is required to ensure that the material has been placed at an appropriate moisture content. The following testing will be required on the waste encapsulation material:

- Particle size analysis;
- Atterberg Limits;
- Laboratory proctor compaction;
- Field density and moisture content; and
- Particle SG.

11.3.3 Geochemical Monitoring of Encapsulation

It is recommended that geochemical monitoring of the encapsulation system is installed to allow the effectiveness of the system to be measured and assessed throughout operations, allowing for design modifications if required. The geochemical monitoring system will determine the rate of oxygen reduction in the dumps and measure the temperature of the system to determine whether sulfide oxidation is occurring.

The geochemical monitoring system will comprise of air sampling points and thermistor strings installed within the dump during construction. The air sampling points simply comprise of flexible tubing laid into a trench cut into the top surface of the dump and backfilled with sand. Multiple tubes are installed in an array extending to various depths into the dump (nominally 1, 2, 5, 10, 15 and 20 m through the encapsulation layer) with the end point of each tube separated by a small bentonite grout plug poured into the trench. Air is sampled using a portable oxygen sampler to determine the effectiveness of excluding oxygen from the waste. If the encapsulation is fully effective, the process of sulfide oxidation in the dump consumes all the oxygen and the oxygen concentration reduces to zero.

The thermistor strings comprise temperature monitoring probes attached to a cable which can be placed in the waste to measure the temperature at various depths into the dump.

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11.3.4 Piezometers

Piezometers, either vibrating wire or standpipe, will be installed at regular intervals in the waste rock dumps. As the WRDs are raised, additional piezometers will be added at bench level.

The piezometers will be monitored at regular intervals as outlined in the monitoring programme and any rises in water level noted. Increases of greater than 10% of the WRD height should be referred to a qualified geotechnical engineer for further investigation. The piezometer levels should be monitored to ensure that the phreatic surface does not reduce the overall stability of the WRDs below acceptable levels. Remedial action will be undertaken if increases in pore water pressure are unacceptably high.

11.3.5 Monitoring Bores

Monitoring bores will be installed upstream and downstream of the WRDs to facilitate early detection of changes in groundwater level and/or quality, both during the operating life and following decommissioning.

Each monitoring bore station will consist of one shallow bore and one deep bore in order to monitor impacts at different depths.

Sampling and testing of groundwater will be undertaken at regular intervals as outlined in the monitoring programme and any changes in concentrations noted. Any increases above threshold values or long-term trends of increases in concentration of key elements should be referred to a qualified geotechnical engineer for further investigation.

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11.3.6 Surface Water Monitoring

Surface water monitoring points located upstream and downstream of the WRDs will be established and regularly monitored and tested. Any increases above threshold values or long-term trends of increases in concentration of key elements should be referred to a qualified geotechnical engineer for further investigation.

V-notch weirs or similar will be installed in major surface water channels to monitor flow rates.

11.4 TECHNICAL AUDIT

It is important that suitably qualified geotechnical advice is available during the operating life of the facility. The Client should keep the Engineer informed of the operating performance of the facility and raise any questions immediately.

The WRDs will require formal annual audits by a suitably qualified engineer and scientist to ensure that the facility is operating in a safe and efficient manner as well as meeting the necessary requirements for encapsulated storage of PAF and potential metal-leaching waste and development of long term stability of physical and vegetated covers and structures. The audit will include, but not be limited to, the following items:

- Current survey plan of WRD;
- Reconciliation of stored waste volume and calculated densities with the expected values given in the design, and assessment of available capacity remaining in terms of volume and time;
- Validation of storage design, using input parameters derived from site measurements and testing, implications for future storage if present trends are continued, and recommendations for any necessary operational or design modifications;
- Presentation and interpretation of monitoring results, proposals for additional monitoring of identified areas, changes to operational procedures resulting from monitoring results and proposals for any necessary seepage recovery systems;
- General description of facility, complete review of waste and water management practices and operating manual procedures, their problems, failures and successes, and any alteration to the facility or operating procedures that are proposed;
- An assessment of the slope stability monitoring undertaken and an assessment of the slope stability achieved through analysis of the monitoring results and visual inspection of the WRD;
- A complete description of the previous year of waste placement with as-built drawings and design proposals for the following year (as appropriate) based on the recorded data;
- Assessment of water flow and level data, analysis of water quality data obtained from surface and bore water samples and identification of any trends associated with the data;
- Evaluation of the performance of drainage structures and their competence and recommendations for improvement of design or remediation of existing structures; and
- An evaluation of the landscape function achieved by the rehabilitation that has been undertaken.

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A comprehensive Audit Report will be prepared and submitted to the Client following each annual audit site visit.

11.5 INCIDENCES AND REPORTING

In the operation of the WRD there are many potential incidences that should be recorded; however, the reporting of such incidences is spilt into two categories:

- Reportable internally – these are incidents that may affect the day to day operations of the facility and are generally relatively minor; and
- Reportable externally – these are serious incidents that impact the environment and the health and safety of employees and the public. These are significant incidents and are reportable by law to the relevant government agency.

As externally reportable incidents are extremely wide ranging, reference should be made to suitable published documents to determine which incidents may be applicable to the facility. Additionally, it is considered that should the licensed conditions be breached then it is likely to be an incident that is externally reportable.

Regardless of the reportable status of an incident, the incident can be split into three general categories:

- Environmental;
- Structural; and
- Health and Safety (Personnel or Public).

Reporting of incidents is an extremely important task as part of the safe construction and operation of waste rock dumps. However, the procedure for reporting should not be one that is prescribed but one that is developed by the Client within the organisation as it is more likely in this way that the procedure will be adopted. However, for general guidance a reporting procedure should include the following:

- Which reporting category is appropriate to the incident;
- If external reporting is appropriate, review specific procedure and implement as appropriate;
- For internal reporting the following should be considered:
  - Which general category is appropriate to the incident;
  - Description of the incident including;
  - Location, date, time, weather conditions, result (damage) and potential cause of the incident.

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- Description of remedial actions to be taken to rectify the incident;
- Description of precautionary measures to be taken to prevent re-occurrence of incident; and
- Review of remedial and precautionary measures once initiated, to assess whether they are achieving the desired result.

The intent of the register and the documentation of minor incidents, which will occur during operation, is to assist in preventing the minor incidents from re-occurring and conditions for major incidents developing.

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12. IMPLICATIONS FOR CURRENT DESIGN

12.1 GENERAL

The waste rock dump design has been progressed by MWMCL on the basis of a number of assessed and assumed parameters. As more information becomes available and more detailed assessments are made of the waste and its storage, the design should be refined. The following sections highlight elements of the current design that we consider should be reviewed in light of the information gathered and the analyses conducted for this report.

12.2 WASTE GEOCHEMISTRY

Geochemical testing of the waste rock to date has predominantly been from samples from around the pit shell. Data from the centre of the proposed open pit are limited. As such the geochemistry (acid forming and metal leaching potential) of the waste rock is poorly understood. The data that are available show a high acid-producing and metal-leaching potential and as such the waste rock dump design should be amended to provide encapsulation to securely contain the waste.

An encapsulation cell construction methodology has been provided which will meet the international good practice requirements for management of acid-forming and metal-leaching mine waste.

12.3 PROPORTION OF ENVIRONMENTALLY PROBLEMATIC MINE WASTE

Due to the lack of exploratory drilling in the hill areas and centre of the proposed open pit, the ratio of NAF to PAF waste is not clearly defined. The testing conducted to date suggests the waste will comprise approximately 71% PAF and 29% NAF. This has two significant impacts on the current design.

Firstly, a significant volume of PAF would be generated that needs to be managed and encapsulated in the waste dumps. This is time consuming and costly when compared to construction of NAF dumps.

Secondly, benign NAF is required to encapsulated the PAF as well as provide cover materials for the dumps on closure. With such a small relatively percentage of benign NAF, there is a risk of a shortfall in NAF material that will need to be made up by borrow of natural materials. Given that space within the site boundary is limited, consideration may need to be given to establishing external borrows and/or undertaken a major pre-strip operation of the waste dump footprints to win NAF materials in advance of waste dump construction. Both will have major cost implications for the project.

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It is therefore recommended that further exploratory drilling be completed as a matter of urgency in order to establish with reasonable certainty the geochemistry of the waste rock and the likely proportions of benign NAF, PAF and metal-leaching NAF materials that will require disposal in the waste dumps.

12.4 AVAILABILITY OF CLOSURE COVER CONSTRUCTION MATERIALS

The current design does not include for cover of the waste dumps other than placement of topsoil. On closure, a store and release cover system is proposed for the WRDs to limit water ingress and therefore reduce the long-term acid and metal generation by the dumps. Some 1 m of low permeability compacted soil liner and 1.5 to 2.0 m of relatively permeable fill will be required to construct the cover, in addition to a 400 mm layer of soil.

As mentioned above, there may be a shortage of benign NAF materials from the open pit and what is available will first be used for WRD construction and encapsulation of PAF waste. There is a risk of a material shortfall on closure which could impact the ability of MWMCL to achieve adequate decommissioning and rehabilitation of the site.

In addition to the further site investigation in the open pit area, identification and investigation of potential borrow sources for low permeability materials and capping should be completed together with a construction materials balance for the site. It is recommended that this be done in advance of establishing the heap leach pads and waste rock dumps as it may be necessary to borrow materials from the footprints of those areas prior to construction.

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12.5 VOLUMETRICS AND FOOTPRINTS

The existing waste dump design[20] utilises a bulk density in the waste dumps of approximately 2 t/m^3. Given the materials and experience from similar conditions on other sites, achieving this density is considered unlikely. Overall waste rock management and optimisation of the dumps to take into account a lower density is necessary to ensure that available areas for storage of waste do not impact on MWMCL's ability to extract the economic ore.

We recommend that the design of the waste dumps in 3D be reviewed and revised to incorporate the recommendations in this report and potential lower density for the placed waste. For initial review, we suggest densities in the range 1.6 to 1.8 t/m^3 be considered.

[20] Basic Design – Volume 1 Specification, China Nerin Engineering Co., Ltd, June 2011.

12.6 BATTER SLOPES

The existing design utilises local slopes of 1V:2.5H and overall waste dump batters of 1V:2.9H. Whilst this has been shown by preliminary analyses to be geotechnically stable there are a number of practical aspects that may warrant flatter slopes.

A closure cover system has to be installed on the WRDs to limit water ingress. To achieve this, a compacted soil liner is to be placed together with a store and release cover. Earthworks equipment cannot work directly on local slopes steeper than about 1V:3H. As such, the closure cover will need to be installed by placing the fill in benches progressively up the slopes. Because of required working widths, additional fill will be needed to achieve this when compared to fill placed on flatter slopes. This fill requirement will place extra demand on an already limited resource and will also significantly increase the closure costs as the placement of fill in this manner is slow and more onerous.

Such steep slopes also limit post-closure land-use options. Grazing is not considered appropriate on slopes steeper than 1V:3H and access also becomes difficult in such terrain.

We therefore recommend that consideration be given to flattening slopes in order to reduce closure costs and also to ensure a more sustainable end land-use for the site.

Note that due to the need to encapsulate PAF waste and also provide progressive rehabilitation, the final slope angles should be fixed and incorporated into construction of the WRDs. It is not something that can be addressed on closure by reshaping of batters due to the cost and footprint requirements.

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13. CONCLUSIONS AND RECOMMENDATIONS

Preliminary design of key elements of the waste rock dumps has been completed. The main conclusions of the work are:

i. Geotechnical conditions in the proposed waste dump areas are poorly understood due to a lack of site investigation. Preliminary stability analyses using available data have not shown any significant issues under static loading conditions, but further investigation is needed to confirm design assumptions.

ii. Simplified pseudostatic analyses show that stability during OBE and SEE seismic events is marginal. These loading cases need to be analysed in more detail using more advance methodologies such as FLAC or PLAXIS software.

iii. Data on the physical and geochemical properties of the waste are limited and further investigation of the open pit area is needed to confirm design assumptions.

iv. The available data suggest a significant acid-generating and metal leaching potential for a large proportion of the waste that will be produced. The PAF and metal leaching NAF waste will need to be encapsulated during operations with intermediate and final engineered covers comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The final encapsulation material will need to be covered by a store and release cover constructed from benign waste or borrow material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the low permeability cover.

v. The data collected to date on composition of waste suggests a high proportion of PAF and metal leaching NAF will be generated but only a small quantity of NAF. This may result in a shortfall of materials for encapsulation of wastes and for construction of the closure cover system. A materials balance based on up-to-date site investigation is urgently needed as materials may need to be borrowed from the footprints of the heap leach pads and/or the waste rock dumps prior to construction.

vi. There are some uncertainties regarding the ability to store the total amount of waste within the footprints currently designated when the recommendations of this report are considered and a more appropriate bulk density is adopted for waste dump design. A review of storage volumes and necessary footprint areas is urgently needed.

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vii. Assessments suggest the current design profile of 1V:2.5H local slopes and 1V:2.9H slopes will be geotechnically stable but that consideration needs to be given to flattening these slopes in order to reduce overall life of mine costs as construction of the cover system and rehabilitation costs will increase significantly for local slopes steeper than 1V:3H.

The waste dump design now needs to be progressed to detailed design. In order to achieve this we make the following recommendations:

i. Undertake site investigations in the WRD foundation areas to assess geotechnical properties.

ii. Update the stability analyses with the new data and undertake a more detailed analysis of performance under SEE loading conditions using FLAC or PLAXIS software.

iii. Undertake site investigations around the site to identify construction material resources and prepare a materials balance for the site.

iv. Additional geochemical assessment should be conducted to better quantify the amount of potentially acid-generating and/or metal-leaching material which will be encountered during the first year(s) of operations to allow detailed waste management planning.

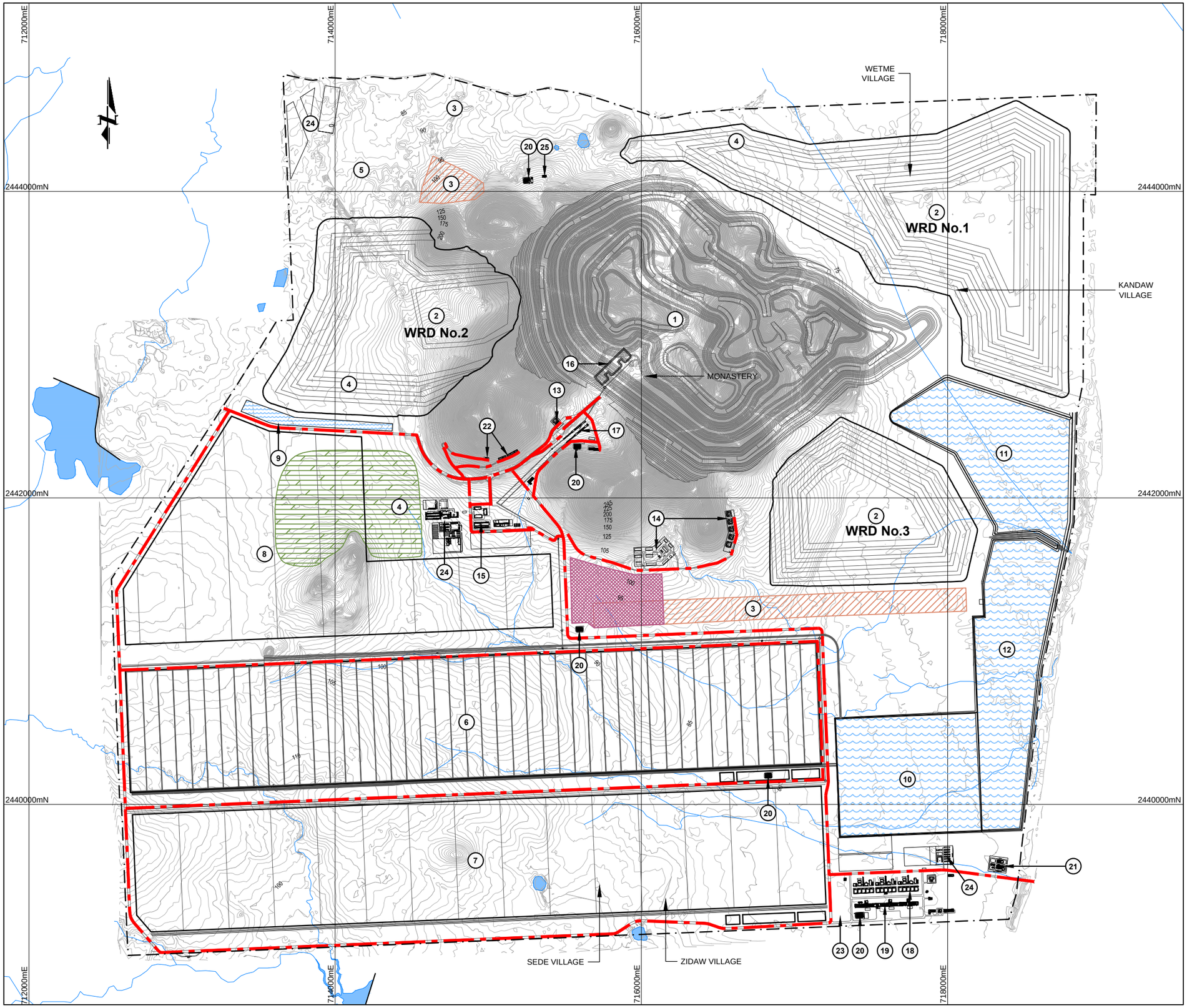
v. Undertake kinetic testing of waste rock samples to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.

vi. Complete an optimisation of the WRD design that incorporates encapsulation of PAF and metal leaching NAF waste, addresses issues with footprint setbacks, slope angles and potential construction materials shortfall, and provides a suitable footprint layout within the site constraints.

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FIGURES

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LEGEND:

- EXISTING POWER LINE
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LETPADAUNG LEASE BOUNDARY
- SITE ROAD ALIGNMENT

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 1m CONTOUR INTERVALS SHOWN.

KEY:

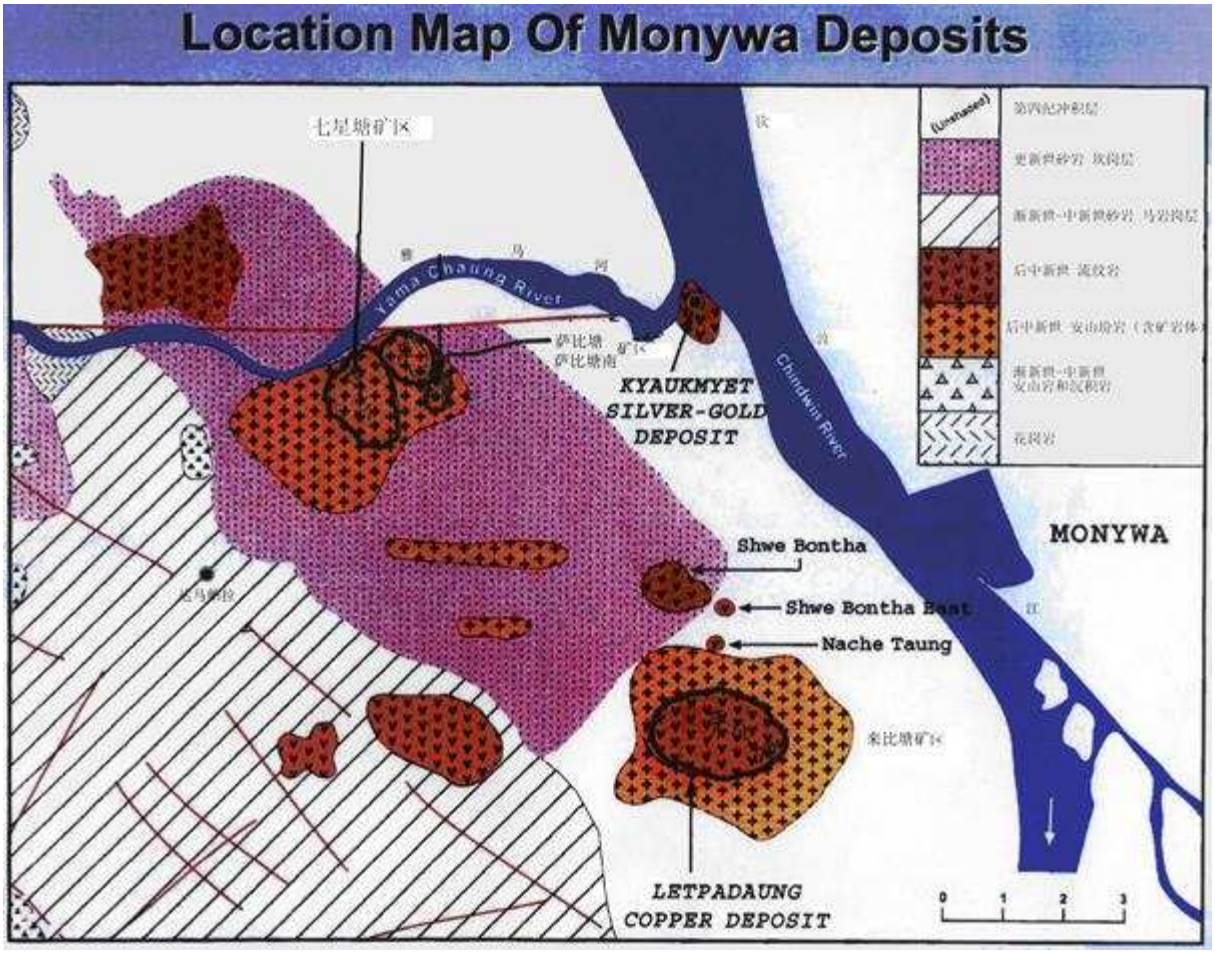
1	PIT
2	WASTE DUMP
3	TOPSOIL STOCKPILE
4	LOW GRADE ORE STOCKPILE
5	RESERVE ORE STOCKPILE
6	HEAP LEACH PAD No.1
7	HEAP LEACH PAD No.2
8	HEAP LEACH PAD No.3
9	WASTE WATER COLLECTION POND
10	HEAP LEACH STORM WATER POND
11	WASTE WATER RESERVOIR (NORTH)
12	WASTE WATER RESERVOIR (SOUTH)
13	FUEL STATION
14	EXPLOSIVES AREA
15	OFFICES/ WAREHOUSES/ MAINTENANCE AREA
16	MOBILE CRUSHER FOR QUARRY
17	CONVEYOR FOUNDATIONS
18	EXTRACTION PLANT
19	ELECTROWINNING PLANT
20	33Kv SUBSTATION
21	230kV SUBSTATION
22	WATER PURIFICATION AREA
23	ACID STORAGE AREA
24	STAFF ACCOMMODATION
25	2Mw DIESEL POWER STATION

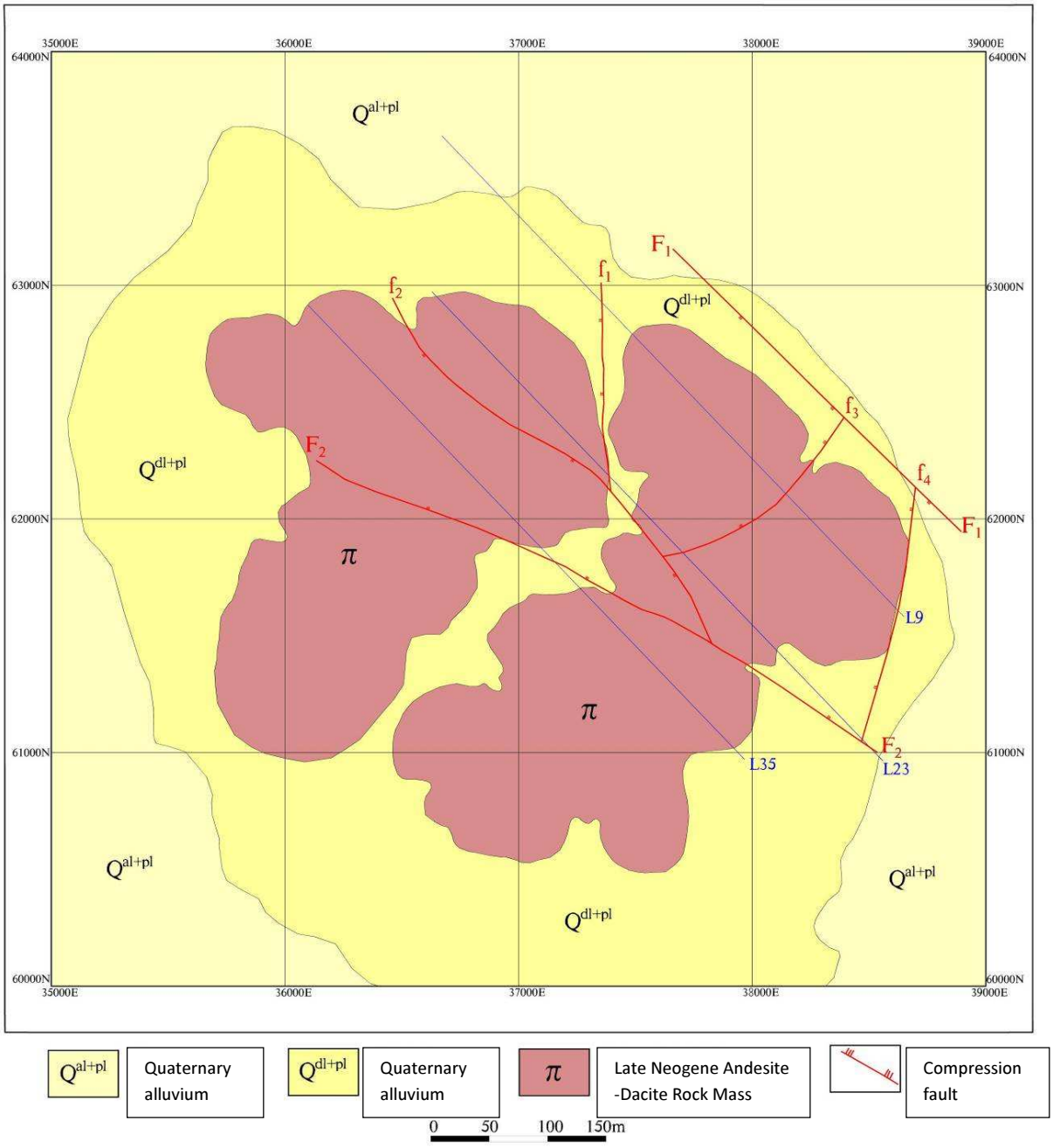
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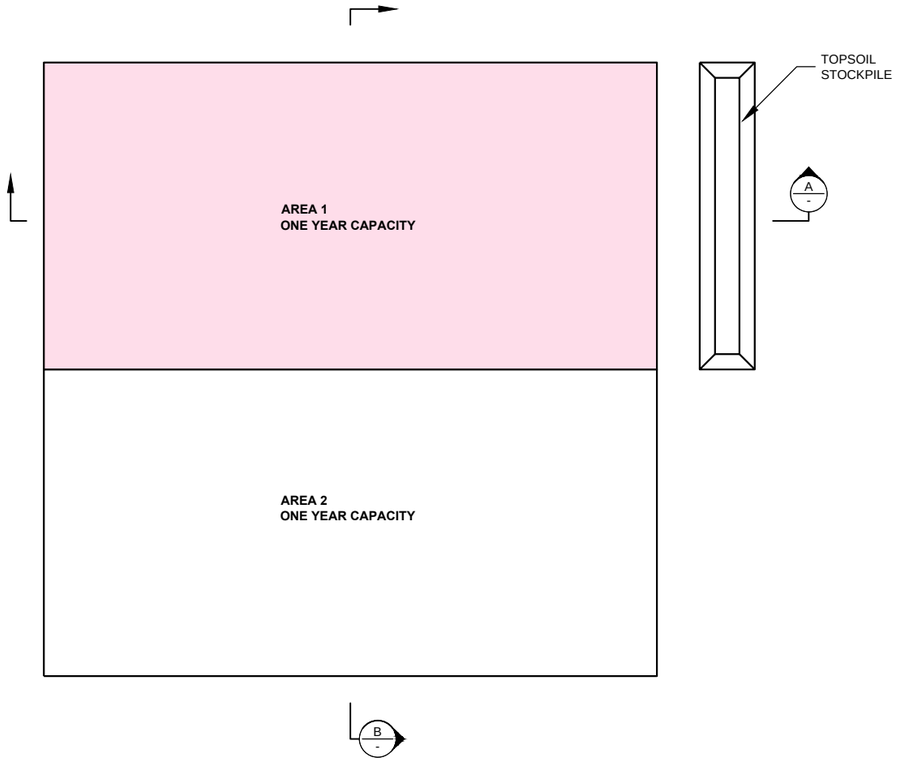
LETPADUANG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
SITE GENERAL ARRANGEMENT

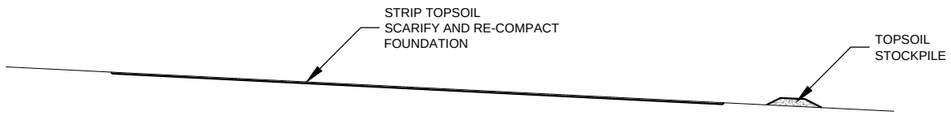
Ref: PE701-00022/19
Figure 1.1


Location Map Of Monywa Deposits
七星塘矿区
Yama Chaung River
KYAUKMYET
SILVER-GOLD
DEPOSIT
Chindwin River
MONYWA
Shwe Bontha
Shwe Bontha East
Nache Taung
LETPADAUNG
COPPER DEPOSIT
0 1 2 3

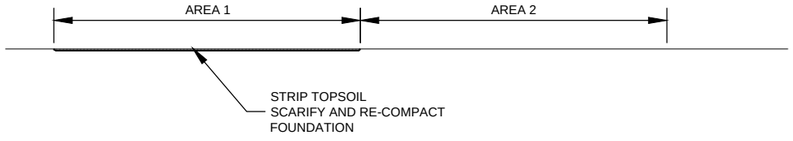

35000E
36000E
37000E
38000E
39000E
64000N
63000N
62000N
61000N
60000N
Q^{al+pl}
Q^{dl+pl}
π
F_1
F_2
f_1
f_2
f_3
f_4
L9
L35
L23
Quaternary alluvium
Quaternary alluvium
Late Neogene Andesite -Dacite Rock Mass
Compression fault
0 50 100 150m

STEP 1:



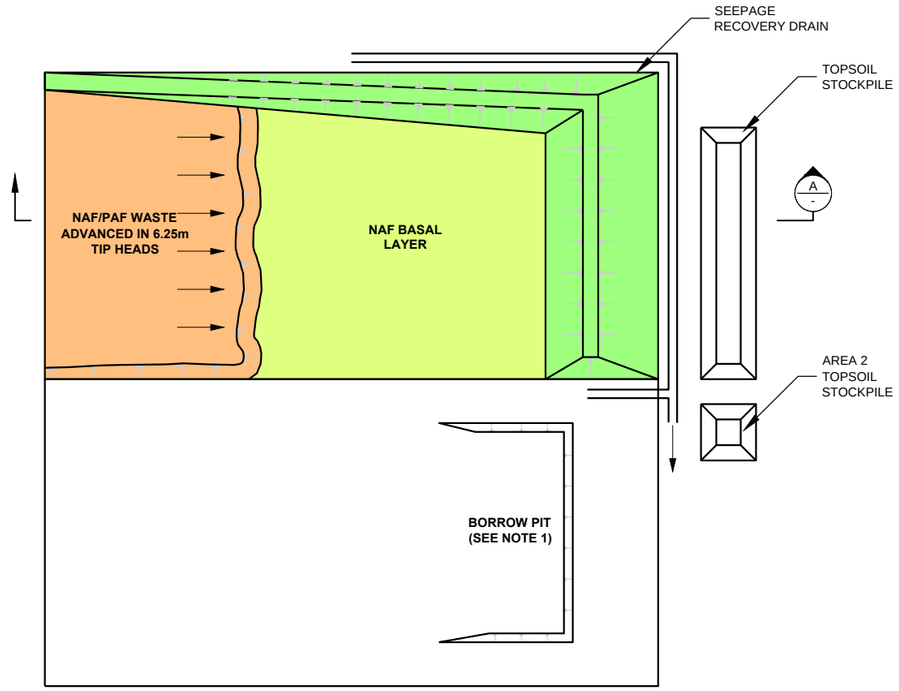


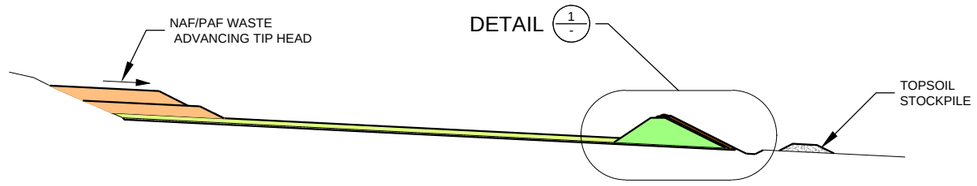
SECTION A - SCALE N.T.S.



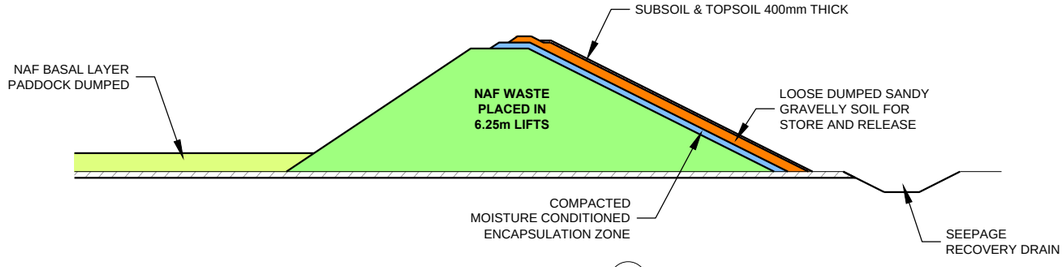
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STEP 2:





SECTION A - SCALE N.T.S.

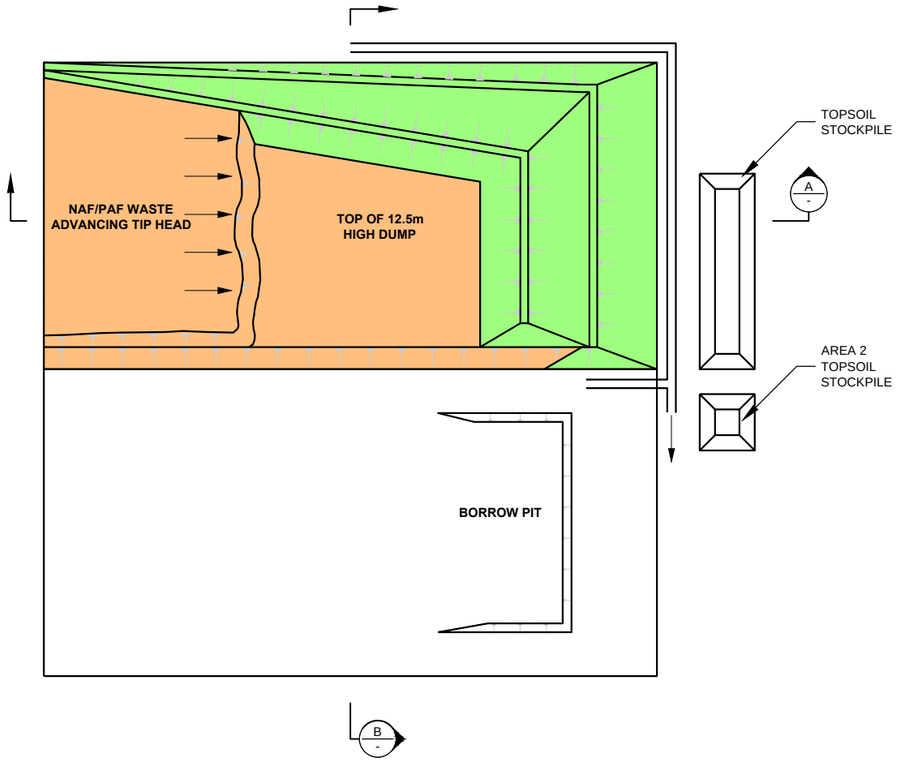


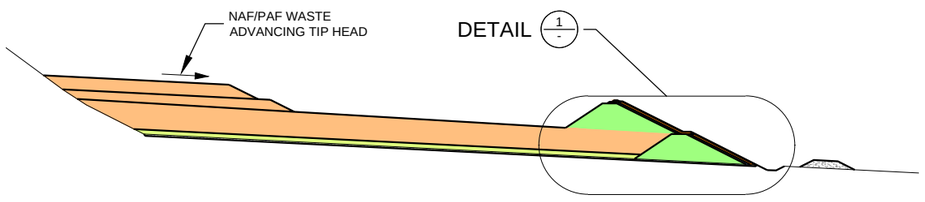
DETAIL 1 - SCALE N.T.S.

NOTE:

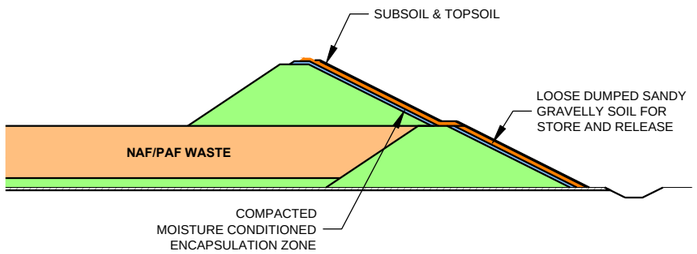
1. BORROW PIT IN NEXT WASTE DUMP AREA TO SUPPLY ENCAPSULATION MATERIAL AND STORE AND RELEASE ZONE.
2. LOCAL OUTER BATTER SLOPE ANGLES TO BE CONFIRMED.

STEP 3:



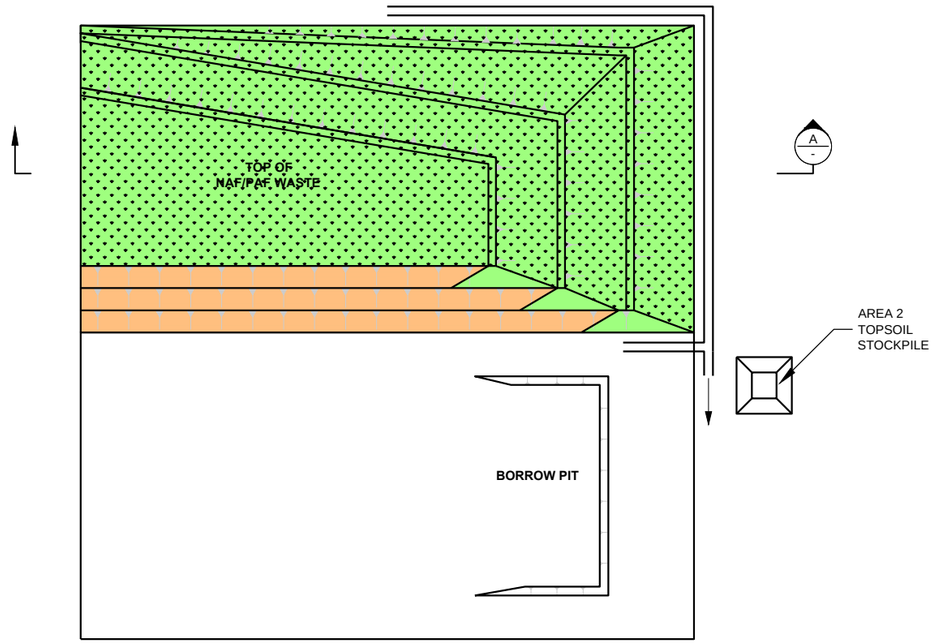


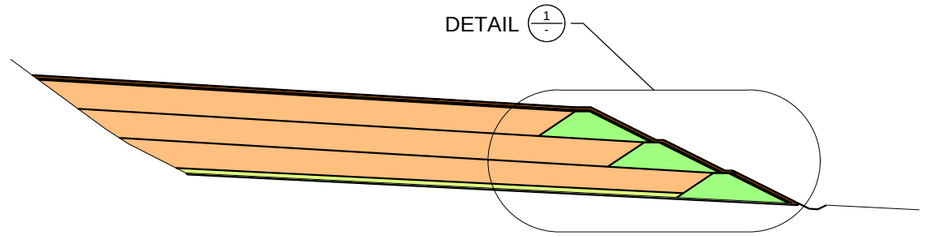
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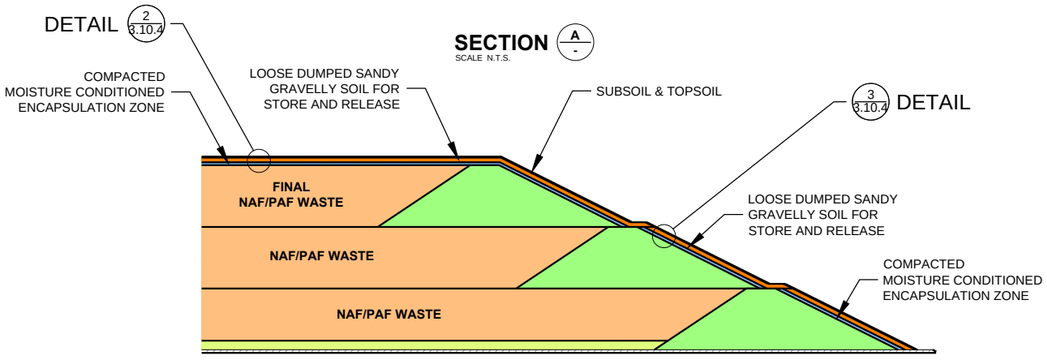
DETAIL 1 - SCALE N.T.S.

STEP 4:



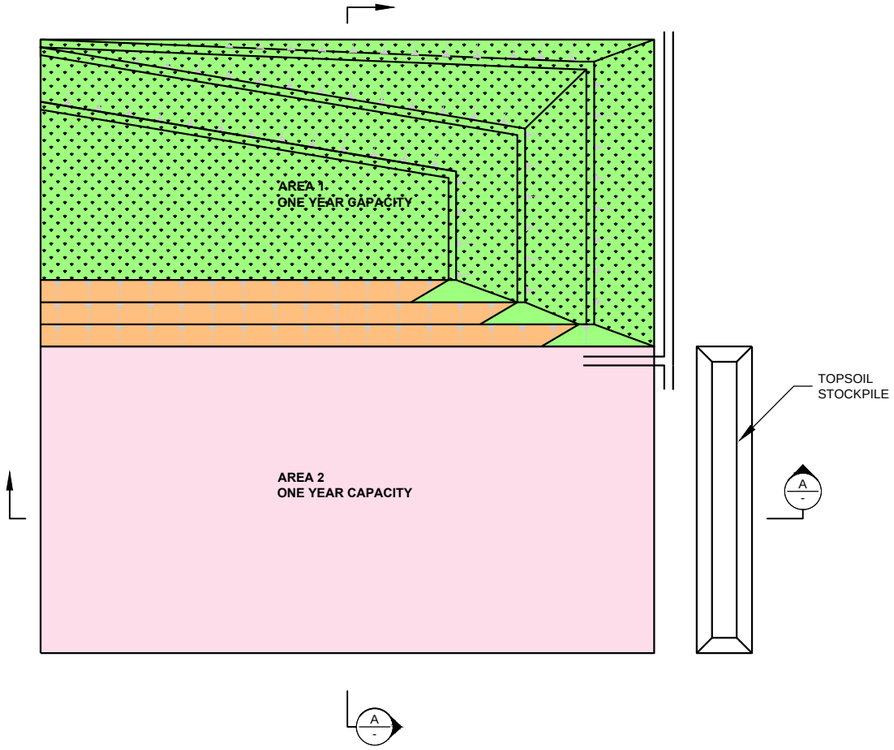


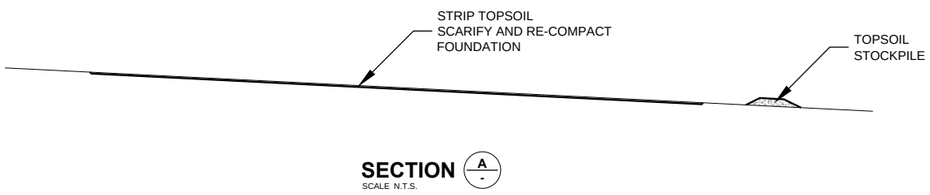
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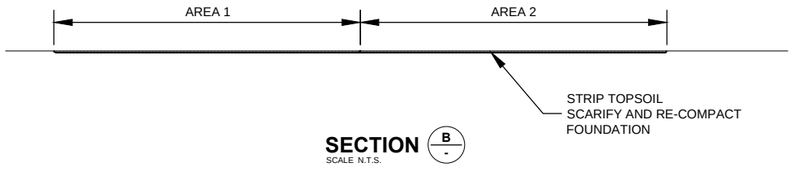
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STEP 5:



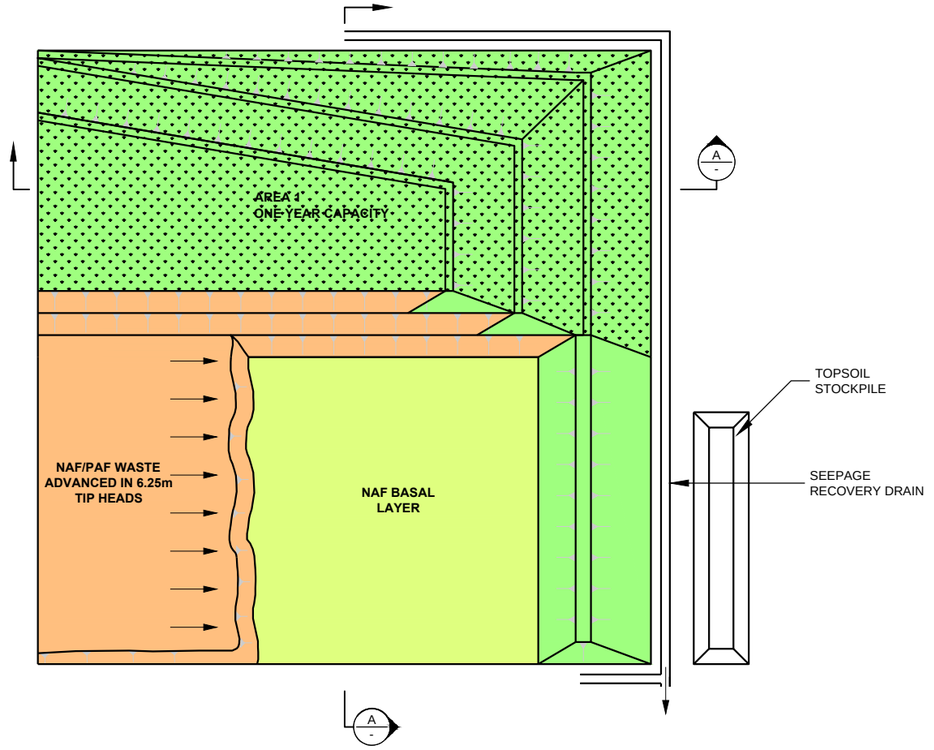


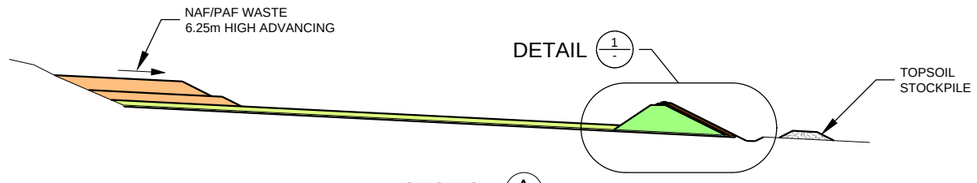
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SCALE N.T.S.



SECTION B -
SCALE N.T.S.

STEP 6:

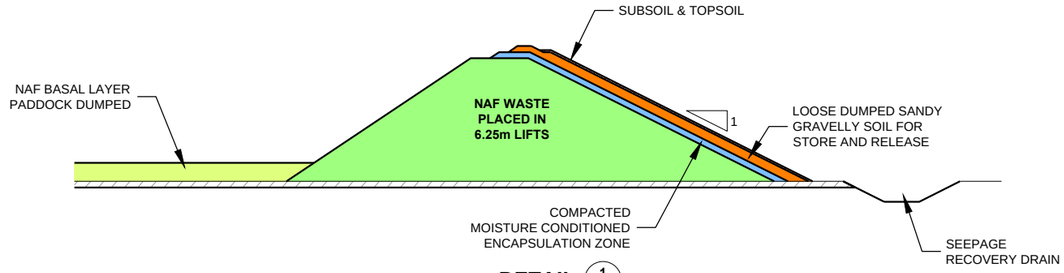




SECTION A -
SCALE N.T.S.



SECTION B -
SCALE N.T.S.



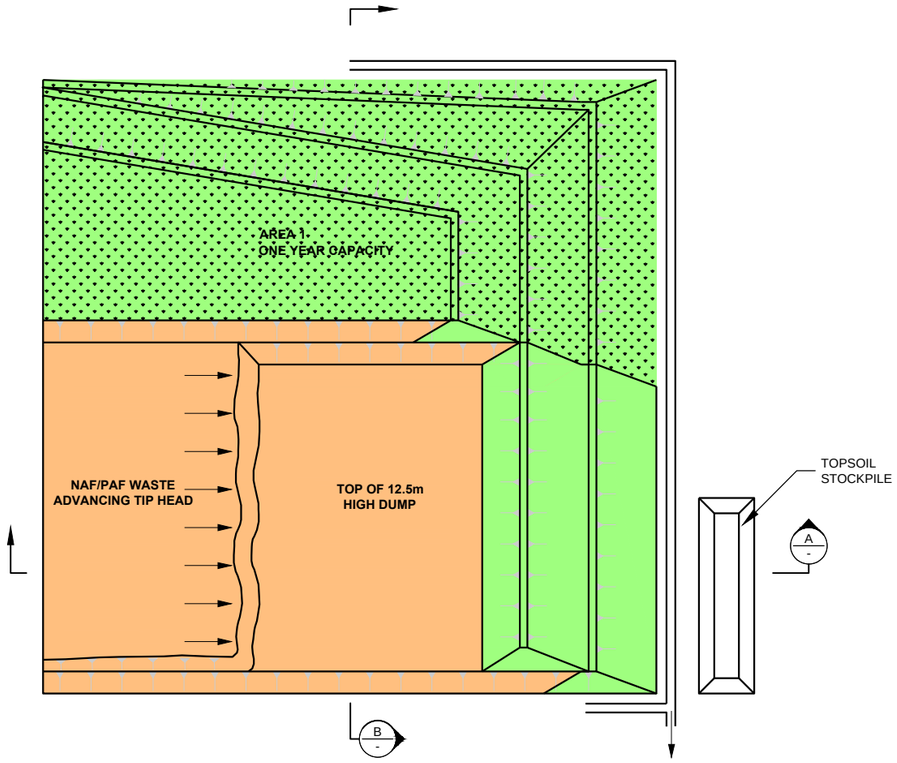
DETAIL 1 -
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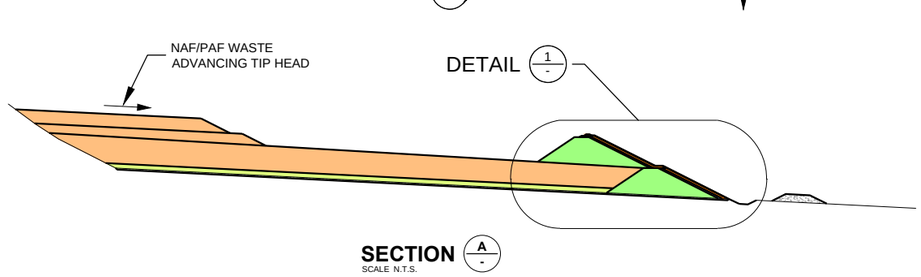
Knight Piésold CONSULTING

LETPADAUNG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
MINE WASTE MANAGEMENT STRATEGY (STEPS 5 & 6)

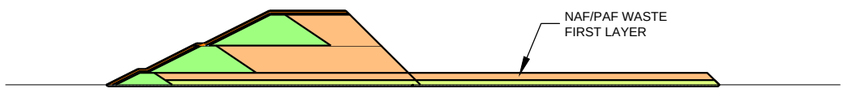
Ref: PE701-00022/19
Figure 7.3

STEP 7:

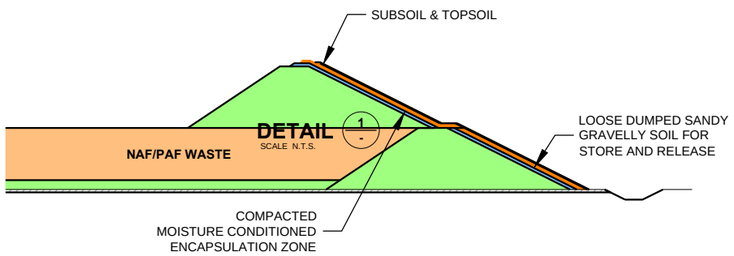




SECTION A
SCALE N.T.S.

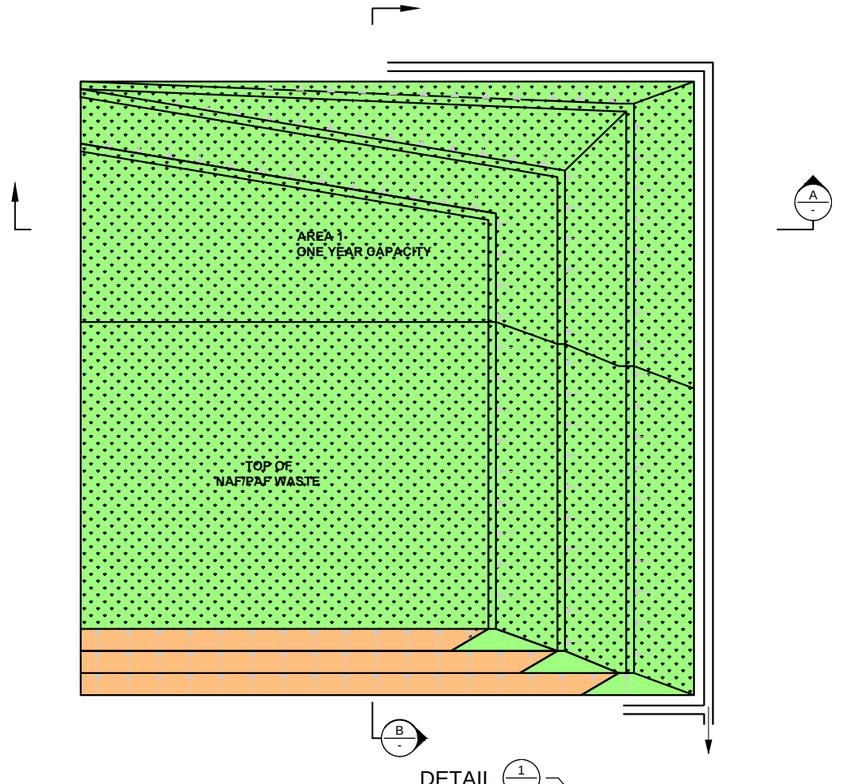


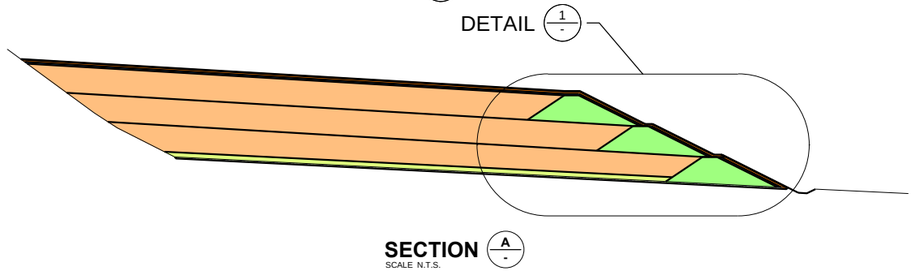
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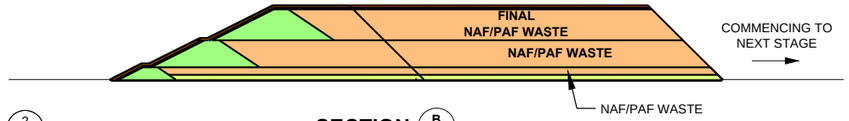
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STEP 8:

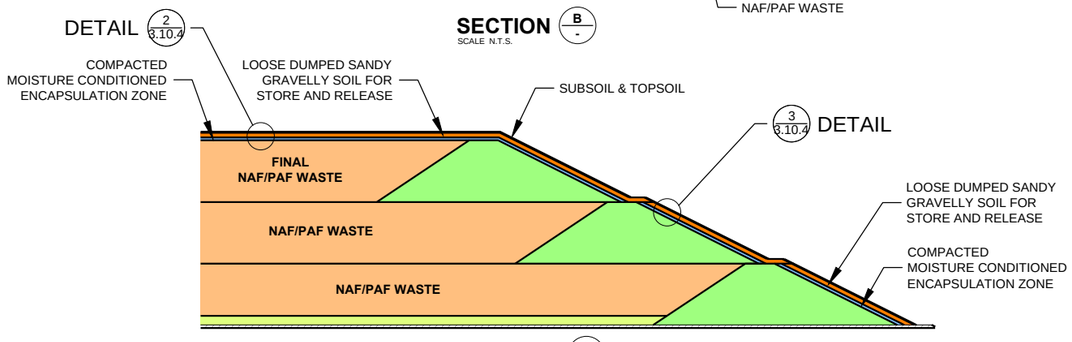




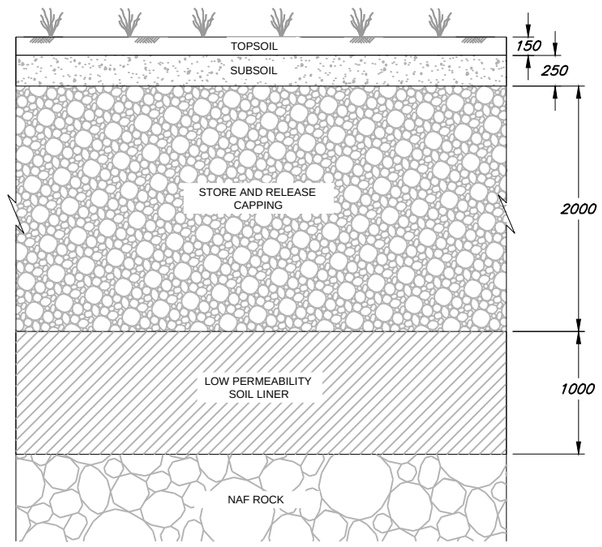
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SCALE N.T.S.



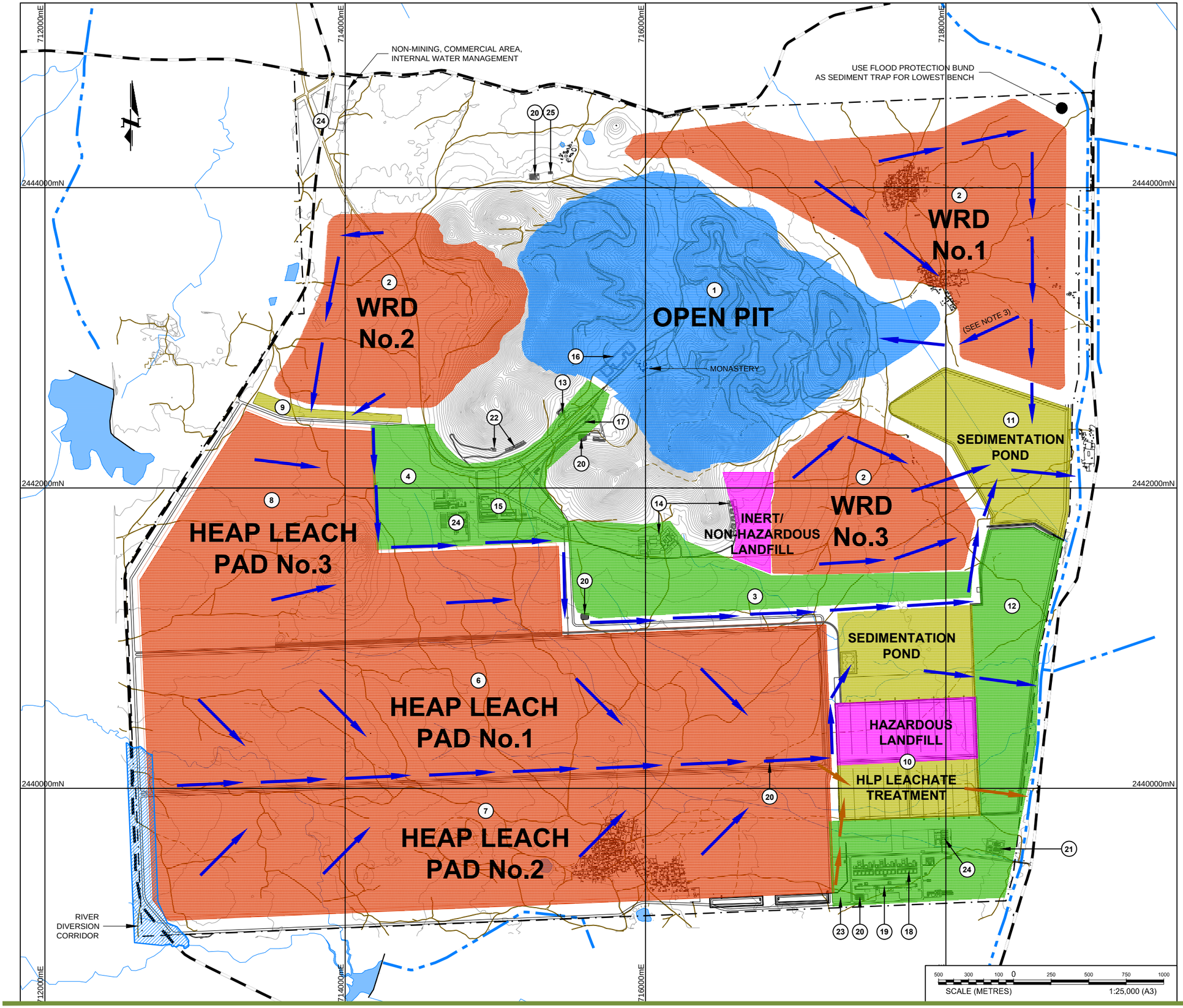
SECTION B
SCALE N.T.S.



DETAIL
1
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SCALE N.T.S.



WASTE ROCK DUMPS



LEGEND:

- EXISTING CANAL
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LEASE BOUNDARY
- RIVER DIVERSION CORRIDOR
- CLOSURE SURFACE WATER FLOWS
- CLOSURE HLP LEACHATE POLISHING

LAND USE LEGEND:

- PIT AND PIT LAKE
- SCRUB/GRAZING
- LANDFILL (FENCED OFF GRASS COVER)
- PONDS (INITIALLY - MAY BECOME AGRICULTURAL USE OVER TIME)
- AGRICULTURAL USE

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 5m CONTOUR INTERVALS SHOWN.
3. IF REQUIRED TO MAINTAIN OPEN PIT LAKE LEVELS, SURFACE WATER RUN-OFF FROM WRD No.1 TO BE DIRECTED INTO THE PIT.

KEY:

1. PIT
2. WASTE DUMP
3. TOPSOIL STOCKPILE
4. LOW GRADE ORE STOCKPILE
5. RESERVE ORE STOCKPILE
6. HEAP LEACH PAD No.1
7. HEAP LEACH PAD No.2
8. HEAP LEACH PAD No.3
9. WASTE WATER COLLECTION POND - CLAY
10. HEAP LEACH STORM WATER POND - HDPE
11. WASTE WATER RESERVOIR (NORTH) - CLAY
12. WASTE WATER RESERVOIR (SOUTH) - CLAY
13. FUEL STATION
14. EXPLOSIVES AREA
15. OFFICES/ WAREHOUSES/ MAINTENANCE AREA
16. MOBILE CRUSHER FOR QUARRY
17. CONVEYOR FOUNDATIONS
18. EXTRACTION PLANT
19. ELECTROWINNING PLANT
20. 33Kv SUBSTATION
21. 230kV SUBSTATION
22. WATER PURIFICATION AREA
23. ACID STORAGE AREA
24. STAFF ACCOMMODATION
25. 2Mw DIESEL POWER STATION

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LETPADUANG COPPER PROJECT
PRELIMINARY WASTE ROCK DUMP DESIGN
CLOSURE LAND-USE AND SURFACE WATER MANAGEMENT

Ref: PE701-00022/19
Figure 9.2

APPENDIX A

Baseline Design Climatology (KP Memo PE13-00538)

Knight Piésold
CONSULTING

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MEMORANDUM

To:	**MYANMAR WANBAO MINING COPPER LTD (MWMCL)**	**Date:**	5th July 2014
Attn:	Glenn Wallis	**Our Ref:**	PE13-00538
		KP File Ref.:	**PE701-22/4-A bl M13010**
cc:		**From:**	Brett Loney

RE: LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY

Please find herein baseline design climatology that has been developed for the Letpadaung project site in Myanmar. The investigation and calculations discussed herein provide the preliminary hydrologic basis for on-going and future design work.

1. DATA SOURCES

Historic climate data from four separate locations were used in deriving baseline design climate estimates. The stations, illustrated on Figure 1.1, are:

- Monywa Township climate station, which is located 5.6 kilometres (km) northeast of Letpadaung Hill. At the time this memorandum was written, Knight Piésold (KP) was unable to confirm the precise location and elevation of this monitoring station; accordingly the location shown in Figure 1.1 was assumed to be within the city of Monywa. Daily precipitation data from this station provided by Myanmar Wanbao Mining Copper Ltd. (MWMCL) cover the period (1961–2013).
- Yangtse climate station, which is located 7.6 km northwest of Letpadaung Hill at the Sabetaung and Kyisintaung (S&K) operations site. Monthly pan evaporation data from this station which was previously collected by KP whilst working on the (S&K) project and subsequently extended by MWMCL cover the period (2000-2013).
- World Meteorological Organization (WMO) climate station number 48037, which is located 4.7 km northeast of Letpadaung Hill. Although the location shown on Figure 1.1 accurately depicts WMO records, KP suspects that the actual location of this station is somewhere nearby and not on a sandbar in the Chindwin River as shown. Daily temperature data from this station was sourced by KP from the Research Data Archive (RDA) at the National Center for Atmospheric Research (NCAR), Computational and Information Systems Laboratory (CISL) in Boulder, Colorado USA. The daily temperature data span the period (1981-2012).
- The Wind Rose sampling point, which is located 0.9 km northwest of Letpadaung Hill; this location was used by Lakes Environmental Consultants (LEC) as a sampling point for extracting processed surface and upper air meteorological data from the results of the MM5 (5th generation Mesoscale Model) and SAMSON hourly surface meteorological datasets. More information about these datasets may be reviewed online at:
  - MM5, refer to http://www.mmm.ucar.edu/mm5/mm5-home.html and
  - SAMSON, refer to http://www.webmet.com/MetGuide/Samson.html.

  Hourly wind speed, wind direction and precipitation data from this source span the period (2010-2012).

2. PRECIPITATION ANALYSIS

Precipitation data from the Monywa Township and Wind Rose sampling point datasets were reduced into a standardised format and then analysed on annual, monthly, and daily time scales as appropriate. Annual data is used for climate characterisation and evaluation of climate change. Monthly data is used primarily for water balance modelling purposes. Daily data is used to derive design storms for sizing water conveyance infrastructure: spillways, channels, etc. The following sections detail the various analyses conducted and the results achieved.

2.1 ANNUAL PRECIPITATION ANALYSIS

Daily precipitation records from the Monywa Township climate station were summed to produce annual totals for the entire period of available record. Incomplete years of record were excluded from the analysis if 15% or greater of the values in that year were missing (approximately two months). This was done to prevent sampling bias from distorting the results. Sampling statistics were computed on these annual sums to provide a broad overview of the variability of annual precipitation in the region surrounding the project site, as given in Table 2.1.

Table 2.1: Annual precipitation statistics – Monywa Township (1961-2013)

Selected Statistic	Statistic[*1] Value
Average number of rain days	65
Average (mm)	774
Median (mm)	727
Std. Deviation (mm)	230
Minimum (mm)	411
Maximum (mm)	1,370
25th Percentile (mm)	610
75th Percentile (mm)	894
Count (yr)	50
Distance to site (km)	5.6

*1 Incomplete data from 1995, 1999 and 2013 were excluded from this analysis.

The sample statistics for annual precipitation at this site were also depicted graphically, as a “box and whisker” plot to illustrate the variability of annual precipitation, as shown on Figure 2.1. For each year shown, the “box and whisker” plot is read as follows:

- Top of each “box” indicates the 75th percentile annual precipitation;
- Central line within each “box” indicates the median (or 50th percentile) annual precipitation;
- Bottom of each “box” indicates the 25th percentile annual precipitation;
- Red diamond inside each “box” indicates the average annual precipitation;
- The “whiskers”, each of length 1.5 times the inter-quartile range (which is the 75th minus the 25th percentile values) indicate the range of expected readings above and below each “box”. Values above and below the “whiskers” are considered to be outliers; and
- Individual yearly outlier values are indicated as blue crosses with values adjacent.

Details of the annual precipitation analysis are given in Attachment 2.1.

2.2 MONTHLY PRECIPITATION ANALYSIS

Daily precipitation records from the Monywa Township dataset were summed in a manner similar to that described in Section 2.1 to produce monthly totals. Incomplete months of record were excluded from the analysis if 25% or greater of the values in that month were missing (approximately one week). As described in Section 2.1, data exclusions were made to prevent sampling bias. Sampling statistics were computed on the values to describe the variability of monthly precipitation at the project site, as given in Table 2.2.

Table 2.2: Monthly precipitation statistics – Monywa Township (1961-2013)

Month	Average (mm)	Median (mm)	Std. Dev. (mm)	Min. (mm)	Max. (mm)	25th Pct. (mm)	75th Pct. (mm)	Average # of Rain Days*1
Jan	2	0	6	0	31	0	0	0
Feb	3	0	15	0	102	0	0	0
Mar	5	1	14	0	96	0	5	1
Apr	26	21	22	0	100	9	38	4
May	102	94	70	12	386	54	141	9
Jun	100	72	79	0	342	42	129	9
Jul	67	59	43	2	182	34	83	8
Aug	121	103	80	0	356	64	172	10
Sep	166	150	89	47	496	99	212	11
Oct	142	136	95	15	513	83	180	10
Nov	33	12	44	0	186	0	45	3
Dec	6	0	17	0	85	0	2	1

*1 Incomplete data from 1995 (January – June), 1999 (January – April) and 2013 (June – December) were excluded from this analysis.

The sample statistics for monthly precipitation from the Monywa Township dataset were also depicted as a “box and whisker” plot to illustrate the variability of monthly precipitation at the project site, as shown on Figure 2.2. September is the wettest month of the year onsite and the primary wet season starts (on average) about the beginning of April and finishes at the end of November. Accordingly, the wet season typically lasts 8 months out of each year, with the remaining 4 months experiencing negligible rainfall. Details of the monthly precipitation analysis are given in Attachment 2.2.

2.3 DAILY PRECIPITATION ANALYSIS

KP performed frequency analysis on daily precipitation data (from the Monywa dataset) to estimate the statistical likelihood of experiencing extreme short-duration storms at the project site. A large number of different probability distributions, e.g.: Log-Pearson 3, Generalised Extreme Value (GEV), Generalised Logistic, Wakeby, Burr, etc. were fitted to the annual maxima of the daily precipitation data using EasyFit Professional 5.4 software (Ref. 1).

Three of the best fits were selected for comparison, as shown on Figure 2.3. Based on the comparison, and to maintain compatibility with other *n* day duration frequency analyses, discussed in Section 2.6, KP selected the GEV fit for use at the Letpadaung site. The results of the GEV fit to historic precipitation records are given in Table 2.3 and details of the daily precipitation frequency analysis are given in Attachment 2.3.

KP notes that frequency is generally expressed as Average Recurrence Interval (ARI), measured in years.

Table 2.3: Extreme daily (24-h) design precipitation

Annual Exceedance Probability (AEP)[*1]	Annual Recurrence Interval (ARI) (yr)	24-h Duration Precipitation	
		Uncorrected Depth (mm)	Corrected[*2] Depth (mm)
0.001	1,000	194	222
0.002	500	184	211
0.005	200	170	195
0.010	100	159	182
0.020	50	147	168
0.050	20	131	149
0.100	10	117	134
0.200	5	102	117
0.500	2	79	90

*1 AEP calculated using the Weibull probability plotting formulation.

*2 Values have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref. 2).

KP utilized the daily design precipitation information in Table 2.3 to derive Intensity / Duration / Frequency (IDF) curves for short duration storms. The rainfall ratio method as given in (Ref. 3) was employed for this purpose. By using tabulated fitting coefficients from (Ref. 4) for the most similar (in climate) listed location (Phnom Penh, Cambodia) and correction factors for 24, 48 and 72 hour duration storms taken from (Ref. 2); KP obtained estimates for the Letpadaung project site, as given in Table 2.4 and illustrated on Figure 2.4.

(KP notes that the world maximum intensity / duration envelope, taken from (Ref. 5) is shown on Figure 2.4 for purposes of comparison.)

Table 2.4: Letpadaung intensity / duration / frequency results

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm[*1]							
	2	5	10	20	50	100	200	500
5 min	157	205	235	262	295	319	341	369
10 min	128	167	192	214	241	260	279	302
15 min	109	142	163	182	205	221	237	256
30 min	76	99	114	127	143	154	165	178
1 h	49	63	72	81	91	98	105	114
2 h	29	38	43	48	55	59	63	68
3 h	21	28	32	35	40	43	46	50
6 h	12	16	18	20	23	24	26	28
12 h	7	9	10	11	13	14	15	16

*1 Intensity values are shown rounded to the nearest mm/h.

Table 2.4: Letpadaung intensity / duration / frequency results, cont'd

Storm Duration	Precipitation Intensity (mm/h) for given ARI (year) Storm[*1]							
	2	5	10	20	50	100	200	500
18 h	5	6	7	8	9	10	10	11
24 h[*2]	4	5	6	6	7	8	8	9
48 h[*3]	2	3	3	4	5	5	6	6
72 h[*4]	2	2	3	3	4	4	5	6

*1 Intensity values are shown rounded to the nearest mm/h.

*2 Intensity values for 24 hour duration storms have been augmented 14.3% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily and sub-daily design storm estimates (Ref. 2).

*3 Intensity values for 48 hour duration storms have been augmented 6.7% (Ref. 2).

*4 Intensity values for 72 hour duration storms have been augmented 4.4% (Ref. 2).

Details of the IDF curve analysis are given in Attachment 2.4.

2.4 TEMPORAL DISTRIBUTION OF PRECIPITATION

KP analysed the hourly precipitation data from the Wind Rose sampling point dataset (2010-2012) to determine the temporal distributions (i.e. hyetographs) of short-duration storms to be used with the IDF results from Section 2.3 in rainfall-runoff modelling. For candidate storm durations ranging from 2 to 45 hours (the longest storm identified in the historic dataset was 45 hours), the hyetograph analysis entailed the following steps:

- Delineate all storms of *n* duration (where *n* is the candidate duration, measured in integer hours).
- Convert hourly readings within each delineated storm of *n* duration to a cumulative percentage basis; this puts the *n* hour storms on a dimensionless basis.
- Select all *n* hour dimensionless storms with total precipitation equal to or exceeding the 85th percentile of all *n* hour storms; which restricts derived hyetal patterns to those associated with heavy rainfall. Then, compute averages for every hour within the selected subset of *n* hour storms. The results of these computations are the dimensionless design hyetographs to be used in rainfall-runoff modelling.

The results of the analysis for a subset of the storms considered (durations ranging between 2 and 9 hours) are given in Table 2.5, with a typical hyetograph (for 4 hour storms) shown on Figure 2.5. Complete results of the Letpadaung hyetograph analysis (i.e. tabulated patterns for all 24 derived durations with corresponding hyetographs) are given in Attachment 2.5.

Table 2.5: Letpadaung hyetograph results for 2 through 9 hour storms

Elapsed Time (h)	Cumulative Percentage of Total Precipitation for *n* hour Storm							
	2	3	4	5	6	7	8	9
0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	55.3%	22.9%	15.3%	6.6%	8.1%	6.7%	0.9%	3.8%
2	100.0%	77.0%	56.2%	37.2%	24.3%	19.0%	4.7%	13.7%
3		100.0%	90.1%	67.8%	45.3%	43.0%	15.6%	34.9%
4			100.0%	93.7%	76.5%	70.1%	51.5%	63.4%
5				100.0%	97.1%	88.5%	73.8%	81.3%

Table 2.5: Letpadaung hyetograph results for 2 through 9 hour storms, cont'd

Elapsed Time (h)	Cumulative Percentage of Total Precipitation for *n* hour Storm							
	2	3	4	5	6	7	8	9
6					100.0%	98.4%	88.3%	88.9%
7						100.0%	97.5%	93.7%
8							100.0%	97.8%
9								100.0%

KP notes that hyetographs for intermediate durations may be estimated via interpolation, after the bounding storms have been put on a dimensionless temporal basis. Storm hyetographs for durations outside of the range given in Attachment 2.5 may be assumed as follows:

- Durations less than 2 hours should employ the 2 hour duration hyetograph, after scaling to the smaller duration;
- Durations in the range (45 h ≤ *n* ≤ 72 h) should employ the 45 hour duration hyetograph, after scaling to the larger duration; and
- Durations greater than 72 hours should not employ the derived hyetographs. Additional studies are required to estimate design hyetographs for long duration continuous storms.

2.5 PRECIPITATION TREND ANALYSIS

KP performed trend analysis on annual precipitation totals from the Monywa Township dataset (1961-2013) in order to ascertain potential impacts of trends in precipitation on planned site development. The results of this analysis, illustrated on Figure 2.6, show that there is no statistically significant trend observable in annual precipitation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future precipitation cycles due to observed climate change.

Details of the precipitation trend analysis are given in Attachment 2.6.

2.6 WATER BALANCE SCENARIOS

KP performed frequency analysis on precipitation values for 15 candidate water balance cycle durations to estimate the statistical likelihood of experiencing extremely "Wet" or "Dry" years at the Letpadaung site. The durations considered include:

- Long duration cycles of 1, 2, 3, 4 and 5 years and
- Short duration cycles of 2, 3, 4, 7, 14, 30, 60, 90, 120 and 180 days.

Exceedance and non-exceedance probabilities were assigned to the *n* (year or day) totals of daily precipitation values, by sorting the values in descending (for the "Wet" series) and ascending (for the "Dry" series) order. The requisite frequency analyses were then conducted in a manner similar to that described in Section 2.3.

For each of the candidate water balance cycle durations, the three best fitting probability distributions were selected for comparison. Based on the comparison, the probability distribution which fits Monywa Township (1961-2013) historical data best for all considered durations is the Generalised Extreme Value (GEV) distribution. Details of the water balance scenario frequency analysis are given in Attachment 2.7.

In order to apportion the statistically-computed climate cycle precipitation totals to daily time series for use in water balance modelling, the wettest (or wettest and driest, in the case of

the 1 year duration cycle) *n* (year or day) continuous records of historical rainfall in the Monywa Township (1963-2013) dataset were identified and converted to series of cumulative daily percentages (of total observed rainfall). These series were then multiplied by the 100 and 500 year ARI depths (for each duration *n*) to derive 32 daily water balance scenarios, which are detailed in Attachment 2.8. A summary of the derived scenarios is given in Table 2.6.

Table 2.6: Letpadaung water balance scenario summary

Scenario	100-yr ARI Total Depth (mm)	500-yr ARI Total Depth (mm)	Temporal Pattern Based on
5 Year Wet	5,479	5,839	1973 – 1979
4 Year Wet	4,630	5,083	1973 – 1976
3 Year Wet	3,644	4,083	1975 – 1977
2 Year Wet	2,544	2,844	2010 – 2011
1 Year Wet	1,555	1,902	1973
1 Year Dry	424	383	1982
180 Day Wet	1,437	1,767	25/05/1973 – 20/11/1973
120 Day Wet	1,067	1,272	2/07/2010 – 29/10/2010
90 Day Wet	921	1,101	30/07/1965 – 27/10/1965
60 Day Wet	740	865	29/08/1965 – 27/10/1965
30 Day Wet	520	596	29/09/2010 – 28/10/2010
14 Day Wet	440	563	9/05/2007 – 22/05/2007
7 Day Wet[*1]	343	447	9/05/2007 – 15/05/2007
4 Day Wet[*2]	308	410	1/06/1984 – 4/06/1984
3 Day Wet[*3]	298	401	1/06/1984 – 3/06/1984
2 Day Wet[*4]	214	249	2/06/1984 – 3/06/1984

*1 Scenario totals for 7 day duration cycles have been augmented 1.8% to account for potential straddling errors in sampling which may occur from the usage of fixed 24 hour duration observational periods in deriving daily design storm estimates (Ref. 2).

*2 Scenario totals for 4 day duration cycles have been augmented 3.4% (Ref. 2).

*3 Scenario totals for 3 day duration cycles have been augmented 4.4% (Ref. 2).

*4 Scenario totals for 2 day duration cycles have been augmented 6.7% (Ref. 2).

3. EVAPORATION ANALYSIS

Pan evaporation data from the Yangtse climate station dataset was reduced into a standardised format and then analysed on annual and monthly time scales as appropriate.

Annual data is used for climate characterisation and evaluation of climate change. Monthly data is used primarily for water balance modelling purposes.

Pan evaporation values may be used to estimate evaporation from natural water bodies (lakes, ponds, etc.). Evaporation from a natural body of water is usually at a lower rate because the body of water does not have metal sides that get hot with the sun. Also, while light penetration in a pan is essentially uniform, light penetration in natural bodies of water decreases with depth. Accordingly, lake evaporation can be estimated by multiplying pan evaporation by a coefficient, which may be assumed as 0.7 in lieu of experimentally calibrated results.

The following sections detail the various analyses conducted and the results achieved.

3.1 ANNUAL EVAPORATION ANALYSIS

Monthly pan evaporation records from the Yangtse climate station were summed to produce annual totals for the entire period of available record. Recorded data from 2007 and onwards was excluded from consideration because the evaporation trend analysis, discussed in Section 3.3, revealed an unexplained shift in recorded values between 2006 and 2007. If the full dataset were to be used "as is", spurious analysis results are likely.

Sampling statistics were computed on these annual sums from the reduced dataset (2000-2006) to provide a broad overview of the typical variability of annual pan evaporation in the region surrounding the project site, as given in Table 3.1.

Table 3.1: Annual pan evaporation statistics – Yangtse climate station (2000-2006)

Selected Statistic	Statistic Value
Average (mm)	2,017
Median (mm)	2,051
Std. Deviation (mm)	75
Minimum (mm)	1,922
Maximum (mm)	2,109
25th Percentile (mm)	1,951
75th Percentile (mm)	2,067
Count (yr)	7
Distance to site (km)	7.6

The sample statistics for annual precipitation at this site were also depicted graphically, as a "box and whisker" plot, as shown on Figure 3.1. Details of the annual pan evaporation analysis are given in Attachment 3.1.

3.2 MONTHLY EVAPORATION ANALYSIS

Monthly pan evaporation from the Yangtse climate station was employed in this analysis. As discussed in Section 3.1, recorded data from 2007 and onwards was excluded from consideration. Sampling statistics were computed on these values to describe the variability of monthly pan evaporation at the project site, as given in Table 3.2.

Table 3.2: Monthly pan evaporation statistics – Yangtse climate station (2000-2006)

Month[*1]	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jan	123	121	5	119	134	121	122
Feb	149	151	13	130	166	141	158
Mar	210	213	14	188	224	201	220
Apr	228	236	21	191	248	218	242
May	202	205	43	118	256	197	223
Jun	203	187	36	165	270	181	219
Jul	172	174	12	153	187	166	180
Aug	184	175	38	133	248	167	198
Sep	160	150	27	128	208	145	173
Oct	145	148	27	102	184	132	157
Nov	125	130	17	102	146	111	137
Dec	117	112	12	98	131	110	127

*1 All computed pan evaporation statistics are measured in (mm).

The sample statistics for monthly pan evaporation were also depicted as a "box and whisker" plot, as shown on Figure 3.2. A cyclical pattern was observed, with the greatest pan evaporation occurring in April and the smallest in December. Details of the monthly pan evaporation analysis are given in Attachment 3.2.

3.3 EVAPORATION TREND ANALYSIS

KP performed trend analysis on annual pan evaporation totals from the Yangtse climate station dataset (2000-2013) in order to ascertain potential impacts of trends in pan evaporation on planned site development. The results of this analysis, illustrated on Figure 3.3, show a statistically significant negative trend. However, further inspection of the data showed an unexplained downshift of nearly 600 mm in annual average pan evaporation between 2006 and 2007.

A shift this large is highly unusual, if not impossible, in nature. Therefore, an attempt was made to try and find an explanation for this behaviour. As no records of a sudden shift in pan evaporation of this magnitude were found for this period in Myanmar, KP efforts shifted to trying to determine which sub-period in the provided historical dataset, either (2000-2006) or (2007-2012) was most likely.

A contour map of iso-lines of equal lake evaporation for Myanmar was obtained from (Ref. 6). This map, reproduced as Figure 3.4, shows that annual average lake evaporation at Monywa City is approximately 1,600 mm/yr, which converts to an equivalent 2,300 mm/yr after application of a 0.7 pan coefficient, which is considerably closer to the average annual evaporation of the first sub-period rather than the second. Based on this observation, KP selected the (2000-2006) period for estimating site pan evaporation values. The data from the second (2007-2012) period was excluded from further consideration.

Focusing on the (2000-2006) period, there is no statistically significant trend observable in annual pan evaporation values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future pan evaporation due to observed climate change.

Details of the pan evaporation trend analysis are given in Attachment 3.3.

3.4 COMPARISON OF PRECIPITATION & EVAPORATION

Average monthly values of precipitation (taken from Section 2.2) and pan evaporation (taken from Section 3.2) were compared to determine if the Letpadaung site is expected to run with a surplus of water from precipitation or if an annual deficit is expected. The results of this comparison are summarised in Table 3.3 and illustrated on Figure 3.5.

Table 3.3: Comparison of monthly average precipitation & evaporation

Month	Ave. Precipitation (mm)	Ave. Pan Evaporation (mm)	Ave. Lake*1 Evaporation (mm)	Precip. minus Lake Evap. (mm)
Jan	2	123	86	-84
Feb	3	149	105	-101
Mar	5	210	147	-142
Apr	26	228	160	-134
May	102	202	142	-40
Jun	100	203	142	-42
Jul	67	172	121	-54
Aug	121	184	129	-7
Sep	166	160	112	54
Oct	142	145	101	50
Nov	33	125	87	-55
Dec	6	117	82	-75
Totals	773	2,017	1,412	-639

*1 Assumed pan coefficient = 0.7.

As Table 3.3 clearly shows, the Letpadaung site is expected to run a strong water deficit on average. The only two months where a positive balance is indicated are September and October. Annual average water augmentation to maintain a neutral balance, not considering storage and additional losses, is 639 mm. Additional details of this comparison are provided in Attachment 3.4.

4. TEMPERATURE ANALYSIS

Average daily temperature data from the WMO 48037 climate station dataset was reduced into a standardised format and then analysed on annual and monthly time scales as appropriate. The following sections detail the various analyses conducted and the results achieved.

4.1 ANNUAL TEMPERATURE ANALYSIS

Daily average temperature records from the WMO 48037 climate station were summed to produce annual totals for the entire period of available record. Incomplete years of record were excluded from the analysis if 15% or greater of the values in that year were missing (approximately two months). This was done to prevent sampling bias. Sampling statistics were computed on these annual sums, as given in Table 4.1.

Table 4.1: Annual average temperature statistics – WMO 48037 station (1981-2012)

Selected Statistic	Statistic*1 Value
Average (°C)	27.8
Median (°C)	27.8
Std. Deviation (°C)	0.8
Minimum (°C)	26.1
Maximum (°C)	29.7
25th Percentile (°C)	27.2
75th Percentile (°C)	28.2
Count (yr)	25
Distance to site (km)	4.7

*1 Incomplete data from 1981, 1986-1989, 1992 and 2012 were excluded from this analysis.

The sample statistics for annual average precipitation at this site were also depicted graphically, as a "box and whisker" plot, as shown on Figure 4.1.

Details of the annual average temperature analysis are given in Attachment 4.1.

4.2 MONTHLY TEMPERATURE ANALYSIS

Daily temperature records from the WMO 48037 dataset were summed in a manner similar to that described in Section 4.1 to produce monthly totals. Incomplete months of record were excluded from the analysis if 25% or greater of the values in that month were missing (approximately one week). This was done to prevent sampling bias. Sampling statistics were computed on these values, as given in Table 4.2.

Table 4.2: Monthly average temperature statistics – WMO 48037 station (1981-2012)

Month*1	Average	Median	Std. Dev.	Min.	Max.	25th Pct.	75th Pct.
Jan	21.9	21.9	1.9	18.4	28.0	21.2	22.5
Feb	24.0	23.6	2.3	21.1	32.9	23.0	24.8
Mar	28.1	28.0	2.3	23.1	35.5	27.0	29.2
Apr	30.9	30.9	1.4	25.9	33.1	30.3	31.7
May	31.0	31.0	1.4	28.1	33.8	30.4	31.7
Jun	30.6	30.5	1.1	27.8	32.9	29.9	31.3
Jul	30.5	30.8	1.2	26.8	32.5	30.1	31.3
Aug	29.9	29.8	1.0	28.4	32.1	29.2	30.6
Sep	29.3	29.3	0.7	27.8	30.4	28.8	29.8
Oct	28.0	28.	0.7	26.5	29.8	27.6	28.4
Nov	25.1	25.3	1.1	23.0	27.6	24.4	25.8
Dec	22.2	22.0	1.9	18.4	28.0	21.3	22.9

*1 All computed temperature statistics are measured in (°C).

The sample statistics for monthly average temperature from the WMO 48037 dataset were also depicted as a "box and whisker" plot, as shown on Figure 4.2. The hottest month (on

average) each year is May, with a cyclical pattern shown. Details of the monthly average temperature analysis are given in Attachment 4.2.

Monthly ranges in temperature were also analysed by computing monthly averages on daily temperature maxima and minima. The results of this analysis are given in Table 4.3 and are illustrated on Figure 4.3.

Table 4.3: Monthly temperature ranges – WMO 48037 station (1981-2012)

Month[*1]	Max.	Average	Min.
Jan	28.5	21.9	15.4
Feb	31.6	24.0	16.9
Mar	36.0	28.1	20.5
Apr	38.4	30.9	24.0
May	36.8	31.0	25.5
Jun	35.4	30.6	26.0
Jul	35.5	30.5	26.1
Aug	34.3	29.9	25.7
Sep	33.4	29.3	25.3
Oct	32.5	28.0	23.8
Nov	30.4	25.1	19.9
Dec	28.0	22.2	16.4

*1 All computed temperature statistics are measured in (°C).

Temperatures are fairly consistent for six months of the year: April through September. The other four "shoulder" months exhibit a cyclical transition from the warm period to the coldest two months of the year: December and January. Details of the monthly temperature range analysis are given in Attachment 4.3.

4.3 TEMPERATURE TREND ANALYSIS

KP performed trend analysis on annual average temperature totals from the WMO 48037 dataset (1981-2012) in order to ascertain potential impacts of trends in temperature on planned site development. The results of this analysis, illustrated on Figure 4.4, show that there is no statistically significant trend observable in annual average temperature values at the Letpadaung site. Accordingly, no additional scaling factors are necessary for employing statistical estimates of future temperature due to observed climate change.

Details of the precipitation trend analysis are given in Attachment 4.4.

5. WIND ROSE ANALYSIS

Wind speed and direction data from the Wind Rose sampling point dataset were analysed using WindRose Pro 3.01 software (Ref. 7). Hourly data spanning the historic period (2010-2012) were used as inputs to the program to produce wind rose plots. Each concentric circle on a wind rose plot represents a different frequency, starting at zero in the center and increasing as the circles move outwards. The direction of each "spoke" indicates the cardinal direction that winds are blowing *from* over the historic period analysed. Additionally, the colours of portions of each spoke indicate the speed with which the wind blows from in a particular direction.

The hourly wind data were used to prepare nine wind rose plots, as follows:

- All wind measurements are shown on Figure 5.1;
- Wind measurements for the period (00:00 – 03:00) are shown on Figure 5.2;
- Wind measurements for the period (03:00 – 06:00) are shown on Figure 5.3;
- Wind measurements for the period (06:00 – 09:00) are shown on Figure 5.4;
- Wind measurements for the period (09:00 – 12:00) are shown on Figure 5.5;
- Wind measurements for the period (12:00 – 15:00) are shown on Figure 5.6;
- Wind measurements for the period (15:00 – 18:00) are shown on Figure 5.7;
- Wind measurements for the period (18:00 – 21:00) are shown on Figure 5.8; and
- Wind measurements for the period (21:00 – 00:00) are shown on Figure 5.9.

Wind rose data may be used for noise and dust analysis as well as for siting airstrips and for calculating fetch lengths for wave run-up calculations that are used in pond / dam sizing.

Details of the wind rose analysis are given in Attachment 5.1. The two years of available data indicate that at Letpadaung, winds blow from the North (0°) to North by Northwest (337.5°) at an average of 3.0 m/s which, on the Beaufort scale is classified as 2 "light breeze". Maximum recorded wind speed during this period is 9.2 m/s, which corresponds to 5 "fresh breeze" on the Beaufort scale.

The direction the wind blows from also tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Generally speaking, the data does not indicate that high wind storms are likely at this site.

6. SUMMARY / CONCLUSIONS

Historic data from four different locations were analysed to derive design values associated with climate parameters of interest: precipitation, evaporation, temperature and wind. The specific design values associated with each climate parameter that have been addressed in this memorandum are listed below.

Precipitation parameters:

- Typical variability of annual precipitation and average number of rain days;
- Typical variability of monthly precipitation and average number of rain days;
- Intensity / Duration / Frequency (IDF) curves for short-duration extreme rainfall events;
- Temporal distributions (i.e. hyetographs) of short-duration precipitation to be used with the IDF curves in rainfall-runoff modelling. Design hyetographs were derived for storm durations ranging from 2 to 45 hours;
- Trend analysis of annual precipitation totals, for ascertaining potential impacts of climate trends on site development; and
- Daily precipitation amounts for 32 climate scenarios (15 durations x 2 storm frequencies for each duration, with the 1 year scenario considered for both Wet and Dry cycles) to be used with water balance modelling, as follows:
  - 500 year Annual Recurrence Interval (ARI), 5 year duration Wet cycle;
  - 100 year ARI, 5 year duration Wet cycle;
  - 500 year ARI, 4 year duration Wet cycle;
  - 100 year ARI, 4 year duration Wet cycle;
  - 500 year ARI, 3 year duration Wet cycle;
  - 100 year ARI, 3 year duration Wet cycle;
  - 500 year ARI, 2 year duration Wet cycle;
  - 100 year ARI, 2 year duration Wet cycle;
  - 500 year ARI, 1 year duration Wet cycle;
  - 100 year ARI, 1 year duration Wet cycle;
  - 500 year ARI, 1 year duration Dry cycle;

- 100 year ARI, 1 year duration Dry cycle;
- 500 year ARI, 180 day duration Wet cycle;
- 100 year ARI, 180 day duration Wet cycle;
- 500 year ARI, 120 day duration Wet cycle;
- 100 year ARI, 120 day duration Wet cycle;
- 500 year ARI, 90 day duration Wet cycle;
- 100 year ARI, 90 day duration Wet cycle;
- 500 year ARI, 60 day duration Wet cycle;
- 100 year ARI, 60 day duration Wet cycle;
- 500 year ARI, 30 day duration Wet cycle;
- 100 year ARI, 30 day duration Wet cycle;
- 500 year ARI, 14 day duration Wet cycle;
- 100 year ARI, 14 day duration Wet cycle;
- 500 year ARI, 7 day duration Wet cycle;
- 100 year ARI, 7 day duration Wet cycle;
- 500 year ARI, 4 day duration Wet cycle;
- 100 year ARI, 4 day duration Wet cycle;
- 500 year ARI, 3 day duration Wet cycle;
- 100 year ARI, 3 day duration Wet cycle;
- 500 year ARI, 2 day duration Wet cycle; and
- 100 year ARI, 2 day duration Wet cycle.

Annual average precipitation is 774 mm, normally occurring over 65 rain days each year. The wet season lasts for eight months, from April through the end of November. The wettest month of the year is September (166 mm on average) and the driest is January (1.9 mm on average).

Evaporation parameters:

- Typical variability of annual evaporation;
- Typical variability of monthly evaporation; and
- Trend analysis of annual evaporation totals, for ascertaining potential impacts of climate trends on site development.

Annual average lake evaporation is estimated at 1,412 mm, which assumes a pan coefficient of 0.7 applied to calculated annual average pan evaporation (2,017 mm). A comparison of precipitation and lake evaporation indicates that the Letpadaung site is expected to run a strong water deficit on average. The only two months where a positive balance is indicated are September and October. Annual average water augmentation to maintain a neutral balance, not considering storage and additional losses, is 639 mm. Adequate water storage and careful management of available water resources will be critical to successful mining operations at Letpadaung.

Temperature parameters:

- Typical variability of annual mean temperature;
- Typical variability of monthly mean temperature, as well as the range of monthly mean temperature between maximum and minimum; and
- Trend analysis of annual temperature averages, for ascertaining potential impacts of climate trends on site development.

Temperatures are fairly consistent during the six warm months of the year: April through September, when the average value is 30.4°C. The other four “shoulder” months exhibit a cyclical transition from the warm period to the coldest two months of the year: December and January, when the average temperature is 22.1°C. Minimum temperature generally occurs in January (15.4°C) and the maximum in April (38.4°C).

Wind parameters:

- Typical variability of wind speed and direction on daily and eight sub-daily time periods (each of 3 hours duration), which are illustrated graphically through the use of wind rose plots.

Winds generally blow from the North (0°) to North by Northwest (337.5°) at an average of 3.0 m/s, with a maximum of is 9.2 m/s. These correspond to Beaufort scale readings of 2 "light breeze" to 5 "fresh breeze". The direction the wind blows from also tends to reverse during the afternoon, blowing from the South (180°) to Southeast (225°). Available wind data indicates that high wind storms are unlikely at the Letpadaung site.

We trust that these results are sufficient for any preliminary design computations.

Yours faithfully
KNIGHT PIÉSOLD PTY LTD

TODD LEWIS
Lead Engineer, Hydrology and Hydraulics

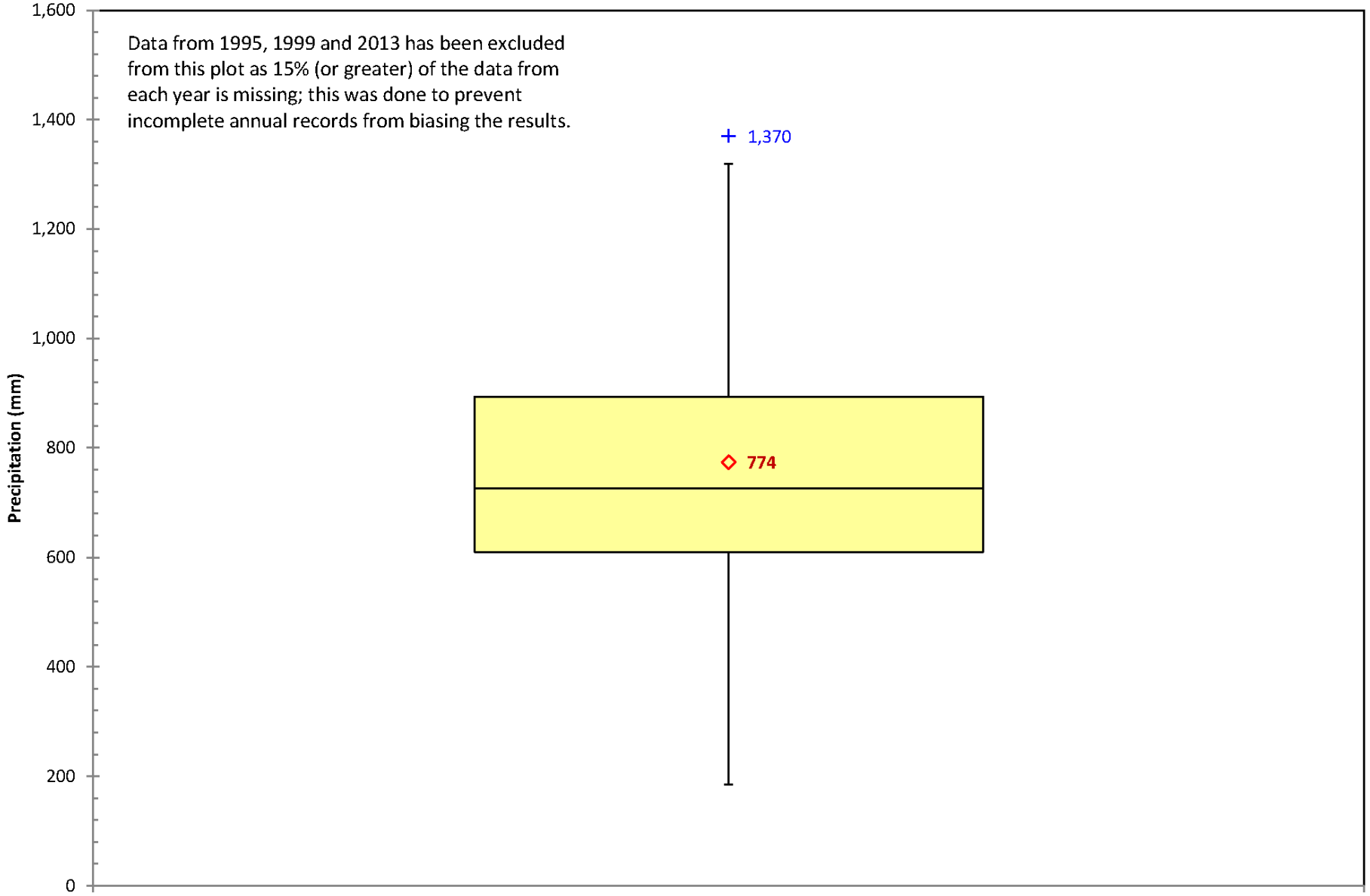
BRETT LONEY
Manager Environmental Services

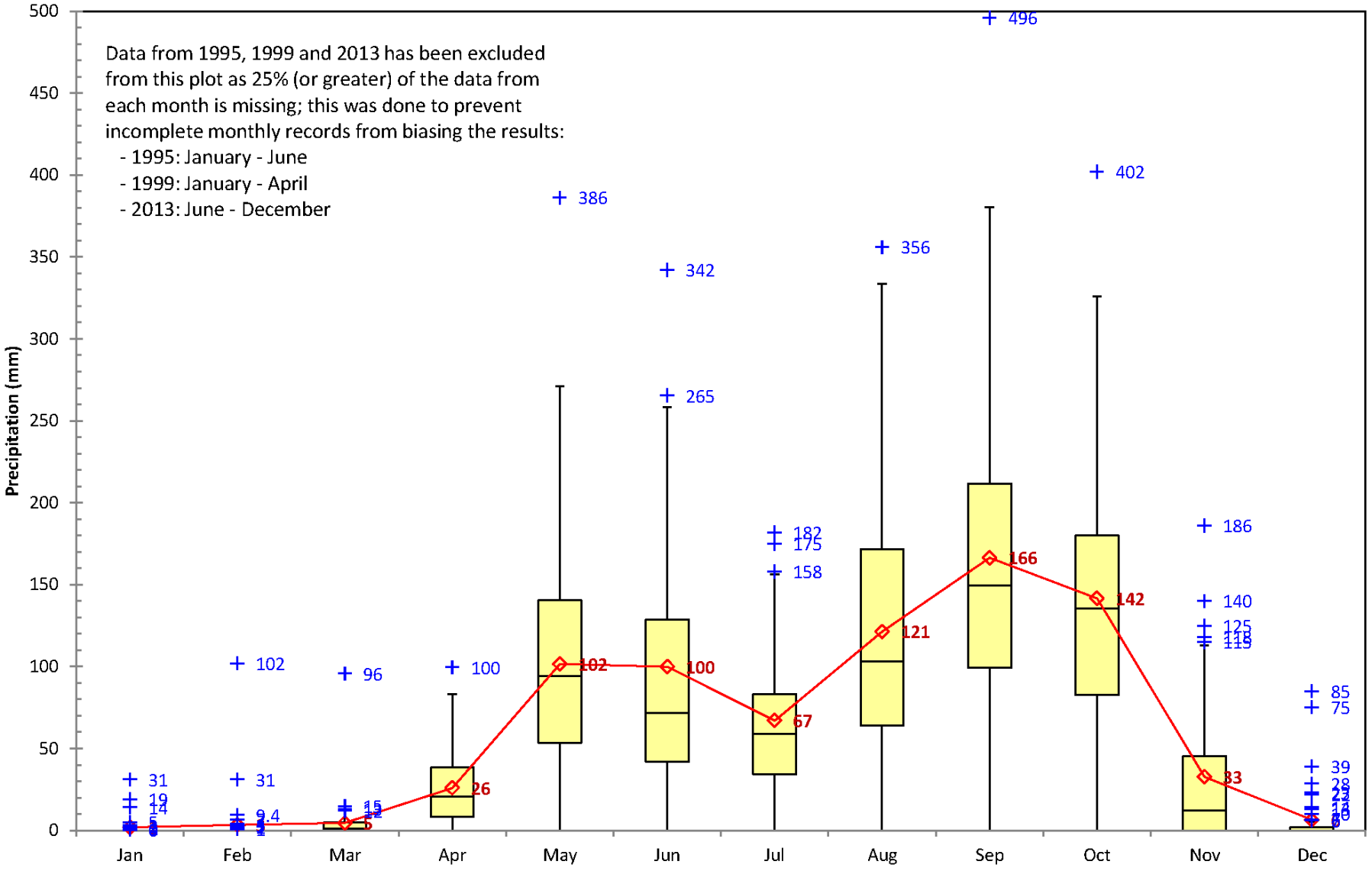
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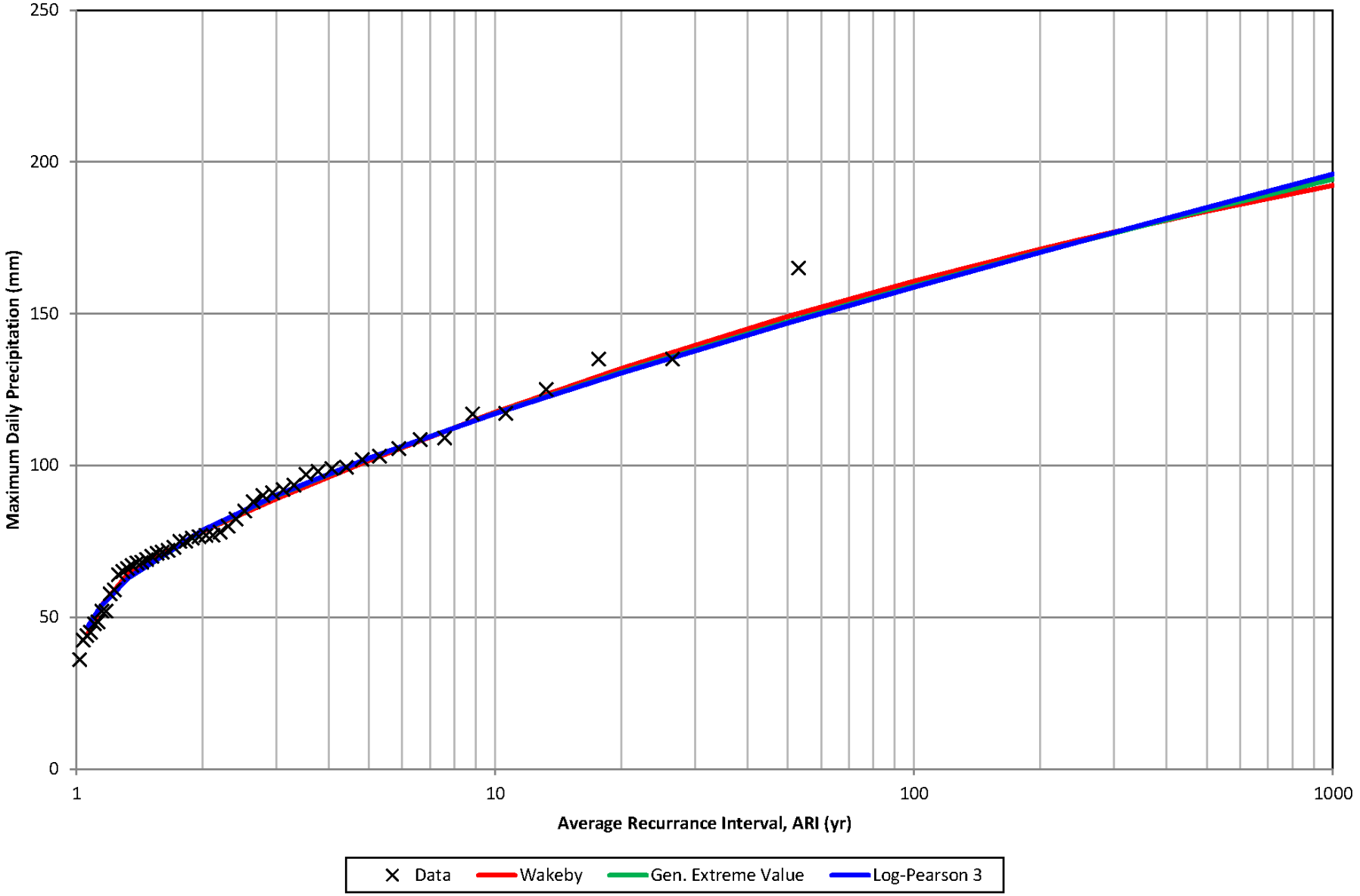
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7. Enviroware. *"WindRose Pro 3.01.46"*, [computer software], 2013.

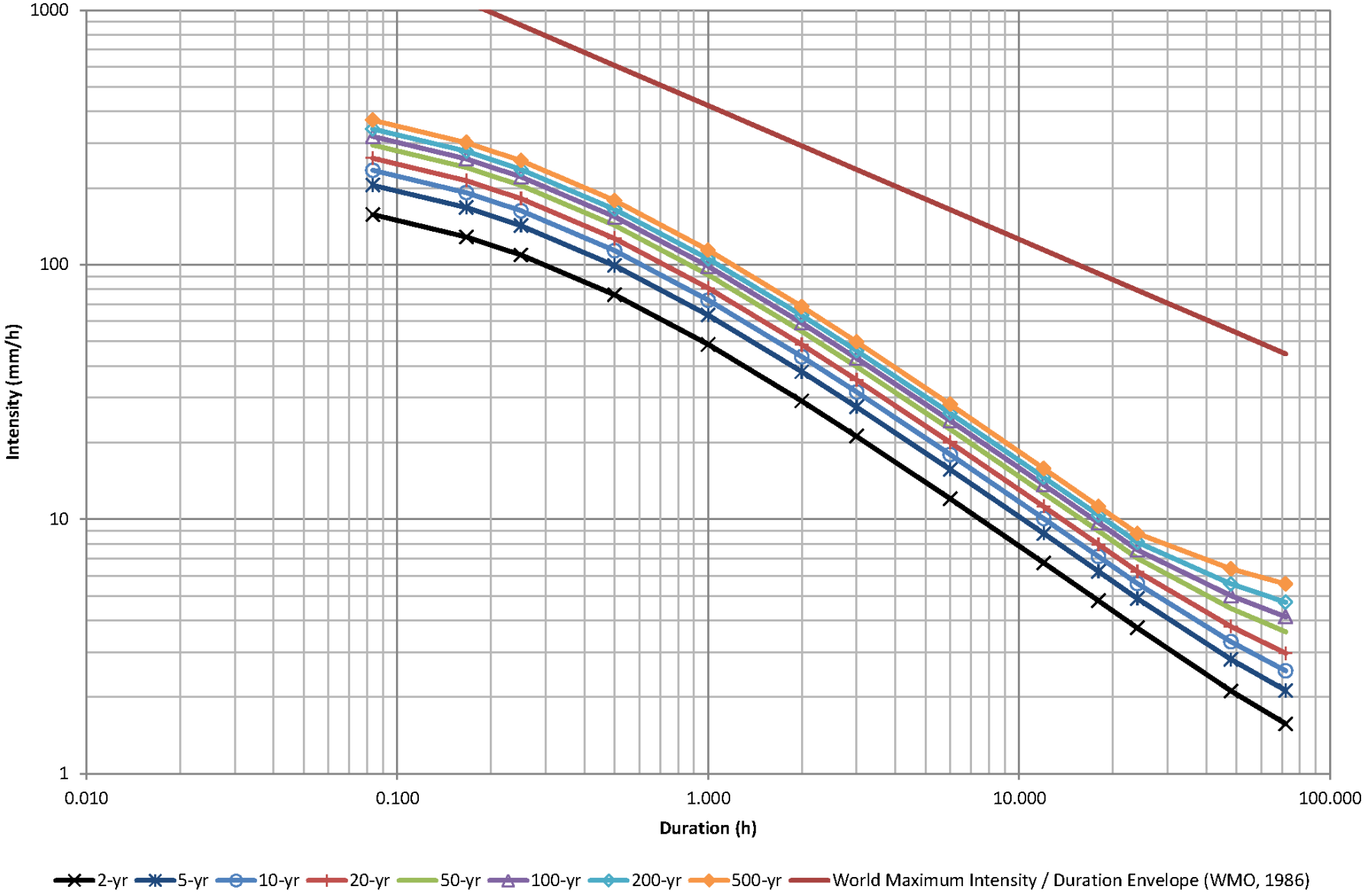
FIGURES

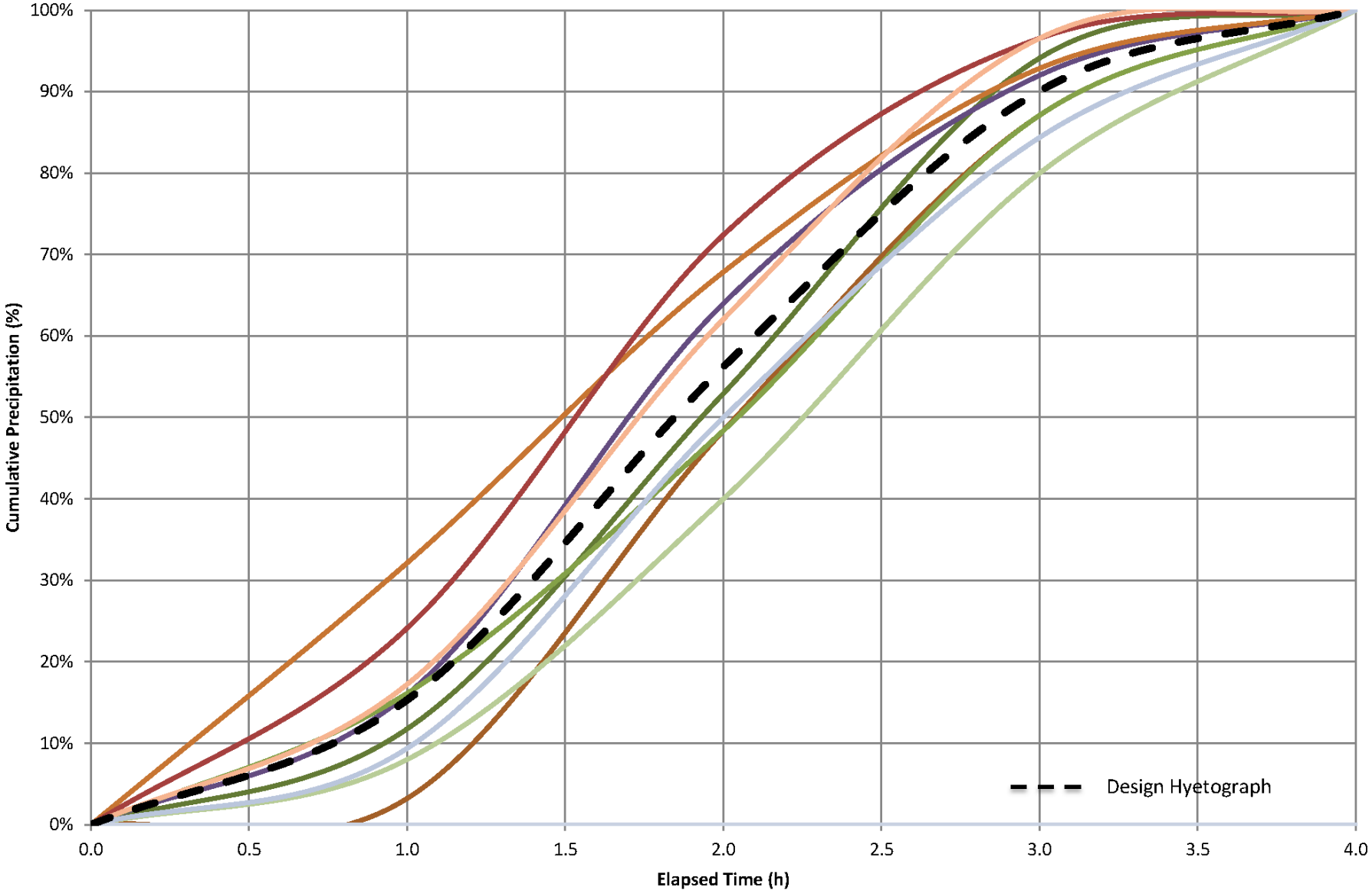

Yama Stream
Sabetaung & Kyisintaung (S&K) Project
Yangtse (S&K) Climate Station
Kyaukka Rd
Ayone Rd
Monywa Township Climate Station (Assumed)
Federal Rd
WMO 480370 Climate Station
Damapala
Wind Rose Sampling Point
Letpadaung Hill
Chindwin River
Image © 2013 DigitalGlobe
© 2013 Google
Google earth
5.00 km
Imagery Date: 4/10/2013
46 Q 716623.92 m E 2446525.79 m N elev 75 m
Eye alt 21.85 km

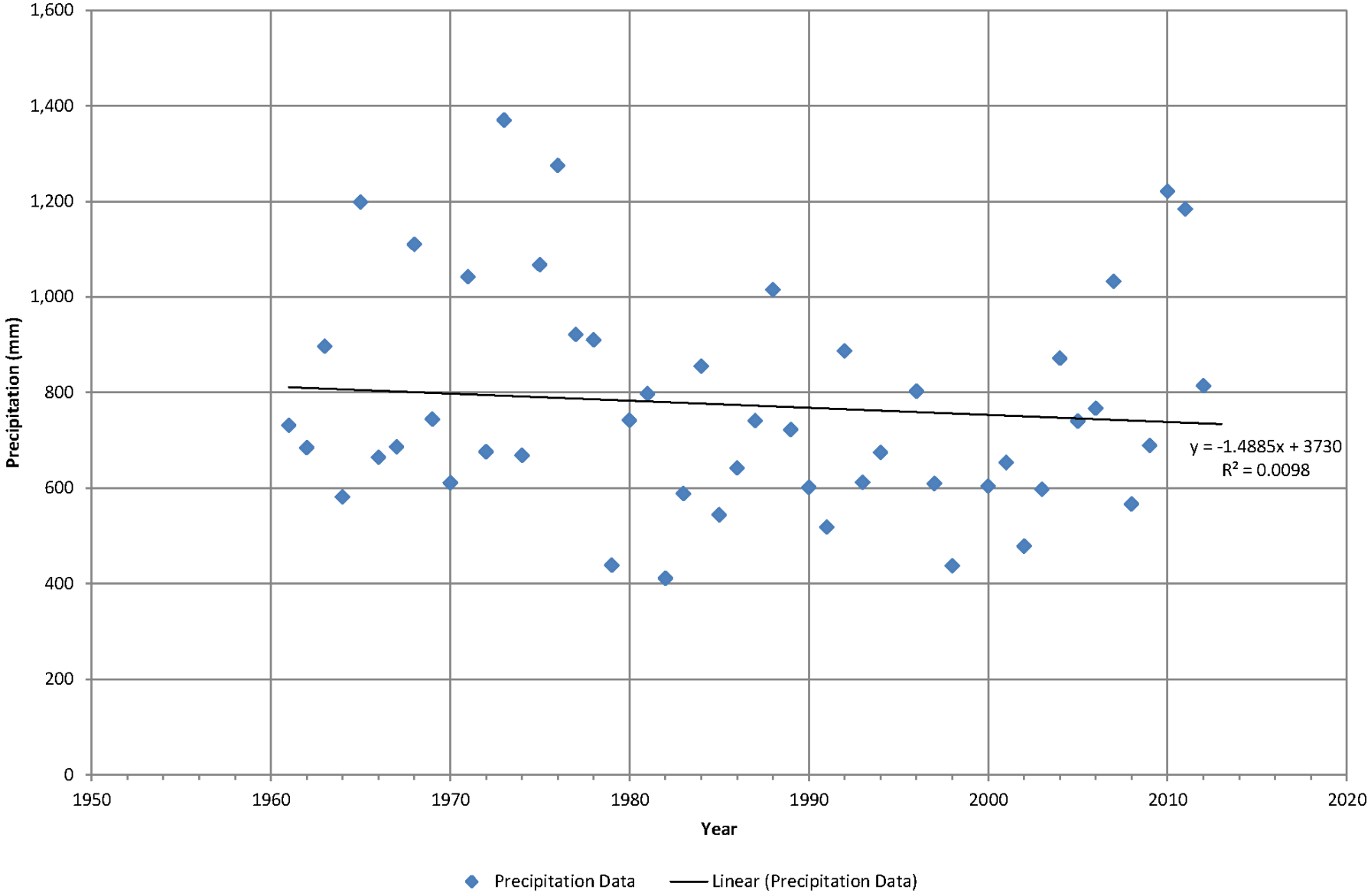

Data from 1995, 1999 and 2013 has been excluded from this plot as 15% (or greater) of the data from each year is missing; this was done to prevent incomplete annual records from biasing the results.
Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
1,370
774

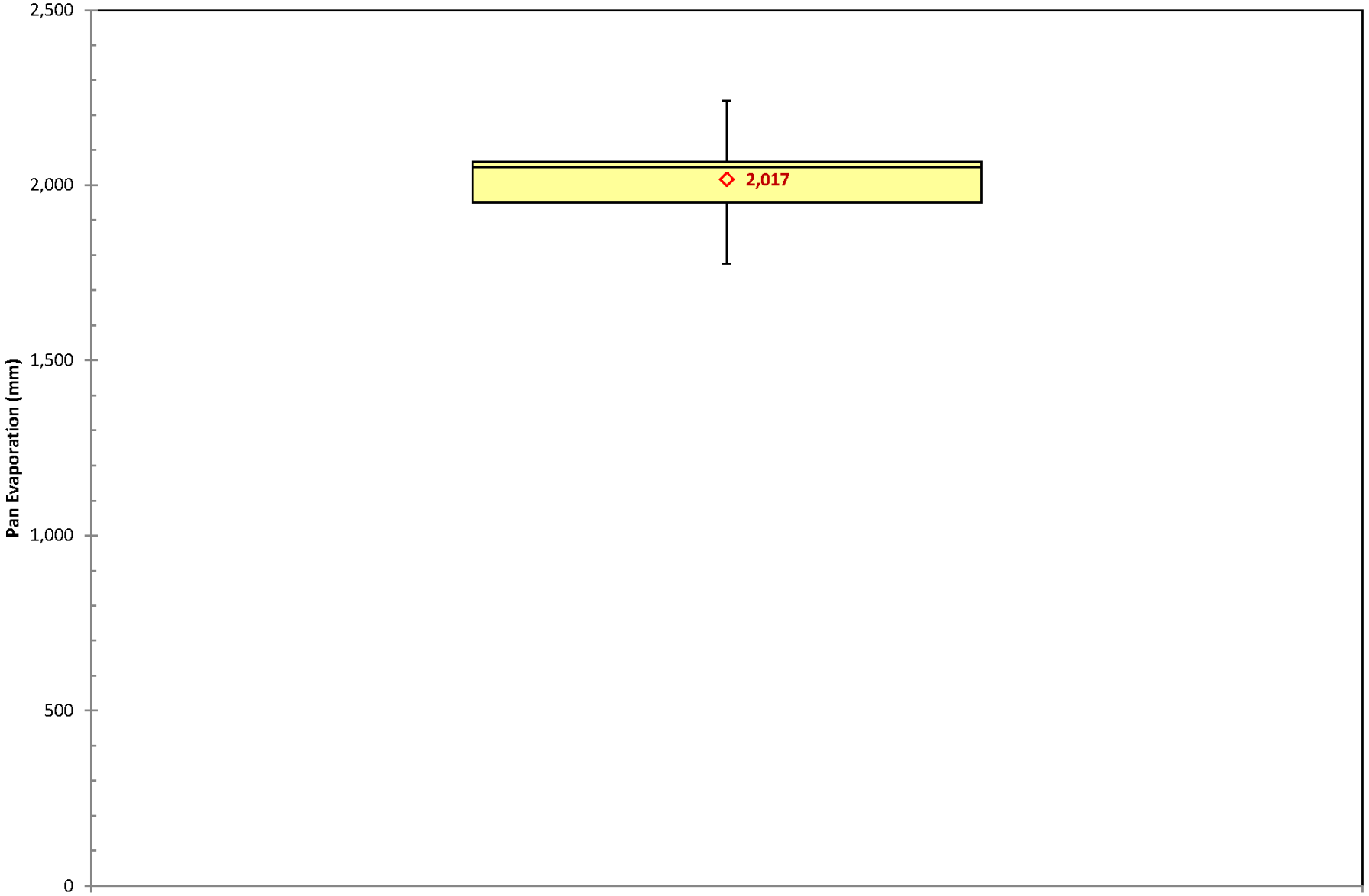

Data from 1995, 1999 and 2013 has been excluded from this plot as 25% (or greater) of the data from each month is missing; this was done to prevent incomplete monthly records from biasing the results:
- 1995: January - June
- 1999: January - April
- 2013: June - December
Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
496
402
386
356
342
265
182
175
158
102
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100
67
121
166
142
33

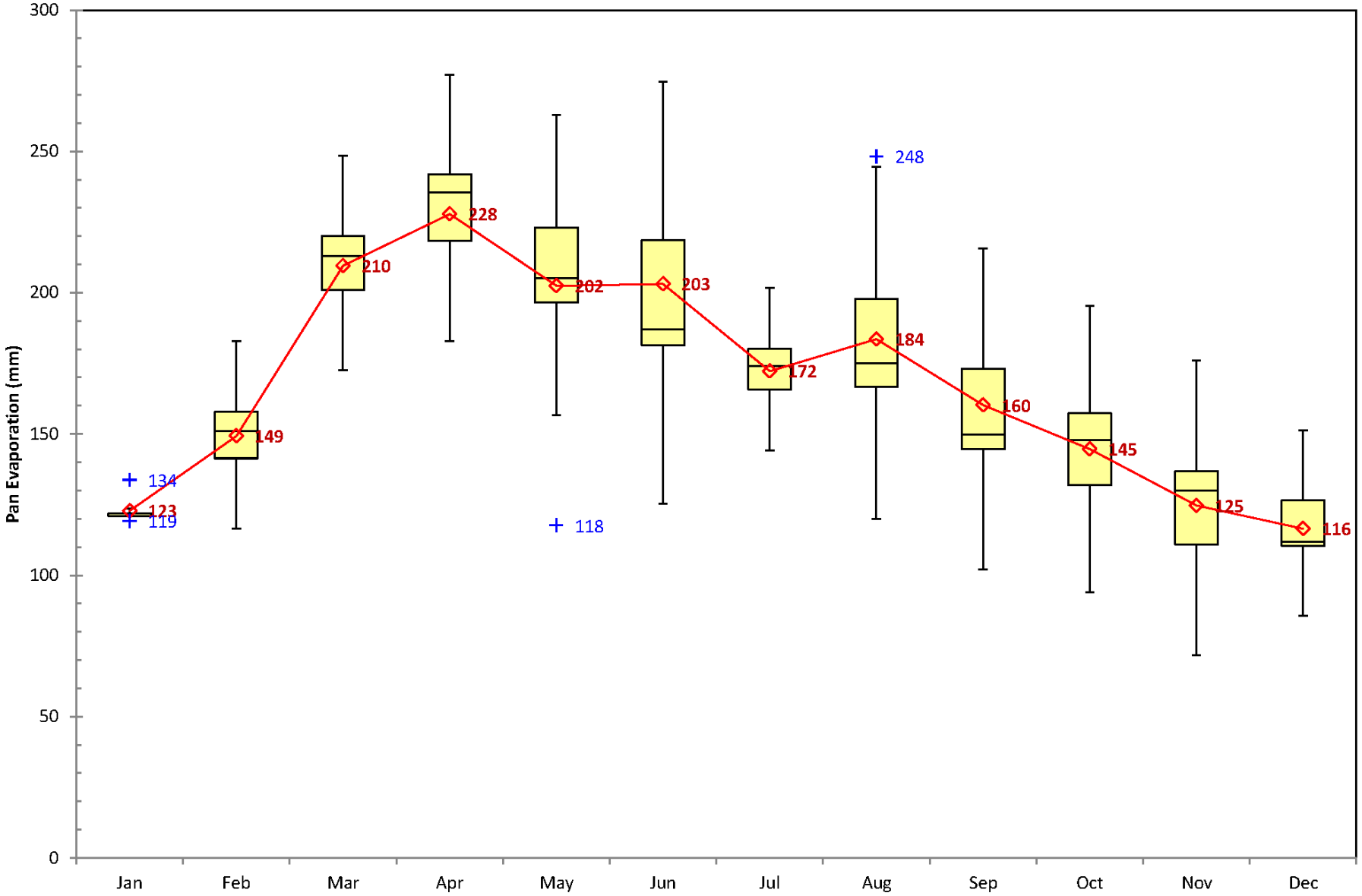

250
200
150
100
50
0
Maximum Daily Precipitation (mm)
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3


1000
100
10
1
Intensity (mm/h)
0.010
0.100
1.000
10.000
100.000
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Intensity / Duration Envelope (WMO, 1986)


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Elapsed Time (h)
Design Hyetograph


1,600
1,400
1,200
1,000
800
600
400
200
0
Precipitation (mm)
1950
1960
1970
1980
1990
2000
2010
2020
Year
y = -1.4885x + 3730
R² = 0.0098
Precipitation Data
Linear (Precipitation Data)

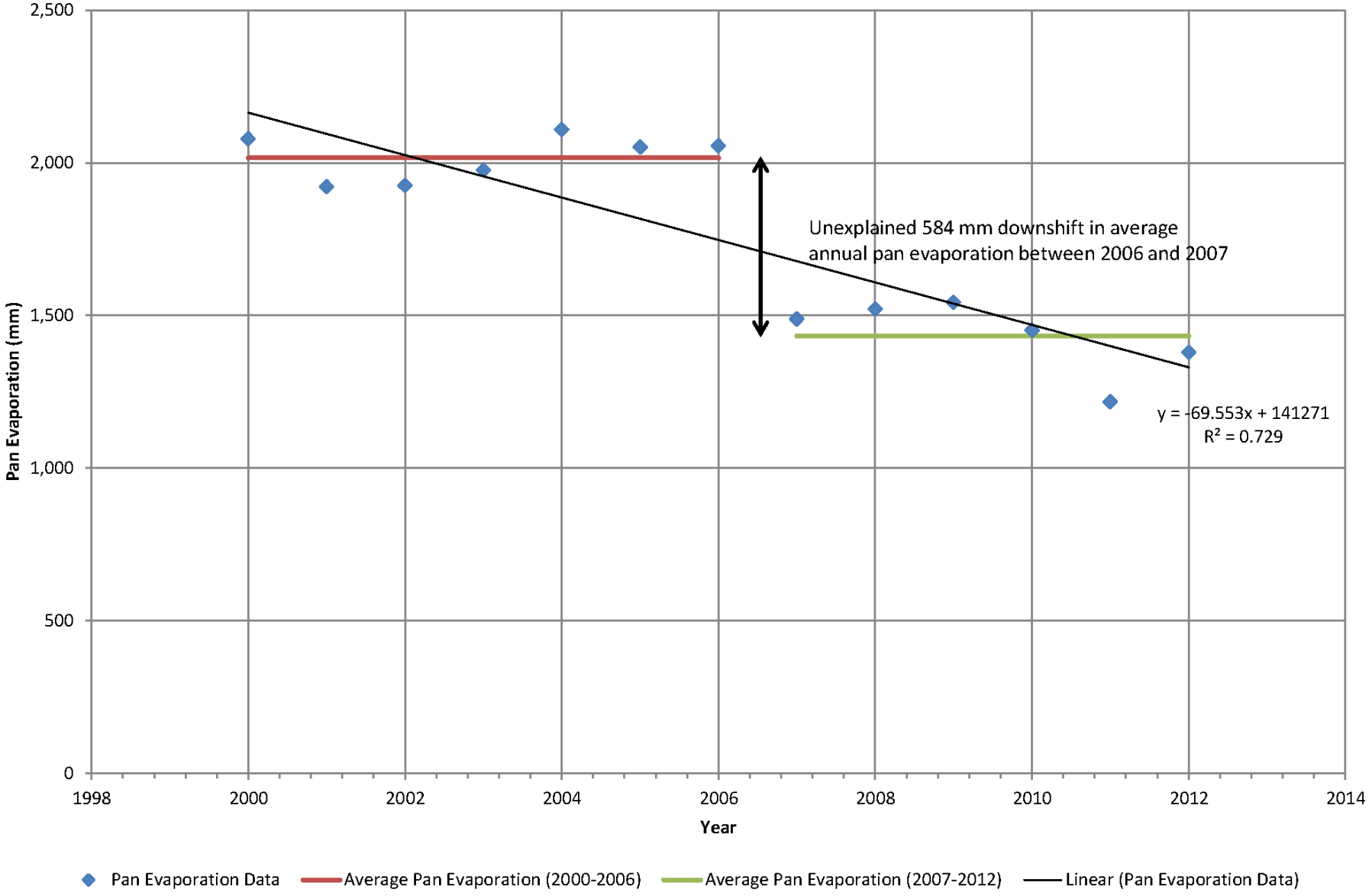

2,500
2,000
1,500
1,000
500
0
Pan Evaporation (mm)
2,017

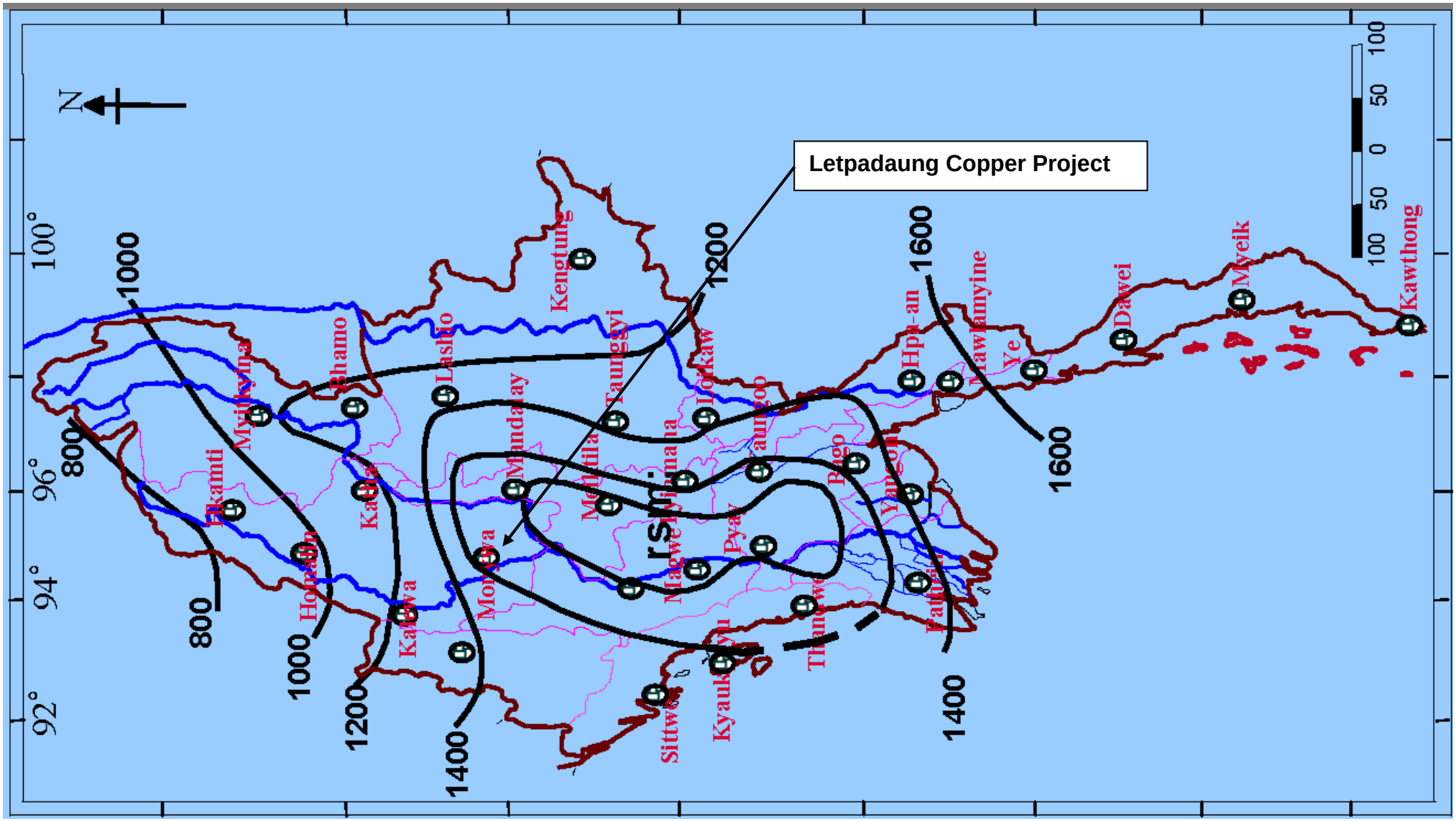


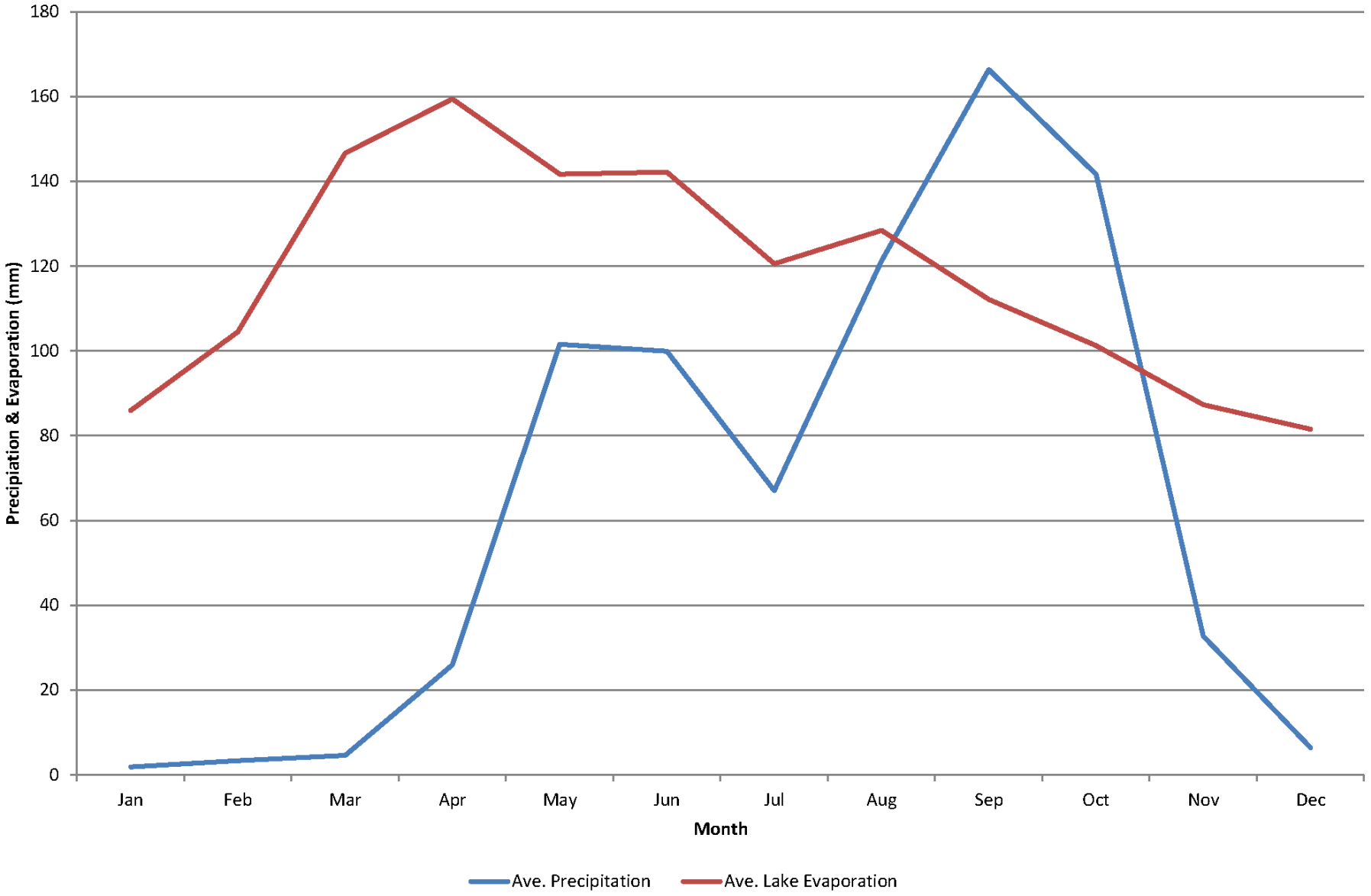
Knight Piésold CONSULTING

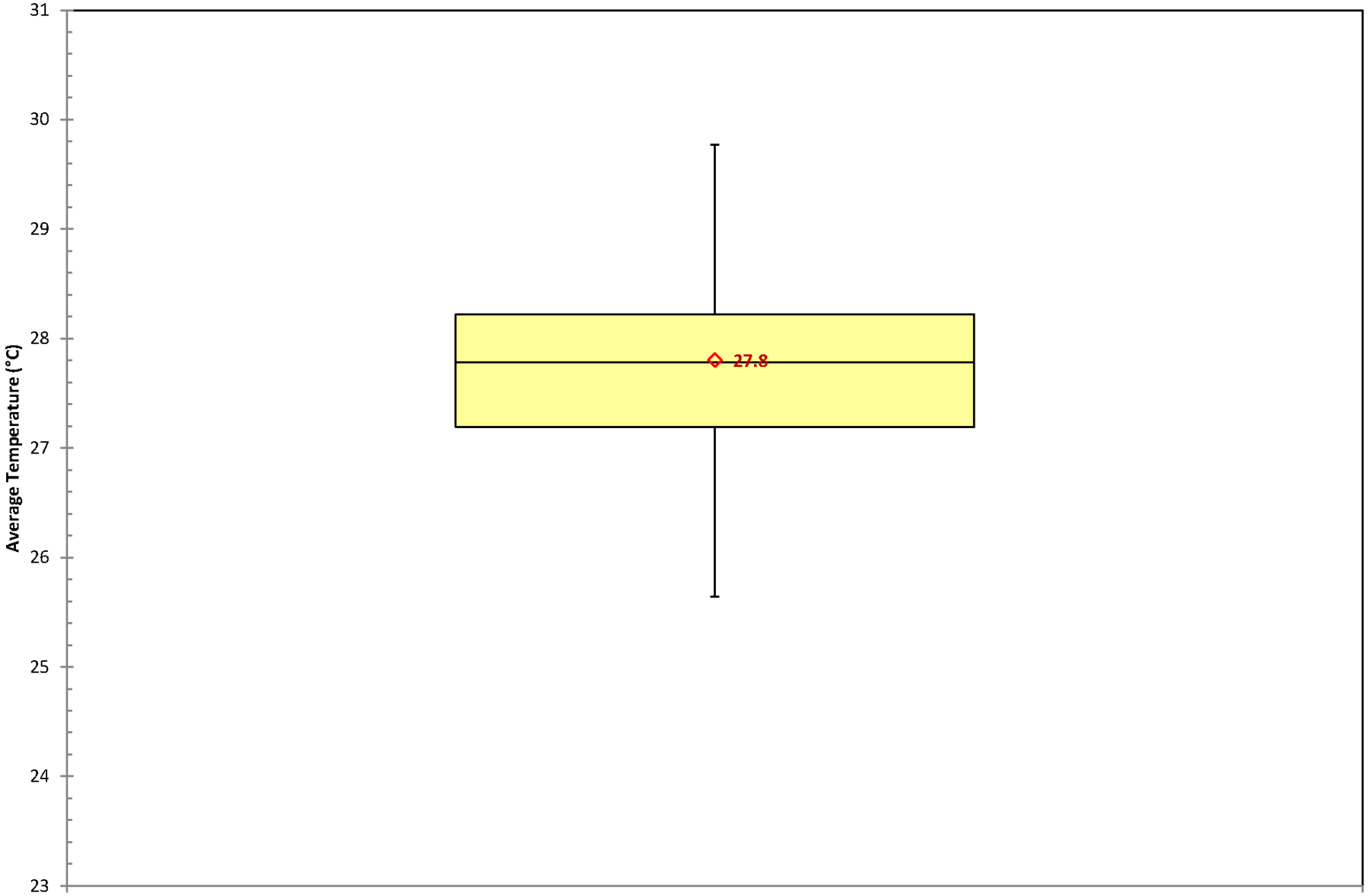
LETPADAUNG COPPER PROJECT – BASELINE DESIGN CLIMATOLOGY
PAN EVAPORATION MONTHLY SAMPLE STATISTICS
YANGTSE CLIMATE STATION (2000-2006)

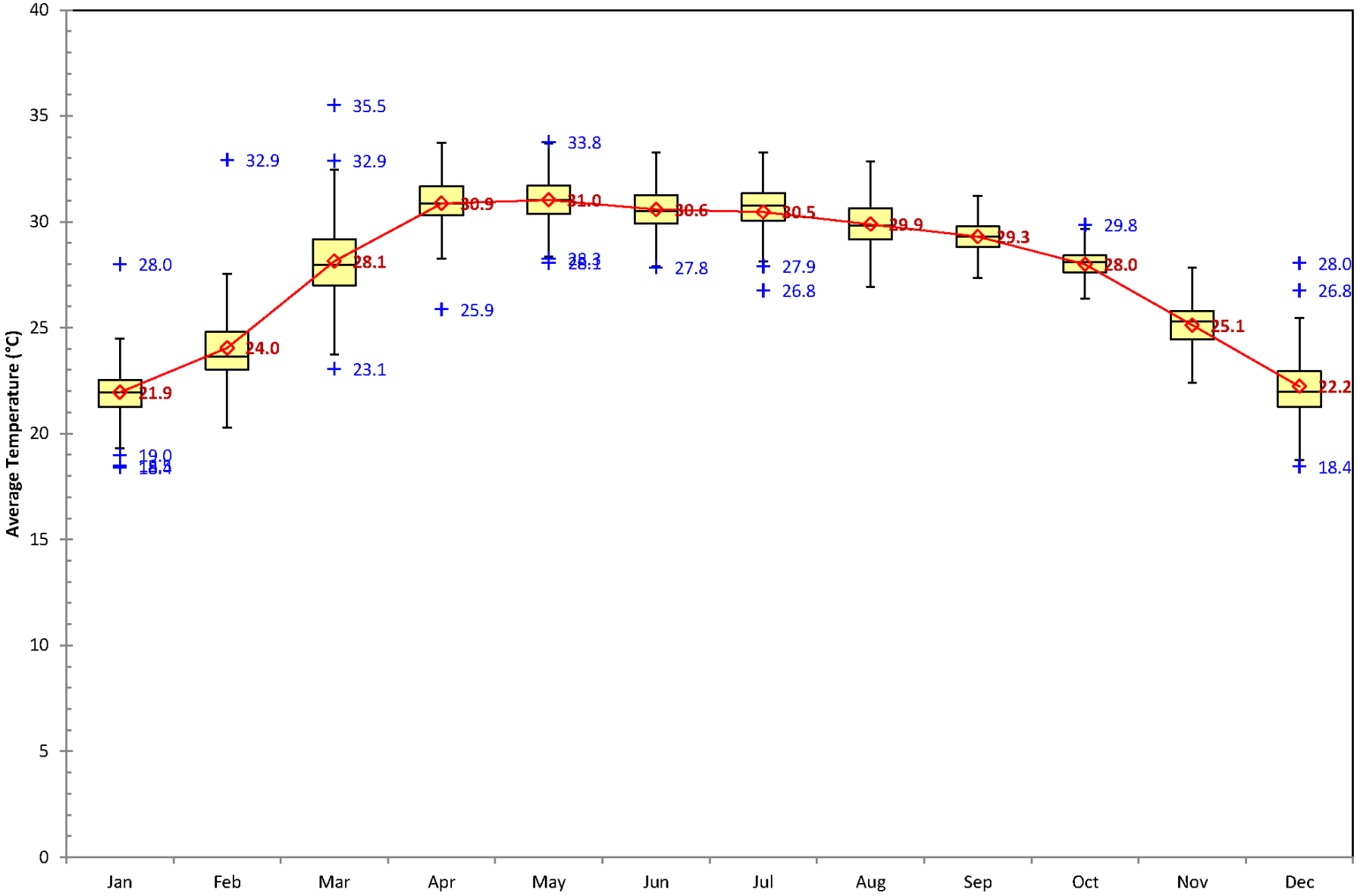
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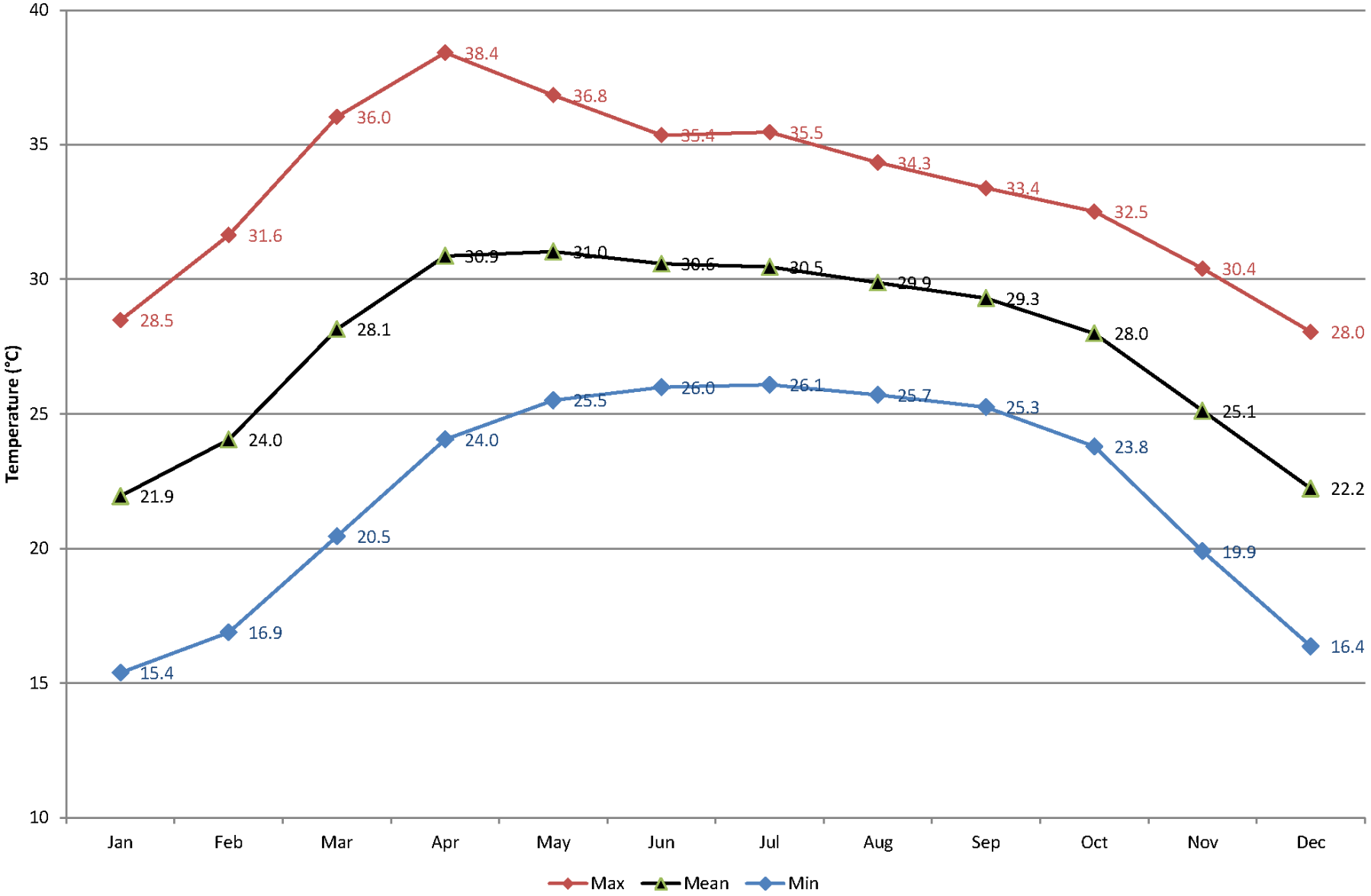

2,500
2,000
1,500
1,000
500
0
Pan Evaporation (mm)
1998
2000
2002
2004
2006
2008
2010
2012
2014
Year
Unexplained 584 mm downshift in average annual pan evaporation between 2006 and 2007
y = -69.553x + 141271
R² = 0.729
Pan Evaporation Data
Average Pan Evaporation (2000-2006)
Average Pan Evaporation (2007-2012)
Linear (Pan Evaporation Data)

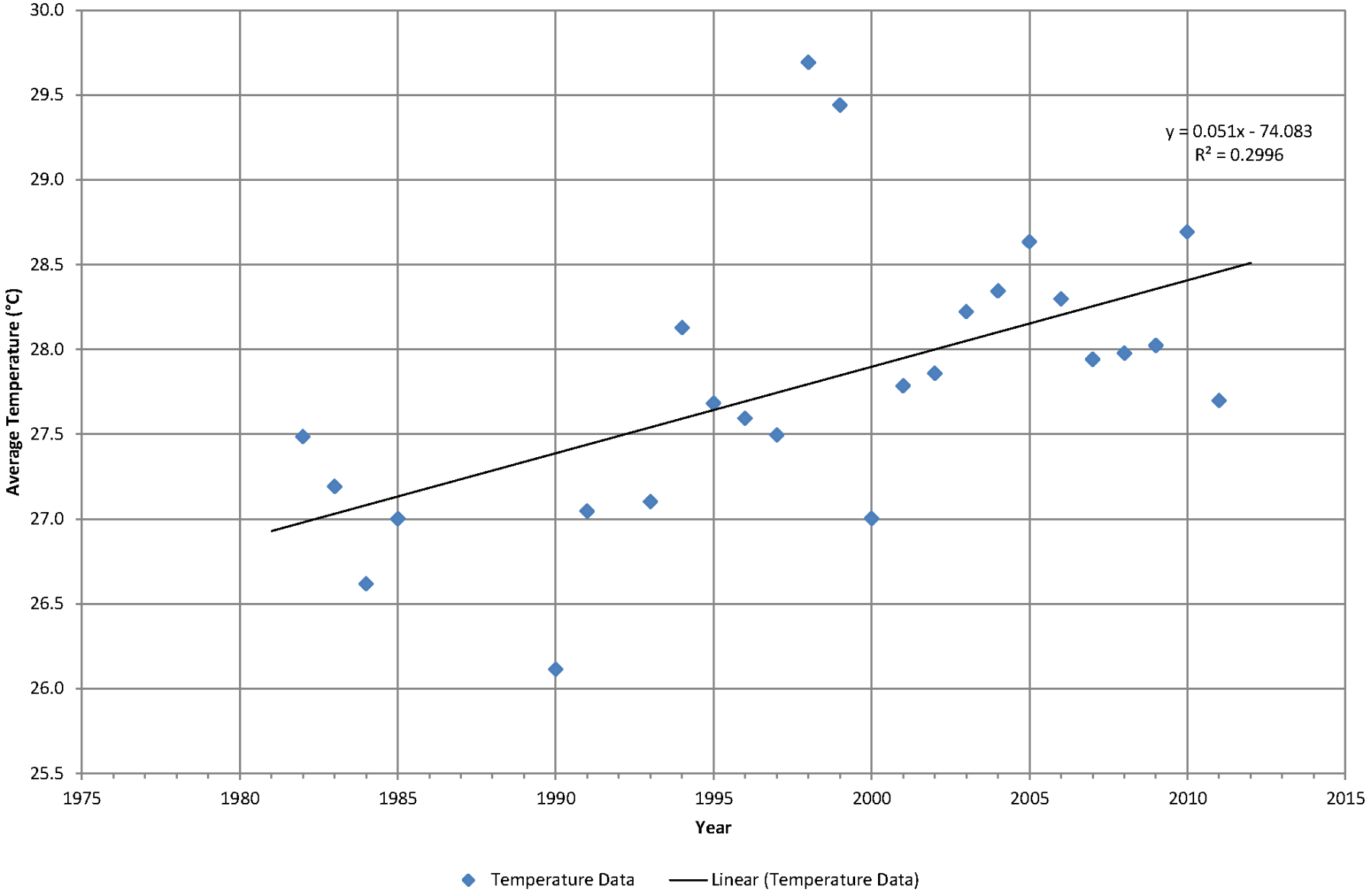

Letpadaung Copper Project
N
100°
96°
94°
92°
800
1000
1200
1400
1600
Kengtung
Lashio
Mandalay
Taunggyi
Loikaw
Hpa-an
Dawei
Myeik
Kawthong
Myitkyina
Bhamo
Kachin
Hommalin
Kalewa
Monywa
Magwe
Pyay
Bago
Thaton
Kyaukpyu
Sittwe
Ye
rsm

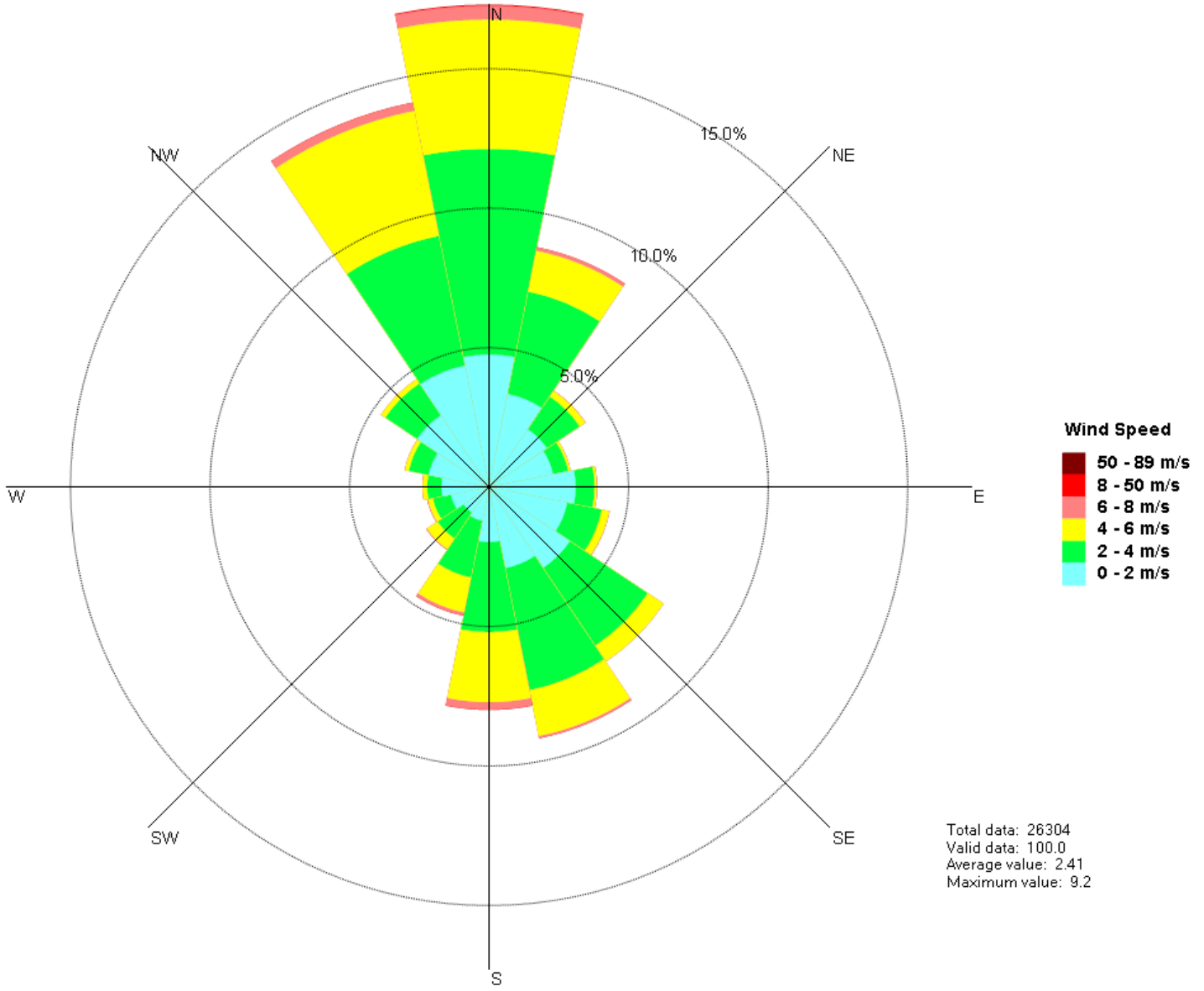

180
160
140
120
100
80
60
40
20
0
Precipiation & Evaporation (mm)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Ave. Precipitation
Ave. Lake Evaporation

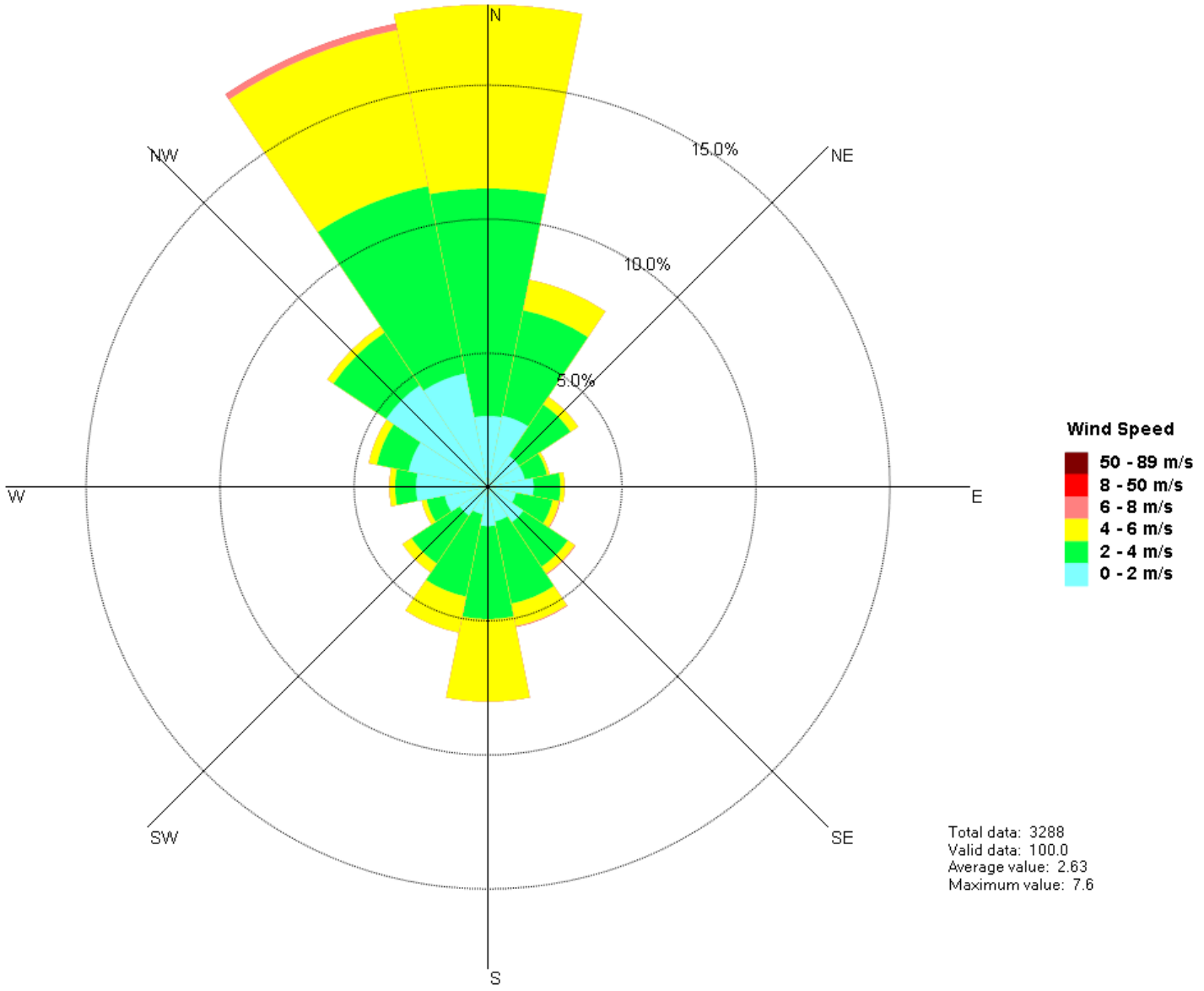

31
30
29
28
27
26
25
24
23
Average Temperature (°C)
27.8

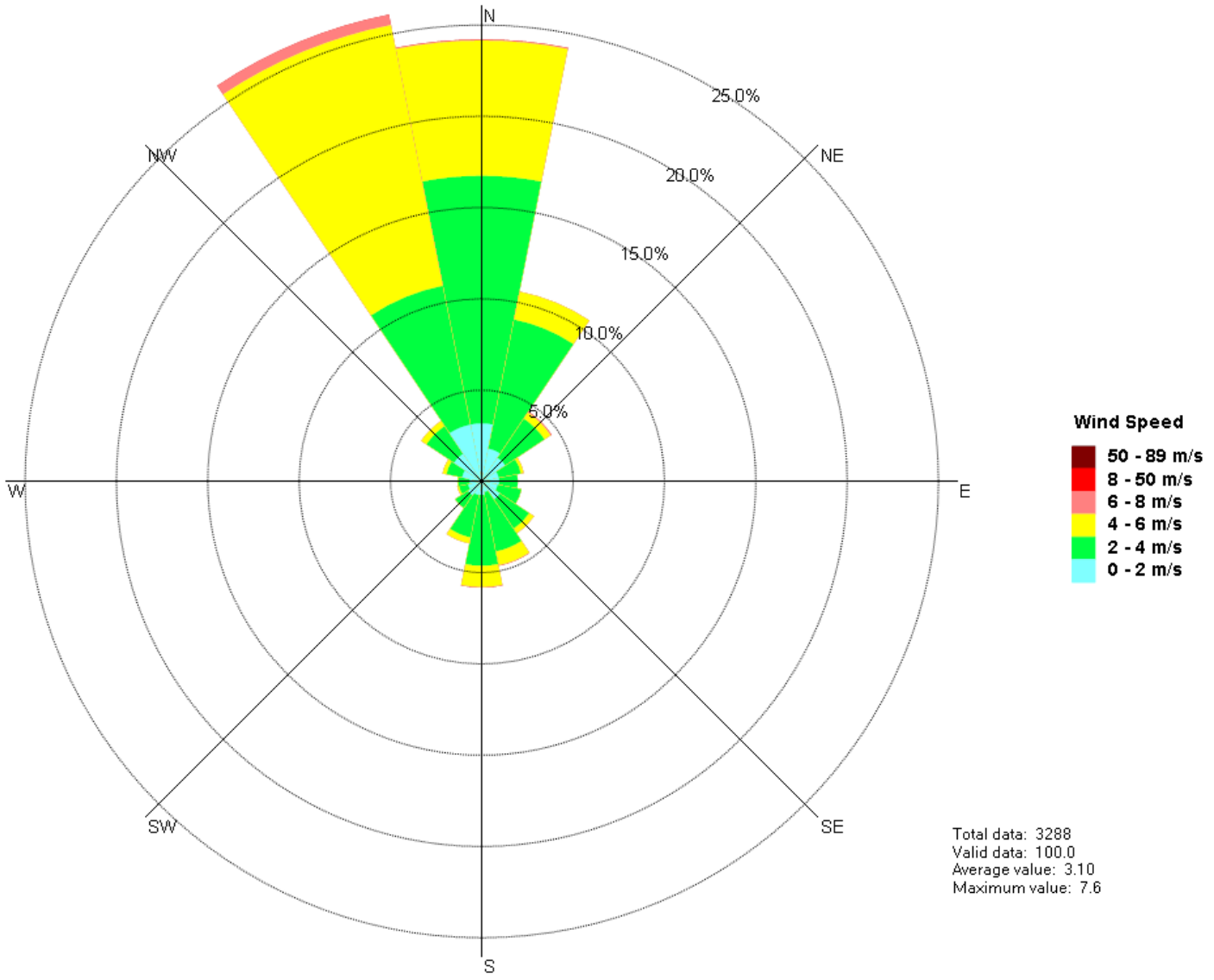

Average Temperature (°C)
40
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
28.0
32.9
35.5
32.9
25.9
33.8
28.1
27.8
27.9
26.8
29.8
28.0
26.8
18.4
19.0

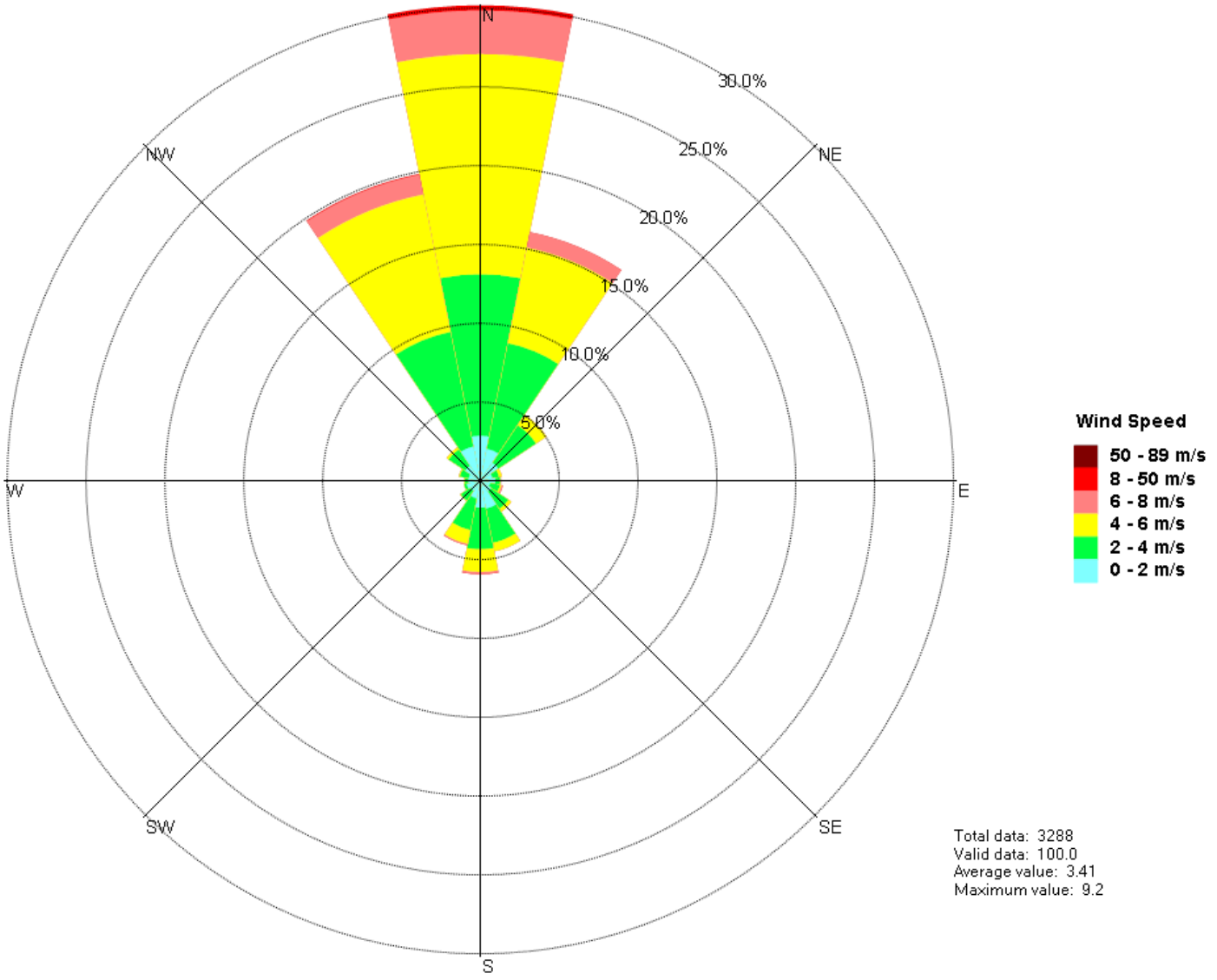

40
35
30
25
20
15
10
Temperature (°C)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
38.4
36.8
36.0
35.4
35.5
34.3
33.4
32.5
30.4
28.0
31.6
28.5
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
28.1
24.0
21.9
25.5
26.0
26.1
25.7
25.3
23.8
19.9
16.4
24.0
20.5
16.9
15.4
Max
Mean
Min

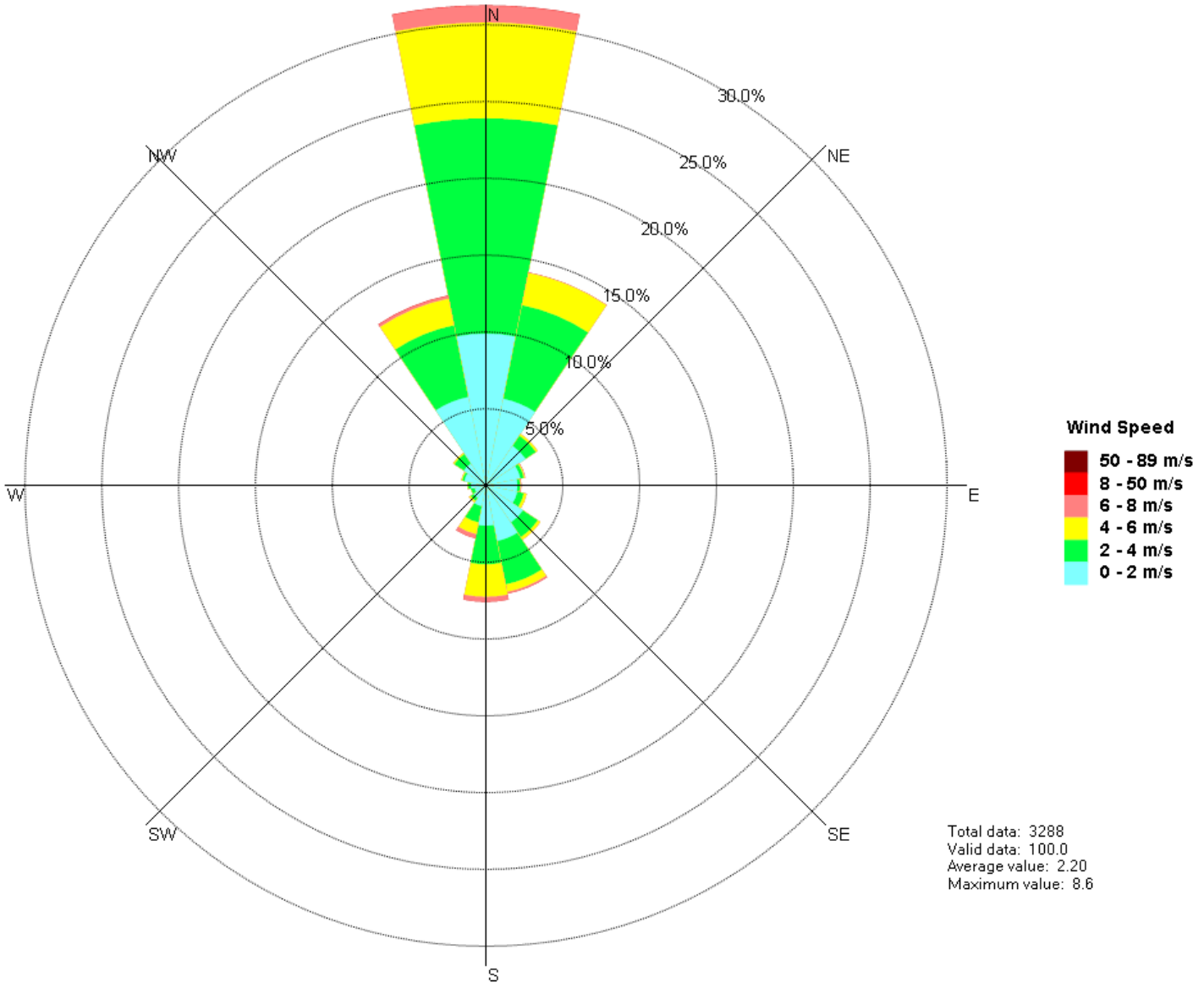

30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
Average Temperature (°C)
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
y = 0.051x - 74.083
R² = 0.2996
Temperature Data
Linear (Temperature Data)

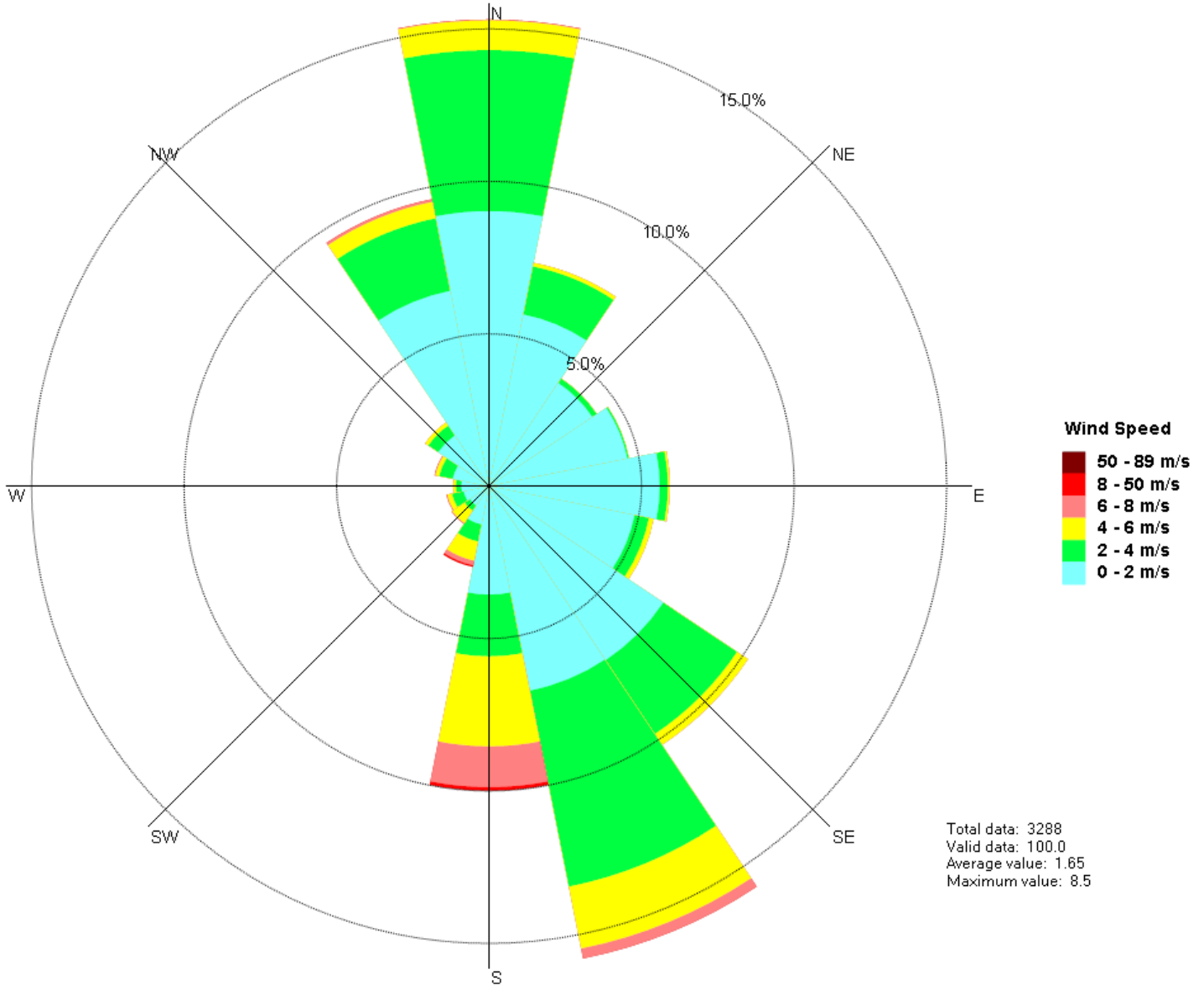

N
NE
E
SE
S
SW
W
NW
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 26304
Valid data: 100.0
Average value: 2.41
Maximum value: 9.2

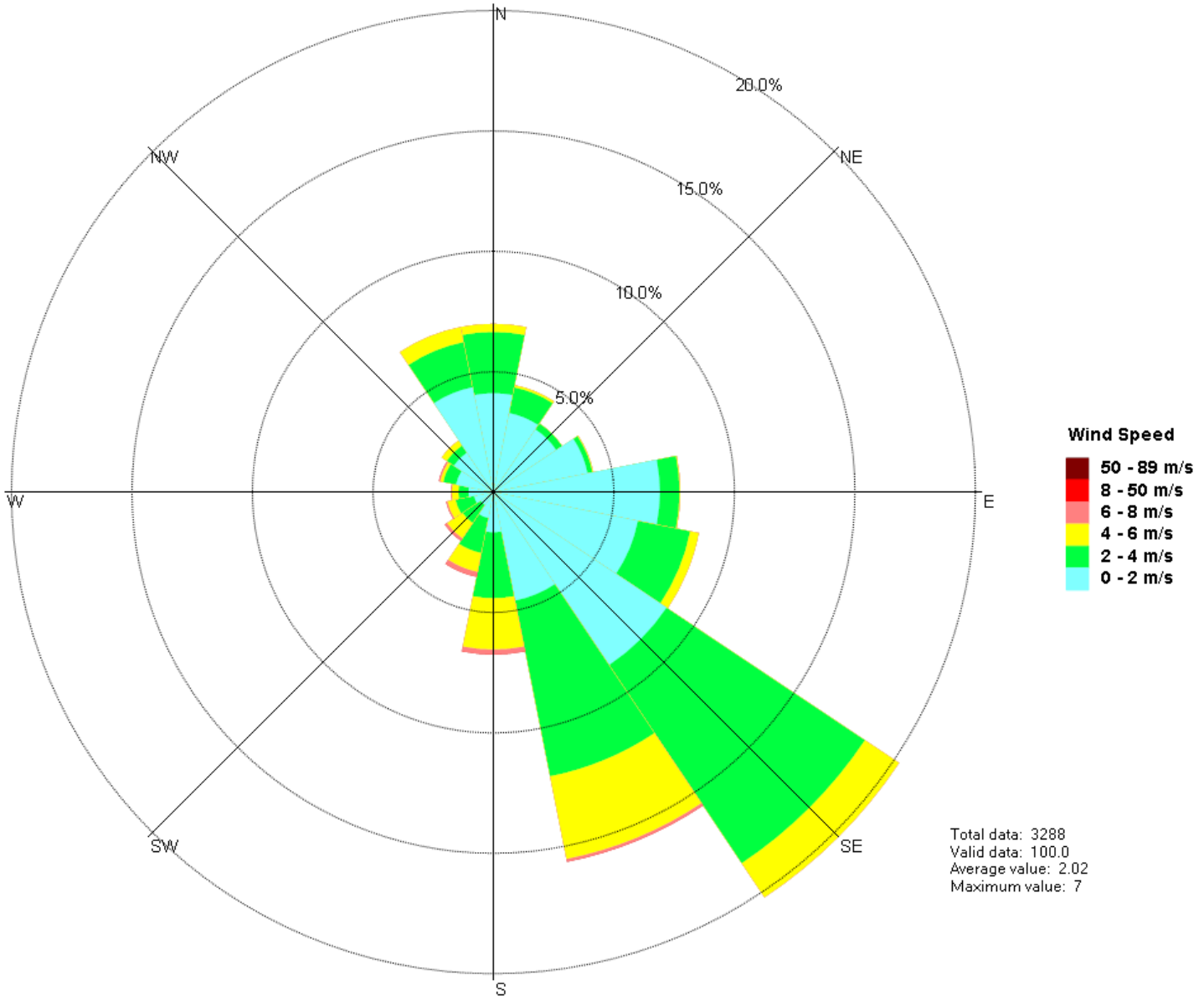

N
NE
E
SE
S
SW
W
NW
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.63
Maximum value: 7.6

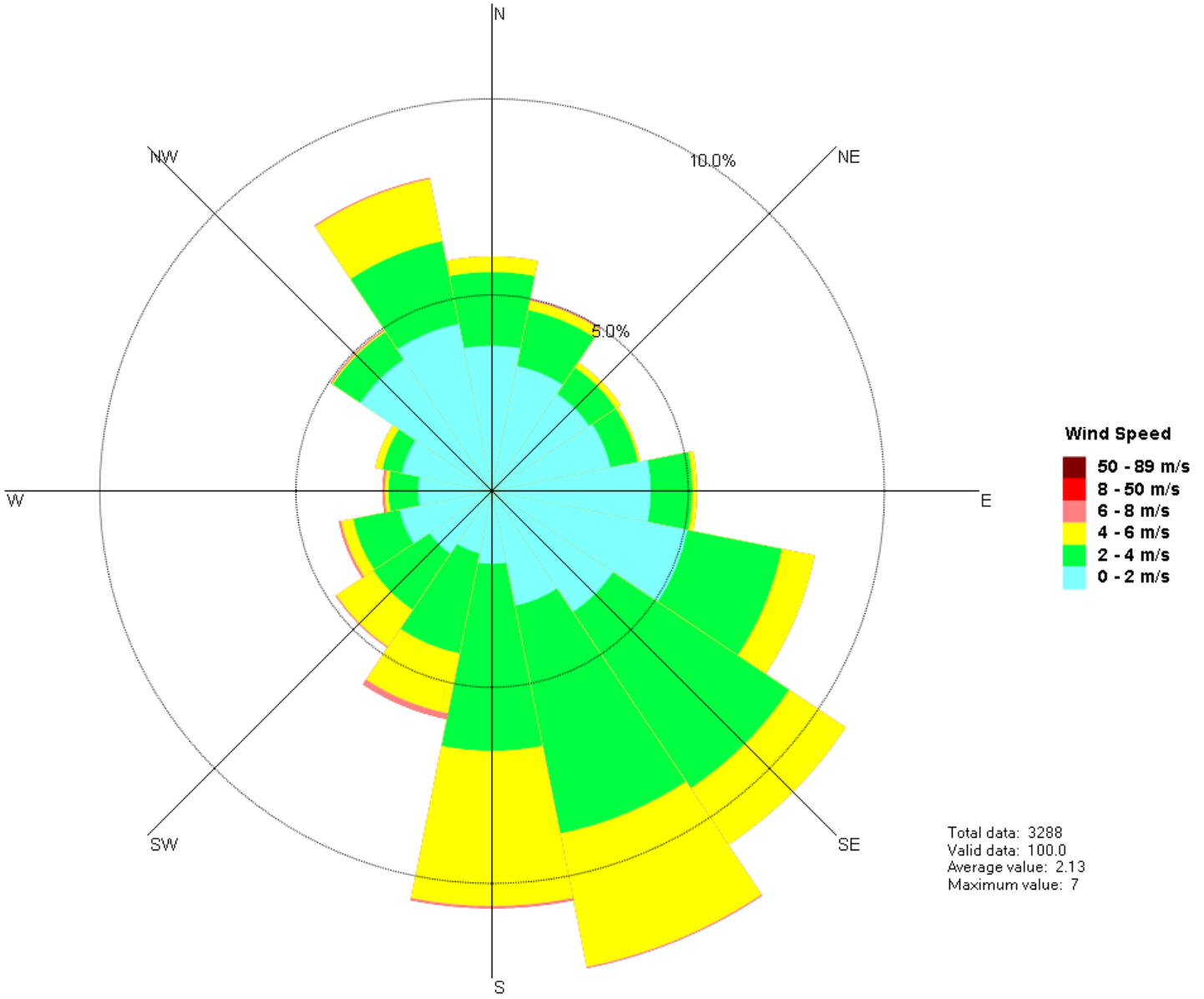

N
NE
E
SE
S
SW
W
NW
25.0%
20.0%
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 3.10
Maximum value: 7.6

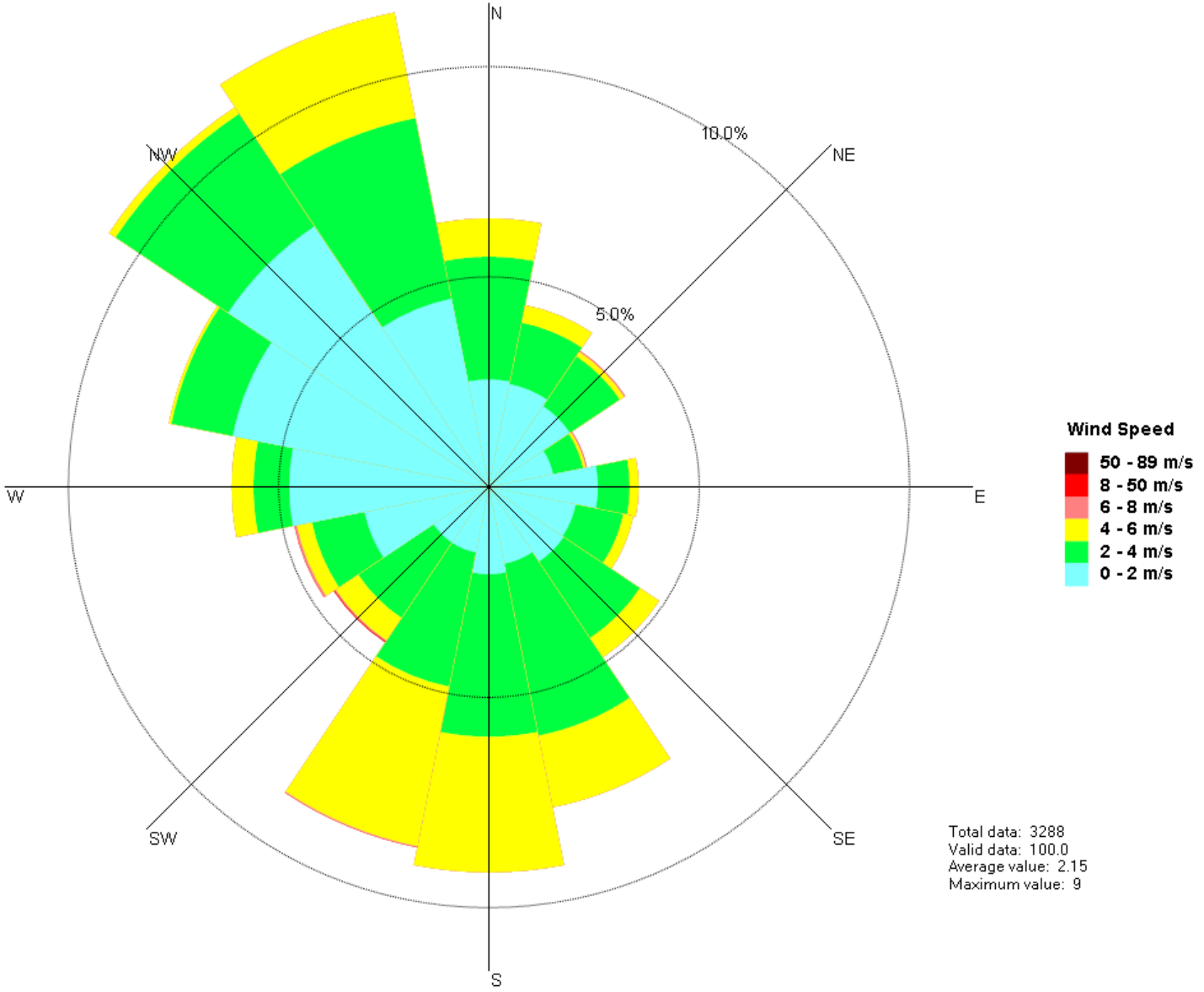

N
NE
E
SE
S
SW
W
NW
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 3.41
Maximum value: 9.2


N
NE
E
SE
S
SW
W
NW
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.20
Maximum value: 8.6


N
NE
E
SE
S
SW
W
NW
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 1.65
Maximum value: 8.5


N
NE
E
SE
S
SW
W
NW
20.0%
15.0%
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.02
Maximum value: 7


N
NE
E
SE
S
SW
W
NW
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.13
Maximum value: 7


N
NE
E
SE
S
SW
W
NW
10.0%
5.0%
Wind Speed
50 - 89 m/s
8 - 50 m/s
6 - 8 m/s
4 - 6 m/s
2 - 4 m/s
0 - 2 m/s
Total data: 3288
Valid data: 100.0
Average value: 2.15
Maximum value: 9

ATTACHMENT 2.1

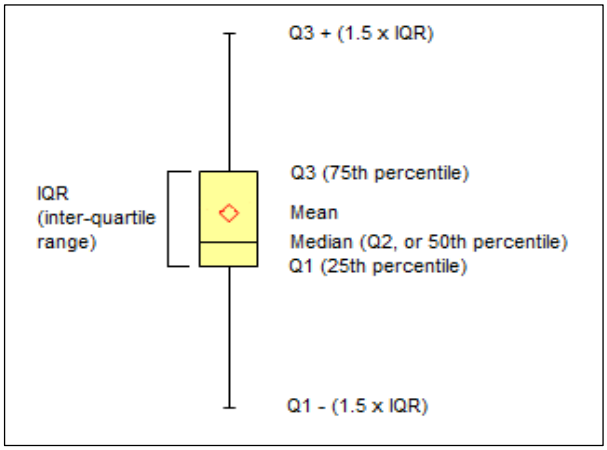
Annual Precipitation Analysis

Annual Precipitation Data: Monywa Township (1961-2013)

Year	Precip. (mm)	Rain Days
1961	731.0	61
1962	684.0	53
1963	896.0	63
1964	581.0	50
1965	1,198.0	91
1966	664.0	60
1967	686.0	67
1968	1,110.0	66
1969	744.0	50
1970	611.0	66
1971	1,042.0	62
1972	676.0	55
1973	1,370.0	99
1974	668.0	61
1975	1,067.0	73
1976	1,275.0	86
1977	921.0	70
1978	910.0	76
1979	438.0	38
1980	742.0	52
1981	797.0	67
1982	411.0	44
1983	588.0	59
1984	855.0	55
1985	544.0	57
1986	642.0	50
1987	741.0	58
1988	1,015.0	62
1989	722.0	49
1990	601.0	50
1991	518.0	55
1992	887.0	68
1993	612.0	60
1994	674.6	58
1995	Exclude	Exclude
1996	802.4	101
1997	609.6	75
1998	437.2	61
1999	Exclude	Exclude
2000	604.2	77
2001	653.3	80
2002	478.2	82
2003	597.4	63
2004	871.6	76
2005	739.9	77
2006	766.8	88
2007	1,032.5	73
2008	566.2	48
2009	689.2	51
2010	1,220.9	64
2011	1,184.2	81
2012	813.7	54
2013	Exclude	Exclude

Stat	Precip. (mm)
Mean	773.8
SD	230.0
Median	726.5
Q1	610.0
Q3	893.8
Minimum	411.0
Maximum	1,370.0
Count	50
Ext Max	1,319.4
Ext Min	184.3
25th Pct	610.0
50th Pct	116.5
75th Pct	167.3
1.5 * IQR	425.7

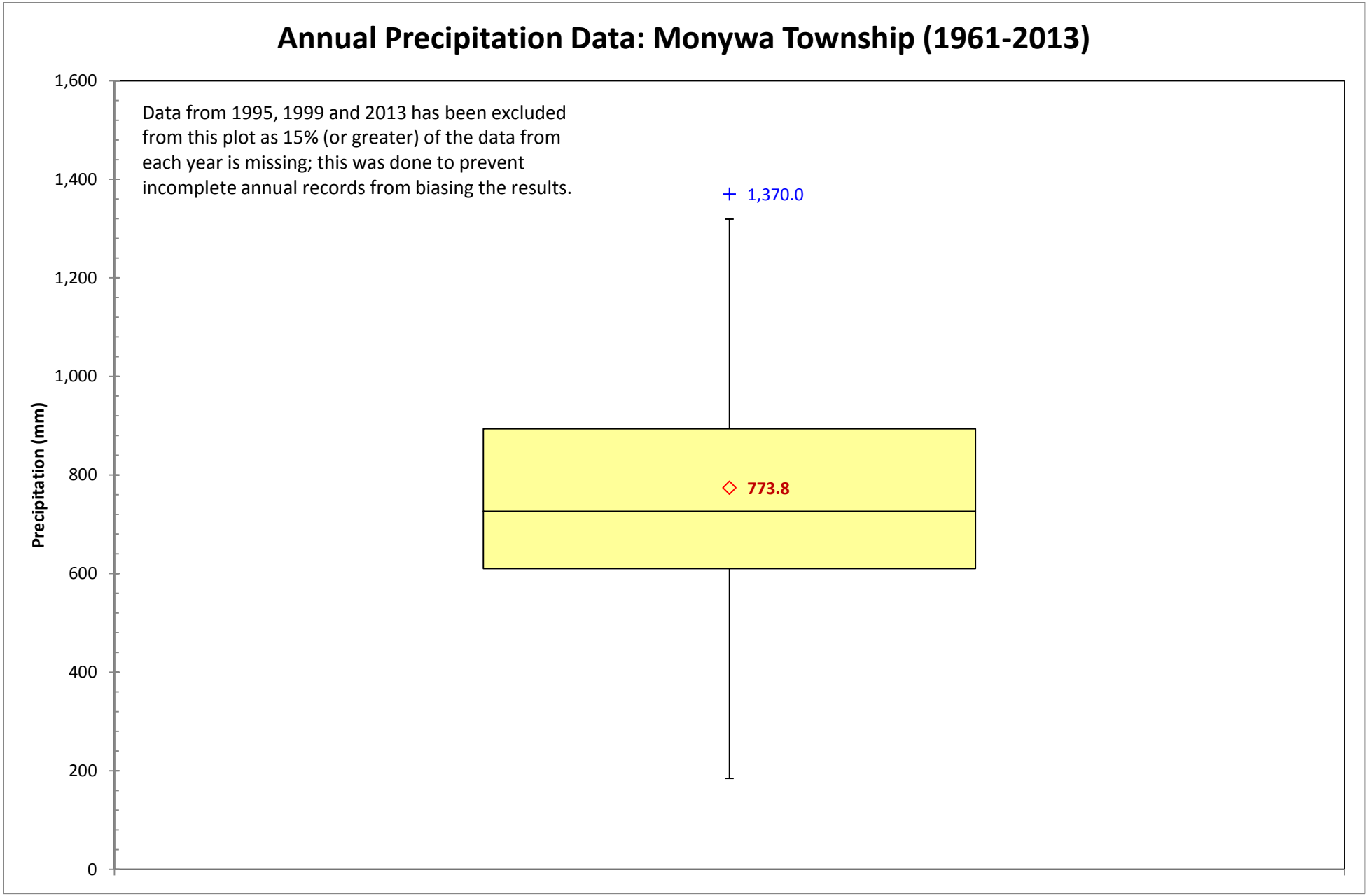
Stat	Rain Days
Mean	64.8



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers

Annual Precipitation Data: Monywa Township (1961-2013)



ATTACHMENT 2.2

Monthly Precipitation Analysis

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format)

Precipitation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1961	0.0	0.0	12.0	60.0	126.0	41.0	72.0	88.0	255.0	38.0	39.0	0.0
1962	1.0	4.0	0.0	1.0	145.0	67.0	82.0	98.0	95.0	191.0	0.0	0.0
1963	0.0	0.0	1.0	58.0	149.0	47.0	51.0	84.0	246.0	260.0	0.0	0.0
1964	0.0	2.0	1.0	3.0	183.0	0.0	48.0	112.0	137.0	85.0	10.0	0.0
1965	5.0	0.0	0.0	2.0	79.0	50.0	69.0	166.0	496.0	236.0	10.0	85.0
1966	0.0	0.0	1.0	27.0	140.0	131.0	15.0	62.0	166.0	112.0	0.0	10.0
1967	19.0	0.0	5.0	12.0	71.0	113.0	80.0	96.0	107.0	183.0	0.0	0.0
1968	14.0	3.0	1.0	44.0	143.0	248.0	100.0	81.0	215.0	261.0	0.0	0.0
1969	0.0	0.0	0.0	31.0	90.0	93.0	114.0	33.0	211.0	172.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	96.0	76.0	16.0	67.0	80.0	166.0	88.0	22.0
1971	0.0	0.0	0.0	55.0	263.0	136.0	120.0	235.0	100.0	118.0	15.0	0.0
1972	0.0	0.0	0.0	61.0	49.0	46.0	23.0	356.0	64.0	28.0	49.0	0.0
1973	0.0	0.0	2.0	19.0	77.0	233.0	134.0	308.0	191.0	219.0	186.0	1.0
1974	0.0	0.0	9.0	8.0	194.0	64.0	34.0	95.0	199.0	21.0	44.0	0.0
1975	31.0	0.0	0.0	10.0	176.0	126.0	46.0	187.0	232.0	180.0	76.0	3.0
1976	0.0	102.0	13.0	8.0	178.0	193.0	60.0	74.0	124.0	402.0	115.0	6.0
1977	0.0	0.0	0.0	29.0	35.0	53.0	44.0	197.0	319.0	173.0	71.0	0.0
1978	0.0	0.0	0.0	16.0	114.0	116.0	182.0	140.0	164.0	178.0	0.0	0.0
1979	0.0	0.0	0.0	2.0	15.0	56.0	158.0	70.0	70.0	28.0	0.0	39.0
1980	0.0	0.0	0.0	40.0	55.0	183.0	123.0	73.0	151.0	117.0	0.0	0.0
1981	0.0	0.0	13.0	32.0	139.0	243.0	31.0	92.0	47.0	82.0	118.0	0.0
1982	0.0	0.0	0.0	2.0	106.0	81.0	11.0	117.0	60.0	33.0	1.0	0.0
1983	0.0	0.0	3.0	12.0	17.0	18.0	17.0	49.0	66.0	252.0	140.0	14.0
1984	0.0	0.0	0.0	83.0	59.0	342.0	80.0	108.0	86.0	95.0	0.0	2.0
1985	0.0	0.0	1.0	53.0	113.0	36.0	98.0	17.0	107.0	79.0	40.0	0.0
1986	0.0	0.0	0.0	14.0	20.0	40.0	75.0	185.0	211.0	71.0	26.0	0.0
1987	3.0	31.0	1.0	54.0	27.0	91.0	53.0	315.0	78.0	57.0	31.0	0.0
1988	0.0	0.0	0.0	12.0	116.0	219.0	175.0	125.0	63.0	180.0	125.0	0.0
1989	0.0	0.0	0.0	12.0	27.0	43.0	59.0	173.0	247.0	159.0	2.0	0.0
1990	0.0	0.0	11.0	5.0	86.0	11.0	17.0	41.0	240.0	83.0	107.0	0.0
1991	0.0	0.0	0.0	44.0	12.0	65.0	29.0	62.0	123.0	106.0	77.0	0.0
1992	1.0	4.0	0.0	7.0	142.0	33.0	42.0	171.0	205.0	192.0	67.0	23.0
1993	0.0	3.0	2.0	24.0	114.0	96.0	26.0	0.0	242.0	105.0	0.0	0.0
1994	0.0	2.0	5.1	4.1	25.7	216.9	58.9	185.7	126.2	18.0	32.0	0.0
1995	N/D	N/D	N/D	N/D	N/D	N/D	50.5	147.6	199.4	98.6	35.1	0.0
1996	0.0	2.8	95.8	32.5	36.8	81.0	73.1	236.0	75.2	94.0	0.0	75.2
1997	0.0	0.8	5.3	25.9	85.1	39.4	111.7	173.5	96.8	71.1	0.0	0.0
1998	0.0	0.0	14.7	9.4	12.5	11.9	111.3	12.7	181.9	82.8	0.0	0.0
1999	N/D	N/D	N/D	N/D	102.6	33.3	82.5	64.5	238.2	163.1	56.1	1.8
2000	0.0	6.6	7.3	25.2	108.7	49.5	26.2	40.1	185.4	154.4	0.8	0.0
2001	0.0	0.0	0.3	2.3	97.0	33.8	34.5	171.4	130.1	163.1	20.8	0.0
2002	2.3	0.0	3.3	3.8	38.4	33.5	52.6	169.6	127.3	33.0	14.5	0.0
2003	0.0	0.0	0.0	19.8	108.9	35.1	40.9	42.9	213.6	133.6	0.0	2.5
2004	0.0	0.0	0.0	27.4	143.8	230.2	74.4	31.0	346.7	15.0	2.0	1.0
2005	0.3	0.0	4.6	36.8	14.7	189.7	21.3	89.4	198.6	146.3	9.7	28.4
2006	0.0	0.0	0.0	39.9	92.8	106.1	80.3	123.7	148.1	137.4	38.6	0.0
2007	0.0	9.4	0.0	48.3	386.2	60.9	37.6	148.0	140.1	185.0	17.0	0.0
2008	19.0	0.0	2.5	28.5	163.3	75.2	73.1	18.5	101.6	83.2	1.3	0.0
2009	0.0	0.0	3.7	20.5	197.5	71.5	2.0	118.5	119.0	156.5	0.0	0.0
2010	0.0	0.0	9.0	18.0	83.0	116.0	131.6	185.0	152.8	512.5	0.0	13.0
2011	0.0	0.0	5.5	99.5	88.5	265.4	85.4	235.2	95.2	303.0	0.0	6.5
2012	0.0	0.0	0.0	32.5	64.5	57.5	54.5	37.0	378.0	153.7	36.0	0.0
2013	0.0	0.0	0.0	9.0	74.5	N/D	N/D	N/D	N/D	N/D	N/D	N/D

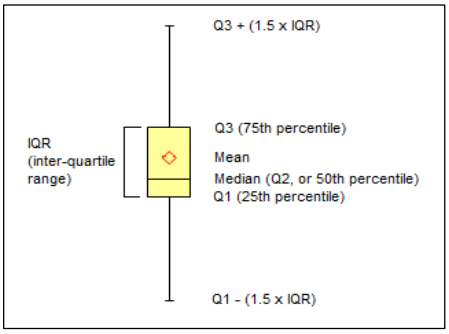
Precipitation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ave. # of Rain Days	0	0	1	4	9	9	8	10	11	10	3	1
Mean	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
SD	5.9	14.8	13.7	22.3	69.5	79.4	42.5	80.4	89.1	94.9	44.4	16.9
Median	0.0	0.0	1.0	20.5	94.4	71.5	59.0	103.0	149.5	135.5	12.2	0.0
Q1	0.0	0.0	0.0	8.5	53.5	42.0	34.4	63.9	99.2	82.6	0.0	0.0
Q3	0.0	0.0	4.8	38.4	140.5	128.5	83.3	171.8	211.7	180.0	45.3	2.1
Minimum	0.0	0.0	0.0	0.0	12.0	0.0	2.0	0.0	47.0	15.0	0.0	0.0
Maximum	31.0	102.0	95.8	99.5	386.2	342.0	182.0	356.0	496.0	512.5	186.0	85.0
Count	51	51	51	51	52	51	52	52	52	52	52	52
Ext Max	0.0	0.0	12.0	83.1	271.0	258.3	156.5	333.8	380.4	326.1	113.1	5.3
Ext Min	0.0	0.0	-7.2	-36.3	-77.0	-87.8	-38.9	-98.0	-69.5	-63.5	-67.9	-3.2
25th Pct	0.0	0.0	0.0	8.5	53.5	42.0	34.4	63.9	99.2	82.6	0.0	0.0
50th Pct	0.0	0.0	1.0	12.0	40.9	29.5	24.6	39.1	50.3	52.9	12.2	0.0
75th Pct	0.0	0.0	3.8	17.9	46.1	57.0	24.3	68.8	62.1	44.5	33.0	2.1
1.5 * IQR	0.0	0.0	7.2	44.8	130.5	129.8	73.3	161.9	168.7	146.1	67.9	3.2

Note: N/D = No Data Available, N/A = Not Applicable.

Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format)

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013)
(Analysis Format | Outliers Removed)

Precipitation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1961	0.0	0.0		60.0	126.0	41.0	72.0	88.0	255.0	38.0	39.0	0.0
1962			0.0	1.0	145.0	67.0	82.0	98.0	95.0	191.0	0.0	0.0
1963	0.0	0.0	1.0	58.0	149.0	47.0	51.0	84.0	246.0	260.0	0.0	0.0
1964	0.0		1.0	3.0	183.0	0.0	48.0	112.0	137.0	85.0	10.0	0.0
1965		0.0	0.0	2.0	79.0	50.0	69.0	166.0		236.0	10.0	
1966	0.0	0.0	1.0	27.0	140.0	131.0	15.0	62.0	166.0	112.0	0.0	
1967		0.0	5.0	12.0	71.0	113.0	80.0	96.0	107.0	183.0	0.0	0.0
1968			1.0	44.0	143.0	248.0	100.0	81.0	215.0	261.0	0.0	0.0
1969	0.0	0.0	0.0	31.0	90.0	93.0	114.0	33.0	211.0	172.0	0.0	0.0
1970	0.0	0.0	0.0	0.0	96.0	76.0	16.0	67.0	80.0	166.0	88.0	
1971	0.0	0.0	0.0	55.0	263.0	136.0	120.0	235.0	100.0	118.0	15.0	0.0
1972	0.0	0.0	0.0	61.0	49.0	46.0	23.0		64.0	28.0	49.0	0.0
1973	0.0	0.0	2.0	19.0	77.0	233.0	134.0	308.0	191.0	219.0		1.0
1974	0.0	0.0	9.0	8.0	194.0	64.0	34.0	95.0	199.0	21.0	44.0	0.0
1975		0.0	0.0	10.0	176.0	126.0	46.0	187.0	232.0	180.0	76.0	3.0
1976	0.0			8.0	178.0	193.0	60.0	74.0	124.0			
1977	0.0	0.0	0.0	29.0	35.0	53.0	44.0	197.0	319.0	173.0	71.0	0.0
1978	0.0	0.0	0.0	16.0	114.0	116.0		140.0	164.0	178.0	0.0	0.0
1979	0.0	0.0	0.0	2.0	15.0	56.0		70.0	70.0	28.0	0.0	
1980	0.0	0.0	0.0	40.0	55.0	183.0	123.0	73.0	151.0	117.0	0.0	0.0
1981	0.0	0.0		32.0	139.0	243.0	31.0	92.0	47.0	82.0		0.0
1982	0.0	0.0	0.0	2.0	106.0	81.0	11.0	117.0	60.0	33.0	1.0	0.0
1983	0.0	0.0	3.0	12.0	17.0	18.0	17.0	49.0	66.0	252.0		
1984	0.0	0.0	0.0	83.0	59.0		80.0	108.0	86.0	95.0	0.0	2.0
1985	0.0	0.0	1.0	53.0	113.0	36.0	98.0	17.0	107.0	79.0	40.0	0.0
1986	0.0	0.0	0.0	14.0	20.0	40.0	75.0	185.0	211.0	71.0	26.0	0.0
1987			1.0	54.0	27.0	91.0	53.0	315.0	78.0	57.0	31.0	0.0
1988	0.0	0.0	0.0	12.0	116.0	219.0		125.0	63.0	180.0		0.0
1989	0.0	0.0	0.0	12.0	27.0	43.0	59.0	173.0	247.0	159.0	2.0	0.0
1990	0.0	0.0	11.0	5.0	86.0	11.0	17.0	41.0	240.0	83.0	107.0	0.0
1991	0.0	0.0	0.0	44.0	12.0	65.0	29.0	62.0	123.0	106.0	77.0	0.0
1992			0.0	7.0	142.0	33.0	42.0	171.0	205.0	192.0	67.0	
1993	0.0		2.0	24.0	114.0	96.0	26.0	0.0	242.0	105.0	0.0	0.0
1994	0.0		5.1	4.1	25.7	216.9	58.9	185.7	126.2	18.0	32.0	0.0
1995	N/D	N/D	N/D	N/D	N/D	N/D	50.5	147.6	199.4	98.6	35.1	0.0
1996	0.0			32.5	36.8	81.0	73.1	236.0	75.2	94.0	0.0	
1997	0.0		5.3	25.9	85.1	39.4	111.7	173.5	96.8	71.1	0.0	0.0
1998	0.0	0.0		9.4	12.5	11.9	111.3	12.7	181.9	82.8	0.0	0.0
1999	N/D	N/D	N/D	N/D	102.6	33.3	82.5	64.5	238.2	163.1	56.1	1.8
2000	0.0		7.3	25.2	108.7	49.5	26.2	40.1	185.4	154.4	0.8	0.0
2001	0.0	0.0	0.3	2.3	97.0	33.8	34.5	171.4	130.1	163.1	20.8	0.0
2002		0.0	3.3	3.8	38.4	33.5	52.6	169.6	127.3	33.0	14.5	0.0
2003	0.0	0.0	0.0	19.8	108.9	35.1	40.9	42.9	213.6	133.6	0.0	2.5
2004	0.0	0.0	0.0	27.4	143.8	230.2	74.4	31.0	346.7	15.0	2.0	1.0
2005		0.0	4.6	36.8	14.7	189.7	21.3	89.4	198.6	146.3	9.7	
2006	0.0	0.0	0.0	39.9	92.8	106.1	80.3	123.7	148.1	137.4	38.6	0.0
2007	0.0		0.0	48.3		60.9	37.6	148.0	140.1	185.0	17.0	0.0
2008		0.0	2.5	28.5	163.3	75.2	73.1	18.5	101.6	83.2	1.3	0.0
2009	0.0	0.0	3.7	20.5	197.5	71.5	2.0	118.5	119.0	156.5	0.0	0.0
2010	0.0	0.0	9.0	18.0	83.0	116.0	131.6	185.0	152.8		0.0	
2011	0.0	0.0	5.5		88.5		85.4	235.2	95.2	303.0	0.0	
2012	0.0	0.0	0.0	32.5	64.5	57.5	54.5	37.0	378.0	153.7	36.0	0.0
2013	0.0	0.0	0.0	9.0	74.5	N/D	N/D	N/D	N/D	N/D	N/D	N/D

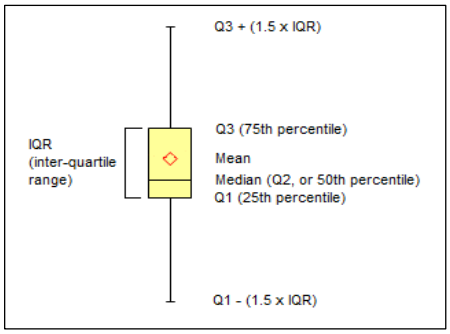
Precipitation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain Days	0.3	0.4	1.0	3.8	9.0	8.6	7.7	10.0	11.3	9.5	2.7	1.0
Mean	0.0	0.0	1.8	24.5	96.0	91.6	60.6	116.7	159.9	129.0	21.6	0.3
SD	0.0	0.0	2.9	19.8	57.3	68.6	34.5	73.9	76.6	70.8	28.4	0.7
Median	0.0	0.0	0.0	20.2	92.8	67.0	54.5	98.0	148.1	125.8	9.7	0.0
Q1	0.0	0.0	0.0	8.3	52.0	41.0	34.0	63.3	98.4	82.2	0.0	0.0
Q3	0.0	0.0	2.9	35.8	139.5	116.0	80.3	171.2	211.0	176.8	37.3	0.0
Minimum	0.0	0.0	0.0	0.0	12.0	0.0	2.0	0.0	47.0	15.0	0.0	0.0
Maximum	0.0	0.0	11.0	83.0	263.0	248.0	134.0	315.0	378.0	303.0	107.0	3.0
Count	41	39	46	50	51	49	49	51	51	50	47	41
Ext Max	0.0	0.0	7.2	77.0	270.8	228.5	149.6	333.2	379.9	318.6	93.2	0.0
Ext Min	0.0	0.0	-4.3	-33.0	-79.3	-71.5	-35.4	-98.7	-70.5	-59.6	-55.9	0.0
25th Pct	0.0	0.0	0.0	8.3	52.0	41.0	34.0	63.3	98.4	82.2	0.0	0.0
50th Pct	0.0	0.0	0.0	11.9	40.8	26.0	20.5	34.7	49.7	43.6	9.7	0.0
75th Pct	0.0	0.0	2.9	15.6	46.7	49.0	25.8	73.2	62.9	50.9	27.6	0.0
1.5 * IQR	0.0	0.0	4.3	41.3	131.3	112.5	69.4	161.9	168.9	141.8	55.9	0.0

Note: N/D = No Data Available, N/A = Not Applicable.

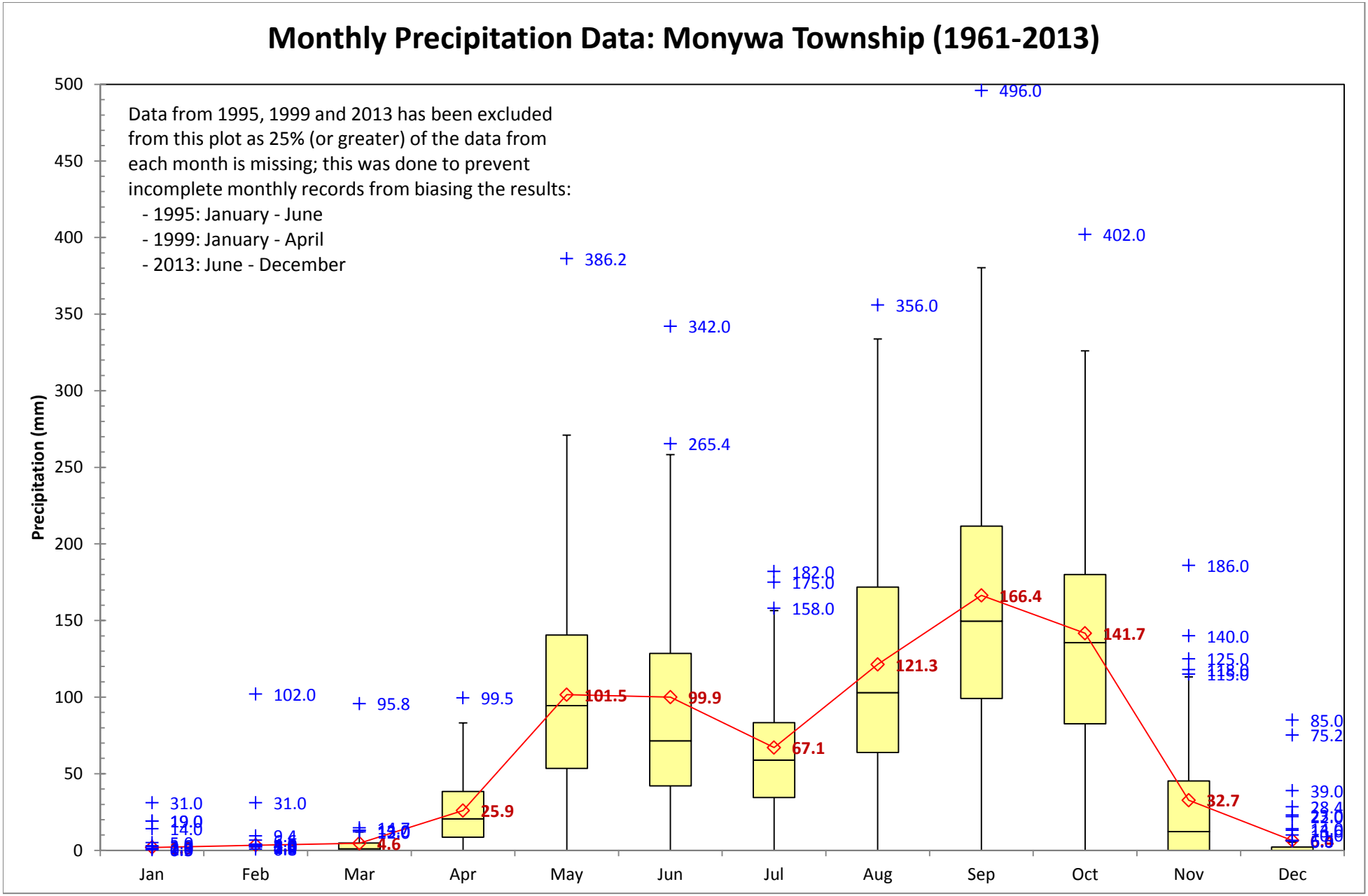
Precipitation Data, Monthly Sampling Frequency: Monywa Township (1961-2013) (Analysis Format | Outliers Removed)

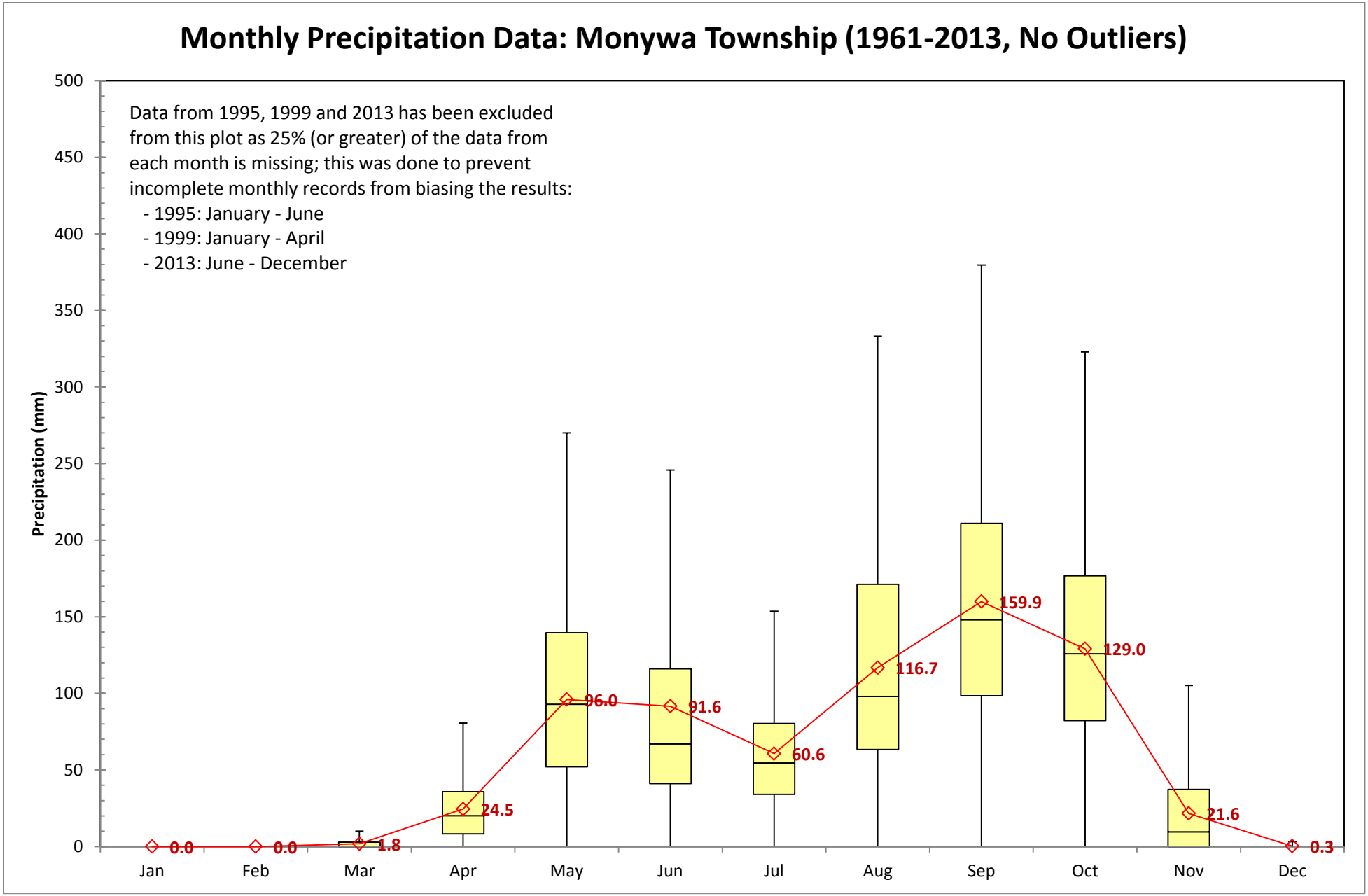
Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Monthly Precipitation Data: Monywa Township (1961-2013)




Monthly Precipitation Data: Monywa Township (1961-2013, No Outliers)
Data from 1995, 1999 and 2013 has been excluded from this plot as 25% (or greater) of the data from each month is missing; this was done to prevent incomplete monthly records from biasing the results:
- 1995: January - June
- 1999: January - April
- 2013: June - December
Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
0.0
0.0
1.8
24.5
96.0
91.6
60.6
116.7
159.9
129.0
21.6
0.3

ATTACHMENT 2.3

Daily Precipitation Frequency Analysis

Precipitation Frequency Analysis, Maximum Annual Daily: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

Max Daily Data		Rank	Weibull	ARI	Ranked
Year	Precip. (mm)	(highest to lowest) m	Exceedance Probability p	(yrs)	Precip (mm)
1961	77.0	1	0.019	53.00	165.0
1962	59.0	2	0.038	26.50	135.0
1963	76.0	3	0.057	17.67	135.0
1964	98.0	4	0.075	13.25	125.0
1965	90.0	5	0.094	10.60	117.1
1966	75.0	6	0.113	8.83	117.0
1967	125.0	7	0.132	7.57	109.0
1968	109.0	8	0.151	6.63	108.5
1969	73.0	9	0.170	5.89	105.5
1970	65.0	10	0.189	5.30	103.0
1971	92.0	11	0.208	4.82	102.0
1972	71.0	12	0.226	4.42	99.3
1973	103.0	13	0.245	4.08	99.0
1974	85.0	14	0.264	3.79	98.0
1975	69.0	15	0.283	3.53	97.0
1976	102.0	16	0.302	3.31	93.5
1977	72.0	17	0.321	3.12	92.0
1978	70.0	18	0.340	2.94	91.0
1979	99.0	19	0.358	2.79	90.0
1980	52.0	20	0.377	2.65	88.0
1981	97.0	21	0.396	2.52	85.0
1982	36.0	22	0.415	2.41	82.3
1983	80.0	23	0.434	2.30	80.0
1984	135.0	24	0.453	2.21	78.0
1985	52.0	25	0.472	2.12	77.0
1986	78.0	26	0.491	2.04	77.0
1987	91.0	27	0.509	1.96	76.5
1988	117.0	28	0.528	1.89	76.0
1989	64.0	29	0.547	1.83	75.0
1990	75.0	30	0.566	1.77	75.0
1991	45.0	31	0.585	1.71	73.0
1992	88.0	32	0.604	1.66	72.0
1993	66.0	33	0.623	1.61	71.4
1994	117.1	34	0.642	1.56	71.0
1995	68.1	35	0.660	1.51	70.0
1996	57.7	36	0.679	1.47	69.0
1997	47.7	37	0.698	1.43	68.1
1998	48.4	38	0.717	1.39	67.8
1999	82.3	39	0.736	1.36	67.0
2000	67.8	40	0.755	1.33	66.0
2001	76.5	41	0.774	1.29	65.0
2002	43.9	42	0.792	1.26	64.0
2003	93.5	43	0.811	1.23	59.0
2004	99.3	44	0.830	1.20	57.7
2005	71.4	45	0.849	1.18	52.0
2006	77.0	46	0.868	1.15	52.0
2007	105.5	47	0.887	1.13	48.4
2008	42.4	48	0.906	1.10	47.7
2009	67.0	49	0.925	1.08	45.0
2010	108.5	50	0.943	1.06	43.9
2011	165.0	51	0.962	1.04	42.4
2012	135.0	52	0.981	1.02	36.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Pearson 5 (3P)	2	5	10
Pearson 6	6	6	36
Gen. Logistic	12	3	36
Burr	18	2	36
Pearson 6 (4P)	5	10	50
Log-Logistic (3P)	4	14	56
Gumbel Max	3	26	78
Gen. Extreme Value	13	7	91
Log-Pearson 3	11	13	143

Three fits were selected for comparison:

1) **Wakeby** (Best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Note that these predictions should be multiplied by **1.143** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

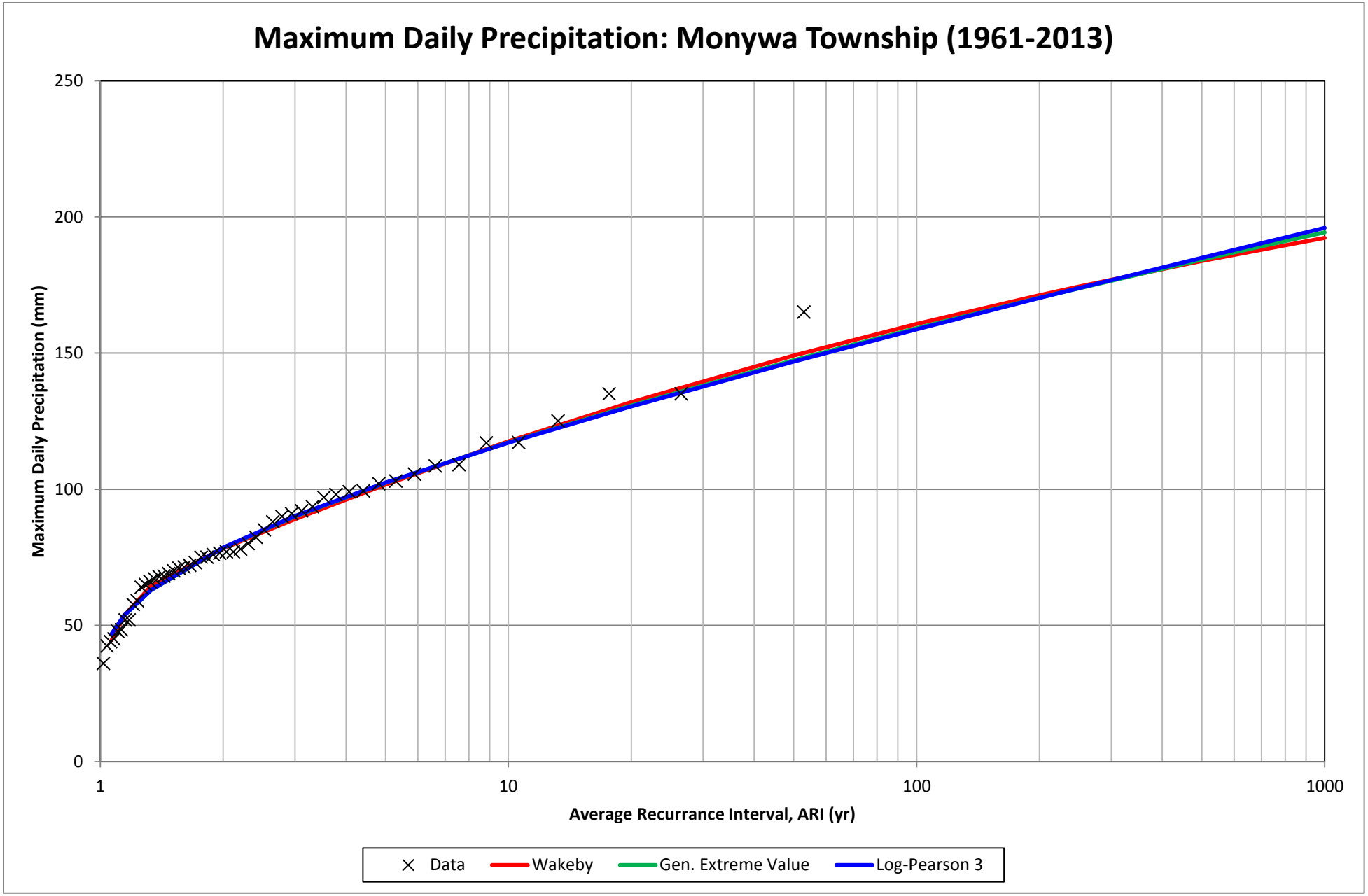
Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

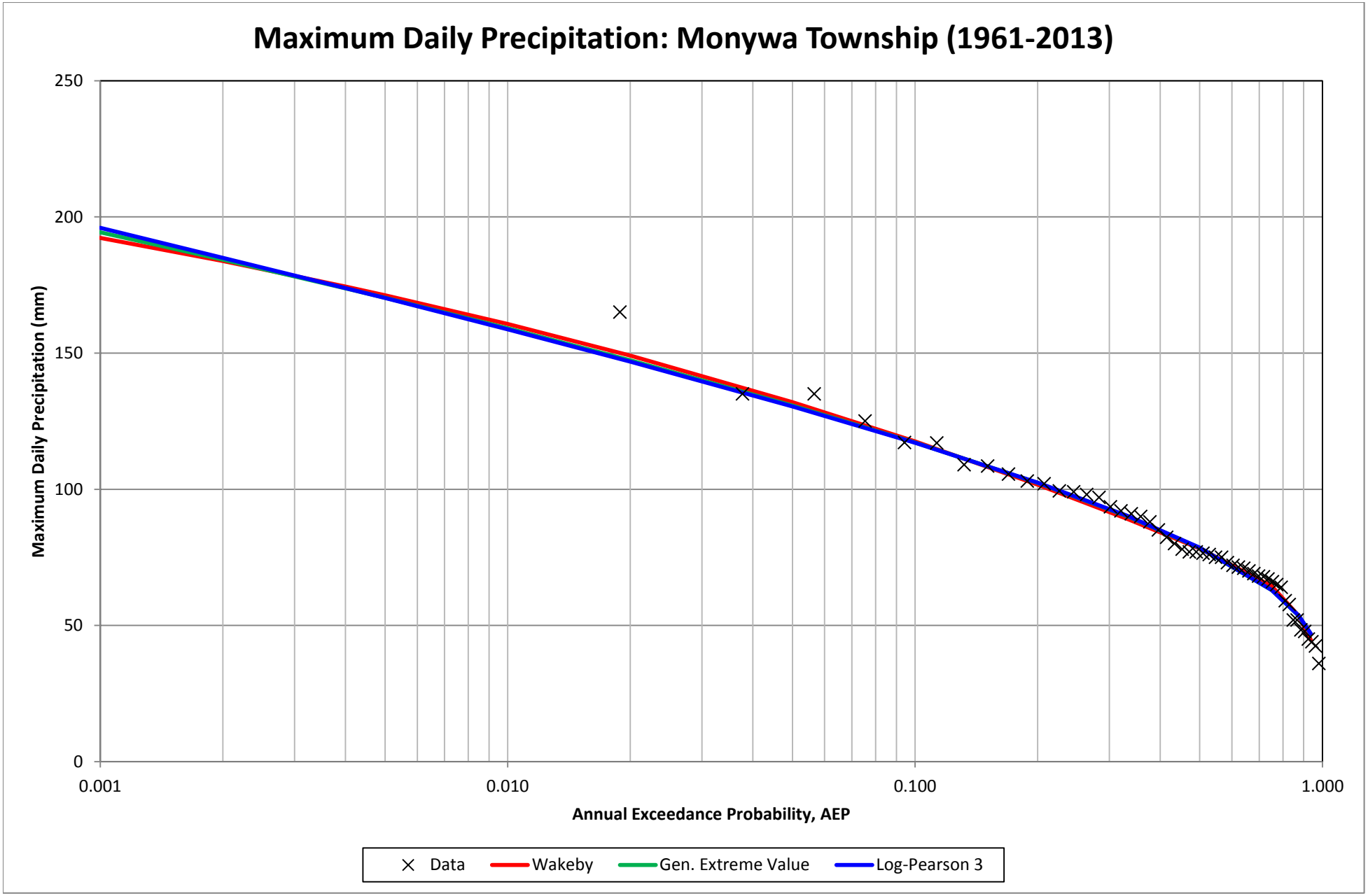
2013 was excluded from this analysis as a significant portion of data from the wet season was missing.

Precipitation Frequency Analysis, Maximum Annual Daily: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent short-term storm precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
			α =	221.90042	k =	-0.06676115	α =	148.2847421
			β =	8.2130851	σ =	22.3984849	β =	-0.0264996
			γ =	29.8116959	μ =	70.39076611	γ =	8.285147763
			δ =	-0.1356425				
			ξ =	31.5886933				
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	192.3	N/A	194.3	26.53	196.0	26.44
0.998	0.002	500	183.8	N/A	184.3	26.53	185.0	26.44
0.996	0.004	250	174.5	N/A	173.8	26.53	173.9	26.44
0.995	0.005	200	171.3	N/A	170.3	26.53	170.2	26.44
0.990	0.010	100	160.7	N/A	159.1	26.53	158.7	26.44
0.980	0.020	50	149.1	N/A	147.3	26.53	146.9	26.44
0.950	0.050	20	132.0	N/A	130.7	26.53	130.4	26.44
0.900	0.100	10	117.6	N/A	117.2	26.53	117.1	26.44
0.800	0.200	5	101.7	N/A	102.4	26.53	102.5	26.44
0.667	0.333	3	89.0	N/A	90.0	26.53	90.2	26.44
0.500	0.500	2.0	78.2	N/A	78.5	26.53	78.6	26.44
0.250	0.750	1.3	64.5	N/A	63.0	26.53	63.0	26.44
0.125	0.875	1.1	53.5	N/A	53.6	26.53	53.6	26.44
0.063	0.937	1.1	44.7	N/A	46.8	26.53	47.0	26.44
Kolmogorov Smirnov (Statistic, Rank)			0.06197	1	0.07306	13	0.07296	11
Anderson Darling (Statistic, Rank)			0.16639	1	0.22384	7	0.22713	13


Maximum Daily Precipitation: Monywa Township (1961-2013)
Maximum Daily Precipitation (mm)
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3


Maximum Daily Precipitation: Monywa Township (1961-2013)
Maximum Daily Precipitation (mm)
250
200
150
100
50
0
0.001
0.010
0.100
1.000
Annual Exceedance Probability, AEP
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

ATTACHMENT 2.4

Precipitation IDF Curve Analysis

Derivation of Intensity / Duration / Frequency (IDF) Curves from Daily ARI Data

IDF curves for the **Letpadaung Copper** project are derived using the Rainfall Ratio method discussed in Chapter 4 of "Highway and Urban Hydrology in the Tropics", 1984, L.H. Watkins and D. Fiddes - London, Great Britain - Pentech Press, Ltd.

Twenty-four hour duration precipitation intensities for various average recurrence interval (ARI) events are used along with empirically-derived coefficients from Table 4.6 of (Watkins & Fiddes, 1984) to construct IDF curves. The fundamental equations used with this technique are:

$I_t = a / (b + t)^n$ and $RR_t = (I_t \cdot t) / (I_{24} \cdot 24)$

where:

I_t = precipitation intensity for a t-hour duration storm (mm/h)

RR_t = rainfall ratio for a t-hour duration storm (mm/mm)

t = precipitation duration (h)

a, b and n = fitting coefficients

by substituting the first expression into the second, the fitting coefficient "a" is eliminated, leaving:

$RR_t = (t / 24) * ((b + 24) / (b + t))^n$

The basic approach then, is using a list of twenty-four hour duration intensities (depth / 24 hours) for various ARI periods and fitting coefficients "b" and "n" selected from Table 4.6 of (Watkins & Fiddes, 1984):

1) Compute the corresponding rainfall ratio (RR_t) for a select duration (t) using the third relationship and then
2) Solve the second relationship for I_t as follows: $I_t = (RR_t * I_{24} * 24) / t$

In this case, the value for Phnom Penh, Cambodia were applied, as given in "Best Practise Guidelines for Flood Risk Assessment", Mekong River Commission, December 2009.

This process is completed for all of the various ARI's and periods selected to construct an IDF curve using the following five-step process.

First, the I_{24} values for the each of the selected ARI's are tabulated:

Annual Exceedance Probability	Average Recurrance Interval (yr)	24-hr Precip. (mm)	24-hr Precip. Factored (mm)	24-hr Intensity I_{24} (mm/h)
50.0%	2	78.5	89.7	3.7
20.0%	5	102.4	117.0	4.9
10.0%	10	117.2	134.0	5.6
5.0%	20	130.7	149.4	6.2
2.0%	50	147.3	168.4	7.0
1.0%	100	159.1	181.9	7.6
0.5%	200	170.3	194.7	8.1
0.2%	500	184.3	210.7	8.8

Second, the fitting coefficient "b" is selected from the aforementioned reference for Phnom Penh, Cambodia: **b =** 0.23

Third, the fitting coefficient "n" is selected from the aforementioned reference for Phnom Penh, Cambodia: **n =** 0.86

Fourth, rainfall ratios (RR_t) and the intensities (I_t) which follow the range of selected durations (t) are computed and tabulated:

Note: IDF and DDF values for 48 and 72 hour storm events were calculated using frequency analysis. Storm depths for 24, 48 and 72 hour events were factored following "Ratio of true to fixed-interval maximum rainfall", ASCE Journal of the Hydraulics Division: Weiss, 1964.

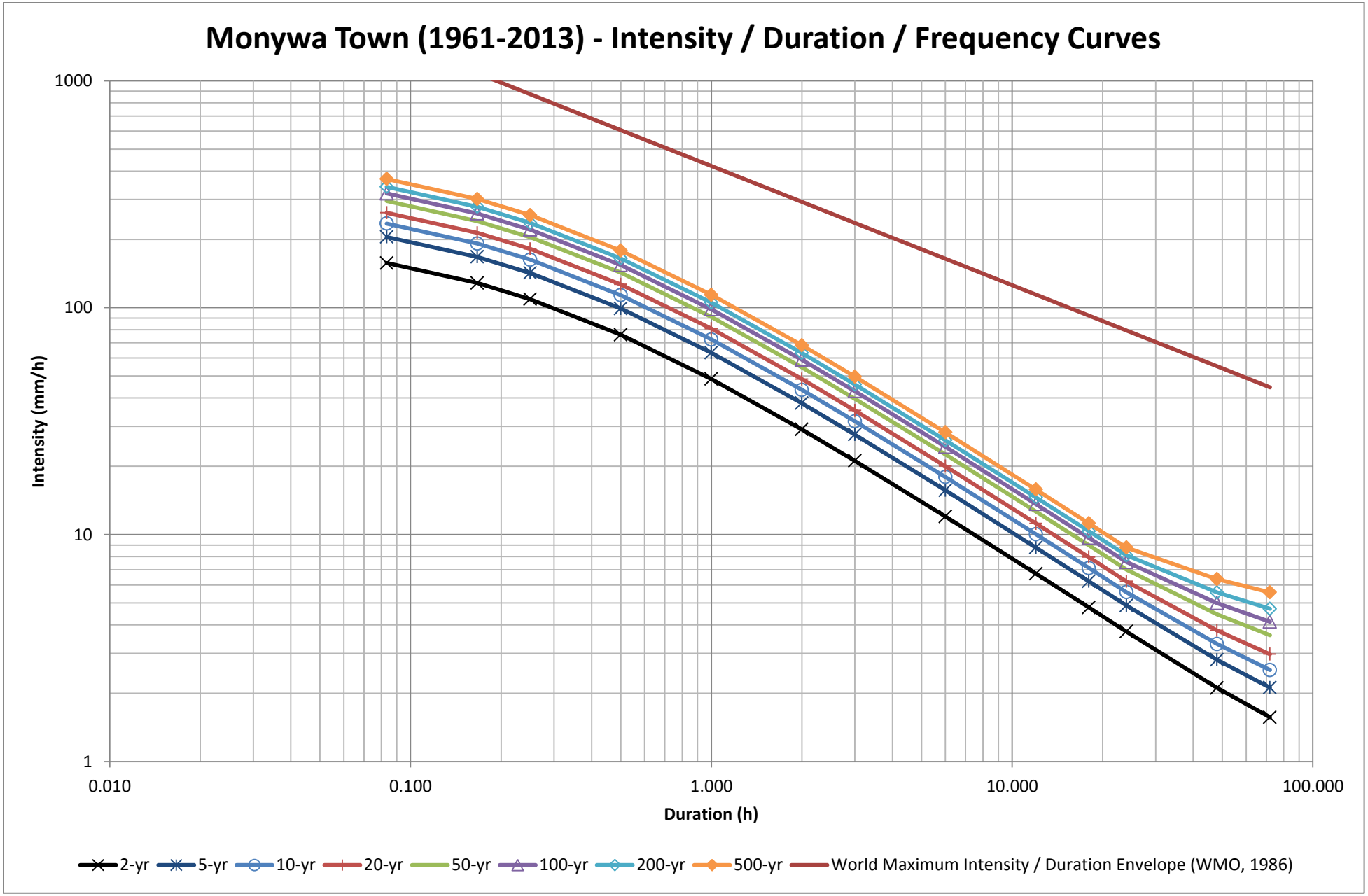
Duration	24	48	72
Factor	1.143	1.067	1.044

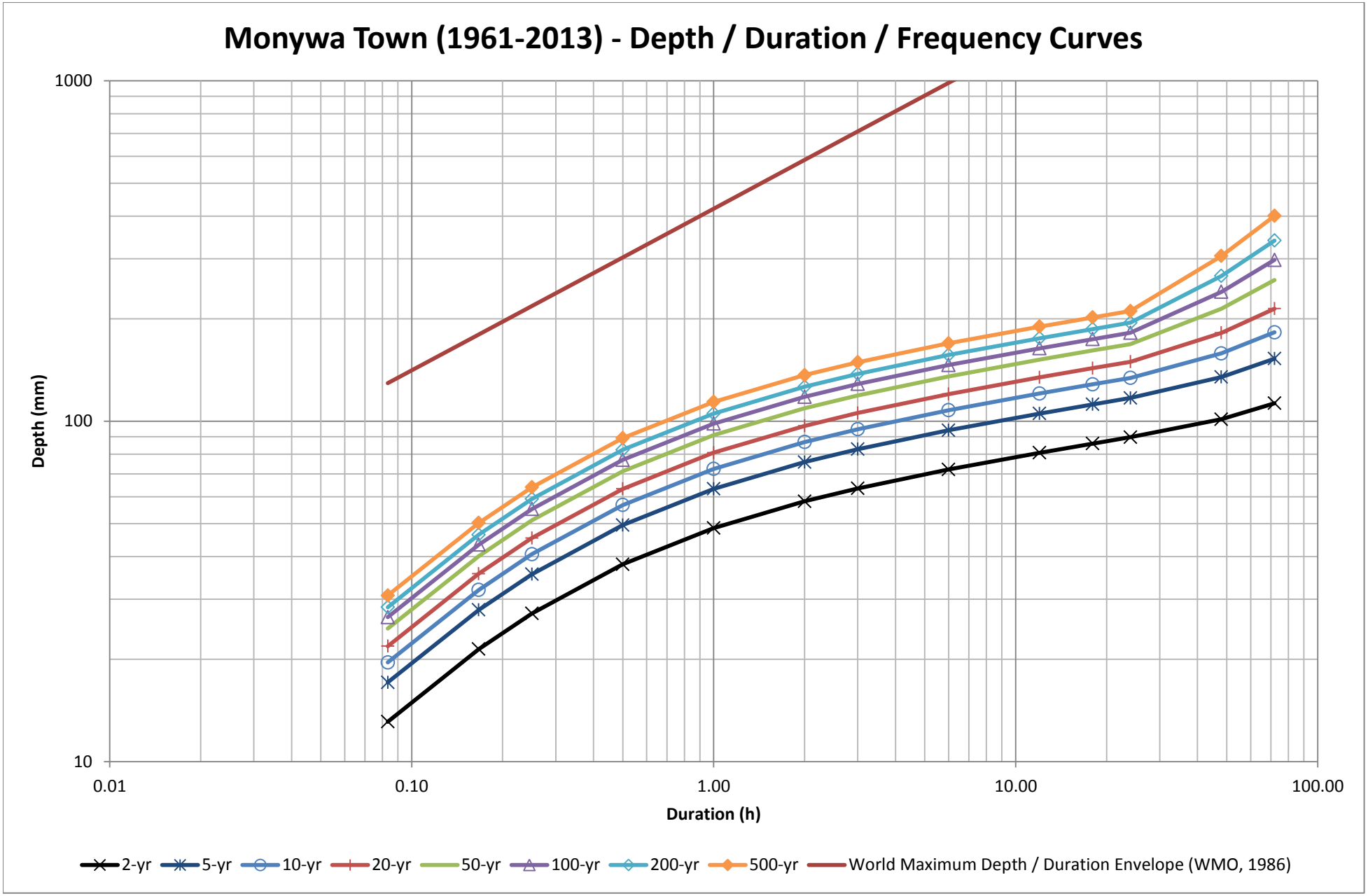
Precipitation Duration t		Rainfall Ratio RR_t	Precipitation Intensity (I_t) for given AEP (%) or ARI (1 in _ year) Storm (mm/h)							
			AEP (%)	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%
			ARI (yr)	2	5	10	20	50	100	200	500
(min)	(h)	(mm/mm)	I_{24} (mm/h)	3.7	4.9	5.6	6.2	7.0	7.6	8.1	8.8
5	0.083	0.146		157.3	205.1	234.8	261.9	295.2	318.8	341.2	369.3
10	0.167	0.239		128.4	167.4	191.7	213.9	241.0	260.3	278.6	301.5
15	0.25	0.304		109.0	142.1	162.7	181.5	204.6	220.9	236.5	255.9
30	0.50	0.423		76.0	99.1	113.5	126.6	142.6	154.0	164.9	178.4
60	1	0.541		48.5	63.3	72.4	80.8	91.1	98.3	105.3	113.9
120	2	0.648		29.1	37.9	43.4	48.4	54.6	59.0	63.1	68.3
180	3	0.707		21.2	27.6	31.6	35.2	39.7	42.9	45.9	49.7
360	6	0.804		12.0	15.7	17.9	20.0	22.6	24.4	26.1	28.2
720	12	0.900		6.7	8.8	10.0	11.2	12.6	13.6	14.6	15.8
1080	18	0.958		4.8	6.2	7.1	8.0	9.0	9.7	10.4	11.2
1440	24	1.000		3.7	4.9	5.6	6.2	7.0	7.6	8.1	8.8
2880	48			2.1	2.8	3.3	3.8	4.5	5.0	5.6	6.4
4320	72			1.6	2.1	2.5	3.0	3.6	4.1	4.7	5.6

Derivation of Intensity / Duration / Frequency (IDF) Curves from Daily ARI Data

Also tabulate the total storm depths:

Precipitation Duration t		Rainfall Ratio RR_t	Precipitation Depth (d_t) for given AEP (%) or ARI (1 in _ year) Storm (mm)							
			AEP (%)	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%
			ARI (yr)	2	5	10	20	50	100	200	500
(min)	(h)	(mm/mm)	d_{24} (mm)	89.7	117.0	134.0	149.4	168.4	181.9	194.7	210.7
5	0.083	0.146		13.1	17.1	19.6	21.8	24.6	26.6	28.4	30.8
10	0.167	0.239		21.4	27.9	32.0	35.6	40.2	43.4	46.4	50.2
15	0.25	0.304		27.2	35.5	40.7	45.4	51.1	55.2	59.1	64.0
30	0.50	0.423		38.0	49.5	56.7	63.3	71.3	77.0	82.4	89.2
60	1	0.541		48.5	63.3	72.4	80.8	91.1	98.3	105.3	113.9
120	2	0.648		58.2	75.9	86.8	96.9	109.2	117.9	126.2	136.6
180	3	0.707		63.5	82.7	94.7	105.7	119.1	128.6	137.7	149.0
360	6	0.804		72.1	94.1	107.7	120.1	135.4	146.2	156.5	169.4
720	12	0.900		80.8	105.3	120.6	134.5	151.6	163.7	175.2	189.6
1080	18	0.958		86.0	112.1	128.3	143.1	161.3	174.2	186.5	201.8
1440	24	1.000		89.7	117.0	134.0	149.4	168.4	181.9	194.7	210.7
2880	48			101.3	134.8	158.2	181.7	214.0	239.8	267.0	305.7
4320	72			112.9	152.6	182.4	214.0	259.6	297.7	339.4	400.7


Monywa Town (1961-2013) - Intensity / Duration / Frequency Curves
Intensity (mm/h)
1000
100
10
1
0.010
0.100
1.000
10.000
100.000
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Intensity / Duration Envelope (WMO, 1986)


Monywa Town (1961-2013) - Depth / Duration / Frequency Curves
1000
100
10
Depth (mm)
0.01
0.10
1.00
10.00
100.00
Duration (h)
2-yr
5-yr
10-yr
20-yr
50-yr
100-yr
200-yr
500-yr
World Maximum Depth / Duration Envelope (WMO, 1986)

ATTACHMENT 2.5

Precipitation Hyetograph Analysis

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

2 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	55.3%
2	100.0%

3 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	22.9%
2	77.0%
3	100.0%

4 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	15.3%
2	56.2%
3	90.1%
4	100.0%

5 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	6.6%
2	37.2%
3	67.8%
4	93.7%
5	100.0%

6 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	8.1%
2	24.3%
3	45.3%
4	76.5%
5	97.1%
6	100.0%

7 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	6.7%
2	19.0%
3	43.0%
4	70.1%
5	88.5%
6	98.4%
7	100.0%

8 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	4.7%
3	15.6%
4	51.5%
5	73.8%
6	88.3%
7	97.5%
8	100.0%

9 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	3.8%
2	13.7%
3	34.9%
4	63.4%
5	81.3%
6	88.9%
7	93.7%
8	97.8%
9	100.0%

10 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.4%
2	3.3%
3	7.9%
4	13.6%
5	21.5%
6	45.0%
7	71.5%
8	83.1%
9	97.5%
10	100.0%

11 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.8%
2	4.8%
3	12.3%
4	22.4%
5	37.3%
6	52.2%
7	66.2%
8	79.8%
9	91.2%
10	98.2%
11	100.0%

12 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.1%
2	4.5%
3	9.0%
4	13.5%
5	18.0%
6	23.6%
7	30.3%
8	42.7%
9	61.8%
10	84.3%
11	96.6%
12	100.0%

13 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	2.8%
2	6.6%
3	11.3%
4	17.9%
5	23.6%
6	32.1%
7	47.2%
8	66.0%
9	84.9%
10	93.4%
11	97.2%
12	99.1%
13	100.0%

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

14 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	3.0%
2	8.7%
3	13.1%
4	15.4%
5	17.3%
6	20.6%
7	27.6%
8	39.9%
9	55.6%
10	67.8%
11	80.8%
12	92.6%
13	98.8%
14	100.0%

15 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	4.0%
2	15.1%
3	30.2%
4	41.3%
5	50.0%
6	57.1%
7	63.5%
8	71.4%
9	81.0%
10	88.1%
11	91.3%
12	94.4%
13	97.6%
14	99.2%
15	100.0%

16 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	5.7%
3	12.3%
4	16.0%
5	20.8%
6	34.9%
7	45.3%
8	50.9%
9	62.3%
10	68.9%
11	72.6%
12	74.5%
13	80.2%
14	89.6%
15	97.2%
16	100.0%

18 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.9%
2	6.2%
3	10.6%
4	14.2%
5	22.1%
6	28.3%
7	34.5%
8	40.7%
9	46.0%
10	52.2%
11	61.1%
12	65.5%
13	70.8%
14	78.8%
15	86.7%
16	95.6%
17	99.1%
18	100.0%

19 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	4.3%
2	11.4%
3	21.4%
4	31.4%
5	41.4%
6	48.6%
7	58.6%
8	70.0%
9	80.0%
10	85.7%
11	88.6%
12	90.0%
13	91.4%
14	92.9%
15	94.3%
16	95.7%
17	97.1%
18	98.6%
19	100.0%

20 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.7%
2	3.3%
3	5.0%
4	7.5%
5	13.3%
6	22.5%
7	30.0%
8	37.5%
9	41.7%
10	43.3%
11	44.2%
12	51.7%
13	60.0%
14	68.3%
15	75.8%
16	83.3%
17	90.8%
18	95.8%
19	99.2%
20	100.0%

21 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.4%
2	4.3%
3	7.1%
4	11.4%
5	17.1%
6	21.4%
7	25.7%
8	30.0%
9	34.3%
10	37.1%
11	41.4%
12	47.1%
13	52.9%
14	60.0%
15	68.6%
16	77.1%
17	84.3%
18	90.0%
19	95.7%
20	98.6%
21	100.0%

23 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.4%
2	0.8%
3	3.5%
4	6.2%
5	8.1%
6	10.8%
7	15.1%
8	22.4%
9	31.7%
10	40.2%
11	47.5%
12	51.7%
13	53.3%
14	54.4%
15	56.0%
16	57.5%
17	59.8%
18	66.4%
19	79.9%
20	91.5%
21	97.3%
22	99.6%
23	100.0%

Design Hyetographs

In some instances there was only one hyetograph available for a certain storm duration. For these durations the singular Hyetograph will be used instead of the design hyetograph which is based on several patterns. All hyetograph patterns are based on storms equal to or exceeding the 85th percentile of measured precipitation depth for storms of the selected duration.

27 Hour

Design Hyetograph	
Hour	% Cum.
0	0.0%
1	2.1%
2	6.7%
3	23.5%
4	52.5%
5	58.1%
6	59.5%
7	60.1%
8	60.4%
9	61.0%
10	62.5%
11	64.8%
12	67.2%
13	69.5%
14	72.1%
15	74.5%
16	76.2%
17	77.4%
18	78.0%
19	78.3%
20	78.9%
21	83.3%
22	89.7%
23	95.0%
24	97.9%
25	99.1%
26	99.7%
27	100.0%

30 Hour

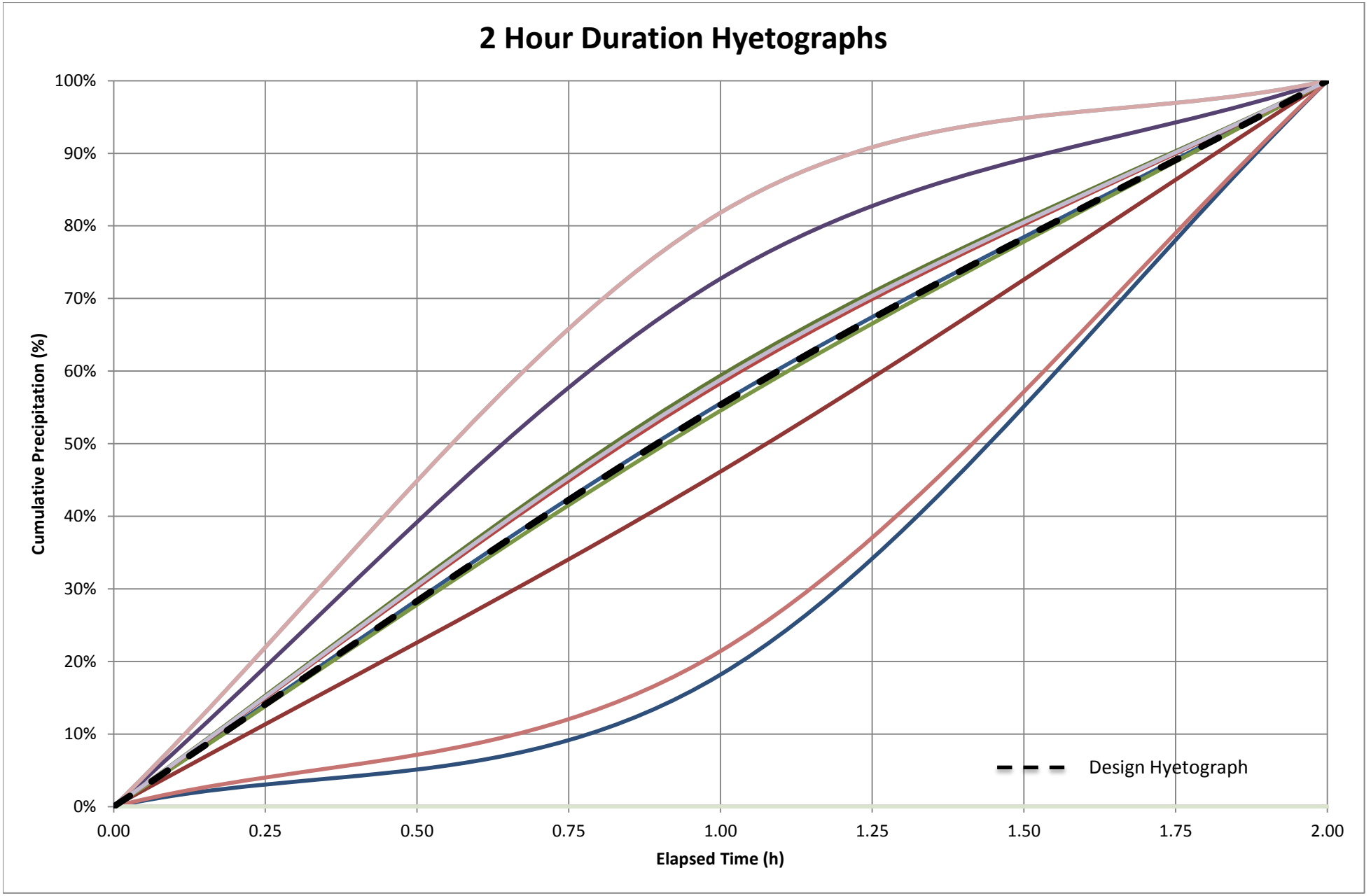
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	1.1%
2	3.7%
3	7.0%
4	11.2%
5	16.0%
6	20.3%
7	24.1%
8	27.3%
9	29.9%
10	31.6%
11	32.6%
12	33.2%
13	33.7%
14	35.3%
15	38.0%
16	41.2%
17	44.4%
18	48.7%
19	56.7%
20	67.9%
21	73.3%
22	74.9%
23	75.9%
24	77.0%
25	79.1%
26	82.4%
27	85.6%
28	89.3%
29	94.7%
30	100.0%

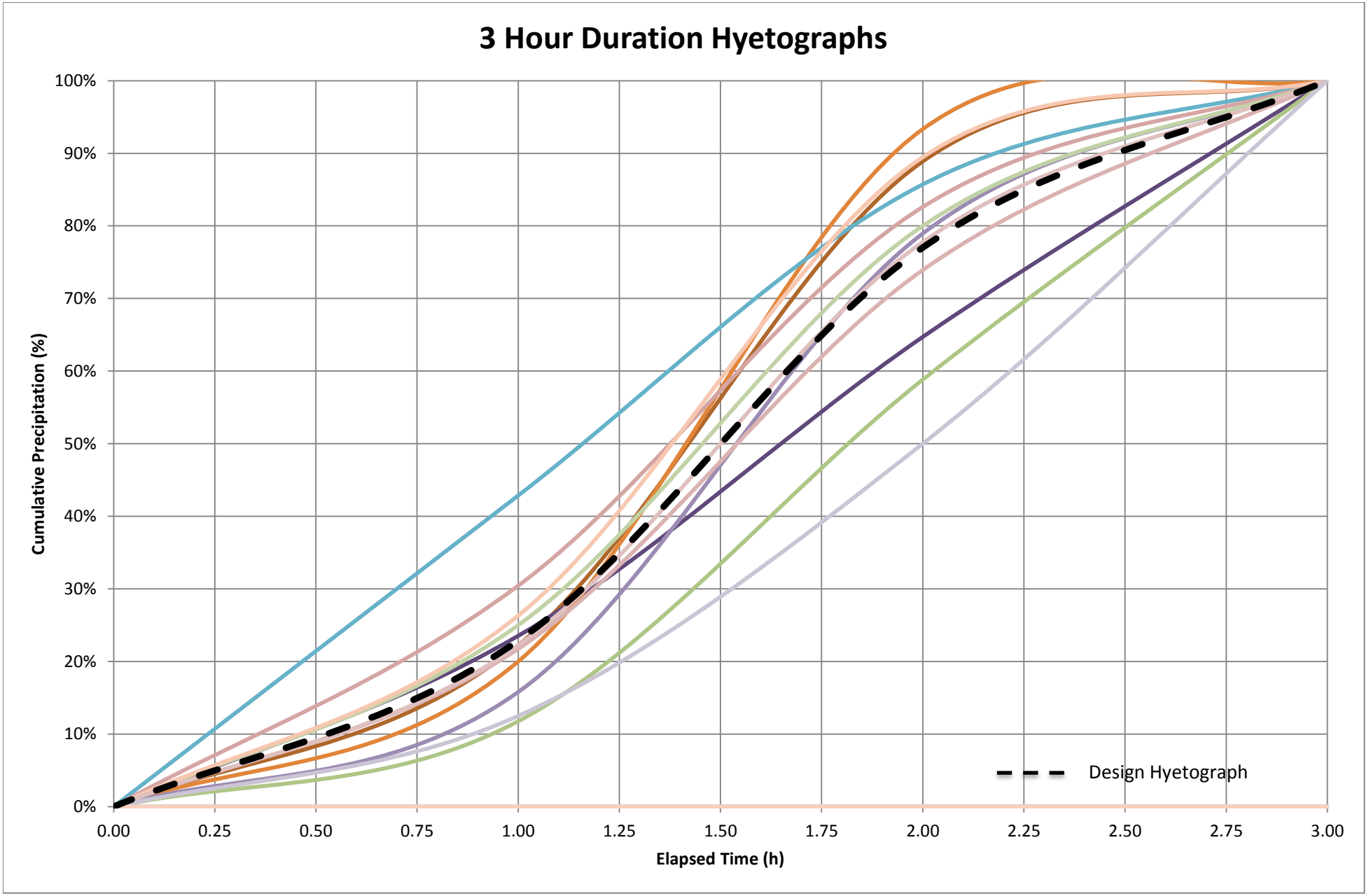
44 Hour

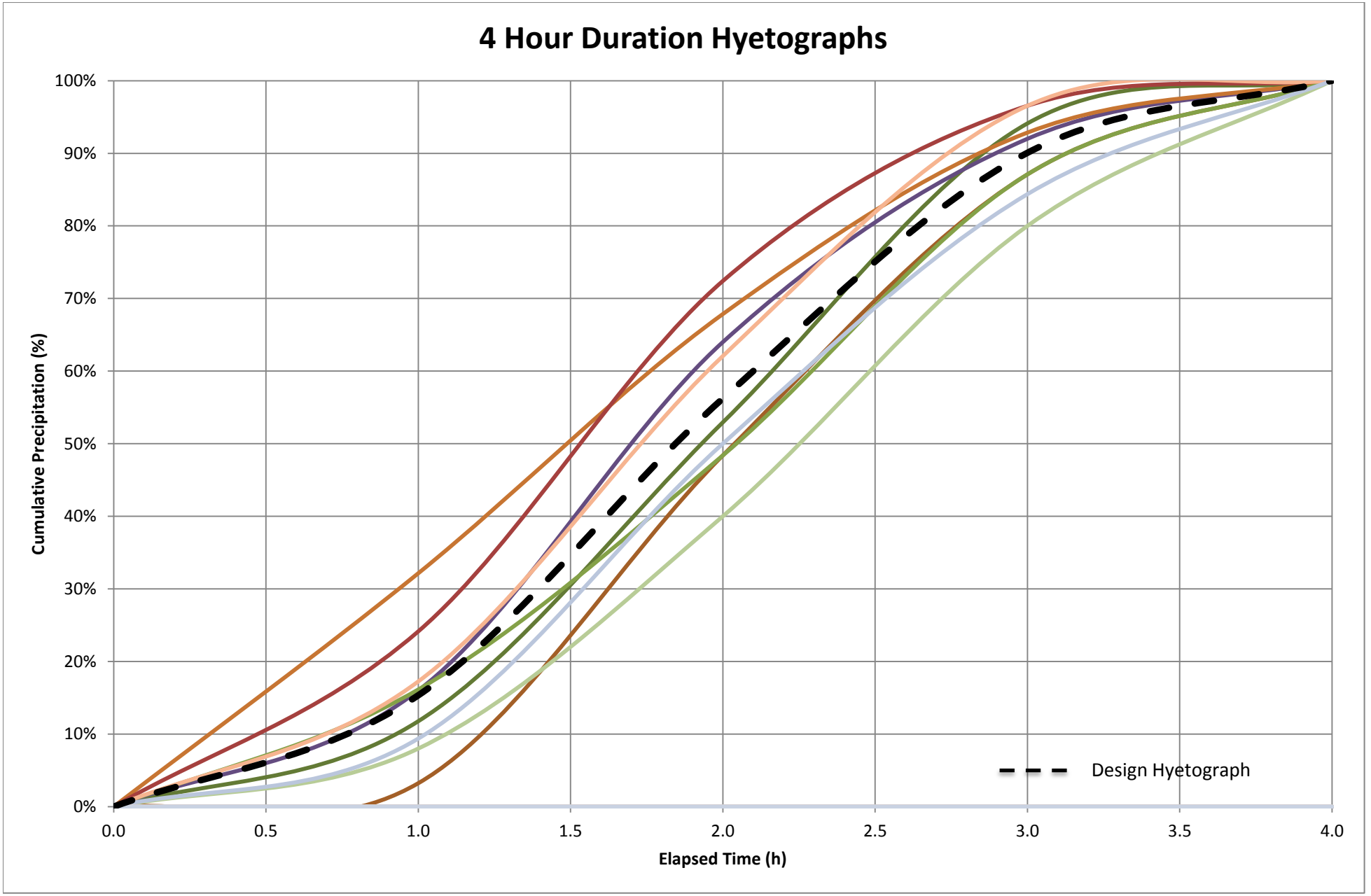
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.3%
2	1.0%
3	2.9%
4	4.5%
5	6.2%
6	7.9%
7	10.5%
8	14.0%
9	18.4%
10	23.6%
11	24.7%
12	26.5%
13	29.0%
14	31.4%
15	35.4%
16	40.6%
17	43.9%
18	45.9%
19	47.9%
20	49.8%
21	51.8%
22	53.1%
23	53.6%
24	53.8%
25	54.0%
26	54.1%
27	54.2%
28	54.7%
29	56.7%
30	61.8%
31	68.9%
32	74.9%
33	79.2%
34	82.6%
35	85.6%
36	88.7%
37	91.2%
38	93.1%
39	94.7%
40	96.5%
41	98.0%
42	99.1%
43	99.9%
44	100.0%

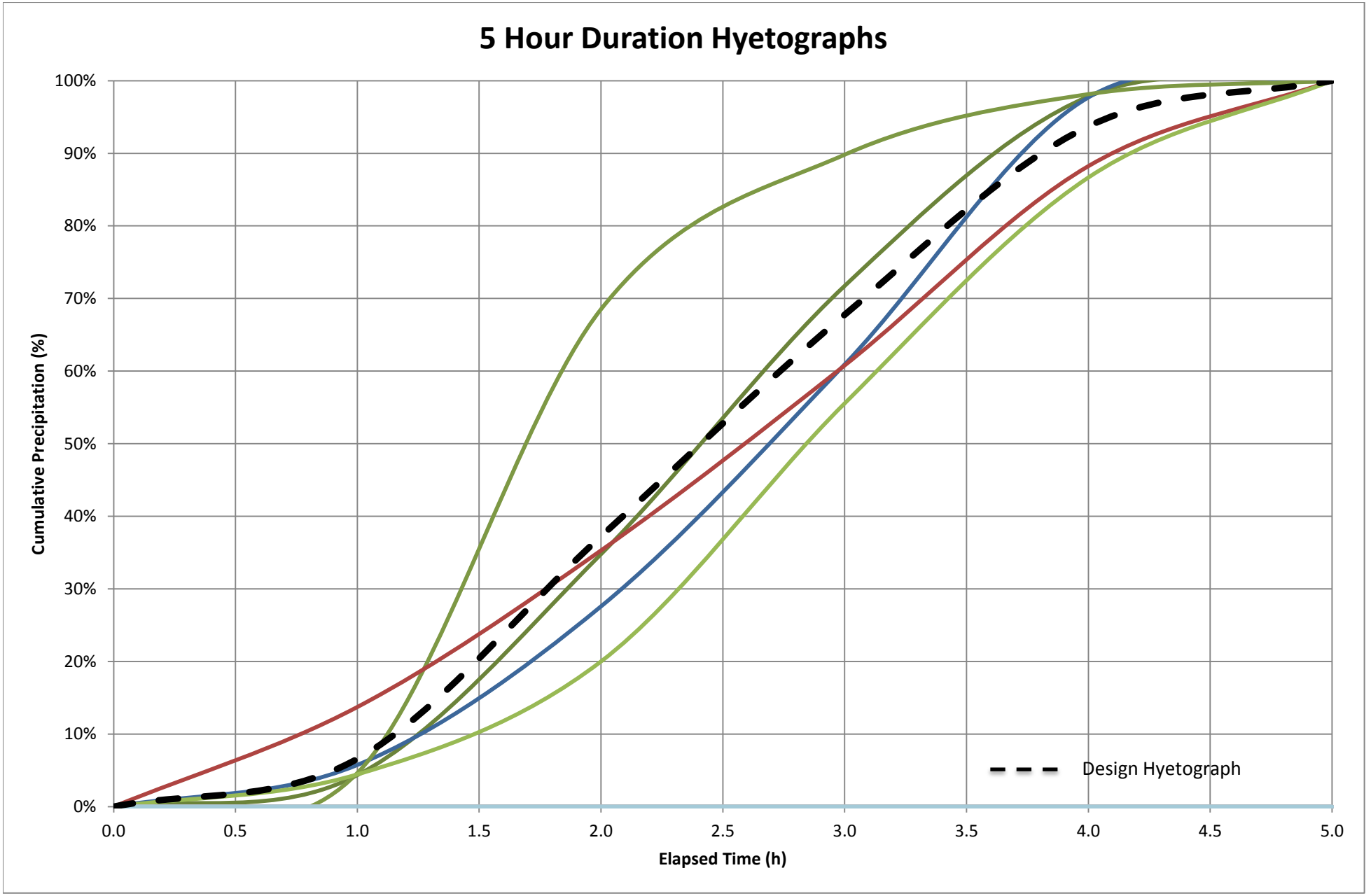
45 Hour

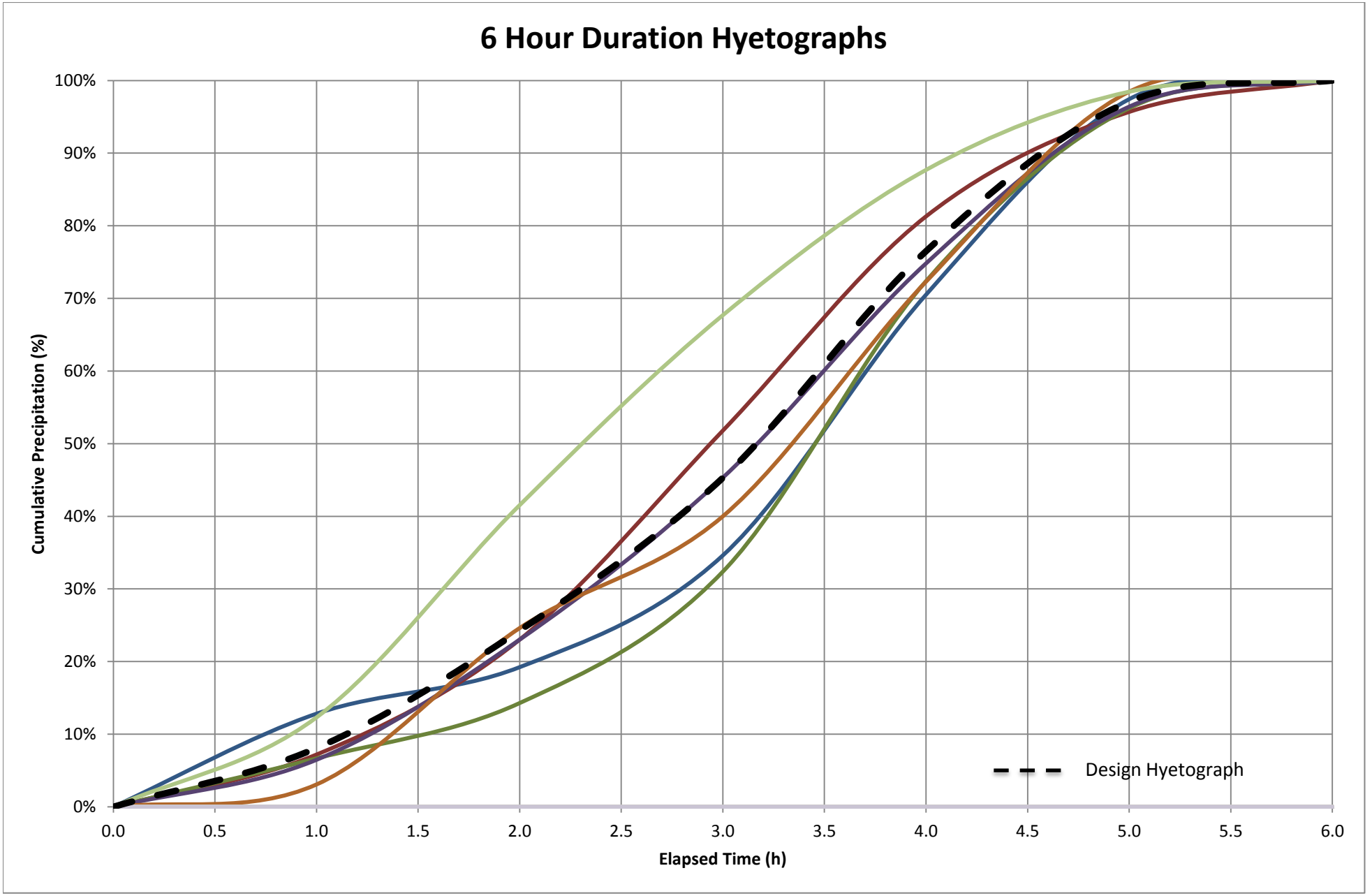
Design Hyetograph	
Hour	% Cum.
0	0.0%
1	0.3%
2	1.5%
3	5.4%
4	10.2%
5	14.8%
6	20.0%
7	25.2%
8	30.2%
9	35.4%
10	40.3%
11	42.0%
12	43.4%
13	45.2%
14	46.9%
15	48.9%
16	50.5%
17	51.4%
18	51.9%
19	52.5%
20	52.7%
21	52.8%
22	53.0%
23	53.1%
24	53.2%
25	53.5%
26	55.5%
27	60.0%
28	65.6%
29	70.1%
30	73.4%
31	76.3%
32	78.9%
33	81.7%
34	84.8%
35	88.3%
36	91.7%
37	93.0%
38	93.2%
39	93.4%
40	94.0%
41	95.1%
42	96.4%
43	98.0%
44	99.5%
45	100.0%

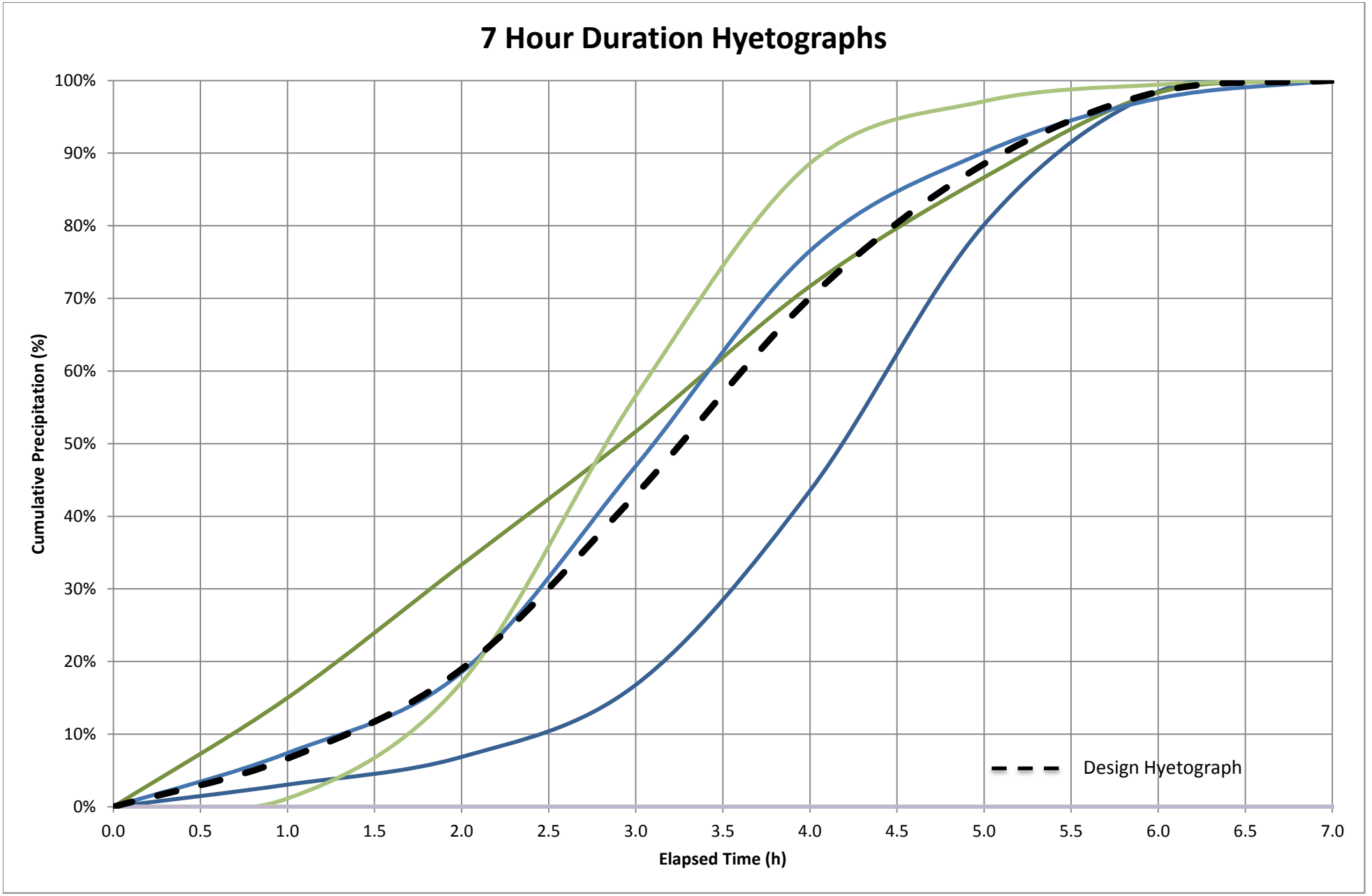

2 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Elapsed Time (h)
Design Hyetograph

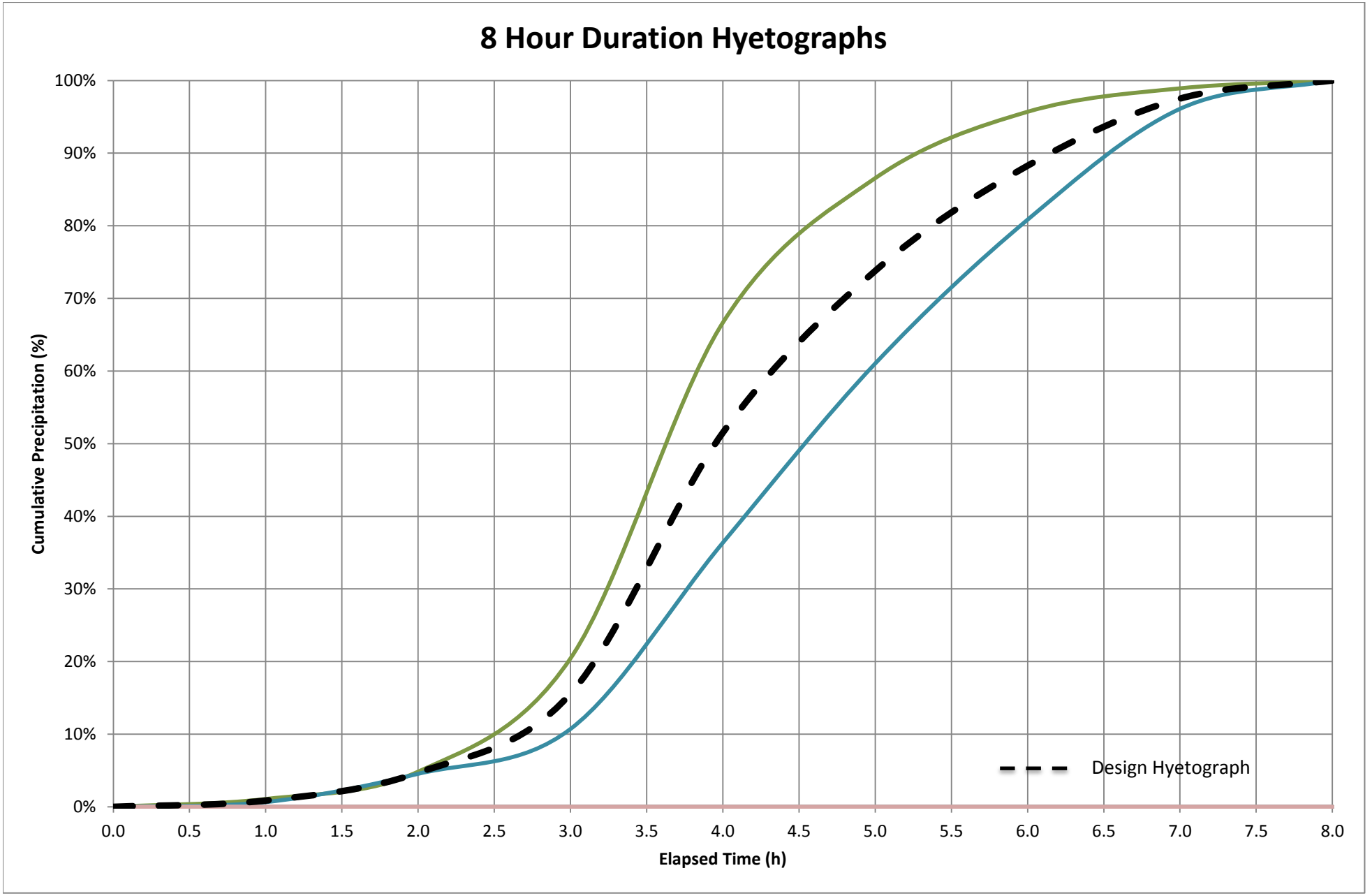

3 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
Elapsed Time (h)
Design Hyetograph

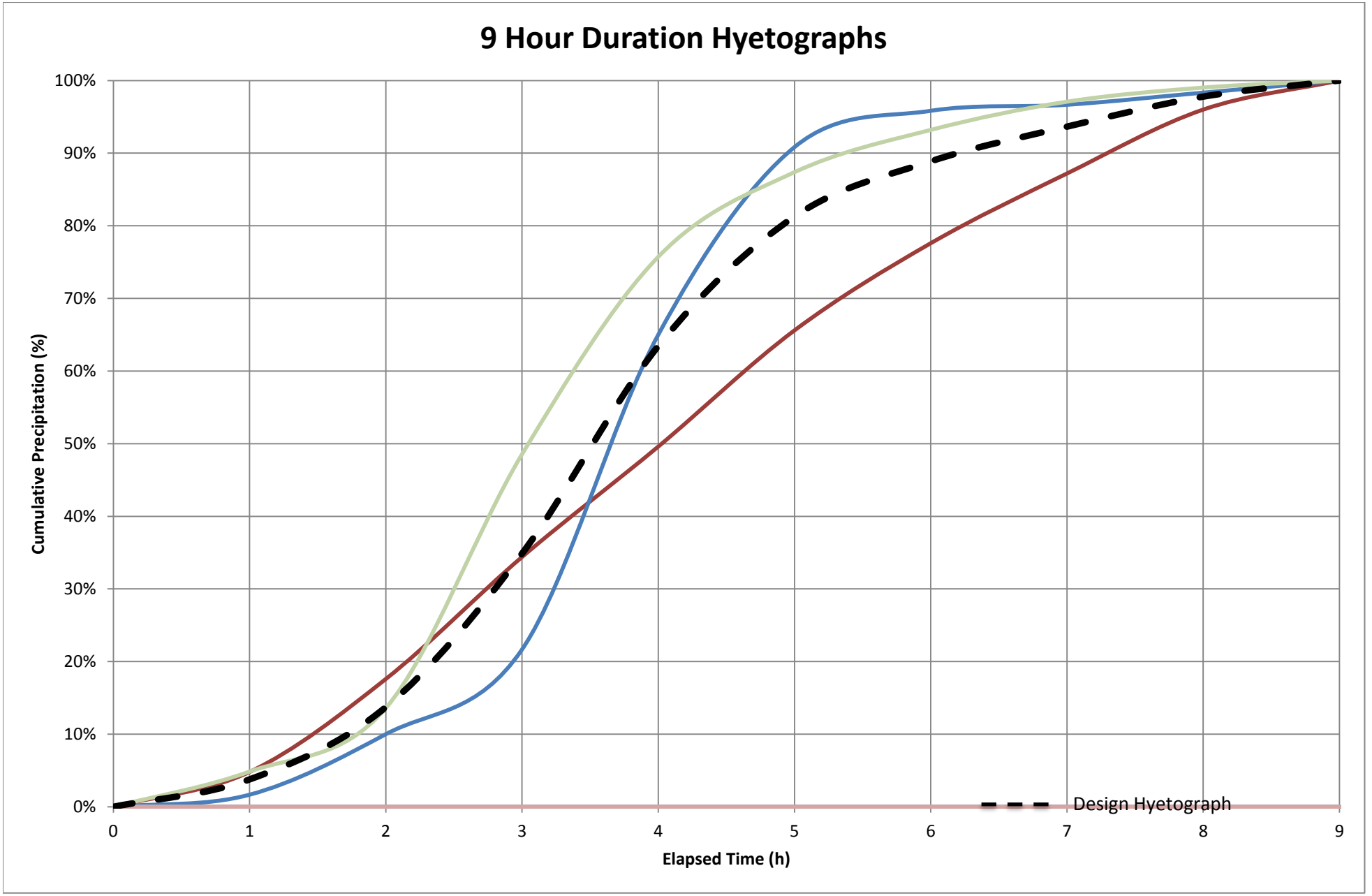

4 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Elapsed Time (h)
Design Hyetograph

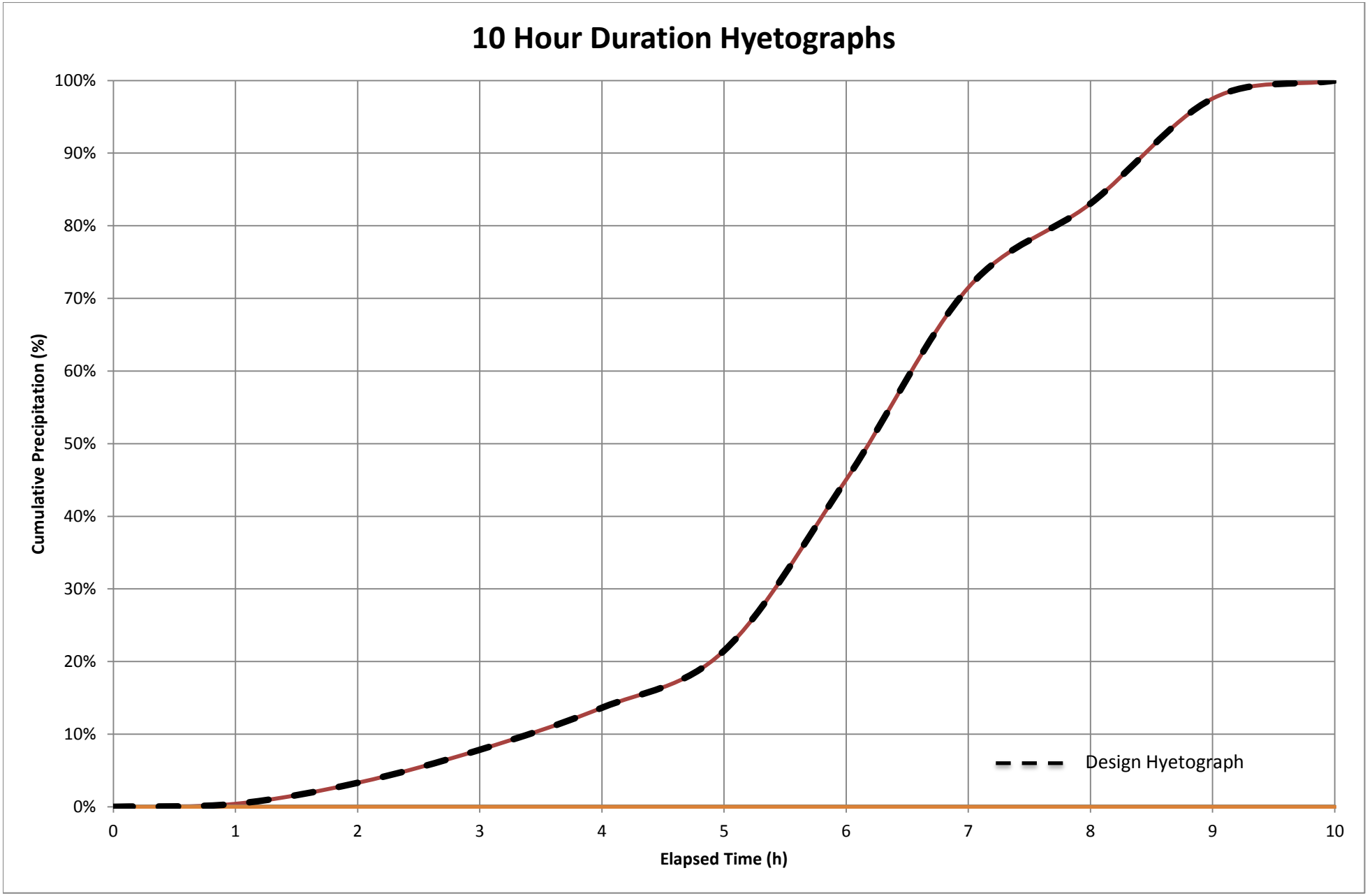

5 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Elapsed Time (h)
Design Hyetograph

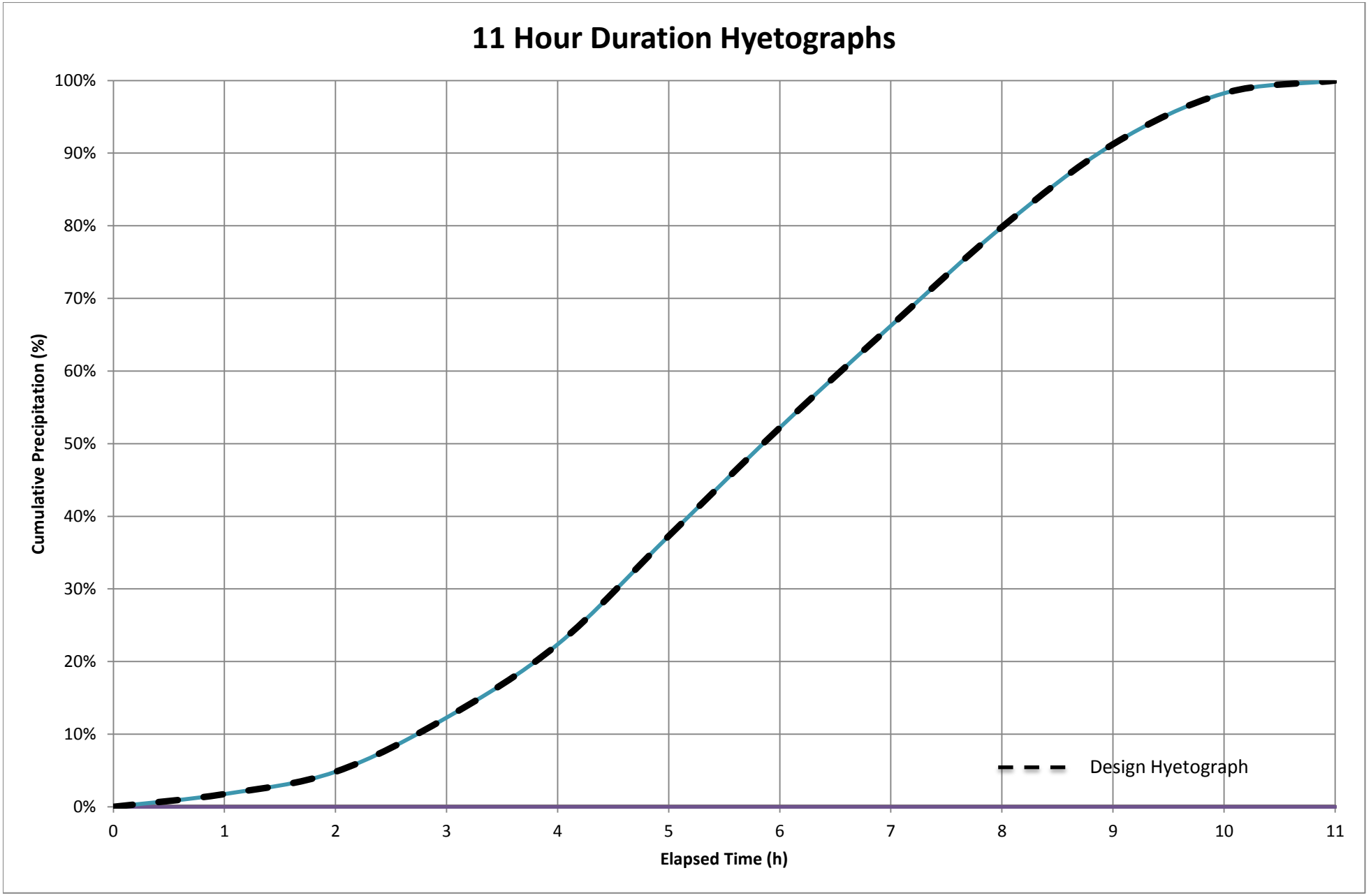

6 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Elapsed Time (h)
Design Hyetograph

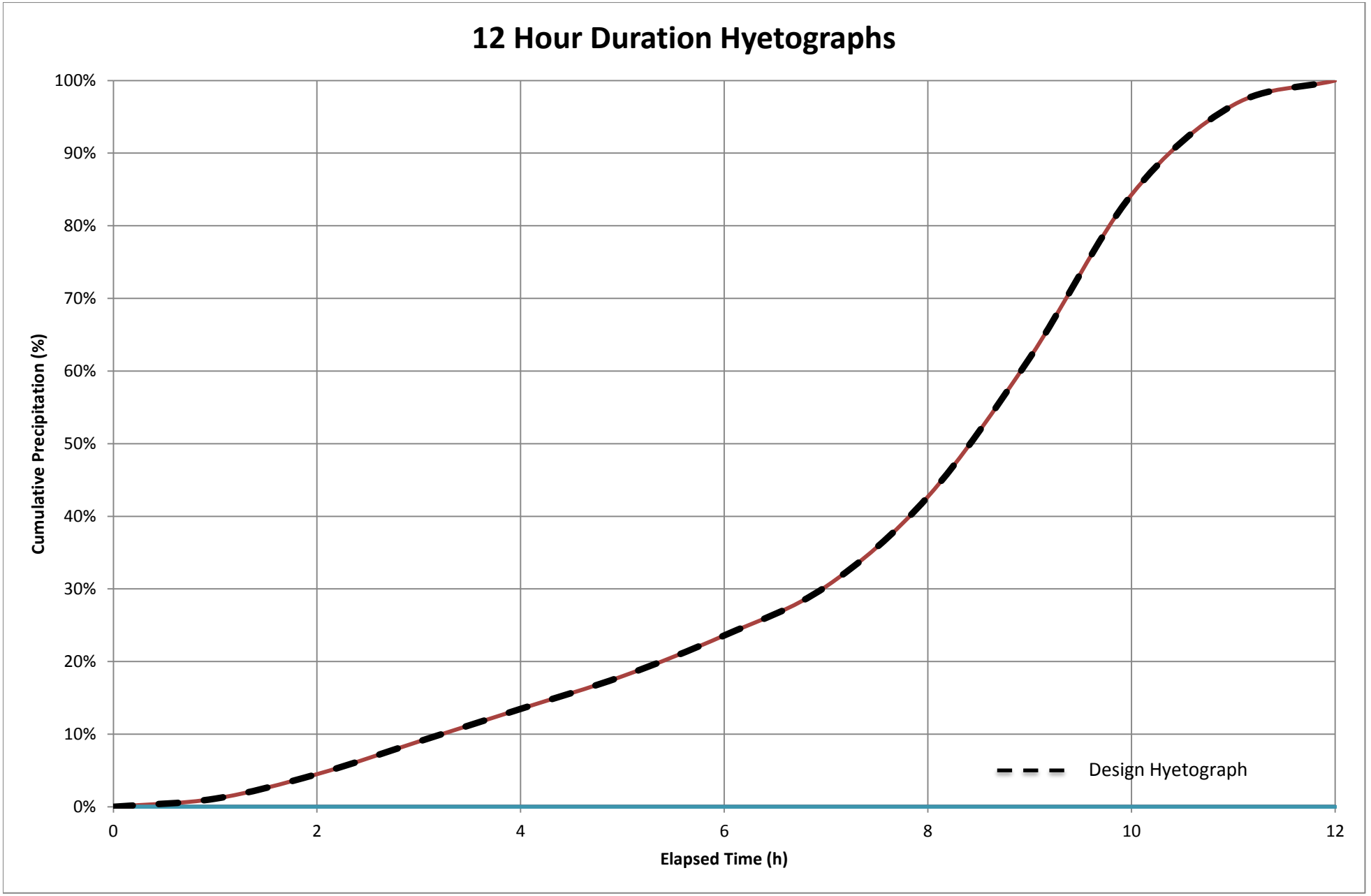

7 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
Elapsed Time (h)
Design Hyetograph

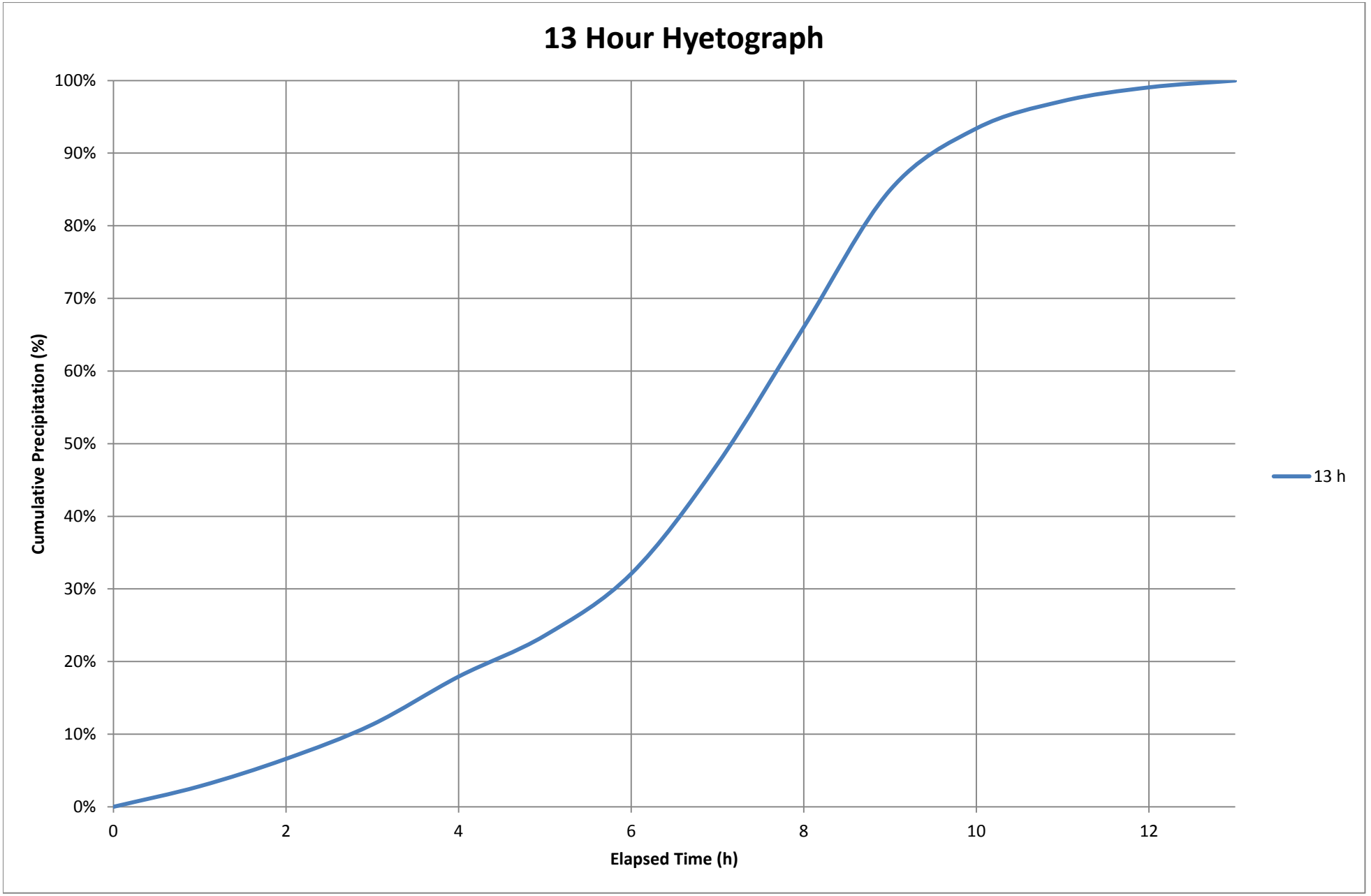

8 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Elapsed Time (h)
Design Hyetograph

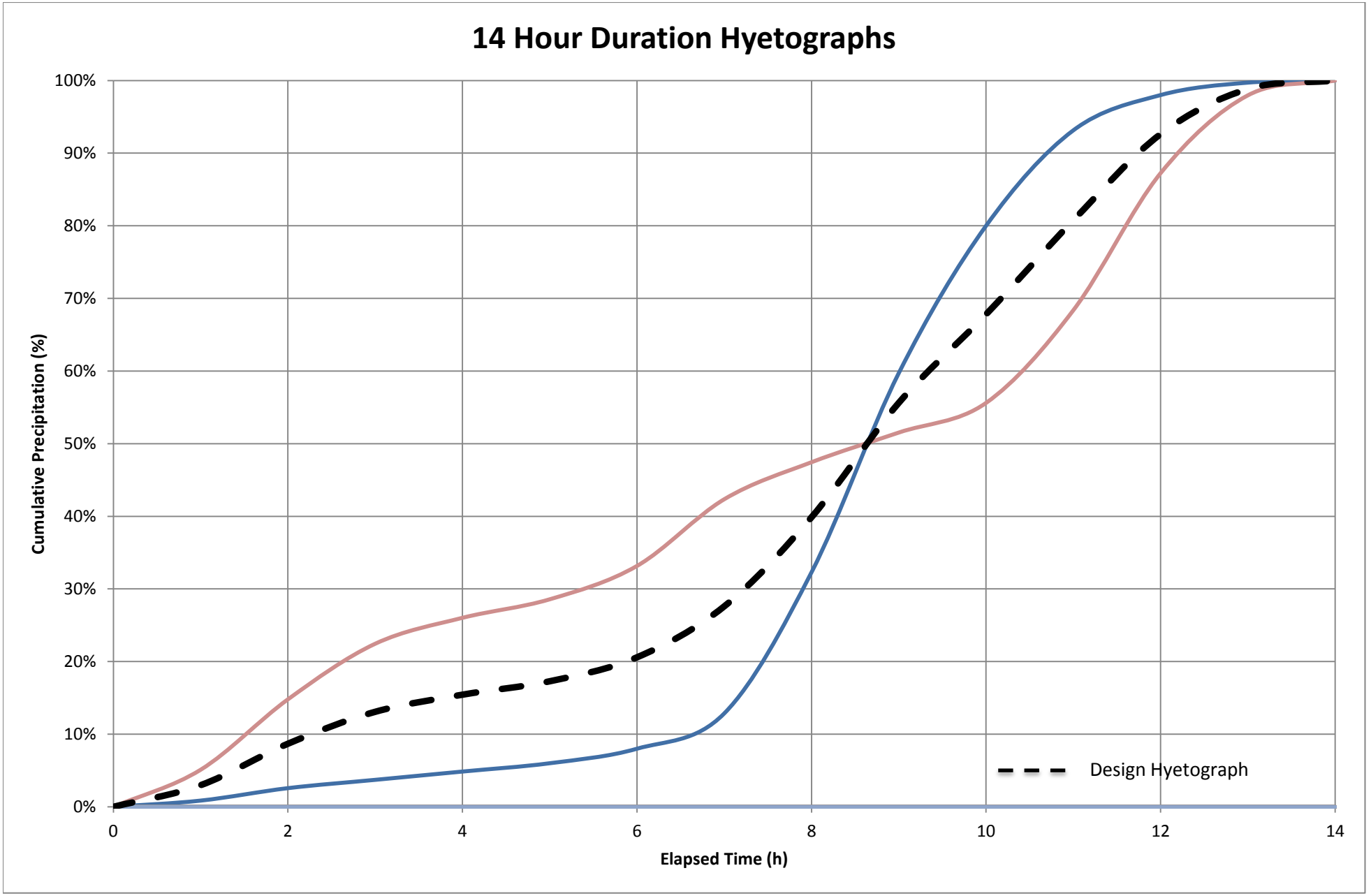

9 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
Elapsed Time (h)
Design Hyetograph

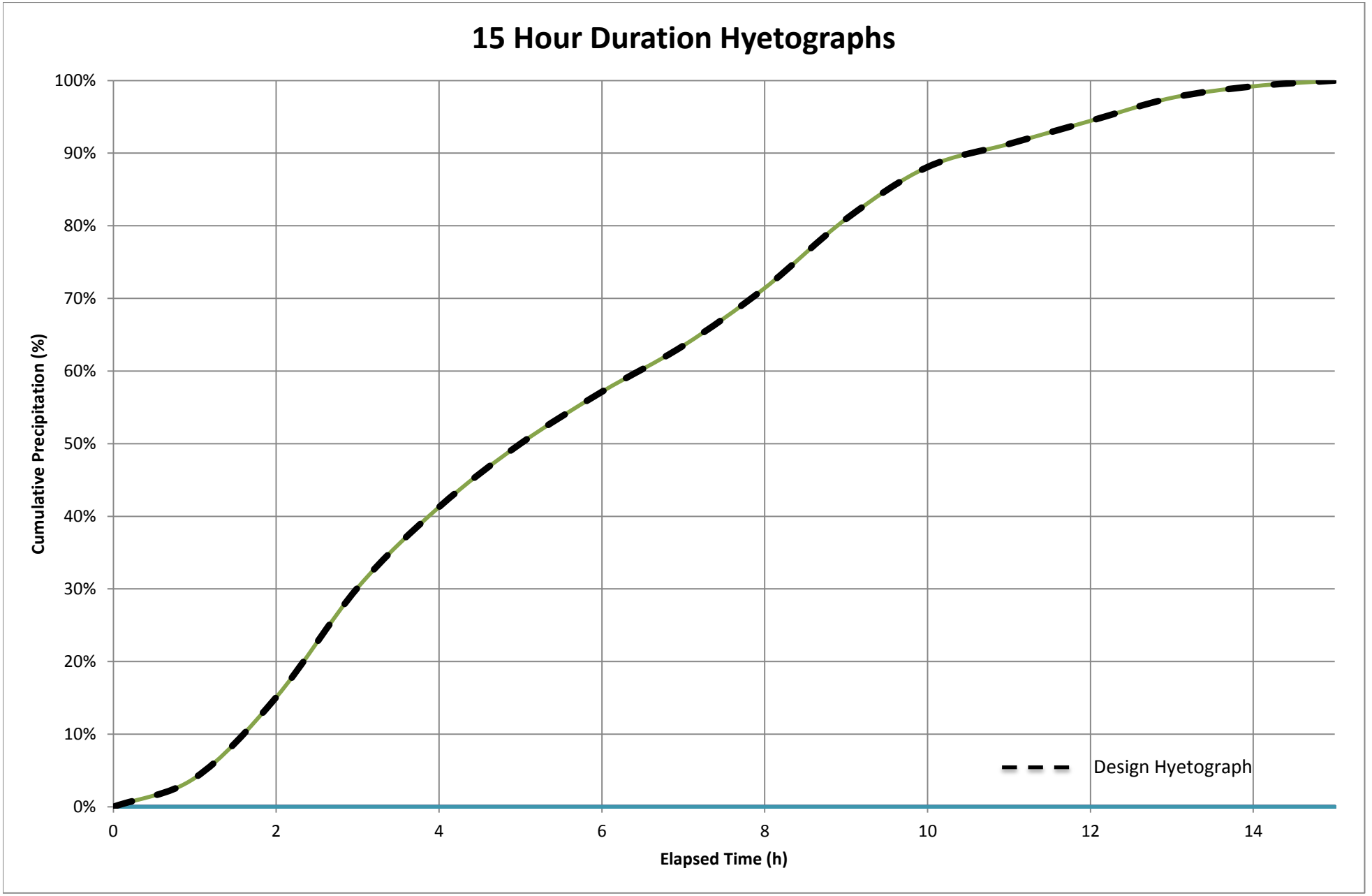

10 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
10
Elapsed Time (h)
Design Hyetograph

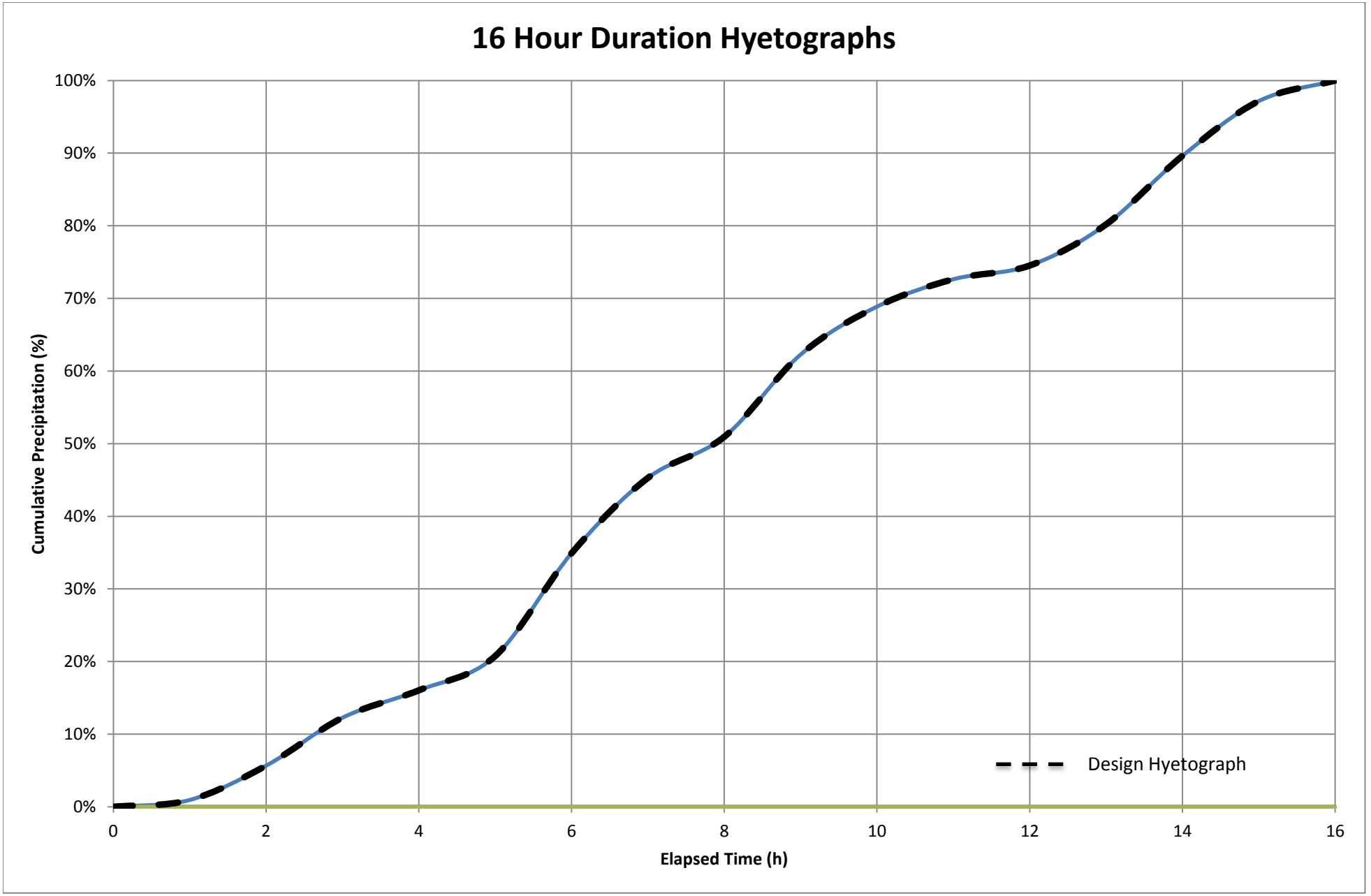

11 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
1
2
3
4
5
6
7
8
9
10
11
Elapsed Time (h)
Design Hyetograph

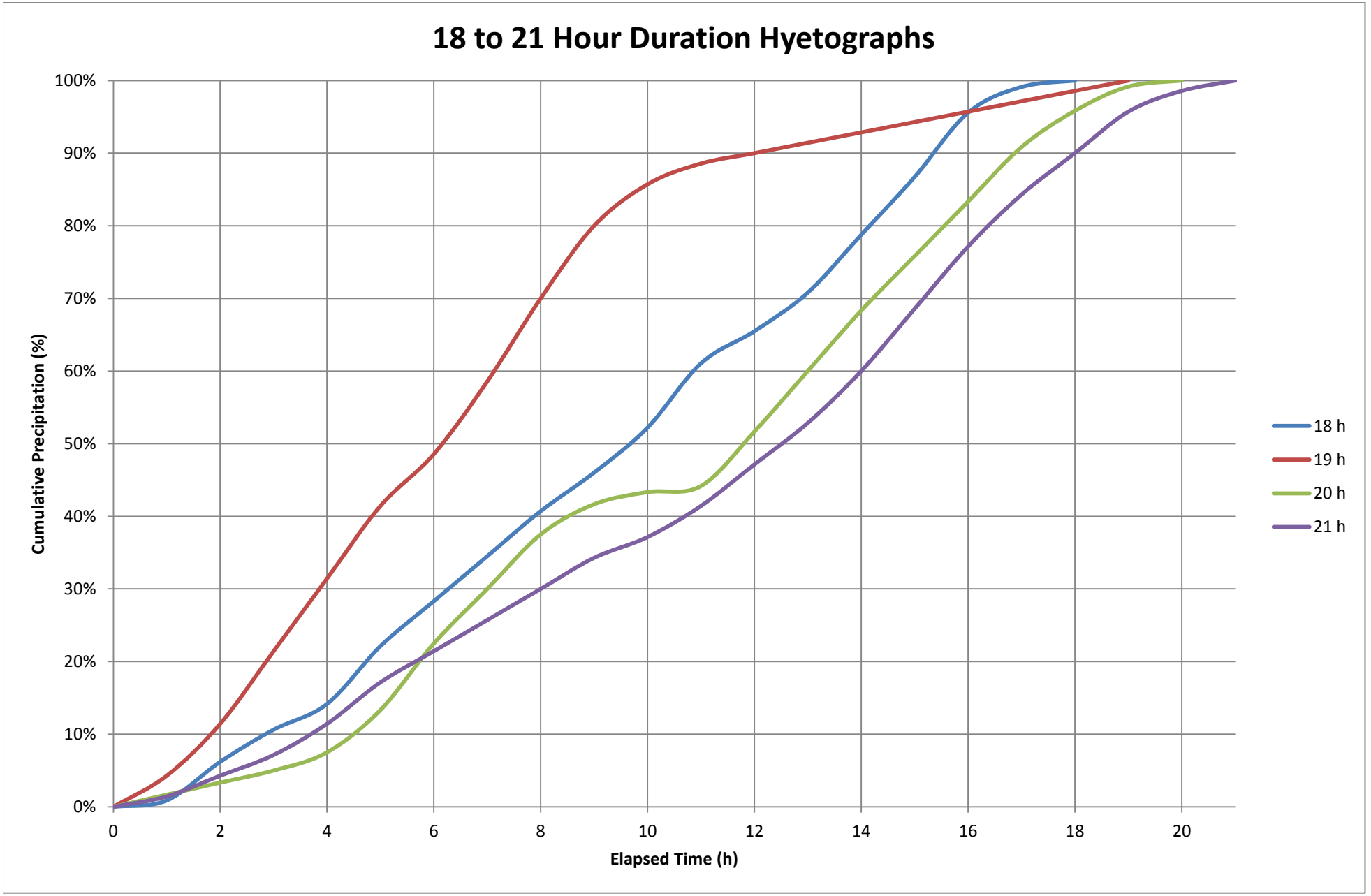

12 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
Elapsed Time (h)
Design Hyetograph

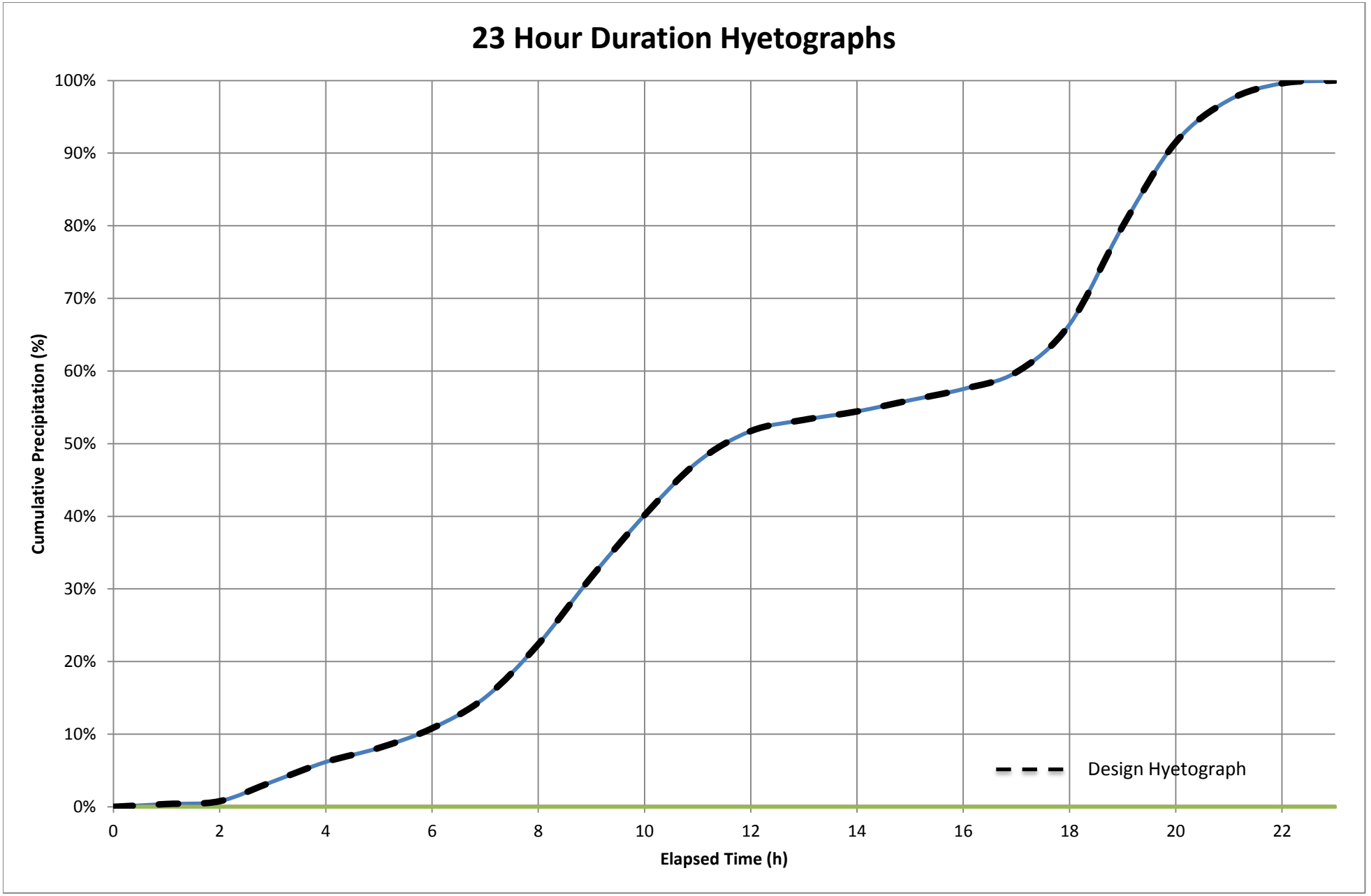

13 Hour Hyetograph
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
Elapsed Time (h)
13 h

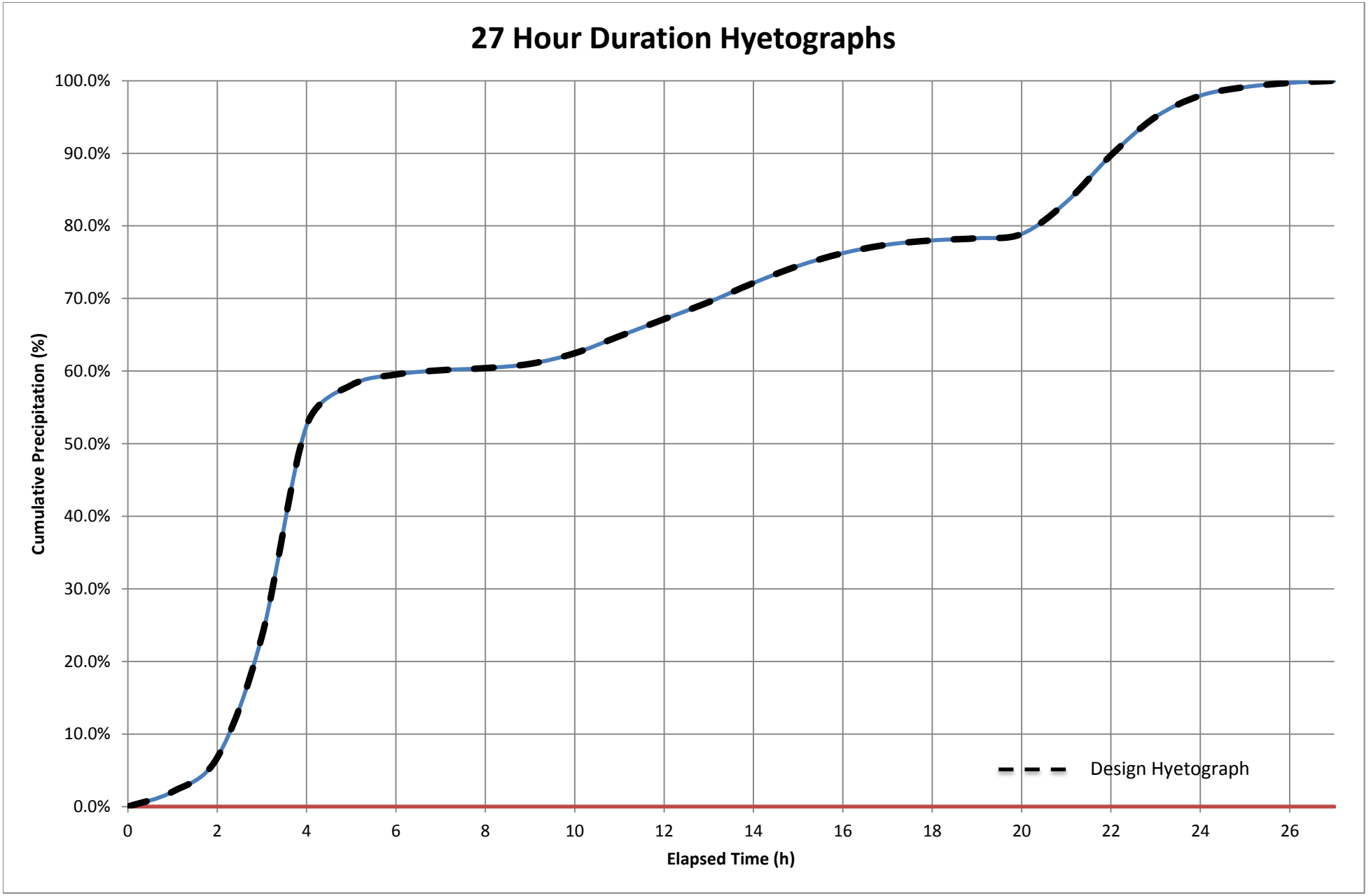

14 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
Elapsed Time (h)
Design Hyetograph

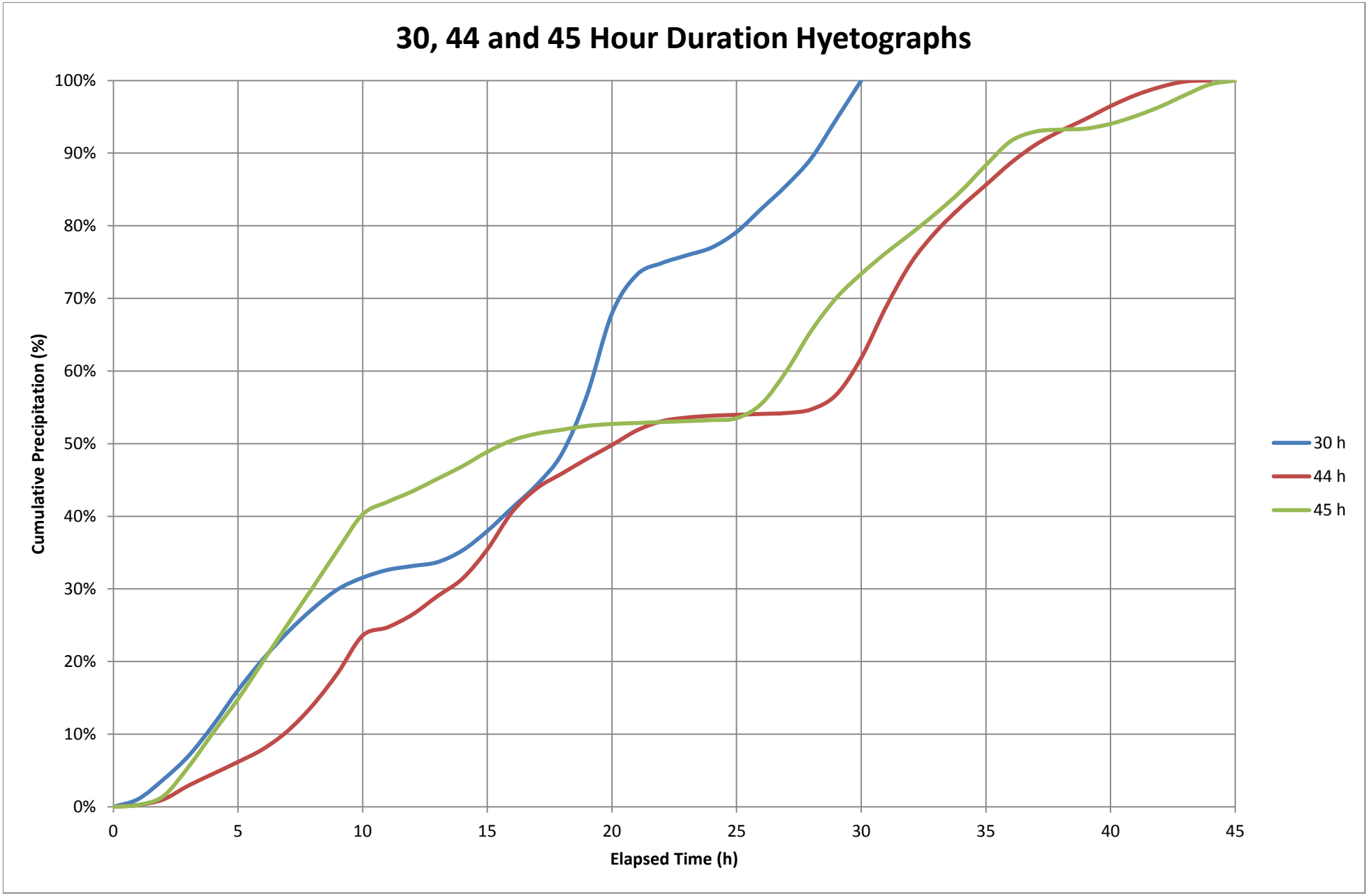

15 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
Elapsed Time (h)
Design Hyetograph


16 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
Elapsed Time (h)
Design Hyetograph


18 to 21 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
4
6
8
10
12
14
16
18
20
Elapsed Time (h)
18 h
19 h
20 h
21 h


23 Hour Duration Hyetographs
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
18
20
22
Elapsed Time (h)
Design Hyetograph


27 Hour Duration Hyetographs
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Cumulative Precipitation (%)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Elapsed Time (h)
Design Hyetograph

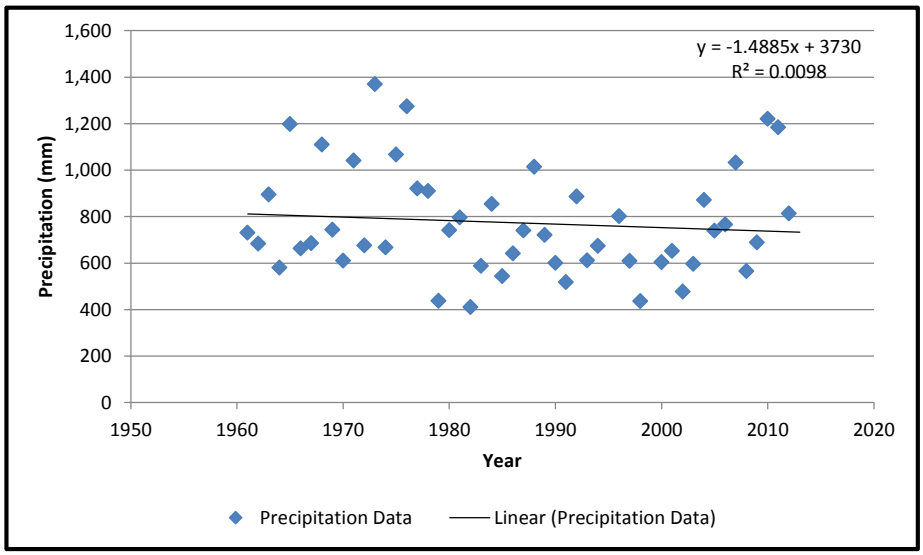

30, 44 and 45 Hour Duration Hyetographs
Cumulative Precipitation (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
10
15
20
25
30
35
40
45
Elapsed Time (h)
30 h
44 h
45 h

ATTACHMENT 2.6

Precipitation Trend Analysis

Climatic Trend Analysis: Monywa Township Precipitation (1961-2013)

Year	Precip (mm)
1961	731
1962	684
1963	896
1964	581
1965	1,198
1966	664
1967	686
1968	1,110
1969	744
1970	611
1971	1,042
1972	676
1973	1,370
1974	668
1975	1,067
1976	1,275
1977	921
1978	910
1979	438
1980	742
1981	797
1982	411
1983	588
1984	855
1985	544
1986	642
1987	741
1988	1,015
1989	722
1990	601
1991	518
1992	887
1993	612
1994	675
1995	Exclude
1996	802
1997	610
1998	437
1999	Exclude
2000	604
2001	653
2002	478
2003	597
2004	872
2005	740
2006	767
2007	1,032
2008	566
2009	689
2010	1,221
2011	1,184
2012	814
2013	Exclude



From the above, KP concludes that there is no statistically significant trend observable in annual precipitation values at this site.

ATTACHMENT 2.7

Water Balance Scenario Frequency Analysis

Precipitation Frequency Analysis, 5 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 39

5 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	5 yr Wet Precip (mm)
1961 - 1965	4090.0	1	0.025	40.00	5301.0
1962 - 1966	4023.0	2	0.050	20.00	5056.0
1963 - 1967	4025.0	3	0.075	13.33	4841.0
1964 - 1968	4239.0	4	0.100	10.00	4823.0
1965 - 1969	4402.0	5	0.125	8.00	4693.0
1966 - 1970	3815.0	6	0.150	6.67	4611.0
1967 - 1971	4193.0	7	0.175	5.71	4474.2
1968 - 1972	4183.0	8	0.200	5.00	4443.0
1969 - 1973	4443.0	9	0.225	4.44	4402.0
1970 - 1974	4367.0	10	0.250	4.00	4367.0
1971 - 1975	4823.0	11	0.275	3.64	4286.0
1972 - 1976	5056.0	12	0.300	3.33	4275.6
1973 - 1977	5301.0	13	0.325	3.08	4239.0
1974 - 1978	4841.0	14	0.350	2.86	4193.0
1975 - 1979	4611.0	15	0.375	2.67	4183.0
1976 - 1980	4286.0	16	0.400	2.50	4090.0
1977 - 1981	3808.0	17	0.425	2.35	4025.0
1978 - 1982	3298.0	18	0.450	2.22	4023.0
1979 - 1983	2976.0	19	0.475	2.11	4008.1
1980 - 1984	3393.0	20	0.500	2.00	3976.9
1981 - 1985	3195.0	21	0.525	1.90	3815.0
1982 - 1986	3040.0	22	0.550	1.82	3808.0
1983 - 1987	3370.0	23	0.575	1.74	3797.0
1984 - 1988	3797.0	24	0.600	1.67	3794.6
1985 - 1989	3664.0	25	0.625	1.60	3743.0
1986 - 1990	3721.0	26	0.650	1.54	3721.0
1987 - 1991	3597.0	27	0.675	1.48	3664.0
1988 - 1992	3743.0	28	0.700	1.43	3597.0
1989 - 1993	3340.0	29	0.725	1.38	3453.9
1990 - 1994	3292.6	30	0.750	1.33	3393.0
1991 - 1995	Exclude	31	0.775	1.29	3370.0
1992 - 1996	Exclude	32	0.800	1.25	3340.4
1993 - 1997	Exclude	33	0.825	1.21	3340.0
1994 - 1998	Exclude	34	0.850	1.18	3298.0
1995 - 1999	Exclude	35	0.875	1.14	3292.6
1996 - 2000	Exclude	36	0.900	1.11	3204.7
1997 - 2001	Exclude	37	0.925	1.08	3195.0
1998 - 2002	Exclude	38	0.950	1.05	3040.0
1999 - 2003	Exclude	39	0.975	1.03	2976.0
2000 - 2004	3204.7				
2001 - 2005	3340.4				
2002 - 2006	3453.9				
2003 - 2007	4008.1				
2004 - 2008	3976.9				
2005 - 2009	3794.6				
2006 - 2010	4275.6				
2007 - 2011	4693.0				
2008 - 2012	4474.2				
2009 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Johnson SB	3	2	6
Gen. Extreme Value	6	3	18
Error	5	5	25
Nakagami	9	4	36
Weibull (3P)	8	7	56
Rayleigh (2P)	7	10	70
Beta	2	41	82
Gamma	15	6	90
Log-Pearson 3	18	9	162

Three fits were selected for comparison:

1) **Johnson SB** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

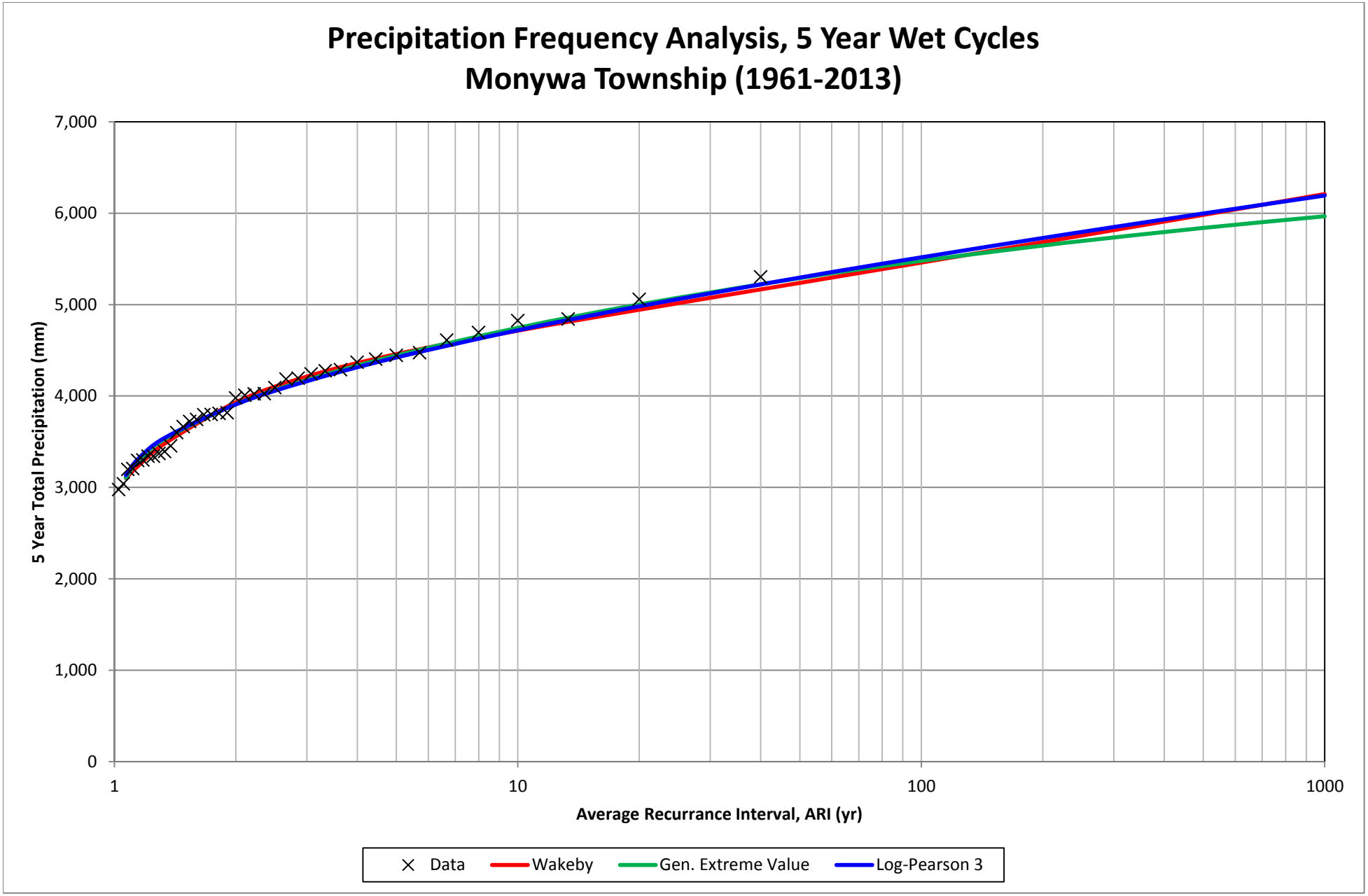
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 5 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 5 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 5 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	1911.522	k =	-0.16718292	α =	2422.254636
			β =	1.802226	σ =	549.6462521	β =	0.002964861
			γ =	302.7783	μ =	3714.507579	γ =	1.090119469
			δ =	0.012517				
			ξ =	2963.906				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	6209.2	N/A	5966.2	592.61	6192.9	581.77
0.998	0.002	500	5981.3	N/A	5838.8	592.61	5996.6	581.77
0.996	0.004	250	5755.4	N/A	5695.6	592.61	5794.8	581.77
0.995	0.005	200	5683.1	N/A	5645.8	592.61	5728.4	581.77
0.990	0.010	100	5459.6	N/A	5478.5	592.61	5517.0	581.77
0.980	0.020	50	5237.6	N/A	5289.9	592.61	5295.5	581.77
0.950	0.050	20	4944.0	N/A	5001.3	592.61	4981.4	581.77
0.900	0.100	10	4715.1	N/A	4745.4	592.61	4719.2	581.77
0.800	0.200	5	4458.5	N/A	4443.7	592.61	4421.7	581.77
0.667	0.333	3	4213.6	N/A	4175.6	592.61	4162.8	581.77
0.500	0.500	2.0	3931.2	N/A	3909.9	592.61	3908.0	581.77
0.250	0.750	1.3	3480.3	N/A	3530.0	592.61	3543.3	581.77
0.125	0.875	1.14	3231.2	N/A	3286.5	592.61	3308.5	581.77
0.063	0.937	1.07	3101.0	N/A	3105.2	592.61	3133.3	581.77
Kolmogorov Smirnov (Statistic, Rank)			0.0563	1	0.0822	6	0.0916	18
Anderson Darling (Statistic, Rank)			0.1431	1	0.2045	3	0.2438	9


Precipitation Frequency Analysis, 5 Year Wet Cycles
Monywa Township (1961-2013)
5 Year Total Precipitation (mm)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 4 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 41

4 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	4 yr Wet Precip (mm)
1961 - 1964	2892.0	1	0.024	42.00	4380.0
1962 - 1965	3359.0	2	0.048	21.00	4173.0
1963 - 1966	3339.0	3	0.071	14.00	3931.0
1964 - 1967	3129.0	4	0.095	10.50	3908.0
1965 - 1968	3658.0	5	0.119	8.40	3781.0
1966 - 1969	3204.0	6	0.143	7.00	3756.0
1967 - 1970	3151.0	7	0.167	6.00	3699.0
1968 - 1971	3507.0	8	0.190	5.25	3660.5
1969 - 1972	3073.0	9	0.214	4.67	3658.0
1970 - 1973	3699.0	10	0.238	4.20	3544.0
1971 - 1974	3756.0	11	0.262	3.82	3508.8
1972 - 1975	3781.0	12	0.286	3.50	3507.0
1973 - 1976	4380.0	13	0.310	3.23	3410.7
1974 - 1977	3931.0	14	0.333	3.00	3359.0
1975 - 1978	4173.0	15	0.357	2.80	3339.0
1976 - 1979	3544.0	16	0.381	2.63	3204.0
1977 - 1980	3011.0	17	0.405	2.47	3151.0
1978 - 1981	2887.0	18	0.429	2.33	3129.0
1979 - 1982	2388.0	19	0.452	2.21	3120.0
1980 - 1983	2538.0	20	0.476	2.10	3105.4
1981 - 1984	2651.0	21	0.500	2.00	3079.0
1982 - 1985	2398.0	22	0.524	1.91	3073.0
1983 - 1986	2629.0	23	0.548	1.83	3054.7
1984 - 1987	2782.0	24	0.571	1.75	3011.0
1985 - 1988	2942.0	25	0.595	1.68	2975.7
1986 - 1989	3120.0	26	0.619	1.62	2942.0
1987 - 1990	3079.0	27	0.643	1.56	2892.0
1988 - 1991	2856.0	28	0.667	1.50	2887.0
1989 - 1992	2728.0	29	0.690	1.45	2856.0
1990 - 1993	2618.0	30	0.714	1.40	2782.0
1991 - 1994	2691.6	31	0.738	1.35	2728.0
1992 - 1995	Exclude	32	0.762	1.31	2691.6
1993 - 1996	Exclude	33	0.786	1.27	2687.1
1994 - 1997	Exclude	34	0.810	1.24	2651.0
1995 - 1998	Exclude	35	0.833	1.20	2629.0
1996 - 1999	Exclude	36	0.857	1.17	2618.0
1997 - 2000	Exclude	37	0.881	1.14	2600.5
1998 - 2001	Exclude	38	0.905	1.11	2538.0
1999 - 2002	Exclude	39	0.929	1.08	2398.0
2000 - 2003	2333.2	40	0.952	1.05	2388.0
2001 - 2004	2600.5				
2002 - 2005	2687.1				
2003 - 2006	2975.7				
2004 - 2007	3410.7				
2005 - 2008	3105.4				
2006 - 2009	3054.7				
2007 - 2010	3508.8				
2008 - 2011	3660.5				
2009 - 2012	3908.0				
2010 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	2	2
Johnson SB	3	1	3
Gen. Extreme Value	4	4	16
Weibull (3P)	6	3	18
Rayleigh (2P)	10	6	60
Gamma (3P)	12	5	60
Log-Pearson 3	8	9	72
Erlang (3P)	7	11	77
Fatigue Life (3P)	13	7	91
Gen. Pareto	2	51	102

Three fits were selected for comparison:

1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

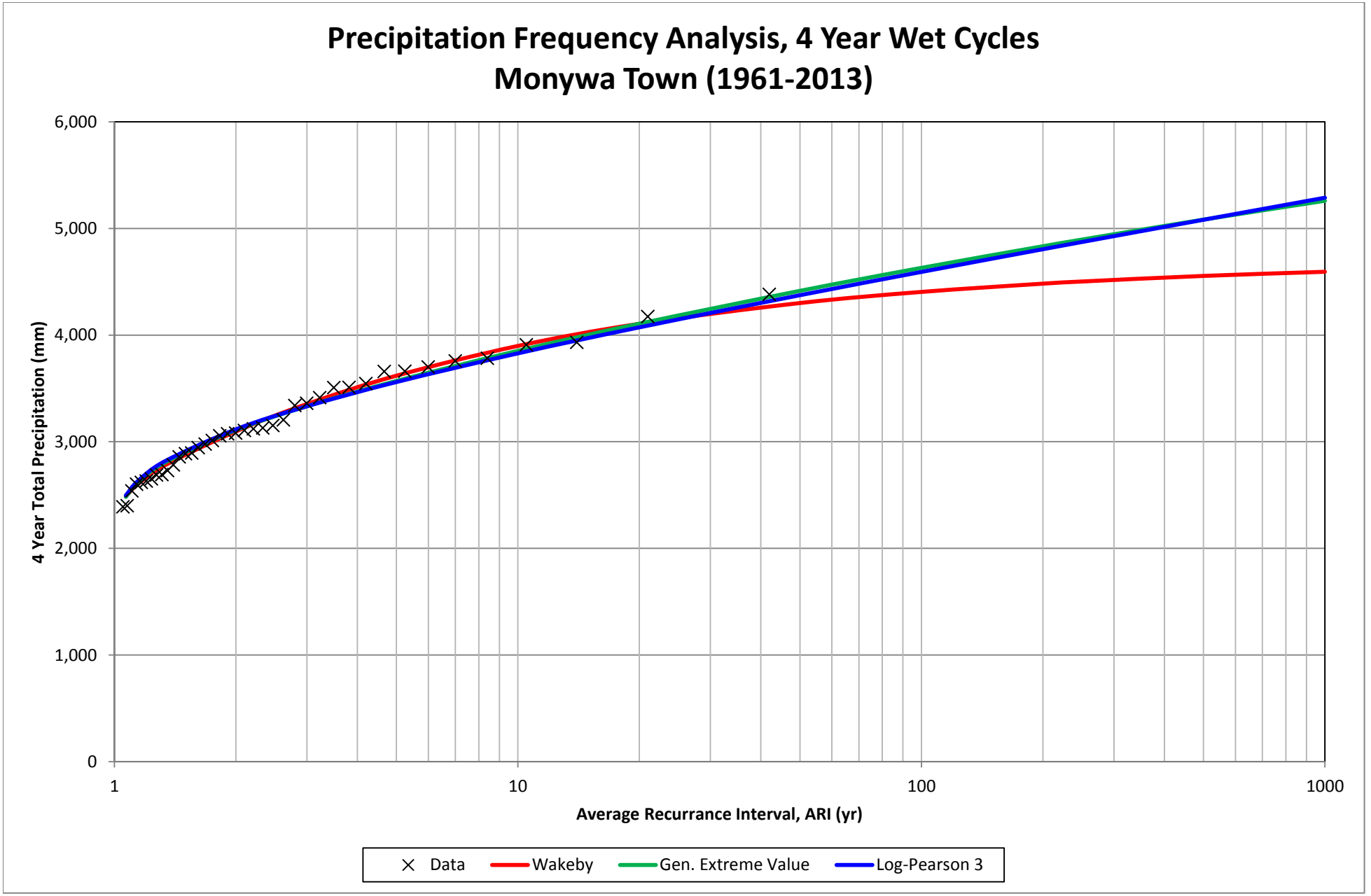
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 4 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 4 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 4 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	2021.286	k =	-0.083376416	α =	84.55063094
			β =	9.582717	σ =	439.7441449	β =	0.016726578
			γ =	927.1087	μ =	2950.042696	γ =	6.635654783
			δ =	-0.42826				
			ξ =	2330.035				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	4593.4	N/A	5259.1	511.81	5287.9	499.12
0.998	0.002	500	4554.6	N/A	5082.6	511.81	5081.2	499.12
0.996	0.004	250	4502.3	N/A	4895.4	511.81	4872.7	499.12
0.995	0.005	200	4481.9	N/A	4832.7	511.81	4804.9	499.12
0.990	0.010	100	4404.5	N/A	4630.2	511.81	4592.1	499.12
0.980	0.020	50	4300.4	N/A	4414.7	511.81	4373.9	499.12
0.950	0.050	20	4105.7	N/A	4107.0	511.81	4072.6	499.12
0.900	0.100	10	3898.2	N/A	3852.3	511.81	3828.5	499.12
0.800	0.200	5	3619.2	N/A	3570.1	511.81	3559.8	499.12
0.667	0.333	3	3354.0	N/A	3332.9	511.81	3332.9	499.12
0.500	0.500	2.0	3096.7	N/A	3108.8	511.81	3116.1	499.12
0.250	0.750	1.3	2778.5	N/A	2804.4	511.81	2816.8	499.12
0.125	0.875	1.14	2602.6	N/A	2618.1	511.81	2631.0	499.12
0.063	0.937	1.07	2487.4	N/A	2483.4	511.81	2495.9	499.12
Kolmogorov Smirnov (Statistic, Rank)			0.0616	1	0.0693	4	0.0733	8
Anderson Darling (Statistic, Rank)			0.1472	2	0.2029	4	0.2365	9


Precipitation Frequency Analysis, 4 Year Wet Cycles
Monywa Town (1961-2013)
4 Year Total Precipitation (mm)
6,000
5,000
4,000
3,000
2,000
1,000
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 3 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 44

3 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	3 yr Wet Precip (mm)
1961 - 1963	2311.0	1	0.022	45.00	3263.0
1962 - 1964	2161.0	2	0.044	22.50	3218.8
1963 - 1965	2675.0	3	0.067	15.00	3106.0
1964 - 1966	2443.0	4	0.089	11.25	3105.0
1965 - 1967	2548.0	5	0.111	9.00	3094.3
1966 - 1968	2460.0	6	0.133	7.50	3088.0
1967 - 1969	2540.0	7	0.156	6.43	3010.0
1968 - 1970	2465.0	8	0.178	5.63	2714.0
1969 - 1971	2397.0	9	0.200	5.00	2675.0
1970 - 1972	2329.0	10	0.222	4.50	2548.0
1971 - 1973	3088.0	11	0.244	4.09	2540.0
1972 - 1974	2714.0	12	0.267	3.75	2539.2
1973 - 1975	3105.0	13	0.289	3.46	2478.0
1974 - 1976	3010.0	14	0.311	3.21	2476.3
1975 - 1977	3263.0	15	0.333	3.00	2465.0
1976 - 1978	3106.0	16	0.356	2.81	2460.0
1977 - 1979	2269.0	17	0.378	2.65	2443.0
1978 - 1980	2090.0	18	0.400	2.50	2398.0
1979 - 1981	1977.0	19	0.422	2.37	2397.0
1980 - 1982	1950.0	20	0.444	2.25	2378.3
1981 - 1983	1796.0	21	0.467	2.14	2365.5
1982 - 1984	1854.0	22	0.489	2.05	2338.0
1983 - 1985	1987.0	23	0.511	1.96	2329.0
1984 - 1986	2041.0	24	0.533	1.88	2311.0
1985 - 1987	1927.0	25	0.556	1.80	2287.9
1986 - 1988	2398.0	26	0.578	1.73	2269.0
1987 - 1989	2478.0	27	0.600	1.67	2208.9
1988 - 1990	2338.0	28	0.622	1.61	2173.6
1989 - 1991	1841.0	29	0.644	1.55	2161.0
1990 - 1992	2006.0	30	0.667	1.50	2090.0
1991 - 1993	2017.0	31	0.689	1.45	2041.0
1992 - 1994	2173.6	32	0.711	1.41	2017.0
1993 - 1995	Exclude	33	0.733	1.36	2006.0
1994 - 1996	Exclude	34	0.756	1.32	1987.0
1995 - 1997	Exclude	35	0.778	1.29	1977.0
1996 - 1998	1849.3	36	0.800	1.25	1950.0
1997 - 1999	Exclude	37	0.822	1.22	1947.2
1998 - 2000	Exclude	38	0.844	1.18	1927.0
1999 - 2001	Exclude	39	0.867	1.15	1854.0
2000 - 2002	1735.8	40	0.889	1.13	1849.3
2001 - 2003	1728.9	41	0.911	1.10	1841.0
2002 - 2004	1947.2	42	0.933	1.07	1796.0
2003 - 2005	2208.9	43	0.956	1.05	1735.8
2004 - 2006	2378.3	44	0.978	1.02	1728.9
2005 - 2007	2539.2				
2006 - 2008	2365.5				
2007 - 2009	2287.9				
2008 - 2010	2476.3				
2009 - 2011	3094.3				
2010 - 2012	3218.8				
2011 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Extreme Value	2	3	6
Pearson 5 (3P)	1	10	10
Wakeby	16	1	16
Frechet (3P)	3	11	33
Weibull (3P)	9	4	36
Johnson SB	22	2	44
Log-Pearson 3	5	9	45
Log-Logistic (3P)	4	12	48
Lognormal (3P)	7	8	56
Inv. Gaussian (3P)	10	6	60

Three fits were selected for comparison:

1) **Pearson 5** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

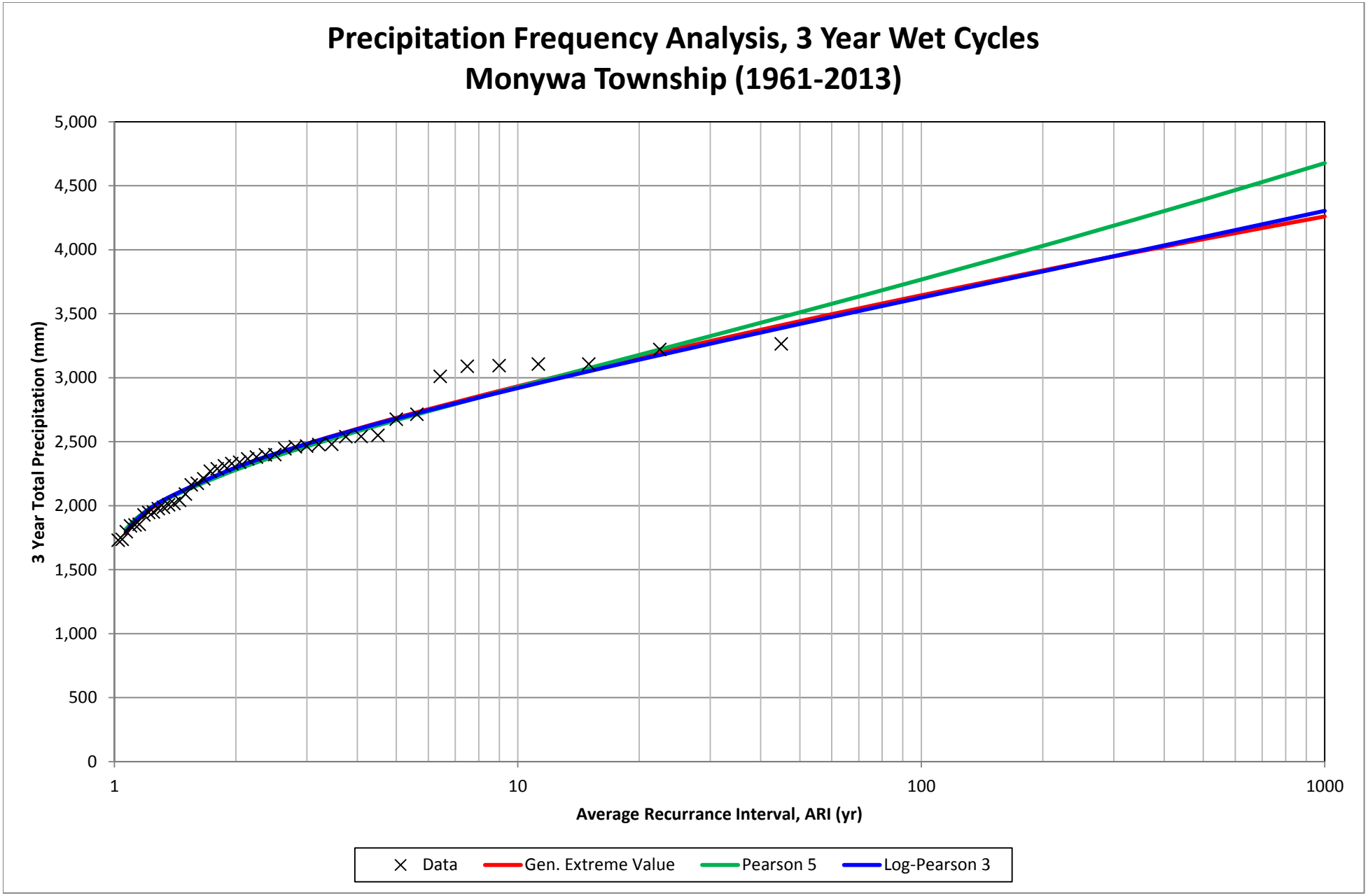
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 3 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 3 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 3 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Pearson 5		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	-0.05346	α =	13.63980555	α =	46.42243888
			σ =	363.1438	β =	19090.81617	β =	0.025855566
			μ =	2162.971	γ =	845.7300296	γ =	6.548325006
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	4260.3	436.49	4676.7	442.70	4304.0	429.50
0.998	0.002	500	4082.9	436.49	4391.5	442.70	4099.6	429.50
0.996	0.004	250	3898.7	436.49	4116.7	442.70	3896.0	429.50
0.995	0.005	200	3837.9	436.49	4030.3	442.70	3830.4	429.50
0.990	0.010	100	3643.9	436.49	3767.1	442.70	3626.4	429.50
0.980	0.020	50	3441.9	436.49	3510.8	442.70	3420.3	429.50
0.950	0.050	20	3160.3	436.49	3178.4	442.70	3141.0	429.50
0.900	0.100	10	2932.9	436.49	2927.1	442.70	2919.5	429.50
0.800	0.200	5	2686.4	436.49	2668.2	442.70	2680.6	429.50
0.667	0.333	3	2483.4	436.49	2463.9	442.70	2483.3	429.50
0.500	0.500	2.0	2294.8	436.49	2280.3	442.70	2298.5	429.50
0.250	0.750	1.3	2043.3	436.49	2045.1	442.70	2049.9	429.50
0.125	0.875	1.14	1891.8	436.49	1909.5	442.70	1899.7	429.50
0.063	0.937	1.07	1783.5	436.49	1815.7	442.70	1792.5	429.50
Kolmogorov Smirnov (Statistic, Rank)			0.0806	2	0.0794	1	0.0834	5
Anderson Darling (Statistic, Rank)			0.4176	3	0.4473	10	0.4428	9


Precipitation Frequency Analysis, 3 Year Wet Cycles
Monywa Township (1961-2013)
3 Year Total Precipitation (mm)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Extreme Value
Pearson 5
Log-Pearson 3

Precipitation Frequency Analysis, 2 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 47

2 Year Data		Rank	Weibull	ARI	Ranked
Years	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	2 yr Wet Precip (mm)
1961 - 1962	1415.0	1	0.021	48.00	2405.1
1962 - 1963	1580.0	2	0.042	24.00	2342.0
1963 - 1964	1477.0	3	0.063	16.00	2196.0
1964 - 1965	1779.0	4	0.083	12.00	2046.0
1965 - 1966	1862.0	5	0.104	9.60	2038.0
1966 - 1967	1350.0	6	0.125	8.00	1997.9
1967 - 1968	1796.0	7	0.146	6.86	1910.1
1968 - 1969	1854.0	8	0.167	6.00	1862.0
1969 - 1970	1355.0	9	0.188	5.33	1854.0
1970 - 1971	1653.0	10	0.208	4.80	1831.0
1971 - 1972	1718.0	11	0.229	4.36	1799.3
1972 - 1973	2046.0	12	0.250	4.00	1796.0
1973 - 1974	2038.0	13	0.271	3.69	1779.0
1974 - 1975	1735.0	14	0.292	3.43	1756.0
1975 - 1976	2342.0	15	0.313	3.20	1737.0
1976 - 1977	2196.0	16	0.333	3.00	1735.0
1977 - 1978	1831.0	17	0.354	2.82	1718.0
1978 - 1979	1348.0	18	0.375	2.67	1653.0
1979 - 1980	1180.0	19	0.396	2.53	1611.5
1980 - 1981	1539.0	20	0.417	2.40	1598.7
1981 - 1982	1208.0	21	0.438	2.29	1580.0
1982 - 1983	999.0	22	0.458	2.18	1539.0
1983 - 1984	1443.0	23	0.479	2.09	1506.7
1984 - 1985	1399.0	24	0.500	2.00	1499.0
1985 - 1986	1186.0	25	0.521	1.92	1477.0
1986 - 1987	1383.0	26	0.542	1.85	1469.0
1987 - 1988	1756.0	27	0.563	1.78	1443.0
1988 - 1989	1737.0	28	0.583	1.71	1415.0
1989 - 1990	1323.0	29	0.604	1.66	1412.0
1990 - 1991	1119.0	30	0.625	1.60	1405.0
1991 - 1992	1405.0	31	0.646	1.55	1399.0
1992 - 1993	1499.0	32	0.667	1.50	1383.0
1993 - 1994	1286.6	33	0.688	1.45	1355.0
1994 - 1995	Exclude	34	0.708	1.41	1350.0
1995 - 1996	Exclude	35	0.729	1.37	1348.0
1996 - 1997	1412.0	36	0.750	1.33	1323.0
1997 - 1998	1046.9	37	0.771	1.30	1286.6
1998 - 1999	Exclude	38	0.792	1.26	1257.5
1999 - 2000	Exclude	39	0.813	1.23	1255.4
2000 - 2001	1257.5	40	0.833	1.20	1208.0
2001 - 2002	1131.5	41	0.854	1.17	1186.0
2002 - 2003	1075.6	42	0.875	1.14	1180.0
2003 - 2004	1469.0	43	0.896	1.12	1131.5
2004 - 2005	1611.5	44	0.917	1.09	1119.0
2005 - 2006	1506.7	45	0.938	1.07	1075.6
2006 - 2007	1799.3	46	0.958	1.04	1046.9
2007 - 2008	1598.7	47	0.979	1.02	999.0
2008 - 2009	1255.4				
2009 - 2010	1910.1				
2010 - 2011	2405.1				
2011 - 2012	1997.9				
2012 - 2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Gamma (4P)	1	8	8
Rice	2	29	58
Johnson SB	3	1	3
Triangular	4	43	172
Beta	5	41	205
Wakeby	6	2	12
Rayleigh (2P)	7	5	35
Gamma	8	19	152
Gen. Extreme Value	10	4	40
Log-Pearson 3	16	6	96

Three fits were selected for comparison:

1) **Gen. Gamma (4P)** (Best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

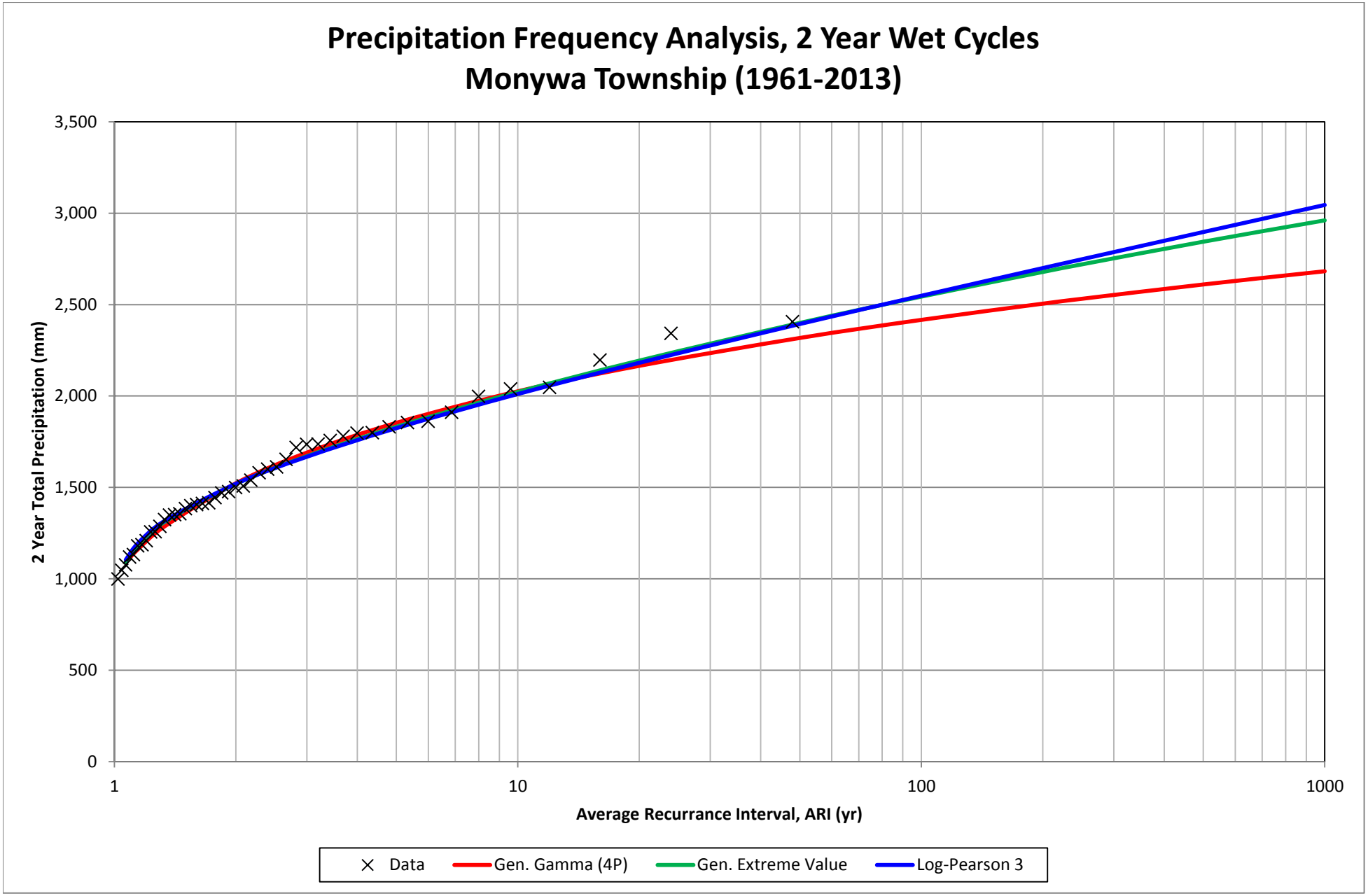
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

Any 2 year series including 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 2 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 2 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Gamma (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	k =	3.002649	k =	-0.087925417	α =	422.6834021
			α =	0.416684	σ =	299.2902393	β =	0.010413888
			β =	982.5662	μ =	1411.245461	γ =	2.928064568
			γ =	991.0833				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2682.4	338.35	2960.7	346.72	3045.0	341.68
0.998	0.002	500	2610.1	338.35	2844.1	346.72	2896.9	341.68
0.996	0.004	250	2531.8	338.35	2720.0	346.72	2747.9	341.68
0.995	0.005	200	2505.0	338.35	2678.4	346.72	2699.6	341.68
0.990	0.010	100	2416.4	338.35	2543.6	346.72	2548.3	341.68
0.980	0.020	50	2317.5	338.35	2399.8	346.72	2393.8	341.68
0.950	0.050	20	2165.2	338.35	2193.6	346.72	2181.6	341.68
0.900	0.100	10	2025.9	338.35	2022.3	346.72	2010.9	341.68
0.800	0.200	5	1853.3	338.35	1831.8	346.72	1824.3	341.68
0.667	0.333	3	1690.8	338.35	1671.3	346.72	1668.0	341.68
0.500	0.500	2.0	1522.9	338.35	1519.2	346.72	1519.9	341.68
0.250	0.750	1.3	1287.6	338.35	1312.1	346.72	1317.6	341.68
0.125	0.875	1.14	1160.6	338.35	1184.9	346.72	1193.6	341.68
0.063	0.937	1.07	1089.0	338.35	1092.9	346.72	1104.3	341.68
Kolmogorov Smirnov (Statistic, Rank)			0.0580	1	0.0723	10	0.0765	16
Anderson Darling (Statistic, Rank)			0.1597	8	0.1427	4	0.1586	6


Precipitation Frequency Analysis, 2 Year Wet Cycles
Monywa Township (1961-2013)
2 Year Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Gamma (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 1 Year Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 50

Annual Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	1 yr Wet Precip (mm)
1961	731.0	1	0.020	51.00	1370.0
1962	684.0	2	0.039	25.50	1275.0
1963	896.0	3	0.059	17.00	1220.9
1964	581.0	4	0.078	12.75	1198.0
1965	1198.0	5	0.098	10.20	1184.2
1966	664.0	6	0.118	8.50	1110.0
1967	686.0	7	0.137	7.29	1067.0
1968	1110.0	8	0.157	6.38	1042.0
1969	744.0	9	0.176	5.67	1032.5
1970	611.0	10	0.196	5.10	1015.0
1971	1042.0	11	0.216	4.64	921.0
1972	676.0	12	0.235	4.25	910.0
1973	1370.0	13	0.255	3.92	896.0
1974	668.0	14	0.275	3.64	887.0
1975	1067.0	15	0.294	3.40	871.6
1976	1275.0	16	0.314	3.19	855.0
1977	921.0	17	0.333	3.00	813.7
1978	910.0	18	0.353	2.83	802.4
1979	438.0	19	0.373	2.68	797.0
1980	742.0	20	0.392	2.55	766.8
1981	797.0	21	0.412	2.43	744.0
1982	411.0	22	0.431	2.32	742.0
1983	588.0	23	0.451	2.22	741.0
1984	855.0	24	0.471	2.13	739.9
1985	544.0	25	0.490	2.04	731.0
1986	642.0	26	0.510	1.96	722.0
1987	741.0	27	0.529	1.89	689.2
1988	1015.0	28	0.549	1.82	686.0
1989	722.0	29	0.569	1.76	684.0
1990	601.0	30	0.588	1.70	676.0
1991	518.0	31	0.608	1.65	674.6
1992	887.0	32	0.627	1.59	668.0
1993	612.0	33	0.647	1.55	664.0
1994	674.6	34	0.667	1.50	653.3
1995	Exclude	35	0.686	1.46	642.0
1996	802.4	36	0.706	1.42	612.0
1997	609.6	37	0.725	1.38	611.0
1998	437.2	38	0.745	1.34	609.6
1999	Exclude	39	0.765	1.31	604.2
2000	604.2	40	0.784	1.28	601.0
2001	653.3	41	0.804	1.24	597.4
2002	478.2	42	0.824	1.21	588.0
2003	597.4	43	0.843	1.19	581.0
2004	871.6	44	0.863	1.16	566.2
2005	739.9	45	0.882	1.13	544.0
2006	766.8	46	0.902	1.11	518.0
2007	1032.5	47	0.922	1.09	478.2
2008	566.2	48	0.941	1.06	438.0
2009	689.2	49	0.961	1.04	437.2
2010	1220.9	50	0.980	1.02	411.0
2011	1184.2				
2012	813.7				
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	2	1	2
Gen. Extreme Value	3	2	6
Pearson 5	4	3	12
Wakeby	1	14	14
Pearson 5 (3P)	8	4	32
Pearson 6 (4P)	9	5	45
Lognormal (3P)	10	6	60
Inv. Gaussian (3P)	11	7	77
Log-Logistic	5	17	85
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

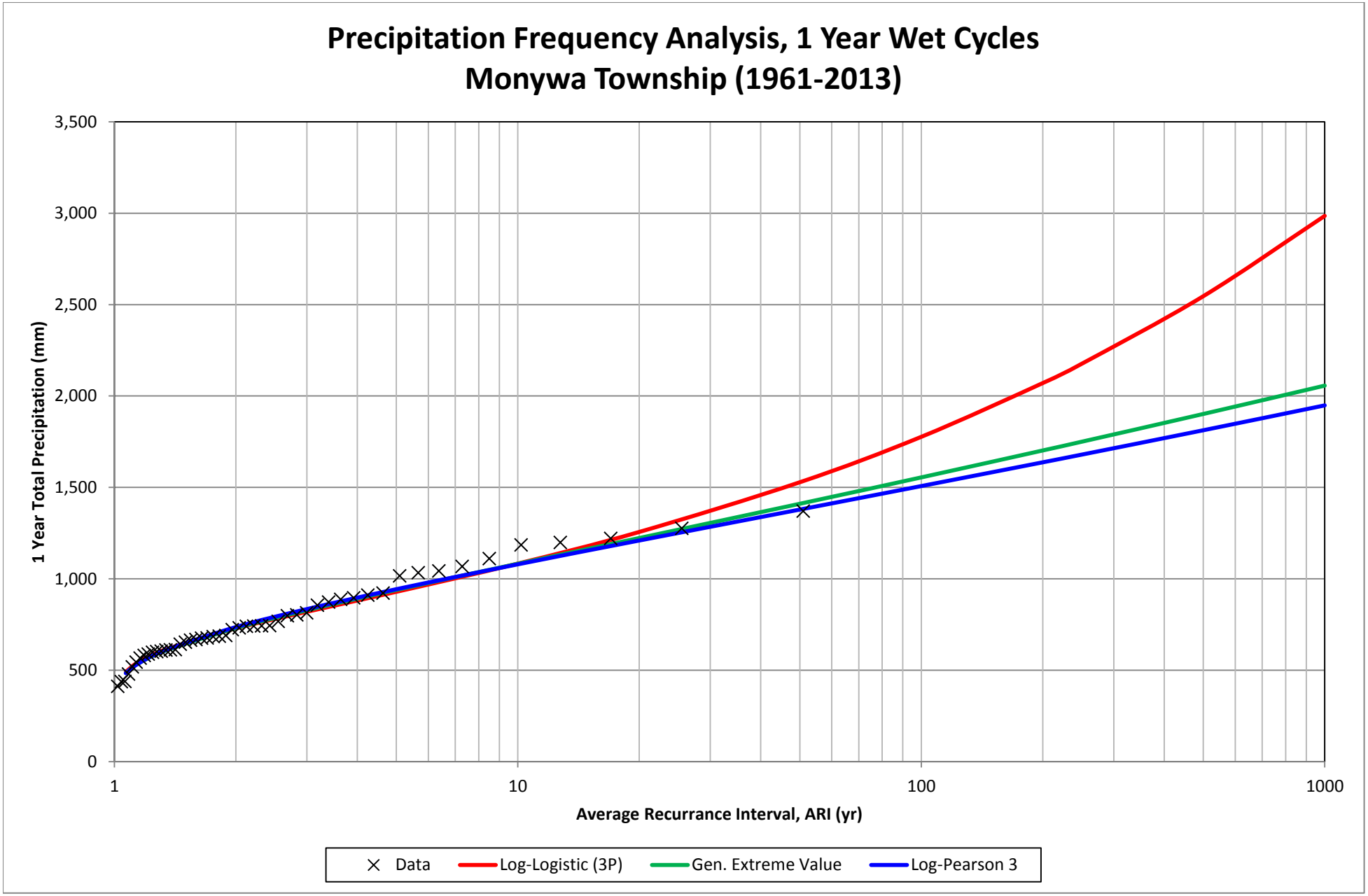
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

The years 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 1 Year Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 1 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	3.967234	k =	0.034040351	α =	120.6291083
			β =	479.8937	σ =	178.832219	β =	0.026212465
			γ =	248.5273	μ =	664.3371342	γ =	3.448149075
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2985.2	282.20	2056.9	240.34	1948.7	234.14
0.998	0.002	500	2546.0	282.20	1901.8	240.34	1812.7	234.14
0.996	0.004	250	2176.7	282.20	1750.2	240.34	1679.6	234.14
0.995	0.005	200	2070.8	282.20	1702.1	240.34	1637.3	234.14
0.990	0.010	100	1776.7	282.20	1554.9	240.34	1507.4	234.14
0.980	0.020	50	1528.5	282.20	1410.6	240.34	1379.0	234.14
0.950	0.050	20	1256.6	282.20	1223.3	240.34	1209.7	234.14
0.900	0.100	10	1083.5	282.20	1082.6	240.34	1079.5	234.14
0.800	0.200	5	929.1	282.20	939.5	240.34	943.4	234.14
0.667	0.333	3	820.3	282.20	828.5	240.34	834.7	234.14
0.500	0.500	2.0	728.4	282.20	730.3	240.34	736.1	234.14
0.250	0.750	1.3	612.3	282.20	606.2	240.34	608.8	234.14
0.125	0.875	1.14	542.4	282.20	535.0	240.34	535.0	234.14
0.063	0.937	1.07	491.5	282.20	485.6	240.34	483.9	234.14
Kolmogorov Smirnov (Statistic, Rank)			0.0684	2	0.0741	3	0.0853	17
Anderson Darling (Statistic, Rank)			0.2649	1	0.2731	2	0.3027	11


Precipitation Frequency Analysis, 1 Year Wet Cycles
Monywa Township (1961-2013)
1 Year Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 1 Year Dry Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 50

Annual Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(lowest to highest) m	Exceedance Probability p	(yr)	1 yr Dry Precip (mm)
1961	731.0	1	0.020	51.00	411.0
1962	684.0	2	0.039	25.50	437.2
1963	896.0	3	0.059	17.00	438.0
1964	581.0	4	0.078	12.75	478.2
1965	1198.0	5	0.098	10.20	518.0
1966	664.0	6	0.118	8.50	544.0
1967	686.0	7	0.137	7.29	566.2
1968	1110.0	8	0.157	6.38	581.0
1969	744.0	9	0.176	5.67	588.0
1970	611.0	10	0.196	5.10	597.4
1971	1042.0	11	0.216	4.64	601.0
1972	676.0	12	0.235	4.25	604.2
1973	1370.0	13	0.255	3.92	609.6
1974	668.0	14	0.275	3.64	611.0
1975	1067.0	15	0.294	3.40	612.0
1976	1275.0	16	0.314	3.19	642.0
1977	921.0	17	0.333	3.00	653.3
1978	910.0	18	0.353	2.83	664.0
1979	438.0	19	0.373	2.68	668.0
1980	742.0	20	0.392	2.55	674.6
1981	797.0	21	0.412	2.43	676.0
1982	411.0	22	0.431	2.32	684.0
1983	588.0	23	0.451	2.22	686.0
1984	855.0	24	0.471	2.13	689.2
1985	544.0	25	0.490	2.04	722.0
1986	642.0	26	0.510	1.96	731.0
1987	741.0	27	0.529	1.89	739.9
1988	1015.0	28	0.549	1.82	741.0
1989	722.0	29	0.569	1.76	742.0
1990	601.0	30	0.588	1.70	744.0
1991	518.0	31	0.608	1.65	766.8
1992	887.0	32	0.627	1.59	797.0
1993	612.0	33	0.647	1.55	802.4
1994	674.6	34	0.667	1.50	813.7
1995	Exclude	35	0.686	1.46	855.0
1996	802.4	36	0.706	1.42	871.6
1997	609.6	37	0.725	1.38	887.0
1998	437.2	38	0.745	1.34	896.0
1999	Exclude	39	0.765	1.31	910.0
2000	604.2	40	0.784	1.28	921.0
2001	653.3	41	0.804	1.24	1015.0
2002	478.2	42	0.824	1.21	1032.5
2003	597.4	43	0.843	1.19	1042.0
2004	871.6	44	0.863	1.16	1067.0
2005	739.9	45	0.882	1.13	1110.0
2006	766.8	46	0.902	1.11	1184.2
2007	1032.5	47	0.922	1.09	1198.0
2008	566.2	48	0.941	1.06	1220.9
2009	689.2	49	0.961	1.04	1275.0
2010	1220.9	50	0.980	1.02	1370.0
2011	1184.2				
2012	813.7				
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	2	1	2
Gen. Extreme Value	3	2	6
Pearson 5	4	3	12
Wakeby	1	14	14
Pearson 5 (3P)	8	4	32
Pearson 6 (4P)	9	5	45
Lognormal (3P)	10	6	60
Inv. Gaussian (3P)	11	7	77
Log-Logistic	5	17	85
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

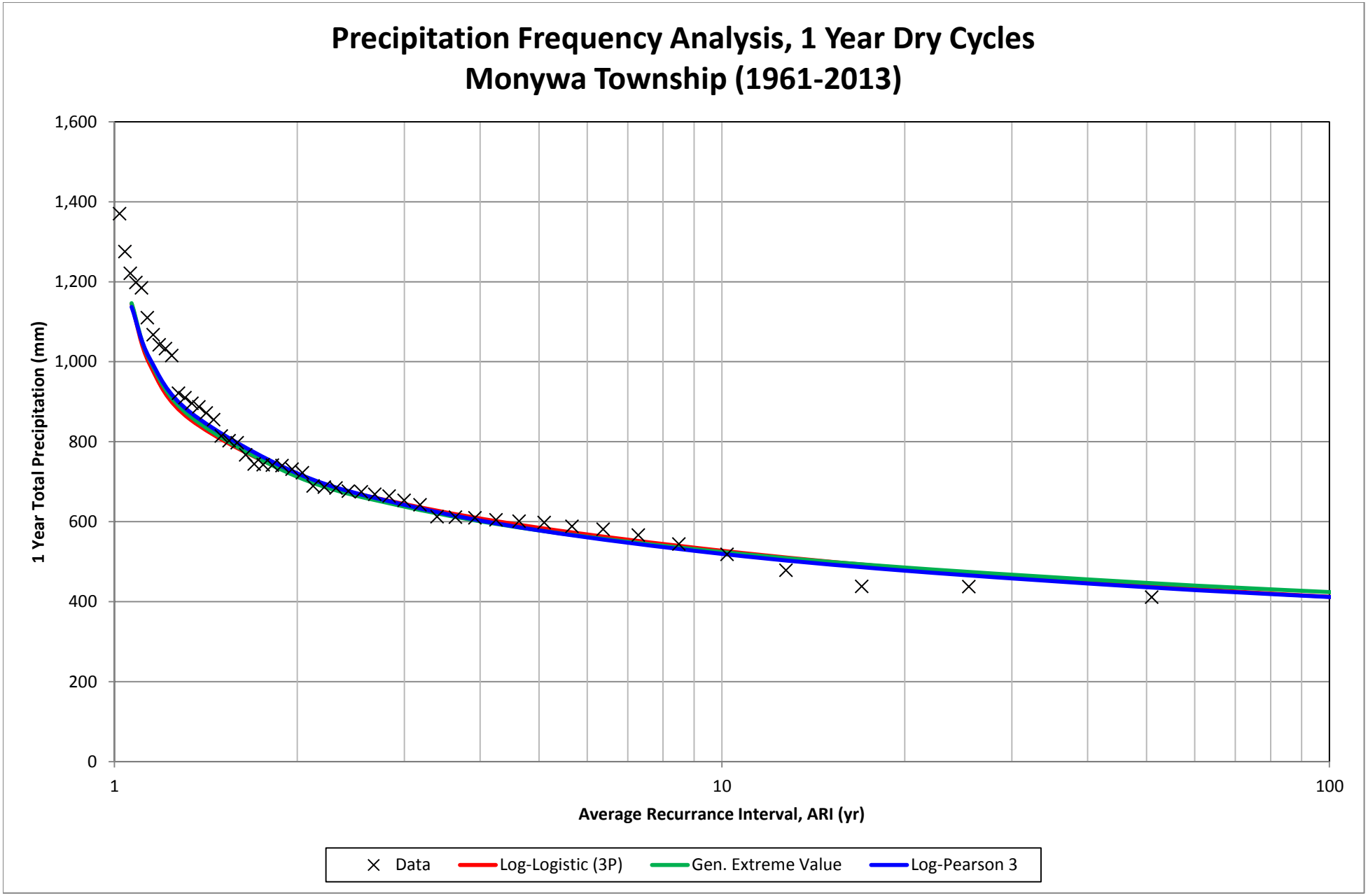
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

The years 1995, 1999 and 2013 were excluded from the analysis as a significant portion of the precipitation data from those years was missing.

Precipitation Frequency Analysis, 1 Year Dry Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent dry-cycle 1 year precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
			α =	3.967234	k =	0.034040351	α =	120.6291083
			β =	479.8937	σ =	178.832219	β =	0.026212465
			γ =	248.5273	μ =	664.3371342	γ =	3.448149075
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.001	0.999	1000	351.1	259.33	368.2	233.54	354.0	224.66
0.002	0.998	500	365.9	259.33	382.6	233.54	368.6	224.66
0.004	0.996	250	383.5	259.33	398.8	233.54	385.3	224.66
0.005	0.995	200	389.9	259.33	404.5	233.54	391.3	224.66
0.010	0.990	100	412.3	259.33	424.0	233.54	411.8	224.66
0.020	0.980	50	439.1	259.33	447.0	233.54	436.3	224.66
0.050	0.950	20	483.8	259.33	485.4	233.54	477.6	224.66
0.100	0.900	10	527.3	259.33	524.1	233.54	519.6	224.66
0.200	0.800	5	584.8	259.33	578.3	233.54	578.3	224.66
0.333	0.667	3	644.1	259.33	637.7	233.54	642.1	224.66
0.500	0.500	2.0	714.9	259.33	712.5	233.54	720.9	224.66
0.750	0.250	1.3	855.7	259.33	863.4	233.54	873.5	224.66
0.875	0.125	1.14	994.2	259.33	1005.0	233.54	1008.6	224.66
0.937	0.063	1.07	1144.8	259.33	1146.5	233.54	1137.1	224.66
Kolmogorov Smirnov (Statistic, Rank)			0.0684	2	0.0741	3	0.0853	17
Anderson Darling (Statistic, Rank)			0.2649	1	0.2731	2	0.3027	11


Precipitation Frequency Analysis, 1 Year Dry Cycles
Monywa Township (1961-2013)
1 Year Total Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
1
10
100
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 180 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

180 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	180 d Wet Precip (mm)
1961	653.0	1	0.019	53.00	1288.0
1962	678.0	2	0.038	26.50	1180.9
1963	837.0	3	0.057	17.67	1139.7
1964	565.0	4	0.075	13.25	1098.0
1965	1098.0	5	0.094	10.60	1046.0
1966	628.0	6	0.113	8.83	1024.0
1967	640.0	7	0.132	7.57	994.0
1968	1024.0	8	0.151	6.63	971.8
1969	713.0	9	0.170	5.89	965.0
1970	560.0	10	0.189	5.30	903.0
1971	965.0	11	0.208	4.82	901.0
1972	600.0	12	0.226	4.42	864.5
1973	1288.0	13	0.245	4.08	863.0
1974	614.0	14	0.264	3.79	851.0
1975	994.0	15	0.283	3.53	837.0
1976	1046.0	16	0.302	3.31	821.0
1977	863.0	17	0.321	3.12	753.7
1978	903.0	18	0.340	2.94	724.2
1979	415.0	19	0.358	2.79	720.0
1980	702.0	20	0.377	2.65	715.2
1981	650.0	21	0.396	2.52	713.0
1982	410.0	22	0.415	2.41	702.0
1983	545.0	23	0.434	2.30	678.0
1984	821.0	24	0.453	2.21	673.6
1985	459.0	25	0.472	2.12	665.0
1986	614.0	26	0.491	2.04	653.0
1987	645.0	27	0.509	1.96	650.0
1988	901.0	28	0.528	1.89	645.7
1989	720.0	29	0.547	1.83	645.0
1990	572.0	30	0.566	1.77	640.0
1991	472.0	31	0.585	1.71	637.8
1992	851.0	32	0.604	1.66	628.0
1993	573.0	33	0.623	1.61	616.5
1994	637.8	34	0.642	1.56	614.0
1995	531.1	35	0.660	1.51	614.0
1996	616.5	36	0.679	1.47	602.3
1997	602.3	37	0.698	1.43	600.0
1998	413.1	38	0.717	1.39	576.3
1999	715.2	39	0.736	1.36	573.0
2000	556.8	40	0.755	1.33	572.0
2001	645.7	41	0.774	1.29	565.0
2002	454.4	42	0.792	1.26	560.0
2003	576.3	43	0.811	1.23	556.8
2004	864.5	44	0.830	1.20	545.0
2005	673.6	45	0.849	1.18	531.1
2006	724.2	46	0.868	1.15	514.9
2007	971.8	47	0.887	1.13	472.0
2008	514.9	48	0.906	1.10	459.0
2009	665.0	49	0.925	1.08	454.4
2010	1180.9	50	0.943	1.06	415.0
2011	1139.7	51	0.962	1.04	413.1
2012	753.7	52	0.981	1.02	410.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Log-Logistic (3P)	1	3	3
Gen. Extreme Value	3	1	3
Burr	2	2	4
Lognormal (3P)	7	4	28
Pearson 6 (4P)	5	6	30
Pearson 5 (3P)	6	5	30
Frechet (3P)	8	9	72
Log-Logistic	4	19	76
Inv. Gaussian (3P)	11	7	77
Log-Pearson 3	17	11	187

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

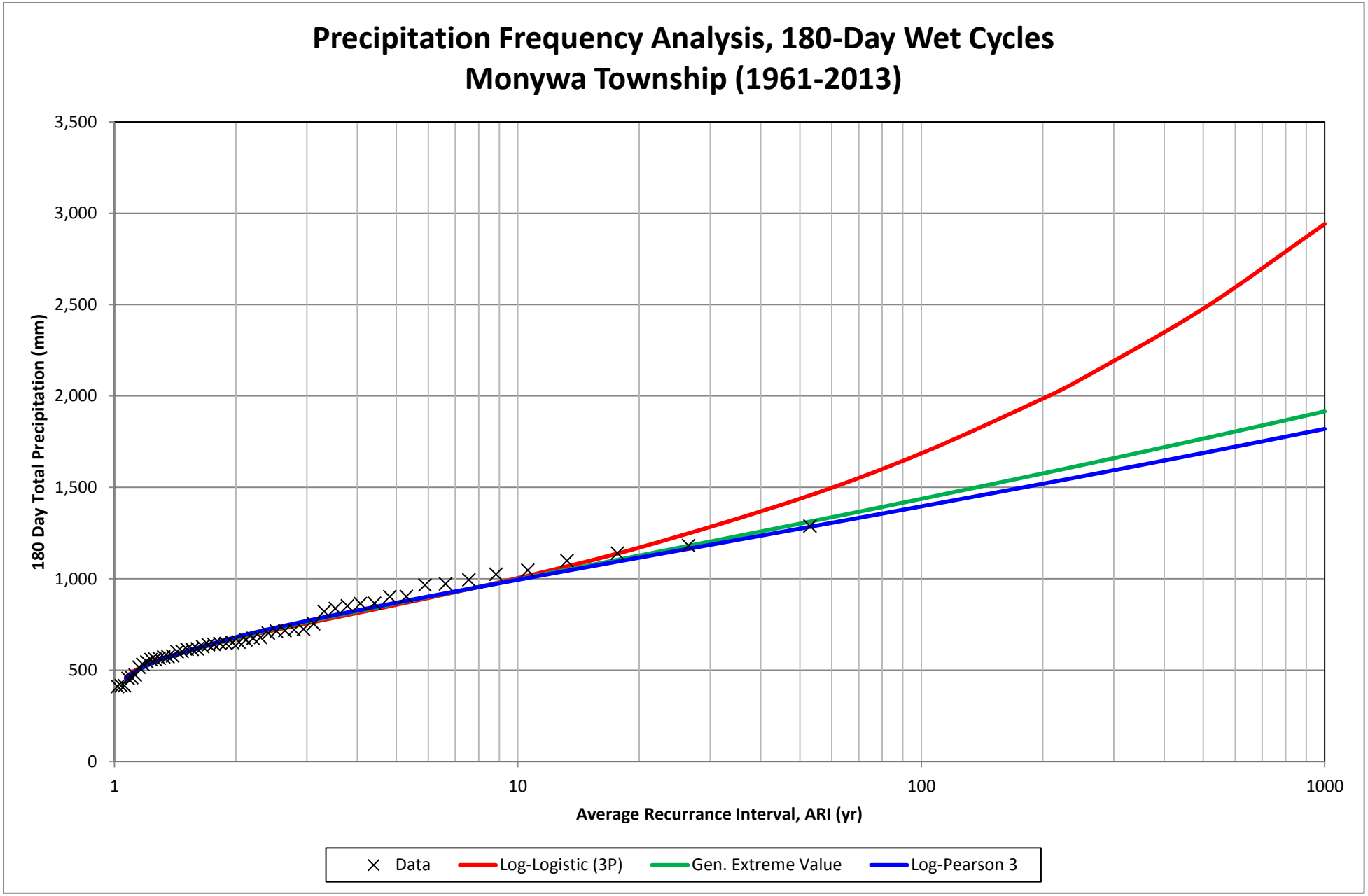
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 180 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 180 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Log-Logistic (3P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	α =	3.636479	k =	0.043959129	α =	63.28937577
			β =	399.3156	σ =	160.9920019	β =	0.03539472
			γ =	273.2777	μ =	616.2480698	γ =	4.294614079
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	2941.2	270.39	1915.6	219.52	1819.9	213.97
0.998	0.002	500	2477.6	270.39	1766.5	219.52	1688.2	213.97
0.996	0.004	250	2094.0	270.39	1621.9	219.52	1560.2	213.97
0.995	0.005	200	1985.2	270.39	1576.2	219.52	1519.7	213.97
0.990	0.010	100	1686.1	270.39	1437.0	219.52	1395.9	213.97
0.980	0.020	50	1437.7	270.39	1301.5	219.52	1274.4	213.97
0.950	0.050	20	1170.6	270.39	1127.0	219.52	1115.6	213.97
0.900	0.100	10	1004.0	270.39	997.1	219.52	994.6	213.97
0.800	0.200	5	857.9	270.39	865.9	219.52	869.2	213.97
0.667	0.333	3	756.6	270.39	764.7	219.52	769.9	213.97
0.500	0.500	2.0	672.6	270.39	675.7	219.52	680.6	213.97
0.250	0.750	1.3	568.5	270.39	564.0	219.52	566.2	213.97
0.125	0.875	1.14	507.1	270.39	500.3	219.52	500.4	213.97
0.063	0.937	1.07	463.3	270.39	456.1	219.52	455.1	213.97
Kolmogorov Smirnov (Statistic, Rank)			0.0671	1	0.0764	2	0.0863	17
Anderson Darling (Statistic, Rank)			0.3558	2	0.3565	3	0.3842	10


Precipitation Frequency Analysis, 180-Day Wet Cycles
Monywa Township (1961-2013)
180 Day Total Precipitation (mm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 120 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

120 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	120 d Wet Precip (mm)
1961	493.0	1	0.019	53.00	980.9
1962	466.0	2	0.038	26.50	977.0
1963	641.0	3	0.057	17.67	928.0
1964	384.0	4	0.075	13.25	802.0
1965	977.0	5	0.094	10.60	781.0
1966	432.0	6	0.113	8.83	754.2
1967	456.0	7	0.132	7.57	718.0
1968	695.0	8	0.151	6.63	717.0
1969	551.0	9	0.170	5.89	712.8
1970	420.0	10	0.189	5.30	703.0
1971	802.0	11	0.208	4.82	695.0
1972	497.0	12	0.226	4.42	673.0
1973	928.0	13	0.245	4.08	654.0
1974	423.0	14	0.264	3.79	653.0
1975	703.0	15	0.283	3.53	641.0
1976	717.0	16	0.302	3.31	640.0
1977	781.0	17	0.321	3.12	636.2
1978	718.0	18	0.340	2.94	632.7
1979	375.0	19	0.358	2.79	597.9
1980	558.0	20	0.377	2.65	589.8
1981	520.0	21	0.396	2.52	577.0
1982	351.0	22	0.415	2.41	558.0
1983	523.0	23	0.434	2.30	551.0
1984	653.0	24	0.453	2.21	544.3
1985	316.0	25	0.472	2.12	537.0
1986	577.0	26	0.491	2.04	532.9
1987	537.0	27	0.509	1.96	531.4
1988	640.0	28	0.528	1.89	523.0
1989	654.0	29	0.547	1.83	520.0
1990	488.0	30	0.566	1.77	505.5
1991	372.0	31	0.585	1.71	497.0
1992	673.0	32	0.604	1.66	496.6
1993	416.0	33	0.623	1.61	493.0
1994	589.8	34	0.642	1.56	488.0
1995	496.6	35	0.660	1.51	466.0
1996	532.9	36	0.679	1.47	465.1
1997	465.1	37	0.698	1.43	456.0
1998	388.7	38	0.717	1.39	452.0
1999	597.9	39	0.736	1.36	432.0
2000	405.1	40	0.755	1.33	431.1
2001	505.5	41	0.774	1.29	423.0
2002	383.2	42	0.792	1.26	420.0
2003	431.1	43	0.811	1.23	416.0
2004	712.8	44	0.830	1.20	405.1
2005	531.4	45	0.849	1.18	388.7
2006	544.3	46	0.868	1.15	384.0
2007	632.7	47	0.887	1.13	383.2
2008	340.1	48	0.906	1.10	375.0
2009	452.0	49	0.925	1.08	372.0
2010	980.9	50	0.943	1.06	351.0
2011	754.2	51	0.962	1.04	340.1
2012	636.2	52	0.981	1.02	316.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Gamma (4P)	1	3	3
Weibull (3P)	5	1	5
Johnson SB	3	2	6
Inv. Gaussian	6	10	60
Gamma (3P)	16	4	64
Gen. Extreme Value	14	5	70
Triangular	2	41	82
Log-Pearson 3	15	8	120
Fatigue Life (3P)	21	6	126
Fatigue Life	8	18	144

Three fits were selected for comparison:

1) **Gen. Gamma (4P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

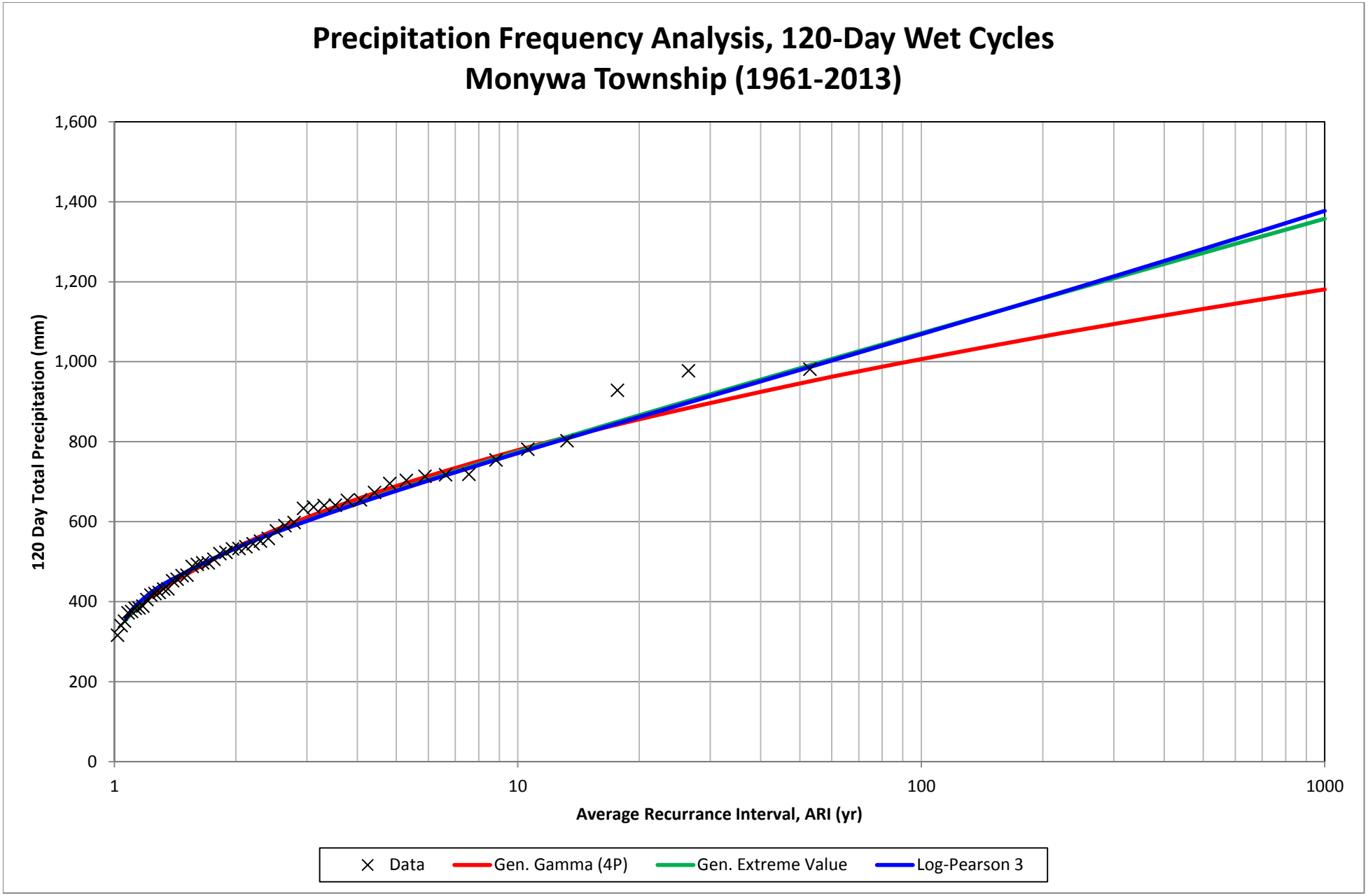
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 120 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 120 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Gamma (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	k =	2.014351	k =	-0.007127425	α =	79.44577123
			α =	0.680568	σ =	129.2860825	β =	0.030828944
			β =	357.1653	μ =	486.2314488	γ =	3.840998652
			γ =	311.3739				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	1181.0	137.96	1357.6	164.29	1377.3	162.20
0.998	0.002	500	1132.1	137.96	1272.0	164.29	1282.0	162.20
0.996	0.004	250	1080.3	137.96	1186.0	164.29	1189.0	162.20
0.995	0.005	200	1063.0	137.96	1158.1	164.29	1159.5	162.20
0.990	0.010	100	1006.5	137.96	1071.3	164.29	1068.9	162.20
0.980	0.020	50	945.6	137.96	983.7	164.29	979.5	162.20
0.950	0.050	20	856.1	137.96	866.2	164.29	861.8	162.20
0.900	0.100	10	778.8	137.96	774.9	164.29	771.5	162.20
0.800	0.200	5	689.2	137.96	679.1	164.29	677.2	162.20
0.667	0.333	3	610.6	137.96	602.7	164.29	602.0	162.20
0.500	0.500	2.0	535.0	137.96	533.6	164.29	533.8	162.20
0.250	0.750	1.3	436.5	137.96	444.0	164.29	445.7	162.20
0.125	0.875	1.14	385.1	137.96	391.3	164.29	394.7	162.20
0.063	0.937	1.07	355.8	137.96	354.3	164.29	359.3	162.20
Kolmogorov Smirnov (Statistic, Rank)			0.0550	1	0.0719	14	0.0740	15
Anderson Darling (Statistic, Rank)			0.1466	3	0.1704	5	0.1777	8


Precipitation Frequency Analysis, 120-Day Wet Cycles
Monywa Township (1961-2013)
120 Day Total Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Gamma (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 90 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

90 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	90 d Wet Precip (mm)
1961	420.0	1	0.019	53.00	899.0
1962	370.0	2	0.038	26.50	864.8
1963	590.0	3	0.057	17.67	738.0
1964	348.0	4	0.075	13.25	718.0
1965	899.0	5	0.094	10.60	683.0
1966	346.0	6	0.113	8.83	654.4
1967	377.0	7	0.132	7.57	605.0
1968	557.0	8	0.151	6.63	596.7
1969	416.0	9	0.170	5.89	594.0
1970	385.0	10	0.189	5.30	590.0
1971	533.0	11	0.208	4.82	585.0
1972	450.0	12	0.226	4.42	561.0
1973	718.0	13	0.245	4.08	557.0
1974	368.0	14	0.264	3.79	555.0
1975	605.0	15	0.283	3.53	536.0
1976	683.0	16	0.302	3.31	533.0
1977	738.0	17	0.321	3.12	517.0
1978	561.0	18	0.340	2.94	515.6
1979	298.0	19	0.358	2.79	503.0
1980	440.0	20	0.377	2.65	503.0
1981	473.0	21	0.396	2.52	486.9
1982	254.0	22	0.415	2.41	473.0
1983	466.0	23	0.434	2.30	470.7
1984	555.0	24	0.453	2.21	466.0
1985	266.0	25	0.472	2.12	465.9
1986	517.0	26	0.491	2.04	465.6
1987	503.0	27	0.509	1.96	463.6
1988	536.0	28	0.528	1.89	460.5
1989	585.0	29	0.547	1.83	450.0
1990	442.0	30	0.566	1.77	445.8
1991	354.0	31	0.585	1.71	443.5
1992	594.0	32	0.604	1.66	442.0
1993	347.0	33	0.623	1.61	440.0
1994	486.9	34	0.642	1.56	420.0
1995	460.5	35	0.660	1.51	416.0
1996	470.7	36	0.679	1.47	396.5
1997	445.8	37	0.698	1.43	394.0
1998	363.0	38	0.717	1.39	385.0
1999	515.6	39	0.736	1.36	380.0
2000	380.0	40	0.755	1.33	377.0
2001	463.6	41	0.774	1.29	370.0
2002	349.5	42	0.792	1.26	368.0
2003	396.5	43	0.811	1.23	363.0
2004	465.9	44	0.830	1.20	354.0
2005	443.5	45	0.849	1.18	349.5
2006	465.6	46	0.868	1.15	348.0
2007	503.0	47	0.887	1.13	347.0
2008	311.6	48	0.906	1.10	346.0
2009	394.0	49	0.925	1.08	311.6
2010	864.8	50	0.943	1.06	298.0
2011	654.4	51	0.962	1.04	266.0
2012	596.7	52	0.981	1.02	254.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Logistic	1	1	1
Log-Logistic (3P)	4	2	8
Burr	2	8	16
Log-Gamma	3	13	39
Pearson 5 (3P)	9	5	45
Frechet (3P)	16	3	48
Pearson 6 (4P)	10	6	60
Gumbel Max	18	4	72
Log-Pearson 3	15	10	150
Gen. Extreme Value	22	9	198

Three fits were selected for comparison:

1) **Gen. Logistic** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

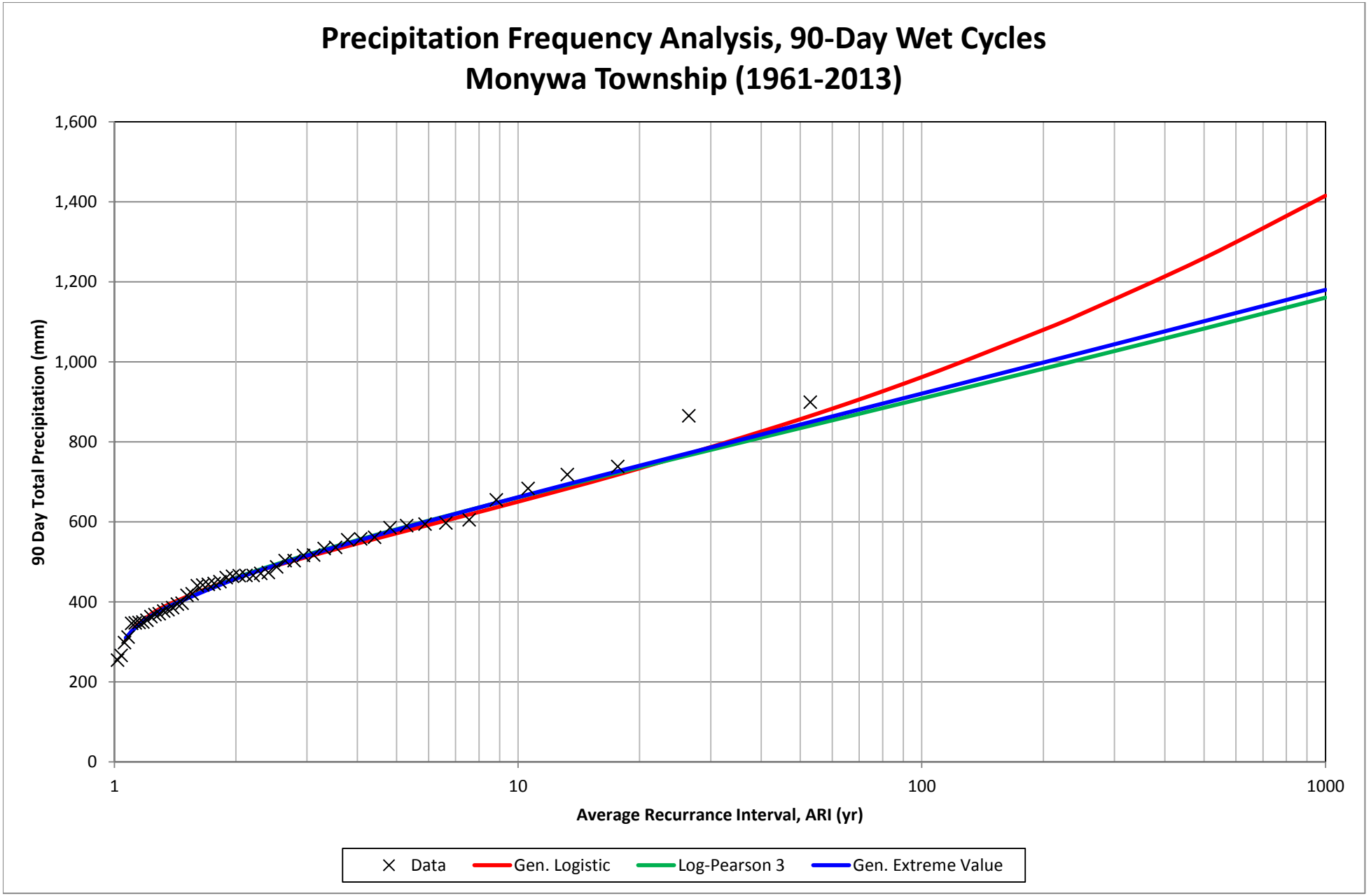
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 90 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 90 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Logistic		Log-Pearson 3		Gen. Extreme Value	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	α = 0.175342 β = 71.06012 ξ = 460.0164		α = 107.5755695 β = 0.026267129 γ = 3.313707262		k = 0.008412194 σ = 107.0507724 μ = 418.5725416	
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	1415.2	N/A	1160.5	137.46	1179.9	138.84
0.998	0.002	500	1259.3	N/A	1083.0	137.46	1101.4	138.84
0.996	0.004	250	1121.1	N/A	1007.0	137.46	1023.4	138.84
0.995	0.005	200	1080.0	N/A	982.8	137.46	998.3	138.84
0.990	0.010	100	961.9	N/A	908.3	137.46	920.7	138.84
0.980	0.020	50	856.6	N/A	834.4	137.46	843.2	138.84
0.950	0.050	20	733.9	N/A	736.5	137.46	740.5	138.84
0.900	0.100	10	650.5	N/A	661.0	137.46	661.8	138.84
0.800	0.200	5	571.5	N/A	581.6	137.46	580.2	138.84
0.667	0.333	3	512.5	N/A	517.8	137.46	515.7	138.84
0.500	0.500	2.0	460.0	N/A	459.7	137.46	457.9	138.84
0.250	0.750	1.3	389.0	N/A	384.2	137.46	383.7	138.84
0.125	0.875	1.14	342.9	N/A	340.1	137.46	340.4	138.84
0.063	0.937	1.07	307.2	N/A	309.5	137.46	310.2	138.84
Kolmogorov Smirnov (Statistic, Rank)			0.0629	1	0.0702	15	0.0756	22
Anderson Darling (Statistic, Rank)			0.1745	1	0.1825	10	0.1820	9


Precipitation Frequency Analysis, 90-Day Wet Cycles
Monywa Township (1961-2013)
90 Day Total Precipitation (mm)
1,600
1,400
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Logistic
Log-Pearson 3
Gen. Extreme Value

Precipitation Frequency Analysis, 60 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

60 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	60 d Wet Precip (mm)
1961	352.0	1	0.019	53.00	749.0
1962	286.0	2	0.038	26.50	666.3
1963	506.0	3	0.057	17.67	643.0
1964	314.0	4	0.075	13.25	574.0
1965	749.0	5	0.094	10.60	556.7
1966	315.0	6	0.113	8.83	522.0
1967	323.0	7	0.132	7.57	506.0
1968	476.0	8	0.151	6.63	498.0
1969	383.0	9	0.170	5.89	481.0
1970	282.0	10	0.189	5.30	476.0
1971	423.0	11	0.208	4.82	474.6
1972	420.0	12	0.226	4.42	473.0
1973	522.0	13	0.245	4.08	456.2
1974	303.0	14	0.264	3.79	447.0
1975	498.0	15	0.283	3.53	443.0
1976	574.0	16	0.302	3.31	442.0
1977	643.0	17	0.321	3.12	441.7
1978	402.0	18	0.340	2.94	428.0
1979	251.0	19	0.358	2.79	423.0
1980	343.0	20	0.377	2.65	420.0
1981	382.0	21	0.396	2.52	414.1
1982	187.0	22	0.415	2.41	413.0
1983	447.0	23	0.434	2.30	402.0
1984	481.0	24	0.453	2.21	388.4
1985	194.0	25	0.472	2.12	386.8
1986	413.0	26	0.491	2.04	383.5
1987	442.0	27	0.509	1.96	383.0
1988	428.0	28	0.528	1.89	382.0
1989	473.0	29	0.547	1.83	352.8
1990	335.0	30	0.566	1.77	352.0
1991	301.0	31	0.585	1.71	347.2
1992	443.0	32	0.604	1.66	347.2
1993	335.0	33	0.623	1.61	343.0
1994	352.8	34	0.642	1.56	339.8
1995	347.2	35	0.660	1.51	335.0
1996	388.4	36	0.679	1.47	335.0
1997	300.7	37	0.698	1.43	323.6
1998	282.0	38	0.717	1.39	323.0
1999	441.7	39	0.736	1.36	315.0
2000	339.8	40	0.755	1.33	314.0
2001	313.5	41	0.774	1.29	313.5
2002	299.7	42	0.792	1.26	303.0
2003	347.2	43	0.811	1.23	301.0
2004	414.1	44	0.830	1.20	300.7
2005	386.8	45	0.849	1.18	299.7
2006	323.6	46	0.868	1.15	286.0
2007	474.6	47	0.887	1.13	282.0
2008	238.5	48	0.906	1.10	282.0
2009	383.5	49	0.925	1.08	251.0
2010	666.3	50	0.943	1.06	238.5
2011	456.2	51	0.962	1.04	194.0
2012	556.7	52	0.981	1.02	187.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Extreme Value	2	4	8
Gumbel Max	1	5	5
Log-Logistic (3P)	22	1	22
Lognormal	3	8	24
Gen. Logistic	20	6	120
Pearson 5 (3P)	12	7	84
Log-Gamma	5	2	10
Fatigue Life	6	9	54
Burr	24	3	72
Log-Pearson 3	10	10	100

Three fits were selected for comparison:

1) **Gumbel Max** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

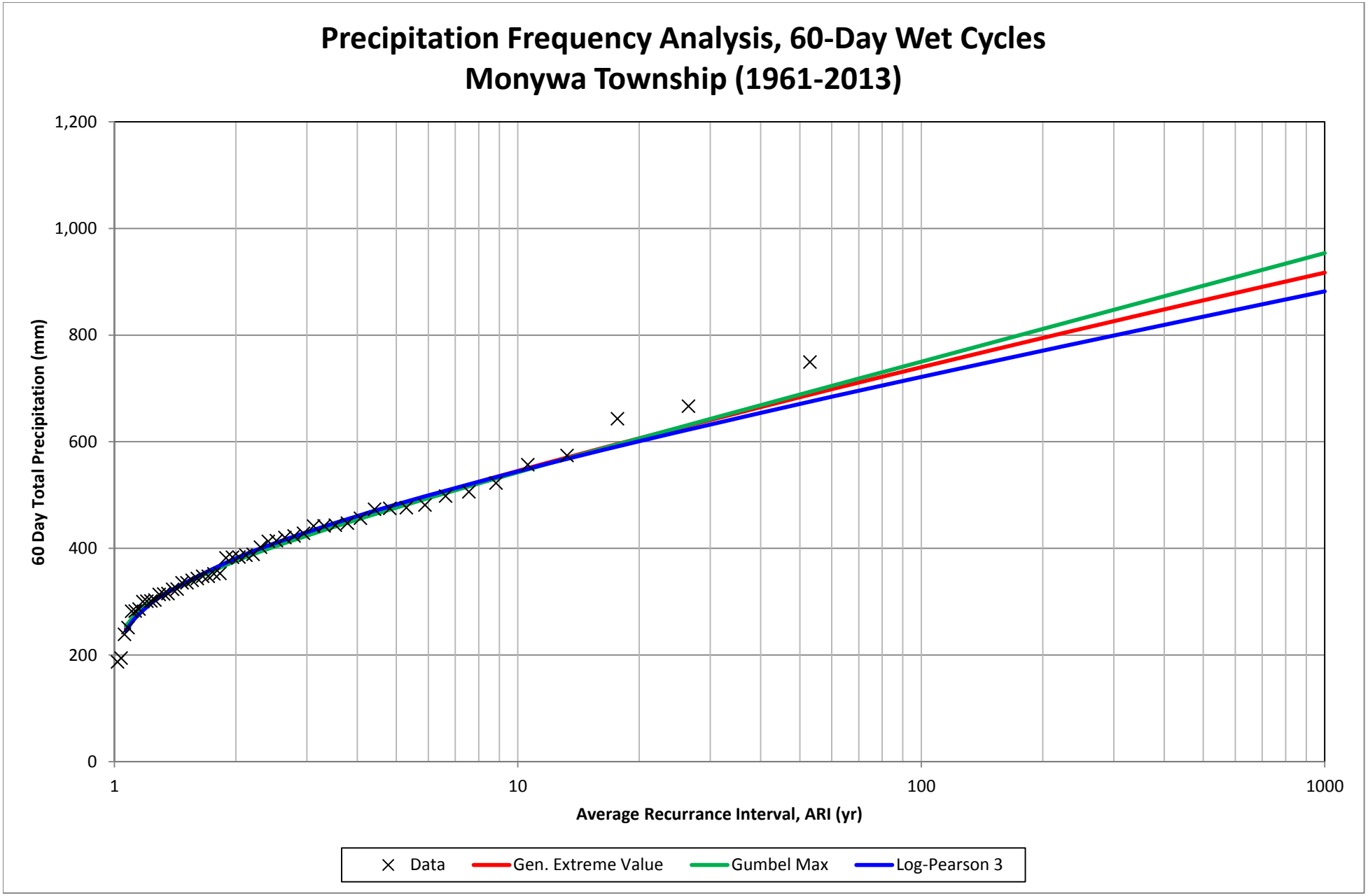
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 60 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 60 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Gumbel Max		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	-0.03209	σ =	88.26703134	α =	671.7214009
			σ =	92.41894	μ =	344.0374253	β =	-0.01090416
			μ =	344.491			γ =	13.26444653
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	917.0	113.87	953.7	113.21	882.0	112.70
0.998	0.002	500	865.1	113.87	892.5	113.21	834.5	112.70
0.996	0.004	250	812.0	113.87	831.2	113.21	786.4	112.70
0.995	0.005	200	794.6	113.87	811.5	113.21	770.7	112.70
0.990	0.010	100	739.7	113.87	750.1	113.21	721.4	112.70
0.980	0.020	50	683.4	113.87	688.4	113.21	670.8	112.70
0.950	0.050	20	606.3	113.87	606.2	113.21	600.9	112.70
0.900	0.100	10	545.1	113.87	542.7	113.21	544.4	112.70
0.800	0.200	5	479.8	113.87	476.4	113.21	482.4	112.70
0.667	0.333	3	426.8	113.87	423.8	113.21	430.4	112.70
0.500	0.500	2.0	378.2	113.87	376.4	113.21	381.3	112.70
0.250	0.750	1.3	314.1	113.87	315.2	113.21	314.6	112.70
0.125	0.875	1.14	276.0	113.87	279.4	113.21	274.2	112.70
0.063	0.937	1.07	249.0	113.87	254.3	113.21	245.4	112.70
Kolmogorov Smirnov (Statistic, Rank)			0.0650	2	0.0603	1	0.0694	10
Anderson Darling (Statistic, Rank)			0.2320	6	0.2507	14	0.2444	10


Precipitation Frequency Analysis, 60-Day Wet Cycles
Monywa Township (1961-2013)
60 Day Total Precipitation (mm)
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Extreme Value
Gumbel Max
Log-Pearson 3

Precipitation Frequency Analysis, 30 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

30 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	30 d Wet Precip (mm)
1961	259.0	1	0.019	53.00	518.0
1962	194.0	2	0.038	26.50	496.0
1963	342.0	3	0.057	17.67	415.0
1964	205.0	4	0.075	13.25	394.2
1965	496.0	5	0.094	10.60	388.0
1966	232.0	6	0.113	8.83	372.0
1967	223.0	7	0.132	7.57	365.0
1968	320.0	8	0.151	6.63	357.0
1969	230.0	9	0.170	5.89	353.2
1970	229.0	10	0.189	5.30	351.0
1971	298.0	11	0.208	4.82	347.0
1972	357.0	12	0.226	4.42	342.0
1973	312.0	13	0.245	4.08	340.0
1974	240.0	14	0.264	3.79	334.0
1975	347.0	15	0.283	3.53	321.0
1976	415.0	16	0.302	3.31	320.0
1977	365.0	17	0.321	3.12	312.0
1978	272.0	18	0.340	2.94	306.0
1979	178.0	19	0.358	2.79	301.0
1980	222.0	20	0.377	2.65	298.0
1981	340.0	21	0.396	2.52	294.9
1982	142.0	22	0.415	2.41	292.0
1983	306.0	23	0.434	2.30	285.2
1984	372.0	24	0.453	2.21	272.0
1985	127.0	25	0.472	2.12	272.0
1986	239.0	26	0.491	2.04	269.0
1987	334.0	27	0.509	1.96	261.1
1988	292.0	28	0.528	1.89	259.0
1989	321.0	29	0.547	1.83	252.0
1990	240.0	30	0.566	1.77	242.0
1991	172.0	31	0.585	1.71	240.0
1992	227.0	32	0.604	1.66	240.0
1993	242.0	33	0.623	1.61	239.0
1994	272.0	34	0.642	1.56	232.0
1995	230.9	35	0.660	1.51	230.9
1996	269.0	36	0.679	1.47	230.0
1997	188.7	37	0.698	1.43	229.0
1998	195.1	38	0.717	1.39	227.0
1999	294.9	39	0.736	1.36	223.0
2000	261.1	40	0.755	1.33	222.0
2001	180.9	41	0.774	1.29	217.2
2002	171.0	42	0.792	1.26	205.0
2003	301.0	43	0.811	1.23	195.1
2004	351.0	44	0.830	1.20	194.0
2005	285.2	45	0.849	1.18	188.7
2006	217.2	46	0.868	1.15	180.9
2007	394.2	47	0.887	1.13	178.7
2008	178.7	48	0.906	1.10	178.0
2009	252.0	49	0.925	1.08	172.0
2010	518.0	50	0.943	1.06	171.0
2011	353.2	51	0.962	1.04	142.0
2012	388.0	52	0.981	1.02	127.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Johnson SB	11	1	11
Log-Gamma	1	19	19
Fatigue Life	3	11	33
Log-Pearson 3	17	2	34
Gamma (3P)	10	4	40
Frechet (3P)	2	20	40
Gen. Extreme Value	16	3	48
Gen. Gamma (4P)	12	5	60
Lognormal	5	14	70
Rayleigh (2P)	4	18	72

Three fits were selected for comparison:

1) **Johnson SB** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

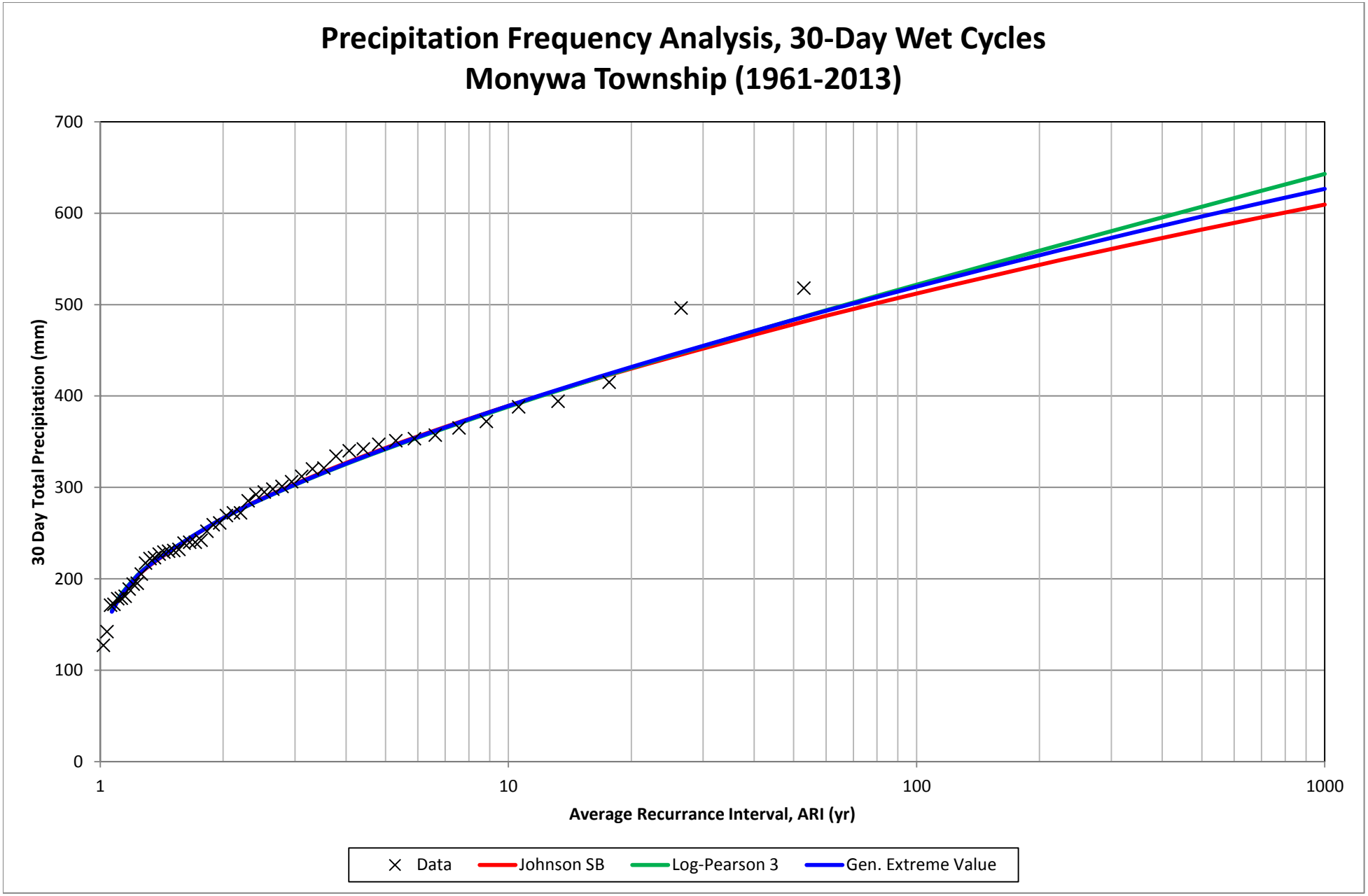
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 30 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 30 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Johnson SB		Log-Pearson 3		Gen. Extreme Value	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	γ =	3.1891087	α =	373.2489569	k =	-0.07695247
			δ =	2.282648	β =	-0.015596338	σ =	72.10509295
			λ =	1179.23	γ =	11.40050618	μ =	240.2813801
			ξ =	32.561480				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	609.4	N/A	643.0	84.04	626.6	84.48
0.998	0.002	500	582.1	N/A	607.1	84.04	596.4	84.48
0.996	0.004	250	553.1	N/A	570.7	84.04	564.5	84.48
0.995	0.005	200	543.4	N/A	558.9	84.04	553.9	84.48
0.990	0.010	100	512.1	N/A	521.7	84.04	519.6	84.48
0.980	0.020	50	478.5	N/A	483.6	84.04	483.3	84.48
0.950	0.050	20	430.0	N/A	430.9	84.04	431.7	84.48
0.900	0.100	10	389.2	N/A	388.3	84.04	389.3	84.48
0.800	0.200	5	343.2	N/A	341.8	84.04	342.4	84.48
0.667	0.333	3	303.8	N/A	302.9	84.04	303.2	84.48
0.500	0.500	2.0	266.4	N/A	266.2	84.04	266.3	84.48
0.250	0.750	1.3	215.9	N/A	216.8	84.04	216.4	84.48
0.125	0.875	1.14	185.8	N/A	187.0	84.04	186.0	84.48
0.063	0.937	1.07	165.0	N/A	165.9	84.04	164.0	84.48
Kolmogorov Smirnov (Statistic, Rank)			0.0638	11	0.0660	17	0.0657	16
Anderson Darling (Statistic, Rank)			0.1768	1	0.1804	2	0.1808	3


Precipitation Frequency Analysis, 30-Day Wet Cycles
Monywa Township (1961-2013)
30 Day Total Precipitation (mm)
700
600
500
400
300
200
100
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Johnson SB
Log-Pearson 3
Gen. Extreme Value

Precipitation Frequency Analysis, 14 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

14 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	14 d Wet Precip (mm)
1961	169.0	1	0.019	53.00	365.9
1962	145.0	2	0.038	26.50	359.0
1963	270.0	3	0.057	17.67	338.0
1964	166.0	4	0.075	13.25	333.0
1965	297.0	5	0.094	10.60	324.5
1966	171.0	6	0.113	8.83	297.0
1967	153.0	7	0.132	7.57	285.0
1968	245.0	8	0.151	6.63	280.0
1969	167.0	9	0.170	5.89	270.0
1970	173.0	10	0.189	5.30	247.0
1971	227.0	11	0.208	4.82	245.0
1972	280.0	12	0.226	4.42	244.0
1973	210.0	13	0.245	4.08	235.0
1974	193.0	14	0.264	3.79	230.0
1975	221.0	15	0.283	3.53	227.0
1976	359.0	16	0.302	3.31	224.5
1977	197.0	17	0.321	3.12	221.0
1978	199.0	18	0.340	2.94	210.0
1979	133.0	19	0.358	2.79	203.5
1980	146.0	20	0.377	2.65	203.0
1981	203.0	21	0.396	2.52	199.0
1982	118.0	22	0.415	2.41	197.9
1983	244.0	23	0.434	2.30	197.0
1984	338.0	24	0.453	2.21	193.0
1985	93.0	25	0.472	2.12	182.0
1986	182.0	26	0.491	2.04	173.0
1987	230.0	27	0.509	1.96	172.5
1988	235.0	28	0.528	1.89	171.0
1989	247.0	29	0.547	1.83	169.0
1990	139.0	30	0.566	1.77	168.4
1991	115.0	31	0.585	1.71	168.1
1992	164.0	32	0.604	1.66	167.0
1993	161.0	33	0.623	1.61	166.0
1994	154.9	34	0.642	1.56	164.0
1995	149.9	35	0.660	1.51	161.0
1996	172.5	36	0.679	1.47	155.7
1997	132.3	37	0.698	1.43	154.9
1998	168.1	38	0.717	1.39	153.5
1999	203.5	39	0.736	1.36	153.0
2000	141.5	40	0.755	1.33	149.9
2001	155.7	41	0.774	1.29	146.0
2002	112.2	42	0.792	1.26	145.0
2003	197.9	43	0.811	1.23	141.5
2004	333.0	44	0.830	1.20	139.7
2005	168.4	45	0.849	1.18	139.0
2006	139.7	46	0.868	1.15	133.0
2007	365.9	47	0.887	1.13	132.3
2008	121.5	48	0.906	1.10	121.5
2009	153.5	49	0.925	1.08	118.0
2010	285.0	50	0.943	1.06	115.0
2011	224.5	51	0.962	1.04	112.2
2012	324.5	52	0.981	1.02	93.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Extreme Value	10	1	10
Log-Logistic (3P)	1	16	16
Wakeby	12	2	24
Pearson 5 (3P)	11	3	33
Frechet	9	4	36
Pearson 6 (4P)	2	25	50
Lognormal (3P)	8	7	56
Burr	13	5	65
Erlang (3P)	6	14	84
Log-Pearson 3	16	9	144

Three fits were selected for comparison:

1) **Log-Logistic (3P)** (2nd best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

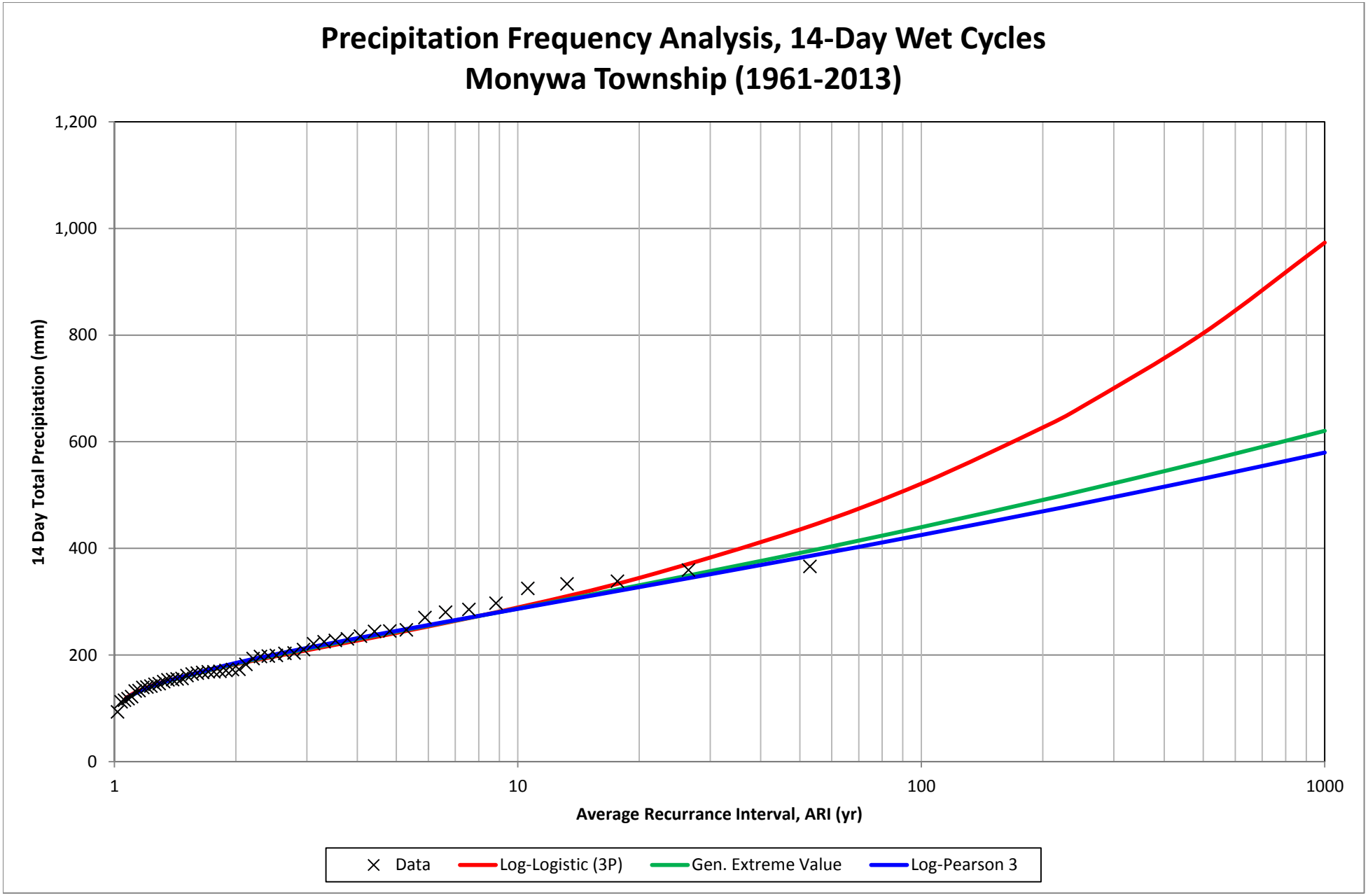
Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

Precipitation Frequency Analysis, 14 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 14 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Extreme Value		Log-Logistic (3P)		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	0.079888	α =	3.342476125	α =	51.89373803
			σ =	49.38084	β =	114.6736834	β =	0.044826575
			μ =	165.2531	γ =	67.8774572	γ =	2.909563599
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	620.4	71.22	973.3	90.18	579.7	69.03
0.998	0.002	500	562.6	71.22	803.5	90.18	530.8	69.03
0.996	0.004	250	507.8	71.22	665.4	90.18	484.0	69.03
0.995	0.005	200	490.8	71.22	626.6	90.18	469.4	69.03
0.990	0.010	100	439.8	71.22	521.3	90.18	425.0	69.03
0.980	0.020	50	391.3	71.22	435.3	90.18	382.2	69.03
0.950	0.050	20	330.8	71.22	344.6	90.18	327.4	69.03
0.900	0.100	10	287.0	71.22	289.2	90.18	286.6	69.03
0.800	0.200	5	243.9	71.22	241.5	90.18	245.3	69.03
0.667	0.333	3	211.5	71.22	209.0	90.18	213.3	69.03
0.500	0.500	2.0	183.6	71.22	182.6	90.18	185.1	69.03
0.250	0.750	1.3	149.3	71.22	150.4	90.18	150.0	69.03
0.125	0.875	1.14	130.1	71.22	131.9	90.18	130.4	69.03
0.063	0.937	1.07	117.0	71.22	119.0	90.18	117.1	69.03
Kolmogorov Smirnov (Statistic, Rank)			0.0942	8	0.0914	7	0.1032	19
Anderson Darling (Statistic, Rank)			0.2409	1	0.2425	2	0.2683	10


Precipitation Frequency Analysis, 14-Day Wet Cycles
Monywa Township (1961-2013)
14 Day Total Precipitation (mm)
1,200
1,000
800
600
400
200
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Log-Logistic (3P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 7 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

7 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	7 d Wet Precip (mm)
1961	122.0	1	0.019	53.00	319.4
1962	116.0	2	0.038	26.50	309.0
1963	165.0	3	0.057	17.67	232.7
1964	141.0	4	0.075	13.25	225.5
1965	178.0	5	0.094	10.60	221.0
1966	141.0	6	0.113	8.83	212.0
1967	144.0	7	0.132	7.57	208.0
1968	203.0	8	0.151	6.63	206.5
1969	112.0	9	0.170	5.89	203.0
1970	96.0	10	0.189	5.30	186.0
1971	159.0	11	0.208	4.82	183.0
1972	162.0	12	0.226	4.42	178.0
1973	183.0	13	0.245	4.08	174.0
1974	186.0	14	0.264	3.79	173.0
1975	166.0	15	0.283	3.53	172.0
1976	221.0	16	0.302	3.31	166.0
1977	150.0	17	0.321	3.12	165.0
1978	131.0	18	0.340	2.94	162.0
1979	119.0	19	0.358	2.79	159.0
1980	109.0	20	0.377	2.65	157.0
1981	132.0	21	0.396	2.52	150.0
1982	89.0	22	0.415	2.41	149.4
1983	174.0	23	0.434	2.30	145.0
1984	309.0	24	0.453	2.21	144.0
1985	92.0	25	0.472	2.12	141.7
1986	172.0	26	0.491	2.04	141.0
1987	157.0	27	0.509	1.96	141.0
1988	208.0	28	0.528	1.89	132.0
1989	212.0	29	0.547	1.83	131.0
1990	98.0	30	0.566	1.77	129.5
1991	108.0	31	0.585	1.71	128.5
1992	145.0	32	0.604	1.66	125.2
1993	118.0	33	0.623	1.61	122.0
1994	120.1	34	0.642	1.56	120.1
1995	132.3	35	0.660	1.51	119.0
1996	128.5	36	0.679	1.47	118.0
1997	91.9	37	0.698	1.43	116.0
1998	100.3	38	0.717	1.39	115.5
1999	141.7	39	0.736	1.36	112.0
2000	125.2	40	0.755	1.33	109.0
2001	107.4	41	0.774	1.29	108.0
2002	99.0	42	0.792	1.26	107.4
2003	149.4	43	0.811	1.23	100.6
2004	232.7	44	0.830	1.20	100.3
2005	129.5	45	0.849	1.18	99.0
2006	100.6	46	0.868	1.15	98.0
2007	319.4	47	0.887	1.13	96.0
2008	84.9	48	0.906	1.10	92.0
2009	115.5	49	0.925	1.08	91.9
2010	225.5	50	0.943	1.06	89.0
2011	173.0	51	0.962	1.04	84.9
2012	206.5	52	0.981	1.02	80.8
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Weibull (3P)	2	3	6
Johnson SB	5	2	10
Phased Bi-Weibull	3	6	18
Gen. Extreme Value	4	7	28
Gamma (3P)	7	4	28
Log-Pearson 3	6	5	30
Lognormal (3P)	12	10	120
Inv. Gaussian (3P)	14	9	126
Gen. Logistic	8	16	128

Three fits were selected for comparison:

1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

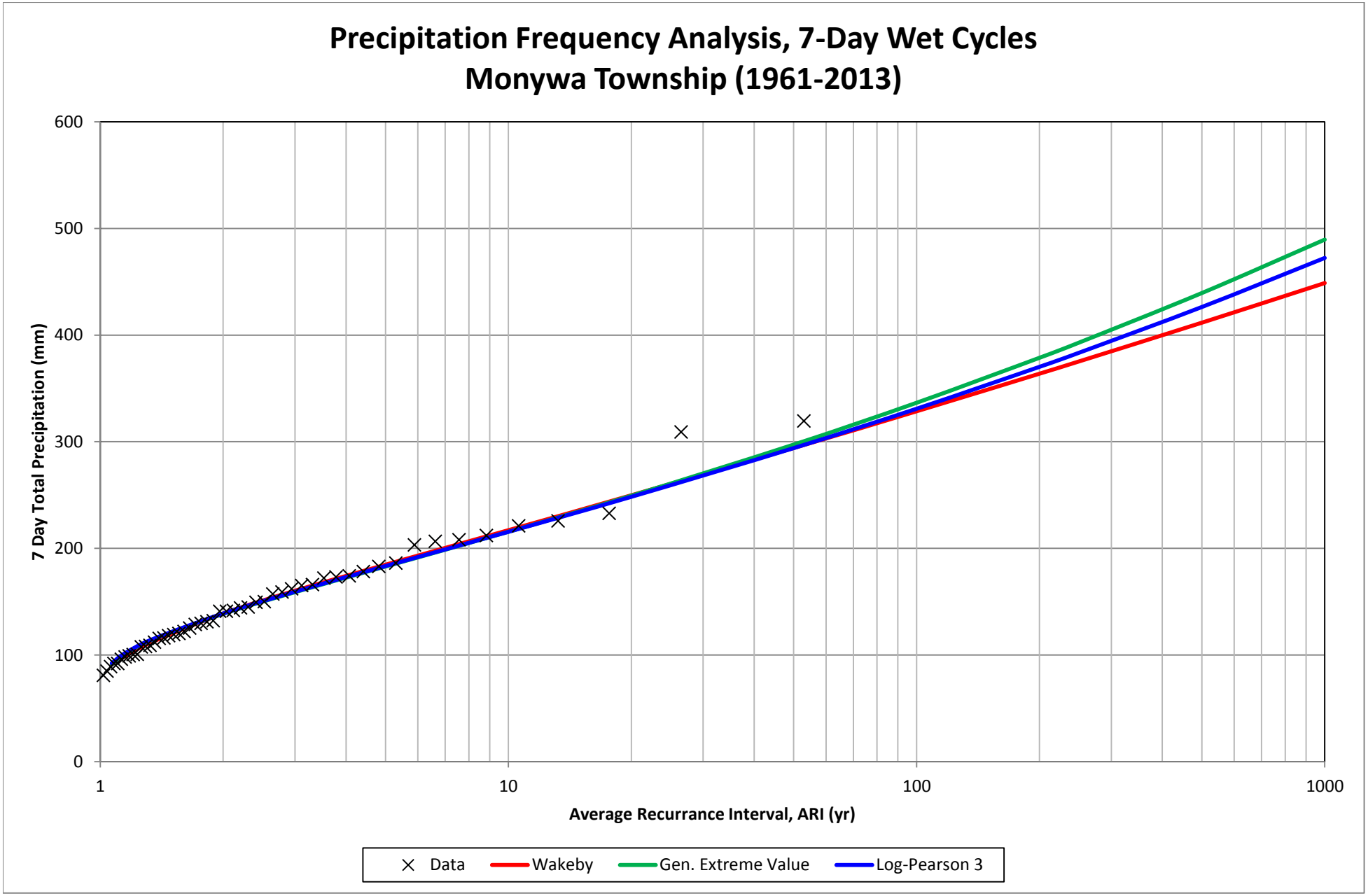
Note that these predictions should be multiplied by **1.018** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 7 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 7 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	73.72227	k =	0.108755469	α =	14.5565948
			β =	2.488256	σ =	35.37236791	β =	0.08155159
			γ =	43.14648	μ =	125.3784974	γ =	3.773859131
			δ =	0.033106				
			ξ =	84.27241				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	448.8	N/A	489.5	53.60	472.3	52.50
0.998	0.002	500	411.6	N/A	439.4	53.60	426.3	52.50
0.996	0.004	250	375.3	N/A	392.9	53.60	383.4	52.50
0.995	0.005	200	363.8	N/A	378.7	53.60	370.2	52.50
0.990	0.010	100	328.5	N/A	336.5	53.60	330.9	52.50
0.980	0.020	50	294.1	N/A	297.3	53.60	294.0	52.50
0.950	0.050	20	249.8	N/A	249.4	53.60	248.3	52.50
0.900	0.100	10	217.0	N/A	215.6	53.60	215.5	52.50
0.800	0.200	5	184.7	N/A	183.0	53.60	183.4	52.50
0.667	0.333	3	160.3	N/A	159.0	53.60	159.4	52.50
0.500	0.500	2.0	138.9	N/A	138.6	53.60	138.9	52.50
0.250	0.750	1.3	111.9	N/A	114.0	53.60	114.3	52.50
0.125	0.875	1.14	98.4	N/A	100.5	53.60	101.1	52.50
0.063	0.937	1.07	91.5	N/A	91.3	53.60	92.3	52.50
Kolmogorov Smirnov (Statistic, Rank)			0.0392	1	0.0473	4	0.0520	6
Anderson Darling (Statistic, Rank)			0.1049	1	0.1532	7	0.1465	5


Precipitation Frequency Analysis, 7-Day Wet Cycles
Monywa Township (1961-2013)
7 Day Total Precipitation (mm)
600
500
400
300
200
100
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 4 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

4 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	4 d Wet Precip (mm)
1961	96.0	1	0.019	53.00	294.0
1962	116.0	2	0.038	26.50	288.0
1963	128.0	3	0.057	17.67	216.0
1964	109.0	4	0.075	13.25	204.0
1965	152.0	5	0.094	10.60	190.0
1966	141.0	6	0.113	8.83	174.0
1967	144.0	7	0.132	7.57	168.0
1968	168.0	8	0.151	6.63	158.0
1969	108.0	9	0.170	5.89	154.0
1970	96.0	10	0.189	5.30	153.0
1971	158.0	11	0.208	4.82	152.0
1972	125.0	12	0.226	4.42	147.6
1973	124.0	13	0.245	4.08	145.0
1974	154.0	14	0.264	3.79	144.0
1975	145.0	15	0.283	3.53	143.0
1976	128.0	16	0.302	3.31	141.7
1977	127.0	17	0.321	3.12	141.0
1978	85.0	18	0.340	2.94	139.0
1979	112.0	19	0.358	2.79	128.8
1980	97.0	20	0.377	2.65	128.0
1981	108.0	21	0.396	2.52	128.0
1982	55.0	22	0.415	2.41	127.0
1983	108.0	23	0.434	2.30	125.0
1984	294.0	24	0.453	2.21	124.0
1985	72.0	25	0.472	2.12	119.1
1986	143.0	26	0.491	2.04	116.0
1987	114.0	27	0.509	1.96	115.5
1988	153.0	28	0.528	1.89	114.0
1989	174.0	29	0.547	1.83	112.0
1990	87.0	30	0.566	1.77	109.0
1991	107.0	31	0.585	1.71	108.0
1992	106.0	32	0.604	1.66	108.0
1993	90.0	33	0.623	1.61	108.0
1994	119.1	34	0.642	1.56	107.0
1995	87.1	35	0.660	1.51	106.0
1996	95.8	36	0.679	1.47	97.0
1997	73.9	37	0.698	1.43	96.3
1998	96.3	38	0.717	1.39	96.0
1999	141.7	39	0.736	1.36	96.0
2000	72.1	40	0.755	1.33	95.8
2001	90.2	41	0.774	1.29	90.2
2002	87.6	42	0.792	1.26	90.0
2003	147.6	43	0.811	1.23	87.6
2004	204.0	44	0.830	1.20	87.1
2005	128.8	45	0.849	1.18	87.0
2006	86.6	46	0.868	1.15	86.6
2007	288.0	47	0.887	1.13	85.0
2008	69.6	48	0.906	1.10	73.9
2009	115.5	49	0.925	1.08	72.1
2010	216.0	50	0.943	1.06	72.0
2011	139.0	51	0.962	1.04	69.6
2012	190.0	52	0.981	1.02	55.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results			
Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Dagum (4P)	1	6	6
Gen. Logistic	7	1	7
Burr (4P)	3	3	9
Frechet (3P)	2	7	14
Log-Logistic (3P)	10	2	20
Dagum	9	4	36
Pearson 6	4	11	44
Pearson 5 (3P)	6	9	54
Gen. Extreme Value	14	8	112
Log-Pearson 3	13	14	182

Three fits were selected for comparison:

1) **Dagum (4P)** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

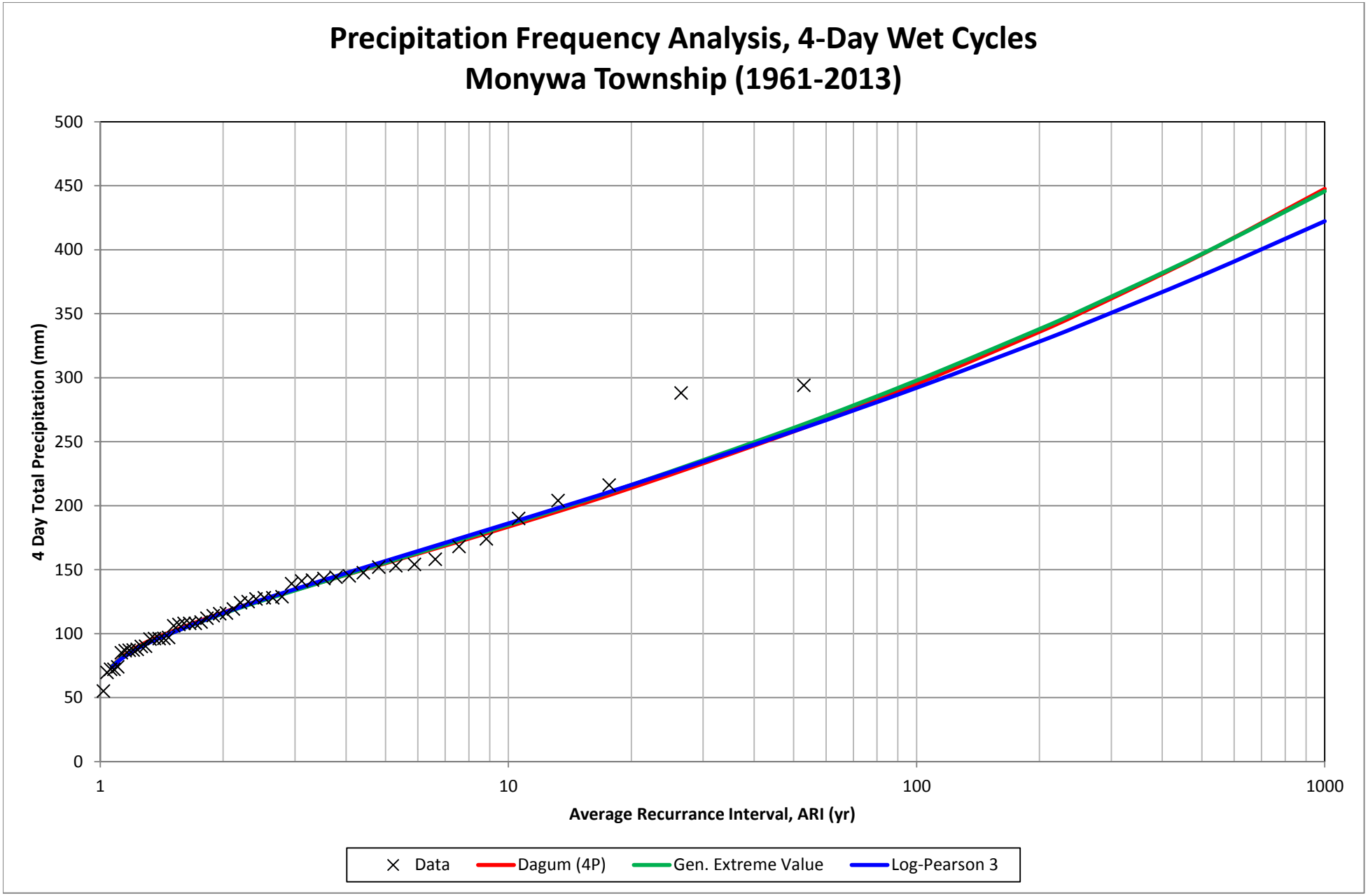
Note that these predictions should be multiplied by **1.034** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods. The correction factor for 4 day durations was linearly interpolated from values given in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 4 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 4 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Dagum (4P)		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	k =	5.96752	k =	0.124568917	α =	19.47467782
			α =	6.967524	σ =	31.19983548	β =	0.076595668
			β =	155.2871	μ =	104.0418997	γ =	3.288776571
			γ =	-93.1777				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	447.6	48.07	445.7	48.66	422.3	48.01
0.998	0.002	500	396.3	48.07	396.7	48.66	379.9	48.01
0.996	0.004	250	349.9	48.07	351.7	48.66	340.4	48.01
0.995	0.005	200	335.9	48.07	338.0	48.66	328.3	48.01
0.990	0.010	100	295.1	48.07	297.8	48.66	292.1	48.01
0.980	0.020	50	258.0	48.07	260.8	48.66	258.2	48.01
0.950	0.050	20	214.0	48.07	216.2	48.66	216.3	48.01
0.900	0.100	10	183.6	48.07	185.1	48.66	186.2	48.01
0.800	0.200	5	155.0	48.07	155.5	48.66	156.8	48.01
0.667	0.333	3	134.2	48.07	133.9	48.66	134.9	48.01
0.500	0.500	2.0	116.6	48.07	115.7	48.66	116.2	48.01
0.250	0.750	1.3	95.1	48.07	94.1	48.66	93.8	48.01
0.125	0.875	1.14	82.9	48.07	82.2	48.66	81.7	48.01
0.063	0.937	1.07	74.4	48.07	74.2	48.66	73.8	48.01
Kolmogorov Smirnov (Statistic, Rank)			0.0547	1	0.0639	14	0.0630	13
Anderson Darling (Statistic, Rank)			0.1956	6	0.2235	8	0.2428	14


Precipitation Frequency Analysis, 4-Day Wet Cycles
Monywa Township (1961-2013)
4 Day Total Precipitation (mm)
500
450
400
350
300
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Dagum (4P)
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 3 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

3 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	3 d Wet Precip (mm)
1961	92.0	1	0.019	53.00	279.0
1962	116.0	2	0.038	26.50	265.0
1963	123.0	3	0.057	17.67	216.0
1964	104.0	4	0.075	13.25	195.3
1965	137.0	5	0.094	10.60	185.5
1966	139.0	6	0.113	8.83	165.0
1967	144.0	7	0.132	7.57	160.0
1968	165.0	8	0.151	6.63	144.0
1969	106.0	9	0.170	5.89	142.0
1970	88.0	10	0.189	5.30	141.0
1971	134.0	11	0.208	4.82	140.5
1972	107.0	12	0.226	4.42	139.0
1973	111.0	13	0.245	4.08	137.0
1974	129.0	14	0.264	3.79	135.0
1975	141.0	15	0.283	3.53	134.0
1976	120.0	16	0.302	3.31	130.0
1977	127.0	17	0.321	3.12	129.0
1978	79.0	18	0.340	2.94	128.8
1979	112.0	19	0.358	2.79	127.0
1980	97.0	20	0.377	2.65	123.0
1981	99.0	21	0.396	2.52	120.0
1982	54.0	22	0.415	2.41	119.1
1983	99.0	23	0.434	2.30	116.0
1984	279.0	24	0.453	2.21	114.0
1985	70.0	25	0.472	2.12	112.0
1986	142.0	26	0.491	2.04	112.0
1987	114.0	27	0.509	1.96	111.0
1988	130.0	28	0.528	1.89	107.0
1989	160.0	29	0.547	1.83	106.0
1990	75.0	30	0.566	1.77	106.0
1991	79.0	31	0.585	1.71	104.0
1992	106.0	32	0.604	1.66	99.0
1993	87.0	33	0.623	1.61	99.0
1994	119.1	34	0.642	1.56	97.0
1995	83.6	35	0.660	1.51	95.8
1996	95.8	36	0.679	1.47	92.0
1997	65.3	37	0.698	1.43	90.2
1998	82.5	38	0.717	1.39	88.0
1999	82.6	39	0.736	1.36	87.1
2000	68.1	40	0.755	1.33	87.0
2001	90.2	41	0.774	1.29	83.6
2002	87.1	42	0.792	1.26	82.8
2003	140.5	43	0.811	1.23	82.6
2004	195.3	44	0.830	1.20	82.5
2005	128.8	45	0.849	1.18	79.0
2006	82.8	46	0.868	1.15	79.0
2007	265.0	47	0.887	1.13	75.0
2008	68.1	48	0.906	1.10	70.0
2009	112.0	49	0.925	1.08	68.1
2010	216.0	50	0.943	1.06	68.1
2011	135.0	51	0.962	1.04	65.3
2012	185.5	52	0.981	1.02	54.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Gen. Logistic	4	1	4
Log-Logistic (3P)	5	2	10
Burr	2	9	18
Dagum (4P)	7	3	21
Dagum	6	5	30
Frechet (3P)	8	4	32
Log-Logistic	3	13	39
Wakeby	1	45	45
Gen. Extreme Value	9	6	54
Log-Pearson 3	13	11	143

Three fits were selected for comparison:

1) **Gen. Logistic** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

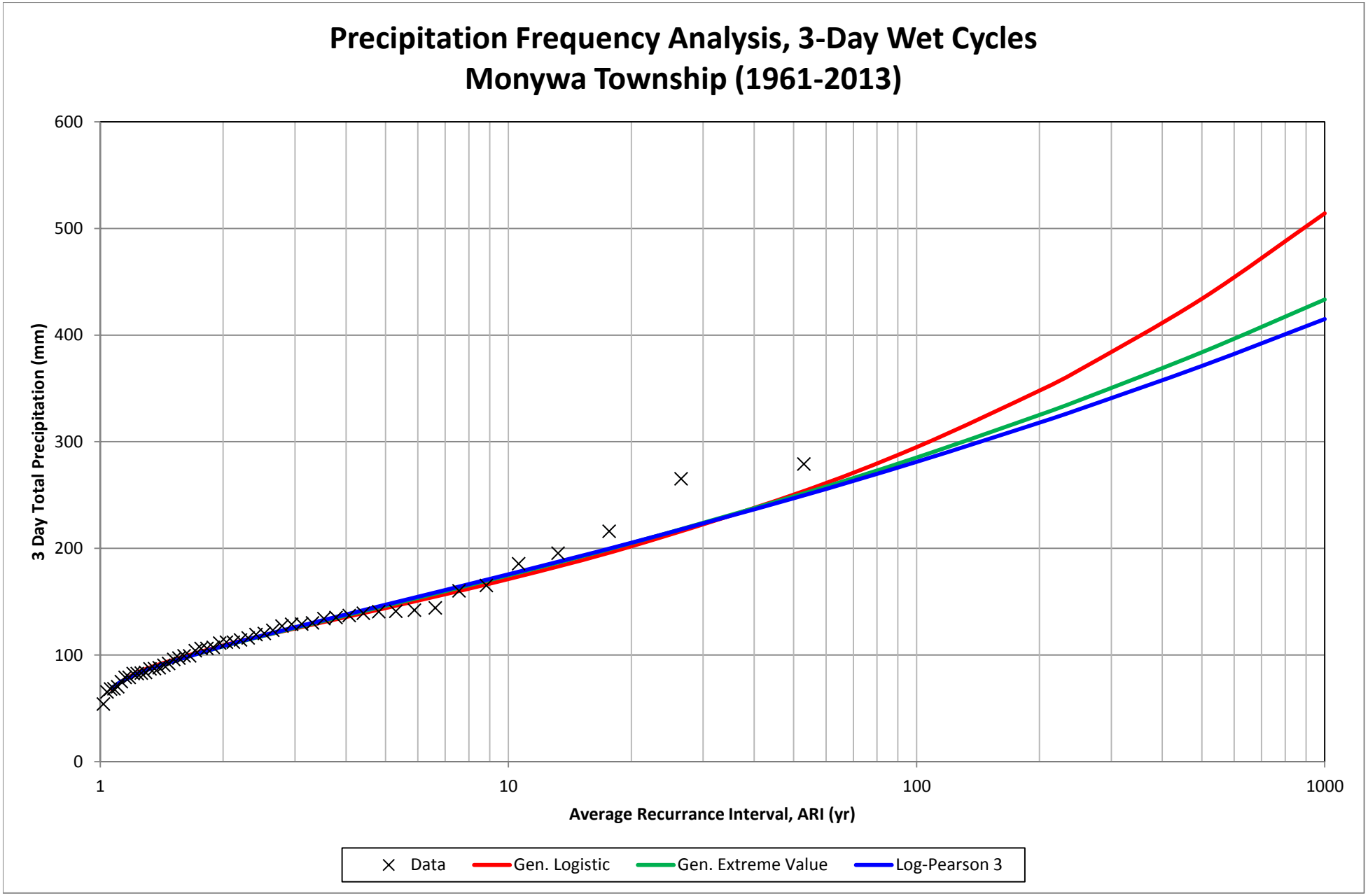
Note that these predictions should be multiplied by **1.044** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 3 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 3 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Gen. Logistic		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI) (yr)	k =	0.259058	k =	0.134098497	α =	15.06559838
			σ =	21.05745	σ =	29.56566364	β =	0.088278212
			μ =	108.9025	μ =	97.07074459	γ =	3.384985514
			Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	514.1	N/A	433.3	46.96	415.0	46.38
0.998	0.002	500	434.0	N/A	383.9	46.96	371.0	46.38
0.996	0.004	250	367.1	N/A	338.8	46.96	330.3	46.38
0.995	0.005	200	347.9	N/A	325.1	46.96	317.9	46.38
0.990	0.010	100	294.9	N/A	285.2	46.96	281.1	46.38
0.980	0.020	50	250.4	N/A	248.6	46.96	247.0	46.38
0.950	0.050	20	201.9	N/A	204.9	46.96	205.2	46.38
0.900	0.100	10	171.2	N/A	174.7	46.96	175.7	46.38
0.800	0.200	5	144.0	N/A	146.2	46.96	147.2	46.38
0.667	0.333	3	124.9	N/A	125.5	46.96	126.1	46.38
0.500	0.500	2.0	108.9	N/A	108.2	46.96	108.4	46.38
0.250	0.750	1.3	88.8	N/A	87.6	46.96	87.4	46.38
0.125	0.875	1.14	76.7	N/A	76.5	46.96	76.3	46.38
0.063	0.937	1.07	68.0	N/A	69.0	46.96	69.0	46.38
Kolmogorov Smirnov (Statistic, Rank)			0.0655	4	0.0765	9	0.0814	13
Anderson Darling (Statistic, Rank)			0.1778	1	0.1925	6	0.2033	11


Precipitation Frequency Analysis, 3-Day Wet Cycles
Monywa Township (1961-2013)
3 Day Total Precipitation (mm)
600
500
400
300
200
100
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Gen. Logistic
Gen. Extreme Value
Log-Pearson 3

Precipitation Frequency Analysis, 2 Day Wet Cycles: Monywa Township (1961-2013)

Distribution fitting performed using EasyFit 5.3 Professional.

Count, n: 52

2 Day Data		Rank	Weibull	ARI	Ranked
Year	Precip (mm)	(highest to lowest) m	Exceedance Probability p	(yr)	2 d Wet Precip (mm)
1961	92.0	1	0.019	53.00	204.0
1962	95.0	2	0.038	26.50	197.8
1963	90.0	3	0.057	17.67	183.5
1964	104.0	4	0.075	13.25	164.0
1965	114.0	5	0.094	10.60	144.3
1966	75.0	6	0.113	8.83	139.0
1967	139.0	7	0.132	7.57	128.8
1968	122.0	8	0.151	6.63	124.0
1969	104.0	9	0.170	5.89	124.0
1970	78.0	10	0.189	5.30	123.0
1971	109.0	11	0.208	4.82	122.0
1972	98.0	12	0.226	4.42	122.0
1973	104.0	13	0.245	4.08	120.7
1974	105.0	14	0.264	3.79	119.1
1975	123.0	15	0.283	3.53	117.0
1976	102.0	16	0.302	3.31	114.0
1977	124.0	17	0.321	3.12	113.0
1978	76.0	18	0.340	2.94	109.0
1979	106.0	19	0.358	2.79	107.0
1980	77.0	20	0.377	2.65	106.0
1981	97.0	21	0.396	2.52	105.0
1982	41.0	22	0.415	2.41	105.0
1983	99.0	23	0.434	2.30	104.0
1984	204.0	24	0.453	2.21	104.0
1985	63.0	25	0.472	2.12	104.0
1986	107.0	26	0.491	2.04	103.0
1987	113.0	27	0.509	1.96	102.0
1988	117.0	28	0.528	1.89	99.0
1989	122.0	29	0.547	1.83	98.0
1990	75.0	30	0.566	1.77	97.0
1991	73.0	31	0.585	1.71	95.3
1992	105.0	32	0.604	1.66	95.0
1993	87.0	33	0.623	1.61	92.0
1994	119.1	34	0.642	1.56	90.0
1995	70.6	35	0.660	1.51	89.2
1996	95.3	36	0.679	1.47	87.0
1997	57.9	37	0.698	1.43	82.3
1998	67.8	38	0.717	1.39	79.5
1999	82.3	39	0.736	1.36	78.0
2000	68.1	40	0.755	1.33	77.0
2001	89.2	41	0.774	1.29	76.0
2002	52.1	42	0.792	1.26	75.0
2003	120.7	43	0.811	1.23	75.0
2004	144.3	44	0.830	1.20	73.0
2005	128.8	45	0.849	1.18	70.6
2006	79.5	46	0.868	1.15	68.1
2007	197.8	47	0.887	1.13	67.8
2008	42.5	48	0.906	1.10	63.0
2009	103.0	49	0.925	1.08	57.9
2010	164.0	50	0.943	1.06	52.1
2011	124.0	51	0.962	1.04	42.5
2012	183.5	52	0.981	1.02	41.0
2013	Exclude				

EasyFit 5.3 Professional Fit Results

Fitted Probability Distribution	Kolmogorov Smirnov Ranking	Anderson Darling Ranking	Weighted Ranking
Wakeby	1	1	1
Log-Logistic (3P)	2	3	6
Gen. Logistic	4	2	8
Burr	3	4	12
Pearson 5 (3P)	16	5	80
Gumbel Max	6	15	90
Pearson 6 (4P)	15	6	90
Gen. Extreme Value	14	8	112
Cauchy	5	26	130
Log-Pearson 3	27	14	378

Three fits were selected for comparison:

1) **Wakeby** (best weighted ranking)
2) **Gen. Extreme Value** (std. hydrologic distribution)
3) **Log-Pearson 3** (std. hydrologic distribution)

Additional details (goodness-of-fit) testing may be examined through the EasyFit 5.3 Professional software interface.

2013 was excluded from the analysis as a significant portion of the wet season data from that year was missing or has yet to occur.

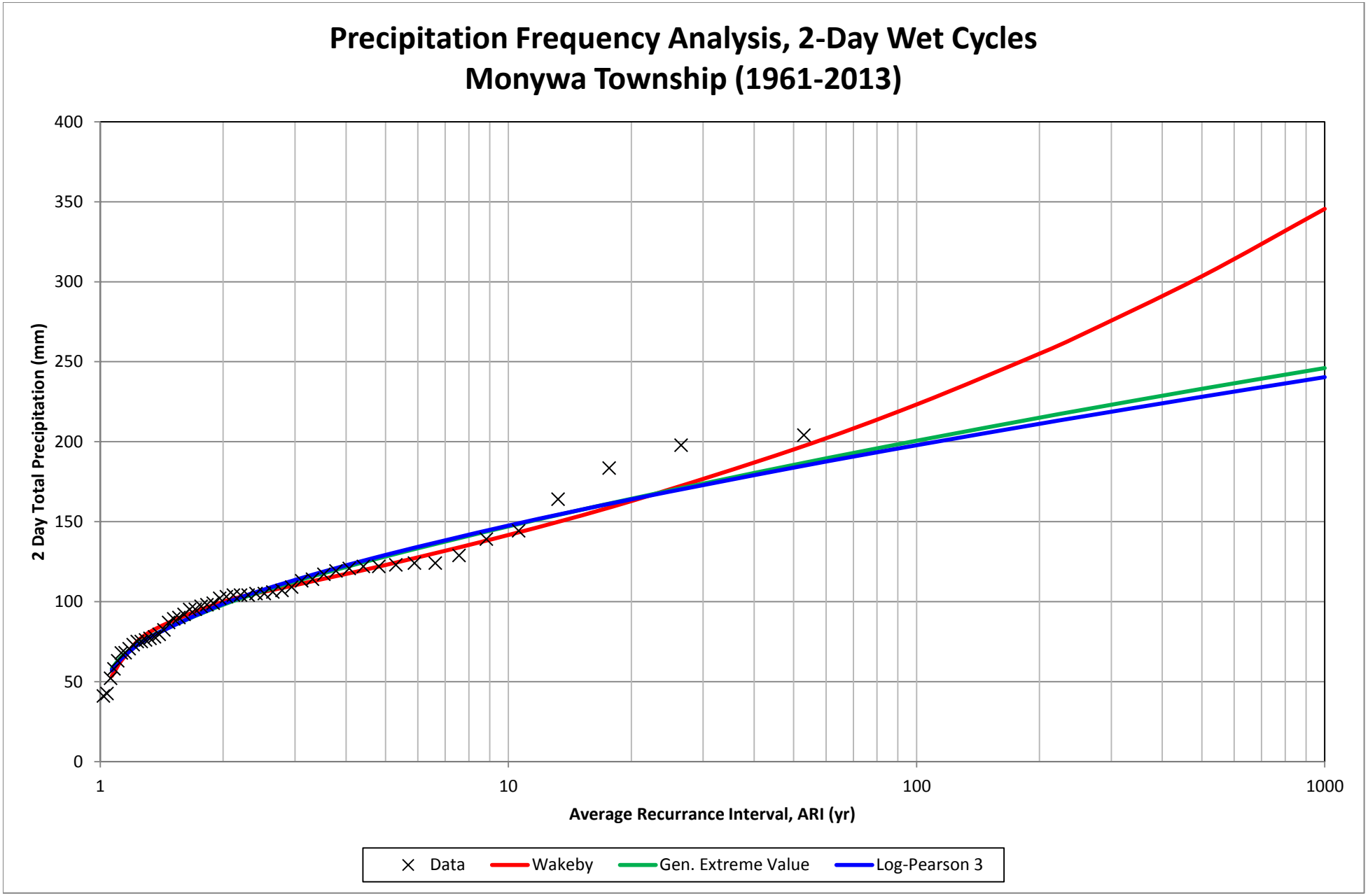
Note that these predictions should be multiplied by **1.067** to account for potential straddling errors in sampling which may occur from fixed 24-h observational periods, as discussed in:

Weiss, L.L., 1964, Ratio of true to fixed-interval maximum rainfall: American Society of Civil Engineers, Journal of Hydraulics Division, v.90, HY-1, p. 77-82.

Precipitation Frequency Analysis, 2 Day Wet Cycles: Monywa Township (1961-2013)

After consideration of these results, and the other n-day precipitation frequency analysis results, Knight Piésold selected the **Gen. Extreme Value** probability distribution to represent wet-cycle 2 day precipitation for the **Monywa Township** climate station near the **Letpadaung Copper** project. This distribution is the best common fit for all of the various durations considered. For consistency, one probability distribution was employed.

Probability Plotting Location			Wakeby		Gen. Extreme Value		Log-Pearson 3	
Annual Non Exceedance Probability (ANEP)	Annual Exceedance Probability (AEP)	Annual Recurrance Interval (ARI)	α =	245.3084	k =	-0.062569239	α =	53.52555281
			β =	5.045338	σ =	28.20174054	β =	-0.0457566
			γ =	19.16715	μ =	87.88256944	γ =	7.02549131
			δ =	0.175864				
			ξ =	38.67424				
		(yr)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)	Prediction (mm)	Std. Dev. (mm)
0.999	0.001	1000	345.6	N/A	246.0	33.56	240.4	33.72
0.998	0.002	500	303.4	N/A	233.1	33.56	228.1	33.72
0.996	0.004	250	266.1	N/A	219.5	33.56	215.4	33.72
0.995	0.005	200	255.0	N/A	215.0	33.56	211.2	33.72
0.990	0.010	100	223.3	N/A	200.6	33.56	197.8	33.72
0.980	0.020	50	195.2	N/A	185.5	33.56	183.8	33.72
0.950	0.050	20	162.9	N/A	164.3	33.56	164.0	33.72
0.900	0.100	10	141.7	N/A	147.1	33.56	147.6	33.72
0.800	0.200	5	122.9	N/A	128.3	33.56	129.2	33.72
0.667	0.333	3	110.4	N/A	112.7	33.56	113.6	33.72
0.500	0.500	2.0	100.0	N/A	98.1	33.56	98.7	33.72
0.250	0.750	1.3	81.6	N/A	78.6	33.56	78.2	33.72
0.125	0.875	1.14	65.1	N/A	66.8	33.56	65.9	33.72
0.063	0.937	1.07	53.5	N/A	58.3	33.56	57.1	33.72
Kolmogorov Smirnov (Statistic, Rank)			0.0577	1	0.0968	14	0.1047	27
Anderson Darling (Statistic, Rank)			0.2143	1	0.4281	8	0.4728	14


Precipitation Frequency Analysis, 2-Day Wet Cycles
Monywa Township (1961-2013)
2 Day Total Precipitation (mm)
400
350
300
250
200
150
100
50
0
1
10
100
1000
Average Recurrance Interval, ARI (yr)
Data
Wakeby
Gen. Extreme Value
Log-Pearson 3

ATTACHMENT 2.8

Water Balance Scenarios

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	Year 1	Year 2	Year 3	Year 4	Year 5
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	3.1	0.0	0.0
11	0.0	0.0	28.9	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	105.4	0.0
38	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	2.1	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	Year 1	Year 2	Year 3	Year 4	Year 5
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	3.3	0.0	0.0
11	0.0	0.0	30.8	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	112.3	0.0
38	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0	0.0
68	2.2	0.0	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	Year 1	Year 2	Year 3	Year 4	Year 5
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	13.4	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	1.0	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	2.1	0.0	0.0	0.0
82	0.0	3.1	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	1.0	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	2.1	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	2.1	0.0	4.1
93	0.0	4.1	0.0	0.0	3.1
94	0.0	0.0	0.0	0.0	1.0
95	0.0	0.0	0.0	0.0	0.0
96	0.0	4.1	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.1	8.3
101	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0
103	16.5	0.0	0.0	0.0	6.2
104	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	1.0
107	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	5.2
110	0.0	0.0	0.0	4.1	0.0
111	0.0	0.0	8.3	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	1.0
114	0.0	0.0	0.0	0.0	0.0
115	3.1	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	1.0	0.0
117	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0	0.0
123	34.1	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	1.0	0.0
125	0.0	0.0	11.4	0.0	0.0
126	0.0	0.0	0.0	0.0	5.2
127	0.0	0.0	0.0	0.0	2.1
128	0.0	0.0	0.0	1.0	0.0
129	1.0	0.0	0.0	0.0	0.0
130	6.2	0.0	0.0	42.4	0.0
131	8.3	1.0	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	3.1
133	0.0	0.0	0.0	47.5	6.2
134	0.0	0.0	11.4	0.0	2.1
135	0.0	0.0	0.0	15.5	0.0
136	2.1	0.0	0.0	0.0	0.0
137	0.0	0.0	27.9	3.1	0.0
138	1.0	7.2	0.0	0.0	0.0
139	0.0	0.0	0.0	0.0	1.0
140	6.2	0.0	0.0	0.0	0.0
141	0.0	0.0	8.3	40.3	0.0
142	0.0	12.4	0.0	0.0	0.0
143	2.1	0.0	0.0	6.2	0.0
144	1.0	20.7	11.4	0.0	0.0
145	6.2	87.8	13.4	14.5	10.3
146	1.0	6.2	50.6	12.4	4.1
147	1.0	24.8	19.6	0.0	0.0
148	9.3	40.3	0.0	0.0	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	Year 1	Year 2	Year 3	Year 4	Year 5
75	0.0	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	14.3	0.0
77	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0
79	0.0	1.1	0.0	0.0	0.0
80	0.0	0.0	0.0	0.0	0.0
81	0.0	2.2	0.0	0.0	0.0
82	0.0	3.3	0.0	0.0	0.0
83	0.0	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0
88	0.0	1.1	0.0	0.0	0.0
89	0.0	0.0	0.0	0.0	0.0
90	0.0	2.2	0.0	0.0	0.0
91	0.0	0.0	0.0	0.0	0.0
92	0.0	0.0	2.2	0.0	4.4
93	0.0	4.4	0.0	0.0	3.3
94	0.0	0.0	0.0	0.0	1.1
95	0.0	0.0	0.0	0.0	0.0
96	0.0	4.4	0.0	0.0	0.0
97	0.0	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.3	8.8
101	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0
103	17.6	0.0	0.0	0.0	6.6
104	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0	1.1
107	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0	5.5
110	0.0	0.0	0.0	4.4	0.0
111	0.0	0.0	8.8	0.0	0.0
112	0.0	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0	1.1
114	0.0	0.0	0.0	0.0	0.0
115	3.3	0.0	0.0	0.0	0.0
116	0.0	0.0	0.0	1.1	0.0
117	0.0	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0	0.0
123	36.3	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	1.1	0.0
125	0.0	0.0	12.1	0.0	0.0
126	0.0	0.0	0.0	0.0	5.5
127	0.0	0.0	0.0	0.0	2.2
128	0.0	0.0	0.0	1.1	0.0
129	1.1	0.0	0.0	0.0	0.0
130	6.6	0.0	0.0	45.2	0.0
131	8.8	1.1	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	3.3
133	0.0	0.0	0.0	50.7	6.6
134	0.0	0.0	12.1	0.0	2.2
135	0.0	0.0	0.0	16.5	0.0
136	2.2	0.0	0.0	0.0	0.0
137	0.0	0.0	29.7	3.3	0.0
138	1.1	7.7	0.0	0.0	0.0
139	0.0	0.0	0.0	0.0	1.1
140	6.6	0.0	0.0	0.0	0.0
141	0.0	0.0	8.8	43.0	0.0
142	0.0	13.2	0.0	0.0	0.0
143	2.2	0.0	0.0	6.6	0.0
144	1.1	22.0	12.1	0.0	0.0
145	6.6	93.6	14.3	15.4	11.0
146	1.1	6.6	54.0	13.2	4.4
147	1.1	26.4	20.9	0.0	0.0
148	9.9	43.0	0.0	0.0	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	Year 1	Year 2	Year 3	Year 4	Year 5
149	0.0	0.0	9.3	0.0	0.0
150	0.0	0.0	0.0	0.0	2.1
151	0.0	0.0	18.6	0.0	0.0
152	7.2	0.0	0.0	0.0	25.8
153	0.0	0.0	0.0	2.1	0.0
154	0.0	0.0	1.0	58.9	0.0
155	5.2	0.0	14.5	25.8	0.0
156	0.0	0.0	4.1	5.2	0.0
157	16.5	0.0	14.5	0.0	0.0
158	4.1	0.0	0.0	0.0	0.0
159	6.2	0.0	0.0	0.0	0.0
160	8.3	0.0	0.0	2.1	0.0
161	79.6	1.0	0.0	24.8	0.0
162	4.1	0.0	0.0	6.2	0.0
163	0.0	16.5	0.0	0.0	0.0
164	0.0	0.0	0.0	0.0	2.1
165	0.0	0.0	0.0	0.0	0.0
166	4.1	26.9	0.0	7.2	1.0
167	1.0	4.1	0.0	0.0	0.0
168	0.0	0.0	26.9	1.0	0.0
169	1.0	0.0	26.9	18.6	0.0
170	0.0	0.0	18.6	0.0	0.0
171	0.0	0.0	14.5	0.0	0.0
172	6.2	0.0	1.0	19.6	0.0
173	0.0	0.0	0.0	1.0	0.0
174	0.0	6.2	0.0	0.0	3.1
175	0.0	2.1	0.0	22.7	7.2
176	2.1	9.3	0.0	2.1	14.5
177	1.0	0.0	8.3	0.0	1.0
178	68.2	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	2.1	0.0
180	0.0	0.0	0.0	0.0	0.0
181	25.8	0.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0	0.0
183	17.6	0.0	0.0	23.8	0.0
184	10.3	0.0	0.0	0.0	1.0
185	0.0	0.0	0.0	0.0	0.0
186	5.2	0.0	0.0	0.0	0.0
187	6.2	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.0	0.0
190	1.0	0.0	0.0	0.0	0.0
191	4.1	0.0	0.0	0.0	0.0
192	48.6	0.0	0.0	0.0	0.0
193	14.5	0.0	0.0	0.0	0.0
194	1.0	0.0	0.0	0.0	0.0
195	21.7	0.0	0.0	0.0	22.7
196	0.0	0.0	20.7	0.0	2.1
197	0.0	0.0	0.0	0.0	1.0
198	0.0	0.0	0.0	0.0	0.0
199	0.0	1.0	0.0	0.0	0.0
200	0.0	10.3	0.0	0.0	1.0
201	1.0	0.0	0.0	0.0	0.0
202	0.0	0.0	12.4	0.0	0.0
203	0.0	0.0	0.0	0.0	13.4
204	0.0	4.1	0.0	0.0	1.0
205	0.0	0.0	1.0	0.0	3.1
206	0.0	0.0	0.0	31.0	0.0
207	0.0	0.0	0.0	1.0	0.0
208	1.0	3.1	0.0	0.0	0.0
209	0.0	10.3	3.1	0.0	0.0
210	0.0	6.2	10.3	3.1	0.0
211	2.1	0.0	0.0	0.0	0.0
212	4.1	0.0	0.0	0.0	0.0
213	0.0	2.1	0.0	2.1	0.0
214	8.3	0.0	1.0	0.0	0.0
215	3.1	0.0	49.6	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0
218	106.4	0.0	0.0	2.1	0.0
219	1.0	0.0	3.1	0.0	0.0
220	0.0	0.0	0.0	0.0	0.0
221	3.1	0.0	0.0	0.0	0.0
222	30.0	0.0	3.1	2.1	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	Year 1	Year 2	Year 3	Year 4	Year 5
149	0.0	0.0	9.9	0.0	0.0
150	0.0	0.0	0.0	0.0	2.2
151	0.0	0.0	19.8	0.0	0.0
152	7.7	0.0	0.0	0.0	27.5
153	0.0	0.0	0.0	2.2	0.0
154	0.0	0.0	1.1	62.8	0.0
155	5.5	0.0	15.4	27.5	0.0
156	0.0	0.0	4.4	5.5	0.0
157	17.6	0.0	15.4	0.0	0.0
158	4.4	0.0	0.0	0.0	0.0
159	6.6	0.0	0.0	0.0	0.0
160	8.8	0.0	0.0	2.2	0.0
161	84.8	1.1	0.0	26.4	0.0
162	4.4	0.0	0.0	6.6	0.0
163	0.0	17.6	0.0	0.0	0.0
164	0.0	0.0	0.0	0.0	2.2
165	0.0	0.0	0.0	0.0	0.0
166	4.4	28.6	0.0	7.7	1.1
167	1.1	4.4	0.0	0.0	0.0
168	0.0	0.0	28.6	1.1	0.0
169	1.1	0.0	28.6	19.8	0.0
170	0.0	0.0	19.8	0.0	0.0
171	0.0	0.0	15.4	0.0	0.0
172	6.6	0.0	1.1	20.9	0.0
173	0.0	0.0	0.0	1.1	0.0
174	0.0	6.6	0.0	0.0	3.3
175	0.0	2.2	0.0	24.2	7.7
176	2.2	9.9	0.0	2.2	15.4
177	1.1	0.0	8.8	0.0	1.1
178	72.7	0.0	0.0	0.0	0.0
179	0.0	0.0	0.0	2.2	0.0
180	0.0	0.0	0.0	0.0	0.0
181	27.5	0.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0	0.0
183	18.7	0.0	0.0	25.3	0.0
184	11.0	0.0	0.0	0.0	1.1
185	0.0	0.0	0.0	0.0	0.0
186	5.5	0.0	0.0	0.0	0.0
187	6.6	0.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.1	0.0
190	1.1	0.0	0.0	0.0	0.0
191	4.4	0.0	0.0	0.0	0.0
192	51.8	0.0	0.0	0.0	0.0
193	15.4	0.0	0.0	0.0	0.0
194	1.1	0.0	0.0	0.0	0.0
195	23.1	0.0	0.0	0.0	24.2
196	0.0	0.0	22.0	0.0	2.2
197	0.0	0.0	0.0	0.0	1.1
198	0.0	0.0	0.0	0.0	0.0
199	0.0	1.1	0.0	0.0	0.0
200	0.0	11.0	0.0	0.0	1.1
201	1.1	0.0	0.0	0.0	0.0
202	0.0	0.0	13.2	0.0	0.0
203	0.0	0.0	0.0	0.0	14.3
204	0.0	4.4	0.0	0.0	1.1
205	0.0	0.0	1.1	0.0	3.3
206	0.0	0.0	0.0	33.0	0.0
207	0.0	0.0	0.0	1.1	0.0
208	1.1	3.3	0.0	0.0	0.0
209	0.0	11.0	3.3	0.0	0.0
210	0.0	6.6	11.0	3.3	0.0
211	2.2	0.0	0.0	0.0	0.0
212	4.4	0.0	0.0	0.0	0.0
213	0.0	2.2	0.0	2.2	0.0
214	8.8	0.0	1.1	0.0	0.0
215	3.3	0.0	52.9	0.0	0.0
216	0.0	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0	0.0
218	113.4	0.0	0.0	2.2	0.0
219	1.1	0.0	3.3	0.0	0.0
220	0.0	0.0	0.0	0.0	0.0
221	3.3	0.0	0.0	0.0	0.0
222	31.9	0.0	3.3	2.2	0.0

Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	Year 1	Year 2	Year 3	Year 4	Year 5
223	48.6	71.3	5.2	0.0	0.0
224	0.0	3.1	0.0	0.0	0.0
225	12.4	2.1	0.0	0.0	0.0
226	0.0	0.0	0.0	1.0	0.0
227	0.0	0.0	0.0	0.0	0.0
228	0.0	4.1	31.0	0.0	0.0
229	0.0	1.0	0.0	1.0	0.0
230	0.0	3.1	0.0	0.0	16.5
231	0.0	0.0	1.0	0.0	33.1
232	1.0	0.0	3.1	0.0	53.7
233	0.0	0.0	6.2	11.4	19.6
234	14.5	0.0	1.0	0.0	12.4
235	0.0	0.0	0.0	0.0	3.1
236	9.3	11.4	0.0	0.0	16.5
237	6.2	0.0	18.6	0.0	0.0
238	0.0	0.0	0.0	1.0	23.8
239	2.1	0.0	12.4	8.3	0.0
240	0.0	0.0	50.6	0.0	0.0
241	72.3	0.0	0.0	0.0	0.0
242	0.0	0.0	6.2	14.5	3.1
243	0.0	0.0	1.0	24.8	21.7
244	0.0	0.0	2.1	10.3	14.5
245	0.0	0.0	2.1	0.0	22.7
246	0.0	0.0	0.0	5.2	0.0
247	0.0	0.0	0.0	1.0	0.0
248	0.0	0.0	0.0	0.0	4.1
249	0.0	0.0	0.0	0.0	0.0
250	0.0	4.1	0.0	0.0	47.5
251	0.0	28.9	2.1	0.0	16.5
252	0.0	0.0	13.4	0.0	9.3
253	2.1	0.0	27.9	0.0	1.0
254	0.0	0.0	11.4	0.0	36.2
255	0.0	0.0	0.0	0.0	14.5
256	0.0	0.0	0.0	15.5	0.0
257	0.0	0.0	0.0	6.2	0.0
258	0.0	0.0	9.3	6.2	4.1
259	0.0	4.1	0.0	20.7	3.1
260	70.3	2.1	0.0	2.1	0.0
261	0.0	2.1	0.0	33.1	0.0
262	0.0	15.5	0.0	1.0	0.0
263	34.1	1.0	4.1	0.0	0.0
264	11.4	14.5	18.6	0.0	53.7
265	34.1	0.0	55.8	0.0	74.4
266	30.0	0.0	71.3	0.0	3.1
267	0.0	0.0	0.0	0.0	0.0
268	3.1	0.0	18.6	0.0	0.0
269	0.0	0.0	3.1	19.6	0.0
270	0.0	26.9	0.0	4.1	0.0
271	0.0	62.0	0.0	0.0	0.0
272	3.1	44.4	0.0	0.0	23.8
273	9.3	0.0	0.0	12.4	1.0
274	16.5	0.0	0.0	1.0	0.0
275	11.4	11.4	0.0	0.0	0.0
276	0.0	0.0	56.8	2.1	0.0
277	0.0	0.0	0.0	4.1	0.0
278	0.0	0.0	1.0	0.0	0.0
279	0.0	0.0	37.2	0.0	0.0
280	0.0	0.0	8.3	0.0	0.0
281	0.0	0.0	19.6	0.0	0.0
282	0.0	0.0	15.5	0.0	38.2
283	0.0	0.0	0.0	0.0	5.2
284	28.9	0.0	0.0	1.0	66.1
285	0.0	0.0	0.0	26.9	7.2
286	0.0	0.0	0.0	45.5	1.0
287	13.4	1.0	0.0	51.7	13.4
288	11.4	0.0	2.1	5.2	0.0
289	12.4	0.0	6.2	2.1	0.0
290	90.9	0.0	0.0	24.8	0.0
291	0.0	0.0	0.0	20.7	0.0
292	12.4	0.0	7.2	78.5	0.0
293	0.0	0.0	0.0	0.0	0.0
294	1.0	0.0	0.0	0.0	5.2
295	5.2	0.0	0.0	53.7	7.2
296	0.0	0.0	0.0	3.1	0.0

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	Year 1	Year 2	Year 3	Year 4	Year 5
223	51.8	76.0	5.5	0.0	0.0
224	0.0	3.3	0.0	0.0	0.0
225	13.2	2.2	0.0	0.0	0.0
226	0.0	0.0	0.0	1.1	0.0
227	0.0	0.0	0.0	0.0	0.0
228	0.0	4.4	33.0	0.0	0.0
229	0.0	1.1	0.0	1.1	0.0
230	0.0	3.3	0.0	0.0	17.6
231	0.0	0.0	1.1	0.0	35.2
232	1.1	0.0	3.3	0.0	57.3
233	0.0	0.0	6.6	12.1	20.9
234	15.4	0.0	1.1	0.0	13.2
235	0.0	0.0	0.0	0.0	3.3
236	9.9	12.1	0.0	0.0	17.6
237	6.6	0.0	19.8	0.0	0.0
238	0.0	0.0	0.0	1.1	25.3
239	2.2	0.0	13.2	8.8	0.0
240	0.0	0.0	54.0	0.0	0.0
241	77.1	0.0	0.0	0.0	0.0
242	0.0	0.0	6.6	15.4	3.3
243	0.0	0.0	1.1	26.4	23.1
244	0.0	0.0	2.2	11.0	15.4
245	0.0	0.0	2.2	0.0	24.2
246	0.0	0.0	0.0	5.5	0.0
247	0.0	0.0	0.0	1.1	0.0
248	0.0	0.0	0.0	0.0	4.4
249	0.0	0.0	0.0	0.0	0.0
250	0.0	4.4	0.0	0.0	50.7
251	0.0	30.8	2.2	0.0	17.6
252	0.0	0.0	14.3	0.0	9.9
253	2.2	0.0	29.7	0.0	1.1
254	0.0	0.0	12.1	0.0	38.6
255	0.0	0.0	0.0	0.0	15.4
256	0.0	0.0	0.0	16.5	0.0
257	0.0	0.0	0.0	6.6	0.0
258	0.0	0.0	9.9	6.6	4.4
259	0.0	4.4	0.0	22.0	3.3
260	74.9	2.2	0.0	2.2	0.0
261	0.0	2.2	0.0	35.2	0.0
262	0.0	16.5	0.0	1.1	0.0
263	36.3	1.1	4.4	0.0	0.0
264	12.1	15.4	19.8	0.0	57.3
265	36.3	0.0	59.5	0.0	79.3
266	31.9	0.0	76.0	0.0	3.3
267	0.0	0.0	0.0	0.0	0.0
268	3.3	0.0	19.8	0.0	0.0
269	0.0	0.0	3.3	20.9	0.0
270	0.0	28.6	0.0	4.4	0.0
271	0.0	66.1	0.0	0.0	0.0
272	3.3	47.4	0.0	0.0	25.3
273	9.9	0.0	0.0	13.2	1.1
274	17.6	0.0	0.0	1.1	0.0
275	12.1	12.1	0.0	0.0	0.0
276	0.0	0.0	60.6	2.2	0.0
277	0.0	0.0	0.0	4.4	0.0
278	0.0	0.0	1.1	0.0	0.0
279	0.0	0.0	39.7	0.0	0.0
280	0.0	0.0	8.8	0.0	0.0
281	0.0	0.0	20.9	0.0	0.0
282	0.0	0.0	16.5	0.0	40.8
283	0.0	0.0	0.0	0.0	5.5
284	30.8	0.0	0.0	1.1	70.5
285	0.0	0.0	0.0	28.6	7.7
286	0.0	0.0	0.0	48.5	1.1
287	14.3	1.1	0.0	55.1	14.3
288	12.1	0.0	2.2	5.5	0.0
289	13.2	0.0	6.6	2.2	0.0
290	96.9	0.0	0.0	26.4	0.0
291	0.0	0.0	0.0	22.0	0.0
292	13.2	0.0	7.7	83.7	0.0
293	0.0	0.0	0.0	0.0	0.0
294	1.1	0.0	0.0	0.0	5.5
295	5.5	0.0	0.0	57.3	7.7
296	0.0	0.0	0.0	3.3	0.0

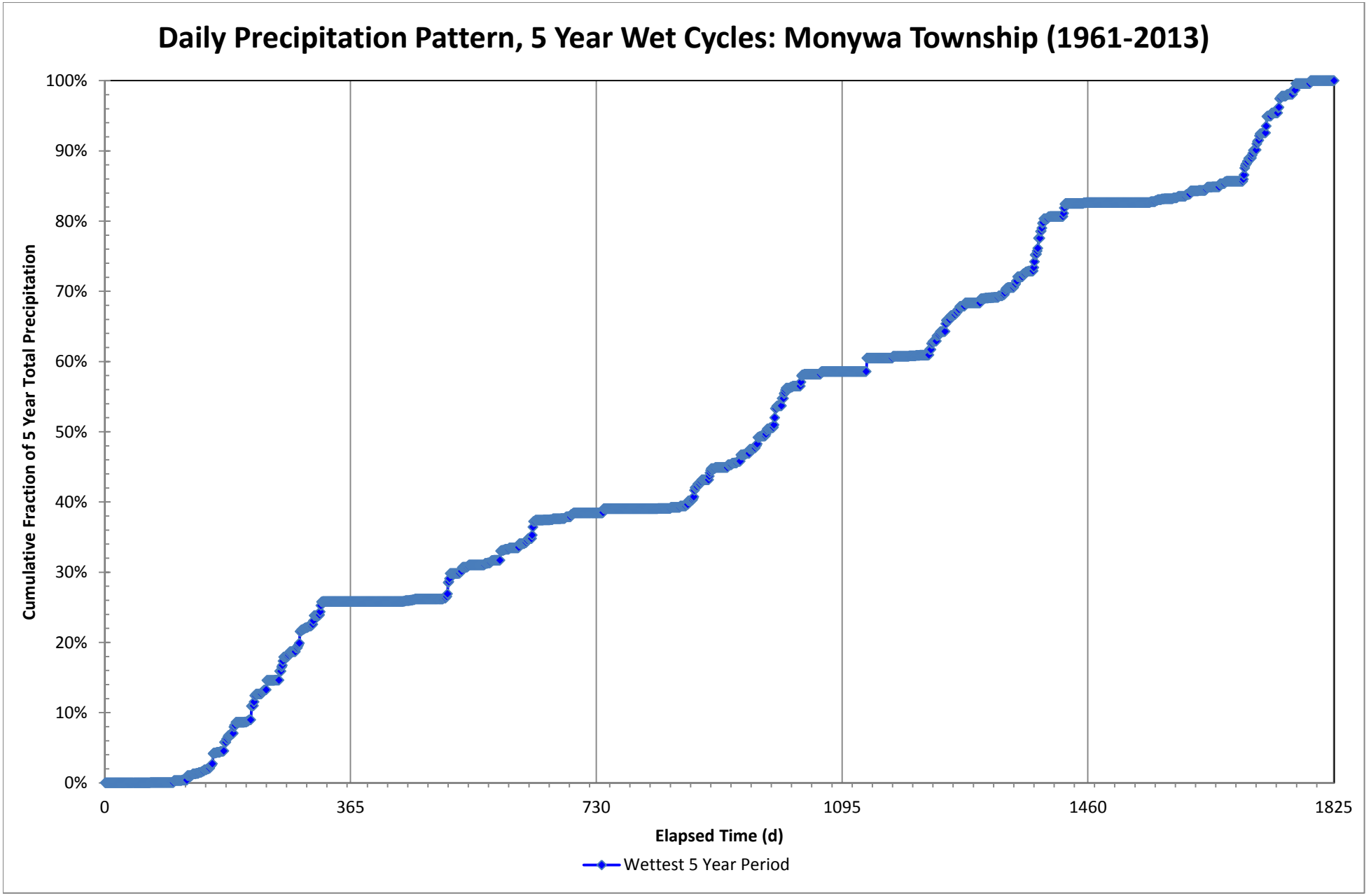
Precipitation, 5 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1415.9	690.4	1102.7	1317.7	951.8
Day	Year 1	Year 2	Year 3	Year 4	Year 5
297	7.2	2.1	0.0	21.7	2.1
298	2.1	0.0	0.0	37.2	0.0
299	1.0	0.0	0.0	6.2	0.0
300	1.0	0.0	0.0	31.0	0.0
301	2.1	6.2	0.0	0.0	0.0
302	2.1	0.0	0.0	0.0	0.0
303	7.2	0.0	0.0	0.0	0.0
304	0.0	1.0	32.0	0.0	33.1
305	0.0	0.0	48.6	0.0	0.0
306	2.1	0.0	6.2	2.1	0.0
307	1.0	0.0	1.0	12.4	0.0
308	10.3	0.0	0.0	0.0	50.6
309	0.0	0.0	4.1	3.1	0.0
310	28.9	0.0	0.0	0.0	0.0
311	39.3	0.0	0.0	0.0	0.0
312	1.0	0.0	0.0	0.0	0.0
313	0.0	1.0	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	0.0
319	4.1	6.2	0.0	0.0	0.0
320	24.8	5.2	0.0	0.0	0.0
321	49.6	3.1	0.0	0.0	0.0
322	26.9	0.0	0.0	0.0	0.0
323	1.0	0.0	0.0	0.0	0.0
324	3.1	0.0	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	0.0
328	0.0	16.5	0.0	0.0	0.0
329	0.0	0.0	0.0	23.8	0.0
330	0.0	4.1	0.0	41.3	22.7
331	0.0	6.2	0.0	30.0	0.0
332	0.0	2.1	0.0	6.2	0.0
333	0.0	1.0	0.0	0.0	0.0
334	0.0	0.0	18.6	0.0	0.0
335	0.0	0.0	3.1	0.0	0.0
336	0.0	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	0.0
344	1.0	0.0	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.1	0.0
360	0.0	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.0	0.0
363	0.0	0.0	0.0	1.0	0.0
364	0.0	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	0.0
366				0.0	

500 year ARI (mm)

Total	1509.0	735.8	1175.2	1404.3	1014.4
Day	Year 1	Year 2	Year 3	Year 4	Year 5
297	7.7	2.2	0.0	23.1	2.2
298	2.2	0.0	0.0	39.7	0.0
299	1.1	0.0	0.0	6.6	0.0
300	1.1	0.0	0.0	33.0	0.0
301	2.2	6.6	0.0	0.0	0.0
302	2.2	0.0	0.0	0.0	0.0
303	7.7	0.0	0.0	0.0	0.0
304	0.0	1.1	34.1	0.0	35.2
305	0.0	0.0	51.8	0.0	0.0
306	2.2	0.0	6.6	2.2	0.0
307	1.1	0.0	1.1	13.2	0.0
308	11.0	0.0	0.0	0.0	54.0
309	0.0	0.0	4.4	3.3	0.0
310	30.8	0.0	0.0	0.0	0.0
311	41.9	0.0	0.0	0.0	0.0
312	1.1	0.0	0.0	0.0	0.0
313	0.0	1.1	0.0	0.0	0.0
314	0.0	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0	0.0
319	4.4	6.6	0.0	0.0	0.0
320	26.4	5.5	0.0	0.0	0.0
321	52.9	3.3	0.0	0.0	0.0
322	28.6	0.0	0.0	0.0	0.0
323	1.1	0.0	0.0	0.0	0.0
324	3.3	0.0	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0	0.0
328	0.0	17.6	0.0	0.0	0.0
329	0.0	0.0	0.0	25.3	0.0
330	0.0	4.4	0.0	44.1	24.2
331	0.0	6.6	0.0	31.9	0.0
332	0.0	2.2	0.0	6.6	0.0
333	0.0	1.1	0.0	0.0	0.0
334	0.0	0.0	19.8	0.0	0.0
335	0.0	0.0	3.3	0.0	0.0
336	0.0	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0	0.0
344	1.1	0.0	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.4	0.0
360	0.0	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.1	0.0
363	0.0	0.0	0.0	1.1	0.0
364	0.0	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0	0.0
366				0.0	


Daily Precipitation Pattern, 5 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 5 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
1460
1825
Elapsed Time (d)
Wettest 5 Year Period

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	Year 1	Year 2	Year 3	Year 4
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	3.2	0.0
11	0.0	0.0	29.6	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	107.8
38	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0
68	2.1	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	Year 1	Year 2	Year 3	Year 4
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	3.5	0.0
11	0.0	0.0	32.5	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	118.4
38	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0
49	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0
53	0.0	0.0	0.0	0.0
54	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0
56	0.0	0.0	0.0	0.0
57	0.0	0.0	0.0	0.0
58	0.0	0.0	0.0	0.0
59	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0
61	0.0	0.0	0.0	0.0
62	0.0	0.0	0.0	0.0
63	0.0	0.0	0.0	0.0
64	0.0	0.0	0.0	0.0
65	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0
67	0.0	0.0	0.0	0.0
68	2.3	0.0	0.0	0.0
69	0.0	0.0	0.0	0.0
70	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0
73	0.0	0.0	0.0	0.0
74	0.0	0.0	0.0	0.0

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	Year 1	Year 2	Year 3	Year 4
75	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	13.7
77	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0
79	0.0	1.1	0.0	0.0
80	0.0	0.0	0.0	0.0
81	0.0	2.1	0.0	0.0
82	0.0	3.2	0.0	0.0
83	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0
88	0.0	1.1	0.0	0.0
89	0.0	0.0	0.0	0.0
90	0.0	2.1	0.0	0.0
91	0.0	0.0	0.0	0.0
92	0.0	0.0	2.1	0.0
93	0.0	4.2	0.0	0.0
94	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0
96	0.0	4.2	0.0	0.0
97	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.2
101	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0
103	16.9	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	4.2
111	0.0	0.0	8.5	0.0
112	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0
115	3.2	0.0	0.0	0.0
116	0.0	0.0	0.0	1.1
117	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0
123	34.9	0.0	0.0	0.0
124	0.0	0.0	0.0	1.1
125	0.0	0.0	11.6	0.0
126	0.0	0.0	0.0	0.0
127	0.0	0.0	0.0	0.0
128	0.0	0.0	0.0	1.1
129	1.1	0.0	0.0	0.0
130	6.3	0.0	0.0	43.3
131	8.5	1.1	0.0	0.0
132	0.0	0.0	0.0	0.0
133	0.0	0.0	0.0	48.6
134	0.0	0.0	11.6	0.0
135	0.0	0.0	0.0	15.9
136	2.1	0.0	0.0	0.0
137	0.0	0.0	28.5	3.2
138	1.1	7.4	0.0	0.0
139	0.0	0.0	0.0	0.0
140	6.3	0.0	0.0	0.0
141	0.0	0.0	8.5	41.2
142	0.0	12.7	0.0	0.0
143	2.1	0.0	0.0	6.3
144	1.1	21.1	11.6	0.0
145	6.3	89.9	13.7	14.8
146	1.1	6.3	51.8	12.7
147	1.1	25.4	20.1	0.0
148	9.5	41.2	0.0	0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	Year 1	Year 2	Year 3	Year 4
75	0.0	0.0	0.0	0.0
76	0.0	0.0	0.0	15.1
77	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	0.0
79	0.0	1.2	0.0	0.0
80	0.0	0.0	0.0	0.0
81	0.0	2.3	0.0	0.0
82	0.0	3.5	0.0	0.0
83	0.0	0.0	0.0	0.0
84	0.0	0.0	0.0	0.0
85	0.0	0.0	0.0	0.0
86	0.0	0.0	0.0	0.0
87	0.0	0.0	0.0	0.0
88	0.0	1.2	0.0	0.0
89	0.0	0.0	0.0	0.0
90	0.0	2.3	0.0	0.0
91	0.0	0.0	0.0	0.0
92	0.0	0.0	2.3	0.0
93	0.0	4.6	0.0	0.0
94	0.0	0.0	0.0	0.0
95	0.0	0.0	0.0	0.0
96	0.0	4.6	0.0	0.0
97	0.0	0.0	0.0	0.0
98	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0
100	0.0	0.0	0.0	3.5
101	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0
103	18.6	0.0	0.0	0.0
104	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	0.0
106	0.0	0.0	0.0	0.0
107	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0
109	0.0	0.0	0.0	0.0
110	0.0	0.0	0.0	4.6
111	0.0	0.0	9.3	0.0
112	0.0	0.0	0.0	0.0
113	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	0.0
115	3.5	0.0	0.0	0.0
116	0.0	0.0	0.0	1.2
117	0.0	0.0	0.0	0.0
118	0.0	0.0	0.0	0.0
119	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0
121	0.0	0.0	0.0	0.0
122	0.0	0.0	0.0	0.0
123	38.3	0.0	0.0	0.0
124	0.0	0.0	0.0	1.2
125	0.0	0.0	12.8	0.0
126	0.0	0.0	0.0	0.0
127	0.0	0.0	0.0	0.0
128	0.0	0.0	0.0	1.2
129	1.2	0.0	0.0	0.0
130	7.0	0.0	0.0	47.6
131	9.3	1.2	0.0	0.0
132	0.0	0.0	0.0	0.0
133	0.0	0.0	0.0	53.4
134	0.0	0.0	12.8	0.0
135	0.0	0.0	0.0	17.4
136	2.3	0.0	0.0	0.0
137	0.0	0.0	31.3	3.5
138	1.2	8.1	0.0	0.0
139	0.0	0.0	0.0	0.0
140	7.0	0.0	0.0	0.0
141	0.0	0.0	9.3	45.3
142	0.0	13.9	0.0	0.0
143	2.3	0.0	0.0	7.0
144	1.2	23.2	12.8	0.0
145	7.0	98.6	15.1	16.2
146	1.2	7.0	56.9	13.9
147	1.2	27.8	22.0	0.0
148	10.4	45.3	0.0	0.0

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	Year 1	Year 2	Year 3	Year 4
149	0.0	0.0	9.5	0.0
150	0.0	0.0	0.0	0.0
151	0.0	0.0	19.0	0.0
152	7.4	0.0	0.0	0.0
153	0.0	0.0	0.0	2.1
154	0.0	0.0	1.1	60.3
155	5.3	0.0	14.8	26.4
156	0.0	0.0	4.2	5.3
157	16.9	0.0	14.8	0.0
158	4.2	0.0	0.0	0.0
159	6.3	0.0	0.0	0.0
160	8.5	0.0	0.0	2.1
161	81.4	1.1	0.0	25.4
162	4.2	0.0	0.0	6.3
163	0.0	16.9	0.0	0.0
164	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0
166	4.2	27.5	0.0	7.4
167	1.1	4.2	0.0	0.0
168	0.0	0.0	27.5	1.1
169	1.1	0.0	27.5	19.0
170	0.0	0.0	19.0	0.0
171	0.0	0.0	14.8	0.0
172	6.3	0.0	1.1	20.1
173	0.0	0.0	0.0	1.1
174	0.0	6.3	0.0	0.0
175	0.0	2.1	0.0	23.3
176	2.1	9.5	0.0	2.1
177	1.1	0.0	8.5	0.0
178	69.8	0.0	0.0	0.0
179	0.0	0.0	0.0	2.1
180	0.0	0.0	0.0	0.0
181	26.4	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0
183	18.0	0.0	0.0	24.3
184	10.6	0.0	0.0	0.0
185	0.0	0.0	0.0	0.0
186	5.3	0.0	0.0	0.0
187	6.3	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.1
190	1.1	0.0	0.0	0.0
191	4.2	0.0	0.0	0.0
192	49.7	0.0	0.0	0.0
193	14.8	0.0	0.0	0.0
194	1.1	0.0	0.0	0.0
195	22.2	0.0	0.0	0.0
196	0.0	0.0	21.1	0.0
197	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0
199	0.0	1.1	0.0	0.0
200	0.0	10.6	0.0	0.0
201	1.1	0.0	0.0	0.0
202	0.0	0.0	12.7	0.0
203	0.0	0.0	0.0	0.0
204	0.0	4.2	0.0	0.0
205	0.0	0.0	1.1	0.0
206	0.0	0.0	0.0	31.7
207	0.0	0.0	0.0	1.1
208	1.1	3.2	0.0	0.0
209	0.0	10.6	3.2	0.0
210	0.0	6.3	10.6	3.2
211	2.1	0.0	0.0	0.0
212	4.2	0.0	0.0	0.0
213	0.0	2.1	0.0	2.1
214	8.5	0.0	1.1	0.0
215	3.2	0.0	50.7	0.0
216	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0
218	108.9	0.0	0.0	2.1
219	1.1	0.0	3.2	0.0
220	0.0	0.0	0.0	0.0
221	3.2	0.0	0.0	0.0
222	30.7	0.0	3.2	2.1

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	Year 1	Year 2	Year 3	Year 4
149	0.0	0.0	10.4	0.0
150	0.0	0.0	0.0	0.0
151	0.0	0.0	20.9	0.0
152	8.1	0.0	0.0	0.0
153	0.0	0.0	0.0	2.3
154	0.0	0.0	1.2	66.1
155	5.8	0.0	16.2	29.0
156	0.0	0.0	4.6	5.8
157	18.6	0.0	16.2	0.0
158	4.6	0.0	0.0	0.0
159	7.0	0.0	0.0	0.0
160	9.3	0.0	0.0	2.3
161	89.4	1.2	0.0	27.8
162	4.6	0.0	0.0	7.0
163	0.0	18.6	0.0	0.0
164	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0
166	4.6	30.2	0.0	8.1
167	1.2	4.6	0.0	0.0
168	0.0	0.0	30.2	1.2
169	1.2	0.0	30.2	20.9
170	0.0	0.0	20.9	0.0
171	0.0	0.0	16.2	0.0
172	7.0	0.0	1.2	22.0
173	0.0	0.0	0.0	1.2
174	0.0	7.0	0.0	0.0
175	0.0	2.3	0.0	25.5
176	2.3	10.4	0.0	2.3
177	1.2	0.0	9.3	0.0
178	76.6	0.0	0.0	0.0
179	0.0	0.0	0.0	2.3
180	0.0	0.0	0.0	0.0
181	29.0	0.0	0.0	0.0
182	0.0	0.0	0.0	0.0
183	19.7	0.0	0.0	26.7
184	11.6	0.0	0.0	0.0
185	0.0	0.0	0.0	0.0
186	5.8	0.0	0.0	0.0
187	7.0	0.0	0.0	0.0
188	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	1.2
190	1.2	0.0	0.0	0.0
191	4.6	0.0	0.0	0.0
192	54.5	0.0	0.0	0.0
193	16.2	0.0	0.0	0.0
194	1.2	0.0	0.0	0.0
195	24.4	0.0	0.0	0.0
196	0.0	0.0	23.2	0.0
197	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0
199	0.0	1.2	0.0	0.0
200	0.0	11.6	0.0	0.0
201	1.2	0.0	0.0	0.0
202	0.0	0.0	13.9	0.0
203	0.0	0.0	0.0	0.0
204	0.0	4.6	0.0	0.0
205	0.0	0.0	1.2	0.0
206	0.0	0.0	0.0	34.8
207	0.0	0.0	0.0	1.2
208	1.2	3.5	0.0	0.0
209	0.0	11.6	3.5	0.0
210	0.0	7.0	11.6	3.5
211	2.3	0.0	0.0	0.0
212	4.6	0.0	0.0	0.0
213	0.0	2.3	0.0	2.3
214	9.3	0.0	1.2	0.0
215	3.5	0.0	55.7	0.0
216	0.0	0.0	0.0	0.0
217	0.0	0.0	0.0	0.0
218	119.5	0.0	0.0	2.3
219	1.2	0.0	3.5	0.0
220	0.0	0.0	0.0	0.0
221	3.5	0.0	0.0	0.0
222	33.7	0.0	3.5	2.3

Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	Year 1	Year 2	Year 3	Year 4
223	49.7	72.9	5.3	0.0
224	0.0	3.2	0.0	0.0
225	12.7	2.1	0.0	0.0
226	0.0	0.0	0.0	1.1
227	0.0	0.0	0.0	0.0
228	0.0	4.2	31.7	0.0
229	0.0	1.1	0.0	1.1
230	0.0	3.2	0.0	0.0
231	0.0	0.0	1.1	0.0
232	1.1	0.0	3.2	0.0
233	0.0	0.0	6.3	11.6
234	14.8	0.0	1.1	0.0
235	0.0	0.0	0.0	0.0
236	9.5	11.6	0.0	0.0
237	6.3	0.0	19.0	0.0
238	0.0	0.0	0.0	1.1
239	2.1	0.0	12.7	8.5
240	0.0	0.0	51.8	0.0
241	74.0	0.0	0.0	0.0
242	0.0	0.0	6.3	14.8
243	0.0	0.0	1.1	25.4
244	0.0	0.0	2.1	10.6
245	0.0	0.0	2.1	0.0
246	0.0	0.0	0.0	5.3
247	0.0	0.0	0.0	1.1
248	0.0	0.0	0.0	0.0
249	0.0	0.0	0.0	0.0
250	0.0	4.2	0.0	0.0
251	0.0	29.6	2.1	0.0
252	0.0	0.0	13.7	0.0
253	2.1	0.0	28.5	0.0
254	0.0	0.0	11.6	0.0
255	0.0	0.0	0.0	0.0
256	0.0	0.0	0.0	15.9
257	0.0	0.0	0.0	6.3
258	0.0	0.0	9.5	6.3
259	0.0	4.2	0.0	21.1
260	71.9	2.1	0.0	2.1
261	0.0	2.1	0.0	33.8
262	0.0	15.9	0.0	1.1
263	34.9	1.1	4.2	0.0
264	11.6	14.8	19.0	0.0
265	34.9	0.0	57.1	0.0
266	30.7	0.0	72.9	0.0
267	0.0	0.0	0.0	0.0
268	3.2	0.0	19.0	0.0
269	0.0	0.0	3.2	20.1
270	0.0	27.5	0.0	4.2
271	0.0	63.4	0.0	0.0
272	3.2	45.5	0.0	0.0
273	9.5	0.0	0.0	12.7
274	16.9	0.0	0.0	1.1
275	11.6	11.6	0.0	0.0
276	0.0	0.0	58.1	2.1
277	0.0	0.0	0.0	4.2
278	0.0	0.0	1.1	0.0
279	0.0	0.0	38.1	0.0
280	0.0	0.0	8.5	0.0
281	0.0	0.0	20.1	0.0
282	0.0	0.0	15.9	0.0
283	0.0	0.0	0.0	0.0
284	29.6	0.0	0.0	1.1
285	0.0	0.0	0.0	27.5
286	0.0	0.0	0.0	46.5
287	13.7	1.1	0.0	52.9
288	11.6	0.0	2.1	5.3
289	12.7	0.0	6.3	2.1
290	93.0	0.0	0.0	25.4
291	0.0	0.0	0.0	21.1
292	12.7	0.0	7.4	80.3
293	0.0	0.0	0.0	0.0
294	1.1	0.0	0.0	0.0
295	5.3	0.0	0.0	55.0
296	0.0	0.0	0.0	3.2

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	Year 1	Year 2	Year 3	Year 4
223	54.5	80.1	5.8	0.0
224	0.0	3.5	0.0	0.0
225	13.9	2.3	0.0	0.0
226	0.0	0.0	0.0	1.2
227	0.0	0.0	0.0	0.0
228	0.0	4.6	34.8	0.0
229	0.0	1.2	0.0	1.2
230	0.0	3.5	0.0	0.0
231	0.0	0.0	1.2	0.0
232	1.2	0.0	3.5	0.0
233	0.0	0.0	7.0	12.8
234	16.2	0.0	1.2	0.0
235	0.0	0.0	0.0	0.0
236	10.4	12.8	0.0	0.0
237	7.0	0.0	20.9	0.0
238	0.0	0.0	0.0	1.2
239	2.3	0.0	13.9	9.3
240	0.0	0.0	56.9	0.0
241	81.2	0.0	0.0	0.0
242	0.0	0.0	7.0	16.2
243	0.0	0.0	1.2	27.8
244	0.0	0.0	2.3	11.6
245	0.0	0.0	2.3	0.0
246	0.0	0.0	0.0	5.8
247	0.0	0.0	0.0	1.2
248	0.0	0.0	0.0	0.0
249	0.0	0.0	0.0	0.0
250	0.0	4.6	0.0	0.0
251	0.0	32.5	2.3	0.0
252	0.0	0.0	15.1	0.0
253	2.3	0.0	31.3	0.0
254	0.0	0.0	12.8	0.0
255	0.0	0.0	0.0	0.0
256	0.0	0.0	0.0	17.4
257	0.0	0.0	0.0	7.0
258	0.0	0.0	10.4	7.0
259	0.0	4.6	0.0	23.2
260	78.9	2.3	0.0	2.3
261	0.0	2.3	0.0	37.1
262	0.0	17.4	0.0	1.2
263	38.3	1.2	4.6	0.0
264	12.8	16.2	20.9	0.0
265	38.3	0.0	62.7	0.0
266	33.7	0.0	80.1	0.0
267	0.0	0.0	0.0	0.0
268	3.5	0.0	20.9	0.0
269	0.0	0.0	3.5	22.0
270	0.0	30.2	0.0	4.6
271	0.0	69.6	0.0	0.0
272	3.5	49.9	0.0	0.0
273	10.4	0.0	0.0	13.9
274	18.6	0.0	0.0	1.2
275	12.8	12.8	0.0	0.0
276	0.0	0.0	63.8	2.3
277	0.0	0.0	0.0	4.6
278	0.0	0.0	1.2	0.0
279	0.0	0.0	41.8	0.0
280	0.0	0.0	9.3	0.0
281	0.0	0.0	22.0	0.0
282	0.0	0.0	17.4	0.0
283	0.0	0.0	0.0	0.0
284	32.5	0.0	0.0	1.2
285	0.0	0.0	0.0	30.2
286	0.0	0.0	0.0	51.1
287	15.1	1.2	0.0	58.0
288	12.8	0.0	2.3	5.8
289	13.9	0.0	7.0	2.3
290	102.1	0.0	0.0	27.8
291	0.0	0.0	0.0	23.2
292	13.9	0.0	8.1	88.2
293	0.0	0.0	0.0	0.0
294	1.2	0.0	0.0	0.0
295	5.8	0.0	0.0	60.3
296	0.0	0.0	0.0	3.5

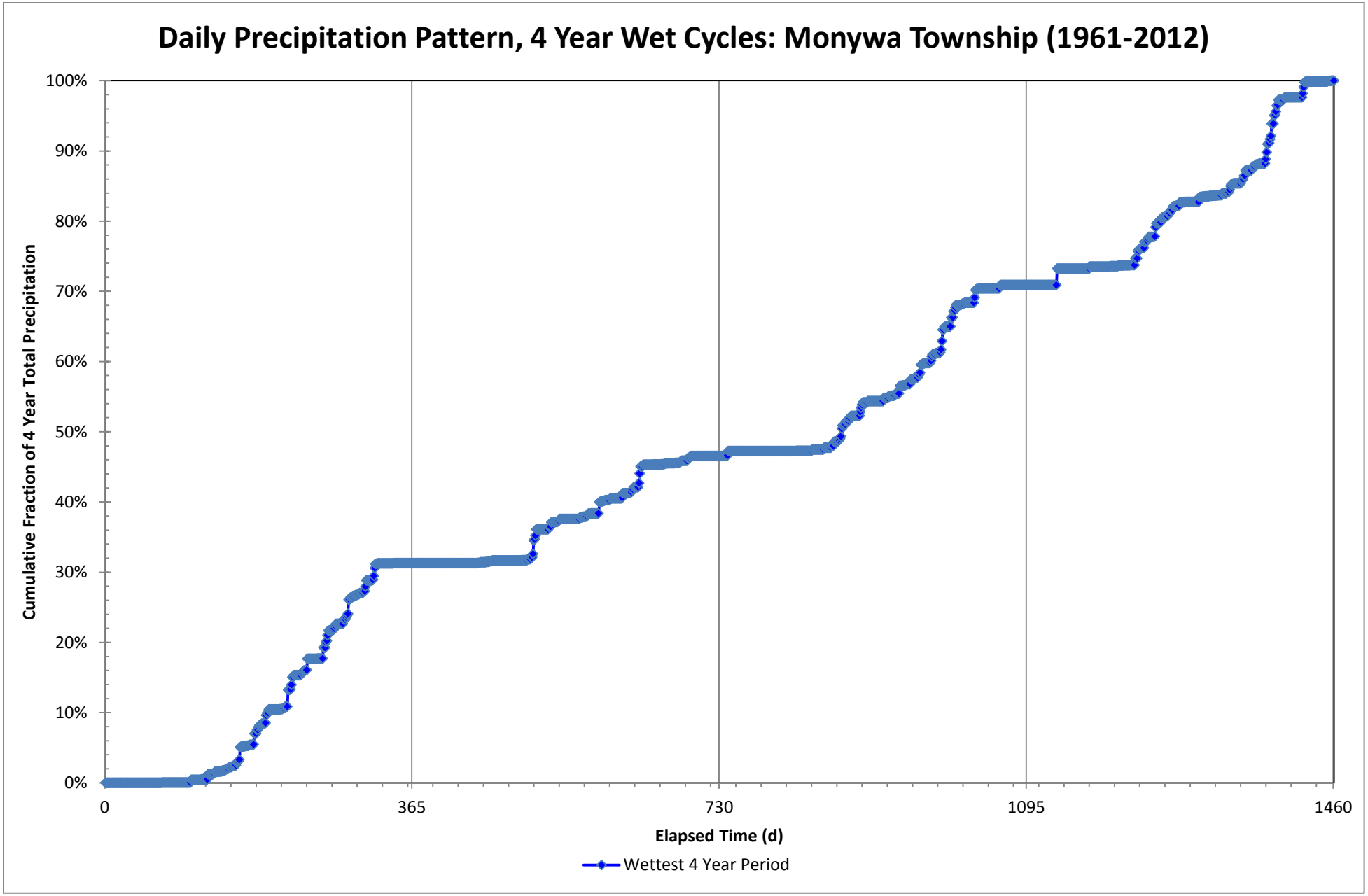
Precipitation, 4 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1448.3	706.2	1127.9	1347.8
Day	Year 1	Year 2	Year 3	Year 4
297	7.4	2.1	0.0	22.2
298	2.1	0.0	0.0	38.1
299	1.1	0.0	0.0	6.3
300	1.1	0.0	0.0	31.7
301	2.1	6.3	0.0	0.0
302	2.1	0.0	0.0	0.0
303	7.4	0.0	0.0	0.0
304	0.0	1.1	32.8	0.0
305	0.0	0.0	49.7	0.0
306	2.1	0.0	6.3	2.1
307	1.1	0.0	1.1	12.7
308	10.6	0.0	0.0	0.0
309	0.0	0.0	4.2	3.2
310	29.6	0.0	0.0	0.0
311	40.2	0.0	0.0	0.0
312	1.1	0.0	0.0	0.0
313	0.0	1.1	0.0	0.0
314	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0
319	4.2	6.3	0.0	0.0
320	25.4	5.3	0.0	0.0
321	50.7	3.2	0.0	0.0
322	27.5	0.0	0.0	0.0
323	1.1	0.0	0.0	0.0
324	3.2	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0
328	0.0	16.9	0.0	0.0
329	0.0	0.0	0.0	24.3
330	0.0	4.2	0.0	42.3
331	0.0	6.3	0.0	30.7
332	0.0	2.1	0.0	6.3
333	0.0	1.1	0.0	0.0
334	0.0	0.0	19.0	0.0
335	0.0	0.0	3.2	0.0
336	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0
344	1.1	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.2
360	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.1
363	0.0	0.0	0.0	1.1
364	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0
366				0.0

500 year ARI (mm)

Total	1589.8	775.1	1238.1	1479.5
Day	Year 1	Year 2	Year 3	Year 4
297	8.1	2.3	0.0	24.4
298	2.3	0.0	0.0	41.8
299	1.2	0.0	0.0	7.0
300	1.2	0.0	0.0	34.8
301	2.3	7.0	0.0	0.0
302	2.3	0.0	0.0	0.0
303	8.1	0.0	0.0	0.0
304	0.0	1.2	36.0	0.0
305	0.0	0.0	54.5	0.0
306	2.3	0.0	7.0	2.3
307	1.2	0.0	1.2	13.9
308	11.6	0.0	0.0	0.0
309	0.0	0.0	4.6	3.5
310	32.5	0.0	0.0	0.0
311	44.1	0.0	0.0	0.0
312	1.2	0.0	0.0	0.0
313	0.0	1.2	0.0	0.0
314	0.0	0.0	0.0	0.0
315	0.0	0.0	0.0	0.0
316	0.0	0.0	0.0	0.0
317	0.0	0.0	0.0	0.0
318	0.0	0.0	0.0	0.0
319	4.6	7.0	0.0	0.0
320	27.8	5.8	0.0	0.0
321	55.7	3.5	0.0	0.0
322	30.2	0.0	0.0	0.0
323	1.2	0.0	0.0	0.0
324	3.5	0.0	0.0	0.0
325	0.0	0.0	0.0	0.0
326	0.0	0.0	0.0	0.0
327	0.0	0.0	0.0	0.0
328	0.0	18.6	0.0	0.0
329	0.0	0.0	0.0	26.7
330	0.0	4.6	0.0	46.4
331	0.0	7.0	0.0	33.7
332	0.0	2.3	0.0	7.0
333	0.0	1.2	0.0	0.0
334	0.0	0.0	20.9	0.0
335	0.0	0.0	3.5	0.0
336	0.0	0.0	0.0	0.0
337	0.0	0.0	0.0	0.0
338	0.0	0.0	0.0	0.0
339	0.0	0.0	0.0	0.0
340	0.0	0.0	0.0	0.0
341	0.0	0.0	0.0	0.0
342	0.0	0.0	0.0	0.0
343	0.0	0.0	0.0	0.0
344	1.2	0.0	0.0	0.0
345	0.0	0.0	0.0	0.0
346	0.0	0.0	0.0	0.0
347	0.0	0.0	0.0	0.0
348	0.0	0.0	0.0	0.0
349	0.0	0.0	0.0	0.0
350	0.0	0.0	0.0	0.0
351	0.0	0.0	0.0	0.0
352	0.0	0.0	0.0	0.0
353	0.0	0.0	0.0	0.0
354	0.0	0.0	0.0	0.0
355	0.0	0.0	0.0	0.0
356	0.0	0.0	0.0	0.0
357	0.0	0.0	0.0	0.0
358	0.0	0.0	0.0	0.0
359	0.0	0.0	0.0	4.6
360	0.0	0.0	0.0	0.0
361	0.0	0.0	0.0	0.0
362	0.0	0.0	0.0	1.2
363	0.0	0.0	0.0	1.2
364	0.0	0.0	0.0	0.0
365	0.0	0.0	0.0	0.0
366				0.0


Daily Precipitation Pattern, 4 Year Wet Cycles: Monywa Township (1961-2012)
Cumulative Fraction of 4 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
1460
Elapsed Time (d)
Wettest 4 Year Period

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	Year 1	Year 2	Year 3
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	3.2
10	3.4	0.0	29.6
11	31.3	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	0.0
18	0.0	0.0	0.0
19	0.0	0.0	0.0
20	0.0	0.0	0.0
21	0.0	0.0	0.0
22	0.0	0.0	0.0
23	0.0	0.0	0.0
24	0.0	0.0	0.0
25	0.0	0.0	0.0
26	0.0	0.0	0.0
27	0.0	0.0	0.0
28	0.0	0.0	0.0
29	0.0	0.0	0.0
30	0.0	0.0	0.0
31	0.0	0.0	0.0
32	0.0	0.0	0.0
33	0.0	0.0	0.0
34	0.0	0.0	0.0
35	0.0	0.0	0.0
36	0.0	0.0	0.0
37	0.0	113.9	0.0
38	0.0	0.0	0.0
39	0.0	0.0	0.0
40	0.0	0.0	0.0
41	0.0	0.0	0.0
42	0.0	0.0	0.0
43	0.0	0.0	0.0
44	0.0	0.0	0.0
45	0.0	0.0	0.0
46	0.0	0.0	0.0
47	0.0	0.0	0.0
48	0.0	0.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
51	0.0	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	0.0
56	0.0	0.0	0.0
57	0.0	0.0	0.0
58	0.0	0.0	0.0
59	0.0	0.0	0.0
60	0.0	0.0	0.0
61	0.0	0.0	0.0
62	0.0	0.0	0.0
63	0.0	0.0	0.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0
66	0.0	0.0	0.0
67	0.0	0.0	0.0
68	0.0	0.0	0.0
69	0.0	0.0	0.0
70	0.0	0.0	0.0
71	0.0	0.0	0.0
72	0.0	0.0	0.0
73	0.0	0.0	0.0
74	0.0	0.0	0.0

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	Year 1	Year 2	Year 3
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	3.8	0.0	0.0
11	35.0	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	0.0
14	0.0	0.0	0.0
15	0.0	0.0	0.0
16	0.0	0.0	0.0
17	0.0	0.0	0.0
18	0.0	0.0	0.0
19	0.0	0.0	0.0
20	0.0	0.0	0.0
21	0.0	0.0	0.0
22	0.0	0.0	0.0
23	0.0	0.0	0.0
24	0.0	0.0	0.0
25	0.0	0.0	0.0
26	0.0	0.0	0.0
27	0.0	0.0	0.0
28	0.0	0.0	0.0
29	0.0	0.0	0.0
30	0.0	0.0	0.0
31	0.0	0.0	0.0
32	0.0	0.0	0.0
33	0.0	0.0	0.0
34	0.0	0.0	0.0
35	0.0	0.0	0.0
36	0.0	0.0	0.0
37	0.0	127.6	0.0
38	0.0	0.0	0.0
39	0.0	0.0	0.0
40	0.0	0.0	0.0
41	0.0	0.0	0.0
42	0.0	0.0	0.0
43	0.0	0.0	0.0
44	0.0	0.0	0.0
45	0.0	0.0	0.0
46	0.0	0.0	0.0
47	0.0	0.0	0.0
48	0.0	0.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
51	0.0	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	0.0
56	0.0	0.0	0.0
57	0.0	0.0	0.0
58	0.0	0.0	0.0
59	0.0	0.0	0.0
60	0.0	0.0	0.0
61	0.0	0.0	0.0
62	0.0	0.0	0.0
63	0.0	0.0	0.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0
66	0.0	0.0	0.0
67	0.0	0.0	0.0
68	0.0	0.0	0.0
69	0.0	0.0	0.0
70	0.0	0.0	0.0
71	0.0	0.0	0.0
72	0.0	0.0	0.0
73	0.0	0.0	0.0
74	0.0	0.0	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	Year 1	Year 2	Year 3
75	0.0	0.0	0.0
76	0.0	14.5	0.0
77	0.0	0.0	0.0
78	0.0	0.0	0.0
79	0.0	0.0	0.0
80	0.0	0.0	0.0
81	0.0	0.0	0.0
82	0.0	0.0	0.0
83	0.0	0.0	0.0
84	0.0	0.0	0.0
85	0.0	0.0	0.0
86	0.0	0.0	0.0
87	0.0	0.0	0.0
88	0.0	0.0	0.0
89	0.0	0.0	0.0
90	0.0	0.0	0.0
91	0.0	0.0	2.1
92	2.2	0.0	0.0
93	0.0	0.0	0.0
94	0.0	0.0	0.0
95	0.0	0.0	0.0
96	0.0	0.0	0.0
97	0.0	0.0	0.0
98	0.0	0.0	0.0
99	0.0	0.0	0.0
100	0.0	3.4	0.0
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	0.0
104	0.0	0.0	0.0
105	0.0	0.0	0.0
106	0.0	0.0	0.0
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	0.0
110	0.0	4.5	8.5
111	8.9	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	0.0
114	0.0	0.0	0.0
115	0.0	0.0	0.0
116	0.0	1.1	0.0
117	0.0	0.0	0.0
118	0.0	0.0	0.0
119	0.0	0.0	0.0
120	0.0	0.0	0.0
121	0.0	0.0	0.0
122	0.0	0.0	0.0
123	0.0	0.0	0.0
124	0.0	1.1	11.6
125	12.3	0.0	0.0
126	0.0	0.0	0.0
127	0.0	0.0	0.0
128	0.0	1.1	0.0
129	0.0	0.0	0.0
130	0.0	45.8	0.0
131	0.0	0.0	0.0
132	0.0	0.0	0.0
133	0.0	51.4	11.6
134	12.3	0.0	0.0
135	0.0	16.8	0.0
136	0.0	0.0	28.5
137	30.2	3.4	0.0
138	0.0	0.0	0.0
139	0.0	0.0	0.0
140	0.0	0.0	8.5
141	8.9	43.6	0.0
142	0.0	0.0	0.0
143	0.0	6.7	11.6
144	12.3	0.0	13.7
145	14.5	15.6	51.8
146	54.7	13.4	20.1
147	21.2	0.0	0.0
148	0.0	0.0	9.5

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	Year 1	Year 2	Year 3
75	0.0	0.0	0.0
76	0.0	16.3	0.0
77	0.0	0.0	0.0
78	0.0	0.0	0.0
79	0.0	0.0	0.0
80	0.0	0.0	0.0
81	0.0	0.0	0.0
82	0.0	0.0	0.0
83	0.0	0.0	0.0
84	0.0	0.0	0.0
85	0.0	0.0	0.0
86	0.0	0.0	0.0
87	0.0	0.0	0.0
88	0.0	0.0	0.0
89	0.0	0.0	0.0
90	0.0	0.0	0.0
91	0.0	0.0	0.0
92	2.5	0.0	5.0
93	0.0	0.0	3.8
94	0.0	0.0	1.3
95	0.0	0.0	0.0
96	0.0	0.0	0.0
97	0.0	0.0	0.0
98	0.0	0.0	0.0
99	0.0	0.0	0.0
100	0.0	3.8	10.0
101	0.0	0.0	0.0
102	0.0	0.0	0.0
103	0.0	0.0	7.5
104	0.0	0.0	0.0
105	0.0	0.0	0.0
106	0.0	0.0	1.3
107	0.0	0.0	0.0
108	0.0	0.0	0.0
109	0.0	0.0	6.3
110	0.0	5.0	0.0
111	10.0	0.0	0.0
112	0.0	0.0	0.0
113	0.0	0.0	1.3
114	0.0	0.0	0.0
115	0.0	0.0	0.0
116	0.0	1.3	0.0
117	0.0	0.0	0.0
118	0.0	0.0	0.0
119	0.0	0.0	0.0
120	0.0	0.0	0.0
121	0.0	0.0	0.0
122	0.0	0.0	0.0
123	0.0	0.0	0.0
124	0.0	1.3	0.0
125	13.8	0.0	0.0
126	0.0	0.0	6.3
127	0.0	0.0	2.5
128	0.0	1.3	0.0
129	0.0	0.0	0.0
130	0.0	51.3	0.0
131	0.0	0.0	0.0
132	0.0	0.0	3.8
133	0.0	57.6	7.5
134	13.8	0.0	2.5
135	0.0	18.8	0.0
136	0.0	0.0	0.0
137	33.8	3.8	0.0
138	0.0	0.0	0.0
139	0.0	0.0	1.3
140	0.0	0.0	0.0
141	10.0	48.8	0.0
142	0.0	0.0	0.0
143	0.0	7.5	0.0
144	13.8	0.0	0.0
145	16.3	17.5	12.5
146	61.3	15.0	5.0
147	23.8	0.0	0.0
148	0.0	0.0	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	Year 1	Year 2	Year 3
149	10.1	0.0	0.0
150	0.0	0.0	19.0
151	20.1	0.0	0.0
152	0.0	0.0	0.0
153	0.0	2.2	1.1
154	1.1	63.7	14.8
155	15.6	27.9	4.2
156	4.5	5.6	14.8
157	15.6	0.0	0.0
158	0.0	0.0	0.0
159	0.0	0.0	0.0
160	0.0	2.2	0.0
161	0.0	26.8	0.0
162	0.0	6.7	0.0
163	0.0	0.0	0.0
164	0.0	0.0	0.0
165	0.0	0.0	0.0
166	0.0	7.8	0.0
167	0.0	0.0	27.5
168	29.0	1.1	27.5
169	29.0	20.1	19.0
170	20.1	0.0	14.8
171	15.6	0.0	1.1
172	1.1	21.2	0.0
173	0.0	1.1	0.0
174	0.0	0.0	0.0
175	0.0	24.6	0.0
176	0.0	2.2	8.5
177	8.9	0.0	0.0
178	0.0	0.0	0.0
179	0.0	2.2	0.0
180	0.0	0.0	0.0
181	0.0	0.0	0.0
182	0.0	0.0	0.0
183	0.0	25.7	0.0
184	0.0	0.0	0.0
185	0.0	0.0	0.0
186	0.0	0.0	0.0
187	0.0	0.0	0.0
188	0.0	0.0	0.0
189	0.0	1.1	0.0
190	0.0	0.0	0.0
191	0.0	0.0	0.0
192	0.0	0.0	0.0
193	0.0	0.0	0.0
194	0.0	0.0	0.0
195	0.0	0.0	21.1
196	22.3	0.0	0.0
197	0.0	0.0	0.0
198	0.0	0.0	0.0
199	0.0	0.0	0.0
200	0.0	0.0	0.0
201	0.0	0.0	12.7
202	13.4	0.0	0.0
203	0.0	0.0	0.0
204	0.0	0.0	1.1
205	1.1	0.0	0.0
206	0.0	33.5	0.0
207	0.0	1.1	0.0
208	0.0	0.0	3.2
209	3.4	0.0	10.6
210	11.2	3.4	0.0
211	0.0	0.0	0.0
212	0.0	0.0	0.0
213	0.0	2.2	1.1
214	1.1	0.0	50.7
215	53.6	0.0	0.0
216	0.0	0.0	0.0
217	0.0	0.0	0.0
218	0.0	2.2	3.2
219	3.4	0.0	0.0
220	0.0	0.0	0.0
221	0.0	0.0	3.2
222	3.4	2.2	5.3

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	Year 1	Year 2	Year 3
149	11.3	0.0	0.0
150	0.0	0.0	2.5
151	22.5	0.0	0.0
152	0.0	0.0	31.3
153	0.0	2.5	0.0
154	1.3	71.3	0.0
155	17.5	31.3	0.0
156	5.0	6.3	0.0
157	17.5	0.0	0.0
158	0.0	0.0	0.0
159	0.0	0.0	0.0
160	0.0	2.5	0.0
161	0.0	30.0	0.0
162	0.0	7.5	0.0
163	0.0	0.0	0.0
164	0.0	0.0	2.5
165	0.0	0.0	0.0
166	0.0	8.8	1.3
167	0.0	0.0	0.0
168	32.5	1.3	0.0
169	32.5	22.5	0.0
170	22.5	0.0	0.0
171	17.5	0.0	0.0
172	1.3	23.8	0.0
173	0.0	1.3	0.0
174	0.0	0.0	3.8
175	0.0	27.5	8.8
176	0.0	2.5	17.5
177	10.0	0.0	1.3
178	0.0	0.0	0.0
179	0.0	2.5	0.0
180	0.0	0.0	0.0
181	0.0	0.0	0.0
182	0.0	0.0	0.0
183	0.0	28.8	0.0
184	0.0	0.0	1.3
185	0.0	0.0	0.0
186	0.0	0.0	0.0
187	0.0	0.0	0.0
188	0.0	0.0	0.0
189	0.0	1.3	0.0
190	0.0	0.0	0.0
191	0.0	0.0	0.0
192	0.0	0.0	0.0
193	0.0	0.0	0.0
194	0.0	0.0	0.0
195	0.0	0.0	27.5
196	25.0	0.0	2.5
197	0.0	0.0	1.3
198	0.0	0.0	0.0
199	0.0	0.0	0.0
200	0.0	0.0	1.3
201	0.0	0.0	0.0
202	15.0	0.0	0.0
203	0.0	0.0	16.3
204	0.0	0.0	1.3
205	1.3	0.0	3.8
206	0.0	37.5	0.0
207	0.0	1.3	0.0
208	0.0	0.0	0.0
209	3.8	0.0	0.0
210	12.5	3.8	0.0
211	0.0	0.0	0.0
212	0.0	0.0	0.0
213	0.0	2.5	0.0
214	1.3	0.0	0.0
215	60.1	0.0	0.0
216	0.0	0.0	0.0
217	0.0	0.0	0.0
218	0.0	2.5	0.0
219	3.8	0.0	0.0
220	0.0	0.0	0.0
221	0.0	0.0	0.0
222	3.8	2.5	0.0

Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	Year 1	Year 2	Year 3
223	5.6	0.0	0.0
224	0.0	0.0	0.0
225	0.0	0.0	0.0
226	0.0	1.1	0.0
227	0.0	0.0	31.7
228	33.5	0.0	0.0
229	0.0	1.1	0.0
230	0.0	0.0	1.1
231	1.1	0.0	3.2
232	3.4	0.0	6.3
233	6.7	12.3	1.1
234	1.1	0.0	0.0
235	0.0	0.0	0.0
236	0.0	0.0	19.0
237	20.1	0.0	0.0
238	0.0	1.1	12.7
239	13.4	8.9	51.8
240	54.7	0.0	0.0
241	0.0	0.0	6.3
242	6.7	15.6	1.1
243	1.1	26.8	2.1
244	2.2	11.2	2.1
245	2.2	0.0	0.0
246	0.0	5.6	0.0
247	0.0	1.1	0.0
248	0.0	0.0	0.0
249	0.0	0.0	0.0
250	0.0	0.0	2.1
251	2.2	0.0	13.7
252	14.5	0.0	28.5
253	30.2	0.0	11.6
254	12.3	0.0	0.0
255	0.0	0.0	0.0
256	0.0	16.8	0.0
257	0.0	6.7	9.5
258	10.1	6.7	0.0
259	0.0	22.3	0.0
260	0.0	2.2	0.0
261	0.0	35.7	0.0
262	0.0	1.1	4.2
263	4.5	0.0	19.0
264	20.1	0.0	57.1
265	60.3	0.0	72.9
266	77.1	0.0	0.0
267	0.0	0.0	19.0
268	20.1	0.0	3.2
269	3.4	21.2	0.0
270	0.0	4.5	0.0
271	0.0	0.0	0.0
272	0.0	0.0	0.0
273	0.0	13.4	0.0
274	0.0	1.1	0.0
275	0.0	0.0	58.1
276	61.4	2.2	0.0
277	0.0	4.5	1.1
278	1.1	0.0	38.1
279	40.2	0.0	8.5
280	8.9	0.0	20.1
281	21.2	0.0	15.9
282	16.8	0.0	0.0
283	0.0	0.0	0.0
284	0.0	1.1	0.0
285	0.0	29.0	0.0
286	0.0	49.1	0.0
287	0.0	55.8	2.1
288	2.2	5.6	6.3
289	6.7	2.2	0.0
290	0.0	26.8	0.0
291	0.0	22.3	7.4
292	7.8	84.9	0.0
293	0.0	0.0	0.0
294	0.0	0.0	0.0
295	0.0	58.1	0.0
296	0.0	3.4	0.0

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	Year 1	Year 2	Year 3
223	6.3	0.0	0.0
224	0.0	0.0	0.0
225	0.0	0.0	0.0
226	0.0	1.3	0.0
227	0.0	0.0	0.0
228	37.5	0.0	0.0
229	0.0	1.3	0.0
230	0.0	0.0	20.0
231	1.3	0.0	40.0
232	3.8	0.0	65.1
233	7.5	13.8	23.8
234	1.3	0.0	15.0
235	0.0	0.0	3.8
236	0.0	0.0	20.0
237	22.5	0.0	0.0
238	0.0	1.3	28.8
239	15.0	10.0	0.0
240	61.3	0.0	0.0
241	0.0	0.0	0.0
242	7.5	17.5	3.8
243	1.3	30.0	26.3
244	2.5	12.5	17.5
245	2.5	0.0	27.5
246	0.0	6.3	0.0
247	0.0	1.3	0.0
248	0.0	0.0	5.0
249	0.0	0.0	0.0
250	0.0	0.0	57.6
251	2.5	0.0	20.0
252	16.3	0.0	11.3
253	33.8	0.0	1.3
254	13.8	0.0	43.8
255	0.0	0.0	17.5
256	0.0	18.8	0.0
257	0.0	7.5	0.0
258	11.3	7.5	5.0
259	0.0	25.0	3.8
260	0.0	2.5	0.0
261	0.0	40.0	0.0
262	0.0	1.3	0.0
263	5.0	0.0	0.0
264	22.5	0.0	65.1
265	67.6	0.0	90.1
266	86.3	0.0	3.8
267	0.0	0.0	0.0
268	22.5	0.0	0.0
269	3.8	23.8	0.0
270	0.0	5.0	0.0
271	0.0	0.0	0.0
272	0.0	0.0	28.8
273	0.0	15.0	1.3
274	0.0	1.3	0.0
275	0.0	0.0	0.0
276	68.8	2.5	0.0
277	0.0	5.0	0.0
278	1.3	0.0	0.0
279	45.0	0.0	0.0
280	10.0	0.0	0.0
281	23.8	0.0	0.0
282	18.8	0.0	46.3
283	0.0	0.0	6.3
284	0.0	1.3	80.1
285	0.0	32.5	8.8
286	0.0	55.1	1.3
287	0.0	62.6	16.3
288	2.5	6.3	0.0
289	7.5	2.5	0.0
290	0.0	30.0	0.0
291	0.0	25.0	0.0
292	8.8	95.1	0.0
293	0.0	0.0	0.0
294	0.0	0.0	6.3
295	0.0	65.1	8.8
296	0.0	3.8	0.0

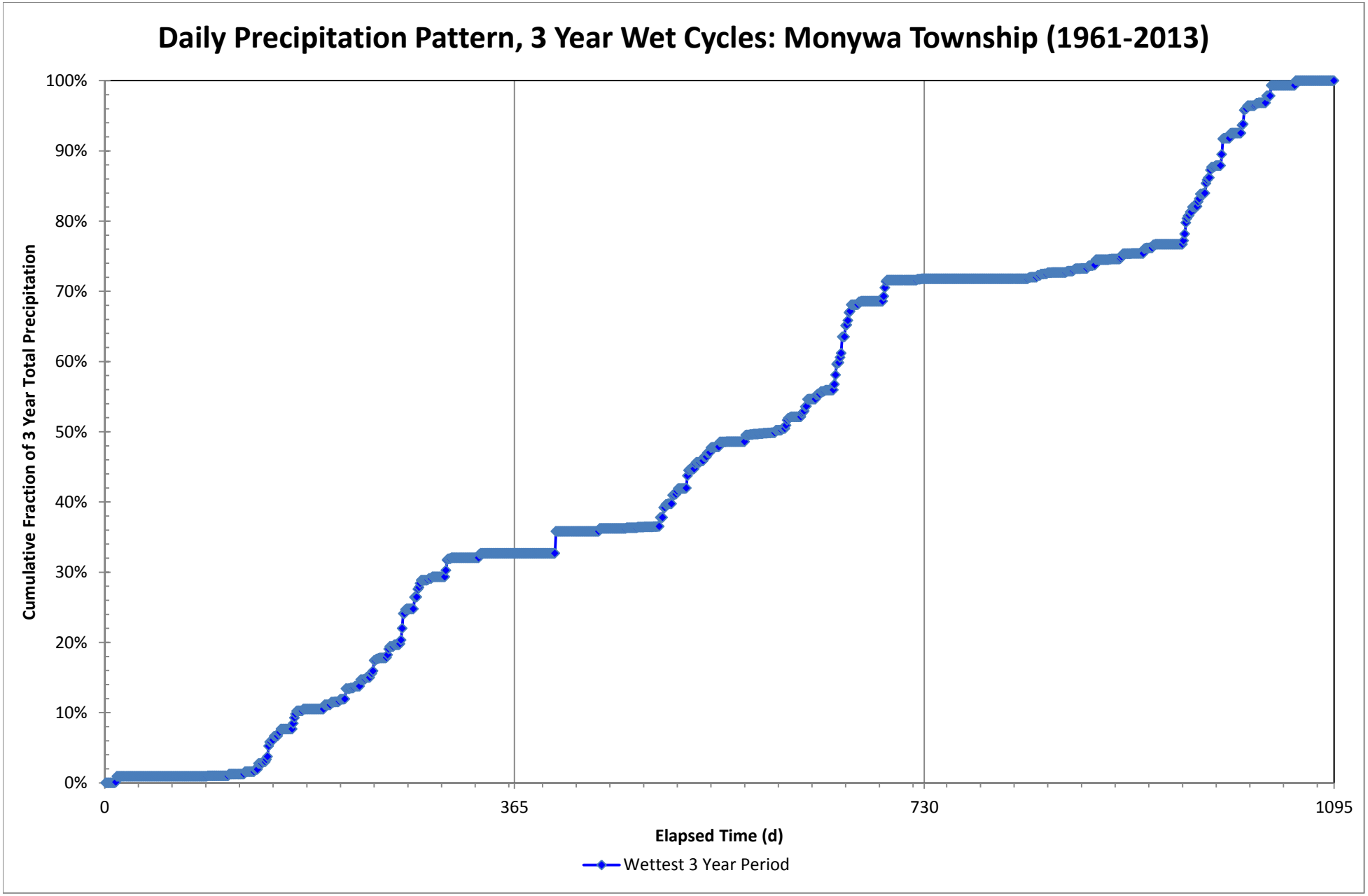
Precipitation, 3 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1191.6	1423.8	1127.9
Day	Year 1	Year 2	Year 3
297	0.0	23.5	0.0
298	0.0	40.2	0.0
299	0.0	6.7	0.0
300	0.0	33.5	0.0
301	0.0	0.0	0.0
302	0.0	0.0	0.0
303	0.0	0.0	32.8
304	34.6	0.0	49.7
305	52.5	0.0	6.3
306	6.7	2.2	1.1
307	1.1	13.4	0.0
308	0.0	0.0	4.2
309	4.5	3.4	0.0
310	0.0	0.0	0.0
311	0.0	0.0	0.0
312	0.0	0.0	0.0
313	0.0	0.0	0.0
314	0.0	0.0	0.0
315	0.0	0.0	0.0
316	0.0	0.0	0.0
317	0.0	0.0	0.0
318	0.0	0.0	0.0
319	0.0	0.0	0.0
320	0.0	0.0	0.0
321	0.0	0.0	0.0
322	0.0	0.0	0.0
323	0.0	0.0	0.0
324	0.0	0.0	0.0
325	0.0	0.0	0.0
326	0.0	0.0	0.0
327	0.0	0.0	0.0
328	0.0	0.0	0.0
329	0.0	25.7	0.0
330	0.0	44.7	0.0
331	0.0	32.4	0.0
332	0.0	6.7	0.0
333	0.0	0.0	19.0
334	20.1	0.0	3.2
335	3.4	0.0	0.0
336	0.0	0.0	0.0
337	0.0	0.0	0.0
338	0.0	0.0	0.0
339	0.0	0.0	0.0
340	0.0	0.0	0.0
341	0.0	0.0	0.0
342	0.0	0.0	0.0
343	0.0	0.0	0.0
344	0.0	0.0	0.0
345	0.0	0.0	0.0
346	0.0	0.0	0.0
347	0.0	0.0	0.0
348	0.0	0.0	0.0
349	0.0	0.0	0.0
350	0.0	0.0	0.0
351	0.0	0.0	0.0
352	0.0	0.0	0.0
353	0.0	0.0	0.0
354	0.0	0.0	0.0
355	0.0	0.0	0.0
356	0.0	0.0	0.0
357	0.0	0.0	0.0
358	0.0	0.0	0.0
359	0.0	4.5	0.0
360	0.0	0.0	0.0
361	0.0	0.0	0.0
362	0.0	1.1	0.0
363	0.0	1.1	0.0
364	0.0	0.0	0.0
365	0.0	0.0	0.0
366		0.0	

500 year ARI (mm)

Total	1335.1	1595.4	1152.4
Day	Year 1	Year 2	Year 3
297	0.0	26.3	2.5
298	0.0	45.0	0.0
299	0.0	7.5	0.0
300	0.0	37.5	0.0
301	0.0	0.0	0.0
302	0.0	0.0	0.0
303	0.0	0.0	0.0
304	38.8	0.0	40.0
305	58.8	0.0	0.0
306	7.5	2.5	0.0
307	1.3	15.0	0.0
308	0.0	0.0	61.3
309	5.0	3.8	0.0
310	0.0	0.0	0.0
311	0.0	0.0	0.0
312	0.0	0.0	0.0
313	0.0	0.0	0.0
314	0.0	0.0	0.0
315	0.0	0.0	0.0
316	0.0	0.0	0.0
317	0.0	0.0	0.0
318	0.0	0.0	0.0
319	0.0	0.0	0.0
320	0.0	0.0	0.0
321	0.0	0.0	0.0
322	0.0	0.0	0.0
323	0.0	0.0	0.0
324	0.0	0.0	0.0
325	0.0	0.0	0.0
326	0.0	0.0	0.0
327	0.0	0.0	0.0
328	0.0	0.0	0.0
329	0.0	28.8	0.0
330	0.0	50.1	27.5
331	0.0	36.3	0.0
332	0.0	7.5	0.0
333	0.0	0.0	0.0
334	22.5	0.0	0.0
335	3.8	0.0	0.0
336	0.0	0.0	0.0
337	0.0	0.0	0.0
338	0.0	0.0	0.0
339	0.0	0.0	0.0
340	0.0	0.0	0.0
341	0.0	0.0	0.0
342	0.0	0.0	0.0
343	0.0	0.0	0.0
344	0.0	0.0	0.0
345	0.0	0.0	0.0
346	0.0	0.0	0.0
347	0.0	0.0	0.0
348	0.0	0.0	0.0
349	0.0	0.0	0.0
350	0.0	0.0	0.0
351	0.0	0.0	0.0
352	0.0	0.0	0.0
353	0.0	0.0	0.0
354	0.0	0.0	0.0
355	0.0	0.0	0.0
356	0.0	0.0	0.0
357	0.0	0.0	0.0
358	0.0	0.0	0.0
359	0.0	5.0	0.0
360	0.0	0.0	0.0
361	0.0	0.0	0.0
362	0.0	1.3	0.0
363	0.0	1.3	0.0
364	0.0	0.0	0.0
365	0.0	0.0	0.0
366		0.0	


Daily Precipitation Pattern, 3 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 3 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
365
730
1095
Elapsed Time (d)
Wettest 3 Year Period

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	Year 1	Year 2
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0
25	0.0	0.0
26	0.0	0.0
27	0.0	0.0
28	0.0	0.0
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	0.0
38	0.0	0.0
39	0.0	0.0
40	0.0	0.0
41	0.0	0.0
42	0.0	0.0
43	0.0	0.0
44	0.0	0.0
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	0.0
52	0.0	0.0
53	0.0	0.0
54	0.0	0.0
55	0.0	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	0.0
59	0.0	0.0
60	0.0	0.0
61	0.0	0.0
62	0.0	0.0
63	0.0	0.0
64	0.0	0.0
65	0.0	0.0
66	0.0	0.0
67	0.0	0.0
68	0.0	0.0
69	0.0	0.0
70	0.0	0.0
71	0.0	0.0
72	0.0	0.0
73	0.0	0.0
74	0.0	0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	Year 1	Year 2
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0
17	0.0	0.0
18	0.0	0.0
19	0.0	0.0
20	0.0	0.0
21	0.0	0.0
22	0.0	0.0
23	0.0	0.0
24	0.0	0.0
25	0.0	0.0
26	0.0	0.0
27	0.0	0.0
28	0.0	0.0
29	0.0	0.0
30	0.0	0.0
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	0.0	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	0.0
38	0.0	0.0
39	0.0	0.0
40	0.0	0.0
41	0.0	0.0
42	0.0	0.0
43	0.0	0.0
44	0.0	0.0
45	0.0	0.0
46	0.0	0.0
47	0.0	0.0
48	0.0	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	0.0
52	0.0	0.0
53	0.0	0.0
54	0.0	0.0
55	0.0	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	0.0
59	0.0	0.0
60	0.0	0.0
61	0.0	0.0
62	0.0	0.0
63	0.0	0.0
64	0.0	0.0
65	0.0	0.0
66	0.0	0.0
67	0.0	0.0
68	0.0	0.0
69	0.0	0.0
70	0.0	0.0
71	0.0	0.0
72	0.0	0.0
73	0.0	0.0
74	0.0	0.0

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	Year 1	Year 2
75	0.0	0.0
76	0.0	0.0
77	0.0	0.0
78	0.0	0.0
79	0.0	0.0
80	0.0	0.0
81	0.0	0.0
82	0.0	0.0
83	0.0	0.0
84	0.0	0.0
85	0.0	0.0
86	0.0	3.7
87	0.0	0.0
88	3.2	1.6
89	0.0	0.5
90	6.3	0.0
91	0.0	0.0
92	0.0	1.6
93	0.0	0.0
94	0.0	0.0
95	0.0	0.0
96	0.0	0.0
97	0.0	0.0
98	0.0	0.0
99	0.0	0.0
100	0.0	0.0
101	0.0	0.0
102	0.0	0.0
103	0.0	0.0
104	0.0	0.0
105	0.0	0.0
106	10.6	0.0
107	0.0	0.0
108	0.0	0.0
109	0.0	0.0
110	0.0	0.0
111	0.0	0.0
112	0.0	0.0
113	0.0	15.9
114	0.0	1.1
115	4.2	0.0
116	0.0	0.0
117	0.0	8.5
118	4.2	73.0
119	0.0	2.1
120	0.0	3.2
121	0.0	0.0
122	0.0	0.0
123	0.0	0.0
124	0.0	7.9
125	0.0	0.0
126	8.5	5.9
127	0.0	0.0
128	0.0	0.5
129	0.0	0.0
130	0.0	0.0
131	0.0	0.0
132	0.0	0.0
133	0.0	0.0
134	0.0	0.0
135	0.0	0.0
136	21.7	5.3
137	0.0	12.2
138	0.0	1.1
139	0.0	0.0
140	1.1	0.0
141	44.4	9.0
142	0.0	0.0
143	0.0	7.9
144	12.2	12.2
145	0.0	0.0
146	0.0	0.0
147	0.0	11.0
148	0.0	5.8

500 year ARI (mm)

Total	1443.7	1400.3
Day	Year 1	Year 2
75	0.0	0.0
76	0.0	0.0
77	0.0	0.0
78	0.0	0.0
79	0.0	0.0
80	0.0	0.0
81	0.0	0.0
82	0.0	0.0
83	0.0	0.0
84	0.0	0.0
85	0.0	0.0
86	0.0	4.1
87	0.0	0.0
88	3.5	1.8
89	0.0	0.6
90	7.1	0.0
91	0.0	0.0
92	0.0	1.8
93	0.0	0.0
94	0.0	0.0
95	0.0	0.0
96	0.0	0.0
97	0.0	0.0
98	0.0	0.0
99	0.0	0.0
100	0.0	0.0
101	0.0	0.0
102	0.0	0.0
103	0.0	0.0
104	0.0	0.0
105	0.0	0.0
106	11.8	0.0
107	0.0	0.0
108	0.0	0.0
109	0.0	0.0
110	0.0	0.0
111	0.0	0.0
112	0.0	0.0
113	0.0	17.7
114	0.0	1.2
115	4.7	0.0
116	0.0	0.0
117	0.0	9.5
118	4.7	81.6
119	0.0	2.4
120	0.0	3.5
121	0.0	0.0
122	0.0	0.0
123	0.0	0.0
124	0.0	8.9
125	0.0	0.0
126	9.5	6.6
127	0.0	0.0
128	0.0	0.6
129	0.0	0.0
130	0.0	0.0
131	0.0	0.0
132	0.0	0.0
133	0.0	0.0
134	0.0	0.0
135	0.0	0.0
136	24.2	5.9
137	0.0	13.6
138	0.0	1.2
139	0.0	0.0
140	1.2	0.0
141	49.7	10.1
142	0.0	0.0
143	0.0	8.9
144	13.6	13.6
145	0.0	0.0
146	0.0	0.0
147	0.0	12.3
148	0.0	6.5

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	Year 1	Year 2
149	0.0	14.8
150	0.0	0.0
151	0.0	0.0
152	0.0	48.6
153	0.0	0.0
154	0.0	3.2
155	4.2	0.0
156	0.0	0.0
157	0.0	105.8
158	0.0	25.4
159	0.0	11.6
160	0.0	4.2
161	0.0	0.0
162	0.0	0.0
163	0.0	0.0
164	0.0	0.0
165	0.0	9.0
166	41.2	0.0
167	3.2	0.5
168	20.1	2.1
169	12.2	0.0
170	0.0	0.0
171	0.0	0.0
172	0.0	0.0
173	0.0	0.0
174	7.4	0.0
175	28.6	69.7
176	1.6	0.5
177	0.0	0.0
178	0.0	0.0
179	4.2	0.0
180	0.0	0.0
181	0.0	0.0
182	0.0	0.0
183	29.3	0.0
184	0.0	0.0
185	0.0	0.0
186	0.0	0.0
187	0.0	0.0
188	0.0	0.0
189	0.0	0.0
190	0.0	0.0
191	0.0	1.6
192	0.0	0.0
193	0.0	0.7
194	0.0	0.0
195	0.0	0.0
196	0.0	29.1
197	5.9	0.0
198	20.6	0.0
199	9.8	0.0
200	2.6	0.0
201	8.5	3.9
202	34.9	0.0
203	0.0	0.0
204	0.0	1.1
205	0.0	4.2
206	0.0	0.5
207	5.3	0.5
208	0.0	0.0
209	0.0	46.5
210	5.8	0.0
211	1.1	0.0
212	15.3	2.1
213	0.0	20.6
214	0.0	0.0
215	0.0	0.0
216	13.2	0.0
217	0.0	0.0
218	0.0	0.0
219	0.0	8.1
220	0.0	4.8
221	0.0	41.2
222	0.0	2.6

500 year ARI (mm)

Total	1443.7	1400.3
Day	Year 1	Year 2
149	0.0	16.6
150	0.0	0.0
151	0.0	0.0
152	0.0	54.4
153	0.0	0.0
154	0.0	3.5
155	4.7	0.0
156	0.0	0.0
157	0.0	118.3
158	0.0	28.4
159	0.0	13.0
160	0.0	4.7
161	0.0	0.0
162	0.0	0.0
163	0.0	0.0
164	0.0	0.0
165	0.0	10.1
166	46.1	0.0
167	3.5	0.6
168	22.5	2.4
169	13.6	0.0
170	0.0	0.0
171	0.0	0.0
172	0.0	0.0
173	0.0	0.0
174	8.3	0.0
175	31.9	77.9
176	1.8	0.6
177	0.0	0.0
178	0.0	0.0
179	4.7	0.0
180	0.0	0.0
181	0.0	0.0
182	0.0	0.0
183	32.8	0.0
184	0.0	0.0
185	0.0	0.0
186	0.0	0.0
187	0.0	0.0
188	0.0	0.0
189	0.0	0.0
190	0.0	0.0
191	0.0	1.8
192	0.0	0.0
193	0.0	0.8
194	0.0	0.0
195	0.0	0.0
196	0.0	32.5
197	6.6	0.0
198	23.1	0.0
199	11.0	0.0
200	3.0	0.0
201	9.5	4.4
202	39.0	0.0
203	0.0	0.0
204	0.0	1.2
205	0.0	4.7
206	0.0	0.6
207	5.9	0.6
208	0.0	0.0
209	0.0	52.0
210	6.5	0.0
211	1.2	0.0
212	17.1	2.4
213	0.0	23.1
214	0.0	0.0
215	0.0	0.0
216	14.8	0.0
217	0.0	0.0
218	0.0	0.0
219	0.0	9.1
220	0.0	5.3
221	0.0	46.1
222	0.0	3.0

Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	Year 1	Year 2
223	4.2	36.0
224	2.6	9.0
225	0.0	0.0
226	0.0	0.0
227	0.0	0.0
228	0.0	25.4
229	47.6	2.6
230	18.5	0.0
231	0.0	3.7
232	0.0	0.5
233	0.0	0.0
234	89.9	0.0
235	0.0	0.0
236	7.4	27.5
237	10.0	1.1
238	0.0	42.8
239	0.0	13.2
240	0.0	9.5
241	2.1	0.0
242	0.0	0.0
243	0.0	0.0
244	0.0	0.0
245	0.0	0.0
246	9.0	0.0
247	9.3	3.7
248	0.0	0.0
249	0.0	0.0
250	0.0	0.0
251	0.0	0.0
252	0.0	4.8
253	0.0	0.0
254	20.1	0.0
255	0.0	0.0
256	1.6	15.9
257	68.2	4.2
258	0.0	0.0
259	0.0	0.0
260	2.1	0.0
261	0.0	0.0
262	0.0	0.0
263	9.0	14.8
264	0.0	1.1
265	35.4	0.0
266	0.0	0.0
267	0.0	0.0
268	0.0	0.0
269	0.0	0.0
270	0.0	0.0
271	0.0	21.7
272	6.9	3.9
273	0.0	30.7
274	0.0	14.8
275	0.0	10.6
276	0.0	14.3
277	0.0	6.9
278	0.0	3.7
279	83.6	0.0
280	89.9	0.0
281	55.0	0.0
282	0.0	0.0
283	1.6	0.0
284	2.1	0.0
285	6.3	0.0
286	5.3	0.0
287	37.0	0.0
288	0.0	2.1
289	20.6	0.0
290	0.0	38.1
291	0.0	22.7
292	0.0	174.5
293	55.5	0.0
294	0.0	0.0
295	54.5	0.0
296	114.7	0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	Year 1	Year 2
223	4.7	40.2
224	3.0	10.1
225	0.0	0.0
226	0.0	0.0
227	0.0	0.0
228	0.0	28.4
229	53.2	3.0
230	20.7	0.0
231	0.0	4.1
232	0.0	0.6
233	0.0	0.0
234	100.5	0.0
235	0.0	0.0
236	8.3	30.7
237	11.2	1.2
238	0.0	47.9
239	0.0	14.8
240	0.0	10.6
241	2.4	0.0
242	0.0	0.0
243	0.0	0.0
244	0.0	0.0
245	0.0	0.0
246	10.1	0.0
247	10.4	4.1
248	0.0	0.0
249	0.0	0.0
250	0.0	0.0
251	0.0	0.0
252	0.0	5.3
253	0.0	0.0
254	22.5	0.0
255	0.0	0.0
256	1.8	17.7
257	76.3	4.7
258	0.0	0.0
259	0.0	0.0
260	2.4	0.0
261	0.0	0.0
262	0.0	0.0
263	10.1	16.6
264	0.0	1.2
265	39.6	0.0
266	0.0	0.0
267	0.0	0.0
268	0.0	0.0
269	0.0	0.0
270	0.0	0.0
271	0.0	24.2
272	7.7	4.4
273	0.0	34.3
274	0.0	16.6
275	0.0	11.8
276	0.0	16.0
277	0.0	7.7
278	0.0	4.1
279	93.4	0.0
280	100.5	0.0
281	61.5	0.0
282	0.0	0.0
283	1.8	0.0
284	2.4	0.0
285	7.1	0.0
286	5.9	0.0
287	41.4	0.0
288	0.0	2.4
289	23.1	0.0
290	0.0	42.6
291	0.0	25.4
292	0.0	195.1
293	62.1	0.0
294	0.0	0.0
295	60.9	0.0
296	128.3	0.0

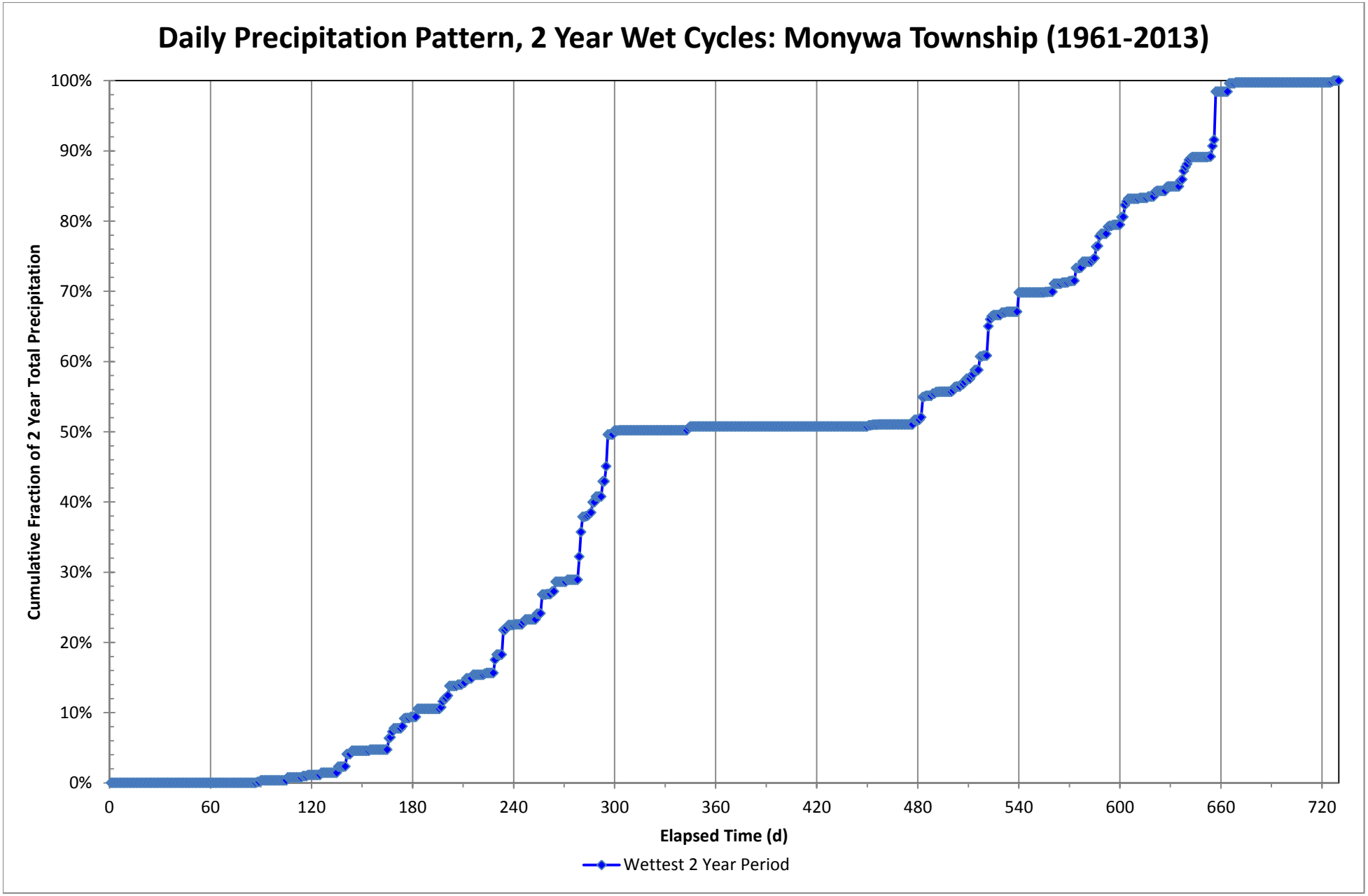
Precipitation, 2 Year Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	1291.2	1252.4
Day	Year 1	Year 2
297	0.0	0.0
298	0.0	0.0
299	0.0	0.0
300	14.8	29.6
301	0.0	0.0
302	0.0	0.0
303	1.1	0.0
304	0.0	3.2
305	0.0	0.0
306	0.0	0.0
307	0.0	0.0
308	0.0	0.0
309	0.0	0.0
310	0.0	0.0
311	0.0	0.0
312	0.0	0.0
313	0.0	0.0
314	0.0	0.0
315	0.0	0.0
316	0.0	0.0
317	0.0	0.0
318	0.0	0.0
319	0.0	0.0
320	0.0	0.0
321	0.0	0.0
322	0.0	0.0
323	0.0	0.0
324	0.0	0.0
325	0.0	0.0
326	0.0	0.0
327	0.0	0.0
328	0.0	0.0
329	0.0	0.0
330	0.0	0.0
331	0.0	0.0
332	0.0	0.0
333	0.0	0.0
334	0.0	0.0
335	0.0	0.0
336	0.0	0.0
337	0.0	0.0
338	0.0	0.0
339	0.0	0.0
340	0.0	0.0
341	0.0	0.0
342	0.0	0.0
343	0.0	0.0
344	8.5	0.0
345	5.3	0.0
346	0.0	0.0
347	0.0	0.0
348	0.0	0.0
349	0.0	0.0
350	0.0	0.0
351	0.0	0.0
352	0.0	0.0
353	0.0	0.0
354	0.0	0.0
355	0.0	0.0
356	0.0	0.0
357	0.0	0.0
358	0.0	0.0
359	0.0	0.0
360	0.0	0.0
361	0.0	2.6
362	0.0	4.2
363	0.0	0.0
364	0.0	0.0
365	0.0	0.0
366		0.0

500 year ARI (mm)

Total	1443.7	1400.3
Day	Year 1	Year 2
297	0.0	0.0
298	0.0	0.0
299	0.0	0.0
300	16.6	33.1
301	0.0	0.0
302	0.0	0.0
303	1.2	0.0
304	0.0	3.5
305	0.0	0.0
306	0.0	0.0
307	0.0	0.0
308	0.0	0.0
309	0.0	0.0
310	0.0	0.0
311	0.0	0.0
312	0.0	0.0
313	0.0	0.0
314	0.0	0.0
315	0.0	0.0
316	0.0	0.0
317	0.0	0.0
318	0.0	0.0
319	0.0	0.0
320	0.0	0.0
321	0.0	0.0
322	0.0	0.0
323	0.0	0.0
324	0.0	0.0
325	0.0	0.0
326	0.0	0.0
327	0.0	0.0
328	0.0	0.0
329	0.0	0.0
330	0.0	0.0
331	0.0	0.0
332	0.0	0.0
333	0.0	0.0
334	0.0	0.0
335	0.0	0.0
336	0.0	0.0
337	0.0	0.0
338	0.0	0.0
339	0.0	0.0
340	0.0	0.0
341	0.0	0.0
342	0.0	0.0
343	0.0	0.0
344	9.5	0.0
345	5.9	0.0
346	0.0	0.0
347	0.0	0.0
348	0.0	0.0
349	0.0	0.0
350	0.0	0.0
351	0.0	0.0
352	0.0	0.0
353	0.0	0.0
354	0.0	0.0
355	0.0	0.0
356	0.0	0.0
357	0.0	0.0
358	0.0	0.0
359	0.0	0.0
360	0.0	0.0
361	0.0	3.0
362	0.0	4.7
363	0.0	0.0
364	0.0	0.0
365	0.0	0.0
366		0.0


Daily Precipitation Pattern, 2 Year Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 2 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
60
120
180
240
300
360
420
480
540
600
660
720
Elapsed Time (d)
Wettest 2 Year Period

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	Year 1
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0
17	0.0
18	0.0
19	0.0
20	0.0
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	0.0
27	0.0
28	0.0
29	0.0
30	0.0
31	0.0
32	0.0
33	0.0
34	0.0
35	0.0
36	0.0
37	0.0
38	0.0
39	0.0
40	0.0
41	0.0
42	0.0
43	0.0
44	0.0
45	0.0
46	0.0
47	0.0
48	0.0
49	0.0
50	0.0
51	0.0
52	0.0
53	0.0
54	0.0
55	0.0
56	0.0
57	0.0
58	0.0
59	0.0
60	0.0
61	0.0
62	0.0
63	0.0
64	0.0
65	0.0
66	0.0
67	0.0
68	2.3
69	0.0
70	0.0
71	0.0
72	0.0
73	0.0
74	0.0

Wet, 500 year ARI (mm)

Total	1901.8
Day	Year 1
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0
17	0.0
18	0.0
19	0.0
20	0.0
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	0.0
27	0.0
28	0.0
29	0.0
30	0.0
31	0.0
32	0.0
33	0.0
34	0.0
35	0.0
36	0.0
37	0.0
38	0.0
39	0.0
40	0.0
41	0.0
42	0.0
43	0.0
44	0.0
45	0.0
46	0.0
47	0.0
48	0.0
49	0.0
50	0.0
51	0.0
52	0.0
53	0.0
54	0.0
55	0.0
56	0.0
57	0.0
58	0.0
59	0.0
60	0.0
61	0.0
62	0.0
63	0.0
64	0.0
65	0.0
66	0.0
67	0.0
68	2.8
69	0.0
70	0.0
71	0.0
72	0.0
73	0.0
74	0.0

Dry, 100 year ARI (mm)

Total	424.0
Day	Year 1
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0
17	0.0
18	0.0
19	0.0
20	0.0
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	0.0
27	0.0
28	0.0
29	0.0
30	0.0
31	0.0
32	0.0
33	0.0
34	0.0
35	0.0
36	0.0
37	0.0
38	0.0
39	0.0
40	0.0
41	0.0
42	0.0
43	0.0
44	0.0
45	0.0
46	0.0
47	0.0
48	0.0
49	0.0
50	0.0
51	0.0
52	0.0
53	0.0
54	0.0
55	0.0
56	0.0
57	0.0
58	0.0
59	0.0
60	0.0
61	0.0
62	0.0
63	0.0
64	0.0
65	0.0
66	0.0
67	0.0
68	0.0
69	0.0
70	0.0
71	0.0
72	0.0
73	0.0
74	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	Year 1
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0
17	0.0
18	0.0
19	0.0
20	0.0
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	0.0
27	0.0
28	0.0
29	0.0
30	0.0
31	0.0
32	0.0
33	0.0
34	0.0
35	0.0
36	0.0
37	0.0
38	0.0
39	0.0
40	0.0
41	0.0
42	0.0
43	0.0
44	0.0
45	0.0
46	0.0
47	0.0
48	0.0
49	0.0
50	0.0
51	0.0
52	0.0
53	0.0
54	0.0
55	0.0
56	0.0
57	0.0
58	0.0
59	0.0
60	0.0
61	0.0
62	0.0
63	0.0
64	0.0
65	0.0
66	0.0
67	0.0
68	0.0
69	0.0
70	0.0
71	0.0
72	0.0
73	0.0
74	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	Year 1
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	18.2
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	0.0
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	3.4
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	37.5
124	0.0
125	0.0
126	0.0
127	0.0
128	0.0
129	1.1
130	6.8
131	9.1
132	0.0
133	0.0
134	0.0
135	0.0
136	2.3
137	0.0
138	1.1
139	0.0
140	6.8
141	0.0
142	0.0
143	2.3
144	1.1
145	6.8
146	1.1
147	1.1
148	10.2

Wet, 500 year ARI (mm)

Total	1901.8
Day	Year 1
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	22.2
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	0.0
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	4.2
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	45.8
124	0.0
125	0.0
126	0.0
127	0.0
128	0.0
129	1.4
130	8.3
131	11.1
132	0.0
133	0.0
134	0.0
135	0.0
136	2.8
137	0.0
138	1.4
139	0.0
140	8.3
141	0.0
142	0.0
143	2.8
144	1.4
145	8.3
146	1.4
147	1.4
148	12.5

Dry, 100 year ARI (mm)

Total	424.0
Day	Year 1
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	0.0
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	2.1
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	0.0
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	4.1
124	0.0
125	17.5
126	0.0
127	0.0
128	0.0
129	0.0
130	0.0
131	0.0
132	3.1
133	0.0
134	0.0
135	37.1
136	1.0
137	0.0
138	0.0
139	0.0
140	0.0
141	7.2
142	0.0
143	12.4
144	1.0
145	25.8
146	0.0
147	0.0
148	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	Year 1
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0
83	0.0
84	0.0
85	0.0
86	0.0
87	0.0
88	0.0
89	0.0
90	0.0
91	0.0
92	0.0
93	0.0
94	0.0
95	0.0
96	0.0
97	0.0
98	0.0
99	0.0
100	0.0
101	0.0
102	0.0
103	0.0
104	0.0
105	0.0
106	0.0
107	0.0
108	0.0
109	1.9
110	0.0
111	0.0
112	0.0
113	0.0
114	0.0
115	0.0
116	0.0
117	0.0
118	0.0
119	0.0
120	0.0
121	0.0
122	0.0
123	3.7
124	0.0
125	15.8
126	0.0
127	0.0
128	0.0
129	0.0
130	0.0
131	0.0
132	2.8
133	0.0
134	0.0
135	33.5
136	0.9
137	0.0
138	0.0
139	0.0
140	0.0
141	6.5
142	0.0
143	11.2
144	0.9
145	23.3
146	0.0
147	0.0
148	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	Year 1
149	0.0
150	0.0
151	0.0
152	7.9
153	0.0
154	0.0
155	5.7
156	0.0
157	18.2
158	4.5
159	6.8
160	9.1
161	87.4
162	4.5
163	0.0
164	0.0
165	0.0
166	4.5
167	1.1
168	0.0
169	1.1
170	0.0
171	0.0
172	6.8
173	0.0
174	0.0
175	0.0
176	2.3
177	1.1
178	74.9
179	0.0
180	0.0
181	28.4
182	0.0
183	19.3
184	11.3
185	0.0
186	5.7
187	6.8
188	0.0
189	0.0
190	1.1
191	4.5
192	53.3
193	15.9
194	1.1
195	23.8
196	0.0
197	0.0
198	0.0
199	0.0
200	0.0
201	1.1
202	0.0
203	0.0
204	0.0
205	0.0
206	0.0
207	0.0
208	1.1
209	0.0
210	0.0
211	2.3
212	4.5
213	0.0
214	9.1
215	3.4
216	0.0
217	0.0
218	116.9
219	1.1
220	0.0
221	3.4
222	32.9

Wet, 500 year ARI (mm)

Total	1901.8
Day	Year 1
149	0.0
150	0.0
151	0.0
152	9.7
153	0.0
154	0.0
155	6.9
156	0.0
157	22.2
158	5.6
159	8.3
160	11.1
161	106.9
162	5.6
163	0.0
164	0.0
165	0.0
166	5.6
167	1.4
168	0.0
169	1.4
170	0.0
171	0.0
172	8.3
173	0.0
174	0.0
175	0.0
176	2.8
177	1.4
178	91.6
179	0.0
180	0.0
181	34.7
182	0.0
183	23.6
184	13.9
185	0.0
186	6.9
187	8.3
188	0.0
189	0.0
190	1.4
191	5.6
192	65.2
193	19.4
194	1.4
195	29.2
196	0.0
197	0.0
198	0.0
199	0.0
200	0.0
201	1.4
202	0.0
203	0.0
204	0.0
205	0.0
206	0.0
207	0.0
208	1.4
209	0.0
210	0.0
211	2.8
212	5.6
213	0.0
214	11.1
215	4.2
216	0.0
217	0.0
218	143.0
219	1.4
220	0.0
221	4.2
222	40.3

Dry, 100 year ARI (mm)

Total	424.0
Day	Year 1
149	0.0
150	0.0
151	0.0
152	0.0
153	27.9
154	11.3
155	1.0
156	0.0
157	0.0
158	16.5
159	0.0
160	0.0
161	0.0
162	0.0
163	0.0
164	5.2
165	11.3
166	0.0
167	0.0
168	0.0
169	1.0
170	0.0
171	5.2
172	1.0
173	0.0
174	0.0
175	0.0
176	0.0
177	0.0
178	0.0
179	0.0
180	3.1
181	0.0
182	0.0
183	0.0
184	0.0
185	0.0
186	0.0
187	0.0
188	0.0
189	0.0
190	0.0
191	0.0
192	4.1
193	1.0
194	0.0
195	0.0
196	0.0
197	0.0
198	0.0
199	0.0
200	0.0
201	0.0
202	0.0
203	0.0
204	0.0
205	0.0
206	0.0
207	0.0
208	0.0
209	0.0
210	0.0
211	0.0
212	6.2
213	19.6
214	4.1
215	0.0
216	0.0
217	0.0
218	0.0
219	36.1
220	0.0
221	0.0
222	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	Year 1
149	0.0
150	0.0
151	0.0
152	0.0
153	25.1
154	10.2
155	0.9
156	0.0
157	0.0
158	14.9
159	0.0
160	0.0
161	0.0
162	0.0
163	0.0
164	4.7
165	10.2
166	0.0
167	0.0
168	0.0
169	0.9
170	0.0
171	4.7
172	0.9
173	0.0
174	0.0
175	0.0
176	0.0
177	0.0
178	0.0
179	0.0
180	2.8
181	0.0
182	0.0
183	0.0
184	0.0
185	0.0
186	0.0
187	0.0
188	0.0
189	0.0
190	0.0
191	0.0
192	3.7
193	0.9
194	0.0
195	0.0
196	0.0
197	0.0
198	0.0
199	0.0
200	0.0
201	0.0
202	0.0
203	0.0
204	0.0
205	0.0
206	0.0
207	0.0
208	0.0
209	0.0
210	0.0
211	0.0
212	5.6
213	17.7
214	3.7
215	0.0
216	0.0
217	0.0
218	0.0
219	32.6
220	0.0
221	0.0
222	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	Year 1
223	53.3
224	0.0
225	13.6
226	0.0
227	0.0
228	0.0
229	0.0
230	0.0
231	0.0
232	1.1
233	0.0
234	15.9
235	0.0
236	10.2
237	6.8
238	0.0
239	2.3
240	0.0
241	79.4
242	0.0
243	0.0
244	0.0
245	0.0
246	0.0
247	0.0
248	0.0
249	0.0
250	0.0
251	0.0
252	0.0
253	2.3
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	77.2
261	0.0
262	0.0
263	37.5
264	12.5
265	37.5
266	32.9
267	0.0
268	3.4
269	0.0
270	0.0
271	0.0
272	3.4
273	10.2
274	18.2
275	12.5
276	0.0
277	0.0
278	0.0
279	0.0
280	0.0
281	0.0
282	0.0
283	0.0
284	31.8
285	0.0
286	0.0
287	14.8
288	12.5
289	13.6
290	99.9
291	0.0
292	13.6
293	0.0
294	1.1
295	5.7
296	0.0

Wet, 500 year ARI (mm)

Total	1901.8
Day	Year 1
223	65.2
224	0.0
225	16.7
226	0.0
227	0.0
228	0.0
229	0.0
230	0.0
231	0.0
232	1.4
233	0.0
234	19.4
235	0.0
236	12.5
237	8.3
238	0.0
239	2.8
240	0.0
241	97.2
242	0.0
243	0.0
244	0.0
245	0.0
246	0.0
247	0.0
248	0.0
249	0.0
250	0.0
251	0.0
252	0.0
253	2.8
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	94.4
261	0.0
262	0.0
263	45.8
264	15.3
265	45.8
266	40.3
267	0.0
268	4.2
269	0.0
270	0.0
271	0.0
272	4.2
273	12.5
274	22.2
275	15.3
276	0.0
277	0.0
278	0.0
279	0.0
280	0.0
281	0.0
282	0.0
283	0.0
284	38.9
285	0.0
286	0.0
287	18.0
288	15.3
289	16.7
290	122.2
291	0.0
292	16.7
293	0.0
294	1.4
295	6.9
296	0.0

Dry, 100 year ARI (mm)

Total	424.0
Day	Year 1
223	13.4
224	7.2
225	35.1
226	1.0
227	0.0
228	0.0
229	2.1
230	2.1
231	0.0
232	0.0
233	0.0
234	0.0
235	0.0
236	0.0
237	0.0
238	0.0
239	0.0
240	0.0
241	0.0
242	0.0
243	0.0
244	10.3
245	0.0
246	0.0
247	7.2
248	2.1
249	29.9
250	0.0
251	0.0
252	4.1
253	8.3
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	0.0
261	0.0
262	0.0
263	0.0
264	0.0
265	0.0
266	0.0
267	0.0
268	0.0
269	0.0
270	0.0
271	0.0
272	0.0
273	0.0
274	0.0
275	2.1
276	19.6
277	10.3
278	0.0
279	0.0
280	0.0
281	1.0
282	0.0
283	0.0
284	0.0
285	0.0
286	0.0
287	1.0
288	0.0
289	0.0
290	0.0
291	0.0
292	0.0
293	0.0
294	0.0
295	0.0
296	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	Year 1
223	12.1
224	6.5
225	31.6
226	0.9
227	0.0
228	0.0
229	1.9
230	1.9
231	0.0
232	0.0
233	0.0
234	0.0
235	0.0
236	0.0
237	0.0
238	0.0
239	0.0
240	0.0
241	0.0
242	0.0
243	0.0
244	9.3
245	0.0
246	0.0
247	6.5
248	1.9
249	27.0
250	0.0
251	0.0
252	3.7
253	7.4
254	0.0
255	0.0
256	0.0
257	0.0
258	0.0
259	0.0
260	0.0
261	0.0
262	0.0
263	0.0
264	0.0
265	0.0
266	0.0
267	0.0
268	0.0
269	0.0
270	0.0
271	0.0
272	0.0
273	0.0
274	0.0
275	1.9
276	17.7
277	9.3
278	0.0
279	0.0
280	0.0
281	0.9
282	0.0
283	0.0
284	0.0
285	0.0
286	0.0
287	0.9
288	0.0
289	0.0
290	0.0
291	0.0
292	0.0
293	0.0
294	0.0
295	0.0
296	0.0

Precipitation, 1 Year Wet and Dry Cycles: Monywa Township (1961-2013)

Wet, 100 year ARI (mm)

Total	1554.9
Day	Year 1
297	7.9
298	2.3
299	1.1
300	1.1
301	2.3
302	2.3
303	7.9
304	0.0
305	0.0
306	2.3
307	1.1
308	11.3
309	0.0
310	31.8
311	43.1
312	1.1
313	0.0
314	0.0
315	0.0
316	0.0
317	0.0
318	0.0
319	4.5
320	27.2
321	54.5
322	29.5
323	1.1
324	3.4
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	1.1
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Wet, 500 year ARI (mm)

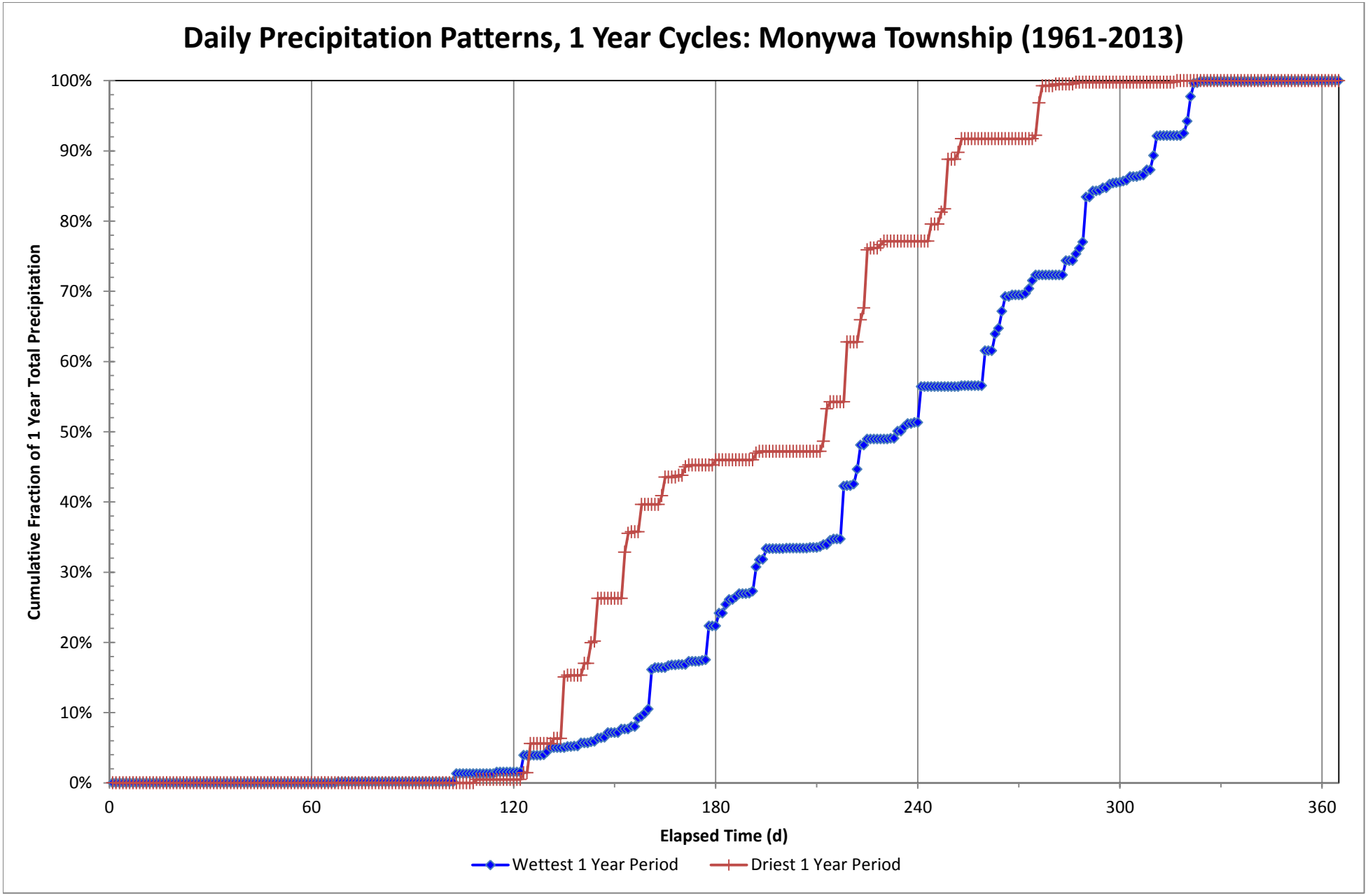
Total	1901.8
Day	Year 1
297	9.7
298	2.8
299	1.4
300	1.4
301	2.8
302	2.8
303	9.7
304	0.0
305	0.0
306	2.8
307	1.4
308	13.9
309	0.0
310	38.9
311	52.8
312	1.4
313	0.0
314	0.0
315	0.0
316	0.0
317	0.0
318	0.0
319	5.6
320	33.3
321	66.6
322	36.1
323	1.4
324	4.2
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	1.4
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Dry, 100 year ARI (mm)

Total	424.0
Day	Year 1
297	0.0
298	0.0
299	0.0
300	0.0
301	0.0
302	0.0
303	0.0
304	0.0
305	0.0
306	0.0
307	0.0
308	0.0
309	0.0
310	0.0
311	0.0
312	0.0
313	0.0
314	0.0
315	0.0
316	0.0
317	1.0
318	0.0
319	0.0
320	0.0
321	0.0
322	0.0
323	0.0
324	0.0
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0

Dry, 500 year ARI (mm)

Total	382.6
Day	Year 1
297	0.0
298	0.0
299	0.0
300	0.0
301	0.0
302	0.0
303	0.0
304	0.0
305	0.0
306	0.0
307	0.0
308	0.0
309	0.0
310	0.0
311	0.0
312	0.0
313	0.0
314	0.0
315	0.0
316	0.0
317	0.9
318	0.0
319	0.0
320	0.0
321	0.0
322	0.0
323	0.0
324	0.0
325	0.0
326	0.0
327	0.0
328	0.0
329	0.0
330	0.0
331	0.0
332	0.0
333	0.0
334	0.0
335	0.0
336	0.0
337	0.0
338	0.0
339	0.0
340	0.0
341	0.0
342	0.0
343	0.0
344	0.0
345	0.0
346	0.0
347	0.0
348	0.0
349	0.0
350	0.0
351	0.0
352	0.0
353	0.0
354	0.0
355	0.0
356	0.0
357	0.0
358	0.0
359	0.0
360	0.0
361	0.0
362	0.0
363	0.0
364	0.0
365	0.0


Daily Precipitation Patterns, 1 Year Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 1 Year Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
60
120
180
240
300
360
Elapsed Time (d)
Wettest 1 Year Period
Driest 1 Year Period

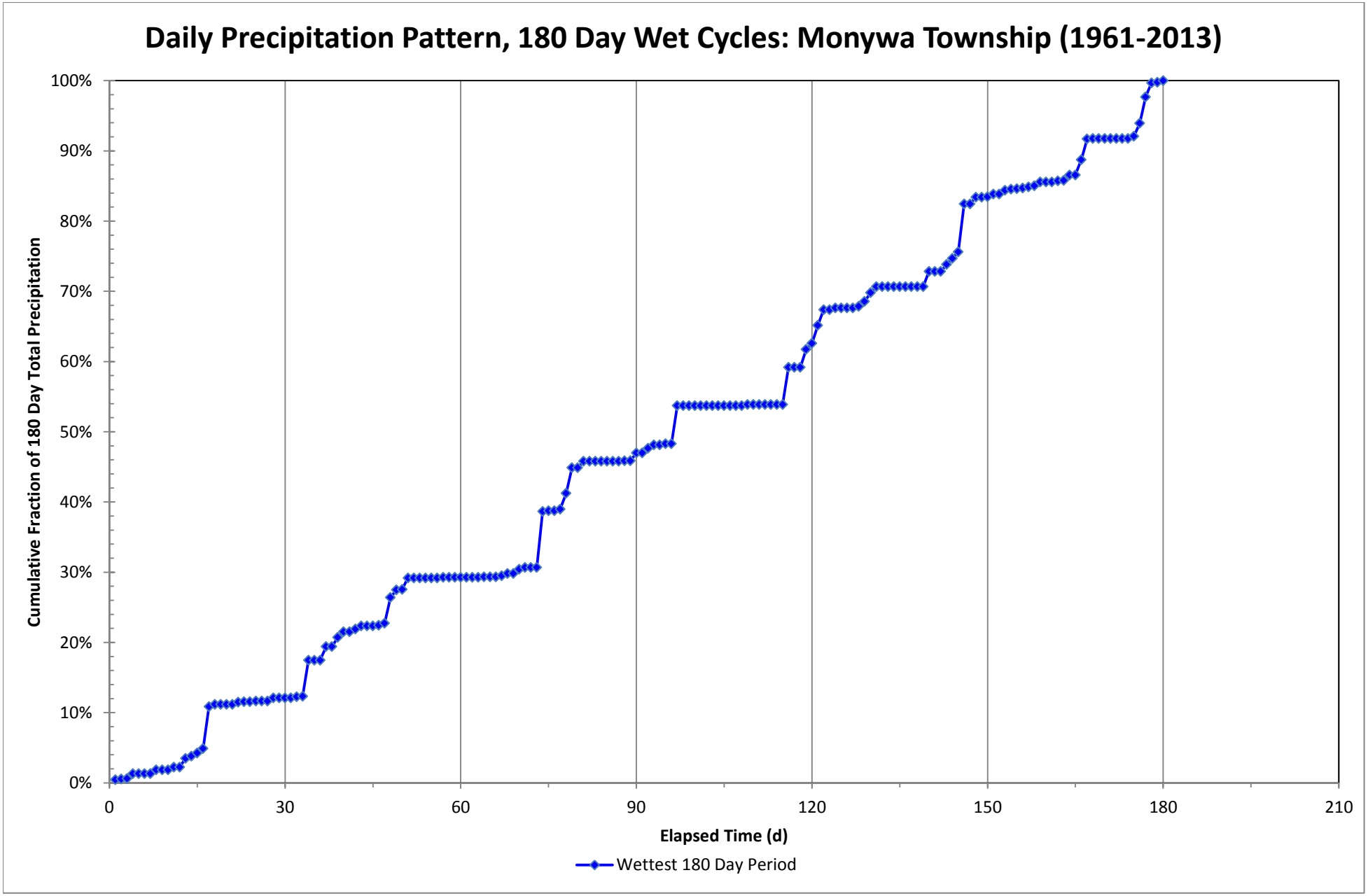
Precipitation, 180 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	174.1	254.4	300.1
Day	Day +0	Day +60	Day +120
1	6.7	0.0	36.8
2	1.1	0.0	32.4
3	1.1	0.0	0.0
4	10.0	1.1	3.3
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	2.2	0.0
8	7.8	4.5	3.3
9	0.0	0.0	10.0
10	0.0	8.9	17.9
11	5.6	3.3	12.3
12	0.0	0.0	0.0
13	17.9	0.0	0.0
14	4.5	114.9	0.0
15	6.7	1.1	0.0
16	8.9	0.0	0.0
17	85.9	3.3	0.0
18	4.5	32.4	0.0
19	0.0	52.4	0.0
20	0.0	0.0	31.2
21	0.0	13.4	0.0
22	4.5	0.0	0.0
23	1.1	0.0	14.5
24	0.0	0.0	12.3
25	1.1	0.0	13.4
26	0.0	0.0	98.2
27	0.0	0.0	0.0
28	6.7	1.1	13.4
29	0.0	0.0	0.0
30	0.0	15.6	1.1
31	0.0	0.0	5.6
32	2.2	10.0	0.0
33	1.1	6.7	7.8
34	73.6	0.0	2.2
35	0.0	2.2	1.1
36	0.0	0.0	1.1
37	27.9	78.1	2.2
38	0.0	0.0	2.2
39	19.0	0.0	7.8
40	11.2	0.0	0.0
41	0.0	0.0	0.0
42	5.6	0.0	2.2
43	6.7	0.0	1.1
44	0.0	0.0	11.2
45	0.0	0.0	0.0
46	1.1	0.0	31.2
47	4.5	0.0	42.4
48	52.4	0.0	1.1
49	15.6	2.2	0.0
50	1.1	0.0	0.0
51	23.4	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	4.5
56	0.0	75.9	26.8
57	1.1	0.0	53.6
58	0.0	0.0	29.0
59	0.0	36.8	1.1
60	0.0	12.3	3.3

500 year ARI (mm)

Total	214.0	312.7	368.9
Day	Day +0	Day +60	Day +120
1	8.2	0.0	45.3
2	1.4	0.0	39.8
3	1.4	0.0	0.0
4	12.3	1.4	4.1
5	0.0	0.0	0.0
6	0.0	0.0	0.0
7	0.0	2.7	0.0
8	9.6	5.5	4.1
9	0.0	0.0	12.3
10	0.0	11.0	21.9
11	6.9	4.1	15.1
12	0.0	0.0	0.0
13	21.9	0.0	0.0
14	5.5	141.3	0.0
15	8.2	1.4	0.0
16	11.0	0.0	0.0
17	105.6	4.1	0.0
18	5.5	39.8	0.0
19	0.0	64.5	0.0
20	0.0	0.0	38.4
21	0.0	16.5	0.0
22	5.5	0.0	0.0
23	1.4	0.0	17.8
24	0.0	0.0	15.1
25	1.4	0.0	16.5
26	0.0	0.0	120.7
27	0.0	0.0	0.0
28	8.2	1.4	16.5
29	0.0	0.0	0.0
30	0.0	19.2	1.4
31	0.0	0.0	6.9
32	2.7	12.3	0.0
33	1.4	8.2	9.6
34	90.5	0.0	2.7
35	0.0	2.7	1.4
36	0.0	0.0	1.4
37	34.3	96.0	2.7
38	0.0	0.0	2.7
39	23.3	0.0	9.6
40	13.7	0.0	0.0
41	0.0	0.0	0.0
42	6.9	0.0	2.7
43	8.2	0.0	1.4
44	0.0	0.0	13.7
45	0.0	0.0	0.0
46	1.4	0.0	38.4
47	5.5	0.0	52.1
48	64.5	0.0	1.4
49	19.2	2.7	0.0
50	1.4	0.0	0.0
51	28.8	0.0	0.0
52	0.0	0.0	0.0
53	0.0	0.0	0.0
54	0.0	0.0	0.0
55	0.0	0.0	5.5
56	0.0	93.3	32.9
57	1.4	0.0	65.8
58	0.0	0.0	35.7
59	0.0	45.3	1.4
60	0.0	15.1	4.1


Daily Precipitation Pattern, 180 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 180 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
30
60
90
120
150
180
210
Elapsed Time (d)
Wettest 180 Day Period

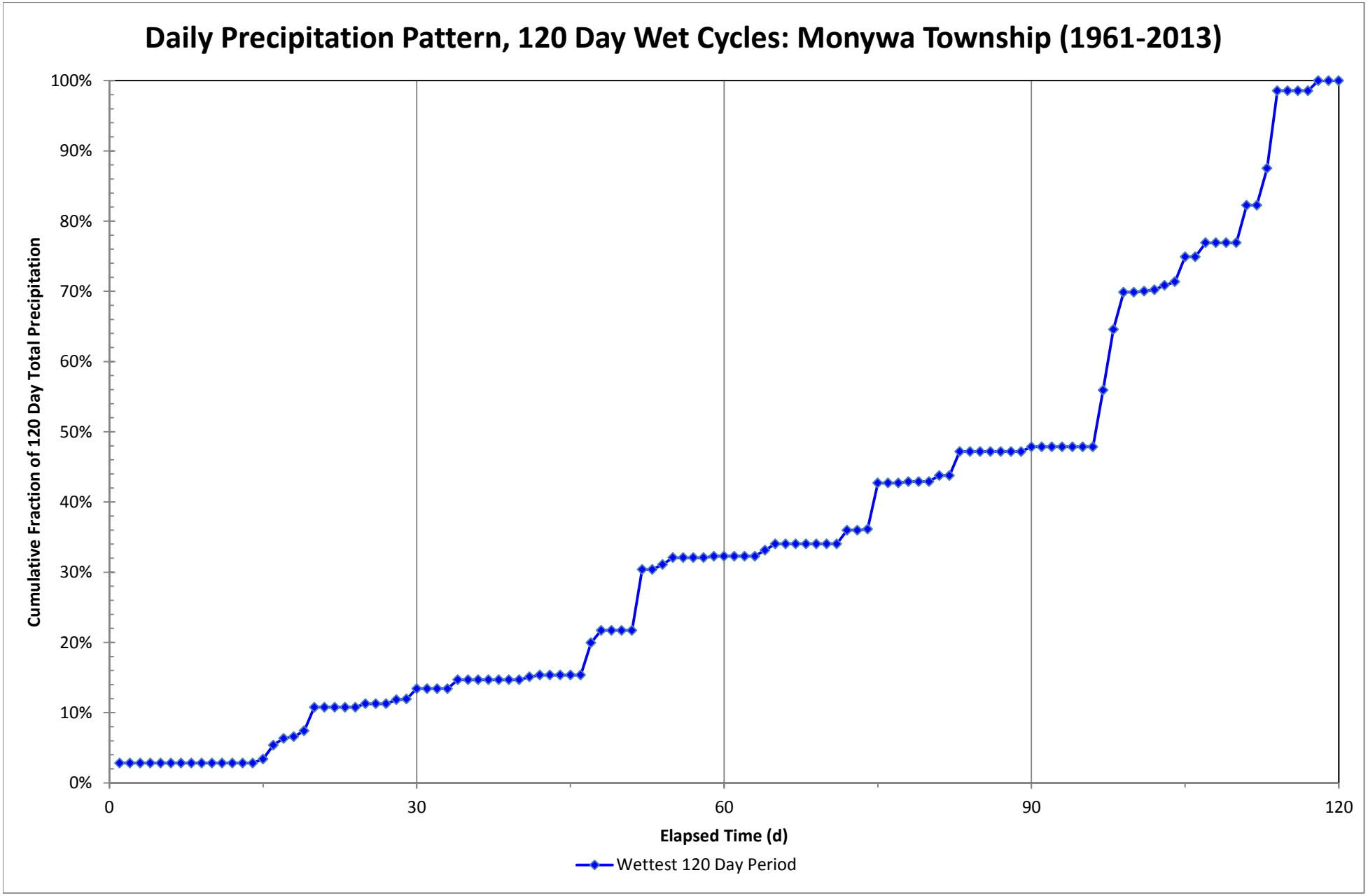
Precipitation, 120 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	143.7	166.9
Day	Day +0	Day +60
1	30.3	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	9.3
5	0.0	9.6
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	20.8
13	0.0	0.0
14	0.0	1.6
15	6.1	70.4
16	21.3	0.0
17	10.2	0.0
18	2.7	2.2
19	8.7	0.0
20	36.0	0.0
21	0.0	9.3
22	0.0	0.0
23	0.0	36.6
24	0.0	0.0
25	5.5	0.0
26	0.0	0.0
27	0.0	0.0
28	6.0	0.0
29	1.1	0.0
30	15.8	7.1
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	13.7	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	86.3
38	0.0	92.8
39	0.0	56.8
40	0.0	0.0
41	4.4	1.6
42	2.7	2.2
43	0.0	6.6
44	0.0	5.5
45	0.0	38.2
46	0.0	0.0
47	49.1	21.3
48	19.1	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	57.3
52	92.8	0.0
53	0.0	56.2
54	7.6	118.5
55	10.4	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	15.3
59	2.2	0.0
60	0.0	0.0

500 year ARI (mm)

Total	170.7	198.2
Day	Day +0	Day +60
1	35.9	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	11.0
5	0.0	11.4
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	24.6
13	0.0	0.0
14	0.0	1.9
15	7.3	83.6
16	25.3	0.0
17	12.1	0.0
18	3.2	2.6
19	10.4	0.0
20	42.8	0.0
21	0.0	11.0
22	0.0	0.0
23	0.0	43.4
24	0.0	0.0
25	6.5	0.0
26	0.0	0.0
27	0.0	0.0
28	7.1	0.0
29	1.3	0.0
30	18.8	8.4
31	0.0	0.0
32	0.0	0.0
33	0.0	0.0
34	16.2	0.0
35	0.0	0.0
36	0.0	0.0
37	0.0	102.4
38	0.0	110.2
39	0.0	67.4
40	0.0	0.0
41	5.2	1.9
42	3.2	2.6
43	0.0	7.8
44	0.0	6.5
45	0.0	45.4
46	0.0	0.0
47	58.4	25.3
48	22.7	0.0
49	0.0	0.0
50	0.0	0.0
51	0.0	68.1
52	110.2	0.0
53	0.0	66.8
54	9.1	140.7
55	12.3	0.0
56	0.0	0.0
57	0.0	0.0
58	0.0	18.2
59	2.6	0.0
60	0.0	0.0


Daily Precipitation Pattern, 120 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 120 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
30
60
90
120
Elapsed Time (d)
Wettest 120 Day Period

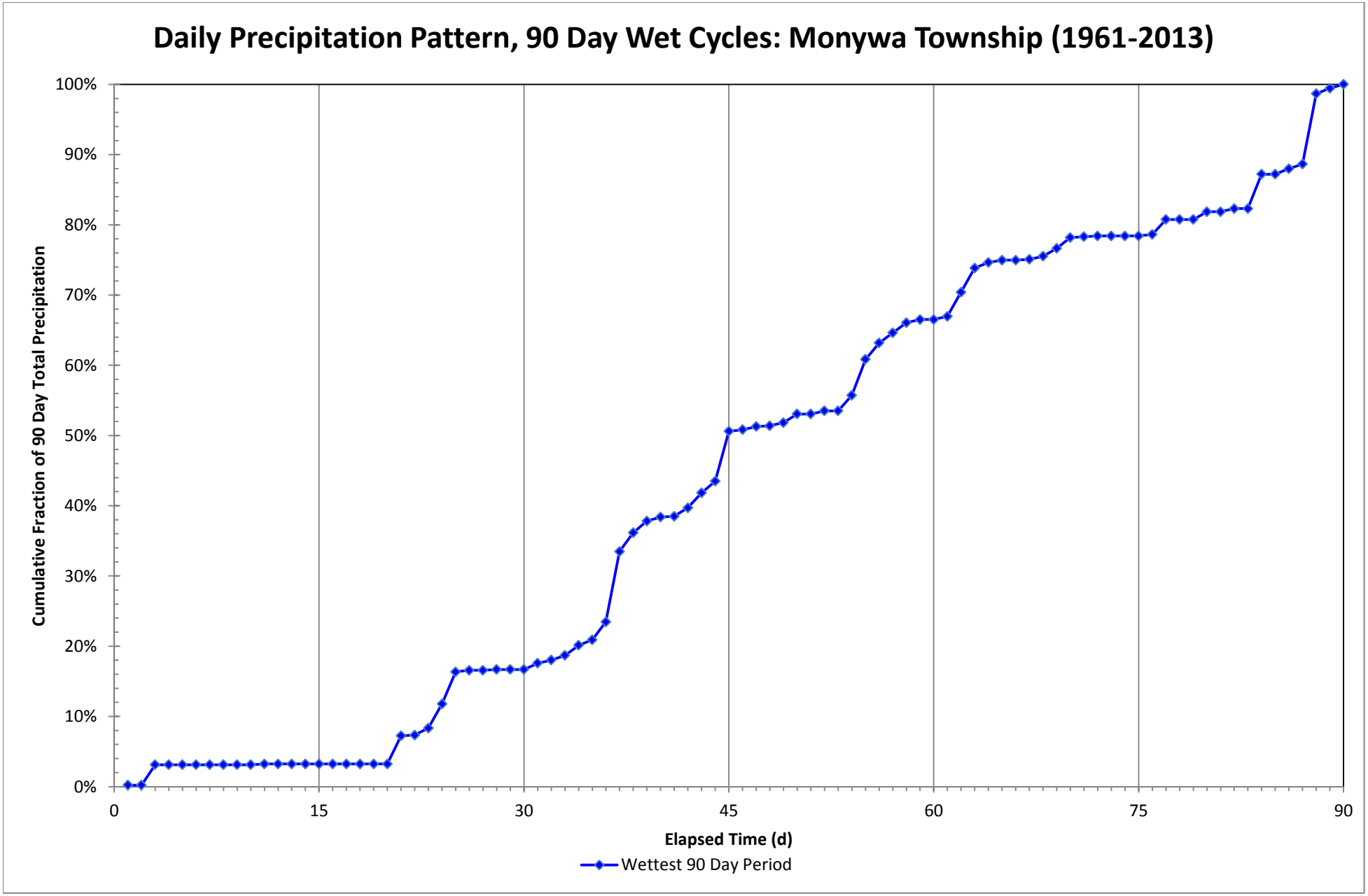
Precipitation, 90 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	153.6	458.8	308.3
Day	Day +0	Day +30	Day +60
1	2.0	8.2	4.1
2	0.0	4.1	31.7
3	26.6	6.1	31.7
4	0.0	13.3	7.2
5	0.0	7.2	3.1
6	0.0	23.6	0.0
7	0.0	92.2	1.0
8	0.0	24.6	4.1
9	0.0	15.4	10.2
10	0.0	5.1	14.3
11	1.0	1.0	1.0
12	0.0	11.3	1.0
13	0.0	19.5	0.0
14	0.0	15.4	0.0
15	0.0	65.5	0.0
16	0.0	2.0	2.0
17	0.0	4.1	19.5
18	0.0	1.0	0.0
19	0.0	4.1	0.0
20	0.0	11.3	10.2
21	36.9	0.0	0.0
22	1.0	4.1	4.1
23	9.2	0.0	0.0
24	31.7	20.5	45.1
25	42.0	47.1	0.0
26	2.0	21.5	7.2
27	0.0	13.3	6.1
28	1.0	13.3	92.2
29	0.0	4.1	7.2
30	0.0	0.0	5.1

500 year ARI (mm)

Total	183.8	548.9	368.8
Day	Day +0	Day +30	Day +60
1	2.5	9.8	4.9
2	0.0	4.9	38.0
3	31.9	7.4	38.0
4	0.0	15.9	8.6
5	0.0	8.6	3.7
6	0.0	28.2	0.0
7	0.0	110.3	1.2
8	0.0	29.4	4.9
9	0.0	18.4	12.3
10	0.0	6.1	17.2
11	1.2	1.2	1.2
12	0.0	13.5	1.2
13	0.0	23.3	0.0
14	0.0	18.4	0.0
15	0.0	78.4	0.0
16	0.0	2.5	2.5
17	0.0	4.9	23.3
18	0.0	1.2	0.0
19	0.0	4.9	0.0
20	0.0	13.5	12.3
21	44.1	0.0	0.0
22	1.2	4.9	4.9
23	11.0	0.0	0.0
24	38.0	24.5	53.9
25	50.2	56.4	0.0
26	2.5	25.7	8.6
27	0.0	15.9	7.4
28	1.2	15.9	110.3
29	0.0	4.9	8.6
30	0.0	0.0	6.1


Daily Precipitation Pattern, 90 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 90 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
15
30
45
60
75
90
Elapsed Time (d)
Wettest 90 Day Period

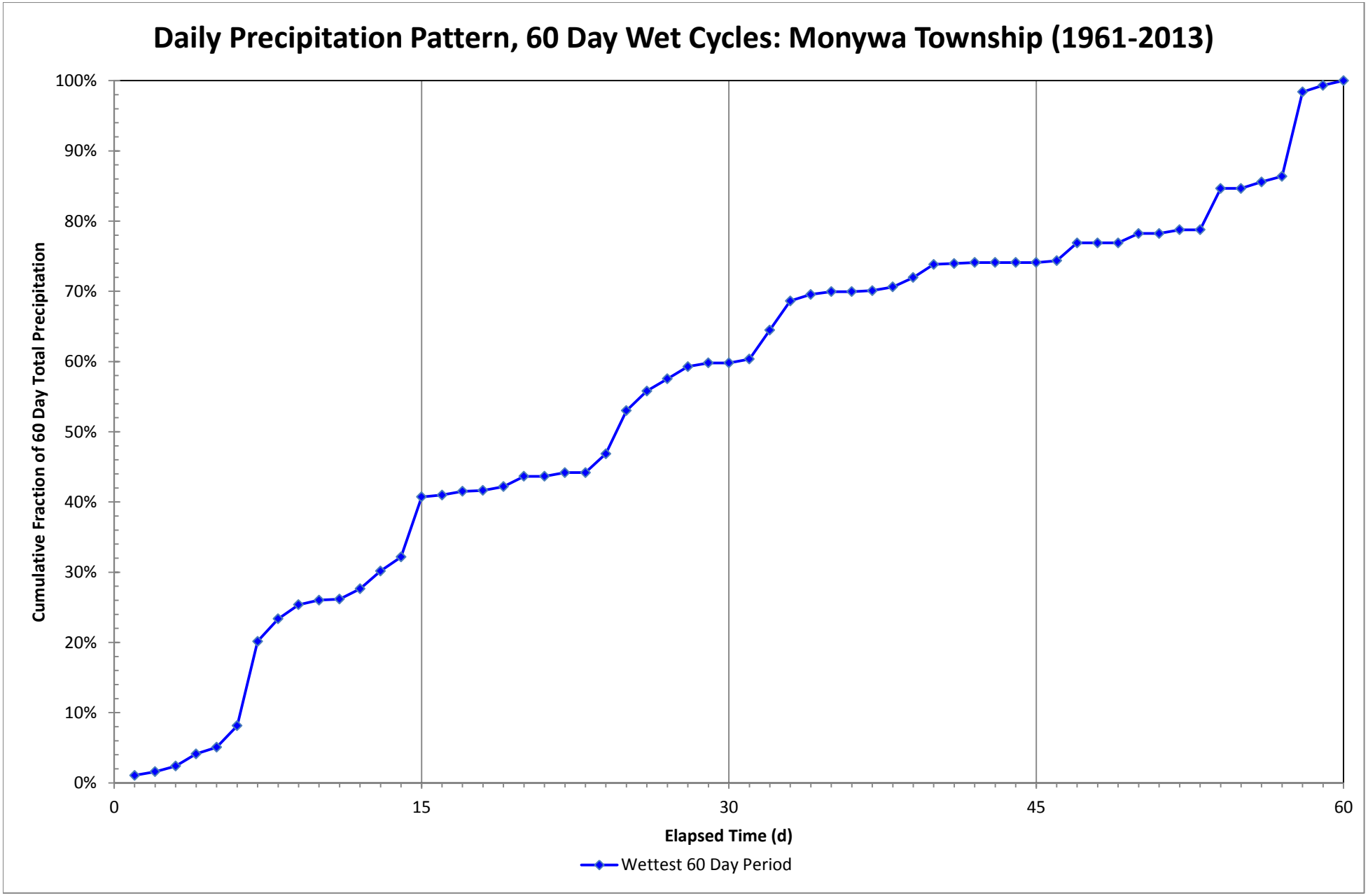
Precipitation, 60 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	442.5	297.3
Day	Day +0	Day +30
1	7.9	4.0
2	4.0	30.6
3	5.9	30.6
4	12.8	6.9
5	6.9	3.0
6	22.7	0.0
7	88.9	1.0
8	23.7	4.0
9	14.8	9.9
10	4.9	13.8
11	1.0	1.0
12	10.9	1.0
13	18.8	0.0
14	14.8	0.0
15	63.2	0.0
16	2.0	2.0
17	4.0	18.8
18	1.0	0.0
19	4.0	0.0
20	10.9	9.9
21	0.0	0.0
22	4.0	4.0
23	0.0	0.0
24	19.8	43.5
25	45.4	0.0
26	20.7	6.9
27	12.8	5.9
28	12.8	88.9
29	4.0	6.9
30	0.0	4.9

500 year ARI (mm)

Total	517.4	347.7
Day	Day +0	Day +30
1	9.2	4.6
2	4.6	35.8
3	6.9	35.8
4	15.0	8.1
5	8.1	3.5
6	26.6	0.0
7	104.0	1.2
8	27.7	4.6
9	17.3	11.6
10	5.8	16.2
11	1.2	1.2
12	12.7	1.2
13	21.9	0.0
14	17.3	0.0
15	73.9	0.0
16	2.3	2.3
17	4.6	21.9
18	1.2	0.0
19	4.6	0.0
20	12.7	11.6
21	0.0	0.0
22	4.6	4.6
23	0.0	0.0
24	23.1	50.8
25	53.1	0.0
26	24.3	8.1
27	15.0	6.9
28	15.0	104.0
29	4.6	8.1
30	0.0	5.8


Daily Precipitation Pattern, 60 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 60 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
15
30
45
60
Elapsed Time (d)
Wettest 60 Day Period

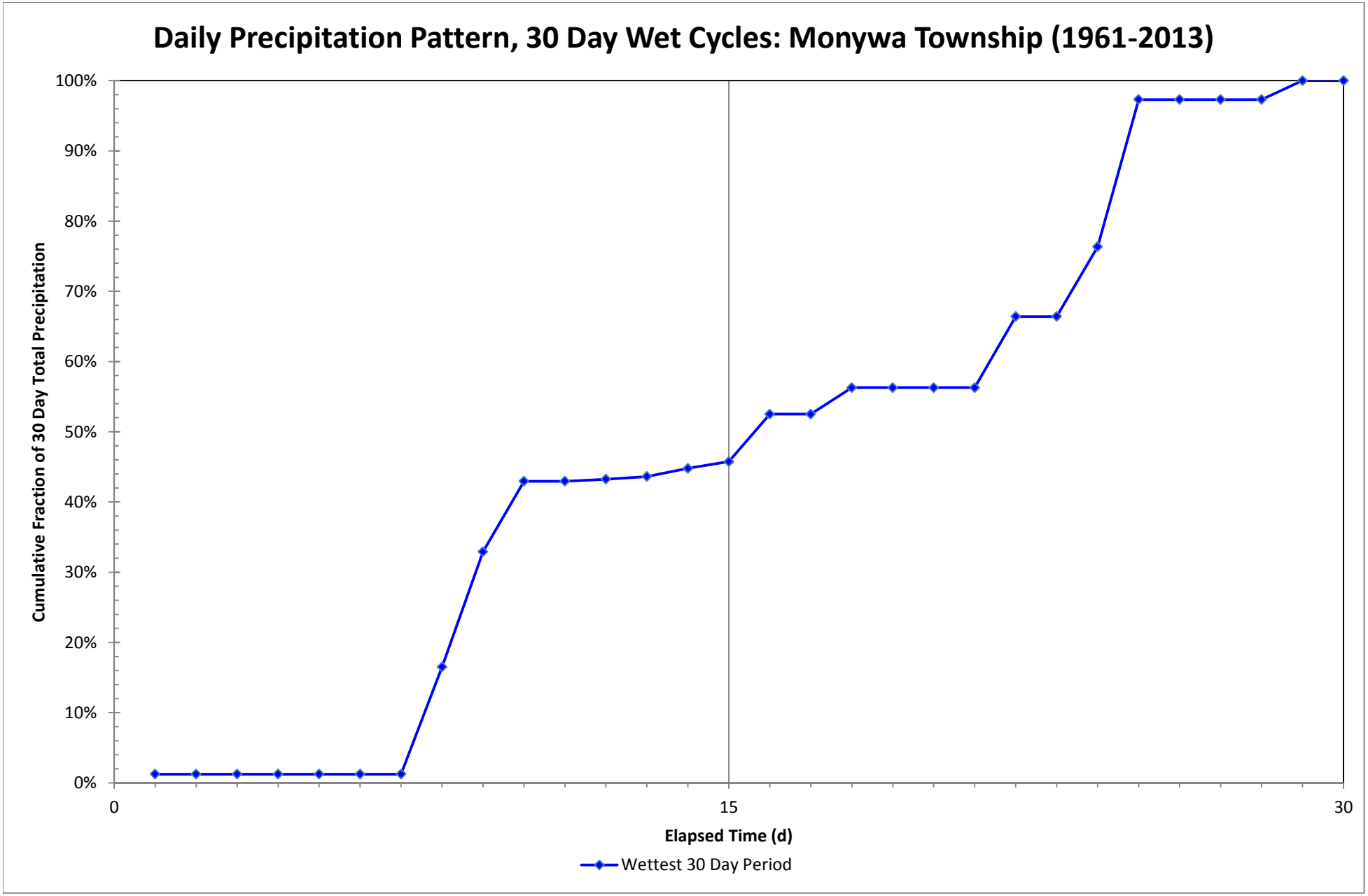
Precipitation, 30 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	519.6
Day	Day +0
1	6.5
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	79.2
9	85.3
10	52.2
11	0.0
12	1.5
13	2.0
14	6.0
15	5.0
16	35.1
17	0.0
18	19.6
19	0.0
20	0.0
21	0.0
22	52.7
23	0.0
24	51.7
25	108.8
26	0.0
27	0.0
28	0.0
29	14.0
30	0.0

500 year ARI (mm)

Total	596.4
Day	Day +0
1	7.5
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	91.0
9	97.9
10	59.9
11	0.0
12	1.7
13	2.3
14	6.9
15	5.8
16	40.3
17	0.0
18	22.5
19	0.0
20	0.0
21	0.0
22	60.4
23	0.0
24	59.3
25	124.9
26	0.0
27	0.0
28	0.0
29	16.1
30	0.0


Daily Precipitation Pattern, 30 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of 30 Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
15
30
Elapsed Time (d)
Wettest 30 Day Period

Precipitation, < 30 Day Wet Cycles: Monywa Township (1961-2013)

100 year ARI (mm)

Total	439.8
Day	Day +0
1	17.2
2	5.8
3	14.8
4	110.9
5	126.8
6	80.8
7	27.6
8	0.0
9	0.0
10	17.4
11	19.8
12	10.2
13	3.0
14	5.4

500 year ARI (mm)

Total	562.6
Day	Day +0
1	22.0
2	7.4
3	18.9
4	141.9
5	162.2
6	103.3
7	35.4
8	0.0
9	0.0
10	22.3
11	25.4
12	13.1
13	3.8
14	6.9

100 year ARI (mm)

Total	342.6
Day	Day +0
1	15.3
2	5.1
3	13.2
4	99.0
5	113.2
6	72.1
7	24.7

500 year ARI (mm)

Total	447.3
Day	Day +0
1	20.0
2	6.7
3	17.2
4	129.3
5	147.8
6	94.1
7	32.2

100 year ARI (mm)

Total	307.9
Day	Day +0
1	78.5
2	72.3
3	141.4
4	15.7

500 year ARI (mm)

Total	410.1
Day	Day +0
1	104.6
2	96.3
3	188.3
4	20.9

100 year ARI (mm)

Total	297.7
Day	Day +0
1	80.0
2	73.6
3	144.1

500 year ARI (mm)

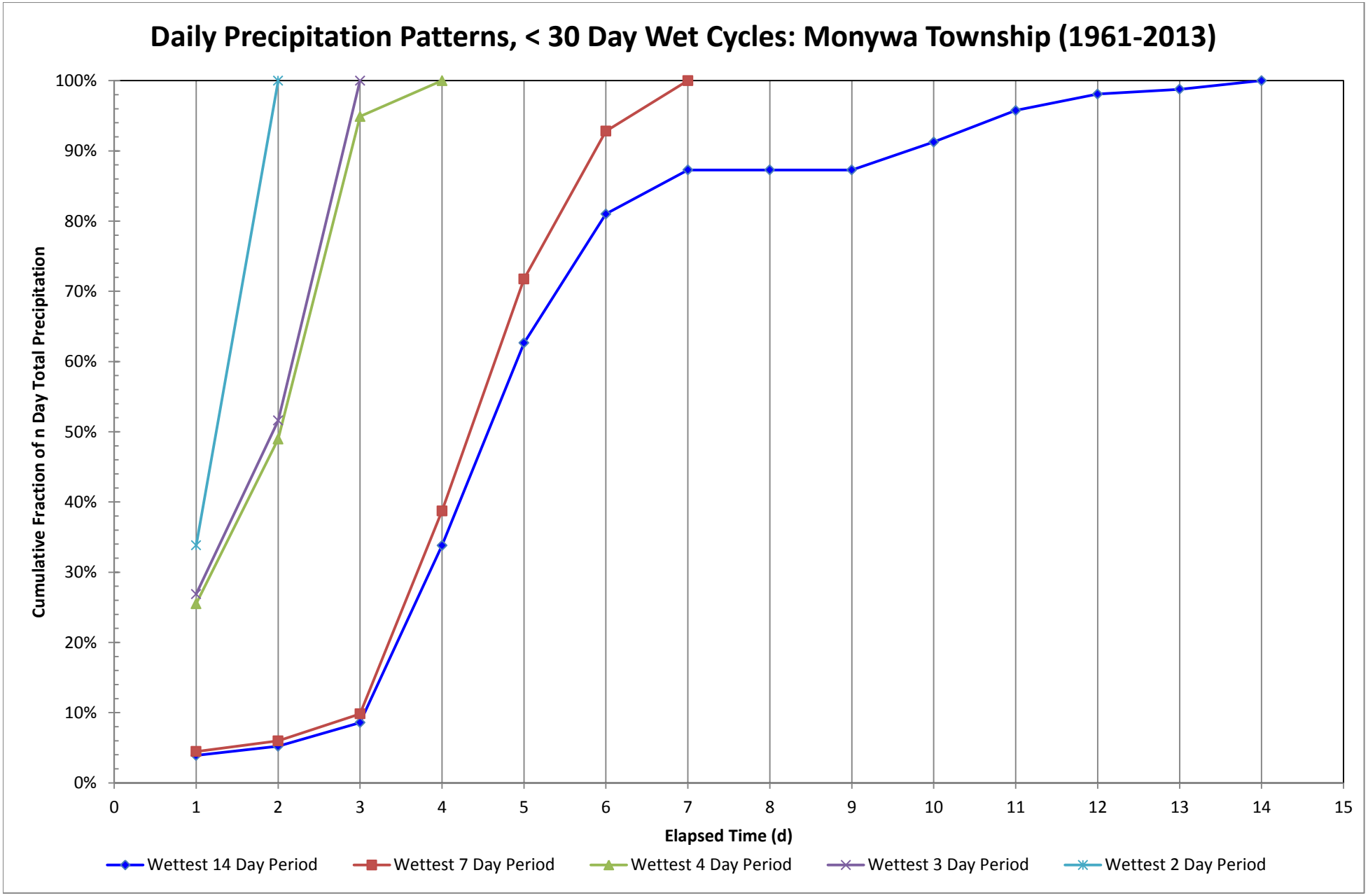
Total	400.7
Day	Day +0
1	107.7
2	99.1
3	193.9

100 year ARI (mm)

Total	214.1
Day	Day +0
1	72.4
2	141.7

500 year ARI (mm)

Total	248.7
Day	Day +0
1	84.1
2	164.6


Daily Precipitation Patterns, < 30 Day Wet Cycles: Monywa Township (1961-2013)
Cumulative Fraction of n Day Total Precipitation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Elapsed Time (d)
Wettest 14 Day Period
Wettest 7 Day Period
Wettest 4 Day Period
Wettest 3 Day Period
Wettest 2 Day Period

ATTACHMENT 3.1

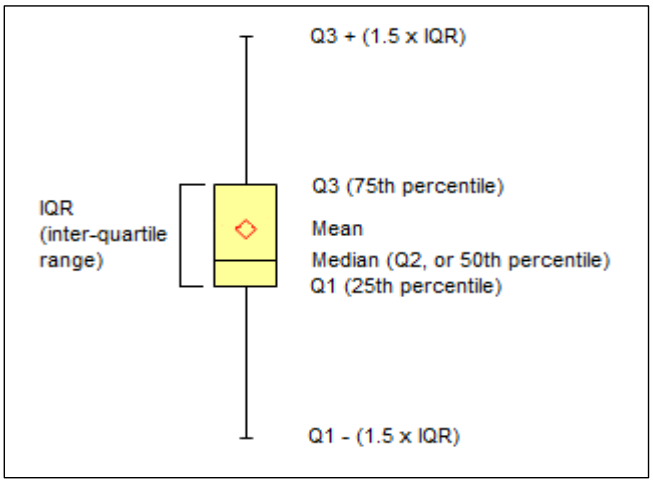
Annual Pan Evaporation Analysis

Pan Evaporation Data, Annual Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format)

Year	Evap. (mm)
2000	2,078.3
2001	1,921.7
2002	1,925.4
2003	1,975.8
2004	2,108.6
2005	2,051.4
2006	2,055.8
2007	Exclude
2008	Exclude
2009	Exclude
2010	Exclude
2011	Exclude
2012	Exclude
2013	Exclude

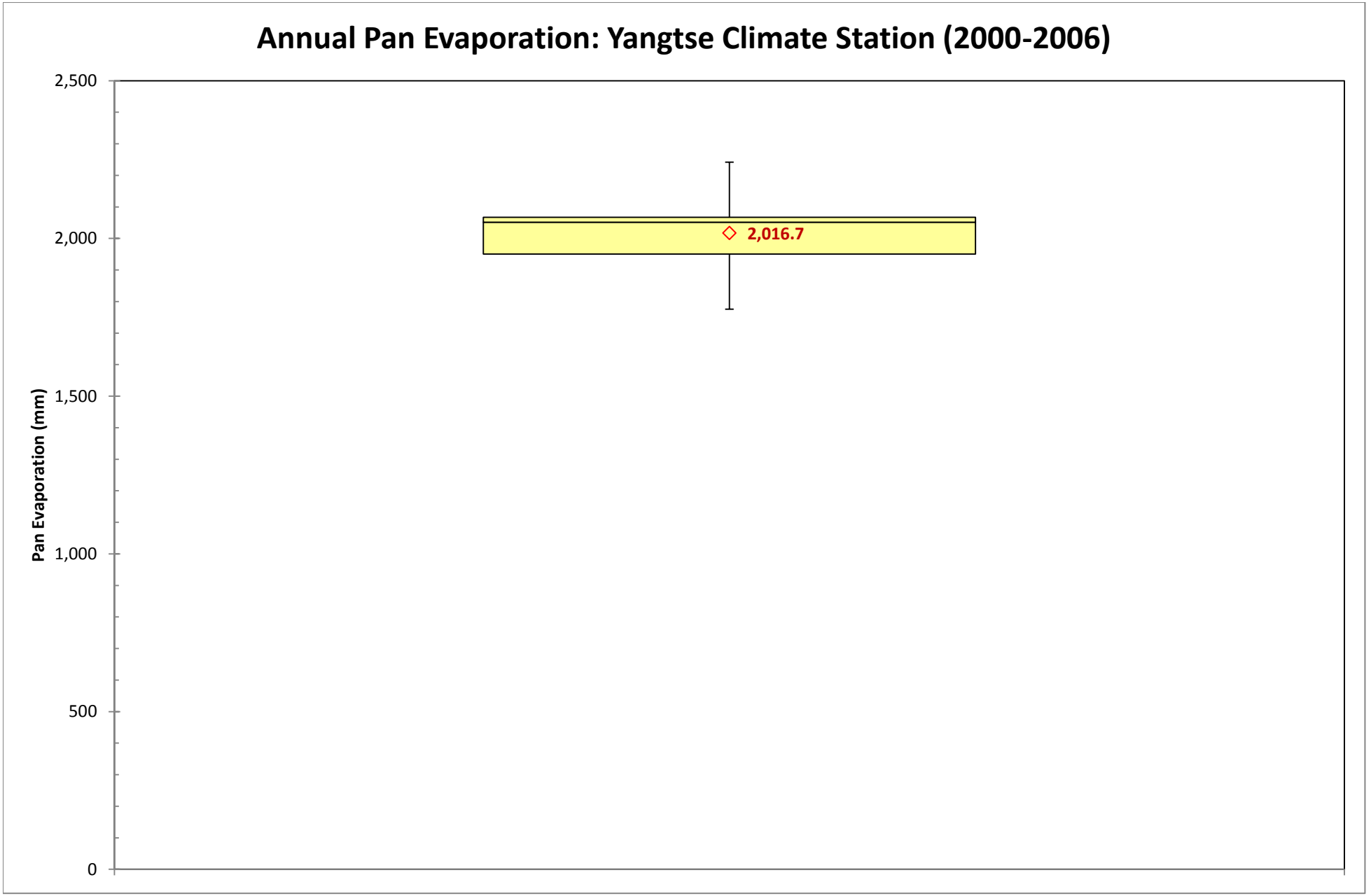
Stat	Evap. (mm)
Mean	2,016.7
SD	75.3
Median	2,051.4
Q1	1,950.6
Q3	2,067.0
Minimum	1,921.7
Maximum	2,108.6
Count	7
Ext Max	2,241.7
Ext Min	1,775.9
25th Pct	1,950.6
50th Pct	100.8
75th Pct	15.7
1.5 * IQR	174.7

Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation. For more discussion on this issue, refer to the climate trend analysis worksheet.



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers


Annual Pan Evaporation: Yangtse Climate Station (2000-2006)
Pan Evaporation (mm)
2,500
2,000
1,500
1,000
500
0
2,016.7

ATTACHMENT 3.2

Monthly Pan Evaporation Analysis

Pan Evaporation Data, Monthly Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format)

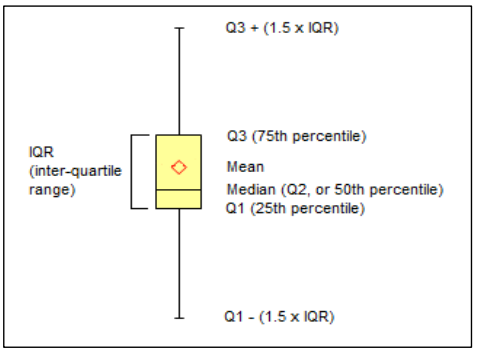
Pan Evaporation Data (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2000	133.7	154.2	218.7	240.0	117.6	211.7	183.6	215.9	168.5	165.9	137.2	131.2
2001	120.9	151.1	209.8	191.2	193.7	178.5	164.1	248.2	149.2	102.2	102.1	110.7
2002	120.9	165.6	221.3	230.2	199.2	164.8	152.5	169.9	128.3	148.7	112.2	111.8
2003	120.9	140.1	187.5	247.8	205.0	184.2	187.3	175.0	149.7	119.1	129.9	129.3
2004	121.0	161.7	212.9	206.3	213.4	269.8	174.1	163.5	177.5	147.8	136.5	124.1
2005	123.0	129.6	192.2	235.5	255.5	186.9	176.7	179.7	208.2	144.8	109.4	109.9
2006	119.2	142.7	224.4	243.7	232.6	225.6	167.3	132.5	140.1	183.9	145.5	98.3
2007	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2008	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2009	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2010	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2011	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2012	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2013	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude

Pan Evaporation Data Summary Statistics (mm)												
Stat.	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	122.8	149.3	209.5	227.8	202.4	203.1	172.2	183.5	160.2	144.6	124.7	116.5
SD	4.9	12.7	14.4	21.1	43.1	35.9	12.0	37.6	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	205.0	186.9	174.1	175.0	149.7	147.8	129.9	111.8
Q1	120.9	141.4	201.0	218.3	196.5	181.4	165.7	166.7	144.7	132.0	110.8	110.3
Q3	122.0	158.0	220.0	241.8	223.0	218.7	180.1	197.8	173.0	157.3	136.9	126.7
Minimum	119.2	129.6	187.5	191.2	117.6	164.8	152.5	132.5	128.3	102.2	102.1	98.3
Maximum	133.7	165.6	224.4	247.8	255.5	269.8	187.3	248.2	208.2	183.9	145.5	131.2
Count	7	7	7	7	7	7	7	7	7	7	7	7
Ext Max	123.7	182.8	248.6	277.2	262.8	274.7	201.8	244.4	215.6	195.3	175.9	151.3
Ext Min	119.2	116.5	172.4	182.9	156.6	125.4	144.1	120.1	102.1	94.0	71.7	85.7
25th Pct	120.9	141.4	201.0	218.3	196.5	181.4	165.7	166.7	144.7	132.0	110.8	110.3
50th Pct	0.0	9.7	11.9	17.2	8.5	5.5	8.4	8.3	5.1	15.9	19.1	1.5
75th Pct	1.1	6.9	7.1	6.3	18.0	31.8	6.0	22.8	23.3	9.5	7.0	14.9
1.5 * IQR	1.7	24.9	28.5	35.4	39.8	56.0	21.6	46.6	42.6	38.0	39.1	24.6

Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation.
For more discussion on this issue, refer to the climate trend analysis worksheet.

Pan Evaporation Data, Monthly Sampling Frequency: Yangtse Climate Station (2000-2013) (Analysis Format | Outliers Removed)

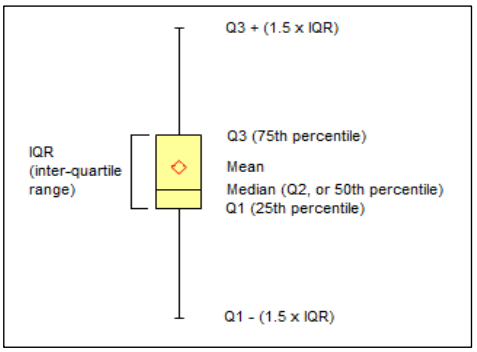
Pan Evaporation Data (mm)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000		154.2	218.7	240.0		211.7	183.6	215.9	168.5	165.9	137.2	131.2
2001	120.9	151.1	209.8	191.2	193.7	178.5	164.1		149.2	102.2	102.1	110.7
2002	120.9	165.6	221.3	230.2	199.2	164.8	152.5	169.9	128.3	148.7	112.2	111.8
2003	120.9	140.1	187.5	247.8	205.0	184.2	187.3	175.0	149.7	119.1	129.9	129.3
2004	121.0	161.7	212.9	206.3	213.4	269.8	174.1	163.5	177.5	147.8	136.5	124.1
2005	123.0	129.6	192.2	235.5	255.5	186.9	176.7	179.7	208.2	144.8	109.4	109.9
2006		142.7	224.4	243.7	232.6	225.6	167.3	132.5	140.1	183.9	145.5	98.3
2007	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2008	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2009	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2010	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2011	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2012	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude
2013	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude

Pan Evaporation Data Summary Statistics (mm)												
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	121.3	149.3	209.5	227.8	216.6	203.1	172.2	172.7	160.2	144.6	124.7	116.5
SD	0.9	12.7	14.4	21.1	23.4	35.9	12.0	26.9	26.9	27.3	16.6	12.0
Median	120.9	151.1	212.9	235.5	209.2	186.9	174.1	172.5	149.7	147.8	129.9	111.8
Q1	120.9	141.4	201.0	218.3	200.7	181.4	165.7	165.1	144.7	132.0	110.8	110.3
Q3	121.0	158.0	220.0	241.8	227.8	218.7	180.1	178.5	173.0	157.3	136.9	126.7
Minimum	120.9	129.6	187.5	191.2	193.7	164.8	152.5	132.5	128.3	102.2	102.1	98.3
Maximum	123.0	165.6	224.4	247.8	255.5	269.8	187.3	215.9	208.2	183.9	145.5	131.2
Count	5	7	7	7	6	7	7	6	7	7	7	7
Ext Max	121.2	182.8	248.6	277.2	268.6	274.7	201.8	198.6	215.6	195.3	175.9	151.3
Ext Min	120.8	116.5	172.4	182.9	159.9	125.4	144.1	145.0	102.1	94.0	71.7	85.7
25th Pct	120.9	141.4	201.0	218.3	200.7	181.4	165.7	165.1	144.7	132.0	110.8	110.3
50th Pct	0.0	9.7	11.9	17.2	8.5	5.5	8.4	7.3	5.1	15.9	19.1	1.5
75th Pct	0.1	6.9	7.1	6.3	18.6	31.8	6.0	6.1	23.3	9.5	7.0	14.9
1.5 * IQR	0.1	24.9	28.5	35.4	40.7	56.0	21.6	20.1	42.6	38.0	39.1	24.6

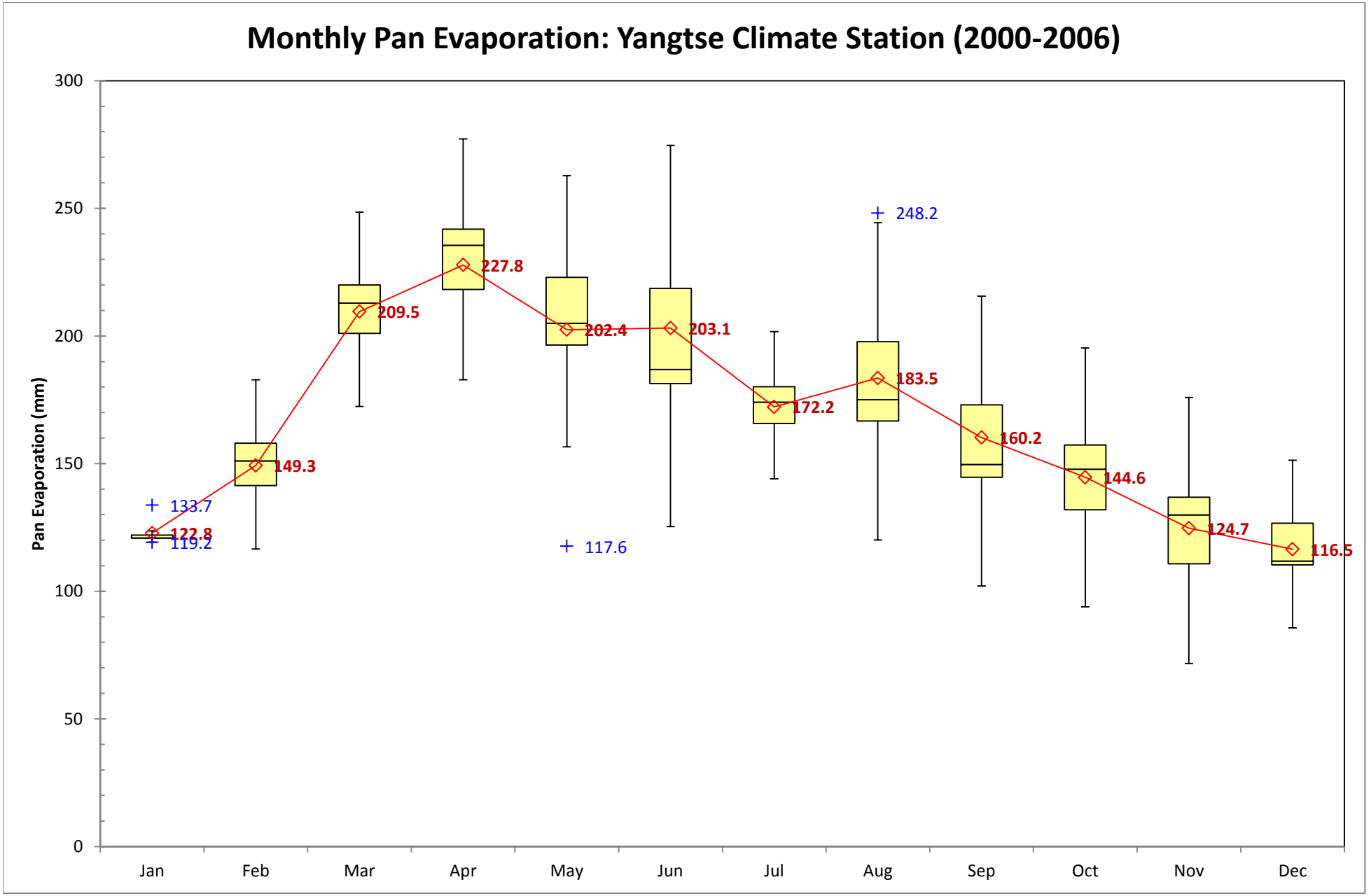
Note: N/D = No Data Available, N/A = Not Applicable.

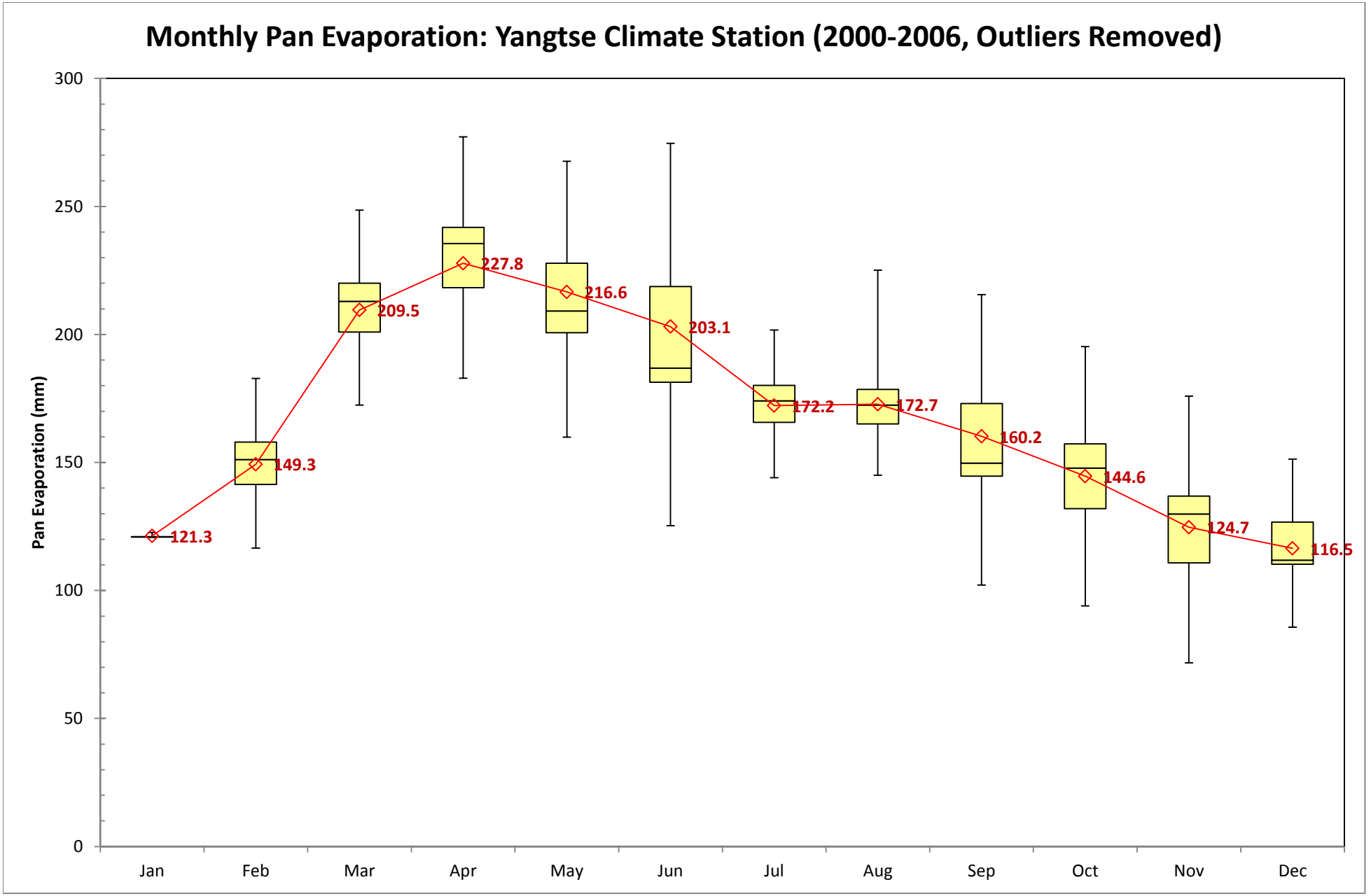
Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statistical outliers



Pan evaporation values from 2007 and onwards were excluded due to an unexplained discrepancy in annual evaporation.
For more discussion on this issue, refer to the climate trend analysis worksheet.


Monthly Pan Evaporation: Yangtse Climate Station (2000-2006)
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
133.7
122.8
119.2
149.3
209.5
227.8
202.4
117.6
203.1
172.2
248.2
183.5
160.2
144.6
124.7
116.5


Monthly Pan Evaporation: Yangtse Climate Station (2000-2006, Outliers Removed)
Pan Evaporation (mm)
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
121.3
149.3
209.5
227.8
216.6
203.1
172.2
172.7
160.2
144.6
124.7
116.5

ATTACHMENT 3.3

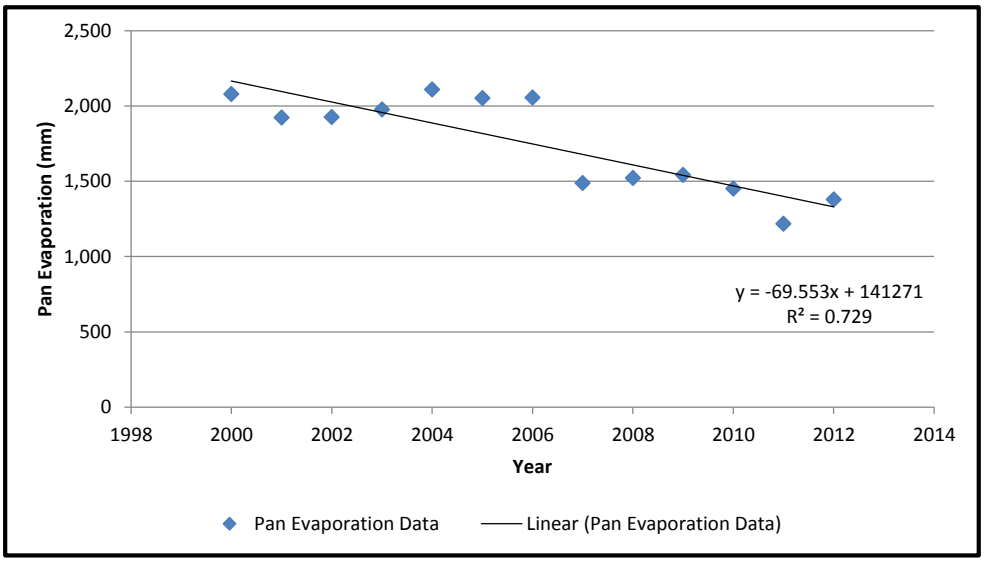
Pan Evaporation Trend Analysis

Knight Piésold CONSULTING	Subject	Myanmar Wanbao Mining	Made by	AB	Job No.	PE701-00022/04
		Copper Ltd. | Letpadaung Copper Project	Checked	TML	Date	25/06/2013
		Basic Climatology	Approved			

Climatic Trend Analysis: Monywa Township Pan Evaporation (2000-2013)

Year	Evap (mm)
2000	2,078
2001	1,922
2002	1,925
2003	1,976
2004	2,109
2005	2,051
2006	2,056
2007	1,488
2008	1,521
2009	1,542
2010	1,451
2011	1,217
2012	1,379
2013	Exclude

Period	Ave. Pan Evap. (mm)
2000-2006	2,017
2007-2012	1,433
2000-2012	1,747



Even though a statistically significant negative trend is shown on the above graph, KP questions its validity. From the dramatic shift in annual pan evaporation occurring from 2007 and onwards (~ 600 mm/yr less), the only conclusion we can draw is that either there was a problem with the instrumentation or that the data was from another site. At this time, there is no satisfactory answer to this question and as a result, pan evaporation data from 2007 and onwards is to be excluded from climate analysis.

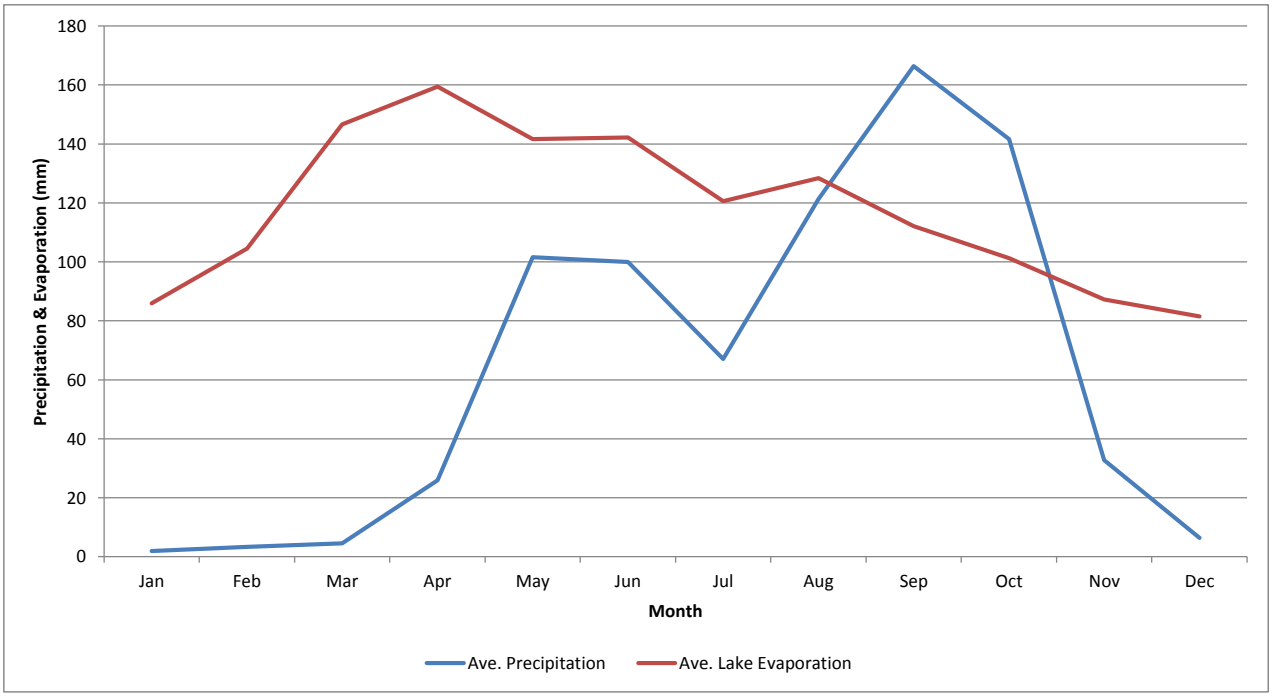
ATTACHMENT 3.4

Comparison of Monthly Average
Precipitation & Evaporation

Comparison of Average Monthly Precipitation and Lake Evaporation

Comparison Data (mm)												
Variable	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Ave. Precipitation	1.9	3.3	4.6	25.9	101.5	99.9	67.1	121.3	166.4	141.7	32.7	6.4
Ave. Pan Evaporation	122.8	149.3	209.5	227.8	202.4	203.1	172.2	183.5	160.2	144.6	124.7	116.5
Ave. Lake Evaporation	86.0	104.5	146.7	159.5	141.7	142.2	120.5	128.5	112.1	101.2	87.3	81.6
Precipitation minus Lake Evaporation	-84.1	-101.2	-142.1	-133.5	-40.1	-42.2	-53.5	-7.2	54.2	40.4	-54.6	-75.1

Pan Coefficient = 0.7 **Net Annual Precipiation minus Lake Evaporation =** -638.9 **mm**



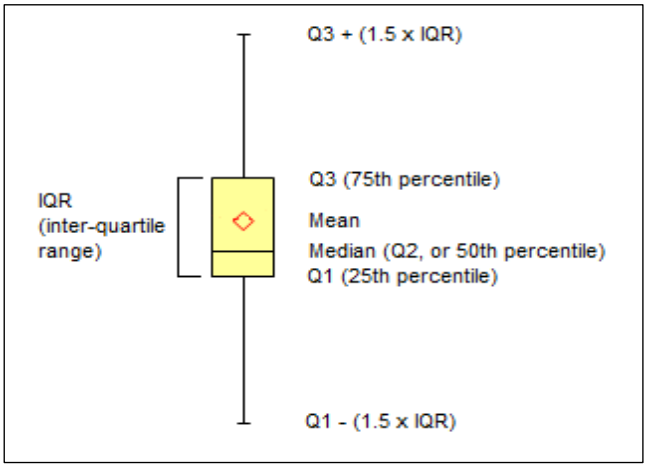
ATTACHMENT 4.1

Annual Average Temperature Analysis

Temperature Data, Annual Sampling Frequency: WMO 48037 Climate Station (1981-2012) (Analysis Format)

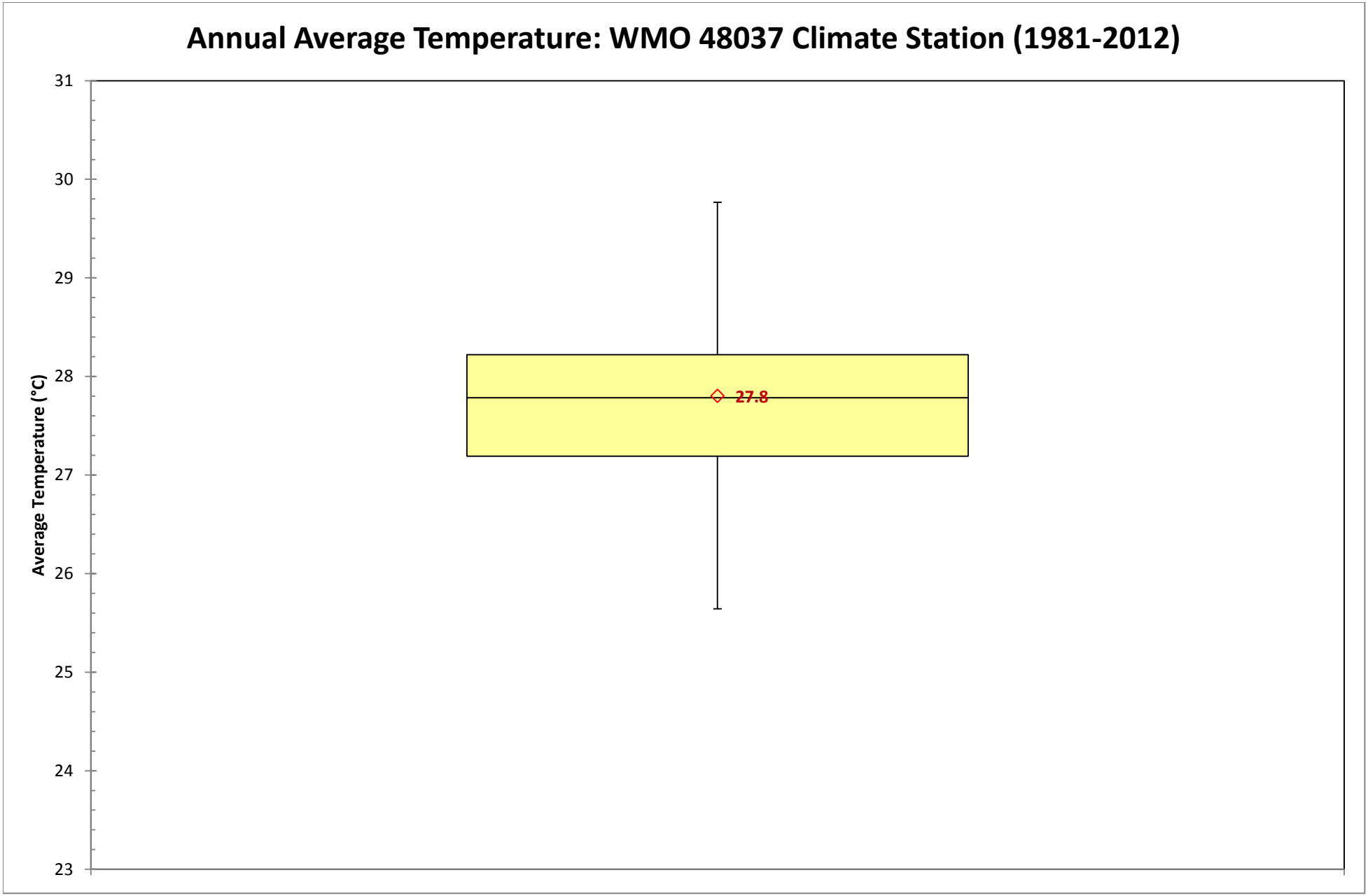
Year	Ave. Temp (°C)
1981	Exclude
1982	27.5
1983	27.2
1984	26.6
1985	27.0
1986	Exclude
1987	Exclude
1988	Exclude
1989	Exclude
1990	26.1
1991	27.0
1992	Exclude
1993	27.1
1994	28.1
1995	27.7
1996	27.6
1997	27.5
1998	29.7
1999	29.4
2000	27.0
2001	27.8
2002	27.9
2003	28.2
2004	28.3
2005	28.6
2006	28.3
2007	27.9
2008	28.0
2009	28.0
2010	28.7
2011	27.7
2012	Exclude

Stat	Ave. Temp (°C)
Mean	27.8
SD	0.8
Median	27.8
Q1	27.2
Q3	28.2
Minimum	26.1
Maximum	29.7
Count	25
Ext Max	29.8
Ext Min	25.6
25th Pct	27.2
50th Pct	0.6
75th Pct	0.4
1.5 * IQR	1.5



Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered outliers


Annual Average Temperature: WMO 48037 Climate Station (1981-2012)
Average Temperature (°C)
31
30
29
28
27
26
25
24
23
27.8

ATTACHMENT 4.2

Monthly Average Temperature Analysis

Temperature Data, Monthly Sampling Frequency: WMO 48037 Climate Station (1981-2012) (Analysis Format)

Average Temperature Data (°C)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	23.0	21.5
1982	21.4	23.4	26.3	30.5	31.4	29.9	31.4	29.9	30.3	28.2	25.8	21.3
1983	18.4	21.5	27.2	31.3	32.7	31.2	31.4	29.6	30.1	28.0	23.7	21.1
1984	20.2	23.0	26.9	30.6	30.6	29.4	29.5	29.3	28.0	26.5	23.4	22.0
1985	22.5	22.3	28.7	31.1	30.6	30.1	26.8	29.2	30.4	26.7	23.8	21.9
1986	21.1	23.2	27.6	31.6	32.3	31.1	30.1	28.9	28.8	26.8	N/D	N/D
1987	N/D	21.9	23.1	30.9	28.1	N/D	N/D	29.0	28.9	28.1	24.8	22.7
1988	21.2	N/D	N/D	N/D	30.4	27.8	28.7	28.4	N/D	N/D	N/D	N/D
1989	N/D	N/D	24.8	N/D	31.0	29.3	27.9	28.6	28.2	27.0	23.7	19.9
1990	21.6	21.1	25.8	25.9	28.3	29.0	29.0	30.1	27.8	28.4	25.4	21.2
1991	20.4	23.8	29.5	30.1	30.4	30.6	30.0	29.4	29.3	27.7	23.4	20.1
1992	18.5	21.3	25.9	30.7	31.7	N/D	N/D	29.3	29.8	27.0	23.9	18.4
1993	19.0	22.2	27.8	29.5	30.5	30.7	30.7	29.8	29.1	27.9	25.0	23.1
1994	23.4	23.1	27.2	31.8	32.5	31.9	31.2	32.1	29.7	27.6	25.6	21.4
1995	21.9	25.0	27.4	30.9	31.4	31.9	30.4	29.9	28.8	28.6	25.3	20.7
1996	21.6	23.9	27.4	30.3	31.4	29.3	30.1	28.6	28.6	27.5	25.7	26.8
1997	20.7	23.2	26.6	29.3	33.4	30.5	30.8	29.2	28.4	28.1	26.0	23.8
1998	24.3	24.2	35.5	30.3	31.3	32.9	31.4	31.4	29.7	29.8	27.6	28.0
1999	28.0	32.9	32.9	33.1	29.5	31.8	31.3	30.0	30.3	28.3	24.8	20.4
2000	22.5	22.8	26.5	30.2	29.2	29.9	30.1	31.0	28.6	27.6	24.4	21.3
2001	21.3	24.8	28.0	32.1	29.9	30.1	30.6	29.5	30.4	28.2	25.3	23.3
2002	23.0	25.9	28.9	31.8	30.6	31.2	29.8	28.7	29.2	28.0	24.6	22.6
2003	21.9	24.5	28.0	32.8	29.9	30.3	31.7	30.9	29.7	29.0	26.3	23.8
2004	22.5	24.5	29.5	30.8	33.8	29.9	30.3	31.4	28.9	28.4	27.2	22.9
2005	23.2	27.1	30.4	28.8	32.9	32.0	31.4	30.9	28.9	29.1	25.8	23.1
2006	23.5	25.6	29.3	31.6	31.1	31.2	31.1	30.0	29.0	28.5	26.5	22.0
2007	22.4	23.3	28.8	31.6	30.5	31.4	31.0	30.3	29.5	28.1	25.5	22.9
2008	22.1	23.4	29.5	32.3	30.1	30.5	30.8	30.8	30.3	28.1	24.9	22.9
2009	23.5	26.1	28.1	31.5	31.6	30.2	31.3	30.2	29.4	27.8	25.4	21.3
2010	21.8	24.5	30.9	32.4	33.1	31.9	32.5	30.8	29.8	28.6	26.3	21.8
2011	22.4	23.6	28.1	30.6	31.1	30.2	31.4	29.2	29.8	27.9	25.4	22.5
2012	22.3	25.3	27.9	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D

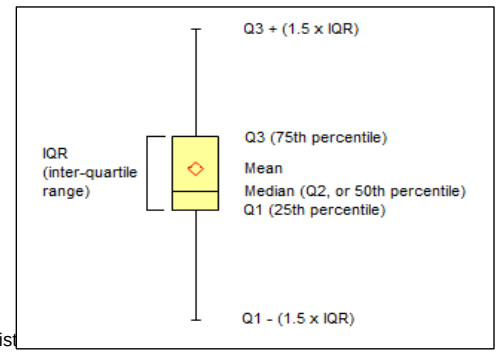
Average Temperature Data Summary Statistics (°C)

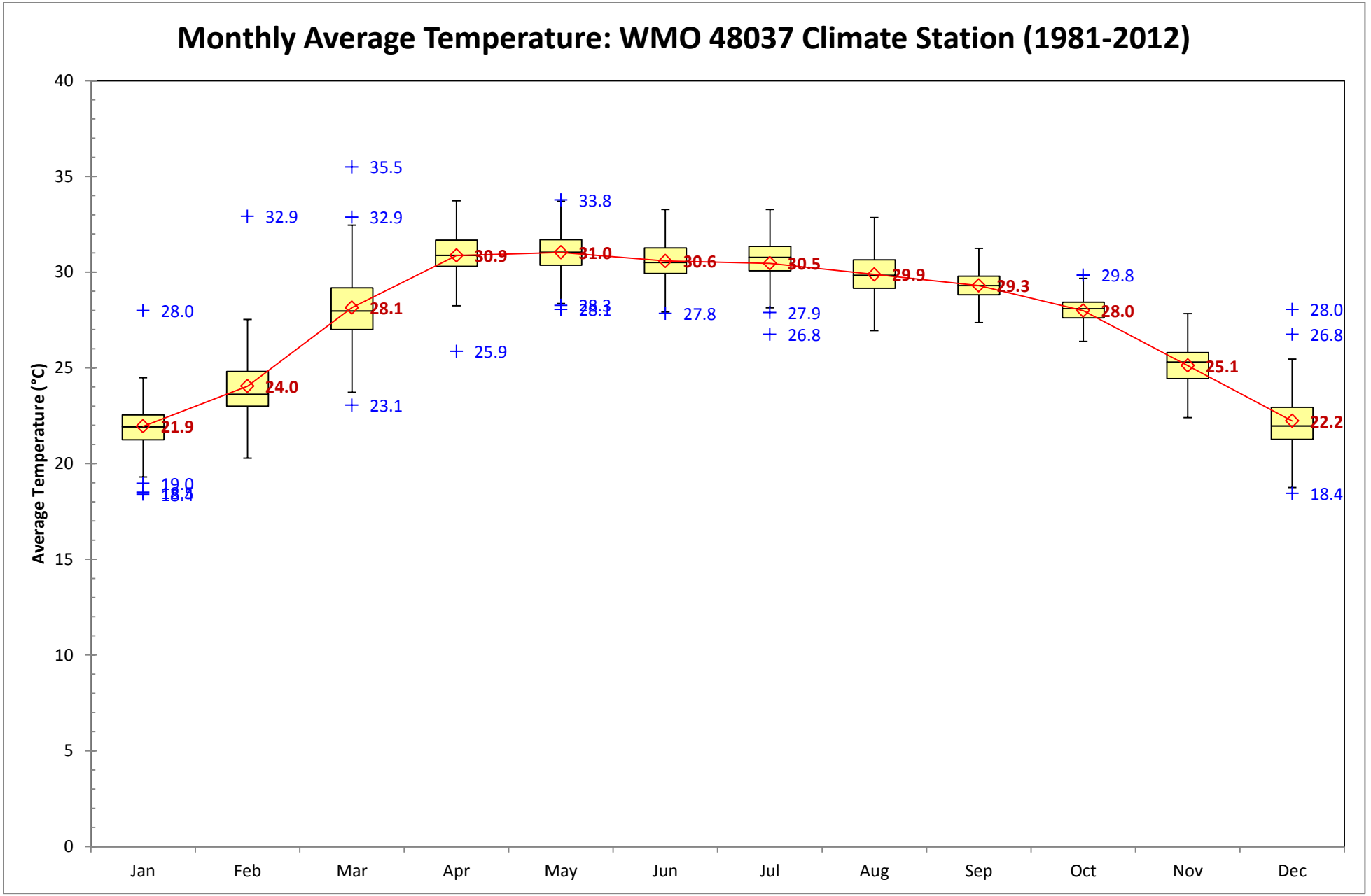
Stat.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
SD	1.9	2.3	2.3	1.4	1.4	1.1	1.2	1.0	0.7	0.7	1.1	1.9
Median	21.9	23.6	28.0	30.9	31.0	30.5	30.8	29.8	29.3	28.1	25.3	22.0
Q1	21.2	23.0	27.0	30.3	30.4	29.9	30.1	29.2	28.8	27.6	24.4	21.3
Q3	22.5	24.8	29.2	31.7	31.7	31.3	31.3	30.6	29.8	28.4	25.8	22.9
Minimum	18.4	21.1	23.1	25.9	28.1	27.8	26.8	28.4	27.8	26.5	23.0	18.4
Maximum	28.0	32.9	35.5	33.1	33.8	32.9	32.5	32.1	30.4	29.8	27.6	28.0
Count	29	29	30	28	30	28	28	30	29	29	29	29
Ext Max	24.5	27.5	32.5	33.7	33.7	33.3	33.3	32.9	31.2	29.7	27.8	25.5
Ext Min	19.3	20.3	23.7	28.2	28.4	27.9	28.1	26.9	27.4	26.4	22.4	18.7
25th Pct	21.2	23.0	27.0	30.3	30.4	29.9	30.1	29.2	28.8	27.6	24.4	21.3
50th Pct	0.7	0.6	1.0	0.6	0.7	0.6	0.7	0.7	0.5	0.5	0.9	0.7
75th Pct	0.6	1.2	1.2	0.8	0.7	0.8	0.6	0.8	0.5	0.3	0.5	1.0
1.5 * IQR	1.9	2.7	3.3	2.1	2.0	2.0	1.9	2.2	1.5	1.2	2.0	2.5

Note: N/D = No Data Available, N/A = Not Applicable.

Explanation of statistical and computed values above

Mean	Average of the given dataset, AVERAGE({data})
SD	Standard deviation of the given dataset, STDEV({data})
Median	Median of the given dataset, MEDIAN({data})
Q1	First quartile of the given dataset, PERCENTILE({data},0.25)
Q3	Third quartile of the given dataset, PERCENTILE({data},0.75)
Minimum	Minimum value of the given dataset, MIN({data})
Maximum	Maximum value of the given dataset, MIN({data})
Count	Number of valid entries in the given dataset, COUNTIF({data},">=0")
25th Pct	Plotting value of the first quartile = Q1
50th Pct	Lower box height = Median - Q1
75th Pct	Upper box height = Q3 - Median
1.5 * IQR	Whisker (error bar) length = 1.5 * (Q3 - Q1); values beneath (Q1 **minus** this) or above (Q3 **plus** this) are considered statist




Monthly Average Temperature: WMO 48037 Climate Station (1981-2012)
Average Temperature (°C)
40
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
28.0
19.0
18.4
21.9
32.9
24.0
35.5
32.9
28.1
23.1
30.9
25.9
33.8
31.0
28.3
28.1
30.6
27.8
30.5
27.9
26.8
29.9
29.3
29.8
28.0
25.1
28.0
26.8
22.2
18.4

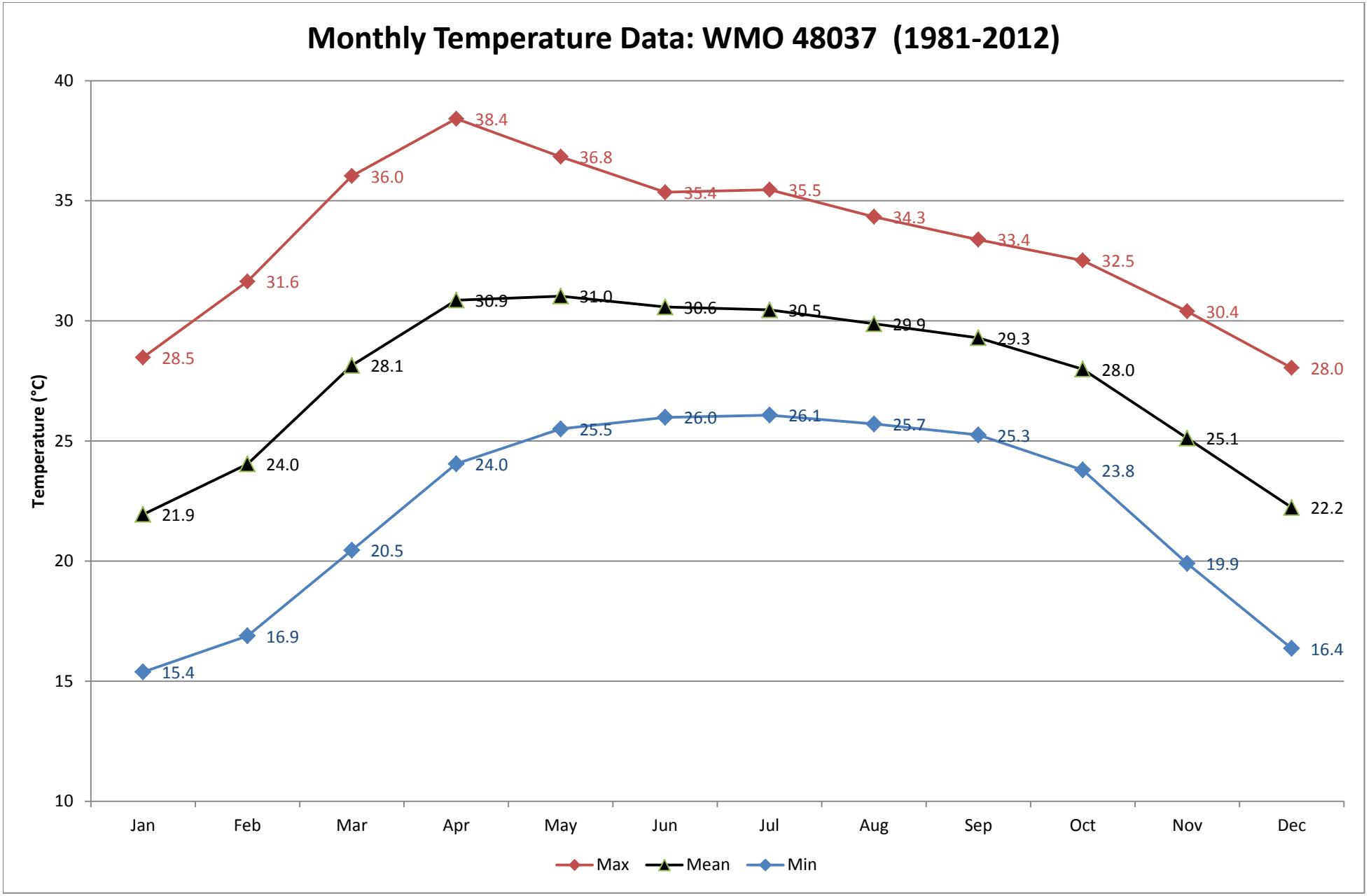
ATTACHMENT 4.3

Monthly Temperature Range Analysis

Knight Piésold CONSULTING	Subject	Myanmar Wanbao Mining	Made by	AB	Job No.	PE701-00022/04
		Copper Ltd. | Letpadaung Copper Project	Checked	TML	Date	21/06/2013
		Basic Climatology	Approved		Sheet No.	

Monthly Temperature Analysis: WMO 48037 (1981-2012)

Temperature Summary Statistics (°C)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Max	28.5	31.6	36.0	38.4	36.8	35.4	35.5	34.3	33.4	32.5	30.4	28.0
Mean	21.9	24.0	28.1	30.9	31.0	30.6	30.5	29.9	29.3	28.0	25.1	22.2
Min	15.4	16.9	20.5	24.0	25.5	26.0	26.1	25.7	25.3	23.8	19.9	16.4

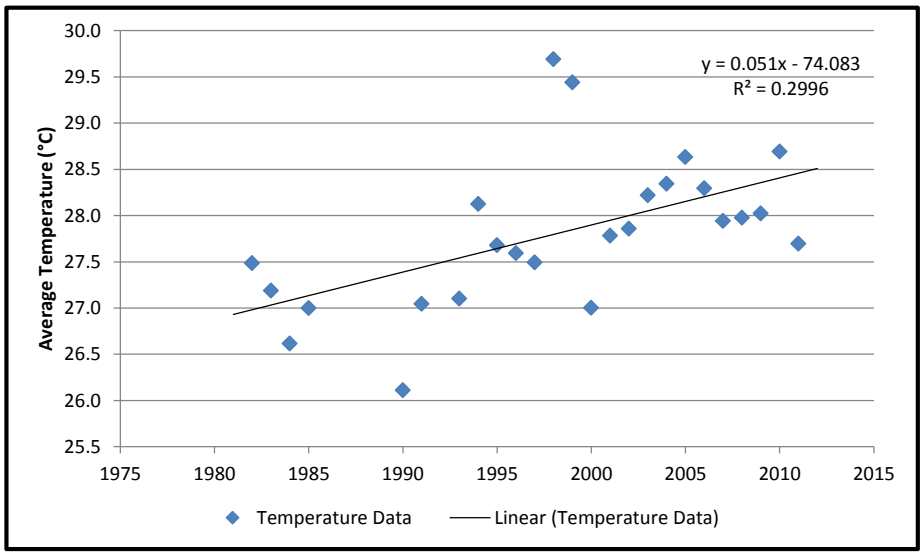

Monthly Temperature Data: WMO 48037 (1981-2012)
Temperature (°C)
40
35
30
25
20
15
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
28.5
31.6
36.0
38.4
36.8
35.4
35.5
34.3
33.4
32.5
30.4
28.0
21.9
24.0
28.1
30.9
31.0
30.6
30.5
29.9
29.3
28.0
25.1
22.2
15.4
16.9
20.5
24.0
25.5
26.0
26.1
25.7
25.3
23.8
19.9
16.4
Max
Mean
Min

ATTACHMENT 4.4

Temperature Trend Analysis

Climatic Trend Analysis: WMO 48037 Average Temperature (1981-2012)

Year	Temp (°C)
1981	Exclude
1982	27.5
1983	27.2
1984	26.6
1985	27.0
1986	Exclude
1987	Exclude
1988	Exclude
1989	Exclude
1990	26.1
1991	27.0
1992	Exclude
1993	27.1
1994	28.1
1995	27.7
1996	27.6
1997	27.5
1998	29.7
1999	29.4
2000	27.0
2001	27.8
2002	27.9
2003	28.2
2004	28.3
2005	28.6
2006	28.3
2007	27.9
2008	28.0
2009	28.0
2010	28.7
2011	27.7
2012	Exclude



From the above, KP concludes that there is no statistically significant trend observable in annual average temperature values at this site.

ATTACHMENT 5.1

Wind Rose Analysis

Wind Rose Analysis Results (All Values): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 26,304 **Number of Valid Points:** 26,304 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.10	0.90	2.40	3.70	5.10	9.20

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	17.29	0.000	3.015	9.200
22.5	8.76	0.000	2.481	7.400
45.0	4.16	0.000	1.660	7.400
67.5	2.98	0.000	1.047	6.700
90.0	3.87	0.000	1.045	7.300
112.5	4.40	0.000	1.612	6.300
135.0	7.52	0.000	2.141	6.200
157.5	9.18	0.000	2.656	7.600
180.0	7.98	0.000	3.185	8.500
202.5	4.70	0.000	2.997	8.300
225.0	2.71	0.000	2.333	9.000
247.5	2.26	0.000	1.601	7.100
270.0	2.39	0.000	1.354	7.000
292.5	3.09	0.000	1.370	6.700
315.0	4.66	0.000	1.550	6.800
337.5	14.05	0.000	2.961	8.100
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	11,172	42.473	0	26,304	100
2 - 4	9,826	37.356	2	15,132	57.527
4 - 6	4,884	18.568	4	5,306	20.172
6 - 8	400	1.521	6	422	1.604
8 - 50	22	0.084	8	22	0.084
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 00:00 to 03:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.20	1.30	2.90	3.90	4.60	7.60

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	17.97	0.000	3.294	5.400
22.5	7.88	0.000	2.608	5.600
45.0	4.05	0.000	2.386	5.300
67.5	2.34	0.000	1.700	4.900
90.0	2.86	0.100	1.723	5.400
112.5	2.74	0.000	2.263	6.000
135.0	3.92	0.100	2.332	6.200
157.5	5.32	0.000	2.825	6.600
180.0	8.00	0.000	3.275	5.600
202.5	5.54	0.000	3.082	5.000
225.0	3.83	0.000	2.329	4.800
247.5	2.52	0.000	1.440	4.500
270.0	3.68	0.000	1.347	4.400
292.5	4.53	0.000	1.602	5.500
315.0	7.21	0.000	1.708	5.000
337.5	17.61	0.000	3.075	7.600
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	1,111	33.79	0	3,288	100
2 - 4	1,452	44.161	2	2,177	66.21
4 - 6	714	21.715	4	725	22.05
6 - 8	11	0.335	6	11	0.335
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 03:00 to 06:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.40	2.30	3.40	4.00	4.90	7.60

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	24.18	0.000	3.381	6.600
22.5	10.58	0.100	2.971	5.500
45.0	4.59	0.100	2.530	6.400
67.5	2.34	0.000	2.174	4.900
90.0	1.98	0.000	1.908	3.800
112.5	2.22	0.000	2.156	3.800
135.0	3.44	0.000	2.471	4.900
157.5	4.71	0.000	3.098	7.600
180.0	5.81	0.100	3.228	7.600
202.5	3.47	0.000	2.687	4.500
225.0	1.76	0.000	1.817	3.900
247.5	1.37	0.000	1.540	4.500
270.0	1.34	0.000	1.809	4.100
292.5	2.19	0.000	2.089	5.500
315.0	3.98	0.000	2.198	5.100
337.5	26.03	0.000	3.815	7.100
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	692	21.046	0	3,288	100
2 - 4	1,675	50.943	2	2,596	78.954
4 - 6	896	27.251	4	921	28.011
6 - 8	25	0.76	6	25	0.76
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 06:00 to 09:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.40	2.30	3.50	4.60	6.10	9.20

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	30.17	0.000	4.112	9.200
22.5	16.09	0.000	3.674	7.400
45.0	5.05	0.000	2.655	5.500
67.5	1.40	0.000	2.022	4.900
90.0	1.31	0.000	1.460	7.300
112.5	1.46	0.000	2.354	6.300
135.0	2.37	0.000	2.205	4.700
157.5	4.56	0.000	2.319	5.700
180.0	5.93	0.000	2.973	6.700
202.5	4.17	0.100	2.889	6.800
225.0	1.55	0.000	1.863	4.000
247.5	1.06	0.100	1.426	3.800
270.0	1.03	0.100	1.229	4.600
292.5	1.40	0.000	1.861	4.400
315.0	2.59	0.000	2.042	4.900
337.5	19.86	0.000	3.887	8.100
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	679	20.651	0	3,288	100
2 - 4	1,319	40.116	2	2,609	79.349
4 - 6	1,099	33.425	4	1,290	39.234
6 - 8	178	5.414	6	191	5.809
8 - 50	13	0.395	8	13	0.395
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 09:00 to 12:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.10	0.70	2.10	3.40	5.20	8.60

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	31.27	0.000	2.813	8.600
22.5	14.14	0.000	2.300	6.500
45.0	4.05	0.000	1.077	5.800
67.5	2.62	0.000	0.765	6.700
90.0	2.31	0.000	0.736	7.100
112.5	2.71	0.000	1.281	5.600
135.0	4.26	0.000	1.354	5.700
157.5	7.18	0.000	2.002	7.400
180.0	7.57	0.000	2.861	7.800
202.5	3.50	0.000	2.720	7.700
225.0	1.34	0.000	1.161	5.100
247.5	1.00	0.000	1.012	3.800
270.0	1.22	0.000	0.893	5.200
292.5	1.64	0.000	0.661	4.600
315.0	2.59	0.000	1.408	5.200
337.5	12.62	0.000	2.273	8.000
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	1,559	47.415	0	3,288	100
2 - 4	1,185	36.04	2	1,729	52.585
4 - 6	472	14.355	4	544	16.545
6 - 8	70	2.129	6	72	2.19
8 - 50	2	0.061	8	2	0.061
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 12:00 to 15:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.00	0.20	1.20	2.60	5.00	8.50

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	15.33	0.000	1.768	6.000
22.5	7.48	0.000	1.181	4.700
45.0	4.26	0.000	0.425	3.300
67.5	4.68	0.000	0.203	2.400
90.0	5.93	0.000	0.411	4.500
112.5	5.51	0.000	0.728	5.500
135.0	10.22	0.000	1.469	5.500
157.5	15.82	0.000	2.317	6.700
180.0	10.01	0.000	3.297	8.500
202.5	2.71	0.000	2.581	8.300
225.0	1.49	0.000	2.418	6.500
247.5	1.43	0.000	1.638	6.200
270.0	1.19	0.000	1.249	5.600
292.5	1.83	0.000	1.565	6.400
315.0	2.52	0.000	1.083	5.600
337.5	9.61	0.000	1.577	6.700
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	2,130	64.781	0	3,288	100
2 - 4	792	24.088	2	1,158	35.219
4 - 6	293	8.911	4	366	11.131
6 - 8	67	2.038	6	73	2.22
8 - 50	6	0.182	8	6	0.182
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 15:00 to 18:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.10	0.70	1.80	3.10	4.70	7.00

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	7.00	0.000	1.830	5.300
22.5	4.53	0.000	1.410	5.000
45.0	3.44	0.000	0.867	3.400
67.5	4.23	0.000	0.630	4.000
90.0	7.76	0.000	0.808	4.100
112.5	8.70	0.100	1.522	5.800
135.0	20.26	0.000	2.281	5.500
157.5	15.66	0.100	2.797	6.600
180.0	6.75	0.000	3.191	7.000
202.5	3.59	0.000	2.914	7.000
225.0	2.43	0.000	3.099	6.900
247.5	2.01	0.000	2.464	6.900
270.0	1.76	0.000	1.995	6.400
292.5	2.31	0.000	1.403	6.700
315.0	2.59	0.000	1.351	5.300
337.5	7.00	0.000	1.837	5.700
Sum:	100.00			

Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	1,778	54.075	0	3,288	100
2 - 4	1,110	33.759	2	1,510	45.925
4 - 6	373	11.344	4	400	12.165
6 - 8	27	0.821	6	27	0.821
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 18:00 to 21:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.00	0.50	2.00	3.60	4.80	7.00

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	5.99	0.000	1.550	4.600
22.5	4.99	0.000	1.399	6.800
45.0	3.95	0.000	1.217	5.000
67.5	3.86	0.000	1.030	4.800
90.0	5.23	0.000	1.226	5.600
112.5	8.39	0.000	1.866	5.200
135.0	10.86	0.000	2.585	5.800
157.5	12.41	0.000	3.027	6.200
180.0	10.65	0.000	3.359	6.300
202.5	5.93	0.000	3.003	6.300
225.0	4.81	0.000	2.452	6.700
247.5	3.98	0.000	1.595	6.600
270.0	2.80	0.000	1.386	7.000
292.5	3.04	0.000	1.055	5.500
315.0	4.96	0.000	1.013	6.800
337.5	8.15	0.000	2.057	6.200
Sum:	100.00			

Wind speed bin statistics					
Bin	Counts	Frequency	Exceeding		
			Values >	Counts	Frequency
(m/s)		(%)	(m/s)		(%)
>0 - 2	1,619	49.24	0	3,288	100
2 - 4	1,131	34.398	2	1,669	50.76
4 - 6	522	15.876	4	538	16.363
6 - 8	16	0.487	6	16	0.487
8 - 50	0	0	8	0	0
50 - 89	0	0.000	50	0	0.000

Wind Rose Analysis Results (Values from 21:00 to 00:00): Wind Rose Dataset (2010-2012)

Analysis performed using WindRose Pro 3.1 software.

Number of points: 3,288 **Number of Valid Points:** 3,288 **Number of excuded samples:** 0

Non-directional wind speed sampling statistics						
Min. (m/s)	5th Pct. (m/s)	25th Pct. (m/s)	50th Pct. (m/s)	75th Pct. (m/s)	95th Pct. (m/s)	Max. (m/s)
0.00	0.10	0.70	2.00	3.50	4.60	9.00

Directional wind speed sampling statistics				
Wind Direction		Wind Speed		
Direction (°)	Frequency (%)	Min. (m/s)	Ave. (m/s)	Max. (m/s)
0.0	6.39	0.000	2.322	5.000
22.5	4.41	0.000	1.839	4.800
45.0	3.89	0.000	1.698	7.400
67.5	2.37	0.000	1.468	6.500
90.0	3.56	0.000	1.377	5.100
112.5	3.50	0.000	1.707	5.200
135.0	4.87	0.000	2.244	5.700
157.5	7.76	0.000	2.892	5.100
180.0	9.16	0.000	3.157	5.400
202.5	8.73	0.000	3.389	6.500
225.0	4.44	0.000	2.483	9.000
247.5	4.71	0.000	1.496	7.100
270.0	6.11	0.000	1.192	5.500
292.5	7.76	0.000	1.160	4.500
315.0	10.86	0.000	1.526	4.900
337.5	11.50	0.000	2.493	5.700
Sum:	100.00			

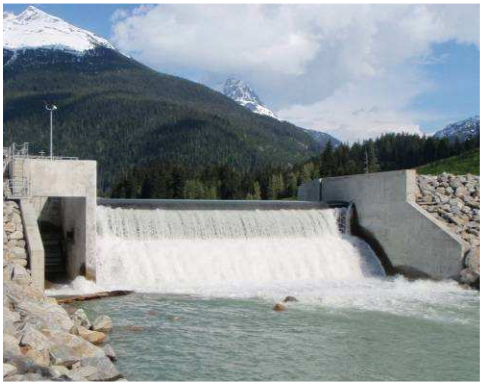
Wind speed bin statistics					
Bin (m/s)	Counts	Frequency (%)	Exceeding		
			Values > (m/s)	Counts	Frequency (%)
>0 - 2	1,604	48.783	0	3,288	100
2 - 4	1,162	35.341	2	1,684	51.217
4 - 6	515	15.663	4	522	15.876
6 - 8	6	0.182	6	7	0.213
8 - 50	1	0.03	8	1	0.03
50 - 89	0	0.000	50	0	0.000

APPENDIX B

Waste Rock Geochemical Assessment (KP Report PE701-00022/16)

Knight Piésold
CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT





WASTE ROCK GEOCHEMICAL ASSESSMENT

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PE701-00022/16
Rev 0
August 2013

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LETPADAUNG COPPER PROJECT

WASTE ROCK GEOCHEMICAL ASSESSMENT

KP Job No. PE701-00022/04

CONTRACT

DOCUMENT INFORMATION

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A	Issued as Draft	TDR	BL	DJTM	01/07/2013
B	Issued for Client Review	TDR/EJT	TDR	DJTM	15/07/2013
0	Issued as Final	TDR/EJT	TDR	DJTM	26/08/2013

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EXECUTIVE SUMMARY

Knight Piésold was requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The project will comprise a high throughput heap leach copper project which will generate approximately 1 billion tonnes of waste rock over the 33 year mine life.

The project is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap is present above the main ore zone of between 10 and 200 m thick. Previous geochemical investigations at the project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold selected 150 samples of waste rock for this study which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

The waste rock, although not all of this sulfur was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur which was present as reactive sulfide minerals was still very high averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming. There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble,

especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material.

Additional characterisation of the waste rock at the project will be required prior to bulk mining and throughout the life of the operation. Operational testing will include net acid generation testing on closely spaced grade control or blast hole samples for every mining bench. The extent of the testing is such that establishment of a site laboratory to conduct both geochemical and geotechnical testing will be required.

The waste will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all waste dump areas.
- Placement of layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps.
- Full encapsulation of all waste with a suitable compacted soil liner.
- Cover of the soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material.
- Water management structures around all waste dump areas to collect potentially contaminated waters.

In addition, the potentially acid generating waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height.
- Installation of interim covers, the frequency of which is still to be determined.

Instrumentation and monitoring of the quality of the construction and the performance of the encapsulation system will be required to confirm that the design intent is being achieved and sulfide oxidation has been reduced to acceptable levels.

1. INTRODUCTION

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The Letpadaung Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

Knight Piésold has conducted an initial geochemical assessment, with samples of waste rock selected and sent to an accredited laboratory for analysis. This report presents the results of the geochemical analysis, with interpretation of the acid generation and metal leaching risk and the implications for the mine waste management at the site. This report follows an interim report which was issued by Knight Piésold prior to receipt of all the test work results (Ref. 1).

It should be noted that this geochemical assessment only relates to the waste rock to be produced by the Letpadaung project. Geochemical studies into the heap leach pad are also required to allow for the design of seepage control measures and closure capping.

1.1 PROJECT DESCRIPTION

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit.
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

1.2 GEOLOGICAL SETTING

The following overview of the geological setting comprises excerpts from the Feasibility Study by Mineral Resources Development (Ref. 2).

The Monywa copper district is located along north-south trending Inner Volcanic Arc, which lies within the Central Burma Tectonic Belt. The project is a high sulfidation mineral system with andesite porphyry the most common rock type hosting the copper

mineralisation. Pyroclastics are the second most abundant rock type at Letpadaung, including tuffs and breccias and reworked volcaniclastic siltstones and sandstones.

Typical alteration zones common to most high sulfidation systems are observed at the Letpadaung Project, including residual silica zones, silica-alunite zones, argillic zones and chlorite zones. Copper mineralisation at Letpadaung is dominated by hypogene chalcocite / digenite, covellite and supergene chalcocite. The copper sulfide mineralisation is overlain by a 10 to 200 m thick strongly weathered leach cap. The leach cap can be considered waste material as it contains very limited economic copper mineralisation.

1.3 PREVIOUS GEOCHEMICAL WORK

Two high level geochemical studies have been conducted at the Letpadaung Project and the neighbouring S&K project. These studies have been reviewed and are summarised in the following sections.

Overall there is a very limited amount of geochemical data (twenty one relevant samples) considering the size of the deposit and the clear risk of acid rock drainage that exists from high sulfidation systems. Furthermore, the methods employed in the two studies have not been tailored to suit the mineralogy of the deposit. Therefore, the results and subsequent conclusions are considered questionable.

1.3.1 Feasibility Study Report

An assessment into the acid rock drainage potential of the Letpadaung Project was conducted by Coffey Partners International Pty Ltd in 1997 (Ref. 3) as part of the feasibility study. This study included geochemical testing of ten waste rock samples collected from both the S&K Deposit and the Letpadaung deposit, with material taken from both the leach cap and the internal waste.

The analysis included determination of total sulfur, pyritic sulfur, sulfate sulfur and “unidentified sulfur”. The total sulfur content in nine out of ten sample was high to extremely high (0.68 to 9.12%) with only a single sample of leach cap lapilli tuff exhibiting a low total sulfur content (<0.01%).

The total sulfur was used to calculate the maximum potential acidity which resulted in nine of the ten samples being classified as potentially acid generating. This approach appears to be overly conservative as the majority of the sulfur in leach cap sample was unidentified sulfur and a large proportion of the sulfur in the internal waste was also present as unidentified sulfur. The leach cap samples were essential devoid of pyritic sulfur.

The acid neutralising capacity (ANC) of the samples was highly variable ranging from material which was essential devoid of ANC (<0.01 kg $CaCO_3$/t) up to a sample with a very high ANC (141 kg $CaCO_3$/t). However, the majority of samples exhibited very low to moderate ANC (0.2 to 10 kg $CaCO_3$/t).

The assessment conducted by Coffey concluded that six out of ten samples were Acid Producing (i.e. had positive net acid producing potentials) with a further three samples classified as Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) with only a single sample was classified as Non Acid Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of less than 2). However, as noted earlier, the presence of unidentified sulfur in the samples could have significantly impacted the acid producing classifications.

The unidentified sulfur could be present in mineral forms which may not be acid generating, such as barite or alunite, but as no mineralogical analysis was conducted on the samples it is not possible to definitively determine the nature of the unidentified sulfur. However, previous geological assessments of the deposit do list alunite as being present (Ref. 2, 4 and 5) and, therefore, it is reasonable to assume that some of the unidentified sulfur is present as alunite. If the results of the assessment are recalculated using just the pyritic sulfur to calculate the maximum potential acidity, only 50% of the samples would be classified as potentially acid forming, rather than the 90% reported by Coffey.

1.3.2 ARD Investigation for S&K

An investigation into acid rock drainage and hydrogeological conditions at the S&K project was conducted by Westec Inc. in 1997 (Ref. 6). As part of the investigation, six grab samples and seven core samples were tested using basic static testing methods. It is worth noting that total sulfur values were used to generate the estimates of maximum potential acidity, as was conducted in the Coffey study and, therefore, the acid generating potential of the samples is likely to have been overestimated if non-acid forming sulfur containing minerals were also present in these samples.

Two of the samples tested were limestone / soil samples assessing potential sources of ARD mitigation material. These samples are not relevant to an assessment of the acid formation potential of the deposit itself and, therefore, have been excluded from the discussion of results below.

The results of this assessment indicate that six of the eleven relevant samples were found to be Acid Producing (i.e. had positive net acid producing potentials), two were found to be Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) and three samples were found to be Non Acid

Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of greater than 2).

2. SAMPLE SELECTION

A site visit was undertaken by Bruce Zhang and Tim Rowles of Knight Piésold from the 25th April through to the 28th April 2013 to gather background data on the project and to select and collect samples of waste rock for geochemical testing.

It was originally intended to select samples of waste rock for geochemical analyses from eleven boreholes recently drilled by Wanbao Myanmar. However, ten of these boreholes were found to be located around the periphery of the pit, with one borehole well outside of the pit limits. Therefore, samples were instead selected from ten of the recently drilled boreholes (i.e. those located around the edge of the pit) plus three boreholes which were drilled within the centre of the pit by Ivanhoe. The core was examined prior to selecting samples and was found to be in good condition with no visible signs of significant oxidation.

A total of one hundred and fifty samples were selected from the boreholes within waste zones. These samples represent the range of waste rock lithologies recorded on the geological logs and also an appropriate range of copper and sulfur grades based on the existing assay results which accompanied the logs. Samples were taken from 5 m below ground level to the current pit design base of 450 m depth. The selected samples are summarised in Table 2.1, with a detailed listing provided in Table 2.2.

Table 2.1: Summary Selected Samples

Lithology	Number of Samples
Andesite Porphyry	95
Breccia	14
Diorite Porphyry	12
Pyroclastic	7
Fault Breccia	5
Hydrothermal Breccia	5
Porphyry	5
Dyke	3
Tuff	2
Hornblend Porphyry	1
Feldspar Porphyry	1

Samples were taken from the core trays by manually breaking the core and taking part of the core, leaving the remainder of the core within the trays. Approximately 500 g to 1 kg of core was collected for each sample from the drill intervals indicated in Table 2.2. The samples were placed in cloth bags, labelled and collated into a single crate before being shipped to Genalysis Intertek in Perth for testing.

Table 2.2: Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-001	LS001	25	Andesite Porphyry
701-22-002	LS001	59	Andesite Porphyry
701-22-003	LS001	65.5	Andesite Porphyry
701-22-004	LS001	89.25	Andesite Porphyry
701-22-005	LS001	122	Andesite Porphyry
701-22-006	LS001	136.75	Dyke
701-22-007	LS001	185	Dyke
701-22-008	LS001	221.65	Dyke
701-22-009	LS001	249.15	Andesite Porphyry
701-22-010	LS001	290.75	Andesite Porphyry
701-22-011	LS001	304.05	Andesite Porphyry
701-22-012	LS001	368.85	Andesite Porphyry
701-22-013	LS001	395	Andesite Porphyry
701-22-014	LS001	411.1	Andesite Porphyry
701-22-015	LS001	423.5	Andesite Porphyry
701-22-016	LS002	94.3	Andesite Porphyry
701-22-017	LS002	104.13	Breccia
701-22-018	LS002	128.6	Andesite Porphyry
701-22-019	LS002	148.4	Andesite Porphyry
701-22-020	LS002	355.8	Diorite Porphyry
701-22-021	LS002	373	Andesite Porphyry
701-22-022	LS002	422.5	Andesite Porphyry
701-22-023	LS002	435.3	Andesite Porphyry
701-22-024	LS002	448.85	Andesite Porphyry
701-22-025	LS002	472.85	Andesite Porphyry
701-22-026	LS003	21.3	Andesite Porphyry
701-22-027	LS003	70	Andesite Porphyry
701-22-028	LS003	74.3	Andesite Porphyry
701-22-029	LS003	97	Andesite Porphyry
701-22-030	LS003	115.5	Andesite Porphyry
701-22-031	LS003	131.7	Andesite Porphyry
701-22-032	LS003	146.75	Breccia
701-22-033	LS003	170.02	Diorite Porphyry
701-22-034	LS003	182.4	Diorite Porphyry
701-22-035	LS003	274.25	Diorite Porphyry
701-22-036	LS003	298.3	Diorite Porphyry
701-22-037	LS003	305	Diorite Porphyry
701-22-038	LS003	324.8	Breccia
701-22-039	LS003	330.2	Andesite Porphyry
701-22-040	LS003	342.8	Diorite Porphyry
701-22-041	LS003	353.35	Feldspar Porphyry
701-22-042	LS003	377.5	Andesite Porphyry
701-22-043	LS003	394.75	Porphyry
701-22-044	LS003	410.9	Porphyry
701-22-045	LS003	440.8	Breccia
701-22-046	LS004	30.21	Andesite Porphyry
701-22-047	LS004	50.21	Andesite Porphyry
701-22-048	LS004	69.25	Andesite Porphyry
701-22-049	LS004	110.45	Andesite Porphyry
701-22-050	LS004	134.45	Andesite Porphyry
701-22-051	LS005	28.4	Diorite Porphyry
701-22-052	LS005	50.1	Diorite Porphyry
701-22-053	LS005	72.5	Breccia
701-22-054	LS005	133.9	Breccia
701-22-055	LS005	141.4	Diorite Porphyry
701-22-056	LS006	34.3	Andesite Porphyry
701-22-057	LS006	52.3	Andesite Porphyry
701-22-058	LS006	70.3	Andesite Porphyry
701-22-059	LS006	127.6	Andesite Porphyry
701-22-060	LS006	140.4	Breccia
701-22-061	LK002	16.05	Porphyry
701-22-062	LK002	36.3	Andesite Porphyry
701-22-063	LK002	113.6	Breccia
701-22-064	LK002	133.3	Porphyry
701-22-065	LK002	167.3	Porphyry
701-22-066	LK003	40.3	Andesite Porphyry
701-22-067	LK003	54.9	Breccia
701-22-068	LK003	108.6	Breccia
701-22-069	LK003	128.7	Pyroclastic
701-22-070	LK003	145.6	Tuff
701-22-071	LK004	51.23	Hornblende Porphyry
701-22-072	LK004	71.63	Breccia
701-22-073	LK004	81.52	Breccia
701-22-074	LK004	104.71	Andesite Porphyry
701-22-075	LK004	137.51	Diorite Porphyry
701-22-076	LK006	45.2	Breccia
701-22-077	LK006	51.8	Andesite Porphyry
701-22-078	LK006	129.7	Andesite Porphyry
701-22-079	LK006	145.7	Breccia
701-22-080	LK006	165.86	Diorite Porphyry

Table 2.2 (Continued): Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-081	LK006	191.35	Tuff
701-22-082	LK006	214.6	Pyroclastic
701-22-083	L013	5	Andesite Porphyry
701-22-084	L013	11	Andesite Porphyry
701-22-085	L013	17.7	Andesite Porphyry
701-22-086	L013	23.4	Andesite Porphyry
701-22-087	L013	28.9	Andesite Porphyry
701-22-088	L013	34.9	Andesite Porphyry
701-22-089	L013	41.25	Andesite Porphyry
701-22-090	L013	47.7	Andesite Porphyry
701-22-091	L013	52.9	Andesite Porphyry
701-22-092	L013	58.8	Andesite Porphyry
701-22-093	L013	69	Andesite Porphyry
701-22-094	L013	75	Hydrothermal Breccia
701-22-095	L013	81.9	Hydrothermal Breccia
701-22-096	L013	86.55	Hydrothermal Breccia
701-22-097	L013	93.25	Fault Breccia
701-22-098	L013	100.4	Hydrothermal Breccia
701-22-099	L013	127.55	Andesite Porphyry
701-22-100	L013	177.05	Andesite Porphyry

ID	Borehole	Depth (m)	Lithology
701-22-101	L013	199.75	Andesite Porphyry
701-22-102	L223	121.75	Fault Breccia
701-22-103	L223	131	Andesite Porphyry
701-22-104	L223	137	Andesite Porphyry
701-22-105	L223	142.1	Andesite Porphyry
701-22-106	L223	150	Andesite Porphyry
701-22-107	L223	156	Andesite Porphyry
701-22-108	L223	164.55	Andesite Porphyry
701-22-109	L223	170	Andesite Porphyry
701-22-110	L223	178.05	Andesite Porphyry
701-22-111	L223	184	Andesite Porphyry
701-22-112	L223	191.95	Andesite Porphyry
701-22-113	L223	198	Andesite Porphyry
701-22-114	L223	206.5	Andesite Porphyry
701-22-115	L223	212	Andesite Porphyry
701-22-116	L223	220.05	Andesite Porphyry
701-22-117	L223	231.2	Andesite Porphyry
701-22-118	L223	240.4	Andesite Porphyry
701-22-119	L223	244	Fault Breccia
701-22-120	L223	319.3	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-121	L223	325.4	Andesite Porphyry
701-22-122	L223	340.3	Fault Breccia
701-22-123	L087	6	Pyroclastic
701-22-124	L087	16	Pyroclastic
701-22-125	L087	26	Pyroclastic
701-22-126	L087	36	Pyroclastic
701-22-127	L087	46	Pyroclastic
701-22-128	L087	56	Andesite Porphyry
701-22-129	L087	66	Fault Breccia
701-22-130	L087	76	Andesite Porphyry
701-22-131	L087	86	Andesite Porphyry
701-22-132	L087	96	Andesite Porphyry
701-22-133	L087	106	Andesite Porphyry
701-22-134	L087	116	Andesite Porphyry
701-22-135	L087	126	Andesite Porphyry
701-22-136	L087	134	Andesite Porphyry
701-22-137	L087	144	Andesite Porphyry
701-22-138	L087	158	Andesite Porphyry
701-22-139	L087	170	Andesite Porphyry
701-22-140	L087	184	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-141	L087	200	Andesite Porphyry
701-22-142	L087	210	Andesite Porphyry
701-22-143	L087	216	Andesite Porphyry
701-22-144	L087	252	Andesite Porphyry
701-22-145	L087	262	Andesite Porphyry
701-22-146	L087	272	Andesite Porphyry
701-22-147	L087	292	Andesite Porphyry
701-22-148	L087	330	Hydrothermal Breccia
701-22-149	L087	349.7	Andesite Porphyry
701-22-150	L087	340	Andesite Porphyry

3. TESTWORK METHODS

3.1 ACID BASE ACCOUNTING

Acid base accounting (ABA) assesses a sample's potential to form acid from the oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample.

Total sulfur and total carbon were determined by LECO induction furnace, with infrared detection. Acid soluble sulfur (HCL S), which includes readily soluble sulfate minerals such as melanterite, epsomite, gypsum and anhydrite as well as a portion of the less soluble iron hydroxyl sulfates such as jarosite, was determined using a hydrochloric acid digest on the solid sample followed by ICP determination of the sulfur content of the digest solution.

Due the presence of alunite and natroalunite in the deposit which would not be identified using the hydrochloric acid digest method, the Chromium Reducible Sulfur (CRS) test was also conducted on the samples to determine the sulfide sulfur content.

The various sulfur species present were then calculated as follows:

Sulfide sulfur (%) = CRS (%)

Acid soluble sulfate (%) = HCL S (%)

Non-acid soluble sulfate (%) = Total sulfur (%) – CRS (%) – HCL S (%)

The test work methods used are based on the ABA methodology defined in the MEND Prediction Manual for Drainage Chemistry from Sulfidic Geological Material (Ref. 7), MEND Acid Rock Drainage Prediction Manual (Ref. 8), and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 9).

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used is based on Sobek et al (Ref. 10), however, a siderite correction step has been added to the method, after Stewart et al (Ref. 11).

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA), which is a measure of the maximum amount of sulfuric acid which can be produced from the total oxidation of all sulfides within the sample, assuming all sulfides are present as pyrite.

The Net Acid Producing Potential (NAPP) is the balance between the Maximum Potential Acidity and the Acid Neutralising Capacity. A negative NAPP indicates that there is an excess neutralising capacity and a positive NAPP indicates there is excess potential acidity.

3.2 STATIC NET ACID GENERATION

Static Net Acid Generation (NAG) test work is a direct measure of a sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

The NAG test procedure used is based upon the Static NAG Test (Ref. 12 and 13). The static NAG test involves the addition of 250 mL of 15 per cent hydrogen peroxide to 2.5g of pulverised sample. The sample is allowed to react overnight prior to heating for a period of three hours. Once the sample has cooled, the pH of the solution is measured prior to titration back to pH 4.5 and 7 to determine the acidity produced by the oxidisation reactions.

3.3 ACID FORMING POTENTIAL

The acid formation potential of a sample is calculated based on the acid base accounting, i.e. the balance between a sample's ability to produce acid from the oxidisation of sulfide minerals (MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (ANC).

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes, and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.

With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and MPA, as these calculated parameters do not take into consideration the true availability of acid producing and acid neutralising phases.

Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG test results to classify the acid formation potential of materials. Knight Piésold's classification system, as summarised in Table 3.1, is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Table 3.1: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain	Positive	≥4.5
	Negative	<4.5

3.4 MULTI-ELEMENT ANALYSIS OF SOLIDS

Multi-element analysis of the samples was conducted to assess elemental enrichments within the samples. A four acid digestion method was employed for the majority of the analyses, with element specific methods used for selenium, mercury and boron.

Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance. The GAI is calculated from the following formula:

$$\mathbf{GAI = Log_2 (C_n / (1.5 \times B_n))}$$

Where:

C_n *= measured concentration of element in sample*

B_n *= average crustal abundance (Bowen, Ref. 17)*

The GAI is expressed on a scale of 0 to 6, with 0 indicating that the element concentration is less than or similar to the average crustal abundance. A GAI of 3 corresponds to a 12 fold increase above the average crustal abundance, and so forth up to a GAI of 6 which represents a 96 fold increase or greater.

Knight Piésold has assigned an arbitrary scale to the GAI with indices of 0 and 1 being unenriched, indices of 2 being classified as slightly enriched, indices of 3 and 4 being classed as significantly enriched and indices of 5 and 6 being classified as highly enriched.

3.5 X-RAY DIFFRACTION ANALAYSIS

Fifteen of the samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. For each sample a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content. On a limited number of samples a grab of sample was prepared by adding an internal standard, TiO_2, and micronising the mixture to 4 µm. The spiked samples were each prepared as an un-oriented powder mount. A duplicate sample was analysed for every fifteen samples submitted.

The XRD patterns were produced on a PANalytical Cubix^3 XRD fitted with copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3°to 65°2 θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database. Quantitative phase analysis was performed using SIROQUANTTM Version 3 software.

3.6 DISTILLED WATER EXTRACT TESTING

Distilled water extraction tests were conducted on fifty samples to assess the potential for leaching of environmentally significant elements from the waste rock, which could have a detrimental effect on the quality of surface water or near surface groundwater. These tests differ from the multi-element tests in that they only record the readily soluble elements, whereas the multi-element tests give the total elemental enrichment of the waste.

The test procedure is based upon the Shake Flask Method as described in the Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (Ref. 9).

The samples were crushed to minus 2 mm particle size, with 50 grams of each sample then mixed with 150 mL of deionized water in suitably sized vessels. The mixtures were then bottle rolled for 24 hours. The pH and the conductivity of the solutions were then measured and the bottles left to stand for a minimum of 3 hours. The solution was then siphoned off and filtered through a 0.45 µm membrane before preservation of the solution by acid addition prior to analysis. The analysis was by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) or Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) depending on the element being analysed and the detection limits required.

The distilled water extract test results were compared to a set of reference water quality standards which are discussed in Section 3.7.

3.7 REFERENCE WATER QUALITY STANDARDS

To allow assessment of the results of the distilled water extract analysis, a set of reference values has been established. These reference values were compiled from internationally accepted guidelines for water quality for release from mining operations (IFC environmental, health and safety guidelines (Ref. 18 & 19) and the ANZECC water quality guideline for livestock drinking water (Ref. 20)).

The use of several guidelines is required as no single guideline contains target concentrations for all parameters. Where a target concentration for a specific element is at different levels in various guidelines, the lowest concentration has been adopted. These reference values for release from mining operations are presented in Table 3.2.

The establishment of these reference water quality values is to allow for evaluation only and it is not implied by the production of the reference water quality values that the Letpadaung Project will be required to meet these reference levels, or that these reference levels should be used as the regulatory framework. The regulatory requirements for the project will be determined by the relevant regulatory authorities during the environmental design phase of the project.

These reference levels are to be used for a preliminary assessment of water quality only. More detailed assessment of the impact of any release from the mine site may be required in later design stages to assess the impact on receiving environments, such as aquatic systems, where different water quality requirements may be applicable.

Table 3.2: Reference Water Quality Guidelines – Release from Mining Operations

Parameter	ANZECC Livestock (mg/L)	IFC 2004 (mg/L)	IFC 2007 (mg/L)	Adopted Reference Level (mg/L)
pH		6 to 9	6 to 9	6 to 9
TDS	2000			2000
Aluminum	5			5
Antimony				N/G
Arsenic	0.5	0.1	0.1	0.1
Barium				N/G
Boron	5			5
Cadmium	0.01	0.1	0.05	0.01
Calcium	1000			1000
Chloride				N/G
Chromium	1			1
Chromium (Cr^{+6})		0.1	0.1	0.1
Cobalt	1			1
Copper	0.4	0.5	0.3	0.3
Cyanide-Total			1	1
Cyanide-Free			0.1	0.1
Cyanide-WAD		0.5	0.5	0.5
Fluoride	2	20		2
Iron		3.5	2	2
Lead	0.1	0.1	0.2	0.1
Magnesium	2000			2000
Manganese				N/G
Mercury	0.002	0.01	0.002	0.002
Molybdenum	0.15			0.15
Nickel	1	0.5	0.5	0.5
Phosphorus				N/G
Selenium	0.02	0.1		0.02
Silver		0.5		0.5
Sodium				N/G
Sulfate	1000			1000
Tin				N/G
Uranium	0.2			0.2
Vanadium				N/G
Zinc	20	2	0.5	0.5

N/G = No guideline value

4. GEOCHEMICAL RESULTS

4.1 XRAY DIFFRACTION

Fifteen samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. The summarised results for the XRD analysis are presented in Table 4.1 with the full results provided in Appendix A. The interpreted results are summarised as follows:

- The most common mineral found in the samples was quartz, comprising between 23% and 63% of the overall sample, averaging 39%.
- Clay minerals including illite, smectite, kaolin and chlorite were found to comprise between 4% and 38% of the samples, averaging 20.5%.
- The amorphous content of the samples ranged from 3% to 35%, averaging 16%.
- Natroalunite and alunite were present in 11 of the 15 samples. These are important minerals in the assessment of acid rock drainage as they commonly lead to overestimation of the sulfide content. The natroalunite and alunite were present at between 0% and 28% but were highly variable and showed no correlation with depth or lithology.
- The carbonate content of the samples varied from 0% to 16%, averaging 3.8%. However, the most common carbonate found in the deposit was siderite (from 0% to 11% and averaging 0.9%). Siderite does not provide any neutralising capacity when the full neutralisation and hydrolysis of aqueous iron is accounted for.
- Two sulfide minerals were identified in the analysis. Pyrite the most common sulfide mineral from 0% to 16% and averaging 4.5%, with chalcopyrite identified in a single sample at 1%.

Table 4.1: Summarised XRD Results

Mineral	Group	Average	Max	Min
Quartz	Silicate	39.3	63.0	23.0
Amorphous content	N/A	15.9	35.0	3.0
Natroalunite	Sulfate	7.5	28.0	0.0
Interlayered illite/ smectite	Clay	8.4	22.0	0.0
Pyrophyllite	Clay	4.3	22.0	0.0
Kaolin	Clay	5.5	22.0	0.0
Chlorite	Clay	1.6	13.0	0.0
Hematite	Oxide	1.1	15.0	0.0
Sodium calcium plagioclase	Feldspar	2.1	12.0	0.0
Pyrite	Sulfide	4.5	16.0	0.0
Siderite	Carbonate	0.9	11.0	0.0
Palygorskite	Clay	0.5	7.0	0.0
Illite/Muscovite	Mica	5.1	16.0	0.0
Potassium feldspar	Feldspar	1.4	8.0	0.0
Ankerite	Carbonate	0.3	4.0	0.0
Dolomite	Carbonate	1.5	8.0	0.0
Calcite	Carbonate	0.7	7.0	0.0
Magnesite	Carbonate	0.4	4.0	0.0
Expanding clay	Clay	0.1	2.0	0.0
Chloritoid	Clay	0.1	2.0	0.0
Diaspore	Hydroxide	0.1	2.0	0.0
Alunite	Sulfate	0.3	3.0	0.0
Jarosite	Hydroxide	0.2	1.0	0.0
Anhydrite	Sulfate	0.1	1.0	0.0
Anatase	Oxide	0.1	1.0	0.0
Chalcopyrite	Sulfide	0.1	1.0	0.0

4.2 SULFUR ANALYSES

The total sulfur content of the waste rock was determined by LECO combustion. In addition, the samples were analysed for sulfide (as Chromium Reducible Sulfur) and sulfate (by acid digest). The results of the analyses are summarised in the following sections, with complete results provided in Appendix B.

4.2.1 Total Sulfur

The total sulfur contents were found to be highly variable across the samples, ranging from 0.03% to 26.6% with an average of 3.49%. The total sulfur contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.1. The total sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.2. The results indicate that 90% of the samples would be classified as having a high to extremely high total sulfur content.

Table 4.2: Total Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 -5%	Extremely High >5%
All	-	4%	3%	3%	35%	35%	20%
Andesite Porphyry	-	5%	4%	4%	45%	26%	15%
Breccia	-	-	-	-	14%	43%	43%
Diorite Porphyry	-	-	-	-	25%	58%	17%
Dyke	-	-	-	-	-	33%	67%
Fault Breccia	-	-	-	-	60%	20%	20%
Feldspar Porphyry	-	-	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	-	80%	20%
Porphyry	-	-	-	-	20%	40%	40%
Pyroclastic	-	-	14%	-	14%	71%	-
Tuff	-	-	-	-	-	50%	50%

4.2.1 Acid Soluble Sulfate

The acid soluble sulfate was found to be highly variable across the samples, ranging from 0.01% to 1.59% with an average of 0.36%. The acid soluble sulfate contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.2. The acid soluble sulfate results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.3. The results indicate that all samples have between 0.01% and 2% acid soluble sulfate, with the highest proportion of samples having between 0.1% and 0.3% sulfate. This indicates that there is a low proportion of readily soluble sulfate within the deposit.

Table 4.3: Acid Soluble Sulfate by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 - 5%	Extremely High >5%
All	-	23%	33%	20%	24%	-	-
Andesite Porphyry	-	27%	36%	20%	17%	-	-
Breccia	-	29%	36%	29%	7%	-	-
Diorite Porphyry	-	25%	33%	33%	8%	-	-
Dyke	-	33%	-	-	67%	-	-
Fault Breccia	-	-	40%	20%	40%	-	-
Feldspar Porphyry	-	-	-	100%	-	-	-
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	100%	-	-
Porphyry	-	-	-	-	100%	-	-
Pyroclastic	-	-	43%	-	57%	-	-
Tuff	-	-	50%	50%	-	-	-

4.2.1 Sulfide Sulfur

Analysis for chromium reducible sulfur was only conducted on those samples which had a total sulfur content of greater than 0.1%. For samples where the chromium reducible sulfur was measured, this was assumed to represent the total sulfide content. For samples with less than 0.1% total sulfur, the sulfide content was assumed to be equal to:

Sulfide Sulfur (%S) = Total Sulfur (%S) – Acid Soluble Sulfate (%S)

The sulfide sulfur contents were found to be highly variable across the samples, ranging from 0.00% to 18.95% with an average of 2.12%. The sulfide sulfur contents showed a slight degree of correlation with depth, as there were more samples with low or insignificant sulfide sulfur contents shallower in the deposit (i.e. up to around 200 m depth). Below 200 m depth there were no samples with less than 0.25% sulfide sulfur. The sulfide contents also showed some correlation to copper grade, with slightly higher copper contents in samples with greater than 5% sulfide sulfur. The distribution of sulfide sulfur, copper grade and depth is presented in Figure 4.3. Although neither of these relationships was suitably well defined or consistent enough to allow either depth

or copper grade to be used as an indicator of likely sulfide sulfur contents, it does indicate that low grade ore which may be stockpiled on site during operations may have higher sulfide contents than general waste rock.

The sulfide sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping presented in Table 4.4. The results indicate that about 25% of the samples had a sulfide content of less than 0.3% (i.e. in the extremely low to low range), 32% of samples had moderate to high sulfide sulfur and 38% of the samples had very high to extremely high sulfide sulfur.

Table 4.4: Sulfide Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 – 2%	Very High 2 – 5%	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
Andesite Porphyry	8%	20%	5%	7%	31%	21%	7%
Breccia	-	-	-	-	21%	43%	36%
Diorite Porphyry	-	-	-	17%	17%	50%	17%
Dyke	-	-	-	-	-	67%	33%
Fault Breccia	-	40%	-	-	40%	20%	-
Feldspar Porphyry	-	-	-	-	-	100%	-
Hornblend Porphyry	100%	-	-	-	-	-	-
Hydrothermal Breccia	-	80%	-	-	-	-	20%
Porphyry	-	20%	20%	20%	-	20%	20%
Pyroclastic	-	71%	-	-	14%	14%	-
Tuff	-	-	-	-	-	50%	50%

The sulfide sulfur results have also been summarised by depth, as this may be useful in mine planning. The results of this classification are provided in Table 4.5.

Table 4.5: Sulfide Sulfur by Depth

Depth (m)	Extremely Low <0.01%	Very low 0.01 - 0.1	Low 0.1 - 0.3	Moderate 0.3 - 0.5	High 0.5 - 2	Very High 2 - 5	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
0 to 50	-	68%	-	5%	18%	5%	5%
50 to 100	3%	37%	7%	10%	23%	20%	-
100 to 150	-	14%	3%	3%	31%	37%	11%
150 to 200	-	32%	-	-	26%	26%	16%
200 to 250	-	18%	9%	18%	36%	18%	-
250 to 300	-	-	-	-	-	43%	57%
300 to 350	-	-	9%	9%	18%	36%	27%
350 to 400	-	-	14%	14%	14%	57%	-
400 to 472	-	-	-	13%	38%	13%	38%

4.3 ACID NEUTRALISING CAPACITY AND CARBONATE CONTENT

The acid neutralising capacity (ANC) of the samples was determined along with the carbon content which, based on the geology of the deposit, was assumed to be representative of the carbonate content. The two results can be used as a check against one another and to identify the contribution of ANC from carbonates and other non-carbonate minerals.

The average acid neutralising capacity of all the samples was moderate to high at 15.4 kg H_2SO_4/t, however, there was a high degree of variability within the samples with the ANC varying from -23 to 155 kg H_2SO_4/t. The negative acid neutralising capacity values are a result of more alkali being required to back titrate the sample solutions to the end point of the test compared to the volume of acid which was added during the test. This indicates that there is residual acidity in the samples. This is discussed further in Section 4.4.

The samples with very high to extremely high acid neutralising capacities were located within discreet zones (i.e. borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m) rather than being evenly distributed throughout the deposit. The carbonate contents of these samples were also significantly higher compared to the other samples, indicating that the carbonates were resulting in the high acid neutralising capacities, as would be expected. The XRD analysis shows that the carbonate minerals in the samples with the high acid neutralising capacity are a mix of ankerite, calcite, dolomite and magnesite.

The calcium and magnesium carbonates will provide significant acid neutralising capacity, however, the ankerite will only provide limited neutralising capacity.

The very high to extremely high acid neutralising capacities were not restricted to a single lithology, suggesting broad scale carbonate alteration within discreet zones.

Outside of these high acid neutralising zones, the acid neutralising capacity was generally very low averaging just 2.9 kg H_2SO_4/t, with approximately 20% of the samples having negative acid neutralising capacities.

The distribution of the acid neutralising capacity with depth and the relationship between acid neutralising capacity and carbonate are shown in Figure 4.4. The distribution of acid neutralising capacity with lithology and depth are provided in Tables 4.6 and 4.7 respectively.

Table 4.6: Acid Neutralising Capacity by Lithology

Lithology	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
Andesite Porphyry	23%	14%	41%	3%	5%	13%	1%
Breccia	21%	21%	36%	-	7%	14%	-
Diorite Porphyry	8%	17%	33%	8%	17%	17%	-
Dyke	100%	-	-	-	-	-	-
Fault Breccia	20%	20%	60%	-	-	-	-
Feldspar Porphyry	-	100%	-	-	-	-	-
Hornblend Porphyry	-	-	-	-	-	100%	-
Hydrothermal Breccia	100%	-	-	-	-	-	-
Porphyry	40%	60%	-	-	-	-	-
Pyroclastic	-	29%	57%	14%	-	-	-
Tuff	50%	-	50%	-	-	-	-

Table 4.7: Acid Neutralising Capacity by Depth

Depth (m)	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
0 to 50	9%	14%	64%	5%	5%	5%	-
50 to 100	20%	20%	33%	-	10%	17%	-
100 to 150	26%	14%	46%	9%	3%	3%	-
150 to 200	16%	16%	32%	-	-	32%	5%
200 to 250	27%	-	27%	-	9%	36%	-
250 to 300	71%	29%	-	-	-	-	-
300 to 350	36%	27%	27%	-	9%	-	-
350 to 400	43%	29%	-	14%	14%	-	-
400 to 472	38%	13%	50%	-	-	-	-

4.4 PASTE pH

The paste pH of the samples was measured at a 1:3 (soil:water) ratio. The pH results ranged from 2.7 to 9.7, with almost a third of samples recording a paste pH of less than 4.5, indicating that a significant proportion of samples contain residual acidity which is readily released when placed in contact with water. In addition, 64 samples recorded a paste pH of between 4.5 and 7, with the remaining 38 samples recording paste pH values greater than 7.

There was no apparent relationship between paste pH and lithology, as shown in Table 4.8. However, reviewing the paste pH results versus sample depths indicates that the vast majority of samples from below 250 m in the deposit recorded paste pH of less than 7, as shown in Table 4.9. The results of the paste pH testing are also provided in Figure 4.5.

Table 4.8: Paste pH by Lithology

Lithology	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
Andesite Porphyry	29%	44%	26%
Breccia	36%	43%	21%
Diorite Porphyry	17%	83%	-
Dyke	100%	-	-
Fault Breccia	40%	40%	20%
Feldspar Porphyry	-	100%	-
Hornblend Porphyry	-	-	100%
Hydrothermal Breccia	20%	80%	-
Porphyry	60%	40%	-
Pyroclastic	29%	29%	43%
Tuff	100%	-	-

Table 4.9: Paste pH by Depth

Depth (m)	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
0 to 50	18%	55%	27%
50 to 100	27%	33%	40%
100 to 150	40%	43%	17%
150 to 200	37%	26%	37%
200 to 250	27%	27%	45%
250 to 300	71%	29%	0%
300 to 350	55%	36%	9%
350 to 400	0%	86%	14%
400 to 472	13%	88%	0%

4.5 NET ACID GENERATION

The NAG test involves the addition of hydrogen peroxide (15% H_2O_2 at a pH of 4.5) to the samples, which oxidises the contained sulfide minerals to release sulfuric acid, which is then neutralised by any available acid consuming minerals within the sample. The pH of the solution is measured and then titrated back to pH 4.5 and then pH 7.0 to give an indication of the net acid generation potential of the sample. As such, a NAG pH of below 4.5 indicates that excess acidity is produced and a pH of greater than 4.5 indicates that excess alkalinity is present.

The NAG test resulted in 96 samples producing NAG pH values of less than pH 4.5, indicating that these samples produce excess acidity under the extreme oxidising conditions imposed by the NAG test. The remaining 54 samples produced pH values greater than 4.5.

The NAG pH shows a strong correlation with depth, with a much greater number of samples recording NAG pH values above 4.5 in the upper 250 m of deposit. Below 250 m depth, all samples were found to have NAG pH values below 4.5 (with the exception of a single sample), as shown in Figure 4.6.

The NAG test has been demonstrated to accurately assess the acid formation potential for samples with less than 1% sulfide sulfur. However, for samples with greater than 1% sulfide sulfur, it is possible that the volume of hydrogen peroxide added during the test may be insufficient to fully oxidise all the sulfide sulfur, resulting in the acid production potential being underestimated. In addition, if these samples with high sulfide sulfur contents also have high ANC values, the final NAG pH may be neutral to alkaline, which would be misleading. Therefore, given that approximately 50% of the samples had sulfide sulfur contents greater than 1%, this limitation of the NAG test has been considered during interpretation of the acid formation potential, as discussed in Section 4.6.

4.6 ACID FORMATION POTENTIAL

To estimate the Acid Formation Potential (AFP) of the samples, the Maximum Potential Acidity (MPA) was calculated based on the sulfide sulfur results using the following formula:

Maximum Potential Acidity (kg H_2SO_4/t) = Sulfide Sulfur (%) x 30.6

This calculation assumes that all the sulfide sulfur is present as pyrite. The mineralogical analysis of the Letpadaung samples indicates that the most common sulfide mineral is pyrite and, therefore, the MPA values calculated from the sulfide contents of the Letpadaung samples is likely to be reasonably accurate.

The Net Acid Producing Potential (NAPP) was then calculated from the Maximum Potential Acidity (MPA) and the measured Acid Neutralising Capacity (ANC) using the following formula:

Net Acid Producing Potential* = Maximum Potential Acidity* – Acid Neutralising Capacity*
**All units kg H_2SO_4/t*

As discussed in Section 3.3 of this report, Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system (as presented in Table 3.1) is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Overall almost a third (30%) of the samples tested were found to be either non-acid forming (25%) or acid consuming (5%), with a further 4% classified as having an uncertain acid formation potential. The remaining 67% of the samples were classified as either Potentially Acid Forming – Low Capacity (9%) or Potentially Acid Forming (58%).

The six samples which were classified as 'uncertain' recorded conflicting acid base accounting results. Five of these samples had low sulfide sulfur contents (0.04% to 0.05%) and very low ANC values (-3 to 3 kg H_2SO_4/t). As such, the samples had marginal NAPP values (-1.8 to 4.2 kg H_2SO_4/t) and NAG pH values around the acid forming cut-off of 4.5. Therefore, these samples should be assumed to be Potentially Acid Forming – Low Capacity.

The other sample which was classified as 'uncertain' produced a NAG pH of 4.8 and a positive NAPP of 16.5 kg H_2SO_4/t. However, review of the acid base accounting results indicates that the sample also had a high sulfide content of 1.26% and a high ANC of 23 kg H_2SO_4/t. Therefore, it is likely that the hydrogen peroxide added in the NAG test was insufficient to oxidise all of the sulfide minerals and, as such, the sample should be considered as potentially acid forming.

Overall 29% of the waste samples can considered as Non Acid Forming with the remaining 71% considered Potentially Acid Forming.

There was no apparent correlation between acid formation potential and lithology, as is shown in Table 4.10 and Figure 4.7.

The distribution of the PAF samples showed a reasonable correlation with depth, with 60% of the samples classified as non-acid forming located within the upper 50 m of the

deposit. The proportion of non-acid forming material decreases with depth and below 250 m, the vast majority of the waste can be considered potentially acid forming. The distribution of acid forming potential by depth is provided in Table 4.11 and Figure 4.8.

Table 4.10: Acid Formation Potential by Lithology

Lithology	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
Andesite Porphyry	5%	29%	3%	7%	55%
Breccia	7%	7%	-	-	86%
Diorite Porphyry	8%	17%	-	-	75%
Dyke	-	-	-	-	100%
Fault Breccia	-	20%	20%	-	60%
Feldspar Porphyry	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-
Hydrothermal Breccia	-	-	40%	40%	20%
Porphyry	-	-	-	60%	40%
Pyroclastic	-	57%	-	14%	29%
Tuff	-	-	-	-	100%

Table 4.11: Acid Formation Potential by Depth

Depth (m)	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
0 to 50	0%	59%	5%	14%	23%
50 to 100	7%	33%	10%	17%	33%
100 to 150	0%	17%	3%	3%	77%
150 to 200	16%	21%	0%	0%	63%
200 to 250	18%	27%	9%	0%	45%
250 to 300	0%	0%	0%	0%	100%
300 to 350	0%	0%	0%	18%	82%
350 to 400	0%	14%	0%	14%	71%
400 to 472	0%	0%	0%	13%	88%

In addition to the acid formation potential classification presented above, another measure of the AFP is the ratio between the ANC and the MPA, as samples which have excess ANC over the MPA have an ANC/MPA ratio greater than 1 and those with excess acidity (i.e. PAF) have an ANC/MPA ratio of less than 1.

There is a broad consensus across the industry that samples which have an ANC/MPA ratio of greater than 2 have a high factor of safety against generation of acid, providing that the acid neutralising capacity is available from highly reactive carbonate (i.e. calcite). Where the neutralising capacity is available from other minerals, such as the iron and magnesium rich carbonates present at Letpadaung, then an ANC/MPA ratio of greater than 3 is required to have a high factor of safety.

The ANC/MPA ratios of the samples indicate that approximately 46% of the non-acid forming and acid consuming samples have low factor of safety (ANC/MPA ratio <2), with 19% of the non-acid forming and acid consuming samples having a moderate factor of safety (ANC/MPA ratio 2 to 3) and the remaining 35% of samples having a high factor of safety (ANC/MPA ratio greater than 3).

The samples with a high factor of safety are predominantly those with high ANC (>80 kg H_2SO_4/t) and are generally restricted to the zones within the deposit which have carbonate alteration (borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m).

For the non-acid forming samples with a low factor of safety, care needs to be taken as there is the potential that the rate of sulfide oxidation may exceed the rate of acid neutralisation available from the neutralising minerals. **Additional testing of the material which has been classified as non-acid forming but has a low ANC/MPA ratio is recommended to confirm that these samples will not generate acid.**

The acid formation potential classifications and associated factors of safety according to the ANC and MPA (calculated from sulfide sulfur) are presented in figures 4.9 and 4.10.

4.7 MULTI-ELEMENT ANALYSIS

Multi-element analysis of the samples was conducted to assess element enrichments. The multi-element analysis results were compared to the average crustal abundance to calculate the geochemical abundance indices. The geochemical abundance index quantifies an assay result for a particular element in terms of average crustal abundance.

The multi-element assay results are presented in Appendix C, with the average crustal abundances (ACA) and corresponding geochemical abundance indices (GAI) presented in Appendix D. The results are also summarised below.

The results of the analyses show that the samples have a high level of elemental enrichment. Fourteen elements were found to be highly enriched in at least one sample, namely sulfur, tellurium, selenium, bismuth, rhenium, arsenic, silver, lead,

copper, indium, antimony, cadmium, molybdenum and zinc. A further four elements were found to be significantly enriched in at least one sample, namely tungsten, tantalum, manganese and mercury, with at least one sample found to be slightly enriched in uranium, tin, caesium, iron, strontium and lithium (all elements listed in decreasing levels of enrichment). However, it should be noted that the laboratory detection limits for tellurium and selenium were equivalent to a significantly enriched classification. Therefore, samples which recorded concentrations of tellurium and selenium below the limits of detection have conservatively been assigned a significantly enriched classification.

There was no apparent correlation between overall enrichment and lithology or depth, however, a weak correlation between total sulfur grades and enrichment was observed, whereby samples with higher total sulfur grades typically recorded higher overall levels of enrichment. In addition, a correlation was observed between acid formation potential and overall enrichments, with PAF and UC samples recording higher levels of enrichment compared to NAF and AC samples.

4.8 DISTILLED WATER EXTACT

Distilled water extract tests were undertaken to assess whether metals are likely to leach from the waste rock at environmentally significant concentrations. A total of 50 samples were analysed for distilled water extract, samples selected such that all key waste lithologies were represented across a range of copper enrichment levels.

The extract results have been compared to reference guidelines for release from mining operations and livestock drinking water. The extract solutions were generally found to be of a poor quality, with only twelve samples (24%) meeting all the water quality guidelines. In addition, the average concentrations (of all samples) for aluminium, cadmium, copper, iron and zinc were found to exceed the water quality criteria. In addition, there were exceedances for cobalt (3 samples), molybdenum (3 samples), nickel (4 samples), sulfate (1 sample) and uranium (1 sample), although the average concentrations of these elements from all samples were within the water quality criteria.

The majority of the extract solutions also recorded pH values below the lower bound acceptance criteria of pH 6. The results of the distilled water extract testing compared to the reference water quality guidelines are presented in Appendix E.

The distilled water extract results have also been compared to the acid forming potential of the samples. Overall, 40% of the AC samples and 70% of the NAF samples met all the water quality criteria, with only 9% of the PAF, PAF-LC and UC

samples meeting all guidelines. This is also reflected in the average concentrations of dissolved metals from each acid forming classification group, as shown in Table 4.12, which indicates that the PAF material is most likely to leach metals at unacceptable concentrations. This is likely partly due to the fact that the pH of the PAF extract solutions typically recorded lower pH values compared to the NAF and AC samples. However, on the basis of these results, **all waste material has the potential to leach metals at environmentally significant concentrations, especially when acidic conditions are imposed.**

Table 4.12: Average Distilled Water Extract Results by AFP

Acid Formation Potential	Al	Cd	Cu	Fe	Mo	Zn	pH*
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	-
AC	1.96	0.00003	0.03	0.46	**0.52**	0.01	8.5
NAF	1.41	0.00011	**2.88**	0.759	0.024	0.08	8.4
PAF	**10.04**	**0.02**	**17.36**	**26.7**	0.001	**2.84**	**3.8**
PAF-LC	0.73	0.006	**0.49**	0.11	0.002	0.31	**3.4**
UC	0.72	0.001	**1.59**	0.10	0.0001	0.24	**5.2**
All Samples	**6.01**	**0.012**	**10.1**	**14.61**	0.06	**1.60**	**4.0**
Water Quality Reference Level	5.0	0.01	0.3	2.0	0.15	0.5	6.0 – 9.0

**Note: pH is based on a logarithmic scale, which has been accounted for when calculating the average pH values. These values are for indicative purposes only.*

5. IMPLICATIONS FOR WASTE ROCK MANAGEMENT

Based on the results of this geochemical assessment, the implications for waste rock management are presented in the following sections.

5.1 ACID GENERATION

The results of the test work indicate that the potential for acid generation at the Letpadaung project is very high to extreme with material at all depths and from all lithologies within the deposit capable of generating acid.

The geochemistry indicates that for the majority of material, i.e. that which has a low acid neutralising capacity, the onset of acid generation is likely to be rapid with limited lag times (although this needs to be confirmed, as detailed in Section 5.3.1). There is also the potential for large quantities of acid to be generated, with the average net acid producing potential of the PAF material calculated at 87 kg H_2SO_4/t. This equates to tens of millions of tonnes of acid which could be potentially be generated by the waste if it is allowed to freely oxidise. It is therefore apparent that allowing the waste to oxidise and lime treating the acid after formation would have an extremely high cost both in terms of the supply of lime and the management and disposal of the neutralisation sludge. For this reason, active management of the mine waste at the project will be required during operations to minimise the likelihood of the waste acidifying, as discussed in Sections 5.3 to 5.5.

5.2 ENRICHMENT AND METAL LEACHING

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. The PAF material was found to have the highest metal leaching potential, although a portion of the AC and NAF samples were also found to leach certain metals above the reference water quality criteria. Further, the pH of the extract solutions from the AC and NAF remained circum neutral during the test, compared to the PAF solutions which became acidic. Therefore, it is likely that the NAF and AC material would also leach metals, and perhaps to the same extent as the PAF material, should acidic conditions develop within the waste dumps. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from the waste dumps at Letpadaung.

5.3 ONGOING WASTE ROCK CHARACTERISATION

Very limited geochemical characterisation of the deposit has been conducted, especially considering the scale of the project and the high risk profile of high sulfur porphyry systems. As such, additional geochemical work will be required pre-mining

and throughout the life of the project. The scale of the work which will be required will be large and will probably warrant establishing an onsite geochemical laboratory to handle the large number of samples and to ensure a rapid turnaround of results.

5.3.1 Pre-Mining Geochemical Characterisation

The results of this test work give an indication of the extent and severity of the likely acid generation of the material contained within the Letpadaung deposit and provides an indication of the drainage water chemistry from the material when it is mined. The results, however, do not provide information on the likely lag time to acidification or the drainage chemistry which is likely to result after oxidation and acidification of the waste. These factors need to be established prior to bulk mining to allow a detailed mine waste management plan to be produced, which will need to be appropriately tailored to the material at Letpadaung.

As such, it is recommended that an additional testing programme be conducted prior to bulk mining at the project. This test work should comprise additional acid base accounting of the material to be mined in the first year(s) of operations to establish more accurate estimates of the proportion of the PAF / NAF material which will generated in these early stages and allow for design and planning of the initial waste dumps.

The scope of this investigation would likely be similar to that presented herewith. However, as this geochemical assessment has shown a good correlation between the NAG test and the other acid base accounting analysis, it may be possible to limit the testing of the majority of the samples to NAG testing only, with detailed geochemistry only conducted on a limited number of samples. **It is therefore recommended that:**

- **Several hundred samples are collected from the waste zones to be mined in Years 1 and 2 of operations.**
- **All samples are submitted for NAG testing, and approximately 20% of the samples have full acid base accounting test work.**

This investigation is critical to defining operational controls for the project and verifying the proposed operational testing procedures and classification criteria.

In addition to this testing, **kinetic testing is required to establish sulfide oxidation rates, the availability of acid neutralising capacity, the lag times to acidification and the drainage water chemistry for a range of materials.** These tests involve accelerated leaching of material by optimising the conditions for acid formation through repeated wetting and drying cycles and free availability of oxygen. The tests should be conducted on materials from all acid formation potential classifications, i.e. acid

consuming, non-acid forming, uncertain and potentially acid forming. Further, it is recommended that around 20 samples are prepared for kinetic testing, with the selected samples biased towards material which will be mined over the next 2 to 5 years.

5.3.2 Operational Geochemical Classification

To allow for active management of potentially acid generating material during operations, there will be a requirement to conduct geochemical testing throughout the life of the project. The scale of the project and the mining rate (~30 Mtpa of waste) is such that a dedicated on site laboratory will be required to manage this test work. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

Test work will be required on grade control samples or blast hole samples ahead of mining to allow waste blocks to be classified and allow potentially acid generating material to be identified for selective handling. Based on the geochemistry of the Letpadaung deposit, conventional operational testing using total sulfur grades and acid neutralising capacity to determine the acid formation potential of the material will not be appropriate, as the alunite and natroalunite will lead to the incorrect classification of a significant proportion of the waste. The alternate tests which are available to the project are chromium reducible sulfur with acid neutralising capacity or the net acid generation test (NAG) test.

A chromium reducible sulfur and acid neutralising capacity testing programme would be slow to conduct and expensive. Therefore, it is considered unsuitable for such a large scale operation, and the NAG test is recommended for ongoing classification of the acid formation potential of the material.

The NAG test should be conducted on bench height composite samples sourced from closely spaced grade control or blast hole chips (i.e. no more than 15m for each mining bench). The NAG test produces three results when conducted in its entirety; the NAG pH, $NAG_{4.5}$ and $NAG_{7.0}$.

The NAG pH provides a quick reference of the likely acid formation potential of the samples but is hard to model in conventional mining planning software as it is a logarithmic scale. Therefore, the NAG pH is not considered suitable for short term mine planning.

The $NAG_{7.0}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 7.0. For many mining operations, this measure is used to determine the acid formation potential of the waste and can be readily modelled.

However, at Letpadaung the waste has an inherently low in situ pH (generally below pH 7.0) and the use of the $NAG_{7.0}$ results would cause almost all material to be classified as potentially acid forming, which would be overly conservative.

It is therefore recommended that the $NAG_{4.5}$ is used to classify the acid formation potential of the waste material at Letpadaung. The $NAG_{4.5}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 4.5 and the result is expressed in kg H_2SO_4/t which, being a non-logarithmic scale, can be modelled in mine planning software.

Given that the distilled water extract testing has indicated that the vast majority of the waste contains leachable metals, there unlikely to be any benefit of conducting additional testing to characterise the leaching potential of the waste, as significant testing would be required to likely identify only a small proportion of suitable NAF waste rock which could be placed on the outer faces of the waste dumps, where it would be subject to rainfall percolation and will higher leachate rates. Instead, it is recommended that all waste be considered leachable and managed appropriately. This is discussed further in Sections 5.5.4 and 5.5.5.

5.4 RATIONAL FOR ACTIVE WASTE MANAGEMENT

The issue of acid rock drainage has been recognised as a significant issue since the 1970's. Initially, management of acid rock drainage focused on treatment of effluent to reduce the downstream environmental impacts. However, it was soon established that the costs associated with long term treatment (lasting decades or longer) was a significant burden and, in some cases, the cost of treatment exceeded the initial profits generated by the mining activities. In the 1990's, research and development started to focus on the reduction of acid rock drainage from mine waste through the application of cover systems post mining. This approach, however, has proven to only be partially effective and in some cases has added little overall benefit, as covers installed post mining do not prevent the oxidation products (which have been generated during mining operations) from continuing to the be released post closure.

A schematic of the generation of oxidation products over time and measurement of acid load in a system where capping was conducted at the end of operations is provided in Figure 5.1. It shows that installation of the cover system had little impact on the acid load and, in fact, the highest acid loads requiring treatment occurred after capping the waste.

Current research into the generation of acid rock drainage has found that the most effective method of control is to minimise the oxidation of waste both during operations

and on closure to prevent a build-up of oxidation products which would otherwise require treatment during operations and post closure. To achieve this aim, an understanding of the mechanisms of oxidation in waste dumps is required.

The oxidation of sulfide minerals requires the presence of both oxygen and water. The amount of water required to allow the sulfide minerals to oxidise is small, and there is generally enough moisture either naturally contained in the waste rock or from atmospheric humidity that the supply of water is not a limiting factor in the initial oxidation of sulfide minerals. There are some exceptions to this, such as hyper arid regions (e.g. the Atacama Desert) but for Letpadaung it is considered that supply of water will not be a limiting factor for initiating sulfide oxidation.

In a geological setting where acid generating material is located above the water table, the rates of oxygen flux into the material is normally sufficiently slow to limit the rate of oxidation to a level where the acid generated can be naturally buffered. However, when sulfidic material is disturbed through mining operations, the amount of oxygen available for sulfide oxidation increases, allowing higher rates of sulfide oxidation to occur. When the rate of sulfide oxidation exceeds the rate at which the naturally occurring neutralising capacity can buffer the acidity, the material acidifies leading to acid rock drainage.

There are two primary mechanisms for sulfide oxidation; the first, which is discussed above, involves atmospheric oxygen and water (equation 5.1). This reaction generally prevails in circum-neutral pH conditions and is a relatively slow reaction. However, as the pH of the material drops through sulfide oxidation, the iron in the system is oxidised to ferric iron (equation 5.2) and this ferric iron then starts to act as the oxidising agent for the sulfide minerals (equation 5.3). This ferric iron reaction is orders of magnitude faster and results in a rapidly increasing rate of sulfide oxidation and consequent acid generation.

$$FeS_2 + 7/2O_2 + H_2O \longrightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+ \quad (5.1)$$

$$Fe^{2+} + 1/4O_2 + H^+ \longrightarrow Fe^{3+} + 1/2H_2O \quad (5.2)$$

$$FeS_2 + 14Fe^{3+} + 8H_2O \longrightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+ \quad (5.3)$$

Waste rock in a conventional waste dump design is dumped from a tip head which may vary in height from 10 m to over 100 m. The action of dumping the waste from a high tip head acts to segregate the waste with the coarser material rilling to base of the tip head and the finer material being retained at the top of the dump. This forms a coarse rubble zone at the base of the tip head and alternating sloping layers of finer and coarse waste through the dump.

The coarse rubble zone and coarse sloping layers allows oxygen to freely flow into and penetrate deep into the waste dump which leads to the initiation of sulfide oxidation within the coarse layers and within the adjacent finer grained material. This initial sulfide oxidation generates heat (as reactions 5.1 & 5.3 are exothermic) which then causes the warm, oxygen depleted air to rise through the sloping layer and vent at the top of the waste dump. This in turn pulls in fresh air through the basal rubble zone supplying oxygen into the system at a faster rate than natural diffusion would allow. As oxidation progresses and the pH drops, the rate of sulfide oxidation increases generating more heat and allowing more oxygen to be pulled into the dump which initiates further sulfide oxidation. This mechanism is shown schematically in Figure 5.2, along with a section through an end tipped waste dump showing the preferred oxidation within the coarse sloping zones. Elimination of this advective system will reduce the rate at which sulfide oxidation occurs and will, therefore, limit the amount of oxidation products in the dump prior to final capping and closure. This is key to the effective management of acid rock drainage in waste dumps.

5.5 MANAGEMENT OF POTENTIALLY ACID GENERATING WASTE

5.5.1 Waste Zone Identification

As discussed in Section 5.3.2, testing will need to be conducted on grade control or blast hole samples to define the acid formation potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF and NAF waste zones. The waste zones will then be marked out in the field by the survey team to identify those waste blocks which are PAF and those which are NAF. This is commonly achieved through coloured tape and pegs defining the boundaries of the different material types. A common convention is to use green tape to indicate NAF waste, red tape to indicate PAF waste and white tape to indicate ore.

5.5.2 Selective Handing

Material will need to be selectively handled to allow separation of PAF and NAF waste so that the waste can be placed into the correct areas of the waste dump. This can be achieved through a simple method of signage in the excavators and trucks. The conventional method is for a coloured sign to be displayed on the excavators and shovels to indicate the type of material being excavated (red for PAF waste / green for NAF waste and white for ore). As the truck is being loaded it should also change the sign displayed on the dashboard of the truck to match that of the excavator and then haul the material to the designated areas for correct disposal of the type of waste or stockpiling/crushing of ore. This system allows spotters and supervisor within the pit

and the waste dump area to visually check that the material is being correctly loaded and dumped in the designated areas.

5.5.3 Waste Placement Methods for PAF Material

The reduction of oxidation rates within the dump is critical to reducing the rate of acid generation and the potential long term water treatment liabilities. As such, it is essential that the waste placement method used for the PAF material reduces the potential for preferential oxygen flow paths.

This should be achieved through the placement of waste in lifts of no greater than 3 m to 5m in height to reduce the segregation of material into coarse and fine fractions. The trucks should be routed over the entire surface of the dump to provide compaction to the waste which will reduce the voids ratio and hence the amount of contained oxygen. Compaction trials on 3 m lifts have shown that trucks of 100 tonnes or greater can produce effective compaction down to the base of lifts at these heights.

PAF waste should not be placed directly onto the natural ground as this interface is typically a preferred flow path for water, and water flowing through the waste will transport oxidation products rapidly out of the dump. Therefore, PAF waste should not be placed within 3 m of the base of the waste dump, with a layer of benign (i.e. non leachable) NAF waste placed prior to PAF placement.

5.5.4 NAF Waste Placement

Based on the acid formation potential estimates for the deposit, approximately 30% of the waste (or 300 Mt) is likely to be non-acid forming. There are no specific controls relating to the placement of NAF waste in respect to acid generation, however, as the majority of NAF waste is expected to be leachable, the material will need to be encapsulated. This is discussed in Section 5.5.5 below.

5.5.5 Encapsulation of Waste

All waste rock will require encapsulation to further reduce the rate at which oxygen can enter the dump and to reduce the amount of meteoric water flowing through the waste.

The rate of oxygen transport through soils is directly dependant on the grain size and degree of saturation of the material. Materials with a high degree of saturation have a high water content in the void spaces. Oxygen diffuses through water 10,000 times slower than it diffuses through air, so the presence of water in the void spaces effectively reduces the potential for oxygen to pass through the encapsulation material. As shown in Figure 5.3, material placed with a degree of saturation of 90% reduces the rate of oxygen diffusion by approximately 3 orders of magnitude compared to material placed dry.

As such, the encapsulation material used should be a fine grained material (silt or clay) which should be heavily moisture conditioned and compacted. Suitable borrow sources for encapsulation material will need to be defined and the geotechnical properties of these material determined. Based on the scale of the Letpadaung project, the borrow requirements are significant and work on defining these sources is required prior to bulk mining commencing.

The encapsulation material will need to be constructed with a high moisture content and consequently a high degree of saturation. However, it is critical that the material is not allowed to desiccate, as this will reduce the degree of saturation and can also lead to desiccation cracking, resulting in pathways for the oxygen to enter the dump. Therefore, the encapsulation material should be covered with benign (i.e. non-acid generating, non-enriched and non-leachable) waste to form a store and release cover. A store and release cover acts to absorb water during higher rainfall periods (i.e. the wet season at Letpadaung) and then slowly releases the moisture over the extended dry periods, preventing desiccation of the encapsulation material and protecting it from erosion.

Detailed geotechnical and water flux testing of the proposed encapsulation and cover materials is required, together with modelling of the climatic conditions, to allow detailed encapsulation and cover design. However, based on projects in similar climates, it is estimated that the encapsulation materials will require a true width of approximately 2 m, and the cover materials will require a thickness of approximately 1.5 to 2.0 m.

Depending on the results of the kinetic testing which has been recommended for the project, there may be a requirement for interim covers to be installed prior to the waste dump achieving its final profile. These covers are intended to limit oxygen and meteoric water ingress into the dump prior to installation of the final cover system. Based on a visual assessment of the waste during the site visit conducted by KP, the waste rock itself does not appear to be suitable for this purpose and additional borrow material will be required.

5.5.6 Geotechnical Monitoring of Encapsulation

Significant resources will need to be assigned to the encapsulation of the PAF waste at the project and, as such, a geotechnical monitoring program will be required to ensure that the material is being placed to the design specification. This will require geotechnical testing of the material during placement to ensure that the material has an appropriate grain size and that it has been compacted to a suitable density. Also, most importantly, the geotechnical testing is required to ensure that the material has been

placed at an appropriate moisture content. The following testing will be required on the waste encapsulation material:

- Particle size analysis
- Atterberg Limits
- Laboratory proctor compaction
- Field density and moisture content
- Particle SG

Based on the scale of the operation and the requirement to encapsulate such a large quantity of material, it is recommended that an on-site geotechnical laboratory be established. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

5.5.7 Geochemical Monitoring of Encapsulation

It is recommended that geochemical monitoring of the encapsulation system is installed to allow the effectiveness of the system to be measured and assessed throughout operations, allowing for design modifications if required. The geochemical monitoring system will determine the rate of oxygen reduction in the dumps and measure the temperature of the system to determine whether sulfide oxidation is occurring.

The geochemical monitoring system will comprise of air sampling points and thermistor strings installed within the dump during construction. The air sampling points simply comprise of flexible tubing laid into a trench cut into the top surface of the dump and backfilled with sand. Multiple tubes are installed in an array extending to various depths into the dump (nominally 1, 2, 5, 10, 15 and 20 m through the encapsulation layer) with the end point of each tube separated by a small bentonite grout plug poured into the trench. Air is sampled using a portable oxygen sampler to determine the effectiveness of excluding oxygen from the waste. If the encapsulation is fully effective, the process of sulfide oxidation in the dump consumes all the oxygen and the oxygen concentration reduces to zero.

The thermistor strings comprise temperature monitoring probes attached to a cable which can be placed in the waste to measure the temperature at various depths into the dump.

5.5.8 Water Management

Runoff from the PAF waste zones is likely to be slightly to highly acidic and runoff from both the NAF and PAF zones will likely contain elevated concentrations of dissolved metals. Therefore, measures will need to be designed and implemented to capture and store this water. Surface water drains will need to be installed around the periphery

of all active waste dumps to divert clean water around the dumps and also intersect runoff from the dumps. This water can then be directed to the water storage facility. The water storage facility will need to be designed with seepage control measures if the natural in-situ materials are found to be of too high permeability to contain the water without leading to excessive seepage.

The base of the dumps will also need to be tested to determine the in-situ permeability and, if required, the base will need to be engineered to reduce the permeability prior to waste placement. Internal drainage will also need to be installed at the upstream toe of the encapsulation zone to collect internal drainage water and direct this to the water storage facility. These internal drains will have to allow water to flow out of the system, but will need to be engineered to prevent oxygen from entering the drainage system. This can be achieved through the inclusion of U-bends in the water pipes to act as a seal.

5.6 IMPLICATIONS FOR CLOSURE

5.6.1 Waste Dumps

Provided that the waste dumps are managed appropriately during operations, the procedures required for closure should be relatively straightforward to implement. The final surface of the waste will need to be compacted, encapsulated and the store and release cover system constructed, as outlined in Section 5.5.5. A growth medium should then be placed over the cover system and seeded to promoted revegetation. The majority of these work should have been conducted during operations.

Ongoing monitoring of the oxygen concentrations and temperatures within the PAF zones will be required post closure to assess to effectiveness of the encapsulation and determine whether sulfide oxidation is occurring. In addition, the runoff and seepage water will need to be collected and tested to determine whether it is suitable for release. If the water is not of an appropriate quality, it will either need to be treated prior to release or contained. It may be possible to direct seepage waters to the open pits on closure, however, this is discussed further in Section 5.6.2 below.

5.6.2 Pits

A detailed geochemical assessment will be required to determine the final void water quality post closure. This involves hydrological and hydrogeological studies to determine the pit filling water balance and storage volumes when steady state conditions are reached. This pit water balance model is then used in the geochemical modelling, whereby element concentrations are applied to the pit inflows (groundwater, surface water, pit wall run-off and direct precipitation on the pit lake), outflows (evaporation and possibly groundwater or over-topping) and wall rock to simulate

reaction processes within the pit lake, such as water-rock interaction, fluid mixing, dissolution, precipitation, association and sorption. Appropriate mitigation controls will be required if the pit lake water quality is predicted to be poor, and the water balance model indicates that outflows to off-site groundwater or surface water resources will likely occur.

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the geochemical characterisation of the waste rock from the Letpadaung project, the following conclusions can be made:

- Knight Piésold selected 150 waste rock samples from 13 boreholes located within the pit extents. Samples were collected from all logged lithologies within these boreholes and from depths ranging from 5 m to 472 m, which is similar to the planned maximum depth of the pit.
- The samples were sent to Genalysis Intertek in Perth who conducted the testing according to the schedule provided by Knight Piésold. The test work conducted was based on internationally accepted methods.
- The waste rock samples were primary composed of quartz, clay minerals (including illite, smectite, kaolin and chlorite) and alunite and natroalunite, with a relatively high amorphous content. The main sulfide mineral in the waste samples was pyrite with trace chalcopyrite. Carbonate was present in the samples, most commonly as siderite, but some calcium and magnesium carbonates were also present in discreet areas.
- The total sulfur contents of the samples was high to extremely high, however, this was in part a reflection of the high alunite and natroalunite contents.
- The sulfide sulfur contents of the samples ranged from extremely low to extremely high, however, the average sulfide content for all samples was 2.1% which is considered very high. There were more samples with extremely low sulfide sulfur in the upper 200 m of the deposit. Below around 250 m depth all samples had sulfur contents greater than 0.1%, with most samples below this depth having high to extremely high sulfide sulfur contents.
- The acid neutralising capacity of the samples was highly variable with a small number of samples from discreet zones in the deposit having high ANC values, correlating with increased carbonate contents. Outside of these carbonate rich zones, the ANC of the deposit was very low averaging less than 3 kg H_2SO_4/tonne.
- The Net Acid Generation test resulted in 96 samples producing acidic conditions, with the number of samples producing acid increasing with depth.
- Overall, 29% of the waste samples can considered as Non-Acid Forming, with the remaining 71% considered Potentially Acid Forming. According to each sampling and testing result about ARD in blasting area in future mining operation, MWMCL will identify ARD content in whole waste rock.

- The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation will be key to managing the metalliferous drainage from both the PAF and NAF material.
- Based on the results of the testing, active management of the potentially acid generating materials will be required, with the recommended methods discussed in the following recommendations.

Based on the results of the geochemical testing, the following recommendations can be made:

- It is recommended that additional geochemical assessment be conducted prior to bulk mining to better quantify the amount of potentially acid generating material which will be encountered during the first year(s) of operations to allow detailed waste management planning.
- It is recommended that kinetic testing of approximately 20 waste rock samples commences prior to bulk of each flitch to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.
- It is recommended that an onsite geochemical laboratory be established to conduct routine geochemical testing during operations.
- It is recommended that grade control or blast hole bench height composite samples are tested at a spacing of no more than 15 m. It is further recommended that the NAG test is used to classify the acid formation potential of the material ahead of mining.
- It is recommended that mining practices are established which allow definition of the PAF and NAF waste in the field and allow for selective mining and placement of the material.
- It is recommended that all PAF waste is placed in lifts of no greater than 3 m to 5m in height to eliminate segregation of the waste which could lead to accelerated acid generation.
- It is recommended that all waste be encapsulated during operations with an engineered cover comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The encapsulation material will need to be covered by benign waste or borrow

material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the cover.

- It is recommended that borrow areas for the encapsulation material be identified and samples of the proposed cover material be collected for geotechnical testing to allow detailed design of the cover system.
- It is recommended that geotechnical testing be conducted during construction of the cover system to ensure that the cover system is constructed to the design specification.
- It is recommended that geochemical monitoring of the cover system, comprising oxygen sampling points and thermistors, be conducted to allow the performance of the cover system to be verified during operations.
- It is recommended that a water management system be designed and constructed to prevent clean water from entering the waste dump area and to collect potentially contaminated water and direct this to a suitably designed water storage facility.
- Ongoing monitoring of the waste dump, encapsulation layer, cover system and drainage water will be required post closure.
- Should the drainage waters be found to be of an unacceptable quality, they will either need to be treated prior to release or contained.
- It may be possible to direct seepage waters to the open pits on closure, however, this would require detailed hydrological, hydrogeological and geochemical modelling to determine whether off-site downstream groundwater or surface water resources would be impacted.

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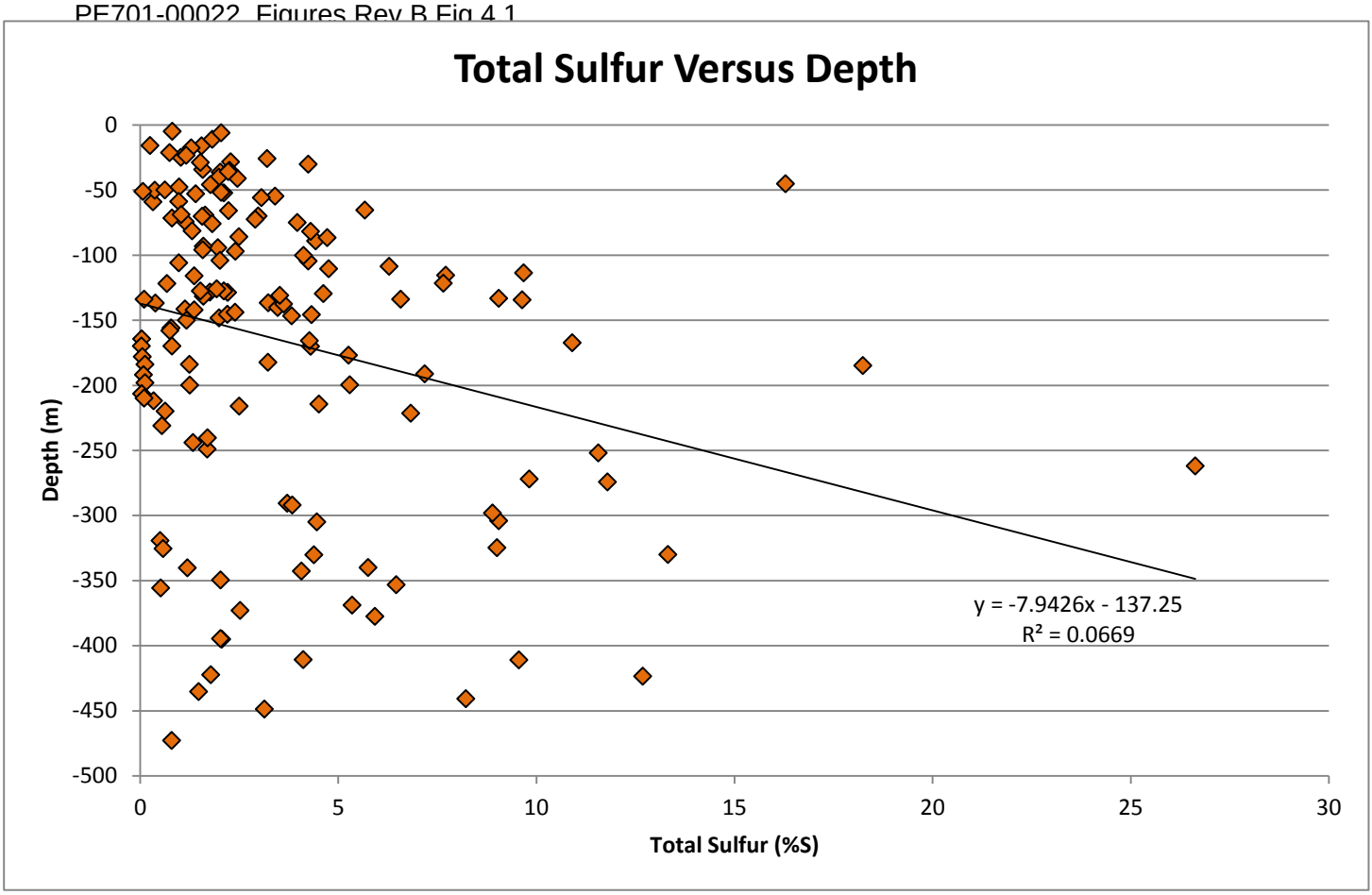
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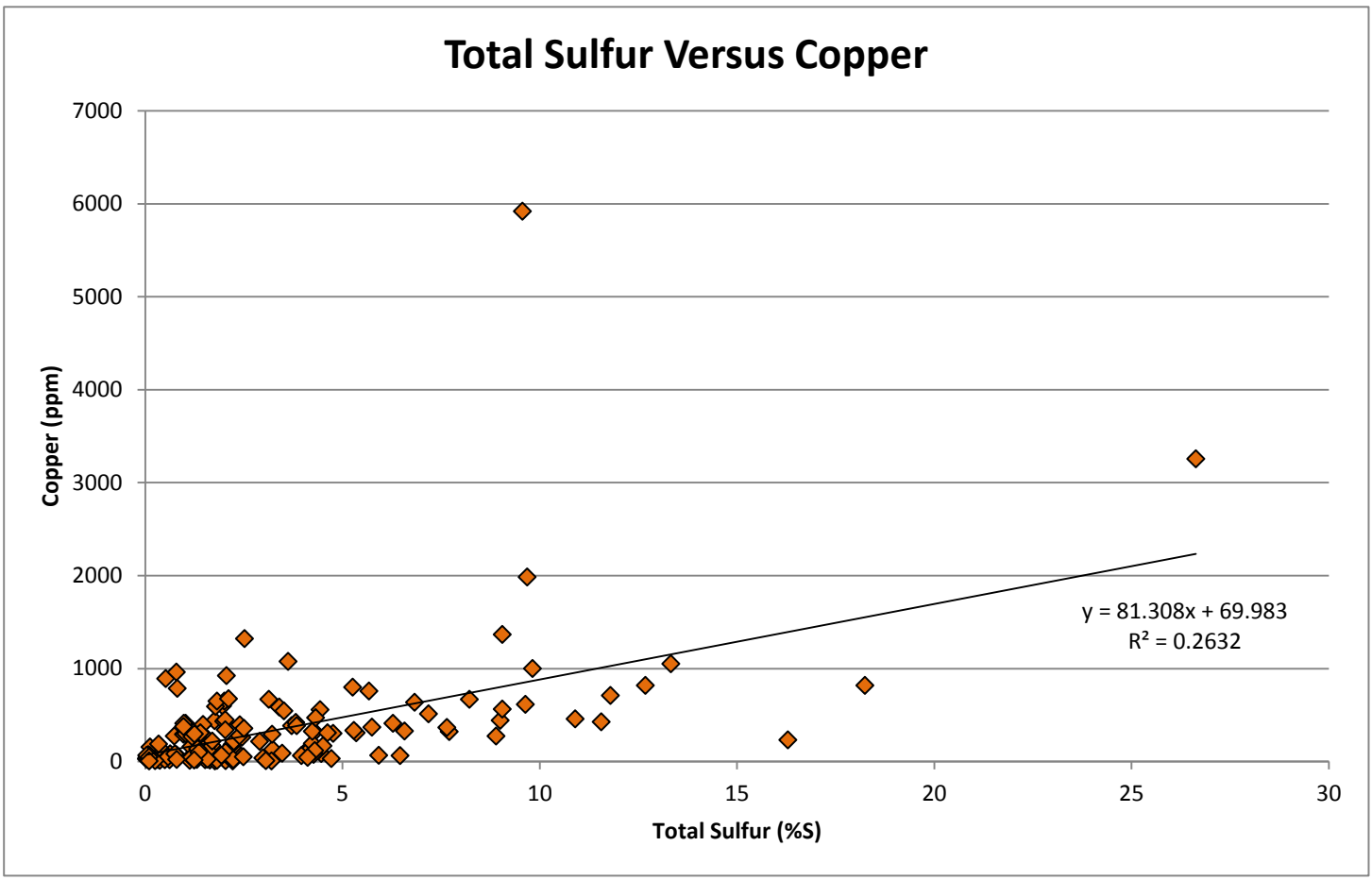
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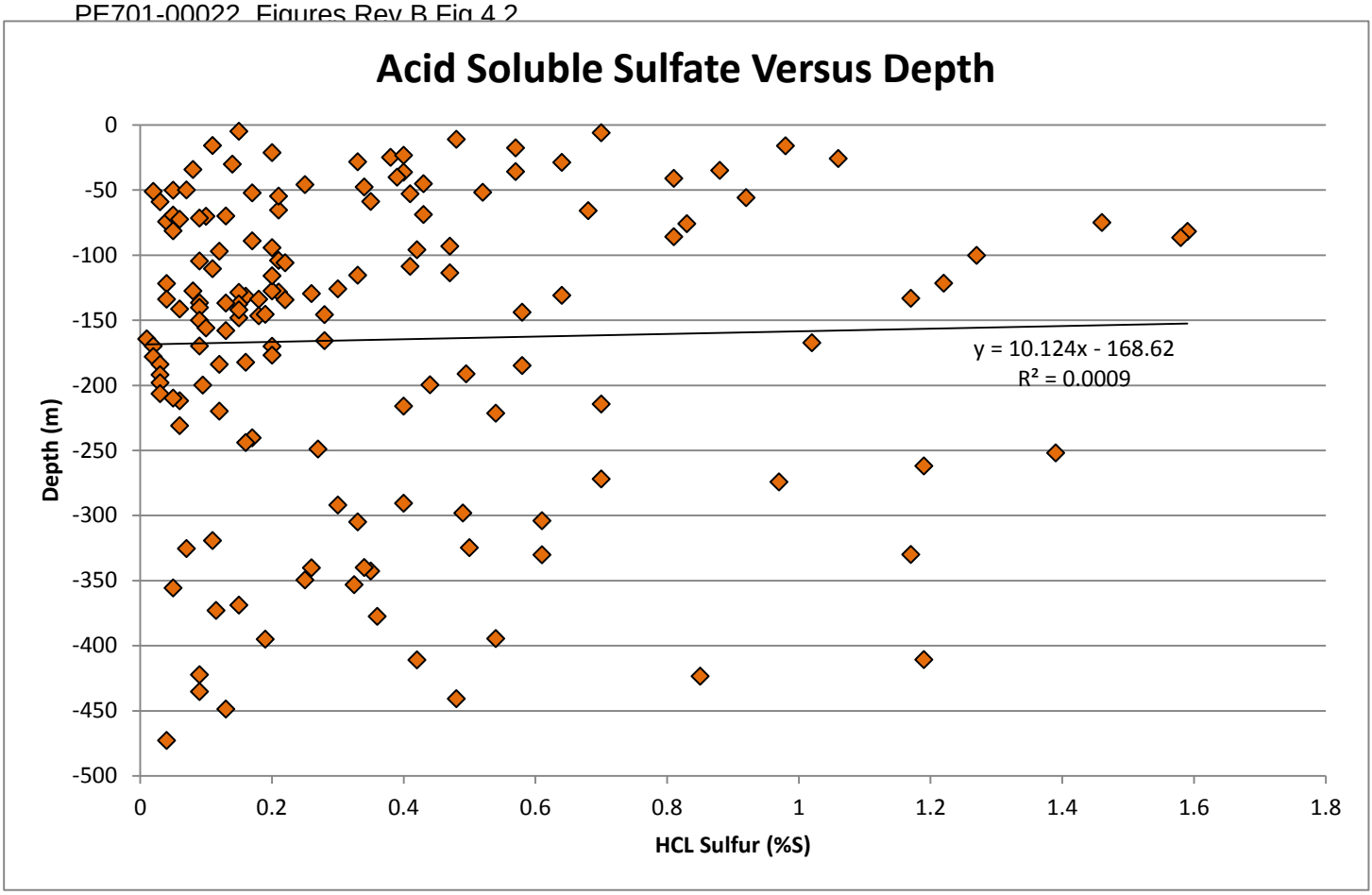
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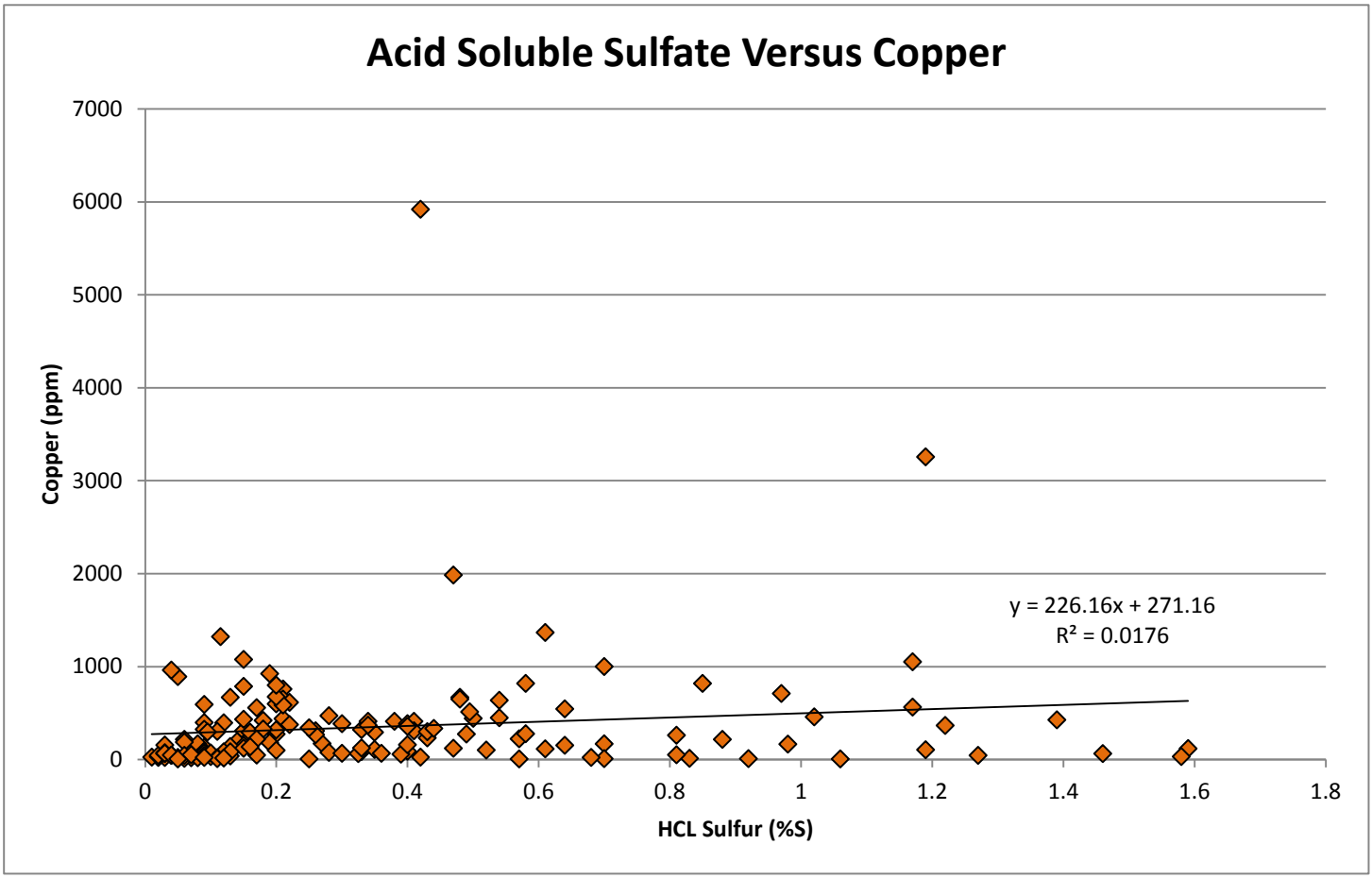
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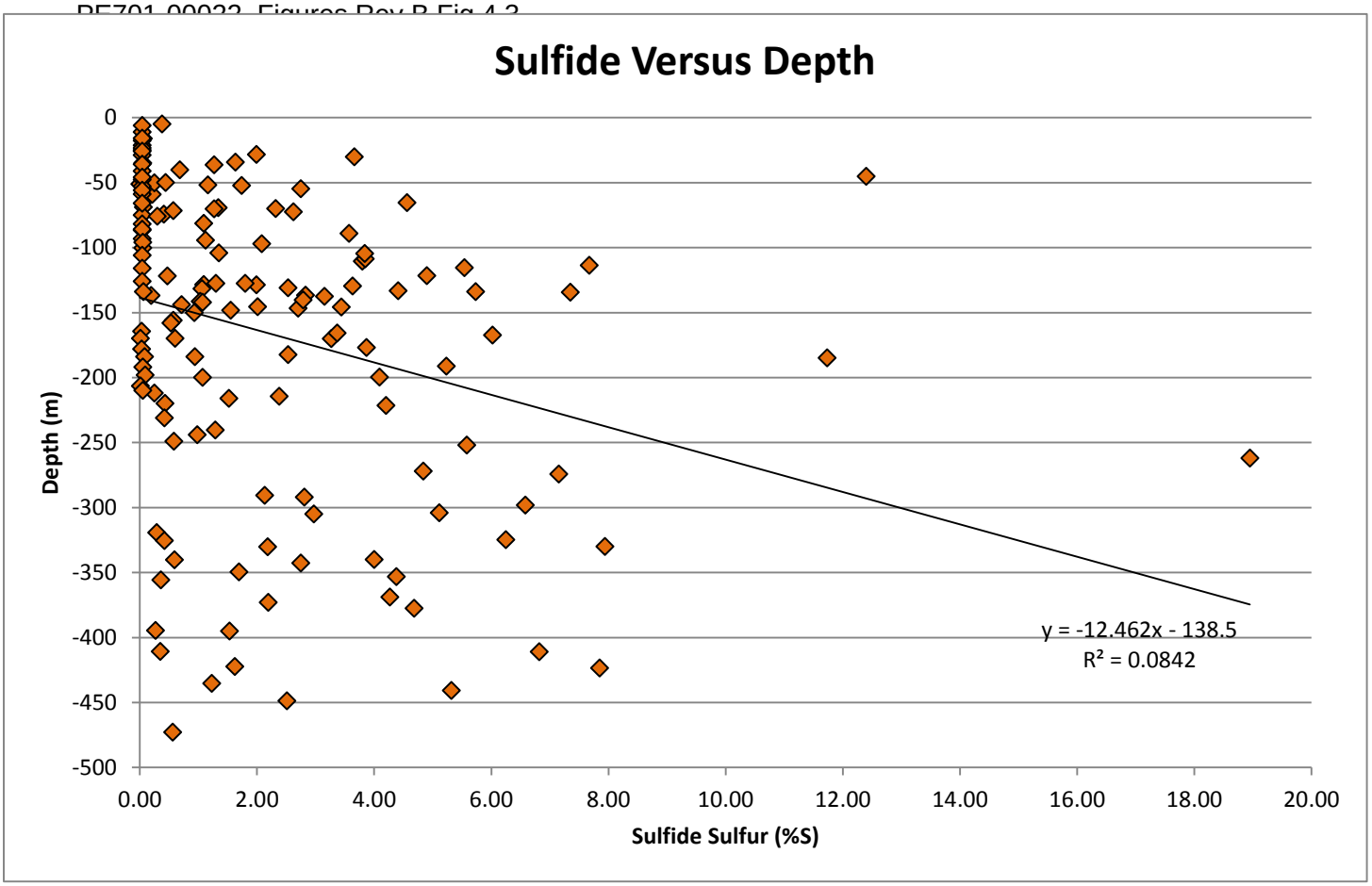
FIGURES

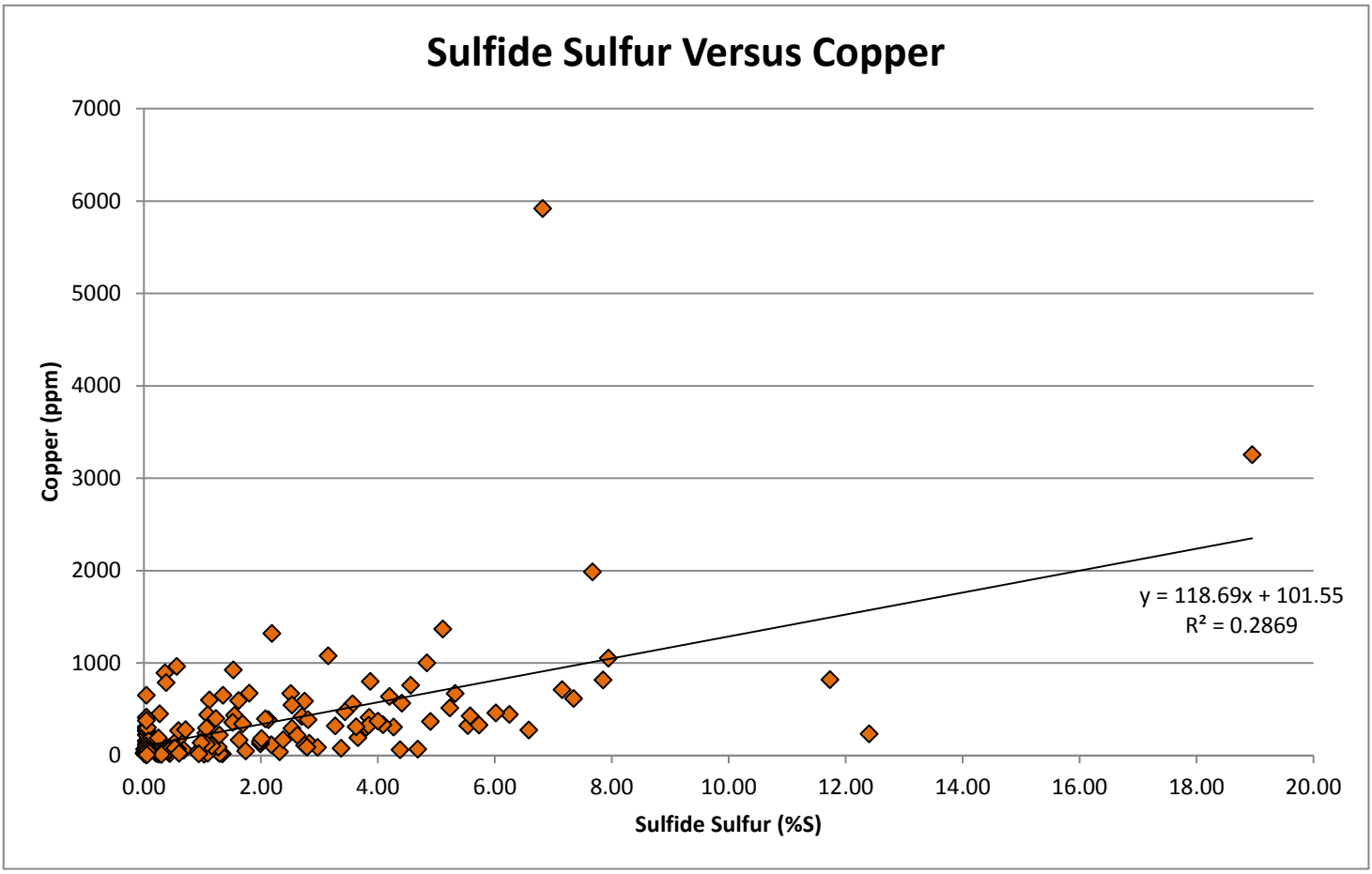

Total Sulfur Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
5
10
15
20
25
30
Total Sulfur (%S)
y = -7.9426x - 137.25
R² = 0.0669

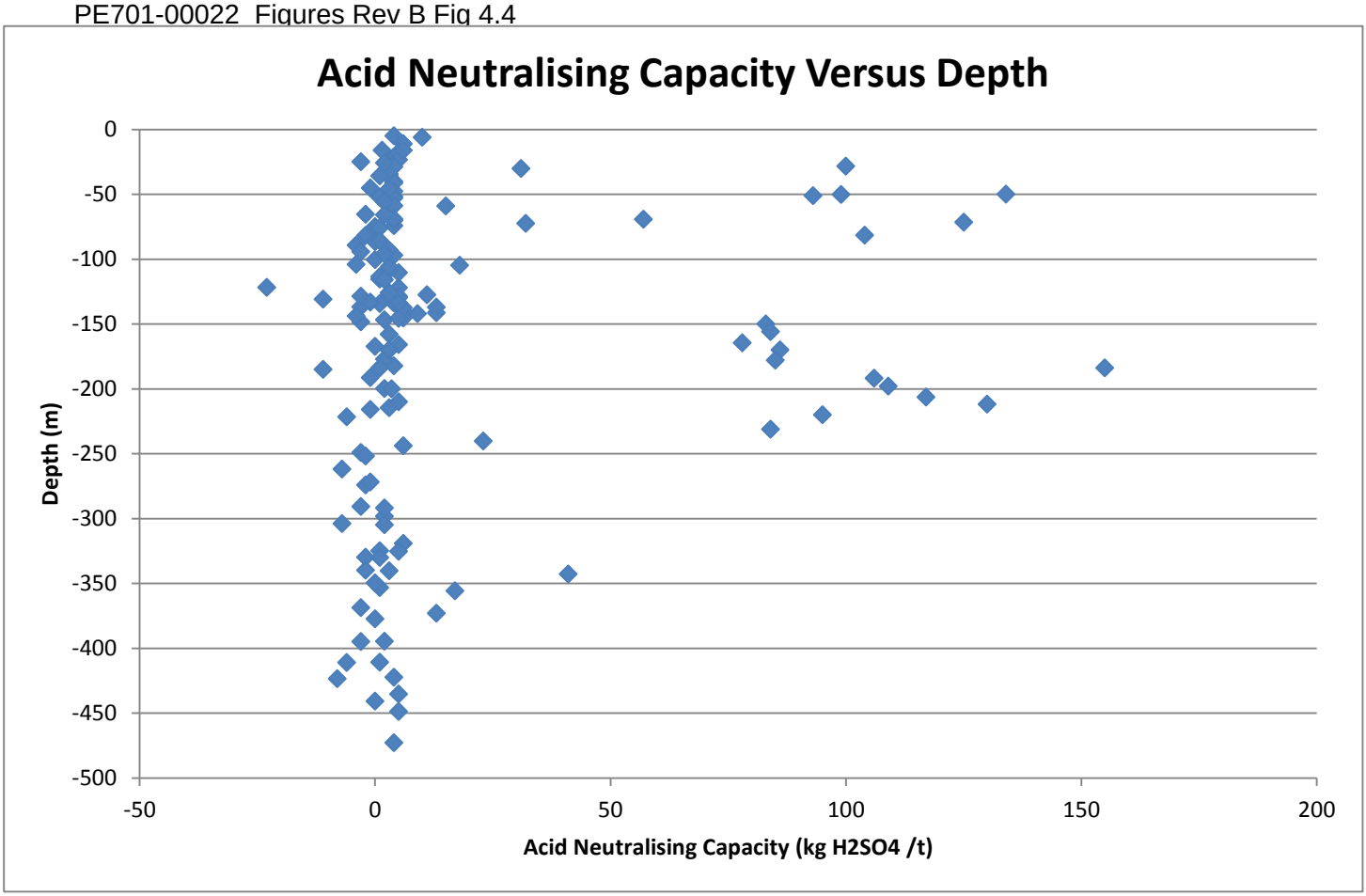

Total Sulfur Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
Total Sulfur (%S)
y = 81.308x + 69.983
R² = 0.2632

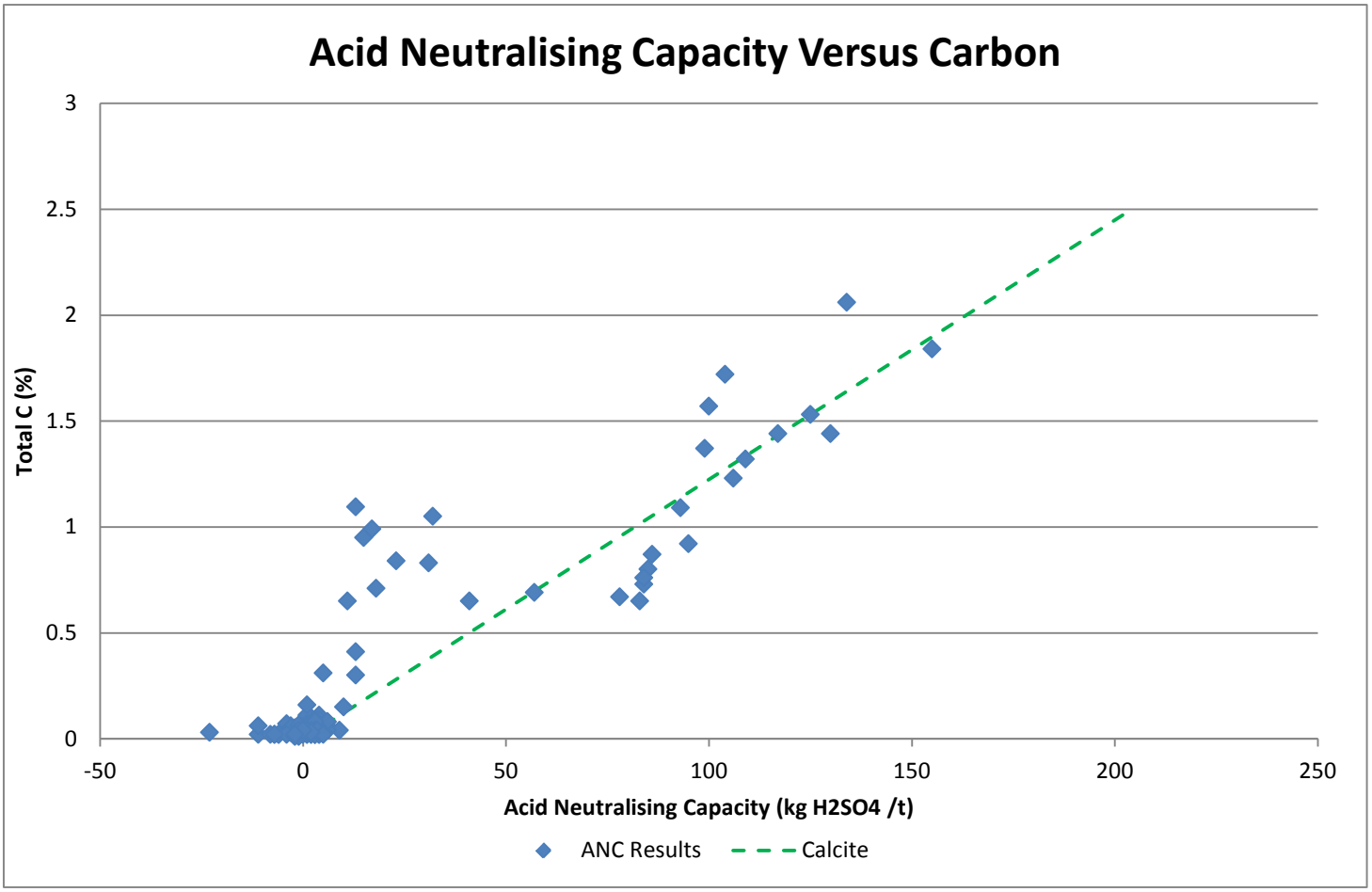

Acid Soluble Sulfate Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
HCL Sulfur (%S)
y = 10.124x - 168.62
R² = 0.0009

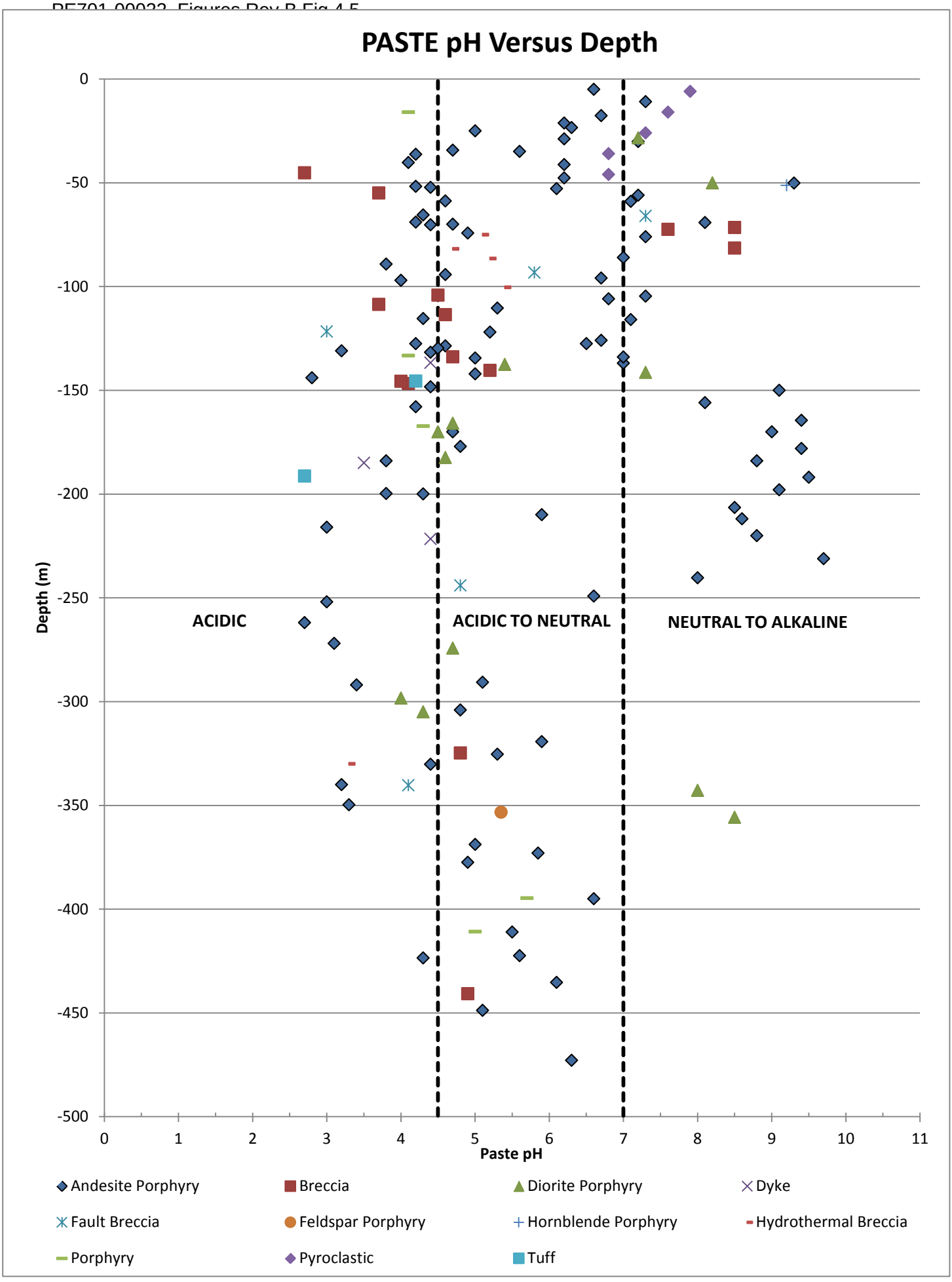

Acid Soluble Sulfate Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
HCL Sulfur (%S)
y = 226.16x + 271.16
R² = 0.0176

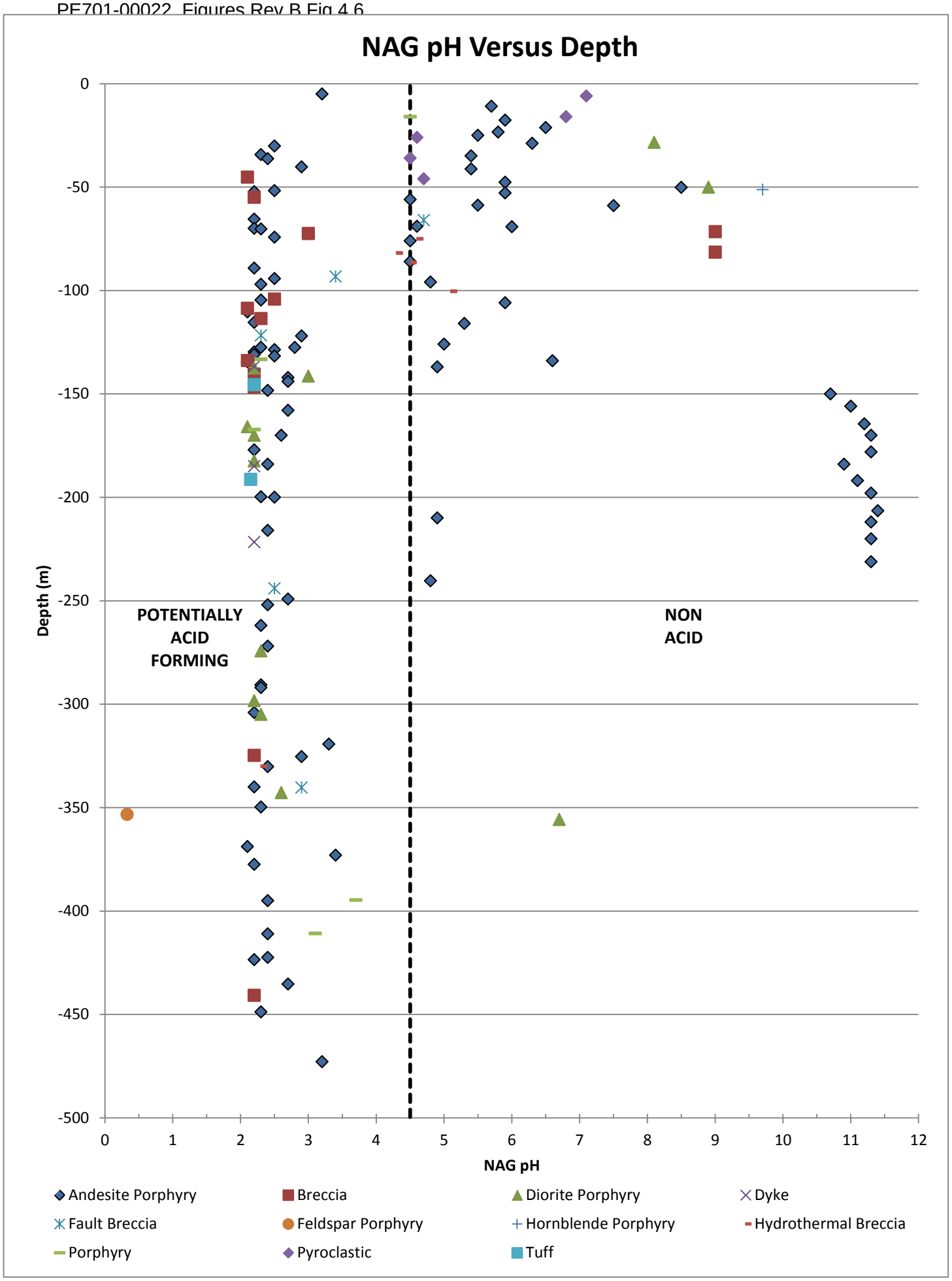

Sulfide Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Sulfide Sulfur (%S)
y = -12.462x - 138.5
R² = 0.0842


Sulfide Sulfur Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Sulfide Sulfur (%S)
y = 118.69x + 101.55
R² = 0.2869

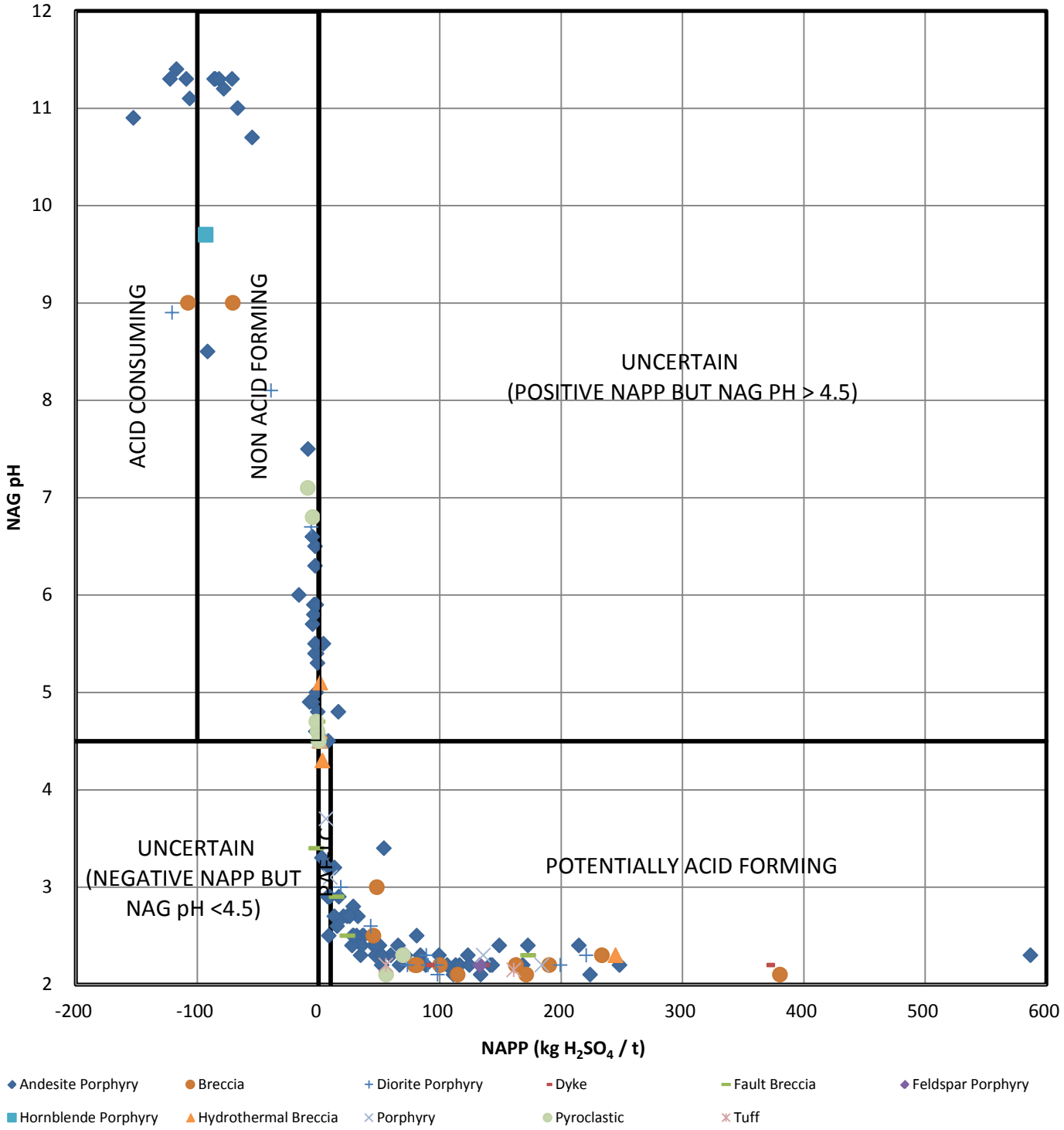

Acid Neutralising Capacity Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
-50
0
50
100
150
200
Acid Neutralising Capacity (kg H2SO4 /t)


Acid Neutralising Capacity Versus Carbon
Total C (%)
3
2.5
2
1.5
1
0.5
0
-50
0
50
100
150
200
250
Acid Neutralising Capacity (kg H2SO4 /t)
ANC Results
Calcite


PASTE pH Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
ACIDIC
ACIDIC TO NEUTRAL
NEUTRAL TO ALKALINE
0
1
2
3
4
5
6
7
8
9
10
11
Paste pH
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

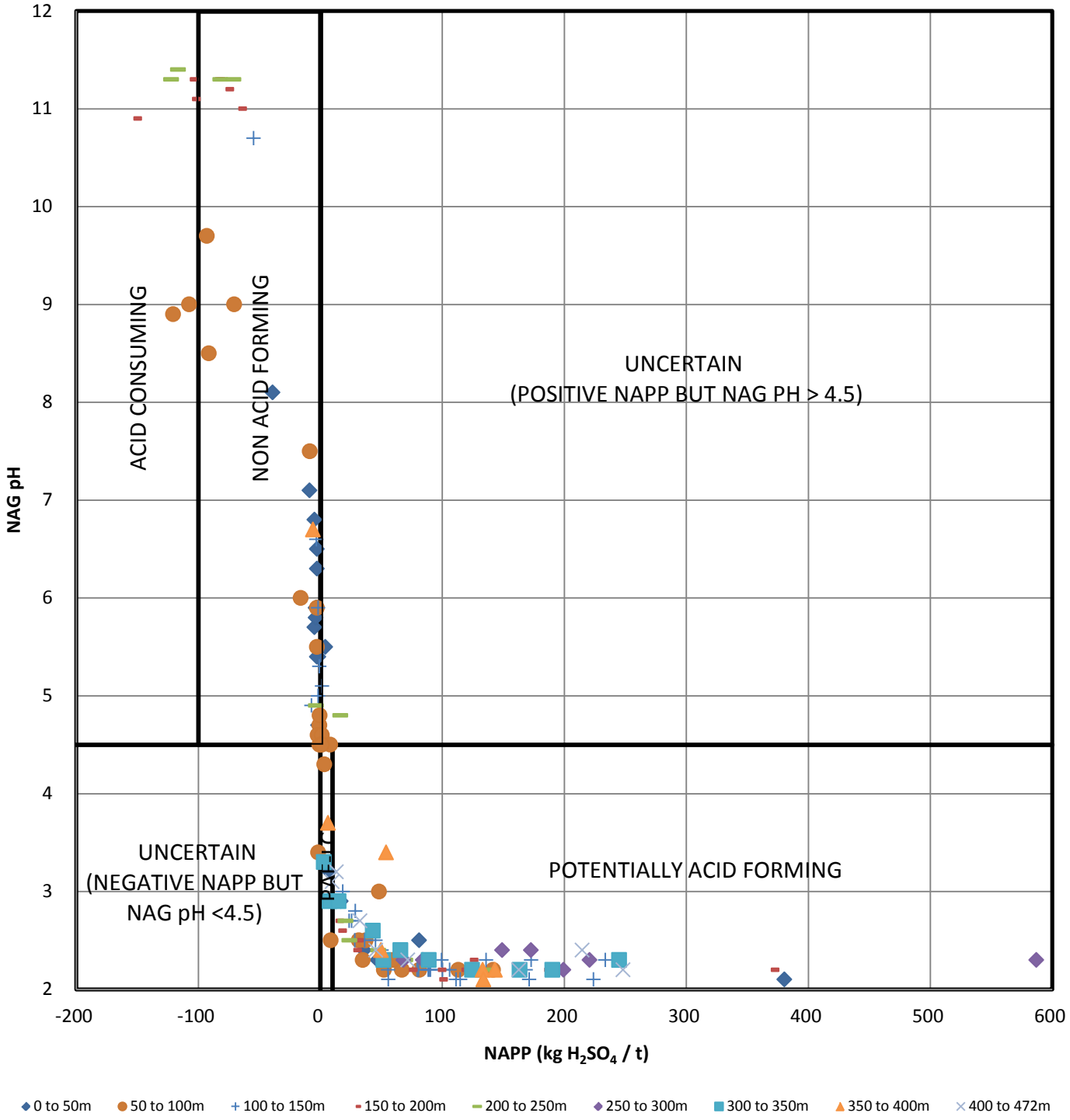

NAG pH Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
POTENTIALLY ACID FORMING
NON ACID
0
1
2
3
4
5
6
7
8
9
10
11
12
NAG pH
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

Acid Formation Potential

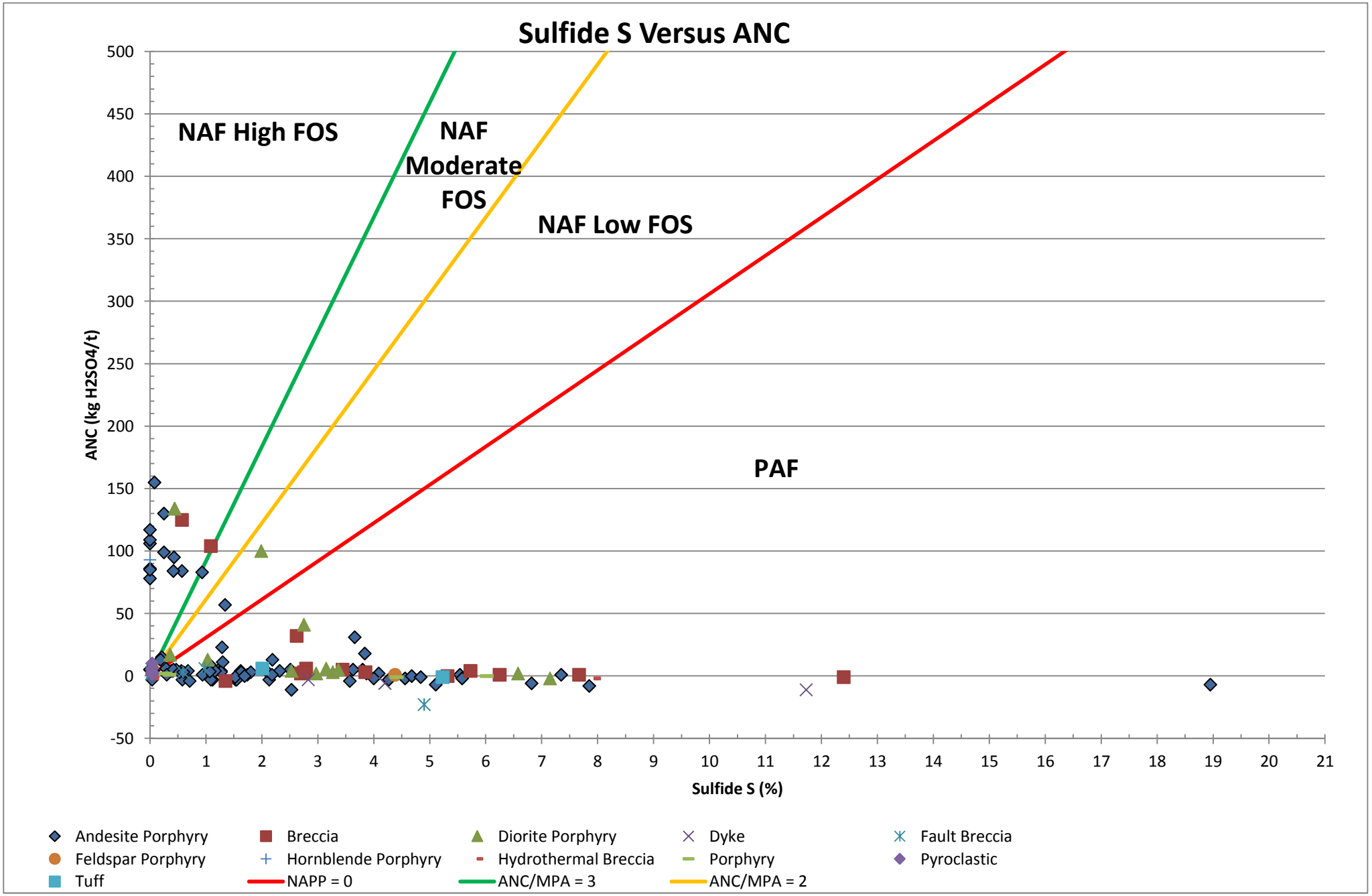


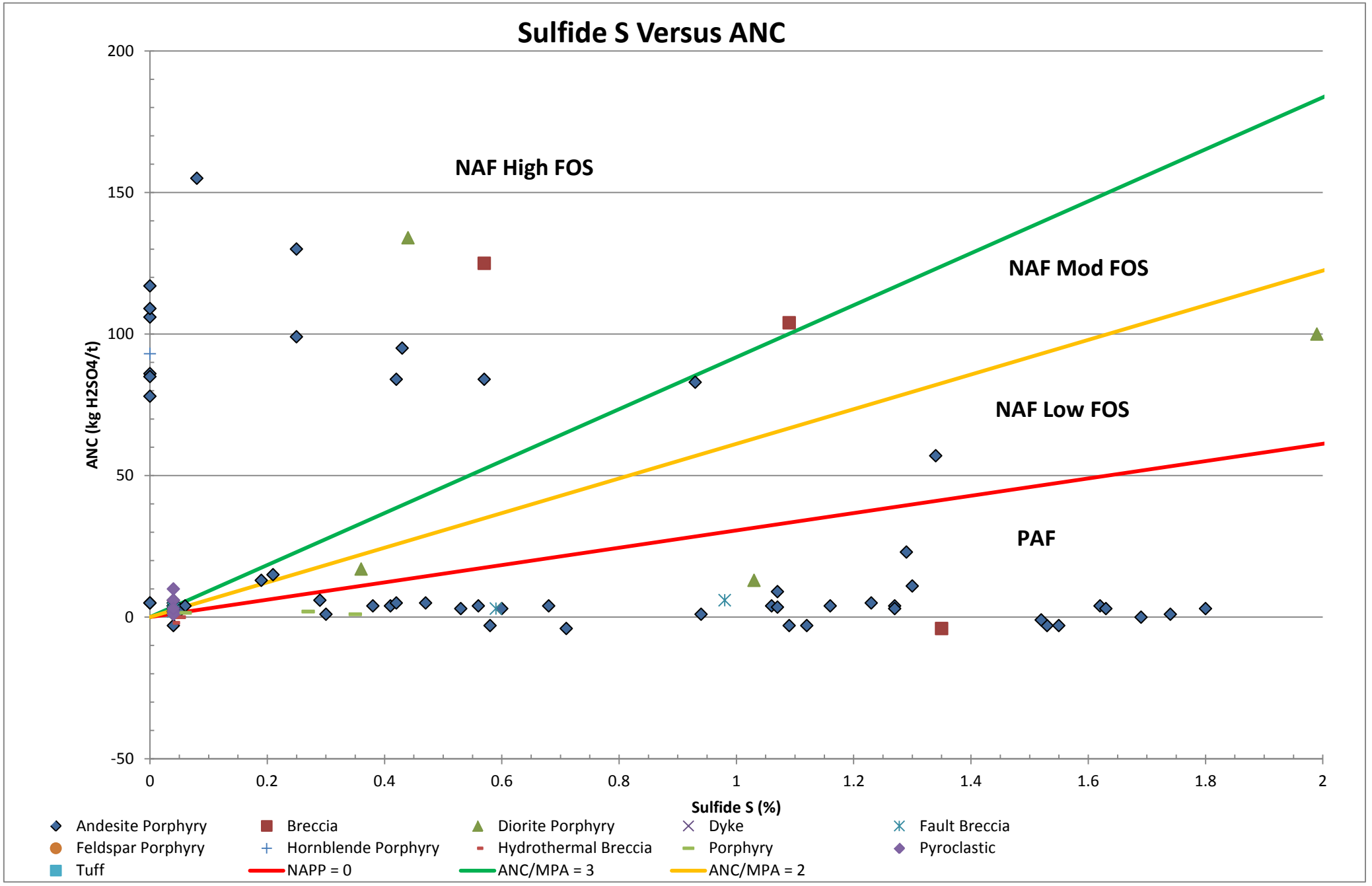
Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

Acid Formation Potential



Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

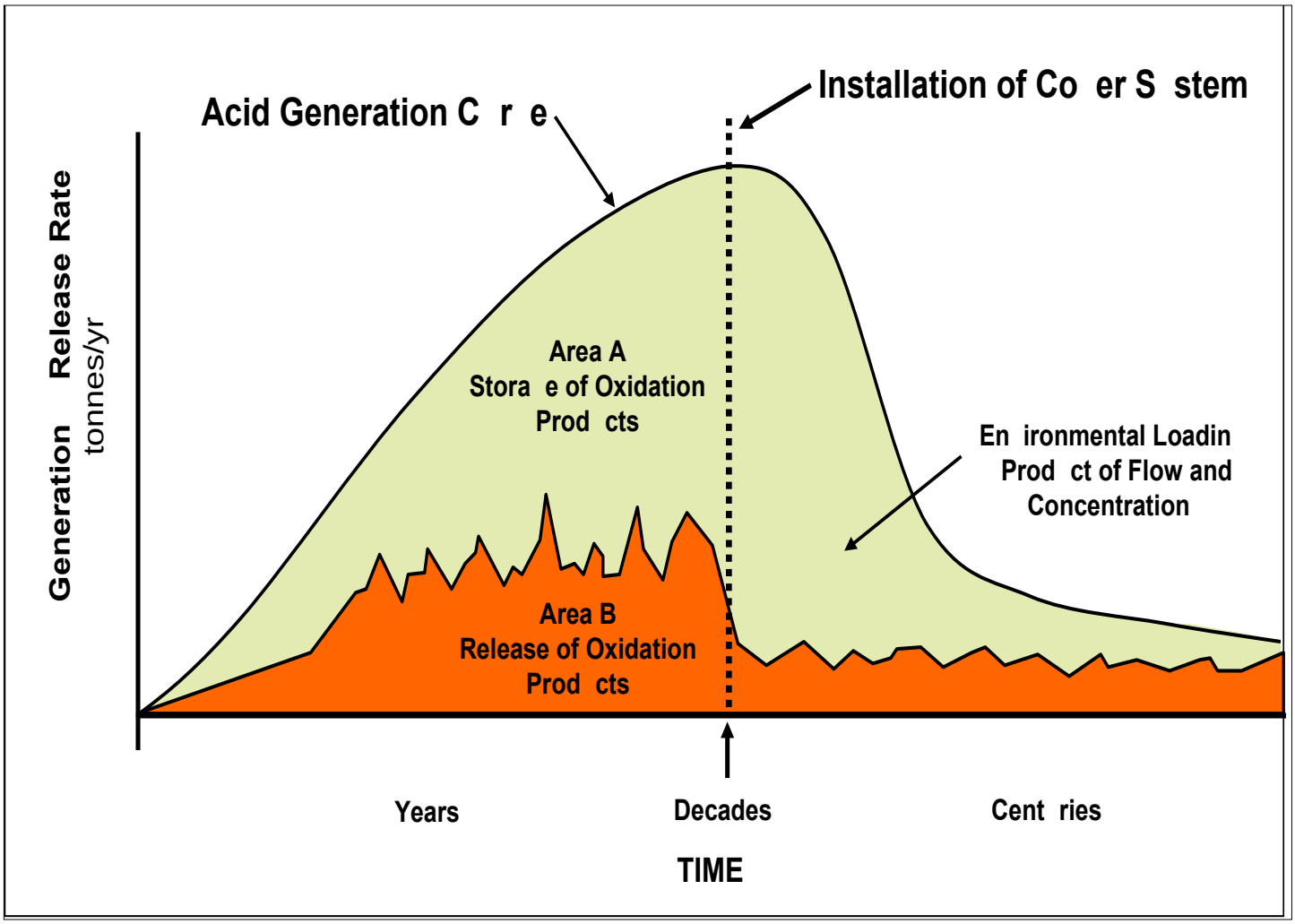

Sulfide S Versus ANC
NAF High FOS
NAF Moderate FOS
NAF Low FOS
PAF
ANC (kg H2SO4/t)
Sulfide S (%)
500
450
400
350
300
250
200
150
100
50
0
-50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff
NAPP = 0
ANC/MPA = 3
ANC/MPA = 2

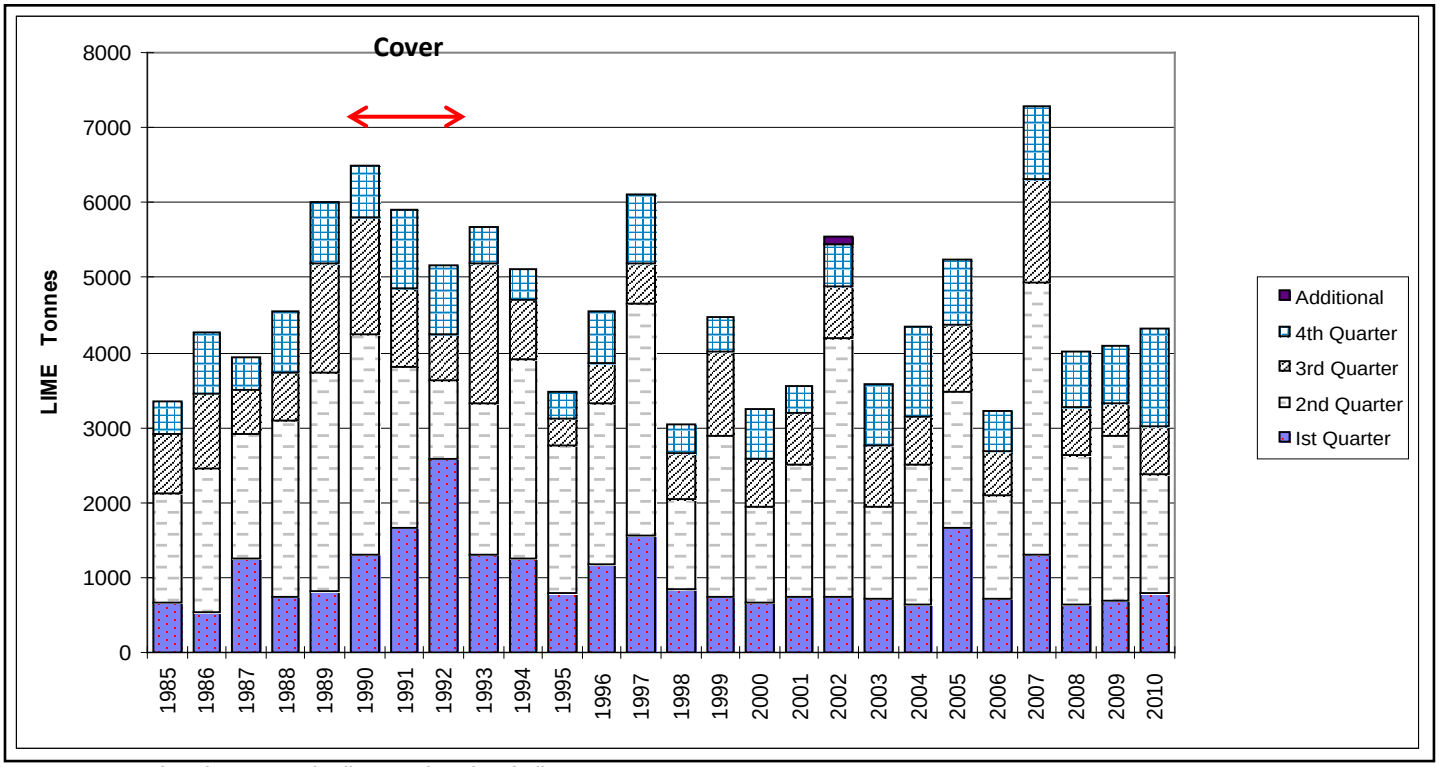


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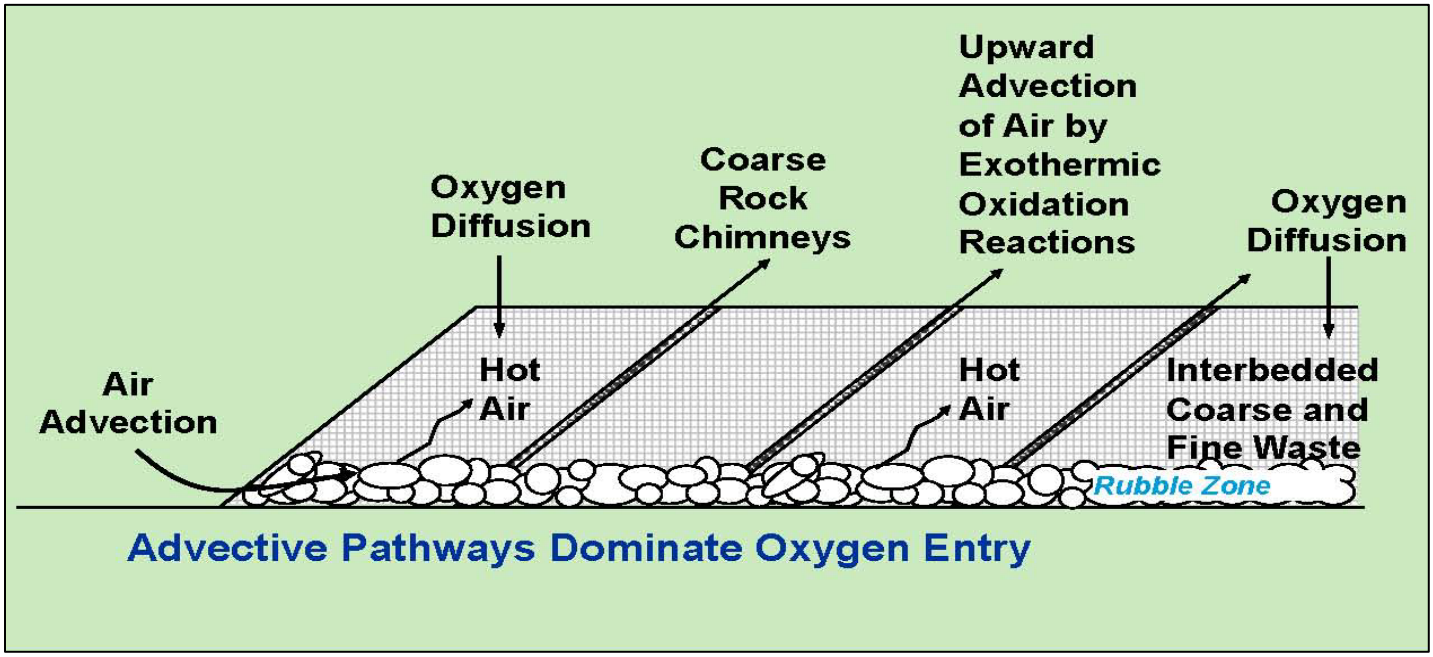
LETPADAUNG COPPER PROJECT
WASTE ROCK GEOCHEMISTRY
ANC & SULFIDE SULFUR (Sulfide less than 2%)

Ref: PE701-00022/16
Figure 4.10



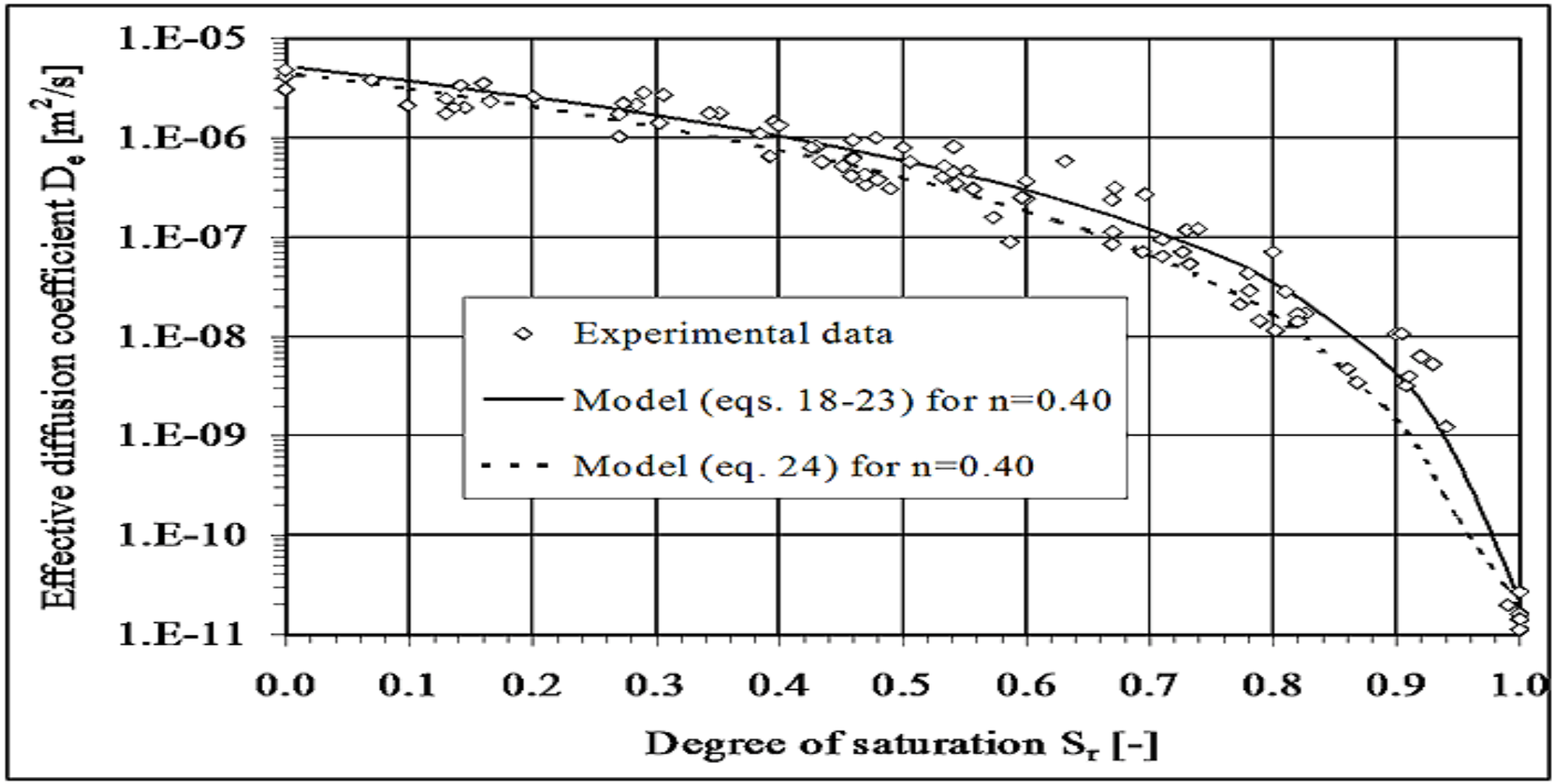


Figures courtesy of Professor Ward Wilson, University of Alberta





Figures courtesy of Professor Ward Wilson, University of Alberta


Effective diffusion coefficient D_e [m^2/s]
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Degree of saturation S_r [-]
Experimental data
Model (eqs. 18-23) for n=0.40
Model (eq. 24) for n=0.40

APPENDIX A

X-RAY Diffraction Results

APPENDIX A - QUANTATIVE XRD RESULTS

Mineral & Class	Sample ID	701-22-001	701-22-008	701-22-020	701-22-023	701-22-032	701-22-041	701-22-044	701-22-052	701-22-071	701-22-072	701-22-081	701-22-097	701-22-115	701-22-126	701-22-148	Average	Max	Min
	Borehole	LS001	LS001	LS002	LS002	LS003	LS003	LS003	LS005	LK004	LK004	LK006	L013	L223	L087	L087			
	Depth	25	221.65	355.8	435.3	146.75	353.35	410.9	50.1	51.23	71.63	191.35	93.25	212	36	330			
	Lithology	Andesite Porphyry	Dyke	Diorite Porphyry	Andesite Porphyry	Breccia	Feldspar Porphyry	Porphyry	Diorite Porphyry	Hornblende Porphyry	Breccia	Tuff	Fault Breccia	Andesite Porphyry	Pyroclastic	Hydrothermal Breccia			
Quartz	Silicate	39.00	38.00	31.00	45.00	45.00	34.00	41.00	40.00	24.00	29.00	43.00	47.00	23.00	63.00	47.00	39.27	63.00	23.00
Amorphous content		12.00	10.00	17.00	13.00	17.00	13.00	7.00	13.00	33.00	29.00	11.00	11.00	35.00	14.00	3.00	15.87	35.00	3.00
Natroalunite	Sulfate	6.00	10.00	-	-	<1	<1	26.00	-	-	-	3.00	9.00	-	15.00	28.00	7.46	28.00	-
Interlayered illite/smectite	Clay	21.00	-	14.00	5.00	18.00	8.00	1.00	15.00	9.00	22.00	13.00	-	-	-	-	8.40	22.00	-
Pyrophyllite	Clay	-	13.00	-	-	-	22.00	-	-	-	-	8.00	13.00	-	5.00	4.00	4.33	22.00	-
Kaolin	Clay	5.00	16.00	5.00	17.00	-	8.00	22.00	5.00	2.00	-	2.00	-	-	-	-	5.47	22.00	-
Chlorite	Clay	-	-	6.00	-	-	-	-	-	-	5.00	-	-	13.00	-	-	1.60	13.00	-
Hematite	Oxide	-	-	-	-	-	-	-	-	-	-	-	15.00	-	1.00	-	1.07	15.00	-
Sodium calcium plagioclase	Feldspar	-	-	9.00	-	-	-	-	-	12.00	1.00	-	-	9.00	-	-	2.07	12.00	-
Pyrite	Sulfide	-	10.00	1.00	2.00	6.00	10.00	1.00	-	<1	2.00	15.00	-	-	-	16.00	4.50	16.00	-
Siderite	Carbonate	-	-	11.00	3.00	-	-	-	-	-	-	-	-	-	-	-	0.93	11.00	-
Palygorskite	Clay	-	-	-	-	-	-	-	-	-	-	-	-	7.00	-	-	0.47	7.00	-
Illite/Muscovite	Mica	16.00	-	1.00	13.00	12.00	2.00	1.00	11.00	7.00	4.00	5.00	-	4.00	-	-	5.07	16.00	-
Potassium feldspar	Feldspar	-	2.00	5.00	-	-	<1	-	-	8.00	-	-	4.00	-	1.00	-	1.43	8.00	-
Ankerite	Carbonate	-	-	-	-	-	-	-	4.00	-	-	-	-	-	-	-	0.27	4.00	-
Dolomite	Carbonate	-	1.00	-	-	-	-	2.00	8.00	3.00	7.00	-	1.00	-	-	-	1.47	8.00	-
Calcite	Carbonate	-	-	-	-	<1	-	-	-	2.00	1.00	-	-	7.00	-	-	0.71	7.00	-
Magnesite	Carbonate	-	-	-	-	-	-	-	4.00	-	2.00	-	-	-	-	-	0.40	4.00	-
Expanding clay	Clay	-	-	-	-	-	-	-	-	2.00	-	-	-	-	-	-	0.13	2.00	-
Chloritoid	Clay	-	-	-	-	-	-	-	-	-	-	-	-	2.00	-	-	0.13	2.00	-
Diaspore	Hydroxide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.00	0.13	2.00	-
Alunite	Sulfate	-	-	1.00	1.00	-	3.00	-	-	-	-	-	-	-	-	-	0.33	3.00	-
Jarosite	Hydroxide	1.00	-	-	1.00	1.00	-	-	-	-	-	-	-	-	-	-	0.20	1.00	-
Anhydrite	Sulfate	-	-	-	<1	1.00	-	-	-	-	-	-	-	-	-	-	0.07	1.00	-
Anatase	Oxide	-	-	-	-	-	-	-	-	-	-	1.00	-	-	-	-	0.07	1.00	-
Chalcopyrite	Sulfide	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX B

Acid Base Accounting Results

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Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m)	Acid Neutralising Capacity (kg H2SO4/tonne)	Total Carbon (%C)	Total Sulfur (%S)	HCL Soluble Sulfur (%S)	Chromium Reducible Sulfur (%S)	Caculated Sulfide Sulfur (%S)	Calcuated Acid Insoluble Sulfate Sulfur (%S)	Paste pH	NAG pH (pH Units)	NAG (4.5) (kg H2SO4/tonne)	NAG (7.0) (kg H2SO4/tonne)	Calcuated Maximum Potential Acidity (kg H2SO4/tonne)	ANC/MPA Unitless	Calcuated Net Acid Producing Potential (kg H2SO4/tonne)	Acid Formation Potential Classification
701-22-001	Andesite Porphyry	LS001	25	-3	0.055	1.025	0.38	0.04	0.04	0.605	5	5.5	0	3	1.2	-2.45	4.22	Uncertain
701-22-002	Andesite Porphyry	LS001	59	15	0.95	0.32	0.03	0.21	0.21	0.08	7.1	7.5	0	0	6.4	2.33	-8.57	Non Acid Forming
701-22-003	Andesite Porphyry	LS001	65.5	-2	0.05	5.67	0.21	4.56	4.56	0.9	4.3	2.2	127	142	139.5	-0.01	141.54	Potentially Acid Forming
701-22-004	Andesite Porphyry	LS001	89.25	-4	0.04	4.43	0.17	3.57	3.57	0.69	3.8	2.2	98	110	109.2	-0.04	113.24	Potentially Acid Forming
701-22-005	Andesite Porphyry	LS001	122	5	0.04	0.67	0.04	0.47	0.47	0.16	5.2	2.9	6	11	14.4	0.35	9.38	Potentially Acid Forming - Low Capacity
701-22-006	Dyke	LS001	136.75	-3	0.04	3.23	0.09	2.83	2.83	0.31	4.4	2.2	79	89	86.6	-0.03	89.60	Potentially Acid Forming
701-22-007	Dyke	LS001	185	-11	0.02	18.24	0.58	11.73	11.73	5.93	3.5	2.2	424	455	358.9	-0.03	369.94	Potentially Acid Forming
701-22-008	Dyke	LS001	221.65	-6	0.02	6.83	0.54	4.2	4.20	2.09	4.4	2.2	133	147	128.5	-0.05	134.52	Potentially Acid Forming
701-22-009	Andesite Porphyry	LS001	249.15	-3	0.03	1.69	0.27	0.58	0.58	0.84	6.6	2.7	12	17	17.7	-0.17	20.75	Potentially Acid Forming
701-22-010	Andesite Porphyry	LS001	290.75	-3	0.04	3.71	0.4	2.13	2.13	1.18	5.1	2.3	67	77	65.2	-0.05	68.18	Potentially Acid Forming
701-22-011	Andesite Porphyry	LS001	304.05	-7	0.02	9.05	0.61	5.11	5.11	3.33	4.8	2.2	180	201	156.4	-0.04	163.37	Potentially Acid Forming
701-22-012	Andesite Porphyry	LS001	368.85	-3	0.03	5.35	0.15	4.27	4.27	0.93	5	2.1	133	144	130.7	-0.02	133.66	Potentially Acid Forming
701-22-013	Andesite Porphyry	LS001	395	-3	0.03	2.06	0.19	1.53	1.53	0.34	6.6	2.4	31	41	46.8	-0.06	49.82	Potentially Acid Forming
701-22-014	Andesite Porphyry	LS001	411.1	-6	0.02	9.56	0.42	6.82	6.82	2.32	5.5	2.4	136	163	208.7	-0.03	214.69	Potentially Acid Forming
701-22-015	Andesite Porphyry	LS001	423.5	-8	0.02	12.68	0.85	7.85	7.85	3.98	4.3	2.2	261	281	240.2	-0.03	248.21	Potentially Acid Forming
701-22-016	Andesite Porphyry	LS002	94.3	-3	0.06	1.96	0.2	1.12	1.12	0.64	4.6	2.5	21	30	34.3	-0.09	37.27	Potentially Acid Forming
701-22-017	Breccia	LS002	104.13	-4	0.07	2.01	0.21	1.35	1.35	0.45	4.5	2.5	27	37	41.3	-0.10	45.31	Potentially Acid Forming
701-22-018	Andesite Porphyry	LS002	128.6	-3	0.05	1.76	0.21	1.09	1.09	0.46	4.6	2.5	20	28	33.4	-0.09	36.35	Potentially Acid Forming
701-22-019	Andesite Porphyry	LS002	148.4	-3	0.05	1.99	0.15	1.55	1.55	0.29	4.4	2.4	33	43	47.4	-0.06	50.43	Potentially Acid Forming
701-22-020	Diorite Porphyry	LS002	355.8	17	0.99	0.52	0.05	0.36	0.36	0.11	8.5	6.7	0	0	11.0	1.54	-5.98	Non Acid Forming
701-22-021	Andesite Porphyry	LS002	373	13	1.095	2.52	0.115	2.19	2.19	0.215	5.85	3.4	7	35.5	67.0	0.19	54.01	Potentially Acid Forming
701-22-022	Andesite Porphyry	LS002	422.5	4	0.05	1.78	0.09	1.62	1.62	0.07	5.6	2.4	29	38	49.6	0.08	45.57	Potentially Acid Forming
701-22-023	Andesite Porphyry	LS002	435.3	5	0.31	1.47	0.09	1.23	1.23	0.15	6.1	2.7	11	24	37.6	0.13	32.64	Potentially Acid Forming
701-22-024	Andesite Porphyry	LS002	448.85	5	0.03	3.13	0.13	2.51	2.51	0.49	5.1	2.3	63	72	76.8	0.07	71.81	Potentially Acid Forming
701-22-025	Andesite Porphyry	LS002	472.85	4	0.02	0.79	0.04	0.56	0.56	0.19	6.3	3.2	3	7	17.1	0.23	13.14	Potentially Acid Forming
701-22-026	Andesite Porphyry	LS003	21.3	4	0.1	0.74	0.2	0.04	0.04	0.5	6.2	6.5	0	0	1.2	3.27	-2.78	Non Acid Forming
701-22-027	Andesite Porphyry	LS003	70	4	0.04	2.98	0.13	2.32	2.32	0.53	4.7	2.2	68	79	71.0	0.06	66.99	Potentially Acid Forming
701-22-028	Andesite Porphyry	LS003	74.3	4	0.06	1.14	0.04	0.41	0.41	0.69	4.9	2.5	17	25	12.5	0.32	8.55	Potentially Acid Forming - Low Capacity
701-22-029	Andesite Porphyry	LS003	97	4	0.05	2.4	0.12	2.08	2.08	0.2	4	2.3	49	61	63.6	0.06	59.65	Potentially Acid Forming
701-22-030	Andesite Porphyry	LS003	115.5	1	0.06	7.71	0.33	5.54	5.54	1.84	4.3	2.2	190	205	169.5	0.01	168.52	Potentially Acid Forming
701-22-031	Andesite Porphyry	LS003	131.7	4	0.07	1.59	0.16	1.06	1.06	0.37	4.4	2.5	21	29	32.4	0.12	28.44	Potentially Acid Forming
701-22-032	Breccia	LS003	146.75	2	0.1	3.82	0.18	2.7	2.70	0.94	4.1	2.2	82	92	82.6	0.02	80.62	Potentially Acid Forming
701-22-033	Diorite Porphyry	LS003	170.02	3	0.05	4.3	0.2	3.27	3.27	0.83	4.5	2.2	93	104	100.1	0.03	97.06	Potentially Acid Forming
701-22-034	Diorite Porphyry	LS003	182.4	4	0.04	3.22	0.16	2.53	2.53	0.53	4.6	2.2	70	82	77.4	0.05	73.42	Potentially Acid Forming
701-22-035	Diorite Porphyry	LS003	274.25	-2	0.03	11.79	0.97	7.15	7.15	3.67	4.7	2.3	223	242	218.8	-0.01	220.79	Potentially Acid Forming
701-22-036	Diorite Porphyry	LS003	298.3	2	0.04	8.89	0.49	6.58	6.58	1.82	4	2.2	208	224	201.3	0.01	199.35	Potentially Acid Forming
701-22-037	Diorite Porphyry	LS003	305	2	0.06	4.46	0.33	2.97	2.97	1.16	4.3	2.3	90	101	90.9	0.02	88.88	Potentially Acid Forming
701-22-038	Breccia	LS003	324.8	1	0.11	9	0.5	6.25	6.25	2.25	4.8	2.2	200	217	191.3	0.01	190.25	Potentially Acid Forming
701-22-039	Andesite Porphyry	LS003	330.2	1	0.07	4.38	0.61	2.18	2.18	1.59	4.4	2.4	60	72	66.7	0.01	65.71	Potentially Acid Forming
701-22-040	Diorite Porphyry	LS003	342.8	41	0.65	4.07	0.35	2.75	2.75	0.97	8	2.6	38	46	84.2	0.49	43.15	Potentially Acid Forming
701-22-041	Feldspar Porphyry	LS003	353.35	1	0.03	6.46	0.325	4.38	4.38	1.755	5.35	2.2	154.5	166.5	134.0	0.01	133.03	Potentially Acid Forming
701-22-042	Andesite Porphyry	LS003	377.5	0	0.03	5.92	0.36	4.68	4.68	0.88	4.9	2.2	133	145	143.2	0.00	143.21	Potentially Acid Forming
701-22-043	Porphyry	LS003	394.75	2	0.04	2.03	0.54	0.27	0.27	1.22	5.7	3.7	1	7	8.3	0.24	6.26	Potentially Acid Forming - Low Capacity
701-22-044	Porphyry	LS003	410.9	1	0.06	4.11	1.19	0.35	0.35	2.57	5	3.1	10	17	10.7	0.09	9.71	Potentially Acid Forming - Low Capacity
701-22-045	Breccia	LS003	440.8	0	0.04	8.22	0.48	5.32	5.32	2.42	4.9	2.2	176	193	162.8	0.00	162.79	Potentially Acid Forming
701-22-046	Andesite Porphyry	LS004	30.21	31	0.83	4.24	0.14	3.66	3.66	0.44	7.2	2.5	53	68	112.0	0.28	81.00	Potentially Acid Forming
701-22-047	Andesite Porphyry	LS004	50.21	99	1.37	0.37	0.05	0.25	0.25	0.07	9.3	8.5	0	0	7.7	12.94	-91.35	Non Acid Forming
701-22-048	Andesite Porphyry	LS004	69.25	57	0.69	1.64	0.05	1.34	1.34	0.25	8.1	6	0	2	41.0	1.39	-16.00	Non Acid Forming
701-22-049	Andesite Porphyry	LS004	110.45	5	0.05	4.76	0.11	3.8	3.80	0.85	5.3	2.1	110	128	116.3	0.04	111.28	Potentially Acid Forming
701-22-050	Andesite Porphyry	LS004	134.45	1	0.16	9.64	0.22	7.35	7.35	2.07	5	2.1	222	244	224.9	0.00	223.91	Potentially Acid Forming
701-22-051	Diorite Porphyry	LS005	28.4	100	1.57	2.28	0.33	1.99	1.99	0	7.2	8.1	0	0	60.9	1.64	-39.11	Non Acid Forming
701-22-052	Diorite Porphyry	LS005	50.1	134	2.06	0.62	0.07	0.44	0.44	0.11	8.2	8.9	0	0	13.5	9.95	-120.54	Acid Consuming
701-22-053	Breccia	LS005	72.5	32	1.05	2.9	0.06	2.62	2.62	0.22	7.6	3	12	26	80.2	0.40	48.17	Potentially Acid Forming
701-22-054	Breccia	LS005	133.9	4	0.04	6.57	0.18	5.73	5.73	0.66	4.7	2.1	160	181	175.3	0.02	171.34	Potentially Acid Forming
701-22-055	Diorite Porphyry	LS005	141.4	13	0.41	1.13	0.06	1.03	1.03	0.04	7.3	3	5	14	31.5	0.41	18.52	Potentially Acid Forming
701-22-056	Andesite Porphyry	LS006	34.3	3	0.03	1.58	0.08	1.63	1.63	0	4.7	2.3	30	40	49.9	0.06	46.88	Potentially Acid Forming
701-22-057	Andesite Porphyry	LS006	52.3	1	0.03	2.11	0.17	1.74	1.74	0.2	4.4	2.2	43	53	53.2	0.02	52.24	Potentially Acid Forming
701-22-058	Andesite Porphyry	LS006	70.3	4	0.04	1.56	0.1	1.27	1.27	0.19	4.4	2.3	28	36	38.9	0.10	34.86	Potentially Acid Forming
701-22-059	Andesite Porphyry	LS006	127.6	11	0.65	1.52	0.08	1.3	1.30	0.14	6.5	2.8	8	27	39.8	0.28	28.78	Potentially Acid Forming
701-22-060	Breccia	LS006	140.4	6	0.05	3.47	0.09	2.79	2.79	0.59	5.2	2.2	81	94	85.4	0.07	79.37	Potentially Acid Forming
701-22-061	Porphyry	LK002	16.05	1.5	0.035	1.55	0.98	0.06	0.06	0.51	4.1	4.5	0	1.5	1.8	0.82	0.34	Potentially Acid Forming - Low Capacity
701-22-062	Andesite Porphyry	LK002	36.3	3	0.04	2.02	0.4	1.27	1.27	0.35	4.2	2.4	23	34	38.9	0.08	35.86	Potentially Acid Forming
701-22-063	Breccia	LK002	113.6	1	0.03	9.68	0.47	7.67	7.67	1.54	4.6	2.3	181	207	234.7	0.00	233.70	Potentially Acid Forming
701-22-064	Porphyry	LK002	133.3	-1	0.02	9.05	1.17	4.41	4.41	3.47	4.1	2.3	126	144	134.9	-0.01	135.95	Potentially Acid Forming
701-22-065	Porphyry	LK002	167.3	0	0.02	10.9	1.02	6.02	6.02	3.86	4.3	2.2	196	215	184.2	0.00	184.21	Potentially Acid Forming
701-22-066	Andesite Porphyry	LK003	40.3	4	0.02	1.98	0.39	0.68	0.68	0.91	4.1	2.9	9	19	20.8	0.19	16.81	Potentially Acid Forming
701-22-067	Breccia	LK003	54.9	3	0.04	3.4	0.21	2.75	2.75	0.44	3.7	2.2	66	81	84.2	0.04	81.15	Potentially Acid Forming
701-22-068	Breccia	LK003	108.6	3	0.05	6.28	0.41	3.85	3.85	2.02	3.7	2.1	137	157	117.8	0.03	114.81	Potentially Acid Forming
701-22-069	Pyroclastic	LK003	128.7	5	0.08	2.21	0.15	1.99	1.99	0.07	3.8	2.1	51	62	60.9	0.08	55.89	Potentially Acid Forming
701-22-070	Tuff	LK003	145.6	6	0.05	2.2	0.19	2.01	2.01	4.44089E-16	4.2	2.2	49	63	61.5	0.10	55.51	Potentially Acid Forming
701-22-071	Hornblende Porphyry	LK004	51.23	93	1.09	0.07	0.02	0	0.00	0.05	9.2	9.7	0	0	0.0	0.00	-93.00	Non Acid Forming
701-22-072	Breccia	LK004	71.63	125	1.53	0.8	0.09	0.57	0.57	0.14	8.5	9	0	0	17.4	7.17	-107.56	Acid Consuming
701-22-073	Breccia	LK004	81.52	104	1.72	1.31	0.05	1.09	1.09	0.17	8.5	9	0	0	33.4	3.12	-70.65	Non Acid Forming
701-22-074	Andesite Porphyry	LK004	104.71	18	0.71	4.24	0.09	3.84	3.84	0.31	7.3	2.3	61	80	117.5	0.15	99.50	Potentially Acid Forming
701-22-075	Diorite Porphyry	LK004	137.51	6	0.05	3.62	0.15	3.15	3.15	0.32	5.4	2.2	67	79	96.4	0.06	90.39	Potentially Acid Forming
701-22-076	Breccia	LK006	45.2	-1	0.05	16.29	0.43	12.4	12.40	3.46	2.7	2.1	409	440	379.4	0.00	380.44	Potentially Acid Forming
701-22-077	Andesite Porphyry	LK006	51.8	4	0.04	2.04	0.52	1.16	1.16	0.36	4.2	2.5	23	32	35.5	0.11	31.50	Potentially Acid Forming
701-22-078	Andesite Porphyry	LK006	129.7	5	0.03	4.62	0.26	3.63	3.63	0.73	4.5	2.2	100	113	111.1	0.05	106.08	Potentially Acid Forming
701-22-079	Breccia	LK006	145.7	5	0.04	4.32	0.28	3.44	3.44	0.6	4	2.2	88	101	105.3	0.05	100.26	Potentially Acid Forming
701-22-080	Diorite Porphyry	LK006	165.86	5	0.04	4.27	0.28	3.37	3.37	0.62	4.7	2.1	95	106	103.1	0.05	98.12	Potentially Acid Forming
701-22-081	Tuff	LK006	191.35	-1	0.065	7.18	0.495	5.23	5.23	1.455	2.7	2.15	166.5	181.5	160.0	-0.01	161.04	Potentially Acid Forming
701-22-082	Pyroclastic	LK006	214.6	3	0.02	4.51	0.7	2.38	2.38	1.43	3.9	2.3	74	84	72.8	0.04	69.83	Potentially Acid Forming
701-22-083	Andesite Porphyry	L013	5	4	0.05	0.81	0.15	0.38	0.38	0.28	6.6	3.2	3	8	11.6	0.34	7.63	Potentially Acid Forming - Low Capacity
701-22-084	Andesite Porphyry	L013	11	6	0.06	1.82	0.48	0.04	0.04	1.3	7.3	5.7	0	4	1.2	4.90	-4.78	Non Acid Forming

Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m)	Acid Neutralising Capacity	Total Carbon	Total Sulfur	HCL Soluble Sulfur	Chromium Reducible Sulfur	Caculated Sulfide Sulfur	Calcuated Acid Insoluble Sulfate Sulfur	Paste pH	NAG pH	NAG (4.5)	NAG (7.0)	Calcuated Maximum Potential Acidity	ANC/MPA	Calcuated Net Acid Producing Potential	Acid Fromation Potential Classification
			(m)	(kg H2SO4/tonne)	(%C)	(%S)	(%S)	(%S)	(%S)	(%S)		(pH Units)	(kg H2SO4/tonne)	(kg H2SO4/tonne)	(kg H2SO4/tonne)	Unit Less	(kg H2SO4/tonne)	
701-22-085	Andesite Porphyry	L013	17.7	5	0.04	1.29	0.57	0.04	0.04	0.68	6.7	5.9	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-086	Andesite Porphyry	L013	23.4	5	0.06	1.16	0.4	0.04	0.04	0.72	6.3	5.8	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-087	Andesite Porphyry	L013	28.9	4	0.05	1.52	0.64	0.04	0.04	0.84	6.2	6.3	0	4	1.2	3.27	-2.78	Non Acid Forming
701-22-088	Andesite Porphyry	L013	34.9	3	0.04	2.25	0.88	0.05	0.05	1.32	5.6	5.4	0	6	1.5	1.96	-1.47	Non Acid Forming
701-22-089	Andesite Porphyry	L013	41.25	4	0.06	2.45	0.81	0.04	0.04	1.6	6.2	5.4	0	7	1.2	3.27	-2.78	Non Acid Forming
701-22-090	Andesite Porphyry	L013	47.7	4	0.05	0.98	0.34	0.04	0.04	0.6	6.2	5.9	0	1	1.2	3.27	-2.78	Non Acid Forming
701-22-091	Andesite Porphyry	L013	52.9	4	0.05	1.4	0.41	0.04	0.04	0.95	6.1	5.9	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-092	Andesite Porphyry	L013	58.8	4	0.11	0.97	0.35	0.04	0.04	0.58	4.6	5.5	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-093	Andesite Porphyry	L013	69	4	0.09	1.03	0.43	0.06	0.06	0.54	4.2	4.6	0	1	1.8	2.18	-2.16	Non Acid Forming
701-22-094	Hydrothermal Breccia	L013	75	0	0.04	3.96	1.46	0.04	0.04	2.46	5.1	4.6	0	13	1.2	0.00	1.22	Uncertain
701-22-095	Hydrothermal Breccia	L013	81.9	-2	0.03	4.3	1.59	0.04	0.04	2.67	4.7	4.3	0	9	1.2	-1.63	3.22	Potentially Acid Forming - Low Capacity
701-22-096	Hydrothermal Breccia	L013	86.55	0	0.04	4.72	1.58	0.04	0.04	3.1	5.2	4.5	0	13	1.2	0.00	1.22	Potentially Acid Forming - Low Capacity
701-22-097	Fault Breccia	L013	93.25	3	0.09	1.59	0.47	0.04	0.04	1.08	5.8	3.4	8	12	1.2	2.45	-1.78	Uncertain
701-22-098	Hydrothermal Breccia	L013	100.4	0	0.03	4.12	1.27	0.05	0.05	2.8	5.4	5.1	0	13	1.5	0.00	1.53	Uncertain
701-22-099	Andesite Porphyry	L013	127.55	3	0.08	2.11	0.2	1.8	1.80	0.11	4.2	2.3	34	43	55.1	0.05	52.08	Potentially Acid Forming
701-22-100	Andesite Porphyry	L013	177.05	2	0.03	5.26	0.2	3.87	3.87	1.19	4.8	2.2	109	121	118.4	0.02	116.42	Potentially Acid Forming
701-22-101	Andesite Porphyry	L013	199.75	2	0.055	5.285	0.44	4.09	4.09	0.755	3.8	2.3	109	120.5	125.2	0.02	123.15	Potentially Acid Forming
701-22-102	Fault Breccia	L223	121.75	-23	0.03	7.65	1.22	4.9	4.90	1.53	3	2.3	145	165	149.9	-0.15	172.94	Potentially Acid Forming
701-22-103	Andesite Porphyry	L223	131	-11	0.06	3.52	0.64	2.53	2.53	0.35	3.2	2.2	70	84	77.4	-0.14	88.42	Potentially Acid Forming
701-22-104	Andesite Porphyry	L223	137	13	0.3	0.38	0.13	0.19	0.19	0.06	7	4.9	0	8	5.8	2.24	-7.19	Non Acid Forming
701-22-105	Andesite Porphyry	L223	142.1	9	0.04	1.36	0.15	1.07	1.07	0.14	5	2.7	11	23	32.7	0.27	23.74	Potentially Acid Forming
701-22-106	Andesite Porphyry	L223	150	83	0.65	1.17	0.09	0.93	0.93	0.15	9.1	10.7	0	0	28.5	2.92	-54.54	Non Acid Forming
701-22-107	Andesite Porphyry	L223	156	84	0.73	0.78	0.1	0.57	0.57	0.11	8.1	11	0	0	17.4	4.82	-66.56	Non Acid Forming
701-22-108	Andesite Porphyry	L223	164.55	78	0.67	0.04	0.01		0.03	0	9.4	11.2	0	0	0.9	0.00	-77.08	Non Acid Forming
701-22-109	Andesite Porphyry	L223	170	86	0.87	0.03	0.02		0.01	0	9	11.3	0	0	0.3	0.00	-85.69	Non Acid Forming
701-22-110	Andesite Porphyry	L223	178.05	85	0.8	0.05	0.02		0.03	0	9.4	11.3	0	0	0.9	0.00	-84.08	Non Acid Forming
701-22-111	Andesite Porphyry	L223	184	155	1.84	0.12	0.03	0.08	0.08	0.01	8.8	10.9	0	0	2.4	63.32	-152.55	Acid Consuming
701-22-112	Andesite Porphyry	L223	191.95	106	1.23	0.08	0.03		0.05	0	9.5	11.1	0	0	1.5	0.00	-104.47	Acid Consuming
701-22-113	Andesite Porphyry	L223	198	109	1.32	0.12	0.03		0.09	0	9.1	11.3	0	0	2.8	0.00	-106.25	Acid Consuming
701-22-114	Andesite Porphyry	L223	206.5	117	1.44	0.04	0.03		0.01	0	8.5	11.4	0	0	0.3	0.00	-116.69	Acid Consuming
701-22-115	Andesite Porphyry	L223	212	130	1.44	0.34	0.06	0.25	0.25	0.03	8.6	11.3	0	0	7.7	16.99	-122.35	Acid Consuming
701-22-116	Andesite Porphyry	L223	220.05	95	0.92	0.63	0.12	0.43	0.43	0.08	8.8	11.3	0	0	13.2	7.22	-81.84	Non Acid Forming
701-22-117	Andesite Porphyry	L223	231.2	84	0.76	0.55	0.06	0.42	0.42	0.07	9.7	11.3	0	0	12.9	6.54	-71.15	Non Acid Forming
701-22-118	Andesite Porphyry	L223	240.4	23	0.84	1.7	0.17	1.29	1.29	0.24	8	4.8	0	12	39.5	0.58	16.47	Uncertain
701-22-119	Fault Breccia	L223	244	6	0.08	1.33	0.16	0.98	0.98	0.19	4.8	2.5	17	23	30.0	0.20	23.99	Potentially Acid Forming
701-22-120	Andesite Porphyry	L223	319.3	6	0.04	0.5	0.11	0.29	0.29	0.1	5.9	3.3	3	5	8.9	0.68	2.87	Potentially Acid Forming - Low Capacity
701-22-121	Andesite Porphyry	L223	325.4	5	0.03	0.58	0.07	0.42	0.42	0.09	5.3	2.9	7	11.5	12.9	0.39	7.85	Potentially Acid Forming - Low Capacity
701-22-122	Fault Breccia	L223	340.3	3	0.05	1.19	0.26	0.59	0.59	0.34	4.1	2.9	7	12	18.1	0.17	15.05	Potentially Acid Forming
701-22-123	Pyroclastic	L087	6	10	0.15	2.04	0.7	0.04	0.04	1.3	7.9	7.1	0	0	1.2	8.17	-8.78	Non Acid Forming
701-22-124	Pyroclastic	L087	16	6	0.08	0.25	0.11	0.04	0.04	0.1	7.6	6.8	0	1	1.2	4.90	-4.78	Non Acid Forming
701-22-125	Pyroclastic	L087	26	2	0.04	3.2	1.06	0.04	0.04	2.1	7.3	4.6	0	13	1.2	1.63	-0.78	Non Acid Forming
701-22-126	Pyroclastic	L087	36	1	0.02	2.22	0.57	0.04	0.04	1.61	6.8	4.5	0	9	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-127	Pyroclastic	L087	46	3	0.02	1.77	0.25	0.04	0.04	1.48	6.8	4.7	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-128	Andesite Porphyry	L087	56	2	0.02	3.06	0.92	0.04	0.04	2.1	7.2	4.5	0	11	1.2	1.63	-0.78	Uncertain
701-22-129	Fault Breccia	L087	66	2	0.03	2.23	0.68	0.04	0.04	1.51	7.3	4.7	0	5	1.2	1.63	-0.78	Non Acid Forming
701-22-130	Andesite Porphyry	L087	76	1	0.02	1.82	0.83	0.3	0.30	0.69	7.3	4.5	0	6	9.2	0.11	8.18	Potentially Acid Forming - Low Capacity
701-22-131	Andesite Porphyry	L087	86	1	0.03	2.49	0.81	0.04	0.04	1.64	7	4.5	0	6	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-132	Andesite Porphyry	L087	96	2	0.02	1.58	0.42	0.05	0.05	1.11	6.7	4.8	0	5	1.5	1.31	-0.47	Non Acid Forming
701-22-133	Andesite Porphyry	L087	106	3	0.08	0.97	0.22	0.04	0.04	0.71	6.8	5.9	0	0	1.2	2.45	-1.78	Non Acid Forming
701-22-134	Andesite Porphyry	L087	116	2	0.04	1.36	0.2	0.04	0.04	1.12	7.1	5.3	0	4	1.2	1.63	-0.78	Non Acid Forming
701-22-135	Andesite Porphyry	L087	126	3	0.02	1.93	0.3	0.04	0.04	1.59	6.7	5	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-136	Andesite Porphyry	L087	134	5	0.03	0.1	0.04		0.06	0	7	6.6	0	1	1.8	0.00	-3.16	Non Acid Forming
701-22-137	Andesite Porphyry	L087	144	-4	0.02	2.39	0.58	0.71	0.71	1.1	2.8	2.7	16	22	21.7	-0.18	25.73	Potentially Acid Forming
701-22-138	Andesite Porphyry	L087	158	3	0.02	0.75	0.13	0.53	0.53	0.09	4.2	2.7	11	15	16.2	0.18	13.22	Potentially Acid Forming
701-22-139	Andesite Porphyry	L087	170	3	0.04	0.8	0.09	0.6	0.60	0.11	4.7	2.6	12	17	18.4	0.16	15.36	Potentially Acid Forming
701-22-140	Andesite Porphyry	L087	184	1	0.04	1.24	0.12	0.94	0.94	0.18	3.8	2.4	24	30	28.8	0.03	27.76	Potentially Acid Forming
701-22-141	Andesite Porphyry	L087	200	3.5	0.04	1.25	0.095	1.07	1.07	0.085	4.3	2.5	19.5	24.5	32.7	0.11	29.24	Potentially Acid Forming
701-22-142	Andesite Porphyry	L087	210	5	0.02	0.1	0.05		0.05	0	5.9	4.9	0	4	1.5	0.00	-3.47	Non Acid Forming
701-22-143	Andesite Porphyry	L087	216	-1	0.04	2.5	0.4	1.52	1.52	0.58	3	2.4	38	45	46.5	-0.02	47.51	Potentially Acid Forming
701-22-144	Andesite Porphyry	L087	252	-2	0.02	11.56	1.39	5.58	5.58	4.59	3	2.4	178	193	170.7	-0.01	172.75	Potentially Acid Forming
701-22-145	Andesite Porphyry	L087	262	-7	0.02	26.63	1.19	18.95	18.95	6.49	2.7	2.3	493	533	579.9	-0.01	586.87	Potentially Acid Forming
701-22-146	Andesite Porphyry	L087	272	-1	0.01	9.82	0.7	4.84	4.84	4.28	3.1	2.4	149	162	148.1	-0.01	149.10	Potentially Acid Forming
701-22-147	Andesite Porphyry	L087	292	2	0.03	3.84	0.3	2.81	2.81	0.73	3.4	2.3	74	81	86.0	0.02	83.99	Potentially Acid Forming
701-22-148	Hydrothermal Breccia	L087	330	-2	0.01	13.32	1.17	7.94	7.94	4.21	3.3	2.3	216	236	243.0	-0.01	244.96	Potentially Acid Forming
701-22-149	Andesite Porphyry	L087	349.7	0	0.04	2.03	0.25	1.69	1.69	0.09	3.3	2.3	35	42	51.7	0.00	51.71	Potentially Acid Forming
701-22-150	Andesite Porphyry	L087	340	-2	0.02	5.75	0.34	4	4.00	1.41	3.2	2.2	133	143	122.4	-0.02	124.40	Potentially Acid Forming

APPENDIX C

Multi-Element Analysis Results

Knight Piésold
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Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**0.07**	**82000**	**1.5**	**10**	**500**	**2.6**	**0.048**	**41000**	**0.11**	**68**	**20**	**100**	**3**	**50**	**6**	**3.8**	**2.1**	**4.1**	**18**	**7.7**	**1.8**	**5.3**	**0.05**	**1.4**	**0.049**	**21000**	**32**	**20**	**0.51**	**23000**	**950**
Andesite Porphyry	LS001	25	701-22-001	0.685	103517	4.1	10	255.25	2.015	0.155	966.5	0.2	65.425	1.3	12.5	2.59	409.05	2.41	1.12	1.02	1.09	15.865	3.23	1.03	1.785	0.01	0.435	0.5825	38446.5	37.265	5.3	0.169	3914	163.5
Andesite Porphyry	LS001	59	701-22-002	0.11	77727	1.6	13	426.1	1.96	0.33	2481	0.75	65.36	12.6	10	3.68	20.6	2.51	1.53	1.02	5.11	16.56	2.94	1.05	1.56	0.01	0.52	0.105	30829	37.9	12.7	0.243	6818	9922
Andesite Porphyry	LS001	65.5	701-22-003	0.86	81128	10.7	10	381.5	2.5	6.78	1432	0.68	46.42	17.3	23	5.8	756.1	4.4	2.85	1.04	5.77	32.57	4.02	0.9	1.17	0.01	0.94	1.456	37121	27.29	2.2	0.406	2838	291
Andesite Porphyry	LS001	89.25	701-22-004	1.16	79579	12.4	10	542.1	1.16	7.05	1079	0.24	69.4	11.8	12	3.18	555.8	5.02	2.86	1.52	4.51	26.34	5.13	1	1.46	0.03	1.05	1.132	35174	37.25	4.9	0.368	3051	133
Andesite Porphyry	LS001	122	701-22-005	0.54	90610	3.7	10	339.8	1.9	0.74	383	0.12	71.18	4.3	12	3.18	45.6	2.68	1.5	1.01	1.58	19.58	3.19	1.18	1.55	0.01	0.65	0.676	35318	38.73	13.6	0.212	7822	1142
Dyke	LS001	136.75	701-22-006	0.65	87705	7.1	10	448.9	0.68	6.94	819	0.04	54.06	11.1	14	1.9	127.9	4.07	2.23	1.2	3.57	28.31	4.15	0.88	1.63	0.02	0.78	0.663	39963	27.27	2.5	0.264	2892	82
Dyke	LS001	185	701-22-007	1.12	58688	789.6	10	584	0.28	10.93	645	0.13	47.41	22.8	20	0.12	817.9	1.9	0.69	1.48	15.86	18.92	3.73	1.83	0.95	0.18	0.26	0.405	2307	21.06	35.3	0.106	136	41
Dyke	LS001	221.65	701-22-008	0.22	80964	37.3	10	452.1	0.16	6.33	967	0.37	29.96	15.6	26	0.1	634.9	0.95	0.3	0.69	4.85	30.12	2.02	0.89	1.06	0.02	0.13	0.092	7904	16.11	4.9	0.058	122	27
Andesite Porphyry	LS001	249.15	701-22-009	0.13	91995	33.9	10	572.7	0.6	0.99	817	0.13	55.84	5.2	13	1.42	170.1	1.2	0.49	0.94	1.31	24.4	2.52	1.26	1.15	0.02	0.18	0.156	37872	30.23	2.9	0.073	2139	54
Andesite Porphyry	LS001	290.75	701-22-010	0.15	86896	9.4	10	393	0.5	3.17	578	0.12	37.29	10.9	19	0.93	383.7	0.79	0.4	0.67	2.93	24.97	1.65	0.86	0.88	0.01	0.13	0.33	31259	20.77	4.3	0.076	1507	72
Andesite Porphyry	LS001	304.05	701-22-011	1	80277	12.5	10	384.8	0.4	16.79	653	0.1	43.59	19.3	26	0.19	1365.5	0.94	0.43	0.77	7.28	35.11	2.01	1.33	1.44	0.04	0.16	0.21	7861	24.18	25.1	0.093	176	42
Andesite Porphyry	LS001	368.85	701-22-012	0.82	86945	4.9	10	607.5	1.27	5.16	618	0.8	76.58	14.7	19	2.36	306	7.7	3.86	2.36	5.16	26.73	7.7	1.07	1.69	0.03	1.49	0.426	32394	42.52	6.5	0.371	2952	51
Andesite Porphyry	LS001	395	701-22-013	0.14	94738	8.4	10	344.8	1.39	2.21	556	0.05	73.5	9.6	17	1.53	922.7	5.67	2.9	1.59	2.24	19.82	5.6	1.42	2.04	0.01	1.1	0.729	28083	41.01	30.6	0.316	2593	93
Andesite Porphyry	LS001	411.1	701-22-014	0.41	67660	90.4	10	351.1	0.16	2.93	531	0.62	71.86	21	18	0.12	5916	0.8	0.26	0.97	7.8	16.91	1.95	2.49	0.21	0.02	0.1	0.205	4843	44.8	7.2	0.037	120	30
Andesite Porphyry	LS001	423.5	701-22-015	0.09	61701	42.4	10	449.4	0.17	1.13	593	0.08	46.46	21.3	17	0.11	815.9	0.24	0.09	0.63	9.39	4.4	0.98	1.23	0.12	0.02	0.03	0.024	12052	26.4	4.7	0.014	106	30
Andesite Porphyry	LS002	94.3	701-22-016	0.17	90445	2.9	10	1084.9	0.78	0.19	456	0.03	44.35	13.1	14	1.69	597.7	1.26	0.68	0.53	1.83	16.27	1.61	1.62	0.51	0.02	0.25	0.034	27655	28.24	3	0.081	2688	45
Breccia	LS002	104.13	701-22-017	0.25	89815	16.5	10	917.2	0.88	0.43	388	0.03	45.24	16.6	12	2.32	647.2	1.37	0.74	0.55	2.18	16.66	1.69	1.58	0.3	0.02	0.26	0.104	28772	29.07	3.1	0.09	3079	61
Andesite Porphyry	LS002	128.6	701-22-018	0.12	87842	8.2	10	986.7	0.57	0.39	356	0.19	53.64	11.7	18	1.84	437	1.99	0.95	0.93	2.06	16.66	2.59	1.52	0.33	0.02	0.36	0.035	30097	30.18	3.3	0.114	2684	33
Andesite Porphyry	LS002	148.4	701-22-019	0.16	86844	20.3	10	750	0.98	0.3	283	0.05	61.46	11.4	15	2.13	431.5	2.26	1.2	0.97	2.62	16.33	2.73	1.37	0.53	0.01	0.42	0.068	34562	35.94	2.7	0.145	2937	44
Diorite Porphyry	LS002	355.8	701-22-020	0.17	69759	1.3	10	1144.9	1.1	0.06	3774	0.2	50.47	12.6	18	7.93	890.5	1.78	0.9	0.88	6.69	15.03	2.48	0.79	0.12	0.01	0.33	0.029	22713	26.97	3.7	0.104	7768	2062
Andesite Porphyry	LS002	373	701-22-021	1.51	86132	14.9	10	301.2	1.46	1.41	924.5	1.375	68.265	20.6	16.5	12.77	1318.95	3.29	1.795	1.335	7.23	19.12	4.125	1.285	0.15	0.025	0.625	0.4145	21548	37.94	15.85	0.1955	4472.5	4588
Andesite Porphyry	LS002	422.5	701-22-022	0.31	89437	5.5	10	461.3	0.91	0.45	386	0.58	66.88	15.7	11	3.58	592.4	2.67	1.39	1.12	2.48	20.64	3.52	1.73	0.31	0.03	0.52	0.159	26166	35.68	29.8	0.177	3004	145
Andesite Porphyry	LS002	435.3	701-22-023	0.21	90678	3.9	10	536.6	1.12	0.43	502	0.78	68.05	16.1	15	3.51	396.8	2.63	1.36	1.3	2.98	18.9	3.49	1.51	0.71	0.02	0.49	0.066	26125	36.93	16.7	0.167	2823	1297
Andesite Porphyry	LS002	448.85	701-22-024	1.81	85770	47.9	10	646.5	1.25	0.44	563	1.81	65.33	22.2	11	5.66	668	3.57	2.01	1.18	3.62	19.45	3.72	1.21	0.3	0.07	0.69	0.701	35515	36.44	6.3	0.224	3955	65
Andesite Porphyry	LS002	472.85	701-22-025	0.24	91866	6.1	10	1129.3	0.93	0.11	540	1.84	86.89	13.5	20	2.43	961.2	5.66	3.4	1.7	1.18	17.29	5.4	1.88	0.47	0.01	1.16	0.062	20377	47.58	15.8	0.453	2374	41
Andesite Porphyry	LS003	21.3	701-22-026	0.46	78451	15.5	10	403.7	0.81	2.46	1160	0.03	42.38	0.6	18	1.17	273.8	0.98	0.52	0.8	3.74	20.09	2.05	0.95	1.6	0.01	0.19	1.252	32775	22.55	0.5	0.103	2199	490
Andesite Porphyry	LS003	70	701-22-027	0.18	85064	1.6	10	721.9	0.94	1.37	757	0.76	55.69	14	20	1.49	36.4	1.96	1.15	0.87	3.1	17.82	6.71	1.12	1.64	0.02	0.39	0.345	38759	31.12	2.7	0.193	3307	119
Andesite Porphyry	LS003	74.3	701-22-028	0.17	63156	2.7	10	345.7	1.24	1.23	307	2.05	33.21	4.9	16	0.89	44.3	2.06	0.84	0.66	1.04	12.34	1.99	0.96	1.33	0.04	0.28	0.392	21720	16.37	2.8	0.117	1687	93
Andesite Porphyry	LS003	97	701-22-029	0.49	91262	20.3	10	452.5	1.14	2.64	582	0.13	27.5	12.3	13	3.63	393.5	7.4	1.01	0.61	2.94	18.68	1.55	1.13	1.79	0.04	0.33	0.993	34180	13.74	1.8	0.162	2469	142
Andesite Porphyry	LS003	115.5	701-22-030	0.59	71142	16	10	235.1	0.66	5.33	729	0.04	20.58	16.1	16	1.12	319.6	1.2	0.66	0.51	7.07	24.06	1.63	0.54	1.11	0.04	0.22	0.748	16239	11.08	0.7	0.129	798	74
Andesite Porphyry	LS003	131.7	701-22-031	0.22	88979	5.9	10	197.1	1.68	1.28	403	0.15	24.61	11.3	19	1.72	238.1	2.05	1.1	0.81	1.65	18.02	2.77	1.57	1.96	0.01	0.36	4.726	26502	12.65	3.2	0.178	1935	150
Breccia	LS003	146.75	701-22-032	0.68	80243	31.1	10	342.5	0.96	1.55	761	0.58	41.1	15.9	39	3.19	419.4	1.63	0.96	0.67	3.78	18.74	2.04	1.04	1.73	0.03	0.32	0.915	37060	21.45	0.5	0.186	2432	205
Diorite Porphyry	LS003	170.02	701-22-033	0.58	81158	15.5	10	566.2	0.85	2.09	920	0.48	39.13	11.2	13	3.45	317	1.56	0.91	0.7	3.91	23.93	2	0.8	1.44	0.01	0.29	0.459	35907	22.01	0.5	0.154	2004	135
Diorite Porphyry	LS003	182.4	701-22-034	0.46	90464	13.5	10	637.5	1.58	1.98	595	0.03	49.8	10.8	11	2.77	291.6	3.02	1.1	1.12	3.32	18.82	4.23	1.21	1.7	0.01	0.45	0.791	29319	25.29	2.7	0.173	1985	200
Diorite Porphyry	LS003	274.25	701-22-035	0.3	70308	31.6	10	351	0.21	3.32	614	0.81	41.33	16.4	67	0.42	709.3	1.14	0.59	1.03	8.2	7.4	2.52	0.68	1.17	0.02	0.19	0.083	17222	22.69	1.5	0.123	191	54
Diorite Porphyry	LS003	298.3	701-22-036	0.57	80956	14.3	10	478.4	0.64	9.53	1025	0.06	30.91	18.5	18	1.49	271.3	1.67	0.88	0.8	7.71	38.25	2.67	0.64	1.54	0.03	0.31	0.515	31247	16.61	0.7	0.151	1338	53
Diorite Porphyry	LS003	305	701-22-037	0.23	86129	7.2	10	509.5	0.54	4.72	1083	0.02	29.54	14.7	17	1.56	83.1	1.62	1.04	0.74	3.74	31.02	2.2	0.9	1.54	0.01	0.32	0.638	35109	14.86	0.6	0.169	1493	53
Breccia	LS003	324.8	701-22-038	0.39	74621	6.4	10	319	0.52	5.35	360	0.08	30.19	21.3	22	1.29	440.4	1.6	0.87	0.71	7.42	24.56	1.84	0.67	0.94	0.01	0.31	0.311	33090	18.65	1.1	0.134	1143	127
Andesite Porphyry	LS003	330.2	701-22-039	0.3	89832	4.7	10	374.2	0.68	0.88	548	0.09	46.5	20.4	26	1.28	114.3	2.77	1.42	0.76	2.82	18.94	2.73	1.02	2.23	0.02	0.5	0.623	34248	27.25	2.1	0.208	1806	78
Diorite Porphyry	LS003	342.8	701-22-040	0.11	78361	6.3	10	527.3	0.53	1.32	17724	0.07	30.53	17.3	14	1.12	105.8	1.26	0.63	0.8	3.53	25.87	2.21	0.81	1.39	0.01	0.23	0.164	31426	16.28	0.9	0.126	1843	70
Feldspar Porphyry	LS003	353.35	701-22-041	0.165	81866	8	10	311.7	0.32	1.68	814.5	0.14	45.965	12.85	13.5	0.39	60.55	0.965	0.42	0.785	5.405	12.135	2.285	0.755	1.08	0.01	0.15	0.0625	10531	24.835	1.15	0.09	517	47
Andesite Porphyry	LS003	377.5	701-22-042	0.13	70220	18.3	10	287.8	0.21	1.02	552	0.48	45.29	14	10	0.34	65.8	0.69	0.23	0.69	4.83	8.91	1.59	0.59	0.47	0.02	0.09	0.03	13445	26.46	1.4	0.036	139	38
Porphyry	LS003	394.75	701-22-043	0.06	94987	2.5	10	591.7	0.89	0.47	300	0.05	23.35	3.7	21	0.79	448	1.3	0.84	0.41	0.75	17.1	1.37	1.07	1.83	0.01	0.27	0.129	28652	13.93	3.4	0.167	977	56
Porphyry	LS003	410.9	701-22-044	0.07	99172	1.9	10	441.8	0.61	0.91	396	0.24	22.11	19.4	23	0.29	102.9	1.52	0.92	0.35	0.71	17.18	1.28	0.97	1.38	0.01	0.31	0.186	26211	15.1	6.1	0.151	384	42
Breccia	LS003	440.8	701-22-045	0.58	56485	21.3	10	192.8	0.25	2.97	339	0.05	36.22	13	27	0.19	666.2	0.88	0.42	0.58	6.73	8.08	1.77	0.87	0.32	0.02	0.15	0.422	5616	19.48	4.1	0.061	117	40
Andesite Porphyry	LS004	30.21	701-22-046	1.64	74128	36.3	13	584.9	2.12	0.75	2409	7.73	51.06	23.1	11	3	191.3	1.67	1.23	0.83	5.57	19.07	2.4	0.84	1.14	0.01	0.36	3.274	35612	28.6	2.7	0.18	6077	22548
Andesite Porphyry	LS004	50.21	701-22-047	0.12	77670	4.5	12	245.6	1.48	0.06	23035	0.29	52.53	9.7	11	3.16	10.9	2.03	1.22	0.83	2.75	16.55	2.35	0.83	1.33	0.01	0.39	0.035	36106	29.69	3.7	0.19	18699	5202
Andesite Porphyry	LS004	69.25	701-22-048	0.26	81970	12.2	17	112.3	2.07	0.05	2139	4.94	53.42	10.4	19	5.4	15	1.47	0.99	0.77	3.84	20.51	2.1	1.02	1.51	0.01	0.32	0.697	32629	29.57	5	0.168	22825	23584
Andesite Porphyry	LS004	110.45	701-22-049	1.11	88013	24.8	10	226.4	1.79	1.44	1118	0.16	36.48	11.6	16	5.49	300.6	2.79	1.68	0.97	4.86	21.73	3.24	0.79	1.91	0.02	0.6	1.992	39809	19.67	1.3	0.234	3257	398
Andesite Porphyry	LS004	134.45	701-22-050	2.33	81532	46.6	10	275.3	0.25	2.45	727	0.16	40.53	18.3	56	0.27	612.9	1.3	0.74	0.97	9.07	19.12	2.76	1.22	1.7	0.03	0.25	0.548	795	21.79	91.4	0.156	276	1372
Diorite Porphyry	LS005	28.4	701-22-051	0.53	74758	12.1	12	1024.8	1.28	1.24	27866	1.94	55.18	11.6	8	1.94	121.7	2.05	1.23	0.92	3.87	16.16	2.68	0.54	1.5	0.01	0.41	1.021	32133	32.13	7	0.186	13348	3669
Diorite Porphyry	LS005	50.1	701-22-052	0.12	75404	3.8	10	856.6	1.14	0.11	29505	0.17	71	9.4	12	1.83	18.8	2.49	1.43	1.12	2.85	15.41	3.02	0.89	1.6	0.01	0.49	0.056	32950	40.09	8.7	0.234	17656	1747
Breccia	LS005	72.5	701-22-053	1.19	79419	5.8	11	378.5	1.25	2.19	2929	4.32	68.75	12.4	9	1.78	215.1	2.45	1.41	1.3	5.2	19.45	3.24	0.97	1.92	0.06	0.49	0.224	32405	37.22	9.7	0.196	10517	20786
Breccia	LS005	133.9	701-22-054	1.45	77268	44.6	10	363.2	2.51	1.95	1131	1.58	66.32	17	26	4.84	325.5	3.64	2.47	1.1	6.41	16.84	3.43	0.77	1.47	0.04	0.82	0.259	34556	36.34	3	0.318	4717	401
Diorite Porphyry	LS005	141.4	701-22-055	0.18	84906	6.2	10	581.1	1.81	0.2	2575	0.07	71.61	9.8	11	2.04	11	2.75	1.6	1.15	3.4	18.09	3.38	0.97	1.89	0.01	0.55	0.043	34304	40.77	6.3	0.251	7312	4184
Andesite Porphyry	LS006	34.3	701-22-056	0.17	82449	4	10	540.3	0.78	0.7	205	0.04	58.01	8.6	8	2.6	165.8	1.32	0.84	0.52	1.99	16.95	1.51	1.12	1.87	0.01	0.39	0.123	37994	34.51	2.1	0.156	3843	129
Andesite Porphyry	LS006	52.3	701-22-057	0.21	102918	39.7	10	1364.1	0.9	0.42	287	1.04	86.79	61.4	12	2.85	45.3	3.8	2.6	1.35	3.04	17.11	4.15	0.91	1.7	0.01	0.84	0.096	26329	49.58	1.6	0.486	2726	50
Andesite Porphyry	LS006	70.3	701-22-058	0.15	109627	4.8	10	1041.3	1.36	0.42	338	0.32	90.64	24.1	19	2.58	31.7	3.15	1.96	1.72	1.67	16.63	4.38	0.98	1.92	0.01	0.65	0.049	24399	49.66	1.6	0.335	2527	46
Andesite Porphyry	LS006	127.6	701-22-059	0.36	86504	5.7	10	282.2	1.54	0.13	1201	5.53	70.24	10	10	7.26	17.4	2.08	1.36	0.98	3.82	18.57	2.76	1.14	1.7	0.05	0.45	0.938	35570	40.71	3.6	0.21	4326	5554
Breccia	LS006	140.4	701-22-060	0.7	87385	15.9	10	652.6	1.7	1.55	919	2.75	81.64	12.8	12	11.86	87.9	2.99	1.94	1.34	3.4	20.54	4.08	0.93	1.86	0.08	2.05	1.017	38085	45.89	2.6	0.269	3721	160
Porphyry	LK002	16.05	701-22-061	0.535	76271	6.8	10	397.85	0.765	3.435	843.5	0.04	52.005	0.6	10	0.855	163.15	1.05	0.54	0.725	3.345	18.5	1.875	1.005	1.54	0.01	0.18	0.415	37111.5	28.925	0.15	0.1055	2028	122.5
Andesite Porphyry	LK002	36.3	701-22-062	0.06	88566	10.2	10	252.3	0.84	1.62	674	0.02	55.75	3.5	13	1.05	87.4	1.16	0.52	0.9	2.38	17.77	2.32	1.14	1.55	0.01	0.18	0.552	37380	31.58	0.4	0.098	1882	118
Breccia	LK002	113.6	701-22-063	0.82	69550	86.5	10	204.5	0.3	3.07	803	0.05	44.72	15.2	40	0.18	1982.7	1.07	0.52	0.78	7.6	13.68	2.18	1.7	1.11	0.06	0.18	0.172	5571	24.22	2.1	0.111	173	44
Porphyry	LK002	133.3	701-22-064	0.46	80467	21.9	10	249.2	0.2	2.21	900	0.05	42.44	9.7	30	0.08	562.5	0.78	0.4	0.76	4.43	14.23	1.97	1.3	0.86	0.01	0.11	0.185	23261	22.83	0.3	0.068	113	41
Porphyry	LK002	167.3	701-22-065	0.38	73634	14.3	10	418.2	0.09	1.86	819	0.04	26.44	12.3	18	0.06	456.4	0.48	0.19	0.55	6.53	9.79	1.47	0.85	0.65	0.01	0.07	0.193	19430	13.91	0.7	0.038	107	42
Andesite Porphyry	LK003	40.3	701-22-066	0.1	116699	4.7	10	367.7	2.05	0.13	317	10.19	54.15	9.2	28	3.11	55	1.77	1.04	0.8	1.15	19.79	2.31	1.44	1.52	0.03	0.35	0.713	34470	31.68	4.4	0.163	2308	188
Breccia	LK003	54.9	701-22-067	1.29	72160	24.6	10	213	0.99	2.28	182	3.21	69.5	11.5	41	6.08	584.7	1.68	1.01	0.76	3.27	16.06	2.49	1.59	1.43	0.08	0.31	1.104	28001	42.14	2.5	0.173	2433	175
Breccia	LK003	108.6	701-22-068	2.37	81507	29.7	10	421.5	1.06	4.24	397	1.36	55.01	17.9	45	5.74	410.8	1.64	0.93	0.77	5.22	19.2	2.35	1.09	1.35	0.28	0.29	0.588	29777	30.72	1.8	0.152	1980	128
Pyroclastic	LK003	128.7	701-22-069	0.79	79365	18.7	10	382.4	1.31	1.68	440	6.07	58.11	16	83	10.97	147.7	1.84	0.98	0.85	2.68	17.61	2.83	1.44	1.36	0.48	0.35	0.791	32554	30.62	1.8	0.171	3026	219
Tuff	LK003	145.6	701-22-070	0.93	79481	13.4	10	367.1	1.28	1.04	262	1.87	47.78	12.4	49	7.08	181.2	1.38	1.05	0.62	2.64	17.03	2.02	1.23	1.7	0.4	0.3	0.309	32478	25.81	2.7	0.17	2891	188
Hornblende Porphyry	LK004	51.23	701-22-071	0.06	81758	2.2	14	588.2	1.22	0.13	36192	0.16	65.85	8.8	9	1.69	19.9	2.31	1.39	1.05	2.76	16	2.98	1.12	1.97	0.01	0.48	0.026	25548	36.78	8.6	0.221	10769	817
Breccia	LK004	71.63	701-22-072	0.17	78189	4.6	17	1384.9	1.21	0.28	37025	0.36	71.01	10.7	12	2.26	67	2.32	1.36	1.07	2.98	15.82	3.06	1.03	1.61	0.01	0.46	0.12	25453	40.22	6.8	0.209	17165	2436
Breccia	LK004	81.52	701-22-073	0.17	78084	14.8	15	176.6	1.38	0.11	25684	0.65	53.61	9	12	3.11	21.2	2.15	1.26	0.97	3.06	16.47	2.48	0.82	1.32	0.01	0.42	0.092	31413	30.17	8.1	0.211	20189	10476
Andesite Porphyry	LK004	104.71	701-22-074	1.94	77045	108	10	246.5	2.45	1.79	4535	9.84	59.5	13.1	13	8.62	322.1	1.7	1.02	0.92	5.43	18.97	2.64	0.97	1.42	0.06	0.37	3.2	33243	32.91	4.6	0.162	6675	13361
Diorite Porphyry	LK004	137.51	701-22-075	2.72	65841	78.6	10	380.9	1.32	2.03	1492	0.39	58.9	4.6	19	5.72	1075.6	3.45	2.23	1.05	3.56	14.42	3.34	0.66	1.57	0.06	0.74	0.861	28869	34	1.7	0.322	2792	659
Breccia	LK006	45.2	701-22-076	1.25	80115	249.6	10	220.3	2.15	0.55	780	0.2	66.08	56.9	267	7.17	230.3	4.59	1.84	1.61	13.94	15.29	5.48	0.75	1.82	0.01	0.76	1.014	25941	33.94	4.4	0.211	2624	227
Andesite Porphyry	LK006	51.8	701-22-077	0.22	104651	7.7	10	115	1.73	0.18	586	4.65	51.71	8.4	39	2.15	101.4	2.8	1.49	1.01	1.71	17.78	3.26	1.54	2.16	0.05	0.52	1.008	29624	28.66	8.4	0.229	3505	282
Andesite Porphyry	LK006	129.7	701-22-078	1.03	83124	132.5	10	427.9	0.86	2.78	1070	0.14	62.18	14.1	35	3.36	307.1	2.68	1.42	1.18	4.07	21.78	4.13	1.2	2.1	0.53	0.49	0.354	33556	31.94	2	0.232	2369	173
Breccia	LK006	145.7	701-22-079	1.42	77515	40.1	10	316	0.64	5.67	664	0.37	57.02	16.4	85	4.54	471	2.31	1.35	1.07	3.69	36.4	3.44	1.18	1.98	0.23	0.42	0.437	28330	30.56	6.6	0.238	2353	77
Diorite Porphyry	LK006	165.86	701-22-080	0.52	85717	16.5	10	432.8	0.3	0.96	713	0.15	20.95	11.5	16	1.19	76.2	0.87	0.44	0.59	3.67	22.67	1.87	0.79	0.97	0.02	0.14	0.194	24680	11.09	1.5	0.078	1120	74

Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**0.07**	**82000**	**1.5**	**10**	**500**	**2.6**	**0.048**	**41000**	**0.11**	**68**	**20**	**100**	**3**	**50**	**6**	**3.8**	**2.1**	**4.1**	**18**	**7.7**	**1.8**	**5.3**	**0.05**	**1.4**	**0.049**	**21000**	**32**	**20**	**0.51**	**23000**	**950**
Tuff	LK006	191.35	701-22-081	0.755	74508.5	48.55	10	300.9	0.755	3.81	344	0.03	53.315	22.85	92	8.42	511.9	1.26	0.79	0.735	6.17	19.205	2.635	1.14	1.475	0.165	0.245	0.189	23433.5	27.82	2.7	0.143	1960.5	43.5
Pyroclastic	LK006	214.6	701-22-082	0.34	74022	37.7	10	302.9	0.51	1.15	682	0.08	52.45	6.6	22	0.88	166.3	1.07	0.61	0.77	3.21	15.3	2.15	1.04	1.51	0.01	0.19	0.076	20608	29.1	2.6	0.152	683	98
Andesite Porphyry	L013	5	701-22-083	0.45	103191	5	10	356.1	1.15	0.54	500	0.02	60.51	1.3	10	3.48	786.3	0.92	0.48	0.49	1.07	17.42	1.74	1.08	0.93	0.02	0.17	0.135	19976	40.68	2.3	0.079	2226	29
Andesite Porphyry	L013	11	701-22-084	0.3	103902	8.3	10	1591.3	1	0.09	606	0.03	45.83	0.7	17	1.62	647.2	1.31	0.66	0.67	6.6	17.59	2.13	1.06	0.47	0.03	0.24	0.3	24954	29.29	1.8	0.075	1651	46
Andesite Porphyry	L013	17.7	701-22-085	0.23	92568	13.5	10	559.9	0.76	0.18	335	0.02	44.75	0.3	11	1.84	222.8	0.77	0.37	0.63	2.37	17.14	1.15	1.54	0.9	0.01	0.14	0.091	31004	32.92	2.9	0.057	2788	42
Andesite Porphyry	L013	23.4	701-22-086	0.22	89426	3.6	10	555.7	0.95	0.25	362	0.02	83.58	1.2	14	1.84	157.1	0.82	0.34	0.68	2.71	17.02	1.71	1.61	0.45	0.01	0.14	0.137	29273	63.17	2.4	0.051	2974	60
Andesite Porphyry	L013	28.9	701-22-087	0.26	97282	2.3	10	417.9	0.8	0.31	298	0.03	62.22	0.8	16	1.89	151.2	0.85	0.39	0.52	0.82	16.28	1.41	1.45	0.3	0.01	0.15	0.134	30891	35.17	2.9	0.055	2725	49
Andesite Porphyry	L013	34.9	701-22-088	0.21	92565	7.1	10	884.6	0.71	0.23	433	0.03	51.47	0.5	16	1.82	214.5	1.55	0.81	0.5	1.84	18.58	1.72	1.58	0.36	0.01	0.3	0.406	33222	36.9	4.8	0.088	1733	63
Andesite Porphyry	L013	41.25	701-22-089	0.15	100724	5.4	10	901.4	0.66	0.43	471	0.02	38.26	0.6	20	1.62	260.6	1.6	0.88	0.5	1.3	17.83	1.7	1.57	0.37	0.01	0.3	0.359	37270	25.96	3.5	0.095	2239	53
Andesite Porphyry	L013	47.7	701-22-090	0.52	90853	33.4	10	278.4	0.69	1.45	395	0.02	39.74	0.6	28	2.04	409.3	1.29	0.63	0.5	2.86	19.33	1.6	1.97	0.55	0.01	0.23	0.422	28578	23.82	4.3	0.074	2700	57
Andesite Porphyry	L013	52.9	701-22-091	0.17	94139	5.2	10	741.2	0.6	0.29	363	0.02	41.61	0.8	16	1.51	306.4	1.22	0.6	0.6	1.25	16.79	1.76	1.49	0.33	0.01	0.22	0.241	24390	26.07	3	0.101	2005	47
Andesite Porphyry	L013	58.8	701-22-092	1.24	84187	12.8	10	414.7	0.89	1.57	367	0.02	47.01	0.6	18	2.74	291.3	1.17	0.65	0.54	3.7	18.6	1.58	1.78	1.02	0.01	0.22	0.295	33588	29.22	2.5	0.094	3482	60
Andesite Porphyry	L013	69	701-22-093	0.27	76378	8.6	10	920	0.84	0.22	283	0.02	43.76	0.8	14	2.1	299.1	1.7	0.93	0.58	3.77	16.54	1.81	1.77	0.37	0.01	0.33	0.212	33802	27.76	2	0.092	3481	94
Hydrothermal Breccia	L013	75	701-22-094	2.59	67415	14.8	10	993.4	0.3	1.12	986	0.02	88.89	0.3	22	0.08	62.6	1.6	0.61	1.64	3.7	8.65	3.86	1.16	1.03	0.04	0.26	0.031	19072	50.74	0.7	0.103	226	56
Hydrothermal Breccia	L013	81.9	701-22-095	6.22	63052	27.1	10	891.5	0.2	0.95	1046	0.02	82.64	0.6	28	0.09	117.4	1.31	0.43	1.2	7.25	16.47	2.78	1.51	0.36	0.08	0.19	0.117	20356	44.79	1.3	0.047	99	47
Hydrothermal Breccia	L013	86.55	701-22-096	4.05	76280	14.9	10	668.4	0.09	1.44	1108	0.03	94.96	1.3	37	0.13	30.9	1.1	0.41	1.04	2.79	12.96	2.23	1.35	0.61	0.01	0.17	0.055	21447	52.41	0.9	0.058	109	61
Fault Breccia	L013	93.25	701-22-097	0.31	63817	53.3	10	708.2	0.29	5.12	972	0.02	89.91	0.4	18	0.22	120.1	2.01	0.45	2.21	8.87	35.91	5.23	2.19	0.61	0.02	0.22	0.262	10461	48.17	1.8	0.051	250	43
Hydrothermal Breccia	L013	100.4	701-22-098	8.94	71032	234.9	10	996.5	0.12	2.17	780	0.02	108.5	0.4	30	0.07	41.4	2.99	0.7	1.84	11.02	24.61	5.16	3.69	0.35	0.6	0.41	0.105	21136	65.97	0.7	0.05	108	35
Andesite Porphyry	L013	127.55	701-22-099	0.13	92005	4	10	608.4	1.26	0.33	664	0.06	60.72	15.3	14	1.37	672.2	2.51	1.14	1.2	2.59	16.54	3.62	1.57	0.77	0.01	0.43	0.18	27989	35.13	2.4	0.151	2656	42
Andesite Porphyry	L013	177.05	701-22-100	0.13	77104	9.6	10	299.5	0.31	0.46	569	0.03	62.95	9.7	33	0.23	798.8	0.59	0.25	0.63	4.72	7.95	1.32	1.6	0.55	0.01	0.1	0.027	12100	37.92	2.4	0.044	427	35
Andesite Porphyry	L013	199.75	701-22-101	0.37	84181.5	70.2	10	476.55	0.875	3.2	832.5	0.19	54.25	14.9	8.5	1.21	331.35	1.985	1.245	0.76	4.555	17.2	2.43	1.31	1.115	0.01	0.415	0.385	34854	32.72	0.9	0.188	2658.5	37.5
Fault Breccia	L223	121.75	701-22-102	1.15	73986	13.6	10	254.4	0.64	3.78	565	0.13	38.1	15.9	20	2.78	365.4	1.3	0.73	0.78	5.53	25.96	1.9	1.14	1.26	0.01	0.24	0.291	16673	20.45	5.3	0.14	624	29
Andesite Porphyry	L223	131	701-22-103	0.88	90218	25.2	10	509.6	1.59	2.78	702	1.59	63	12.5	49	2.69	542.7	2.14	1	1.01	3.75	17.83	2.82	1.32	1.55	0.01	0.37	0.25	23250	35.59	7.9	0.158	2617	111
Andesite Porphyry	L223	137	701-22-104	0.11	92445	3.4	10	2336.4	1.32	0.33	2656	0.36	66.28	12	17	6.05	139.4	4.27	2.44	1.56	5.53	18.56	5.34	0.96	2.69	0.01	0.89	0.067	28107	35.11	16.1	0.356	6848	3212
Andesite Porphyry	L223	142.1	701-22-105	0.3	90010	10.8	10	366.1	1.87	0.47	2526	0.04	62.36	12.5	15	9.42	120.5	2.77	1.64	1.05	1.95	18.2	3.31	1.09	2.48	0.01	0.56	0.076	28004	34.57	7.1	0.241	5546	151
Andesite Porphyry	L223	150	701-22-106	0.06	83668	2.9	13	673.8	1.26	0.19	30074	0.15	59.29	11.3	14	5.91	44	2.54	1.49	1.09	3.09	16.32	3.2	1	2.09	0.01	0.53	0.017	28266	33.2	10.2	0.217	15884	648
Andesite Porphyry	L223	156	701-22-107	0.07	82823	4.7	14	550	1.18	0.1	31360	0.08	58.54	11.2	10	4.63	69.5	2.49	1.43	1.03	3.03	16.57	3.15	0.97	1.91	0.01	0.5	0.033	24193	32.64	11.8	0.214	16589	760
Andesite Porphyry	L223	164.55	701-22-108	0.05	78650	1.6	14	771.1	1.05	0.04	28364	0.03	53.73	10.5	12	2.67	25.2	2.44	1.37	0.99	2.9	15.99	2.86	0.98	1.97	0.01	0.47	0.019	25123	29.68	10.2	0.199	15034	597
Andesite Porphyry	L223	170	701-22-109	0.05	83545	1.5	16	807.5	1.04	0.08	33866	0.04	65.42	9.4	8	2.59	31.2	2.51	1.41	1.14	2.63	15.8	3.19	0.82	1.56	0.01	0.49	0.013	26237	36.77	8.3	0.208	12438	526
Andesite Porphyry	L223	178.05	701-22-110	0.05	83748	0.9	14	824.9	1.48	0.18	32675	0.04	61.29	10	8	2.88	41.5	2.33	1.3	1.02	2.41	16.58	2.94	0.92	1.66	0.01	0.45	0.013	28304	34.25	10.2	0.199	13872	435
Andesite Porphyry	L223	184	701-22-111	0.1	71817	4.5	24	586.1	0.98	0.17	60694	0.71	73.87	8.9	8	5.76	154.1	2.74	1.46	1.25	3.12	13.93	3.35	0.9	1.26	0.01	0.53	0.041	25014	43.26	9.9	0.216	12201	1154
Andesite Porphyry	L223	191.95	701-22-112	0.05	80740	2.5	23	636.7	1.08	0.07	41901	0.17	56.91	10.8	11	7.84	71.1	2.49	1.43	1.07	3.35	16.26	3.11	0.91	1.56	0.01	0.49	0.041	27898	31.27	11.1	0.218	13776	1023
Andesite Porphyry	L223	198	701-22-113	0.05	81245	2.2	21	507.8	1.2	0.06	45287	0.31	60.57	11.3	12	6.75	61.8	2.3	1.35	0.99	2.91	16.41	2.98	0.99	1.66	0.01	0.47	0.027	28264	33.53	10.2	0.219	10280	759
Andesite Porphyry	L223	206.5	701-22-114	0.05	75323	1.1	17	347.6	1.08	0.11	49237	0.39	54.75	8.4	11	5.59	65.1	2.22	1.24	0.9	2.6	16.03	2.7	0.76	1.23	0.01	0.43	0.03	23675	30.6	8	0.187	9481	677
Andesite Porphyry	L223	212	701-22-115	0.16	68794	6.1	23	282.4	1.13	0.19	42055	0.24	57.94	13.8	17	5.78	185.1	2.44	1.42	0.95	3.09	16.27	3.04	0.64	1.3	0.01	0.49	0.064	19691	32.88	13.5	0.203	11685	670
Andesite Porphyry	L223	220.05	701-22-116	0.21	74328	3.9	19	479.7	1.18	0.25	30275	0.1	64.71	13.1	12	4.49	80.9	2.8	1.61	1.29	2.91	17.19	3.56	0.82	2.04	0.01	0.56	0.023	21700	35.49	14.2	0.241	12043	528
Andesite Porphyry	L223	231.2	701-22-117	0.05	65118	2.7	19	667.6	0.9	0.45	27343	0.04	47.57	13.2	9	10.2	42.8	2.3	1.33	0.94	2.78	16.21	2.66	0.8	2	0.01	0.46	0.034	21691	26.09	15.3	0.2	13673	508
Andesite Porphyry	L223	240.4	701-22-118	0.1	66653	8.6	10	2144.2	1.01	0.26	6170	0.29	56.7	22	11	4.4	218.4	2.26	1.25	1.01	7.14	14.69	2.87	0.71	1.91	0.01	0.44	0.091	21586	31.07	8.3	0.183	10615	2952
Fault Breccia	L223	244	701-22-119	0.06	91667	10.1	10	950.2	1.84	0.29	979	0.07	74.59	7.4	7	2.81	134.9	6.37	3.73	1.95	1.65	18.66	6.2	1.04	2.53	0.01	1.28	0.059	10260	41.13	19.8	0.464	2006	44
Andesite Porphyry	L223	319.3	701-22-120	0.05	89302	1.9	10	1539.6	1.49	0.36	614	0.02	81.83	2.6	4	2.27	18.9	2.82	1.83	1.08	1.08	18.56	3.2	1.15	2.2	0.01	0.6	0.032	11398	44.06	3.9	0.299	2413	40
Andesite Porphyry	L223	325.4	701-22-121	0.19	90018	6.15	10	97.65	1.295	0.455	228	0.02	63.59	1.9	3.5	1.39	48.45	2.175	1.22	1.06	0.96	17.1	2.77	0.765	1.785	0.01	0.41	0.0855	11185.5	35.555	8.9	0.184	1416.5	32.5
Fault Breccia	L223	340.3	701-22-122	0.12	80384	6.7	10	270.5	1.28	0.82	470	0.05	68.37	6.5	4	1.41	267.4	4.6	3.49	1.09	1.08	18.17	3.31	1.08	2.36	0.01	1.1	0.153	11425	36.31	10	0.487	1183	34
Pyroclastic	L087	6	701-22-123	0.44	28106	13.3	10	443.2	0.14	0.63	3117	0.02	44.42	0.5	13	0.09	8.6	0.85	0.44	0.53	1.77	3.25	1.39	0.99	1.07	0.01	0.14	0.005	10074	24.28	0.5	0.094	952	34
Pyroclastic	L087	16	701-22-124	0.94	5217	9.4	10	1500.7	0.21	1.85	1360	0.02	27.48	0.3	11	0.11	9.2	0.65	0.41	0.26	0.79	1.22	0.86	1.16	0.97	0.05	0.12	0.005	1079	15.71	1.2	0.088	229	45
Pyroclastic	L087	26	701-22-125	0.61	47574	25.1	10	500.1	0.11	1.26	799	0.02	50.78	0.2	20	0.07	5.9	0.8	0.37	0.9	3.57	8.23	1.87	0.79	0.97	0.04	0.13	0.009	14691	28.1	0.2	0.077	206	31
Pyroclastic	L087	36	701-22-126	0.19	52739	20.6	10	711.6	0.21	1.36	789	0.02	50.63	0.4	19	0.07	3.7	0.87	0.48	0.85	1.9	8.98	2.08	0.78	1.85	0.03	0.16	0.005	11898	27.44	0.3	0.123	97	36
Pyroclastic	L087	46	701-22-127	0.25	59191	11.7	10	469.4	0.05	1.45	779	0.02	46.09	0.1	18	0.07	3.3	0.97	0.48	0.7	1.49	13.59	2.23	0.93	1.13	0.02	0.15	0.005	7169	22.5	0.3	0.111	119	29
Andesite Porphyry	L087	56	701-22-128	0.33	48233	17	10	412.2	0.13	1.54	801	0.03	65.76	0.3	22	0.07	8.8	1.15	0.63	1.06	2.73	6.8	2.58	1	1.44	0.01	0.19	0.008	15787	35.72	0.4	0.134	130	33
Fault Breccia	L087	66	701-22-129	0.55	30118	18.5	10	531	0.14	2.49	549	0.03	53.81	0.2	17	0.07	22	1.07	0.56	0.93	2.07	4.31	2.28	1.13	1.24	0.01	0.17	0.005	10276	31.39	0.2	0.125	123	40
Andesite Porphyry	L087	76	701-22-130	0.68	40052	23.6	10	416.9	0.13	1.75	634	0.02	35.18	0.2	17	0.08	9.6	0.83	0.5	0.7	1.74	6.76	1.69	1.18	1.12	0.01	0.16	0.009	13256	19.02	0.4	0.107	124	35
Andesite Porphyry	L087	86	701-22-131	0.49	33322	68.4	10	657	0.09	1.65	441	0.02	43.72	0.5	25	0.06	50.5	0.41	0.28	0.55	10.32	11.88	1.19	1.95	0.71	0.02	0.08	0.101	12564	24.22	0.3	0.073	149	28
Andesite Porphyry	L087	96	701-22-132	0.29	60424	101.5	10	560.9	0.19	3.63	666	0.02	44.38	0.2	9	0.08	22.7	0.81	0.4	0.76	1.74	14.62	1.87	0.69	1.21	0.01	0.13	0.023	9907	25.62	0.5	0.12	115	18
Andesite Porphyry	L087	106	701-22-133	0.57	59684	9	10	472.4	0.27	2.25	680	0.02	57.82	0.5	8	0.26	373.2	1.29	0.64	0.86	2.21	14.5	2.4	0.43	1.12	0.01	0.22	0.042	7249	30.95	0.5	0.138	459	37
Andesite Porphyry	L087	116	701-22-134	0.37	44946	16.9	10	794.9	0.06	4.42	640	0.02	70.03	0.2	12	0.09	98.1	0.89	0.34	0.92	4.27	17.56	2.08	0.55	0.61	0.01	0.13	0.053	5455	43.05	0.7	0.065	104	76
Andesite Porphyry	L087	126	701-22-135	0.59	52352	10.1	10	669.5	0.18	1.42	814	0.02	59.48	0.2	14	0.17	65.6	0.65	0.34	0.82	4.78	9.52	1.76	0.64	0.93	0.01	0.11	0.063	7254	32.65	0.5	0.073	102	107
Andesite Porphyry	L087	134	701-22-136	0.46	67255	4.5	10	335.6	0.96	3.15	512	0.03	56.73	1	9	1.14	46.3	1.84	1.12	0.76	3.47	26.79	2.39	1.06	1.91	0.02	0.39	0.285	28050	32.43	0.8	0.203	1621	246
Andesite Porphyry	L087	144	701-22-137	0.22	95143	14.5	10	654.6	1.06	0.28	503	3.37	28.86	48.5	8	2.04	276.6	1.89	1.14	0.53	1.51	15.39	1.8	1.22	1.46	0.04	0.38	0.224	41916	17.95	3.6	0.185	2952	43
Andesite Porphyry	L087	158	701-22-138	0.23	96617	4	10	495	1.82	0.75	568	0.74	76.3	9.2	10	5.34	79.7	2.8	1.6	1.17	1.26	17.24	3.31	1.31	1.71	0.02	0.55	0.108	35059	44.42	13.9	0.231	3446	57
Andesite Porphyry	L087	170	701-22-139	0.07	111852	3.2	10	1325.7	1.43	0.07	421	0.04	109.8	5.1	11	4.13	19.8	4.09	2.17	1.87	1.3	21.2	5.32	1.35	2.19	0.01	0.77	0.037	22166	62.28	11.3	0.329	2179	45
Andesite Porphyry	L087	184	701-22-140	0.09	110558	3.1	10	310.5	1.18	0.1	343	0.07	90.87	27.7	8	3.45	15.4	2.42	1.17	1.35	1.61	19.66	3.57	1	1.97	0.02	0.42	0.039	29580	52.44	3.6	0.188	3028	38
Andesite Porphyry	L087	200	701-22-141	0.125	101364.5	4.9	10	556.35	1.155	0.095	485	0.25	84.315	7	9	2.48	295.95	1.37	0.75	1	1.435	18.56	2.355	1.235	1.775	0.01	0.255	0.0855	26519.5	45.91	5.55	0.1435	2745	50
Andesite Porphyry	L087	210	701-22-142	0.05	116648	3.2	10	1125.2	1.53	0.06	702	0.02	103.8	1.4	7	1.6	4.2	2.38	1.22	1.79	0.8	18.87	4.4	1.42	1.67	0.01	0.43	0.037	19819	54.69	6.7	0.22	1621	29
Andesite Porphyry	L087	216	701-22-143	0.44	98109	34.1	10	623.1	0.65	0.86	357	0.32	39.07	11.9	10	1.8	354.9	1.2	0.81	0.36	2.18	18.34	1.11	1.11	1.58	0.02	0.26	0.451	36433	26.77	3.1	0.15	2980	46
Andesite Porphyry	L087	252	701-22-144	0.07	67645	14.5	10	165.7	0.11	1.28	591	0.02	33.14	4.9	23	0.07	425.6	0.75	0.32	0.66	6.58	7.91	1.73	0.64	0.71	0.01	0.13	0.022	26027	17.96	0.4	0.054	134	20
Andesite Porphyry	L087	262	701-22-145	0.73	41737	54.9	10	56	0.05	8.1	447	0.04	25.31	6	17	0.05	3253.6	0.45	0.21	0.47	19.02	2.4	1.05	0.52	0.53	0.05	0.07	0.051	11699	12.34	0.2	0.048	55	61
Andesite Porphyry	L087	272	701-22-146	0.13	63754	25.7	10	275.4	0.15	1.04	451	0.06	38.76	9.4	21	0.08	998.9	0.63	0.31	0.61	5.58	8.56	1.41	0.79	0.95	0.01	0.1	0.087	13393	21.18	0.4	0.082	68	16
Andesite Porphyry	L087	292	701-22-147	0.23	86290	6.1	10	306.3	0.39	2.23	776	0.08	32.25	10.4	13	0.74	383.3	1.24	0.65	0.64	3.24	11.49	1.83	0.56	1.35	0.01	0.21	0.19	15714	19.17	0.9	0.122	754	38
Hydrothermal Breccia	L087	330	701-22-148	0.11	63098	44.2	10	115.6	0.05	0.29	544	0.03	40.1	18.5	30	0.05	1049.8	0.26	0.12	0.39	8.33	2.8	0.68	0.98	0.24	0.01	0.04	0.023	21676	22.22	0.3	0.024	70	19
Andesite Porphyry	L087	349.7	701-22-149	0.29	97095	13.1	10	597.4	0.86	2.39	526	0.04	58.4	10.9	14	1.67	339	1.3	0.81	0.61	2.26	17.4	1.73	1.16	1.94	0.02	0.26	0.332	32803	36.01	3.5	0.152	2423	81
Andesite Porphyry	L087	340	701-22-150	0.2	88653	9.4	10	120	0.18	2.02	744	0.21	55.7	13	16	0.41	368.3	1.42	0.64	1.03	5.14	13.63	2.83	1.33	1.51	0.01	0.23	0.081	2437	31.12	1.6	0.143	164	31

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**1.5**	**23000**	**20**	**38**	**80**	**1000**	**14**	**9.5**	**90**	**0.0004**	**260**	**0.2**	**16**	**0.05**	**7.9**	**2.2**	**370**	**2**	**1.1**	**0.005**	**12**	**5600**	**0.6**	**0.48**	**2.4**	**160**	**1**	**30**	**3.3**	**75**	190
Andesite Porphyry	LS001	25	701-22-001	1.25	1476.5	4.29	22.895	24.5	702	325.9	6.543	161.14	0.002	10301	0.37	9.4	0.9	3.79	0.7	76.335	0.365	0.4495	0.065	21.115	2255	1.845	0.16	3.625	84	2.1	9.31	1.095	64.5	54.05
Andesite Porphyry	LS001	59	701-22-002	2.3	303	3.55	23.19	11.4	608	51.9	6.65	135.1	0.002	2913	0.37	7.5	0.5	3.79	0.5	13.09	0.36	0.421	0.05	23.46	1619	1.6	0.24	4.58	81	1.8	14.15	1.54	542	48.3
Andesite Porphyry	LS001	65.5	701-22-003	2.7	295	2.64	19.96	12.4	668	30.9	4.971	140.1	0.007	57011	0.69	17	2.5	3.93	3.4	49.34	0.22	0.671	0.74	13.37	1927	1.73	0.43	6.56	124	1.6	25.17	2.94	425	38.2
Andesite Porphyry	LS001	89.25	701-22-004	1.4	346	3.25	28.11	6	869	167.9	7.626	138.6	0.002	42187	0.52	11	2.2	5.48	3.2	278.89	0.3	0.797	1.92	17.36	1558	1.78	0.4	5.48	107	2.3	25.63	2.58	50	44.4
Andesite Porphyry	LS001	122	701-22-005	1.4	365	4.08	26.68	3.9	130	9.9	7.392	151.77	0.002	5889	0.29	8	0.5	4.42	0.7	16.33	0.4	0.436	0.34	19.27	2020	1.93	0.2	4.34	87	2.6	14.5	1.42	158	48.4
Dyke	LS001	136.75	701-22-006	1.3	380	3.32	20.77	7	620	82.5	5.487	158.52	0.002	32511	0.32	11.8	1.9	4.09	0.9	175.07	0.3	0.633	1.08	18.07	1733	2.22	0.31	5.16	105	2.6	20.27	1.88	39	52.7
Dyke	LS001	185	701-22-007	1.5	589	1.92	24.15	31.4	922	415.5	5.695	2.99	0.003	169611	3.98	9.9	4.5	5.66	4.5	1065.68	0.17	0.439	1.63	12.23	1101	9.44	0.1	7.02	90	5.3	4.89	0.69	19	33.1
Dyke	LS001	221.65	701-22-008	2.5	1685	1.65	12.05	16	703	205.7	3.209	3.14	0.008	66532	1.1	13.6	2.1	2.5	2	352.6	0.14	0.23	1.09	11.13	1455	0.14	0.04	3.52	135	2.5	2.63	0.32	11	19
Andesite Porphyry	LS001	249.15	701-22-009	3.9	1196	1.98	21.48	3.8	533	124.5	5.763	125.49	0.022	17061	0.6	15.5	0.8	3.7	1.6	203.56	0.17	0.273	0.42	15.23	1959	1.61	0.09	3.5	134	2.5	3.7	0.5	17	33.6
Andesite Porphyry	LS001	290.75	701-22-010	2.2	822	1.69	13.61	7.3	374	103.3	3.69	90.37	0.002	37126	0.47	12.9	1.6	2.52	0.6	94.52	0.14	0.187	0.74	14.03	1082	1.12	0.06	3.27	96	1.8	3.15	0.49	13	26.1
Andesite Porphyry	LS001	304.05	701-22-011	2.2	819	2.21	16.51	21.7	537	106.8	4.5	8.25	0.002	86321	0.81	12.8	4.2	2.94	2.2	313.24	0.19	0.219	2.71	14.72	1512	0.15	0.07	5.89	114	5.5	3.51	0.54	8	42.4
Andesite Porphyry	LS001	368.85	701-22-012	2.2	1437	4.29	31.86	9.5	676	59.3	8.209	113.56	0.002	51858	0.68	14.4	6.6	7.39	1.9	414.61	0.36	1.228	3.35	24.11	2512	1.21	0.53	6.68	91	2.5	37.37	2.85	162	50.5
Andesite Porphyry	LS001	395	701-22-013	2.3	1072	4.37	28.72	3.9	466	10.4	7.722	114.42	0.002	22324	0.42	14.7	1.2	5.53	0.7	23.98	0.35	0.918	0.57	22.73	2970	1.54	0.41	4.9	104	2.5	27.21	2.28	24	64.7
Andesite Porphyry	LS001	411.1	701-22-014	181.9	1129	0.8	20.7	10.5	518	54.1	7.096	3.08	0.055	90545	2.03	8.2	6	3.18	6.5	421.95	0.07	0.213	1.21	11.2	546	0.7	0.03	3.25	88	5.7	2.14	0.23	23	6
Andesite Porphyry	LS001	423.5	701-22-015	48.8	1377	0.68	16.8	10.7	531	51.4	4.877	3.25	0.079	117410	1.75	4.6	6	2.62	13.3	553.05	0.07	0.078	0.35	10.71	457	0.08	0.01	0.65	88	5.1	0.8	0.08	9	3.6
Andesite Porphyry	LS002	94.3	701-22-016	13.2	710	1.58	13.49	7.2	589	15.8	4.047	79.18	0.107	20485	0.6	12.8	2.4	2.27	0.9	155.7	0.14	0.218	0.05	16.56	1369	0.84	0.09	2.01	119	1.4	6.55	0.69	19	18.9
Breccia	LS002	104.13	701-22-017	8.3	575	1.49	13.7	6.4	421	35	4.173	95.57	0.07	21817	0.47	11.6	3.2	2.29	0.8	91.6	0.14	0.226	0.06	15.08	1347	1.2	0.12	1.92	99	1.5	7.25	0.67	31	10.9
Andesite Porphyry	LS002	128.6	701-22-018	5.4	1093	1.29	20.22	8.1	427	18.4	5.561	91.47	0.049	18517	0.4	13.6	1.4	3.57	1.2	95.69	0.11	0.353	0.07	14.73	1143	1.12	0.13	3.27	104	1.9	9.06	0.79	46	9.4
Andesite Porphyry	LS002	148.4	701-22-019	3.8	1139	1.61	21.37	6.6	376	25.2	6.217	105.6	0.03	22178	0.56	11.4	1.7	3.57	1.7	87.22	0.13	0.387	0.06	16.01	1071	1.22	0.16	3.57	101	2.7	11.91	1.09	27	9.6
Diorite Porphyry	LS002	355.8	701-22-020	2.8	12422	2.89	19.67	11.2	502	14.2	5.319	83.44	0.01	4699	0.05	10.7	0.8	3.48	0.6	178.14	0.21	0.326	0.08	15.06	1931	0.74	0.12	1.29	95	0.5	8.38	0.77	1071	7.8
Andesite Porphyry	LS002	373	701-22-021	1.25	1196.5	2.955	28.09	11.75	808	157.25	7.401	94.665	0.009	26436.5	0.575	16.65	0.95	5.19	0.75	284.9	0.2	0.561	0.75	14	2806	1.215	0.23	1.67	144.5	0.75	17.575	1.47	631.5	7.55
Andesite Porphyry	LS002	422.5	701-22-022	2.6	1472	2.46	26.12	7.2	191	86	7.14	102.63	0.01	18431	0.26	11.9	1.4	4.65	1.5	62.43	0.2	0.455	0.16	19.33	2055	1.11	0.19	2.88	115	2.4	13	1.24	95	16.6
Andesite Porphyry	LS002	435.3	701-22-023	2.2	1551	3.82	26.6	6.5	284	54.3	7.285	99	0.016	14162	0.25	13	1.4	4.77	0.8	128.74	0.31	0.455	0.24	20.86	2824	1.2	0.2	2.96	121	2.1	13.2	1.1	298	27.2
Andesite Porphyry	LS002	448.85	701-22-024	2.4	1859	2.74	24.76	14.2	416	418	6.736	135.89	0.022	31865	0.62	11.9	1.7	4.46	0.9	176.09	0.22	0.543	0.35	19.53	2323	1.75	0.28	3.08	117	1.6	20.37	1.55	519	14.5
Andesite Porphyry	LS002	472.85	701-22-025	7.6	1255	3.57	34.32	6.6	880	17	9.189	70.98	0.037	6956	0.39	11.8	0.9	6.46	0.7	343.12	0.33	0.861	0.07	23.19	2539	0.78	0.48	2.91	116	2.3	31.06	3.69	185	23.9
Andesite Porphyry	LS003	21.3	701-22-026	1.6	624	1.65	15.83	1.1	624	68.7	4.422	114.14	0.002	6448	1.46	10.1	1.9	3.14	0.8	64.55	0.16	0.207	0.96	12.82	1068	1.44	0.09	3.16	93	0.6	4.47	1.18	34	48.5
Andesite Porphyry	LS003	70	701-22-027	1.4	655	2.99	20.53	9.5	441	126.9	5.807	149.69	0.007	29576	0.44	12.3	1	3.48	1.1	84.11	0.25	0.338	0.42	18.66	1893	1.86	0.17	4.17	106	1.1	10.21	1.41	243	53.6
Andesite Porphyry	LS003	74.3	701-22-028	1.4	205	2.41	11.41	7.3	143	16.4	3.21	88.98	0.002	6858	0.46	6.7	0.5	2.2	0.6	31.38	0.2	0.311	0.24	13.79	1585	1.13	0.11	3.09	71	0.6	6.32	0.79	448	39.3
Andesite Porphyry	LS003	97	701-22-029	0.5	449	1.55	10.73	7.7	379	65.7	2.917	132.8	0.002	26827	0.58	10.3	0.5	2.13	0.8	112.54	0.13	0.312	0.72	11.79	929	1.59	0.16	3.3	85	1.6	8.81	1	42	57
Andesite Porphyry	LS003	115.5	701-22-030	2	382	1.18	8.12	12.5	480	176.9	2.141	51.65	0.002	72205	0.67	8.7	1.8	1.84	1.7	110.9	0.1	0.23	0.6	11.91	664	0.7	0.11	3.82	76	1.1	5.57	0.8	19	35.9
Andesite Porphyry	LS003	131.7	701-22-031	1.2	310	3.2	10.43	13.4	323	15.4	2.718	98.69	0.002	16302	0.71	10.6	0.5	2.52	0.6	115.73	0.27	0.377	0.15	14.4	2070	1.27	0.17	4.2	90	1.1	8.68	1.14	36	64.4
Breccia	LS003	146.75	701-22-032	2	439	2.79	15.01	17.9	477	51.9	3.994	148.26	0.004	37881	1.76	11.8	0.9	2.67	1.1	149.7	0.21	0.275	0.51	14.09	1307	2.16	0.16	4.66	89	1.1	11.61	1.12	219	55.4
Diorite Porphyry	LS003	170.02	701-22-033	1.1	638	2.22	14.34	6.7	651	77	3.857	131.58	0.002	40301	0.56	11	0.9	2.4	1.1	93.73	0.19	0.274	0.64	13.13	1204	1.79	0.14	4.71	84	1.1	7.74	1.23	251	50.7
Diorite Porphyry	LS003	182.4	701-22-034	2.7	545	2.3	19.1	7.8	733	20	5.221	113.43	0.002	32716	0.49	8.7	0.9	3.7	0.7	287.25	0.19	0.621	0.69	14.62	1238	1.58	0.15	3.54	80	0.8	9.39	1.05	25	52.8
Diorite Porphyry	LS003	274.25	701-22-035	3	1580	1.59	17.59	31.1	454	90.6	4.524	11.44	0.006	107002	2.49	9.6	2.4	3.7	10.1	452.33	0.12	0.249	0.33	16.01	664	0.21	0.11	4.19	84	1.4	4.89	0.83	59	38.4
Diorite Porphyry	LS003	298.3	701-22-036	1.8	741	3.33	12.85	10.2	708	100.2	3.335	95.48	0.002	83613	0.85	13.8	2.4	2.99	4.6	230.14	0.24	0.336	0.81	12.13	1669	1.24	0.14	6.44	94	2.4	7.78	1.02	21	46.5
Diorite Porphyry	LS003	305	701-22-037	0.9	902	2.61	11.65	7.6	671	63	3.088	113.03	0.002	40639	0.63	14.3	0.7	3.31	1.3	130.84	0.18	0.301	1.32	11.99	1330	1.34	0.16	5.19	104	1.8	8.16	1.04	16	51
Breccia	LS003	324.8	701-22-038	3.9	969	1.47	10.84	13.1	394	33	3.067	98.89	0.005	84643	0.45	14.8	2.5	2.01	3	194.63	0.12	0.266	0.29	8.68	826	1.05	0.13	3.52	97	1.4	7.6	0.88	30	28.4
Andesite Porphyry	LS003	330.2	701-22-039	1.3	561	3.97	15.93	11.3	466	64.4	4.708	85.31	0.002	43426	0.46	20.7	0.8	2.96	0.6	214.29	0.32	0.45	0.66	20.14	2866	1.14	0.21	6.27	128	1.4	12.6	1.47	32	67.7
Diorite Porphyry	LS003	342.8	701-22-040	3.2	894	1.97	13.41	12.3	619	96.2	3.311	97.98	0.002	38595	0.39	11.4	1.3	2.74	1.2	240.09	0.2	0.276	0.82	11.97	919	1.25	0.1	5.33	84	2	5.11	0.76	141	45.7
Feldspar Porphyry	LS003	353.35	701-22-041	1.25	764	1.185	17.79	9	741	105.85	4.917	27.45	0.002	60052	0.46	9.05	2.45	3.155	1.15	444.495	0.085	0.2465	0.84	10.64	752.5	0.365	0.07	3.955	83	1.15	3.475	0.495	39.5	35.4
Andesite Porphyry	LS003	377.5	701-22-042	4.2	735	0.61	16.24	10.2	611	72.8	4.538	14.92	0.007	54322	0.61	8.3	1.8	2.72	2	595.91	0.04	0.17	0.27	8.82	340	0.17	0.03	3.43	75	3.2	1.99	0.24	168	20.4
Porphyry	LS003	394.75	701-22-043	2.1	1096	3.4	8.34	3.5	101	9.1	2.409	63.65	0.002	21159	0.51	14.8	0.5	1.54	0.9	25.26	0.29	0.201	0.2	16.59	2463	0.63	0.14	3.8	101	12.3	7.04	0.87	14	59.1
Porphyry	LS003	410.9	701-22-044	1.7	1087	3.25	7.54	10.7	146	11.3	2.235	29.44	0.002	38815	0.3	15.3	0.5	1.39	0.7	41.2	0.26	0.219	0.26	15.77	1990	0.28	0.14	4.44	93	1.8	7.57	0.99	14	50.3
Breccia	LS003	440.8	701-22-045	2.5	808	0.96	14.59	24.6	476	47.8	3.851	6.19	0.006	75010	2.74	5.8	2.2	2.67	11.6	667.21	0.07	0.189	0.55	15.01	241	0.2	0.06	1.76	60	1.8	3.59	0.36	17	14.1
Andesite Porphyry	LS004	30.21	701-22-046	1.7	612	3.91	18.72	17.4	580	232.3	5.174	146.99	0.003	42999	1.08	8.7	0.6	3.14	2	36.73	0.29	0.369	0.18	13.4	1859	1.69	0.16	3.1	75	8.3	8.83	1.11	2799	34.9
Andesite Porphyry	LS004	50.21	701-22-047	0.6	684	3.9	18.17	8.3	581	43.7	5.255	158.07	0.002	3389	0.42	8.6	0.5	2.97	0.7	31.32	0.3	0.334	0.05	13.83	2000	1.75	0.19	4.62	69	0.9	11.21	1.19	276	43.6
Andesite Porphyry	LS004	69.25	701-22-048	1.2	639	3.95	19.61	8.9	614	162.5	5.485	141.19	0.002	16643	0.79	9.9	0.5	3.31	0.6	18.71	0.29	0.264	0.05	13.52	2234	1.65	0.15	3.4	84	1	8	1.08	1703	49.5
Andesite Porphyry	LS004	110.45	701-22-049	1.3	670	3.32	15.13	8.6	667	96.1	3.954	163.07	0.002	45173	1.72	11.5	1.2	3.44	0.7	154.71	0.25	0.477	0.76	12.63	2084	2.11	0.25	3.53	95	2.4	15.16	1.66	150	64
Andesite Porphyry	LS004	134.45	701-22-050	2.4	530	4.33	16.18	33.2	849	219.8	4.376	3.55	0.002	87035	2.5	11.5	1.8	3.43	2.3	1186.83	0.29	0.301	1.51	14.02	2332	0.19	0.12	4.11	89	1.8	5.99	0.86	258	58.3
Diorite Porphyry	LS005	28.4	701-22-051	2.8	612	3.47	19.75	8.6	523	133.4	5.607	122.53	0.002	25389	0.65	10	1	3.47	0.6	228.61	0.27	0.38	0.33	19.34	2159	1.29	0.19	3.47	92	1.9	10.95	1.23	671	55.9
Diorite Porphyry	LS005	50.1	701-22-052	1.8	577	3.83	25.28	6.2	616	18	7.153	143.59	0.002	5441	0.4	9.2	0.5	4.13	0.5	63.7	0.35	0.423	0.16	22.48	1925	1.65	0.21	5.38	77	1.4	13.19	1.52	100	46.9
Breccia	LS005	72.5	701-22-053	1.6	738	3.93	26.63	7.6	725	607.6	7.336	138.75	0.002	27848	0.62	11.2	1.9	4.77	1	48.93	0.32	0.403	0.56	19.5	2592	1.72	0.19	4.12	118	1.1	11.62	2.36	1510	66.8
Breccia	LS005	133.9	701-22-054	6.7	1141	2.81	26.01	18.1	593	130.2	7.186	155.85	0.017	62521	1.45	11	2.7	4.79	2.3	82.79	0.22	0.516	1.43	14.08	1817	2.32	0.35	3.34	90	2.4	23.48	2.28	549	50.3
Diorite Porphyry	LS005	141.4	701-22-055	1.6	1197	4.08	26.17	6.4	752	21.2	7.331	135.82	0.002	10685	0.41	9.1	0.5	4.47	0.6	28.16	0.34	0.46	0.15	23.1	2286	1.47	0.23	4.88	88	1.1	14.49	1.63	78	61.6
Andesite Porphyry	LS006	34.3	701-22-056	1	707	4.24	18.42	4.1	71	25.1	5.599	154.37	0.005	15433	0.28	7.2	0.7	2.55	0.7	15.06	0.35	0.204	0.36	21.8	2255	1.74	0.13	4.37	64	1.3	7.17	0.98	32	56.8
Andesite Porphyry	LS006	52.3	701-22-057	2.9	879	3.74	33.06	15.5	346	95.4	9.099	102.53	0.002	20818	0.59	10.8	1.3	5.63	0.7	145.71	0.29	0.599	0.85	24.94	2055	1.16	0.42	6.05	106	1.1	25.23	2.95	55	53.9
Andesite Porphyry	LS006	70.3	701-22-058	1.8	630	4	38.47	9.5	383	35.6	9.782	95.69	0.002	15230	0.21	11.6	0.7	6.82	0.7	91.12	0.33	0.555	0.55	27.01	2293	0.97	0.31	6.36	96	1.5	17.71	2.14	38	58.6
Andesite Porphyry	LS006	127.6	701-22-059	1.2	747	3.78	25.28	9.2	567	332.9	7.198	135.76	0.002	14879	0.37	9.5	0.5	4.16	0.5	73.6	0.3	0.362	0.17	25.29	2133	1.56	0.19	8.01	89	1.6	11.08	1.41	1683	52
Breccia	LS006	140.4	701-22-060	1.2	881	3.3	31.48	11.4	1303	488.9	8.508	145.87	0.002	34099	0.48	11.8	0.8	5.68	0.6	877.78	0.27	0.511	0.65	24.97	2089	1.75	0.29	6.71	107	1.9	16.2	1.81	773	57
Porphyry	LK002	16.05	701-22-061	1	709.5	2.595	17.68	2.45	557	23.6	5.1365	132.01	0.002	17529.5	0.78	7.3	1.05	2.88	0.8	49.48	0.23	0.214	0.72	17.205	931	1.34	0.08	3.48	65	1.6	4.66	0.6	36.5	50.4
Andesite Porphyry	LK002	36.3	701-22-062	0.6	333	3.13	19.67	4	563	64.4	5.678	164.18	0.002	22547	0.69	7	0.5	3.34	0.7	48.24	0.29	0.256	0.29	17.01	1213	1.41	0.08	3.41	55	1.5	4.62	0.58	23	46.9
Breccia	LK002	113.6	701-22-063	2	531	2.36	18.03	30.4	662	111.6	5.1	4.5	0.005	91181	5.25	8.8	2.4	3.29	5	449.33	0.16	0.239	0.74	12.35	1206	0.44	0.09	2.94	91	2.6	4.38	0.63	23	34.7
Porphyry	LK002	133.3	701-22-064	2.4	1700	1.61	16.66	11	745	185.2	4.712	3.89	0.036	83916	1.75	8.6	1.6	2.83	3.4	182.67	0.13	0.208	0.36	9.9	919	0.06	0.11	2.81	88	1.6	2.52	0.4	8	43.2
Porphyry	LK002	167.3	701-22-065	2.7	1361	0.88	11.54	11.7	545	137.8	2.786	3.48	0.037	102161	1.26	8.2	2.7	2	2.5	222.33	0.07	0.133	0.33	8.4	552	0.07	0.03	1.75	80	1.6	1.62	0.2	9	15.9
Andesite Porphyry	LK003	40.3	701-22-066	0.6	391	3.42	18.8	26	486	89.3	5.331	117.48	0.006	23024	0.6	14.1	0.6	3.22	0.7	168.25	0.24	0.32	0.1	11.93	2655	1.82	0.15	2.45	129	4	8.22	0.94	2375	56.2
Breccia	LK003	54.9	701-22-067	1.5	365	5.78	21.89	28.6	142	52.8	6.579	129.11	0.002	35677	1.36	7	0.9	3.66	1.4	10.85	0.45	0.301	0.62	16.82	1925	1.89	0.16	3.49	56	1.6	8.37	1.13	1409	49.3
Breccia	LK003	108.6	701-22-068	1.8	699	3.73	17.21	30.6	350	70	5.231	109.43	0.003	58733	1.61	12.5	1.7	2.99	2.1	139.02	0.29	0.294	1.6	14.21	1723	1.65	0.15	4.15	84	2.1	7.88	0.95	450	40.9
Pyroclastic	LK003	128.7	701-22-069	1.9	621	5.34	22.8	50.8	394	53.4	6.147	164.51	0.002	25574	1.81	9.9	0.5	4.08	1.8	116.67	0.4	0.361	0.73	14.29	1891	2.37	0.15	2.97	75	2	8.43	1.17	1915	43.1
Tuff	LK003	145.6	701-22-070	1	539	5.34	16.85	30.6	254	32.2	4.789	155.31	0.002	24978	2.08	8.2	0.7	3.03	1.5	45.57	0.42	0.243	0.56	16.98	1757	1.9	0.15	3.7	61	1.9	7.42	1.06	644	52.8
Hornblende Porphyry	LK004	51.23	701-22-071	2.6	16162	4.58	23.6	5.7	648	10	6.663	92.3	0.002	974	0.15	8.1	0.5	4.01	0.5	271.54	0.36	0.42	0.05	18.17	2105	0.39	0.21	3.77	71	1.3	12.66	1.49	66	62.4
Breccia	LK004	71.63	701-22-072	1.3	3933	3.81	25.98	8.7	726	24	7.299	104.31	0.002	7516	0.33	10.1	0.5	4.5	0.7	107.46	0.31	0.394	0.08	19.2	2239	0.91	0.19	4.95	86	1.5	12.1	1.38	186	50.5
Breccia	LK004	81.52	701-22-073	1.3	1324	3.64	19.36	15.5	663	49.6	5.434	146.48	0.002	14544	0.53	8.9	0.5	3.32	0.5	42.15	0.27	0.368	0.11	12.88	1855	1.57	0.18	3.24	74	1.3	12.08	1.22	329	44.6
Andesite Porphyry	LK004	104.71	701-22-074	1.9	943	3.58	21.6	13.2	837	426.7	6.079	161.45	0.002	42389	2.64	9.6	1.4	3.62	1.1	37.67	0.26	0.316	0.99	13.9	1974	2.97	0.15	3.65	81	2.3	9	1.04	3221	44.1
Diorite Porphyry	LK004	137.51	701-22-075	2.6	686	5.54	20.15	8.4	677	137.8	6.229	144.53	0.002	36784	5.54	4.1	2	3.91	0.7	195.29	0.42	0.682	1.1	22.29	1232	4.49	0.3	4.54	32	3	20.54	2.21	184	39.5
Breccia	LK006	45.2	701-22-076	0.6	243	4.13	29.21	242.5	1282	71.7	7.54	158.97	0.002	150590	9.17	23	1.4	5.85	0.9	35.03	0.25	0.839	0.42	9.87	3194	3.38	0.25	2.27	118	2.2	16.95	1.58	83	71.5
Andesite Porphyry	LK006	51.8	701-22-077	1.6	289	4.02	18.35	17.1	463	39	5.169	139.72	0.002	22594	1.6	15.9	0.5	3.39	0.6	60.85	0.3	0.818	0.05	14.91	3276	1.86	0.23	4.06	118	1.3	12.15	1.61	1218	74.1
Andesite Porphyry	LK006	129.7	701-22-078	1.2	366	7.11	25.52	32.7	1001	135.8	6.759	167.61	0.002	45232	9.53	11.5	1.2	5.08	2	426.93	0.42	0.511	0.48	15.69	2723	2.88	0.22	5.53	97	4.5	12.74	1.59	175	74
Breccia	LK006	145.7	701-22-079	1.9	418	5.74	22.2	47.4	713	194.4	6.533	138.62	0.003	45316	3.54	13.1	1	4.35	4.3	438.73	0.36	0.443	0.74	17.78	2166	1.82	0.2	5.54	95	2.4	10.7	1.46	408	73.5
Diorite Porphyry	LK006	165.86	701-22-080	1.4	691	2.02	8.58	11.2	637	127.2	2.237	84.51	0.002	42387	1.27	10.7	1.9	1.9	3.2	386.94	0.15	0.221	0.5	8.61	1257	0.94	0.08	4.3	91	1.2	3.24	0.45	65	31.8

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**1.5**	**23000**	**20**	**38**	**80**	**1000**	**14**	**9.5**	**90**	**0.0004**	**260**	**0.2**	**16**	**0.05**	**7.9**	**2.2**	**370**	**2**	**1.1**	**0.005**	**12**	**5600**	**0.6**	**0.48**	**2.4**	**160**	**1**	**30**	**3.3**	**75**	**190**
Tuff	LK006	191.35	701-22-081	1.2	882.5	8.555	22.37	96.1	352	143.35	5.875	120.07	0.002	69346.5	2.73	12.2	1.1	4.025	5.2	282.99	0.605	0.28	1.46	15.57	3167.5	1.27	0.13	3.35	94	3	5.92	0.975	17	47.9
Pyroclastic	LK006	214.6	701-22-082	1.8	785	6.87	19.4	9	623	330.3	5.527	56.03	0.002	46295	2.9	6.9	1.1	3.47	3.8	311.82	0.51	0.241	0.41	26.84	1332	0.62	0.11	7.69	52	3.3	4.97	0.92	12	44.3
Andesite Porphyry	L013	5	701-22-083	4.6	494	4.3	18.21	9.7	195	35.3	5.494	75.03	0.019	8179	0.17	14.4	0.5	2.58	0.9	83.32	0.36	0.195	0.1	16.47	2431	0.89	0.06	2.59	89	1.9	4.66	0.52	42	30.7
Andesite Porphyry	L013	11	701-22-084	10.3	799	2.74	15.86	6.5	880	65.3	4.423	60.67	0.018	19101	0.14	17	1.3	2.97	0.8	158.93	0.27	0.249	0.28	18.02	1819	0.7	0.08	2.58	230	1.5	7.11	0.49	52	24.5
Andesite Porphyry	L013	17.7	701-22-085	7.9	708	3.43	12.41	3.1	278	205.8	3.845	96.6	0.014	12568	0.2	11.8	4.3	1.78	1.5	68.63	0.3	0.142	0.34	10.46	2015	1.15	0.06	3.96	120	1.4	3.11	0.38	25	24.4
Andesite Porphyry	L013	23.4	701-22-086	7.2	679	2.91	23.02	5.3	304	40.7	7.33	98.33	0.007	11426	0.19	10.5	2.1	3.13	1.3	64.67	0.26	0.172	0.16	21.19	1913	1.13	0.05	3.3	112	1.4	3.15	0.32	28	13.8
Andesite Porphyry	L013	28.9	701-22-087	6	851	3.47	18.58	7.8	202	39	5.998	90.05	0.03	16433	0.16	16.4	0.6	2.48	1.1	52.02	0.3	0.164	0.08	19.59	2066	0.98	0.05	1.97	100	2.4	3.82	0.35	24	13.1
Andesite Porphyry	L013	34.9	701-22-088	13.2	1007	2.57	12.06	2.3	580	25.3	4.157	79.31	0.005	26759	0.32	14.1	2.2	1.86	1	148.11	0.25	0.254	0.38	22.15	1792	0.94	0.12	1.56	86	4.8	7.86	0.66	27	16.4
Andesite Porphyry	L013	41.25	701-22-089	7.7	1219	2.72	10.91	2.5	527	18.6	3.384	100.99	0.003	28568	0.26	20.6	1.9	1.88	1.1	144.14	0.23	0.26	0.3	12.08	1806	1.15	0.11	1.35	128	2.4	8.29	0.78	27	11.9
Andesite Porphyry	L013	47.7	701-22-090	7.4	784	2.83	13.18	2.4	186	68.6	3.855	96.16	0.003	10001	0.35	11	2.4	2.04	2.2	57.61	0.22	0.221	0.87	17.16	2077	1.32	0.08	2.3	105	2.6	6.02	1.08	15	10.8
Andesite Porphyry	L013	52.9	701-22-091	9.6	834	3.16	14.22	4.4	527	38.1	4.038	82.68	0.007	13146	0.15	10.8	4	2.42	1.6	148.85	0.26	0.234	0.12	12.72	2190	1.02	0.07	1.55	87	1.9	5.18	0.47	28	9.2
Andesite Porphyry	L013	58.8	701-22-092	4.2	764	3.2	15.1	2.1	266	151.6	4.453	117.82	0.002	10053	0.29	8.1	1.1	2.35	1.1	113.25	0.26	0.214	0.93	21.82	1897	1.67	0.1	2.69	87	2.1	6.05	0.97	15	38
Andesite Porphyry	L013	69	701-22-093	18.9	718	2.65	14.07	1.7	439	19.6	4.104	117.92	0.007	10229	0.15	8.6	1.4	2.21	1.3	60.26	0.24	0.377	1.57	17.38	1638	1.63	0.11	1.89	93	1.7	8.29	0.65	18	9.5
Hydrothermal Breccia	L013	75	701-22-094	2.7	4187	3.44	32.76	1.8	1297	157.9	9.213	3.95	0.004	42213	2.26	6.6	7.8	6.06	7.2	1017.44	0.27	0.386	0.34	26.72	2505	0.05	0.08	4.05	91	4.1	5	0.5	5	29.6
Hydrothermal Breccia	L013	81.9	701-22-095	9.7	4484	1.07	29.19	1.5	1297	189.1	8.441	4.46	0.004	46556	0.82	6.2	18.8	4.97	2	792.98	0.09	0.299	0.87	24.41	671	0.04	0.06	3.55	85	2.1	3.83	0.59	7	16.2
Hydrothermal Breccia	L013	86.55	701-22-096	4.7	5133	2.88	30.4	1.5	1169	240.6	9.372	3.81	0.004	47839	1.06	6.7	12.4	4.26	2.7	731.77	0.23	0.237	0.52	26.36	1712	0.04	0.05	3.15	84	2.8	3.53	0.31	5	17.6
Fault Breccia	L013	93.25	701-22-097	10.1	774	0.97	41.69	3	1685	209.4	10.231	5.4	0.004	17410	1.74	6.3	10	9.13	1.5	1704.67	0.07	0.517	1.88	27.31	659	0.08	0.05	8.58	109	2.9	4.17	0.31	15	19.9
Hydrothermal Breccia	L013	100.4	701-22-098	6	3701	1.1	34.42	0.8	1426	247.5	9.949	2.72	0.004	45201	2.66	7.6	29.8	6.57	3.3	1009.31	0.09	0.656	3.73	26.59	560	0.02	0.06	5.38	90	1.5	5.67	0.32	16	7.6
Andesite Porphyry	L013	127.55	701-22-099	12.5	2010	0.96	22.52	8.8	392	10.6	6.215	91.48	0.087	25032	0.17	10.6	2.3	4.19	1.3	209.43	0.09	0.482	0.22	19.59	901	1.48	0.16	3.42	88	1.5	11.31	1.01	25	37.2
Andesite Porphyry	L013	177.05	701-22-100	6.9	1161	0.98	19.76	13.3	786	26.5	6.103	37.88	0.085	46826	0.27	4.9	6.9	2.69	3.2	465.23	0.1	0.14	0.31	21.17	650	0.56	0.04	2.3	77	4.2	2.41	0.26	10	18.4
Andesite Porphyry	L013	199.75	701-22-101	4.5	1543.5	1.415	17.79	9.75	627.5	47.65	5.3305	106.865	0.041	52430	0.38	8.15	4.9	2.96	1.6	196.805	0.13	0.2305	0.735	22.52	834.5	1.83	0.195	3.755	63	1.2	6.225	1.38	20	38.1
Fault Breccia	L223	121.75	701-22-102	1.7	569	2.2	15.15	11.4	708	53.2	4.079	39.82	0.01	63045	0.84	8.7	2.5	2.84	2.1	482.74	0.18	0.246	1.47	11.44	1589	0.53	0.11	4.29	78	2.3	7.83	0.82	17	44.3
Andesite Porphyry	L223	131	701-22-103	1.2	708	2.55	22.5	26.3	480	17	6.325	91.46	0.007	38605	0.61	9.7	1.8	3.84	2.6	318.02	0.25	0.394	0.46	14.69	1494	1.1	0.15	4.8	87	1.2	7.7	1.01	94	43.8
Andesite Porphyry	L223	137	701-22-104	1.9	1460	4.25	28.32	11.7	651	15.5	7.295	105.51	0.003	4294	0.31	13.9	0.6	5.92	1.1	58.04	0.35	0.743	0.4	18.33	2922	1.09	0.35	4.42	117	1.5	22.58	2.29	452	91
Andesite Porphyry	L223	142.1	701-22-105	1.6	1262	4.2	23.92	8.2	733	16.5	6.562	111.81	0.003	13244	0.51	10.7	0.5	4.34	1.5	23.89	0.35	0.458	0.84	18.47	2702	0.81	0.23	5.4	103	1.7	14.33	1.6	74	86.2
Andesite Porphyry	L223	150	701-22-106	4.1	21636	3.99	22.7	6.5	619	9.4	6.171	86.41	0.002	11382	0.13	11.7	0.7	3.99	0.6	342.38	0.31	0.433	0.05	16.36	2651	0.49	0.21	3.62	103	1.3	13.46	1.4	42	70.5
Andesite Porphyry	L223	156	701-22-107	5.1	19585	4	22.47	5.6	645	9.2	6.135	71.47	0.002	7493	0.26	11.6	0.5	3.99	0.6	303.81	0.31	0.425	0.25	16.19	2590	0.44	0.21	3.45	102	1.7	13.06	1.33	33	71
Andesite Porphyry	L223	164.55	701-22-108	3.9	23723	3.91	20.6	6.2	595	7.3	5.698	63.44	0.003	391	0.13	10.7	0.5	3.73	0.4	401.43	0.32	0.42	0.05	15.55	2457	0.36	0.2	3.3	97	1.8	11.81	1.33	24	56.9
Andesite Porphyry	L223	170	701-22-109	3.8	23048	4.2	24.16	6.1	630	5.1	6.763	71.21	0.003	213	0.24	10.9	0.6	4.18	0.5	371.97	0.32	0.438	0.05	16.49	2525	0.37	0.21	3.38	88	2.2	12.87	1.4	22	55
Andesite Porphyry	L223	178.05	701-22-110	2.1	22177	4.1	23.14	5.7	681	4.9	6.265	79.73	0.003	421	0.2	11.4	0.5	3.98	0.5	354.98	0.32	0.399	0.05	16.7	2526	0.36	0.2	3.86	93	2.5	11.96	1.31	23	63.1
Andesite Porphyry	L223	184	701-22-111	8.1	8201	3.29	26.3	6	613	16.8	7.388	68.04	0.003	966	0.18	9.8	0.8	4.43	1.1	167.06	0.26	0.477	0.1	14.45	2112	0.45	0.21	3.29	84	2.6	13.76	1.41	73	40.8
Andesite Porphyry	L223	191.95	701-22-112	4.1	10930	3.86	21.97	7.2	627	10.6	5.917	89.2	0.004	655	0.14	13.2	0.5	3.95	1	227.9	0.29	0.423	0.05	15	2836	0.59	0.2	3.1	111	1.9	12.59	1.31	56	51.5
Andesite Porphyry	L223	198	701-22-113	2.8	2831	4.12	22.85	6	675	6.7	6.264	95.27	0.002	965	0.19	10.5	0.5	3.89	0.5	79.63	0.32	0.397	0.05	17.14	2490	0.69	0.2	2.71	92	1.1	11.86	1.41	56	54.2
Andesite Porphyry	L223	206.5	701-22-114	5.3	14640	4.09	20.3	6.1	615	8	5.66	59.35	0.005	316	0.14	9.9	0.5	3.63	0.5	152.79	0.33	0.391	0.05	14.6	2431	0.41	0.18	2.94	92	1.6	10.7	1.3	44	38.8
Andesite Porphyry	L223	212	701-22-115	48.7	10375	3.89	21.94	9.6	583	29.3	6.034	65.77	0.016	2737	0.33	11.6	0.5	3.98	1	159.5	0.3	0.441	0.05	15.3	2117	0.42	0.22	3.52	81	2.3	12.85	1.37	74	39.2
Andesite Porphyry	L223	220.05	701-22-116	6	17734	3.94	24.96	5.3	568	19	6.748	77.81	0.002	4697	0.23	13.6	0.5	4.6	0.8	313.55	0.31	0.479	0.35	16.25	2436	0.44	0.23	3.61	97	2.7	14.94	1.49	41	68.1
Andesite Porphyry	L223	231.2	701-22-117	4.5	17118	3.88	18.27	5.3	505	4.7	5.027	75.64	0.003	4154	0.25	11.4	0.5	3.52	0.6	341.74	0.3	0.406	0.19	12.77	2290	0.49	0.2	3.26	95	1.5	11.61	1.42	30	66.1
Andesite Porphyry	L223	240.4	701-22-118	2.5	9704	3.38	21.98	12.3	543	14.1	5.892	86.41	0.004	14538	0.39	11.1	0.9	3.92	1.5	176.44	0.3	0.415	0.32	15.01	2035	0.61	0.19	3.51	90	1.4	10.92	1.28	601	74
Fault Breccia	L223	244	701-22-119	1.4	961	4.11	32.63	3.1	975	51.1	8.261	49.82	0.003	10730	0.64	16.1	0.7	6.56	1.6	628.18	0.34	0.96	0.31	19.32	2320	0.46	0.52	4.55	117	2.5	34.07	3.27	62	95.6
Andesite Porphyry	L223	319.3	701-22-120	1.5	1485	5.18	31.27	0.7	547	15.4	8.549	51.13	0.002	3754	0.36	9.2	0.5	5.09	0.6	194.12	0.41	0.464	0.2	21.91	1856	0.27	0.33	5.48	84	1	16.57	2.06	34	68.5
Andesite Porphyry	L223	325.4	701-22-121	1.1	712.5	5.05	22.585	1	153	19.15	6.391	55.545	0.002	5225	0.51	5.8	0.5	3.98	0.8	40.21	0.41	0.3875	0.14	22.235	1924	0.325	0.175	3.67	44.5	1.05	11.1	1.22	20	50.4
Fault Breccia	L223	340.3	701-22-122	1.5	663	4.75	27.49	3.1	530	50.5	7.444	52.21	0.002	9578	1.05	8.4	0.5	4.44	1	369.97	0.39	0.596	0.06	20.6	2039	0.37	0.49	16.98	55	1.5	38.62	3.07	27	78.5
Pyroclastic	L087	6	701-22-123	4.3	1071	1.43	16.05	1.6	405	71.1	4.573	1.97	0.002	19034	3.63	3.7	3.9	2.43	10.6	249.34	0.13	0.169	0.26	11.64	626	0.02	0.07	2.62	34	5.1	3.78	0.5	4	32.5
Pyroclastic	L087	16	701-22-124	2.3	417	1.34	9.76	0.7	192	101.5	2.826	2.06	0.002	1955	3.35	1.8	5.7	1.42	5.9	123.17	0.1	0.107	0.09	9.26	690	0.02	0.07	2.12	8	5.6	3.11	0.51	5	33.2
Pyroclastic	L087	26	701-22-125	4.3	1815	1.2	19.91	1.4	552	146.7	5.343	1.84	0.002	29384	1.53	5.2	1.8	3.21	7.6	338.37	0.11	0.186	0.14	13.13	551	0.02	0.07	3.02	54	2.4	3.09	0.52	4	29.4
Pyroclastic	L087	36	701-22-126	4.4	1468	2.78	18.85	0.5	582	137.7	5.278	1.56	0.002	22510	4.34	8	0.8	3.1	4.3	185.87	0.23	0.224	0.16	13.89	1390	0.02	0.09	3.65	53	3.8	3.66	0.71	2	53.7
Pyroclastic	L087	46	701-22-127	5.3	1233	2.37	18.04	0.5	620	300.2	4.817	1.29	0.002	14386	2.9	8.1	1	3.31	3.8	237.45	0.19	0.236	0.19	16.07	1023	0.02	0.08	4.26	71	1.9	3.79	0.62	3	36.3
Andesite Porphyry	L087	56	701-22-128	3.9	1965	2.69	25.8	0.5	598	149.3	7.126	1.98	0.002	30423	2.72	6.2	5.5	4.33	8.6	394.6	0.24	0.257	0.31	16.07	1409	0.02	0.11	4.2	89	6.2	4.88	0.92	4	46.1
Fault Breccia	L087	66	701-22-129	4.9	1141	1.69	20.6	1.5	517	100.8	6.013	1.71	0.002	19794	2.92	3.7	3.2	3.62	8.5	520.91	0.16	0.253	0.36	13.92	785	0.02	0.1	3.92	43	6.7	4.6	0.85	5	43
Andesite Porphyry	L087	76	701-22-130	5.4	1718	1.6	15.02	0.5	517	116	4.221	1.85	0.002	25873	7.63	4.9	5.1	2.53	13.1	560.48	0.15	0.182	0.33	13.24	816	0.03	0.08	3.32	57	6.2	3.96	0.65	3	37.6
Andesite Porphyry	L087	86	701-22-131	3.1	1456	0.92	15.54	0.8	470	121.8	4.424	2	0.002	24534	3.13	3.8	5.3	2.31	4.8	380.29	0.08	0.11	0.78	12.78	318	0.02	0.05	2.58	76	2.8	2.1	0.35	4	23.4
Andesite Porphyry	L087	96	701-22-132	7.9	993	2.34	15.81	0.5	589	143.3	4.439	2.5	0.002	18329	5.15	6.2	1.4	2.82	2.2	189.88	0.23	0.199	8.89	19.49	795	0.04	0.07	3.94	72	1.6	3.08	0.73	2	42.6
Andesite Porphyry	L087	106	701-22-133	2.4	632	1.74	20.36	1.3	584	76.4	5.807	15.41	0.002	8216	0.72	6.8	3.9	3.51	1.7	173.53	0.15	0.279	0.41	18.51	696	0.18	0.11	4.08	61	0.9	6.14	0.84	18	36.5
Andesite Porphyry	L087	116	701-22-134	2.5	937	0.99	22.42	0.5	784	160.9	6.625	1.75	0.003	11383	3.55	4.6	3.5	3.53	4.8	527.27	0.1	0.213	0.68	24.88	508	0.04	0.05	3.96	58	1.4	2.91	0.41	6	21.9
Andesite Porphyry	L087	126	701-22-135	1.7	2035	0.83	21.97	0.5	792	124.4	6.059	2.64	0.002	17192	1.19	6.3	4.2	3.3	1.8	576.39	0.09	0.161	0.37	19.68	301	0.04	0.06	2.85	65	0.9	2.86	0.46	7	30
Andesite Porphyry	L087	134	701-22-136	1.5	391	3.25	19.27	0.7	515	37.4	5.505	110.84	0.002	1126	0.62	10.6	0.5	3.33	1.4	709.9	0.29	0.41	0.52	25.25	1496	1.01	0.19	5.78	93	1.6	9.79	1.67	17	60.4
Andesite Porphyry	L087	144	701-22-137	1.4	478	2.9	9.58	11.9	627	252.2	2.785	123.21	0.006	26473	0.31	13.7	0.5	1.79	0.5	129.28	0.25	0.301	0.22	19.99	1576	1.44	0.21	6.78	103	1.8	10	1.24	368	48.3
Andesite Porphyry	L087	158	701-22-138	1.4	460	4.08	27.11	3.9	480	56.9	7.61	140.88	0.002	7422	0.26	9.9	0.5	4.43	0.8	89.43	0.32	0.492	0.19	25.26	2334	1.38	0.24	4.98	88	1.3	13.94	1.57	194	50.7
Andesite Porphyry	L087	170	701-22-139	1.4	454	4.92	40.86	1.8	408	18.6	11.334	87.11	0.002	7696	0.29	14.3	0.5	7	0.8	120.71	0.4	0.744	0.05	32.63	3217	0.69	0.31	5.36	125	2.4	18.33	2.25	35	71.3
Andesite Porphyry	L087	184	701-22-140	1.2	435	4.38	32.23	6	287	25.1	9.102	117.2	0.002	12440	0.22	10.3	0.5	5.24	0.6	81.29	0.35	0.461	0.2	28.69	2475	0.86	0.17	5.4	90	1.4	9.69	1.22	29	59.9
Andesite Porphyry	L087	200	701-22-141	1.6	477	3.67	31.44	4.95	515.5	64.05	8.877	99.85	0.002	12217	0.51	8.45	0.5	4.625	0.55	123.605	0.305	0.2625	0.125	28.59	2060	0.995	0.12	5.315	79	1.35	5.93	0.89	39.5	51
Andesite Porphyry	L087	210	701-22-142	0.6	383	3.6	43.44	4	1214	9.3	11.54	69.96	0.002	903	0.21	9.3	0.5	7.68	0.5	131.86	0.32	0.49	0.05	27.88	1991	0.69	0.18	3.54	89	1	9.99	1.31	37	48.8
Andesite Porphyry	L087	216	701-22-143	1.8	762	3.54	11.18	7	287	181.7	3.527	111.76	0.003	29401	0.62	11.7	1.3	1.52	0.8	67.83	0.3	0.181	0.6	23.4	2074	1.18	0.13	4.61	94	1.6	6.85	0.95	87	46.4
Andesite Porphyry	L087	252	701-22-144	1.4	2620	2	13.82	1.8	654	173.7	3.807	2.73	0.003	114418	0.87	6.3	1	2.42	1.4	548.88	0.16	0.195	0.2	8.05	1396	0.04	0.04	2.64	74	4.1	2.85	0.37	5	23.7
Andesite Porphyry	L087	262	701-22-145	1.3	1705	1.51	9.08	4.5	363	82.2	2.489	2	0.002	220491	2.22	2.2	2.7	1.63	5.2	209.14	0.13	0.104	0.77	6.95	600	0.1	0.04	1.56	37	4.3	1.77	0.31	6	17.5
Andesite Porphyry	L087	272	701-22-146	1.4	2150	2.25	14.35	8.3	506	51.2	4.059	1.68	0.002	85164	2.54	6.2	1.5	2.24	3.9	562.61	0.21	0.15	0.7	12.25	958	0.06	0.05	3.07	68	2.1	2.68	0.46	3	30.7
Andesite Porphyry	L087	292	701-22-147	2	845	2.91	11.52	8.2	705	54.7	3.233	38.16	0.002	39914	0.75	8.2	3	2.16	1.3	329.72	0.25	0.226	1.3	22.25	1674	0.48	0.1	4.94	98	1.6	5.47	0.74	18	40
Hydrothermal Breccia	L087	330	701-22-148	46.8	2568	0.65	14.07	14.6	574	70	4.072	2.22	0.044	124586	1.55	7.6	2.4	1.63	5.5	451.39	0.05	0.06	0.48	11.55	405	0.07	0.02	0.88	73	2.7	1.11	0.16	3	7
Andesite Porphyry	L087	349.7	701-22-149	1.9	550	4.3	17.29	10.6	290	68.4	5.368	115.42	0.003	22144	1.16	9.5	1.2	2.54	0.8	109.22	0.54	0.226	1.08	25.83	2569	1.38	0.13	5.02	80	2.2	6.84	0.93	33	58.1
Andesite Porphyry	L087	340	701-22-150	1.4	626	4.08	22.32	13	727	22.2	5.82	3.17	0.002	53792	1.35	10.2	2.3	4.06	2.2	367.62	0.35	0.316	0.9	23.72	2301	0.3	0.1	6.99	104	6.8	5.22	0.73	13	49.3

APPENDIX D

Geochemical Abundance Index Results

Knight Piésold CONSULTING

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Andesite Porphyry	LS001	25.00	701-22-001	3	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0
Andesite Porphyry	LS001	65.50	701-22-003	3	0	2	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	89.25	701-22-004	3	0	2	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	2	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	136.75	701-22-006	3	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	185.00	701-22-007	3	0	6	0	0	0	6	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
Dyke	LS001	221.65	701-22-008	1	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS001	290.75	701-22-010	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	3	0	2	0	0	0	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	3	0	1	0	0	0	6	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	2	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	2	0	5	0	0	0	5	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	4	0	0	0	4	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	LS002	94.30	701-22-016	1	0	0	0	1	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Breccia	LS002	104.13	701-22-017	1	0	3	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	2	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	148.40	701-22-019	1	0	3	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS002	355.80	701-22-020	1	0	0	0	1	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	LS002	373.00	701-22-021	4	0	3	0	0	0	4	0	3	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0
Andesite Porphyry	LS002	422.50	701-22-022	2	0	1	0	0	0	3	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	1	0	1	0	0	0	3	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	448.85	701-22-024	4	0	4	0	0	0	3	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	472.85	701-22-025	1	0	1	0	1	0	1	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	21.30	701-22-026	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	1	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	74.30	701-22-028	1	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	97.00	701-22-029	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	1	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	3	0	4	0	0	0	4	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	170.02	701-22-033	2	0	3	0	0	0	5	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	182.40	701-22-034	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	2	0	4	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	1	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	2	0	2	0	0	0	6	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	330.20	701-22-039	2	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Feldspar Porphyry	LS003	353.35	701-22-041	1	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	3	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	4	0	4	0	0	0	3	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS004	69.25	701-22-048	1	0	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	110.45	701-22-049	3	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	4	0	4	0	0	0	5	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0
Diorite Porphyry	LS005	28.40	701-22-051	2	0	2	0	0	0	4	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	4	0	1	0	0	0	5	0	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	0
Breccia	LS005	133.90	701-22-054	4	0	4	0	0	0	5	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS006	34.30	701-22-056	1	0	1	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	1	0	4	0	1	0	3	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	1	0	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	2	0	1	0	0	0	1	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0
Breccia	LS006	140.40	701-22-060	3	0	3	0	0	0	4	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Porphyry	LK002	16.05	701-22-061	2	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	3	0	5	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	133.30	701-22-064	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	1	0	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK003	54.90	701-22-067	4	0	3	0	0	0	5	0	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK003	108.60	701-22-068	4	0	4	0	0	0	6	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Pyroclastic	LK003	128.70	701-22-069	3	0	3	0	0	0	5	0	5	0	0	0	1	1	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
Tuff	LK003	145.60	701-22-070	3	0	3	0	0	0	4	0	4	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	1	0	1	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Breccia	LK004	81.52	701-22-073	1	0	3	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Andesite Porphyry	LK004	104.71	701-22-074	4	0	6	0	0	0	5	0	6	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	3	0	0
Diorite Porphyry	LK004	137.51	701-22-075	5	0	5	0	0	0	5	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK006	45.20	701-22-076	4	0	6	0	0	0	3	0	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	1	0	2	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	129.70	701-22-078	3	0	6	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0
Breccia	LK006	145.70	701-22-079	4	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LK006	165.86	701-22-080	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	3	0	4	0	0	0	6	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	2	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	2	0	1	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	11.00	701-22-084	2	0	2	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	17.70	701-22-085	1	0	3	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	23.40	701-22-086	1	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	28.90	701-22-087	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	34.90	701-22-088	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0
Andesite Porphyry	L013	41.25	701-22-089	1	0	1	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	47.70	701-22-090	2	0	4	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	52.90	701-22-091	1	0	1	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	58.80	701-22-092	4	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	69.00	701-22-093	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Hydrothermal Breccia	L013	75.00	701-22-094	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	6	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	86.55	701-22-096	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L013	93.25	701-22-097	2	0	5	0	0	0	6	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	100.40	701-22-098	6	0	6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	1	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	2	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	199.75	701-22-101	2	0	5	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Fault Breccia	L223	121.75	701-22-102	3	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	3	0	3	0	0	0	5	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	1	0	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	L223	142.10	701-22-105	2	0	2	0	0	0	3	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	1	1	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	212.00	701-22-115	1	0	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L223	220.05	701-22-116	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	2	0	2	0	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Fault Breccia	L223	244.00	701-22-119	0	0	2	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	1	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	2	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	2	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	16.00	701-22-124	3	0	2	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	3	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	36.00	701-22-126	1	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	46.00	701-22-127	1	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	56.00	701-22-128	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L087	66.00	701-22-129	2	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	76.00	701-22-130	3	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	86.00	701-22-131	2	0	5	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	1	0	5	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L087	106.00	701-22-133	2	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	2	0	3	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	2	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	2	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	1	0	3	0	0	0	2	0	4	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	158.00	701-22-138	1	0	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	2	0	4	0	0	0	4	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	3	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	3	0	5	0	0	0	6	0	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	4	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	1	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	4	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L087	349.70	701-22-149	1	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Andesite Porphyry	LS001	25.00	701-22-001	0	0	0	0	4	0	0	2	5	0	0	4	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS001	65.50	701-22-003	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	2	0
Andesite Porphyry	LS001	89.25	701-22-004	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Dyke	LS001	136.75	701-22-006	0	0	0	0	2	0	0	2	6	0	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Dyke	LS001	185.00	701-22-007	0	0	0	0	4	0	0	2	6	4	0	6	0	0	1	0	0	6	0	0	3	0	1	0	2	0	0	0	0
Dyke	LS001	221.65	701-22-008	0	0	0	0	3	0	0	4	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	0	0	3	0	0	5	5	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	290.75	701-22-010	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	0	0	0	0	2	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	0	0	0	0	1	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	1	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	0	0	0	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	0	0	0	0	1	0	0	6	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	0	0	1	0	0	6	6	3	0	6	0	2	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS002	94.30	701-22-016	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS002	104.13	701-22-017	0	0	0	0	1	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	0	0	0	0	0	6	6	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	148.40	701-22-019	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Diorite Porphyry	LS002	355.80	701-22-020	0	0	0	0	0	0	0	4	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0
Andesite Porphyry	LS002	373.00	701-22-021	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	422.50	701-22-022	0	0	0	0	2	0	0	4	6	0	0	4	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	0	0	0	0	1	0	0	5	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	448.85	701-22-024	0	0	0	0	4	0	0	5	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	472.85	701-22-025	0	0	0	0	0	0	0	6	4	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	1	0
Andesite Porphyry	LS003	21.30	701-22-026	0	0	0	0	2	0	0	2	4	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	74.30	701-22-028	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	97.00	701-22-029	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	0	0	0	0	1	0	0	3	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	170.02	701-22-033	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	182.40	701-22-034	0	0	0	0	0	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	0	0	0	0	2	0	0	3	6	3	0	5	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	0	0	0	0	1	0	0	3	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	330.20	701-22-039	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	0	0	2	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Feldspar Porphyry	LS003	353.35	701-22-041	0	0	0	0	2	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	0	0	2	0	0	4	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	0	2	6	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	0	0	0	0	1	0	0	3	6	3	0	5	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	0	0	0	0	3	0	0	2	6	2	0	3	0	0	0	0	0	5	0	0	1	0	0	0	2	0	0	5	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS004	69.25	701-22-048	0	0	0	0	3	0	0	2	5	1	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	4	0
Andesite Porphyry	LS004	110.45	701-22-049	0	0	0	0	2	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	0	0	0	0	3	0	0	2	6	3	0	5	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS005	28.40	701-22-051	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	3	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	4	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	0	0	0	0	5	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LS005	133.90	701-22-054	0	0	0	0	3	0	0	5	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	34.30	701-22-056	0	0	0	0	0	0	0	3	5	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	0	0	0	0	1	0	0	2	5	0	0	3	0	0	0	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	0	0	0	0	4	0	0	2	5	0	0	3	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	4	0
Breccia	LS006	140.40	701-22-060	0	0	0	0	5	0	0	2	6	1	0	3	0	0	1	0	0	6	0	0	1	0	1	0	0	0	0	3	0
Porphyry	LK002	16.05	701-22-061	0	0	0	0	0	0	0	2	5	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	0	0	0	0	2	0	0	3	6	4	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Porphyry	LK002	133.30	701-22-064	0	0	0	0	3	0	0	6	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	0	0	0	0	3	0	0	6	6	2	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	0	0	2	0	0	3	6	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	1	0	0	4	0
Breccia	LK003	54.90	701-22-067	0	0	0	0	1	0	0	2	6	2	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LK003	108.60	701-22-068	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Pyroclastic	LK003	128.70	701-22-069	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Tuff	LK003	145.60	701-22-070	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	3	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0
Breccia	LK004	81.52	701-22-073	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LK004	104.71	701-22-074	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	5	0
Diorite Porphyry	LK004	137.51	701-22-075	0	0	0	0	3	0	0	2	6	4	0	5	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	1	0
Breccia	LK006	45.20	701-22-076	0	0	1	0	2	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	0	0	0	0	1	0	0	2	6	2	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	3	0
Andesite Porphyry	LK006	129.70	701-22-078	0	0	0	0	3	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	1	0	2	0	0	1	0
Breccia	LK006	145.70	701-22-079	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	2	0
Diorite Porphyry	LK006	165.86	701-22-080	0	0	0	0	3	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	0	0	0	0	3	0	0	2	6	3	0	4	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	0	0	0	0	1	0	0	5	4	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	11.00	701-22-084	0	0	0	0	2	0	0	5	6	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	17.70	701-22-085	0	0	0	0	3	0	0	5	5	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	23.40	701-22-086	0	0	0	0	1	0	0	4	5	0	0	5	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	28.90	701-22-087	0	0	0	0	1	0	0	6	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	34.90	701-22-088	0	0	0	0	0	0	0	3	6	0	0	5	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L013	41.25	701-22-089	0	0	0	0	0	0	0	2	6	0	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	47.70	701-22-090	0	0	0	0	2	0	0	2	5	0	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	52.90	701-22-091	0	0	0	0	1	0	0	4	5	0	0	6	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	58.80	701-22-092	0	0	0	0	3	0	0	2	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	69.00	701-22-093	0	0	0	0	0	0	0	4	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Hydrothermal Breccia	L013	75.00	701-22-094	0	0	0	0	3	0	0	3	6	3	0	6	0	1	1	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	0	0	0	0	3	0	0	3	6	1	0	6	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	86.55	701-22-096	0	0	0	0	4	0	0	3	6	2	0	6	0	0	0	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Fault Breccia	L013	93.25	701-22-097	0	0	0	0	3	0	0	3	5	3	0	6	0	0	2	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Hydrothermal Breccia	L013	100.40	701-22-098	0	0	0	0	4	0	0	3	6	3	0	6	0	0	1	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	0	0	0	0	0	6	6	0	0	5	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	0	0	0	0	0	6	6	0	0	6	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	199.75	701-22-101	0	0	0	0	1	0	0	6	6	0	0	6	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Fault Breccia	L223	121.75	701-22-102	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	0	0	0	0	0	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	142.10	701-22-105	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	0	0	0	0	3	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	212.00	701-22-115	0	0	0	0	0	0	0	5	3	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	220.05	701-22-116	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	0	0	0	0	0	3	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Fault Breccia	L223	244.00	701-22-119	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	0	0	1	0	0	2	5	2	0	3	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	0	0	0	0	2	0	0	2	6	4	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	16.00	701-22-124	0	0	0	0	2	0	0	2	2	3	0	6	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	0	0	0	0	3	0	0	2	6	2	0	5	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	36.00	701-22-126	0	0	0	0	3	0	0	2	6	4	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	46.00	701-22-127	0	0	0	0	4	0	0	2	5	3	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	56.00	701-22-128	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Fault Breccia	L087	66.00	701-22-129	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	76.00	701-22-130	0	0	0	0	2	0	0	2	6	5	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	86.00	701-22-131	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	106.00	701-22-133	0	0	0	0	2	0	0	2	4	1	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	0	0	0	0	3	0	0	2	5	4	0	6	0	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	0	0	0	0	3	0	0	2	5	2	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	0	0	0	0	1	0	0	2	2	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	0	0	0	0	4	0	0	3	6	0	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L087	158.00	701-22-138	0	0	0	0	1	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	5	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	0	0	2	0	0	2	5	1	0	3	0	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	0	0	3	0	0	2	6	2	0	4	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	0	0	1	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	0	0	0	0	1	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	0	0	2	0	0	6	6	2	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	349.70	701-22-149	0	0	0	0	2	0	0	2	6	2	0	4	0	0	0	0	0	6	1	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	0	0	0	0	0	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0

APPENDIX E

Distilled Water Extract Results

Knight Piésold CONSULTING

Appendix E

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl	Co	Cr	Cu	EC	F	Fe-Sol	Hg	K	Mg
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
Andesite Porphyry	LS001	25	701-22-001	0.00003	0.69	0.0001	0.02	0.01	0.0001	0.000005	7.8	0.003	8	0.01	0.01	**1.7**	257	0.1	0.08	0.0001	16.9	6.4
Andesite Porphyry	LS001	122	701-22-005	0.00006	0.55	0.0003	0.02	0.01	0.0026	0.000213	8.73	0.001	6	0.03	0.01	0.05	511	0.1	0.19	0.0001	22.9	18.6
Dyke	LS001	221.65	701-22-008	0.00001	3.18	0.006	0.02	0.03	0.0006	0.001998	14	**0.062**	17	0.55	0.01	**17.91**	438	0.2	1.94	0.0001	2.5	13.9
Andesite Porphyry	LS001	249.15	701-22-009	0.00001	0.49	0.0024	0.03	0.01	0.0001	0.000065	1.52	0.0005	84	0.01	0.01	0.15	560	0.6	0.07	0.0001	18.7	6.3
Andesite Porphyry	LS001	368.85	701-22-012	0.00021	0.4	0.0002	0.02	0.02	0.001	0.000088	7.1	0.009	191	0.16	0.01	**4.4**	1242	0.2	0.11	0.0001	29.4	23.2
Andesite Porphyry	LS001	423.5	701-22-015	0.00001	2.04	0.0004	0.01	0.02	0.0005	0.000005	11.94	0.003	47	0.35	0.01	**15.46**	466	0.2	**2.6**	0.0001	3.4	10.4
Andesite Porphyry	LS002	128.6	701-22-018	0.00001	0.23	0.0011	0.02	0.03	0.0001	0.000007	7.45	0.009	25	0.10	0.01	**2.07**	449	0.1	0.1	0.0001	22.4	14.2
Andesite Porphyry	LS002	148.4	701-22-019	0.00001	0.5	0.0039	0.02	0.03	0.0002	0.000005	9.36	0.002	32	0.15	0.01	**9.94**	549	0.1	0.19	0.0001	23.9	17.2
Diorite Porphyry	LS002	355.8	701-22-020	0.00007	3.5	0.0074	0.04	1.18	0.0008	0.000097	4.03	0.0004	74	0.002	0.01	0.3	672	1.5	**4.52**	0.0001	4.2	6.6
Andesite Porphyry	LS002	435.3	701-22-023	0.00005	0.06	0.0037	0.10	0.02	0.0002	0.000014	10.74	0.009	278	0.10	0.01	**4.58**	1370	0.2	0.12	0.0001	34.5	25.9
Andesite Porphyry	LS003	70	701-22-027	0.00001	1.81	0.0026	0.01	0.03	0.0005	0.000058	22.86	0.008	4	0.24	0.01	**0.36**	433	0.5	0.78	0.0001	26.4	15.4
Andesite Porphyry	LS003	131.7	701-22-031	0.00001	1.28	0.0029	0.01	0.01	0.0009	0.000025	17.8	0.008	22	0.30	0.01	**1.9**	548	0.2	0.83	0.0001	19.6	27.2
Breccia	LS003	146.75	701-22-032	0.00004	1.07	0.0035	0.18	0.01	0.0008	0.000028	17.09	0.010	26	0.46	0.01	**3.33**	644	0.2	1.23	0.0001	24.8	28.7
Diorite Porphyry	LS003	170.02	701-22-033	0.00001	0.52	0.002	0.17	0.02	0.0003	0.000036	11.4	0.003	12	0.12	0.01	**0.62**	509	0.1	0.64	0.0001	26.8	20.9
Andesite Porphyry	LS003	330.2	701-22-039	0.00003	0.9	0.0021	0.17	0.01	0.0006	0.000005	18.19	0.004	61	0.73	0.01	**2.93**	832	0.2	0.4	0.0001	26.8	32.0
Feldspar Porphyry	LS003	353.35	701-22-041	0.00002	0.08	0.0017	0.10	0.004	0.0001	0.000005	19.39	0.004	55	0.28	0.01	0.045	496	0.1	0.05	0.0001	9.0	16.5
Porphyry	LS003	410.9	701-22-044	0.00005	0.34	0.0027	0.12	0.01	0.0002	0.000005	25.48	**0.029**	286	**1.44**	0.01	**1.11**	1179	0.2	0.09	0.0001	14.2	33.9
Andesite Porphyry	LS004	30.21	701-22-046	0.00001	0.08	0.0016	0.28	0.02	0.0001	0.000005	25.78	**0.043**	73	0.02	0.03	0.05	1000	0.4	0.01	0.0001	50.1	24.7
Andesite Porphyry	LS004	110.45	701-22-049	0.00003	0.13	0.0024	0.25	0.01	0.0029	0.000016	10.46	0.001	99	0.03	0.01	**2.38**	905	0.1	0.05	0.0001	41.7	13.2
Diorite Porphyry	LS005	50.1	701-22-052	0.00007	0.45	0.0039	0.04	0.06	0.0001	0.000005	6.85	0.00002	23	0.001	0.01	0.01	344	0.6	0.02	0.0001	15.8	7.9
Diorite Porphyry	LS005	141.4	701-22-055	0.00009	0.11	0.0019	0.04	0.03	0.0001	0.000005	9.18	0.00003	236	0.002	0.01	0.01	1169	0.4	0.03	0.0001	24.8	17.9
Andesite Porphyry	LS006	127.6	701-22-059	0.00001	0.21	0.0014	0.07	0.01	0.0001	0.000005	9.39	0.006	97	0.03	0.01	0.01	874	0.3	0.05	0.0001	37.4	21.6
Breccia	LS006	140.4	701-22-060	0.00012	0.39	0.0022	0.05	0.01	0.0017	0.000013	8.99	0.006	175	0.09	0.01	**0.83**	1022	0.2	0.07	0.0001	37.9	19.7
Porphyry	LK002	133.3	701-22-064	0.00001	2.81	0.001	0.03	0.0005	0.0002	0.000005	10.44	0.005	33	0.12	0.01	**9.6**	335	0.1	**3.04**	0.0001	4.8	7.6
Breccia	LK003	54.9	701-22-067	0.00003	**17.83**	0.0077	0.04	0.02	0.002	0.00002	11.02	**0.269**	17	0.70	0.01	**14.94**	598	0.1	**7.34**	0.0001	20.2	10.9
Hornblende Porphyry	LK004	51.23	701-22-071	0.00003	3.24	0.0056	0.04	0.23	0.0008	0.000057	8.83	0.0001	27	0.001	0.01	0.02	499	0.1	1.98	0.0001	5.5	7.6
Breccia	LK004	71.63	701-22-072	0.00008	1.38	0.0049	0.02	0.07	0.0002	0.000007	8.4	0.00002	115	0.002	0.01	0.01	925	0.4	0.44	0.0001	17.5	5.3
Tuff	LK006	191.35	701-22-081	0.00007	**68.74**	0.0213	0.01	0.003	0.0016	0.000409	23.80	0.001	31	**3.39**	0.10	**13.87**	2302	0.1	**249.7**	0.0001	21.3	40.5
Andesite Porphyry	L013	11	701-22-084	0.00001	0.02	0.001	0.03	0.02	0.0001	0.000005	12.95	0.00002	30	0.001	0.01	0.11	328	0.3	0.03	0.0001	18.4	14.0
Andesite Porphyry	L013	34.9	701-22-088	0.00003	0.99	0.0011	0.01	0.01	0.0001	0.000005	4.91	0.0001	13	0.003	0.01	**3.06**	245	0.1	0.13	0.0001	23.1	4.4
Andesite Porphyry	L013	69	701-22-093	0.00002	3.12	0.0016	0.01	0.03	0.0002	0.000016	9.56	0.0004	5	0.04	0.01	**25.25**	437	0.1	0.18	0.0001	30.1	6.6
Hydrothermal Breccia	L013	75	701-22-094	0.00002	1.02	0.001	0.01	0.03	0.0001	0.000005	18.3	0.001	15	0.02	0.01	**1.91**	324	0.1	0.19	0.0001	9.6	7.7
Fault Breccia	L013	93.25	701-22-097	0.00002	0.45	0.001	0.01	0.01	0.0001	0.000005	12.73	0.001	56	0.01	0.01	**1.15**	523	0.1	0.03	0.0001	6.1	15.3
Andesite Porphyry	L013	127.55	701-22-099	0.00018	**7.37**	0.0023	0.01	0.06	0.0013	0.000005	29.14	0.004	7	0.27	0.01	**61.14**	956	0.2	**2.16**	0.0001	22.0	46.6
Andesite Porphyry	L223	156	701-22-107	0.00002	0.08	0.002	0.02	0.01	0.0001	0.000005	27.63	0.0001	12	0.002	0.01	0.02	869	0.3	0.01	0.0001	9.4	12.8
Andesite Porphyry	L223	170	701-22-109	0.00004	2.84	0.0022	0.02	0.10	0.0003	0.000011	6.54	0.00002	28	0.002	0.01	0.01	396	0.3	0.7	0.0001	5.0	2.7
Andesite Porphyry	L223	184	701-22-111	0.00001	2.92	0.0071	0.06	0.17	0.0005	0.000166	11.6	0.00006	27	0.001	0.01	0.08	546	0.9	0.86	0.0001	8.1	5.5
Andesite Porphyry	L223	206.5	701-22-114	0.00001	2.32	0.0015	0.04	0.10	0.0002	0.000034	7.85	0.00002	99	0.001	0.01	0.02	617	0.3	0.44	0.0001	11.9	2.9
Andesite Porphyry	L223	212	701-22-115	0.00004	2.74	0.0029	0.04	0.02	0.0002	0.000033	6.29	0.00002	74	0.002	0.01	0.03	590	0.4	0.56	0.0001	6.9	2.2
Andesite Porphyry	L223	325.4	701-22-121	0.00001	0.795	0.0012	0.03	0.01	0.0010	0.000005	9.2	0.0003	78	0.05	0.01	**1.22**	888	0.2	0.06	0.0001	19.7	20.4
Fault Breccia	L223	340.3	701-22-122	0.00007	**18.5**	0.0012	0.06	0.01	0.0071	0.000005	36.42	0.005	54	0.60	0.01	**51.26**	1496	0.9	1.39	0.0001	30.9	96.2
Pyroclastic	L087	6	701-22-123	0.00002	0.15	0.0026	0.01	0.03	0.0001	0.000005	28.66	0.00002	18	0.001	0.01	0.03	320	0.7	0.01	0.0001	6.1	8.8
Pyroclastic	L087	36	701-22-126	0.00002	0.09	0.0007	0.01	0.07	0.0001	0.000005	19.63	0.00004	35	0.01	0.01	0.01	339	0.4	0.01	0.0001	8.4	6.7
Andesite Porphyry	L087	76	701-22-130	0.00007	1.85	0.0012	0.01	0.05	0.0001	0.000005	23.05	0.00005	59	0.001	0.01	0.06	509	0.3	0.18	0.0001	11.9	13.6
Andesite Porphyry	L087	96	701-22-132	0.00001	0.12	0.001	0.01	0.03	0.0001	0.000005	6.71	0.00002	27	0.003	0.01	0.01	240	0.1	0.02	0.0001	5.7	6.1
Andesite Porphyry	L087	126	701-22-135	0.00003	0.04	0.001	0.01	0.01	0.0001	0.000011	7.44	0.00003	18	0.004	0.01	0.02	194	0.1	0.01	0.0001	8.8	4.2
Andesite Porphyry	L087	184	701-22-140	0.00002	**18.93**	0.0047	0.01	0.01	0.0092	0.000005	49.34	**0.012**	10	**5.49**	0.01	**0.35**	1034	0.5	**3.02**	0.0001	16.1	73.6
Andesite Porphyry	L087	272	701-22-146	0.00001	**47.16**	0.0037	0.01	0.0001	0.0008	0.000005	14.37	**0.028**	3	0.36	0.33	**130.44**	1344	0.1	**167.5**	0.0001	1.1	7.4
Andesite Porphyry	L087	292	701-22-147	0.00003	**33.36**	0.0027	0.01	0.003	0.0019	0.000005	39.62	**0.024**	7	0.92	0.02	**86.26**	1321	0.1	**35.2**	0.0001	10.6	46.1
Hydrothermal Breccia	L087	330	701-22-148	0.00001	**42.85**	0.0044	0.01	0.0004	0.0005	0.000005	10.55	0.004	2	0.14	0.18	**33.88**	1176	0.1	**241.2**	0.0001	1.3	3.9
			Average	0.0000376	**6.01**	0.003	0.05	0.05	0.0009	0.00007	14.81	**0.01**	56.60	0.35	0.02	**10.10**	716.38	0.28	**14.61**	0.00	17.49	18.03
Adopted Reference Level				0.5	5	0.1	5	N/G	N/G	N/G	1000	0.01	N/G	1	1	0.3	N/G	2	2	0.002	N/G	2000

Appendix E

Lithology	Borehole	Depth (m)	ID	Mn	Mo	Na	Ni	P	Pb	pH	S	SO4	Sb	Se	Sn	Sr	TDSEva	Th	U	V	Zn	AFP
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	NONE	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/Kg	mg/l	mg/l	mg/l	mg/l	-
Andesite Porphyry	LS001	25	701-22-001	1.3	0.00010	14.4	0.01	0.1	0.0017	5	26.2	78	0.00001	0.0011	0.0001	0.01	178	0.00005	0.0001	0.01	0.3	UC
Andesite Porphyry	LS001	122	701-22-005	1.26	0.00015	49.9	0.02	0.1	0.0018	5.2	61.2	183	0.00004	0.0112	0.0001	0.02	401	0.00021	0.0022	0.01	0.68	PAF-LC
Dyke	LS001	221.65	701-22-008	0.5	0.00029	30.3	0.14	0.3	0.0031	4.4	56.1	168	0.0007	0.0026	0.0057	0.07	362	0.00041	0.0220	0.01	0.89	PAF
Andesite Porphyry	LS001	249.15	701-22-009	0.04	0.01145	92.7	0.01	0.1	0.0006	6.6	34.2	102	0.00479	0.0015	0.0001	0.01	389	0.00025	0.0011	0.01	0.02	PAF
Andesite Porphyry	LS001	368.85	701-22-012	0.09	0.00007	239.6	0.07	0.1	0.0012	5	116.6	349	0.00024	0.022	0.0001	0.02	947	0.00007	0.0133	0.01	0.8	PAF
Andesite Porphyry	LS001	423.5	701-22-015	0.37	0.00008	43.6	0.13	0.3	0.0005	4.3	45.6	137	0.00032	0.0015	0.0001	0.15	420	0.00007	0.0146	0.01	0.45	PAF
Andesite Porphyry	LS002	128.6	701-22-018	0.25	0.00005	39.5	0.06	0.1	0.0005	4.6	48.9	146	0.00011	0.0069	0.0001	0.02	382	0.00004	0.0341	0.01	1.82	PAF
Andesite Porphyry	LS002	148.4	701-22-019	0.32	0.00005	42.9	0.11	0.2	0.0006	4.4	58.5	175	0.00054	0.005	0.0001	0.02	350	0.00014	0.0535	0.01	1.78	PAF
Diorite Porphyry	LS002	355.8	701-22-020	0.12	0.00799	132.4	0.01	0.4	0.0042	8.5	28.4	85	0.00021	0.003	0.0001	0.01	488	0.00121	0.0005	0.08	0.66	NAF
Andesite Porphyry	LS002	435.3	701-22-023	2	0.00006	243.8	0.05	0.1	0.0005	6.1	91	273	0.00004	0.0035	0.0001	0.02	1016	0.00034	0.0003	0.01	2.76	PAF
Andesite Porphyry	LS003	70	701-22-027	0.68	0.00012	12.9	0.16	0.1	0.0009	4.7	57.5	172	0.00058	0.0036	0.0001	0.07	265	0.00014	0.0052	0.01	1.63	PAF
Andesite Porphyry	LS003	131.7	701-22-031	2.1	0.00005	31.5	0.13	0.1	0.0006	4.4	71.7	215	0.00014	0.0016	0.0001	0.01	440	0.00025	0.0245	0.01	1.99	PAF
Breccia	LS003	146.75	701-22-032	2.1	0.00005	37.3	0.2	0.1	0.0017	4.1	83.8	251	0.00019	0.0021	0.0001	0.01	439	0.00019	0.0597	0.01	2.84	PAF
Diorite Porphyry	LS003	170.02	701-22-033	0.9	0.00005	36	0.04	0.1	0.001	4.5	65.1	195	0.00012	0.0014	0.0001	0.01	340	0.00029	0.0392	0.01	0.93	PAF
Andesite Porphyry	LS003	330.2	701-22-039	1.15	0.00006	85.6	0.22	0.1	0.0005	4.4	99.5	298	0.00019	0.0052	0.0001	0.01	625	0.00015	0.0264	0.01	0.61	PAF
Feldspar Porphyry	LS003	353.35	701-22-041	0.68	0.00016	46.65	0.07	0.1	0.0006	5.35	47.05	141	0.00033	0.0028	0.0001	0.04	350	0.00002	0.0053	0.01	0.695	PAF
Porphyry	LS003	410.9	701-22-044	0.57	0.0002	161.8	0.56	0.1	0.0005	5	51	153	0.00054	0.0046	0.0001	0.02	720	0.00004	0.0068	0.01	0.84	PAF-LC
Andesite Porphyry	LS004	30.21	701-22-046	19.09	0.00358	117.1	0.01	0.1	0.0066	7.2	117.6	352	0.00034	0.0013	0.0001	0.94	680	0.00001	0.0001	0.01	0.59	PAF
Andesite Porphyry	LS004	110.45	701-22-049	1.57	0.00008	140.4	0.02	0.1	0.0013	5.3	90.5	271	0.00145	0.0021	0.0001	0.35	580	0.00002	0.0021	0.01	0.98	PAF
Diorite Porphyry	LS005	50.1	701-22-052	0.01	0.01026	47.3	0.01	0.1	0.0012	8.2	29.7	89	0.00047	0.0009	0.0001	0.03	210	0.00001	0.0062	0.01	0.01	AC
Diorite Porphyry	LS005	141.4	701-22-055	1.12	0.00228	203.8	0.01	0.1	0.0007	7.3	55.1	165	0.00018	0.0025	0.0001	0.14	657	0.00001	0.0003	0.01	0.01	PAF
Andesite Porphyry	LS006	127.6	701-22-059	5.83	0.00007	122	0.02	0.1	0.0007	6.5	82.1	246	0.00002	0.0063	0.0001	0.01	443	0.00006	0.0007	0.01	0.87	PAF
Breccia	LS006	140.4	701-22-060	0.22	0.00012	163.7	0.1	0.1	0.0017	5.2	75.5	226	0.00029	0.0078	0.0001	0.02	700	0.00008	0.0036	0.01	0.95	PAF
Porphyry	LK002	133.3	701-22-064	0.4	0.00006	22.9	0.09	0.2	0.0006	4.1	34.5	103	0.00049	0.0015	0.0001	0.01	203	0.00004	0.0133	0.01	0.19	PAF
Breccia	LK003	54.9	701-22-067	1.88	0.00008	6.3	0.51	0.4	0.013	3.7	91.4	274	0.00021	0.0047	0.0001	0.01	391	0.00096	0.0315	0.01	45.3	PAF
Hornblende Porphyry	LK004	51.23	701-22-071	0.13	0.00851	124.5	0.01	0.1	0.0025	9.2	17.4	52	0.00018	0.0012	0.0001	0.05	246	0.00075	0.0023	0.06	0.01	NAF
Breccia	LK004	71.63	701-22-072	0.02	0.03562	208.2	0.01	0.1	0.0015	8.5	60.7	182	0.00038	0.0015	0.0001	0.06	620	0.00012	0.0042	0.02	0.01	AC
Tuff	LK006	191.35	701-22-081	0.41	0.00062	65.6	1.905	0.5	0.0100	2.7	419.5	1257	0.00047	0.00325	0.0001	0.03	1481	0.01840	0.0914	0.07	1.02	PAF
Andesite Porphyry	L013	11	701-22-084	0.02	0.00555	23.3	0.01	0.1	0.0006	7.3	20.3	61	0.00004	0.0023	0.0001	0.63	180	0.00008	0.0002	0.01	0.01	NAF
Andesite Porphyry	L013	34.9	701-22-088	0.05	0.00012	18.6	0.01	0.1	0.0005	5.6	23.5	70	0.00003	0.0043	0.0001	0.03	155	0.00014	0.0001	0.01	0.01	NAF
Andesite Porphyry	L013	69	701-22-093	0.19	0.00008	26.6	0.02	0.5	0.0005	4.2	55.7	167	0.00001	0.0121	0.0001	0.03	265	0.00050	0.0007	0.01	0.07	NAF
Hydrothermal Breccia	L013	75	701-22-094	0.34	0.00018	25	0.01	0.1	0.0005	5.1	36.6	110	0.00011	0.0037	0.0001	0.25	195	0.00066	0.0003	0.01	0.14	UC
Fault Breccia	L013	93.25	701-22-097	0.73	0.00005	71.5	0.01	0.1	0.0005	5.8	49.4	148	0.00003	0.0193	0.0001	0.08	331	0.00009	0.0002	0.01	0.27	UC
Andesite Porphyry	L013	127.55	701-22-099	1.49	0.00033	63.7	0.1	1.2	0.0009	4.2	164.2	492	0.00022	0.0229	0.0001	0.09	682	0.00652	0.0077	0.01	3.16	PAF
Andesite Porphyry	L223	156	701-22-107	0.02	0.06095	157.8	0.01	0.1	0.0006	8.1	134.8	404	0.00028	0.0019	0.0001	0.30	631	0.00007	0.0037	0.01	0.01	NAF
Andesite Porphyry	L223	170	701-22-109	0.05	0.14508	86.2	0.01	0.1	0.0014	9	12.2	37	0.00012	0.0017	0.0001	0.08	386	0.00062	0.0026	0.03	0.01	NAF
Andesite Porphyry	L223	184	701-22-111	0.09	0.96708	124.7	0.01	0.1	0.0054	8.8	26.8	80	0.00016	0.0596	0.0001	0.09	306	0.00043	0.0030	0.02	0.01	AC
Andesite Porphyry	L223	206.5	701-22-114	0.02	0.53322	126.5	0.01	0.1	0.0016	8.5	19.3	58	0.00011	0.0015	0.0001	0.10	352	0.00048	0.0008	0.02	0.01	AC
Andesite Porphyry	L223	212	701-22-115	0.02	1.049	123.9	0.01	0.1	0.0034	8.6	37.1	111	0.00052	0.0012	0.0001	0.07	400	0.00049	0.0017	0.01	0.01	AC
Andesite Porphyry	L223	325.4	701-22-121	0.115	0.00072	144.65	0.01	0.1	0.0006	5.3	97.75	293	0.00005	0.0027	0.0001	0.01	615	0.00004	0.0014	0.01	0.02	PAF-LC
Fault Breccia	L223	340.3	701-22-122	0.73	0.00054	164.3	0.18	0.9	0.0005	4.1	294.5	882	0.00004	0.0059	0.0001	0.08	1355	0.00022	0.9309	0.01	0.44	PAF
Pyroclastic	L087	6	701-22-123	0.01	0.01194	23.8	0.01	0.1	0.0005	7.9	25.8	77	0.00127	0.0017	0.0001	0.26	183	0.00001	0.0035	0.01	0.01	NAF
Pyroclastic	L087	36	701-22-126	0.08	0.00245	32.1	0.01	0.1	0.0018	6.8	27.6	83	0.00035	0.0012	0.0001	0.23	205	0.00003	0.0002	0.01	0.01	PAF-LC
Andesite Porphyry	L087	76	701-22-130	0.18	0.00821	57	0.01	0.1	0.0032	7.3	44.8	134	0.00188	0.0014	0.0001	0.18	403	0.00020	0.0003	0.01	0.01	PAF-LC
Andesite Porphyry	L087	96	701-22-132	0.04	0.00155	27.3	0.01	0.1	0.001	6.7	18.8	56	0.00034	0.0011	0.0001	0.16	149	0.00003	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	126	701-22-135	0.08	0.00163	18.3	0.01	0.1	0.0008	6.7	16.5	49	0.00054	0.001	0.0001	0.09	126	0.00001	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	184	701-22-140	2.11	0.00106	40.2	1.18	0.1	0.0005	3.8	198	593	0.00002	0.0027	0.0001	0.03	966	0.00058	0.0449	0.01	1.56	PAF
Andesite Porphyry	L087	272	701-22-146	0.74	0.00263	6.5	0.19	2.6	0.0006	3.1	261.9	785	0.00014	0.0028	0.0001	0.03	879	0.03736	0.0252	0.01	0.55	PAF
Andesite Porphyry	L087	292	701-22-147	2.71	0.00096	51.5	0.29	1.7	0.0005	3.4	247.9	743	0.00014	0.0079	0.0001	0.07	961	0.01012	0.0433	0.01	3.56	PAF
Hydrothermal Breccia	L087	330	701-22-148	0.58	0.00143	4.6	0.12	0.9	0.0005	3.3	242.3	726	0.00027	0.0104	0.0001	0.04	810	0.00303	0.0077	0.01	0.32	PAF
			Average	1.11	0.06	79.61	0.14	0.28	0.002	5.8	83.44	249.98	0.0004	0.01	0.0002	0.10	497	0.002	0.03	0.01	1.60	
Adopted Reference Level				N/G	0.15	N/G	0.5	N/G	0.1	6	N/G	1000	N/G	0.02	N/G	N/G	2000	N/G	0.2	N/G	0.5	

APPENDIX F

Laboratory Testing Certificates

Knight Piésold
CONSULTING

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Quantitative X-Ray Diffraction Analysis

Report Prepared for:	Tim Rowles Knight Piesold Pty. Ltd. trowles@knightpiesold.com
Samples Received:	22-May-2013
Samples Analysed:	29-May-2013 -12-June-2013
Written by:	Dr Sharon Ness
Date:	12-June-2013
Intertek Genalysis Job No:	752.0/1307181 (Rev 1)

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Introduction

Fifteen (15) samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents.

Sampling and Preparation

The samples were crushed and milled to < 60 µm

For each sample (except 701-22-097), a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content.

A grab of sample 701-22-097 was prepared by adding an internal standard, TiO2, and micronising the mixture to 4µm.

The spiked samples were each prepared as an un-oriented powder mount.

A second grab was taken of 701-22-001 and prepared as a duplicate analysis.

Instrumentation

The XRD patterns were produced on a PANalytical Cubix^3 XRD fitted with Copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3^o to 65°2θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database.

Quantitative phase analysis was performed using SIROQUANT^{TM} Version 3 software.

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Results

The quantitative analysis of the crystalline and amorphous content of each sample is as follows:

Sample ID **701-22-001**

		original	duplicate	
Phase	**Formula**	**wt%**	**wt%**	**Notes**
Amorphous content		13	12	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	17	15	
Interlayered illite/smectite		21	21	see Note 1
Jarosite	(K,Na)Fe3(SO4)2(OH)6	<1	1	
Kaolin	Al2Si2O5(OH)4	5	6	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	5	6	
Quartz	SiO2	39	39	

Sample ID **701-22-008**

Phase	Formula	wt%	Notes
Amorphous content		10	
Dolomite	CaMg(CO3)2	1	
Kaolin	Al2Si2O5(OH)4	16	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	10	
Potassium feldspar	KAlSi3O8	2	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	38	

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Sample ID **701-22-020**

Phase	Formula	wt%	Notes
Amorphous content		17	
Alunite	KAl3(SO4)2(OH)6	1	
Chalcopyrite	CuFeS2	<1	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	6	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		14	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Potassium feldspar	KAlSi3O8	5	
Pyrite	FeS2	1	
Quartz	SiO2	31	
Siderite	FeCO3	11	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-023**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	1	
Anhydrite	CaSO4	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	13	
Interlayered illite/smectite		5	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Kaolin	Al2Si2O5(OH)4	17	
Pyrite	FeS2	2	
Quartz	SiO2	45	
Siderite	FeCO3	3	

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Sample ID **701-22-032**

Phase	Formula	wt%	Notes
Amorphous content		17	
Anhydrite	CaSO4	1	
Calcite	CaCO3	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	12	
Interlayered illite/smectite		18	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	<1	
Pyrite	FeS2	6	
Quartz	SiO2	45	

Sample ID **701-22-041**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	3	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	2	
Interlayered illite/smectite		8	see Note 1
Kaolin	Al2Si2O5(OH)4	8	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	<1	
Potassium feldspar	KAlSi3O8	<1	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	22	
Quartz	SiO2	34	

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Sample ID **701-22-044**

Phase	Formula	wt%	Notes
Amorphous content		7	
Dolomite	CaMg(CO3)2	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		1	see Note 1
Kaolin	Al2Si2O5(OH)4	22	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	26	
Pyrite	FeS2	1	
Quartz	SiO2	41	

Sample ID **701-22-052**

Phase	Formula	wt%	Notes
Amorphous content		13	
Ankerite	Ca(Fe,Mg)(CO3)2	4	
Dolomite	CaMg(CO3)2	8	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	11	
Interlayered illite/smectite		15	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Magnesite	MgCO3	4	see Note 2
Quartz	SiO2	40	

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Sample ID **701-22-071**

Phase	Formula	wt%	Notes
Amorphous content		33	
Calcite	CaCO3	2	
Dolomite	CaMg(CO3)2	3	
Expanding clay		2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	7	
Interlayered illite/smectite		9	see Note 1
Kaolin	Al2Si2O5(OH)4	2	
Potassium feldspar	KAlSi3O8	8	
Pyrite	FeS2	<1	
Quartz	SiO2	24	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	12	

Sample ID **701-22-072**

Phase	Formula	wt%	Notes
Amorphous content		29	
Calcite	CaCO3	1	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	5	
Dolomite	(Ca,Fe,Mg)2(CO3)2	7	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	4	
Interlayered illite/smectite		22	see Note 1
Magnesite	MgCO3	2	see Note 2
Pyrite	FeS2	2	
Quartz	SiO2	29	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	1	

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Sample ID **701-22-081**

Phase	Formula	wt%	Notes
Amorphous content		11	
Anatase	TiO2	1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	5	
Interlayered illite/smectite		13	see Note 1
Kaolin	Al2Si2O5(OH)4	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	3	
Pyrite	FeS2	15	
Pyrophyllite	Al2Si4O10(OH)2	8	
Quartz	SiO2	43	

Sample ID **701-22-097**

Phase	Formula	wt%	Notes
Amorphous content		11	see Note 3
Dolomite	CaMg(CO3)2	1	
Hematite	Fe2O3	15	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	9	
Potassium feldspar	KAlSi3O8	4	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	47	

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Sample ID **701-22-115**

Phase	Formula	wt%	Notes
Amorphous content		35	
Calcite	CaCO3	7	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	13	
Chloritoid	(Fe,Mg)2Al4Si2O10(OH)4	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	4	
Palygorskite	Mg5(Si4O10)2(OH)2(H2O)8	7	see Note 1
Quartz	SiO2	23	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-126**

Phase	Formula	wt%	Notes
Amorphous content		14	
Hematite	Fe2O3	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	15	
Potassium feldspar	KAlSi3O8	1	
Pyrophyllite	Al2Si4O10(OH)2	5	
Quartz	SiO2	63	

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Sample ID **701-22-148**

Phase	Formula	wt%	Notes
Amorphous content		3	
Diaspore	AlO(OH)	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	28	
Pyrite	FeS2	16	
Pyrophyllite	Al2Si4O10(OH)2	4	
Quartz	SiO2	47	

Calculation of the phase abundances have been based on the Brindley contrast corrections using a particle diameter of 10 µm.

Uncertainty in the SIROQUANT™ analyses should reflect errors (absolute) of no greater than: +/- 10% for phases 50-95%, +/- 5% for phases 10-50% and +/- 2% for phases 3-10%. Phases of < 3% are approaching detection limit and normally no refinements are made on these.

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Quality Control

NIST Standard Reference Material 656

The powder consists of sub-micrometer, equi-axial, non-aggregated grains that do not display the effects of absorption contrast, extinction or preferred orientation.

An aliquot of this CRM, spiked with 10% Al2O3 for the amorphous content determination, was prepared as un-oriented powder mount of the total sample and the scan analysed with SIROQUANT™.

The results are as follows

Sample ID **β 656 (High β Phase Powder)**

		result	std dev	SRM certified	SRM uncert
Phase	**Formula**	**wt%**	**wt%**	**wt%**	**wt%**
Amorphous content		8.8	0.1	8.6	0.81
Si3N4, alpha	SiN4	16.3	0.6	16.3	2.54
Si3N4, beta	SiN4	74.9	0.4	75.1	0.60

Each interval defined by the certified value and its uncertainty is a 95% confidence interval for the true value of the mean in the absence of systematic error.

Discussion

Notes

1. For confirmation of the clay mineral identification, clay separation and oriented clay mounts (glycol and heat treated) would be required.

2. The magnesite phase possibly has some substitution of the magnesium by calcium.

3. Calculation of the phase abundances has been based on the Brindley contrast corrections using a particle diameter of 4 µm, this being the median particle size determined for this sample after miconising.

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Discussion

General

Quantification of the crystalline mineral phases was performed with the SIROQUANT™ software package. This software uses the full-profile Rietveld method of refining the profile of the calculated XRD pattern against the profile of the measured XRD pattern. The total calculated pattern is the sum of the calculated patterns of the individual phases.

Corrections are incorporated the process that allows for a more accurate description of the mineral's contribution to the measured pattern and to allow for variation due to atomic substitution, layer disordering, preferred orientation, and other factors that affect the acquisition of the XRD scan.

The limitations of qualitative XRD analysis are as follows:

1. There is a limit of detection of 1-2% on most crystalline phases.
2. The detection of a phase may be dependent on its crystallinity.
3. Where there exist multiple phases, overlap of diffracted reflections can occur, thus rendering some ambiguity into the interpretation.
4. Some phases cannot be unambiguously identified as they are present in minor or trace amounts.

The limitations of quantitative XRD analysis by a full-profile Rietveld method are as follows:

1. The limitations for qualitative XRD analysis apply
2. The method as described is standardless: it relies solely on the published crystallographic data available for each phase. Some data may not exactly describe the phases present.
3. Particle size is important with respect to the absorption of the X-rays by the sample. Milling to < 60 µm will usually produce a median particle size of approximately10 µm which is, in most cases, sufficient to minimize absorption contrast effects. However, this particle size may not be sufficient to minimize the absorption contrast effect if the samples contain a significant amount of iron-bearing phases. This is because the absorption contrast between them and other lower absorber phases is the most severe when analysed with Copper radiation. Micronising reduces the particle size to that more suitable for analysis with this radiation.

The accuracy of the analysis is dependent on sampling and sample preparation in addition to the calculated profiles being exactly representative of the chemistry of the component phases and their crystallinity. Some preferred orientation effects and reflection overlaps may occur which cannot be adequately resolved.

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Amorphous content

The amorphous content was determined from the addition of a known spike of a well-crystalline internal standard (ZnO or TiO2) to each sample.

When amorphous material is present, the weight percentage of the spike found by SIROQUANT™ is larger than actually weighed out. SIROQUANT™ then calculates the amount of amorphous material that causes the difference in the spike weight percentages and normalises all weight percentages to include the amorphous content.

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ANALYTICAL REPORT

KNIGHT PIESOLD PTY LIMITED
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EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1307060
No. of SAMPLES	:	150
No. of ELEMENTS	:	80
CLIENT O/N	:	PE701-00022 SS13001(REVB) (Job 1
SAMPLE SUBMISSION No.	:	PE701-00022 SS13001(REVB)
PROJECT	:	LETPADAUNG
STATE	:	Rock Chip
DATE RECEIVED	:	20/05/2013
DATE COMPLETED	:	19/06/2013
DATE PRINTED	:	19/06/2013
PRIMARY LABORATORY	:	Intertek Genalysis Perth

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

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SAMPLE DETAILS

DISCLAIMER

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SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

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SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

1. Note: Detection Limit only apply when TDS <100mg/l for MS and TDS<5000mg/l for OES except when indicated in spreadsheet

   NB pH Ws/MTR and EC/MTR both measured on 1:3 [soil:water] extract
   All anions and metals read on the same extract, solution values are reported

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0001 701-22-001	0.72	0.02	9.97%	0.76	-3	4.2
0002 701-22-002	0.11		7.77%		15	1.6
0003 701-22-003	0.86		8.11%		-2	10.7
0004 701-22-004	1.16		7.96%		-4	12.4
0005 701-22-005	0.54	0.06	9.06%	0.55	5	3.7
0006 701-22-006	0.65		8.77%		-3	7.1
0007 701-22-007	1.12		5.87%		-11	789.6*
0008 701-22-008	0.22	X	8.10%	3.18	-6	37.3
0009 701-22-009	0.13	X	9.20%	0.49	-3	33.9
0010 701-22-010	0.15		8.69%		-3	9.4
0011 701-22-011	1.00		8.03%		-7	12.5
0012 701-22-012	0.82	0.21	8.69%	0.40	-3	4.9
0013 701-22-013	0.14		9.47%		-3	8.4
0014 701-22-014	0.41		6.77%		-6	90.4
0015 701-22-015	0.09	X	6.17%	2.04	-8	42.4
0016 701-22-016	0.17		9.04%		-3	2.9
0017 701-22-017	0.25		8.98%		-4	16.5
0018 701-22-018	0.12	X	8.78%	0.23	-3	8.2
0019 701-22-019	0.16	0.01	8.68%	0.50	-3	20.3
0020 701-22-020	0.17	0.07	6.98%	3.50	17	1.3
0021 701-22-021	1.47		8.26%		13	15.2
0022 701-22-022	0.31		8.94%		4	5.5
0023 701-22-023	0.21	0.05	9.07%	0.06	5	3.9
0024 701-22-024	1.81		8.58%		5	47.9
0025 701-22-025	0.24		9.19%		4	6.1
0026 701-22-026	0.46		7.85%		4	15.5
0027 701-22-027	0.18	X	8.51%	1.81	4	1.6
0028 701-22-028	0.17		6.32%		4	2.7
0029 701-22-029	0.49		9.13%		4	20.3
0030 701-22-030	0.59		7.11%		1	16.0
0031 701-22-031	0.22	X	8.90%	1.28	4	5.9
0032 701-22-032	0.68	0.04	8.02%	1.07	2	31.1
0033 701-22-033	0.58	0.01	8.12%	0.52	3	15.5
0034 701-22-034	0.46		9.05%		4	13.5
0035 701-22-035	0.30		7.03%		-2	31.6
0036 701-22-036	0.57		8.10%		2	14.3
0037 701-22-037	0.23		8.61%		2	7.2
0038 701-22-038	0.39		7.46%		1	6.4

ANALYSIS

0039 701-22-039	0.30	0.03	8.98%	0.90	1	4.7
0040 701-22-040	0.11		7.84%		41	6.3

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.1	X	0.02	252.9	9.66	1.85
0002 701-22-002		13		426.1		1.96
0003 701-22-003		X		381.5		2.50
0004 701-22-004		X		542.1		1.16
0005 701-22-005	0.3	X	0.02	339.8	12.37	1.90
0006 701-22-006		X		448.9		0.68
0007 701-22-007		10		584.0		0.28
0008 701-22-008	6.0	X	0.02	452.1	25.24	0.16
0009 701-22-009	2.4	X	0.03	572.7	10.55	0.60
0010 701-22-010		X		393.0		0.50
0011 701-22-011		X		384.8		0.40
0012 701-22-012	0.2	X	0.02	607.5	17.18	1.27
0013 701-22-013		X		344.8		1.39
0014 701-22-014		X		351.1		0.16
0015 701-22-015	0.4	X	0.01	449.4	19.89	0.17
0016 701-22-016		X		1084.9		0.78
0017 701-22-017		X		917.2		0.88
0018 701-22-018	1.1	X	0.02	986.7	29.61	0.57
0019 701-22-019	3.9	X	0.02	750.0	34.94	0.98
0020 701-22-020	7.4	X	0.04	1144.9	1184.79	1.10
0021 701-22-021		X		298.3		1.44
0022 701-22-022		X		461.3		0.91
0023 701-22-023	3.7	X	0.10	536.6	22.41	1.12
0024 701-22-024		X		646.5		1.25
0025 701-22-025		X		1129.3		0.93
0026 701-22-026		X		403.7		0.81
0027 701-22-027	2.6	X	0.01	721.9	31.63	0.94
0028 701-22-028		X		345.7		1.24
0029 701-22-029		X		452.5		1.14
0030 701-22-030		X		235.1		0.66
0031 701-22-031	2.9	X	0.01	197.1	10.41	1.68
0032 701-22-032	3.5	X	0.18	342.5	14.54	0.96
0033 701-22-033	2.0	X	0.17	566.2	17.91	0.85
0034 701-22-034		X		637.5		1.58
0035 701-22-035		X		351.0		0.21
0036 701-22-036		X		478.4		0.64
0037 701-22-037		X		509.5		0.54
0038 701-22-038		X		319.0		0.52

ANALYSIS

0039 701-22-039	2.1	X	0.17	374.2	5.99	0.68
0040 701-22-040		X		527.3		0.53

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	0.1	0.16	X	0.06	946	8.08
0002 701-22-002		0.33		0.95	2481	
0003 701-22-003		6.78		0.05	1432	
0004 701-22-004		7.05		0.04	1079	
0005 701-22-005	2.6	0.74	0.213	0.04	383	8.73
0006 701-22-006		6.94		0.04	819	
0007 701-22-007		10.93		0.02	645	
0008 701-22-008	0.6	6.33	1.998	0.02	967	14.00
0009 701-22-009	X	0.99	0.065	0.03	817	1.52
0010 701-22-010		3.17		0.04	578	
0011 701-22-011		16.79*		0.02	653	
0012 701-22-012	1.0	5.16	0.088	0.03	618	7.10
0013 701-22-013		2.21		0.03	556	
0014 701-22-014		2.93		0.02	531	
0015 701-22-015	0.5	1.13	X	0.02	593	11.94
0016 701-22-016		0.19		0.06	456	
0017 701-22-017		0.43		0.07	388	
0018 701-22-018	X	0.39	0.007	0.05	356	7.45
0019 701-22-019	0.2	0.30	X	0.05	283	9.36
0020 701-22-020	0.8	0.06	0.097	0.99	3774	4.03
0021 701-22-021		1.37		1.09	907	
0022 701-22-022		0.45		0.05	386	
0023 701-22-023	0.2	0.43	0.014	0.31	502	10.74
0024 701-22-024		0.44		0.03	563	
0025 701-22-025		0.11		0.02	540	
0026 701-22-026		2.46		0.10	1160	
0027 701-22-027	0.5	1.37	0.058	0.04	757	22.86
0028 701-22-028		1.23		0.06	307	
0029 701-22-029		2.64		0.05	582	
0030 701-22-030		5.33		0.06	729	
0031 701-22-031	0.9	1.28	0.025	0.07	403	17.80
0032 701-22-032	0.8	1.55	0.028	0.10	761	17.09
0033 701-22-033	0.3	2.09	0.036	0.05	920	11.40
0034 701-22-034		1.98		0.04	595	
0035 701-22-035		3.32		0.03	614	
0036 701-22-036		9.53		0.04	1025	
0037 701-22-037		4.72		0.06	1083	
0038 701-22-038		5.35		0.11	360	

ANALYSIS

0039 701-22-039	0.6	0.88	X	0.07	548	18.19
0040 701-22-040		1.32		0.65	1.77%	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0001 701-22-001	0.20	3.07	66.93	7	1.3	11.8
0002 701-22-002	0.75		65.36		12.6	
0003 701-22-003	0.68		46.42		17.3	
0004 701-22-004	0.24		69.40		11.8	
0005 701-22-005	0.12	0.79	71.18	6	4.3	26.5
0006 701-22-006	0.04		54.06		11.1	
0007 701-22-007	0.13		47.41		22.8	
0008 701-22-008	0.37	62.04	29.96	17	15.6	549.3
0009 701-22-009	0.13	0.46	55.84	84	5.2	9.1
0010 701-22-010	0.12		37.29		10.9	
0011 701-22-011	0.10		43.59		19.3	
0012 701-22-012	0.80	9.14	76.58	191	14.7	158.6
0013 701-22-013	0.05		73.50		9.6	
0014 701-22-014	0.62		71.86		21.0	
0015 701-22-015	0.08	3.29	46.46	47	21.3	350.5
0016 701-22-016	0.03		44.35		13.1	
0017 701-22-017	0.03		45.24		16.6	
0018 701-22-018	0.19	9.09	53.64	25	11.7	99.8
0019 701-22-019	0.05	1.73	61.46	32	11.4	149.3
0020 701-22-020	0.20	0.35	50.47	74	12.6	2.2
0021 701-22-021	1.37		69.35		20.7	
0022 701-22-022	0.58		66.88		15.7	
0023 701-22-023	0.78	9.15	68.05	278	16.1	97.9
0024 701-22-024	1.81		65.33		22.2	
0025 701-22-025	1.84		86.89		13.5	
0026 701-22-026	0.03		42.38		0.6	
0027 701-22-027	0.76	8.42	55.69	4	14.0	241.1
0028 701-22-028	2.05		33.21		4.9	
0029 701-22-029	0.13		27.50		12.3	
0030 701-22-030	0.04		20.58		16.1	
0031 701-22-031	0.15	7.88	24.61	22	11.3	297.5
0032 701-22-032	0.58	9.87	41.10	26	15.9	459.0
0033 701-22-033	0.48	2.88	39.13	12	11.2	119.8
0034 701-22-034	0.03		49.80		10.8	
0035 701-22-035	0.81		41.33		16.4	
0036 701-22-036	0.06		30.91		18.5	
0037 701-22-037	0.02		29.54		14.7	
0038 701-22-038	0.08		30.19		21.3	

ANALYSIS

0039 701-22-039	0.09	3.95	46.50	61	20.4	732.0
0040 701-22-040	0.07		30.53		17.3	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	No	14	X	2.55	407.4	1.77
0002 701-22-002	Yes	10		3.68	20.6	
0003 701-22-003	No	23		5.80	756.1	
0004 701-22-004	No	12		3.18	555.8	
0005 701-22-005	No	12	X	3.18	45.6	0.05
0006 701-22-006	No	14		1.90	127.9	
0007 701-22-007	No	20		0.12	817.9	
0008 701-22-008	No	26	X	0.10	634.9	17.91
0009 701-22-009	No	13	X	1.42	170.1	0.15
0010 701-22-010	No	19		0.93	383.7	
0011 701-22-011	No	26		0.19	1365.5	
0012 701-22-012	No	19	X	2.36	306.0	4.40
0013 701-22-013	No	17		1.53	922.7	
0014 701-22-014	No	18		0.12	5916.0*	
0015 701-22-015	No	17	X	0.11	815.9	15.46
0016 701-22-016	No	14		1.69	597.7	
0017 701-22-017	No	12		2.32	647.2	
0018 701-22-018	No	18	X	1.84	437.0	2.07
0019 701-22-019	No	15	X	2.13	431.5	9.94
0020 701-22-020	Yes	18	X	7.93	890.5	0.30
0021 701-22-021	Yes	17		12.62	1301.8	
0022 701-22-022	No	11		3.58	592.4	
0023 701-22-023	Yes	15	X	3.51	396.8	4.58
0024 701-22-024	No	11		5.66	668.0	
0025 701-22-025	No	20		2.43	961.2	
0026 701-22-026	No	18		1.17	273.8	
0027 701-22-027	No	20	X	1.49	36.4	0.36
0028 701-22-028	No	16		0.89	44.3	
0029 701-22-029	No	13		3.63	393.5	
0030 701-22-030	No	16		1.12	319.6	
0031 701-22-031	No	19	X	1.72	238.1	1.90
0032 701-22-032	No	39	X	3.19	419.4	3.33
0033 701-22-033	No	13	X	3.45	317.0	0.62
0034 701-22-034	No	11		2.77	291.6	
0035 701-22-035	No	67		0.42	709.3	
0036 701-22-036	No	18		1.49	271.3	
0037 701-22-037	No	17		1.56	83.1	
0038 701-22-038	No	22		1.29	440.4	

ANALYSIS

0039 701-22-039	No	26	X	1.28	114.3	2.93
0040 701-22-040	No	14		1.12	105.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0001 701-22-001	2.46	258	1.11	1.05	X	1.09
0002 701-22-002	2.51		1.53	1.02		5.11
0003 701-22-003	4.40		2.85	1.04		5.77
0004 701-22-004	5.02		2.86	1.52		4.51
0005 701-22-005	2.68	511	1.50	1.01	0.1	1.58
0006 701-22-006	4.07		2.23	1.20		3.57
0007 701-22-007	1.90		0.69	1.48		15.86
0008 701-22-008	0.95	438	0.30	0.69	0.2	4.85
0009 701-22-009	1.20	560	0.49	0.94	0.6	1.31
0010 701-22-010	0.79		0.40	0.67		2.93
0011 701-22-011	0.94		0.43	0.77		7.28
0012 701-22-012	7.70	1242	3.86	2.36	0.2	5.16
0013 701-22-013	5.67		2.90	1.59		2.24
0014 701-22-014	0.80		0.26	0.97		7.80
0015 701-22-015	0.24	466	0.09	0.63	0.2	9.39
0016 701-22-016	1.26		0.68	0.53		1.83
0017 701-22-017	1.37		0.74	0.55		2.18
0018 701-22-018	1.99	449	0.95	0.93	X	2.06
0019 701-22-019	2.26	549	1.20	0.97	X	2.62
0020 701-22-020	1.78	672	0.90	0.88	1.5	6.69
0021 701-22-021	3.11		1.77	1.32		7.17
0022 701-22-022	2.67		1.39	1.12		2.48
0023 701-22-023	2.63	1370	1.36	1.30	0.2	2.98
0024 701-22-024	3.57		2.01	1.18		3.62
0025 701-22-025	5.66		3.40	1.70		1.18
0026 701-22-026	0.98		0.52	0.80		3.74
0027 701-22-027	1.96	433	1.15	0.87	0.5	3.10
0028 701-22-028	2.06		0.84	0.66		1.04
0029 701-22-029	7.40		1.01	0.61		2.94
0030 701-22-030	1.20		0.66	0.51		7.07
0031 701-22-031	2.05	548	1.10	0.81	0.2	1.65
0032 701-22-032	1.63	644	0.96	0.67	0.2	3.78
0033 701-22-033	1.56	509	0.91	0.70	0.1	3.91
0034 701-22-034	3.02		1.10	1.12		3.32
0035 701-22-035	1.14		0.59	1.03		8.20
0036 701-22-036	1.67		0.88	0.80		7.71
0037 701-22-037	1.62		1.04	0.74		3.74
0038 701-22-038	1.60		0.87	0.71		7.42

ANALYSIS

0039 701-22-039	2.77	832	1.42	0.76	0.2	2.82
0040 701-22-040	1.26		0.63	0.80		3.53

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.05	1.4	0	15.97	3.27	1.07
0002 701-22-002		1.2	0	16.56	2.94	1.05
0003 701-22-003		1.4	0	32.57	4.02	0.90
0004 701-22-004		1.4	0	26.34	5.13	1.00
0005 701-22-005	0.19	1.5	0	19.58	3.19	1.18
0006 701-22-006		1.4	0	28.31	4.15	0.88
0007 701-22-007		1.4	0	18.92	3.73	1.83
0008 701-22-008	1.94	1.3	0	30.12	2.02	0.89
0009 701-22-009	0.07	1.3	0	24.40	2.52	1.26
0010 701-22-010		1.4	0	24.97	1.65	0.86
0011 701-22-011		1.4	0	35.11	2.01	1.33
0012 701-22-012	0.11	1.3	0	26.73	7.70	1.07
0013 701-22-013		1.4	0	19.82	5.60	1.42
0014 701-22-014		1.3	0	16.91	1.95	2.49
0015 701-22-015	2.60	1.4	0	4.40	0.98	1.23
0016 701-22-016		1.4	0	16.27	1.61	1.62
0017 701-22-017		1.4	0	16.66	1.69	1.58
0018 701-22-018	0.10	1.4	0	16.66	2.59	1.52
0019 701-22-019	0.19	1.4	0	16.33	2.73	1.37
0020 701-22-020	4.52	1.2	0	15.03	2.48	0.79
0021 701-22-021		1.2	0	19.12	4.04	1.33
0022 701-22-022		1.5	0	20.64	3.52	1.73
0023 701-22-023	0.12	1.6	0	18.90	3.49	1.51
0024 701-22-024		1.5	0	19.45	3.72	1.21
0025 701-22-025		1.5	0	17.29	5.40	1.88
0026 701-22-026		1.5	0	20.09	2.05	0.95
0027 701-22-027	0.78	1.5	0	17.82	6.71	1.12
0028 701-22-028		1.5	0	12.34	1.99	0.96
0029 701-22-029		1.5	0	18.68	1.55	1.13
0030 701-22-030		1.5	0	24.06	1.63	0.54
0031 701-22-031	0.83	1.5	0	18.02	2.77	1.57
0032 701-22-032	1.23	1.5	0	18.74	2.04	1.04
0033 701-22-033	0.64	1.4	0	23.93	2.00	0.80
0034 701-22-034		1.4	0	18.82	4.23	1.21
0035 701-22-035		1.4	0	7.40	2.52	0.68
0036 701-22-036		1.5	0	38.25	2.67	0.64
0037 701-22-037		1.5	0	31.02	2.20	0.90
0038 701-22-038		1.4	0	24.56	1.84	0.67

ANALYSIS

0039 701-22-039	0.40	1.5	0	18.94	2.73	1.02
0040 701-22-040		1.7	0	25.87	2.21	0.81

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0001 701-22-001	1.84	X	X	0.43	0.593	3.81%
0002 701-22-002	1.56	0.01		0.52	0.105	3.08%
0003 701-22-003	1.17	0.01		0.94	1.456	3.71%
0004 701-22-004	1.46	0.03		1.05	1.132	3.52%
0005 701-22-005	1.55	0.01	X	0.65	0.676	3.53%
0006 701-22-006	1.63	0.02		0.78	0.663	4.00%
0007 701-22-007	0.95	0.18		0.26	0.405	2307
0008 701-22-008	1.06	0.02	X	0.13	0.092	7904
0009 701-22-009	1.15	0.02	X	0.18	0.156	3.79%
0010 701-22-010	0.88	X		0.13	0.330	3.13%
0011 701-22-011	1.44	0.04		0.16	0.210	7861
0012 701-22-012	1.69	0.03	X	1.49	0.426	3.24%
0013 701-22-013	2.04	X		1.10	0.729	2.81%
0014 701-22-014	0.21	0.02		0.10	0.205	4843
0015 701-22-015	0.12	0.02	X	0.03	0.024	1.21%
0016 701-22-016	0.51	0.02		0.25	0.034	2.77%
0017 701-22-017	0.30	0.02		0.26	0.104	2.88%
0018 701-22-018	0.33	0.02	X	0.36	0.035	3.01%
0019 701-22-019	0.53	X	X	0.42	0.068	3.46%
0020 701-22-020	0.12	0.01	X	0.33	0.029	2.27%
0021 701-22-021	0.14	0.03		0.62	0.410	2.13%
0022 701-22-022	0.31	0.03		0.52	0.159	2.62%
0023 701-22-023	0.71	0.02	X	0.49	0.066	2.61%
0024 701-22-024	0.30	0.07		0.69	0.701	3.55%
0025 701-22-025	0.47	X		1.16	0.062	2.04%
0026 701-22-026	1.60	X		0.19	1.252	3.28%
0027 701-22-027	1.64	0.02	X	0.39	0.345	3.88%
0028 701-22-028	1.33	0.04		0.28	0.392	2.17%
0029 701-22-029	1.79	0.04		0.33	0.993	3.42%
0030 701-22-030	1.11	0.04		0.22	0.748	1.62%
0031 701-22-031	1.96	X	X	0.36	4.726	2.65%
0032 701-22-032	1.73	0.03	X	0.32	0.915	3.71%
0033 701-22-033	1.44	0.01	X	0.29	0.459	3.59%
0034 701-22-034	1.70	X		0.45	0.791	2.93%
0035 701-22-035	1.17	0.02		0.19	0.083	1.72%
0036 701-22-036	1.54	0.03		0.31	0.515	3.12%
0037 701-22-037	1.54	X		0.32	0.638	3.51%
0038 701-22-038	0.94	X		0.31	0.311	3.31%

ANALYSIS

0039 701-22-039	2.23	0.02	X	0.50	0.623	3.42%
0040 701-22-040	1.39	X		0.23	0.164	3.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	16.7	38.34	5.5	0.164	3760	6.52
0002 701-22-002		37.90	12.7	0.243	6818	
0003 701-22-003		27.29	2.2	0.406	2838	
0004 701-22-004		37.25	4.9	0.368	3051	
0005 701-22-005	22.9	38.73	13.6	0.212	7822	18.57
0006 701-22-006		27.27	2.5	0.264	2892	
0007 701-22-007		21.06	35.3	0.106	136	
0008 701-22-008	2.5	16.11	4.9	0.058	122	13.85
0009 701-22-009	18.7	30.23	2.9	0.073	2139	6.30
0010 701-22-010		20.77	4.3	0.076	1507	
0011 701-22-011		24.18	25.1	0.093	176	
0012 701-22-012	29.4	42.52	6.5	0.371	2952	23.23
0013 701-22-013		41.01	30.6	0.316	2593	
0014 701-22-014		44.80	7.2	0.037	120	
0015 701-22-015	3.4	26.40	4.7	0.014	106	10.35
0016 701-22-016		28.24	3.0	0.081	2688	
0017 701-22-017		29.07	3.1	0.090	3079	
0018 701-22-018	22.4	30.18	3.3	0.114	2684	14.24
0019 701-22-019	23.9	35.94	2.7	0.145	2937	17.24
0020 701-22-020	4.2	26.97	3.7	0.104	7768	6.55
0021 701-22-021		38.44	15.9	0.188	4270	
0022 701-22-022		35.68	29.8	0.177	3004	
0023 701-22-023	34.5	36.93	16.7	0.167	2823	25.94
0024 701-22-024		36.44	6.3	0.224	3955	
0025 701-22-025		47.58	15.8	0.453	2374	
0026 701-22-026		22.55	0.5	0.103	2199	
0027 701-22-027	26.4	31.12	2.7	0.193	3307	15.40
0028 701-22-028		16.37	2.8	0.117	1687	
0029 701-22-029		13.74	1.8	0.162	2469	
0030 701-22-030		11.08	0.7	0.129	798	
0031 701-22-031	19.6	12.65	3.2	0.178	1935	27.21
0032 701-22-032	24.8	21.45	0.5	0.186	2432	28.73
0033 701-22-033	26.8	22.01	0.5	0.154	2004	20.94
0034 701-22-034		25.29	2.7	0.173	1985	
0035 701-22-035		22.69	1.5	0.123	191	
0036 701-22-036		16.61	0.7	0.151	1338	
0037 701-22-037		14.86	0.6	0.169	1493	
0038 701-22-038		18.65	1.1	0.134	1143	

ANALYSIS

0039 701-22-039	26.8	27.25	2.1	0.208	1806	31.97
0040 701-22-040		16.28	0.9	0.126	1843	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0001 701-22-001	163	1.33		1.4	0.12	32
0002 701-22-002	9922			2.3		10
0003 701-22-003	291			2.7		174
0004 701-22-004	133			1.4		136
0005 701-22-005	1142	1.26		1.4	0.15	21
0006 701-22-006	82			1.3		99
0007 701-22-007	41			1.5		558
0008 701-22-008	27	0.50		2.5	0.29	209
0009 701-22-009	54	0.04		3.9	11.45	52
0010 701-22-010	72			2.2		114
0011 701-22-011	42			2.2		277
0012 701-22-012	51	0.09		2.2	0.07	164
0013 701-22-013	93			2.3		63
0014 701-22-014	30			181.9*		293
0015 701-22-015	30	0.37		48.8	0.08	388
0016 701-22-016	45			13.2		60
0017 701-22-017	61			8.3		62
0018 701-22-018	33	0.25		5.4	X	54
0019 701-22-019	44	0.32		3.8	X	61
0020 701-22-020	2062	0.12		2.8	7.99	16
0021 701-22-021	4514			1.3		80
0022 701-22-022	145			2.6		54
0023 701-22-023	1297	2.00		2.2	0.06	45
0024 701-22-024	65			2.4		96
0025 701-22-025	41			7.6		24
0026 701-22-026	490			1.6		23
0027 701-22-027	119	0.68		1.4	0.12	91
0028 701-22-028	93			1.4		35
0029 701-22-029	142			0.5		73
0030 701-22-030	74			2.0		236
0031 701-22-031	150	2.10		1.2	X	49
0032 701-22-032	205	2.10		2.0	X	117
0033 701-22-033	135	0.90		1.1	X	132
0034 701-22-034	200			2.7		99
0035 701-22-035	54			3.0		361
0036 701-22-036	53			1.8		272
0037 701-22-037	53			0.9		136
0038 701-22-038	127			3.9		275

ANALYSIS

0039 701-22-039	78	1.15	1.3	0.06	134
0040 701-22-040	70		3.2		125

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0001 701-22-001	1473	14.2	2	5.6	0	35
0002 701-22-002	303		0	7.5	0	-5
0003 701-22-003	295		142	2.2	127	175
0004 701-22-004	346		110	2.2	98	140
0005 701-22-005	365	49.9	11	2.9	6	15
0006 701-22-006	380		89	2.2	79	102
0007 701-22-007	589		455	2.2	424	569
0008 701-22-008	1685	30.3	147	2.2	133	215
0009 701-22-009	1196	92.7	17	2.7	12	55
0010 701-22-010	822		77	2.3	67	116
0011 701-22-011	819		201	2.2	180	284
0012 701-22-012	1437	239.6	144	2.1	133	167
0013 701-22-013	1072		41	2.4	31	66
0014 701-22-014	1129		163	2.4	136	298
0015 701-22-015	1377	43.6	281	2.2	261	396
0016 701-22-016	710		30	2.5	21	63
0017 701-22-017	575		37	2.5	27	65
0018 701-22-018	1093	39.5	28	2.5	20	57
0019 701-22-019	1139	42.9	43	2.4	33	64
0020 701-22-020	1.24%	132.4	0	6.7	0	-1
0021 701-22-021	1196		36	3.2	7	67
0022 701-22-022	1472		38	2.4	29	50
0023 701-22-023	1551	243.8	24	2.7	11	40
0024 701-22-024	1859		72	2.3	63	91
0025 701-22-025	1255		7	3.2	3	20
0026 701-22-026	624		0	6.5	0	19
0027 701-22-027	655	12.9	79	2.2	68	87
0028 701-22-028	205		25	2.5	17	31
0029 701-22-029	449		61	2.3	49	69
0030 701-22-030	382		205	2.2	190	235
0031 701-22-031	310	31.5	29	2.5	21	45
0032 701-22-032	439	37.3	92	2.2	82	115
0033 701-22-033	638	36.0	104	2.2	93	129
0034 701-22-034	545		82	2.2	70	94
0035 701-22-035	1580		242	2.3	223	363
0036 701-22-036	741		224	2.2	208	270
0037 701-22-037	902		101	2.3	90	134
0038 701-22-038	969		217	2.2	200	274

ANALYSIS

0039 701-22-039	561	85.6	72	2.4	60	133
0040 701-22-040	894		46	2.6	38	84

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	4.32	23.55	22.9	X	651	X
0002 701-22-002	3.55	23.19	11.4		608	
0003 701-22-003	2.64	19.96	12.4		668	
0004 701-22-004	3.25	28.11	6.0		869	
0005 701-22-005	4.08	26.68	3.9	0.02	130	X
0006 701-22-006	3.32	20.77	7.0		620	
0007 701-22-007	1.92	24.15	31.4		922	
0008 701-22-008	1.65	12.05	16.0	0.14	703	0.3
0009 701-22-009	1.98	21.48	3.8	X	533	X
0010 701-22-010	1.69	13.61	7.3		374	
0011 701-22-011	2.21	16.51	21.7		537	
0012 701-22-012	4.29	31.86	9.5	0.07	676	X
0013 701-22-013	4.37	28.72	3.9		466	
0014 701-22-014	0.80	20.70	10.5		518	
0015 701-22-015	0.68	16.80	10.7	0.13	531	0.3
0016 701-22-016	1.58	13.49	7.2		589	
0017 701-22-017	1.49	13.70	6.4		421	
0018 701-22-018	1.29	20.22	8.1	0.06	427	X
0019 701-22-019	1.61	21.37	6.6	0.11	376	0.2
0020 701-22-020	2.89	19.67	11.2	X	502	0.4
0021 701-22-021	2.64	28.43	11.0		753	
0022 701-22-022	2.46	26.12	7.2		191	
0023 701-22-023	3.82	26.60	6.5	0.05	284	X
0024 701-22-024	2.74	24.76	14.2		416	
0025 701-22-025	3.57	34.32	6.6		880	
0026 701-22-026	1.65	15.83	1.1		624	
0027 701-22-027	2.99	20.53	9.5	0.16	441	X
0028 701-22-028	2.41	11.41	7.3		143	
0029 701-22-029	1.55	10.73	7.7		379	
0030 701-22-030	1.18	8.12	12.5		480	
0031 701-22-031	3.20	10.43	13.4	0.13	323	X
0032 701-22-032	2.79	15.01	17.9	0.20	477	X
0033 701-22-033	2.22	14.34	6.7	0.04	651	X
0034 701-22-034	2.30	19.10	7.8		733	
0035 701-22-035	1.59	17.59	31.1		454	
0036 701-22-036	3.33	12.85	10.2		708	
0037 701-22-037	2.61	11.65	7.6		671	
0038 701-22-038	1.47	10.84	13.1		394	

ANALYSIS

0039 701-22-039	3.97	15.93	11.3	0.22	466	X
0040 701-22-040	1.97	13.41	12.3		619	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	324.0	1.8	4.9		6.654	162.63
0002 701-22-002	51.9		7.1	2.9	6.650	135.10
0003 701-22-003	30.9		4.3		4.971	140.10
0004 701-22-004	167.9		3.8		7.626	138.60
0005 701-22-005	9.9	1.8	5.2		7.392	151.77
0006 701-22-006	82.5		4.4		5.487	158.52
0007 701-22-007	415.5		3.5		5.695	2.99
0008 701-22-008	205.7	3.1	4.4		3.209	3.14
0009 701-22-009	124.5	0.6	6.6		5.763	125.49
0010 701-22-010	103.3		5.1		3.690	90.37
0011 701-22-011	106.8		4.8		4.500	8.25
0012 701-22-012	59.3	1.2	5.0		8.209	113.56
0013 701-22-013	10.4		6.6		7.722	114.42
0014 701-22-014	54.1		5.5		7.096	3.08
0015 701-22-015	51.4	X	4.3		4.877	3.25
0016 701-22-016	15.8		4.6		4.047	79.18
0017 701-22-017	35.0		4.5		4.173	95.57
0018 701-22-018	18.4	0.5	4.6		5.561	91.47
0019 701-22-019	25.2	0.6	4.4		6.217	105.60
0020 701-22-020	14.2	4.2	8.5	2.8	5.319	83.44
0021 701-22-021	157.3		5.9	2.8	7.478	95.49
0022 701-22-022	86.0		5.6		7.140	102.63
0023 701-22-023	54.3	0.5	6.1	3.2	7.285	99.00
0024 701-22-024	418.0		5.1		6.736	135.89
0025 701-22-025	17.0		6.3		9.189	70.98
0026 701-22-026	68.7		6.2		4.422	114.14
0027 701-22-027	126.9	0.9	4.7		5.807	149.69
0028 701-22-028	16.4		4.9		3.210	88.98
0029 701-22-029	65.7		4.0		2.917	132.80
0030 701-22-030	176.9		4.3		2.141	51.65
0031 701-22-031	15.4	0.6	4.4		2.718	98.69
0032 701-22-032	51.9	1.7	4.1		3.994	148.26
0033 701-22-033	77.0	1.0	4.5		3.857	131.58
0034 701-22-034	20.0		4.6		5.221	113.43
0035 701-22-035	90.6		4.7		4.524	11.44
0036 701-22-036	100.2		4.0		3.335	95.48
0037 701-22-037	63.0		4.3		3.088	113.03
0038 701-22-038	33.0		4.8		3.067	98.89

ANALYSIS

0039 701-22-039	64.4	X	4.4	4.708	85.31
0040 701-22-040	96.2		8.0	3.311	97.98

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0001 701-22-001	X	1.04	9974	25.1	X	0.37
0002 701-22-002	X	0.32	2913		0.21	0.03
0003 701-22-003	0.007	5.67	5.70%		4.56	0.21
0004 701-22-004	X	4.43	4.22%		3.57	0.17
0005 701-22-005	X	0.67	5889	61.2	0.47	0.04
0006 701-22-006	X	3.23	3.25%		2.83	0.09
0007 701-22-007	0.003	18.24	16.96%		11.73	0.58
0008 701-22-008	0.008	6.83	6.65%	56.1	4.20	0.54
0009 701-22-009	0.022	1.69	1.71%	34.2	0.58	0.27
0010 701-22-010	0.002	3.71	3.71%		2.13	0.40
0011 701-22-011	X	9.05	8.63%		5.11	0.61
0012 701-22-012	X	5.35	5.19%	116.6	4.27	0.15
0013 701-22-013	X	2.06	2.23%		1.53	0.19
0014 701-22-014	0.055	9.56	9.05%		6.82	0.42
0015 701-22-015	0.079	12.68	11.74%	45.6	7.85	0.85
0016 701-22-016	0.107	1.96	2.05%		1.12	0.20
0017 701-22-017	0.070	2.01	2.18%		1.35	0.21
0018 701-22-018	0.049	1.76	1.85%	48.9	1.09	0.21
0019 701-22-019	0.030	1.99	2.22%	58.5	1.55	0.15
0020 701-22-020	0.010	0.52	4699	28.4	0.36	0.05
0021 701-22-021	0.009	2.62	2.54%		2.19	0.12
0022 701-22-022	0.010	1.78	1.84%		1.62	0.09
0023 701-22-023	0.016	1.47	1.42%	91.0	1.23	0.09
0024 701-22-024	0.022	3.13	3.19%		2.51	0.13
0025 701-22-025	0.037	0.79	6956		0.56	0.04
0026 701-22-026	X	0.74	6448		X	0.20
0027 701-22-027	0.007	2.98	2.96%	57.5	2.32	0.13
0028 701-22-028	X	1.14	6858		0.41	0.04
0029 701-22-029	X	2.40	2.68%		2.08	0.12
0030 701-22-030	0.002	7.71	7.22%		5.54	0.33
0031 701-22-031	X	1.59	1.63%	71.7	1.06	0.16
0032 701-22-032	0.004	3.82	3.79%	83.8	2.70	0.18
0033 701-22-033	X	4.30	4.03%	65.1	3.27	0.20
0034 701-22-034	X	3.22	3.27%		2.53	0.16
0035 701-22-035	0.006	11.79	10.70%		7.15	0.97
0036 701-22-036	X	8.89	8.36%		6.58	0.49
0037 701-22-037	X	4.46	4.06%		2.97	0.33
0038 701-22-038	0.005	9.00	8.46%		6.25	0.50

ANALYSIS

0039 701-22-039	X	4.38	4.34%	99.5	2.18	0.61
0040 701-22-040	X	4.07	3.86%		2.75	0.35

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.36	X	9.6	0.9	0.8	0.47
0002 701-22-002	0.37		7.5	X		0.02
0003 701-22-003	0.69		17.0	2.5		1.78
0004 701-22-004	0.52		11.0	2.2		1.85
0005 701-22-005	0.29	0.04	8.0	0.5	11.2	0.21
0006 701-22-006	0.32		11.8	1.9		1.60
0007 701-22-007	3.98		9.9	4.5		4.07
0008 701-22-008	1.10	0.70	13.6	2.1	2.6	1.43
0009 701-22-009	0.60	4.79	15.5	0.8	1.5	0.64
0010 701-22-010	0.47		12.9	1.6		1.15
0011 701-22-011	0.81		12.8	4.2		4.15
0012 701-22-012	0.68	0.24	14.4	6.6	22.0	5.99
0013 701-22-013	0.42		14.7	1.2		0.57
0014 701-22-014	2.03		8.2	6.0		5.43
0015 701-22-015	1.75	0.32	4.6	6.0	1.5	4.95
0016 701-22-016	0.60		12.8	2.4		1.87
0017 701-22-017	0.47		11.6	3.2		2.00
0018 701-22-018	0.40	0.11	13.6	1.4	6.9	1.00
0019 701-22-019	0.56	0.54	11.4	1.7	5.0	1.38
0020 701-22-020	0.05	0.21	10.7	0.8	3.0	0.54
0021 701-22-021	0.56		16.5	1.0		0.91
0022 701-22-022	0.26		11.9	1.4		0.94
0023 701-22-023	0.25	0.04	13.0	1.4	3.5	1.15
0024 701-22-024	0.62		11.9	1.7		1.66
0025 701-22-025	0.39		11.8	0.9		0.89
0026 701-22-026	1.46		10.1	1.9		1.73
0027 701-22-027	0.44	0.58	12.3	1.0	3.6	0.76
0028 701-22-028	0.46		6.7	X		0.22
0029 701-22-029	0.58		10.3	X		0.38
0030 701-22-030	0.67		8.7	1.8		1.65
0031 701-22-031	0.71	0.14	10.6	X	1.6	0.10
0032 701-22-032	1.76	0.19	11.8	0.9	2.1	X
0033 701-22-033	0.56	0.12	11.0	0.9	1.4	X
0034 701-22-034	0.49		8.7	0.9		0.64
0035 701-22-035	2.49		9.6	2.4		1.55
0036 701-22-036	0.85		13.8	2.4		1.96
0037 701-22-037	0.63		14.3	0.7		0.60
0038 701-22-038	0.45		14.8	2.5		1.99

ANALYSIS

0039 701-22-039	0.46	0.19	20.7	0.8	5.2	0.51
0040 701-22-040	0.39		11.4	1.3		1.12

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	3.93	0.7	X	76.31	10.72	0.39
0002 701-22-002	3.79	0.5		13.09		0.36
0003 701-22-003	3.93	3.4		49.34		0.22
0004 701-22-004	5.48	3.2		278.89		0.30
0005 701-22-005	4.42	0.7	X	16.33	15.41	0.40
0006 701-22-006	4.09	0.9		175.07		0.30
0007 701-22-007	5.66	4.5		1065.68		0.17
0008 701-22-008	2.50	2.0	5.7	352.60	72.26	0.14
0009 701-22-009	3.70	1.6	X	203.56	6.20	0.17
0010 701-22-010	2.52	0.6		94.52		0.14
0011 701-22-011	2.94	2.2		313.24		0.19
0012 701-22-012	7.39	1.9	X	414.61	20.44	0.36
0013 701-22-013	5.53	0.7		23.98		0.35
0014 701-22-014	3.18	6.5		421.95		0.07
0015 701-22-015	2.62	13.3	X	553.05	147.55	0.07
0016 701-22-016	2.27	0.9		155.70		0.14
0017 701-22-017	2.29	0.8		91.60		0.14
0018 701-22-018	3.57	1.2	X	95.69	17.73	0.11
0019 701-22-019	3.57	1.7	X	87.22	17.13	0.13
0020 701-22-020	3.48	0.6	X	178.14	10.48	0.21
0021 701-22-021	5.30	0.7		285.42		0.19
0022 701-22-022	4.65	1.5		62.43		0.20
0023 701-22-023	4.77	0.8	X	128.74	20.83	0.31
0024 701-22-024	4.46	0.9		176.09		0.22
0025 701-22-025	6.46	0.7		343.12		0.33
0026 701-22-026	3.14	0.8		64.55		0.16
0027 701-22-027	3.48	1.1	X	84.11	68.58	0.25
0028 701-22-028	2.20	0.6		31.38		0.20
0029 701-22-029	2.13	0.8		112.54		0.13
0030 701-22-030	1.84	1.7		110.90		0.10
0031 701-22-031	2.52	0.6	X	115.73	11.21	0.27
0032 701-22-032	2.67	1.1	X	149.70	12.15	0.21
0033 701-22-033	2.40	1.1	X	93.73	9.51	0.19
0034 701-22-034	3.70	0.7		287.25		0.19
0035 701-22-035	3.70	10.1		452.33		0.12
0036 701-22-036	2.99	4.6		230.14		0.24
0037 701-22-037	3.31	1.3		130.84		0.18
0038 701-22-038	2.01	3.0		194.63		0.12

ANALYSIS

0039 701-22-039	2.96	0.6	X	214.29	13.06	0.32
0040 701-22-040	2.74	1.2		240.09		0.20

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0001 701-22-001	0.459	160	0.07	20.90	0.081	2244
0002 701-22-002	0.421		X	23.46		1619
0003 701-22-003	0.671		0.74	13.37		1927
0004 701-22-004	0.797		1.92	17.36		1558
0005 701-22-005	0.436	401	0.34	19.27	0.212	2020
0006 701-22-006	0.633		1.08	18.07		1733
0007 701-22-007	0.439		1.63	12.23		1101
0008 701-22-008	0.230	362	1.09	11.13	0.410	1455
0009 701-22-009	0.273	389	0.42	15.23	0.248	1959
0010 701-22-010	0.187		0.74	14.03		1082
0011 701-22-011	0.219		2.71	14.72		1512
0012 701-22-012	1.228	947	3.35	24.11	0.065	2512
0013 701-22-013	0.918		0.57	22.73		2970
0014 701-22-014	0.213		1.21	11.20		546
0015 701-22-015	0.078	420	0.35	10.71	0.068	457
0016 701-22-016	0.218		X	16.56		1369
0017 701-22-017	0.226		0.06	15.08		1347
0018 701-22-018	0.353	382	0.07	14.73	0.041	1143
0019 701-22-019	0.387	350	0.06	16.01	0.143	1071
0020 701-22-020	0.326	488	0.08	15.06	1.213	1931
0021 701-22-021	0.563		0.72	13.58		2525
0022 701-22-022	0.455		0.16	19.33		2055
0023 701-22-023	0.455	1016	0.24	20.86	0.337	2824
0024 701-22-024	0.543		0.35	19.53		2323
0025 701-22-025	0.861		0.07	23.19		2539
0026 701-22-026	0.207		0.96	12.82		1068
0027 701-22-027	0.338	265	0.42	18.66	0.136	1893
0028 701-22-028	0.311		0.24	13.79		1585
0029 701-22-029	0.312		0.72	11.79		929
0030 701-22-030	0.230		0.60	11.91		664
0031 701-22-031	0.377	440	0.15	14.40	0.248	2070
0032 701-22-032	0.275	439	0.51	14.09	0.188	1307
0033 701-22-033	0.274	340	0.64	13.13	0.294	1204
0034 701-22-034	0.621		0.69	14.62		1238
0035 701-22-035	0.249		0.33	16.01		664
0036 701-22-036	0.336		0.81	12.13		1669
0037 701-22-037	0.301		1.32	11.99		1330
0038 701-22-038	0.266		0.29	8.68		826

ANALYSIS

0039 701-22-039	0.450	625	0.66	20.14	0.152	2866
0040 701-22-040	0.276		0.82	11.97		919

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	1.85	0.16	3.61	0.184	84	X
0002 701-22-002	1.60	0.24	4.58		81	
0003 701-22-003	1.73	0.43	6.56		124	
0004 701-22-004	1.78	0.40	5.48		107	
0005 701-22-005	1.93	0.20	4.34	2.174	87	X
0006 701-22-006	2.22	0.31	5.16		105	
0007 701-22-007	9.44	0.10	7.02		90	
0008 701-22-008	0.14	0.04	3.52	22.026	135	X
0009 701-22-009	1.61	0.09	3.50	1.131	134	X
0010 701-22-010	1.12	0.06	3.27		96	
0011 701-22-011	0.15	0.07	5.89		114	
0012 701-22-012	1.21	0.53	6.68	13.273	91	X
0013 701-22-013	1.54	0.41	4.90		104	
0014 701-22-014	0.70	0.03	3.25		88	
0015 701-22-015	0.08	0.01	0.65	14.649	88	X
0016 701-22-016	0.84	0.09	2.01		119	
0017 701-22-017	1.20	0.12	1.92		99	
0018 701-22-018	1.12	0.13	3.27	34.096	104	X
0019 701-22-019	1.22	0.16	3.57	53.465	101	X
0020 701-22-020	0.74	0.12	1.29	0.521	95	0.08
0021 701-22-021	1.20	0.23	1.59		143	
0022 701-22-022	1.11	0.19	2.88		115	
0023 701-22-023	1.20	0.20	2.96	0.260	121	X
0024 701-22-024	1.75	0.28	3.08		117	
0025 701-22-025	0.78	0.48	2.91		116	
0026 701-22-026	1.44	0.09	3.16		93	
0027 701-22-027	1.86	0.17	4.17	5.165	106	X
0028 701-22-028	1.13	0.11	3.09		71	
0029 701-22-029	1.59	0.16	3.30		85	
0030 701-22-030	0.70	0.11	3.82		76	
0031 701-22-031	1.27	0.17	4.20	24.531	90	X
0032 701-22-032	2.16	0.16	4.66	59.662	89	X
0033 701-22-033	1.79	0.14	4.71	39.155	84	X
0034 701-22-034	1.58	0.15	3.54		80	
0035 701-22-035	0.21	0.11	4.19		84	
0036 701-22-036	1.24	0.14	6.44		94	
0037 701-22-037	1.34	0.16	5.19		104	
0038 701-22-038	1.05	0.13	3.52		97	

ANALYSIS

0039 701-22-039	1.14	0.21	6.27	26.375	128	X
0040 701-22-040	1.25	0.10	5.33		84	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0001 701-22-001	2.6	9.31	1.12	62	0.31	54.3
0002 701-22-002	1.8	14.15	1.54	542		48.3
0003 701-22-003	1.6	25.17	2.94	425		38.2
0004 701-22-004	2.3	25.63	2.58	50		44.4
0005 701-22-005	2.6	14.50	1.42	158	0.68	48.4
0006 701-22-006	2.6	20.27	1.88	39		52.7
0007 701-22-007	5.3	4.89	0.69	19		33.1
0008 701-22-008	2.5	2.63	0.32	11	0.89	19.0
0009 701-22-009	2.5	3.70	0.50	17	0.02	33.6
0010 701-22-010	1.8	3.15	0.49	13		26.1
0011 701-22-011	5.5	3.51	0.54	8		42.4
0012 701-22-012	2.5	37.37	2.85	162	0.80	50.5
0013 701-22-013	2.5	27.21	2.28	24		64.7
0014 701-22-014	5.7	2.14	0.23	23		6.0
0015 701-22-015	5.1	0.80	0.08	9	0.45	3.6
0016 701-22-016	1.4	6.55	0.69	19		18.9
0017 701-22-017	1.5	7.25	0.67	31		10.9
0018 701-22-018	1.9	9.06	0.79	46	1.82	9.4
0019 701-22-019	2.7	11.91	1.09	27	1.78	9.6
0020 701-22-020	0.5	8.38	0.77	1071	0.66	7.8
0021 701-22-021	0.8	16.91	1.44	592		4.6
0022 701-22-022	2.4	13.00	1.24	95		16.6
0023 701-22-023	2.1	13.20	1.10	298	2.76	27.2
0024 701-22-024	1.6	20.37	1.55	519		14.5
0025 701-22-025	2.3	31.06	3.69	185		23.9
0026 701-22-026	0.6	4.47	1.18	34		48.5
0027 701-22-027	1.1	10.21	1.41	243	1.63	53.6
0028 701-22-028	0.6	6.32	0.79	448		39.3
0029 701-22-029	1.6	8.81	1.00	42		57.0
0030 701-22-030	1.1	5.57	0.80	19		35.9
0031 701-22-031	1.1	8.68	1.14	36	1.99	64.4
0032 701-22-032	1.1	11.61	1.12	219	2.84	55.4
0033 701-22-033	1.1	7.74	1.23	251	0.93	50.7
0034 701-22-034	0.8	9.39	1.05	25		52.8
0035 701-22-035	1.4	4.89	0.83	59		38.4
0036 701-22-036	2.4	7.78	1.02	21		46.5
0037 701-22-037	1.8	8.16	1.04	16		51.0
0038 701-22-038	1.4	7.60	0.88	30		28.4

ANALYSIS

0039 701-22-039	1.4	12.60	1.47	32	0.61	67.7
0040 701-22-040	2.0	5.11	0.76	141		45.7

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0041 701-22-041	0.16	0.02	8.14%	0.08	1	7.8
0042 701-22-042	0.13		7.02%		0	18.3
0043 701-22-043	0.06		9.50%		2	2.5
0044 701-22-044	0.07	0.05	9.92%	0.34	1	1.9
0045 701-22-045	0.58		5.65%		0	21.3
0046 701-22-046	1.64	0.01	7.41%	0.08	31	36.3
0047 701-22-047	0.12		7.77%		99	4.5
0048 701-22-048	0.26		8.20%		57	12.2
0049 701-22-049	1.11	0.03	8.80%	0.13	5	24.8
0050 701-22-050	2.33		8.15%		1	46.6
0051 701-22-051	0.53		7.48%		100	12.1
0052 701-22-052	0.12	0.07	7.54%	0.45	134	3.8
0053 701-22-053	1.19		7.94%		32	5.8
0054 701-22-054	1.45		7.73%		4	44.6
0055 701-22-055	0.18	0.09	8.49%	0.11	13	6.2
0056 701-22-056	0.17		8.24%		3	4.0
0057 701-22-057	0.21		10.29%		1	39.7
0058 701-22-058	0.15		10.96%		4	4.8
0059 701-22-059	0.36	X	8.65%	0.21	11	5.7
0060 701-22-060	0.70	0.12	8.74%	0.39	6	15.9
0061 701-22-061	0.58		7.57%		2	6.7
0062 701-22-062	0.06		8.86%		3	10.2
0063 701-22-063	0.82		6.95%		1	86.5
0064 701-22-064	0.46	0.01	8.05%	2.81	-1	21.9
0065 701-22-065	0.38		7.36%		0	14.3
0066 701-22-066	0.10		11.67%*		4	4.7
0067 701-22-067	1.29	0.03	7.22%	17.83	3	24.6
0068 701-22-068	2.37		8.15%		3	29.7
0069 701-22-069	0.79		7.94%		5	18.7
0070 701-22-070	0.93		7.95%		6	13.4
0071 701-22-071	0.06	0.03	8.18%	3.24	93	2.2
0072 701-22-072	0.17	0.08	7.82%	1.38	125	4.6
0073 701-22-073	0.17		7.81%		104	14.8
0074 701-22-074	1.94		7.70%		18	108.0
0075 701-22-075	2.72		6.58%		6	78.6
0076 701-22-076	1.25		8.01%		-1	249.6
0077 701-22-077	0.22		10.47%		4	7.7
0078 701-22-078	1.03		8.31%		5	132.5

ANALYSIS

0079 701-22-079	1.42	7.75%	5	40.1
0080 701-22-080	0.52	8.57%	5	16.5

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	X	0.18	326.8	4.51	0.28
0042 701-22-042		X		287.8		0.21
0043 701-22-043		X		591.7		0.89
0044 701-22-044	2.7	X	0.12	441.8	5.99	0.61
0045 701-22-045		X		192.8		0.25
0046 701-22-046	1.6	13	0.28	584.9	18.96	2.12
0047 701-22-047		12		245.6		1.48
0048 701-22-048		17		112.3		2.07
0049 701-22-049	2.4	X	0.25	226.4	14.50	1.79
0050 701-22-050		X		275.3		0.25
0051 701-22-051		12		1024.8		1.28
0052 701-22-052	3.9	X	0.04	856.6	60.96	1.14
0053 701-22-053		11		378.5		1.25
0054 701-22-054		X		363.2		2.51
0055 701-22-055	1.9	X	0.04	581.1	30.01	1.81
0056 701-22-056		X		540.3		0.78
0057 701-22-057		X		1364.1		0.90
0058 701-22-058		X		1041.3		1.36
0059 701-22-059	1.4	X	0.07	282.2	7.50	1.54
0060 701-22-060	2.2	X	0.05	652.6	14.78	1.70
0061 701-22-061		X		398.8		0.74
0062 701-22-062		X		252.3		0.84
0063 701-22-063		X		204.5		0.30
0064 701-22-064	1.0	X	0.03	249.2	0.46	0.20
0065 701-22-065		X		418.2		0.09
0066 701-22-066		X		367.7		2.05
0067 701-22-067	7.7	X	0.04	213.0	20.46	0.99
0068 701-22-068		X		421.5		1.06
0069 701-22-069		X		382.4		1.31
0070 701-22-070		X		367.1		1.28
0071 701-22-071	5.6	14	0.04	588.2	227.06	1.22
0072 701-22-072	4.9	17	0.02	1384.9	71.60	1.21
0073 701-22-073		15		176.6		1.38
0074 701-22-074		X		246.5		2.45
0075 701-22-075		X		380.9		1.32
0076 701-22-076		X		220.3		2.15
0077 701-22-077		X		115.0		1.73
0078 701-22-078		X		427.9		0.86

ANALYSIS

0079 701-22-079	X	316.0	0.64
0080 701-22-080	X	432.8	0.30

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	X	1.60	X	0.03	803	19.38
0042 701-22-042		1.02		0.03	552	
0043 701-22-043		0.47		0.04	300	
0044 701-22-044	0.2	0.91	X	0.06	396	25.48
0045 701-22-045		2.97		0.04	339	
0046 701-22-046	X	0.75	X	0.83	2409	25.78
0047 701-22-047		0.06		1.37	2.30%	
0048 701-22-048		0.05		0.69	2139	
0049 701-22-049	2.9	1.44	0.016	0.05	1118	10.46
0050 701-22-050		2.45		0.16	727	
0051 701-22-051		1.24		1.57	2.79%	
0052 701-22-052	X	0.11	X	2.06	2.95%	6.85
0053 701-22-053		2.19		1.05	2929	
0054 701-22-054		1.95		0.04	1131	
0055 701-22-055	X	0.20	X	0.41	2575	9.18
0056 701-22-056		0.70		0.03	205	
0057 701-22-057		0.42		0.03	287	
0058 701-22-058		0.42		0.04	338	
0059 701-22-059	0.1	0.13	X	0.65	1201	9.39
0060 701-22-060	1.7	1.55	0.013	0.05	919	8.99
0061 701-22-061		3.45		0.04	778	
0062 701-22-062		1.62		0.04	674	
0063 701-22-063		3.07		0.03	803	
0064 701-22-064	0.2	2.21	0.005	0.02	900	10.44
0065 701-22-065		1.86		0.02	819	
0066 701-22-066		0.13		0.02	317	
0067 701-22-067	2.0	2.28	0.020	0.04	182	11.02
0068 701-22-068		4.24		0.05	397	
0069 701-22-069		1.68		0.08	440	
0070 701-22-070		1.04		0.05	262	
0071 701-22-071	0.8	0.13	0.057	1.09	3.62%	8.83
0072 701-22-072	0.2	0.28	0.007	1.53	3.70%	8.40
0073 701-22-073		0.11		1.72	2.57%	
0074 701-22-074		1.79		0.71	4535	
0075 701-22-075		2.03		0.05	1492	
0076 701-22-076		0.55		0.05	780	
0077 701-22-077		0.18		0.04	586	
0078 701-22-078		2.78		0.03	1070	

ANALYSIS

0079 701-22-079	5.67	0.04	664
0080 701-22-080	0.96	0.04	713

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0041 701-22-041	0.15	3.98	45.92	56	13.1	285.9
0042 701-22-042	0.48		45.29		14.0	
0043 701-22-043	0.05		23.35		3.7	
0044 701-22-044	0.24	29.01	22.11	286	19.4	1438.7
0045 701-22-045	0.05		36.22		13.0	
0046 701-22-046	7.73	43.13	51.06	73	23.1	22.6
0047 701-22-047	0.29		52.53		9.7	
0048 701-22-048	4.94		53.42		10.4	
0049 701-22-049	0.16	1.39	36.48	99	11.6	33.0
0050 701-22-050	0.16		40.53		18.3	
0051 701-22-051	1.94		55.18		11.6	
0052 701-22-052	0.17	X	71.00	23	9.4	0.6
0053 701-22-053	4.32		68.75		12.4	
0054 701-22-054	1.58		66.32		17.0	
0055 701-22-055	0.07	0.03	71.61	236	9.8	2.0
0056 701-22-056	0.04		58.01		8.6	
0057 701-22-057	1.04		86.79		61.4*	
0058 701-22-058	0.32		90.64		24.1	
0059 701-22-059	5.53	5.84	70.24	97	10.0	28.9
0060 701-22-060	2.75	5.99	81.64	175	12.8	89.2
0061 701-22-061	0.04		49.15		0.6	
0062 701-22-062	0.02		55.75		3.5	
0063 701-22-063	0.05		44.72		15.2	
0064 701-22-064	0.05	5.37	42.44	33	9.7	115.2
0065 701-22-065	0.04		26.44		12.3	
0066 701-22-066	10.19*		54.15		9.2	
0067 701-22-067	3.21	268.89	69.50	17	11.5	696.4
0068 701-22-068	1.36		55.01		17.9	
0069 701-22-069	6.07		58.11		16.0	
0070 701-22-070	1.87		47.78		12.4	
0071 701-22-071	0.16	0.10	65.85	27	8.8	1.0
0072 701-22-072	0.36	X	71.01	115	10.7	1.6
0073 701-22-073	0.65		53.61		9.0	
0074 701-22-074	9.84		59.50		13.1	
0075 701-22-075	0.39		58.90		4.6	
0076 701-22-076	0.20		66.08		56.9	
0077 701-22-077	4.65		51.71		8.4	
0078 701-22-078	0.14		62.18		14.1	

ANALYSIS

0079 701-22-079	0.37	57.02	16.4
0080 701-22-080	0.15	20.95	11.5

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	No	16	X	0.38	59.2	0.05
0042 701-22-042	No	10		0.34	65.8	
0043 701-22-043	No	21		0.79	448.0	
0044 701-22-044	No	23	X	0.29	102.9	1.11
0045 701-22-045	No	27		0.19	666.2	
0046 701-22-046	Yes	11	0.03	3.00	191.3	0.05
0047 701-22-047	No	11		3.16	10.9	
0048 701-22-048	Yes	19		5.40	15.0	
0049 701-22-049	No	16	X	5.49	300.6	2.38
0050 701-22-050	No	56		0.27	612.9	
0051 701-22-051	No	8		1.94	121.7	
0052 701-22-052	No	12	X	1.83	18.8	X
0053 701-22-053	No	9		1.78	215.1	
0054 701-22-054	No	26		4.84	325.5	
0055 701-22-055	Yes	11	X	2.04	11.0	X
0056 701-22-056	No	8		2.60	165.8	
0057 701-22-057	No	12		2.85	45.3	
0058 701-22-058	No	19		2.58	31.7	
0059 701-22-059	No	10	X	7.26	17.4	0.01
0060 701-22-060	No	12	X	11.86	87.9	0.83
0061 701-22-061	No	13		0.84	160.8	
0062 701-22-062	No	13		1.05	87.4	
0063 701-22-063	No	40		0.18	1982.7	
0064 701-22-064	No	30	X	0.08	562.5	9.60
0065 701-22-065	No	18		0.06	456.4	
0066 701-22-066	No	28		3.11	55.0	
0067 701-22-067	No	41	X	6.08	584.7	14.94
0068 701-22-068	No	45		5.74	410.8	
0069 701-22-069	No	83		10.97	147.7	
0070 701-22-070	No	49		7.08	181.2	
0071 701-22-071	No	9	X	1.69	19.9	0.02
0072 701-22-072	No	12	X	2.26	67.0	0.01
0073 701-22-073	Yes	12		3.11	21.2	
0074 701-22-074	No	13		8.62	322.1	
0075 701-22-075	No	19		5.72	1075.6	
0076 701-22-076	No	267*		7.17	230.3	
0077 701-22-077	No	39		2.15	101.4	
0078 701-22-078	No	35		3.36	307.1	

ANALYSIS

0079 701-22-079	No	85	4.54	471.0
0080 701-22-080	No	16	1.19	76.2

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0041 701-22-041	0.97	497	0.40	0.78	X	5.38
0042 701-22-042	0.69		0.23	0.69		4.83
0043 701-22-043	1.30		0.84	0.41		0.75
0044 701-22-044	1.52	1179	0.92	0.35	0.2	0.71
0045 701-22-045	0.88		0.42	0.58		6.73
0046 701-22-046	1.67	1000	1.23	0.83	0.4	5.57
0047 701-22-047	2.03		1.22	0.83		2.75
0048 701-22-048	1.47		0.99	0.77		3.84
0049 701-22-049	2.79	905	1.68	0.97	0.1	4.86
0050 701-22-050	1.30		0.74	0.97		9.07
0051 701-22-051	2.05		1.23	0.92		3.87
0052 701-22-052	2.49	344	1.43	1.12	0.6	2.85
0053 701-22-053	2.45		1.41	1.30		5.20
0054 701-22-054	3.64		2.47	1.10		6.41
0055 701-22-055	2.75	1169	1.60	1.15	0.4	3.40
0056 701-22-056	1.32		0.84	0.52		1.99
0057 701-22-057	3.80		2.60	1.35		3.04
0058 701-22-058	3.15		1.96	1.72		1.67
0059 701-22-059	2.08	874	1.36	0.98	0.3	3.82
0060 701-22-060	2.99	1022	1.94	1.34	0.2	3.40
0061 701-22-061	0.96		0.54	0.69		3.26
0062 701-22-062	1.16		0.52	0.90		2.38
0063 701-22-063	1.07		0.52	0.78		7.60
0064 701-22-064	0.78	335	0.40	0.76	X	4.43
0065 701-22-065	0.48		0.19	0.55		6.53
0066 701-22-066	1.77		1.04	0.80		1.15
0067 701-22-067	1.68	598	1.01	0.76	X	3.27
0068 701-22-068	1.64		0.93	0.77		5.22
0069 701-22-069	1.84		0.98	0.85		2.68
0070 701-22-070	1.38		1.05	0.62		2.64
0071 701-22-071	2.31	499	1.39	1.05	0.1	2.76
0072 701-22-072	2.32	925	1.36	1.07	0.4	2.98
0073 701-22-073	2.15		1.26	0.97		3.06
0074 701-22-074	1.70		1.02	0.92		5.43
0075 701-22-075	3.45		2.23	1.05		3.56
0076 701-22-076	4.59		1.84	1.61		13.94
0077 701-22-077	2.80		1.49	1.01		1.71
0078 701-22-078	2.68		1.42	1.18		4.07

ANALYSIS

0079 701-22-079	2.31	1.35	1.07	3.69
0080 701-22-080	0.87	0.44	0.59	3.67

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.06	1.4	0	12.29	2.27	0.78
0042 701-22-042		1.5	0	8.91	1.59	0.59
0043 701-22-043		1.5	0	17.10	1.37	1.07
0044 701-22-044	0.09	1.4	0	17.18	1.28	0.97
0045 701-22-045		1.5	0	8.08	1.77	0.87
0046 701-22-046	X	1.1	0	19.07	2.40	0.84
0047 701-22-047		1.4	1	16.55	2.35	0.83
0048 701-22-048		1.4	0	20.51	2.10	1.02
0049 701-22-049	0.05	1.5	0	21.73	3.24	0.79
0050 701-22-050		1.5	0	19.12	2.76	1.22
0051 701-22-051		1.4	1	16.16	2.68	0.54
0052 701-22-052	0.02	1.3	1	15.41	3.02	0.89
0053 701-22-053		1.4	0	19.45	3.24	0.97
0054 701-22-054		1.5	0	16.84	3.43	0.77
0055 701-22-055	0.03	1.7	0	18.09	3.38	0.97
0056 701-22-056		1.4	0	16.95	1.51	1.12
0057 701-22-057		1.5	0	17.11	4.15	0.91
0058 701-22-058		1.5	0	16.63	4.38	0.98
0059 701-22-059	0.05	1.8	0	18.57	2.76	1.14
0060 701-22-060	0.07	1.5	0	20.54	4.08	0.93
0061 701-22-061		1.4	0	18.63	1.85	1.08
0062 701-22-062		1.5	0	17.77	2.32	1.14
0063 701-22-063		1.5	0	13.68	2.18	1.70
0064 701-22-064	3.04	1.5	0	14.23	1.97	1.30
0065 701-22-065		1.4	0	9.79	1.47	0.85
0066 701-22-066		1.4	0	19.79	2.31	1.44
0067 701-22-067	7.34	1.5	0	16.06	2.49	1.59
0068 701-22-068		1.5	0	19.20	2.35	1.09
0069 701-22-069		1.6	0	17.61	2.83	1.44
0070 701-22-070		1.5	0	17.03	2.02	1.23
0071 701-22-071	1.98	1.3	2	16.00	2.98	1.12
0072 701-22-072	0.44	1.5	2	15.82	3.06	1.03
0073 701-22-073		1.4	1	16.47	2.48	0.82
0074 701-22-074		1.1	0	18.97	2.64	0.97
0075 701-22-075		1.6	0	14.42	3.34	0.66
0076 701-22-076		1.5	0	15.29	5.48	0.75
0077 701-22-077		1.5	0	17.78	3.26	1.54
0078 701-22-078		1.5	0	21.78	4.13	1.20

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0079 701-22-079	1.5	0	36.40	3.44	1.18
0080 701-22-080	1.5	0	22.67	1.87	0.79

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.98	X	X	0.15	0.060	1.05%
0042 701-22-042	0.47	0.02		0.09	0.030	1.34%
0043 701-22-043	1.83	X		0.27	0.129	2.87%
0044 701-22-044	1.38	X	X	0.31	0.186	2.62%
0045 701-22-045	0.32	0.02		0.15	0.422	5616
0046 701-22-046	1.14	X	X	0.36	3.274	3.56%
0047 701-22-047	1.33	X		0.39	0.035	3.61%
0048 701-22-048	1.51	X		0.32	0.697	3.26%
0049 701-22-049	1.91	0.02	X	0.60	1.992	3.98%
0050 701-22-050	1.70	0.03		0.25	0.548	795
0051 701-22-051	1.50	X		0.41	1.021	3.21%
0052 701-22-052	1.60	X	X	0.49	0.056	3.29%
0053 701-22-053	1.92	0.06		0.49	0.224	3.24%
0054 701-22-054	1.47	0.04		0.82	0.259	3.46%
0055 701-22-055	1.89	X	X	0.55	0.043	3.43%
0056 701-22-056	1.87	X		0.39	0.123	3.80%
0057 701-22-057	1.70	X		0.84	0.096	2.63%
0058 701-22-058	1.92	X		0.65	0.049	2.44%
0059 701-22-059	1.70	0.05	X	0.45	0.938	3.56%
0060 701-22-060	1.86	0.08	X	2.05	1.017	3.81%
0061 701-22-061	1.54	X		0.18	0.421	3.69%
0062 701-22-062	1.55	X		0.18	0.552	3.74%
0063 701-22-063	1.11	0.06		0.18	0.172	5571
0064 701-22-064	0.86	0.01	X	0.11	0.185	2.33%
0065 701-22-065	0.65	0.01		0.07	0.193	1.94%
0066 701-22-066	1.52	0.03		0.35	0.713	3.45%
0067 701-22-067	1.43	0.08	X	0.31	1.104	2.80%
0068 701-22-068	1.35	0.28		0.29	0.588	2.98%
0069 701-22-069	1.36	0.48		0.35	0.791	3.26%
0070 701-22-070	1.70	0.40		0.30	0.309	3.25%
0071 701-22-071	1.97	X	X	0.48	0.026	2.55%
0072 701-22-072	1.61	X	X	0.46	0.120	2.55%
0073 701-22-073	1.32	X		0.42	0.092	3.14%
0074 701-22-074	1.42	0.06		0.37	3.200	3.32%
0075 701-22-075	1.57	0.06		0.74	0.861	2.89%
0076 701-22-076	1.82	0.01		0.76	1.014	2.59%
0077 701-22-077	2.16	0.05		0.52	1.008	2.96%
0078 701-22-078	2.10	0.53		0.49	0.354	3.36%

ANALYSIS

0079 701-22-079	1.98	0.23	0.42	0.437	2.83%
0080 701-22-080	0.97	0.02	0.14	0.194	2.47%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	9.0	24.91	1.1	0.088	495	16.65
0042 701-22-042		26.46	1.4	0.036	139	
0043 701-22-043		13.93	3.4	0.167	977	
0044 701-22-044	14.2	15.10	6.1	0.151	384	33.88
0045 701-22-045		19.48	4.1	0.061	117	
0046 701-22-046	50.1	28.60	2.7	0.180	6077	24.72
0047 701-22-047		29.69	3.7	0.190	1.87%	
0048 701-22-048		29.57	5.0	0.168	2.28%	
0049 701-22-049	41.7	19.67	1.3	0.234	3257	13.16
0050 701-22-050		21.79	91.4	0.156	276	
0051 701-22-051		32.13	7.0	0.186	1.33%	
0052 701-22-052	15.8	40.09	8.7	0.234	1.77%	7.87
0053 701-22-053		37.22	9.7	0.196	1.05%	
0054 701-22-054		36.34	3.0	0.318	4717	
0055 701-22-055	24.8	40.77	6.3	0.251	7312	17.85
0056 701-22-056		34.51	2.1	0.156	3843	
0057 701-22-057		49.58	1.6	0.486	2726	
0058 701-22-058		49.66	1.6	0.335	2527	
0059 701-22-059	37.4	40.71	3.6	0.210	4326	21.64
0060 701-22-060	37.9	45.89	2.6	0.269	3721	19.71
0061 701-22-061		27.83	0.1	0.096	1998	
0062 701-22-062		31.58	0.4	0.098	1882	
0063 701-22-063		24.22	2.1	0.111	173	
0064 701-22-064	4.8	22.83	0.3	0.068	113	7.58
0065 701-22-065		13.91	0.7	0.038	107	
0066 701-22-066		31.68	4.4	0.163	2308	
0067 701-22-067	20.2	42.14	2.5	0.173	2433	10.89
0068 701-22-068		30.72	1.8	0.152	1980	
0069 701-22-069		30.62	1.8	0.171	3026	
0070 701-22-070		25.81	2.7	0.170	2891	
0071 701-22-071	5.5	36.78	8.6	0.221	1.08%	7.63
0072 701-22-072	17.5	40.22	6.8	0.209	1.72%	5.29
0073 701-22-073		30.17	8.1	0.211	2.02%	
0074 701-22-074		32.91	4.6	0.162	6675	
0075 701-22-075		34.00	1.7	0.322	2792	
0076 701-22-076		33.94	4.4	0.211	2624	
0077 701-22-077		28.66	8.4	0.229	3505	
0078 701-22-078		31.94	2.0	0.232	2369	

ANALYSIS

0079 701-22-079	30.56	6.6	0.238	2353
0080 701-22-080	11.09	1.5	0.078	1120

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0041 701-22-041	50	0.69		1.3	0.19	198
0042 701-22-042	38			4.2		181
0043 701-22-043	56			2.1		62
0044 701-22-044	42	0.57		1.7	0.20	126
0045 701-22-045	40			2.5		252
0046 701-22-046	>2.00%	19.09	2.25%	1.7	3.58	130
0047 701-22-047	5202			0.6		11
0048 701-22-048	>2.00%		2.36%	1.2		50
0049 701-22-049	398	1.57		1.3	0.08	146
0050 701-22-050	1372			2.4		295
0051 701-22-051	3669			2.8		70
0052 701-22-052	1747	0.01		1.8	10.26	19
0053 701-22-053	>2.00%		2.08%	1.6		89
0054 701-22-054	401			6.7		201
0055 701-22-055	4184	1.12		1.6	2.28	35
0056 701-22-056	129			1.0		48
0057 701-22-057	50			2.9		65
0058 701-22-058	46			1.8		48
0059 701-22-059	5554	5.83		1.2	0.07	47
0060 701-22-060	160	0.22		1.2	0.12	106
0061 701-22-061	146			1.1		51
0062 701-22-062	118			0.6		62
0063 701-22-063	44			2.0		296
0064 701-22-064	41	0.40		2.4	0.06	277
0065 701-22-065	42			2.7		334
0066 701-22-066	188			0.6		61
0067 701-22-067	175	1.88		1.5	0.08	104
0068 701-22-068	128			1.8		192
0069 701-22-069	219			1.9		68
0070 701-22-070	188			1.0		67
0071 701-22-071	817	0.13		2.6	8.51	2
0072 701-22-072	2436	0.02		1.3	35.62	24
0073 701-22-073	1.05%			1.3		40
0074 701-22-074	1.34%			1.9		130
0075 701-22-075	659			2.6		111
0076 701-22-076	227			0.6		498
0077 701-22-077	282			1.6		62
0078 701-22-078	173			1.2		141

ANALYSIS

0079 701-22-079	77	1.9	132
0080 701-22-080	74	1.4	131

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0041 701-22-041	749	47.2	167	2.2	156	197
0042 701-22-042	735		145	2.2	133	181
0043 701-22-043	1096		7	3.7	1	60
0044 701-22-044	1087	161.8	17	3.1	10	125
0045 701-22-045	808		193	2.2	176	251
0046 701-22-046	612	117.1	68	2.5	53	99
0047 701-22-047	684		0	8.5	0	-88
0048 701-22-048	639		2	6.0	0	-7
0049 701-22-049	670	140.4	128	2.1	110	141
0050 701-22-050	530		244	2.1	222	294
0051 701-22-051	612		0	8.1	0	-30
0052 701-22-052	577	47.3	0	8.9	0	-115
0053 701-22-053	738		26	3.0	12	57
0054 701-22-054	1141		181	2.1	160	197
0055 701-22-055	1197	203.8	14	3.0	5	22
0056 701-22-056	707		40	2.3	30	45
0057 701-22-057	879		53	2.2	43	64
0058 701-22-058	630		36	2.3	28	44
0059 701-22-059	747	122.0	27	2.8	8	35
0060 701-22-060	881	163.7	94	2.2	81	100
0061 701-22-061	703		2	4.6	0	49
0062 701-22-062	333		34	2.4	23	59
0063 701-22-063	531		207	2.3	181	295
0064 701-22-064	1700	22.9	144	2.3	126	278
0065 701-22-065	1361		215	2.2	196	333
0066 701-22-066	391		19	2.9	9	57
0067 701-22-067	365	6.3	81	2.2	66	101
0068 701-22-068	699		157	2.1	137	189
0069 701-22-069	621		62	2.1	51	63
0070 701-22-070	539		63	2.2	49	61
0071 701-22-071	1.62%	124.5	0	9.7	0	-91
0072 701-22-072	3933	208.2	0	9.0	0	-101
0073 701-22-073	1324		0	9.0	0	-64
0074 701-22-074	943		80	2.3	61	112
0075 701-22-075	686		79	2.2	67	105
0076 701-22-076	243		440	2.1	409	499
0077 701-22-077	289		32	2.5	23	58
0078 701-22-078	366		113	2.2	100	136

ANALYSIS

0079 701-22-079	418	101	2.2	88	127
0080 701-22-080	691	106	2.1	95	126

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	1.15	17.91	8.9	0.07	675	X
0042 701-22-042	0.61	16.24	10.2		611	
0043 701-22-043	3.40	8.34	3.5		101	
0044 701-22-044	3.25	7.54	10.7	0.56	146	X
0045 701-22-045	0.96	14.59	24.6		476	
0046 701-22-046	3.91	18.72	17.4	X	580	X
0047 701-22-047	3.90	18.17	8.3		581	
0048 701-22-048	3.95	19.61	8.9		614	
0049 701-22-049	3.32	15.13	8.6	0.02	667	X
0050 701-22-050	4.33	16.18	33.2		849	
0051 701-22-051	3.47	19.75	8.6		523	
0052 701-22-052	3.83	25.28	6.2	X	616	X
0053 701-22-053	3.93	26.63	7.6		725	
0054 701-22-054	2.81	26.01	18.1		593	
0055 701-22-055	4.08	26.17	6.4	X	752	X
0056 701-22-056	4.24	18.42	4.1		71	
0057 701-22-057	3.74	33.06	15.5		346	
0058 701-22-058	4.00	38.47	9.5		383	
0059 701-22-059	3.78	25.28	9.2	0.02	567	X
0060 701-22-060	3.30	31.48	11.4	0.10	1303	X
0061 701-22-061	2.60	16.89	3.0		559	
0062 701-22-062	3.13	19.67	4.0		563	
0063 701-22-063	2.36	18.03	30.4		662	
0064 701-22-064	1.61	16.66	11.0	0.09	745	0.2
0065 701-22-065	0.88	11.54	11.7		545	
0066 701-22-066	3.42	18.80	26.0		486	
0067 701-22-067	5.78	21.89	28.6	0.51	142	0.4
0068 701-22-068	3.73	17.21	30.6		350	
0069 701-22-069	5.34	22.80	50.8		394	
0070 701-22-070	5.34	16.85	30.6		254	
0071 701-22-071	4.58	23.60	5.7	X	648	X
0072 701-22-072	3.81	25.98	8.7	X	726	X
0073 701-22-073	3.64	19.36	15.5		663	
0074 701-22-074	3.58	21.60	13.2		837	
0075 701-22-075	5.54	20.15	8.4		677	
0076 701-22-076	4.13	29.21	242.5*		1282	
0077 701-22-077	4.02	18.35	17.1		463	
0078 701-22-078	7.11	25.52	32.7		1001	

ANALYSIS

0079 701-22-079	5.74	22.20	47.4	713
0080 701-22-080	2.02	8.58	11.2	637

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	104.1	0.6	5.3		4.916	28.10
0042 701-22-042	72.8		4.9		4.538	14.92
0043 701-22-043	9.1		5.7		2.409	63.65
0044 701-22-044	11.3	X	5.0		2.235	29.44
0045 701-22-045	47.8		4.9		3.851	6.19
0046 701-22-046	232.3	6.6	7.2	3.4	5.174	146.99
0047 701-22-047	43.7		9.3	3.4	5.255	158.07
0048 701-22-048	162.5		8.1		5.485	141.19
0049 701-22-049	96.1	1.3	5.3		3.954	163.07
0050 701-22-050	219.8		5.0		4.376	3.55
0051 701-22-051	133.4		7.2	3.4	5.607	122.53
0052 701-22-052	18.0	1.2	8.2	3.5	7.153	143.59
0053 701-22-053	607.6*		7.6	3.1	7.336	138.75
0054 701-22-054	130.2		4.7		7.186	155.85
0055 701-22-055	21.2	0.7	7.3	3.0	7.331	135.82
0056 701-22-056	25.1		4.7		5.599	154.37
0057 701-22-057	95.4		4.4		9.099	102.53
0058 701-22-058	35.6		4.4		9.782	95.69
0059 701-22-059	332.9	0.7	6.5	2.9	7.198	135.76
0060 701-22-060	488.9	1.7	5.2		8.508	145.87
0061 701-22-061	23.8		4.1		4.971	133.02
0062 701-22-062	64.4		4.2		5.678	164.18
0063 701-22-063	111.6		4.6		5.100	4.50
0064 701-22-064	185.2	0.6	4.1		4.712	3.89
0065 701-22-065	137.8		4.3		2.786	3.48
0066 701-22-066	89.3		4.1		5.331	117.48
0067 701-22-067	52.8	13.0	3.7		6.579	129.11
0068 701-22-068	70.0		3.7		5.231	109.43
0069 701-22-069	53.4		3.8		6.147	164.51
0070 701-22-070	32.2		4.2		4.789	155.31
0071 701-22-071	10.0	2.5	9.2	3.7	6.663	92.30
0072 701-22-072	24.0	1.5	8.5	3.5	7.299	104.31
0073 701-22-073	49.6		8.5	3.4	5.434	146.48
0074 701-22-074	426.7		7.3	3.3	6.079	161.45
0075 701-22-075	137.8		5.4		6.229	144.53
0076 701-22-076	71.7		2.7		7.540	158.97
0077 701-22-077	39.0		4.2		5.169	139.72
0078 701-22-078	135.8		4.5		6.759	167.61

ANALYSIS

0079 701-22-079	194.4	4.0	6.533	138.62
0080 701-22-080	127.2	4.7	2.237	84.51

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0041 701-22-041	X	6.48	5.82%	46.7	4.38	0.34
0042 701-22-042	0.007	5.92	5.43%		4.68	0.36
0043 701-22-043	X	2.03	2.12%		0.27	0.54
0044 701-22-044	X	4.11	3.88%	51.0	0.35	1.19
0045 701-22-045	0.006	8.22	7.50%		5.32	0.48
0046 701-22-046	0.003	4.24	4.30%	117.6	3.66	0.14
0047 701-22-047	X	0.37	3389		0.25	0.05
0048 701-22-048	0.002	1.64	1.66%		1.34	0.05
0049 701-22-049	X	4.76	4.52%	90.5	3.80	0.11
0050 701-22-050	X	9.64	8.70%		7.35	0.22
0051 701-22-051	X	2.28	2.54%		1.99	0.33
0052 701-22-052	X	0.62	5441	29.7	0.44	0.07
0053 701-22-053	X	2.90	2.78%		2.62	0.06
0054 701-22-054	0.017	6.57	6.25%		5.73	0.18
0055 701-22-055	X	1.13	1.07%	55.1	1.03	0.06
0056 701-22-056	0.005	1.58	1.54%		1.63	0.08
0057 701-22-057	X	2.11	2.08%		1.74	0.17
0058 701-22-058	X	1.56	1.52%		1.27	0.10
0059 701-22-059	X	1.52	1.49%	82.1	1.30	0.08
0060 701-22-060	X	3.47	3.41%	75.5	2.79	0.09
0061 701-22-061	X	1.66	1.77%		0.06	0.90
0062 701-22-062	X	2.02	2.25%		1.27	0.40
0063 701-22-063	0.005	9.68	9.12%		7.67	0.47
0064 701-22-064	0.036	9.05	8.39%	34.5	4.41	1.17
0065 701-22-065	0.037	10.90	10.22%		6.02	1.02
0066 701-22-066	0.006	1.98	2.30%		0.68	0.39
0067 701-22-067	X	3.40	3.57%	91.4	2.75	0.21
0068 701-22-068	0.003	6.28	5.87%		3.85	0.41
0069 701-22-069	X	2.21	2.56%		1.99	0.15
0070 701-22-070	0.002	2.20	2.50%		2.01	0.19
0071 701-22-071	0.002	0.07	974	17.4		0.02
0072 701-22-072	X	0.80	7516	60.7	0.57	0.09
0073 701-22-073	X	1.31	1.45%		1.09	0.05
0074 701-22-074	X	4.24	4.24%		3.84	0.09
0075 701-22-075	X	3.62	3.68%		3.15	0.15
0076 701-22-076	0.002	16.29	15.06%		12.40	0.43
0077 701-22-077	X	2.04	2.26%		1.16	0.52
0078 701-22-078	0.002	4.62	4.52%		3.63	0.26

ANALYSIS

0079 701-22-079	0.003	4.32	4.53%	3.44	0.28
0080 701-22-080	X	4.27	4.24%	3.37	0.28

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.46	0.32	9.0	2.2	2.8	2.06
0042 701-22-042	0.61		8.3	1.8		1.75
0043 701-22-043	0.51		14.8	X		0.10
0044 701-22-044	0.30	0.54	15.3	X	4.6	0.56
0045 701-22-045	2.74		5.8	2.2		1.73
0046 701-22-046	1.08	0.34	8.7	0.6	1.3	0.32
0047 701-22-047	0.42		8.6	X		0.02
0048 701-22-048	0.79		9.9	X		0.04
0049 701-22-049	1.72	1.45	11.5	1.2	2.1	0.67
0050 701-22-050	2.50		11.5	1.8		2.11
0051 701-22-051	0.65		10.0	1.0		0.33
0052 701-22-052	0.40	0.47	9.2	X	0.9	0.03
0053 701-22-053	0.62		11.2	1.9		1.54
0054 701-22-054	1.45		11.0	2.7		2.16
0055 701-22-055	0.41	0.18	9.1	X	2.5	0.15
0056 701-22-056	0.28		7.2	0.7		0.42
0057 701-22-057	0.59		10.8	1.3		0.92
0058 701-22-058	0.21		11.6	0.7		0.49
0059 701-22-059	0.37	0.02	9.5	X	6.3	0.16
0060 701-22-060	0.48	0.29	11.8	0.8	7.8	0.80
0061 701-22-061	0.87		7.1	1.1		0.83
0062 701-22-062	0.69		7.0	X		0.16
0063 701-22-063	5.25		8.8	2.4		2.14
0064 701-22-064	1.75	0.49	8.6	1.6	1.5	1.56
0065 701-22-065	1.26		8.2	2.7		2.00
0066 701-22-066	0.60		14.1	0.6		0.10
0067 701-22-067	1.36	0.21	7.0	0.9	4.7	0.84
0068 701-22-068	1.61		12.5	1.7		1.73
0069 701-22-069	1.81		9.9	0.5		0.53
0070 701-22-070	2.08		8.2	0.7		0.58
0071 701-22-071	0.15	0.18	8.1	X	1.2	X
0072 701-22-072	0.33	0.38	10.1	X	1.5	0.13
0073 701-22-073	0.53		8.9	X		0.10
0074 701-22-074	2.64		9.6	1.4		1.08
0075 701-22-075	5.54		4.1	2.0		1.83
0076 701-22-076	9.17		23.0	1.4		1.14
0077 701-22-077	1.60		15.9	0.5		0.04
0078 701-22-078	9.53*		11.5	1.2		0.70

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0079 701-22-079	3.54	13.1	1.0	0.97
0080 701-22-080	1.27	10.7	1.9	1.55

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ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	3.18	1.1	X	437.76	43.48	0.08
0042 701-22-042	2.72	2.0		595.91		0.04
0043 701-22-043	1.54	0.9		25.26		0.29
0044 701-22-044	1.39	0.7	X	41.20	18.33	0.26
0045 701-22-045	2.67	11.6		667.21		0.07
0046 701-22-046	3.14	2.0	X	36.73	936.43	0.29
0047 701-22-047	2.97	0.7		31.32		0.30
0048 701-22-048	3.31	0.6		18.71		0.29
0049 701-22-049	3.44	0.7	X	154.71	348.10	0.25
0050 701-22-050	3.43	2.3		1186.83		0.29
0051 701-22-051	3.47	0.6		228.61		0.27
0052 701-22-052	4.13	0.5	0.1	63.70	29.47	0.35
0053 701-22-053	4.77	1.0		48.93		0.32
0054 701-22-054	4.79	2.3		82.79		0.22
0055 701-22-055	4.47	0.6	X	28.16	136.79	0.34
0056 701-22-056	2.55	0.7		15.06		0.35
0057 701-22-057	5.63	0.7		145.71		0.29
0058 701-22-058	6.82	0.7		91.12		0.33
0059 701-22-059	4.16	0.5	X	73.60	5.48	0.30
0060 701-22-060	5.68	0.6	X	877.78	19.48	0.27
0061 701-22-061	2.79	0.8		49.73		0.23
0062 701-22-062	3.34	0.7		48.24		0.29
0063 701-22-063	3.29	5.0		449.33		0.16
0064 701-22-064	2.83	3.4	X	182.67	12.76	0.13
0065 701-22-065	2.00	2.5		222.33		0.07
0066 701-22-066	3.22	0.7		168.25		0.24
0067 701-22-067	3.66	1.4	X	10.85	8.75	0.45
0068 701-22-068	2.99	2.1		139.02		0.29
0069 701-22-069	4.08	1.8		116.67		0.40
0070 701-22-070	3.03	1.5		45.57		0.42
0071 701-22-071	4.01	0.5	X	271.54	53.77	0.36
0072 701-22-072	4.50	0.7	0.1	107.46	58.08	0.31
0073 701-22-073	3.32	0.5		42.15		0.27
0074 701-22-074	3.62	1.1		37.67		0.26
0075 701-22-075	3.91	0.7		195.29		0.42
0076 701-22-076	5.85	0.9		35.03		0.25
0077 701-22-077	3.39	0.6		60.85		0.30
0078 701-22-078	5.08	2.0		426.93		0.42

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0079 701-22-079	4.35	4.3	438.73	0.36
0080 701-22-080	1.90	3.2	386.94	0.15

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ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.244	352	0.81	10.10	0.016	705
0042 701-22-042	0.170		0.27	8.82		340
0043 701-22-043	0.201		0.20	16.59		2463
0044 701-22-044	0.219	720	0.26	15.77	0.040	1990
0045 701-22-045	0.189		0.55	15.01		241
0046 701-22-046	0.369	680	0.18	13.40	0.012	1859
0047 701-22-047	0.334		X	13.83		2000
0048 701-22-048	0.264		X	13.52		2234
0049 701-22-049	0.477	580	0.76	12.63	0.021	2084
0050 701-22-050	0.301		1.51	14.02		2332
0051 701-22-051	0.380		0.33	19.34		2159
0052 701-22-052	0.423	210	0.16	22.48	0.010	1925
0053 701-22-053	0.403		0.56	19.50		2592
0054 701-22-054	0.516		1.43	14.08		1817
0055 701-22-055	0.460	657	0.15	23.10	0.013	2286
0056 701-22-056	0.204		0.36	21.80		2255
0057 701-22-057	0.599		0.85	24.94		2055
0058 701-22-058	0.555		0.55	27.01		2293
0059 701-22-059	0.362	443	0.17	25.29	0.060	2133
0060 701-22-060	0.511	700	0.65	24.97	0.075	2089
0061 701-22-061	0.209		0.78	16.60		933
0062 701-22-062	0.256		0.29	17.01		1213
0063 701-22-063	0.239		0.74	12.35		1206
0064 701-22-064	0.208	203	0.36	9.90	0.040	919
0065 701-22-065	0.133		0.33	8.40		552
0066 701-22-066	0.320		0.10	11.93		2655
0067 701-22-067	0.301	391	0.62	16.82	0.956	1925
0068 701-22-068	0.294		1.60	14.21		1723
0069 701-22-069	0.361		0.73	14.29		1891
0070 701-22-070	0.243		0.56	16.98		1757
0071 701-22-071	0.420	246	X	18.17	0.748	2105
0072 701-22-072	0.394	620	0.08	19.20	0.115	2239
0073 701-22-073	0.368		0.11	12.88		1855
0074 701-22-074	0.316		0.99	13.90		1974
0075 701-22-075	0.682		1.10	22.29		1232
0076 701-22-076	0.839		0.42	9.87		3194
0077 701-22-077	0.818		X	14.91		3276
0078 701-22-078	0.511		0.48	15.69		2723

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0079 701-22-079	0.443	0.74	17.78	2166
0080 701-22-080	0.221	0.50	8.61	1257

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ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	0.37	0.08	3.84	5.967	82	X
0042 701-22-042	0.17	0.03	3.43		75	
0043 701-22-043	0.63	0.14	3.80		101	
0044 701-22-044	0.28	0.14	4.44	6.777	93	X
0045 701-22-045	0.20	0.06	1.76		60	
0046 701-22-046	1.69	0.16	3.10	0.078	75	X
0047 701-22-047	1.75	0.19	4.62		69	
0048 701-22-048	1.65	0.15	3.40		84	
0049 701-22-049	2.11	0.25	3.53	2.098	95	X
0050 701-22-050	0.19	0.12	4.11		89	
0051 701-22-051	1.29	0.19	3.47		92	
0052 701-22-052	1.65	0.21	5.38	6.165	77	0.01
0053 701-22-053	1.72	0.19	4.12		118	
0054 701-22-054	2.32	0.35	3.34		90	
0055 701-22-055	1.47	0.23	4.88	0.291	88	X
0056 701-22-056	1.74	0.13	4.37		64	
0057 701-22-057	1.16	0.42	6.05		106	
0058 701-22-058	0.97	0.31	6.36		96	
0059 701-22-059	1.56	0.19	8.01	0.727	89	X
0060 701-22-060	1.75	0.29	6.71	3.615	107	X
0061 701-22-061	1.36	0.08	3.43		66	
0062 701-22-062	1.41	0.08	3.41		55	
0063 701-22-063	0.44	0.09	2.94		91	
0064 701-22-064	0.06	0.11	2.81	13.348	88	X
0065 701-22-065	0.07	0.03	1.75		80	
0066 701-22-066	1.82	0.15	2.45		129	
0067 701-22-067	1.89	0.16	3.49	31.470	56	X
0068 701-22-068	1.65	0.15	4.15		84	
0069 701-22-069	2.37	0.15	2.97		75	
0070 701-22-070	1.90	0.15	3.70		61	
0071 701-22-071	0.39	0.21	3.77	2.346	71	0.06
0072 701-22-072	0.91	0.19	4.95	4.166	86	0.02
0073 701-22-073	1.57	0.18	3.24		74	
0074 701-22-074	2.97	0.15	3.65		81	
0075 701-22-075	4.49	0.30	4.54		32	
0076 701-22-076	3.38	0.25	2.27		118	
0077 701-22-077	1.86	0.23	4.06		118	
0078 701-22-078	2.88	0.22	5.53		97	

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0079 701-22-079	1.82	0.20	5.54	95
0080 701-22-080	0.94	0.08	4.30	91

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ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	3.43	0.48	40	0.70	32.6
0042 701-22-042	3.2	1.99	0.24	168		20.4
0043 701-22-043	12.3	7.04	0.87	14		59.1
0044 701-22-044	1.8	7.57	0.99	14	0.84	50.3
0045 701-22-045	1.8	3.59	0.36	17		14.1
0046 701-22-046	8.3	8.83	1.11	2799	0.59	34.9
0047 701-22-047	0.9	11.21	1.19	276		43.6
0048 701-22-048	1.0	8.00	1.08	1703		49.5
0049 701-22-049	2.4	15.16	1.66	150	0.98	64.0
0050 701-22-050	1.8	5.99	0.86	258		58.3
0051 701-22-051	1.9	10.95	1.23	671		55.9
0052 701-22-052	1.4	13.19	1.52	100	X	46.9
0053 701-22-053	1.1	11.62	2.36	1510		66.8
0054 701-22-054	2.4	23.48	2.28	549		50.3
0055 701-22-055	1.1	14.49	1.63	78	X	61.6
0056 701-22-056	1.3	7.17	0.98	32		56.8
0057 701-22-057	1.1	25.23	2.95	55		53.9
0058 701-22-058	1.5	17.71	2.14	38		58.6
0059 701-22-059	1.6	11.08	1.41	1683	0.87	52.0
0060 701-22-060	1.9	16.20	1.81	773	0.95	57.0
0061 701-22-061	1.7	4.27	0.57	42		52.2
0062 701-22-062	1.5	4.62	0.58	23		46.9
0063 701-22-063	2.6	4.38	0.63	23		34.7
0064 701-22-064	1.6	2.52	0.40	8	0.19	43.2
0065 701-22-065	1.6	1.62	0.20	9		15.9
0066 701-22-066	4.0	8.22	0.94	2375		56.2
0067 701-22-067	1.6	8.37	1.13	1409	45.30	49.3
0068 701-22-068	2.1	7.88	0.95	450		40.9
0069 701-22-069	2.0	8.43	1.17	1915		43.1
0070 701-22-070	1.9	7.42	1.06	644		52.8
0071 701-22-071	1.3	12.66	1.49	66	X	62.4
0072 701-22-072	1.5	12.10	1.38	186	X	50.5
0073 701-22-073	1.3	12.08	1.22	329		44.6
0074 701-22-074	2.3	9.00	1.04	3221*		44.1
0075 701-22-075	3.0	20.54	2.21	184		39.5
0076 701-22-076	2.2	16.95	1.58	83		71.5
0077 701-22-077	1.3	12.15	1.61	1218		74.1
0078 701-22-078	4.5	12.74	1.59	175		74.0

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0079 701-22-079	2.4	10.70	1.46	408	73.5
0080 701-22-080	1.2	3.24	0.45	65	31.8

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ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0081 701-22-081	0.74	0.07	7.42%	69.57	0	49.0
0082 701-22-082	0.34		7.40%		3	37.7
0083 701-22-083	0.45		10.32%		4	5.0
0084 701-22-084	0.30	X	10.39%	0.02	6	8.3
0085 701-22-085	0.23		9.26%		5	13.5
0086 701-22-086	0.22		8.94%		5	3.6
0087 701-22-087	0.26		9.73%		4	2.3
0088 701-22-088	0.21	0.03	9.26%	0.99	3	7.1
0089 701-22-089	0.15		10.07%		4	5.4
0090 701-22-090	0.52		9.09%		4	33.4
0091 701-22-091	0.17		9.41%		4	5.2
0092 701-22-092	1.24		8.42%		4	12.8
0093 701-22-093	0.27	0.02	7.64%	3.12	4	8.6
0094 701-22-094	2.59	0.02	6.74%	1.02	0	14.8
0095 701-22-095	6.22		6.31%		-2	27.1
0096 701-22-096	4.05		7.63%		0	14.9
0097 701-22-097	0.31	0.02	6.38%	0.45	3	53.3
0098 701-22-098	8.94*		7.10%		0	234.9
0099 701-22-099	0.13	0.18	9.20%	7.37	3	4.0
0100 701-22-100	0.13		7.71%		2	9.6
0101 701-22-101	0.40		8.30%		2	70.7
0102 701-22-102	1.15		7.40%		-23	13.6
0103 701-22-103	0.88		9.02%		-11	25.2
0104 701-22-104	0.11		9.24%		13	3.4
0105 701-22-105	0.30		9.00%		9	10.8
0106 701-22-106	0.06		8.37%		83	2.9
0107 701-22-107	0.07	0.02	8.28%	0.08	84	4.7
0108 701-22-108	X		7.86%		78	1.6
0109 701-22-109	X	0.04	8.35%	2.84	86	1.5
0110 701-22-110	X		8.37%		85	0.9
0111 701-22-111	0.10	0.01	7.18%	2.92	155	4.5
0112 701-22-112	X		8.07%		106	2.5
0113 701-22-113	X		8.12%		109	2.2
0114 701-22-114	X	X	7.53%	2.32	117	1.1
0115 701-22-115	0.16	0.04	6.88%	2.74	130	6.1
0116 701-22-116	0.21		7.43%		95	3.9
0117 701-22-117	X		6.51%		84	2.7
0118 701-22-118	0.10		6.67%		23	8.6

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0119 701-22-119	0.06	9.17%	6	10.1
0120 701-22-120	0.05	8.93%	6	1.9

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ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	21.3	X	X	311.5	3.92	0.65
0082 701-22-082		X		302.9		0.51
0083 701-22-083		X		356.1		1.15
0084 701-22-084	1.0	X	0.03	1591.3	19.82	1.00
0085 701-22-085		X		559.9		0.76
0086 701-22-086		X		555.7		0.95
0087 701-22-087		X		417.9		0.80
0088 701-22-088	1.1	X	X	884.6	5.25	0.71
0089 701-22-089		X		901.4		0.66
0090 701-22-090		X		278.4		0.69
0091 701-22-091		X		741.2		0.60
0092 701-22-092		X		414.7		0.89
0093 701-22-093	1.6	X	X	920.0	29.64	0.84
0094 701-22-094	1.0	X	X	993.4	29.49	0.30
0095 701-22-095		X		891.5		0.20
0096 701-22-096		X		668.4		0.09
0097 701-22-097	1.0	X	0.01	708.2	6.59	0.29
0098 701-22-098		X		996.5		0.12
0099 701-22-099	2.3	X	X	608.4	55.05	1.26
0100 701-22-100		X		299.5		0.31
0101 701-22-101		X		633.8		0.83
0102 701-22-102		X		254.4		0.64
0103 701-22-103		X		509.6		1.59
0104 701-22-104		X		2336.4*		1.32
0105 701-22-105		X		366.1		1.87
0106 701-22-106		13		673.8		1.26
0107 701-22-107	2.0	14	0.02	550.0	6.25	1.18
0108 701-22-108		14		771.1		1.05
0109 701-22-109	2.2	16	0.02	807.5	101.68	1.04
0110 701-22-110		14		824.9		1.48
0111 701-22-111	7.1	24	0.06	586.1	173.44	0.98
0112 701-22-112		23		636.7		1.08
0113 701-22-113		21		507.8		1.20
0114 701-22-114	1.5	17	0.04	347.6	101.98	1.08
0115 701-22-115	2.9	23	0.04	282.4	20.86	1.13
0116 701-22-116		19		479.7		1.18
0117 701-22-117		19		667.6		0.90
0118 701-22-118		X		2144.2		1.01

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0119 701-22-119	X	950.2	1.84
0120 701-22-120	X	1539.6	1.49

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ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.7	3.86	0.410	0.07	359	26.39
0082 701-22-082		1.15		0.02	682	
0083 701-22-083		0.54		0.05	500	
0084 701-22-084	X	0.09	X	0.06	606	12.95
0085 701-22-085		0.18		0.04	335	
0086 701-22-086		0.25		0.06	362	
0087 701-22-087		0.31		0.05	298	
0088 701-22-088	X	0.23	X	0.04	433	4.91
0089 701-22-089		0.43		0.06	471	
0090 701-22-090		1.45		0.05	395	
0091 701-22-091		0.29		0.05	363	
0092 701-22-092		1.57		0.11	367	
0093 701-22-093	0.2	0.22	0.016	0.09	283	9.56
0094 701-22-094	X	1.12	X	0.04	986	18.30
0095 701-22-095		0.95		0.03	1046	
0096 701-22-096		1.44		0.04	1108	
0097 701-22-097	X	5.12	X	0.09	972	12.73
0098 701-22-098		2.17		0.03	780	
0099 701-22-099	1.3	0.33	X	0.08	664	29.14
0100 701-22-100		0.46		0.03	569	
0101 701-22-101		3.21		0.06	884	
0102 701-22-102		3.78		0.03	565	
0103 701-22-103		2.78		0.06	702	
0104 701-22-104		0.33		0.30	2656	
0105 701-22-105		0.47		0.04	2526	
0106 701-22-106		0.19		0.65	3.01%	
0107 701-22-107	X	0.10	X	0.73	3.14%	27.63
0108 701-22-108		0.04		0.67	2.84%	
0109 701-22-109	0.3	0.08	0.011	0.87	3.39%	6.54
0110 701-22-110		0.18		0.80	3.27%	
0111 701-22-111	0.5	0.17	0.166	1.84	6.07%*	11.60
0112 701-22-112		0.07		1.23	4.19%	
0113 701-22-113		0.06		1.32	4.53%	
0114 701-22-114	0.2	0.11	0.034	1.44	4.92%	7.85
0115 701-22-115	0.2	0.19	0.033	1.44	4.21%	6.29
0116 701-22-116		0.25		0.92	3.03%	
0117 701-22-117		0.45		0.76	2.73%	
0118 701-22-118		0.26		0.84	6170	

ANALYSIS

0119 701-22-119	0.29	0.08	979
0120 701-22-120	0.36	0.04	614

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0081 701-22-081	0.03	1.28	59.10	31	23.4	3571.9
0082 701-22-082	0.08		52.45		6.6	
0083 701-22-083	X		60.51		1.3	
0084 701-22-084	0.03	X	45.83	30	0.7	0.9
0085 701-22-085	X		44.75		0.3	
0086 701-22-086	X		83.58		1.2	
0087 701-22-087	0.03		62.22		0.8	
0088 701-22-088	0.03	0.07	51.47	13	0.5	2.8
0089 701-22-089	X		38.26		0.6	
0090 701-22-090	X		39.74		0.6	
0091 701-22-091	X		41.61		0.8	
0092 701-22-092	X		47.01		0.6	
0093 701-22-093	X	0.41	43.76	5	0.8	36.5
0094 701-22-094	X	0.74	88.89	15	0.3	22.9
0095 701-22-095	X		82.64		0.6	
0096 701-22-096	0.03		94.96		1.3	
0097 701-22-097	X	0.57	89.91	56	0.4	9.9
0098 701-22-098	X		108.50		0.4	
0099 701-22-099	0.06	3.64	60.72	7	15.3	270.0
0100 701-22-100	0.03		62.95		9.7	
0101 701-22-101	0.20		57.76		15.3	
0102 701-22-102	0.13		38.10		15.9	
0103 701-22-103	1.59		63.00		12.5	
0104 701-22-104	0.36		66.28		12.0	
0105 701-22-105	0.04		62.36		12.5	
0106 701-22-106	0.15		59.29		11.3	
0107 701-22-107	0.08	0.06	58.54	12	11.2	1.7
0108 701-22-108	0.03		53.73		10.5	
0109 701-22-109	0.04	0.02	65.42	28	9.4	2.3
0110 701-22-110	0.04		61.29		10.0	
0111 701-22-111	0.71	0.06	73.87	27	8.9	1.0
0112 701-22-112	0.17		56.91		10.8	
0113 701-22-113	0.31		60.57		11.3	
0114 701-22-114	0.39	X	54.75	99	8.4	1.4
0115 701-22-115	0.24	X	57.94	74	13.8	1.5
0116 701-22-116	0.10		64.71		13.1	
0117 701-22-117	0.04		47.57		13.2	
0118 701-22-118	0.29		56.70		22.0	

ANALYSIS

0119 701-22-119	0.07	74.59	7.4
0120 701-22-120	X	81.83	2.6

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	No	99	0.10	8.39	510.0	14.08
0082 701-22-082	No	22		0.88	166.3	
0083 701-22-083	No	10		3.48	786.3	
0084 701-22-084	No	17	X	1.62	647.2	0.11
0085 701-22-085	No	11		1.84	222.8	
0086 701-22-086	No	14		1.84	157.1	
0087 701-22-087	No	16		1.89	151.2	
0088 701-22-088	No	16	X	1.82	214.5	3.06
0089 701-22-089	No	20		1.62	260.6	
0090 701-22-090	No	28		2.04	409.3	
0091 701-22-091	No	16		1.51	306.4	
0092 701-22-092	No	18		2.74	291.3	
0093 701-22-093	No	14	X	2.10	299.1	25.25
0094 701-22-094	No	22	X	0.08	62.6	1.91
0095 701-22-095	No	28		0.09	117.4	
0096 701-22-096	No	37		0.13	30.9	
0097 701-22-097	No	18	X	0.22	120.1	1.15
0098 701-22-098	No	30		0.07	41.4	
0099 701-22-099	No	14	X	1.37	672.2	61.14
0100 701-22-100	No	33		0.23	798.8	
0101 701-22-101	No	10		1.22	335.0	
0102 701-22-102	No	20		2.78	365.4	
0103 701-22-103	No	49		2.69	542.7	
0104 701-22-104	No	17		6.05	139.4	
0105 701-22-105	No	15		9.42	120.5	
0106 701-22-106	No	14		5.91	44.0	
0107 701-22-107	No	10	X	4.63	69.5	0.02
0108 701-22-108	No	12		2.67	25.2	
0109 701-22-109	No	8	X	2.59	31.2	0.01
0110 701-22-110	No	8		2.88	41.5	
0111 701-22-111	No	8	X	5.76	154.1	0.08
0112 701-22-112	No	11		7.84	71.1	
0113 701-22-113	No	12		6.75	61.8	
0114 701-22-114	No	11	X	5.59	65.1	0.02
0115 701-22-115	No	17	X	5.78	185.1	0.03
0116 701-22-116	No	12		4.49	80.9	
0117 701-22-117	No	9		10.20	42.8	
0118 701-22-118	Yes	11		4.40	218.4	

ANALYSIS

0119 701-22-119	No	7	2.81	134.9
0120 701-22-120	No	4	2.27	18.9

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0081 701-22-081	1.31	2264	0.89	0.80	X	6.01
0082 701-22-082	1.07		0.61	0.77		3.21
0083 701-22-083	0.92		0.48	0.49		1.07
0084 701-22-084	1.31	328	0.66	0.67	0.3	6.60
0085 701-22-085	0.77		0.37	0.63		2.37
0086 701-22-086	0.82		0.34	0.68		2.71
0087 701-22-087	0.85		0.39	0.52		0.82
0088 701-22-088	1.55	245	0.81	0.50	X	1.84
0089 701-22-089	1.60		0.88	0.50		1.30
0090 701-22-090	1.29		0.63	0.50		2.86
0091 701-22-091	1.22		0.60	0.60		1.25
0092 701-22-092	1.17		0.65	0.54		3.70
0093 701-22-093	1.70	437	0.93	0.58	X	3.77
0094 701-22-094	1.60	324	0.61	1.64	X	3.70
0095 701-22-095	1.31		0.43	1.20		7.25
0096 701-22-096	1.10		0.41	1.04		2.79
0097 701-22-097	2.01	523	0.45	2.21	0.1	8.87
0098 701-22-098	2.99		0.70	1.84		11.02
0099 701-22-099	2.51	956	1.14	1.20	0.2	2.59
0100 701-22-100	0.59		0.25	0.63		4.72
0101 701-22-101	1.21		0.70	0.76		4.49
0102 701-22-102	1.30		0.73	0.78		5.53
0103 701-22-103	2.14		1.00	1.01		3.75
0104 701-22-104	4.27		2.44	1.56		5.53
0105 701-22-105	2.77		1.64	1.05		1.95
0106 701-22-106	2.54		1.49	1.09		3.09
0107 701-22-107	2.49	869	1.43	1.03	0.3	3.03
0108 701-22-108	2.44		1.37	0.99		2.90
0109 701-22-109	2.51	396	1.41	1.14	0.3	2.63
0110 701-22-110	2.33		1.30	1.02		2.41
0111 701-22-111	2.74	546	1.46	1.25	0.9	3.12
0112 701-22-112	2.49		1.43	1.07		3.35
0113 701-22-113	2.30		1.35	0.99		2.91
0114 701-22-114	2.22	617	1.24	0.90	0.3	2.60
0115 701-22-115	2.44	590	1.42	0.95	0.4	3.09
0116 701-22-116	2.80		1.61	1.29		2.91
0117 701-22-117	2.30		1.33	0.94		2.78
0118 701-22-118	2.26		1.25	1.01		7.14

ANALYSIS

0119 701-22-119	6.37	3.73	1.95	1.65
0120 701-22-120	2.82	1.83	1.08	1.08

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	249.62	1.5	0	19.59	2.84	1.13
0082 701-22-082		1.5	0	15.30	2.15	1.04
0083 701-22-083		1.5	0	17.42	1.74	1.08
0084 701-22-084	0.03	1.5	0	17.59	2.13	1.06
0085 701-22-085		1.5	0	17.14	1.15	1.54
0086 701-22-086		1.5	0	17.02	1.71	1.61
0087 701-22-087		1.5	0	16.28	1.41	1.45
0088 701-22-088	0.13	1.5	0	18.58	1.72	1.58
0089 701-22-089		1.5	0	17.83	1.70	1.57
0090 701-22-090		1.5	0	19.33	1.60	1.97
0091 701-22-091		1.5	0	16.79	1.76	1.49
0092 701-22-092		1.5	0	18.60	1.58	1.78
0093 701-22-093	0.18	1.4	0	16.54	1.81	1.77
0094 701-22-094	0.19	1.4	0	8.65	3.86	1.16
0095 701-22-095		1.5	0	16.47	2.78	1.51
0096 701-22-096		1.5	0	12.96	2.23	1.35
0097 701-22-097	0.03	1.5	0	35.91	5.23	2.19
0098 701-22-098		1.5	0	24.61	5.16	3.69
0099 701-22-099	2.16	1.5	0	16.54	3.62	1.57
0100 701-22-100		1.5	0	7.95	1.32	1.60
0101 701-22-101		1.5	0	17.86	2.18	1.45
0102 701-22-102		1.5	0	25.96	1.90	1.14
0103 701-22-103		1.5	0	17.83	2.82	1.32
0104 701-22-104		1.5	0	18.56	5.34	0.96
0105 701-22-105		1.8	0	18.20	3.31	1.09
0106 701-22-106		1.3	1	16.32	3.20	1.00
0107 701-22-107	0.01	1.3	2	16.57	3.15	0.97
0108 701-22-108		1.3	2	15.99	2.86	0.98
0109 701-22-109	0.70	1.3	2	15.80	3.19	0.82
0110 701-22-110		1.3	2	16.58	2.94	0.92
0111 701-22-111	0.86	1.5	2	13.93	3.35	0.90
0112 701-22-112		1.4	2	16.26	3.11	0.91
0113 701-22-113		1.3	2	16.41	2.98	0.99
0114 701-22-114	0.44	1.3	2	16.03	2.70	0.76
0115 701-22-115	0.56	1.5	2	16.27	3.04	0.64
0116 701-22-116		1.3	2	17.19	3.56	0.82
0117 701-22-117		1.3	2	16.21	2.66	0.80
0118 701-22-118		1.2	0	14.69	2.87	0.71

ANALYSIS

0119 701-22-119	1.5	0	18.66	6.20	1.04
0120 701-22-120	1.6	0	18.56	3.20	1.15

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0081 701-22-081	1.87	0.17	X	0.28	0.196	2.32%
0082 701-22-082	1.51	0.01		0.19	0.076	2.06%
0083 701-22-083	0.93	0.02		0.17	0.135	2.00%
0084 701-22-084	0.47	0.03	X	0.24	0.300	2.50%
0085 701-22-085	0.90	X		0.14	0.091	3.10%
0086 701-22-086	0.45	X		0.14	0.137	2.93%
0087 701-22-087	0.30	X		0.15	0.134	3.09%
0088 701-22-088	0.36	X	X	0.30	0.406	3.32%
0089 701-22-089	0.37	X		0.30	0.359	3.73%
0090 701-22-090	0.55	0.01		0.23	0.422	2.86%
0091 701-22-091	0.33	X		0.22	0.241	2.44%
0092 701-22-092	1.02	X		0.22	0.295	3.36%
0093 701-22-093	0.37	0.01	X	0.33	0.212	3.38%
0094 701-22-094	1.03	0.04	X	0.26	0.031	1.91%
0095 701-22-095	0.36	0.08		0.19	0.117	2.04%
0096 701-22-096	0.61	X		0.17	0.055	2.14%
0097 701-22-097	0.61	0.02	X	0.22	0.262	1.05%
0098 701-22-098	0.35	0.60		0.41	0.105	2.11%
0099 701-22-099	0.77	X	X	0.43	0.180	2.80%
0100 701-22-100	0.55	X		0.10	0.027	1.21%
0101 701-22-101	1.26	X		0.25	0.391	3.48%
0102 701-22-102	1.26	X		0.24	0.291	1.67%
0103 701-22-103	1.55	0.01		0.37	0.250	2.33%
0104 701-22-104	2.69	X		0.89	0.067	2.81%
0105 701-22-105	2.48	X		0.56	0.076	2.80%
0106 701-22-106	2.09	X		0.53	0.017	2.83%
0107 701-22-107	1.91	X	X	0.50	0.033	2.42%
0108 701-22-108	1.97	X		0.47	0.019	2.51%
0109 701-22-109	1.56	X	X	0.49	0.013	2.62%
0110 701-22-110	1.66	X		0.45	0.013	2.83%
0111 701-22-111	1.26	X	X	0.53	0.041	2.50%
0112 701-22-112	1.56	X		0.49	0.041	2.79%
0113 701-22-113	1.66	X		0.47	0.027	2.83%
0114 701-22-114	1.23	X	X	0.43	0.030	2.37%
0115 701-22-115	1.30	X	X	0.49	0.064	1.97%
0116 701-22-116	2.04	X		0.56	0.023	2.17%
0117 701-22-117	2.00	X		0.46	0.034	2.17%
0118 701-22-118	1.91	X		0.44	0.091	2.16%

ANALYSIS

0119 701-22-119	2.53	X	1.28	0.059	1.03%
0120 701-22-120	2.20	X	0.60	0.032	1.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	21.0	30.95	2.6	0.162	1910	41.00
0082 701-22-082		29.10	2.6	0.152	683	
0083 701-22-083		40.68	2.3	0.079	2226	
0084 701-22-084	18.4	29.29	1.8	0.075	1651	13.99
0085 701-22-085		32.92	2.9	0.057	2788	
0086 701-22-086		63.17	2.4	0.051	2974	
0087 701-22-087		35.17	2.9	0.055	2725	
0088 701-22-088	23.1	36.90	4.8	0.088	1733	4.37
0089 701-22-089		25.96	3.5	0.095	2239	
0090 701-22-090		23.82	4.3	0.074	2700	
0091 701-22-091		26.07	3.0	0.101	2005	
0092 701-22-092		29.22	2.5	0.094	3482	
0093 701-22-093	30.1	27.76	2.0	0.092	3481	6.57
0094 701-22-094	9.6	50.74	0.7	0.103	226	7.65
0095 701-22-095		44.79	1.3	0.047	99	
0096 701-22-096		52.41	0.9	0.058	109	
0097 701-22-097	6.1	48.17	1.8	0.051	250	15.29
0098 701-22-098		65.97	0.7	0.050	108	
0099 701-22-099	22.0	35.13	2.4	0.151	2656	46.55
0100 701-22-100		37.92	2.4	0.044	427	
0101 701-22-101		35.00	1.0	0.135	2625	
0102 701-22-102		20.45	5.3	0.140	624	
0103 701-22-103		35.59	7.9	0.158	2617	
0104 701-22-104		35.11	16.1	0.356	6848	
0105 701-22-105		34.57	7.1	0.241	5546	
0106 701-22-106		33.20	10.2	0.217	1.59%	
0107 701-22-107	9.4	32.64	11.8	0.214	1.66%	12.83
0108 701-22-108		29.68	10.2	0.199	1.50%	
0109 701-22-109	5.0	36.77	8.3	0.208	1.24%	2.66
0110 701-22-110		34.25	10.2	0.199	1.39%	
0111 701-22-111	8.1	43.26	9.9	0.216	1.22%	5.52
0112 701-22-112		31.27	11.1	0.218	1.38%	
0113 701-22-113		33.53	10.2	0.219	1.03%	
0114 701-22-114	11.9	30.60	8.0	0.187	9481	2.91
0115 701-22-115	6.9	32.88	13.5	0.203	1.17%	2.18
0116 701-22-116		35.49	14.2	0.241	1.20%	
0117 701-22-117		26.09	15.3	0.200	1.37%	
0118 701-22-118		31.07	8.3	0.183	1.06%	

ANALYSIS

0119 701-22-119	41.13	19.8	0.464	2006
0120 701-22-120	44.06	3.9	0.299	2413

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0081 701-22-081	46	0.51		1.2	0.64	223
0082 701-22-082	98			1.8		138
0083 701-22-083	29			4.6		25
0084 701-22-084	46	0.02		10.3	5.55	56
0085 701-22-085	42			7.9		39
0086 701-22-086	60			7.2		35
0087 701-22-087	49			6.0		47
0088 701-22-088	63	0.05		13.2	0.12	69
0089 701-22-089	53			7.7		75
0090 701-22-090	57			7.4		30
0091 701-22-091	47			9.6		43
0092 701-22-092	60			4.2		30
0093 701-22-093	94	0.19		18.9	0.08	32
0094 701-22-094	56	0.34		2.7	0.18	121
0095 701-22-095	47			9.7		132
0096 701-22-096	61			4.7		144
0097 701-22-097	43	0.73		10.1	0.05	49
0098 701-22-098	35			6.0		126
0099 701-22-099	42	1.49		12.5	0.33	65
0100 701-22-100	35			6.9		161
0101 701-22-101	37			4.3		162
0102 701-22-102	29			1.7		234
0103 701-22-103	111			1.2		108
0104 701-22-104	3212			1.9		12
0105 701-22-105	151			1.6		42
0106 701-22-106	648			4.1		36
0107 701-22-107	760	0.02		5.1	60.95	24
0108 701-22-108	597			3.9		1
0109 701-22-109	526	0.05		3.8	145.08	1
0110 701-22-110	435			2.1		2
0111 701-22-111	1154	0.09		8.1	967.08	4
0112 701-22-112	1023			4.1		2
0113 701-22-113	759			2.8		4
0114 701-22-114	677	0.02		5.3	533.22	1
0115 701-22-115	670	0.02		48.7	1049.00	10
0116 701-22-116	528			6.0		19
0117 701-22-117	508			4.5		17
0118 701-22-118	2952			2.5		52

ANALYSIS

0119 701-22-119	44	1.4	41
0120 701-22-120	40	1.5	15

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0081 701-22-081	875	66.9	182	2.1	167	223
0082 701-22-082	785		84	2.3	74	135
0083 701-22-083	494		8	3.2	3	21
0084 701-22-084	799	23.3	4	5.7	0	50
0085 701-22-085	708		3	5.9	0	34
0086 701-22-086	679		3	5.8	0	30
0087 701-22-087	851		4	6.3	0	42
0088 701-22-088	1007	18.6	6	5.4	0	66
0089 701-22-089	1219		7	5.4	0	71
0090 701-22-090	784		1	5.9	0	26
0091 701-22-091	834		2	5.9	0	39
0092 701-22-092	764		2	5.5	0	26
0093 701-22-093	718	26.6	1	4.6	0	28
0094 701-22-094	4187	25.0	13	4.6	0	121
0095 701-22-095	4484		9	4.3	0	134
0096 701-22-096	5133		13	4.5	0	144
0097 701-22-097	774	71.5	12	3.4	8	46
0098 701-22-098	3701		13	5.1	0	126
0099 701-22-099	2010	63.7	43	2.3	34	62
0100 701-22-100	1161		121	2.2	109	159
0101 701-22-101	1534		114	2.4	104	160
0102 701-22-102	569		165	2.3	145	257
0103 701-22-103	708		84	2.2	70	119
0104 701-22-104	1460		8	4.9	0	-1
0105 701-22-105	1262		23	2.7	11	33
0106 701-22-106	2.16%		0	10.7	0	-47
0107 701-22-107	1.96%	157.8	0	11.0	0	-60
0108 701-22-108	2.37%		0	11.2	0	-77
0109 701-22-109	2.30%	86.2	0	11.3	0	-85
0110 701-22-110	2.22%		0	11.3	0	-83
0111 701-22-111	8201	124.7	0	10.9	0	-151
0112 701-22-112	1.09%		0	11.1	0	-104
0113 701-22-113	2831		0	11.3	0	-105
0114 701-22-114	1.46%	126.5	0	11.4	0	-116
0115 701-22-115	1.04%	123.9	0	11.3	0	-120
0116 701-22-116	1.77%		0	11.3	0	-76
0117 701-22-117	1.71%		0	11.3	0	-67
0118 701-22-118	9704		12	4.8	0	29

ANALYSIS

0119 701-22-119	961	23	2.5	17	35
0120 701-22-120	1485	5	3.3	3	9

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	9.27	24.59	93.9	1.92	365	0.5
0082 701-22-082	6.87	19.40	9.0		623	
0083 701-22-083	4.30	18.21	9.7		195	
0084 701-22-084	2.74	15.86	6.5	X	880	X
0085 701-22-085	3.43	12.41	3.1		278	
0086 701-22-086	2.91	23.02	5.3		304	
0087 701-22-087	3.47	18.58	7.8		202	
0088 701-22-088	2.57	12.06	2.3	X	580	X
0089 701-22-089	2.72	10.91	2.5		527	
0090 701-22-090	2.83	13.18	2.4		186	
0091 701-22-091	3.16	14.22	4.4		527	
0092 701-22-092	3.20	15.10	2.1		266	
0093 701-22-093	2.65	14.07	1.7	0.02	439	0.5
0094 701-22-094	3.44	32.76	1.8	0.01	1297	X
0095 701-22-095	1.07	29.19	1.5		1297	
0096 701-22-096	2.88	30.40	1.5		1169	
0097 701-22-097	0.97	41.69	3.0	X	1685*	X
0098 701-22-098	1.10	34.42	0.8		1426	
0099 701-22-099	0.96	22.52	8.8	0.10	392	1.2
0100 701-22-100	0.98	19.76	13.3		786	
0101 701-22-101	1.68	18.73	10.1		678	
0102 701-22-102	2.20	15.15	11.4		708	
0103 701-22-103	2.55	22.50	26.3		480	
0104 701-22-104	4.25	28.32	11.7		651	
0105 701-22-105	4.20	23.92	8.2		733	
0106 701-22-106	3.99	22.70	6.5		619	
0107 701-22-107	4.00	22.47	5.6	X	645	X
0108 701-22-108	3.91	20.60	6.2		595	
0109 701-22-109	4.20	24.16	6.1	X	630	X
0110 701-22-110	4.10	23.14	5.7		681	
0111 701-22-111	3.29	26.30	6.0	X	613	X
0112 701-22-112	3.86	21.97	7.2		627	
0113 701-22-113	4.12	22.85	6.0		675	
0114 701-22-114	4.09	20.30	6.1	X	615	X
0115 701-22-115	3.89	21.94	9.6	X	583	X
0116 701-22-116	3.94	24.96	5.3		568	
0117 701-22-117	3.88	18.27	5.3		505	
0118 701-22-118	3.38	21.98	12.3		543	

ANALYSIS

0119 701-22-119	4.11	32.63	3.1	975
0120 701-22-120	5.18	31.27	0.7	547

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	151.9	8.9	2.7		6.518	121.20
0082 701-22-082	330.3		3.9		5.527	56.03
0083 701-22-083	35.3		6.6		5.494	75.03
0084 701-22-084	65.3	0.6	7.3		4.423	60.67
0085 701-22-085	205.8		6.7		3.845	96.60
0086 701-22-086	40.7		6.3		7.330	98.33
0087 701-22-087	39.0		6.2		5.998	90.05
0088 701-22-088	25.3	X	5.6		4.157	79.31
0089 701-22-089	18.6		6.2		3.384	100.99
0090 701-22-090	68.6		6.2		3.855	96.16
0091 701-22-091	38.1		6.1		4.038	82.68
0092 701-22-092	151.6		4.6		4.453	117.82
0093 701-22-093	19.6	0.5	4.2		4.104	117.92
0094 701-22-094	157.9	X	5.1		9.213	3.95
0095 701-22-095	189.1		4.7		8.441	4.46
0096 701-22-096	240.6		5.2		9.372	3.81
0097 701-22-097	209.4	X	5.8		10.231	5.40
0098 701-22-098	247.5		5.4		9.949	2.72
0099 701-22-099	10.6	0.9	4.2		6.215	91.48
0100 701-22-100	26.5		4.8		6.103	37.88
0101 701-22-101	50.9		3.8		5.726	107.36
0102 701-22-102	53.2		3.0	4.0	4.079	39.82
0103 701-22-103	17.0		3.2		6.325	91.46
0104 701-22-104	15.5		7.0		7.295	105.51
0105 701-22-105	16.5		5.0		6.562	111.81
0106 701-22-106	9.4		9.1		6.171	86.41
0107 701-22-107	9.2	0.6	8.1		6.135	71.47
0108 701-22-108	7.3		9.4		5.698	63.44
0109 701-22-109	5.1	1.4	9.0		6.763	71.21
0110 701-22-110	4.9		9.4	3.8	6.265	79.73
0111 701-22-111	16.8	5.4	8.8		7.388	68.04
0112 701-22-112	10.6		9.5	3.9	5.917	89.20
0113 701-22-113	6.7		9.1		6.264	95.27
0114 701-22-114	8.0	1.6	8.5		5.660	59.35
0115 701-22-115	29.3	3.4	8.6	3.9	6.034	65.77
0116 701-22-116	19.0		8.8		6.748	77.81
0117 701-22-117	4.7		9.7		5.027	75.64
0118 701-22-118	14.1		8.0	2.8	5.892	86.41

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0119 701-22-119	51.1	4.8	8.261	49.82
0120 701-22-120	15.4	5.9	8.549	51.13

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ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0081 701-22-081	X	7.28	6.81%	422.7	5.23	0.50
0082 701-22-082	X	4.51	4.63%		2.38	0.70
0083 701-22-083	0.019	0.81	8179		0.38	0.15
0084 701-22-084	0.018	1.82	1.91%	20.3	X	0.48
0085 701-22-085	0.014	1.29	1.26%		X	0.57
0086 701-22-086	0.007	1.16	1.14%		X	0.40
0087 701-22-087	0.030	1.52	1.64%		X	0.64
0088 701-22-088	0.005	2.25	2.68%	23.5	0.05	0.88
0089 701-22-089	0.003	2.45	2.86%		X	0.81
0090 701-22-090	0.003	0.98	1.00%		X	0.34
0091 701-22-091	0.007	1.40	1.31%		X	0.41
0092 701-22-092	X	0.97	1.01%		X	0.35
0093 701-22-093	0.007	1.03	1.02%	55.7	0.06	0.43
0094 701-22-094	0.004	3.96	4.22%	36.6	X	1.46
0095 701-22-095	0.004	4.30	4.66%		X	1.59
0096 701-22-096	0.004	4.72	4.78%		X	1.58
0097 701-22-097	0.004	1.59	1.74%	49.4	X	0.47
0098 701-22-098	0.004	4.12	4.52%		0.05	1.27
0099 701-22-099	0.087	2.11	2.50%	164.2	1.80	0.20
0100 701-22-100	0.085	5.26	4.68%		3.87	0.20
0101 701-22-101	0.043	5.29	5.34%		4.09	0.39
0102 701-22-102	0.010	7.65	6.30%		4.90	1.22
0103 701-22-103	0.007	3.52	3.86%		2.53	0.64
0104 701-22-104	0.003	0.38	4294		0.19	0.13
0105 701-22-105	0.003	1.36	1.32%		1.07	0.15
0106 701-22-106	0.002	1.17	1.14%		0.93	0.09
0107 701-22-107	0.002	0.78	7493	134.8	0.57	0.10
0108 701-22-108	0.003	0.04	391			X
0109 701-22-109	0.003	0.03	213	12.2		0.02
0110 701-22-110	0.003	0.05	421			0.02
0111 701-22-111	0.003	0.12	966	26.8	0.08	0.03
0112 701-22-112	0.004	0.08	655			0.03
0113 701-22-113	X	0.12	965			0.03
0114 701-22-114	0.005	0.04	316	19.3		0.03
0115 701-22-115	0.016	0.34	2737	37.1	0.25	0.06
0116 701-22-116	0.002	0.63	4697		0.43	0.12
0117 701-22-117	0.003	0.55	4154		0.42	0.06
0118 701-22-118	0.004	1.70	1.45%		1.29	0.17

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0119 701-22-119	0.003	1.33	1.07%	0.98	0.16
0120 701-22-120	X	0.50	3754	0.29	0.11

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	2.88	0.47	12.5	1.4	3.3	0.90
0082 701-22-082	2.90		6.9	1.1		0.65
0083 701-22-083	0.17		14.4	X		0.47
0084 701-22-084	0.14	0.04	17.0	1.3	2.3	1.35
0085 701-22-085	0.20		11.8	4.3		3.69
0086 701-22-086	0.19		10.5	2.1		1.79
0087 701-22-087	0.16		16.4	0.6		0.29
0088 701-22-088	0.32	0.03	14.1	2.2	4.3	1.22
0089 701-22-089	0.26		20.6	1.9		1.24
0090 701-22-090	0.35		11.0	2.4		1.94
0091 701-22-091	0.15		10.8	4.0		3.74
0092 701-22-092	0.29		8.1	1.1		1.18
0093 701-22-093	0.15	X	8.6	1.4	12.1	1.08
0094 701-22-094	2.26	0.11	6.6	7.8	3.7	6.77
0095 701-22-095	0.82		6.2	18.8		17.64
0096 701-22-096	1.06		6.7	12.4		10.84
0097 701-22-097	1.74	0.03	6.3	10.0	19.3	9.43
0098 701-22-098	2.66		7.6	29.8		27.55
0099 701-22-099	0.17	0.22	10.6	2.3	22.9	1.93
0100 701-22-100	0.27		4.9	6.9		6.20
0101 701-22-101	0.40		8.2	5.0		4.85
0102 701-22-102	0.84		8.7	2.5		2.66
0103 701-22-103	0.61		9.7	1.8		1.86
0104 701-22-104	0.31		13.9	0.6		0.18
0105 701-22-105	0.51		10.7	X		0.25
0106 701-22-106	0.13		11.7	0.7		0.25
0107 701-22-107	0.26	0.28	11.6	0.5	1.9	0.14
0108 701-22-108	0.13		10.7	X		X
0109 701-22-109	0.24	0.12	10.9	0.6	1.7	X
0110 701-22-110	0.20		11.4	X		0.03
0111 701-22-111	0.18	0.16	9.8	0.8	59.6	0.26
0112 701-22-112	0.14		13.2	X		X
0113 701-22-113	0.19		10.5	X		X
0114 701-22-114	0.14	0.11	9.9	X	1.5	X
0115 701-22-115	0.33	0.52	11.6	X	1.2	0.03
0116 701-22-116	0.23		13.6	X		0.21
0117 701-22-117	0.25		11.4	X		0.09
0118 701-22-118	0.39		11.1	0.9		0.64

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0119 701-22-119	0.64	16.1	0.7	0.60
0120 701-22-120	0.36	9.2	X	0.14

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ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	4.46	5.2	X	287.53	37.66	0.65
0082 701-22-082	3.47	3.8		311.82		0.51
0083 701-22-083	2.58	0.9		83.32		0.36
0084 701-22-084	2.97	0.8	X	158.93	632.67	0.27
0085 701-22-085	1.78	1.5		68.63		0.30
0086 701-22-086	3.13	1.3		64.67		0.26
0087 701-22-087	2.48	1.1		52.02		0.30
0088 701-22-088	1.86	1.0	X	148.11	33.50	0.25
0089 701-22-089	1.88	1.1		144.14		0.23
0090 701-22-090	2.04	2.2		57.61		0.22
0091 701-22-091	2.42	1.6		148.85		0.26
0092 701-22-092	2.35	1.1		113.25		0.26
0093 701-22-093	2.21	1.3	X	60.26	30.94	0.24
0094 701-22-094	6.06	7.2	X	1017.44	251.43	0.27
0095 701-22-095	4.97	2.0		792.98		0.09
0096 701-22-096	4.26	2.7		731.77		0.23
0097 701-22-097	9.13	1.5	X	1704.67*	80.15	0.07
0098 701-22-098	6.57	3.3		1009.31		0.09
0099 701-22-099	4.19	1.3	X	209.43	93.60	0.09
0100 701-22-100	2.69	3.2		465.23		0.10
0101 701-22-101	2.95	1.7		209.64*		0.16
0102 701-22-102	2.84	2.1		482.74		0.18
0103 701-22-103	3.84	2.6		318.02		0.25
0104 701-22-104	5.92	1.1		58.04		0.35
0105 701-22-105	4.34	1.5		23.89		0.35
0106 701-22-106	3.99	0.6		342.38		0.31
0107 701-22-107	3.99	0.6	X	303.81	299.60	0.31
0108 701-22-108	3.73	0.4		401.43		0.32
0109 701-22-109	4.18	0.5	X	371.97	77.45	0.32
0110 701-22-110	3.98	0.5		354.98		0.32
0111 701-22-111	4.43	1.1	X	167.06	90.62	0.26
0112 701-22-112	3.95	1.0		227.90		0.29
0113 701-22-113	3.89	0.5		79.63		0.32
0114 701-22-114	3.63	0.5	X	152.79	98.20	0.33
0115 701-22-115	3.98	1.0	X	159.50	70.94	0.30
0116 701-22-116	4.60	0.8		313.55		0.31
0117 701-22-117	3.52	0.6		341.74		0.30
0118 701-22-118	3.92	1.5		176.44		0.30

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0119 701-22-119	6.56	1.6	628.18	0.34
0120 701-22-120	5.09	0.6	194.12	0.41

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ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0081 701-22-081	0.299	1475	1.56	16.29	18.414	3221
0082 701-22-082	0.241		0.41	26.84		1332
0083 701-22-083	0.195		0.10	16.47		2431
0084 701-22-084	0.249	180	0.28	18.02	0.078	1819
0085 701-22-085	0.142		0.34	10.46		2015
0086 701-22-086	0.172		0.16	21.19		1913
0087 701-22-087	0.164		0.08	19.59		2066
0088 701-22-088	0.254	155	0.38	22.15	0.142	1792
0089 701-22-089	0.260		0.30	12.08		1806
0090 701-22-090	0.221		0.87	17.16		2077
0091 701-22-091	0.234		0.12	12.72		2190
0092 701-22-092	0.214		0.93	21.82		1897
0093 701-22-093	0.377	265	1.57	17.38	0.496	1638
0094 701-22-094	0.386	195	0.34	26.72	0.660	2505
0095 701-22-095	0.299		0.87	24.41		671
0096 701-22-096	0.237		0.52	26.36		1712
0097 701-22-097	0.517	331	1.88	27.31	0.094	659
0098 701-22-098	0.656		3.73	26.59		560
0099 701-22-099	0.482	682	0.22	19.59	6.524	901
0100 701-22-100	0.140		0.31	21.17		650
0101 701-22-101	0.232		0.82	23.40		984
0102 701-22-102	0.246		1.47	11.44		1589
0103 701-22-103	0.394		0.46	14.69		1494
0104 701-22-104	0.743		0.40	18.33		2922
0105 701-22-105	0.458		0.84	18.47		2702
0106 701-22-106	0.433		X	16.36		2651
0107 701-22-107	0.425	631	0.25	16.19	0.074	2590
0108 701-22-108	0.420		X	15.55		2457
0109 701-22-109	0.438	386	X	16.49	0.624	2525
0110 701-22-110	0.399		X	16.70		2526
0111 701-22-111	0.477	306	0.10	14.45	0.426	2112
0112 701-22-112	0.423		X	15.00		2836
0113 701-22-113	0.397		X	17.14		2490
0114 701-22-114	0.391	352	X	14.60	0.478	2431
0115 701-22-115	0.441	400	X	15.30	0.489	2117
0116 701-22-116	0.479		0.35	16.25		2436
0117 701-22-117	0.406		0.19	12.77		2290
0118 701-22-118	0.415		0.32	15.01		2035

ANALYSIS

0119 701-22-119	0.960	0.31	19.32	2320
0120 701-22-120	0.464	0.20	21.91	1856

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.28	0.15	3.74	92.993	89	0.07
0082 701-22-082	0.62	0.11	7.69		52	
0083 701-22-083	0.89	0.06	2.59		89	
0084 701-22-084	0.70	0.08	2.58	0.227	230	X
0085 701-22-085	1.15	0.06	3.96		120	
0086 701-22-086	1.13	0.05	3.30		112	
0087 701-22-087	0.98	0.05	1.97		100	
0088 701-22-088	0.94	0.12	1.56	0.111	86	X
0089 701-22-089	1.15	0.11	1.35		128	
0090 701-22-090	1.32	0.08	2.30		105	
0091 701-22-091	1.02	0.07	1.55		87	
0092 701-22-092	1.67	0.10	2.69		87	
0093 701-22-093	1.63	0.11	1.89	0.706	93	X
0094 701-22-094	0.05	0.08	4.05	0.297	91	X
0095 701-22-095	0.04	0.06	3.55		85	
0096 701-22-096	0.04	0.05	3.15		84	
0097 701-22-097	0.08	0.05	8.58	0.194	109	X
0098 701-22-098	0.02	0.06	5.38		90	
0099 701-22-099	1.48	0.16	3.42	7.744	88	X
0100 701-22-100	0.56	0.04	2.30		77	
0101 701-22-101	1.83	0.12	3.94		64	
0102 701-22-102	0.53	0.11	4.29		78	
0103 701-22-103	1.10	0.15	4.80		87	
0104 701-22-104	1.09	0.35	4.42		117	
0105 701-22-105	0.81	0.23	5.40		103	
0106 701-22-106	0.49	0.21	3.62		103	
0107 701-22-107	0.44	0.21	3.45	3.732	102	X
0108 701-22-108	0.36	0.20	3.30		97	
0109 701-22-109	0.37	0.21	3.38	2.562	88	0.03
0110 701-22-110	0.36	0.20	3.86		93	
0111 701-22-111	0.45	0.21	3.29	2.995	84	0.02
0112 701-22-112	0.59	0.20	3.10		111	
0113 701-22-113	0.69	0.20	2.71		92	
0114 701-22-114	0.41	0.18	2.94	0.803	92	0.02
0115 701-22-115	0.42	0.22	3.52	1.670	81	0.01
0116 701-22-116	0.44	0.23	3.61		97	
0117 701-22-117	0.49	0.20	3.26		95	
0118 701-22-118	0.61	0.19	3.51		90	

ANALYSIS

0119 701-22-119	0.46	0.52	4.55	117
0120 701-22-120	0.27	0.33	5.48	84

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0081 701-22-081	3.4	6.40	1.14	18	1.03	55.5
0082 701-22-082	3.3	4.97	0.92	12		44.3
0083 701-22-083	1.9	4.66	0.52	42		30.7
0084 701-22-084	1.5	7.11	0.49	52	X	24.5
0085 701-22-085	1.4	3.11	0.38	25		24.4
0086 701-22-086	1.4	3.15	0.32	28		13.8
0087 701-22-087	2.4	3.82	0.35	24		13.1
0088 701-22-088	4.8	7.86	0.66	27	X	16.4
0089 701-22-089	2.4	8.29	0.78	27		11.9
0090 701-22-090	2.6	6.02	1.08	15		10.8
0091 701-22-091	1.9	5.18	0.47	28		9.2
0092 701-22-092	2.1	6.05	0.97	15		38.0
0093 701-22-093	1.7	8.29	0.65	18	0.07	9.5
0094 701-22-094	4.1	5.00	0.50	5	0.14	29.6
0095 701-22-095	2.1	3.83	0.59	7		16.2
0096 701-22-096	2.8	3.53	0.31	5		17.6
0097 701-22-097	2.9	4.17	0.31	15	0.27	19.9
0098 701-22-098	1.5	5.67	0.32	16		7.6
0099 701-22-099	1.5	11.31	1.01	25	3.16	37.2
0100 701-22-100	4.2	2.41	0.26	10		18.4
0101 701-22-101	1.3	6.17	1.14	20		43.5
0102 701-22-102	2.3	7.83	0.82	17		44.3
0103 701-22-103	1.2	7.70	1.01	94		43.8
0104 701-22-104	1.5	22.58	2.29	452		91.0
0105 701-22-105	1.7	14.33	1.60	74		86.2
0106 701-22-106	1.3	13.46	1.40	42		70.5
0107 701-22-107	1.7	13.06	1.33	33	X	71.0
0108 701-22-108	1.8	11.81	1.33	24		56.9
0109 701-22-109	2.2	12.87	1.40	22	X	55.0
0110 701-22-110	2.5	11.96	1.31	23		63.1
0111 701-22-111	2.6	13.76	1.41	73	X	40.8
0112 701-22-112	1.9	12.59	1.31	56		51.5
0113 701-22-113	1.1	11.86	1.41	56		54.2
0114 701-22-114	1.6	10.70	1.30	44	X	38.8
0115 701-22-115	2.3	12.85	1.37	74	X	39.2
0116 701-22-116	2.7	14.94	1.49	41		68.1
0117 701-22-117	1.5	11.61	1.42	30		66.1
0118 701-22-118	1.4	10.92	1.28	601		74.0

ANALYSIS

0119 701-22-119	2.5	34.07	3.27	62	95.6
0120 701-22-120	1.0	16.57	2.06	34	68.5

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0121 701-22-121	0.16	0.01	8.71%	0.70	5	6.2
0122 701-22-122	0.12	0.07	8.04%	18.50	3	6.7
0123 701-22-123	0.44	0.02	2.81%	0.15	10	13.3
0124 701-22-124	0.94		5217		6	9.4
0125 701-22-125	0.61		4.76%		2	25.1
0126 701-22-126	0.19	0.02	5.27%	0.09	1	20.6
0127 701-22-127	0.25		5.92%		3	11.7
0128 701-22-128	0.33		4.82%		2	17.0
0129 701-22-129	0.55		3.01%		2	18.5
0130 701-22-130	0.68	0.07	4.01%	1.85	1	23.6
0131 701-22-131	0.49		3.33%		1	68.4
0132 701-22-132	0.29	0.01	6.04%	0.12	2	101.5
0133 701-22-133	0.57		5.97%		3	9.0
0134 701-22-134	0.37		4.49%		2	16.9
0135 701-22-135	0.59	0.03	5.24%	0.04	3	10.1
0136 701-22-136	0.46		6.73%		5	4.5
0137 701-22-137	0.22		9.51%		-4	14.5
0138 701-22-138	0.23		9.66%		3	4.0
0139 701-22-139	0.07		11.19%		3	3.2
0140 701-22-140	0.09	0.02	11.06%	18.93	1	3.1
0141 701-22-141	0.12		10.12%		3	4.8
0142 701-22-142	X		11.66%		5	3.2
0143 701-22-143	0.44		9.81%		-1	34.1
0144 701-22-144	0.07		6.76%		-2	14.5
0145 701-22-145	0.73		4.17%		-7	54.9
0146 701-22-146	0.13	X	6.38%	47.16	-1	25.7
0147 701-22-147	0.23	0.03	8.63%	33.36	2	6.1
0148 701-22-148	0.11	X	6.31%	42.85	-2	44.2
0149 701-22-149	0.29		9.71%		0	13.1
0150 701-22-150	0.20		8.87%		-2	9.4
CHECKS						
0001 701-22-001	0.65	0.04	10.73%	0.62	-3	4.0
0002 701-22-021	1.55		8.97%		13	14.6
0003 701-22-041	0.17	X	8.24%	0.08	1	8.2
0004 701-22-061	0.49		7.69%		1	6.9
0005 701-22-081	0.77	0.06	7.48%	67.91	-2	48.1
0006 701-22-101	0.34		8.54%		2	69.7

ANALYSIS

0007 701-22-121	0.22	X	9.30%	0.89	5	6.1
0008 701-22-141	0.13		10.15%		4	5.0

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.6	X	0.03	98.6	11.75	1.23
0122 701-22-122	1.2	X	0.06	270.5	5.66	1.28
0123 701-22-123	2.6	X	X	443.2	30.15	0.14
0124 701-22-124		X		1500.7		0.21
0125 701-22-125		X		500.1		0.11
0126 701-22-126	0.7	X	X	711.6	65.35	0.21
0127 701-22-127		X		469.4		0.05
0128 701-22-128		X		412.2		0.13
0129 701-22-129		X		531.0		0.14
0130 701-22-130	1.2	X	X	416.9	54.72	0.13
0131 701-22-131		X		657.0		0.09
0132 701-22-132	1.0	X	X	560.9	32.50	0.19
0133 701-22-133		X		472.4		0.27
0134 701-22-134		X		794.9		0.06
0135 701-22-135	1.0	X	X	669.5	13.52	0.18
0136 701-22-136		X		335.6		0.96
0137 701-22-137		X		654.6		1.06
0138 701-22-138		X		495.0		1.82
0139 701-22-139		X		1325.7		1.43
0140 701-22-140	4.7	X	X	310.5	10.27	1.18
0141 701-22-141		X		550.3		1.26
0142 701-22-142		X		1125.2		1.53
0143 701-22-143		X		623.1		0.65
0144 701-22-144		X		165.7		0.11
0145 701-22-145		X		56.0		X
0146 701-22-146	3.7	X	X	275.4	0.09	0.15
0147 701-22-147	2.7	X	X	306.3	3.24	0.39
0148 701-22-148	4.4	X	X	115.6	0.44	X
0149 701-22-149		X		597.4		0.86
0150 701-22-150		X		120.0		0.18
CHECKS						
0001 701-22-001	X	X	0.01	257.6	6.09	2.18
0002 701-22-021		X		304.1		1.48
0003 701-22-041	1.5	X	X	296.6	3.73	0.36
0004 701-22-061		X		396.9		0.79
0005 701-22-081	21.3	X	X	290.3	2.79	0.86
0006 701-22-101		X		319.3		0.92

ANALYSIS

0007 701-22-121	1.7	X	0.03	96.7	11.47	1.36
0008 701-22-141		X		562.4		1.05

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.9	0.44	X	0.02	207	9.70
0122 701-22-122	7.1	0.82	X	0.05	470	36.42
0123 701-22-123	X	0.63	X	0.15	3117	28.66
0124 701-22-124		1.85		0.08	1360	
0125 701-22-125		1.26		0.04	799	
0126 701-22-126	X	1.36	X	0.02	789	19.63
0127 701-22-127		1.45		0.02	779	
0128 701-22-128		1.54		0.02	801	
0129 701-22-129		2.49		0.03	549	
0130 701-22-130	X	1.75	X	0.02	634	23.05
0131 701-22-131		1.65		0.03	441	
0132 701-22-132	X	3.63	X	0.02	666	6.71
0133 701-22-133		2.25		0.08	680	
0134 701-22-134		4.42		0.04	640	
0135 701-22-135	X	1.42	0.011	0.02	814	7.44
0136 701-22-136		3.15		0.03	512	
0137 701-22-137		0.28		0.02	503	
0138 701-22-138		0.75		0.02	568	
0139 701-22-139		0.07		0.04	421	
0140 701-22-140	9.2	0.10	X	0.04	343	49.34
0141 701-22-141		0.09		0.04	484	
0142 701-22-142		0.06		0.02	702	
0143 701-22-143		0.86		0.04	357	
0144 701-22-144		1.28		0.02	591	
0145 701-22-145		8.10		0.02	447	
0146 701-22-146	0.8	1.04	X	X	451	14.37
0147 701-22-147	1.9	2.23	X	0.03	776	39.62
0148 701-22-148	0.5	0.29	X	0.01	544	10.55
0149 701-22-149		2.39		0.04	526	
0150 701-22-150		2.02		0.02	744	
CHECKS						
0001 701-22-001	X	0.15	X	0.05	987	7.52
0002 701-22-021		1.45		1.10	942	
0003 701-22-041	X	1.76	X	0.03	826	19.39
0004 701-22-061		3.42		0.03	909	
0005 701-22-081	1.4	3.76	0.408	0.06	329	21.20
0006 701-22-101		3.19		0.05	781	

ANALYSIS

0007 701-22-121	1.0	0.47	X	0.04	249	8.70
0008 701-22-141		0.10		0.04	486	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0121 701-22-121	X	0.24	64.45	76	1.9	47.6
0122 701-22-122	0.05	5.25	68.37	54	6.5	604.4
0123 701-22-123	X	X	44.42	18	0.5	1.4
0124 701-22-124	X		27.48		0.3	
0125 701-22-125	X		50.78		0.2	
0126 701-22-126	X	0.04	50.63	35	0.4	14.5
0127 701-22-127	X		46.09		0.1	
0128 701-22-128	0.03		65.76		0.3	
0129 701-22-129	0.03		53.81		0.2	
0130 701-22-130	X	0.05	35.18	59	0.2	1.2
0131 701-22-131	X		43.72		0.5	
0132 701-22-132	X	X	44.38	27	0.2	3.1
0133 701-22-133	X		57.82		0.5	
0134 701-22-134	X		70.03		0.2	
0135 701-22-135	X	0.03	59.48	18	0.2	4.3
0136 701-22-136	0.03		56.73		1.0	
0137 701-22-137	3.37		28.86		48.5	
0138 701-22-138	0.74		76.30		9.2	
0139 701-22-139	0.04		109.80		5.1	
0140 701-22-140	0.07	11.89	90.87	10	27.7	5491.4
0141 701-22-141	0.26		84.58		7.0	
0142 701-22-142	X		103.80		1.4	
0143 701-22-143	0.32		39.07		11.9	
0144 701-22-144	X		33.14		4.9	
0145 701-22-145	0.04		25.31		6.0	
0146 701-22-146	0.06	28.32	38.76	3	9.4	362.7
0147 701-22-147	0.08	23.88	32.25	7	10.4	922.6
0148 701-22-148	0.03	3.57	40.10	2	18.5	142.3
0149 701-22-149	0.04		58.40		10.9	
0150 701-22-150	0.21		55.70		13.0	
CHECKS						
0001 701-22-001	0.20	3.05	63.92	8	1.3	10.7
0002 701-22-021	1.38		67.18		20.5	
0003 701-22-041	0.13	4.00	46.01	54	12.6	277.8
0004 701-22-061	0.04		54.86		0.6	
0005 701-22-081	0.03	1.08	47.53	30	22.3	3216.0
0006 701-22-101	0.18		50.74		14.5	

ANALYSIS

0007 701-22-121	X	0.27	62.73	80	1.9	50.1
0008 701-22-141	0.24		84.05		7.0	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	No	3	X	1.40	43.7	1.20
0122 701-22-122	No	4	X	1.41	267.4	51.26
0123 701-22-123	No	13	X	0.09	8.6	0.03
0124 701-22-124	No	11		0.11	9.2	
0125 701-22-125	No	20		0.07	5.9	
0126 701-22-126	No	19	X	0.07	3.7	0.01
0127 701-22-127	No	18		0.07	3.3	
0128 701-22-128	No	22		0.07	8.8	
0129 701-22-129	No	17		0.07	22.0	
0130 701-22-130	No	17	X	0.08	9.6	0.06
0131 701-22-131	No	25		0.06	50.5	
0132 701-22-132	No	9	X	0.08	22.7	0.01
0133 701-22-133	No	8		0.26	373.2	
0134 701-22-134	No	12		0.09	98.1	
0135 701-22-135	No	14	X	0.17	65.6	0.02
0136 701-22-136	No	9		1.14	46.3	
0137 701-22-137	No	8		2.04	276.6	
0138 701-22-138	No	10		5.34	79.7	
0139 701-22-139	No	11		4.13	19.8	
0140 701-22-140	No	8	X	3.45	15.4	0.35
0141 701-22-141	No	8		2.46	293.8	
0142 701-22-142	No	7		1.60	4.2	
0143 701-22-143	No	10		1.80	354.9	
0144 701-22-144	No	23		0.07	425.6	
0145 701-22-145	No	17		X	3253.6	
0146 701-22-146	No	21	0.33	0.08	998.9	130.44
0147 701-22-147	No	13	0.02	0.74	383.3	86.26
0148 701-22-148	No	30	0.18	0.05	1049.8	33.88
0149 701-22-149	No	14		1.67	339.0	
0150 701-22-150	No	16		0.41	368.3	
CHECKS						
0001 701-22-001	No	11	X	2.63	410.7	1.63
0002 701-22-021	Yes	16		12.92	1336.1	
0003 701-22-041	No	11	X	0.40	61.9	0.04
0004 701-22-061	No	7		0.87	165.5	
0005 701-22-081	No	85	0.09	8.45	513.8	13.65
0006 701-22-101	No	7		1.20	327.7	

ANALYSIS

0007 701-22-121	No	4	X	1.38	53.2	1.23
0008 701-22-141	No	10		2.50	298.1	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0121 701-22-121	2.09	895	1.14	1.06	0.2	0.87
0122 701-22-122	4.60	1496	3.49	1.09	0.9	1.08
0123 701-22-123	0.85	320	0.44	0.53	0.7	1.77
0124 701-22-124	0.65		0.41	0.26		0.79
0125 701-22-125	0.80		0.37	0.90		3.57
0126 701-22-126	0.87	339	0.48	0.85	0.4	1.90
0127 701-22-127	0.97		0.48	0.70		1.49
0128 701-22-128	1.15		0.63	1.06		2.73
0129 701-22-129	1.07		0.56	0.93		2.07
0130 701-22-130	0.83	509	0.50	0.70	0.3	1.74
0131 701-22-131	0.41		0.28	0.55		10.32
0132 701-22-132	0.81	240	0.40	0.76	0.1	1.74
0133 701-22-133	1.29		0.64	0.86		2.21
0134 701-22-134	0.89		0.34	0.92		4.27
0135 701-22-135	0.65	194	0.34	0.82	0.1	4.78
0136 701-22-136	1.84		1.12	0.76		3.47
0137 701-22-137	1.89		1.14	0.53		1.51
0138 701-22-138	2.80		1.60	1.17		1.26
0139 701-22-139	4.09		2.17	1.87		1.30
0140 701-22-140	2.42	1034	1.17	1.35	0.5	1.61
0141 701-22-141	1.39		0.74	1.03		1.41
0142 701-22-142	2.38		1.22	1.79		0.80
0143 701-22-143	1.20		0.81	0.36		2.18
0144 701-22-144	0.75		0.32	0.66		6.58
0145 701-22-145	0.45		0.21	0.47		19.02*
0146 701-22-146	0.63	1344	0.31	0.61	X	5.58
0147 701-22-147	1.24	1321	0.65	0.64	X	3.24
0148 701-22-148	0.26	1176	0.12	0.39	X	8.33
0149 701-22-149	1.30		0.81	0.61		2.26
0150 701-22-150	1.42		0.64	1.03		5.14
CHECKS						
0001 701-22-001	2.36	256	1.13	0.99	X	1.09
0002 701-22-021	3.47		1.82	1.35		7.29
0003 701-22-041	0.96	494	0.44	0.79	X	5.43
0004 701-22-061	1.14		0.54	0.76		3.43
0005 701-22-081	1.21	2340	0.69	0.67	X	6.33
0006 701-22-101	2.76		1.79	0.76		4.62

ANALYSIS

0007 701-22-121	2.26	880	1.30	1.06	0.2	1.05
0008 701-22-141	1.35		0.76	0.97		1.46

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.03	1.5	0	17.10	2.75	0.78
0122 701-22-122	1.39	1.5	0	18.17	3.31	1.08
0123 701-22-123	X	1.5	0	3.25	1.39	0.99
0124 701-22-124		1.5	0	1.22	0.86	1.16
0125 701-22-125		1.5	0	8.23	1.87	0.79
0126 701-22-126	X	1.4	0	8.98	2.08	0.78
0127 701-22-127		1.4	0	13.59	2.23	0.93
0128 701-22-128		1.4	0	6.80	2.58	1.00
0129 701-22-129		1.5	0	4.31	2.28	1.13
0130 701-22-130	0.18	1.4	0	6.76	1.69	1.18
0131 701-22-131		1.5	0	11.88	1.19	1.95
0132 701-22-132	0.02	1.5	0	14.62	1.87	0.69
0133 701-22-133		1.8	0	14.50	2.40	0.43
0134 701-22-134		1.6	0	17.56	2.08	0.55
0135 701-22-135	X	1.5	0	9.52	1.76	0.64
0136 701-22-136		1.5	0	26.79	2.39	1.06
0137 701-22-137		1.5	0	15.39	1.80	1.22
0138 701-22-138		1.5	0	17.24	3.31	1.31
0139 701-22-139		1.4	0	21.20	5.32	1.35
0140 701-22-140	3.02	1.5	0	19.66	3.57	1.00
0141 701-22-141		1.5	0	18.31	2.39	1.26
0142 701-22-142		1.5	0	18.87	4.40	1.42
0143 701-22-143		1.5	0	18.34	1.11	1.11
0144 701-22-144		1.4	0	7.91	1.73	0.64
0145 701-22-145		1.4	0	2.40	1.05	0.52
0146 701-22-146	167.49	1.4	0	8.56	1.41	0.79
0147 701-22-147	35.23	1.4	0	11.49	1.83	0.56
0148 701-22-148	241.22	1.4	0	2.80	0.68	0.98
0149 701-22-149		1.5	0	17.40	1.73	1.16
0150 701-22-150		1.5	0	13.63	2.83	1.33
CHECKS						
0001 701-22-001	0.10	1.5	0	15.76	3.19	0.99
0002 701-22-021		1.1	0	19.12	4.21	1.24
0003 701-22-041	0.04	1.4	0	11.98	2.30	0.73
0004 701-22-061		1.5	0	18.37	1.90	0.93
0005 701-22-081	249.69	1.4	0	18.82	2.43	1.15
0006 701-22-101		1.5	0	16.54	2.68	1.17

ANALYSIS

0007 701-22-121	0.09	1.5	0	17.10	2.79	0.75
0008 701-22-141		1.5	0	18.81	2.32	1.21

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0121 701-22-121	1.77	X	X	0.39	0.086	1.02%
0122 701-22-122	2.36	X	X	1.10	0.153	1.14%
0123 701-22-123	1.07	X	X	0.14	X	1.01%
0124 701-22-124	0.97	0.05		0.12	X	1079
0125 701-22-125	0.97	0.04		0.13	0.009	1.47%
0126 701-22-126	1.85	0.03	X	0.16	X	1.19%
0127 701-22-127	1.13	0.02		0.15	0.005	7169
0128 701-22-128	1.44	0.01		0.19	0.008	1.58%
0129 701-22-129	1.24	0.01		0.17	X	1.03%
0130 701-22-130	1.12	X	X	0.16	0.009	1.33%
0131 701-22-131	0.71	0.02		0.08	0.101	1.26%
0132 701-22-132	1.21	X	X	0.13	0.023	9907
0133 701-22-133	1.12	X		0.22	0.042	7249
0134 701-22-134	0.61	X		0.13	0.053	5455
0135 701-22-135	0.93	X	X	0.11	0.063	7254
0136 701-22-136	1.91	0.02		0.39	0.285	2.80%
0137 701-22-137	1.46	0.04		0.38	0.224	4.19%
0138 701-22-138	1.71	0.02		0.55	0.108	3.51%
0139 701-22-139	2.19	X		0.77	0.037	2.22%
0140 701-22-140	1.97	0.02	X	0.42	0.039	2.96%
0141 701-22-141	1.79	X		0.25	0.083	2.64%
0142 701-22-142	1.67	X		0.43	0.037	1.98%
0143 701-22-143	1.58	0.02		0.26	0.451	3.64%
0144 701-22-144	0.71	X		0.13	0.022	2.60%
0145 701-22-145	0.53	0.05		0.07	0.051	1.17%
0146 701-22-146	0.95	0.01	X	0.10	0.087	1.34%
0147 701-22-147	1.35	X	X	0.21	0.190	1.57%
0148 701-22-148	0.24	0.01	X	0.04	0.023	2.17%
0149 701-22-149	1.94	0.02		0.26	0.332	3.28%
0150 701-22-150	1.51	0.01		0.23	0.081	2437
CHECKS						
0001 701-22-001	1.73	X	X	0.44	0.572	3.88%
0002 701-22-021	0.16	0.02		0.63	0.419	2.18%
0003 701-22-041	1.18	X	X	0.15	0.065	1.06%
0004 701-22-061	1.54	X		0.18	0.409	3.74%
0005 701-22-081	1.08	0.16	X	0.21	0.182	2.36%
0006 701-22-101	0.97	X		0.58	0.379	3.49%

ANALYSIS

0007 701-22-121	1.80	X	X	0.43	0.085	1.22%
0008 701-22-141	1.76	X		0.26	0.088	2.66%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	19.8	36.18	9.0	0.178	1368	20.21
0122 701-22-122	30.9	36.31	10.0	0.487	1183	96.17
0123 701-22-123	6.1	24.28	0.5	0.094	952	8.82
0124 701-22-124		15.71	1.2	0.088	229	
0125 701-22-125		28.10	0.2	0.077	206	
0126 701-22-126	8.4	27.44	0.3	0.123	97	6.74
0127 701-22-127		22.50	0.3	0.111	119	
0128 701-22-128		35.72	0.4	0.134	130	
0129 701-22-129		31.39	0.2	0.125	123	
0130 701-22-130	11.9	19.02	0.4	0.107	124	13.60
0131 701-22-131		24.22	0.3	0.073	149	
0132 701-22-132	5.7	25.62	0.5	0.120	115	6.12
0133 701-22-133		30.95	0.5	0.138	459	
0134 701-22-134		43.05	0.7	0.065	104	
0135 701-22-135	8.8	32.65	0.5	0.073	102	4.22
0136 701-22-136		32.43	0.8	0.203	1621	
0137 701-22-137		17.95	3.6	0.185	2952	
0138 701-22-138		44.42	13.9	0.231	3446	
0139 701-22-139		62.28	11.3	0.329	2179	
0140 701-22-140	16.1	52.44	3.6	0.188	3028	73.63
0141 701-22-141		45.96	5.4	0.145	2728	
0142 701-22-142		54.69	6.7	0.220	1621	
0143 701-22-143		26.77	3.1	0.150	2980	
0144 701-22-144		17.96	0.4	0.054	134	
0145 701-22-145		12.34	0.2	0.048	55	
0146 701-22-146	1.1	21.18	0.4	0.082	68	7.44
0147 701-22-147	10.6	19.17	0.9	0.122	754	46.10
0148 701-22-148	1.3	22.22	0.3	0.024	70	3.86
0149 701-22-149		36.01	3.5	0.152	2423	
0150 701-22-150		31.12	1.6	0.143	164	
CHECKS						
0001 701-22-001	17.1	36.19	5.1	0.174	4068	6.18
0002 701-22-021		37.44	15.8	0.203	4675	
0003 701-22-041	8.9	24.76	1.2	0.092	539	16.43
0004 701-22-061		30.02	0.2	0.115	2058	
0005 701-22-081	21.5	24.69	2.8	0.124	2011	40.09
0006 701-22-101		30.44	0.8	0.241	2692	

ANALYSIS

0007 701-22-121	19.6	34.93	8.8	0.190	1465	20.49
0008 701-22-141		45.86	5.7	0.142	2762	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0121 701-22-121	27	0.12		1.1	1.25	17
0122 701-22-122	34	0.73		1.5	0.54	36
0123 701-22-123	34	X		4.3	11.94	62
0124 701-22-124	45			2.3		8
0125 701-22-125	31			4.3		98
0126 701-22-126	36	0.08		4.4	2.45	68
0127 701-22-127	29			5.3		54
0128 701-22-128	33			3.9		94
0129 701-22-129	40			4.9		68
0130 701-22-130	35	0.18		5.4	8.21	56
0131 701-22-131	28			3.1		76
0132 701-22-132	18	0.04		7.9	1.55	48
0133 701-22-133	37			2.4		30
0134 701-22-134	76			2.5		42
0135 701-22-135	107	0.08		1.7	1.63	59
0136 701-22-136	246			1.5		3
0137 701-22-137	43			1.4		73
0138 701-22-138	57			1.4		23
0139 701-22-139	45			1.4		24
0140 701-22-140	38	2.11		1.2	1.06	38
0141 701-22-141	51			1.6		38
0142 701-22-142	29			0.6		3
0143 701-22-143	46			1.8		77
0144 701-22-144	20			1.4		354
0145 701-22-145	61			1.3		815
0146 701-22-146	16	0.74		1.4	2.63	300
0147 701-22-147	38	2.71		2.0	0.96	118
0148 701-22-148	19	0.58		46.8	1.43	408
0149 701-22-149	81			1.9		62
0150 701-22-150	31			1.4		176
CHECKS						
0001 701-22-001	164	1.27		1.1	0.07	31
0002 701-22-021	4662			1.2		74
0003 701-22-041	44	0.67		1.2	0.12	197
0004 701-22-061	99			0.9		44
0005 701-22-081	41	0.31		1.2	0.59	217
0006 701-22-101	38			4.7		162

ANALYSIS

0007 701-22-121	38	0.11	1.1	0.18	19
0008 701-22-141	49		1.6		39

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0121 701-22-121	697	145.5	11	2.9	7	12
0122 701-22-122	663	164.3	12	2.9	7	33
0123 701-22-123	1071	23.8	0	7.1	0	52
0124 701-22-124	417		1	6.8	0	2
0125 701-22-125	1815		13	4.6	0	96
0126 701-22-126	1468	32.1	9	4.5	0	67
0127 701-22-127	1233		6	4.7	0	51
0128 701-22-128	1965		11	4.5	0	92
0129 701-22-129	1141		5	4.7	0	66
0130 701-22-130	1718	57.0	6	4.5	0	55
0131 701-22-131	1456		6	4.5	0	75
0132 701-22-132	993	27.3	5	4.8	0	46
0133 701-22-133	632		0	5.9	0	27
0134 701-22-134	937		4	5.3	0	40
0135 701-22-135	2035	18.3	6	5.0	0	56
0136 701-22-136	391		1	6.6	0	-2
0137 701-22-137	478		22	2.7	16	77
0138 701-22-138	460		15	2.7	11	20
0139 701-22-139	454		17	2.6	12	21
0140 701-22-140	435	40.2	30	2.4	24	37
0141 701-22-141	474		24	2.4	19	35
0142 701-22-142	383		4	4.9	0	-2
0143 701-22-143	762		45	2.4	38	77
0144 701-22-144	2620		193	2.4	178	356
0145 701-22-145	1705		533	2.3	493	822
0146 701-22-146	2150	6.5	162	2.4	149	301
0147 701-22-147	845	51.5	81	2.3	74	115
0148 701-22-148	2568	4.6	236	2.3	216	409
0149 701-22-149	550		42	2.3	35	62
0150 701-22-150	626		143	2.2	133	178
CHECKS						
0001 701-22-001	1480	14.6	4	5.4	0	34
0002 701-22-021	1197		35	3.6	7	61
0003 701-22-041	779	46.1	166	2.2	153	196
0004 701-22-061	716		1	4.4	0	43
0005 701-22-081	890	64.3	181	2.2	166	219
0006 701-22-101	1553		127	2.2	114	160

ANALYSIS

0007 701-22-121	728	143.8	12	2.9	7	14
0008 701-22-141	480		25	2.6	20	35

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	5.05	22.86	0.9	X	138	X
0122 701-22-122	4.75	27.49	3.1	0.18	530	0.9
0123 701-22-123	1.43	16.05	1.6	X	405	X
0124 701-22-124	1.34	9.76	0.7		192	
0125 701-22-125	1.20	19.91	1.4		552	
0126 701-22-126	2.78	18.85	X	X	582	X
0127 701-22-127	2.37	18.04	X		620	
0128 701-22-128	2.69	25.80	X		598	
0129 701-22-129	1.69	20.60	1.5		517	
0130 701-22-130	1.60	15.02	X	X	517	X
0131 701-22-131	0.92	15.54	0.8		470	
0132 701-22-132	2.34	15.81	X	X	589	X
0133 701-22-133	1.74	20.36	1.3		584	
0134 701-22-134	0.99	22.42	X		784	
0135 701-22-135	0.83	21.97	X	X	792	X
0136 701-22-136	3.25	19.27	0.7		515	
0137 701-22-137	2.90	9.58	11.9		627	
0138 701-22-138	4.08	27.11	3.9		480	
0139 701-22-139	4.92	40.86	1.8		408	
0140 701-22-140	4.38	32.23	6.0	1.18	287	X
0141 701-22-141	3.63	31.37	4.7		508	
0142 701-22-142	3.60	43.44	4.0		1214	
0143 701-22-143	3.54	11.18	7.0		287	
0144 701-22-144	2.00	13.82	1.8		654	
0145 701-22-145	1.51	9.08	4.5		363	
0146 701-22-146	2.25	14.35	8.3	0.19	506	2.6
0147 701-22-147	2.91	11.52	8.2	0.29	705	1.7
0148 701-22-148	0.65	14.07	14.6	0.12	574	0.9
0149 701-22-149	4.30	17.29	10.6		290	
0150 701-22-150	4.08	22.32	13.0		727	
CHECKS						
0001 701-22-001	4.26	22.24	26.1	X	753	X
0002 701-22-021	3.27	27.75	12.5		863	
0003 701-22-041	1.22	17.67	9.1	0.07	807	X
0004 701-22-061	2.59	18.47	1.9		555	
0005 701-22-081	7.84	20.15	98.3	1.89	339	0.5
0006 701-22-101	1.15	16.85	9.4		577	

ANALYSIS

0007 701-22-121	5.05	22.31	1.1	X	168	X
0008 701-22-141	3.71	31.51	5.2		523	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	19.0	X	5.1		6.456	55.88
0122 701-22-122	50.5	X	4.1		7.444	52.21
0123 701-22-123	71.1	X	7.9		4.573	1.97
0124 701-22-124	101.5		7.6	3.8	2.826	2.06
0125 701-22-125	146.7		7.3		5.343	1.84
0126 701-22-126	137.7	1.8	6.8		5.278	1.56
0127 701-22-127	300.2		6.8		4.817	1.29
0128 701-22-128	149.3		7.2		7.126	1.98
0129 701-22-129	100.8		7.3		6.013	1.71
0130 701-22-130	116.0	3.2	7.3		4.221	1.85
0131 701-22-131	121.8		7.0		4.424	2.00
0132 701-22-132	143.3	1.0	6.7		4.439	2.50
0133 701-22-133	76.4		6.8		5.807	15.41
0134 701-22-134	160.9		7.1		6.625	1.75
0135 701-22-135	124.4	0.8	6.7		6.059	2.64
0136 701-22-136	37.4		7.0		5.505	110.84
0137 701-22-137	252.2		2.8		2.785	123.21
0138 701-22-138	56.9		4.2		7.610	140.88
0139 701-22-139	18.6		4.7		11.334	87.11
0140 701-22-140	25.1	X	3.8		9.102	117.20
0141 701-22-141	62.8		4.3		8.901	98.43
0142 701-22-142	9.3		5.9		11.540	69.96
0143 701-22-143	181.7		3.0		3.527	111.76
0144 701-22-144	173.7		3.0		3.807	2.73
0145 701-22-145	82.2		2.7		2.489	2.00
0146 701-22-146	51.2	0.6	3.1		4.059	1.68
0147 701-22-147	54.7	0.5	3.4		3.233	38.16
0148 701-22-148	70.0	0.5	3.3		4.072	2.22
0149 701-22-149	68.4		3.3		5.368	115.42
0150 701-22-150	22.2		3.2		5.820	3.17
CHECKS						
0001 701-22-001	327.8	1.6	5.1		6.432	159.65
0002 701-22-021	157.2		5.8	2.6	7.324	93.84
0003 701-22-041	107.6	X	5.4		4.918	26.80
0004 701-22-061	23.4		4.1		5.302	131.00
0005 701-22-081	134.8	11.0	2.7		5.232	118.94
0006 701-22-101	44.4		3.8		4.935	106.37

ANALYSIS

0007 701-22-121	19.3	0.6	5.5	6.326	55.21
0008 701-22-141	65.3			8.853	101.27

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0121 701-22-121	X	0.55	4757	96.6	0.42	0.07
0122 701-22-122	0.002	1.19	9578	294.5	0.59	0.26
0123 701-22-123	0.002	2.04	1.90%	25.8	X	0.70
0124 701-22-124	X	0.25	1955		X	0.11
0125 701-22-125	X	3.20	2.94%		X	1.06
0126 701-22-126	X	2.22	2.25%	27.6	X	0.57
0127 701-22-127	X	1.77	1.44%		X	0.25
0128 701-22-128	X	3.06	3.04%		X	0.92
0129 701-22-129	X	2.23	1.98%		X	0.68
0130 701-22-130	X	1.82	2.59%	44.8	0.30	0.83
0131 701-22-131	X	2.49	2.45%		X	0.81
0132 701-22-132	X	1.58	1.83%	18.8	0.05	0.42
0133 701-22-133	X	0.97	8216		X	0.22
0134 701-22-134	0.003	1.36	1.14%		X	0.20
0135 701-22-135	X	1.93	1.72%	16.5	X	0.30
0136 701-22-136	X	0.10	1126			0.04
0137 701-22-137	0.006	2.39	2.65%		0.71	0.58
0138 701-22-138	X	0.75	7422		0.53	0.13
0139 701-22-139	X	0.80	7696		0.60	0.09
0140 701-22-140	X	1.24	1.24%	198.0	0.94	0.12
0141 701-22-141	X	1.24	1.21%		1.07	0.09
0142 701-22-142	X	0.10	903			0.05
0143 701-22-143	0.003	2.50	2.94%		1.52	0.40
0144 701-22-144	0.003	11.56	11.44%		5.58	1.39
0145 701-22-145	X	26.63	22.05%		18.95	1.19
0146 701-22-146	X	9.82	8.52%	261.9	4.84	0.70
0147 701-22-147	X	3.84	3.99%	247.9	2.81	0.30
0148 701-22-148	0.044	13.32	12.46%	242.3	7.94	1.17
0149 701-22-149	0.003	2.03	2.21%		1.69	0.25
0150 701-22-150	X	5.75	5.38%		4.00	0.34
CHECKS						
0001 701-22-001	X	1.01	1.06%	27.2	X	0.39
0002 701-22-021	0.009	2.42	2.75%			0.11
0003 701-22-041	0.002	6.44	6.19%	47.4		0.31
0004 701-22-061	X	1.44	1.74%			1.06
0005 701-22-081	X	7.08	7.06%	416.3		0.49
0006 701-22-101	0.039	5.28	5.14%			0.49

ANALYSIS

0007 701-22-121	X	0.61	5693	98.9	0.07
0008 701-22-141	X	1.26	1.24%		0.10

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.51	0.05	5.8	X	2.6	0.09
0122 701-22-122	1.05	0.04	8.4	X	5.9	0.13
0123 701-22-123	3.63	1.27	3.7	3.9	1.7	3.71
0124 701-22-124	3.35		1.8	5.7		6.19
0125 701-22-125	1.53		5.2	1.8		1.28
0126 701-22-126	4.34	0.35	8.0	0.8	1.2	0.78
0127 701-22-127	2.90		8.1	1.0		1.09
0128 701-22-128	2.72		6.2	5.5		4.79
0129 701-22-129	2.92		3.7	3.2		3.08
0130 701-22-130	7.63	1.88	4.9	5.1	1.4	4.73
0131 701-22-131	3.13		3.8	5.3		4.77
0132 701-22-132	5.15	0.34	6.2	1.4	1.1	1.30
0133 701-22-133	0.72		6.8	3.9		3.02
0134 701-22-134	3.55		4.6	3.5		2.94
0135 701-22-135	1.19	0.54	6.3	4.2	1.0	4.04
0136 701-22-136	0.62		10.6	X		0.49
0137 701-22-137	0.31		13.7	X		0.26
0138 701-22-138	0.26		9.9	0.5		0.21
0139 701-22-139	0.29		14.3	X		0.10
0140 701-22-140	0.22	0.02	10.3	X	2.7	0.25
0141 701-22-141	0.54		8.4	X		0.24
0142 701-22-142	0.21		9.3	X		0.02
0143 701-22-143	0.62		11.7	1.3		1.22
0144 701-22-144	0.87		6.3	1.0		0.51
0145 701-22-145	2.22		2.2	2.7		2.88
0146 701-22-146	2.54	0.14	6.2	1.5	2.8	1.01
0147 701-22-147	0.75	0.14	8.2	3.0	7.9	3.12
0148 701-22-148	1.55	0.27	7.6	2.4	10.4	2.61
0149 701-22-149	1.16		9.5	1.2		1.19
0150 701-22-150	1.35		10.2	2.3		1.71
CHECKS						
0001 701-22-001	0.38	X	9.2	0.9	1.3	0.53
0002 701-22-021	0.59		16.8	0.9		1.01
0003 701-22-041	0.46	0.34	9.1	2.7	2.8	2.34
0004 701-22-061	0.69		7.5	1.0		0.91
0005 701-22-081	2.58	0.47	11.9	0.8	3.2	0.97
0006 701-22-101	0.36		8.1	4.8		4.77

ANALYSIS

0007 701-22-121	0.51	0.04	5.8	X	2.8	0.12
0008 701-22-141	0.48		8.5	X		0.26

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	3.95	0.8	X	40.02	13.17	0.41
0122 701-22-122	4.44	1.0	X	369.97	76.16	0.39
0123 701-22-123	2.43	10.6	X	249.34	256.35	0.13
0124 701-22-124	1.42	5.9		123.17		0.10
0125 701-22-125	3.21	7.6		338.37		0.11
0126 701-22-126	3.10	4.3	X	185.87	225.98	0.23
0127 701-22-127	3.31	3.8		237.45		0.19
0128 701-22-128	4.33	8.6		394.60		0.24
0129 701-22-129	3.62	8.5		520.91		0.16
0130 701-22-130	2.53	13.1	0.1	560.48	183.34	0.15
0131 701-22-131	2.31	4.8		380.29		0.08
0132 701-22-132	2.82	2.2	X	189.88	157.63	0.23
0133 701-22-133	3.51	1.7		173.53		0.15
0134 701-22-134	3.53	4.8		527.27		0.10
0135 701-22-135	3.30	1.8	X	576.39	94.23	0.09
0136 701-22-136	3.33	1.4		709.90		0.29
0137 701-22-137	1.79	0.5		129.28		0.25
0138 701-22-138	4.43	0.8		89.43		0.32
0139 701-22-139	7.00	0.8		120.71		0.40
0140 701-22-140	5.24	0.6	X	81.29	31.02	0.35
0141 701-22-141	4.61	0.5		121.60		0.30
0142 701-22-142	7.68	0.5		131.86		0.32
0143 701-22-143	1.52	0.8		67.83		0.30
0144 701-22-144	2.42	1.4		548.88		0.16
0145 701-22-145	1.63	5.2		209.14		0.13
0146 701-22-146	2.24	3.9	X	562.61	26.04	0.21
0147 701-22-147	2.16	1.3	X	329.72	65.53	0.25
0148 701-22-148	1.63	5.5	X	451.39	40.84	0.05
0149 701-22-149	2.54	0.8		109.22		0.54
0150 701-22-150	4.06	2.2		367.62		0.35
CHECKS						
0001 701-22-001	3.65	0.7	X	76.36	10.04	0.34
0002 701-22-021	5.08	0.8		284.38		0.21
0003 701-22-041	3.13	1.2	X	451.23	41.67	0.09
0004 701-22-061	2.97	0.8		49.23		0.23
0005 701-22-081	3.59	5.2	X	278.45	30.25	0.56
0006 701-22-101	2.97	1.5		183.97		0.10

ANALYSIS

0007 701-22-121	4.01	0.8	X	40.40	11.73	0.41
0008 701-22-141	4.64	0.6		125.61		0.31

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0121 701-22-121	0.370	600	0.15	22.14	0.024	1967
0122 701-22-122	0.596	1355	0.06	20.60	0.223	2039
0123 701-22-123	0.169	183	0.26	11.64	0.011	626
0124 701-22-124	0.107		0.09	9.26		690
0125 701-22-125	0.186		0.14	13.13		551
0126 701-22-126	0.224	205	0.16	13.89	0.027	1390
0127 701-22-127	0.236		0.19	16.07		1023
0128 701-22-128	0.257		0.31	16.07		1409
0129 701-22-129	0.253		0.36	13.92		785
0130 701-22-130	0.182	403	0.33	13.24	0.200	816
0131 701-22-131	0.110		0.78	12.78		318
0132 701-22-132	0.199	149	8.89	19.49	0.033	795
0133 701-22-133	0.279		0.41	18.51		696
0134 701-22-134	0.213		0.68	24.88		508
0135 701-22-135	0.161	126	0.37	19.68	0.010	301
0136 701-22-136	0.410		0.52	25.25		1496
0137 701-22-137	0.301		0.22	19.99		1576
0138 701-22-138	0.492		0.19	25.26		2334
0139 701-22-139	0.744		X	32.63		3217
0140 701-22-140	0.461	966	0.20	28.69	0.582	2475
0141 701-22-141	0.262		0.13	28.40		2037
0142 701-22-142	0.490		X	27.88		1991
0143 701-22-143	0.181		0.60	23.40		2074
0144 701-22-144	0.195		0.20	8.05		1396
0145 701-22-145	0.104		0.77	6.95		600
0146 701-22-146	0.150	879	0.70	12.25	37.361	958
0147 701-22-147	0.226	961	1.30	22.25	10.119	1674
0148 701-22-148	0.060	810	0.48	11.55	3.034	405
0149 701-22-149	0.226		1.08	25.83		2569
0150 701-22-150	0.316		0.90	23.72		2301
CHECKS						
0001 701-22-001	0.440	196	0.06	21.33	0.025	2266
0002 701-22-021	0.559		0.78	14.42		3087
0003 701-22-041	0.249	348	0.87	11.18	0.021	800
0004 701-22-061	0.219		0.66	17.81		929
0005 701-22-081	0.261	1486	1.36	14.85	18.376	3114
0006 701-22-101	0.229		0.65	21.64		685

ANALYSIS

0007 701-22-121	0.405	629	0.13	22.33	0.049	1881
0008 701-22-141	0.263		0.12	28.78		2083

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.33	0.17	3.66	1.198	41	X
0122 701-22-122	0.37	0.49	16.98	930.896	55	X
0123 701-22-123	0.02	0.07	2.62	3.510	34	X
0124 701-22-124	0.02	0.07	2.12		8	
0125 701-22-125	X	0.07	3.02		54	
0126 701-22-126	X	0.09	3.65	0.247	53	X
0127 701-22-127	X	0.08	4.26		71	
0128 701-22-128	X	0.11	4.20		89	
0129 701-22-129	0.02	0.10	3.92		43	
0130 701-22-130	0.03	0.08	3.32	0.332	57	X
0131 701-22-131	X	0.05	2.58		76	
0132 701-22-132	0.04	0.07	3.94	0.179	72	X
0133 701-22-133	0.18	0.11	4.08		61	
0134 701-22-134	0.04	0.05	3.96		58	
0135 701-22-135	0.04	0.06	2.85	0.186	65	X
0136 701-22-136	1.01	0.19	5.78		93	
0137 701-22-137	1.44	0.21	6.78		103	
0138 701-22-138	1.38	0.24	4.98		88	
0139 701-22-139	0.69	0.31	5.36		125	
0140 701-22-140	0.86	0.17	5.40	44.866	90	X
0141 701-22-141	0.97	0.12	5.32		80	
0142 701-22-142	0.69	0.18	3.54		89	
0143 701-22-143	1.18	0.13	4.61		94	
0144 701-22-144	0.04	0.04	2.64		74	
0145 701-22-145	0.10	0.04	1.56		37	
0146 701-22-146	0.06	0.05	3.07	25.166	68	X
0147 701-22-147	0.48	0.10	4.94	43.285	98	X
0148 701-22-148	0.07	0.02	0.88	7.741	73	X
0149 701-22-149	1.38	0.13	5.02		80	
0150 701-22-150	0.30	0.10	6.99		104	
CHECKS						
0001 701-22-001	1.84	0.16	3.64	0.111	84	X
0002 701-22-021	1.23	0.23	1.75		146	
0003 701-22-041	0.36	0.06	4.07	4.718	84	X
0004 701-22-061	1.32	0.08	3.53		64	
0005 701-22-081	1.26	0.11	2.96	89.824	99	0.07
0006 701-22-101	1.83	0.27	3.57		62	

ANALYSIS

0007 701-22-121	0.32	0.18	3.68	1.523	48	X
0008 701-22-141	1.02	0.12	5.31		78	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0121 701-22-121	1.0	10.52	1.16	18	0.02	49.4
0122 701-22-122	1.5	38.62	3.07	27	0.44	78.5
0123 701-22-123	5.1	3.78	0.50	4	X	32.5
0124 701-22-124	5.6	3.11	0.51	5		33.2
0125 701-22-125	2.4	3.09	0.52	4		29.4
0126 701-22-126	3.8	3.66	0.71	2	X	53.7
0127 701-22-127	1.9	3.79	0.62	3		36.3
0128 701-22-128	6.2	4.88	0.92	4		46.1
0129 701-22-129	6.7	4.60	0.85	5		43.0
0130 701-22-130	6.2	3.96	0.65	3	X	37.6
0131 701-22-131	2.8	2.10	0.35	4		23.4
0132 701-22-132	1.6	3.08	0.73	2	X	42.6
0133 701-22-133	0.9	6.14	0.84	18		36.5
0134 701-22-134	1.4	2.91	0.41	6		21.9
0135 701-22-135	0.9	2.86	0.46	7	X	30.0
0136 701-22-136	1.6	9.79	1.67	17		60.4
0137 701-22-137	1.8	10.00	1.24	368		48.3
0138 701-22-138	1.3	13.94	1.57	194		50.7
0139 701-22-139	2.4	18.33	2.25	35		71.3
0140 701-22-140	1.4	9.69	1.22	29	1.56	59.9
0141 701-22-141	1.4	5.86	0.86	39		50.7
0142 701-22-142	1.0	9.99	1.31	37		48.8
0143 701-22-143	1.6	6.85	0.95	87		46.4
0144 701-22-144	4.1	2.85	0.37	5		23.7
0145 701-22-145	4.3	1.77	0.31	6		17.5
0146 701-22-146	2.1	2.68	0.46	3	0.55	30.7
0147 701-22-147	1.6	5.47	0.74	18	3.56	40.0
0148 701-22-148	2.7	1.11	0.16	3	0.32	7.0
0149 701-22-149	2.2	6.84	0.93	33		58.1
0150 701-22-150	6.8	5.22	0.73	13		49.3
CHECKS						
0001 701-22-001	1.6	9.31	1.07	67	0.29	53.8
0002 701-22-021	0.7	18.24	1.50	671		10.5
0003 701-22-041	0.5	3.52	0.51	39	0.69	38.2
0004 701-22-061	1.5	5.05	0.63	31		48.6
0005 701-22-081	2.6	5.44	0.81	16	1.01	40.3
0006 701-22-101	1.1	6.28	1.62	20		32.7

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0007 701-22-121	1.1	11.68	1.28	22	0.02	51.4
0008 701-22-141	1.3	6.00	0.92	40		51.3

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ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.20		7.87%			14.7
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.31		6.47%			16.8
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				0.04		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	X		6.20%			0.8
0022 AMIS0167	0.92		1.39%			158.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.30		6.15%			128.8
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	29.30		3.48%			1060.5
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0001 NGL-27		X				
0002 OREAS 45d				184.6		0.83
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		22				
0009 OREAS 45e				254.8		0.72
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			
0015 Control Blank						
0016 OREAS 45e		24				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				822.0		0.29
0022 AMIS0167				90.5		0.47
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		11				
0029 GTS-2a				183.4		0.85
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		X				
0035 CCU-1c						
0036 MPL-5				607.7		17.58
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2	
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ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		0.34			1873	
0003 OREAS 45e				0.55		
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d				1.05		
0008 OREAS 45d						
0009 OREAS 45e		0.28			637	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96				0.16		
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		0.03			11.52%	
0022 AMIS0167		1.07			1021	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1				12.56		
0028 AE21						
0029 GTS-2a		0.28			3.60%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3				8.68		
0034 Au5						
0035 CCU-1c				0.09		
0036 MPL-5		40.49			4.41%	
0037 OREAS 97.01						
0038 PD-1						

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ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.07		36.50		29.6	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.04		24.59		57.5	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank				X		
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.09		18.06		29.3	
0022 AMIS0167	0.42		46.41		37.7	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.43		25.29		22.9	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	3.21		587.02		138.4	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		539		3.83	373.5	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		983		1.24	787.0	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		237		0.45	106.8	
0022 AMIS0167		404		1.10	64.4	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		132		1.65	78.7	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		604		24.33	2028.5	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.18		1.32	0.61		15.45
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.18		1.22	0.58		26.02
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank					X	
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.97		1.59	1.24		4.87
0022 AMIS0167	5.88		2.87	0.74		2.50
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	2.17		1.33	1.12		7.01
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	8.64		2.18	4.97		3.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d				21.84	2.38	1.55
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e				17.14	1.99	0.57
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	X					
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				12.30	3.01	1.80
0022 AMIS0167				3.20	4.77	0.93
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a				21.13	3.43	0.50
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5				32.42	23.30	15.92
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0001 NGL-27		0.01				
0002 OREAS 45d	3.69			0.44	0.097	4391
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		0.04				
0009 OREAS 45e	3.37			0.41	0.096	3457
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e		X				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.99			0.59	0.061	8790
0022 AMIS0167	1.95			1.00	0.006	4681
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		X				
0029 GTS-2a	2.83			0.43	0.119	1.83%
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		0.19				
0035 CCU-1c						
0036 MPL-5	1.28			1.08	21.017	1.21%
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		16.99	18.2	0.196	2206	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		11.46	5.9	0.177	1382	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	0.1					X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		8.43	42.9	0.190	5.38%	
0022 AMIS0167		23.91	4.2	0.288	1427	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		10.33	24.0	0.272	2.05%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		326.54	34.1	0.167	8923	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	503			2.6		
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	548			2.4		
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		X				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1129			0.7		
0022 AMIS0167	217			3.9		
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1332			4.1		
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2342			20.0		
0037 OREAS 97.01						
0038 PD-1						

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ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	1039					
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	629					
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		0.1				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.68%					
0022 AMIS0167	669					
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	5690					
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	5877					
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	12.44	14.56	204.2		376	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	6.69	9.72	399.3		314	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				X		X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	5.92	10.68	74.6		366	
0022 AMIS0167	3.46	19.21	104.6		165	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.28	17.24	67.5		802	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	36.44	239.38	2487.9		739	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	22.5				3.789	43.00
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	18.5				2.628	22.47
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	8.4				2.337	19.98
0022 AMIS0167	247.4				5.068	17.48
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	20.0				3.581	58.43
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2101.3				64.600	367.62
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	X		617			
0003 OREAS 45e		0.06				
0004 OREAS 97.01						
0005 PD-1						4.62
0006 PD-1					3.18	
0007 OREAS 45d		0.07				
0008 OREAS 45d						
0009 OREAS 45e	X		526			
0010 OREAS 97.01						
0011 PD-1						4.47
0012 RTS-2					1.41	
0013 Control Blank						
0014 Control Blank				0.1		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96		4.13				
0018 OREAS 97.01						
0019 PD-1						4.47
0020 PD-1					3.70	
0021 WGB-1	X		385			
0022 AMIS0167	X		8375			
0023 OREAS 97.01						
0024 PD-1						4.37
0025 PL-21						
0026 RTS-2					1.23	
0027 STSD-1		0.25				
0028 AE21						
0029 GTS-2a	X		2971			
0030 OREAS 97.01						
0031 PD-1						4.40
0032 PD-1					3.48	
0033 STSD-3		0.19				
0034 Au5						
0035 CCU-1c		32.40				
0036 MPL-5	1.601		1.18%			
0037 OREAS 97.01						
0038 PD-1						4.51

ANALYSIS

0039 RTS-2 1.20

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ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.77		47.5	2.7		
0003 OREAS 45e						
0004 OREAS 97.01						0.67
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.05		88.2	2.8		
0010 OREAS 97.01						0.70
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						0.65
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.24		42.3	0.5		
0022 AMIS0167	7.59		2.8	0.7		
0023 OREAS 97.01						0.70
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.19		30.6	0.9		
0030 OREAS 97.01						0.72
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	353.34		48.0	126.6		
0037 OREAS 97.01						0.72
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	3.07	2.7		34.03		0.92
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.37	1.3		16.87		0.53
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.82	3.9		113.82		0.33
0022 AMIS0167	4.84	1.5		22.69		1.36
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	4.65	1.2		93.07		0.08
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	38.21	8.2		428.66		74.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.383		0.12	14.40		6554
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.329		0.16	12.71		5079
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.464		X	0.91		5191
0022 AMIS0167	0.890		0.19	50.87		713
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.631		1.31	1.23		1081
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2.191		29.82	93.62		2405
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.29	0.19	2.61		236	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.17	0.19	2.39		320	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.36	0.23	0.62		230	
0022 AMIS0167	0.18	0.39	479.51		64	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.36	0.23	0.35		135	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	6.29	0.24	10.50		205	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.2	9.84	1.29	40		133.6
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.0	8.48	1.25	40		104.0
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank					0.04	
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.4	14.28	1.40	36		27.4
0022 AMIS0167	0.9	20.58	2.44	170		64.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	19.5	9.96	1.68	182		97.1
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	28.9	22.52	1.40	1314		39.3
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		
0044 Control Blank						
0045 OREAS 24b	X		8.28%			8.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				2.01		
0051 AlcoaHi4-OES				50.68		
0052 SOLN-001				50.01		
0053 Alcoa18-MS		5.23				
BLANKS						
0001 Control Blank	X	X	X	X		X
0002 Control Blank	X		X			0.7
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		67			X

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			
0044 Control Blank						
0045 OREAS 24b				737.0		2.09
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			1.03			
0051 AlcoaHi4-OES			19.22			
0052 SOLN-001			X			
0053 Alcoa18-MS	34.6				5.32	

BLANKS						
0001 Control Blank	X	X	X	0.1	0.06	X
0002 Control Blank				0.7		X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				X		X

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0041 CCU-1d				0.09		
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b		0.59			1.13%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						50.83
0051 AlcoaHi4-OES						984.13
0052 SOLN-001						194.49
0053 Alcoa18-MS	5.1		5.125			
BLANKS						
0001 Control Blank	X	X	X	X	X	0.02
0002 Control Blank		X			X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X			X	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank				X		
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.07		84.62		16.2	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.90				565.6
BLANKS						
0001 Control Blank	X	X	0.08	X	X	X
0002 Control Blank	X		0.08		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		X		X	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			X
0044 Control Blank						
0045 OREAS 24b		105		10.50	40.6	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			0.49			0.54
0051 AlcoaHi4-OES			19.92			2.51
0052 SOLN-001			X			0.05
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank		1	X	X	X	X
0002 Control Blank		1		X	0.7	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X		X	0.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank					X	
0045 OREAS 24b	4.18		2.21	1.35		4.84
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	0.11	X	X	X	X	0.01
0002 Control Blank	X		X	X		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.10		0.05	X		X

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					
0044 Control Blank						
0045 OREAS 24b				20.74	5.80	1.34
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	2.08					
0051 AlcoaHi4-OES	100.93					
0052 SOLN-001	50.19					
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X			X	0.10	X
0002 Control Blank				0.10	X	X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				0.11	0.05	X

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	3.89			0.78	0.071	3.07%
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			4.8			

BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X			X	X	X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X			0.02	X	X

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					X
0044 Control Blank						
0045 OREAS 24b		43.55	46.9	0.334	1.66%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	3.9					50.29
0051 AlcoaHi4-OES	484.3					202.55
0052 SOLN-001	101.2					193.81
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	0.09	X	X	X	X
0002 Control Blank		0.02	X	X	X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X	X	X	X	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	484			4.1		
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381			2.40%			
0050 Alcoa12-OES		0.50				
0051 AlcoaHi4-OES		19.88				
0052 SOLN-001		0.01				
0053 Alcoa18-MS					6.40	
BLANKS						
0001 Control Blank	4	X		0.1	X	
0002 Control Blank	X			X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	5			X		

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	8998					
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES		249.0				
0051 AlcoaHi4-OES		2051.3				
0052 SOLN-001		496.6				
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	33	X	3	5.0	0	
0002 Control Blank	X					
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X					

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		X
0044 Control Blank						
0045 OREAS 24b	13.67	38.25	61.6		729	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				0.51		1.1
0051 AlcoaHi4-OES				20.55		49.3
0052 SOLN-001				X		X
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	X	0.5	X	X	X
0002 Control Blank	X	0.05	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.33	0.02	X		X	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	23.0				9.967	168.78
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		6.3				
BLANKS						
0001 Control Blank	X	X	5.8		X	X
0002 Control Blank	0.7				0.012	0.18
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	1.1				0.007	0.07

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0041 CCU-1d		31.55				
0042 Control Blank						
0043 Control Blank				0.3		
0044 Control Blank						
0045 OREAS 24b	X		2234			
0046 OREAS 97.01						
0047 PD-1						4.32
0048 PD-1					3.48	
0049 BCS381						
0050 Alcoa12-OES				21.1		
0051 AlcoaHi4-OES				265.3		
0052 SOLN-001				499.1		
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	0.01	X	X		X
0002 Control Blank	X		X			
0003 Control Blank						
0004 Control Blank						0.63
0005 Control Blank						
0006 Acid Blank	X		X			

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	1.00		15.7	X		
0046 OREAS 97.01						0.69
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.74			31.3	
BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X		0.3	X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						X
0006 Acid Blank	X		0.3	X		

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	7.34	4.3		125.44		1.01
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			5.8		529.55	
BLANKS						
0001 Control Blank	0.09	X	X	0.05	0.04	X
0002 Control Blank	X	X		X		0.01
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.02	X		0.15		0.02

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.798		X	16.94		4249
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS					5.692	
BLANKS						
0001 Control Blank	X		X	X	X	X
0002 Control Blank	X		X	0.03		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.011		X	0.01		26

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b	0.84	0.38	3.11		105	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						0.50
0051 AlcoaHi4-OES						20.30
0052 SOLN-001						X
0053 Alcoa18-MS				5.313		
BLANKS						
0001 Control Blank	X	X	X	X	1	X
0002 Control Blank	X	X	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	X	X		X	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank					X	
0044 Control Blank						
0045 OREAS 24b	3.9	19.98	2.11	107		135.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES					0.48	
0051 AlcoaHi4-OES					20.57	
0052 SOLN-001					X	
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	X	X	4	X	X
0002 Control Blank	0.2	0.06	0.01	X		0.3
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	0.57	0.04	2		0.3

METHOD CODE DESCRIPTION

/CALC Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.

/COL Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/CSA Intertek Genalysis Perth

Induction Furnace Analysed by Infrared Spectrometry

/GR Intertek Genalysis Perth

Analysed by Gravimetric Technique.

/MS Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE Intertek Genalysis Perth

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

4A/MS Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4A/OE Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

4AH/OE Intertek Genalysis Perth

Modified (for higher precision) multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

ANCx/MTR Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement

ANCx/QUAL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection

ANCx/VOL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.

METHOD CODE DESCRIPTION

AR01/MS Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Mass Spectrometry.

AR01/OE Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

NAGx/MTR Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement

NAGx/VOL Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

S71/OE Intertek Genalysis Perth

Digestion to eliminate sulphides. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

SCR/VOL Intertek Genalysis Perth

Chromium Reducible Suplhur Analysed by Volumetric Technique.

SE1/MS Intertek Genalysis Perth

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Pl

Ws/MTR Intertek Genalysis Perth

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed with Electronic Meter Measurement

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APPENDIX C

WRD Slope Stability (KP Report PE701-00022/22)

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APPENDIX D

Surface Water Management Plan (KP Report PE701-00022/18)

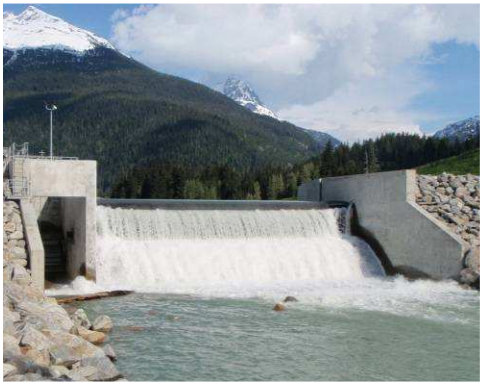
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APPENDIX J

Geochemical Study

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT





WASTE ROCK GEOCHEMICAL ASSESSMENT

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PE701-00022/16
Rev 0
August 2013

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LETPADAUNG COPPER PROJECT

WASTE ROCK GEOCHEMICAL ASSESSMENT

KP Job No. PE701-00022/04

CONTRACT

DOCUMENT INFORMATION

REV	DESCRIPTION	PREPARED	REVIEW	KNIGHT PIESOLD APPROVAL	DATE
A	Issued as Draft	TDR	BL	DJTM	01/07/2013
B	Issued for Client Review	TDR/EJT	TDR	DJTM	15/07/2013
0	Issued as Final	TDR/EJT	TDR	DJTM	26/08/2013

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DATE _____

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EXECUTIVE SUMMARY

Knight Piésold was requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The project will comprise a high throughput heap leach copper project which will generate approximately 1 billion tonnes of waste rock over the 33 year mine life.

The project is a high sulfidation porphyry system hosted in altered intrusive and volcanic rocks. A leach cap is present above the main ore zone of between 10 and 200 m thick. Previous geochemical investigations at the project have been limited in extent and poorly executed resulting in an overestimation of the acid generating potential of the material.

Knight Piésold selected 150 samples of waste rock for this study which were collected from boreholes distributed across the pit and from a depth range commensurate to that of the proposed pit. The samples were sent to an accredited laboratory in Perth for geochemical testing. Testing of the samples was conducted in accordance with internationally accepted methods for assessment acid rock drainage potential and metal leaching potential. The test work included analysis of the mineralogical content, sulfur contents and sulfur forms, acid neutralising capacity and net acid generation to determine the potential for acid rock drainage from the waste rock, and multi-element analysis and distilled water extract to assess the risk of metal leaching from the waste.

The waste rock, although not all of this sulfur was present as reactive sulfide minerals capable of generating acid. However, the portion of the sulfur which was present as reactive sulfide minerals was still very high averaging over 2%, which equates to an average maximum potential acidity of approximately 60 kg of sulfuric acid which can be produced per tonne of waste.

The acid neutralising capacity of the waste was generally very low with the exception of discreet zones within the deposit which were shown to have some carbonate mineralisation, providing additional acid neutralising capacity.

Overall approximately 71% of the samples were found to be potentially acid forming with only 29% of the samples found to be non-acid forming. There was no relationship between the lithology of the samples and the acid formation potential. However, there was a clear trend of decreasing amounts of non-acid generating material with depth, and below 250 m depth essentially all samples were potentially acid forming.

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble,

especially under acidic conditions. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from both the PAF and NAF material.

Additional characterisation of the waste rock at the project will be required prior to bulk mining and throughout the life of the operation. Operational testing will include net acid generation testing on closely spaced grade control or blast hole samples for every mining bench. The extent of the testing is such that establishment of a site laboratory to conduct both geochemical and geotechnical testing will be required.

The waste will require certain handling and placement methods to reduce the risk of acid generation and metal leaching which will include:

- Preparation of the foundations below all waste dump areas.
- Placement of layer of benign waste (i.e. non-acid generating, non-enriched and non-leachable) at the base of the dumps.
- Full encapsulation of all waste with a suitable compacted soil liner.
- Cover of the soil liner with a layer of benign (i.e. non-acid forming, non-enriched and non-leachable) waste or borrow material.
- Water management structures around all waste dump areas to collect potentially contaminated waters.

In addition, the potentially acid generating waste will need to be identified during operations and will require further controls to reduce the risk of acid generation which will include:

- Placement of PAF waste in lifts not exceeding 3 to 5 metres in height.
- Installation of interim covers, the frequency of which is still to be determined.

Instrumentation and monitoring of the quality of the construction and the performance of the encapsulation system will be required to confirm that the design intent is being achieved and sulfide oxidation has been reduced to acceptable levels.

1. INTRODUCTION

Knight Piésold has been requested by Myanmar Wanbao Mining Copper Ltd (MWMCL) to commence an investigation into the acid rock drainage and metal leaching potential of the waste rock which will be produced at the Letpadaung Project. The Letpadaung Project is located in the Monywa Copper district of Central Myanmar approximately 585 km north-northwest of Yangon. The Letpadaung deposit lies within the Salingyi Township and is about 3 km west of the Chindwin River, approximately 26 km by road from Monywa.

Knight Piésold has conducted an initial geochemical assessment, with samples of waste rock selected and sent to an accredited laboratory for analysis. This report presents the results of the geochemical analysis, with interpretation of the acid generation and metal leaching risk and the implications for the mine waste management at the site. This report follows an interim report which was issued by Knight Piésold prior to receipt of all the test work results (Ref. 1).

It should be noted that this geochemical assessment only relates to the waste rock to be produced by the Letpadaung project. Geochemical studies into the heap leach pad are also required to allow for the design of seepage control measures and closure capping.

1.1 PROJECT DESCRIPTION

The project has an estimated mineral resource of approximately 1 billion tonnes with a strip ratio of 0.99, resulting in approximately 1 billion tonnes of waste being generated over the proposed 33 year mine life. Waste will be stored in four locations during operations as follows:

- Stage 1 – Waste rock to be placed in Waste Dumps 1 and 2 located adjacent to the pit.
- Stage 2 – Waste rock to be primarily placed in Waste Dump 3 and the Stage 1 pit, with limited material also placed in Waste Dumps 1 and 2.

1.2 GEOLOGICAL SETTING

The following overview of the geological setting comprises excerpts from the Feasibility Study by Mineral Resources Development (Ref. 2).

The Monywa copper district is located along north-south trending Inner Volcanic Arc, which lies within the Central Burma Tectonic Belt. The project is a high sulfidation mineral system with andesite porphyry the most common rock type hosting the copper

mineralisation. Pyroclastics are the second most abundant rock type at Letpadaung, including tuffs and breccias and reworked volcaniclastic siltstones and sandstones.

Typical alteration zones common to most high sulfidation systems are observed at the Letpadaung Project, including residual silica zones, silica-alunite zones, argillic zones and chlorite zones. Copper mineralisation at Letpadaung is dominated by hypogene chalcocite / digenite, covellite and supergene chalcocite. The copper sulfide mineralisation is overlain by a 10 to 200 m thick strongly weathered leach cap. The leach cap can be considered waste material as it contains very limited economic copper mineralisation.

1.3 PREVIOUS GEOCHEMICAL WORK

Two high level geochemical studies have been conducted at the Letpadaung Project and the neighbouring S&K project. These studies have been reviewed and are summarised in the following sections.

Overall there is a very limited amount of geochemical data (twenty one relevant samples) considering the size of the deposit and the clear risk of acid rock drainage that exists from high sulfidation systems. Furthermore, the methods employed in the two studies have not been tailored to suit the mineralogy of the deposit. Therefore, the results and subsequent conclusions are considered questionable.

1.3.1 Feasibility Study Report

An assessment into the acid rock drainage potential of the Letpadaung Project was conducted by Coffey Partners International Pty Ltd in 1997 (Ref. 3) as part of the feasibility study. This study included geochemical testing of ten waste rock samples collected from both the S&K Deposit and the Letpadaung deposit, with material taken from both the leach cap and the internal waste.

The analysis included determination of total sulfur, pyritic sulfur, sulfate sulfur and “unidentified sulfur”. The total sulfur content in nine out of ten sample was high to extremely high (0.68 to 9.12%) with only a single sample of leach cap lapilli tuff exhibiting a low total sulfur content (<0.01%).

The total sulfur was used to calculate the maximum potential acidity which resulted in nine of the ten samples being classified as potentially acid generating. This approach appears to be overly conservative as the majority of the sulfur in leach cap sample was unidentified sulfur and a large proportion of the sulfur in the internal waste was also present as unidentified sulfur. The leach cap samples were essential devoid of pyritic sulfur.

The acid neutralising capacity (ANC) of the samples was highly variable ranging from material which was essential devoid of ANC (<0.01 kg $CaCO_3$/t) up to a sample with a very high ANC (141 kg $CaCO_3$/t). However, the majority of samples exhibited very low to moderate ANC (0.2 to 10 kg $CaCO_3$/t).

The assessment conducted by Coffey concluded that six out of ten samples were Acid Producing (i.e. had positive net acid producing potentials) with a further three samples classified as Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) with only a single sample was classified as Non Acid Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of less than 2). However, as noted earlier, the presence of unidentified sulfur in the samples could have significantly impacted the acid producing classifications.

The unidentified sulfur could be present in mineral forms which may not be acid generating, such as barite or alunite, but as no mineralogical analysis was conducted on the samples it is not possible to definitively determine the nature of the unidentified sulfur. However, previous geological assessments of the deposit do list alunite as being present (Ref. 2, 4 and 5) and, therefore, it is reasonable to assume that some of the unidentified sulfur is present as alunite. If the results of the assessment are recalculated using just the pyritic sulfur to calculate the maximum potential acidity, only 50% of the samples would be classified as potentially acid forming, rather than the 90% reported by Coffey.

1.3.2 ARD Investigation for S&K

An investigation into acid rock drainage and hydrogeological conditions at the S&K project was conducted by Westec Inc. in 1997 (Ref. 6). As part of the investigation, six grab samples and seven core samples were tested using basic static testing methods. It is worth noting that total sulfur values were used to generate the estimates of maximum potential acidity, as was conducted in the Coffey study and, therefore, the acid generating potential of the samples is likely to have been overestimated if non-acid forming sulfur containing minerals were also present in these samples.

Two of the samples tested were limestone / soil samples assessing potential sources of ARD mitigation material. These samples are not relevant to an assessment of the acid formation potential of the deposit itself and, therefore, have been excluded from the discussion of results below.

The results of this assessment indicate that six of the eleven relevant samples were found to be Acid Producing (i.e. had positive net acid producing potentials), two were found to be Possibly Acid Producing (i.e. negative acid producing potential but MPA/ANC ratio of less than 2) and three samples were found to be Non Acid

Producing (i.e. had negative net acid producing potentials with MPA/ANC ratio of greater than 2).

2. SAMPLE SELECTION

A site visit was undertaken by Bruce Zhang and Tim Rowles of Knight Piésold from the 25th April through to the 28th April 2013 to gather background data on the project and to select and collect samples of waste rock for geochemical testing.

It was originally intended to select samples of waste rock for geochemical analyses from eleven boreholes recently drilled by Wanbao Myanmar. However, ten of these boreholes were found to be located around the periphery of the pit, with one borehole well outside of the pit limits. Therefore, samples were instead selected from ten of the recently drilled boreholes (i.e. those located around the edge of the pit) plus three boreholes which were drilled within the centre of the pit by Ivanhoe. The core was examined prior to selecting samples and was found to be in good condition with no visible signs of significant oxidation.

A total of one hundred and fifty samples were selected from the boreholes within waste zones. These samples represent the range of waste rock lithologies recorded on the geological logs and also an appropriate range of copper and sulfur grades based on the existing assay results which accompanied the logs. Samples were taken from 5 m below ground level to the current pit design base of 450 m depth. The selected samples are summarised in Table 2.1, with a detailed listing provided in Table 2.2.

Table 2.1: Summary Selected Samples

Lithology	Number of Samples
Andesite Porphyry	95
Breccia	14
Diorite Porphyry	12
Pyroclastic	7
Fault Breccia	5
Hydrothermal Breccia	5
Porphyry	5
Dyke	3
Tuff	2
Hornblend Porphyry	1
Feldspar Porphyry	1

Samples were taken from the core trays by manually breaking the core and taking part of the core, leaving the remainder of the core within the trays. Approximately 500 g to 1 kg of core was collected for each sample from the drill intervals indicated in Table 2.2. The samples were placed in cloth bags, labelled and collated into a single crate before being shipped to Genalysis Intertek in Perth for testing.

Table 2.2: Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-001	LS001	25	Andesite Porphyry
701-22-002	LS001	59	Andesite Porphyry
701-22-003	LS001	65.5	Andesite Porphyry
701-22-004	LS001	89.25	Andesite Porphyry
701-22-005	LS001	122	Andesite Porphyry
701-22-006	LS001	136.75	Dyke
701-22-007	LS001	185	Dyke
701-22-008	LS001	221.65	Dyke
701-22-009	LS001	249.15	Andesite Porphyry
701-22-010	LS001	290.75	Andesite Porphyry
701-22-011	LS001	304.05	Andesite Porphyry
701-22-012	LS001	368.85	Andesite Porphyry
701-22-013	LS001	395	Andesite Porphyry
701-22-014	LS001	411.1	Andesite Porphyry
701-22-015	LS001	423.5	Andesite Porphyry
701-22-016	LS002	94.3	Andesite Porphyry
701-22-017	LS002	104.13	Breccia
701-22-018	LS002	128.6	Andesite Porphyry
701-22-019	LS002	148.4	Andesite Porphyry
701-22-020	LS002	355.8	Diorite Porphyry
701-22-021	LS002	373	Andesite Porphyry
701-22-022	LS002	422.5	Andesite Porphyry
701-22-023	LS002	435.3	Andesite Porphyry
701-22-024	LS002	448.85	Andesite Porphyry
701-22-025	LS002	472.85	Andesite Porphyry
701-22-026	LS003	21.3	Andesite Porphyry
701-22-027	LS003	70	Andesite Porphyry
701-22-028	LS003	74.3	Andesite Porphyry
701-22-029	LS003	97	Andesite Porphyry
701-22-030	LS003	115.5	Andesite Porphyry
701-22-031	LS003	131.7	Andesite Porphyry
701-22-032	LS003	146.75	Breccia
701-22-033	LS003	170.02	Diorite Porphyry
701-22-034	LS003	182.4	Diorite Porphyry
701-22-035	LS003	274.25	Diorite Porphyry
701-22-036	LS003	298.3	Diorite Porphyry
701-22-037	LS003	305	Diorite Porphyry
701-22-038	LS003	324.8	Breccia
701-22-039	LS003	330.2	Andesite Porphyry
701-22-040	LS003	342.8	Diorite Porphyry
701-22-041	LS003	353.35	Feldspar Porphyry
701-22-042	LS003	377.5	Andesite Porphyry
701-22-043	LS003	394.75	Porphyry
701-22-044	LS003	410.9	Porphyry
701-22-045	LS003	440.8	Breccia
701-22-046	LS004	30.21	Andesite Porphyry
701-22-047	LS004	50.21	Andesite Porphyry
701-22-048	LS004	69.25	Andesite Porphyry
701-22-049	LS004	110.45	Andesite Porphyry
701-22-050	LS004	134.45	Andesite Porphyry
701-22-051	LS005	28.4	Diorite Porphyry
701-22-052	LS005	50.1	Diorite Porphyry
701-22-053	LS005	72.5	Breccia
701-22-054	LS005	133.9	Breccia
701-22-055	LS005	141.4	Diorite Porphyry
701-22-056	LS006	34.3	Andesite Porphyry
701-22-057	LS006	52.3	Andesite Porphyry
701-22-058	LS006	70.3	Andesite Porphyry
701-22-059	LS006	127.6	Andesite Porphyry
701-22-060	LS006	140.4	Breccia
701-22-061	LK002	16.05	Porphyry
701-22-062	LK002	36.3	Andesite Porphyry
701-22-063	LK002	113.6	Breccia
701-22-064	LK002	133.3	Porphyry
701-22-065	LK002	167.3	Porphyry
701-22-066	LK003	40.3	Andesite Porphyry
701-22-067	LK003	54.9	Breccia
701-22-068	LK003	108.6	Breccia
701-22-069	LK003	128.7	Pyroclastic
701-22-070	LK003	145.6	Tuff
701-22-071	LK004	51.23	Hornblende Porphyry
701-22-072	LK004	71.63	Breccia
701-22-073	LK004	81.52	Breccia
701-22-074	LK004	104.71	Andesite Porphyry
701-22-075	LK004	137.51	Diorite Porphyry
701-22-076	LK006	45.2	Breccia
701-22-077	LK006	51.8	Andesite Porphyry
701-22-078	LK006	129.7	Andesite Porphyry
701-22-079	LK006	145.7	Breccia
701-22-080	LK006	165.86	Diorite Porphyry

Table 2.2 (Continued): Samples Details

ID	Borehole	Depth (m)	Lithology
701-22-081	LK006	191.35	Tuff
701-22-082	LK006	214.6	Pyroclastic
701-22-083	L013	5	Andesite Porphyry
701-22-084	L013	11	Andesite Porphyry
701-22-085	L013	17.7	Andesite Porphyry
701-22-086	L013	23.4	Andesite Porphyry
701-22-087	L013	28.9	Andesite Porphyry
701-22-088	L013	34.9	Andesite Porphyry
701-22-089	L013	41.25	Andesite Porphyry
701-22-090	L013	47.7	Andesite Porphyry
701-22-091	L013	52.9	Andesite Porphyry
701-22-092	L013	58.8	Andesite Porphyry
701-22-093	L013	69	Andesite Porphyry
701-22-094	L013	75	Hydrothermal Breccia
701-22-095	L013	81.9	Hydrothermal Breccia
701-22-096	L013	86.55	Hydrothermal Breccia
701-22-097	L013	93.25	Fault Breccia
701-22-098	L013	100.4	Hydrothermal Breccia
701-22-099	L013	127.55	Andesite Porphyry
701-22-100	L013	177.05	Andesite Porphyry

ID	Borehole	Depth (m)	Lithology
701-22-101	L013	199.75	Andesite Porphyry
701-22-102	L223	121.75	Fault Breccia
701-22-103	L223	131	Andesite Porphyry
701-22-104	L223	137	Andesite Porphyry
701-22-105	L223	142.1	Andesite Porphyry
701-22-106	L223	150	Andesite Porphyry
701-22-107	L223	156	Andesite Porphyry
701-22-108	L223	164.55	Andesite Porphyry
701-22-109	L223	170	Andesite Porphyry
701-22-110	L223	178.05	Andesite Porphyry
701-22-111	L223	184	Andesite Porphyry
701-22-112	L223	191.95	Andesite Porphyry
701-22-113	L223	198	Andesite Porphyry
701-22-114	L223	206.5	Andesite Porphyry
701-22-115	L223	212	Andesite Porphyry
701-22-116	L223	220.05	Andesite Porphyry
701-22-117	L223	231.2	Andesite Porphyry
701-22-118	L223	240.4	Andesite Porphyry
701-22-119	L223	244	Fault Breccia
701-22-120	L223	319.3	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-121	L223	325.4	Andesite Porphyry
701-22-122	L223	340.3	Fault Breccia
701-22-123	L087	6	Pyroclastic
701-22-124	L087	16	Pyroclastic
701-22-125	L087	26	Pyroclastic
701-22-126	L087	36	Pyroclastic
701-22-127	L087	46	Pyroclastic
701-22-128	L087	56	Andesite Porphyry
701-22-129	L087	66	Fault Breccia
701-22-130	L087	76	Andesite Porphyry
701-22-131	L087	86	Andesite Porphyry
701-22-132	L087	96	Andesite Porphyry
701-22-133	L087	106	Andesite Porphyry
701-22-134	L087	116	Andesite Porphyry
701-22-135	L087	126	Andesite Porphyry
701-22-136	L087	134	Andesite Porphyry
701-22-137	L087	144	Andesite Porphyry
701-22-138	L087	158	Andesite Porphyry
701-22-139	L087	170	Andesite Porphyry
701-22-140	L087	184	Andesite Porphyry

ID	Borehole	Depth	Lithology
701-22-141	L087	200	Andesite Porphyry
701-22-142	L087	210	Andesite Porphyry
701-22-143	L087	216	Andesite Porphyry
701-22-144	L087	252	Andesite Porphyry
701-22-145	L087	262	Andesite Porphyry
701-22-146	L087	272	Andesite Porphyry
701-22-147	L087	292	Andesite Porphyry
701-22-148	L087	330	Hydrothermal Breccia
701-22-149	L087	349.7	Andesite Porphyry
701-22-150	L087	340	Andesite Porphyry

3. TESTWORK METHODS

3.1 ACID BASE ACCOUNTING

Acid base accounting (ABA) assesses a sample's potential to form acid from the oxidation of sulfides and the ability to neutralise acid by the dissolution of minerals, especially carbonates, contained in the sample.

Total sulfur and total carbon were determined by LECO induction furnace, with infrared detection. Acid soluble sulfur (HCL S), which includes readily soluble sulfate minerals such as melanterite, epsomite, gypsum and anhydrite as well as a portion of the less soluble iron hydroxyl sulfates such as jarosite, was determined using a hydrochloric acid digest on the solid sample followed by ICP determination of the sulfur content of the digest solution.

Due the presence of alunite and natroalunite in the deposit which would not be identified using the hydrochloric acid digest method, the Chromium Reducible Sulfur (CRS) test was also conducted on the samples to determine the sulfide sulfur content.

The various sulfur species present were then calculated as follows:

Sulfide sulfur (%) = CRS (%)

Acid soluble sulfate (%) = HCL S (%)

Non-acid soluble sulfate (%) = Total sulfur (%) – CRS (%) – HCL S (%)

The test work methods used are based on the ABA methodology defined in the MEND Prediction Manual for Drainage Chemistry from Sulfidic Geological Material (Ref. 7), MEND Acid Rock Drainage Prediction Manual (Ref. 8), and Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (Ref. 9).

Acid Neutralising Capacity (ANC) was determined by digestion in a standard solution of HCl, followed by back titration with NaOH to determine the amount of acid consumed. The technique used is based on Sobek et al (Ref. 10), however, a siderite correction step has been added to the method, after Stewart et al (Ref. 11).

The results of the ABA test work are used to calculate the Maximum Potential Acidity (MPA), which is a measure of the maximum amount of sulfuric acid which can be produced from the total oxidation of all sulfides within the sample, assuming all sulfides are present as pyrite.

The Net Acid Producing Potential (NAPP) is the balance between the Maximum Potential Acidity and the Acid Neutralising Capacity. A negative NAPP indicates that there is an excess neutralising capacity and a positive NAPP indicates there is excess potential acidity.

3.2 STATIC NET ACID GENERATION

Static Net Acid Generation (NAG) test work is a direct measure of a sample's ability to produce acid through sulfide oxidation. The addition of hydrogen peroxide to samples causes rapid oxidation of the contained sulfides to produce sulfuric acid.

The NAG test procedure used is based upon the Static NAG Test (Ref. 12 and 13). The static NAG test involves the addition of 250 mL of 15 per cent hydrogen peroxide to 2.5g of pulverised sample. The sample is allowed to react overnight prior to heating for a period of three hours. Once the sample has cooled, the pH of the solution is measured prior to titration back to pH 4.5 and 7 to determine the acidity produced by the oxidisation reactions.

3.3 ACID FORMING POTENTIAL

The acid formation potential of a sample is calculated based on the acid base accounting, i.e. the balance between a sample's ability to produce acid from the oxidisation of sulfide minerals (MPA) and the sample's ability to neutralise acid by the dissolution of alkaline minerals contained within the sample (ANC).

Historically a safety margin was applied to ratio between the ANC and MPA to allow for variability in the rates of acid production and neutralisation processes, and the potential for geographic separation of the acid producing and acid neutralising phases. This safety margin was generally set by industry at 2 in North America and 3 in Australia.

With recent advances in the understanding and acceptance of the NAG test there has been a move away from this method of classifying materials based solely on the ANC and MPA, as these calculated parameters do not take into consideration the true availability of acid producing and acid neutralising phases.

Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG test results to classify the acid formation potential of materials. Knight Piésold's classification system, as summarised in Table 3.1, is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Table 3.1: Acid Formation Potential Classification System

Acid Formation Potential Class	NAPP (kg H_2SO_4 /t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than -100	≥4.5
Uncertain	Positive	≥4.5
	Negative	<4.5

3.4 MULTI-ELEMENT ANALYSIS OF SOLIDS

Multi-element analysis of the samples was conducted to assess elemental enrichments within the samples. A four acid digestion method was employed for the majority of the analyses, with element specific methods used for selenium, mercury and boron.

Multi-element analysis results were compared to the average crustal abundance to give the geochemical abundance indices. The Geochemical Abundance Index (GAI) quantifies an assay result for a particular element in terms of average crustal abundance. The GAI is calculated from the following formula:

$$\mathbf{GAI = Log_2 (C_n / (1.5 \times B_n))}$$

Where:

C_n *= measured concentration of element in sample*

B_n *= average crustal abundance (Bowen, Ref. 17)*

The GAI is expressed on a scale of 0 to 6, with 0 indicating that the element concentration is less than or similar to the average crustal abundance. A GAI of 3 corresponds to a 12 fold increase above the average crustal abundance, and so forth up to a GAI of 6 which represents a 96 fold increase or greater.

Knight Piésold has assigned an arbitrary scale to the GAI with indices of 0 and 1 being unenriched, indices of 2 being classified as slightly enriched, indices of 3 and 4 being classed as significantly enriched and indices of 5 and 6 being classified as highly enriched.

3.5 X-RAY DIFFRACTION ANALAYSIS

Fifteen of the samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. For each sample a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content. On a limited number of samples a grab of sample was prepared by adding an internal standard, TiO_2, and micronising the mixture to 4 µm. The spiked samples were each prepared as an un-oriented powder mount. A duplicate sample was analysed for every fifteen samples submitted.

The XRD patterns were produced on a PANalytical Cubix^3 XRD fitted with copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3°to 65°2 θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database. Quantitative phase analysis was performed using SIROQUANTTM Version 3 software.

3.6 DISTILLED WATER EXTRACT TESTING

Distilled water extraction tests were conducted on fifty samples to assess the potential for leaching of environmentally significant elements from the waste rock, which could have a detrimental effect on the quality of surface water or near surface groundwater. These tests differ from the multi-element tests in that they only record the readily soluble elements, whereas the multi-element tests give the total elemental enrichment of the waste.

The test procedure is based upon the Shake Flask Method as described in the Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (Ref. 9).

The samples were crushed to minus 2 mm particle size, with 50 grams of each sample then mixed with 150 mL of deionized water in suitably sized vessels. The mixtures were then bottle rolled for 24 hours. The pH and the conductivity of the solutions were then measured and the bottles left to stand for a minimum of 3 hours. The solution was then siphoned off and filtered through a 0.45 µm membrane before preservation of the solution by acid addition prior to analysis. The analysis was by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) or Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) depending on the element being analysed and the detection limits required.

The distilled water extract test results were compared to a set of reference water quality standards which are discussed in Section 3.7.

3.7 REFERENCE WATER QUALITY STANDARDS

To allow assessment of the results of the distilled water extract analysis, a set of reference values has been established. These reference values were compiled from internationally accepted guidelines for water quality for release from mining operations (IFC environmental, health and safety guidelines (Ref. 18 & 19) and the ANZECC water quality guideline for livestock drinking water (Ref. 20)).

The use of several guidelines is required as no single guideline contains target concentrations for all parameters. Where a target concentration for a specific element is at different levels in various guidelines, the lowest concentration has been adopted. These reference values for release from mining operations are presented in Table 3.2.

The establishment of these reference water quality values is to allow for evaluation only and it is not implied by the production of the reference water quality values that the Letpadaung Project will be required to meet these reference levels, or that these reference levels should be used as the regulatory framework. The regulatory requirements for the project will be determined by the relevant regulatory authorities during the environmental design phase of the project.

These reference levels are to be used for a preliminary assessment of water quality only. More detailed assessment of the impact of any release from the mine site may be required in later design stages to assess the impact on receiving environments, such as aquatic systems, where different water quality requirements may be applicable.

Table 3.2: Reference Water Quality Guidelines – Release from Mining Operations

Parameter	ANZECC Livestock (mg/L)	IFC 2004 (mg/L)	IFC 2007 (mg/L)	Adopted Reference Level (mg/L)
pH		6 to 9	6 to 9	6 to 9
TDS	2000			2000
Aluminum	5			5
Antimony				N/G
Arsenic	0.5	0.1	0.1	0.1
Barium				N/G
Boron	5			5
Cadmium	0.01	0.1	0.05	0.01
Calcium	1000			1000
Chloride				N/G
Chromium	1			1
Chromium (Cr^{+6})		0.1	0.1	0.1
Cobalt	1			1
Copper	0.4	0.5	0.3	0.3
Cyanide-Total			1	1
Cyanide-Free			0.1	0.1
Cyanide-WAD		0.5	0.5	0.5
Fluoride	2	20		2
Iron		3.5	2	2
Lead	0.1	0.1	0.2	0.1
Magnesium	2000			2000
Manganese				N/G
Mercury	0.002	0.01	0.002	0.002
Molybdenum	0.15			0.15
Nickel	1	0.5	0.5	0.5
Phosphorus				N/G
Selenium	0.02	0.1		0.02
Silver		0.5		0.5
Sodium				N/G
Sulfate	1000			1000
Tin				N/G
Uranium	0.2			0.2
Vanadium				N/G
Zinc	20	2	0.5	0.5

N/G = No guideline value

4. GEOCHEMICAL RESULTS

4.1 XRAY DIFFRACTION

Fifteen samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents. The summarised results for the XRD analysis are presented in Table 4.1 with the full results provided in Appendix A. The interpreted results are summarised as follows:

- The most common mineral found in the samples was quartz, comprising between 23% and 63% of the overall sample, averaging 39%.
- Clay minerals including illite, smectite, kaolin and chlorite were found to comprise between 4% and 38% of the samples, averaging 20.5%.
- The amorphous content of the samples ranged from 3% to 35%, averaging 16%.
- Natroalunite and alunite were present in 11 of the 15 samples. These are important minerals in the assessment of acid rock drainage as they commonly lead to overestimation of the sulfide content. The natroalunite and alunite were present at between 0% and 28% but were highly variable and showed no correlation with depth or lithology.
- The carbonate content of the samples varied from 0% to 16%, averaging 3.8%. However, the most common carbonate found in the deposit was siderite (from 0% to 11% and averaging 0.9%). Siderite does not provide any neutralising capacity when the full neutralisation and hydrolysis of aqueous iron is accounted for.
- Two sulfide minerals were identified in the analysis. Pyrite the most common sulfide mineral from 0% to 16% and averaging 4.5%, with chalcopyrite identified in a single sample at 1%.

Table 4.1: Summarised XRD Results

Mineral	Group	Average	Max	Min
Quartz	Silicate	39.3	63.0	23.0
Amorphous content	N/A	15.9	35.0	3.0
Natroalunite	Sulfate	7.5	28.0	0.0
Interlayered illite/ smectite	Clay	8.4	22.0	0.0
Pyrophyllite	Clay	4.3	22.0	0.0
Kaolin	Clay	5.5	22.0	0.0
Chlorite	Clay	1.6	13.0	0.0
Hematite	Oxide	1.1	15.0	0.0
Sodium calcium plagioclase	Feldspar	2.1	12.0	0.0
Pyrite	Sulfide	4.5	16.0	0.0
Siderite	Carbonate	0.9	11.0	0.0
Palygorskite	Clay	0.5	7.0	0.0
Illite/Muscovite	Mica	5.1	16.0	0.0
Potassium feldspar	Feldspar	1.4	8.0	0.0
Ankerite	Carbonate	0.3	4.0	0.0
Dolomite	Carbonate	1.5	8.0	0.0
Calcite	Carbonate	0.7	7.0	0.0
Magnesite	Carbonate	0.4	4.0	0.0
Expanding clay	Clay	0.1	2.0	0.0
Chloritoid	Clay	0.1	2.0	0.0
Diaspore	Hydroxide	0.1	2.0	0.0
Alunite	Sulfate	0.3	3.0	0.0
Jarosite	Hydroxide	0.2	1.0	0.0
Anhydrite	Sulfate	0.1	1.0	0.0
Anatase	Oxide	0.1	1.0	0.0
Chalcopyrite	Sulfide	0.1	1.0	0.0

4.2 SULFUR ANALYSES

The total sulfur content of the waste rock was determined by LECO combustion. In addition, the samples were analysed for sulfide (as Chromium Reducible Sulfur) and sulfate (by acid digest). The results of the analyses are summarised in the following sections, with complete results provided in Appendix B.

4.2.1 Total Sulfur

The total sulfur contents were found to be highly variable across the samples, ranging from 0.03% to 26.6% with an average of 3.49%. The total sulfur contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.1. The total sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.2. The results indicate that 90% of the samples would be classified as having a high to extremely high total sulfur content.

Table 4.2: Total Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 -5%	Extremely High >5%
All	-	4%	3%	3%	35%	35%	20%
Andesite Porphyry	-	5%	4%	4%	45%	26%	15%
Breccia	-	-	-	-	14%	43%	43%
Diorite Porphyry	-	-	-	-	25%	58%	17%
Dyke	-	-	-	-	-	33%	67%
Fault Breccia	-	-	-	-	60%	20%	20%
Feldspar Porphyry	-	-	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	-	80%	20%
Porphyry	-	-	-	-	20%	40%	40%
Pyroclastic	-	-	14%	-	14%	71%	-
Tuff	-	-	-	-	-	50%	50%

4.2.1 Acid Soluble Sulfate

The acid soluble sulfate was found to be highly variable across the samples, ranging from 0.01% to 1.59% with an average of 0.36%. The acid soluble sulfate contents showed little correlation to depth, copper grade or lithology, as shown in Figure 4.2. The acid soluble sulfate results have been grouped using an arbitrary scale, with the percentage of samples in each grouping provided in Table 4.3. The results indicate that all samples have between 0.01% and 2% acid soluble sulfate, with the highest proportion of samples having between 0.1% and 0.3% sulfate. This indicates that there is a low proportion of readily soluble sulfate within the deposit.

Table 4.3: Acid Soluble Sulfate by Lithology

Lithology	Extremely Low <0.01%	Very Low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 - 2%	Very High 2 - 5%	Extremely High >5%
All	-	23%	33%	20%	24%	-	-
Andesite Porphyry	-	27%	36%	20%	17%	-	-
Breccia	-	29%	36%	29%	7%	-	-
Diorite Porphyry	-	25%	33%	33%	8%	-	-
Dyke	-	33%	-	-	67%	-	-
Fault Breccia	-	-	40%	20%	40%	-	-
Feldspar Porphyry	-	-	-	100%	-	-	-
Hornblend Porphyry	-	100%	-	-	-	-	-
Hydrothermal Breccia	-	-	-	-	100%	-	-
Porphyry	-	-	-	-	100%	-	-
Pyroclastic	-	-	43%	-	57%	-	-
Tuff	-	-	50%	50%	-	-	-

4.2.1 Sulfide Sulfur

Analysis for chromium reducible sulfur was only conducted on those samples which had a total sulfur content of greater than 0.1%. For samples where the chromium reducible sulfur was measured, this was assumed to represent the total sulfide content. For samples with less than 0.1% total sulfur, the sulfide content was assumed to be equal to:

Sulfide Sulfur (%S) = Total Sulfur (%S) – Acid Soluble Sulfate (%S)

The sulfide sulfur contents were found to be highly variable across the samples, ranging from 0.00% to 18.95% with an average of 2.12%. The sulfide sulfur contents showed a slight degree of correlation with depth, as there were more samples with low or insignificant sulfide sulfur contents shallower in the deposit (i.e. up to around 200 m depth). Below 200 m depth there were no samples with less than 0.25% sulfide sulfur. The sulfide contents also showed some correlation to copper grade, with slightly higher copper contents in samples with greater than 5% sulfide sulfur. The distribution of sulfide sulfur, copper grade and depth is presented in Figure 4.3. Although neither of these relationships was suitably well defined or consistent enough to allow either depth

or copper grade to be used as an indicator of likely sulfide sulfur contents, it does indicate that low grade ore which may be stockpiled on site during operations may have higher sulfide contents than general waste rock.

The sulfide sulfur results have been grouped using an arbitrary scale, with the percentage of samples in each grouping presented in Table 4.4. The results indicate that about 25% of the samples had a sulfide content of less than 0.3% (i.e. in the extremely low to low range), 32% of samples had moderate to high sulfide sulfur and 38% of the samples had very high to extremely high sulfide sulfur.

Table 4.4: Sulfide Sulfur by Lithology

Lithology	Extremely Low <0.01%	Very low 0.01 - 0.1%	Low 0.1 - 0.3%	Moderate 0.3 - 0.5%	High 0.5 – 2%	Very High 2 – 5%	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
Andesite Porphyry	8%	20%	5%	7%	31%	21%	7%
Breccia	-	-	-	-	21%	43%	36%
Diorite Porphyry	-	-	-	17%	17%	50%	17%
Dyke	-	-	-	-	-	67%	33%
Fault Breccia	-	40%	-	-	40%	20%	-
Feldspar Porphyry	-	-	-	-	-	100%	-
Hornblend Porphyry	100%	-	-	-	-	-	-
Hydrothermal Breccia	-	80%	-	-	-	-	20%
Porphyry	-	20%	20%	20%	-	20%	20%
Pyroclastic	-	71%	-	-	14%	14%	-
Tuff	-	-	-	-	-	50%	50%

The sulfide sulfur results have also been summarised by depth, as this may be useful in mine planning. The results of this classification are provided in Table 4.5.

Table 4.5: Sulfide Sulfur by Depth

Depth (m)	Extremely Low <0.01%	Very low 0.01 - 0.1	Low 0.1 - 0.3	Moderate 0.3 - 0.5	High 0.5 - 2	Very High 2 - 5	Extremely High >5%
All	6%	21%	4%	7%	25%	26%	12%
0 to 50	-	68%	-	5%	18%	5%	5%
50 to 100	3%	37%	7%	10%	23%	20%	-
100 to 150	-	14%	3%	3%	31%	37%	11%
150 to 200	-	32%	-	-	26%	26%	16%
200 to 250	-	18%	9%	18%	36%	18%	-
250 to 300	-	-	-	-	-	43%	57%
300 to 350	-	-	9%	9%	18%	36%	27%
350 to 400	-	-	14%	14%	14%	57%	-
400 to 472	-	-	-	13%	38%	13%	38%

4.3 ACID NEUTRALISING CAPACITY AND CARBONATE CONTENT

The acid neutralising capacity (ANC) of the samples was determined along with the carbon content which, based on the geology of the deposit, was assumed to be representative of the carbonate content. The two results can be used as a check against one another and to identify the contribution of ANC from carbonates and other non-carbonate minerals.

The average acid neutralising capacity of all the samples was moderate to high at 15.4 kg H_2SO_4/t, however, there was a high degree of variability within the samples with the ANC varying from -23 to 155 kg H_2SO_4/t. The negative acid neutralising capacity values are a result of more alkali being required to back titrate the sample solutions to the end point of the test compared to the volume of acid which was added during the test. This indicates that there is residual acidity in the samples. This is discussed further in Section 4.4.

The samples with very high to extremely high acid neutralising capacities were located within discreet zones (i.e. borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m) rather than being evenly distributed throughout the deposit. The carbonate contents of these samples were also significantly higher compared to the other samples, indicating that the carbonates were resulting in the high acid neutralising capacities, as would be expected. The XRD analysis shows that the carbonate minerals in the samples with the high acid neutralising capacity are a mix of ankerite, calcite, dolomite and magnesite.

The calcium and magnesium carbonates will provide significant acid neutralising capacity, however, the ankerite will only provide limited neutralising capacity.

The very high to extremely high acid neutralising capacities were not restricted to a single lithology, suggesting broad scale carbonate alteration within discreet zones.

Outside of these high acid neutralising zones, the acid neutralising capacity was generally very low averaging just 2.9 kg H_2SO_4/t, with approximately 20% of the samples having negative acid neutralising capacities.

The distribution of the acid neutralising capacity with depth and the relationship between acid neutralising capacity and carbonate are shown in Figure 4.4. The distribution of acid neutralising capacity with lithology and depth are provided in Tables 4.6 and 4.7 respectively.

Table 4.6: Acid Neutralising Capacity by Lithology

Lithology	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
Andesite Porphyry	23%	14%	41%	3%	5%	13%	1%
Breccia	21%	21%	36%	-	7%	14%	-
Diorite Porphyry	8%	17%	33%	8%	17%	17%	-
Dyke	100%	-	-	-	-	-	-
Fault Breccia	20%	20%	60%	-	-	-	-
Feldspar Porphyry	-	100%	-	-	-	-	-
Hornblend Porphyry	-	-	-	-	-	100%	-
Hydrothermal Breccia	100%	-	-	-	-	-	-
Porphyry	40%	60%	-	-	-	-	-
Pyroclastic	-	29%	57%	14%	-	-	-
Tuff	50%	-	50%	-	-	-	-

Table 4.7: Acid Neutralising Capacity by Depth

Depth (m)	Extremely Low <0.3 H_2SO_4/t	Very low 0.3 - 3 H_2SO_4/t	Low 3 - 10 H_2SO_4/t	Moderate 10 - 15 H_2SO_4/t	High 15 - 60 H_2SO_4/t	Very High 60 - 150 H_2SO_4/t	Extremely High >150 H_2SO_4/t
All	25%	17%	37%	3%	5%	11%	1%
0 to 50	9%	14%	64%	5%	5%	5%	-
50 to 100	20%	20%	33%	-	10%	17%	-
100 to 150	26%	14%	46%	9%	3%	3%	-
150 to 200	16%	16%	32%	-	-	32%	5%
200 to 250	27%	-	27%	-	9%	36%	-
250 to 300	71%	29%	-	-	-	-	-
300 to 350	36%	27%	27%	-	9%	-	-
350 to 400	43%	29%	-	14%	14%	-	-
400 to 472	38%	13%	50%	-	-	-	-

4.4 PASTE pH

The paste pH of the samples was measured at a 1:3 (soil:water) ratio. The pH results ranged from 2.7 to 9.7, with almost a third of samples recording a paste pH of less than 4.5, indicating that a significant proportion of samples contain residual acidity which is readily released when placed in contact with water. In addition, 64 samples recorded a paste pH of between 4.5 and 7, with the remaining 38 samples recording paste pH values greater than 7.

There was no apparent relationship between paste pH and lithology, as shown in Table 4.8. However, reviewing the paste pH results versus sample depths indicates that the vast majority of samples from below 250 m in the deposit recorded paste pH of less than 7, as shown in Table 4.9. The results of the paste pH testing are also provided in Figure 4.5.

Table 4.8: Paste pH by Lithology

Lithology	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
Andesite Porphyry	29%	44%	26%
Breccia	36%	43%	21%
Diorite Porphyry	17%	83%	-
Dyke	100%	-	-
Fault Breccia	40%	40%	20%
Feldspar Porphyry	-	100%	-
Hornblend Porphyry	-	-	100%
Hydrothermal Breccia	20%	80%	-
Porphyry	60%	40%	-
Pyroclastic	29%	29%	43%
Tuff	100%	-	-

Table 4.9: Paste pH by Depth

Depth (m)	Acidic (pH < 4.5)	Weakly Acidic to Neutral (pH 4.5 - 7)	Neutral to Alkaline (pH > 7)
All	32%	43%	25%
0 to 50	18%	55%	27%
50 to 100	27%	33%	40%
100 to 150	40%	43%	17%
150 to 200	37%	26%	37%
200 to 250	27%	27%	45%
250 to 300	71%	29%	0%
300 to 350	55%	36%	9%
350 to 400	0%	86%	14%
400 to 472	13%	88%	0%

4.5 NET ACID GENERATION

The NAG test involves the addition of hydrogen peroxide (15% H_2O_2 at a pH of 4.5) to the samples, which oxidises the contained sulfide minerals to release sulfuric acid, which is then neutralised by any available acid consuming minerals within the sample. The pH of the solution is measured and then titrated back to pH 4.5 and then pH 7.0 to give an indication of the net acid generation potential of the sample. As such, a NAG pH of below 4.5 indicates that excess acidity is produced and a pH of greater than 4.5 indicates that excess alkalinity is present.

The NAG test resulted in 96 samples producing NAG pH values of less than pH 4.5, indicating that these samples produce excess acidity under the extreme oxidising conditions imposed by the NAG test. The remaining 54 samples produced pH values greater than 4.5.

The NAG pH shows a strong correlation with depth, with a much greater number of samples recording NAG pH values above 4.5 in the upper 250 m of deposit. Below 250 m depth, all samples were found to have NAG pH values below 4.5 (with the exception of a single sample), as shown in Figure 4.6.

The NAG test has been demonstrated to accurately assess the acid formation potential for samples with less than 1% sulfide sulfur. However, for samples with greater than 1% sulfide sulfur, it is possible that the volume of hydrogen peroxide added during the test may be insufficient to fully oxidise all the sulfide sulfur, resulting in the acid production potential being underestimated. In addition, if these samples with high sulfide sulfur contents also have high ANC values, the final NAG pH may be neutral to alkaline, which would be misleading. Therefore, given that approximately 50% of the samples had sulfide sulfur contents greater than 1%, this limitation of the NAG test has been considered during interpretation of the acid formation potential, as discussed in Section 4.6.

4.6 ACID FORMATION POTENTIAL

To estimate the Acid Formation Potential (AFP) of the samples, the Maximum Potential Acidity (MPA) was calculated based on the sulfide sulfur results using the following formula:

Maximum Potential Acidity (kg H_2SO_4/t) = Sulfide Sulfur (%) x 30.6

This calculation assumes that all the sulfide sulfur is present as pyrite. The mineralogical analysis of the Letpadaung samples indicates that the most common sulfide mineral is pyrite and, therefore, the MPA values calculated from the sulfide contents of the Letpadaung samples is likely to be reasonably accurate.

The Net Acid Producing Potential (NAPP) was then calculated from the Maximum Potential Acidity (MPA) and the measured Acid Neutralising Capacity (ANC) using the following formula:

Net Acid Producing Potential* = Maximum Potential Acidity* – Acid Neutralising Capacity*
**All units kg H_2SO_4/t*

As discussed in Section 3.3 of this report, Knight Piésold prefers to utilise the results of the Acid Base Accounting in combination with the NAG testing results to classify the acid formation potential of materials. Knight Piésold's classification system (as presented in Table 3.1) is based the Australian Governments Guidelines on Managing Acidic and Metalliferous Drainage (Ref. 14) and is broadly similar to the classification system contained within the AMIRA ARD Test Handbook (Ref. 15), which is advocated by the Global Acid Rock Drainage Guidelines (Ref. 16).

Overall almost a third (30%) of the samples tested were found to be either non-acid forming (25%) or acid consuming (5%), with a further 4% classified as having an uncertain acid formation potential. The remaining 67% of the samples were classified as either Potentially Acid Forming – Low Capacity (9%) or Potentially Acid Forming (58%).

The six samples which were classified as 'uncertain' recorded conflicting acid base accounting results. Five of these samples had low sulfide sulfur contents (0.04% to 0.05%) and very low ANC values (-3 to 3 kg H_2SO_4/t). As such, the samples had marginal NAPP values (-1.8 to 4.2 kg H_2SO_4/t) and NAG pH values around the acid forming cut-off of 4.5. Therefore, these samples should be assumed to be Potentially Acid Forming – Low Capacity.

The other sample which was classified as 'uncertain' produced a NAG pH of 4.8 and a positive NAPP of 16.5 kg H_2SO_4/t. However, review of the acid base accounting results indicates that the sample also had a high sulfide content of 1.26% and a high ANC of 23 kg H_2SO_4/t. Therefore, it is likely that the hydrogen peroxide added in the NAG test was insufficient to oxidise all of the sulfide minerals and, as such, the sample should be considered as potentially acid forming.

Overall 29% of the waste samples can considered as Non Acid Forming with the remaining 71% considered Potentially Acid Forming.

There was no apparent correlation between acid formation potential and lithology, as is shown in Table 4.10 and Figure 4.7.

The distribution of the PAF samples showed a reasonable correlation with depth, with 60% of the samples classified as non-acid forming located within the upper 50 m of the

deposit. The proportion of non-acid forming material decreases with depth and below 250 m, the vast majority of the waste can be considered potentially acid forming. The distribution of acid forming potential by depth is provided in Table 4.11 and Figure 4.8.

Table 4.10: Acid Formation Potential by Lithology

Lithology	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
Andesite Porphyry	5%	29%	3%	7%	55%
Breccia	7%	7%	-	-	86%
Diorite Porphyry	8%	17%	-	-	75%
Dyke	-	-	-	-	100%
Fault Breccia	-	20%	20%	-	60%
Feldspar Porphyry	-	-	-	-	100%
Hornblend Porphyry	-	100%	-	-	-
Hydrothermal Breccia	-	-	40%	40%	20%
Porphyry	-	-	-	60%	40%
Pyroclastic	-	57%	-	14%	29%
Tuff	-	-	-	-	100%

Table 4.11: Acid Formation Potential by Depth

Depth (m)	Acid Consuming	Non Acid Forming	Uncertain	Potentially Acid Forming (Low Capacity)	Potentially Acid Forming
All	5%	25%	4%	9%	58%
0 to 50	0%	59%	5%	14%	23%
50 to 100	7%	33%	10%	17%	33%
100 to 150	0%	17%	3%	3%	77%
150 to 200	16%	21%	0%	0%	63%
200 to 250	18%	27%	9%	0%	45%
250 to 300	0%	0%	0%	0%	100%
300 to 350	0%	0%	0%	18%	82%
350 to 400	0%	14%	0%	14%	71%
400 to 472	0%	0%	0%	13%	88%

In addition to the acid formation potential classification presented above, another measure of the AFP is the ratio between the ANC and the MPA, as samples which have excess ANC over the MPA have an ANC/MPA ratio greater than 1 and those with excess acidity (i.e. PAF) have an ANC/MPA ratio of less than 1.

There is a broad consensus across the industry that samples which have an ANC/MPA ratio of greater than 2 have a high factor of safety against generation of acid, providing that the acid neutralising capacity is available from highly reactive carbonate (i.e. calcite). Where the neutralising capacity is available from other minerals, such as the iron and magnesium rich carbonates present at Letpadaung, then an ANC/MPA ratio of greater than 3 is required to have a high factor of safety.

The ANC/MPA ratios of the samples indicate that approximately 46% of the non-acid forming and acid consuming samples have low factor of safety (ANC/MPA ratio <2), with 19% of the non-acid forming and acid consuming samples having a moderate factor of safety (ANC/MPA ratio 2 to 3) and the remaining 35% of samples having a high factor of safety (ANC/MPA ratio greater than 3).

The samples with a high factor of safety are predominantly those with high ANC (>80 kg H_2SO_4/t) and are generally restricted to the zones within the deposit which have carbonate alteration (borehole LS004 from 50 to 70 m, borehole LS005 from 28 to 50 m, borehole LK0004 from 51 to 81 m and borehole L223 from 150 to 230 m).

For the non-acid forming samples with a low factor of safety, care needs to be taken as there is the potential that the rate of sulfide oxidation may exceed the rate of acid neutralisation available from the neutralising minerals. **Additional testing of the material which has been classified as non-acid forming but has a low ANC/MPA ratio is recommended to confirm that these samples will not generate acid.**

The acid formation potential classifications and associated factors of safety according to the ANC and MPA (calculated from sulfide sulfur) are presented in figures 4.9 and 4.10.

4.7 MULTI-ELEMENT ANALYSIS

Multi-element analysis of the samples was conducted to assess element enrichments. The multi-element analysis results were compared to the average crustal abundance to calculate the geochemical abundance indices. The geochemical abundance index quantifies an assay result for a particular element in terms of average crustal abundance.

The multi-element assay results are presented in Appendix C, with the average crustal abundances (ACA) and corresponding geochemical abundance indices (GAI) presented in Appendix D. The results are also summarised below.

The results of the analyses show that the samples have a high level of elemental enrichment. Fourteen elements were found to be highly enriched in at least one sample, namely sulfur, tellurium, selenium, bismuth, rhenium, arsenic, silver, lead,

copper, indium, antimony, cadmium, molybdenum and zinc. A further four elements were found to be significantly enriched in at least one sample, namely tungsten, tantalum, manganese and mercury, with at least one sample found to be slightly enriched in uranium, tin, caesium, iron, strontium and lithium (all elements listed in decreasing levels of enrichment). However, it should be noted that the laboratory detection limits for tellurium and selenium were equivalent to a significantly enriched classification. Therefore, samples which recorded concentrations of tellurium and selenium below the limits of detection have conservatively been assigned a significantly enriched classification.

There was no apparent correlation between overall enrichment and lithology or depth, however, a weak correlation between total sulfur grades and enrichment was observed, whereby samples with higher total sulfur grades typically recorded higher overall levels of enrichment. In addition, a correlation was observed between acid formation potential and overall enrichments, with PAF and UC samples recording higher levels of enrichment compared to NAF and AC samples.

4.8 DISTILLED WATER EXTACT

Distilled water extract tests were undertaken to assess whether metals are likely to leach from the waste rock at environmentally significant concentrations. A total of 50 samples were analysed for distilled water extract, samples selected such that all key waste lithologies were represented across a range of copper enrichment levels.

The extract results have been compared to reference guidelines for release from mining operations and livestock drinking water. The extract solutions were generally found to be of a poor quality, with only twelve samples (24%) meeting all the water quality guidelines. In addition, the average concentrations (of all samples) for aluminium, cadmium, copper, iron and zinc were found to exceed the water quality criteria. In addition, there were exceedances for cobalt (3 samples), molybdenum (3 samples), nickel (4 samples), sulfate (1 sample) and uranium (1 sample), although the average concentrations of these elements from all samples were within the water quality criteria.

The majority of the extract solutions also recorded pH values below the lower bound acceptance criteria of pH 6. The results of the distilled water extract testing compared to the reference water quality guidelines are presented in Appendix E.

The distilled water extract results have also been compared to the acid forming potential of the samples. Overall, 40% of the AC samples and 70% of the NAF samples met all the water quality criteria, with only 9% of the PAF, PAF-LC and UC

samples meeting all guidelines. This is also reflected in the average concentrations of dissolved metals from each acid forming classification group, as shown in Table 4.12, which indicates that the PAF material is most likely to leach metals at unacceptable concentrations. This is likely partly due to the fact that the pH of the PAF extract solutions typically recorded lower pH values compared to the NAF and AC samples. However, on the basis of these results, **all waste material has the potential to leach metals at environmentally significant concentrations, especially when acidic conditions are imposed.**

Table 4.12: Average Distilled Water Extract Results by AFP

Acid Formation Potential	Al	Cd	Cu	Fe	Mo	Zn	pH*
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	-
AC	1.96	0.00003	0.03	0.46	**0.52**	0.01	8.5
NAF	1.41	0.00011	**2.88**	0.759	0.024	0.08	8.4
PAF	**10.04**	**0.02**	**17.36**	**26.7**	0.001	**2.84**	**3.8**
PAF-LC	0.73	0.006	**0.49**	0.11	0.002	0.31	**3.4**
UC	0.72	0.001	**1.59**	0.10	0.0001	0.24	**5.2**
All Samples	**6.01**	**0.012**	**10.1**	**14.61**	0.06	**1.60**	**4.0**
Water Quality Reference Level	5.0	0.01	0.3	2.0	0.15	0.5	6.0 – 9.0

**Note: pH is based on a logarithmic scale, which has been accounted for when calculating the average pH values. These values are for indicative purposes only.*

5. IMPLICATIONS FOR WASTE ROCK MANAGEMENT

Based on the results of this geochemical assessment, the implications for waste rock management are presented in the following sections.

5.1 ACID GENERATION

The results of the test work indicate that the potential for acid generation at the Letpadaung project is very high to extreme with material at all depths and from all lithologies within the deposit capable of generating acid.

The geochemistry indicates that for the majority of material, i.e. that which has a low acid neutralising capacity, the onset of acid generation is likely to be rapid with limited lag times (although this needs to be confirmed, as detailed in Section 5.3.1). There is also the potential for large quantities of acid to be generated, with the average net acid producing potential of the PAF material calculated at 87 kg H_2SO_4/t. This equates to tens of millions of tonnes of acid which could be potentially be generated by the waste if it is allowed to freely oxidise. It is therefore apparent that allowing the waste to oxidise and lime treating the acid after formation would have an extremely high cost both in terms of the supply of lime and the management and disposal of the neutralisation sludge. For this reason, active management of the mine waste at the project will be required during operations to minimise the likelihood of the waste acidifying, as discussed in Sections 5.3 to 5.5.

5.2 ENRICHMENT AND METAL LEACHING

The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. The PAF material was found to have the highest metal leaching potential, although a portion of the AC and NAF samples were also found to leach certain metals above the reference water quality criteria. Further, the pH of the extract solutions from the AC and NAF remained circum neutral during the test, compared to the PAF solutions which became acidic. Therefore, it is likely that the NAF and AC material would also leach metals, and perhaps to the same extent as the PAF material, should acidic conditions develop within the waste dumps. Therefore, controlling the acid generation from PAF material will be key to managing the metalliferous drainage from the waste dumps at Letpadaung.

5.3 ONGOING WASTE ROCK CHARACTERISATION

Very limited geochemical characterisation of the deposit has been conducted, especially considering the scale of the project and the high risk profile of high sulfur porphyry systems. As such, additional geochemical work will be required pre-mining

and throughout the life of the project. The scale of the work which will be required will be large and will probably warrant establishing an onsite geochemical laboratory to handle the large number of samples and to ensure a rapid turnaround of results.

5.3.1 Pre-Mining Geochemical Characterisation

The results of this test work give an indication of the extent and severity of the likely acid generation of the material contained within the Letpadaung deposit and provides an indication of the drainage water chemistry from the material when it is mined. The results, however, do not provide information on the likely lag time to acidification or the drainage chemistry which is likely to result after oxidation and acidification of the waste. These factors need to be established prior to bulk mining to allow a detailed mine waste management plan to be produced, which will need to be appropriately tailored to the material at Letpadaung.

As such, it is recommended that an additional testing programme be conducted prior to bulk mining at the project. This test work should comprise additional acid base accounting of the material to be mined in the first year(s) of operations to establish more accurate estimates of the proportion of the PAF / NAF material which will generated in these early stages and allow for design and planning of the initial waste dumps.

The scope of this investigation would likely be similar to that presented herewith. However, as this geochemical assessment has shown a good correlation between the NAG test and the other acid base accounting analysis, it may be possible to limit the testing of the majority of the samples to NAG testing only, with detailed geochemistry only conducted on a limited number of samples. **It is therefore recommended that:**

- **Several hundred samples are collected from the waste zones to be mined in Years 1 and 2 of operations.**
- **All samples are submitted for NAG testing, and approximately 20% of the samples have full acid base accounting test work.**

This investigation is critical to defining operational controls for the project and verifying the proposed operational testing procedures and classification criteria.

In addition to this testing, **kinetic testing is required to establish sulfide oxidation rates, the availability of acid neutralising capacity, the lag times to acidification and the drainage water chemistry for a range of materials.** These tests involve accelerated leaching of material by optimising the conditions for acid formation through repeated wetting and drying cycles and free availability of oxygen. The tests should be conducted on materials from all acid formation potential classifications, i.e. acid

consuming, non-acid forming, uncertain and potentially acid forming. Further, it is recommended that around 20 samples are prepared for kinetic testing, with the selected samples biased towards material which will be mined over the next 2 to 5 years.

5.3.2 Operational Geochemical Classification

To allow for active management of potentially acid generating material during operations, there will be a requirement to conduct geochemical testing throughout the life of the project. The scale of the project and the mining rate (~30 Mtpa of waste) is such that a dedicated on site laboratory will be required to manage this test work. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

Test work will be required on grade control samples or blast hole samples ahead of mining to allow waste blocks to be classified and allow potentially acid generating material to be identified for selective handling. Based on the geochemistry of the Letpadaung deposit, conventional operational testing using total sulfur grades and acid neutralising capacity to determine the acid formation potential of the material will not be appropriate, as the alunite and natroalunite will lead to the incorrect classification of a significant proportion of the waste. The alternate tests which are available to the project are chromium reducible sulfur with acid neutralising capacity or the net acid generation test (NAG) test.

A chromium reducible sulfur and acid neutralising capacity testing programme would be slow to conduct and expensive. Therefore, it is considered unsuitable for such a large scale operation, and the NAG test is recommended for ongoing classification of the acid formation potential of the material.

The NAG test should be conducted on bench height composite samples sourced from closely spaced grade control or blast hole chips (i.e. no more than 15m for each mining bench). The NAG test produces three results when conducted in its entirety; the NAG pH, $NAG_{4.5}$ and $NAG_{7.0}$.

The NAG pH provides a quick reference of the likely acid formation potential of the samples but is hard to model in conventional mining planning software as it is a logarithmic scale. Therefore, the NAG pH is not considered suitable for short term mine planning.

The $NAG_{7.0}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 7.0. For many mining operations, this measure is used to determine the acid formation potential of the waste and can be readily modelled.

However, at Letpadaung the waste has an inherently low in situ pH (generally below pH 7.0) and the use of the $NAG_{7.0}$ results would cause almost all material to be classified as potentially acid forming, which would be overly conservative.

It is therefore recommended that the $NAG_{4.5}$ is used to classify the acid formation potential of the waste material at Letpadaung. The $NAG_{4.5}$ result is a measure of the amount of alkalinity required to bring the pH of the NAG solution up to pH 4.5 and the result is expressed in kg H_2SO_4/t which, being a non-logarithmic scale, can be modelled in mine planning software.

Given that the distilled water extract testing has indicated that the vast majority of the waste contains leachable metals, there unlikely to be any benefit of conducting additional testing to characterise the leaching potential of the waste, as significant testing would be required to likely identify only a small proportion of suitable NAF waste rock which could be placed on the outer faces of the waste dumps, where it would be subject to rainfall percolation and will higher leachate rates. Instead, it is recommended that all waste be considered leachable and managed appropriately. This is discussed further in Sections 5.5.4 and 5.5.5.

5.4 RATIONAL FOR ACTIVE WASTE MANAGEMENT

The issue of acid rock drainage has been recognised as a significant issue since the 1970's. Initially, management of acid rock drainage focused on treatment of effluent to reduce the downstream environmental impacts. However, it was soon established that the costs associated with long term treatment (lasting decades or longer) was a significant burden and, in some cases, the cost of treatment exceeded the initial profits generated by the mining activities. In the 1990's, research and development started to focus on the reduction of acid rock drainage from mine waste through the application of cover systems post mining. This approach, however, has proven to only be partially effective and in some cases has added little overall benefit, as covers installed post mining do not prevent the oxidation products (which have been generated during mining operations) from continuing to the be released post closure.

A schematic of the generation of oxidation products over time and measurement of acid load in a system where capping was conducted at the end of operations is provided in Figure 5.1. It shows that installation of the cover system had little impact on the acid load and, in fact, the highest acid loads requiring treatment occurred after capping the waste.

Current research into the generation of acid rock drainage has found that the most effective method of control is to minimise the oxidation of waste both during operations

and on closure to prevent a build-up of oxidation products which would otherwise require treatment during operations and post closure. To achieve this aim, an understanding of the mechanisms of oxidation in waste dumps is required.

The oxidation of sulfide minerals requires the presence of both oxygen and water. The amount of water required to allow the sulfide minerals to oxidise is small, and there is generally enough moisture either naturally contained in the waste rock or from atmospheric humidity that the supply of water is not a limiting factor in the initial oxidation of sulfide minerals. There are some exceptions to this, such as hyper arid regions (e.g. the Atacama Desert) but for Letpadaung it is considered that supply of water will not be a limiting factor for initiating sulfide oxidation.

In a geological setting where acid generating material is located above the water table, the rates of oxygen flux into the material is normally sufficiently slow to limit the rate of oxidation to a level where the acid generated can be naturally buffered. However, when sulfidic material is disturbed through mining operations, the amount of oxygen available for sulfide oxidation increases, allowing higher rates of sulfide oxidation to occur. When the rate of sulfide oxidation exceeds the rate at which the naturally occurring neutralising capacity can buffer the acidity, the material acidifies leading to acid rock drainage.

There are two primary mechanisms for sulfide oxidation; the first, which is discussed above, involves atmospheric oxygen and water (equation 5.1). This reaction generally prevails in circum-neutral pH conditions and is a relatively slow reaction. However, as the pH of the material drops through sulfide oxidation, the iron in the system is oxidised to ferric iron (equation 5.2) and this ferric iron then starts to act as the oxidising agent for the sulfide minerals (equation 5.3). This ferric iron reaction is orders of magnitude faster and results in a rapidly increasing rate of sulfide oxidation and consequent acid generation.

$$FeS_2 + 7/2O_2 + H_2O \longrightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+ \quad (5.1)$$

$$Fe^{2+} + 1/4O_2 + H^+ \longrightarrow Fe^{3+} + 1/2H_2O \quad (5.2)$$

$$FeS_2 + 14Fe^{3+} + 8H_2O \longrightarrow 15Fe^{2+} + 2SO_4^{2-} + 16H^+ \quad (5.3)$$

Waste rock in a conventional waste dump design is dumped from a tip head which may vary in height from 10 m to over 100 m. The action of dumping the waste from a high tip head acts to segregate the waste with the coarser material rilling to base of the tip head and the finer material being retained at the top of the dump. This forms a coarse rubble zone at the base of the tip head and alternating sloping layers of finer and coarse waste through the dump.

The coarse rubble zone and coarse sloping layers allows oxygen to freely flow into and penetrate deep into the waste dump which leads to the initiation of sulfide oxidation within the coarse layers and within the adjacent finer grained material. This initial sulfide oxidation generates heat (as reactions 5.1 & 5.3 are exothermic) which then causes the warm, oxygen depleted air to rise through the sloping layer and vent at the top of the waste dump. This in turn pulls in fresh air through the basal rubble zone supplying oxygen into the system at a faster rate than natural diffusion would allow. As oxidation progresses and the pH drops, the rate of sulfide oxidation increases generating more heat and allowing more oxygen to be pulled into the dump which initiates further sulfide oxidation. This mechanism is shown schematically in Figure 5.2, along with a section through an end tipped waste dump showing the preferred oxidation within the coarse sloping zones. Elimination of this advective system will reduce the rate at which sulfide oxidation occurs and will, therefore, limit the amount of oxidation products in the dump prior to final capping and closure. This is key to the effective management of acid rock drainage in waste dumps.

5.5 MANAGEMENT OF POTENTIALLY ACID GENERATING WASTE

5.5.1 Waste Zone Identification

As discussed in Section 5.3.2, testing will need to be conducted on grade control or blast hole samples to define the acid formation potential of the waste ahead of mining. The results of the testing will be used by the mine planner to define PAF and NAF waste zones. The waste zones will then be marked out in the field by the survey team to identify those waste blocks which are PAF and those which are NAF. This is commonly achieved through coloured tape and pegs defining the boundaries of the different material types. A common convention is to use green tape to indicate NAF waste, red tape to indicate PAF waste and white tape to indicate ore.

5.5.2 Selective Handing

Material will need to be selectively handled to allow separation of PAF and NAF waste so that the waste can be placed into the correct areas of the waste dump. This can be achieved through a simple method of signage in the excavators and trucks. The conventional method is for a coloured sign to be displayed on the excavators and shovels to indicate the type of material being excavated (red for PAF waste / green for NAF waste and white for ore). As the truck is being loaded it should also change the sign displayed on the dashboard of the truck to match that of the excavator and then haul the material to the designated areas for correct disposal of the type of waste or stockpiling/crushing of ore. This system allows spotters and supervisor within the pit

and the waste dump area to visually check that the material is being correctly loaded and dumped in the designated areas.

5.5.3 Waste Placement Methods for PAF Material

The reduction of oxidation rates within the dump is critical to reducing the rate of acid generation and the potential long term water treatment liabilities. As such, it is essential that the waste placement method used for the PAF material reduces the potential for preferential oxygen flow paths.

This should be achieved through the placement of waste in lifts of no greater than 3 m to 5m in height to reduce the segregation of material into coarse and fine fractions. The trucks should be routed over the entire surface of the dump to provide compaction to the waste which will reduce the voids ratio and hence the amount of contained oxygen. Compaction trials on 3 m lifts have shown that trucks of 100 tonnes or greater can produce effective compaction down to the base of lifts at these heights.

PAF waste should not be placed directly onto the natural ground as this interface is typically a preferred flow path for water, and water flowing through the waste will transport oxidation products rapidly out of the dump. Therefore, PAF waste should not be placed within 3 m of the base of the waste dump, with a layer of benign (i.e. non leachable) NAF waste placed prior to PAF placement.

5.5.4 NAF Waste Placement

Based on the acid formation potential estimates for the deposit, approximately 30% of the waste (or 300 Mt) is likely to be non-acid forming. There are no specific controls relating to the placement of NAF waste in respect to acid generation, however, as the majority of NAF waste is expected to be leachable, the material will need to be encapsulated. This is discussed in Section 5.5.5 below.

5.5.5 Encapsulation of Waste

All waste rock will require encapsulation to further reduce the rate at which oxygen can enter the dump and to reduce the amount of meteoric water flowing through the waste.

The rate of oxygen transport through soils is directly dependant on the grain size and degree of saturation of the material. Materials with a high degree of saturation have a high water content in the void spaces. Oxygen diffuses through water 10,000 times slower than it diffuses through air, so the presence of water in the void spaces effectively reduces the potential for oxygen to pass through the encapsulation material. As shown in Figure 5.3, material placed with a degree of saturation of 90% reduces the rate of oxygen diffusion by approximately 3 orders of magnitude compared to material placed dry.

As such, the encapsulation material used should be a fine grained material (silt or clay) which should be heavily moisture conditioned and compacted. Suitable borrow sources for encapsulation material will need to be defined and the geotechnical properties of these material determined. Based on the scale of the Letpadaung project, the borrow requirements are significant and work on defining these sources is required prior to bulk mining commencing.

The encapsulation material will need to be constructed with a high moisture content and consequently a high degree of saturation. However, it is critical that the material is not allowed to desiccate, as this will reduce the degree of saturation and can also lead to desiccation cracking, resulting in pathways for the oxygen to enter the dump. Therefore, the encapsulation material should be covered with benign (i.e. non-acid generating, non-enriched and non-leachable) waste to form a store and release cover. A store and release cover acts to absorb water during higher rainfall periods (i.e. the wet season at Letpadaung) and then slowly releases the moisture over the extended dry periods, preventing desiccation of the encapsulation material and protecting it from erosion.

Detailed geotechnical and water flux testing of the proposed encapsulation and cover materials is required, together with modelling of the climatic conditions, to allow detailed encapsulation and cover design. However, based on projects in similar climates, it is estimated that the encapsulation materials will require a true width of approximately 2 m, and the cover materials will require a thickness of approximately 1.5 to 2.0 m.

Depending on the results of the kinetic testing which has been recommended for the project, there may be a requirement for interim covers to be installed prior to the waste dump achieving its final profile. These covers are intended to limit oxygen and meteoric water ingress into the dump prior to installation of the final cover system. Based on a visual assessment of the waste during the site visit conducted by KP, the waste rock itself does not appear to be suitable for this purpose and additional borrow material will be required.

5.5.6 Geotechnical Monitoring of Encapsulation

Significant resources will need to be assigned to the encapsulation of the PAF waste at the project and, as such, a geotechnical monitoring program will be required to ensure that the material is being placed to the design specification. This will require geotechnical testing of the material during placement to ensure that the material has an appropriate grain size and that it has been compacted to a suitable density. Also, most importantly, the geotechnical testing is required to ensure that the material has been

placed at an appropriate moisture content. The following testing will be required on the waste encapsulation material:

- Particle size analysis
- Atterberg Limits
- Laboratory proctor compaction
- Field density and moisture content
- Particle SG

Based on the scale of the operation and the requirement to encapsulate such a large quantity of material, it is recommended that an on-site geotechnical laboratory be established. This laboratory could be established and operated by the mining company or subcontracted to a specialist laboratory company.

5.5.7 Geochemical Monitoring of Encapsulation

It is recommended that geochemical monitoring of the encapsulation system is installed to allow the effectiveness of the system to be measured and assessed throughout operations, allowing for design modifications if required. The geochemical monitoring system will determine the rate of oxygen reduction in the dumps and measure the temperature of the system to determine whether sulfide oxidation is occurring.

The geochemical monitoring system will comprise of air sampling points and thermistor strings installed within the dump during construction. The air sampling points simply comprise of flexible tubing laid into a trench cut into the top surface of the dump and backfilled with sand. Multiple tubes are installed in an array extending to various depths into the dump (nominally 1, 2, 5, 10, 15 and 20 m through the encapsulation layer) with the end point of each tube separated by a small bentonite grout plug poured into the trench. Air is sampled using a portable oxygen sampler to determine the effectiveness of excluding oxygen from the waste. If the encapsulation is fully effective, the process of sulfide oxidation in the dump consumes all the oxygen and the oxygen concentration reduces to zero.

The thermistor strings comprise temperature monitoring probes attached to a cable which can be placed in the waste to measure the temperature at various depths into the dump.

5.5.8 Water Management

Runoff from the PAF waste zones is likely to be slightly to highly acidic and runoff from both the NAF and PAF zones will likely contain elevated concentrations of dissolved metals. Therefore, measures will need to be designed and implemented to capture and store this water. Surface water drains will need to be installed around the periphery

of all active waste dumps to divert clean water around the dumps and also intersect runoff from the dumps. This water can then be directed to the water storage facility. The water storage facility will need to be designed with seepage control measures if the natural in-situ materials are found to be of too high permeability to contain the water without leading to excessive seepage.

The base of the dumps will also need to be tested to determine the in-situ permeability and, if required, the base will need to be engineered to reduce the permeability prior to waste placement. Internal drainage will also need to be installed at the upstream toe of the encapsulation zone to collect internal drainage water and direct this to the water storage facility. These internal drains will have to allow water to flow out of the system, but will need to be engineered to prevent oxygen from entering the drainage system. This can be achieved through the inclusion of U-bends in the water pipes to act as a seal.

5.6 IMPLICATIONS FOR CLOSURE

5.6.1 Waste Dumps

Provided that the waste dumps are managed appropriately during operations, the procedures required for closure should be relatively straightforward to implement. The final surface of the waste will need to be compacted, encapsulated and the store and release cover system constructed, as outlined in Section 5.5.5. A growth medium should then be placed over the cover system and seeded to promoted revegetation. The majority of these work should have been conducted during operations.

Ongoing monitoring of the oxygen concentrations and temperatures within the PAF zones will be required post closure to assess to effectiveness of the encapsulation and determine whether sulfide oxidation is occurring. In addition, the runoff and seepage water will need to be collected and tested to determine whether it is suitable for release. If the water is not of an appropriate quality, it will either need to be treated prior to release or contained. It may be possible to direct seepage waters to the open pits on closure, however, this is discussed further in Section 5.6.2 below.

5.6.2 Pits

A detailed geochemical assessment will be required to determine the final void water quality post closure. This involves hydrological and hydrogeological studies to determine the pit filling water balance and storage volumes when steady state conditions are reached. This pit water balance model is then used in the geochemical modelling, whereby element concentrations are applied to the pit inflows (groundwater, surface water, pit wall run-off and direct precipitation on the pit lake), outflows (evaporation and possibly groundwater or over-topping) and wall rock to simulate

reaction processes within the pit lake, such as water-rock interaction, fluid mixing, dissolution, precipitation, association and sorption. Appropriate mitigation controls will be required if the pit lake water quality is predicted to be poor, and the water balance model indicates that outflows to off-site groundwater or surface water resources will likely occur.

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the geochemical characterisation of the waste rock from the Letpadaung project, the following conclusions can be made:

- Knight Piésold selected 150 waste rock samples from 13 boreholes located within the pit extents. Samples were collected from all logged lithologies within these boreholes and from depths ranging from 5 m to 472 m, which is similar to the planned maximum depth of the pit.
- The samples were sent to Genalysis Intertek in Perth who conducted the testing according to the schedule provided by Knight Piésold. The test work conducted was based on internationally accepted methods.
- The waste rock samples were primary composed of quartz, clay minerals (including illite, smectite, kaolin and chlorite) and alunite and natroalunite, with a relatively high amorphous content. The main sulfide mineral in the waste samples was pyrite with trace chalcopyrite. Carbonate was present in the samples, most commonly as siderite, but some calcium and magnesium carbonates were also present in discreet areas.
- The total sulfur contents of the samples was high to extremely high, however, this was in part a reflection of the high alunite and natroalunite contents.
- The sulfide sulfur contents of the samples ranged from extremely low to extremely high, however, the average sulfide content for all samples was 2.1% which is considered very high. There were more samples with extremely low sulfide sulfur in the upper 200 m of the deposit. Below around 250 m depth all samples had sulfur contents greater than 0.1%, with most samples below this depth having high to extremely high sulfide sulfur contents.
- The acid neutralising capacity of the samples was highly variable with a small number of samples from discreet zones in the deposit having high ANC values, correlating with increased carbonate contents. Outside of these carbonate rich zones, the ANC of the deposit was very low averaging less than 3 kg H_2SO_4/tonne.
- The Net Acid Generation test resulted in 96 samples producing acidic conditions, with the number of samples producing acid increasing with depth.
- Overall, 29% of the waste samples can considered as Non-Acid Forming, with the remaining 71% considered Potentially Acid Forming. According to each sampling and testing result about ARD in blasting area in future mining operation, MWMCL will identify ARD content in whole waste rock.

- The multi-element analysis indicated the majority of the waste rock to be highly enriched, and the distilled water extract testing indicated that some of these metals are readily soluble, especially under acidic conditions. Therefore, controlling the acid generation will be key to managing the metalliferous drainage from both the PAF and NAF material.
- Based on the results of the testing, active management of the potentially acid generating materials will be required, with the recommended methods discussed in the following recommendations.

Based on the results of the geochemical testing, the following recommendations can be made:

- It is recommended that additional geochemical assessment be conducted prior to bulk mining to better quantify the amount of potentially acid generating material which will be encountered during the first year(s) of operations to allow detailed waste management planning.
- It is recommended that kinetic testing of approximately 20 waste rock samples commences prior to bulk of each flitch to assess the sulfide oxidation rates and lag times to acidification of the PAF waste, to confirm the classification of the NAF waste, to better understand the behaviour of uncertain material and to develop an understanding of the likely drainage chemistry.
- It is recommended that an onsite geochemical laboratory be established to conduct routine geochemical testing during operations.
- It is recommended that grade control or blast hole bench height composite samples are tested at a spacing of no more than 15 m. It is further recommended that the NAG test is used to classify the acid formation potential of the material ahead of mining.
- It is recommended that mining practices are established which allow definition of the PAF and NAF waste in the field and allow for selective mining and placement of the material.
- It is recommended that all PAF waste is placed in lifts of no greater than 3 m to 5m in height to eliminate segregation of the waste which could lead to accelerated acid generation.
- It is recommended that all waste be encapsulated during operations with an engineered cover comprising fine grained soil material compacted with a high moisture content to reduce diffusion of oxygen through the cover system. The encapsulation material will need to be covered by benign waste or borrow

material (i.e. non-acid generating, non-leachable and non-enriched) to prevent desiccation of the cover.

- It is recommended that borrow areas for the encapsulation material be identified and samples of the proposed cover material be collected for geotechnical testing to allow detailed design of the cover system.
- It is recommended that geotechnical testing be conducted during construction of the cover system to ensure that the cover system is constructed to the design specification.
- It is recommended that geochemical monitoring of the cover system, comprising oxygen sampling points and thermistors, be conducted to allow the performance of the cover system to be verified during operations.
- It is recommended that a water management system be designed and constructed to prevent clean water from entering the waste dump area and to collect potentially contaminated water and direct this to a suitably designed water storage facility.
- Ongoing monitoring of the waste dump, encapsulation layer, cover system and drainage water will be required post closure.
- Should the drainage waters be found to be of an unacceptable quality, they will either need to be treated prior to release or contained.
- It may be possible to direct seepage waters to the open pits on closure, however, this would require detailed hydrological, hydrogeological and geochemical modelling to determine whether off-site downstream groundwater or surface water resources would be impacted.

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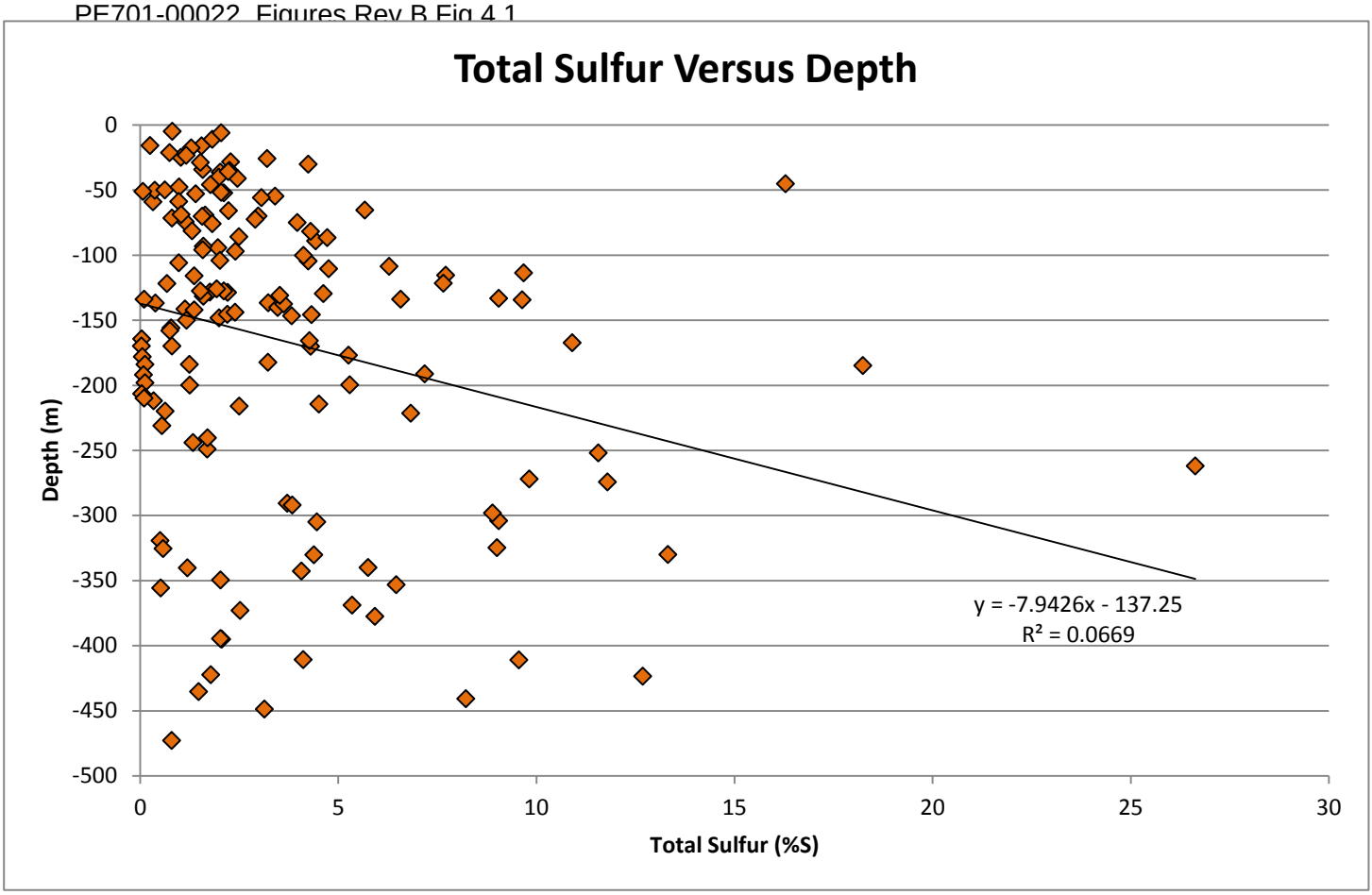
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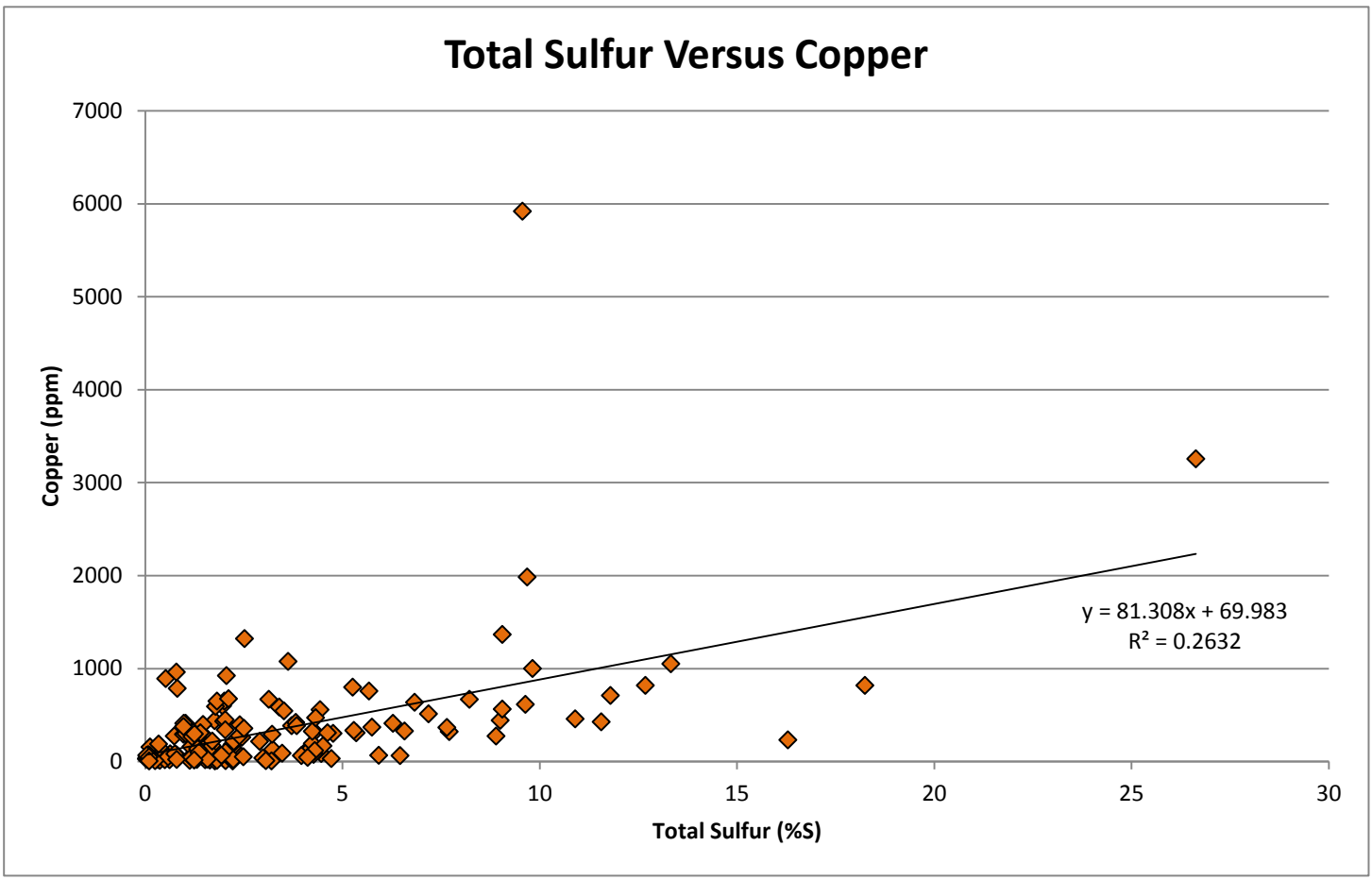
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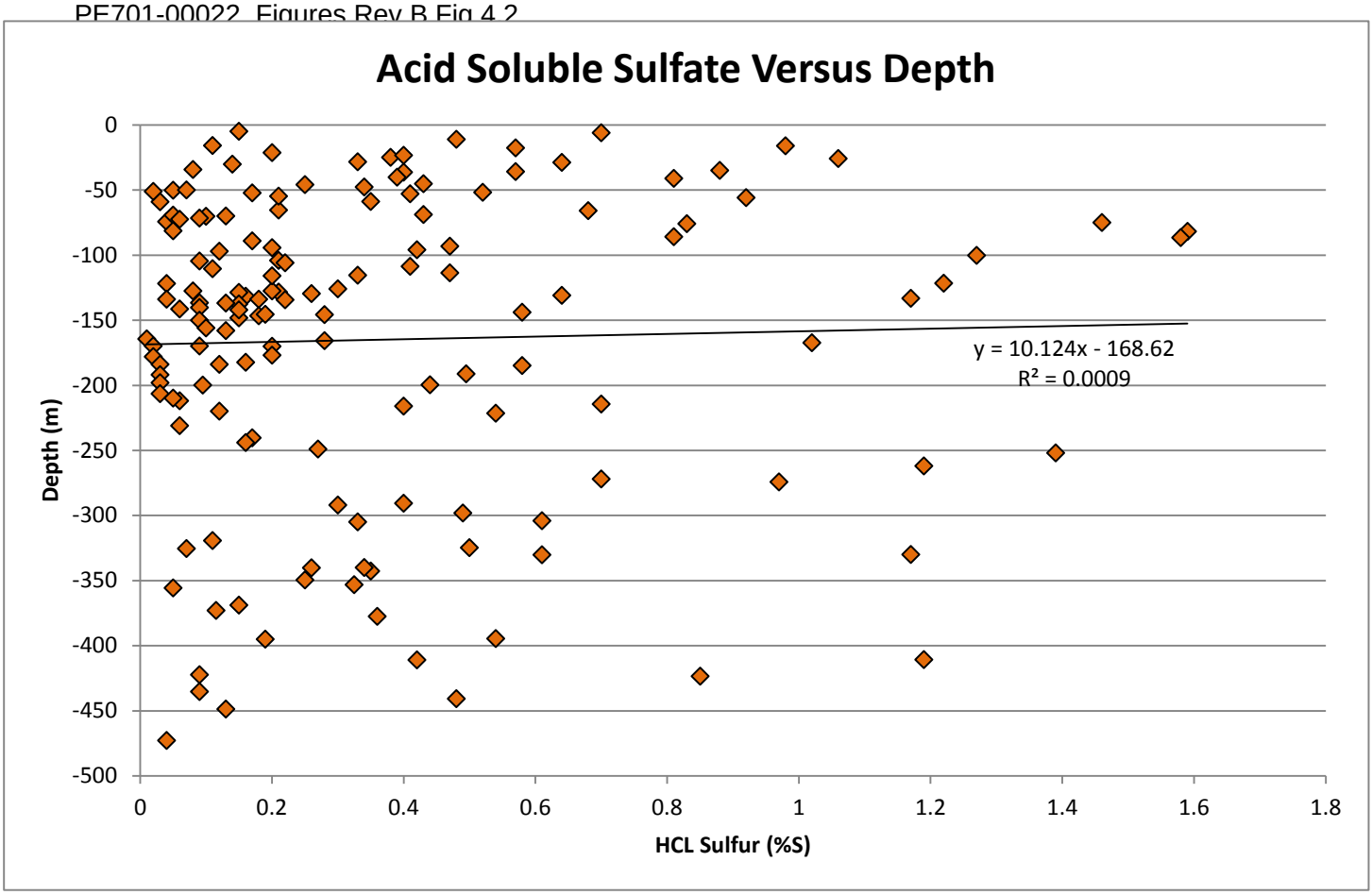
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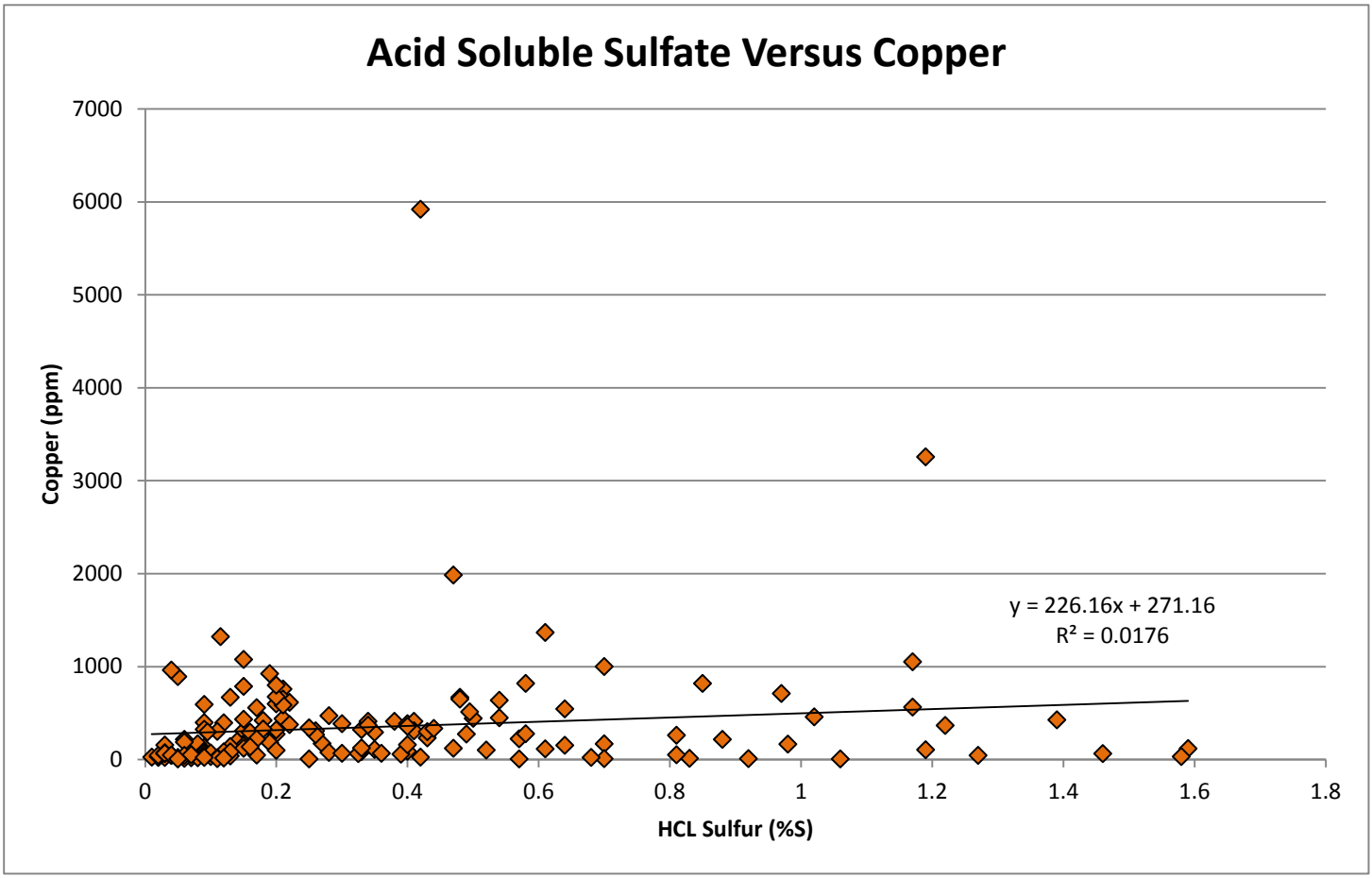
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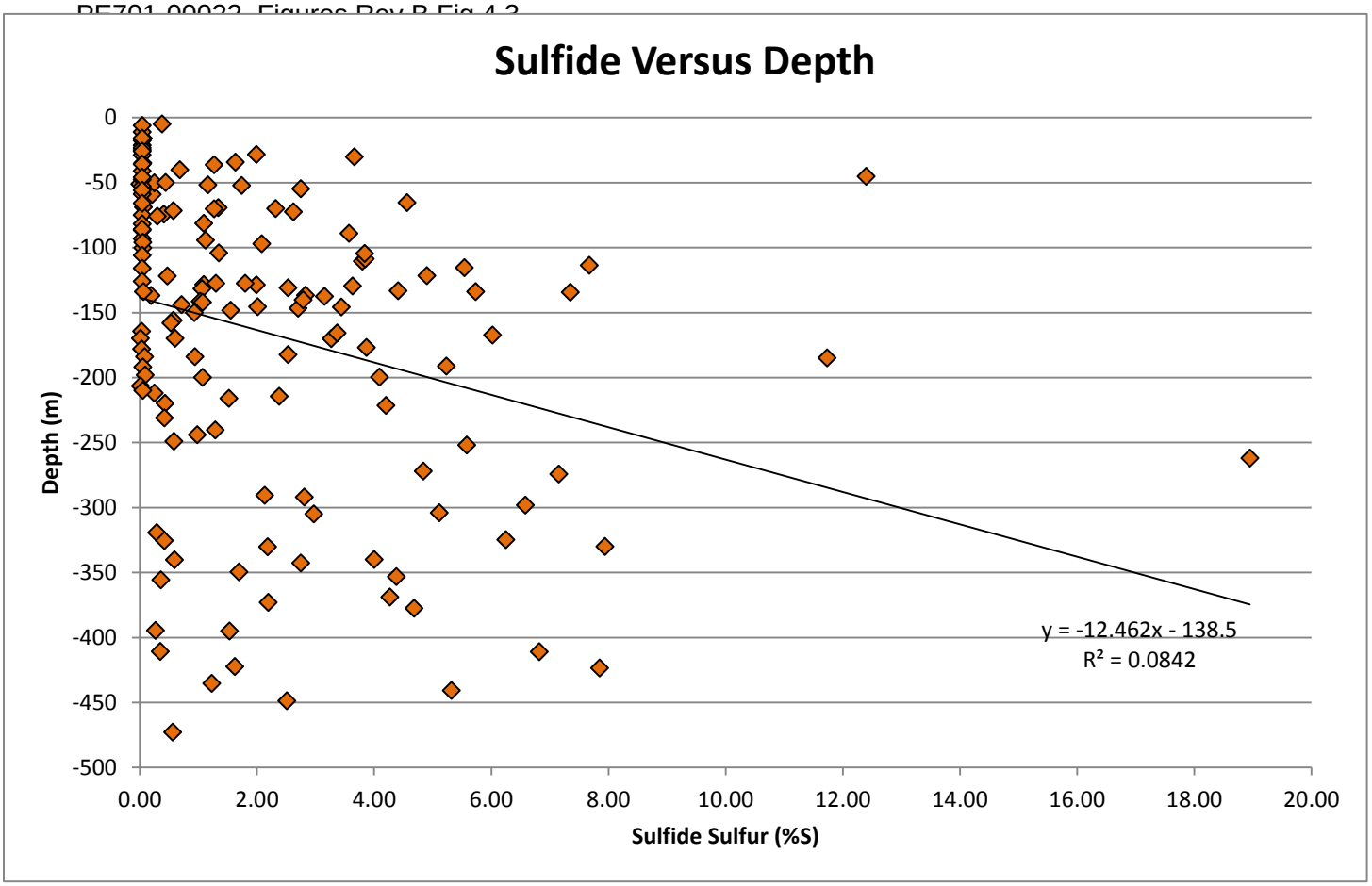
FIGURES

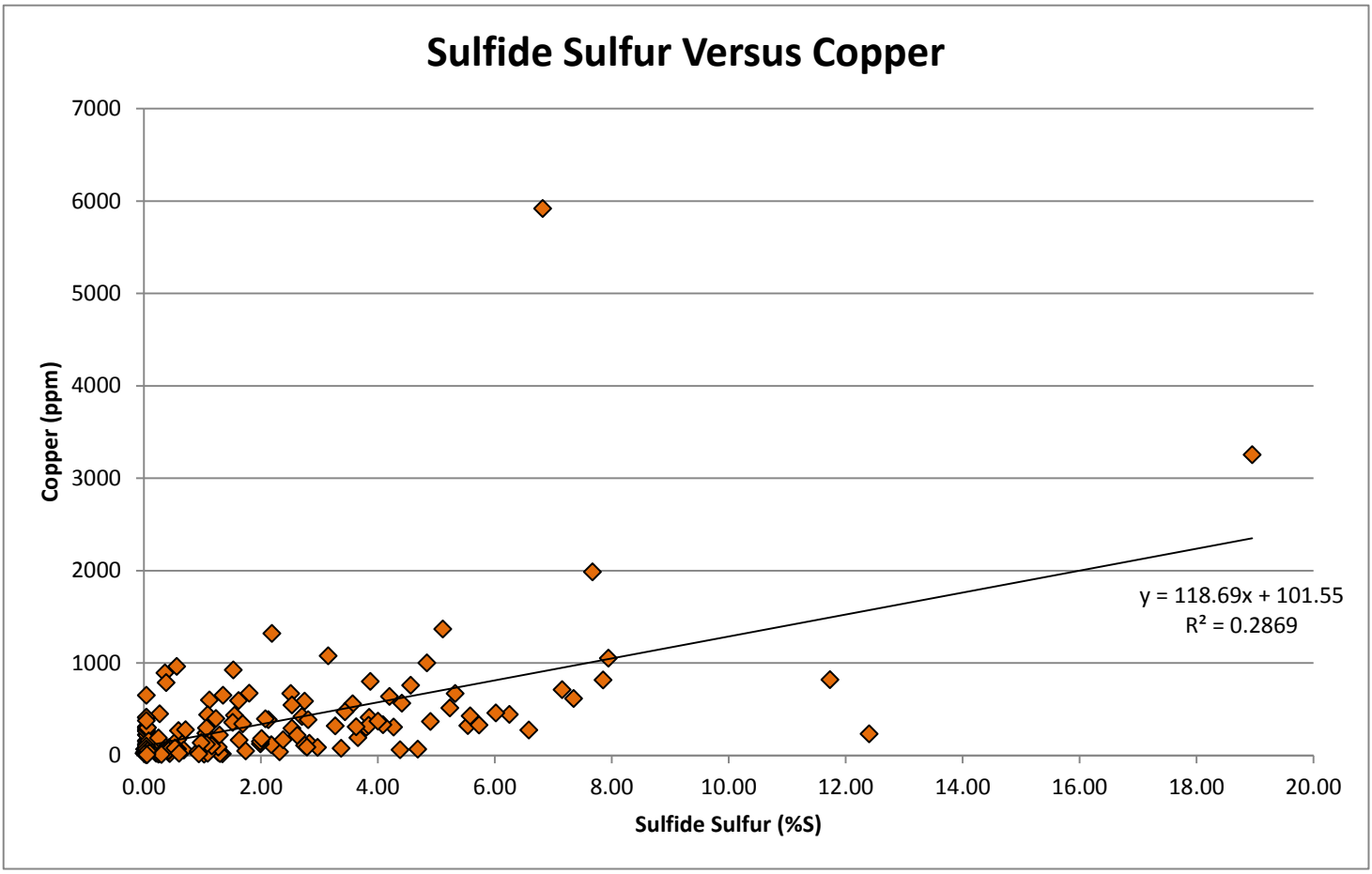

Total Sulfur Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
5
10
15
20
25
30
Total Sulfur (%S)
y = -7.9426x - 137.25
R² = 0.0669

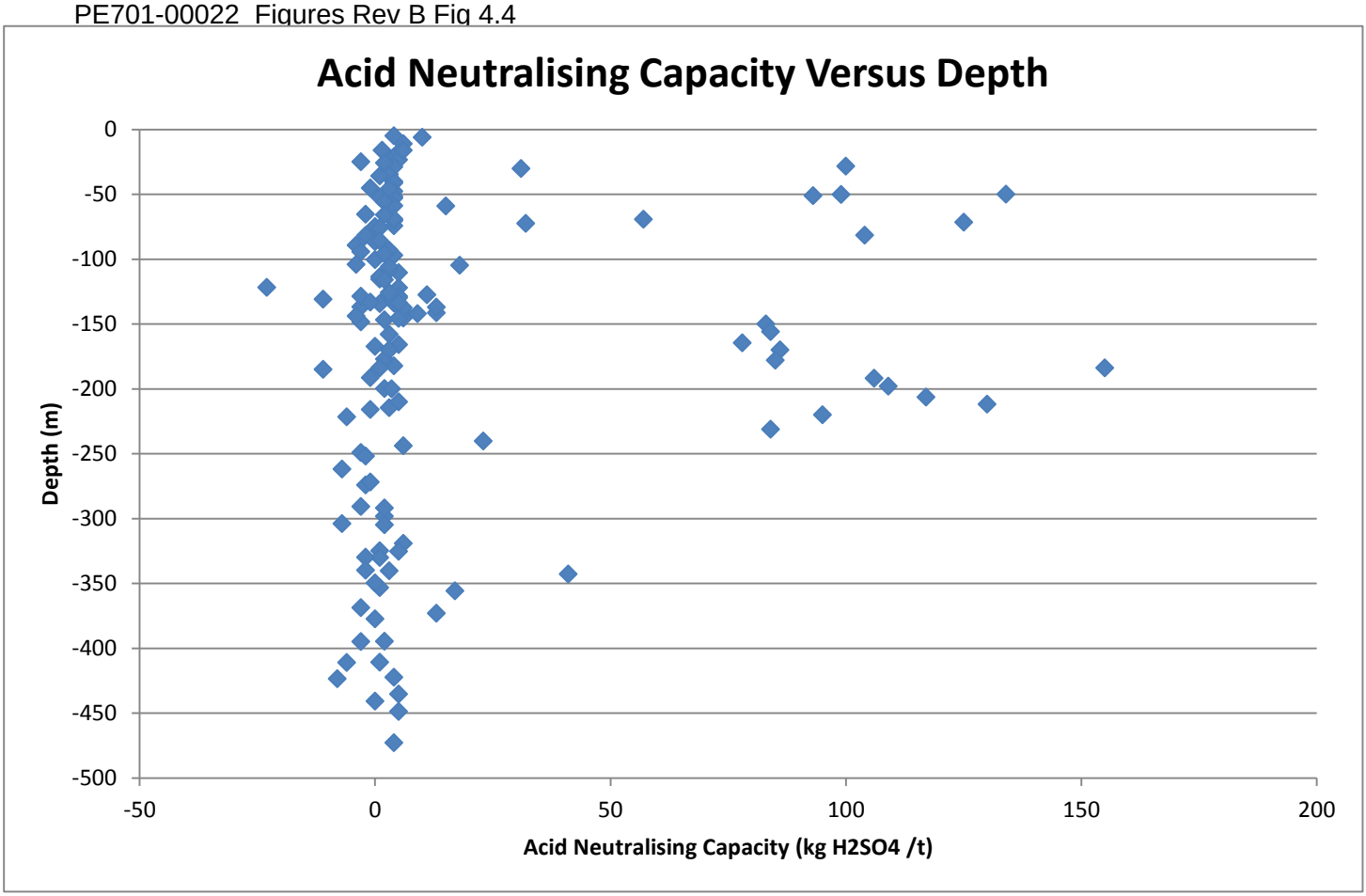

Total Sulfur Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
Total Sulfur (%S)
y = 81.308x + 69.983
R² = 0.2632

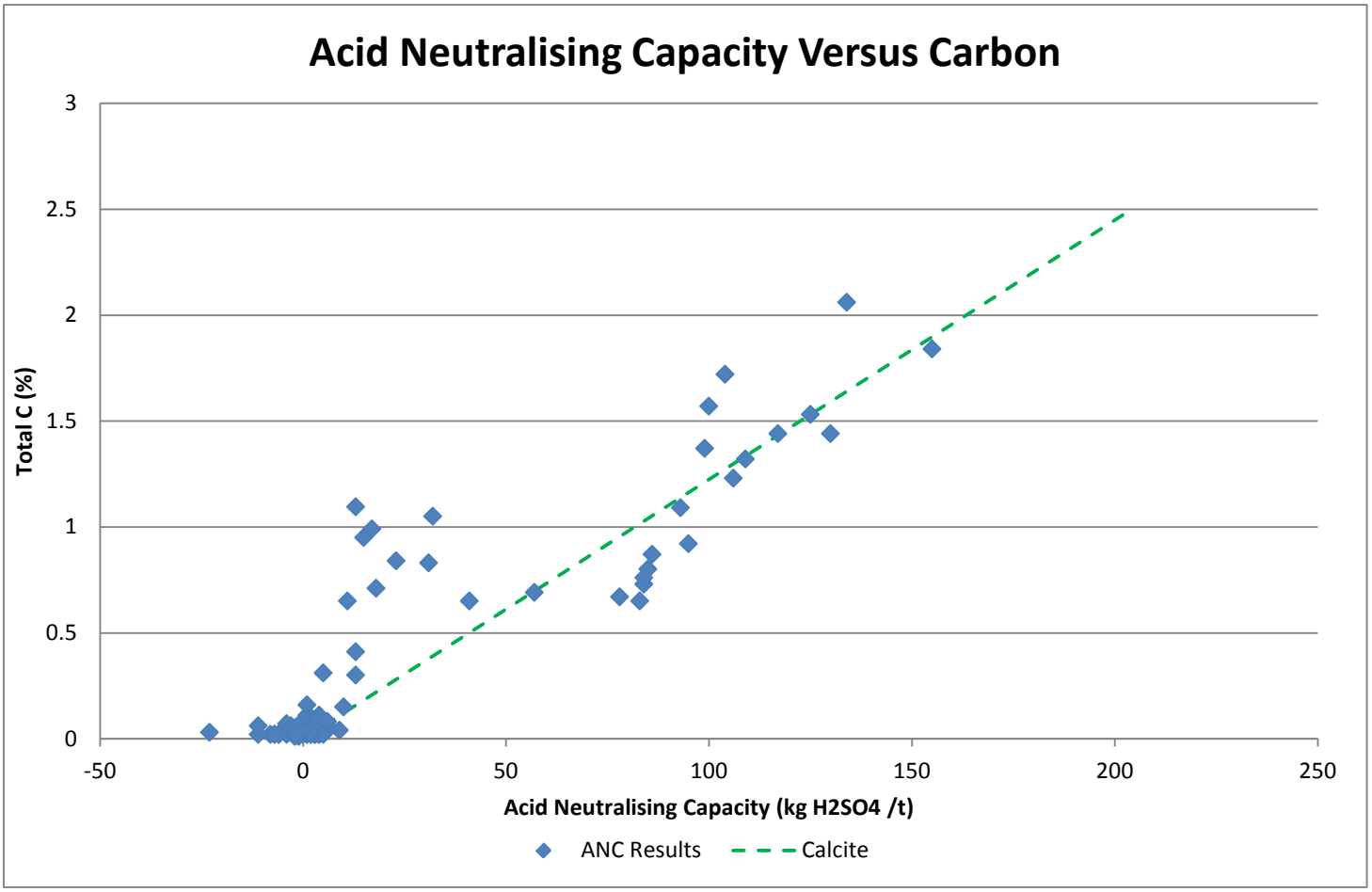

Acid Soluble Sulfate Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
HCL Sulfur (%S)
y = 10.124x - 168.62
R² = 0.0009

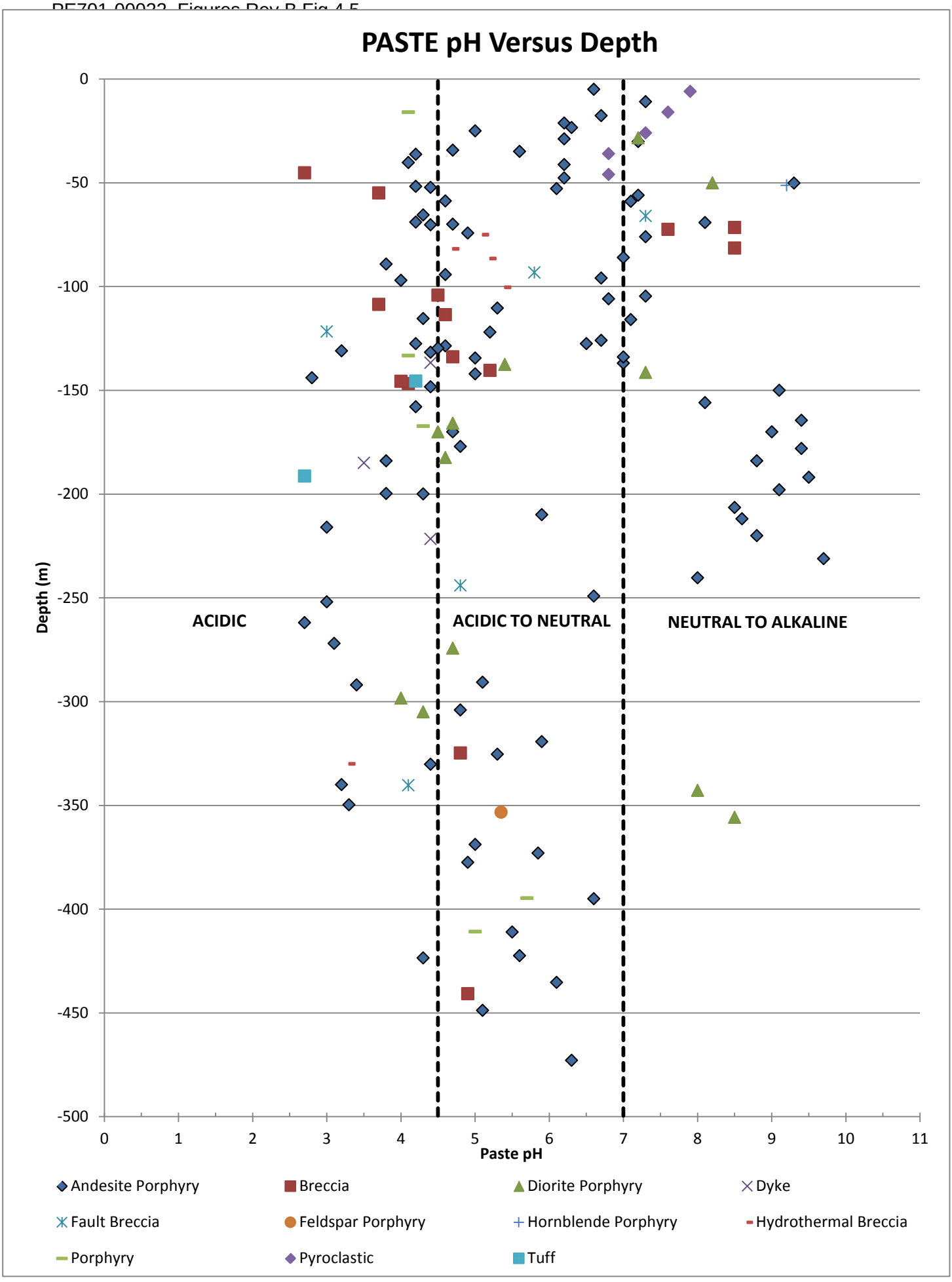

Acid Soluble Sulfate Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
HCL Sulfur (%S)
y = 226.16x + 271.16
R² = 0.0176

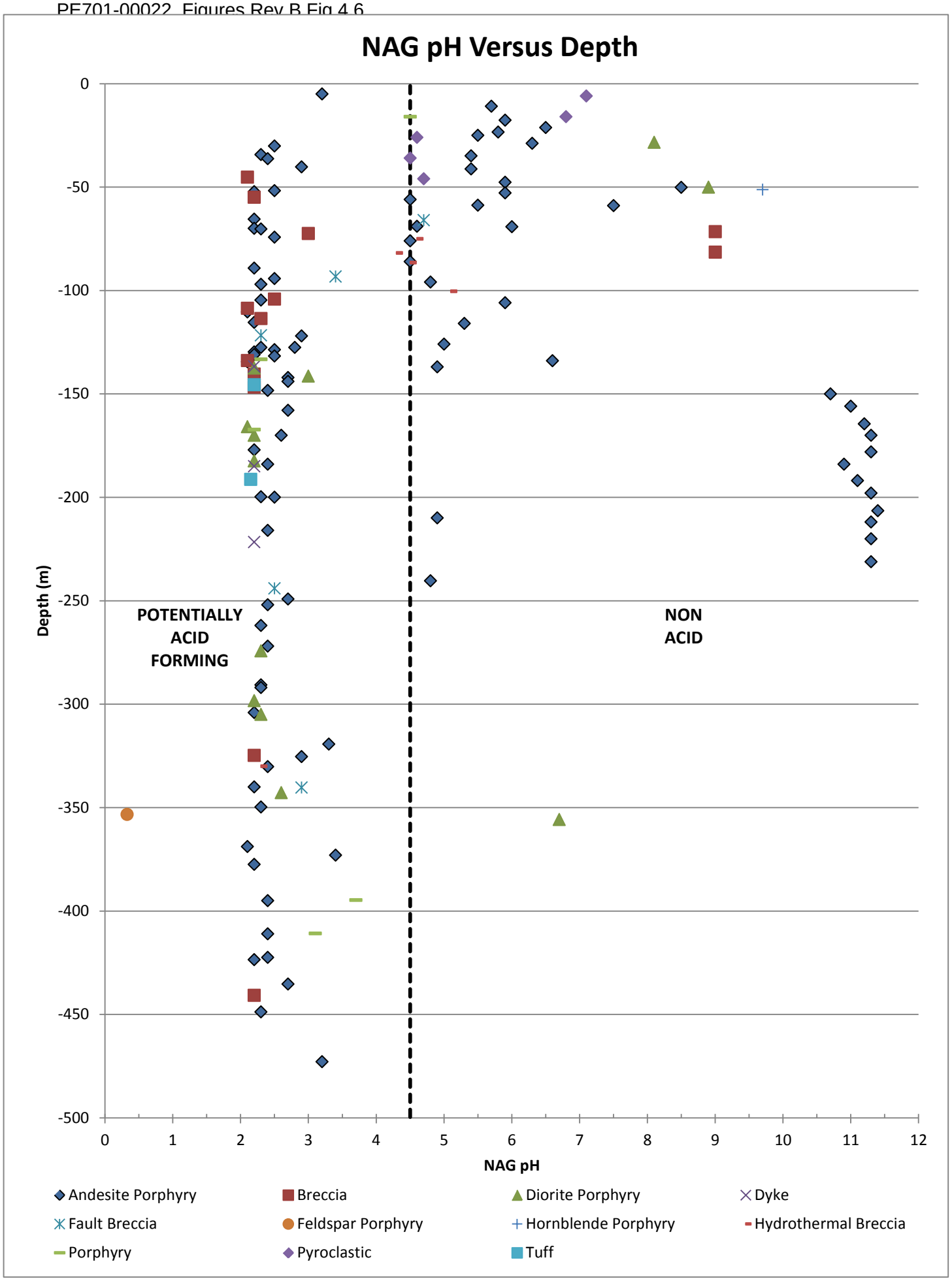

Sulfide Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Sulfide Sulfur (%S)
y = -12.462x - 138.5
R² = 0.0842


Sulfide Sulfur Versus Copper
Copper (ppm)
7000
6000
5000
4000
3000
2000
1000
0
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
Sulfide Sulfur (%S)
y = 118.69x + 101.55
R² = 0.2869

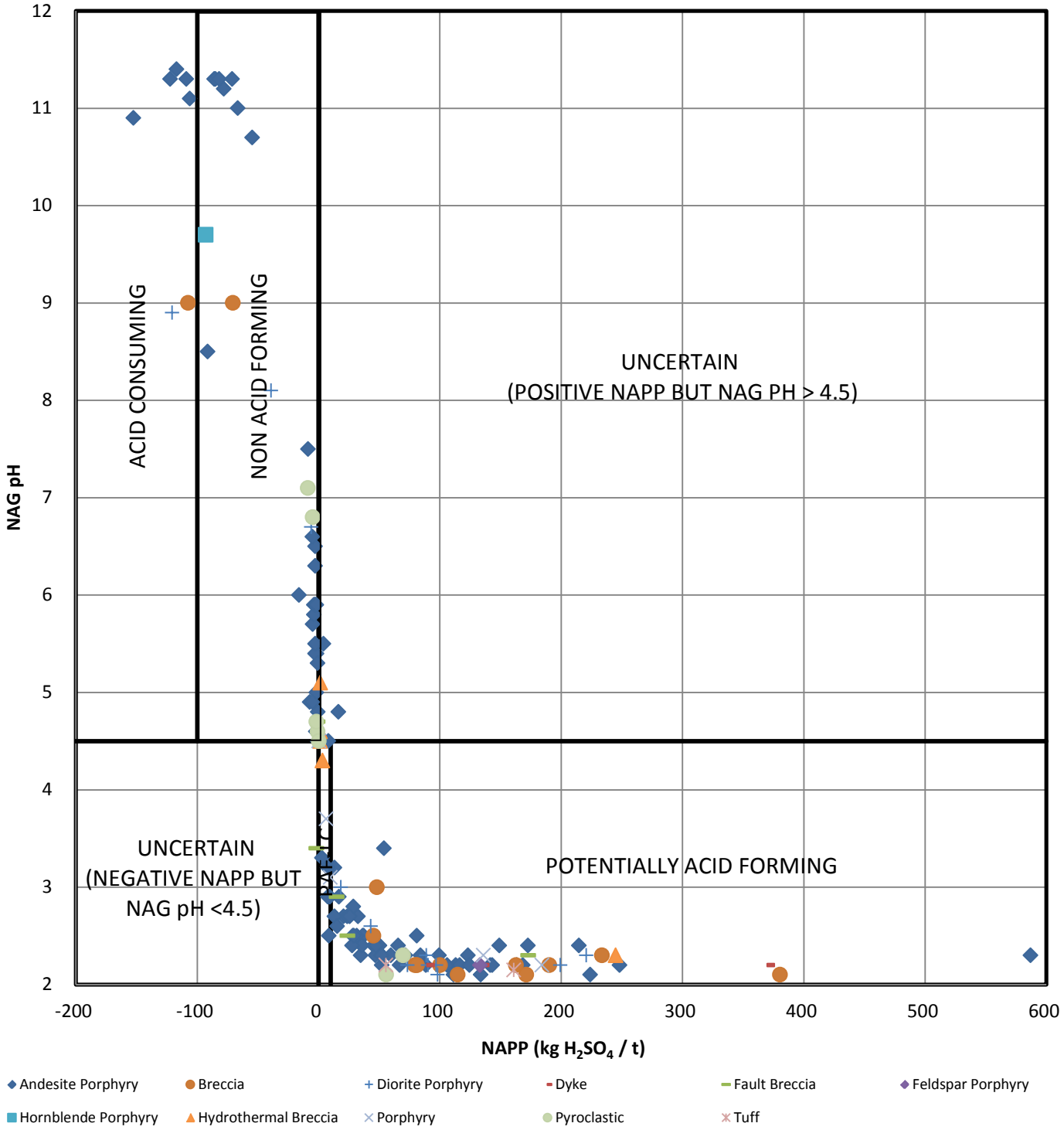

Acid Neutralising Capacity Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
-50
0
50
100
150
200
Acid Neutralising Capacity (kg H2SO4 /t)


Acid Neutralising Capacity Versus Carbon
Total C (%)
3
2.5
2
1.5
1
0.5
0
-50
0
50
100
150
200
250
Acid Neutralising Capacity (kg H2SO4 /t)
ANC Results
Calcite


PASTE pH Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
ACIDIC
ACIDIC TO NEUTRAL
NEUTRAL TO ALKALINE
0
1
2
3
4
5
6
7
8
9
10
11
Paste pH
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

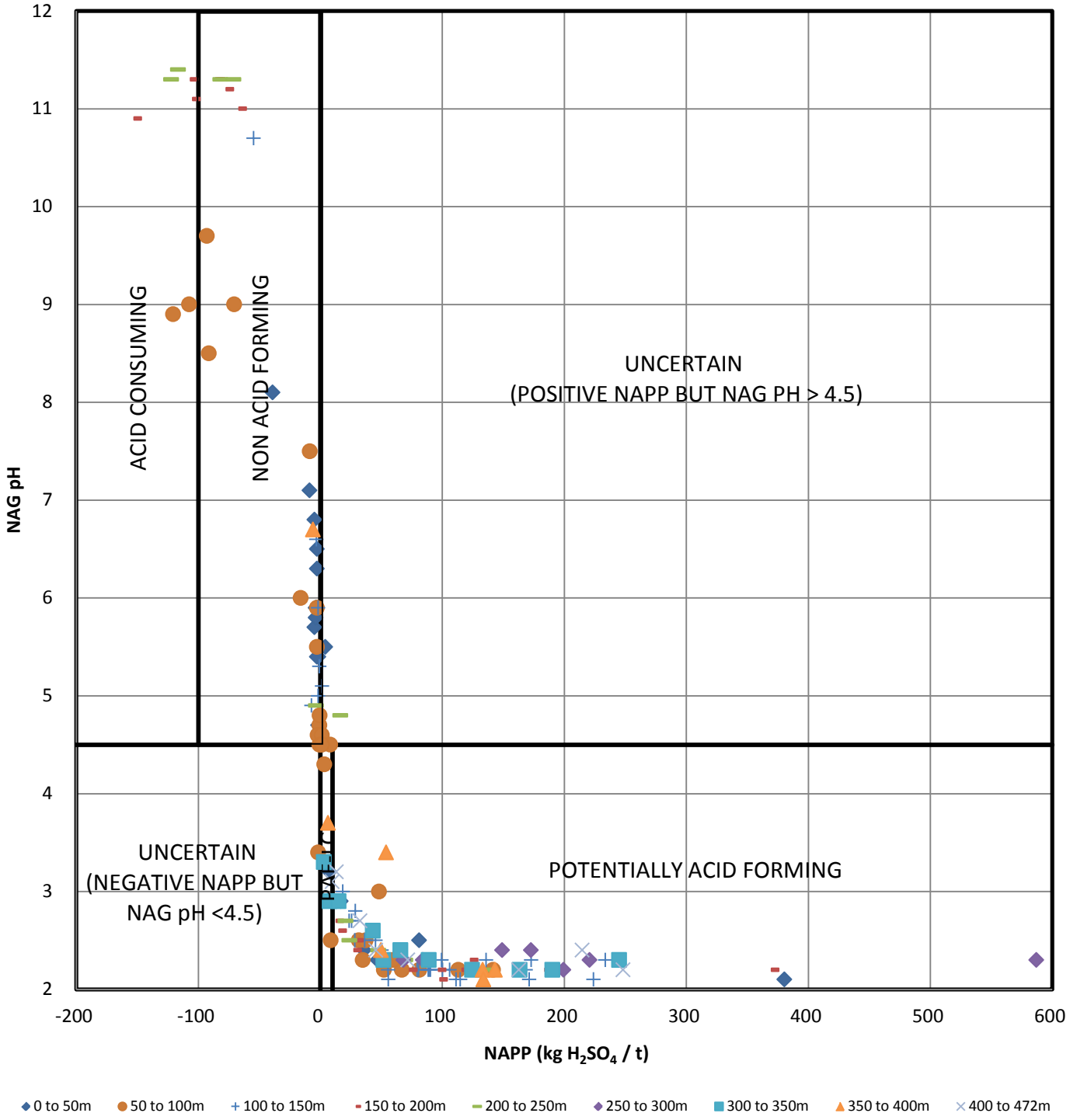

NAG pH Versus Depth
Depth (m)
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
POTENTIALLY ACID FORMING
NON ACID
0
1
2
3
4
5
6
7
8
9
10
11
12
NAG pH
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff

Acid Formation Potential

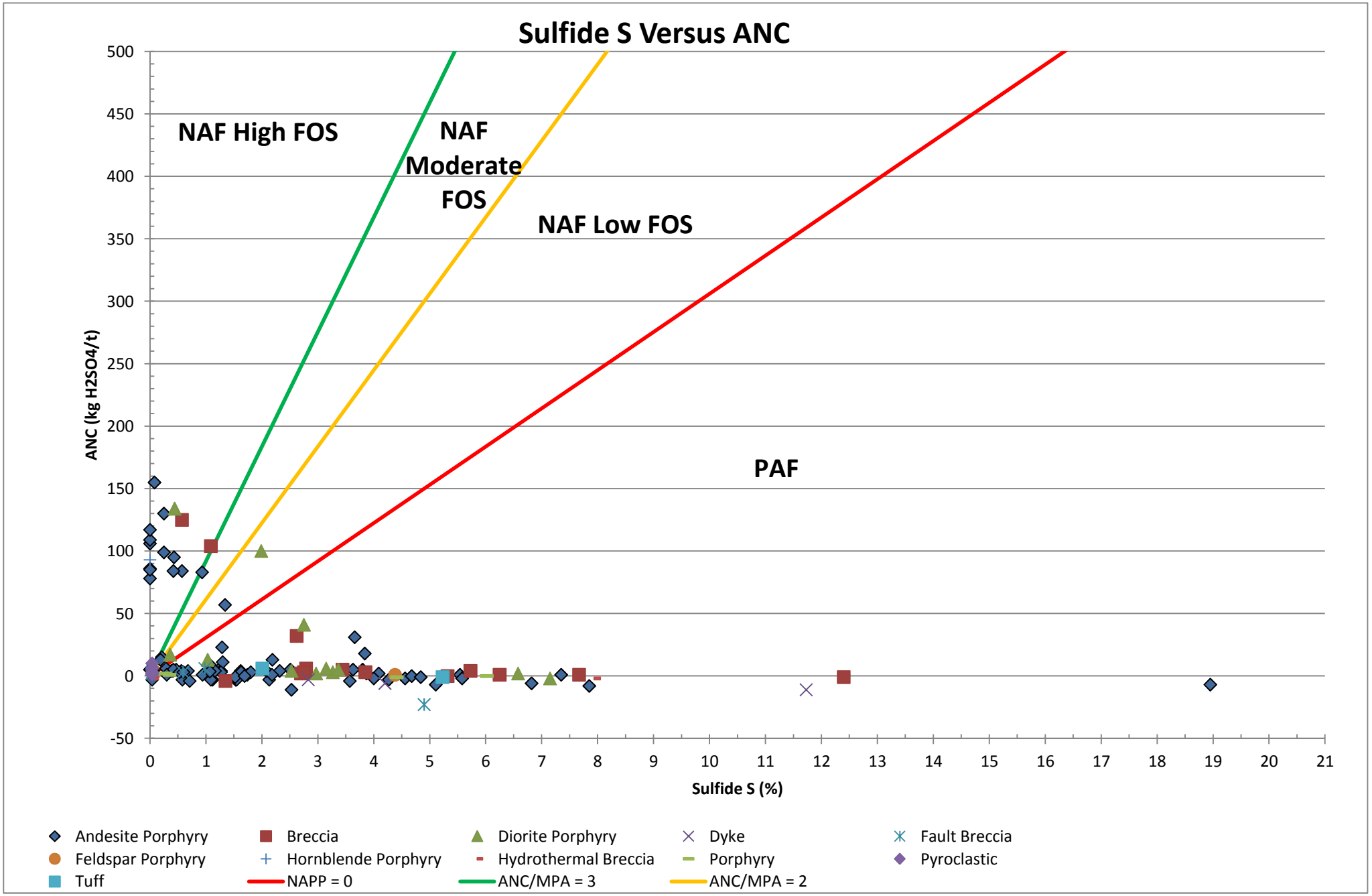


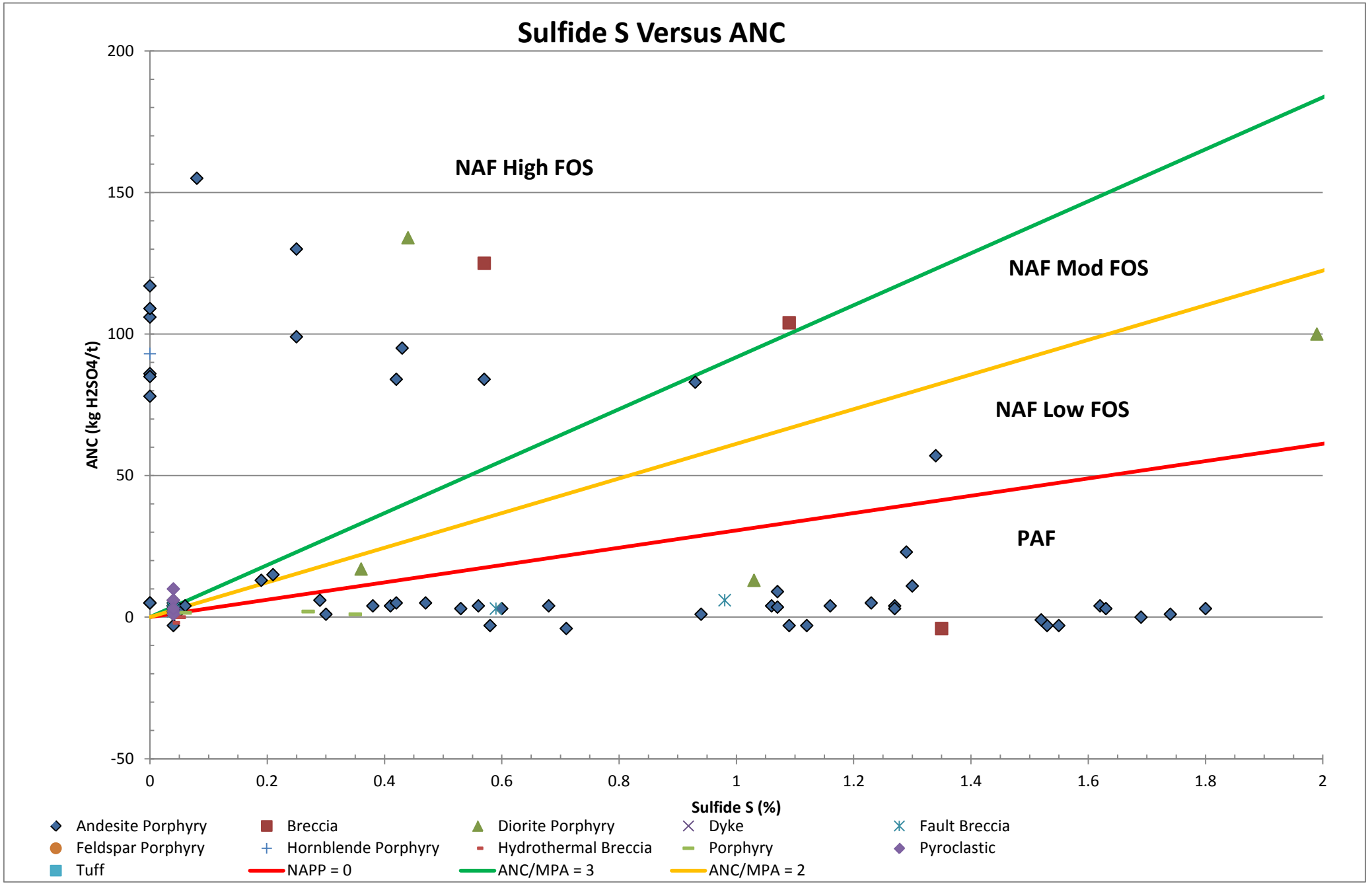
Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

Acid Formation Potential



Acid Formation Potential	NAPP k H SO_4 / t	NAG pH
Potential Acid Forming (PAF)	>10	<4.5
Potential Acid Forming - Low Capacity (PAF - LC)	0 to 10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Acid Consuming (AC)	Less than - 100	≥4.5
Uncertain	Positve	≥4.5
	Negative	<4.5

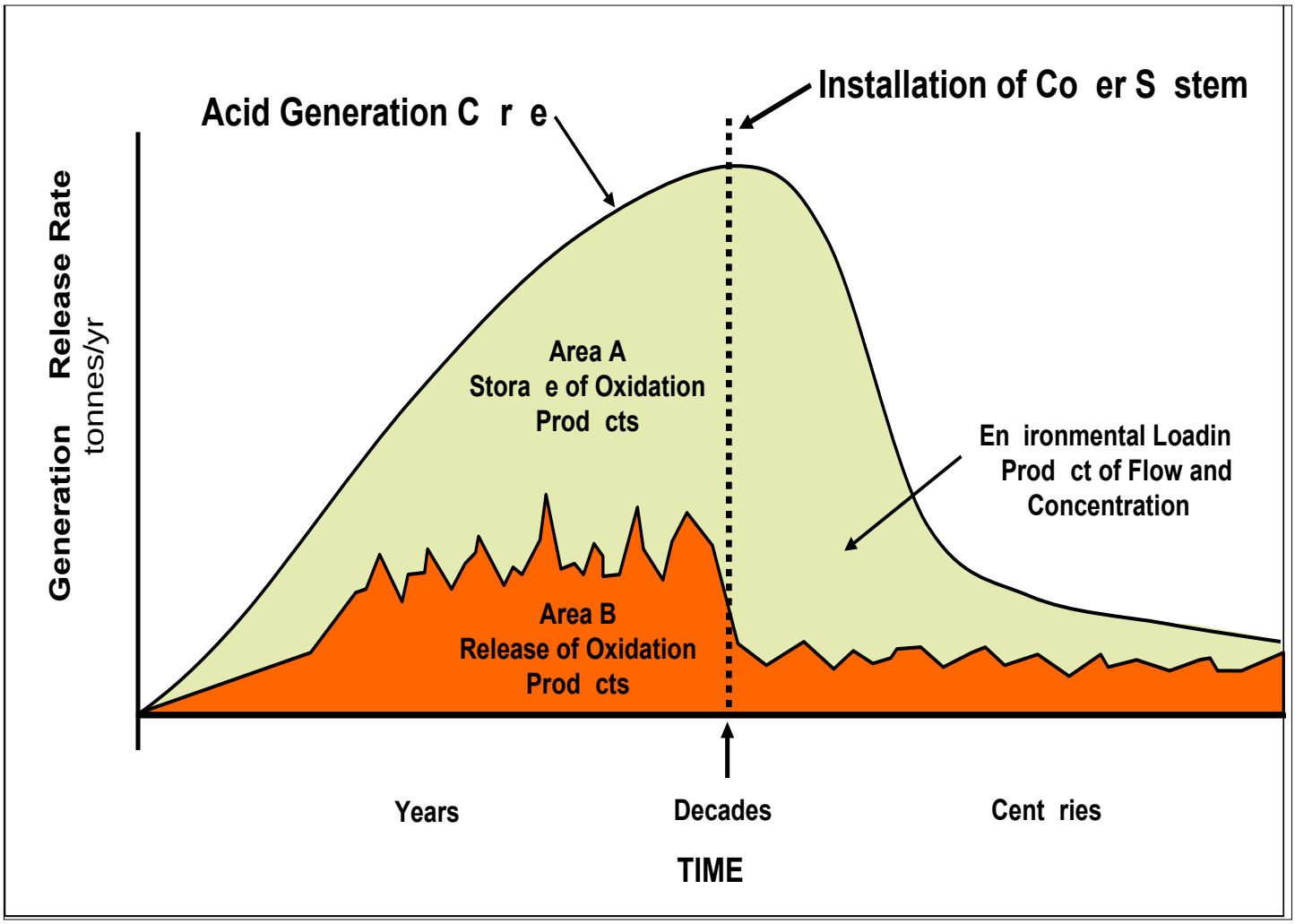

Sulfide S Versus ANC
NAF High FOS
NAF Moderate FOS
NAF Low FOS
PAF
ANC (kg H2SO4/t)
Sulfide S (%)
500
450
400
350
300
250
200
150
100
50
0
-50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Andesite Porphyry
Breccia
Diorite Porphyry
Dyke
Fault Breccia
Feldspar Porphyry
Hornblende Porphyry
Hydrothermal Breccia
Porphyry
Pyroclastic
Tuff
NAPP = 0
ANC/MPA = 3
ANC/MPA = 2

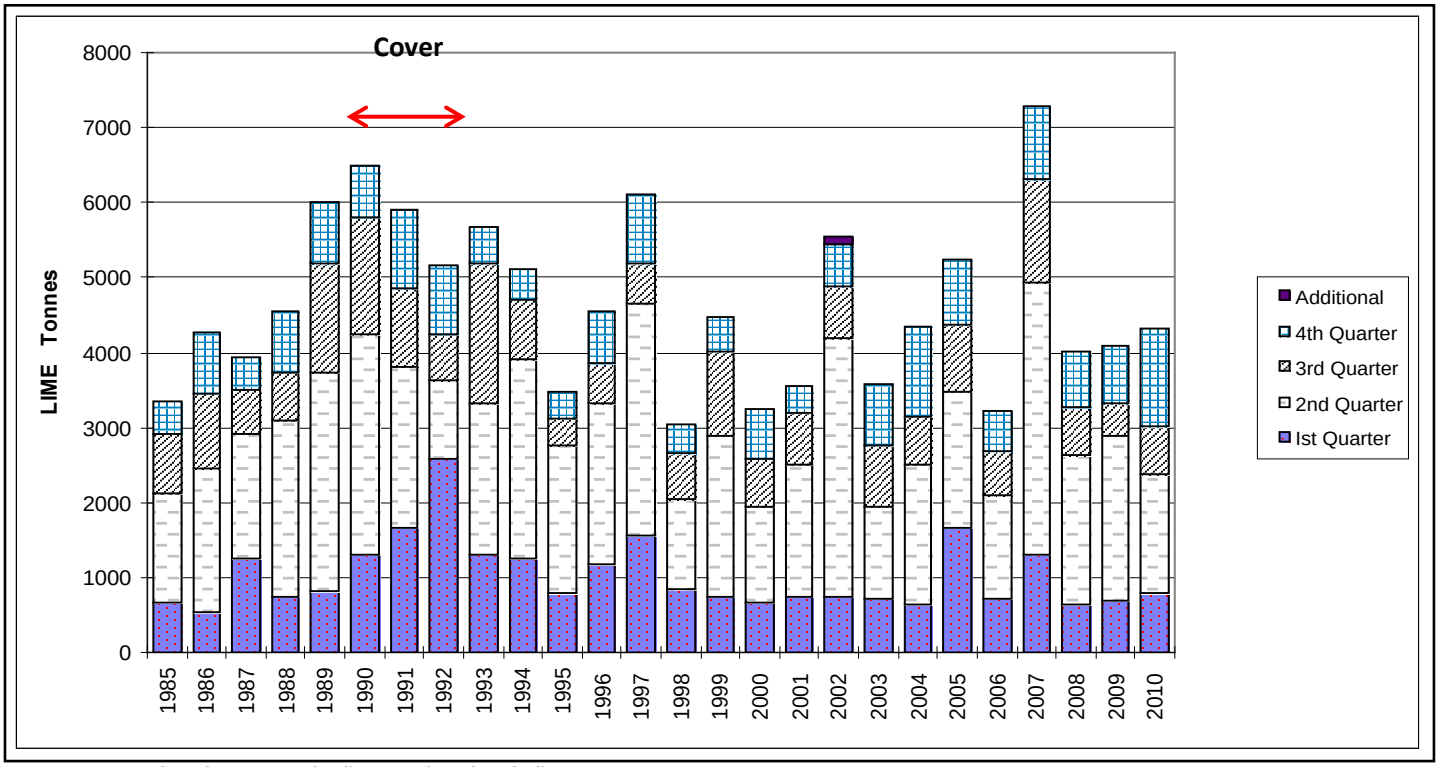


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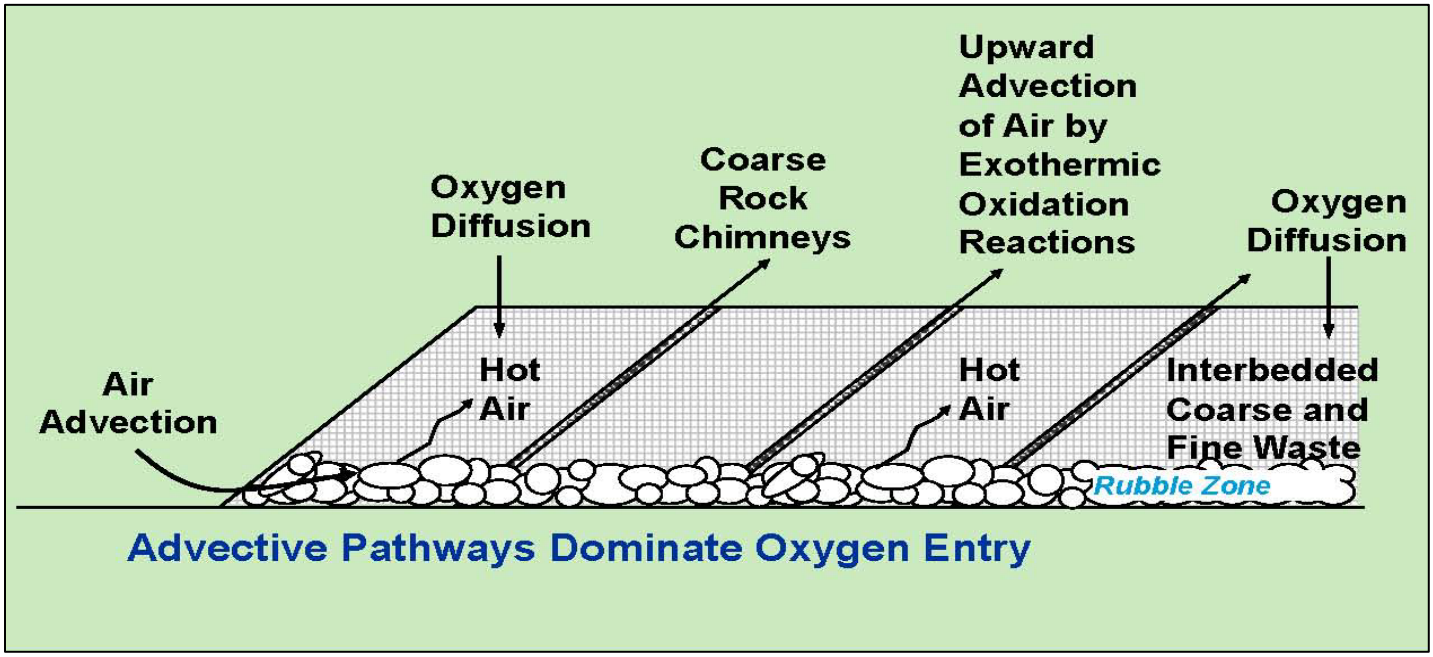
LETPADAUNG COPPER PROJECT
WASTE ROCK GEOCHEMISTRY
ANC & SULFIDE SULFUR (Sulfide less than 2%)

Ref: PE701-00022/16
Figure 4.10



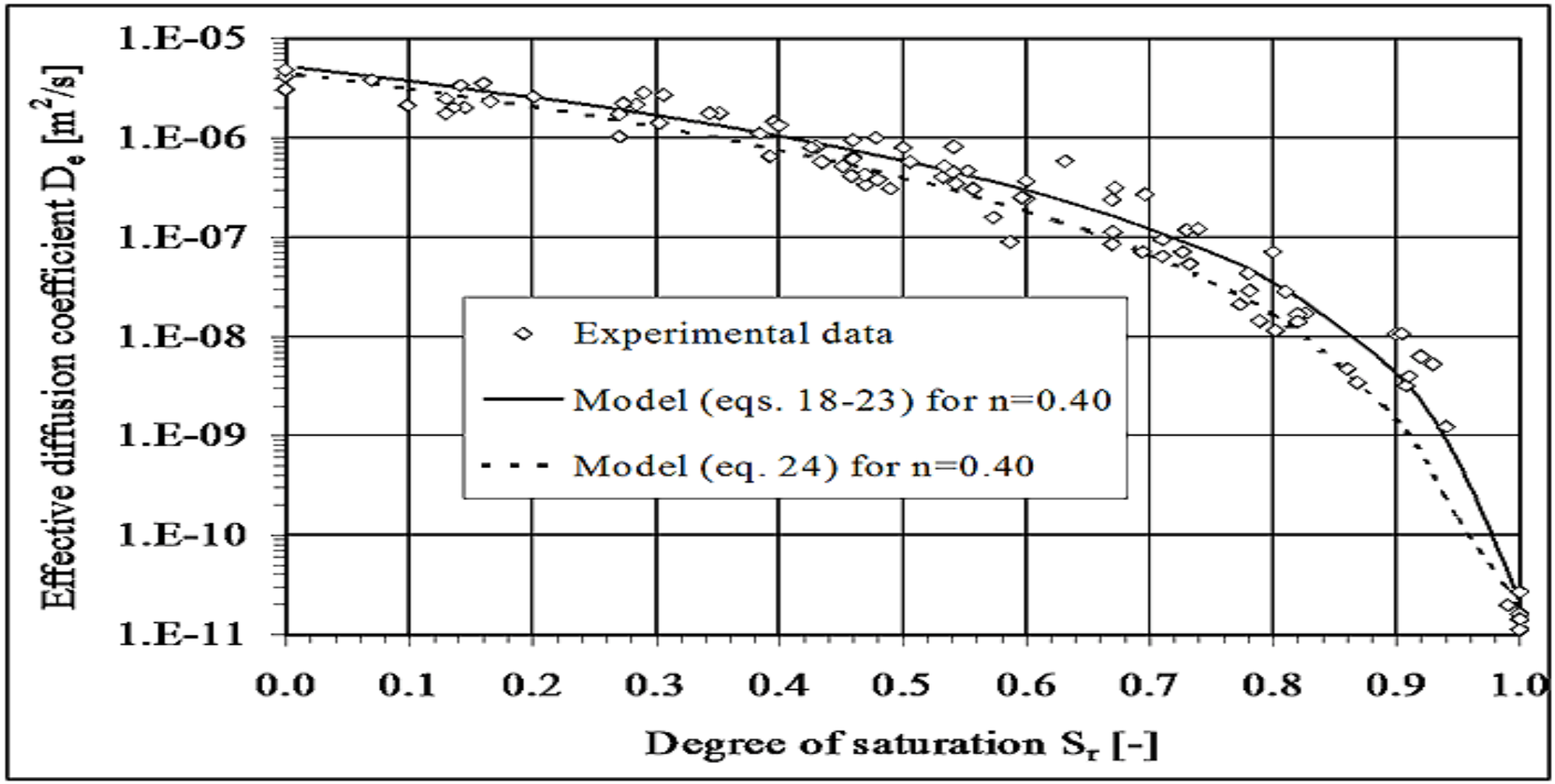


Figures courtesy of Professor Ward Wilson, University of Alberta





Figures courtesy of Professor Ward Wilson, University of Alberta


Effective diffusion coefficient D_e [m^2/s]
1.E-05
1.E-06
1.E-07
1.E-08
1.E-09
1.E-10
1.E-11
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Degree of saturation S_r [-]
Experimental data
Model (eqs. 18-23) for n=0.40
Model (eq. 24) for n=0.40

APPENDIX A

X-RAY Diffraction Results

APPENDIX A - QUANTATIVE XRD RESULTS

Mineral & Class	Sample ID	701-22-001	701-22-008	701-22-020	701-22-023	701-22-032	701-22-041	701-22-044	701-22-052	701-22-071	701-22-072	701-22-081	701-22-097	701-22-115	701-22-126	701-22-148	Average	Max	Min
	Borehole	LS001	LS001	LS002	LS002	LS003	LS003	LS003	LS005	LK004	LK004	LK006	L013	L223	L087	L087			
	Depth	25	221.65	355.8	435.3	146.75	353.35	410.9	50.1	51.23	71.63	191.35	93.25	212	36	330			
	Lithology	Andesite Porphyry	Dyke	Diorite Porphyry	Andesite Porphyry	Breccia	Feldspar Porphyry	Porphyry	Diorite Porphyry	Hornblende Porphyry	Breccia	Tuff	Fault Breccia	Andesite Porphyry	Pyroclastic	Hydrothermal Breccia			
Quartz	Silicate	39.00	38.00	31.00	45.00	45.00	34.00	41.00	40.00	24.00	29.00	43.00	47.00	23.00	63.00	47.00	39.27	63.00	23.00
Amorphous content		12.00	10.00	17.00	13.00	17.00	13.00	7.00	13.00	33.00	29.00	11.00	11.00	35.00	14.00	3.00	15.87	35.00	3.00
Natroalunite	Sulfate	6.00	10.00	-	-	<1	<1	26.00	-	-	-	3.00	9.00	-	15.00	28.00	7.46	28.00	-
Interlayered illite/smectite	Clay	21.00	-	14.00	5.00	18.00	8.00	1.00	15.00	9.00	22.00	13.00	-	-	-	-	8.40	22.00	-
Pyrophyllite	Clay	-	13.00	-	-	-	22.00	-	-	-	-	8.00	13.00	-	5.00	4.00	4.33	22.00	-
Kaolin	Clay	5.00	16.00	5.00	17.00	-	8.00	22.00	5.00	2.00	-	2.00	-	-	-	-	5.47	22.00	-
Chlorite	Clay	-	-	6.00	-	-	-	-	-	-	5.00	-	-	13.00	-	-	1.60	13.00	-
Hematite	Oxide	-	-	-	-	-	-	-	-	-	-	-	15.00	-	1.00	-	1.07	15.00	-
Sodium calcium plagioclase	Feldspar	-	-	9.00	-	-	-	-	-	12.00	1.00	-	-	9.00	-	-	2.07	12.00	-
Pyrite	Sulfide	-	10.00	1.00	2.00	6.00	10.00	1.00	-	<1	2.00	15.00	-	-	-	16.00	4.50	16.00	-
Siderite	Carbonate	-	-	11.00	3.00	-	-	-	-	-	-	-	-	-	-	-	0.93	11.00	-
Palygorskite	Clay	-	-	-	-	-	-	-	-	-	-	-	-	7.00	-	-	0.47	7.00	-
Illite/Muscovite	Mica	16.00	-	1.00	13.00	12.00	2.00	1.00	11.00	7.00	4.00	5.00	-	4.00	-	-	5.07	16.00	-
Potassium feldspar	Feldspar	-	2.00	5.00	-	-	<1	-	-	8.00	-	-	4.00	-	1.00	-	1.43	8.00	-
Ankerite	Carbonate	-	-	-	-	-	-	-	4.00	-	-	-	-	-	-	-	0.27	4.00	-
Dolomite	Carbonate	-	1.00	-	-	-	-	2.00	8.00	3.00	7.00	-	1.00	-	-	-	1.47	8.00	-
Calcite	Carbonate	-	-	-	-	<1	-	-	-	2.00	1.00	-	-	7.00	-	-	0.71	7.00	-
Magnesite	Carbonate	-	-	-	-	-	-	-	4.00	-	2.00	-	-	-	-	-	0.40	4.00	-
Expanding clay	Clay	-	-	-	-	-	-	-	-	2.00	-	-	-	-	-	-	0.13	2.00	-
Chloritoid	Clay	-	-	-	-	-	-	-	-	-	-	-	-	2.00	-	-	0.13	2.00	-
Diaspore	Hydroxide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.00	0.13	2.00	-
Alunite	Sulfate	-	-	1.00	1.00	-	3.00	-	-	-	-	-	-	-	-	-	0.33	3.00	-
Jarosite	Hydroxide	1.00	-	-	1.00	1.00	-	-	-	-	-	-	-	-	-	-	0.20	1.00	-
Anhydrite	Sulfate	-	-	-	<1	1.00	-	-	-	-	-	-	-	-	-	-	0.07	1.00	-
Anatase	Oxide	-	-	-	-	-	-	-	-	-	-	1.00	-	-	-	-	0.07	1.00	-
Chalcopyrite	Sulfide	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX B

Acid Base Accounting Results

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Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m)	Acid Neutralising Capacity (kg H2SO4/tonne)	Total Carbon (%C)	Total Sulfur (%S)	HCL Soluble Sulfur (%S)	Chromium Reducible Sulfur (%S)	Caculated Sulfide Sulfur (%S)	Calcuated Acid Insoluble Sulfate Sulfur (%S)	Paste pH	NAG pH (pH Units)	NAG (4.5) (kg H2SO4/tonne)	NAG (7.0) (kg H2SO4/tonne)	Calcuated Maximum Potential Acidity (kg H2SO4/tonne)	ANC/MPA Unitless	Calcuated Net Acid Producing Potential (kg H2SO4/tonne)	Acid Formation Potential Classification
701-22-001	Andesite Porphyry	LS001	25	-3	0.055	1.025	0.38	0.04	0.04	0.605	5	5.5	0	3	1.2	-2.45	4.22	Uncertain
701-22-002	Andesite Porphyry	LS001	59	15	0.95	0.32	0.03	0.21	0.21	0.08	7.1	7.5	0	0	6.4	2.33	-8.57	Non Acid Forming
701-22-003	Andesite Porphyry	LS001	65.5	-2	0.05	5.67	0.21	4.56	4.56	0.9	4.3	2.2	127	142	139.5	-0.01	141.54	Potentially Acid Forming
701-22-004	Andesite Porphyry	LS001	89.25	-4	0.04	4.43	0.17	3.57	3.57	0.69	3.8	2.2	98	110	109.2	-0.04	113.24	Potentially Acid Forming
701-22-005	Andesite Porphyry	LS001	122	5	0.04	0.67	0.04	0.47	0.47	0.16	5.2	2.9	6	11	14.4	0.35	9.38	Potentially Acid Forming - Low Capacity
701-22-006	Dyke	LS001	136.75	-3	0.04	3.23	0.09	2.83	2.83	0.31	4.4	2.2	79	89	86.6	-0.03	89.60	Potentially Acid Forming
701-22-007	Dyke	LS001	185	-11	0.02	18.24	0.58	11.73	11.73	5.93	3.5	2.2	424	455	358.9	-0.03	369.94	Potentially Acid Forming
701-22-008	Dyke	LS001	221.65	-6	0.02	6.83	0.54	4.2	4.20	2.09	4.4	2.2	133	147	128.5	-0.05	134.52	Potentially Acid Forming
701-22-009	Andesite Porphyry	LS001	249.15	-3	0.03	1.69	0.27	0.58	0.58	0.84	6.6	2.7	12	17	17.7	-0.17	20.75	Potentially Acid Forming
701-22-010	Andesite Porphyry	LS001	290.75	-3	0.04	3.71	0.4	2.13	2.13	1.18	5.1	2.3	67	77	65.2	-0.05	68.18	Potentially Acid Forming
701-22-011	Andesite Porphyry	LS001	304.05	-7	0.02	9.05	0.61	5.11	5.11	3.33	4.8	2.2	180	201	156.4	-0.04	163.37	Potentially Acid Forming
701-22-012	Andesite Porphyry	LS001	368.85	-3	0.03	5.35	0.15	4.27	4.27	0.93	5	2.1	133	144	130.7	-0.02	133.66	Potentially Acid Forming
701-22-013	Andesite Porphyry	LS001	395	-3	0.03	2.06	0.19	1.53	1.53	0.34	6.6	2.4	31	41	46.8	-0.06	49.82	Potentially Acid Forming
701-22-014	Andesite Porphyry	LS001	411.1	-6	0.02	9.56	0.42	6.82	6.82	2.32	5.5	2.4	136	163	208.7	-0.03	214.69	Potentially Acid Forming
701-22-015	Andesite Porphyry	LS001	423.5	-8	0.02	12.68	0.85	7.85	7.85	3.98	4.3	2.2	261	281	240.2	-0.03	248.21	Potentially Acid Forming
701-22-016	Andesite Porphyry	LS002	94.3	-3	0.06	1.96	0.2	1.12	1.12	0.64	4.6	2.5	21	30	34.3	-0.09	37.27	Potentially Acid Forming
701-22-017	Breccia	LS002	104.13	-4	0.07	2.01	0.21	1.35	1.35	0.45	4.5	2.5	27	37	41.3	-0.10	45.31	Potentially Acid Forming
701-22-018	Andesite Porphyry	LS002	128.6	-3	0.05	1.76	0.21	1.09	1.09	0.46	4.6	2.5	20	28	33.4	-0.09	36.35	Potentially Acid Forming
701-22-019	Andesite Porphyry	LS002	148.4	-3	0.05	1.99	0.15	1.55	1.55	0.29	4.4	2.4	33	43	47.4	-0.06	50.43	Potentially Acid Forming
701-22-020	Diorite Porphyry	LS002	355.8	17	0.99	0.52	0.05	0.36	0.36	0.11	8.5	6.7	0	0	11.0	1.54	-5.98	Non Acid Forming
701-22-021	Andesite Porphyry	LS002	373	13	1.095	2.52	0.115	2.19	2.19	0.215	5.85	3.4	7	35.5	67.0	0.19	54.01	Potentially Acid Forming
701-22-022	Andesite Porphyry	LS002	422.5	4	0.05	1.78	0.09	1.62	1.62	0.07	5.6	2.4	29	38	49.6	0.08	45.57	Potentially Acid Forming
701-22-023	Andesite Porphyry	LS002	435.3	5	0.31	1.47	0.09	1.23	1.23	0.15	6.1	2.7	11	24	37.6	0.13	32.64	Potentially Acid Forming
701-22-024	Andesite Porphyry	LS002	448.85	5	0.03	3.13	0.13	2.51	2.51	0.49	5.1	2.3	63	72	76.8	0.07	71.81	Potentially Acid Forming
701-22-025	Andesite Porphyry	LS002	472.85	4	0.02	0.79	0.04	0.56	0.56	0.19	6.3	3.2	3	7	17.1	0.23	13.14	Potentially Acid Forming
701-22-026	Andesite Porphyry	LS003	21.3	4	0.1	0.74	0.2	0.04	0.04	0.5	6.2	6.5	0	0	1.2	3.27	-2.78	Non Acid Forming
701-22-027	Andesite Porphyry	LS003	70	4	0.04	2.98	0.13	2.32	2.32	0.53	4.7	2.2	68	79	71.0	0.06	66.99	Potentially Acid Forming
701-22-028	Andesite Porphyry	LS003	74.3	4	0.06	1.14	0.04	0.41	0.41	0.69	4.9	2.5	17	25	12.5	0.32	8.55	Potentially Acid Forming - Low Capacity
701-22-029	Andesite Porphyry	LS003	97	4	0.05	2.4	0.12	2.08	2.08	0.2	4	2.3	49	61	63.6	0.06	59.65	Potentially Acid Forming
701-22-030	Andesite Porphyry	LS003	115.5	1	0.06	7.71	0.33	5.54	5.54	1.84	4.3	2.2	190	205	169.5	0.01	168.52	Potentially Acid Forming
701-22-031	Andesite Porphyry	LS003	131.7	4	0.07	1.59	0.16	1.06	1.06	0.37	4.4	2.5	21	29	32.4	0.12	28.44	Potentially Acid Forming
701-22-032	Breccia	LS003	146.75	2	0.1	3.82	0.18	2.7	2.70	0.94	4.1	2.2	82	92	82.6	0.02	80.62	Potentially Acid Forming
701-22-033	Diorite Porphyry	LS003	170.02	3	0.05	4.3	0.2	3.27	3.27	0.83	4.5	2.2	93	104	100.1	0.03	97.06	Potentially Acid Forming
701-22-034	Diorite Porphyry	LS003	182.4	4	0.04	3.22	0.16	2.53	2.53	0.53	4.6	2.2	70	82	77.4	0.05	73.42	Potentially Acid Forming
701-22-035	Diorite Porphyry	LS003	274.25	-2	0.03	11.79	0.97	7.15	7.15	3.67	4.7	2.3	223	242	218.8	-0.01	220.79	Potentially Acid Forming
701-22-036	Diorite Porphyry	LS003	298.3	2	0.04	8.89	0.49	6.58	6.58	1.82	4	2.2	208	224	201.3	0.01	199.35	Potentially Acid Forming
701-22-037	Diorite Porphyry	LS003	305	2	0.06	4.46	0.33	2.97	2.97	1.16	4.3	2.3	90	101	90.9	0.02	88.88	Potentially Acid Forming
701-22-038	Breccia	LS003	324.8	1	0.11	9	0.5	6.25	6.25	2.25	4.8	2.2	200	217	191.3	0.01	190.25	Potentially Acid Forming
701-22-039	Andesite Porphyry	LS003	330.2	1	0.07	4.38	0.61	2.18	2.18	1.59	4.4	2.4	60	72	66.7	0.01	65.71	Potentially Acid Forming
701-22-040	Diorite Porphyry	LS003	342.8	41	0.65	4.07	0.35	2.75	2.75	0.97	8	2.6	38	46	84.2	0.49	43.15	Potentially Acid Forming
701-22-041	Feldspar Porphyry	LS003	353.35	1	0.03	6.46	0.325	4.38	4.38	1.755	5.35	2.2	154.5	166.5	134.0	0.01	133.03	Potentially Acid Forming
701-22-042	Andesite Porphyry	LS003	377.5	0	0.03	5.92	0.36	4.68	4.68	0.88	4.9	2.2	133	145	143.2	0.00	143.21	Potentially Acid Forming
701-22-043	Porphyry	LS003	394.75	2	0.04	2.03	0.54	0.27	0.27	1.22	5.7	3.7	1	7	8.3	0.24	6.26	Potentially Acid Forming - Low Capacity
701-22-044	Porphyry	LS003	410.9	1	0.06	4.11	1.19	0.35	0.35	2.57	5	3.1	10	17	10.7	0.09	9.71	Potentially Acid Forming - Low Capacity
701-22-045	Breccia	LS003	440.8	0	0.04	8.22	0.48	5.32	5.32	2.42	4.9	2.2	176	193	162.8	0.00	162.79	Potentially Acid Forming
701-22-046	Andesite Porphyry	LS004	30.21	31	0.83	4.24	0.14	3.66	3.66	0.44	7.2	2.5	53	68	112.0	0.28	81.00	Potentially Acid Forming
701-22-047	Andesite Porphyry	LS004	50.21	99	1.37	0.37	0.05	0.25	0.25	0.07	9.3	8.5	0	0	7.7	12.94	-91.35	Non Acid Forming
701-22-048	Andesite Porphyry	LS004	69.25	57	0.69	1.64	0.05	1.34	1.34	0.25	8.1	6	0	2	41.0	1.39	-16.00	Non Acid Forming
701-22-049	Andesite Porphyry	LS004	110.45	5	0.05	4.76	0.11	3.8	3.80	0.85	5.3	2.1	110	128	116.3	0.04	111.28	Potentially Acid Forming
701-22-050	Andesite Porphyry	LS004	134.45	1	0.16	9.64	0.22	7.35	7.35	2.07	5	2.1	222	244	224.9	0.00	223.91	Potentially Acid Forming
701-22-051	Diorite Porphyry	LS005	28.4	100	1.57	2.28	0.33	1.99	1.99	0	7.2	8.1	0	0	60.9	1.64	-39.11	Non Acid Forming
701-22-052	Diorite Porphyry	LS005	50.1	134	2.06	0.62	0.07	0.44	0.44	0.11	8.2	8.9	0	0	13.5	9.95	-120.54	Acid Consuming
701-22-053	Breccia	LS005	72.5	32	1.05	2.9	0.06	2.62	2.62	0.22	7.6	3	12	26	80.2	0.40	48.17	Potentially Acid Forming
701-22-054	Breccia	LS005	133.9	4	0.04	6.57	0.18	5.73	5.73	0.66	4.7	2.1	160	181	175.3	0.02	171.34	Potentially Acid Forming
701-22-055	Diorite Porphyry	LS005	141.4	13	0.41	1.13	0.06	1.03	1.03	0.04	7.3	3	5	14	31.5	0.41	18.52	Potentially Acid Forming
701-22-056	Andesite Porphyry	LS006	34.3	3	0.03	1.58	0.08	1.63	1.63	0	4.7	2.3	30	40	49.9	0.06	46.88	Potentially Acid Forming
701-22-057	Andesite Porphyry	LS006	52.3	1	0.03	2.11	0.17	1.74	1.74	0.2	4.4	2.2	43	53	53.2	0.02	52.24	Potentially Acid Forming
701-22-058	Andesite Porphyry	LS006	70.3	4	0.04	1.56	0.1	1.27	1.27	0.19	4.4	2.3	28	36	38.9	0.10	34.86	Potentially Acid Forming
701-22-059	Andesite Porphyry	LS006	127.6	11	0.65	1.52	0.08	1.3	1.30	0.14	6.5	2.8	8	27	39.8	0.28	28.78	Potentially Acid Forming
701-22-060	Breccia	LS006	140.4	6	0.05	3.47	0.09	2.79	2.79	0.59	5.2	2.2	81	94	85.4	0.07	79.37	Potentially Acid Forming
701-22-061	Porphyry	LK002	16.05	1.5	0.035	1.55	0.98	0.06	0.06	0.51	4.1	4.5	0	1.5	1.8	0.82	0.34	Potentially Acid Forming - Low Capacity
701-22-062	Andesite Porphyry	LK002	36.3	3	0.04	2.02	0.4	1.27	1.27	0.35	4.2	2.4	23	34	38.9	0.08	35.86	Potentially Acid Forming
701-22-063	Breccia	LK002	113.6	1	0.03	9.68	0.47	7.67	7.67	1.54	4.6	2.3	181	207	234.7	0.00	233.70	Potentially Acid Forming
701-22-064	Porphyry	LK002	133.3	-1	0.02	9.05	1.17	4.41	4.41	3.47	4.1	2.3	126	144	134.9	-0.01	135.95	Potentially Acid Forming
701-22-065	Porphyry	LK002	167.3	0	0.02	10.9	1.02	6.02	6.02	3.86	4.3	2.2	196	215	184.2	0.00	184.21	Potentially Acid Forming
701-22-066	Andesite Porphyry	LK003	40.3	4	0.02	1.98	0.39	0.68	0.68	0.91	4.1	2.9	9	19	20.8	0.19	16.81	Potentially Acid Forming
701-22-067	Breccia	LK003	54.9	3	0.04	3.4	0.21	2.75	2.75	0.44	3.7	2.2	66	81	84.2	0.04	81.15	Potentially Acid Forming
701-22-068	Breccia	LK003	108.6	3	0.05	6.28	0.41	3.85	3.85	2.02	3.7	2.1	137	157	117.8	0.03	114.81	Potentially Acid Forming
701-22-069	Pyroclastic	LK003	128.7	5	0.08	2.21	0.15	1.99	1.99	0.07	3.8	2.1	51	62	60.9	0.08	55.89	Potentially Acid Forming
701-22-070	Tuff	LK003	145.6	6	0.05	2.2	0.19	2.01	2.01	4.44089E-16	4.2	2.2	49	63	61.5	0.10	55.51	Potentially Acid Forming
701-22-071	Hornblende Porphyry	LK004	51.23	93	1.09	0.07	0.02	0	0.00	0.05	9.2	9.7	0	0	0.0	0.00	-93.00	Non Acid Forming
701-22-072	Breccia	LK004	71.63	125	1.53	0.8	0.09	0.57	0.57	0.14	8.5	9	0	0	17.4	7.17	-107.56	Acid Consuming
701-22-073	Breccia	LK004	81.52	104	1.72	1.31	0.05	1.09	1.09	0.17	8.5	9	0	0	33.4	3.12	-70.65	Non Acid Forming
701-22-074	Andesite Porphyry	LK004	104.71	18	0.71	4.24	0.09	3.84	3.84	0.31	7.3	2.3	61	80	117.5	0.15	99.50	Potentially Acid Forming
701-22-075	Diorite Porphyry	LK004	137.51	6	0.05	3.62	0.15	3.15	3.15	0.32	5.4	2.2	67	79	96.4	0.06	90.39	Potentially Acid Forming
701-22-076	Breccia	LK006	45.2	-1	0.05	16.29	0.43	12.4	12.40	3.46	2.7	2.1	409	440	379.4	0.00	380.44	Potentially Acid Forming
701-22-077	Andesite Porphyry	LK006	51.8	4	0.04	2.04	0.52	1.16	1.16	0.36	4.2	2.5	23	32	35.5	0.11	31.50	Potentially Acid Forming
701-22-078	Andesite Porphyry	LK006	129.7	5	0.03	4.62	0.26	3.63	3.63	0.73	4.5	2.2	100	113	111.1	0.05	106.08	Potentially Acid Forming
701-22-079	Breccia	LK006	145.7	5	0.04	4.32	0.28	3.44	3.44	0.6	4	2.2	88	101	105.3	0.05	100.26	Potentially Acid Forming
701-22-080	Diorite Porphyry	LK006	165.86	5	0.04	4.27	0.28	3.37	3.37	0.62	4.7	2.1	95	106	103.1	0.05	98.12	Potentially Acid Forming
701-22-081	Tuff	LK006	191.35	-1	0.065	7.18	0.495	5.23	5.23	1.455	2.7	2.15	166.5	181.5	160.0	-0.01	161.04	Potentially Acid Forming
701-22-082	Pyroclastic	LK006	214.6	3	0.02	4.51	0.7	2.38	2.38	1.43	3.9	2.3	74	84	72.8	0.04	69.83	Potentially Acid Forming
701-22-083	Andesite Porphyry	L013	5	4	0.05	0.81	0.15	0.38	0.38	0.28	6.6	3.2	3	8	11.6	0.34	7.63	Potentially Acid Forming - Low Capacity
701-22-084	Andesite Porphyry	L013	11	6	0.06	1.82	0.48	0.04	0.04	1.3	7.3	5.7	0	4	1.2	4.90	-4.78	Non Acid Forming

Appendix B: Acid Base Accounting Results

Sample ID	Lithology	Borehole	Depth (m)	Acid Neutralising Capacity	Total Carbon	Total Sulfur	HCL Soluble Sulfur	Chromium Reducible Sulfur	Caculated Sulfide Sulfur	Calcuated Acid Insoluble Sulfate Sulfur	Paste pH	NAG pH	NAG (4.5)	NAG (7.0)	Calcuated Maximum Potential Acidity	ANC/MPA	Calcuated Net Acid Producing Potential	Acid Fromation Potential Classification
			(m)	(kg H2SO4/tonne)	(%C)	(%S)	(%S)	(%S)	(%S)	(%S)		(pH Units)	(kg H2SO4/tonne)	(kg H2SO4/tonne)	(kg H2SO4/tonne)	Unit Less	(kg H2SO4/tonne)	
701-22-085	Andesite Porphyry	L013	17.7	5	0.04	1.29	0.57	0.04	0.04	0.68	6.7	5.9	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-086	Andesite Porphyry	L013	23.4	5	0.06	1.16	0.4	0.04	0.04	0.72	6.3	5.8	0	3	1.2	4.08	-3.78	Non Acid Forming
701-22-087	Andesite Porphyry	L013	28.9	4	0.05	1.52	0.64	0.04	0.04	0.84	6.2	6.3	0	4	1.2	3.27	-2.78	Non Acid Forming
701-22-088	Andesite Porphyry	L013	34.9	3	0.04	2.25	0.88	0.05	0.05	1.32	5.6	5.4	0	6	1.5	1.96	-1.47	Non Acid Forming
701-22-089	Andesite Porphyry	L013	41.25	4	0.06	2.45	0.81	0.04	0.04	1.6	6.2	5.4	0	7	1.2	3.27	-2.78	Non Acid Forming
701-22-090	Andesite Porphyry	L013	47.7	4	0.05	0.98	0.34	0.04	0.04	0.6	6.2	5.9	0	1	1.2	3.27	-2.78	Non Acid Forming
701-22-091	Andesite Porphyry	L013	52.9	4	0.05	1.4	0.41	0.04	0.04	0.95	6.1	5.9	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-092	Andesite Porphyry	L013	58.8	4	0.11	0.97	0.35	0.04	0.04	0.58	4.6	5.5	0	2	1.2	3.27	-2.78	Non Acid Forming
701-22-093	Andesite Porphyry	L013	69	4	0.09	1.03	0.43	0.06	0.06	0.54	4.2	4.6	0	1	1.8	2.18	-2.16	Non Acid Forming
701-22-094	Hydrothermal Breccia	L013	75	0	0.04	3.96	1.46	0.04	0.04	2.46	5.1	4.6	0	13	1.2	0.00	1.22	Uncertain
701-22-095	Hydrothermal Breccia	L013	81.9	-2	0.03	4.3	1.59	0.04	0.04	2.67	4.7	4.3	0	9	1.2	-1.63	3.22	Potentially Acid Forming - Low Capacity
701-22-096	Hydrothermal Breccia	L013	86.55	0	0.04	4.72	1.58	0.04	0.04	3.1	5.2	4.5	0	13	1.2	0.00	1.22	Potentially Acid Forming - Low Capacity
701-22-097	Fault Breccia	L013	93.25	3	0.09	1.59	0.47	0.04	0.04	1.08	5.8	3.4	8	12	1.2	2.45	-1.78	Uncertain
701-22-098	Hydrothermal Breccia	L013	100.4	0	0.03	4.12	1.27	0.05	0.05	2.8	5.4	5.1	0	13	1.5	0.00	1.53	Uncertain
701-22-099	Andesite Porphyry	L013	127.55	3	0.08	2.11	0.2	1.8	1.80	0.11	4.2	2.3	34	43	55.1	0.05	52.08	Potentially Acid Forming
701-22-100	Andesite Porphyry	L013	177.05	2	0.03	5.26	0.2	3.87	3.87	1.19	4.8	2.2	109	121	118.4	0.02	116.42	Potentially Acid Forming
701-22-101	Andesite Porphyry	L013	199.75	2	0.055	5.285	0.44	4.09	4.09	0.755	3.8	2.3	109	120.5	125.2	0.02	123.15	Potentially Acid Forming
701-22-102	Fault Breccia	L223	121.75	-23	0.03	7.65	1.22	4.9	4.90	1.53	3	2.3	145	165	149.9	-0.15	172.94	Potentially Acid Forming
701-22-103	Andesite Porphyry	L223	131	-11	0.06	3.52	0.64	2.53	2.53	0.35	3.2	2.2	70	84	77.4	-0.14	88.42	Potentially Acid Forming
701-22-104	Andesite Porphyry	L223	137	13	0.3	0.38	0.13	0.19	0.19	0.06	7	4.9	0	8	5.8	2.24	-7.19	Non Acid Forming
701-22-105	Andesite Porphyry	L223	142.1	9	0.04	1.36	0.15	1.07	1.07	0.14	5	2.7	11	23	32.7	0.27	23.74	Potentially Acid Forming
701-22-106	Andesite Porphyry	L223	150	83	0.65	1.17	0.09	0.93	0.93	0.15	9.1	10.7	0	0	28.5	2.92	-54.54	Non Acid Forming
701-22-107	Andesite Porphyry	L223	156	84	0.73	0.78	0.1	0.57	0.57	0.11	8.1	11	0	0	17.4	4.82	-66.56	Non Acid Forming
701-22-108	Andesite Porphyry	L223	164.55	78	0.67	0.04	0.01		0.03	0	9.4	11.2	0	0	0.9	0.00	-77.08	Non Acid Forming
701-22-109	Andesite Porphyry	L223	170	86	0.87	0.03	0.02		0.01	0	9	11.3	0	0	0.3	0.00	-85.69	Non Acid Forming
701-22-110	Andesite Porphyry	L223	178.05	85	0.8	0.05	0.02		0.03	0	9.4	11.3	0	0	0.9	0.00	-84.08	Non Acid Forming
701-22-111	Andesite Porphyry	L223	184	155	1.84	0.12	0.03	0.08	0.08	0.01	8.8	10.9	0	0	2.4	63.32	-152.55	Acid Consuming
701-22-112	Andesite Porphyry	L223	191.95	106	1.23	0.08	0.03		0.05	0	9.5	11.1	0	0	1.5	0.00	-104.47	Acid Consuming
701-22-113	Andesite Porphyry	L223	198	109	1.32	0.12	0.03		0.09	0	9.1	11.3	0	0	2.8	0.00	-106.25	Acid Consuming
701-22-114	Andesite Porphyry	L223	206.5	117	1.44	0.04	0.03		0.01	0	8.5	11.4	0	0	0.3	0.00	-116.69	Acid Consuming
701-22-115	Andesite Porphyry	L223	212	130	1.44	0.34	0.06	0.25	0.25	0.03	8.6	11.3	0	0	7.7	16.99	-122.35	Acid Consuming
701-22-116	Andesite Porphyry	L223	220.05	95	0.92	0.63	0.12	0.43	0.43	0.08	8.8	11.3	0	0	13.2	7.22	-81.84	Non Acid Forming
701-22-117	Andesite Porphyry	L223	231.2	84	0.76	0.55	0.06	0.42	0.42	0.07	9.7	11.3	0	0	12.9	6.54	-71.15	Non Acid Forming
701-22-118	Andesite Porphyry	L223	240.4	23	0.84	1.7	0.17	1.29	1.29	0.24	8	4.8	0	12	39.5	0.58	16.47	Uncertain
701-22-119	Fault Breccia	L223	244	6	0.08	1.33	0.16	0.98	0.98	0.19	4.8	2.5	17	23	30.0	0.20	23.99	Potentially Acid Forming
701-22-120	Andesite Porphyry	L223	319.3	6	0.04	0.5	0.11	0.29	0.29	0.1	5.9	3.3	3	5	8.9	0.68	2.87	Potentially Acid Forming - Low Capacity
701-22-121	Andesite Porphyry	L223	325.4	5	0.03	0.58	0.07	0.42	0.42	0.09	5.3	2.9	7	11.5	12.9	0.39	7.85	Potentially Acid Forming - Low Capacity
701-22-122	Fault Breccia	L223	340.3	3	0.05	1.19	0.26	0.59	0.59	0.34	4.1	2.9	7	12	18.1	0.17	15.05	Potentially Acid Forming
701-22-123	Pyroclastic	L087	6	10	0.15	2.04	0.7	0.04	0.04	1.3	7.9	7.1	0	0	1.2	8.17	-8.78	Non Acid Forming
701-22-124	Pyroclastic	L087	16	6	0.08	0.25	0.11	0.04	0.04	0.1	7.6	6.8	0	1	1.2	4.90	-4.78	Non Acid Forming
701-22-125	Pyroclastic	L087	26	2	0.04	3.2	1.06	0.04	0.04	2.1	7.3	4.6	0	13	1.2	1.63	-0.78	Non Acid Forming
701-22-126	Pyroclastic	L087	36	1	0.02	2.22	0.57	0.04	0.04	1.61	6.8	4.5	0	9	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-127	Pyroclastic	L087	46	3	0.02	1.77	0.25	0.04	0.04	1.48	6.8	4.7	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-128	Andesite Porphyry	L087	56	2	0.02	3.06	0.92	0.04	0.04	2.1	7.2	4.5	0	11	1.2	1.63	-0.78	Uncertain
701-22-129	Fault Breccia	L087	66	2	0.03	2.23	0.68	0.04	0.04	1.51	7.3	4.7	0	5	1.2	1.63	-0.78	Non Acid Forming
701-22-130	Andesite Porphyry	L087	76	1	0.02	1.82	0.83	0.3	0.30	0.69	7.3	4.5	0	6	9.2	0.11	8.18	Potentially Acid Forming - Low Capacity
701-22-131	Andesite Porphyry	L087	86	1	0.03	2.49	0.81	0.04	0.04	1.64	7	4.5	0	6	1.2	0.82	0.22	Potentially Acid Forming - Low Capacity
701-22-132	Andesite Porphyry	L087	96	2	0.02	1.58	0.42	0.05	0.05	1.11	6.7	4.8	0	5	1.5	1.31	-0.47	Non Acid Forming
701-22-133	Andesite Porphyry	L087	106	3	0.08	0.97	0.22	0.04	0.04	0.71	6.8	5.9	0	0	1.2	2.45	-1.78	Non Acid Forming
701-22-134	Andesite Porphyry	L087	116	2	0.04	1.36	0.2	0.04	0.04	1.12	7.1	5.3	0	4	1.2	1.63	-0.78	Non Acid Forming
701-22-135	Andesite Porphyry	L087	126	3	0.02	1.93	0.3	0.04	0.04	1.59	6.7	5	0	6	1.2	2.45	-1.78	Non Acid Forming
701-22-136	Andesite Porphyry	L087	134	5	0.03	0.1	0.04		0.06	0	7	6.6	0	1	1.8	0.00	-3.16	Non Acid Forming
701-22-137	Andesite Porphyry	L087	144	-4	0.02	2.39	0.58	0.71	0.71	1.1	2.8	2.7	16	22	21.7	-0.18	25.73	Potentially Acid Forming
701-22-138	Andesite Porphyry	L087	158	3	0.02	0.75	0.13	0.53	0.53	0.09	4.2	2.7	11	15	16.2	0.18	13.22	Potentially Acid Forming
701-22-139	Andesite Porphyry	L087	170	3	0.04	0.8	0.09	0.6	0.60	0.11	4.7	2.6	12	17	18.4	0.16	15.36	Potentially Acid Forming
701-22-140	Andesite Porphyry	L087	184	1	0.04	1.24	0.12	0.94	0.94	0.18	3.8	2.4	24	30	28.8	0.03	27.76	Potentially Acid Forming
701-22-141	Andesite Porphyry	L087	200	3.5	0.04	1.25	0.095	1.07	1.07	0.085	4.3	2.5	19.5	24.5	32.7	0.11	29.24	Potentially Acid Forming
701-22-142	Andesite Porphyry	L087	210	5	0.02	0.1	0.05		0.05	0	5.9	4.9	0	4	1.5	0.00	-3.47	Non Acid Forming
701-22-143	Andesite Porphyry	L087	216	-1	0.04	2.5	0.4	1.52	1.52	0.58	3	2.4	38	45	46.5	-0.02	47.51	Potentially Acid Forming
701-22-144	Andesite Porphyry	L087	252	-2	0.02	11.56	1.39	5.58	5.58	4.59	3	2.4	178	193	170.7	-0.01	172.75	Potentially Acid Forming
701-22-145	Andesite Porphyry	L087	262	-7	0.02	26.63	1.19	18.95	18.95	6.49	2.7	2.3	493	533	579.9	-0.01	586.87	Potentially Acid Forming
701-22-146	Andesite Porphyry	L087	272	-1	0.01	9.82	0.7	4.84	4.84	4.28	3.1	2.4	149	162	148.1	-0.01	149.10	Potentially Acid Forming
701-22-147	Andesite Porphyry	L087	292	2	0.03	3.84	0.3	2.81	2.81	0.73	3.4	2.3	74	81	86.0	0.02	83.99	Potentially Acid Forming
701-22-148	Hydrothermal Breccia	L087	330	-2	0.01	13.32	1.17	7.94	7.94	4.21	3.3	2.3	216	236	243.0	-0.01	244.96	Potentially Acid Forming
701-22-149	Andesite Porphyry	L087	349.7	0	0.04	2.03	0.25	1.69	1.69	0.09	3.3	2.3	35	42	51.7	0.00	51.71	Potentially Acid Forming
701-22-150	Andesite Porphyry	L087	340	-2	0.02	5.75	0.34	4	4.00	1.41	3.2	2.2	133	143	122.4	-0.02	124.40	Potentially Acid Forming

APPENDIX C

Multi-Element Analysis Results

Knight Piésold
CONSULTING

Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**0.07**	**82000**	**1.5**	**10**	**500**	**2.6**	**0.048**	**41000**	**0.11**	**68**	**20**	**100**	**3**	**50**	**6**	**3.8**	**2.1**	**4.1**	**18**	**7.7**	**1.8**	**5.3**	**0.05**	**1.4**	**0.049**	**21000**	**32**	**20**	**0.51**	**23000**	**950**
Andesite Porphyry	LS001	25	701-22-001	0.685	103517	4.1	10	255.25	2.015	0.155	966.5	0.2	65.425	1.3	12.5	2.59	409.05	2.41	1.12	1.02	1.09	15.865	3.23	1.03	1.785	0.01	0.435	0.5825	38446.5	37.265	5.3	0.169	3914	163.5
Andesite Porphyry	LS001	59	701-22-002	0.11	77727	1.6	13	426.1	1.96	0.33	2481	0.75	65.36	12.6	10	3.68	20.6	2.51	1.53	1.02	5.11	16.56	2.94	1.05	1.56	0.01	0.52	0.105	30829	37.9	12.7	0.243	6818	9922
Andesite Porphyry	LS001	65.5	701-22-003	0.86	81128	10.7	10	381.5	2.5	6.78	1432	0.68	46.42	17.3	23	5.8	756.1	4.4	2.85	1.04	5.77	32.57	4.02	0.9	1.17	0.01	0.94	1.456	37121	27.29	2.2	0.406	2838	291
Andesite Porphyry	LS001	89.25	701-22-004	1.16	79579	12.4	10	542.1	1.16	7.05	1079	0.24	69.4	11.8	12	3.18	555.8	5.02	2.86	1.52	4.51	26.34	5.13	1	1.46	0.03	1.05	1.132	35174	37.25	4.9	0.368	3051	133
Andesite Porphyry	LS001	122	701-22-005	0.54	90610	3.7	10	339.8	1.9	0.74	383	0.12	71.18	4.3	12	3.18	45.6	2.68	1.5	1.01	1.58	19.58	3.19	1.18	1.55	0.01	0.65	0.676	35318	38.73	13.6	0.212	7822	1142
Dyke	LS001	136.75	701-22-006	0.65	87705	7.1	10	448.9	0.68	6.94	819	0.04	54.06	11.1	14	1.9	127.9	4.07	2.23	1.2	3.57	28.31	4.15	0.88	1.63	0.02	0.78	0.663	39963	27.27	2.5	0.264	2892	82
Dyke	LS001	185	701-22-007	1.12	58688	789.6	10	584	0.28	10.93	645	0.13	47.41	22.8	20	0.12	817.9	1.9	0.69	1.48	15.86	18.92	3.73	1.83	0.95	0.18	0.26	0.405	2307	21.06	35.3	0.106	136	41
Dyke	LS001	221.65	701-22-008	0.22	80964	37.3	10	452.1	0.16	6.33	967	0.37	29.96	15.6	26	0.1	634.9	0.95	0.3	0.69	4.85	30.12	2.02	0.89	1.06	0.02	0.13	0.092	7904	16.11	4.9	0.058	122	27
Andesite Porphyry	LS001	249.15	701-22-009	0.13	91995	33.9	10	572.7	0.6	0.99	817	0.13	55.84	5.2	13	1.42	170.1	1.2	0.49	0.94	1.31	24.4	2.52	1.26	1.15	0.02	0.18	0.156	37872	30.23	2.9	0.073	2139	54
Andesite Porphyry	LS001	290.75	701-22-010	0.15	86896	9.4	10	393	0.5	3.17	578	0.12	37.29	10.9	19	0.93	383.7	0.79	0.4	0.67	2.93	24.97	1.65	0.86	0.88	0.01	0.13	0.33	31259	20.77	4.3	0.076	1507	72
Andesite Porphyry	LS001	304.05	701-22-011	1	80277	12.5	10	384.8	0.4	16.79	653	0.1	43.59	19.3	26	0.19	1365.5	0.94	0.43	0.77	7.28	35.11	2.01	1.33	1.44	0.04	0.16	0.21	7861	24.18	25.1	0.093	176	42
Andesite Porphyry	LS001	368.85	701-22-012	0.82	86945	4.9	10	607.5	1.27	5.16	618	0.8	76.58	14.7	19	2.36	306	7.7	3.86	2.36	5.16	26.73	7.7	1.07	1.69	0.03	1.49	0.426	32394	42.52	6.5	0.371	2952	51
Andesite Porphyry	LS001	395	701-22-013	0.14	94738	8.4	10	344.8	1.39	2.21	556	0.05	73.5	9.6	17	1.53	922.7	5.67	2.9	1.59	2.24	19.82	5.6	1.42	2.04	0.01	1.1	0.729	28083	41.01	30.6	0.316	2593	93
Andesite Porphyry	LS001	411.1	701-22-014	0.41	67660	90.4	10	351.1	0.16	2.93	531	0.62	71.86	21	18	0.12	5916	0.8	0.26	0.97	7.8	16.91	1.95	2.49	0.21	0.02	0.1	0.205	4843	44.8	7.2	0.037	120	30
Andesite Porphyry	LS001	423.5	701-22-015	0.09	61701	42.4	10	449.4	0.17	1.13	593	0.08	46.46	21.3	17	0.11	815.9	0.24	0.09	0.63	9.39	4.4	0.98	1.23	0.12	0.02	0.03	0.024	12052	26.4	4.7	0.014	106	30
Andesite Porphyry	LS002	94.3	701-22-016	0.17	90445	2.9	10	1084.9	0.78	0.19	456	0.03	44.35	13.1	14	1.69	597.7	1.26	0.68	0.53	1.83	16.27	1.61	1.62	0.51	0.02	0.25	0.034	27655	28.24	3	0.081	2688	45
Breccia	LS002	104.13	701-22-017	0.25	89815	16.5	10	917.2	0.88	0.43	388	0.03	45.24	16.6	12	2.32	647.2	1.37	0.74	0.55	2.18	16.66	1.69	1.58	0.3	0.02	0.26	0.104	28772	29.07	3.1	0.09	3079	61
Andesite Porphyry	LS002	128.6	701-22-018	0.12	87842	8.2	10	986.7	0.57	0.39	356	0.19	53.64	11.7	18	1.84	437	1.99	0.95	0.93	2.06	16.66	2.59	1.52	0.33	0.02	0.36	0.035	30097	30.18	3.3	0.114	2684	33
Andesite Porphyry	LS002	148.4	701-22-019	0.16	86844	20.3	10	750	0.98	0.3	283	0.05	61.46	11.4	15	2.13	431.5	2.26	1.2	0.97	2.62	16.33	2.73	1.37	0.53	0.01	0.42	0.068	34562	35.94	2.7	0.145	2937	44
Diorite Porphyry	LS002	355.8	701-22-020	0.17	69759	1.3	10	1144.9	1.1	0.06	3774	0.2	50.47	12.6	18	7.93	890.5	1.78	0.9	0.88	6.69	15.03	2.48	0.79	0.12	0.01	0.33	0.029	22713	26.97	3.7	0.104	7768	2062
Andesite Porphyry	LS002	373	701-22-021	1.51	86132	14.9	10	301.2	1.46	1.41	924.5	1.375	68.265	20.6	16.5	12.77	1318.95	3.29	1.795	1.335	7.23	19.12	4.125	1.285	0.15	0.025	0.625	0.4145	21548	37.94	15.85	0.1955	4472.5	4588
Andesite Porphyry	LS002	422.5	701-22-022	0.31	89437	5.5	10	461.3	0.91	0.45	386	0.58	66.88	15.7	11	3.58	592.4	2.67	1.39	1.12	2.48	20.64	3.52	1.73	0.31	0.03	0.52	0.159	26166	35.68	29.8	0.177	3004	145
Andesite Porphyry	LS002	435.3	701-22-023	0.21	90678	3.9	10	536.6	1.12	0.43	502	0.78	68.05	16.1	15	3.51	396.8	2.63	1.36	1.3	2.98	18.9	3.49	1.51	0.71	0.02	0.49	0.066	26125	36.93	16.7	0.167	2823	1297
Andesite Porphyry	LS002	448.85	701-22-024	1.81	85770	47.9	10	646.5	1.25	0.44	563	1.81	65.33	22.2	11	5.66	668	3.57	2.01	1.18	3.62	19.45	3.72	1.21	0.3	0.07	0.69	0.701	35515	36.44	6.3	0.224	3955	65
Andesite Porphyry	LS002	472.85	701-22-025	0.24	91866	6.1	10	1129.3	0.93	0.11	540	1.84	86.89	13.5	20	2.43	961.2	5.66	3.4	1.7	1.18	17.29	5.4	1.88	0.47	0.01	1.16	0.062	20377	47.58	15.8	0.453	2374	41
Andesite Porphyry	LS003	21.3	701-22-026	0.46	78451	15.5	10	403.7	0.81	2.46	1160	0.03	42.38	0.6	18	1.17	273.8	0.98	0.52	0.8	3.74	20.09	2.05	0.95	1.6	0.01	0.19	1.252	32775	22.55	0.5	0.103	2199	490
Andesite Porphyry	LS003	70	701-22-027	0.18	85064	1.6	10	721.9	0.94	1.37	757	0.76	55.69	14	20	1.49	36.4	1.96	1.15	0.87	3.1	17.82	6.71	1.12	1.64	0.02	0.39	0.345	38759	31.12	2.7	0.193	3307	119
Andesite Porphyry	LS003	74.3	701-22-028	0.17	63156	2.7	10	345.7	1.24	1.23	307	2.05	33.21	4.9	16	0.89	44.3	2.06	0.84	0.66	1.04	12.34	1.99	0.96	1.33	0.04	0.28	0.392	21720	16.37	2.8	0.117	1687	93
Andesite Porphyry	LS003	97	701-22-029	0.49	91262	20.3	10	452.5	1.14	2.64	582	0.13	27.5	12.3	13	3.63	393.5	7.4	1.01	0.61	2.94	18.68	1.55	1.13	1.79	0.04	0.33	0.993	34180	13.74	1.8	0.162	2469	142
Andesite Porphyry	LS003	115.5	701-22-030	0.59	71142	16	10	235.1	0.66	5.33	729	0.04	20.58	16.1	16	1.12	319.6	1.2	0.66	0.51	7.07	24.06	1.63	0.54	1.11	0.04	0.22	0.748	16239	11.08	0.7	0.129	798	74
Andesite Porphyry	LS003	131.7	701-22-031	0.22	88979	5.9	10	197.1	1.68	1.28	403	0.15	24.61	11.3	19	1.72	238.1	2.05	1.1	0.81	1.65	18.02	2.77	1.57	1.96	0.01	0.36	4.726	26502	12.65	3.2	0.178	1935	150
Breccia	LS003	146.75	701-22-032	0.68	80243	31.1	10	342.5	0.96	1.55	761	0.58	41.1	15.9	39	3.19	419.4	1.63	0.96	0.67	3.78	18.74	2.04	1.04	1.73	0.03	0.32	0.915	37060	21.45	0.5	0.186	2432	205
Diorite Porphyry	LS003	170.02	701-22-033	0.58	81158	15.5	10	566.2	0.85	2.09	920	0.48	39.13	11.2	13	3.45	317	1.56	0.91	0.7	3.91	23.93	2	0.8	1.44	0.01	0.29	0.459	35907	22.01	0.5	0.154	2004	135
Diorite Porphyry	LS003	182.4	701-22-034	0.46	90464	13.5	10	637.5	1.58	1.98	595	0.03	49.8	10.8	11	2.77	291.6	3.02	1.1	1.12	3.32	18.82	4.23	1.21	1.7	0.01	0.45	0.791	29319	25.29	2.7	0.173	1985	200
Diorite Porphyry	LS003	274.25	701-22-035	0.3	70308	31.6	10	351	0.21	3.32	614	0.81	41.33	16.4	67	0.42	709.3	1.14	0.59	1.03	8.2	7.4	2.52	0.68	1.17	0.02	0.19	0.083	17222	22.69	1.5	0.123	191	54
Diorite Porphyry	LS003	298.3	701-22-036	0.57	80956	14.3	10	478.4	0.64	9.53	1025	0.06	30.91	18.5	18	1.49	271.3	1.67	0.88	0.8	7.71	38.25	2.67	0.64	1.54	0.03	0.31	0.515	31247	16.61	0.7	0.151	1338	53
Diorite Porphyry	LS003	305	701-22-037	0.23	86129	7.2	10	509.5	0.54	4.72	1083	0.02	29.54	14.7	17	1.56	83.1	1.62	1.04	0.74	3.74	31.02	2.2	0.9	1.54	0.01	0.32	0.638	35109	14.86	0.6	0.169	1493	53
Breccia	LS003	324.8	701-22-038	0.39	74621	6.4	10	319	0.52	5.35	360	0.08	30.19	21.3	22	1.29	440.4	1.6	0.87	0.71	7.42	24.56	1.84	0.67	0.94	0.01	0.31	0.311	33090	18.65	1.1	0.134	1143	127
Andesite Porphyry	LS003	330.2	701-22-039	0.3	89832	4.7	10	374.2	0.68	0.88	548	0.09	46.5	20.4	26	1.28	114.3	2.77	1.42	0.76	2.82	18.94	2.73	1.02	2.23	0.02	0.5	0.623	34248	27.25	2.1	0.208	1806	78
Diorite Porphyry	LS003	342.8	701-22-040	0.11	78361	6.3	10	527.3	0.53	1.32	17724	0.07	30.53	17.3	14	1.12	105.8	1.26	0.63	0.8	3.53	25.87	2.21	0.81	1.39	0.01	0.23	0.164	31426	16.28	0.9	0.126	1843	70
Feldspar Porphyry	LS003	353.35	701-22-041	0.165	81866	8	10	311.7	0.32	1.68	814.5	0.14	45.965	12.85	13.5	0.39	60.55	0.965	0.42	0.785	5.405	12.135	2.285	0.755	1.08	0.01	0.15	0.0625	10531	24.835	1.15	0.09	517	47
Andesite Porphyry	LS003	377.5	701-22-042	0.13	70220	18.3	10	287.8	0.21	1.02	552	0.48	45.29	14	10	0.34	65.8	0.69	0.23	0.69	4.83	8.91	1.59	0.59	0.47	0.02	0.09	0.03	13445	26.46	1.4	0.036	139	38
Porphyry	LS003	394.75	701-22-043	0.06	94987	2.5	10	591.7	0.89	0.47	300	0.05	23.35	3.7	21	0.79	448	1.3	0.84	0.41	0.75	17.1	1.37	1.07	1.83	0.01	0.27	0.129	28652	13.93	3.4	0.167	977	56
Porphyry	LS003	410.9	701-22-044	0.07	99172	1.9	10	441.8	0.61	0.91	396	0.24	22.11	19.4	23	0.29	102.9	1.52	0.92	0.35	0.71	17.18	1.28	0.97	1.38	0.01	0.31	0.186	26211	15.1	6.1	0.151	384	42
Breccia	LS003	440.8	701-22-045	0.58	56485	21.3	10	192.8	0.25	2.97	339	0.05	36.22	13	27	0.19	666.2	0.88	0.42	0.58	6.73	8.08	1.77	0.87	0.32	0.02	0.15	0.422	5616	19.48	4.1	0.061	117	40
Andesite Porphyry	LS004	30.21	701-22-046	1.64	74128	36.3	13	584.9	2.12	0.75	2409	7.73	51.06	23.1	11	3	191.3	1.67	1.23	0.83	5.57	19.07	2.4	0.84	1.14	0.01	0.36	3.274	35612	28.6	2.7	0.18	6077	22548
Andesite Porphyry	LS004	50.21	701-22-047	0.12	77670	4.5	12	245.6	1.48	0.06	23035	0.29	52.53	9.7	11	3.16	10.9	2.03	1.22	0.83	2.75	16.55	2.35	0.83	1.33	0.01	0.39	0.035	36106	29.69	3.7	0.19	18699	5202
Andesite Porphyry	LS004	69.25	701-22-048	0.26	81970	12.2	17	112.3	2.07	0.05	2139	4.94	53.42	10.4	19	5.4	15	1.47	0.99	0.77	3.84	20.51	2.1	1.02	1.51	0.01	0.32	0.697	32629	29.57	5	0.168	22825	23584
Andesite Porphyry	LS004	110.45	701-22-049	1.11	88013	24.8	10	226.4	1.79	1.44	1118	0.16	36.48	11.6	16	5.49	300.6	2.79	1.68	0.97	4.86	21.73	3.24	0.79	1.91	0.02	0.6	1.992	39809	19.67	1.3	0.234	3257	398
Andesite Porphyry	LS004	134.45	701-22-050	2.33	81532	46.6	10	275.3	0.25	2.45	727	0.16	40.53	18.3	56	0.27	612.9	1.3	0.74	0.97	9.07	19.12	2.76	1.22	1.7	0.03	0.25	0.548	795	21.79	91.4	0.156	276	1372
Diorite Porphyry	LS005	28.4	701-22-051	0.53	74758	12.1	12	1024.8	1.28	1.24	27866	1.94	55.18	11.6	8	1.94	121.7	2.05	1.23	0.92	3.87	16.16	2.68	0.54	1.5	0.01	0.41	1.021	32133	32.13	7	0.186	13348	3669
Diorite Porphyry	LS005	50.1	701-22-052	0.12	75404	3.8	10	856.6	1.14	0.11	29505	0.17	71	9.4	12	1.83	18.8	2.49	1.43	1.12	2.85	15.41	3.02	0.89	1.6	0.01	0.49	0.056	32950	40.09	8.7	0.234	17656	1747
Breccia	LS005	72.5	701-22-053	1.19	79419	5.8	11	378.5	1.25	2.19	2929	4.32	68.75	12.4	9	1.78	215.1	2.45	1.41	1.3	5.2	19.45	3.24	0.97	1.92	0.06	0.49	0.224	32405	37.22	9.7	0.196	10517	20786
Breccia	LS005	133.9	701-22-054	1.45	77268	44.6	10	363.2	2.51	1.95	1131	1.58	66.32	17	26	4.84	325.5	3.64	2.47	1.1	6.41	16.84	3.43	0.77	1.47	0.04	0.82	0.259	34556	36.34	3	0.318	4717	401
Diorite Porphyry	LS005	141.4	701-22-055	0.18	84906	6.2	10	581.1	1.81	0.2	2575	0.07	71.61	9.8	11	2.04	11	2.75	1.6	1.15	3.4	18.09	3.38	0.97	1.89	0.01	0.55	0.043	34304	40.77	6.3	0.251	7312	4184
Andesite Porphyry	LS006	34.3	701-22-056	0.17	82449	4	10	540.3	0.78	0.7	205	0.04	58.01	8.6	8	2.6	165.8	1.32	0.84	0.52	1.99	16.95	1.51	1.12	1.87	0.01	0.39	0.123	37994	34.51	2.1	0.156	3843	129
Andesite Porphyry	LS006	52.3	701-22-057	0.21	102918	39.7	10	1364.1	0.9	0.42	287	1.04	86.79	61.4	12	2.85	45.3	3.8	2.6	1.35	3.04	17.11	4.15	0.91	1.7	0.01	0.84	0.096	26329	49.58	1.6	0.486	2726	50
Andesite Porphyry	LS006	70.3	701-22-058	0.15	109627	4.8	10	1041.3	1.36	0.42	338	0.32	90.64	24.1	19	2.58	31.7	3.15	1.96	1.72	1.67	16.63	4.38	0.98	1.92	0.01	0.65	0.049	24399	49.66	1.6	0.335	2527	46
Andesite Porphyry	LS006	127.6	701-22-059	0.36	86504	5.7	10	282.2	1.54	0.13	1201	5.53	70.24	10	10	7.26	17.4	2.08	1.36	0.98	3.82	18.57	2.76	1.14	1.7	0.05	0.45	0.938	35570	40.71	3.6	0.21	4326	5554
Breccia	LS006	140.4	701-22-060	0.7	87385	15.9	10	652.6	1.7	1.55	919	2.75	81.64	12.8	12	11.86	87.9	2.99	1.94	1.34	3.4	20.54	4.08	0.93	1.86	0.08	2.05	1.017	38085	45.89	2.6	0.269	3721	160
Porphyry	LK002	16.05	701-22-061	0.535	76271	6.8	10	397.85	0.765	3.435	843.5	0.04	52.005	0.6	10	0.855	163.15	1.05	0.54	0.725	3.345	18.5	1.875	1.005	1.54	0.01	0.18	0.415	37111.5	28.925	0.15	0.1055	2028	122.5
Andesite Porphyry	LK002	36.3	701-22-062	0.06	88566	10.2	10	252.3	0.84	1.62	674	0.02	55.75	3.5	13	1.05	87.4	1.16	0.52	0.9	2.38	17.77	2.32	1.14	1.55	0.01	0.18	0.552	37380	31.58	0.4	0.098	1882	118
Breccia	LK002	113.6	701-22-063	0.82	69550	86.5	10	204.5	0.3	3.07	803	0.05	44.72	15.2	40	0.18	1982.7	1.07	0.52	0.78	7.6	13.68	2.18	1.7	1.11	0.06	0.18	0.172	5571	24.22	2.1	0.111	173	44
Porphyry	LK002	133.3	701-22-064	0.46	80467	21.9	10	249.2	0.2	2.21	900	0.05	42.44	9.7	30	0.08	562.5	0.78	0.4	0.76	4.43	14.23	1.97	1.3	0.86	0.01	0.11	0.185	23261	22.83	0.3	0.068	113	41
Porphyry	LK002	167.3	701-22-065	0.38	73634	14.3	10	418.2	0.09	1.86	819	0.04	26.44	12.3	18	0.06	456.4	0.48	0.19	0.55	6.53	9.79	1.47	0.85	0.65	0.01	0.07	0.193	19430	13.91	0.7	0.038	107	42
Andesite Porphyry	LK003	40.3	701-22-066	0.1	116699	4.7	10	367.7	2.05	0.13	317	10.19	54.15	9.2	28	3.11	55	1.77	1.04	0.8	1.15	19.79	2.31	1.44	1.52	0.03	0.35	0.713	34470	31.68	4.4	0.163	2308	188
Breccia	LK003	54.9	701-22-067	1.29	72160	24.6	10	213	0.99	2.28	182	3.21	69.5	11.5	41	6.08	584.7	1.68	1.01	0.76	3.27	16.06	2.49	1.59	1.43	0.08	0.31	1.104	28001	42.14	2.5	0.173	2433	175
Breccia	LK003	108.6	701-22-068	2.37	81507	29.7	10	421.5	1.06	4.24	397	1.36	55.01	17.9	45	5.74	410.8	1.64	0.93	0.77	5.22	19.2	2.35	1.09	1.35	0.28	0.29	0.588	29777	30.72	1.8	0.152	1980	128
Pyroclastic	LK003	128.7	701-22-069	0.79	79365	18.7	10	382.4	1.31	1.68	440	6.07	58.11	16	83	10.97	147.7	1.84	0.98	0.85	2.68	17.61	2.83	1.44	1.36	0.48	0.35	0.791	32554	30.62	1.8	0.171	3026	219
Tuff	LK003	145.6	701-22-070	0.93	79481	13.4	10	367.1	1.28	1.04	262	1.87	47.78	12.4	49	7.08	181.2	1.38	1.05	0.62	2.64	17.03	2.02	1.23	1.7	0.4	0.3	0.309	32478	25.81	2.7	0.17	2891	188
Hornblende Porphyry	LK004	51.23	701-22-071	0.06	81758	2.2	14	588.2	1.22	0.13	36192	0.16	65.85	8.8	9	1.69	19.9	2.31	1.39	1.05	2.76	16	2.98	1.12	1.97	0.01	0.48	0.026	25548	36.78	8.6	0.221	10769	817
Breccia	LK004	71.63	701-22-072	0.17	78189	4.6	17	1384.9	1.21	0.28	37025	0.36	71.01	10.7	12	2.26	67	2.32	1.36	1.07	2.98	15.82	3.06	1.03	1.61	0.01	0.46	0.12	25453	40.22	6.8	0.209	17165	2436
Breccia	LK004	81.52	701-22-073	0.17	78084	14.8	15	176.6	1.38	0.11	25684	0.65	53.61	9	12	3.11	21.2	2.15	1.26	0.97	3.06	16.47	2.48	0.82	1.32	0.01	0.42	0.092	31413	30.17	8.1	0.211	20189	10476
Andesite Porphyry	LK004	104.71	701-22-074	1.94	77045	108	10	246.5	2.45	1.79	4535	9.84	59.5	13.1	13	8.62	322.1	1.7	1.02	0.92	5.43	18.97	2.64	0.97	1.42	0.06	0.37	3.2	33243	32.91	4.6	0.162	6675	13361
Diorite Porphyry	LK004	137.51	701-22-075	2.72	65841	78.6	10	380.9	1.32	2.03	1492	0.39	58.9	4.6	19	5.72	1075.6	3.45	2.23	1.05	3.56	14.42	3.34	0.66	1.57	0.06	0.74	0.861	28869	34	1.7	0.322	2792	659
Breccia	LK006	45.2	701-22-076	1.25	80115	249.6	10	220.3	2.15	0.55	780	0.2	66.08	56.9	267	7.17	230.3	4.59	1.84	1.61	13.94	15.29	5.48	0.75	1.82	0.01	0.76	1.014	25941	33.94	4.4	0.211	2624	227
Andesite Porphyry	LK006	51.8	701-22-077	0.22	104651	7.7	10	115	1.73	0.18	586	4.65	51.71	8.4	39	2.15	101.4	2.8	1.49	1.01	1.71	17.78	3.26	1.54	2.16	0.05	0.52	1.008	29624	28.66	8.4	0.229	3505	282
Andesite Porphyry	LK006	129.7	701-22-078	1.03	83124	132.5	10	427.9	0.86	2.78	1070	0.14	62.18	14.1	35	3.36	307.1	2.68	1.42	1.18	4.07	21.78	4.13	1.2	2.1	0.53	0.49	0.354	33556	31.94	2	0.232	2369	173
Breccia	LK006	145.7	701-22-079	1.42	77515	40.1	10	316	0.64	5.67	664	0.37	57.02	16.4	85	4.54	471	2.31	1.35	1.07	3.69	36.4	3.44	1.18	1.98	0.23	0.42	0.437	28330	30.56	6.6	0.238	2353	77
Diorite Porphyry	LK006	165.86	701-22-080	0.52	85717	16.5	10	432.8	0.3	0.96	713	0.15	20.95	11.5	16	1.19	76.2	0.87	0.44	0.59	3.67	22.67	1.87	0.79	0.97	0.02	0.14	0.194	24680	11.09	1.5	0.078	1120	74

Appendix C

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**0.07**	**82000**	**1.5**	**10**	**500**	**2.6**	**0.048**	**41000**	**0.11**	**68**	**20**	**100**	**3**	**50**	**6**	**3.8**	**2.1**	**4.1**	**18**	**7.7**	**1.8**	**5.3**	**0.05**	**1.4**	**0.049**	**21000**	**32**	**20**	**0.51**	**23000**	**950**
Tuff	LK006	191.35	701-22-081	0.755	74508.5	48.55	10	300.9	0.755	3.81	344	0.03	53.315	22.85	92	8.42	511.9	1.26	0.79	0.735	6.17	19.205	2.635	1.14	1.475	0.165	0.245	0.189	23433.5	27.82	2.7	0.143	1960.5	43.5
Pyroclastic	LK006	214.6	701-22-082	0.34	74022	37.7	10	302.9	0.51	1.15	682	0.08	52.45	6.6	22	0.88	166.3	1.07	0.61	0.77	3.21	15.3	2.15	1.04	1.51	0.01	0.19	0.076	20608	29.1	2.6	0.152	683	98
Andesite Porphyry	L013	5	701-22-083	0.45	103191	5	10	356.1	1.15	0.54	500	0.02	60.51	1.3	10	3.48	786.3	0.92	0.48	0.49	1.07	17.42	1.74	1.08	0.93	0.02	0.17	0.135	19976	40.68	2.3	0.079	2226	29
Andesite Porphyry	L013	11	701-22-084	0.3	103902	8.3	10	1591.3	1	0.09	606	0.03	45.83	0.7	17	1.62	647.2	1.31	0.66	0.67	6.6	17.59	2.13	1.06	0.47	0.03	0.24	0.3	24954	29.29	1.8	0.075	1651	46
Andesite Porphyry	L013	17.7	701-22-085	0.23	92568	13.5	10	559.9	0.76	0.18	335	0.02	44.75	0.3	11	1.84	222.8	0.77	0.37	0.63	2.37	17.14	1.15	1.54	0.9	0.01	0.14	0.091	31004	32.92	2.9	0.057	2788	42
Andesite Porphyry	L013	23.4	701-22-086	0.22	89426	3.6	10	555.7	0.95	0.25	362	0.02	83.58	1.2	14	1.84	157.1	0.82	0.34	0.68	2.71	17.02	1.71	1.61	0.45	0.01	0.14	0.137	29273	63.17	2.4	0.051	2974	60
Andesite Porphyry	L013	28.9	701-22-087	0.26	97282	2.3	10	417.9	0.8	0.31	298	0.03	62.22	0.8	16	1.89	151.2	0.85	0.39	0.52	0.82	16.28	1.41	1.45	0.3	0.01	0.15	0.134	30891	35.17	2.9	0.055	2725	49
Andesite Porphyry	L013	34.9	701-22-088	0.21	92565	7.1	10	884.6	0.71	0.23	433	0.03	51.47	0.5	16	1.82	214.5	1.55	0.81	0.5	1.84	18.58	1.72	1.58	0.36	0.01	0.3	0.406	33222	36.9	4.8	0.088	1733	63
Andesite Porphyry	L013	41.25	701-22-089	0.15	100724	5.4	10	901.4	0.66	0.43	471	0.02	38.26	0.6	20	1.62	260.6	1.6	0.88	0.5	1.3	17.83	1.7	1.57	0.37	0.01	0.3	0.359	37270	25.96	3.5	0.095	2239	53
Andesite Porphyry	L013	47.7	701-22-090	0.52	90853	33.4	10	278.4	0.69	1.45	395	0.02	39.74	0.6	28	2.04	409.3	1.29	0.63	0.5	2.86	19.33	1.6	1.97	0.55	0.01	0.23	0.422	28578	23.82	4.3	0.074	2700	57
Andesite Porphyry	L013	52.9	701-22-091	0.17	94139	5.2	10	741.2	0.6	0.29	363	0.02	41.61	0.8	16	1.51	306.4	1.22	0.6	0.6	1.25	16.79	1.76	1.49	0.33	0.01	0.22	0.241	24390	26.07	3	0.101	2005	47
Andesite Porphyry	L013	58.8	701-22-092	1.24	84187	12.8	10	414.7	0.89	1.57	367	0.02	47.01	0.6	18	2.74	291.3	1.17	0.65	0.54	3.7	18.6	1.58	1.78	1.02	0.01	0.22	0.295	33588	29.22	2.5	0.094	3482	60
Andesite Porphyry	L013	69	701-22-093	0.27	76378	8.6	10	920	0.84	0.22	283	0.02	43.76	0.8	14	2.1	299.1	1.7	0.93	0.58	3.77	16.54	1.81	1.77	0.37	0.01	0.33	0.212	33802	27.76	2	0.092	3481	94
Hydrothermal Breccia	L013	75	701-22-094	2.59	67415	14.8	10	993.4	0.3	1.12	986	0.02	88.89	0.3	22	0.08	62.6	1.6	0.61	1.64	3.7	8.65	3.86	1.16	1.03	0.04	0.26	0.031	19072	50.74	0.7	0.103	226	56
Hydrothermal Breccia	L013	81.9	701-22-095	6.22	63052	27.1	10	891.5	0.2	0.95	1046	0.02	82.64	0.6	28	0.09	117.4	1.31	0.43	1.2	7.25	16.47	2.78	1.51	0.36	0.08	0.19	0.117	20356	44.79	1.3	0.047	99	47
Hydrothermal Breccia	L013	86.55	701-22-096	4.05	76280	14.9	10	668.4	0.09	1.44	1108	0.03	94.96	1.3	37	0.13	30.9	1.1	0.41	1.04	2.79	12.96	2.23	1.35	0.61	0.01	0.17	0.055	21447	52.41	0.9	0.058	109	61
Fault Breccia	L013	93.25	701-22-097	0.31	63817	53.3	10	708.2	0.29	5.12	972	0.02	89.91	0.4	18	0.22	120.1	2.01	0.45	2.21	8.87	35.91	5.23	2.19	0.61	0.02	0.22	0.262	10461	48.17	1.8	0.051	250	43
Hydrothermal Breccia	L013	100.4	701-22-098	8.94	71032	234.9	10	996.5	0.12	2.17	780	0.02	108.5	0.4	30	0.07	41.4	2.99	0.7	1.84	11.02	24.61	5.16	3.69	0.35	0.6	0.41	0.105	21136	65.97	0.7	0.05	108	35
Andesite Porphyry	L013	127.55	701-22-099	0.13	92005	4	10	608.4	1.26	0.33	664	0.06	60.72	15.3	14	1.37	672.2	2.51	1.14	1.2	2.59	16.54	3.62	1.57	0.77	0.01	0.43	0.18	27989	35.13	2.4	0.151	2656	42
Andesite Porphyry	L013	177.05	701-22-100	0.13	77104	9.6	10	299.5	0.31	0.46	569	0.03	62.95	9.7	33	0.23	798.8	0.59	0.25	0.63	4.72	7.95	1.32	1.6	0.55	0.01	0.1	0.027	12100	37.92	2.4	0.044	427	35
Andesite Porphyry	L013	199.75	701-22-101	0.37	84181.5	70.2	10	476.55	0.875	3.2	832.5	0.19	54.25	14.9	8.5	1.21	331.35	1.985	1.245	0.76	4.555	17.2	2.43	1.31	1.115	0.01	0.415	0.385	34854	32.72	0.9	0.188	2658.5	37.5
Fault Breccia	L223	121.75	701-22-102	1.15	73986	13.6	10	254.4	0.64	3.78	565	0.13	38.1	15.9	20	2.78	365.4	1.3	0.73	0.78	5.53	25.96	1.9	1.14	1.26	0.01	0.24	0.291	16673	20.45	5.3	0.14	624	29
Andesite Porphyry	L223	131	701-22-103	0.88	90218	25.2	10	509.6	1.59	2.78	702	1.59	63	12.5	49	2.69	542.7	2.14	1	1.01	3.75	17.83	2.82	1.32	1.55	0.01	0.37	0.25	23250	35.59	7.9	0.158	2617	111
Andesite Porphyry	L223	137	701-22-104	0.11	92445	3.4	10	2336.4	1.32	0.33	2656	0.36	66.28	12	17	6.05	139.4	4.27	2.44	1.56	5.53	18.56	5.34	0.96	2.69	0.01	0.89	0.067	28107	35.11	16.1	0.356	6848	3212
Andesite Porphyry	L223	142.1	701-22-105	0.3	90010	10.8	10	366.1	1.87	0.47	2526	0.04	62.36	12.5	15	9.42	120.5	2.77	1.64	1.05	1.95	18.2	3.31	1.09	2.48	0.01	0.56	0.076	28004	34.57	7.1	0.241	5546	151
Andesite Porphyry	L223	150	701-22-106	0.06	83668	2.9	13	673.8	1.26	0.19	30074	0.15	59.29	11.3	14	5.91	44	2.54	1.49	1.09	3.09	16.32	3.2	1	2.09	0.01	0.53	0.017	28266	33.2	10.2	0.217	15884	648
Andesite Porphyry	L223	156	701-22-107	0.07	82823	4.7	14	550	1.18	0.1	31360	0.08	58.54	11.2	10	4.63	69.5	2.49	1.43	1.03	3.03	16.57	3.15	0.97	1.91	0.01	0.5	0.033	24193	32.64	11.8	0.214	16589	760
Andesite Porphyry	L223	164.55	701-22-108	0.05	78650	1.6	14	771.1	1.05	0.04	28364	0.03	53.73	10.5	12	2.67	25.2	2.44	1.37	0.99	2.9	15.99	2.86	0.98	1.97	0.01	0.47	0.019	25123	29.68	10.2	0.199	15034	597
Andesite Porphyry	L223	170	701-22-109	0.05	83545	1.5	16	807.5	1.04	0.08	33866	0.04	65.42	9.4	8	2.59	31.2	2.51	1.41	1.14	2.63	15.8	3.19	0.82	1.56	0.01	0.49	0.013	26237	36.77	8.3	0.208	12438	526
Andesite Porphyry	L223	178.05	701-22-110	0.05	83748	0.9	14	824.9	1.48	0.18	32675	0.04	61.29	10	8	2.88	41.5	2.33	1.3	1.02	2.41	16.58	2.94	0.92	1.66	0.01	0.45	0.013	28304	34.25	10.2	0.199	13872	435
Andesite Porphyry	L223	184	701-22-111	0.1	71817	4.5	24	586.1	0.98	0.17	60694	0.71	73.87	8.9	8	5.76	154.1	2.74	1.46	1.25	3.12	13.93	3.35	0.9	1.26	0.01	0.53	0.041	25014	43.26	9.9	0.216	12201	1154
Andesite Porphyry	L223	191.95	701-22-112	0.05	80740	2.5	23	636.7	1.08	0.07	41901	0.17	56.91	10.8	11	7.84	71.1	2.49	1.43	1.07	3.35	16.26	3.11	0.91	1.56	0.01	0.49	0.041	27898	31.27	11.1	0.218	13776	1023
Andesite Porphyry	L223	198	701-22-113	0.05	81245	2.2	21	507.8	1.2	0.06	45287	0.31	60.57	11.3	12	6.75	61.8	2.3	1.35	0.99	2.91	16.41	2.98	0.99	1.66	0.01	0.47	0.027	28264	33.53	10.2	0.219	10280	759
Andesite Porphyry	L223	206.5	701-22-114	0.05	75323	1.1	17	347.6	1.08	0.11	49237	0.39	54.75	8.4	11	5.59	65.1	2.22	1.24	0.9	2.6	16.03	2.7	0.76	1.23	0.01	0.43	0.03	23675	30.6	8	0.187	9481	677
Andesite Porphyry	L223	212	701-22-115	0.16	68794	6.1	23	282.4	1.13	0.19	42055	0.24	57.94	13.8	17	5.78	185.1	2.44	1.42	0.95	3.09	16.27	3.04	0.64	1.3	0.01	0.49	0.064	19691	32.88	13.5	0.203	11685	670
Andesite Porphyry	L223	220.05	701-22-116	0.21	74328	3.9	19	479.7	1.18	0.25	30275	0.1	64.71	13.1	12	4.49	80.9	2.8	1.61	1.29	2.91	17.19	3.56	0.82	2.04	0.01	0.56	0.023	21700	35.49	14.2	0.241	12043	528
Andesite Porphyry	L223	231.2	701-22-117	0.05	65118	2.7	19	667.6	0.9	0.45	27343	0.04	47.57	13.2	9	10.2	42.8	2.3	1.33	0.94	2.78	16.21	2.66	0.8	2	0.01	0.46	0.034	21691	26.09	15.3	0.2	13673	508
Andesite Porphyry	L223	240.4	701-22-118	0.1	66653	8.6	10	2144.2	1.01	0.26	6170	0.29	56.7	22	11	4.4	218.4	2.26	1.25	1.01	7.14	14.69	2.87	0.71	1.91	0.01	0.44	0.091	21586	31.07	8.3	0.183	10615	2952
Fault Breccia	L223	244	701-22-119	0.06	91667	10.1	10	950.2	1.84	0.29	979	0.07	74.59	7.4	7	2.81	134.9	6.37	3.73	1.95	1.65	18.66	6.2	1.04	2.53	0.01	1.28	0.059	10260	41.13	19.8	0.464	2006	44
Andesite Porphyry	L223	319.3	701-22-120	0.05	89302	1.9	10	1539.6	1.49	0.36	614	0.02	81.83	2.6	4	2.27	18.9	2.82	1.83	1.08	1.08	18.56	3.2	1.15	2.2	0.01	0.6	0.032	11398	44.06	3.9	0.299	2413	40
Andesite Porphyry	L223	325.4	701-22-121	0.19	90018	6.15	10	97.65	1.295	0.455	228	0.02	63.59	1.9	3.5	1.39	48.45	2.175	1.22	1.06	0.96	17.1	2.77	0.765	1.785	0.01	0.41	0.0855	11185.5	35.555	8.9	0.184	1416.5	32.5
Fault Breccia	L223	340.3	701-22-122	0.12	80384	6.7	10	270.5	1.28	0.82	470	0.05	68.37	6.5	4	1.41	267.4	4.6	3.49	1.09	1.08	18.17	3.31	1.08	2.36	0.01	1.1	0.153	11425	36.31	10	0.487	1183	34
Pyroclastic	L087	6	701-22-123	0.44	28106	13.3	10	443.2	0.14	0.63	3117	0.02	44.42	0.5	13	0.09	8.6	0.85	0.44	0.53	1.77	3.25	1.39	0.99	1.07	0.01	0.14	0.005	10074	24.28	0.5	0.094	952	34
Pyroclastic	L087	16	701-22-124	0.94	5217	9.4	10	1500.7	0.21	1.85	1360	0.02	27.48	0.3	11	0.11	9.2	0.65	0.41	0.26	0.79	1.22	0.86	1.16	0.97	0.05	0.12	0.005	1079	15.71	1.2	0.088	229	45
Pyroclastic	L087	26	701-22-125	0.61	47574	25.1	10	500.1	0.11	1.26	799	0.02	50.78	0.2	20	0.07	5.9	0.8	0.37	0.9	3.57	8.23	1.87	0.79	0.97	0.04	0.13	0.009	14691	28.1	0.2	0.077	206	31
Pyroclastic	L087	36	701-22-126	0.19	52739	20.6	10	711.6	0.21	1.36	789	0.02	50.63	0.4	19	0.07	3.7	0.87	0.48	0.85	1.9	8.98	2.08	0.78	1.85	0.03	0.16	0.005	11898	27.44	0.3	0.123	97	36
Pyroclastic	L087	46	701-22-127	0.25	59191	11.7	10	469.4	0.05	1.45	779	0.02	46.09	0.1	18	0.07	3.3	0.97	0.48	0.7	1.49	13.59	2.23	0.93	1.13	0.02	0.15	0.005	7169	22.5	0.3	0.111	119	29
Andesite Porphyry	L087	56	701-22-128	0.33	48233	17	10	412.2	0.13	1.54	801	0.03	65.76	0.3	22	0.07	8.8	1.15	0.63	1.06	2.73	6.8	2.58	1	1.44	0.01	0.19	0.008	15787	35.72	0.4	0.134	130	33
Fault Breccia	L087	66	701-22-129	0.55	30118	18.5	10	531	0.14	2.49	549	0.03	53.81	0.2	17	0.07	22	1.07	0.56	0.93	2.07	4.31	2.28	1.13	1.24	0.01	0.17	0.005	10276	31.39	0.2	0.125	123	40
Andesite Porphyry	L087	76	701-22-130	0.68	40052	23.6	10	416.9	0.13	1.75	634	0.02	35.18	0.2	17	0.08	9.6	0.83	0.5	0.7	1.74	6.76	1.69	1.18	1.12	0.01	0.16	0.009	13256	19.02	0.4	0.107	124	35
Andesite Porphyry	L087	86	701-22-131	0.49	33322	68.4	10	657	0.09	1.65	441	0.02	43.72	0.5	25	0.06	50.5	0.41	0.28	0.55	10.32	11.88	1.19	1.95	0.71	0.02	0.08	0.101	12564	24.22	0.3	0.073	149	28
Andesite Porphyry	L087	96	701-22-132	0.29	60424	101.5	10	560.9	0.19	3.63	666	0.02	44.38	0.2	9	0.08	22.7	0.81	0.4	0.76	1.74	14.62	1.87	0.69	1.21	0.01	0.13	0.023	9907	25.62	0.5	0.12	115	18
Andesite Porphyry	L087	106	701-22-133	0.57	59684	9	10	472.4	0.27	2.25	680	0.02	57.82	0.5	8	0.26	373.2	1.29	0.64	0.86	2.21	14.5	2.4	0.43	1.12	0.01	0.22	0.042	7249	30.95	0.5	0.138	459	37
Andesite Porphyry	L087	116	701-22-134	0.37	44946	16.9	10	794.9	0.06	4.42	640	0.02	70.03	0.2	12	0.09	98.1	0.89	0.34	0.92	4.27	17.56	2.08	0.55	0.61	0.01	0.13	0.053	5455	43.05	0.7	0.065	104	76
Andesite Porphyry	L087	126	701-22-135	0.59	52352	10.1	10	669.5	0.18	1.42	814	0.02	59.48	0.2	14	0.17	65.6	0.65	0.34	0.82	4.78	9.52	1.76	0.64	0.93	0.01	0.11	0.063	7254	32.65	0.5	0.073	102	107
Andesite Porphyry	L087	134	701-22-136	0.46	67255	4.5	10	335.6	0.96	3.15	512	0.03	56.73	1	9	1.14	46.3	1.84	1.12	0.76	3.47	26.79	2.39	1.06	1.91	0.02	0.39	0.285	28050	32.43	0.8	0.203	1621	246
Andesite Porphyry	L087	144	701-22-137	0.22	95143	14.5	10	654.6	1.06	0.28	503	3.37	28.86	48.5	8	2.04	276.6	1.89	1.14	0.53	1.51	15.39	1.8	1.22	1.46	0.04	0.38	0.224	41916	17.95	3.6	0.185	2952	43
Andesite Porphyry	L087	158	701-22-138	0.23	96617	4	10	495	1.82	0.75	568	0.74	76.3	9.2	10	5.34	79.7	2.8	1.6	1.17	1.26	17.24	3.31	1.31	1.71	0.02	0.55	0.108	35059	44.42	13.9	0.231	3446	57
Andesite Porphyry	L087	170	701-22-139	0.07	111852	3.2	10	1325.7	1.43	0.07	421	0.04	109.8	5.1	11	4.13	19.8	4.09	2.17	1.87	1.3	21.2	5.32	1.35	2.19	0.01	0.77	0.037	22166	62.28	11.3	0.329	2179	45
Andesite Porphyry	L087	184	701-22-140	0.09	110558	3.1	10	310.5	1.18	0.1	343	0.07	90.87	27.7	8	3.45	15.4	2.42	1.17	1.35	1.61	19.66	3.57	1	1.97	0.02	0.42	0.039	29580	52.44	3.6	0.188	3028	38
Andesite Porphyry	L087	200	701-22-141	0.125	101364.5	4.9	10	556.35	1.155	0.095	485	0.25	84.315	7	9	2.48	295.95	1.37	0.75	1	1.435	18.56	2.355	1.235	1.775	0.01	0.255	0.0855	26519.5	45.91	5.55	0.1435	2745	50
Andesite Porphyry	L087	210	701-22-142	0.05	116648	3.2	10	1125.2	1.53	0.06	702	0.02	103.8	1.4	7	1.6	4.2	2.38	1.22	1.79	0.8	18.87	4.4	1.42	1.67	0.01	0.43	0.037	19819	54.69	6.7	0.22	1621	29
Andesite Porphyry	L087	216	701-22-143	0.44	98109	34.1	10	623.1	0.65	0.86	357	0.32	39.07	11.9	10	1.8	354.9	1.2	0.81	0.36	2.18	18.34	1.11	1.11	1.58	0.02	0.26	0.451	36433	26.77	3.1	0.15	2980	46
Andesite Porphyry	L087	252	701-22-144	0.07	67645	14.5	10	165.7	0.11	1.28	591	0.02	33.14	4.9	23	0.07	425.6	0.75	0.32	0.66	6.58	7.91	1.73	0.64	0.71	0.01	0.13	0.022	26027	17.96	0.4	0.054	134	20
Andesite Porphyry	L087	262	701-22-145	0.73	41737	54.9	10	56	0.05	8.1	447	0.04	25.31	6	17	0.05	3253.6	0.45	0.21	0.47	19.02	2.4	1.05	0.52	0.53	0.05	0.07	0.051	11699	12.34	0.2	0.048	55	61
Andesite Porphyry	L087	272	701-22-146	0.13	63754	25.7	10	275.4	0.15	1.04	451	0.06	38.76	9.4	21	0.08	998.9	0.63	0.31	0.61	5.58	8.56	1.41	0.79	0.95	0.01	0.1	0.087	13393	21.18	0.4	0.082	68	16
Andesite Porphyry	L087	292	701-22-147	0.23	86290	6.1	10	306.3	0.39	2.23	776	0.08	32.25	10.4	13	0.74	383.3	1.24	0.65	0.64	3.24	11.49	1.83	0.56	1.35	0.01	0.21	0.19	15714	19.17	0.9	0.122	754	38
Hydrothermal Breccia	L087	330	701-22-148	0.11	63098	44.2	10	115.6	0.05	0.29	544	0.03	40.1	18.5	30	0.05	1049.8	0.26	0.12	0.39	8.33	2.8	0.68	0.98	0.24	0.01	0.04	0.023	21676	22.22	0.3	0.024	70	19
Andesite Porphyry	L087	349.7	701-22-149	0.29	97095	13.1	10	597.4	0.86	2.39	526	0.04	58.4	10.9	14	1.67	339	1.3	0.81	0.61	2.26	17.4	1.73	1.16	1.94	0.02	0.26	0.332	32803	36.01	3.5	0.152	2423	81
Andesite Porphyry	L087	340	701-22-150	0.2	88653	9.4	10	120	0.18	2.02	744	0.21	55.7	13	16	0.41	368.3	1.42	0.64	1.03	5.14	13.63	2.83	1.33	1.51	0.01	0.23	0.081	2437	31.12	1.6	0.143	164	31

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**1.5**	**23000**	**20**	**38**	**80**	**1000**	**14**	**9.5**	**90**	**0.0004**	**260**	**0.2**	**16**	**0.05**	**7.9**	**2.2**	**370**	**2**	**1.1**	**0.005**	**12**	**5600**	**0.6**	**0.48**	**2.4**	**160**	**1**	**30**	**3.3**	**75**	**190**
Andesite Porphyry	LS001	25	701-22-001	1.25	1476.5	4.29	22.895	24.5	702	325.9	6.543	161.14	0.002	10301	0.37	9.4	0.9	3.79	0.7	76.335	0.365	0.4495	0.065	21.115	2255	1.845	0.16	3.625	84	2.1	9.31	1.095	64.5	54.05
Andesite Porphyry	LS001	59	701-22-002	2.3	303	3.55	23.19	11.4	608	51.9	6.65	135.1	0.002	2913	0.37	7.5	0.5	3.79	0.5	13.09	0.36	0.421	0.05	23.46	1619	1.6	0.24	4.58	81	1.8	14.15	1.54	542	48.3
Andesite Porphyry	LS001	65.5	701-22-003	2.7	295	2.64	19.96	12.4	668	30.9	4.971	140.1	0.007	57011	0.69	17	2.5	3.93	3.4	49.34	0.22	0.671	0.74	13.37	1927	1.73	0.43	6.56	124	1.6	25.17	2.94	425	38.2
Andesite Porphyry	LS001	89.25	701-22-004	1.4	346	3.25	28.11	6	869	167.9	7.626	138.6	0.002	42187	0.52	11	2.2	5.48	3.2	278.89	0.3	0.797	1.92	17.36	1558	1.78	0.4	5.48	107	2.3	25.63	2.58	50	44.4
Andesite Porphyry	LS001	122	701-22-005	1.4	365	4.08	26.68	3.9	130	9.9	7.392	151.77	0.002	5889	0.29	8	0.5	4.42	0.7	16.33	0.4	0.436	0.34	19.27	2020	1.93	0.2	4.34	87	2.6	14.5	1.42	158	48.4
Dyke	LS001	136.75	701-22-006	1.3	380	3.32	20.77	7	620	82.5	5.487	158.52	0.002	32511	0.32	11.8	1.9	4.09	0.9	175.07	0.3	0.633	1.08	18.07	1733	2.22	0.31	5.16	105	2.6	20.27	1.88	39	52.7
Dyke	LS001	185	701-22-007	1.5	589	1.92	24.15	31.4	922	415.5	5.695	2.99	0.003	169611	3.98	9.9	4.5	5.66	4.5	1065.68	0.17	0.439	1.63	12.23	1101	9.44	0.1	7.02	90	5.3	4.89	0.69	19	33.1
Dyke	LS001	221.65	701-22-008	2.5	1685	1.65	12.05	16	703	205.7	3.209	3.14	0.008	66532	1.1	13.6	2.1	2.5	2	352.6	0.14	0.23	1.09	11.13	1455	0.14	0.04	3.52	135	2.5	2.63	0.32	11	19
Andesite Porphyry	LS001	249.15	701-22-009	3.9	1196	1.98	21.48	3.8	533	124.5	5.763	125.49	0.022	17061	0.6	15.5	0.8	3.7	1.6	203.56	0.17	0.273	0.42	15.23	1959	1.61	0.09	3.5	134	2.5	3.7	0.5	17	33.6
Andesite Porphyry	LS001	290.75	701-22-010	2.2	822	1.69	13.61	7.3	374	103.3	3.69	90.37	0.002	37126	0.47	12.9	1.6	2.52	0.6	94.52	0.14	0.187	0.74	14.03	1082	1.12	0.06	3.27	96	1.8	3.15	0.49	13	26.1
Andesite Porphyry	LS001	304.05	701-22-011	2.2	819	2.21	16.51	21.7	537	106.8	4.5	8.25	0.002	86321	0.81	12.8	4.2	2.94	2.2	313.24	0.19	0.219	2.71	14.72	1512	0.15	0.07	5.89	114	5.5	3.51	0.54	8	42.4
Andesite Porphyry	LS001	368.85	701-22-012	2.2	1437	4.29	31.86	9.5	676	59.3	8.209	113.56	0.002	51858	0.68	14.4	6.6	7.39	1.9	414.61	0.36	1.228	3.35	24.11	2512	1.21	0.53	6.68	91	2.5	37.37	2.85	162	50.5
Andesite Porphyry	LS001	395	701-22-013	2.3	1072	4.37	28.72	3.9	466	10.4	7.722	114.42	0.002	22324	0.42	14.7	1.2	5.53	0.7	23.98	0.35	0.918	0.57	22.73	2970	1.54	0.41	4.9	104	2.5	27.21	2.28	24	64.7
Andesite Porphyry	LS001	411.1	701-22-014	181.9	1129	0.8	20.7	10.5	518	54.1	7.096	3.08	0.055	90545	2.03	8.2	6	3.18	6.5	421.95	0.07	0.213	1.21	11.2	546	0.7	0.03	3.25	88	5.7	2.14	0.23	23	6
Andesite Porphyry	LS001	423.5	701-22-015	48.8	1377	0.68	16.8	10.7	531	51.4	4.877	3.25	0.079	117410	1.75	4.6	6	2.62	13.3	553.05	0.07	0.078	0.35	10.71	457	0.08	0.01	0.65	88	5.1	0.8	0.08	9	3.6
Andesite Porphyry	LS002	94.3	701-22-016	13.2	710	1.58	13.49	7.2	589	15.8	4.047	79.18	0.107	20485	0.6	12.8	2.4	2.27	0.9	155.7	0.14	0.218	0.05	16.56	1369	0.84	0.09	2.01	119	1.4	6.55	0.69	19	18.9
Breccia	LS002	104.13	701-22-017	8.3	575	1.49	13.7	6.4	421	35	4.173	95.57	0.07	21817	0.47	11.6	3.2	2.29	0.8	91.6	0.14	0.226	0.06	15.08	1347	1.2	0.12	1.92	99	1.5	7.25	0.67	31	10.9
Andesite Porphyry	LS002	128.6	701-22-018	5.4	1093	1.29	20.22	8.1	427	18.4	5.561	91.47	0.049	18517	0.4	13.6	1.4	3.57	1.2	95.69	0.11	0.353	0.07	14.73	1143	1.12	0.13	3.27	104	1.9	9.06	0.79	46	9.4
Andesite Porphyry	LS002	148.4	701-22-019	3.8	1139	1.61	21.37	6.6	376	25.2	6.217	105.6	0.03	22178	0.56	11.4	1.7	3.57	1.7	87.22	0.13	0.387	0.06	16.01	1071	1.22	0.16	3.57	101	2.7	11.91	1.09	27	9.6
Diorite Porphyry	LS002	355.8	701-22-020	2.8	12422	2.89	19.67	11.2	502	14.2	5.319	83.44	0.01	4699	0.05	10.7	0.8	3.48	0.6	178.14	0.21	0.326	0.08	15.06	1931	0.74	0.12	1.29	95	0.5	8.38	0.77	1071	7.8
Andesite Porphyry	LS002	373	701-22-021	1.25	1196.5	2.955	28.09	11.75	808	157.25	7.401	94.665	0.009	26436.5	0.575	16.65	0.95	5.19	0.75	284.9	0.2	0.561	0.75	14	2806	1.215	0.23	1.67	144.5	0.75	17.575	1.47	631.5	7.55
Andesite Porphyry	LS002	422.5	701-22-022	2.6	1472	2.46	26.12	7.2	191	86	7.14	102.63	0.01	18431	0.26	11.9	1.4	4.65	1.5	62.43	0.2	0.455	0.16	19.33	2055	1.11	0.19	2.88	115	2.4	13	1.24	95	16.6
Andesite Porphyry	LS002	435.3	701-22-023	2.2	1551	3.82	26.6	6.5	284	54.3	7.285	99	0.016	14162	0.25	13	1.4	4.77	0.8	128.74	0.31	0.455	0.24	20.86	2824	1.2	0.2	2.96	121	2.1	13.2	1.1	298	27.2
Andesite Porphyry	LS002	448.85	701-22-024	2.4	1859	2.74	24.76	14.2	416	418	6.736	135.89	0.022	31865	0.62	11.9	1.7	4.46	0.9	176.09	0.22	0.543	0.35	19.53	2323	1.75	0.28	3.08	117	1.6	20.37	1.55	519	14.5
Andesite Porphyry	LS002	472.85	701-22-025	7.6	1255	3.57	34.32	6.6	880	17	9.189	70.98	0.037	6956	0.39	11.8	0.9	6.46	0.7	343.12	0.33	0.861	0.07	23.19	2539	0.78	0.48	2.91	116	2.3	31.06	3.69	185	23.9
Andesite Porphyry	LS003	21.3	701-22-026	1.6	624	1.65	15.83	1.1	624	68.7	4.422	114.14	0.002	6448	1.46	10.1	1.9	3.14	0.8	64.55	0.16	0.207	0.96	12.82	1068	1.44	0.09	3.16	93	0.6	4.47	1.18	34	48.5
Andesite Porphyry	LS003	70	701-22-027	1.4	655	2.99	20.53	9.5	441	126.9	5.807	149.69	0.007	29576	0.44	12.3	1	3.48	1.1	84.11	0.25	0.338	0.42	18.66	1893	1.86	0.17	4.17	106	1.1	10.21	1.41	243	53.6
Andesite Porphyry	LS003	74.3	701-22-028	1.4	205	2.41	11.41	7.3	143	16.4	3.21	88.98	0.002	6858	0.46	6.7	0.5	2.2	0.6	31.38	0.2	0.311	0.24	13.79	1585	1.13	0.11	3.09	71	0.6	6.32	0.79	448	39.3
Andesite Porphyry	LS003	97	701-22-029	0.5	449	1.55	10.73	7.7	379	65.7	2.917	132.8	0.002	26827	0.58	10.3	0.5	2.13	0.8	112.54	0.13	0.312	0.72	11.79	929	1.59	0.16	3.3	85	1.6	8.81	1	42	57
Andesite Porphyry	LS003	115.5	701-22-030	2	382	1.18	8.12	12.5	480	176.9	2.141	51.65	0.002	72205	0.67	8.7	1.8	1.84	1.7	110.9	0.1	0.23	0.6	11.91	664	0.7	0.11	3.82	76	1.1	5.57	0.8	19	35.9
Andesite Porphyry	LS003	131.7	701-22-031	1.2	310	3.2	10.43	13.4	323	15.4	2.718	98.69	0.002	16302	0.71	10.6	0.5	2.52	0.6	115.73	0.27	0.377	0.15	14.4	2070	1.27	0.17	4.2	90	1.1	8.68	1.14	36	64.4
Breccia	LS003	146.75	701-22-032	2	439	2.79	15.01	17.9	477	51.9	3.994	148.26	0.004	37881	1.76	11.8	0.9	2.67	1.1	149.7	0.21	0.275	0.51	14.09	1307	2.16	0.16	4.66	89	1.1	11.61	1.12	219	55.4
Diorite Porphyry	LS003	170.02	701-22-033	1.1	638	2.22	14.34	6.7	651	77	3.857	131.58	0.002	40301	0.56	11	0.9	2.4	1.1	93.73	0.19	0.274	0.64	13.13	1204	1.79	0.14	4.71	84	1.1	7.74	1.23	251	50.7
Diorite Porphyry	LS003	182.4	701-22-034	2.7	545	2.3	19.1	7.8	733	20	5.221	113.43	0.002	32716	0.49	8.7	0.9	3.7	0.7	287.25	0.19	0.621	0.69	14.62	1238	1.58	0.15	3.54	80	0.8	9.39	1.05	25	52.8
Diorite Porphyry	LS003	274.25	701-22-035	3	1580	1.59	17.59	31.1	454	90.6	4.524	11.44	0.006	107002	2.49	9.6	2.4	3.7	10.1	452.33	0.12	0.249	0.33	16.01	664	0.21	0.11	4.19	84	1.4	4.89	0.83	59	38.4
Diorite Porphyry	LS003	298.3	701-22-036	1.8	741	3.33	12.85	10.2	708	100.2	3.335	95.48	0.002	83613	0.85	13.8	2.4	2.99	4.6	230.14	0.24	0.336	0.81	12.13	1669	1.24	0.14	6.44	94	2.4	7.78	1.02	21	46.5
Diorite Porphyry	LS003	305	701-22-037	0.9	902	2.61	11.65	7.6	671	63	3.088	113.03	0.002	40639	0.63	14.3	0.7	3.31	1.3	130.84	0.18	0.301	1.32	11.99	1330	1.34	0.16	5.19	104	1.8	8.16	1.04	16	51
Breccia	LS003	324.8	701-22-038	3.9	969	1.47	10.84	13.1	394	33	3.067	98.89	0.005	84643	0.45	14.8	2.5	2.01	3	194.63	0.12	0.266	0.29	8.68	826	1.05	0.13	3.52	97	1.4	7.6	0.88	30	28.4
Andesite Porphyry	LS003	330.2	701-22-039	1.3	561	3.97	15.93	11.3	466	64.4	4.708	85.31	0.002	43426	0.46	20.7	0.8	2.96	0.6	214.29	0.32	0.45	0.66	20.14	2866	1.14	0.21	6.27	128	1.4	12.6	1.47	32	67.7
Diorite Porphyry	LS003	342.8	701-22-040	3.2	894	1.97	13.41	12.3	619	96.2	3.311	97.98	0.002	38595	0.39	11.4	1.3	2.74	1.2	240.09	0.2	0.276	0.82	11.97	919	1.25	0.1	5.33	84	2	5.11	0.76	141	45.7
Feldspar Porphyry	LS003	353.35	701-22-041	1.25	764	1.185	17.79	9	741	105.85	4.917	27.45	0.002	60052	0.46	9.05	2.45	3.155	1.15	444.495	0.085	0.2465	0.84	10.64	752.5	0.365	0.07	3.955	83	1.15	3.475	0.495	39.5	35.4
Andesite Porphyry	LS003	377.5	701-22-042	4.2	735	0.61	16.24	10.2	611	72.8	4.538	14.92	0.007	54322	0.61	8.3	1.8	2.72	2	595.91	0.04	0.17	0.27	8.82	340	0.17	0.03	3.43	75	3.2	1.99	0.24	168	20.4
Porphyry	LS003	394.75	701-22-043	2.1	1096	3.4	8.34	3.5	101	9.1	2.409	63.65	0.002	21159	0.51	14.8	0.5	1.54	0.9	25.26	0.29	0.201	0.2	16.59	2463	0.63	0.14	3.8	101	12.3	7.04	0.87	14	59.1
Porphyry	LS003	410.9	701-22-044	1.7	1087	3.25	7.54	10.7	146	11.3	2.235	29.44	0.002	38815	0.3	15.3	0.5	1.39	0.7	41.2	0.26	0.219	0.26	15.77	1990	0.28	0.14	4.44	93	1.8	7.57	0.99	14	50.3
Breccia	LS003	440.8	701-22-045	2.5	808	0.96	14.59	24.6	476	47.8	3.851	6.19	0.006	75010	2.74	5.8	2.2	2.67	11.6	667.21	0.07	0.189	0.55	15.01	241	0.2	0.06	1.76	60	1.8	3.59	0.36	17	14.1
Andesite Porphyry	LS004	30.21	701-22-046	1.7	612	3.91	18.72	17.4	580	232.3	5.174	146.99	0.003	42999	1.08	8.7	0.6	3.14	2	36.73	0.29	0.369	0.18	13.4	1859	1.69	0.16	3.1	75	8.3	8.83	1.11	2799	34.9
Andesite Porphyry	LS004	50.21	701-22-047	0.6	684	3.9	18.17	8.3	581	43.7	5.255	158.07	0.002	3389	0.42	8.6	0.5	2.97	0.7	31.32	0.3	0.334	0.05	13.83	2000	1.75	0.19	4.62	69	0.9	11.21	1.19	276	43.6
Andesite Porphyry	LS004	69.25	701-22-048	1.2	639	3.95	19.61	8.9	614	162.5	5.485	141.19	0.002	16643	0.79	9.9	0.5	3.31	0.6	18.71	0.29	0.264	0.05	13.52	2234	1.65	0.15	3.4	84	1	8	1.08	1703	49.5
Andesite Porphyry	LS004	110.45	701-22-049	1.3	670	3.32	15.13	8.6	667	96.1	3.954	163.07	0.002	45173	1.72	11.5	1.2	3.44	0.7	154.71	0.25	0.477	0.76	12.63	2084	2.11	0.25	3.53	95	2.4	15.16	1.66	150	64
Andesite Porphyry	LS004	134.45	701-22-050	2.4	530	4.33	16.18	33.2	849	219.8	4.376	3.55	0.002	87035	2.5	11.5	1.8	3.43	2.3	1186.83	0.29	0.301	1.51	14.02	2332	0.19	0.12	4.11	89	1.8	5.99	0.86	258	58.3
Diorite Porphyry	LS005	28.4	701-22-051	2.8	612	3.47	19.75	8.6	523	133.4	5.607	122.53	0.002	25389	0.65	10	1	3.47	0.6	228.61	0.27	0.38	0.33	19.34	2159	1.29	0.19	3.47	92	1.9	10.95	1.23	671	55.9
Diorite Porphyry	LS005	50.1	701-22-052	1.8	577	3.83	25.28	6.2	616	18	7.153	143.59	0.002	5441	0.4	9.2	0.5	4.13	0.5	63.7	0.35	0.423	0.16	22.48	1925	1.65	0.21	5.38	77	1.4	13.19	1.52	100	46.9
Breccia	LS005	72.5	701-22-053	1.6	738	3.93	26.63	7.6	725	607.6	7.336	138.75	0.002	27848	0.62	11.2	1.9	4.77	1	48.93	0.32	0.403	0.56	19.5	2592	1.72	0.19	4.12	118	1.1	11.62	2.36	1510	66.8
Breccia	LS005	133.9	701-22-054	6.7	1141	2.81	26.01	18.1	593	130.2	7.186	155.85	0.017	62521	1.45	11	2.7	4.79	2.3	82.79	0.22	0.516	1.43	14.08	1817	2.32	0.35	3.34	90	2.4	23.48	2.28	549	50.3
Diorite Porphyry	LS005	141.4	701-22-055	1.6	1197	4.08	26.17	6.4	752	21.2	7.331	135.82	0.002	10685	0.41	9.1	0.5	4.47	0.6	28.16	0.34	0.46	0.15	23.1	2286	1.47	0.23	4.88	88	1.1	14.49	1.63	78	61.6
Andesite Porphyry	LS006	34.3	701-22-056	1	707	4.24	18.42	4.1	71	25.1	5.599	154.37	0.005	15433	0.28	7.2	0.7	2.55	0.7	15.06	0.35	0.204	0.36	21.8	2255	1.74	0.13	4.37	64	1.3	7.17	0.98	32	56.8
Andesite Porphyry	LS006	52.3	701-22-057	2.9	879	3.74	33.06	15.5	346	95.4	9.099	102.53	0.002	20818	0.59	10.8	1.3	5.63	0.7	145.71	0.29	0.599	0.85	24.94	2055	1.16	0.42	6.05	106	1.1	25.23	2.95	55	53.9
Andesite Porphyry	LS006	70.3	701-22-058	1.8	630	4	38.47	9.5	383	35.6	9.782	95.69	0.002	15230	0.21	11.6	0.7	6.82	0.7	91.12	0.33	0.555	0.55	27.01	2293	0.97	0.31	6.36	96	1.5	17.71	2.14	38	58.6
Andesite Porphyry	LS006	127.6	701-22-059	1.2	747	3.78	25.28	9.2	567	332.9	7.198	135.76	0.002	14879	0.37	9.5	0.5	4.16	0.5	73.6	0.3	0.362	0.17	25.29	2133	1.56	0.19	8.01	89	1.6	11.08	1.41	1683	52
Breccia	LS006	140.4	701-22-060	1.2	881	3.3	31.48	11.4	1303	488.9	8.508	145.87	0.002	34099	0.48	11.8	0.8	5.68	0.6	877.78	0.27	0.511	0.65	24.97	2089	1.75	0.29	6.71	107	1.9	16.2	1.81	773	57
Porphyry	LK002	16.05	701-22-061	1	709.5	2.595	17.68	2.45	557	23.6	5.1365	132.01	0.002	17529.5	0.78	7.3	1.05	2.88	0.8	49.48	0.23	0.214	0.72	17.205	931	1.34	0.08	3.48	65	1.6	4.66	0.6	36.5	50.4
Andesite Porphyry	LK002	36.3	701-22-062	0.6	333	3.13	19.67	4	563	64.4	5.678	164.18	0.002	22547	0.69	7	0.5	3.34	0.7	48.24	0.29	0.256	0.29	17.01	1213	1.41	0.08	3.41	55	1.5	4.62	0.58	23	46.9
Breccia	LK002	113.6	701-22-063	2	531	2.36	18.03	30.4	662	111.6	5.1	4.5	0.005	91181	5.25	8.8	2.4	3.29	5	449.33	0.16	0.239	0.74	12.35	1206	0.44	0.09	2.94	91	2.6	4.38	0.63	23	34.7
Porphyry	LK002	133.3	701-22-064	2.4	1700	1.61	16.66	11	745	185.2	4.712	3.89	0.036	83916	1.75	8.6	1.6	2.83	3.4	182.67	0.13	0.208	0.36	9.9	919	0.06	0.11	2.81	88	1.6	2.52	0.4	8	43.2
Porphyry	LK002	167.3	701-22-065	2.7	1361	0.88	11.54	11.7	545	137.8	2.786	3.48	0.037	102161	1.26	8.2	2.7	2	2.5	222.33	0.07	0.133	0.33	8.4	552	0.07	0.03	1.75	80	1.6	1.62	0.2	9	15.9
Andesite Porphyry	LK003	40.3	701-22-066	0.6	391	3.42	18.8	26	486	89.3	5.331	117.48	0.006	23024	0.6	14.1	0.6	3.22	0.7	168.25	0.24	0.32	0.1	11.93	2655	1.82	0.15	2.45	129	4	8.22	0.94	2375	56.2
Breccia	LK003	54.9	701-22-067	1.5	365	5.78	21.89	28.6	142	52.8	6.579	129.11	0.002	35677	1.36	7	0.9	3.66	1.4	10.85	0.45	0.301	0.62	16.82	1925	1.89	0.16	3.49	56	1.6	8.37	1.13	1409	49.3
Breccia	LK003	108.6	701-22-068	1.8	699	3.73	17.21	30.6	350	70	5.231	109.43	0.003	58733	1.61	12.5	1.7	2.99	2.1	139.02	0.29	0.294	1.6	14.21	1723	1.65	0.15	4.15	84	2.1	7.88	0.95	450	40.9
Pyroclastic	LK003	128.7	701-22-069	1.9	621	5.34	22.8	50.8	394	53.4	6.147	164.51	0.002	25574	1.81	9.9	0.5	4.08	1.8	116.67	0.4	0.361	0.73	14.29	1891	2.37	0.15	2.97	75	2	8.43	1.17	1915	43.1
Tuff	LK003	145.6	701-22-070	1	539	5.34	16.85	30.6	254	32.2	4.789	155.31	0.002	24978	2.08	8.2	0.7	3.03	1.5	45.57	0.42	0.243	0.56	16.98	1757	1.9	0.15	3.7	61	1.9	7.42	1.06	644	52.8
Hornblende Porphyry	LK004	51.23	701-22-071	2.6	16162	4.58	23.6	5.7	648	10	6.663	92.3	0.002	974	0.15	8.1	0.5	4.01	0.5	271.54	0.36	0.42	0.05	18.17	2105	0.39	0.21	3.77	71	1.3	12.66	1.49	66	62.4
Breccia	LK004	71.63	701-22-072	1.3	3933	3.81	25.98	8.7	726	24	7.299	104.31	0.002	7516	0.33	10.1	0.5	4.5	0.7	107.46	0.31	0.394	0.08	19.2	2239	0.91	0.19	4.95	86	1.5	12.1	1.38	186	50.5
Breccia	LK004	81.52	701-22-073	1.3	1324	3.64	19.36	15.5	663	49.6	5.434	146.48	0.002	14544	0.53	8.9	0.5	3.32	0.5	42.15	0.27	0.368	0.11	12.88	1855	1.57	0.18	3.24	74	1.3	12.08	1.22	329	44.6
Andesite Porphyry	LK004	104.71	701-22-074	1.9	943	3.58	21.6	13.2	837	426.7	6.079	161.45	0.002	42389	2.64	9.6	1.4	3.62	1.1	37.67	0.26	0.316	0.99	13.9	1974	2.97	0.15	3.65	81	2.3	9	1.04	3221	44.1
Diorite Porphyry	LK004	137.51	701-22-075	2.6	686	5.54	20.15	8.4	677	137.8	6.229	144.53	0.002	36784	5.54	4.1	2	3.91	0.7	195.29	0.42	0.682	1.1	22.29	1232	4.49	0.3	4.54	32	3	20.54	2.21	184	39.5
Breccia	LK006	45.2	701-22-076	0.6	243	4.13	29.21	242.5	1282	71.7	7.54	158.97	0.002	150590	9.17	23	1.4	5.85	0.9	35.03	0.25	0.839	0.42	9.87	3194	3.38	0.25	2.27	118	2.2	16.95	1.58	83	71.5
Andesite Porphyry	LK006	51.8	701-22-077	1.6	289	4.02	18.35	17.1	463	39	5.169	139.72	0.002	22594	1.6	15.9	0.5	3.39	0.6	60.85	0.3	0.818	0.05	14.91	3276	1.86	0.23	4.06	118	1.3	12.15	1.61	1218	74.1
Andesite Porphyry	LK006	129.7	701-22-078	1.2	366	7.11	25.52	32.7	1001	135.8	6.759	167.61	0.002	45232	9.53	11.5	1.2	5.08	2	426.93	0.42	0.511	0.48	15.69	2723	2.88	0.22	5.53	97	4.5	12.74	1.59	175	74
Breccia	LK006	145.7	701-22-079	1.9	418	5.74	22.2	47.4	713	194.4	6.533	138.62	0.003	45316	3.54	13.1	1	4.35	4.3	438.73	0.36	0.443	0.74	17.78	2166	1.82	0.2	5.54	95	2.4	10.7	1.46	408	73.5
Diorite Porphyry	LK006	165.86	701-22-080	1.4	691	2.02	8.58	11.2	637	127.2	2.237	84.51	0.002	42387	1.27	10.7	1.9	1.9	3.2	386.94	0.15	0.221	0.5	8.61	1257	0.94	0.08	4.3	91	1.2	3.24	0.45	65	31.8

Appendix C

Lithology	Borehole	Depth (m)	ID	Mo	Na	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Geochemical Abundance Index				**1.5**	**23000**	**20**	**38**	**80**	**1000**	**14**	**9.5**	**90**	**0.0004**	**260**	**0.2**	**16**	**0.05**	**7.9**	**2.2**	**370**	**2**	**1.1**	**0.005**	**12**	**5600**	**0.6**	**0.48**	**2.4**	**160**	**1**	**30**	**3.3**	**75**	**190**
Tuff	LK006	191.35	701-22-081	1.2	882.5	8.555	22.37	96.1	352	143.35	5.875	120.07	0.002	69346.5	2.73	12.2	1.1	4.025	5.2	282.99	0.605	0.28	1.46	15.57	3167.5	1.27	0.13	3.35	94	3	5.92	0.975	17	47.9
Pyroclastic	LK006	214.6	701-22-082	1.8	785	6.87	19.4	9	623	330.3	5.527	56.03	0.002	46295	2.9	6.9	1.1	3.47	3.8	311.82	0.51	0.241	0.41	26.84	1332	0.62	0.11	7.69	52	3.3	4.97	0.92	12	44.3
Andesite Porphyry	L013	5	701-22-083	4.6	494	4.3	18.21	9.7	195	35.3	5.494	75.03	0.019	8179	0.17	14.4	0.5	2.58	0.9	83.32	0.36	0.195	0.1	16.47	2431	0.89	0.06	2.59	89	1.9	4.66	0.52	42	30.7
Andesite Porphyry	L013	11	701-22-084	10.3	799	2.74	15.86	6.5	880	65.3	4.423	60.67	0.018	19101	0.14	17	1.3	2.97	0.8	158.93	0.27	0.249	0.28	18.02	1819	0.7	0.08	2.58	230	1.5	7.11	0.49	52	24.5
Andesite Porphyry	L013	17.7	701-22-085	7.9	708	3.43	12.41	3.1	278	205.8	3.845	96.6	0.014	12568	0.2	11.8	4.3	1.78	1.5	68.63	0.3	0.142	0.34	10.46	2015	1.15	0.06	3.96	120	1.4	3.11	0.38	25	24.4
Andesite Porphyry	L013	23.4	701-22-086	7.2	679	2.91	23.02	5.3	304	40.7	7.33	98.33	0.007	11426	0.19	10.5	2.1	3.13	1.3	64.67	0.26	0.172	0.16	21.19	1913	1.13	0.05	3.3	112	1.4	3.15	0.32	28	13.8
Andesite Porphyry	L013	28.9	701-22-087	6	851	3.47	18.58	7.8	202	39	5.998	90.05	0.03	16433	0.16	16.4	0.6	2.48	1.1	52.02	0.3	0.164	0.08	19.59	2066	0.98	0.05	1.97	100	2.4	3.82	0.35	24	13.1
Andesite Porphyry	L013	34.9	701-22-088	13.2	1007	2.57	12.06	2.3	580	25.3	4.157	79.31	0.005	26759	0.32	14.1	2.2	1.86	1	148.11	0.25	0.254	0.38	22.15	1792	0.94	0.12	1.56	86	4.8	7.86	0.66	27	16.4
Andesite Porphyry	L013	41.25	701-22-089	7.7	1219	2.72	10.91	2.5	527	18.6	3.384	100.99	0.003	28568	0.26	20.6	1.9	1.88	1.1	144.14	0.23	0.26	0.3	12.08	1806	1.15	0.11	1.35	128	2.4	8.29	0.78	27	11.9
Andesite Porphyry	L013	47.7	701-22-090	7.4	784	2.83	13.18	2.4	186	68.6	3.855	96.16	0.003	10001	0.35	11	2.4	2.04	2.2	57.61	0.22	0.221	0.87	17.16	2077	1.32	0.08	2.3	105	2.6	6.02	1.08	15	10.8
Andesite Porphyry	L013	52.9	701-22-091	9.6	834	3.16	14.22	4.4	527	38.1	4.038	82.68	0.007	13146	0.15	10.8	4	2.42	1.6	148.85	0.26	0.234	0.12	12.72	2190	1.02	0.07	1.55	87	1.9	5.18	0.47	28	9.2
Andesite Porphyry	L013	58.8	701-22-092	4.2	764	3.2	15.1	2.1	266	151.6	4.453	117.82	0.002	10053	0.29	8.1	1.1	2.35	1.1	113.25	0.26	0.214	0.93	21.82	1897	1.67	0.1	2.69	87	2.1	6.05	0.97	15	38
Andesite Porphyry	L013	69	701-22-093	18.9	718	2.65	14.07	1.7	439	19.6	4.104	117.92	0.007	10229	0.15	8.6	1.4	2.21	1.3	60.26	0.24	0.377	1.57	17.38	1638	1.63	0.11	1.89	93	1.7	8.29	0.65	18	9.5
Hydrothermal Breccia	L013	75	701-22-094	2.7	4187	3.44	32.76	1.8	1297	157.9	9.213	3.95	0.004	42213	2.26	6.6	7.8	6.06	7.2	1017.44	0.27	0.386	0.34	26.72	2505	0.05	0.08	4.05	91	4.1	5	0.5	5	29.6
Hydrothermal Breccia	L013	81.9	701-22-095	9.7	4484	1.07	29.19	1.5	1297	189.1	8.441	4.46	0.004	46556	0.82	6.2	18.8	4.97	2	792.98	0.09	0.299	0.87	24.41	671	0.04	0.06	3.55	85	2.1	3.83	0.59	7	16.2
Hydrothermal Breccia	L013	86.55	701-22-096	4.7	5133	2.88	30.4	1.5	1169	240.6	9.372	3.81	0.004	47839	1.06	6.7	12.4	4.26	2.7	731.77	0.23	0.237	0.52	26.36	1712	0.04	0.05	3.15	84	2.8	3.53	0.31	5	17.6
Fault Breccia	L013	93.25	701-22-097	10.1	774	0.97	41.69	3	1685	209.4	10.231	5.4	0.004	17410	1.74	6.3	10	9.13	1.5	1704.67	0.07	0.517	1.88	27.31	659	0.08	0.05	8.58	109	2.9	4.17	0.31	15	19.9
Hydrothermal Breccia	L013	100.4	701-22-098	6	3701	1.1	34.42	0.8	1426	247.5	9.949	2.72	0.004	45201	2.66	7.6	29.8	6.57	3.3	1009.31	0.09	0.656	3.73	26.59	560	0.02	0.06	5.38	90	1.5	5.67	0.32	16	7.6
Andesite Porphyry	L013	127.55	701-22-099	12.5	2010	0.96	22.52	8.8	392	10.6	6.215	91.48	0.087	25032	0.17	10.6	2.3	4.19	1.3	209.43	0.09	0.482	0.22	19.59	901	1.48	0.16	3.42	88	1.5	11.31	1.01	25	37.2
Andesite Porphyry	L013	177.05	701-22-100	6.9	1161	0.98	19.76	13.3	786	26.5	6.103	37.88	0.085	46826	0.27	4.9	6.9	2.69	3.2	465.23	0.1	0.14	0.31	21.17	650	0.56	0.04	2.3	77	4.2	2.41	0.26	10	18.4
Andesite Porphyry	L013	199.75	701-22-101	4.5	1543.5	1.415	17.79	9.75	627.5	47.65	5.3305	106.865	0.041	52430	0.38	8.15	4.9	2.96	1.6	196.805	0.13	0.2305	0.735	22.52	834.5	1.83	0.195	3.755	63	1.2	6.225	1.38	20	38.1
Fault Breccia	L223	121.75	701-22-102	1.7	569	2.2	15.15	11.4	708	53.2	4.079	39.82	0.01	63045	0.84	8.7	2.5	2.84	2.1	482.74	0.18	0.246	1.47	11.44	1589	0.53	0.11	4.29	78	2.3	7.83	0.82	17	44.3
Andesite Porphyry	L223	131	701-22-103	1.2	708	2.55	22.5	26.3	480	17	6.325	91.46	0.007	38605	0.61	9.7	1.8	3.84	2.6	318.02	0.25	0.394	0.46	14.69	1494	1.1	0.15	4.8	87	1.2	7.7	1.01	94	43.8
Andesite Porphyry	L223	137	701-22-104	1.9	1460	4.25	28.32	11.7	651	15.5	7.295	105.51	0.003	4294	0.31	13.9	0.6	5.92	1.1	58.04	0.35	0.743	0.4	18.33	2922	1.09	0.35	4.42	117	1.5	22.58	2.29	452	91
Andesite Porphyry	L223	142.1	701-22-105	1.6	1262	4.2	23.92	8.2	733	16.5	6.562	111.81	0.003	13244	0.51	10.7	0.5	4.34	1.5	23.89	0.35	0.458	0.84	18.47	2702	0.81	0.23	5.4	103	1.7	14.33	1.6	74	86.2
Andesite Porphyry	L223	150	701-22-106	4.1	21636	3.99	22.7	6.5	619	9.4	6.171	86.41	0.002	11382	0.13	11.7	0.7	3.99	0.6	342.38	0.31	0.433	0.05	16.36	2651	0.49	0.21	3.62	103	1.3	13.46	1.4	42	70.5
Andesite Porphyry	L223	156	701-22-107	5.1	19585	4	22.47	5.6	645	9.2	6.135	71.47	0.002	7493	0.26	11.6	0.5	3.99	0.6	303.81	0.31	0.425	0.25	16.19	2590	0.44	0.21	3.45	102	1.7	13.06	1.33	33	71
Andesite Porphyry	L223	164.55	701-22-108	3.9	23723	3.91	20.6	6.2	595	7.3	5.698	63.44	0.003	391	0.13	10.7	0.5	3.73	0.4	401.43	0.32	0.42	0.05	15.55	2457	0.36	0.2	3.3	97	1.8	11.81	1.33	24	56.9
Andesite Porphyry	L223	170	701-22-109	3.8	23048	4.2	24.16	6.1	630	5.1	6.763	71.21	0.003	213	0.24	10.9	0.6	4.18	0.5	371.97	0.32	0.438	0.05	16.49	2525	0.37	0.21	3.38	88	2.2	12.87	1.4	22	55
Andesite Porphyry	L223	178.05	701-22-110	2.1	22177	4.1	23.14	5.7	681	4.9	6.265	79.73	0.003	421	0.2	11.4	0.5	3.98	0.5	354.98	0.32	0.399	0.05	16.7	2526	0.36	0.2	3.86	93	2.5	11.96	1.31	23	63.1
Andesite Porphyry	L223	184	701-22-111	8.1	8201	3.29	26.3	6	613	16.8	7.388	68.04	0.003	966	0.18	9.8	0.8	4.43	1.1	167.06	0.26	0.477	0.1	14.45	2112	0.45	0.21	3.29	84	2.6	13.76	1.41	73	40.8
Andesite Porphyry	L223	191.95	701-22-112	4.1	10930	3.86	21.97	7.2	627	10.6	5.917	89.2	0.004	655	0.14	13.2	0.5	3.95	1	227.9	0.29	0.423	0.05	15	2836	0.59	0.2	3.1	111	1.9	12.59	1.31	56	51.5
Andesite Porphyry	L223	198	701-22-113	2.8	2831	4.12	22.85	6	675	6.7	6.264	95.27	0.002	965	0.19	10.5	0.5	3.89	0.5	79.63	0.32	0.397	0.05	17.14	2490	0.69	0.2	2.71	92	1.1	11.86	1.41	56	54.2
Andesite Porphyry	L223	206.5	701-22-114	5.3	14640	4.09	20.3	6.1	615	8	5.66	59.35	0.005	316	0.14	9.9	0.5	3.63	0.5	152.79	0.33	0.391	0.05	14.6	2431	0.41	0.18	2.94	92	1.6	10.7	1.3	44	38.8
Andesite Porphyry	L223	212	701-22-115	48.7	10375	3.89	21.94	9.6	583	29.3	6.034	65.77	0.016	2737	0.33	11.6	0.5	3.98	1	159.5	0.3	0.441	0.05	15.3	2117	0.42	0.22	3.52	81	2.3	12.85	1.37	74	39.2
Andesite Porphyry	L223	220.05	701-22-116	6	17734	3.94	24.96	5.3	568	19	6.748	77.81	0.002	4697	0.23	13.6	0.5	4.6	0.8	313.55	0.31	0.479	0.35	16.25	2436	0.44	0.23	3.61	97	2.7	14.94	1.49	41	68.1
Andesite Porphyry	L223	231.2	701-22-117	4.5	17118	3.88	18.27	5.3	505	4.7	5.027	75.64	0.003	4154	0.25	11.4	0.5	3.52	0.6	341.74	0.3	0.406	0.19	12.77	2290	0.49	0.2	3.26	95	1.5	11.61	1.42	30	66.1
Andesite Porphyry	L223	240.4	701-22-118	2.5	9704	3.38	21.98	12.3	543	14.1	5.892	86.41	0.004	14538	0.39	11.1	0.9	3.92	1.5	176.44	0.3	0.415	0.32	15.01	2035	0.61	0.19	3.51	90	1.4	10.92	1.28	601	74
Fault Breccia	L223	244	701-22-119	1.4	961	4.11	32.63	3.1	975	51.1	8.261	49.82	0.003	10730	0.64	16.1	0.7	6.56	1.6	628.18	0.34	0.96	0.31	19.32	2320	0.46	0.52	4.55	117	2.5	34.07	3.27	62	95.6
Andesite Porphyry	L223	319.3	701-22-120	1.5	1485	5.18	31.27	0.7	547	15.4	8.549	51.13	0.002	3754	0.36	9.2	0.5	5.09	0.6	194.12	0.41	0.464	0.2	21.91	1856	0.27	0.33	5.48	84	1	16.57	2.06	34	68.5
Andesite Porphyry	L223	325.4	701-22-121	1.1	712.5	5.05	22.585	1	153	19.15	6.391	55.545	0.002	5225	0.51	5.8	0.5	3.98	0.8	40.21	0.41	0.3875	0.14	22.235	1924	0.325	0.175	3.67	44.5	1.05	11.1	1.22	20	50.4
Fault Breccia	L223	340.3	701-22-122	1.5	663	4.75	27.49	3.1	530	50.5	7.444	52.21	0.002	9578	1.05	8.4	0.5	4.44	1	369.97	0.39	0.596	0.06	20.6	2039	0.37	0.49	16.98	55	1.5	38.62	3.07	27	78.5
Pyroclastic	L087	6	701-22-123	4.3	1071	1.43	16.05	1.6	405	71.1	4.573	1.97	0.002	19034	3.63	3.7	3.9	2.43	10.6	249.34	0.13	0.169	0.26	11.64	626	0.02	0.07	2.62	34	5.1	3.78	0.5	4	32.5
Pyroclastic	L087	16	701-22-124	2.3	417	1.34	9.76	0.7	192	101.5	2.826	2.06	0.002	1955	3.35	1.8	5.7	1.42	5.9	123.17	0.1	0.107	0.09	9.26	690	0.02	0.07	2.12	8	5.6	3.11	0.51	5	33.2
Pyroclastic	L087	26	701-22-125	4.3	1815	1.2	19.91	1.4	552	146.7	5.343	1.84	0.002	29384	1.53	5.2	1.8	3.21	7.6	338.37	0.11	0.186	0.14	13.13	551	0.02	0.07	3.02	54	2.4	3.09	0.52	4	29.4
Pyroclastic	L087	36	701-22-126	4.4	1468	2.78	18.85	0.5	582	137.7	5.278	1.56	0.002	22510	4.34	8	0.8	3.1	4.3	185.87	0.23	0.224	0.16	13.89	1390	0.02	0.09	3.65	53	3.8	3.66	0.71	2	53.7
Pyroclastic	L087	46	701-22-127	5.3	1233	2.37	18.04	0.5	620	300.2	4.817	1.29	0.002	14386	2.9	8.1	1	3.31	3.8	237.45	0.19	0.236	0.19	16.07	1023	0.02	0.08	4.26	71	1.9	3.79	0.62	3	36.3
Andesite Porphyry	L087	56	701-22-128	3.9	1965	2.69	25.8	0.5	598	149.3	7.126	1.98	0.002	30423	2.72	6.2	5.5	4.33	8.6	394.6	0.24	0.257	0.31	16.07	1409	0.02	0.11	4.2	89	6.2	4.88	0.92	4	46.1
Fault Breccia	L087	66	701-22-129	4.9	1141	1.69	20.6	1.5	517	100.8	6.013	1.71	0.002	19794	2.92	3.7	3.2	3.62	8.5	520.91	0.16	0.253	0.36	13.92	785	0.02	0.1	3.92	43	6.7	4.6	0.85	5	43
Andesite Porphyry	L087	76	701-22-130	5.4	1718	1.6	15.02	0.5	517	116	4.221	1.85	0.002	25873	7.63	4.9	5.1	2.53	13.1	560.48	0.15	0.182	0.33	13.24	816	0.03	0.08	3.32	57	6.2	3.96	0.65	3	37.6
Andesite Porphyry	L087	86	701-22-131	3.1	1456	0.92	15.54	0.8	470	121.8	4.424	2	0.002	24534	3.13	3.8	5.3	2.31	4.8	380.29	0.08	0.11	0.78	12.78	318	0.02	0.05	2.58	76	2.8	2.1	0.35	4	23.4
Andesite Porphyry	L087	96	701-22-132	7.9	993	2.34	15.81	0.5	589	143.3	4.439	2.5	0.002	18329	5.15	6.2	1.4	2.82	2.2	189.88	0.23	0.199	8.89	19.49	795	0.04	0.07	3.94	72	1.6	3.08	0.73	2	42.6
Andesite Porphyry	L087	106	701-22-133	2.4	632	1.74	20.36	1.3	584	76.4	5.807	15.41	0.002	8216	0.72	6.8	3.9	3.51	1.7	173.53	0.15	0.279	0.41	18.51	696	0.18	0.11	4.08	61	0.9	6.14	0.84	18	36.5
Andesite Porphyry	L087	116	701-22-134	2.5	937	0.99	22.42	0.5	784	160.9	6.625	1.75	0.003	11383	3.55	4.6	3.5	3.53	4.8	527.27	0.1	0.213	0.68	24.88	508	0.04	0.05	3.96	58	1.4	2.91	0.41	6	21.9
Andesite Porphyry	L087	126	701-22-135	1.7	2035	0.83	21.97	0.5	792	124.4	6.059	2.64	0.002	17192	1.19	6.3	4.2	3.3	1.8	576.39	0.09	0.161	0.37	19.68	301	0.04	0.06	2.85	65	0.9	2.86	0.46	7	30
Andesite Porphyry	L087	134	701-22-136	1.5	391	3.25	19.27	0.7	515	37.4	5.505	110.84	0.002	1126	0.62	10.6	0.5	3.33	1.4	709.9	0.29	0.41	0.52	25.25	1496	1.01	0.19	5.78	93	1.6	9.79	1.67	17	60.4
Andesite Porphyry	L087	144	701-22-137	1.4	478	2.9	9.58	11.9	627	252.2	2.785	123.21	0.006	26473	0.31	13.7	0.5	1.79	0.5	129.28	0.25	0.301	0.22	19.99	1576	1.44	0.21	6.78	103	1.8	10	1.24	368	48.3
Andesite Porphyry	L087	158	701-22-138	1.4	460	4.08	27.11	3.9	480	56.9	7.61	140.88	0.002	7422	0.26	9.9	0.5	4.43	0.8	89.43	0.32	0.492	0.19	25.26	2334	1.38	0.24	4.98	88	1.3	13.94	1.57	194	50.7
Andesite Porphyry	L087	170	701-22-139	1.4	454	4.92	40.86	1.8	408	18.6	11.334	87.11	0.002	7696	0.29	14.3	0.5	7	0.8	120.71	0.4	0.744	0.05	32.63	3217	0.69	0.31	5.36	125	2.4	18.33	2.25	35	71.3
Andesite Porphyry	L087	184	701-22-140	1.2	435	4.38	32.23	6	287	25.1	9.102	117.2	0.002	12440	0.22	10.3	0.5	5.24	0.6	81.29	0.35	0.461	0.2	28.69	2475	0.86	0.17	5.4	90	1.4	9.69	1.22	29	59.9
Andesite Porphyry	L087	200	701-22-141	1.6	477	3.67	31.44	4.95	515.5	64.05	8.877	99.85	0.002	12217	0.51	8.45	0.5	4.625	0.55	123.605	0.305	0.2625	0.125	28.59	2060	0.995	0.12	5.315	79	1.35	5.93	0.89	39.5	51
Andesite Porphyry	L087	210	701-22-142	0.6	383	3.6	43.44	4	1214	9.3	11.54	69.96	0.002	903	0.21	9.3	0.5	7.68	0.5	131.86	0.32	0.49	0.05	27.88	1991	0.69	0.18	3.54	89	1	9.99	1.31	37	48.8
Andesite Porphyry	L087	216	701-22-143	1.8	762	3.54	11.18	7	287	181.7	3.527	111.76	0.003	29401	0.62	11.7	1.3	1.52	0.8	67.83	0.3	0.181	0.6	23.4	2074	1.18	0.13	4.61	94	1.6	6.85	0.95	87	46.4
Andesite Porphyry	L087	252	701-22-144	1.4	2620	2	13.82	1.8	654	173.7	3.807	2.73	0.003	114418	0.87	6.3	1	2.42	1.4	548.88	0.16	0.195	0.2	8.05	1396	0.04	0.04	2.64	74	4.1	2.85	0.37	5	23.7
Andesite Porphyry	L087	262	701-22-145	1.3	1705	1.51	9.08	4.5	363	82.2	2.489	2	0.002	220491	2.22	2.2	2.7	1.63	5.2	209.14	0.13	0.104	0.77	6.95	600	0.1	0.04	1.56	37	4.3	1.77	0.31	6	17.5
Andesite Porphyry	L087	272	701-22-146	1.4	2150	2.25	14.35	8.3	506	51.2	4.059	1.68	0.002	85164	2.54	6.2	1.5	2.24	3.9	562.61	0.21	0.15	0.7	12.25	958	0.06	0.05	3.07	68	2.1	2.68	0.46	3	30.7
Andesite Porphyry	L087	292	701-22-147	2	845	2.91	11.52	8.2	705	54.7	3.233	38.16	0.002	39914	0.75	8.2	3	2.16	1.3	329.72	0.25	0.226	1.3	22.25	1674	0.48	0.1	4.94	98	1.6	5.47	0.74	18	40
Hydrothermal Breccia	L087	330	701-22-148	46.8	2568	0.65	14.07	14.6	574	70	4.072	2.22	0.044	124586	1.55	7.6	2.4	1.63	5.5	451.39	0.05	0.06	0.48	11.55	405	0.07	0.02	0.88	73	2.7	1.11	0.16	3	7
Andesite Porphyry	L087	349.7	701-22-149	1.9	550	4.3	17.29	10.6	290	68.4	5.368	115.42	0.003	22144	1.16	9.5	1.2	2.54	0.8	109.22	0.54	0.226	1.08	25.83	2569	1.38	0.13	5.02	80	2.2	6.84	0.93	33	58.1
Andesite Porphyry	L087	340	701-22-150	1.4	626	4.08	22.32	13	727	22.2	5.82	3.17	0.002	53792	1.35	10.2	2.3	4.06	2.2	367.62	0.35	0.316	0.9	23.72	2301	0.3	0.1	6.99	104	6.8	5.22	0.73	13	49.3

APPENDIX D

Geochemical Abundance Index Results

Knight Piésold CONSULTING

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Andesite Porphyry	LS001	25.00	701-22-001	3	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0
Andesite Porphyry	LS001	65.50	701-22-003	3	0	2	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	89.25	701-22-004	3	0	2	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	2	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	136.75	701-22-006	3	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Dyke	LS001	185.00	701-22-007	3	0	6	0	0	0	6	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
Dyke	LS001	221.65	701-22-008	1	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS001	290.75	701-22-010	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	3	0	2	0	0	0	6	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	3	0	1	0	0	0	6	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	2	0	0	0	5	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	2	0	5	0	0	0	5	0	2	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	4	0	0	0	4	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	LS002	94.30	701-22-016	1	0	0	0	1	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Breccia	LS002	104.13	701-22-017	1	0	3	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	2	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	148.40	701-22-019	1	0	3	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS002	355.80	701-22-020	1	0	0	0	1	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	LS002	373.00	701-22-021	4	0	3	0	0	0	4	0	3	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0
Andesite Porphyry	LS002	422.50	701-22-022	2	0	1	0	0	0	3	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	1	0	1	0	0	0	3	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	448.85	701-22-024	4	0	4	0	0	0	3	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	472.85	701-22-025	1	0	1	0	1	0	1	0	3	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	21.30	701-22-026	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	1	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	74.30	701-22-028	1	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	97.00	701-22-029	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	1	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	3	0	4	0	0	0	4	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	170.02	701-22-033	2	0	3	0	0	0	5	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	182.40	701-22-034	2	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	2	0	4	0	0	0	6	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	2	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	1	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	2	0	2	0	0	0	6	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	330.20	701-22-039	2	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Feldspar Porphyry	LS003	353.35	701-22-041	1	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	3	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	4	0	4	0	0	0	3	0	6	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS004	69.25	701-22-048	1	0	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4	0	0
Andesite Porphyry	LS004	110.45	701-22-049	3	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	4	0	4	0	0	0	5	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0
Diorite Porphyry	LS005	28.40	701-22-051	2	0	2	0	0	0	4	0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1	0	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	4	0	1	0	0	0	5	0	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	0
Breccia	LS005	133.90	701-22-054	4	0	4	0	0	0	5	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Andesite Porphyry	LS006	34.30	701-22-056	1	0	1	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	1	0	4	0	1	0	3	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	1	0	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	2	0	1	0	0	0	1	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0
Breccia	LS006	140.40	701-22-060	3	0	3	0	0	0	4	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Porphyry	LK002	16.05	701-22-061	2	0	2	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	3	0	5	0	0	0	5	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	133.30	701-22-064	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	2	0	3	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	1	0	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Breccia	LK003	54.90	701-22-067	4	0	3	0	0	0	5	0	4	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK003	108.60	701-22-068	4	0	4	0	0	0	6	0	3	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Pyroclastic	LK003	128.70	701-22-069	3	0	3	0	0	0	5	0	5	0	0	0	1	1	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0
Tuff	LK003	145.60	701-22-070	3	0	3	0	0	0	4	0	4	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	1	0	1	0	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Breccia	LK004	81.52	701-22-073	1	0	3	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Andesite Porphyry	LK004	104.71	701-22-074	4	0	6	0	0	0	5	0	6	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	3	0	0
Diorite Porphyry	LK004	137.51	701-22-075	5	0	5	0	0	0	5	0	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Breccia	LK006	45.20	701-22-076	4	0	6	0	0	0	3	0	0	0	1	1	1	2	0	0	0	1	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	1	0	2	0	0	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Andesite Porphyry	LK006	129.70	701-22-078	3	0	6	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	0
Breccia	LK006	145.70	701-22-079	4	0	4	0	0	0	6	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	0
Diorite Porphyry	LK006	165.86	701-22-080	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	3	0	4	0	0	0	6	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	2	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	2	0	1	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	11.00	701-22-084	2	0	2	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	17.70	701-22-085	1	0	3	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	23.40	701-22-086	1	0	1	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	28.90	701-22-087	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	34.90	701-22-088	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0
Andesite Porphyry	L013	41.25	701-22-089	1	0	1	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	47.70	701-22-090	2	0	4	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	52.90	701-22-091	1	0	1	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	58.80	701-22-092	4	0	3	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	69.00	701-22-093	1	0	2	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Ga	Gd	Ge	Hf	Hg	Ho	In	K	La	Li	Lu	Mg	Mn	Mo	Na
Geochemical Abundance Index				0.07	82000	1.5	10	500	2.6	0.048	41000	0.11	68	20	100	3	50	6	3.8	2.1	4.1	18	7.7	1.8	5.3	0.05	1.4	0.049	21000	32	20	0.51	23000	950	1.5	23000
Hydrothermal Breccia	L013	75.00	701-22-094	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	6	0	4	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	86.55	701-22-096	5	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L013	93.25	701-22-097	2	0	5	0	0	0	6	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0
Hydrothermal Breccia	L013	100.40	701-22-098	6	0	6	0	0	0	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	1	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	2	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L013	199.75	701-22-101	2	0	5	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Fault Breccia	L223	121.75	701-22-102	3	0	3	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	3	0	3	0	0	0	5	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	1	0	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Andesite Porphyry	L223	142.10	701-22-105	2	0	2	0	0	0	3	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	1	1	0	0	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	212.00	701-22-115	1	0	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L223	220.05	701-22-116	1	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	2	0	2	0	2	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Fault Breccia	L223	244.00	701-22-119	0	0	2	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	1	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	2	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	2	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	16.00	701-22-124	3	0	2	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	3	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	36.00	701-22-126	1	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pyroclastic	L087	46.00	701-22-127	1	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	56.00	701-22-128	2	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Fault Breccia	L087	66.00	701-22-129	2	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	76.00	701-22-130	3	0	3	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	86.00	701-22-131	2	0	5	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	1	0	5	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L087	106.00	701-22-133	2	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	2	0	3	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	2	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	2	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	1	0	3	0	0	0	2	0	4	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	158.00	701-22-138	1	0	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	2	0	4	0	0	0	4	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	3	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	3	0	5	0	0	0	6	0	0	0	0	0	0	5	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	4	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	1	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	4	0	0	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Andesite Porphyry	L087	349.70	701-22-149	1	0	3	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	1	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Andesite Porphyry	LS001	25.00	701-22-001	0	0	0	0	4	0	0	2	5	0	0	4	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	59.00	701-22-002	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS001	65.50	701-22-003	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	2	0
Andesite Porphyry	LS001	89.25	701-22-004	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Andesite Porphyry	LS001	122.00	701-22-005	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Dyke	LS001	136.75	701-22-006	0	0	0	0	2	0	0	2	6	0	0	5	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	0	0
Dyke	LS001	185.00	701-22-007	0	0	0	0	4	0	0	2	6	4	0	6	0	0	1	0	0	6	0	0	3	0	1	0	2	0	0	0	0
Dyke	LS001	221.65	701-22-008	0	0	0	0	3	0	0	4	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	249.15	701-22-009	0	0	0	0	3	0	0	5	5	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	290.75	701-22-010	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS001	304.05	701-22-011	0	0	0	0	2	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0
Andesite Porphyry	LS001	368.85	701-22-012	0	0	0	0	1	0	0	2	6	1	0	6	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	1	0
Andesite Porphyry	LS001	395.00	701-22-013	0	0	0	0	0	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS001	411.10	701-22-014	0	0	0	0	1	0	0	6	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS001	423.50	701-22-015	0	0	0	0	1	0	0	6	6	3	0	6	0	2	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	LS002	94.30	701-22-016	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS002	104.13	701-22-017	0	0	0	0	1	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	128.60	701-22-018	0	0	0	0	0	0	0	6	6	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS002	148.40	701-22-019	0	0	0	0	0	0	0	6	6	1	0	5	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Diorite Porphyry	LS002	355.80	701-22-020	0	0	0	0	0	0	0	4	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0
Andesite Porphyry	LS002	373.00	701-22-021	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	422.50	701-22-022	0	0	0	0	2	0	0	4	6	0	0	4	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	LS002	435.30	701-22-023	0	0	0	0	1	0	0	5	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	1	0
Andesite Porphyry	LS002	448.85	701-22-024	0	0	0	0	4	0	0	5	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LS002	472.85	701-22-025	0	0	0	0	0	0	0	6	4	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	1	0
Andesite Porphyry	LS003	21.30	701-22-026	0	0	0	0	2	0	0	2	4	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	70.00	701-22-027	0	0	0	0	3	0	0	4	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS003	74.30	701-22-028	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	LS003	97.00	701-22-029	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	115.50	701-22-030	0	0	0	0	3	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	131.70	701-22-031	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	146.75	701-22-032	0	0	0	0	1	0	0	3	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	170.02	701-22-033	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	1	0
Diorite Porphyry	LS003	182.40	701-22-034	0	0	0	0	0	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	274.25	701-22-035	0	0	0	0	2	0	0	3	6	3	0	5	0	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Diorite Porphyry	LS003	298.30	701-22-036	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	1	0	0	0	0
Diorite Porphyry	LS003	305.00	701-22-037	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS003	324.80	701-22-038	0	0	0	0	1	0	0	3	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	330.20	701-22-039	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Diorite Porphyry	LS003	342.80	701-22-040	0	0	0	0	2	0	0	2	6	0	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Feldspar Porphyry	LS003	353.35	701-22-041	0	0	0	0	2	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS003	377.50	701-22-042	0	0	0	0	2	0	0	4	6	1	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	1	0
Porphyry	LS003	394.75	701-22-043	0	0	0	0	0	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	3	0	0	0	0
Porphyry	LS003	410.90	701-22-044	0	0	0	0	0	0	0	2	6	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Breccia	LS003	440.80	701-22-045	0	0	0	0	1	0	0	3	6	3	0	5	0	2	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LS004	30.21	701-22-046	0	0	0	0	3	0	0	2	6	2	0	3	0	0	0	0	0	5	0	0	1	0	0	0	2	0	0	5	0
Andesite Porphyry	LS004	50.21	701-22-047	0	0	0	0	1	0	0	2	3	0	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	LS004	69.25	701-22-048	0	0	0	0	3	0	0	2	5	1	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	4	0
Andesite Porphyry	LS004	110.45	701-22-049	0	0	0	0	2	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	LS004	134.45	701-22-050	0	0	0	0	3	0	0	2	6	3	0	5	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	1	0
Diorite Porphyry	LS005	28.40	701-22-051	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	3	0
Diorite Porphyry	LS005	50.10	701-22-052	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	4	0	0	1	0	1	0	0	0	0	0	0
Breccia	LS005	72.50	701-22-053	0	0	0	0	5	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LS005	133.90	701-22-054	0	0	0	0	3	0	0	5	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	2	0
Diorite Porphyry	LS005	141.40	701-22-055	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	34.30	701-22-056	0	0	0	0	0	0	0	3	5	0	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LS006	52.30	701-22-057	0	0	0	0	2	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	70.30	701-22-058	0	0	0	0	1	0	0	2	5	0	0	3	0	0	0	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	LS006	127.60	701-22-059	0	0	0	0	4	0	0	2	5	0	0	3	0	0	0	0	0	5	0	0	1	0	1	0	0	0	0	4	0
Breccia	LS006	140.40	701-22-060	0	0	0	0	5	0	0	2	6	1	0	3	0	0	1	0	0	6	0	0	1	0	1	0	0	0	0	3	0
Porphyry	LK002	16.05	701-22-061	0	0	0	0	0	0	0	2	5	1	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	LK002	36.30	701-22-062	0	0	0	0	2	0	0	2	6	1	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Breccia	LK002	113.60	701-22-063	0	0	0	0	2	0	0	3	6	4	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Porphyry	LK002	133.30	701-22-064	0	0	0	0	3	0	0	6	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Porphyry	LK002	167.30	701-22-065	0	0	0	0	3	0	0	6	6	2	0	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	LK003	40.30	701-22-066	0	0	0	0	2	0	0	3	6	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	1	0	0	4	0
Breccia	LK003	54.90	701-22-067	0	0	0	0	1	0	0	2	6	2	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Breccia	LK003	108.60	701-22-068	0	0	0	0	2	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	2	0
Pyroclastic	LK003	128.70	701-22-069	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	4	0
Tuff	LK003	145.60	701-22-070	0	0	0	0	1	0	0	2	6	3	0	3	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	3	0
Hornblende Porphyry	LK004	51.23	701-22-071	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Breccia	LK004	71.63	701-22-072	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0
Breccia	LK004	81.52	701-22-073	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	LK004	104.71	701-22-074	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	5	0
Diorite Porphyry	LK004	137.51	701-22-075	0	0	0	0	3	0	0	2	6	4	0	5	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	1	0
Breccia	LK006	45.20	701-22-076	0	0	1	0	2	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	0	0	1	0	0	0	0
Andesite Porphyry	LK006	51.80	701-22-077	0	0	0	0	1	0	0	2	6	2	0	3	0	0	0	0	0	3	0	0	1	0	0	0	0	0	0	3	0
Andesite Porphyry	LK006	129.70	701-22-078	0	0	0	0	3	0	0	2	6	5	0	4	0	0	0	0	0	6	0	0	2	0	1	0	2	0	0	1	0
Breccia	LK006	145.70	701-22-079	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	1	0	1	0	1	0	0	2	0
Diorite Porphyry	LK006	165.86	701-22-080	0	0	0	0	3	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Tuff	LK006	191.35	701-22-081	0	0	0	0	3	0	0	2	6	3	0	4	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	LK006	214.60	701-22-082	0	0	0	0	4	0	0	2	6	3	0	4	0	0	0	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L013	5.00	701-22-083	0	0	0	0	1	0	0	5	4	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	11.00	701-22-084	0	0	0	0	2	0	0	5	6	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	17.70	701-22-085	0	0	0	0	3	0	0	5	5	0	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	23.40	701-22-086	0	0	0	0	1	0	0	4	5	0	0	5	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	28.90	701-22-087	0	0	0	0	1	0	0	6	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	34.90	701-22-088	0	0	0	0	0	0	0	3	6	0	0	5	0	0	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L013	41.25	701-22-089	0	0	0	0	0	0	0	2	6	0	0	5	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	47.70	701-22-090	0	0	0	0	2	0	0	2	5	0	0	5	0	0	0	0	0	6	0	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	52.90	701-22-091	0	0	0	0	1	0	0	4	5	0	0	6	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	58.80	701-22-092	0	0	0	0	3	0	0	2	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	69.00	701-22-093	0	0	0	0	0	0	0	4	5	0	0	4	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0

Appendix D

Lithology	Borehole	Depth (m)	ID	Nb	Nd	Ni	P	Pb	Pr	Rb	Re	S	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	Tm	U	V	W	Y	Yb	Zn	Zr
Geochemical Abundance Index				20	38	80	1000	14	9.5	90	0.0004	260	0.2	16	0.05	7.9	2.2	370	2	1.1	0.005	12	5600	0.6	0.48	2.4	160	1	30	3.3	75	190
Hydrothermal Breccia	L013	75.00	701-22-094	0	0	0	0	3	0	0	3	6	3	0	6	0	1	1	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Hydrothermal Breccia	L013	81.90	701-22-095	0	0	0	0	3	0	0	3	6	1	0	6	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L013	86.55	701-22-096	0	0	0	0	4	0	0	3	6	2	0	6	0	0	0	0	0	6	1	0	0	0	0	0	1	0	0	0	0
Fault Breccia	L013	93.25	701-22-097	0	0	0	0	3	0	0	3	5	3	0	6	0	0	2	0	0	6	1	0	0	0	1	0	1	0	0	0	0
Hydrothermal Breccia	L013	100.40	701-22-098	0	0	0	0	4	0	0	3	6	3	0	6	0	0	1	0	0	6	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L013	127.55	701-22-099	0	0	0	0	0	0	0	6	6	0	0	5	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	0	0
Andesite Porphyry	L013	177.05	701-22-100	0	0	0	0	0	0	0	6	6	0	0	6	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L013	199.75	701-22-101	0	0	0	0	1	0	0	6	6	0	0	6	0	0	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0
Fault Breccia	L223	121.75	701-22-102	0	0	0	0	1	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	131.00	701-22-103	0	0	0	0	0	0	0	4	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	137.00	701-22-104	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	2	0
Andesite Porphyry	L223	142.10	701-22-105	0	0	0	0	0	0	0	2	5	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	150.00	701-22-106	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	156.00	701-22-107	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	164.55	701-22-108	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	170.00	701-22-109	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	178.05	701-22-110	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	184.00	701-22-111	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	191.95	701-22-112	0	0	0	0	0	0	0	3	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	198.00	701-22-113	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	206.50	701-22-114	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	212.00	701-22-115	0	0	0	0	0	0	0	5	3	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	220.05	701-22-116	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	231.20	701-22-117	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L223	240.40	701-22-118	0	0	0	0	0	0	0	3	5	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	2	0
Fault Breccia	L223	244.00	701-22-119	0	0	0	0	1	0	0	2	5	1	0	3	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L223	319.30	701-22-120	0	0	0	0	0	0	0	2	3	0	0	3	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L223	325.40	701-22-121	0	0	0	0	0	0	0	2	4	1	0	3	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Fault Breccia	L223	340.30	701-22-122	0	0	0	0	1	0	0	2	5	2	0	3	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0
Pyroclastic	L087	6.00	701-22-123	0	0	0	0	2	0	0	2	6	4	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	16.00	701-22-124	0	0	0	0	2	0	0	2	2	3	0	6	0	1	0	0	0	4	0	0	0	0	0	0	2	0	0	0	0
Pyroclastic	L087	26.00	701-22-125	0	0	0	0	3	0	0	2	6	2	0	5	0	1	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	36.00	701-22-126	0	0	0	0	3	0	0	2	6	4	0	3	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	0
Pyroclastic	L087	46.00	701-22-127	0	0	0	0	4	0	0	2	5	3	0	4	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	56.00	701-22-128	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Fault Breccia	L087	66.00	701-22-129	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	76.00	701-22-130	0	0	0	0	2	0	0	2	6	5	0	6	0	2	0	0	0	5	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	86.00	701-22-131	0	0	0	0	3	0	0	2	6	3	0	6	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	96.00	701-22-132	0	0	0	0	3	0	0	2	6	4	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	106.00	701-22-133	0	0	0	0	2	0	0	2	4	1	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	116.00	701-22-134	0	0	0	0	3	0	0	2	5	4	0	6	0	1	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	126.00	701-22-135	0	0	0	0	3	0	0	2	5	2	0	6	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	134.00	701-22-136	0	0	0	0	1	0	0	2	2	1	0	3	0	0	0	0	0	6	0	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	144.00	701-22-137	0	0	0	0	4	0	0	3	6	0	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	2	0
Andesite Porphyry	L087	158.00	701-22-138	0	0	0	0	1	0	0	2	4	0	0	3	0	0	0	0	0	5	0	0	1	0	0	0	0	0	0	1	0
Andesite Porphyry	L087	170.00	701-22-139	0	0	0	0	0	0	0	2	4	0	0	3	0	0	0	0	0	3	1	0	0	0	1	0	1	0	0	0	0
Andesite Porphyry	L087	184.00	701-22-140	0	0	0	0	0	0	0	2	5	0	0	3	0	0	0	0	0	5	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	200.00	701-22-141	0	0	0	0	2	0	0	2	5	1	0	3	0	0	0	0	0	4	1	0	0	0	1	0	0	0	0	0	0
Andesite Porphyry	L087	210.00	701-22-142	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	216.00	701-22-143	0	0	0	0	3	0	0	2	6	1	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	252.00	701-22-144	0	0	0	0	3	0	0	2	6	2	0	4	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	262.00	701-22-145	0	0	0	0	2	0	0	2	6	3	0	5	0	1	0	0	0	6	0	0	0	0	0	0	2	0	0	0	0
Andesite Porphyry	L087	272.00	701-22-146	0	0	0	0	1	0	0	2	6	3	0	4	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Andesite Porphyry	L087	292.00	701-22-147	0	0	0	0	1	0	0	2	6	1	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Hydrothermal Breccia	L087	330.00	701-22-148	0	0	0	0	2	0	0	6	6	2	0	5	0	1	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	349.70	701-22-149	0	0	0	0	2	0	0	2	6	2	0	4	0	0	0	0	0	6	1	0	1	0	0	0	1	0	0	0	0
Andesite Porphyry	L087	340.00	701-22-150	0	0	0	0	0	0	0	2	6	2	0	5	0	0	0	0	0	6	0	0	0	0	1	0	2	0	0	0	0

APPENDIX E

Distilled Water Extract Results

Knight Piésold CONSULTING

Appendix E

Lithology	Borehole	Depth (m)	ID	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Cl	Co	Cr	Cu	EC	F	Fe-Sol	Hg	K	Mg
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l
Andesite Porphyry	LS001	25	701-22-001	0.00003	0.69	0.0001	0.02	0.01	0.0001	0.000005	7.8	0.003	8	0.01	0.01	**1.7**	257	0.1	0.08	0.0001	16.9	6.4
Andesite Porphyry	LS001	122	701-22-005	0.00006	0.55	0.0003	0.02	0.01	0.0026	0.000213	8.73	0.001	6	0.03	0.01	0.05	511	0.1	0.19	0.0001	22.9	18.6
Dyke	LS001	221.65	701-22-008	0.00001	3.18	0.006	0.02	0.03	0.0006	0.001998	14	**0.062**	17	0.55	0.01	**17.91**	438	0.2	1.94	0.0001	2.5	13.9
Andesite Porphyry	LS001	249.15	701-22-009	0.00001	0.49	0.0024	0.03	0.01	0.0001	0.000065	1.52	0.0005	84	0.01	0.01	0.15	560	0.6	0.07	0.0001	18.7	6.3
Andesite Porphyry	LS001	368.85	701-22-012	0.00021	0.4	0.0002	0.02	0.02	0.001	0.000088	7.1	0.009	191	0.16	0.01	**4.4**	1242	0.2	0.11	0.0001	29.4	23.2
Andesite Porphyry	LS001	423.5	701-22-015	0.00001	2.04	0.0004	0.01	0.02	0.0005	0.000005	11.94	0.003	47	0.35	0.01	**15.46**	466	0.2	**2.6**	0.0001	3.4	10.4
Andesite Porphyry	LS002	128.6	701-22-018	0.00001	0.23	0.0011	0.02	0.03	0.0001	0.000007	7.45	0.009	25	0.10	0.01	**2.07**	449	0.1	0.1	0.0001	22.4	14.2
Andesite Porphyry	LS002	148.4	701-22-019	0.00001	0.5	0.0039	0.02	0.03	0.0002	0.000005	9.36	0.002	32	0.15	0.01	**9.94**	549	0.1	0.19	0.0001	23.9	17.2
Diorite Porphyry	LS002	355.8	701-22-020	0.00007	3.5	0.0074	0.04	1.18	0.0008	0.000097	4.03	0.0004	74	0.002	0.01	0.3	672	1.5	**4.52**	0.0001	4.2	6.6
Andesite Porphyry	LS002	435.3	701-22-023	0.00005	0.06	0.0037	0.10	0.02	0.0002	0.000014	10.74	0.009	278	0.10	0.01	**4.58**	1370	0.2	0.12	0.0001	34.5	25.9
Andesite Porphyry	LS003	70	701-22-027	0.00001	1.81	0.0026	0.01	0.03	0.0005	0.000058	22.86	0.008	4	0.24	0.01	**0.36**	433	0.5	0.78	0.0001	26.4	15.4
Andesite Porphyry	LS003	131.7	701-22-031	0.00001	1.28	0.0029	0.01	0.01	0.0009	0.000025	17.8	0.008	22	0.30	0.01	**1.9**	548	0.2	0.83	0.0001	19.6	27.2
Breccia	LS003	146.75	701-22-032	0.00004	1.07	0.0035	0.18	0.01	0.0008	0.000028	17.09	0.010	26	0.46	0.01	**3.33**	644	0.2	1.23	0.0001	24.8	28.7
Diorite Porphyry	LS003	170.02	701-22-033	0.00001	0.52	0.002	0.17	0.02	0.0003	0.000036	11.4	0.003	12	0.12	0.01	**0.62**	509	0.1	0.64	0.0001	26.8	20.9
Andesite Porphyry	LS003	330.2	701-22-039	0.00003	0.9	0.0021	0.17	0.01	0.0006	0.000005	18.19	0.004	61	0.73	0.01	**2.93**	832	0.2	0.4	0.0001	26.8	32.0
Feldspar Porphyry	LS003	353.35	701-22-041	0.00002	0.08	0.0017	0.10	0.004	0.0001	0.000005	19.39	0.004	55	0.28	0.01	0.045	496	0.1	0.05	0.0001	9.0	16.5
Porphyry	LS003	410.9	701-22-044	0.00005	0.34	0.0027	0.12	0.01	0.0002	0.000005	25.48	**0.029**	286	**1.44**	0.01	**1.11**	1179	0.2	0.09	0.0001	14.2	33.9
Andesite Porphyry	LS004	30.21	701-22-046	0.00001	0.08	0.0016	0.28	0.02	0.0001	0.000005	25.78	**0.043**	73	0.02	0.03	0.05	1000	0.4	0.01	0.0001	50.1	24.7
Andesite Porphyry	LS004	110.45	701-22-049	0.00003	0.13	0.0024	0.25	0.01	0.0029	0.000016	10.46	0.001	99	0.03	0.01	**2.38**	905	0.1	0.05	0.0001	41.7	13.2
Diorite Porphyry	LS005	50.1	701-22-052	0.00007	0.45	0.0039	0.04	0.06	0.0001	0.000005	6.85	0.00002	23	0.001	0.01	0.01	344	0.6	0.02	0.0001	15.8	7.9
Diorite Porphyry	LS005	141.4	701-22-055	0.00009	0.11	0.0019	0.04	0.03	0.0001	0.000005	9.18	0.00003	236	0.002	0.01	0.01	1169	0.4	0.03	0.0001	24.8	17.9
Andesite Porphyry	LS006	127.6	701-22-059	0.00001	0.21	0.0014	0.07	0.01	0.0001	0.000005	9.39	0.006	97	0.03	0.01	0.01	874	0.3	0.05	0.0001	37.4	21.6
Breccia	LS006	140.4	701-22-060	0.00012	0.39	0.0022	0.05	0.01	0.0017	0.000013	8.99	0.006	175	0.09	0.01	**0.83**	1022	0.2	0.07	0.0001	37.9	19.7
Porphyry	LK002	133.3	701-22-064	0.00001	2.81	0.001	0.03	0.0005	0.0002	0.000005	10.44	0.005	33	0.12	0.01	**9.6**	335	0.1	**3.04**	0.0001	4.8	7.6
Breccia	LK003	54.9	701-22-067	0.00003	**17.83**	0.0077	0.04	0.02	0.002	0.00002	11.02	**0.269**	17	0.70	0.01	**14.94**	598	0.1	**7.34**	0.0001	20.2	10.9
Hornblende Porphyry	LK004	51.23	701-22-071	0.00003	3.24	0.0056	0.04	0.23	0.0008	0.000057	8.83	0.0001	27	0.001	0.01	0.02	499	0.1	1.98	0.0001	5.5	7.6
Breccia	LK004	71.63	701-22-072	0.00008	1.38	0.0049	0.02	0.07	0.0002	0.000007	8.4	0.00002	115	0.002	0.01	0.01	925	0.4	0.44	0.0001	17.5	5.3
Tuff	LK006	191.35	701-22-081	0.00007	**68.74**	0.0213	0.01	0.003	0.0016	0.000409	23.80	0.001	31	**3.39**	0.10	**13.87**	2302	0.1	**249.7**	0.0001	21.3	40.5
Andesite Porphyry	L013	11	701-22-084	0.00001	0.02	0.001	0.03	0.02	0.0001	0.000005	12.95	0.00002	30	0.001	0.01	0.11	328	0.3	0.03	0.0001	18.4	14.0
Andesite Porphyry	L013	34.9	701-22-088	0.00003	0.99	0.0011	0.01	0.01	0.0001	0.000005	4.91	0.0001	13	0.003	0.01	**3.06**	245	0.1	0.13	0.0001	23.1	4.4
Andesite Porphyry	L013	69	701-22-093	0.00002	3.12	0.0016	0.01	0.03	0.0002	0.000016	9.56	0.0004	5	0.04	0.01	**25.25**	437	0.1	0.18	0.0001	30.1	6.6
Hydrothermal Breccia	L013	75	701-22-094	0.00002	1.02	0.001	0.01	0.03	0.0001	0.000005	18.3	0.001	15	0.02	0.01	**1.91**	324	0.1	0.19	0.0001	9.6	7.7
Fault Breccia	L013	93.25	701-22-097	0.00002	0.45	0.001	0.01	0.01	0.0001	0.000005	12.73	0.001	56	0.01	0.01	**1.15**	523	0.1	0.03	0.0001	6.1	15.3
Andesite Porphyry	L013	127.55	701-22-099	0.00018	**7.37**	0.0023	0.01	0.06	0.0013	0.000005	29.14	0.004	7	0.27	0.01	**61.14**	956	0.2	**2.16**	0.0001	22.0	46.6
Andesite Porphyry	L223	156	701-22-107	0.00002	0.08	0.002	0.02	0.01	0.0001	0.000005	27.63	0.0001	12	0.002	0.01	0.02	869	0.3	0.01	0.0001	9.4	12.8
Andesite Porphyry	L223	170	701-22-109	0.00004	2.84	0.0022	0.02	0.10	0.0003	0.000011	6.54	0.00002	28	0.002	0.01	0.01	396	0.3	0.7	0.0001	5.0	2.7
Andesite Porphyry	L223	184	701-22-111	0.00001	2.92	0.0071	0.06	0.17	0.0005	0.000166	11.6	0.00006	27	0.001	0.01	0.08	546	0.9	0.86	0.0001	8.1	5.5
Andesite Porphyry	L223	206.5	701-22-114	0.00001	2.32	0.0015	0.04	0.10	0.0002	0.000034	7.85	0.00002	99	0.001	0.01	0.02	617	0.3	0.44	0.0001	11.9	2.9
Andesite Porphyry	L223	212	701-22-115	0.00004	2.74	0.0029	0.04	0.02	0.0002	0.000033	6.29	0.00002	74	0.002	0.01	0.03	590	0.4	0.56	0.0001	6.9	2.2
Andesite Porphyry	L223	325.4	701-22-121	0.00001	0.795	0.0012	0.03	0.01	0.0010	0.000005	9.2	0.0003	78	0.05	0.01	**1.22**	888	0.2	0.06	0.0001	19.7	20.4
Fault Breccia	L223	340.3	701-22-122	0.00007	**18.5**	0.0012	0.06	0.01	0.0071	0.000005	36.42	0.005	54	0.60	0.01	**51.26**	1496	0.9	1.39	0.0001	30.9	96.2
Pyroclastic	L087	6	701-22-123	0.00002	0.15	0.0026	0.01	0.03	0.0001	0.000005	28.66	0.00002	18	0.001	0.01	0.03	320	0.7	0.01	0.0001	6.1	8.8
Pyroclastic	L087	36	701-22-126	0.00002	0.09	0.0007	0.01	0.07	0.0001	0.000005	19.63	0.00004	35	0.01	0.01	0.01	339	0.4	0.01	0.0001	8.4	6.7
Andesite Porphyry	L087	76	701-22-130	0.00007	1.85	0.0012	0.01	0.05	0.0001	0.000005	23.05	0.00005	59	0.001	0.01	0.06	509	0.3	0.18	0.0001	11.9	13.6
Andesite Porphyry	L087	96	701-22-132	0.00001	0.12	0.001	0.01	0.03	0.0001	0.000005	6.71	0.00002	27	0.003	0.01	0.01	240	0.1	0.02	0.0001	5.7	6.1
Andesite Porphyry	L087	126	701-22-135	0.00003	0.04	0.001	0.01	0.01	0.0001	0.000011	7.44	0.00003	18	0.004	0.01	0.02	194	0.1	0.01	0.0001	8.8	4.2
Andesite Porphyry	L087	184	701-22-140	0.00002	**18.93**	0.0047	0.01	0.01	0.0092	0.000005	49.34	**0.012**	10	**5.49**	0.01	**0.35**	1034	0.5	**3.02**	0.0001	16.1	73.6
Andesite Porphyry	L087	272	701-22-146	0.00001	**47.16**	0.0037	0.01	0.0001	0.0008	0.000005	14.37	**0.028**	3	0.36	0.33	**130.44**	1344	0.1	**167.5**	0.0001	1.1	7.4
Andesite Porphyry	L087	292	701-22-147	0.00003	**33.36**	0.0027	0.01	0.003	0.0019	0.000005	39.62	**0.024**	7	0.92	0.02	**86.26**	1321	0.1	**35.2**	0.0001	10.6	46.1
Hydrothermal Breccia	L087	330	701-22-148	0.00001	**42.85**	0.0044	0.01	0.0004	0.0005	0.000005	10.55	0.004	2	0.14	0.18	**33.88**	1176	0.1	**241.2**	0.0001	1.3	3.9
			Average	0.0000376	**6.01**	0.003	0.05	0.05	0.0009	0.00007	14.81	**0.01**	56.60	0.35	0.02	**10.10**	716.38	0.28	**14.61**	0.00	17.49	18.03
Adopted Reference Level				0.5	5	0.1	5	N/G	N/G	N/G	1000	0.01	N/G	1	1	0.3	N/G	2	2	0.002	N/G	2000

Appendix E

Lithology	Borehole	Depth (m)	ID	Mn	Mo	Na	Ni	P	Pb	pH	S	SO4	Sb	Se	Sn	Sr	TDSEva	Th	U	V	Zn	AFP
				mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	NONE	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/Kg	mg/l	mg/l	mg/l	mg/l	-
Andesite Porphyry	LS001	25	701-22-001	1.3	0.00010	14.4	0.01	0.1	0.0017	5	26.2	78	0.00001	0.0011	0.0001	0.01	178	0.00005	0.0001	0.01	0.3	UC
Andesite Porphyry	LS001	122	701-22-005	1.26	0.00015	49.9	0.02	0.1	0.0018	5.2	61.2	183	0.00004	0.0112	0.0001	0.02	401	0.00021	0.0022	0.01	0.68	PAF-LC
Dyke	LS001	221.65	701-22-008	0.5	0.00029	30.3	0.14	0.3	0.0031	4.4	56.1	168	0.0007	0.0026	0.0057	0.07	362	0.00041	0.0220	0.01	0.89	PAF
Andesite Porphyry	LS001	249.15	701-22-009	0.04	0.01145	92.7	0.01	0.1	0.0006	6.6	34.2	102	0.00479	0.0015	0.0001	0.01	389	0.00025	0.0011	0.01	0.02	PAF
Andesite Porphyry	LS001	368.85	701-22-012	0.09	0.00007	239.6	0.07	0.1	0.0012	5	116.6	349	0.00024	0.022	0.0001	0.02	947	0.00007	0.0133	0.01	0.8	PAF
Andesite Porphyry	LS001	423.5	701-22-015	0.37	0.00008	43.6	0.13	0.3	0.0005	4.3	45.6	137	0.00032	0.0015	0.0001	0.15	420	0.00007	0.0146	0.01	0.45	PAF
Andesite Porphyry	LS002	128.6	701-22-018	0.25	0.00005	39.5	0.06	0.1	0.0005	4.6	48.9	146	0.00011	0.0069	0.0001	0.02	382	0.00004	0.0341	0.01	1.82	PAF
Andesite Porphyry	LS002	148.4	701-22-019	0.32	0.00005	42.9	0.11	0.2	0.0006	4.4	58.5	175	0.00054	0.005	0.0001	0.02	350	0.00014	0.0535	0.01	1.78	PAF
Diorite Porphyry	LS002	355.8	701-22-020	0.12	0.00799	132.4	0.01	0.4	0.0042	8.5	28.4	85	0.00021	0.003	0.0001	0.01	488	0.00121	0.0005	0.08	0.66	NAF
Andesite Porphyry	LS002	435.3	701-22-023	2	0.00006	243.8	0.05	0.1	0.0005	6.1	91	273	0.00004	0.0035	0.0001	0.02	1016	0.00034	0.0003	0.01	2.76	PAF
Andesite Porphyry	LS003	70	701-22-027	0.68	0.00012	12.9	0.16	0.1	0.0009	4.7	57.5	172	0.00058	0.0036	0.0001	0.07	265	0.00014	0.0052	0.01	1.63	PAF
Andesite Porphyry	LS003	131.7	701-22-031	2.1	0.00005	31.5	0.13	0.1	0.0006	4.4	71.7	215	0.00014	0.0016	0.0001	0.01	440	0.00025	0.0245	0.01	1.99	PAF
Breccia	LS003	146.75	701-22-032	2.1	0.00005	37.3	0.2	0.1	0.0017	4.1	83.8	251	0.00019	0.0021	0.0001	0.01	439	0.00019	0.0597	0.01	2.84	PAF
Diorite Porphyry	LS003	170.02	701-22-033	0.9	0.00005	36	0.04	0.1	0.001	4.5	65.1	195	0.00012	0.0014	0.0001	0.01	340	0.00029	0.0392	0.01	0.93	PAF
Andesite Porphyry	LS003	330.2	701-22-039	1.15	0.00006	85.6	0.22	0.1	0.0005	4.4	99.5	298	0.00019	0.0052	0.0001	0.01	625	0.00015	0.0264	0.01	0.61	PAF
Feldspar Porphyry	LS003	353.35	701-22-041	0.68	0.00016	46.65	0.07	0.1	0.0006	5.35	47.05	141	0.00033	0.0028	0.0001	0.04	350	0.00002	0.0053	0.01	0.695	PAF
Porphyry	LS003	410.9	701-22-044	0.57	0.0002	161.8	0.56	0.1	0.0005	5	51	153	0.00054	0.0046	0.0001	0.02	720	0.00004	0.0068	0.01	0.84	PAF-LC
Andesite Porphyry	LS004	30.21	701-22-046	19.09	0.00358	117.1	0.01	0.1	0.0066	7.2	117.6	352	0.00034	0.0013	0.0001	0.94	680	0.00001	0.0001	0.01	0.59	PAF
Andesite Porphyry	LS004	110.45	701-22-049	1.57	0.00008	140.4	0.02	0.1	0.0013	5.3	90.5	271	0.00145	0.0021	0.0001	0.35	580	0.00002	0.0021	0.01	0.98	PAF
Diorite Porphyry	LS005	50.1	701-22-052	0.01	0.01026	47.3	0.01	0.1	0.0012	8.2	29.7	89	0.00047	0.0009	0.0001	0.03	210	0.00001	0.0062	0.01	0.01	AC
Diorite Porphyry	LS005	141.4	701-22-055	1.12	0.00228	203.8	0.01	0.1	0.0007	7.3	55.1	165	0.00018	0.0025	0.0001	0.14	657	0.00001	0.0003	0.01	0.01	PAF
Andesite Porphyry	LS006	127.6	701-22-059	5.83	0.00007	122	0.02	0.1	0.0007	6.5	82.1	246	0.00002	0.0063	0.0001	0.01	443	0.00006	0.0007	0.01	0.87	PAF
Breccia	LS006	140.4	701-22-060	0.22	0.00012	163.7	0.1	0.1	0.0017	5.2	75.5	226	0.00029	0.0078	0.0001	0.02	700	0.00008	0.0036	0.01	0.95	PAF
Porphyry	LK002	133.3	701-22-064	0.4	0.00006	22.9	0.09	0.2	0.0006	4.1	34.5	103	0.00049	0.0015	0.0001	0.01	203	0.00004	0.0133	0.01	0.19	PAF
Breccia	LK003	54.9	701-22-067	1.88	0.00008	6.3	0.51	0.4	0.013	3.7	91.4	274	0.00021	0.0047	0.0001	0.01	391	0.00096	0.0315	0.01	45.3	PAF
Hornblende Porphyry	LK004	51.23	701-22-071	0.13	0.00851	124.5	0.01	0.1	0.0025	9.2	17.4	52	0.00018	0.0012	0.0001	0.05	246	0.00075	0.0023	0.06	0.01	NAF
Breccia	LK004	71.63	701-22-072	0.02	0.03562	208.2	0.01	0.1	0.0015	8.5	60.7	182	0.00038	0.0015	0.0001	0.06	620	0.00012	0.0042	0.02	0.01	AC
Tuff	LK006	191.35	701-22-081	0.41	0.00062	65.6	1.905	0.5	0.0100	2.7	419.5	1257	0.00047	0.00325	0.0001	0.03	1481	0.01840	0.0914	0.07	1.02	PAF
Andesite Porphyry	L013	11	701-22-084	0.02	0.00555	23.3	0.01	0.1	0.0006	7.3	20.3	61	0.00004	0.0023	0.0001	0.63	180	0.00008	0.0002	0.01	0.01	NAF
Andesite Porphyry	L013	34.9	701-22-088	0.05	0.00012	18.6	0.01	0.1	0.0005	5.6	23.5	70	0.00003	0.0043	0.0001	0.03	155	0.00014	0.0001	0.01	0.01	NAF
Andesite Porphyry	L013	69	701-22-093	0.19	0.00008	26.6	0.02	0.5	0.0005	4.2	55.7	167	0.00001	0.0121	0.0001	0.03	265	0.00050	0.0007	0.01	0.07	NAF
Hydrothermal Breccia	L013	75	701-22-094	0.34	0.00018	25	0.01	0.1	0.0005	5.1	36.6	110	0.00011	0.0037	0.0001	0.25	195	0.00066	0.0003	0.01	0.14	UC
Fault Breccia	L013	93.25	701-22-097	0.73	0.00005	71.5	0.01	0.1	0.0005	5.8	49.4	148	0.00003	0.0193	0.0001	0.08	331	0.00009	0.0002	0.01	0.27	UC
Andesite Porphyry	L013	127.55	701-22-099	1.49	0.00033	63.7	0.1	1.2	0.0009	4.2	164.2	492	0.00022	0.0229	0.0001	0.09	682	0.00652	0.0077	0.01	3.16	PAF
Andesite Porphyry	L223	156	701-22-107	0.02	0.06095	157.8	0.01	0.1	0.0006	8.1	134.8	404	0.00028	0.0019	0.0001	0.30	631	0.00007	0.0037	0.01	0.01	NAF
Andesite Porphyry	L223	170	701-22-109	0.05	0.14508	86.2	0.01	0.1	0.0014	9	12.2	37	0.00012	0.0017	0.0001	0.08	386	0.00062	0.0026	0.03	0.01	NAF
Andesite Porphyry	L223	184	701-22-111	0.09	0.96708	124.7	0.01	0.1	0.0054	8.8	26.8	80	0.00016	0.0596	0.0001	0.09	306	0.00043	0.0030	0.02	0.01	AC
Andesite Porphyry	L223	206.5	701-22-114	0.02	0.53322	126.5	0.01	0.1	0.0016	8.5	19.3	58	0.00011	0.0015	0.0001	0.10	352	0.00048	0.0008	0.02	0.01	AC
Andesite Porphyry	L223	212	701-22-115	0.02	1.049	123.9	0.01	0.1	0.0034	8.6	37.1	111	0.00052	0.0012	0.0001	0.07	400	0.00049	0.0017	0.01	0.01	AC
Andesite Porphyry	L223	325.4	701-22-121	0.115	0.00072	144.65	0.01	0.1	0.0006	5.3	97.75	293	0.00005	0.0027	0.0001	0.01	615	0.00004	0.0014	0.01	0.02	PAF-LC
Fault Breccia	L223	340.3	701-22-122	0.73	0.00054	164.3	0.18	0.9	0.0005	4.1	294.5	882	0.00004	0.0059	0.0001	0.08	1355	0.00022	0.9309	0.01	0.44	PAF
Pyroclastic	L087	6	701-22-123	0.01	0.01194	23.8	0.01	0.1	0.0005	7.9	25.8	77	0.00127	0.0017	0.0001	0.26	183	0.00001	0.0035	0.01	0.01	NAF
Pyroclastic	L087	36	701-22-126	0.08	0.00245	32.1	0.01	0.1	0.0018	6.8	27.6	83	0.00035	0.0012	0.0001	0.23	205	0.00003	0.0002	0.01	0.01	PAF-LC
Andesite Porphyry	L087	76	701-22-130	0.18	0.00821	57	0.01	0.1	0.0032	7.3	44.8	134	0.00188	0.0014	0.0001	0.18	403	0.00020	0.0003	0.01	0.01	PAF-LC
Andesite Porphyry	L087	96	701-22-132	0.04	0.00155	27.3	0.01	0.1	0.001	6.7	18.8	56	0.00034	0.0011	0.0001	0.16	149	0.00003	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	126	701-22-135	0.08	0.00163	18.3	0.01	0.1	0.0008	6.7	16.5	49	0.00054	0.001	0.0001	0.09	126	0.00001	0.0002	0.01	0.01	NAF
Andesite Porphyry	L087	184	701-22-140	2.11	0.00106	40.2	1.18	0.1	0.0005	3.8	198	593	0.00002	0.0027	0.0001	0.03	966	0.00058	0.0449	0.01	1.56	PAF
Andesite Porphyry	L087	272	701-22-146	0.74	0.00263	6.5	0.19	2.6	0.0006	3.1	261.9	785	0.00014	0.0028	0.0001	0.03	879	0.03736	0.0252	0.01	0.55	PAF
Andesite Porphyry	L087	292	701-22-147	2.71	0.00096	51.5	0.29	1.7	0.0005	3.4	247.9	743	0.00014	0.0079	0.0001	0.07	961	0.01012	0.0433	0.01	3.56	PAF
Hydrothermal Breccia	L087	330	701-22-148	0.58	0.00143	4.6	0.12	0.9	0.0005	3.3	242.3	726	0.00027	0.0104	0.0001	0.04	810	0.00303	0.0077	0.01	0.32	PAF
			Average	1.11	0.06	79.61	0.14	0.28	0.002	5.8	83.44	249.98	0.0004	0.01	0.0002	0.10	497	0.002	0.03	0.01	1.60	
Adopted Reference Level				N/G	0.15	N/G	0.5	N/G	0.1	6	N/G	1000	N/G	0.02	N/G	N/G	2000	N/G	0.2	N/G	0.5	

APPENDIX F

Laboratory Testing Certificates

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Quantitative X-Ray Diffraction Analysis

Report Prepared for:	Tim Rowles Knight Piesold Pty. Ltd. trowles@knightpiesold.com
Samples Received:	22-May-2013
Samples Analysed:	29-May-2013 -12-June-2013
Written by:	Dr Sharon Ness
Date:	12-June-2013
Intertek Genalysis Job No:	752.0/1307181 (Rev 1)

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Introduction

Fifteen (15) samples were submitted for quantitative powder X-ray diffraction (XRD) phase analysis of the crystalline and amorphous contents.

Sampling and Preparation

The samples were crushed and milled to < 60 µm

For each sample (except 701-22-097), a grab was taken from the bulk powder and an internal standard, ZnO, added for the determination of the amorphous content.

A grab of sample 701-22-097 was prepared by adding an internal standard, TiO2, and micronising the mixture to 4µm.

The spiked samples were each prepared as an un-oriented powder mount.

A second grab was taken of 701-22-001 and prepared as a duplicate analysis.

Instrumentation

The XRD patterns were produced on a PANalytical Cubix^3 XRD fitted with Copper radiation (operating at 45 kV and 40 mA), scanning a range of 1.3^o to 65°2θ. A graphite monochromator was used in the diffracted beam.

Qualitative analysis was performed with Bruker Diffrac.EVA 3.0 Search/Match software with the ICDD PDF-2 (2011) database.

Quantitative phase analysis was performed using SIROQUANT^{TM} Version 3 software.

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Results

The quantitative analysis of the crystalline and amorphous content of each sample is as follows:

Sample ID **701-22-001**

		original	duplicate	
Phase	**Formula**	**wt%**	**wt%**	**Notes**
Amorphous content		13	12	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	17	15	
Interlayered illite/smectite		21	21	see Note 1
Jarosite	(K,Na)Fe3(SO4)2(OH)6	<1	1	
Kaolin	Al2Si2O5(OH)4	5	6	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	5	6	
Quartz	SiO2	39	39	

Sample ID **701-22-008**

Phase	Formula	wt%	Notes
Amorphous content		10	
Dolomite	CaMg(CO3)2	1	
Kaolin	Al2Si2O5(OH)4	16	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	10	
Potassium feldspar	KAlSi3O8	2	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	38	

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Sample ID **701-22-020**

Phase	Formula	wt%	Notes
Amorphous content		17	
Alunite	KAl3(SO4)2(OH)6	1	
Chalcopyrite	CuFeS2	<1	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	6	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		14	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Potassium feldspar	KAlSi3O8	5	
Pyrite	FeS2	1	
Quartz	SiO2	31	
Siderite	FeCO3	11	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-023**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	1	
Anhydrite	CaSO4	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	13	
Interlayered illite/smectite		5	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Kaolin	Al2Si2O5(OH)4	17	
Pyrite	FeS2	2	
Quartz	SiO2	45	
Siderite	FeCO3	3	

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Sample ID **701-22-032**

Phase	Formula	wt%	Notes
Amorphous content		17	
Anhydrite	CaSO4	1	
Calcite	CaCO3	<1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	12	
Interlayered illite/smectite		18	see Note 1
Jarosite	KFe3(SO4)2(OH)6	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	<1	
Pyrite	FeS2	6	
Quartz	SiO2	45	

Sample ID **701-22-041**

Phase	Formula	wt%	Notes
Amorphous content		13	
Alunite	KAl3(SO4)2(OH)6	3	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	2	
Interlayered illite/smectite		8	see Note 1
Kaolin	Al2Si2O5(OH)4	8	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	<1	
Potassium feldspar	KAlSi3O8	<1	
Pyrite	FeS2	10	
Pyrophyllite	Al2Si4O10(OH)2	22	
Quartz	SiO2	34	

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Sample ID **701-22-044**

Phase	Formula	wt%	Notes
Amorphous content		7	
Dolomite	CaMg(CO3)2	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	1	
Interlayered illite/smectite		1	see Note 1
Kaolin	Al2Si2O5(OH)4	22	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	26	
Pyrite	FeS2	1	
Quartz	SiO2	41	

Sample ID **701-22-052**

Phase	Formula	wt%	Notes
Amorphous content		13	
Ankerite	Ca(Fe,Mg)(CO3)2	4	
Dolomite	CaMg(CO3)2	8	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	11	
Interlayered illite/smectite		15	see Note 1
Kaolin	Al2Si2O5(OH)4	5	
Magnesite	MgCO3	4	see Note 2
Quartz	SiO2	40	

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Sample ID **701-22-071**

Phase	Formula	wt%	Notes
Amorphous content		33	
Calcite	CaCO3	2	
Dolomite	CaMg(CO3)2	3	
Expanding clay		2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	7	
Interlayered illite/smectite		9	see Note 1
Kaolin	Al2Si2O5(OH)4	2	
Potassium feldspar	KAlSi3O8	8	
Pyrite	FeS2	<1	
Quartz	SiO2	24	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	12	

Sample ID **701-22-072**

Phase	Formula	wt%	Notes
Amorphous content		29	
Calcite	CaCO3	1	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	5	
Dolomite	(Ca,Fe,Mg)2(CO3)2	7	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	4	
Interlayered illite/smectite		22	see Note 1
Magnesite	MgCO3	2	see Note 2
Pyrite	FeS2	2	
Quartz	SiO2	29	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	1	

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Sample ID **701-22-081**

Phase	Formula	wt%	Notes
Amorphous content		11	
Anatase	TiO2	1	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	5	
Interlayered illite/smectite		13	see Note 1
Kaolin	Al2Si2O5(OH)4	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	3	
Pyrite	FeS2	15	
Pyrophyllite	Al2Si4O10(OH)2	8	
Quartz	SiO2	43	

Sample ID **701-22-097**

Phase	Formula	wt%	Notes
Amorphous content		11	see Note 3
Dolomite	CaMg(CO3)2	1	
Hematite	Fe2O3	15	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	9	
Potassium feldspar	KAlSi3O8	4	
Pyrophyllite	Al2Si4O10(OH)2	13	
Quartz	SiO2	47	

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Sample ID **701-22-115**

Phase	Formula	wt%	Notes
Amorphous content		35	
Calcite	CaCO3	7	
Chlorite	(Fe,Al,Mg)6(Si,Al)4O10(OH)8	13	
Chloritoid	(Fe,Mg)2Al4Si2O10(OH)4	2	
Illite/Muscovite	(K,Ca,Na)(Al,Mg,Fe)2(Si,Al)4O10(OH)2	4	
Palygorskite	Mg5(Si4O10)2(OH)2(H2O)8	7	see Note 1
Quartz	SiO2	23	
Sodium calcium plagioclase	(Na,Ca)(Al,Si)2Si2O8	9	

Sample ID **701-22-126**

Phase	Formula	wt%	Notes
Amorphous content		14	
Hematite	Fe2O3	1	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	15	
Potassium feldspar	KAlSi3O8	1	
Pyrophyllite	Al2Si4O10(OH)2	5	
Quartz	SiO2	63	

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Sample ID **701-22-148**

Phase	Formula	wt%	Notes
Amorphous content		3	
Diaspore	AlO(OH)	2	
Natroalunite	(K,Na)Al3(SO4)2(OH)6	28	
Pyrite	FeS2	16	
Pyrophyllite	Al2Si4O10(OH)2	4	
Quartz	SiO2	47	

Calculation of the phase abundances have been based on the Brindley contrast corrections using a particle diameter of 10 µm.

Uncertainty in the SIROQUANT™ analyses should reflect errors (absolute) of no greater than: +/- 10% for phases 50-95%, +/- 5% for phases 10-50% and +/- 2% for phases 3-10%. Phases of < 3% are approaching detection limit and normally no refinements are made on these.

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Quality Control

NIST Standard Reference Material 656

The powder consists of sub-micrometer, equi-axial, non-aggregated grains that do not display the effects of absorption contrast, extinction or preferred orientation.

An aliquot of this CRM, spiked with 10% Al2O3 for the amorphous content determination, was prepared as un-oriented powder mount of the total sample and the scan analysed with SIROQUANT™.

The results are as follows

Sample ID **β 656 (High β Phase Powder)**

		result	std dev	SRM certified	SRM uncert
Phase	**Formula**	**wt%**	**wt%**	**wt%**	**wt%**
Amorphous content		8.8	0.1	8.6	0.81
Si3N4, alpha	SiN4	16.3	0.6	16.3	2.54
Si3N4, beta	SiN4	74.9	0.4	75.1	0.60

Each interval defined by the certified value and its uncertainty is a 95% confidence interval for the true value of the mean in the absence of systematic error.

Discussion

Notes

1. For confirmation of the clay mineral identification, clay separation and oriented clay mounts (glycol and heat treated) would be required.

2. The magnesite phase possibly has some substitution of the magnesium by calcium.

3. Calculation of the phase abundances has been based on the Brindley contrast corrections using a particle diameter of 4 µm, this being the median particle size determined for this sample after miconising.

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Discussion

General

Quantification of the crystalline mineral phases was performed with the SIROQUANT™ software package. This software uses the full-profile Rietveld method of refining the profile of the calculated XRD pattern against the profile of the measured XRD pattern. The total calculated pattern is the sum of the calculated patterns of the individual phases.

Corrections are incorporated the process that allows for a more accurate description of the mineral's contribution to the measured pattern and to allow for variation due to atomic substitution, layer disordering, preferred orientation, and other factors that affect the acquisition of the XRD scan.

The limitations of qualitative XRD analysis are as follows:

1. There is a limit of detection of 1-2% on most crystalline phases.
2. The detection of a phase may be dependent on its crystallinity.
3. Where there exist multiple phases, overlap of diffracted reflections can occur, thus rendering some ambiguity into the interpretation.
4. Some phases cannot be unambiguously identified as they are present in minor or trace amounts.

The limitations of quantitative XRD analysis by a full-profile Rietveld method are as follows:

1. The limitations for qualitative XRD analysis apply
2. The method as described is standardless: it relies solely on the published crystallographic data available for each phase. Some data may not exactly describe the phases present.
3. Particle size is important with respect to the absorption of the X-rays by the sample. Milling to < 60 µm will usually produce a median particle size of approximately10 µm which is, in most cases, sufficient to minimize absorption contrast effects. However, this particle size may not be sufficient to minimize the absorption contrast effect if the samples contain a significant amount of iron-bearing phases. This is because the absorption contrast between them and other lower absorber phases is the most severe when analysed with Copper radiation. Micronising reduces the particle size to that more suitable for analysis with this radiation.

The accuracy of the analysis is dependent on sampling and sample preparation in addition to the calculated profiles being exactly representative of the chemistry of the component phases and their crystallinity. Some preferred orientation effects and reflection overlaps may occur which cannot be adequately resolved.

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Amorphous content

The amorphous content was determined from the addition of a known spike of a well-crystalline internal standard (ZnO or TiO2) to each sample.

When amorphous material is present, the weight percentage of the spike found by SIROQUANT™ is larger than actually weighed out. SIROQUANT™ then calculates the amount of amorphous material that causes the difference in the spike weight percentages and normalises all weight percentages to include the amorphous content.

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ANALYTICAL REPORT

KNIGHT PIESOLD PTY LIMITED
PO Box 6837
EAST PERTH, W.A. 6892
AUSTRALIA

JOB INFORMATION

JOB CODE	:	752.0/1307060
No. of SAMPLES	:	150
No. of ELEMENTS	:	80
CLIENT O/N	:	PE701-00022 SS13001(REVB) (Job 1
SAMPLE SUBMISSION No.	:	PE701-00022 SS13001(REVB)
PROJECT	:	LETPADAUNG
STATE	:	Rock Chip
DATE RECEIVED	:	20/05/2013
DATE COMPLETED	:	19/06/2013
DATE PRINTED	:	19/06/2013
PRIMARY LABORATORY	:	Intertek Genalysis Perth

LEGEND

X	= Less than Detection Limit
N/R	= Sample Not Received
*	= Result Checked
( )	= Result still to come
I/S	= Insufficient Sample for Analysis
E6	= Result X 1,000,000
UA	= Unable to Assay
>	= Value beyond Limit of Method
OV	= Value over-range for Package

MAIN OFFICE AND LABORATORY

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SAMPLE DETAILS

DISCLAIMER

Intertek Genalysis wishes to make the following disclaimer pertaining to the accompanying analytical results.

All work is performed in accordance with the Intertek Minerals Standard Terms and Conditions of work http://www.intertek.com/terms/

This report relates specifically to the sample(s) that were drawn and/or provided by the client or their nominated third party. The reported result(s) provide no warranty or verification on the sample(s) representing any specific goods and/or shipment and only relate to the sample(s) as received and tested. This report was prepared solely for the use of the client named in this report. Intertek accepts no responsibility for any loss, damage or liability suffered by a third party as a result of any reliance upon or use of this report.

SIGNIFICANT FIGURES

It is common practice to report data derived from analytical instrumentation to a maximum of two or three significant figures. Some data reported herein may show more figures than this. The reporting of more than two or three figures in no way implies that the third, fourth and subsequent figures may be real or significant.

Intertek Genalysis accepts no responsibility whatsoever for any interpretation by any party of any data where more than two or three significant figures have been reported.

SAMPLE STORAGE DETAILS

GENERAL CONDITIONS

SAMPLE STORAGE OF SOLIDS

Bulk Residues and Pulps will be stored for 60 DAYS without charge. After this time all Bulk Residues and Pulps will be stored at a rate of $3.30 per cubic metre per day until your written advice regarding collection or disposal is received. Expenses related to the return or disposal of samples will be charged to you at cost. Current disposal cost is charged at $100.00 per cubic metre.

SAMPLE STORAGE OF SOLUTIONS

Samples received as liquids, waters or solutions will be held for 60 DAYS free of charge then disposed of, unless written advice for return or collection is received.

NOTES

1. Note: Detection Limit only apply when TDS <100mg/l for MS and TDS<5000mg/l for OES except when indicated in spreadsheet

   NB pH Ws/MTR and EC/MTR both measured on 1:3 [soil:water] extract
   All anions and metals read on the same extract, solution values are reported

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0001 701-22-001	0.72	0.02	9.97%	0.76	-3	4.2
0002 701-22-002	0.11		7.77%		15	1.6
0003 701-22-003	0.86		8.11%		-2	10.7
0004 701-22-004	1.16		7.96%		-4	12.4
0005 701-22-005	0.54	0.06	9.06%	0.55	5	3.7
0006 701-22-006	0.65		8.77%		-3	7.1
0007 701-22-007	1.12		5.87%		-11	789.6*
0008 701-22-008	0.22	X	8.10%	3.18	-6	37.3
0009 701-22-009	0.13	X	9.20%	0.49	-3	33.9
0010 701-22-010	0.15		8.69%		-3	9.4
0011 701-22-011	1.00		8.03%		-7	12.5
0012 701-22-012	0.82	0.21	8.69%	0.40	-3	4.9
0013 701-22-013	0.14		9.47%		-3	8.4
0014 701-22-014	0.41		6.77%		-6	90.4
0015 701-22-015	0.09	X	6.17%	2.04	-8	42.4
0016 701-22-016	0.17		9.04%		-3	2.9
0017 701-22-017	0.25		8.98%		-4	16.5
0018 701-22-018	0.12	X	8.78%	0.23	-3	8.2
0019 701-22-019	0.16	0.01	8.68%	0.50	-3	20.3
0020 701-22-020	0.17	0.07	6.98%	3.50	17	1.3
0021 701-22-021	1.47		8.26%		13	15.2
0022 701-22-022	0.31		8.94%		4	5.5
0023 701-22-023	0.21	0.05	9.07%	0.06	5	3.9
0024 701-22-024	1.81		8.58%		5	47.9
0025 701-22-025	0.24		9.19%		4	6.1
0026 701-22-026	0.46		7.85%		4	15.5
0027 701-22-027	0.18	X	8.51%	1.81	4	1.6
0028 701-22-028	0.17		6.32%		4	2.7
0029 701-22-029	0.49		9.13%		4	20.3
0030 701-22-030	0.59		7.11%		1	16.0
0031 701-22-031	0.22	X	8.90%	1.28	4	5.9
0032 701-22-032	0.68	0.04	8.02%	1.07	2	31.1
0033 701-22-033	0.58	0.01	8.12%	0.52	3	15.5
0034 701-22-034	0.46		9.05%		4	13.5
0035 701-22-035	0.30		7.03%		-2	31.6
0036 701-22-036	0.57		8.10%		2	14.3
0037 701-22-037	0.23		8.61%		2	7.2
0038 701-22-038	0.39		7.46%		1	6.4

ANALYSIS

0039 701-22-039	0.30	0.03	8.98%	0.90	1	4.7
0040 701-22-040	0.11		7.84%		41	6.3

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.1	X	0.02	252.9	9.66	1.85
0002 701-22-002		13		426.1		1.96
0003 701-22-003		X		381.5		2.50
0004 701-22-004		X		542.1		1.16
0005 701-22-005	0.3	X	0.02	339.8	12.37	1.90
0006 701-22-006		X		448.9		0.68
0007 701-22-007		10		584.0		0.28
0008 701-22-008	6.0	X	0.02	452.1	25.24	0.16
0009 701-22-009	2.4	X	0.03	572.7	10.55	0.60
0010 701-22-010		X		393.0		0.50
0011 701-22-011		X		384.8		0.40
0012 701-22-012	0.2	X	0.02	607.5	17.18	1.27
0013 701-22-013		X		344.8		1.39
0014 701-22-014		X		351.1		0.16
0015 701-22-015	0.4	X	0.01	449.4	19.89	0.17
0016 701-22-016		X		1084.9		0.78
0017 701-22-017		X		917.2		0.88
0018 701-22-018	1.1	X	0.02	986.7	29.61	0.57
0019 701-22-019	3.9	X	0.02	750.0	34.94	0.98
0020 701-22-020	7.4	X	0.04	1144.9	1184.79	1.10
0021 701-22-021		X		298.3		1.44
0022 701-22-022		X		461.3		0.91
0023 701-22-023	3.7	X	0.10	536.6	22.41	1.12
0024 701-22-024		X		646.5		1.25
0025 701-22-025		X		1129.3		0.93
0026 701-22-026		X		403.7		0.81
0027 701-22-027	2.6	X	0.01	721.9	31.63	0.94
0028 701-22-028		X		345.7		1.24
0029 701-22-029		X		452.5		1.14
0030 701-22-030		X		235.1		0.66
0031 701-22-031	2.9	X	0.01	197.1	10.41	1.68
0032 701-22-032	3.5	X	0.18	342.5	14.54	0.96
0033 701-22-033	2.0	X	0.17	566.2	17.91	0.85
0034 701-22-034		X		637.5		1.58
0035 701-22-035		X		351.0		0.21
0036 701-22-036		X		478.4		0.64
0037 701-22-037		X		509.5		0.54
0038 701-22-038		X		319.0		0.52

ANALYSIS

0039 701-22-039	2.1	X	0.17	374.2	5.99	0.68
0040 701-22-040		X		527.3		0.53

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	0.1	0.16	X	0.06	946	8.08
0002 701-22-002		0.33		0.95	2481	
0003 701-22-003		6.78		0.05	1432	
0004 701-22-004		7.05		0.04	1079	
0005 701-22-005	2.6	0.74	0.213	0.04	383	8.73
0006 701-22-006		6.94		0.04	819	
0007 701-22-007		10.93		0.02	645	
0008 701-22-008	0.6	6.33	1.998	0.02	967	14.00
0009 701-22-009	X	0.99	0.065	0.03	817	1.52
0010 701-22-010		3.17		0.04	578	
0011 701-22-011		16.79*		0.02	653	
0012 701-22-012	1.0	5.16	0.088	0.03	618	7.10
0013 701-22-013		2.21		0.03	556	
0014 701-22-014		2.93		0.02	531	
0015 701-22-015	0.5	1.13	X	0.02	593	11.94
0016 701-22-016		0.19		0.06	456	
0017 701-22-017		0.43		0.07	388	
0018 701-22-018	X	0.39	0.007	0.05	356	7.45
0019 701-22-019	0.2	0.30	X	0.05	283	9.36
0020 701-22-020	0.8	0.06	0.097	0.99	3774	4.03
0021 701-22-021		1.37		1.09	907	
0022 701-22-022		0.45		0.05	386	
0023 701-22-023	0.2	0.43	0.014	0.31	502	10.74
0024 701-22-024		0.44		0.03	563	
0025 701-22-025		0.11		0.02	540	
0026 701-22-026		2.46		0.10	1160	
0027 701-22-027	0.5	1.37	0.058	0.04	757	22.86
0028 701-22-028		1.23		0.06	307	
0029 701-22-029		2.64		0.05	582	
0030 701-22-030		5.33		0.06	729	
0031 701-22-031	0.9	1.28	0.025	0.07	403	17.80
0032 701-22-032	0.8	1.55	0.028	0.10	761	17.09
0033 701-22-033	0.3	2.09	0.036	0.05	920	11.40
0034 701-22-034		1.98		0.04	595	
0035 701-22-035		3.32		0.03	614	
0036 701-22-036		9.53		0.04	1025	
0037 701-22-037		4.72		0.06	1083	
0038 701-22-038		5.35		0.11	360	

ANALYSIS

0039 701-22-039	0.6	0.88	X	0.07	548	18.19
0040 701-22-040		1.32		0.65	1.77%	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0001 701-22-001	0.20	3.07	66.93	7	1.3	11.8
0002 701-22-002	0.75		65.36		12.6	
0003 701-22-003	0.68		46.42		17.3	
0004 701-22-004	0.24		69.40		11.8	
0005 701-22-005	0.12	0.79	71.18	6	4.3	26.5
0006 701-22-006	0.04		54.06		11.1	
0007 701-22-007	0.13		47.41		22.8	
0008 701-22-008	0.37	62.04	29.96	17	15.6	549.3
0009 701-22-009	0.13	0.46	55.84	84	5.2	9.1
0010 701-22-010	0.12		37.29		10.9	
0011 701-22-011	0.10		43.59		19.3	
0012 701-22-012	0.80	9.14	76.58	191	14.7	158.6
0013 701-22-013	0.05		73.50		9.6	
0014 701-22-014	0.62		71.86		21.0	
0015 701-22-015	0.08	3.29	46.46	47	21.3	350.5
0016 701-22-016	0.03		44.35		13.1	
0017 701-22-017	0.03		45.24		16.6	
0018 701-22-018	0.19	9.09	53.64	25	11.7	99.8
0019 701-22-019	0.05	1.73	61.46	32	11.4	149.3
0020 701-22-020	0.20	0.35	50.47	74	12.6	2.2
0021 701-22-021	1.37		69.35		20.7	
0022 701-22-022	0.58		66.88		15.7	
0023 701-22-023	0.78	9.15	68.05	278	16.1	97.9
0024 701-22-024	1.81		65.33		22.2	
0025 701-22-025	1.84		86.89		13.5	
0026 701-22-026	0.03		42.38		0.6	
0027 701-22-027	0.76	8.42	55.69	4	14.0	241.1
0028 701-22-028	2.05		33.21		4.9	
0029 701-22-029	0.13		27.50		12.3	
0030 701-22-030	0.04		20.58		16.1	
0031 701-22-031	0.15	7.88	24.61	22	11.3	297.5
0032 701-22-032	0.58	9.87	41.10	26	15.9	459.0
0033 701-22-033	0.48	2.88	39.13	12	11.2	119.8
0034 701-22-034	0.03		49.80		10.8	
0035 701-22-035	0.81		41.33		16.4	
0036 701-22-036	0.06		30.91		18.5	
0037 701-22-037	0.02		29.54		14.7	
0038 701-22-038	0.08		30.19		21.3	

ANALYSIS

0039 701-22-039	0.09	3.95	46.50	61	20.4	732.0
0040 701-22-040	0.07		30.53		17.3	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	No	14	X	2.55	407.4	1.77
0002 701-22-002	Yes	10		3.68	20.6	
0003 701-22-003	No	23		5.80	756.1	
0004 701-22-004	No	12		3.18	555.8	
0005 701-22-005	No	12	X	3.18	45.6	0.05
0006 701-22-006	No	14		1.90	127.9	
0007 701-22-007	No	20		0.12	817.9	
0008 701-22-008	No	26	X	0.10	634.9	17.91
0009 701-22-009	No	13	X	1.42	170.1	0.15
0010 701-22-010	No	19		0.93	383.7	
0011 701-22-011	No	26		0.19	1365.5	
0012 701-22-012	No	19	X	2.36	306.0	4.40
0013 701-22-013	No	17		1.53	922.7	
0014 701-22-014	No	18		0.12	5916.0*	
0015 701-22-015	No	17	X	0.11	815.9	15.46
0016 701-22-016	No	14		1.69	597.7	
0017 701-22-017	No	12		2.32	647.2	
0018 701-22-018	No	18	X	1.84	437.0	2.07
0019 701-22-019	No	15	X	2.13	431.5	9.94
0020 701-22-020	Yes	18	X	7.93	890.5	0.30
0021 701-22-021	Yes	17		12.62	1301.8	
0022 701-22-022	No	11		3.58	592.4	
0023 701-22-023	Yes	15	X	3.51	396.8	4.58
0024 701-22-024	No	11		5.66	668.0	
0025 701-22-025	No	20		2.43	961.2	
0026 701-22-026	No	18		1.17	273.8	
0027 701-22-027	No	20	X	1.49	36.4	0.36
0028 701-22-028	No	16		0.89	44.3	
0029 701-22-029	No	13		3.63	393.5	
0030 701-22-030	No	16		1.12	319.6	
0031 701-22-031	No	19	X	1.72	238.1	1.90
0032 701-22-032	No	39	X	3.19	419.4	3.33
0033 701-22-033	No	13	X	3.45	317.0	0.62
0034 701-22-034	No	11		2.77	291.6	
0035 701-22-035	No	67		0.42	709.3	
0036 701-22-036	No	18		1.49	271.3	
0037 701-22-037	No	17		1.56	83.1	
0038 701-22-038	No	22		1.29	440.4	

ANALYSIS

0039 701-22-039	No	26	X	1.28	114.3	2.93
0040 701-22-040	No	14		1.12	105.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0001 701-22-001	2.46	258	1.11	1.05	X	1.09
0002 701-22-002	2.51		1.53	1.02		5.11
0003 701-22-003	4.40		2.85	1.04		5.77
0004 701-22-004	5.02		2.86	1.52		4.51
0005 701-22-005	2.68	511	1.50	1.01	0.1	1.58
0006 701-22-006	4.07		2.23	1.20		3.57
0007 701-22-007	1.90		0.69	1.48		15.86
0008 701-22-008	0.95	438	0.30	0.69	0.2	4.85
0009 701-22-009	1.20	560	0.49	0.94	0.6	1.31
0010 701-22-010	0.79		0.40	0.67		2.93
0011 701-22-011	0.94		0.43	0.77		7.28
0012 701-22-012	7.70	1242	3.86	2.36	0.2	5.16
0013 701-22-013	5.67		2.90	1.59		2.24
0014 701-22-014	0.80		0.26	0.97		7.80
0015 701-22-015	0.24	466	0.09	0.63	0.2	9.39
0016 701-22-016	1.26		0.68	0.53		1.83
0017 701-22-017	1.37		0.74	0.55		2.18
0018 701-22-018	1.99	449	0.95	0.93	X	2.06
0019 701-22-019	2.26	549	1.20	0.97	X	2.62
0020 701-22-020	1.78	672	0.90	0.88	1.5	6.69
0021 701-22-021	3.11		1.77	1.32		7.17
0022 701-22-022	2.67		1.39	1.12		2.48
0023 701-22-023	2.63	1370	1.36	1.30	0.2	2.98
0024 701-22-024	3.57		2.01	1.18		3.62
0025 701-22-025	5.66		3.40	1.70		1.18
0026 701-22-026	0.98		0.52	0.80		3.74
0027 701-22-027	1.96	433	1.15	0.87	0.5	3.10
0028 701-22-028	2.06		0.84	0.66		1.04
0029 701-22-029	7.40		1.01	0.61		2.94
0030 701-22-030	1.20		0.66	0.51		7.07
0031 701-22-031	2.05	548	1.10	0.81	0.2	1.65
0032 701-22-032	1.63	644	0.96	0.67	0.2	3.78
0033 701-22-033	1.56	509	0.91	0.70	0.1	3.91
0034 701-22-034	3.02		1.10	1.12		3.32
0035 701-22-035	1.14		0.59	1.03		8.20
0036 701-22-036	1.67		0.88	0.80		7.71
0037 701-22-037	1.62		1.04	0.74		3.74
0038 701-22-038	1.60		0.87	0.71		7.42

ANALYSIS

0039 701-22-039	2.77	832	1.42	0.76	0.2	2.82
0040 701-22-040	1.26		0.63	0.80		3.53

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.05	1.4	0	15.97	3.27	1.07
0002 701-22-002		1.2	0	16.56	2.94	1.05
0003 701-22-003		1.4	0	32.57	4.02	0.90
0004 701-22-004		1.4	0	26.34	5.13	1.00
0005 701-22-005	0.19	1.5	0	19.58	3.19	1.18
0006 701-22-006		1.4	0	28.31	4.15	0.88
0007 701-22-007		1.4	0	18.92	3.73	1.83
0008 701-22-008	1.94	1.3	0	30.12	2.02	0.89
0009 701-22-009	0.07	1.3	0	24.40	2.52	1.26
0010 701-22-010		1.4	0	24.97	1.65	0.86
0011 701-22-011		1.4	0	35.11	2.01	1.33
0012 701-22-012	0.11	1.3	0	26.73	7.70	1.07
0013 701-22-013		1.4	0	19.82	5.60	1.42
0014 701-22-014		1.3	0	16.91	1.95	2.49
0015 701-22-015	2.60	1.4	0	4.40	0.98	1.23
0016 701-22-016		1.4	0	16.27	1.61	1.62
0017 701-22-017		1.4	0	16.66	1.69	1.58
0018 701-22-018	0.10	1.4	0	16.66	2.59	1.52
0019 701-22-019	0.19	1.4	0	16.33	2.73	1.37
0020 701-22-020	4.52	1.2	0	15.03	2.48	0.79
0021 701-22-021		1.2	0	19.12	4.04	1.33
0022 701-22-022		1.5	0	20.64	3.52	1.73
0023 701-22-023	0.12	1.6	0	18.90	3.49	1.51
0024 701-22-024		1.5	0	19.45	3.72	1.21
0025 701-22-025		1.5	0	17.29	5.40	1.88
0026 701-22-026		1.5	0	20.09	2.05	0.95
0027 701-22-027	0.78	1.5	0	17.82	6.71	1.12
0028 701-22-028		1.5	0	12.34	1.99	0.96
0029 701-22-029		1.5	0	18.68	1.55	1.13
0030 701-22-030		1.5	0	24.06	1.63	0.54
0031 701-22-031	0.83	1.5	0	18.02	2.77	1.57
0032 701-22-032	1.23	1.5	0	18.74	2.04	1.04
0033 701-22-033	0.64	1.4	0	23.93	2.00	0.80
0034 701-22-034		1.4	0	18.82	4.23	1.21
0035 701-22-035		1.4	0	7.40	2.52	0.68
0036 701-22-036		1.5	0	38.25	2.67	0.64
0037 701-22-037		1.5	0	31.02	2.20	0.90
0038 701-22-038		1.4	0	24.56	1.84	0.67

ANALYSIS

0039 701-22-039	0.40	1.5	0	18.94	2.73	1.02
0040 701-22-040		1.7	0	25.87	2.21	0.81

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0001 701-22-001	1.84	X	X	0.43	0.593	3.81%
0002 701-22-002	1.56	0.01		0.52	0.105	3.08%
0003 701-22-003	1.17	0.01		0.94	1.456	3.71%
0004 701-22-004	1.46	0.03		1.05	1.132	3.52%
0005 701-22-005	1.55	0.01	X	0.65	0.676	3.53%
0006 701-22-006	1.63	0.02		0.78	0.663	4.00%
0007 701-22-007	0.95	0.18		0.26	0.405	2307
0008 701-22-008	1.06	0.02	X	0.13	0.092	7904
0009 701-22-009	1.15	0.02	X	0.18	0.156	3.79%
0010 701-22-010	0.88	X		0.13	0.330	3.13%
0011 701-22-011	1.44	0.04		0.16	0.210	7861
0012 701-22-012	1.69	0.03	X	1.49	0.426	3.24%
0013 701-22-013	2.04	X		1.10	0.729	2.81%
0014 701-22-014	0.21	0.02		0.10	0.205	4843
0015 701-22-015	0.12	0.02	X	0.03	0.024	1.21%
0016 701-22-016	0.51	0.02		0.25	0.034	2.77%
0017 701-22-017	0.30	0.02		0.26	0.104	2.88%
0018 701-22-018	0.33	0.02	X	0.36	0.035	3.01%
0019 701-22-019	0.53	X	X	0.42	0.068	3.46%
0020 701-22-020	0.12	0.01	X	0.33	0.029	2.27%
0021 701-22-021	0.14	0.03		0.62	0.410	2.13%
0022 701-22-022	0.31	0.03		0.52	0.159	2.62%
0023 701-22-023	0.71	0.02	X	0.49	0.066	2.61%
0024 701-22-024	0.30	0.07		0.69	0.701	3.55%
0025 701-22-025	0.47	X		1.16	0.062	2.04%
0026 701-22-026	1.60	X		0.19	1.252	3.28%
0027 701-22-027	1.64	0.02	X	0.39	0.345	3.88%
0028 701-22-028	1.33	0.04		0.28	0.392	2.17%
0029 701-22-029	1.79	0.04		0.33	0.993	3.42%
0030 701-22-030	1.11	0.04		0.22	0.748	1.62%
0031 701-22-031	1.96	X	X	0.36	4.726	2.65%
0032 701-22-032	1.73	0.03	X	0.32	0.915	3.71%
0033 701-22-033	1.44	0.01	X	0.29	0.459	3.59%
0034 701-22-034	1.70	X		0.45	0.791	2.93%
0035 701-22-035	1.17	0.02		0.19	0.083	1.72%
0036 701-22-036	1.54	0.03		0.31	0.515	3.12%
0037 701-22-037	1.54	X		0.32	0.638	3.51%
0038 701-22-038	0.94	X		0.31	0.311	3.31%

ANALYSIS

0039 701-22-039	2.23	0.02	X	0.50	0.623	3.42%
0040 701-22-040	1.39	X		0.23	0.164	3.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	16.7	38.34	5.5	0.164	3760	6.52
0002 701-22-002		37.90	12.7	0.243	6818	
0003 701-22-003		27.29	2.2	0.406	2838	
0004 701-22-004		37.25	4.9	0.368	3051	
0005 701-22-005	22.9	38.73	13.6	0.212	7822	18.57
0006 701-22-006		27.27	2.5	0.264	2892	
0007 701-22-007		21.06	35.3	0.106	136	
0008 701-22-008	2.5	16.11	4.9	0.058	122	13.85
0009 701-22-009	18.7	30.23	2.9	0.073	2139	6.30
0010 701-22-010		20.77	4.3	0.076	1507	
0011 701-22-011		24.18	25.1	0.093	176	
0012 701-22-012	29.4	42.52	6.5	0.371	2952	23.23
0013 701-22-013		41.01	30.6	0.316	2593	
0014 701-22-014		44.80	7.2	0.037	120	
0015 701-22-015	3.4	26.40	4.7	0.014	106	10.35
0016 701-22-016		28.24	3.0	0.081	2688	
0017 701-22-017		29.07	3.1	0.090	3079	
0018 701-22-018	22.4	30.18	3.3	0.114	2684	14.24
0019 701-22-019	23.9	35.94	2.7	0.145	2937	17.24
0020 701-22-020	4.2	26.97	3.7	0.104	7768	6.55
0021 701-22-021		38.44	15.9	0.188	4270	
0022 701-22-022		35.68	29.8	0.177	3004	
0023 701-22-023	34.5	36.93	16.7	0.167	2823	25.94
0024 701-22-024		36.44	6.3	0.224	3955	
0025 701-22-025		47.58	15.8	0.453	2374	
0026 701-22-026		22.55	0.5	0.103	2199	
0027 701-22-027	26.4	31.12	2.7	0.193	3307	15.40
0028 701-22-028		16.37	2.8	0.117	1687	
0029 701-22-029		13.74	1.8	0.162	2469	
0030 701-22-030		11.08	0.7	0.129	798	
0031 701-22-031	19.6	12.65	3.2	0.178	1935	27.21
0032 701-22-032	24.8	21.45	0.5	0.186	2432	28.73
0033 701-22-033	26.8	22.01	0.5	0.154	2004	20.94
0034 701-22-034		25.29	2.7	0.173	1985	
0035 701-22-035		22.69	1.5	0.123	191	
0036 701-22-036		16.61	0.7	0.151	1338	
0037 701-22-037		14.86	0.6	0.169	1493	
0038 701-22-038		18.65	1.1	0.134	1143	

ANALYSIS

0039 701-22-039	26.8	27.25	2.1	0.208	1806	31.97
0040 701-22-040		16.28	0.9	0.126	1843	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0001 701-22-001	163	1.33		1.4	0.12	32
0002 701-22-002	9922			2.3		10
0003 701-22-003	291			2.7		174
0004 701-22-004	133			1.4		136
0005 701-22-005	1142	1.26		1.4	0.15	21
0006 701-22-006	82			1.3		99
0007 701-22-007	41			1.5		558
0008 701-22-008	27	0.50		2.5	0.29	209
0009 701-22-009	54	0.04		3.9	11.45	52
0010 701-22-010	72			2.2		114
0011 701-22-011	42			2.2		277
0012 701-22-012	51	0.09		2.2	0.07	164
0013 701-22-013	93			2.3		63
0014 701-22-014	30			181.9*		293
0015 701-22-015	30	0.37		48.8	0.08	388
0016 701-22-016	45			13.2		60
0017 701-22-017	61			8.3		62
0018 701-22-018	33	0.25		5.4	X	54
0019 701-22-019	44	0.32		3.8	X	61
0020 701-22-020	2062	0.12		2.8	7.99	16
0021 701-22-021	4514			1.3		80
0022 701-22-022	145			2.6		54
0023 701-22-023	1297	2.00		2.2	0.06	45
0024 701-22-024	65			2.4		96
0025 701-22-025	41			7.6		24
0026 701-22-026	490			1.6		23
0027 701-22-027	119	0.68		1.4	0.12	91
0028 701-22-028	93			1.4		35
0029 701-22-029	142			0.5		73
0030 701-22-030	74			2.0		236
0031 701-22-031	150	2.10		1.2	X	49
0032 701-22-032	205	2.10		2.0	X	117
0033 701-22-033	135	0.90		1.1	X	132
0034 701-22-034	200			2.7		99
0035 701-22-035	54			3.0		361
0036 701-22-036	53			1.8		272
0037 701-22-037	53			0.9		136
0038 701-22-038	127			3.9		275

ANALYSIS

0039 701-22-039	78	1.15	1.3	0.06	134
0040 701-22-040	70		3.2		125

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0001 701-22-001	1473	14.2	2	5.6	0	35
0002 701-22-002	303		0	7.5	0	-5
0003 701-22-003	295		142	2.2	127	175
0004 701-22-004	346		110	2.2	98	140
0005 701-22-005	365	49.9	11	2.9	6	15
0006 701-22-006	380		89	2.2	79	102
0007 701-22-007	589		455	2.2	424	569
0008 701-22-008	1685	30.3	147	2.2	133	215
0009 701-22-009	1196	92.7	17	2.7	12	55
0010 701-22-010	822		77	2.3	67	116
0011 701-22-011	819		201	2.2	180	284
0012 701-22-012	1437	239.6	144	2.1	133	167
0013 701-22-013	1072		41	2.4	31	66
0014 701-22-014	1129		163	2.4	136	298
0015 701-22-015	1377	43.6	281	2.2	261	396
0016 701-22-016	710		30	2.5	21	63
0017 701-22-017	575		37	2.5	27	65
0018 701-22-018	1093	39.5	28	2.5	20	57
0019 701-22-019	1139	42.9	43	2.4	33	64
0020 701-22-020	1.24%	132.4	0	6.7	0	-1
0021 701-22-021	1196		36	3.2	7	67
0022 701-22-022	1472		38	2.4	29	50
0023 701-22-023	1551	243.8	24	2.7	11	40
0024 701-22-024	1859		72	2.3	63	91
0025 701-22-025	1255		7	3.2	3	20
0026 701-22-026	624		0	6.5	0	19
0027 701-22-027	655	12.9	79	2.2	68	87
0028 701-22-028	205		25	2.5	17	31
0029 701-22-029	449		61	2.3	49	69
0030 701-22-030	382		205	2.2	190	235
0031 701-22-031	310	31.5	29	2.5	21	45
0032 701-22-032	439	37.3	92	2.2	82	115
0033 701-22-033	638	36.0	104	2.2	93	129
0034 701-22-034	545		82	2.2	70	94
0035 701-22-035	1580		242	2.3	223	363
0036 701-22-036	741		224	2.2	208	270
0037 701-22-037	902		101	2.3	90	134
0038 701-22-038	969		217	2.2	200	274

ANALYSIS

0039 701-22-039	561	85.6	72	2.4	60	133
0040 701-22-040	894		46	2.6	38	84

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	4.32	23.55	22.9	X	651	X
0002 701-22-002	3.55	23.19	11.4		608	
0003 701-22-003	2.64	19.96	12.4		668	
0004 701-22-004	3.25	28.11	6.0		869	
0005 701-22-005	4.08	26.68	3.9	0.02	130	X
0006 701-22-006	3.32	20.77	7.0		620	
0007 701-22-007	1.92	24.15	31.4		922	
0008 701-22-008	1.65	12.05	16.0	0.14	703	0.3
0009 701-22-009	1.98	21.48	3.8	X	533	X
0010 701-22-010	1.69	13.61	7.3		374	
0011 701-22-011	2.21	16.51	21.7		537	
0012 701-22-012	4.29	31.86	9.5	0.07	676	X
0013 701-22-013	4.37	28.72	3.9		466	
0014 701-22-014	0.80	20.70	10.5		518	
0015 701-22-015	0.68	16.80	10.7	0.13	531	0.3
0016 701-22-016	1.58	13.49	7.2		589	
0017 701-22-017	1.49	13.70	6.4		421	
0018 701-22-018	1.29	20.22	8.1	0.06	427	X
0019 701-22-019	1.61	21.37	6.6	0.11	376	0.2
0020 701-22-020	2.89	19.67	11.2	X	502	0.4
0021 701-22-021	2.64	28.43	11.0		753	
0022 701-22-022	2.46	26.12	7.2		191	
0023 701-22-023	3.82	26.60	6.5	0.05	284	X
0024 701-22-024	2.74	24.76	14.2		416	
0025 701-22-025	3.57	34.32	6.6		880	
0026 701-22-026	1.65	15.83	1.1		624	
0027 701-22-027	2.99	20.53	9.5	0.16	441	X
0028 701-22-028	2.41	11.41	7.3		143	
0029 701-22-029	1.55	10.73	7.7		379	
0030 701-22-030	1.18	8.12	12.5		480	
0031 701-22-031	3.20	10.43	13.4	0.13	323	X
0032 701-22-032	2.79	15.01	17.9	0.20	477	X
0033 701-22-033	2.22	14.34	6.7	0.04	651	X
0034 701-22-034	2.30	19.10	7.8		733	
0035 701-22-035	1.59	17.59	31.1		454	
0036 701-22-036	3.33	12.85	10.2		708	
0037 701-22-037	2.61	11.65	7.6		671	
0038 701-22-038	1.47	10.84	13.1		394	

ANALYSIS

0039 701-22-039	3.97	15.93	11.3	0.22	466	X
0040 701-22-040	1.97	13.41	12.3		619	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0001 701-22-001	324.0	1.8	4.9		6.654	162.63
0002 701-22-002	51.9		7.1	2.9	6.650	135.10
0003 701-22-003	30.9		4.3		4.971	140.10
0004 701-22-004	167.9		3.8		7.626	138.60
0005 701-22-005	9.9	1.8	5.2		7.392	151.77
0006 701-22-006	82.5		4.4		5.487	158.52
0007 701-22-007	415.5		3.5		5.695	2.99
0008 701-22-008	205.7	3.1	4.4		3.209	3.14
0009 701-22-009	124.5	0.6	6.6		5.763	125.49
0010 701-22-010	103.3		5.1		3.690	90.37
0011 701-22-011	106.8		4.8		4.500	8.25
0012 701-22-012	59.3	1.2	5.0		8.209	113.56
0013 701-22-013	10.4		6.6		7.722	114.42
0014 701-22-014	54.1		5.5		7.096	3.08
0015 701-22-015	51.4	X	4.3		4.877	3.25
0016 701-22-016	15.8		4.6		4.047	79.18
0017 701-22-017	35.0		4.5		4.173	95.57
0018 701-22-018	18.4	0.5	4.6		5.561	91.47
0019 701-22-019	25.2	0.6	4.4		6.217	105.60
0020 701-22-020	14.2	4.2	8.5	2.8	5.319	83.44
0021 701-22-021	157.3		5.9	2.8	7.478	95.49
0022 701-22-022	86.0		5.6		7.140	102.63
0023 701-22-023	54.3	0.5	6.1	3.2	7.285	99.00
0024 701-22-024	418.0		5.1		6.736	135.89
0025 701-22-025	17.0		6.3		9.189	70.98
0026 701-22-026	68.7		6.2		4.422	114.14
0027 701-22-027	126.9	0.9	4.7		5.807	149.69
0028 701-22-028	16.4		4.9		3.210	88.98
0029 701-22-029	65.7		4.0		2.917	132.80
0030 701-22-030	176.9		4.3		2.141	51.65
0031 701-22-031	15.4	0.6	4.4		2.718	98.69
0032 701-22-032	51.9	1.7	4.1		3.994	148.26
0033 701-22-033	77.0	1.0	4.5		3.857	131.58
0034 701-22-034	20.0		4.6		5.221	113.43
0035 701-22-035	90.6		4.7		4.524	11.44
0036 701-22-036	100.2		4.0		3.335	95.48
0037 701-22-037	63.0		4.3		3.088	113.03
0038 701-22-038	33.0		4.8		3.067	98.89

ANALYSIS

0039 701-22-039	64.4	X	4.4	4.708	85.31
0040 701-22-040	96.2		8.0	3.311	97.98

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0001 701-22-001	X	1.04	9974	25.1	X	0.37
0002 701-22-002	X	0.32	2913		0.21	0.03
0003 701-22-003	0.007	5.67	5.70%		4.56	0.21
0004 701-22-004	X	4.43	4.22%		3.57	0.17
0005 701-22-005	X	0.67	5889	61.2	0.47	0.04
0006 701-22-006	X	3.23	3.25%		2.83	0.09
0007 701-22-007	0.003	18.24	16.96%		11.73	0.58
0008 701-22-008	0.008	6.83	6.65%	56.1	4.20	0.54
0009 701-22-009	0.022	1.69	1.71%	34.2	0.58	0.27
0010 701-22-010	0.002	3.71	3.71%		2.13	0.40
0011 701-22-011	X	9.05	8.63%		5.11	0.61
0012 701-22-012	X	5.35	5.19%	116.6	4.27	0.15
0013 701-22-013	X	2.06	2.23%		1.53	0.19
0014 701-22-014	0.055	9.56	9.05%		6.82	0.42
0015 701-22-015	0.079	12.68	11.74%	45.6	7.85	0.85
0016 701-22-016	0.107	1.96	2.05%		1.12	0.20
0017 701-22-017	0.070	2.01	2.18%		1.35	0.21
0018 701-22-018	0.049	1.76	1.85%	48.9	1.09	0.21
0019 701-22-019	0.030	1.99	2.22%	58.5	1.55	0.15
0020 701-22-020	0.010	0.52	4699	28.4	0.36	0.05
0021 701-22-021	0.009	2.62	2.54%		2.19	0.12
0022 701-22-022	0.010	1.78	1.84%		1.62	0.09
0023 701-22-023	0.016	1.47	1.42%	91.0	1.23	0.09
0024 701-22-024	0.022	3.13	3.19%		2.51	0.13
0025 701-22-025	0.037	0.79	6956		0.56	0.04
0026 701-22-026	X	0.74	6448		X	0.20
0027 701-22-027	0.007	2.98	2.96%	57.5	2.32	0.13
0028 701-22-028	X	1.14	6858		0.41	0.04
0029 701-22-029	X	2.40	2.68%		2.08	0.12
0030 701-22-030	0.002	7.71	7.22%		5.54	0.33
0031 701-22-031	X	1.59	1.63%	71.7	1.06	0.16
0032 701-22-032	0.004	3.82	3.79%	83.8	2.70	0.18
0033 701-22-033	X	4.30	4.03%	65.1	3.27	0.20
0034 701-22-034	X	3.22	3.27%		2.53	0.16
0035 701-22-035	0.006	11.79	10.70%		7.15	0.97
0036 701-22-036	X	8.89	8.36%		6.58	0.49
0037 701-22-037	X	4.46	4.06%		2.97	0.33
0038 701-22-038	0.005	9.00	8.46%		6.25	0.50

ANALYSIS

0039 701-22-039	X	4.38	4.34%	99.5	2.18	0.61
0040 701-22-040	X	4.07	3.86%		2.75	0.35

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	0.36	X	9.6	0.9	0.8	0.47
0002 701-22-002	0.37		7.5	X		0.02
0003 701-22-003	0.69		17.0	2.5		1.78
0004 701-22-004	0.52		11.0	2.2		1.85
0005 701-22-005	0.29	0.04	8.0	0.5	11.2	0.21
0006 701-22-006	0.32		11.8	1.9		1.60
0007 701-22-007	3.98		9.9	4.5		4.07
0008 701-22-008	1.10	0.70	13.6	2.1	2.6	1.43
0009 701-22-009	0.60	4.79	15.5	0.8	1.5	0.64
0010 701-22-010	0.47		12.9	1.6		1.15
0011 701-22-011	0.81		12.8	4.2		4.15
0012 701-22-012	0.68	0.24	14.4	6.6	22.0	5.99
0013 701-22-013	0.42		14.7	1.2		0.57
0014 701-22-014	2.03		8.2	6.0		5.43
0015 701-22-015	1.75	0.32	4.6	6.0	1.5	4.95
0016 701-22-016	0.60		12.8	2.4		1.87
0017 701-22-017	0.47		11.6	3.2		2.00
0018 701-22-018	0.40	0.11	13.6	1.4	6.9	1.00
0019 701-22-019	0.56	0.54	11.4	1.7	5.0	1.38
0020 701-22-020	0.05	0.21	10.7	0.8	3.0	0.54
0021 701-22-021	0.56		16.5	1.0		0.91
0022 701-22-022	0.26		11.9	1.4		0.94
0023 701-22-023	0.25	0.04	13.0	1.4	3.5	1.15
0024 701-22-024	0.62		11.9	1.7		1.66
0025 701-22-025	0.39		11.8	0.9		0.89
0026 701-22-026	1.46		10.1	1.9		1.73
0027 701-22-027	0.44	0.58	12.3	1.0	3.6	0.76
0028 701-22-028	0.46		6.7	X		0.22
0029 701-22-029	0.58		10.3	X		0.38
0030 701-22-030	0.67		8.7	1.8		1.65
0031 701-22-031	0.71	0.14	10.6	X	1.6	0.10
0032 701-22-032	1.76	0.19	11.8	0.9	2.1	X
0033 701-22-033	0.56	0.12	11.0	0.9	1.4	X
0034 701-22-034	0.49		8.7	0.9		0.64
0035 701-22-035	2.49		9.6	2.4		1.55
0036 701-22-036	0.85		13.8	2.4		1.96
0037 701-22-037	0.63		14.3	0.7		0.60
0038 701-22-038	0.45		14.8	2.5		1.99

ANALYSIS

0039 701-22-039	0.46	0.19	20.7	0.8	5.2	0.51
0040 701-22-040	0.39		11.4	1.3		1.12

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0001 701-22-001	3.93	0.7	X	76.31	10.72	0.39
0002 701-22-002	3.79	0.5		13.09		0.36
0003 701-22-003	3.93	3.4		49.34		0.22
0004 701-22-004	5.48	3.2		278.89		0.30
0005 701-22-005	4.42	0.7	X	16.33	15.41	0.40
0006 701-22-006	4.09	0.9		175.07		0.30
0007 701-22-007	5.66	4.5		1065.68		0.17
0008 701-22-008	2.50	2.0	5.7	352.60	72.26	0.14
0009 701-22-009	3.70	1.6	X	203.56	6.20	0.17
0010 701-22-010	2.52	0.6		94.52		0.14
0011 701-22-011	2.94	2.2		313.24		0.19
0012 701-22-012	7.39	1.9	X	414.61	20.44	0.36
0013 701-22-013	5.53	0.7		23.98		0.35
0014 701-22-014	3.18	6.5		421.95		0.07
0015 701-22-015	2.62	13.3	X	553.05	147.55	0.07
0016 701-22-016	2.27	0.9		155.70		0.14
0017 701-22-017	2.29	0.8		91.60		0.14
0018 701-22-018	3.57	1.2	X	95.69	17.73	0.11
0019 701-22-019	3.57	1.7	X	87.22	17.13	0.13
0020 701-22-020	3.48	0.6	X	178.14	10.48	0.21
0021 701-22-021	5.30	0.7		285.42		0.19
0022 701-22-022	4.65	1.5		62.43		0.20
0023 701-22-023	4.77	0.8	X	128.74	20.83	0.31
0024 701-22-024	4.46	0.9		176.09		0.22
0025 701-22-025	6.46	0.7		343.12		0.33
0026 701-22-026	3.14	0.8		64.55		0.16
0027 701-22-027	3.48	1.1	X	84.11	68.58	0.25
0028 701-22-028	2.20	0.6		31.38		0.20
0029 701-22-029	2.13	0.8		112.54		0.13
0030 701-22-030	1.84	1.7		110.90		0.10
0031 701-22-031	2.52	0.6	X	115.73	11.21	0.27
0032 701-22-032	2.67	1.1	X	149.70	12.15	0.21
0033 701-22-033	2.40	1.1	X	93.73	9.51	0.19
0034 701-22-034	3.70	0.7		287.25		0.19
0035 701-22-035	3.70	10.1		452.33		0.12
0036 701-22-036	2.99	4.6		230.14		0.24
0037 701-22-037	3.31	1.3		130.84		0.18
0038 701-22-038	2.01	3.0		194.63		0.12

ANALYSIS

0039 701-22-039	2.96	0.6	X	214.29	13.06	0.32
0040 701-22-040	2.74	1.2		240.09		0.20

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0001 701-22-001	0.459	160	0.07	20.90	0.081	2244
0002 701-22-002	0.421		X	23.46		1619
0003 701-22-003	0.671		0.74	13.37		1927
0004 701-22-004	0.797		1.92	17.36		1558
0005 701-22-005	0.436	401	0.34	19.27	0.212	2020
0006 701-22-006	0.633		1.08	18.07		1733
0007 701-22-007	0.439		1.63	12.23		1101
0008 701-22-008	0.230	362	1.09	11.13	0.410	1455
0009 701-22-009	0.273	389	0.42	15.23	0.248	1959
0010 701-22-010	0.187		0.74	14.03		1082
0011 701-22-011	0.219		2.71	14.72		1512
0012 701-22-012	1.228	947	3.35	24.11	0.065	2512
0013 701-22-013	0.918		0.57	22.73		2970
0014 701-22-014	0.213		1.21	11.20		546
0015 701-22-015	0.078	420	0.35	10.71	0.068	457
0016 701-22-016	0.218		X	16.56		1369
0017 701-22-017	0.226		0.06	15.08		1347
0018 701-22-018	0.353	382	0.07	14.73	0.041	1143
0019 701-22-019	0.387	350	0.06	16.01	0.143	1071
0020 701-22-020	0.326	488	0.08	15.06	1.213	1931
0021 701-22-021	0.563		0.72	13.58		2525
0022 701-22-022	0.455		0.16	19.33		2055
0023 701-22-023	0.455	1016	0.24	20.86	0.337	2824
0024 701-22-024	0.543		0.35	19.53		2323
0025 701-22-025	0.861		0.07	23.19		2539
0026 701-22-026	0.207		0.96	12.82		1068
0027 701-22-027	0.338	265	0.42	18.66	0.136	1893
0028 701-22-028	0.311		0.24	13.79		1585
0029 701-22-029	0.312		0.72	11.79		929
0030 701-22-030	0.230		0.60	11.91		664
0031 701-22-031	0.377	440	0.15	14.40	0.248	2070
0032 701-22-032	0.275	439	0.51	14.09	0.188	1307
0033 701-22-033	0.274	340	0.64	13.13	0.294	1204
0034 701-22-034	0.621		0.69	14.62		1238
0035 701-22-035	0.249		0.33	16.01		664
0036 701-22-036	0.336		0.81	12.13		1669
0037 701-22-037	0.301		1.32	11.99		1330
0038 701-22-038	0.266		0.29	8.68		826

ANALYSIS

0039 701-22-039	0.450	625	0.66	20.14	0.152	2866
0040 701-22-040	0.276		0.82	11.97		919

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0001 701-22-001	1.85	0.16	3.61	0.184	84	X
0002 701-22-002	1.60	0.24	4.58		81	
0003 701-22-003	1.73	0.43	6.56		124	
0004 701-22-004	1.78	0.40	5.48		107	
0005 701-22-005	1.93	0.20	4.34	2.174	87	X
0006 701-22-006	2.22	0.31	5.16		105	
0007 701-22-007	9.44	0.10	7.02		90	
0008 701-22-008	0.14	0.04	3.52	22.026	135	X
0009 701-22-009	1.61	0.09	3.50	1.131	134	X
0010 701-22-010	1.12	0.06	3.27		96	
0011 701-22-011	0.15	0.07	5.89		114	
0012 701-22-012	1.21	0.53	6.68	13.273	91	X
0013 701-22-013	1.54	0.41	4.90		104	
0014 701-22-014	0.70	0.03	3.25		88	
0015 701-22-015	0.08	0.01	0.65	14.649	88	X
0016 701-22-016	0.84	0.09	2.01		119	
0017 701-22-017	1.20	0.12	1.92		99	
0018 701-22-018	1.12	0.13	3.27	34.096	104	X
0019 701-22-019	1.22	0.16	3.57	53.465	101	X
0020 701-22-020	0.74	0.12	1.29	0.521	95	0.08
0021 701-22-021	1.20	0.23	1.59		143	
0022 701-22-022	1.11	0.19	2.88		115	
0023 701-22-023	1.20	0.20	2.96	0.260	121	X
0024 701-22-024	1.75	0.28	3.08		117	
0025 701-22-025	0.78	0.48	2.91		116	
0026 701-22-026	1.44	0.09	3.16		93	
0027 701-22-027	1.86	0.17	4.17	5.165	106	X
0028 701-22-028	1.13	0.11	3.09		71	
0029 701-22-029	1.59	0.16	3.30		85	
0030 701-22-030	0.70	0.11	3.82		76	
0031 701-22-031	1.27	0.17	4.20	24.531	90	X
0032 701-22-032	2.16	0.16	4.66	59.662	89	X
0033 701-22-033	1.79	0.14	4.71	39.155	84	X
0034 701-22-034	1.58	0.15	3.54		80	
0035 701-22-035	0.21	0.11	4.19		84	
0036 701-22-036	1.24	0.14	6.44		94	
0037 701-22-037	1.34	0.16	5.19		104	
0038 701-22-038	1.05	0.13	3.52		97	

ANALYSIS

0039 701-22-039	1.14	0.21	6.27	26.375	128	X
0040 701-22-040	1.25	0.10	5.33		84	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0001 701-22-001	2.6	9.31	1.12	62	0.31	54.3
0002 701-22-002	1.8	14.15	1.54	542		48.3
0003 701-22-003	1.6	25.17	2.94	425		38.2
0004 701-22-004	2.3	25.63	2.58	50		44.4
0005 701-22-005	2.6	14.50	1.42	158	0.68	48.4
0006 701-22-006	2.6	20.27	1.88	39		52.7
0007 701-22-007	5.3	4.89	0.69	19		33.1
0008 701-22-008	2.5	2.63	0.32	11	0.89	19.0
0009 701-22-009	2.5	3.70	0.50	17	0.02	33.6
0010 701-22-010	1.8	3.15	0.49	13		26.1
0011 701-22-011	5.5	3.51	0.54	8		42.4
0012 701-22-012	2.5	37.37	2.85	162	0.80	50.5
0013 701-22-013	2.5	27.21	2.28	24		64.7
0014 701-22-014	5.7	2.14	0.23	23		6.0
0015 701-22-015	5.1	0.80	0.08	9	0.45	3.6
0016 701-22-016	1.4	6.55	0.69	19		18.9
0017 701-22-017	1.5	7.25	0.67	31		10.9
0018 701-22-018	1.9	9.06	0.79	46	1.82	9.4
0019 701-22-019	2.7	11.91	1.09	27	1.78	9.6
0020 701-22-020	0.5	8.38	0.77	1071	0.66	7.8
0021 701-22-021	0.8	16.91	1.44	592		4.6
0022 701-22-022	2.4	13.00	1.24	95		16.6
0023 701-22-023	2.1	13.20	1.10	298	2.76	27.2
0024 701-22-024	1.6	20.37	1.55	519		14.5
0025 701-22-025	2.3	31.06	3.69	185		23.9
0026 701-22-026	0.6	4.47	1.18	34		48.5
0027 701-22-027	1.1	10.21	1.41	243	1.63	53.6
0028 701-22-028	0.6	6.32	0.79	448		39.3
0029 701-22-029	1.6	8.81	1.00	42		57.0
0030 701-22-030	1.1	5.57	0.80	19		35.9
0031 701-22-031	1.1	8.68	1.14	36	1.99	64.4
0032 701-22-032	1.1	11.61	1.12	219	2.84	55.4
0033 701-22-033	1.1	7.74	1.23	251	0.93	50.7
0034 701-22-034	0.8	9.39	1.05	25		52.8
0035 701-22-035	1.4	4.89	0.83	59		38.4
0036 701-22-036	2.4	7.78	1.02	21		46.5
0037 701-22-037	1.8	8.16	1.04	16		51.0
0038 701-22-038	1.4	7.60	0.88	30		28.4

ANALYSIS

0039 701-22-039	1.4	12.60	1.47	32	0.61	67.7
0040 701-22-040	2.0	5.11	0.76	141		45.7

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0041 701-22-041	0.16	0.02	8.14%	0.08	1	7.8
0042 701-22-042	0.13		7.02%		0	18.3
0043 701-22-043	0.06		9.50%		2	2.5
0044 701-22-044	0.07	0.05	9.92%	0.34	1	1.9
0045 701-22-045	0.58		5.65%		0	21.3
0046 701-22-046	1.64	0.01	7.41%	0.08	31	36.3
0047 701-22-047	0.12		7.77%		99	4.5
0048 701-22-048	0.26		8.20%		57	12.2
0049 701-22-049	1.11	0.03	8.80%	0.13	5	24.8
0050 701-22-050	2.33		8.15%		1	46.6
0051 701-22-051	0.53		7.48%		100	12.1
0052 701-22-052	0.12	0.07	7.54%	0.45	134	3.8
0053 701-22-053	1.19		7.94%		32	5.8
0054 701-22-054	1.45		7.73%		4	44.6
0055 701-22-055	0.18	0.09	8.49%	0.11	13	6.2
0056 701-22-056	0.17		8.24%		3	4.0
0057 701-22-057	0.21		10.29%		1	39.7
0058 701-22-058	0.15		10.96%		4	4.8
0059 701-22-059	0.36	X	8.65%	0.21	11	5.7
0060 701-22-060	0.70	0.12	8.74%	0.39	6	15.9
0061 701-22-061	0.58		7.57%		2	6.7
0062 701-22-062	0.06		8.86%		3	10.2
0063 701-22-063	0.82		6.95%		1	86.5
0064 701-22-064	0.46	0.01	8.05%	2.81	-1	21.9
0065 701-22-065	0.38		7.36%		0	14.3
0066 701-22-066	0.10		11.67%*		4	4.7
0067 701-22-067	1.29	0.03	7.22%	17.83	3	24.6
0068 701-22-068	2.37		8.15%		3	29.7
0069 701-22-069	0.79		7.94%		5	18.7
0070 701-22-070	0.93		7.95%		6	13.4
0071 701-22-071	0.06	0.03	8.18%	3.24	93	2.2
0072 701-22-072	0.17	0.08	7.82%	1.38	125	4.6
0073 701-22-073	0.17		7.81%		104	14.8
0074 701-22-074	1.94		7.70%		18	108.0
0075 701-22-075	2.72		6.58%		6	78.6
0076 701-22-076	1.25		8.01%		-1	249.6
0077 701-22-077	0.22		10.47%		4	7.7
0078 701-22-078	1.03		8.31%		5	132.5

ANALYSIS

0079 701-22-079	1.42	7.75%	5	40.1
0080 701-22-080	0.52	8.57%	5	16.5

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	X	0.18	326.8	4.51	0.28
0042 701-22-042		X		287.8		0.21
0043 701-22-043		X		591.7		0.89
0044 701-22-044	2.7	X	0.12	441.8	5.99	0.61
0045 701-22-045		X		192.8		0.25
0046 701-22-046	1.6	13	0.28	584.9	18.96	2.12
0047 701-22-047		12		245.6		1.48
0048 701-22-048		17		112.3		2.07
0049 701-22-049	2.4	X	0.25	226.4	14.50	1.79
0050 701-22-050		X		275.3		0.25
0051 701-22-051		12		1024.8		1.28
0052 701-22-052	3.9	X	0.04	856.6	60.96	1.14
0053 701-22-053		11		378.5		1.25
0054 701-22-054		X		363.2		2.51
0055 701-22-055	1.9	X	0.04	581.1	30.01	1.81
0056 701-22-056		X		540.3		0.78
0057 701-22-057		X		1364.1		0.90
0058 701-22-058		X		1041.3		1.36
0059 701-22-059	1.4	X	0.07	282.2	7.50	1.54
0060 701-22-060	2.2	X	0.05	652.6	14.78	1.70
0061 701-22-061		X		398.8		0.74
0062 701-22-062		X		252.3		0.84
0063 701-22-063		X		204.5		0.30
0064 701-22-064	1.0	X	0.03	249.2	0.46	0.20
0065 701-22-065		X		418.2		0.09
0066 701-22-066		X		367.7		2.05
0067 701-22-067	7.7	X	0.04	213.0	20.46	0.99
0068 701-22-068		X		421.5		1.06
0069 701-22-069		X		382.4		1.31
0070 701-22-070		X		367.1		1.28
0071 701-22-071	5.6	14	0.04	588.2	227.06	1.22
0072 701-22-072	4.9	17	0.02	1384.9	71.60	1.21
0073 701-22-073		15		176.6		1.38
0074 701-22-074		X		246.5		2.45
0075 701-22-075		X		380.9		1.32
0076 701-22-076		X		220.3		2.15
0077 701-22-077		X		115.0		1.73
0078 701-22-078		X		427.9		0.86

ANALYSIS

0079 701-22-079	X	316.0	0.64
0080 701-22-080	X	432.8	0.30

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	X	1.60	X	0.03	803	19.38
0042 701-22-042		1.02		0.03	552	
0043 701-22-043		0.47		0.04	300	
0044 701-22-044	0.2	0.91	X	0.06	396	25.48
0045 701-22-045		2.97		0.04	339	
0046 701-22-046	X	0.75	X	0.83	2409	25.78
0047 701-22-047		0.06		1.37	2.30%	
0048 701-22-048		0.05		0.69	2139	
0049 701-22-049	2.9	1.44	0.016	0.05	1118	10.46
0050 701-22-050		2.45		0.16	727	
0051 701-22-051		1.24		1.57	2.79%	
0052 701-22-052	X	0.11	X	2.06	2.95%	6.85
0053 701-22-053		2.19		1.05	2929	
0054 701-22-054		1.95		0.04	1131	
0055 701-22-055	X	0.20	X	0.41	2575	9.18
0056 701-22-056		0.70		0.03	205	
0057 701-22-057		0.42		0.03	287	
0058 701-22-058		0.42		0.04	338	
0059 701-22-059	0.1	0.13	X	0.65	1201	9.39
0060 701-22-060	1.7	1.55	0.013	0.05	919	8.99
0061 701-22-061		3.45		0.04	778	
0062 701-22-062		1.62		0.04	674	
0063 701-22-063		3.07		0.03	803	
0064 701-22-064	0.2	2.21	0.005	0.02	900	10.44
0065 701-22-065		1.86		0.02	819	
0066 701-22-066		0.13		0.02	317	
0067 701-22-067	2.0	2.28	0.020	0.04	182	11.02
0068 701-22-068		4.24		0.05	397	
0069 701-22-069		1.68		0.08	440	
0070 701-22-070		1.04		0.05	262	
0071 701-22-071	0.8	0.13	0.057	1.09	3.62%	8.83
0072 701-22-072	0.2	0.28	0.007	1.53	3.70%	8.40
0073 701-22-073		0.11		1.72	2.57%	
0074 701-22-074		1.79		0.71	4535	
0075 701-22-075		2.03		0.05	1492	
0076 701-22-076		0.55		0.05	780	
0077 701-22-077		0.18		0.04	586	
0078 701-22-078		2.78		0.03	1070	

ANALYSIS

0079 701-22-079	5.67	0.04	664
0080 701-22-080	0.96	0.04	713

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0041 701-22-041	0.15	3.98	45.92	56	13.1	285.9
0042 701-22-042	0.48		45.29		14.0	
0043 701-22-043	0.05		23.35		3.7	
0044 701-22-044	0.24	29.01	22.11	286	19.4	1438.7
0045 701-22-045	0.05		36.22		13.0	
0046 701-22-046	7.73	43.13	51.06	73	23.1	22.6
0047 701-22-047	0.29		52.53		9.7	
0048 701-22-048	4.94		53.42		10.4	
0049 701-22-049	0.16	1.39	36.48	99	11.6	33.0
0050 701-22-050	0.16		40.53		18.3	
0051 701-22-051	1.94		55.18		11.6	
0052 701-22-052	0.17	X	71.00	23	9.4	0.6
0053 701-22-053	4.32		68.75		12.4	
0054 701-22-054	1.58		66.32		17.0	
0055 701-22-055	0.07	0.03	71.61	236	9.8	2.0
0056 701-22-056	0.04		58.01		8.6	
0057 701-22-057	1.04		86.79		61.4*	
0058 701-22-058	0.32		90.64		24.1	
0059 701-22-059	5.53	5.84	70.24	97	10.0	28.9
0060 701-22-060	2.75	5.99	81.64	175	12.8	89.2
0061 701-22-061	0.04		49.15		0.6	
0062 701-22-062	0.02		55.75		3.5	
0063 701-22-063	0.05		44.72		15.2	
0064 701-22-064	0.05	5.37	42.44	33	9.7	115.2
0065 701-22-065	0.04		26.44		12.3	
0066 701-22-066	10.19*		54.15		9.2	
0067 701-22-067	3.21	268.89	69.50	17	11.5	696.4
0068 701-22-068	1.36		55.01		17.9	
0069 701-22-069	6.07		58.11		16.0	
0070 701-22-070	1.87		47.78		12.4	
0071 701-22-071	0.16	0.10	65.85	27	8.8	1.0
0072 701-22-072	0.36	X	71.01	115	10.7	1.6
0073 701-22-073	0.65		53.61		9.0	
0074 701-22-074	9.84		59.50		13.1	
0075 701-22-075	0.39		58.90		4.6	
0076 701-22-076	0.20		66.08		56.9	
0077 701-22-077	4.65		51.71		8.4	
0078 701-22-078	0.14		62.18		14.1	

ANALYSIS

0079 701-22-079	0.37	57.02	16.4
0080 701-22-080	0.15	20.95	11.5

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	No	16	X	0.38	59.2	0.05
0042 701-22-042	No	10		0.34	65.8	
0043 701-22-043	No	21		0.79	448.0	
0044 701-22-044	No	23	X	0.29	102.9	1.11
0045 701-22-045	No	27		0.19	666.2	
0046 701-22-046	Yes	11	0.03	3.00	191.3	0.05
0047 701-22-047	No	11		3.16	10.9	
0048 701-22-048	Yes	19		5.40	15.0	
0049 701-22-049	No	16	X	5.49	300.6	2.38
0050 701-22-050	No	56		0.27	612.9	
0051 701-22-051	No	8		1.94	121.7	
0052 701-22-052	No	12	X	1.83	18.8	X
0053 701-22-053	No	9		1.78	215.1	
0054 701-22-054	No	26		4.84	325.5	
0055 701-22-055	Yes	11	X	2.04	11.0	X
0056 701-22-056	No	8		2.60	165.8	
0057 701-22-057	No	12		2.85	45.3	
0058 701-22-058	No	19		2.58	31.7	
0059 701-22-059	No	10	X	7.26	17.4	0.01
0060 701-22-060	No	12	X	11.86	87.9	0.83
0061 701-22-061	No	13		0.84	160.8	
0062 701-22-062	No	13		1.05	87.4	
0063 701-22-063	No	40		0.18	1982.7	
0064 701-22-064	No	30	X	0.08	562.5	9.60
0065 701-22-065	No	18		0.06	456.4	
0066 701-22-066	No	28		3.11	55.0	
0067 701-22-067	No	41	X	6.08	584.7	14.94
0068 701-22-068	No	45		5.74	410.8	
0069 701-22-069	No	83		10.97	147.7	
0070 701-22-070	No	49		7.08	181.2	
0071 701-22-071	No	9	X	1.69	19.9	0.02
0072 701-22-072	No	12	X	2.26	67.0	0.01
0073 701-22-073	Yes	12		3.11	21.2	
0074 701-22-074	No	13		8.62	322.1	
0075 701-22-075	No	19		5.72	1075.6	
0076 701-22-076	No	267*		7.17	230.3	
0077 701-22-077	No	39		2.15	101.4	
0078 701-22-078	No	35		3.36	307.1	

ANALYSIS

0079 701-22-079	No	85	4.54	471.0
0080 701-22-080	No	16	1.19	76.2

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0041 701-22-041	0.97	497	0.40	0.78	X	5.38
0042 701-22-042	0.69		0.23	0.69		4.83
0043 701-22-043	1.30		0.84	0.41		0.75
0044 701-22-044	1.52	1179	0.92	0.35	0.2	0.71
0045 701-22-045	0.88		0.42	0.58		6.73
0046 701-22-046	1.67	1000	1.23	0.83	0.4	5.57
0047 701-22-047	2.03		1.22	0.83		2.75
0048 701-22-048	1.47		0.99	0.77		3.84
0049 701-22-049	2.79	905	1.68	0.97	0.1	4.86
0050 701-22-050	1.30		0.74	0.97		9.07
0051 701-22-051	2.05		1.23	0.92		3.87
0052 701-22-052	2.49	344	1.43	1.12	0.6	2.85
0053 701-22-053	2.45		1.41	1.30		5.20
0054 701-22-054	3.64		2.47	1.10		6.41
0055 701-22-055	2.75	1169	1.60	1.15	0.4	3.40
0056 701-22-056	1.32		0.84	0.52		1.99
0057 701-22-057	3.80		2.60	1.35		3.04
0058 701-22-058	3.15		1.96	1.72		1.67
0059 701-22-059	2.08	874	1.36	0.98	0.3	3.82
0060 701-22-060	2.99	1022	1.94	1.34	0.2	3.40
0061 701-22-061	0.96		0.54	0.69		3.26
0062 701-22-062	1.16		0.52	0.90		2.38
0063 701-22-063	1.07		0.52	0.78		7.60
0064 701-22-064	0.78	335	0.40	0.76	X	4.43
0065 701-22-065	0.48		0.19	0.55		6.53
0066 701-22-066	1.77		1.04	0.80		1.15
0067 701-22-067	1.68	598	1.01	0.76	X	3.27
0068 701-22-068	1.64		0.93	0.77		5.22
0069 701-22-069	1.84		0.98	0.85		2.68
0070 701-22-070	1.38		1.05	0.62		2.64
0071 701-22-071	2.31	499	1.39	1.05	0.1	2.76
0072 701-22-072	2.32	925	1.36	1.07	0.4	2.98
0073 701-22-073	2.15		1.26	0.97		3.06
0074 701-22-074	1.70		1.02	0.92		5.43
0075 701-22-075	3.45		2.23	1.05		3.56
0076 701-22-076	4.59		1.84	1.61		13.94
0077 701-22-077	2.80		1.49	1.01		1.71
0078 701-22-078	2.68		1.42	1.18		4.07

ANALYSIS

0079 701-22-079	2.31	1.35	1.07	3.69
0080 701-22-080	0.87	0.44	0.59	3.67

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.06	1.4	0	12.29	2.27	0.78
0042 701-22-042		1.5	0	8.91	1.59	0.59
0043 701-22-043		1.5	0	17.10	1.37	1.07
0044 701-22-044	0.09	1.4	0	17.18	1.28	0.97
0045 701-22-045		1.5	0	8.08	1.77	0.87
0046 701-22-046	X	1.1	0	19.07	2.40	0.84
0047 701-22-047		1.4	1	16.55	2.35	0.83
0048 701-22-048		1.4	0	20.51	2.10	1.02
0049 701-22-049	0.05	1.5	0	21.73	3.24	0.79
0050 701-22-050		1.5	0	19.12	2.76	1.22
0051 701-22-051		1.4	1	16.16	2.68	0.54
0052 701-22-052	0.02	1.3	1	15.41	3.02	0.89
0053 701-22-053		1.4	0	19.45	3.24	0.97
0054 701-22-054		1.5	0	16.84	3.43	0.77
0055 701-22-055	0.03	1.7	0	18.09	3.38	0.97
0056 701-22-056		1.4	0	16.95	1.51	1.12
0057 701-22-057		1.5	0	17.11	4.15	0.91
0058 701-22-058		1.5	0	16.63	4.38	0.98
0059 701-22-059	0.05	1.8	0	18.57	2.76	1.14
0060 701-22-060	0.07	1.5	0	20.54	4.08	0.93
0061 701-22-061		1.4	0	18.63	1.85	1.08
0062 701-22-062		1.5	0	17.77	2.32	1.14
0063 701-22-063		1.5	0	13.68	2.18	1.70
0064 701-22-064	3.04	1.5	0	14.23	1.97	1.30
0065 701-22-065		1.4	0	9.79	1.47	0.85
0066 701-22-066		1.4	0	19.79	2.31	1.44
0067 701-22-067	7.34	1.5	0	16.06	2.49	1.59
0068 701-22-068		1.5	0	19.20	2.35	1.09
0069 701-22-069		1.6	0	17.61	2.83	1.44
0070 701-22-070		1.5	0	17.03	2.02	1.23
0071 701-22-071	1.98	1.3	2	16.00	2.98	1.12
0072 701-22-072	0.44	1.5	2	15.82	3.06	1.03
0073 701-22-073		1.4	1	16.47	2.48	0.82
0074 701-22-074		1.1	0	18.97	2.64	0.97
0075 701-22-075		1.6	0	14.42	3.34	0.66
0076 701-22-076		1.5	0	15.29	5.48	0.75
0077 701-22-077		1.5	0	17.78	3.26	1.54
0078 701-22-078		1.5	0	21.78	4.13	1.20

ANALYSIS

0079 701-22-079	1.5	0	36.40	3.44	1.18
0080 701-22-080	1.5	0	22.67	1.87	0.79

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.98	X	X	0.15	0.060	1.05%
0042 701-22-042	0.47	0.02		0.09	0.030	1.34%
0043 701-22-043	1.83	X		0.27	0.129	2.87%
0044 701-22-044	1.38	X	X	0.31	0.186	2.62%
0045 701-22-045	0.32	0.02		0.15	0.422	5616
0046 701-22-046	1.14	X	X	0.36	3.274	3.56%
0047 701-22-047	1.33	X		0.39	0.035	3.61%
0048 701-22-048	1.51	X		0.32	0.697	3.26%
0049 701-22-049	1.91	0.02	X	0.60	1.992	3.98%
0050 701-22-050	1.70	0.03		0.25	0.548	795
0051 701-22-051	1.50	X		0.41	1.021	3.21%
0052 701-22-052	1.60	X	X	0.49	0.056	3.29%
0053 701-22-053	1.92	0.06		0.49	0.224	3.24%
0054 701-22-054	1.47	0.04		0.82	0.259	3.46%
0055 701-22-055	1.89	X	X	0.55	0.043	3.43%
0056 701-22-056	1.87	X		0.39	0.123	3.80%
0057 701-22-057	1.70	X		0.84	0.096	2.63%
0058 701-22-058	1.92	X		0.65	0.049	2.44%
0059 701-22-059	1.70	0.05	X	0.45	0.938	3.56%
0060 701-22-060	1.86	0.08	X	2.05	1.017	3.81%
0061 701-22-061	1.54	X		0.18	0.421	3.69%
0062 701-22-062	1.55	X		0.18	0.552	3.74%
0063 701-22-063	1.11	0.06		0.18	0.172	5571
0064 701-22-064	0.86	0.01	X	0.11	0.185	2.33%
0065 701-22-065	0.65	0.01		0.07	0.193	1.94%
0066 701-22-066	1.52	0.03		0.35	0.713	3.45%
0067 701-22-067	1.43	0.08	X	0.31	1.104	2.80%
0068 701-22-068	1.35	0.28		0.29	0.588	2.98%
0069 701-22-069	1.36	0.48		0.35	0.791	3.26%
0070 701-22-070	1.70	0.40		0.30	0.309	3.25%
0071 701-22-071	1.97	X	X	0.48	0.026	2.55%
0072 701-22-072	1.61	X	X	0.46	0.120	2.55%
0073 701-22-073	1.32	X		0.42	0.092	3.14%
0074 701-22-074	1.42	0.06		0.37	3.200	3.32%
0075 701-22-075	1.57	0.06		0.74	0.861	2.89%
0076 701-22-076	1.82	0.01		0.76	1.014	2.59%
0077 701-22-077	2.16	0.05		0.52	1.008	2.96%
0078 701-22-078	2.10	0.53		0.49	0.354	3.36%

ANALYSIS

0079 701-22-079	1.98	0.23	0.42	0.437	2.83%
0080 701-22-080	0.97	0.02	0.14	0.194	2.47%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	9.0	24.91	1.1	0.088	495	16.65
0042 701-22-042		26.46	1.4	0.036	139	
0043 701-22-043		13.93	3.4	0.167	977	
0044 701-22-044	14.2	15.10	6.1	0.151	384	33.88
0045 701-22-045		19.48	4.1	0.061	117	
0046 701-22-046	50.1	28.60	2.7	0.180	6077	24.72
0047 701-22-047		29.69	3.7	0.190	1.87%	
0048 701-22-048		29.57	5.0	0.168	2.28%	
0049 701-22-049	41.7	19.67	1.3	0.234	3257	13.16
0050 701-22-050		21.79	91.4	0.156	276	
0051 701-22-051		32.13	7.0	0.186	1.33%	
0052 701-22-052	15.8	40.09	8.7	0.234	1.77%	7.87
0053 701-22-053		37.22	9.7	0.196	1.05%	
0054 701-22-054		36.34	3.0	0.318	4717	
0055 701-22-055	24.8	40.77	6.3	0.251	7312	17.85
0056 701-22-056		34.51	2.1	0.156	3843	
0057 701-22-057		49.58	1.6	0.486	2726	
0058 701-22-058		49.66	1.6	0.335	2527	
0059 701-22-059	37.4	40.71	3.6	0.210	4326	21.64
0060 701-22-060	37.9	45.89	2.6	0.269	3721	19.71
0061 701-22-061		27.83	0.1	0.096	1998	
0062 701-22-062		31.58	0.4	0.098	1882	
0063 701-22-063		24.22	2.1	0.111	173	
0064 701-22-064	4.8	22.83	0.3	0.068	113	7.58
0065 701-22-065		13.91	0.7	0.038	107	
0066 701-22-066		31.68	4.4	0.163	2308	
0067 701-22-067	20.2	42.14	2.5	0.173	2433	10.89
0068 701-22-068		30.72	1.8	0.152	1980	
0069 701-22-069		30.62	1.8	0.171	3026	
0070 701-22-070		25.81	2.7	0.170	2891	
0071 701-22-071	5.5	36.78	8.6	0.221	1.08%	7.63
0072 701-22-072	17.5	40.22	6.8	0.209	1.72%	5.29
0073 701-22-073		30.17	8.1	0.211	2.02%	
0074 701-22-074		32.91	4.6	0.162	6675	
0075 701-22-075		34.00	1.7	0.322	2792	
0076 701-22-076		33.94	4.4	0.211	2624	
0077 701-22-077		28.66	8.4	0.229	3505	
0078 701-22-078		31.94	2.0	0.232	2369	

ANALYSIS

0079 701-22-079	30.56	6.6	0.238	2353
0080 701-22-080	11.09	1.5	0.078	1120

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0041 701-22-041	50	0.69		1.3	0.19	198
0042 701-22-042	38			4.2		181
0043 701-22-043	56			2.1		62
0044 701-22-044	42	0.57		1.7	0.20	126
0045 701-22-045	40			2.5		252
0046 701-22-046	>2.00%	19.09	2.25%	1.7	3.58	130
0047 701-22-047	5202			0.6		11
0048 701-22-048	>2.00%		2.36%	1.2		50
0049 701-22-049	398	1.57		1.3	0.08	146
0050 701-22-050	1372			2.4		295
0051 701-22-051	3669			2.8		70
0052 701-22-052	1747	0.01		1.8	10.26	19
0053 701-22-053	>2.00%		2.08%	1.6		89
0054 701-22-054	401			6.7		201
0055 701-22-055	4184	1.12		1.6	2.28	35
0056 701-22-056	129			1.0		48
0057 701-22-057	50			2.9		65
0058 701-22-058	46			1.8		48
0059 701-22-059	5554	5.83		1.2	0.07	47
0060 701-22-060	160	0.22		1.2	0.12	106
0061 701-22-061	146			1.1		51
0062 701-22-062	118			0.6		62
0063 701-22-063	44			2.0		296
0064 701-22-064	41	0.40		2.4	0.06	277
0065 701-22-065	42			2.7		334
0066 701-22-066	188			0.6		61
0067 701-22-067	175	1.88		1.5	0.08	104
0068 701-22-068	128			1.8		192
0069 701-22-069	219			1.9		68
0070 701-22-070	188			1.0		67
0071 701-22-071	817	0.13		2.6	8.51	2
0072 701-22-072	2436	0.02		1.3	35.62	24
0073 701-22-073	1.05%			1.3		40
0074 701-22-074	1.34%			1.9		130
0075 701-22-075	659			2.6		111
0076 701-22-076	227			0.6		498
0077 701-22-077	282			1.6		62
0078 701-22-078	173			1.2		141

ANALYSIS

0079 701-22-079	77	1.9	132
0080 701-22-080	74	1.4	131

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0041 701-22-041	749	47.2	167	2.2	156	197
0042 701-22-042	735		145	2.2	133	181
0043 701-22-043	1096		7	3.7	1	60
0044 701-22-044	1087	161.8	17	3.1	10	125
0045 701-22-045	808		193	2.2	176	251
0046 701-22-046	612	117.1	68	2.5	53	99
0047 701-22-047	684		0	8.5	0	-88
0048 701-22-048	639		2	6.0	0	-7
0049 701-22-049	670	140.4	128	2.1	110	141
0050 701-22-050	530		244	2.1	222	294
0051 701-22-051	612		0	8.1	0	-30
0052 701-22-052	577	47.3	0	8.9	0	-115
0053 701-22-053	738		26	3.0	12	57
0054 701-22-054	1141		181	2.1	160	197
0055 701-22-055	1197	203.8	14	3.0	5	22
0056 701-22-056	707		40	2.3	30	45
0057 701-22-057	879		53	2.2	43	64
0058 701-22-058	630		36	2.3	28	44
0059 701-22-059	747	122.0	27	2.8	8	35
0060 701-22-060	881	163.7	94	2.2	81	100
0061 701-22-061	703		2	4.6	0	49
0062 701-22-062	333		34	2.4	23	59
0063 701-22-063	531		207	2.3	181	295
0064 701-22-064	1700	22.9	144	2.3	126	278
0065 701-22-065	1361		215	2.2	196	333
0066 701-22-066	391		19	2.9	9	57
0067 701-22-067	365	6.3	81	2.2	66	101
0068 701-22-068	699		157	2.1	137	189
0069 701-22-069	621		62	2.1	51	63
0070 701-22-070	539		63	2.2	49	61
0071 701-22-071	1.62%	124.5	0	9.7	0	-91
0072 701-22-072	3933	208.2	0	9.0	0	-101
0073 701-22-073	1324		0	9.0	0	-64
0074 701-22-074	943		80	2.3	61	112
0075 701-22-075	686		79	2.2	67	105
0076 701-22-076	243		440	2.1	409	499
0077 701-22-077	289		32	2.5	23	58
0078 701-22-078	366		113	2.2	100	136

ANALYSIS

0079 701-22-079	418	101	2.2	88	127
0080 701-22-080	691	106	2.1	95	126

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	1.15	17.91	8.9	0.07	675	X
0042 701-22-042	0.61	16.24	10.2		611	
0043 701-22-043	3.40	8.34	3.5		101	
0044 701-22-044	3.25	7.54	10.7	0.56	146	X
0045 701-22-045	0.96	14.59	24.6		476	
0046 701-22-046	3.91	18.72	17.4	X	580	X
0047 701-22-047	3.90	18.17	8.3		581	
0048 701-22-048	3.95	19.61	8.9		614	
0049 701-22-049	3.32	15.13	8.6	0.02	667	X
0050 701-22-050	4.33	16.18	33.2		849	
0051 701-22-051	3.47	19.75	8.6		523	
0052 701-22-052	3.83	25.28	6.2	X	616	X
0053 701-22-053	3.93	26.63	7.6		725	
0054 701-22-054	2.81	26.01	18.1		593	
0055 701-22-055	4.08	26.17	6.4	X	752	X
0056 701-22-056	4.24	18.42	4.1		71	
0057 701-22-057	3.74	33.06	15.5		346	
0058 701-22-058	4.00	38.47	9.5		383	
0059 701-22-059	3.78	25.28	9.2	0.02	567	X
0060 701-22-060	3.30	31.48	11.4	0.10	1303	X
0061 701-22-061	2.60	16.89	3.0		559	
0062 701-22-062	3.13	19.67	4.0		563	
0063 701-22-063	2.36	18.03	30.4		662	
0064 701-22-064	1.61	16.66	11.0	0.09	745	0.2
0065 701-22-065	0.88	11.54	11.7		545	
0066 701-22-066	3.42	18.80	26.0		486	
0067 701-22-067	5.78	21.89	28.6	0.51	142	0.4
0068 701-22-068	3.73	17.21	30.6		350	
0069 701-22-069	5.34	22.80	50.8		394	
0070 701-22-070	5.34	16.85	30.6		254	
0071 701-22-071	4.58	23.60	5.7	X	648	X
0072 701-22-072	3.81	25.98	8.7	X	726	X
0073 701-22-073	3.64	19.36	15.5		663	
0074 701-22-074	3.58	21.60	13.2		837	
0075 701-22-075	5.54	20.15	8.4		677	
0076 701-22-076	4.13	29.21	242.5*		1282	
0077 701-22-077	4.02	18.35	17.1		463	
0078 701-22-078	7.11	25.52	32.7		1001	

ANALYSIS

0079 701-22-079	5.74	22.20	47.4	713
0080 701-22-080	2.02	8.58	11.2	637

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0041 701-22-041	104.1	0.6	5.3		4.916	28.10
0042 701-22-042	72.8		4.9		4.538	14.92
0043 701-22-043	9.1		5.7		2.409	63.65
0044 701-22-044	11.3	X	5.0		2.235	29.44
0045 701-22-045	47.8		4.9		3.851	6.19
0046 701-22-046	232.3	6.6	7.2	3.4	5.174	146.99
0047 701-22-047	43.7		9.3	3.4	5.255	158.07
0048 701-22-048	162.5		8.1		5.485	141.19
0049 701-22-049	96.1	1.3	5.3		3.954	163.07
0050 701-22-050	219.8		5.0		4.376	3.55
0051 701-22-051	133.4		7.2	3.4	5.607	122.53
0052 701-22-052	18.0	1.2	8.2	3.5	7.153	143.59
0053 701-22-053	607.6*		7.6	3.1	7.336	138.75
0054 701-22-054	130.2		4.7		7.186	155.85
0055 701-22-055	21.2	0.7	7.3	3.0	7.331	135.82
0056 701-22-056	25.1		4.7		5.599	154.37
0057 701-22-057	95.4		4.4		9.099	102.53
0058 701-22-058	35.6		4.4		9.782	95.69
0059 701-22-059	332.9	0.7	6.5	2.9	7.198	135.76
0060 701-22-060	488.9	1.7	5.2		8.508	145.87
0061 701-22-061	23.8		4.1		4.971	133.02
0062 701-22-062	64.4		4.2		5.678	164.18
0063 701-22-063	111.6		4.6		5.100	4.50
0064 701-22-064	185.2	0.6	4.1		4.712	3.89
0065 701-22-065	137.8		4.3		2.786	3.48
0066 701-22-066	89.3		4.1		5.331	117.48
0067 701-22-067	52.8	13.0	3.7		6.579	129.11
0068 701-22-068	70.0		3.7		5.231	109.43
0069 701-22-069	53.4		3.8		6.147	164.51
0070 701-22-070	32.2		4.2		4.789	155.31
0071 701-22-071	10.0	2.5	9.2	3.7	6.663	92.30
0072 701-22-072	24.0	1.5	8.5	3.5	7.299	104.31
0073 701-22-073	49.6		8.5	3.4	5.434	146.48
0074 701-22-074	426.7		7.3	3.3	6.079	161.45
0075 701-22-075	137.8		5.4		6.229	144.53
0076 701-22-076	71.7		2.7		7.540	158.97
0077 701-22-077	39.0		4.2		5.169	139.72
0078 701-22-078	135.8		4.5		6.759	167.61

ANALYSIS

0079 701-22-079	194.4	4.0	6.533	138.62
0080 701-22-080	127.2	4.7	2.237	84.51

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0041 701-22-041	X	6.48	5.82%	46.7	4.38	0.34
0042 701-22-042	0.007	5.92	5.43%		4.68	0.36
0043 701-22-043	X	2.03	2.12%		0.27	0.54
0044 701-22-044	X	4.11	3.88%	51.0	0.35	1.19
0045 701-22-045	0.006	8.22	7.50%		5.32	0.48
0046 701-22-046	0.003	4.24	4.30%	117.6	3.66	0.14
0047 701-22-047	X	0.37	3389		0.25	0.05
0048 701-22-048	0.002	1.64	1.66%		1.34	0.05
0049 701-22-049	X	4.76	4.52%	90.5	3.80	0.11
0050 701-22-050	X	9.64	8.70%		7.35	0.22
0051 701-22-051	X	2.28	2.54%		1.99	0.33
0052 701-22-052	X	0.62	5441	29.7	0.44	0.07
0053 701-22-053	X	2.90	2.78%		2.62	0.06
0054 701-22-054	0.017	6.57	6.25%		5.73	0.18
0055 701-22-055	X	1.13	1.07%	55.1	1.03	0.06
0056 701-22-056	0.005	1.58	1.54%		1.63	0.08
0057 701-22-057	X	2.11	2.08%		1.74	0.17
0058 701-22-058	X	1.56	1.52%		1.27	0.10
0059 701-22-059	X	1.52	1.49%	82.1	1.30	0.08
0060 701-22-060	X	3.47	3.41%	75.5	2.79	0.09
0061 701-22-061	X	1.66	1.77%		0.06	0.90
0062 701-22-062	X	2.02	2.25%		1.27	0.40
0063 701-22-063	0.005	9.68	9.12%		7.67	0.47
0064 701-22-064	0.036	9.05	8.39%	34.5	4.41	1.17
0065 701-22-065	0.037	10.90	10.22%		6.02	1.02
0066 701-22-066	0.006	1.98	2.30%		0.68	0.39
0067 701-22-067	X	3.40	3.57%	91.4	2.75	0.21
0068 701-22-068	0.003	6.28	5.87%		3.85	0.41
0069 701-22-069	X	2.21	2.56%		1.99	0.15
0070 701-22-070	0.002	2.20	2.50%		2.01	0.19
0071 701-22-071	0.002	0.07	974	17.4		0.02
0072 701-22-072	X	0.80	7516	60.7	0.57	0.09
0073 701-22-073	X	1.31	1.45%		1.09	0.05
0074 701-22-074	X	4.24	4.24%		3.84	0.09
0075 701-22-075	X	3.62	3.68%		3.15	0.15
0076 701-22-076	0.002	16.29	15.06%		12.40	0.43
0077 701-22-077	X	2.04	2.26%		1.16	0.52
0078 701-22-078	0.002	4.62	4.52%		3.63	0.26

ANALYSIS

0079 701-22-079	0.003	4.32	4.53%	3.44	0.28
0080 701-22-080	X	4.27	4.24%	3.37	0.28

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	0.46	0.32	9.0	2.2	2.8	2.06
0042 701-22-042	0.61		8.3	1.8		1.75
0043 701-22-043	0.51		14.8	X		0.10
0044 701-22-044	0.30	0.54	15.3	X	4.6	0.56
0045 701-22-045	2.74		5.8	2.2		1.73
0046 701-22-046	1.08	0.34	8.7	0.6	1.3	0.32
0047 701-22-047	0.42		8.6	X		0.02
0048 701-22-048	0.79		9.9	X		0.04
0049 701-22-049	1.72	1.45	11.5	1.2	2.1	0.67
0050 701-22-050	2.50		11.5	1.8		2.11
0051 701-22-051	0.65		10.0	1.0		0.33
0052 701-22-052	0.40	0.47	9.2	X	0.9	0.03
0053 701-22-053	0.62		11.2	1.9		1.54
0054 701-22-054	1.45		11.0	2.7		2.16
0055 701-22-055	0.41	0.18	9.1	X	2.5	0.15
0056 701-22-056	0.28		7.2	0.7		0.42
0057 701-22-057	0.59		10.8	1.3		0.92
0058 701-22-058	0.21		11.6	0.7		0.49
0059 701-22-059	0.37	0.02	9.5	X	6.3	0.16
0060 701-22-060	0.48	0.29	11.8	0.8	7.8	0.80
0061 701-22-061	0.87		7.1	1.1		0.83
0062 701-22-062	0.69		7.0	X		0.16
0063 701-22-063	5.25		8.8	2.4		2.14
0064 701-22-064	1.75	0.49	8.6	1.6	1.5	1.56
0065 701-22-065	1.26		8.2	2.7		2.00
0066 701-22-066	0.60		14.1	0.6		0.10
0067 701-22-067	1.36	0.21	7.0	0.9	4.7	0.84
0068 701-22-068	1.61		12.5	1.7		1.73
0069 701-22-069	1.81		9.9	0.5		0.53
0070 701-22-070	2.08		8.2	0.7		0.58
0071 701-22-071	0.15	0.18	8.1	X	1.2	X
0072 701-22-072	0.33	0.38	10.1	X	1.5	0.13
0073 701-22-073	0.53		8.9	X		0.10
0074 701-22-074	2.64		9.6	1.4		1.08
0075 701-22-075	5.54		4.1	2.0		1.83
0076 701-22-076	9.17		23.0	1.4		1.14
0077 701-22-077	1.60		15.9	0.5		0.04
0078 701-22-078	9.53*		11.5	1.2		0.70

ANALYSIS

0079 701-22-079	3.54	13.1	1.0	0.97
0080 701-22-080	1.27	10.7	1.9	1.55

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0041 701-22-041	3.18	1.1	X	437.76	43.48	0.08
0042 701-22-042	2.72	2.0		595.91		0.04
0043 701-22-043	1.54	0.9		25.26		0.29
0044 701-22-044	1.39	0.7	X	41.20	18.33	0.26
0045 701-22-045	2.67	11.6		667.21		0.07
0046 701-22-046	3.14	2.0	X	36.73	936.43	0.29
0047 701-22-047	2.97	0.7		31.32		0.30
0048 701-22-048	3.31	0.6		18.71		0.29
0049 701-22-049	3.44	0.7	X	154.71	348.10	0.25
0050 701-22-050	3.43	2.3		1186.83		0.29
0051 701-22-051	3.47	0.6		228.61		0.27
0052 701-22-052	4.13	0.5	0.1	63.70	29.47	0.35
0053 701-22-053	4.77	1.0		48.93		0.32
0054 701-22-054	4.79	2.3		82.79		0.22
0055 701-22-055	4.47	0.6	X	28.16	136.79	0.34
0056 701-22-056	2.55	0.7		15.06		0.35
0057 701-22-057	5.63	0.7		145.71		0.29
0058 701-22-058	6.82	0.7		91.12		0.33
0059 701-22-059	4.16	0.5	X	73.60	5.48	0.30
0060 701-22-060	5.68	0.6	X	877.78	19.48	0.27
0061 701-22-061	2.79	0.8		49.73		0.23
0062 701-22-062	3.34	0.7		48.24		0.29
0063 701-22-063	3.29	5.0		449.33		0.16
0064 701-22-064	2.83	3.4	X	182.67	12.76	0.13
0065 701-22-065	2.00	2.5		222.33		0.07
0066 701-22-066	3.22	0.7		168.25		0.24
0067 701-22-067	3.66	1.4	X	10.85	8.75	0.45
0068 701-22-068	2.99	2.1		139.02		0.29
0069 701-22-069	4.08	1.8		116.67		0.40
0070 701-22-070	3.03	1.5		45.57		0.42
0071 701-22-071	4.01	0.5	X	271.54	53.77	0.36
0072 701-22-072	4.50	0.7	0.1	107.46	58.08	0.31
0073 701-22-073	3.32	0.5		42.15		0.27
0074 701-22-074	3.62	1.1		37.67		0.26
0075 701-22-075	3.91	0.7		195.29		0.42
0076 701-22-076	5.85	0.9		35.03		0.25
0077 701-22-077	3.39	0.6		60.85		0.30
0078 701-22-078	5.08	2.0		426.93		0.42

ANALYSIS

0079 701-22-079	4.35	4.3	438.73	0.36
0080 701-22-080	1.90	3.2	386.94	0.15

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0041 701-22-041	0.244	352	0.81	10.10	0.016	705
0042 701-22-042	0.170		0.27	8.82		340
0043 701-22-043	0.201		0.20	16.59		2463
0044 701-22-044	0.219	720	0.26	15.77	0.040	1990
0045 701-22-045	0.189		0.55	15.01		241
0046 701-22-046	0.369	680	0.18	13.40	0.012	1859
0047 701-22-047	0.334		X	13.83		2000
0048 701-22-048	0.264		X	13.52		2234
0049 701-22-049	0.477	580	0.76	12.63	0.021	2084
0050 701-22-050	0.301		1.51	14.02		2332
0051 701-22-051	0.380		0.33	19.34		2159
0052 701-22-052	0.423	210	0.16	22.48	0.010	1925
0053 701-22-053	0.403		0.56	19.50		2592
0054 701-22-054	0.516		1.43	14.08		1817
0055 701-22-055	0.460	657	0.15	23.10	0.013	2286
0056 701-22-056	0.204		0.36	21.80		2255
0057 701-22-057	0.599		0.85	24.94		2055
0058 701-22-058	0.555		0.55	27.01		2293
0059 701-22-059	0.362	443	0.17	25.29	0.060	2133
0060 701-22-060	0.511	700	0.65	24.97	0.075	2089
0061 701-22-061	0.209		0.78	16.60		933
0062 701-22-062	0.256		0.29	17.01		1213
0063 701-22-063	0.239		0.74	12.35		1206
0064 701-22-064	0.208	203	0.36	9.90	0.040	919
0065 701-22-065	0.133		0.33	8.40		552
0066 701-22-066	0.320		0.10	11.93		2655
0067 701-22-067	0.301	391	0.62	16.82	0.956	1925
0068 701-22-068	0.294		1.60	14.21		1723
0069 701-22-069	0.361		0.73	14.29		1891
0070 701-22-070	0.243		0.56	16.98		1757
0071 701-22-071	0.420	246	X	18.17	0.748	2105
0072 701-22-072	0.394	620	0.08	19.20	0.115	2239
0073 701-22-073	0.368		0.11	12.88		1855
0074 701-22-074	0.316		0.99	13.90		1974
0075 701-22-075	0.682		1.10	22.29		1232
0076 701-22-076	0.839		0.42	9.87		3194
0077 701-22-077	0.818		X	14.91		3276
0078 701-22-078	0.511		0.48	15.69		2723

ANALYSIS

0079 701-22-079	0.443	0.74	17.78	2166
0080 701-22-080	0.221	0.50	8.61	1257

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0041 701-22-041	0.37	0.08	3.84	5.967	82	X
0042 701-22-042	0.17	0.03	3.43		75	
0043 701-22-043	0.63	0.14	3.80		101	
0044 701-22-044	0.28	0.14	4.44	6.777	93	X
0045 701-22-045	0.20	0.06	1.76		60	
0046 701-22-046	1.69	0.16	3.10	0.078	75	X
0047 701-22-047	1.75	0.19	4.62		69	
0048 701-22-048	1.65	0.15	3.40		84	
0049 701-22-049	2.11	0.25	3.53	2.098	95	X
0050 701-22-050	0.19	0.12	4.11		89	
0051 701-22-051	1.29	0.19	3.47		92	
0052 701-22-052	1.65	0.21	5.38	6.165	77	0.01
0053 701-22-053	1.72	0.19	4.12		118	
0054 701-22-054	2.32	0.35	3.34		90	
0055 701-22-055	1.47	0.23	4.88	0.291	88	X
0056 701-22-056	1.74	0.13	4.37		64	
0057 701-22-057	1.16	0.42	6.05		106	
0058 701-22-058	0.97	0.31	6.36		96	
0059 701-22-059	1.56	0.19	8.01	0.727	89	X
0060 701-22-060	1.75	0.29	6.71	3.615	107	X
0061 701-22-061	1.36	0.08	3.43		66	
0062 701-22-062	1.41	0.08	3.41		55	
0063 701-22-063	0.44	0.09	2.94		91	
0064 701-22-064	0.06	0.11	2.81	13.348	88	X
0065 701-22-065	0.07	0.03	1.75		80	
0066 701-22-066	1.82	0.15	2.45		129	
0067 701-22-067	1.89	0.16	3.49	31.470	56	X
0068 701-22-068	1.65	0.15	4.15		84	
0069 701-22-069	2.37	0.15	2.97		75	
0070 701-22-070	1.90	0.15	3.70		61	
0071 701-22-071	0.39	0.21	3.77	2.346	71	0.06
0072 701-22-072	0.91	0.19	4.95	4.166	86	0.02
0073 701-22-073	1.57	0.18	3.24		74	
0074 701-22-074	2.97	0.15	3.65		81	
0075 701-22-075	4.49	0.30	4.54		32	
0076 701-22-076	3.38	0.25	2.27		118	
0077 701-22-077	1.86	0.23	4.06		118	
0078 701-22-078	2.88	0.22	5.53		97	

ANALYSIS

0079 701-22-079	1.82	0.20	5.54	95
0080 701-22-080	0.94	0.08	4.30	91

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0041 701-22-041	1.8	3.43	0.48	40	0.70	32.6
0042 701-22-042	3.2	1.99	0.24	168		20.4
0043 701-22-043	12.3	7.04	0.87	14		59.1
0044 701-22-044	1.8	7.57	0.99	14	0.84	50.3
0045 701-22-045	1.8	3.59	0.36	17		14.1
0046 701-22-046	8.3	8.83	1.11	2799	0.59	34.9
0047 701-22-047	0.9	11.21	1.19	276		43.6
0048 701-22-048	1.0	8.00	1.08	1703		49.5
0049 701-22-049	2.4	15.16	1.66	150	0.98	64.0
0050 701-22-050	1.8	5.99	0.86	258		58.3
0051 701-22-051	1.9	10.95	1.23	671		55.9
0052 701-22-052	1.4	13.19	1.52	100	X	46.9
0053 701-22-053	1.1	11.62	2.36	1510		66.8
0054 701-22-054	2.4	23.48	2.28	549		50.3
0055 701-22-055	1.1	14.49	1.63	78	X	61.6
0056 701-22-056	1.3	7.17	0.98	32		56.8
0057 701-22-057	1.1	25.23	2.95	55		53.9
0058 701-22-058	1.5	17.71	2.14	38		58.6
0059 701-22-059	1.6	11.08	1.41	1683	0.87	52.0
0060 701-22-060	1.9	16.20	1.81	773	0.95	57.0
0061 701-22-061	1.7	4.27	0.57	42		52.2
0062 701-22-062	1.5	4.62	0.58	23		46.9
0063 701-22-063	2.6	4.38	0.63	23		34.7
0064 701-22-064	1.6	2.52	0.40	8	0.19	43.2
0065 701-22-065	1.6	1.62	0.20	9		15.9
0066 701-22-066	4.0	8.22	0.94	2375		56.2
0067 701-22-067	1.6	8.37	1.13	1409	45.30	49.3
0068 701-22-068	2.1	7.88	0.95	450		40.9
0069 701-22-069	2.0	8.43	1.17	1915		43.1
0070 701-22-070	1.9	7.42	1.06	644		52.8
0071 701-22-071	1.3	12.66	1.49	66	X	62.4
0072 701-22-072	1.5	12.10	1.38	186	X	50.5
0073 701-22-073	1.3	12.08	1.22	329		44.6
0074 701-22-074	2.3	9.00	1.04	3221*		44.1
0075 701-22-075	3.0	20.54	2.21	184		39.5
0076 701-22-076	2.2	16.95	1.58	83		71.5
0077 701-22-077	1.3	12.15	1.61	1218		74.1
0078 701-22-078	4.5	12.74	1.59	175		74.0

ANALYSIS

0079 701-22-079	2.4	10.70	1.46	408	73.5
0080 701-22-080	1.2	3.24	0.45	65	31.8

ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0081 701-22-081	0.74	0.07	7.42%	69.57	0	49.0
0082 701-22-082	0.34		7.40%		3	37.7
0083 701-22-083	0.45		10.32%		4	5.0
0084 701-22-084	0.30	X	10.39%	0.02	6	8.3
0085 701-22-085	0.23		9.26%		5	13.5
0086 701-22-086	0.22		8.94%		5	3.6
0087 701-22-087	0.26		9.73%		4	2.3
0088 701-22-088	0.21	0.03	9.26%	0.99	3	7.1
0089 701-22-089	0.15		10.07%		4	5.4
0090 701-22-090	0.52		9.09%		4	33.4
0091 701-22-091	0.17		9.41%		4	5.2
0092 701-22-092	1.24		8.42%		4	12.8
0093 701-22-093	0.27	0.02	7.64%	3.12	4	8.6
0094 701-22-094	2.59	0.02	6.74%	1.02	0	14.8
0095 701-22-095	6.22		6.31%		-2	27.1
0096 701-22-096	4.05		7.63%		0	14.9
0097 701-22-097	0.31	0.02	6.38%	0.45	3	53.3
0098 701-22-098	8.94*		7.10%		0	234.9
0099 701-22-099	0.13	0.18	9.20%	7.37	3	4.0
0100 701-22-100	0.13		7.71%		2	9.6
0101 701-22-101	0.40		8.30%		2	70.7
0102 701-22-102	1.15		7.40%		-23	13.6
0103 701-22-103	0.88		9.02%		-11	25.2
0104 701-22-104	0.11		9.24%		13	3.4
0105 701-22-105	0.30		9.00%		9	10.8
0106 701-22-106	0.06		8.37%		83	2.9
0107 701-22-107	0.07	0.02	8.28%	0.08	84	4.7
0108 701-22-108	X		7.86%		78	1.6
0109 701-22-109	X	0.04	8.35%	2.84	86	1.5
0110 701-22-110	X		8.37%		85	0.9
0111 701-22-111	0.10	0.01	7.18%	2.92	155	4.5
0112 701-22-112	X		8.07%		106	2.5
0113 701-22-113	X		8.12%		109	2.2
0114 701-22-114	X	X	7.53%	2.32	117	1.1
0115 701-22-115	0.16	0.04	6.88%	2.74	130	6.1
0116 701-22-116	0.21		7.43%		95	3.9
0117 701-22-117	X		6.51%		84	2.7
0118 701-22-118	0.10		6.67%		23	8.6

ANALYSIS

0119 701-22-119	0.06	9.17%	6	10.1
0120 701-22-120	0.05	8.93%	6	1.9

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	21.3	X	X	311.5	3.92	0.65
0082 701-22-082		X		302.9		0.51
0083 701-22-083		X		356.1		1.15
0084 701-22-084	1.0	X	0.03	1591.3	19.82	1.00
0085 701-22-085		X		559.9		0.76
0086 701-22-086		X		555.7		0.95
0087 701-22-087		X		417.9		0.80
0088 701-22-088	1.1	X	X	884.6	5.25	0.71
0089 701-22-089		X		901.4		0.66
0090 701-22-090		X		278.4		0.69
0091 701-22-091		X		741.2		0.60
0092 701-22-092		X		414.7		0.89
0093 701-22-093	1.6	X	X	920.0	29.64	0.84
0094 701-22-094	1.0	X	X	993.4	29.49	0.30
0095 701-22-095		X		891.5		0.20
0096 701-22-096		X		668.4		0.09
0097 701-22-097	1.0	X	0.01	708.2	6.59	0.29
0098 701-22-098		X		996.5		0.12
0099 701-22-099	2.3	X	X	608.4	55.05	1.26
0100 701-22-100		X		299.5		0.31
0101 701-22-101		X		633.8		0.83
0102 701-22-102		X		254.4		0.64
0103 701-22-103		X		509.6		1.59
0104 701-22-104		X		2336.4*		1.32
0105 701-22-105		X		366.1		1.87
0106 701-22-106		13		673.8		1.26
0107 701-22-107	2.0	14	0.02	550.0	6.25	1.18
0108 701-22-108		14		771.1		1.05
0109 701-22-109	2.2	16	0.02	807.5	101.68	1.04
0110 701-22-110		14		824.9		1.48
0111 701-22-111	7.1	24	0.06	586.1	173.44	0.98
0112 701-22-112		23		636.7		1.08
0113 701-22-113		21		507.8		1.20
0114 701-22-114	1.5	17	0.04	347.6	101.98	1.08
0115 701-22-115	2.9	23	0.04	282.4	20.86	1.13
0116 701-22-116		19		479.7		1.18
0117 701-22-117		19		667.6		0.90
0118 701-22-118		X		2144.2		1.01

ANALYSIS

0119 701-22-119	X	950.2	1.84
0120 701-22-120	X	1539.6	1.49

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.7	3.86	0.410	0.07	359	26.39
0082 701-22-082		1.15		0.02	682	
0083 701-22-083		0.54		0.05	500	
0084 701-22-084	X	0.09	X	0.06	606	12.95
0085 701-22-085		0.18		0.04	335	
0086 701-22-086		0.25		0.06	362	
0087 701-22-087		0.31		0.05	298	
0088 701-22-088	X	0.23	X	0.04	433	4.91
0089 701-22-089		0.43		0.06	471	
0090 701-22-090		1.45		0.05	395	
0091 701-22-091		0.29		0.05	363	
0092 701-22-092		1.57		0.11	367	
0093 701-22-093	0.2	0.22	0.016	0.09	283	9.56
0094 701-22-094	X	1.12	X	0.04	986	18.30
0095 701-22-095		0.95		0.03	1046	
0096 701-22-096		1.44		0.04	1108	
0097 701-22-097	X	5.12	X	0.09	972	12.73
0098 701-22-098		2.17		0.03	780	
0099 701-22-099	1.3	0.33	X	0.08	664	29.14
0100 701-22-100		0.46		0.03	569	
0101 701-22-101		3.21		0.06	884	
0102 701-22-102		3.78		0.03	565	
0103 701-22-103		2.78		0.06	702	
0104 701-22-104		0.33		0.30	2656	
0105 701-22-105		0.47		0.04	2526	
0106 701-22-106		0.19		0.65	3.01%	
0107 701-22-107	X	0.10	X	0.73	3.14%	27.63
0108 701-22-108		0.04		0.67	2.84%	
0109 701-22-109	0.3	0.08	0.011	0.87	3.39%	6.54
0110 701-22-110		0.18		0.80	3.27%	
0111 701-22-111	0.5	0.17	0.166	1.84	6.07%*	11.60
0112 701-22-112		0.07		1.23	4.19%	
0113 701-22-113		0.06		1.32	4.53%	
0114 701-22-114	0.2	0.11	0.034	1.44	4.92%	7.85
0115 701-22-115	0.2	0.19	0.033	1.44	4.21%	6.29
0116 701-22-116		0.25		0.92	3.03%	
0117 701-22-117		0.45		0.76	2.73%	
0118 701-22-118		0.26		0.84	6170	

ANALYSIS

0119 701-22-119	0.29	0.08	979
0120 701-22-120	0.36	0.04	614

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0081 701-22-081	0.03	1.28	59.10	31	23.4	3571.9
0082 701-22-082	0.08		52.45		6.6	
0083 701-22-083	X		60.51		1.3	
0084 701-22-084	0.03	X	45.83	30	0.7	0.9
0085 701-22-085	X		44.75		0.3	
0086 701-22-086	X		83.58		1.2	
0087 701-22-087	0.03		62.22		0.8	
0088 701-22-088	0.03	0.07	51.47	13	0.5	2.8
0089 701-22-089	X		38.26		0.6	
0090 701-22-090	X		39.74		0.6	
0091 701-22-091	X		41.61		0.8	
0092 701-22-092	X		47.01		0.6	
0093 701-22-093	X	0.41	43.76	5	0.8	36.5
0094 701-22-094	X	0.74	88.89	15	0.3	22.9
0095 701-22-095	X		82.64		0.6	
0096 701-22-096	0.03		94.96		1.3	
0097 701-22-097	X	0.57	89.91	56	0.4	9.9
0098 701-22-098	X		108.50		0.4	
0099 701-22-099	0.06	3.64	60.72	7	15.3	270.0
0100 701-22-100	0.03		62.95		9.7	
0101 701-22-101	0.20		57.76		15.3	
0102 701-22-102	0.13		38.10		15.9	
0103 701-22-103	1.59		63.00		12.5	
0104 701-22-104	0.36		66.28		12.0	
0105 701-22-105	0.04		62.36		12.5	
0106 701-22-106	0.15		59.29		11.3	
0107 701-22-107	0.08	0.06	58.54	12	11.2	1.7
0108 701-22-108	0.03		53.73		10.5	
0109 701-22-109	0.04	0.02	65.42	28	9.4	2.3
0110 701-22-110	0.04		61.29		10.0	
0111 701-22-111	0.71	0.06	73.87	27	8.9	1.0
0112 701-22-112	0.17		56.91		10.8	
0113 701-22-113	0.31		60.57		11.3	
0114 701-22-114	0.39	X	54.75	99	8.4	1.4
0115 701-22-115	0.24	X	57.94	74	13.8	1.5
0116 701-22-116	0.10		64.71		13.1	
0117 701-22-117	0.04		47.57		13.2	
0118 701-22-118	0.29		56.70		22.0	

ANALYSIS

0119 701-22-119	0.07	74.59	7.4
0120 701-22-120	X	81.83	2.6

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	No	99	0.10	8.39	510.0	14.08
0082 701-22-082	No	22		0.88	166.3	
0083 701-22-083	No	10		3.48	786.3	
0084 701-22-084	No	17	X	1.62	647.2	0.11
0085 701-22-085	No	11		1.84	222.8	
0086 701-22-086	No	14		1.84	157.1	
0087 701-22-087	No	16		1.89	151.2	
0088 701-22-088	No	16	X	1.82	214.5	3.06
0089 701-22-089	No	20		1.62	260.6	
0090 701-22-090	No	28		2.04	409.3	
0091 701-22-091	No	16		1.51	306.4	
0092 701-22-092	No	18		2.74	291.3	
0093 701-22-093	No	14	X	2.10	299.1	25.25
0094 701-22-094	No	22	X	0.08	62.6	1.91
0095 701-22-095	No	28		0.09	117.4	
0096 701-22-096	No	37		0.13	30.9	
0097 701-22-097	No	18	X	0.22	120.1	1.15
0098 701-22-098	No	30		0.07	41.4	
0099 701-22-099	No	14	X	1.37	672.2	61.14
0100 701-22-100	No	33		0.23	798.8	
0101 701-22-101	No	10		1.22	335.0	
0102 701-22-102	No	20		2.78	365.4	
0103 701-22-103	No	49		2.69	542.7	
0104 701-22-104	No	17		6.05	139.4	
0105 701-22-105	No	15		9.42	120.5	
0106 701-22-106	No	14		5.91	44.0	
0107 701-22-107	No	10	X	4.63	69.5	0.02
0108 701-22-108	No	12		2.67	25.2	
0109 701-22-109	No	8	X	2.59	31.2	0.01
0110 701-22-110	No	8		2.88	41.5	
0111 701-22-111	No	8	X	5.76	154.1	0.08
0112 701-22-112	No	11		7.84	71.1	
0113 701-22-113	No	12		6.75	61.8	
0114 701-22-114	No	11	X	5.59	65.1	0.02
0115 701-22-115	No	17	X	5.78	185.1	0.03
0116 701-22-116	No	12		4.49	80.9	
0117 701-22-117	No	9		10.20	42.8	
0118 701-22-118	Yes	11		4.40	218.4	

ANALYSIS

0119 701-22-119	No	7	2.81	134.9
0120 701-22-120	No	4	2.27	18.9

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0081 701-22-081	1.31	2264	0.89	0.80	X	6.01
0082 701-22-082	1.07		0.61	0.77		3.21
0083 701-22-083	0.92		0.48	0.49		1.07
0084 701-22-084	1.31	328	0.66	0.67	0.3	6.60
0085 701-22-085	0.77		0.37	0.63		2.37
0086 701-22-086	0.82		0.34	0.68		2.71
0087 701-22-087	0.85		0.39	0.52		0.82
0088 701-22-088	1.55	245	0.81	0.50	X	1.84
0089 701-22-089	1.60		0.88	0.50		1.30
0090 701-22-090	1.29		0.63	0.50		2.86
0091 701-22-091	1.22		0.60	0.60		1.25
0092 701-22-092	1.17		0.65	0.54		3.70
0093 701-22-093	1.70	437	0.93	0.58	X	3.77
0094 701-22-094	1.60	324	0.61	1.64	X	3.70
0095 701-22-095	1.31		0.43	1.20		7.25
0096 701-22-096	1.10		0.41	1.04		2.79
0097 701-22-097	2.01	523	0.45	2.21	0.1	8.87
0098 701-22-098	2.99		0.70	1.84		11.02
0099 701-22-099	2.51	956	1.14	1.20	0.2	2.59
0100 701-22-100	0.59		0.25	0.63		4.72
0101 701-22-101	1.21		0.70	0.76		4.49
0102 701-22-102	1.30		0.73	0.78		5.53
0103 701-22-103	2.14		1.00	1.01		3.75
0104 701-22-104	4.27		2.44	1.56		5.53
0105 701-22-105	2.77		1.64	1.05		1.95
0106 701-22-106	2.54		1.49	1.09		3.09
0107 701-22-107	2.49	869	1.43	1.03	0.3	3.03
0108 701-22-108	2.44		1.37	0.99		2.90
0109 701-22-109	2.51	396	1.41	1.14	0.3	2.63
0110 701-22-110	2.33		1.30	1.02		2.41
0111 701-22-111	2.74	546	1.46	1.25	0.9	3.12
0112 701-22-112	2.49		1.43	1.07		3.35
0113 701-22-113	2.30		1.35	0.99		2.91
0114 701-22-114	2.22	617	1.24	0.90	0.3	2.60
0115 701-22-115	2.44	590	1.42	0.95	0.4	3.09
0116 701-22-116	2.80		1.61	1.29		2.91
0117 701-22-117	2.30		1.33	0.94		2.78
0118 701-22-118	2.26		1.25	1.01		7.14

ANALYSIS

0119 701-22-119	6.37	3.73	1.95	1.65
0120 701-22-120	2.82	1.83	1.08	1.08

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	249.62	1.5	0	19.59	2.84	1.13
0082 701-22-082		1.5	0	15.30	2.15	1.04
0083 701-22-083		1.5	0	17.42	1.74	1.08
0084 701-22-084	0.03	1.5	0	17.59	2.13	1.06
0085 701-22-085		1.5	0	17.14	1.15	1.54
0086 701-22-086		1.5	0	17.02	1.71	1.61
0087 701-22-087		1.5	0	16.28	1.41	1.45
0088 701-22-088	0.13	1.5	0	18.58	1.72	1.58
0089 701-22-089		1.5	0	17.83	1.70	1.57
0090 701-22-090		1.5	0	19.33	1.60	1.97
0091 701-22-091		1.5	0	16.79	1.76	1.49
0092 701-22-092		1.5	0	18.60	1.58	1.78
0093 701-22-093	0.18	1.4	0	16.54	1.81	1.77
0094 701-22-094	0.19	1.4	0	8.65	3.86	1.16
0095 701-22-095		1.5	0	16.47	2.78	1.51
0096 701-22-096		1.5	0	12.96	2.23	1.35
0097 701-22-097	0.03	1.5	0	35.91	5.23	2.19
0098 701-22-098		1.5	0	24.61	5.16	3.69
0099 701-22-099	2.16	1.5	0	16.54	3.62	1.57
0100 701-22-100		1.5	0	7.95	1.32	1.60
0101 701-22-101		1.5	0	17.86	2.18	1.45
0102 701-22-102		1.5	0	25.96	1.90	1.14
0103 701-22-103		1.5	0	17.83	2.82	1.32
0104 701-22-104		1.5	0	18.56	5.34	0.96
0105 701-22-105		1.8	0	18.20	3.31	1.09
0106 701-22-106		1.3	1	16.32	3.20	1.00
0107 701-22-107	0.01	1.3	2	16.57	3.15	0.97
0108 701-22-108		1.3	2	15.99	2.86	0.98
0109 701-22-109	0.70	1.3	2	15.80	3.19	0.82
0110 701-22-110		1.3	2	16.58	2.94	0.92
0111 701-22-111	0.86	1.5	2	13.93	3.35	0.90
0112 701-22-112		1.4	2	16.26	3.11	0.91
0113 701-22-113		1.3	2	16.41	2.98	0.99
0114 701-22-114	0.44	1.3	2	16.03	2.70	0.76
0115 701-22-115	0.56	1.5	2	16.27	3.04	0.64
0116 701-22-116		1.3	2	17.19	3.56	0.82
0117 701-22-117		1.3	2	16.21	2.66	0.80
0118 701-22-118		1.2	0	14.69	2.87	0.71

ANALYSIS

0119 701-22-119	1.5	0	18.66	6.20	1.04
0120 701-22-120	1.6	0	18.56	3.20	1.15

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0081 701-22-081	1.87	0.17	X	0.28	0.196	2.32%
0082 701-22-082	1.51	0.01		0.19	0.076	2.06%
0083 701-22-083	0.93	0.02		0.17	0.135	2.00%
0084 701-22-084	0.47	0.03	X	0.24	0.300	2.50%
0085 701-22-085	0.90	X		0.14	0.091	3.10%
0086 701-22-086	0.45	X		0.14	0.137	2.93%
0087 701-22-087	0.30	X		0.15	0.134	3.09%
0088 701-22-088	0.36	X	X	0.30	0.406	3.32%
0089 701-22-089	0.37	X		0.30	0.359	3.73%
0090 701-22-090	0.55	0.01		0.23	0.422	2.86%
0091 701-22-091	0.33	X		0.22	0.241	2.44%
0092 701-22-092	1.02	X		0.22	0.295	3.36%
0093 701-22-093	0.37	0.01	X	0.33	0.212	3.38%
0094 701-22-094	1.03	0.04	X	0.26	0.031	1.91%
0095 701-22-095	0.36	0.08		0.19	0.117	2.04%
0096 701-22-096	0.61	X		0.17	0.055	2.14%
0097 701-22-097	0.61	0.02	X	0.22	0.262	1.05%
0098 701-22-098	0.35	0.60		0.41	0.105	2.11%
0099 701-22-099	0.77	X	X	0.43	0.180	2.80%
0100 701-22-100	0.55	X		0.10	0.027	1.21%
0101 701-22-101	1.26	X		0.25	0.391	3.48%
0102 701-22-102	1.26	X		0.24	0.291	1.67%
0103 701-22-103	1.55	0.01		0.37	0.250	2.33%
0104 701-22-104	2.69	X		0.89	0.067	2.81%
0105 701-22-105	2.48	X		0.56	0.076	2.80%
0106 701-22-106	2.09	X		0.53	0.017	2.83%
0107 701-22-107	1.91	X	X	0.50	0.033	2.42%
0108 701-22-108	1.97	X		0.47	0.019	2.51%
0109 701-22-109	1.56	X	X	0.49	0.013	2.62%
0110 701-22-110	1.66	X		0.45	0.013	2.83%
0111 701-22-111	1.26	X	X	0.53	0.041	2.50%
0112 701-22-112	1.56	X		0.49	0.041	2.79%
0113 701-22-113	1.66	X		0.47	0.027	2.83%
0114 701-22-114	1.23	X	X	0.43	0.030	2.37%
0115 701-22-115	1.30	X	X	0.49	0.064	1.97%
0116 701-22-116	2.04	X		0.56	0.023	2.17%
0117 701-22-117	2.00	X		0.46	0.034	2.17%
0118 701-22-118	1.91	X		0.44	0.091	2.16%

ANALYSIS

0119 701-22-119	2.53	X	1.28	0.059	1.03%
0120 701-22-120	2.20	X	0.60	0.032	1.14%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	21.0	30.95	2.6	0.162	1910	41.00
0082 701-22-082		29.10	2.6	0.152	683	
0083 701-22-083		40.68	2.3	0.079	2226	
0084 701-22-084	18.4	29.29	1.8	0.075	1651	13.99
0085 701-22-085		32.92	2.9	0.057	2788	
0086 701-22-086		63.17	2.4	0.051	2974	
0087 701-22-087		35.17	2.9	0.055	2725	
0088 701-22-088	23.1	36.90	4.8	0.088	1733	4.37
0089 701-22-089		25.96	3.5	0.095	2239	
0090 701-22-090		23.82	4.3	0.074	2700	
0091 701-22-091		26.07	3.0	0.101	2005	
0092 701-22-092		29.22	2.5	0.094	3482	
0093 701-22-093	30.1	27.76	2.0	0.092	3481	6.57
0094 701-22-094	9.6	50.74	0.7	0.103	226	7.65
0095 701-22-095		44.79	1.3	0.047	99	
0096 701-22-096		52.41	0.9	0.058	109	
0097 701-22-097	6.1	48.17	1.8	0.051	250	15.29
0098 701-22-098		65.97	0.7	0.050	108	
0099 701-22-099	22.0	35.13	2.4	0.151	2656	46.55
0100 701-22-100		37.92	2.4	0.044	427	
0101 701-22-101		35.00	1.0	0.135	2625	
0102 701-22-102		20.45	5.3	0.140	624	
0103 701-22-103		35.59	7.9	0.158	2617	
0104 701-22-104		35.11	16.1	0.356	6848	
0105 701-22-105		34.57	7.1	0.241	5546	
0106 701-22-106		33.20	10.2	0.217	1.59%	
0107 701-22-107	9.4	32.64	11.8	0.214	1.66%	12.83
0108 701-22-108		29.68	10.2	0.199	1.50%	
0109 701-22-109	5.0	36.77	8.3	0.208	1.24%	2.66
0110 701-22-110		34.25	10.2	0.199	1.39%	
0111 701-22-111	8.1	43.26	9.9	0.216	1.22%	5.52
0112 701-22-112		31.27	11.1	0.218	1.38%	
0113 701-22-113		33.53	10.2	0.219	1.03%	
0114 701-22-114	11.9	30.60	8.0	0.187	9481	2.91
0115 701-22-115	6.9	32.88	13.5	0.203	1.17%	2.18
0116 701-22-116		35.49	14.2	0.241	1.20%	
0117 701-22-117		26.09	15.3	0.200	1.37%	
0118 701-22-118		31.07	8.3	0.183	1.06%	

ANALYSIS

0119 701-22-119	41.13	19.8	0.464	2006
0120 701-22-120	44.06	3.9	0.299	2413

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0081 701-22-081	46	0.51		1.2	0.64	223
0082 701-22-082	98			1.8		138
0083 701-22-083	29			4.6		25
0084 701-22-084	46	0.02		10.3	5.55	56
0085 701-22-085	42			7.9		39
0086 701-22-086	60			7.2		35
0087 701-22-087	49			6.0		47
0088 701-22-088	63	0.05		13.2	0.12	69
0089 701-22-089	53			7.7		75
0090 701-22-090	57			7.4		30
0091 701-22-091	47			9.6		43
0092 701-22-092	60			4.2		30
0093 701-22-093	94	0.19		18.9	0.08	32
0094 701-22-094	56	0.34		2.7	0.18	121
0095 701-22-095	47			9.7		132
0096 701-22-096	61			4.7		144
0097 701-22-097	43	0.73		10.1	0.05	49
0098 701-22-098	35			6.0		126
0099 701-22-099	42	1.49		12.5	0.33	65
0100 701-22-100	35			6.9		161
0101 701-22-101	37			4.3		162
0102 701-22-102	29			1.7		234
0103 701-22-103	111			1.2		108
0104 701-22-104	3212			1.9		12
0105 701-22-105	151			1.6		42
0106 701-22-106	648			4.1		36
0107 701-22-107	760	0.02		5.1	60.95	24
0108 701-22-108	597			3.9		1
0109 701-22-109	526	0.05		3.8	145.08	1
0110 701-22-110	435			2.1		2
0111 701-22-111	1154	0.09		8.1	967.08	4
0112 701-22-112	1023			4.1		2
0113 701-22-113	759			2.8		4
0114 701-22-114	677	0.02		5.3	533.22	1
0115 701-22-115	670	0.02		48.7	1049.00	10
0116 701-22-116	528			6.0		19
0117 701-22-117	508			4.5		17
0118 701-22-118	2952			2.5		52

ANALYSIS

0119 701-22-119	44	1.4	41
0120 701-22-120	40	1.5	15

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0081 701-22-081	875	66.9	182	2.1	167	223
0082 701-22-082	785		84	2.3	74	135
0083 701-22-083	494		8	3.2	3	21
0084 701-22-084	799	23.3	4	5.7	0	50
0085 701-22-085	708		3	5.9	0	34
0086 701-22-086	679		3	5.8	0	30
0087 701-22-087	851		4	6.3	0	42
0088 701-22-088	1007	18.6	6	5.4	0	66
0089 701-22-089	1219		7	5.4	0	71
0090 701-22-090	784		1	5.9	0	26
0091 701-22-091	834		2	5.9	0	39
0092 701-22-092	764		2	5.5	0	26
0093 701-22-093	718	26.6	1	4.6	0	28
0094 701-22-094	4187	25.0	13	4.6	0	121
0095 701-22-095	4484		9	4.3	0	134
0096 701-22-096	5133		13	4.5	0	144
0097 701-22-097	774	71.5	12	3.4	8	46
0098 701-22-098	3701		13	5.1	0	126
0099 701-22-099	2010	63.7	43	2.3	34	62
0100 701-22-100	1161		121	2.2	109	159
0101 701-22-101	1534		114	2.4	104	160
0102 701-22-102	569		165	2.3	145	257
0103 701-22-103	708		84	2.2	70	119
0104 701-22-104	1460		8	4.9	0	-1
0105 701-22-105	1262		23	2.7	11	33
0106 701-22-106	2.16%		0	10.7	0	-47
0107 701-22-107	1.96%	157.8	0	11.0	0	-60
0108 701-22-108	2.37%		0	11.2	0	-77
0109 701-22-109	2.30%	86.2	0	11.3	0	-85
0110 701-22-110	2.22%		0	11.3	0	-83
0111 701-22-111	8201	124.7	0	10.9	0	-151
0112 701-22-112	1.09%		0	11.1	0	-104
0113 701-22-113	2831		0	11.3	0	-105
0114 701-22-114	1.46%	126.5	0	11.4	0	-116
0115 701-22-115	1.04%	123.9	0	11.3	0	-120
0116 701-22-116	1.77%		0	11.3	0	-76
0117 701-22-117	1.71%		0	11.3	0	-67
0118 701-22-118	9704		12	4.8	0	29

ANALYSIS

0119 701-22-119	961	23	2.5	17	35
0120 701-22-120	1485	5	3.3	3	9

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	9.27	24.59	93.9	1.92	365	0.5
0082 701-22-082	6.87	19.40	9.0		623	
0083 701-22-083	4.30	18.21	9.7		195	
0084 701-22-084	2.74	15.86	6.5	X	880	X
0085 701-22-085	3.43	12.41	3.1		278	
0086 701-22-086	2.91	23.02	5.3		304	
0087 701-22-087	3.47	18.58	7.8		202	
0088 701-22-088	2.57	12.06	2.3	X	580	X
0089 701-22-089	2.72	10.91	2.5		527	
0090 701-22-090	2.83	13.18	2.4		186	
0091 701-22-091	3.16	14.22	4.4		527	
0092 701-22-092	3.20	15.10	2.1		266	
0093 701-22-093	2.65	14.07	1.7	0.02	439	0.5
0094 701-22-094	3.44	32.76	1.8	0.01	1297	X
0095 701-22-095	1.07	29.19	1.5		1297	
0096 701-22-096	2.88	30.40	1.5		1169	
0097 701-22-097	0.97	41.69	3.0	X	1685*	X
0098 701-22-098	1.10	34.42	0.8		1426	
0099 701-22-099	0.96	22.52	8.8	0.10	392	1.2
0100 701-22-100	0.98	19.76	13.3		786	
0101 701-22-101	1.68	18.73	10.1		678	
0102 701-22-102	2.20	15.15	11.4		708	
0103 701-22-103	2.55	22.50	26.3		480	
0104 701-22-104	4.25	28.32	11.7		651	
0105 701-22-105	4.20	23.92	8.2		733	
0106 701-22-106	3.99	22.70	6.5		619	
0107 701-22-107	4.00	22.47	5.6	X	645	X
0108 701-22-108	3.91	20.60	6.2		595	
0109 701-22-109	4.20	24.16	6.1	X	630	X
0110 701-22-110	4.10	23.14	5.7		681	
0111 701-22-111	3.29	26.30	6.0	X	613	X
0112 701-22-112	3.86	21.97	7.2		627	
0113 701-22-113	4.12	22.85	6.0		675	
0114 701-22-114	4.09	20.30	6.1	X	615	X
0115 701-22-115	3.89	21.94	9.6	X	583	X
0116 701-22-116	3.94	24.96	5.3		568	
0117 701-22-117	3.88	18.27	5.3		505	
0118 701-22-118	3.38	21.98	12.3		543	

ANALYSIS

0119 701-22-119	4.11	32.63	3.1	975
0120 701-22-120	5.18	31.27	0.7	547

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0081 701-22-081	151.9	8.9	2.7		6.518	121.20
0082 701-22-082	330.3		3.9		5.527	56.03
0083 701-22-083	35.3		6.6		5.494	75.03
0084 701-22-084	65.3	0.6	7.3		4.423	60.67
0085 701-22-085	205.8		6.7		3.845	96.60
0086 701-22-086	40.7		6.3		7.330	98.33
0087 701-22-087	39.0		6.2		5.998	90.05
0088 701-22-088	25.3	X	5.6		4.157	79.31
0089 701-22-089	18.6		6.2		3.384	100.99
0090 701-22-090	68.6		6.2		3.855	96.16
0091 701-22-091	38.1		6.1		4.038	82.68
0092 701-22-092	151.6		4.6		4.453	117.82
0093 701-22-093	19.6	0.5	4.2		4.104	117.92
0094 701-22-094	157.9	X	5.1		9.213	3.95
0095 701-22-095	189.1		4.7		8.441	4.46
0096 701-22-096	240.6		5.2		9.372	3.81
0097 701-22-097	209.4	X	5.8		10.231	5.40
0098 701-22-098	247.5		5.4		9.949	2.72
0099 701-22-099	10.6	0.9	4.2		6.215	91.48
0100 701-22-100	26.5		4.8		6.103	37.88
0101 701-22-101	50.9		3.8		5.726	107.36
0102 701-22-102	53.2		3.0	4.0	4.079	39.82
0103 701-22-103	17.0		3.2		6.325	91.46
0104 701-22-104	15.5		7.0		7.295	105.51
0105 701-22-105	16.5		5.0		6.562	111.81
0106 701-22-106	9.4		9.1		6.171	86.41
0107 701-22-107	9.2	0.6	8.1		6.135	71.47
0108 701-22-108	7.3		9.4		5.698	63.44
0109 701-22-109	5.1	1.4	9.0		6.763	71.21
0110 701-22-110	4.9		9.4	3.8	6.265	79.73
0111 701-22-111	16.8	5.4	8.8		7.388	68.04
0112 701-22-112	10.6		9.5	3.9	5.917	89.20
0113 701-22-113	6.7		9.1		6.264	95.27
0114 701-22-114	8.0	1.6	8.5		5.660	59.35
0115 701-22-115	29.3	3.4	8.6	3.9	6.034	65.77
0116 701-22-116	19.0		8.8		6.748	77.81
0117 701-22-117	4.7		9.7		5.027	75.64
0118 701-22-118	14.1		8.0	2.8	5.892	86.41

ANALYSIS

0119 701-22-119	51.1	4.8	8.261	49.82
0120 701-22-120	15.4	5.9	8.549	51.13

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0081 701-22-081	X	7.28	6.81%	422.7	5.23	0.50
0082 701-22-082	X	4.51	4.63%		2.38	0.70
0083 701-22-083	0.019	0.81	8179		0.38	0.15
0084 701-22-084	0.018	1.82	1.91%	20.3	X	0.48
0085 701-22-085	0.014	1.29	1.26%		X	0.57
0086 701-22-086	0.007	1.16	1.14%		X	0.40
0087 701-22-087	0.030	1.52	1.64%		X	0.64
0088 701-22-088	0.005	2.25	2.68%	23.5	0.05	0.88
0089 701-22-089	0.003	2.45	2.86%		X	0.81
0090 701-22-090	0.003	0.98	1.00%		X	0.34
0091 701-22-091	0.007	1.40	1.31%		X	0.41
0092 701-22-092	X	0.97	1.01%		X	0.35
0093 701-22-093	0.007	1.03	1.02%	55.7	0.06	0.43
0094 701-22-094	0.004	3.96	4.22%	36.6	X	1.46
0095 701-22-095	0.004	4.30	4.66%		X	1.59
0096 701-22-096	0.004	4.72	4.78%		X	1.58
0097 701-22-097	0.004	1.59	1.74%	49.4	X	0.47
0098 701-22-098	0.004	4.12	4.52%		0.05	1.27
0099 701-22-099	0.087	2.11	2.50%	164.2	1.80	0.20
0100 701-22-100	0.085	5.26	4.68%		3.87	0.20
0101 701-22-101	0.043	5.29	5.34%		4.09	0.39
0102 701-22-102	0.010	7.65	6.30%		4.90	1.22
0103 701-22-103	0.007	3.52	3.86%		2.53	0.64
0104 701-22-104	0.003	0.38	4294		0.19	0.13
0105 701-22-105	0.003	1.36	1.32%		1.07	0.15
0106 701-22-106	0.002	1.17	1.14%		0.93	0.09
0107 701-22-107	0.002	0.78	7493	134.8	0.57	0.10
0108 701-22-108	0.003	0.04	391			X
0109 701-22-109	0.003	0.03	213	12.2		0.02
0110 701-22-110	0.003	0.05	421			0.02
0111 701-22-111	0.003	0.12	966	26.8	0.08	0.03
0112 701-22-112	0.004	0.08	655			0.03
0113 701-22-113	X	0.12	965			0.03
0114 701-22-114	0.005	0.04	316	19.3		0.03
0115 701-22-115	0.016	0.34	2737	37.1	0.25	0.06
0116 701-22-116	0.002	0.63	4697		0.43	0.12
0117 701-22-117	0.003	0.55	4154		0.42	0.06
0118 701-22-118	0.004	1.70	1.45%		1.29	0.17

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0119 701-22-119	0.003	1.33	1.07%	0.98	0.16
0120 701-22-120	X	0.50	3754	0.29	0.11

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ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	2.88	0.47	12.5	1.4	3.3	0.90
0082 701-22-082	2.90		6.9	1.1		0.65
0083 701-22-083	0.17		14.4	X		0.47
0084 701-22-084	0.14	0.04	17.0	1.3	2.3	1.35
0085 701-22-085	0.20		11.8	4.3		3.69
0086 701-22-086	0.19		10.5	2.1		1.79
0087 701-22-087	0.16		16.4	0.6		0.29
0088 701-22-088	0.32	0.03	14.1	2.2	4.3	1.22
0089 701-22-089	0.26		20.6	1.9		1.24
0090 701-22-090	0.35		11.0	2.4		1.94
0091 701-22-091	0.15		10.8	4.0		3.74
0092 701-22-092	0.29		8.1	1.1		1.18
0093 701-22-093	0.15	X	8.6	1.4	12.1	1.08
0094 701-22-094	2.26	0.11	6.6	7.8	3.7	6.77
0095 701-22-095	0.82		6.2	18.8		17.64
0096 701-22-096	1.06		6.7	12.4		10.84
0097 701-22-097	1.74	0.03	6.3	10.0	19.3	9.43
0098 701-22-098	2.66		7.6	29.8		27.55
0099 701-22-099	0.17	0.22	10.6	2.3	22.9	1.93
0100 701-22-100	0.27		4.9	6.9		6.20
0101 701-22-101	0.40		8.2	5.0		4.85
0102 701-22-102	0.84		8.7	2.5		2.66
0103 701-22-103	0.61		9.7	1.8		1.86
0104 701-22-104	0.31		13.9	0.6		0.18
0105 701-22-105	0.51		10.7	X		0.25
0106 701-22-106	0.13		11.7	0.7		0.25
0107 701-22-107	0.26	0.28	11.6	0.5	1.9	0.14
0108 701-22-108	0.13		10.7	X		X
0109 701-22-109	0.24	0.12	10.9	0.6	1.7	X
0110 701-22-110	0.20		11.4	X		0.03
0111 701-22-111	0.18	0.16	9.8	0.8	59.6	0.26
0112 701-22-112	0.14		13.2	X		X
0113 701-22-113	0.19		10.5	X		X
0114 701-22-114	0.14	0.11	9.9	X	1.5	X
0115 701-22-115	0.33	0.52	11.6	X	1.2	0.03
0116 701-22-116	0.23		13.6	X		0.21
0117 701-22-117	0.25		11.4	X		0.09
0118 701-22-118	0.39		11.1	0.9		0.64

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0119 701-22-119	0.64	16.1	0.7	0.60
0120 701-22-120	0.36	9.2	X	0.14

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ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0081 701-22-081	4.46	5.2	X	287.53	37.66	0.65
0082 701-22-082	3.47	3.8		311.82		0.51
0083 701-22-083	2.58	0.9		83.32		0.36
0084 701-22-084	2.97	0.8	X	158.93	632.67	0.27
0085 701-22-085	1.78	1.5		68.63		0.30
0086 701-22-086	3.13	1.3		64.67		0.26
0087 701-22-087	2.48	1.1		52.02		0.30
0088 701-22-088	1.86	1.0	X	148.11	33.50	0.25
0089 701-22-089	1.88	1.1		144.14		0.23
0090 701-22-090	2.04	2.2		57.61		0.22
0091 701-22-091	2.42	1.6		148.85		0.26
0092 701-22-092	2.35	1.1		113.25		0.26
0093 701-22-093	2.21	1.3	X	60.26	30.94	0.24
0094 701-22-094	6.06	7.2	X	1017.44	251.43	0.27
0095 701-22-095	4.97	2.0		792.98		0.09
0096 701-22-096	4.26	2.7		731.77		0.23
0097 701-22-097	9.13	1.5	X	1704.67*	80.15	0.07
0098 701-22-098	6.57	3.3		1009.31		0.09
0099 701-22-099	4.19	1.3	X	209.43	93.60	0.09
0100 701-22-100	2.69	3.2		465.23		0.10
0101 701-22-101	2.95	1.7		209.64*		0.16
0102 701-22-102	2.84	2.1		482.74		0.18
0103 701-22-103	3.84	2.6		318.02		0.25
0104 701-22-104	5.92	1.1		58.04		0.35
0105 701-22-105	4.34	1.5		23.89		0.35
0106 701-22-106	3.99	0.6		342.38		0.31
0107 701-22-107	3.99	0.6	X	303.81	299.60	0.31
0108 701-22-108	3.73	0.4		401.43		0.32
0109 701-22-109	4.18	0.5	X	371.97	77.45	0.32
0110 701-22-110	3.98	0.5		354.98		0.32
0111 701-22-111	4.43	1.1	X	167.06	90.62	0.26
0112 701-22-112	3.95	1.0		227.90		0.29
0113 701-22-113	3.89	0.5		79.63		0.32
0114 701-22-114	3.63	0.5	X	152.79	98.20	0.33
0115 701-22-115	3.98	1.0	X	159.50	70.94	0.30
0116 701-22-116	4.60	0.8		313.55		0.31
0117 701-22-117	3.52	0.6		341.74		0.30
0118 701-22-118	3.92	1.5		176.44		0.30

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0119 701-22-119	6.56	1.6	628.18	0.34
0120 701-22-120	5.09	0.6	194.12	0.41

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ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0081 701-22-081	0.299	1475	1.56	16.29	18.414	3221
0082 701-22-082	0.241		0.41	26.84		1332
0083 701-22-083	0.195		0.10	16.47		2431
0084 701-22-084	0.249	180	0.28	18.02	0.078	1819
0085 701-22-085	0.142		0.34	10.46		2015
0086 701-22-086	0.172		0.16	21.19		1913
0087 701-22-087	0.164		0.08	19.59		2066
0088 701-22-088	0.254	155	0.38	22.15	0.142	1792
0089 701-22-089	0.260		0.30	12.08		1806
0090 701-22-090	0.221		0.87	17.16		2077
0091 701-22-091	0.234		0.12	12.72		2190
0092 701-22-092	0.214		0.93	21.82		1897
0093 701-22-093	0.377	265	1.57	17.38	0.496	1638
0094 701-22-094	0.386	195	0.34	26.72	0.660	2505
0095 701-22-095	0.299		0.87	24.41		671
0096 701-22-096	0.237		0.52	26.36		1712
0097 701-22-097	0.517	331	1.88	27.31	0.094	659
0098 701-22-098	0.656		3.73	26.59		560
0099 701-22-099	0.482	682	0.22	19.59	6.524	901
0100 701-22-100	0.140		0.31	21.17		650
0101 701-22-101	0.232		0.82	23.40		984
0102 701-22-102	0.246		1.47	11.44		1589
0103 701-22-103	0.394		0.46	14.69		1494
0104 701-22-104	0.743		0.40	18.33		2922
0105 701-22-105	0.458		0.84	18.47		2702
0106 701-22-106	0.433		X	16.36		2651
0107 701-22-107	0.425	631	0.25	16.19	0.074	2590
0108 701-22-108	0.420		X	15.55		2457
0109 701-22-109	0.438	386	X	16.49	0.624	2525
0110 701-22-110	0.399		X	16.70		2526
0111 701-22-111	0.477	306	0.10	14.45	0.426	2112
0112 701-22-112	0.423		X	15.00		2836
0113 701-22-113	0.397		X	17.14		2490
0114 701-22-114	0.391	352	X	14.60	0.478	2431
0115 701-22-115	0.441	400	X	15.30	0.489	2117
0116 701-22-116	0.479		0.35	16.25		2436
0117 701-22-117	0.406		0.19	12.77		2290
0118 701-22-118	0.415		0.32	15.01		2035

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0119 701-22-119	0.960	0.31	19.32	2320
0120 701-22-120	0.464	0.20	21.91	1856

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ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0081 701-22-081	1.28	0.15	3.74	92.993	89	0.07
0082 701-22-082	0.62	0.11	7.69		52	
0083 701-22-083	0.89	0.06	2.59		89	
0084 701-22-084	0.70	0.08	2.58	0.227	230	X
0085 701-22-085	1.15	0.06	3.96		120	
0086 701-22-086	1.13	0.05	3.30		112	
0087 701-22-087	0.98	0.05	1.97		100	
0088 701-22-088	0.94	0.12	1.56	0.111	86	X
0089 701-22-089	1.15	0.11	1.35		128	
0090 701-22-090	1.32	0.08	2.30		105	
0091 701-22-091	1.02	0.07	1.55		87	
0092 701-22-092	1.67	0.10	2.69		87	
0093 701-22-093	1.63	0.11	1.89	0.706	93	X
0094 701-22-094	0.05	0.08	4.05	0.297	91	X
0095 701-22-095	0.04	0.06	3.55		85	
0096 701-22-096	0.04	0.05	3.15		84	
0097 701-22-097	0.08	0.05	8.58	0.194	109	X
0098 701-22-098	0.02	0.06	5.38		90	
0099 701-22-099	1.48	0.16	3.42	7.744	88	X
0100 701-22-100	0.56	0.04	2.30		77	
0101 701-22-101	1.83	0.12	3.94		64	
0102 701-22-102	0.53	0.11	4.29		78	
0103 701-22-103	1.10	0.15	4.80		87	
0104 701-22-104	1.09	0.35	4.42		117	
0105 701-22-105	0.81	0.23	5.40		103	
0106 701-22-106	0.49	0.21	3.62		103	
0107 701-22-107	0.44	0.21	3.45	3.732	102	X
0108 701-22-108	0.36	0.20	3.30		97	
0109 701-22-109	0.37	0.21	3.38	2.562	88	0.03
0110 701-22-110	0.36	0.20	3.86		93	
0111 701-22-111	0.45	0.21	3.29	2.995	84	0.02
0112 701-22-112	0.59	0.20	3.10		111	
0113 701-22-113	0.69	0.20	2.71		92	
0114 701-22-114	0.41	0.18	2.94	0.803	92	0.02
0115 701-22-115	0.42	0.22	3.52	1.670	81	0.01
0116 701-22-116	0.44	0.23	3.61		97	
0117 701-22-117	0.49	0.20	3.26		95	
0118 701-22-118	0.61	0.19	3.51		90	

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0119 701-22-119	0.46	0.52	4.55	117
0120 701-22-120	0.27	0.33	5.48	84

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ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0081 701-22-081	3.4	6.40	1.14	18	1.03	55.5
0082 701-22-082	3.3	4.97	0.92	12		44.3
0083 701-22-083	1.9	4.66	0.52	42		30.7
0084 701-22-084	1.5	7.11	0.49	52	X	24.5
0085 701-22-085	1.4	3.11	0.38	25		24.4
0086 701-22-086	1.4	3.15	0.32	28		13.8
0087 701-22-087	2.4	3.82	0.35	24		13.1
0088 701-22-088	4.8	7.86	0.66	27	X	16.4
0089 701-22-089	2.4	8.29	0.78	27		11.9
0090 701-22-090	2.6	6.02	1.08	15		10.8
0091 701-22-091	1.9	5.18	0.47	28		9.2
0092 701-22-092	2.1	6.05	0.97	15		38.0
0093 701-22-093	1.7	8.29	0.65	18	0.07	9.5
0094 701-22-094	4.1	5.00	0.50	5	0.14	29.6
0095 701-22-095	2.1	3.83	0.59	7		16.2
0096 701-22-096	2.8	3.53	0.31	5		17.6
0097 701-22-097	2.9	4.17	0.31	15	0.27	19.9
0098 701-22-098	1.5	5.67	0.32	16		7.6
0099 701-22-099	1.5	11.31	1.01	25	3.16	37.2
0100 701-22-100	4.2	2.41	0.26	10		18.4
0101 701-22-101	1.3	6.17	1.14	20		43.5
0102 701-22-102	2.3	7.83	0.82	17		44.3
0103 701-22-103	1.2	7.70	1.01	94		43.8
0104 701-22-104	1.5	22.58	2.29	452		91.0
0105 701-22-105	1.7	14.33	1.60	74		86.2
0106 701-22-106	1.3	13.46	1.40	42		70.5
0107 701-22-107	1.7	13.06	1.33	33	X	71.0
0108 701-22-108	1.8	11.81	1.33	24		56.9
0109 701-22-109	2.2	12.87	1.40	22	X	55.0
0110 701-22-110	2.5	11.96	1.31	23		63.1
0111 701-22-111	2.6	13.76	1.41	73	X	40.8
0112 701-22-112	1.9	12.59	1.31	56		51.5
0113 701-22-113	1.1	11.86	1.41	56		54.2
0114 701-22-114	1.6	10.70	1.30	44	X	38.8
0115 701-22-115	2.3	12.85	1.37	74	X	39.2
0116 701-22-116	2.7	14.94	1.49	41		68.1
0117 701-22-117	1.5	11.61	1.42	30		66.1
0118 701-22-118	1.4	10.92	1.28	601		74.0

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0119 701-22-119	2.5	34.07	3.27	62	95.6
0120 701-22-120	1.0	16.57	2.06	34	68.5

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ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
SAMPLE NUMBERS						
0121 701-22-121	0.16	0.01	8.71%	0.70	5	6.2
0122 701-22-122	0.12	0.07	8.04%	18.50	3	6.7
0123 701-22-123	0.44	0.02	2.81%	0.15	10	13.3
0124 701-22-124	0.94		5217		6	9.4
0125 701-22-125	0.61		4.76%		2	25.1
0126 701-22-126	0.19	0.02	5.27%	0.09	1	20.6
0127 701-22-127	0.25		5.92%		3	11.7
0128 701-22-128	0.33		4.82%		2	17.0
0129 701-22-129	0.55		3.01%		2	18.5
0130 701-22-130	0.68	0.07	4.01%	1.85	1	23.6
0131 701-22-131	0.49		3.33%		1	68.4
0132 701-22-132	0.29	0.01	6.04%	0.12	2	101.5
0133 701-22-133	0.57		5.97%		3	9.0
0134 701-22-134	0.37		4.49%		2	16.9
0135 701-22-135	0.59	0.03	5.24%	0.04	3	10.1
0136 701-22-136	0.46		6.73%		5	4.5
0137 701-22-137	0.22		9.51%		-4	14.5
0138 701-22-138	0.23		9.66%		3	4.0
0139 701-22-139	0.07		11.19%		3	3.2
0140 701-22-140	0.09	0.02	11.06%	18.93	1	3.1
0141 701-22-141	0.12		10.12%		3	4.8
0142 701-22-142	X		11.66%		5	3.2
0143 701-22-143	0.44		9.81%		-1	34.1
0144 701-22-144	0.07		6.76%		-2	14.5
0145 701-22-145	0.73		4.17%		-7	54.9
0146 701-22-146	0.13	X	6.38%	47.16	-1	25.7
0147 701-22-147	0.23	0.03	8.63%	33.36	2	6.1
0148 701-22-148	0.11	X	6.31%	42.85	-2	44.2
0149 701-22-149	0.29		9.71%		0	13.1
0150 701-22-150	0.20		8.87%		-2	9.4
CHECKS						
0001 701-22-001	0.65	0.04	10.73%	0.62	-3	4.0
0002 701-22-021	1.55		8.97%		13	14.6
0003 701-22-041	0.17	X	8.24%	0.08	1	8.2
0004 701-22-061	0.49		7.69%		1	6.9
0005 701-22-081	0.77	0.06	7.48%	67.91	-2	48.1
0006 701-22-101	0.34		8.54%		2	69.7

ANALYSIS

0007 701-22-121	0.22	X	9.30%	0.89	5	6.1
0008 701-22-141	0.13		10.15%		4	5.0

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.6	X	0.03	98.6	11.75	1.23
0122 701-22-122	1.2	X	0.06	270.5	5.66	1.28
0123 701-22-123	2.6	X	X	443.2	30.15	0.14
0124 701-22-124		X		1500.7		0.21
0125 701-22-125		X		500.1		0.11
0126 701-22-126	0.7	X	X	711.6	65.35	0.21
0127 701-22-127		X		469.4		0.05
0128 701-22-128		X		412.2		0.13
0129 701-22-129		X		531.0		0.14
0130 701-22-130	1.2	X	X	416.9	54.72	0.13
0131 701-22-131		X		657.0		0.09
0132 701-22-132	1.0	X	X	560.9	32.50	0.19
0133 701-22-133		X		472.4		0.27
0134 701-22-134		X		794.9		0.06
0135 701-22-135	1.0	X	X	669.5	13.52	0.18
0136 701-22-136		X		335.6		0.96
0137 701-22-137		X		654.6		1.06
0138 701-22-138		X		495.0		1.82
0139 701-22-139		X		1325.7		1.43
0140 701-22-140	4.7	X	X	310.5	10.27	1.18
0141 701-22-141		X		550.3		1.26
0142 701-22-142		X		1125.2		1.53
0143 701-22-143		X		623.1		0.65
0144 701-22-144		X		165.7		0.11
0145 701-22-145		X		56.0		X
0146 701-22-146	3.7	X	X	275.4	0.09	0.15
0147 701-22-147	2.7	X	X	306.3	3.24	0.39
0148 701-22-148	4.4	X	X	115.6	0.44	X
0149 701-22-149		X		597.4		0.86
0150 701-22-150		X		120.0		0.18
CHECKS						
0001 701-22-001	X	X	0.01	257.6	6.09	2.18
0002 701-22-021		X		304.1		1.48
0003 701-22-041	1.5	X	X	296.6	3.73	0.36
0004 701-22-061		X		396.9		0.79
0005 701-22-081	21.3	X	X	290.3	2.79	0.86
0006 701-22-101		X		319.3		0.92

ANALYSIS

0007 701-22-121	1.7	X	0.03	96.7	11.47	1.36
0008 701-22-141		X		562.4		1.05

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.9	0.44	X	0.02	207	9.70
0122 701-22-122	7.1	0.82	X	0.05	470	36.42
0123 701-22-123	X	0.63	X	0.15	3117	28.66
0124 701-22-124		1.85		0.08	1360	
0125 701-22-125		1.26		0.04	799	
0126 701-22-126	X	1.36	X	0.02	789	19.63
0127 701-22-127		1.45		0.02	779	
0128 701-22-128		1.54		0.02	801	
0129 701-22-129		2.49		0.03	549	
0130 701-22-130	X	1.75	X	0.02	634	23.05
0131 701-22-131		1.65		0.03	441	
0132 701-22-132	X	3.63	X	0.02	666	6.71
0133 701-22-133		2.25		0.08	680	
0134 701-22-134		4.42		0.04	640	
0135 701-22-135	X	1.42	0.011	0.02	814	7.44
0136 701-22-136		3.15		0.03	512	
0137 701-22-137		0.28		0.02	503	
0138 701-22-138		0.75		0.02	568	
0139 701-22-139		0.07		0.04	421	
0140 701-22-140	9.2	0.10	X	0.04	343	49.34
0141 701-22-141		0.09		0.04	484	
0142 701-22-142		0.06		0.02	702	
0143 701-22-143		0.86		0.04	357	
0144 701-22-144		1.28		0.02	591	
0145 701-22-145		8.10		0.02	447	
0146 701-22-146	0.8	1.04	X	X	451	14.37
0147 701-22-147	1.9	2.23	X	0.03	776	39.62
0148 701-22-148	0.5	0.29	X	0.01	544	10.55
0149 701-22-149		2.39		0.04	526	
0150 701-22-150		2.02		0.02	744	
CHECKS						
0001 701-22-001	X	0.15	X	0.05	987	7.52
0002 701-22-021		1.45		1.10	942	
0003 701-22-041	X	1.76	X	0.03	826	19.39
0004 701-22-061		3.42		0.03	909	
0005 701-22-081	1.4	3.76	0.408	0.06	329	21.20
0006 701-22-101		3.19		0.05	781	

ANALYSIS

0007 701-22-121	1.0	0.47	X	0.04	249	8.70
0008 701-22-141		0.10		0.04	486	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
SAMPLE NUMBERS						
0121 701-22-121	X	0.24	64.45	76	1.9	47.6
0122 701-22-122	0.05	5.25	68.37	54	6.5	604.4
0123 701-22-123	X	X	44.42	18	0.5	1.4
0124 701-22-124	X		27.48		0.3	
0125 701-22-125	X		50.78		0.2	
0126 701-22-126	X	0.04	50.63	35	0.4	14.5
0127 701-22-127	X		46.09		0.1	
0128 701-22-128	0.03		65.76		0.3	
0129 701-22-129	0.03		53.81		0.2	
0130 701-22-130	X	0.05	35.18	59	0.2	1.2
0131 701-22-131	X		43.72		0.5	
0132 701-22-132	X	X	44.38	27	0.2	3.1
0133 701-22-133	X		57.82		0.5	
0134 701-22-134	X		70.03		0.2	
0135 701-22-135	X	0.03	59.48	18	0.2	4.3
0136 701-22-136	0.03		56.73		1.0	
0137 701-22-137	3.37		28.86		48.5	
0138 701-22-138	0.74		76.30		9.2	
0139 701-22-139	0.04		109.80		5.1	
0140 701-22-140	0.07	11.89	90.87	10	27.7	5491.4
0141 701-22-141	0.26		84.58		7.0	
0142 701-22-142	X		103.80		1.4	
0143 701-22-143	0.32		39.07		11.9	
0144 701-22-144	X		33.14		4.9	
0145 701-22-145	0.04		25.31		6.0	
0146 701-22-146	0.06	28.32	38.76	3	9.4	362.7
0147 701-22-147	0.08	23.88	32.25	7	10.4	922.6
0148 701-22-148	0.03	3.57	40.10	2	18.5	142.3
0149 701-22-149	0.04		58.40		10.9	
0150 701-22-150	0.21		55.70		13.0	
CHECKS						
0001 701-22-001	0.20	3.05	63.92	8	1.3	10.7
0002 701-22-021	1.38		67.18		20.5	
0003 701-22-041	0.13	4.00	46.01	54	12.6	277.8
0004 701-22-061	0.04		54.86		0.6	
0005 701-22-081	0.03	1.08	47.53	30	22.3	3216.0
0006 701-22-101	0.18		50.74		14.5	

ANALYSIS

0007 701-22-121	X	0.27	62.73	80	1.9	50.1
0008 701-22-141	0.24		84.05		7.0	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	No	3	X	1.40	43.7	1.20
0122 701-22-122	No	4	X	1.41	267.4	51.26
0123 701-22-123	No	13	X	0.09	8.6	0.03
0124 701-22-124	No	11		0.11	9.2	
0125 701-22-125	No	20		0.07	5.9	
0126 701-22-126	No	19	X	0.07	3.7	0.01
0127 701-22-127	No	18		0.07	3.3	
0128 701-22-128	No	22		0.07	8.8	
0129 701-22-129	No	17		0.07	22.0	
0130 701-22-130	No	17	X	0.08	9.6	0.06
0131 701-22-131	No	25		0.06	50.5	
0132 701-22-132	No	9	X	0.08	22.7	0.01
0133 701-22-133	No	8		0.26	373.2	
0134 701-22-134	No	12		0.09	98.1	
0135 701-22-135	No	14	X	0.17	65.6	0.02
0136 701-22-136	No	9		1.14	46.3	
0137 701-22-137	No	8		2.04	276.6	
0138 701-22-138	No	10		5.34	79.7	
0139 701-22-139	No	11		4.13	19.8	
0140 701-22-140	No	8	X	3.45	15.4	0.35
0141 701-22-141	No	8		2.46	293.8	
0142 701-22-142	No	7		1.60	4.2	
0143 701-22-143	No	10		1.80	354.9	
0144 701-22-144	No	23		0.07	425.6	
0145 701-22-145	No	17		X	3253.6	
0146 701-22-146	No	21	0.33	0.08	998.9	130.44
0147 701-22-147	No	13	0.02	0.74	383.3	86.26
0148 701-22-148	No	30	0.18	0.05	1049.8	33.88
0149 701-22-149	No	14		1.67	339.0	
0150 701-22-150	No	16		0.41	368.3	
CHECKS						
0001 701-22-001	No	11	X	2.63	410.7	1.63
0002 701-22-021	Yes	16		12.92	1336.1	
0003 701-22-041	No	11	X	0.40	61.9	0.04
0004 701-22-061	No	7		0.87	165.5	
0005 701-22-081	No	85	0.09	8.45	513.8	13.65
0006 701-22-101	No	7		1.20	327.7	

ANALYSIS

0007 701-22-121	No	4	X	1.38	53.2	1.23
0008 701-22-141	No	10		2.50	298.1	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
SAMPLE NUMBERS						
0121 701-22-121	2.09	895	1.14	1.06	0.2	0.87
0122 701-22-122	4.60	1496	3.49	1.09	0.9	1.08
0123 701-22-123	0.85	320	0.44	0.53	0.7	1.77
0124 701-22-124	0.65		0.41	0.26		0.79
0125 701-22-125	0.80		0.37	0.90		3.57
0126 701-22-126	0.87	339	0.48	0.85	0.4	1.90
0127 701-22-127	0.97		0.48	0.70		1.49
0128 701-22-128	1.15		0.63	1.06		2.73
0129 701-22-129	1.07		0.56	0.93		2.07
0130 701-22-130	0.83	509	0.50	0.70	0.3	1.74
0131 701-22-131	0.41		0.28	0.55		10.32
0132 701-22-132	0.81	240	0.40	0.76	0.1	1.74
0133 701-22-133	1.29		0.64	0.86		2.21
0134 701-22-134	0.89		0.34	0.92		4.27
0135 701-22-135	0.65	194	0.34	0.82	0.1	4.78
0136 701-22-136	1.84		1.12	0.76		3.47
0137 701-22-137	1.89		1.14	0.53		1.51
0138 701-22-138	2.80		1.60	1.17		1.26
0139 701-22-139	4.09		2.17	1.87		1.30
0140 701-22-140	2.42	1034	1.17	1.35	0.5	1.61
0141 701-22-141	1.39		0.74	1.03		1.41
0142 701-22-142	2.38		1.22	1.79		0.80
0143 701-22-143	1.20		0.81	0.36		2.18
0144 701-22-144	0.75		0.32	0.66		6.58
0145 701-22-145	0.45		0.21	0.47		19.02*
0146 701-22-146	0.63	1344	0.31	0.61	X	5.58
0147 701-22-147	1.24	1321	0.65	0.64	X	3.24
0148 701-22-148	0.26	1176	0.12	0.39	X	8.33
0149 701-22-149	1.30		0.81	0.61		2.26
0150 701-22-150	1.42		0.64	1.03		5.14
CHECKS						
0001 701-22-001	2.36	256	1.13	0.99	X	1.09
0002 701-22-021	3.47		1.82	1.35		7.29
0003 701-22-041	0.96	494	0.44	0.79	X	5.43
0004 701-22-061	1.14		0.54	0.76		3.43
0005 701-22-081	1.21	2340	0.69	0.67	X	6.33
0006 701-22-101	2.76		1.79	0.76		4.62

ANALYSIS

0007 701-22-121	2.26	880	1.30	1.06	0.2	1.05
0008 701-22-141	1.35		0.76	0.97		1.46

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.03	1.5	0	17.10	2.75	0.78
0122 701-22-122	1.39	1.5	0	18.17	3.31	1.08
0123 701-22-123	X	1.5	0	3.25	1.39	0.99
0124 701-22-124		1.5	0	1.22	0.86	1.16
0125 701-22-125		1.5	0	8.23	1.87	0.79
0126 701-22-126	X	1.4	0	8.98	2.08	0.78
0127 701-22-127		1.4	0	13.59	2.23	0.93
0128 701-22-128		1.4	0	6.80	2.58	1.00
0129 701-22-129		1.5	0	4.31	2.28	1.13
0130 701-22-130	0.18	1.4	0	6.76	1.69	1.18
0131 701-22-131		1.5	0	11.88	1.19	1.95
0132 701-22-132	0.02	1.5	0	14.62	1.87	0.69
0133 701-22-133		1.8	0	14.50	2.40	0.43
0134 701-22-134		1.6	0	17.56	2.08	0.55
0135 701-22-135	X	1.5	0	9.52	1.76	0.64
0136 701-22-136		1.5	0	26.79	2.39	1.06
0137 701-22-137		1.5	0	15.39	1.80	1.22
0138 701-22-138		1.5	0	17.24	3.31	1.31
0139 701-22-139		1.4	0	21.20	5.32	1.35
0140 701-22-140	3.02	1.5	0	19.66	3.57	1.00
0141 701-22-141		1.5	0	18.31	2.39	1.26
0142 701-22-142		1.5	0	18.87	4.40	1.42
0143 701-22-143		1.5	0	18.34	1.11	1.11
0144 701-22-144		1.4	0	7.91	1.73	0.64
0145 701-22-145		1.4	0	2.40	1.05	0.52
0146 701-22-146	167.49	1.4	0	8.56	1.41	0.79
0147 701-22-147	35.23	1.4	0	11.49	1.83	0.56
0148 701-22-148	241.22	1.4	0	2.80	0.68	0.98
0149 701-22-149		1.5	0	17.40	1.73	1.16
0150 701-22-150		1.5	0	13.63	2.83	1.33
CHECKS						
0001 701-22-001	0.10	1.5	0	15.76	3.19	0.99
0002 701-22-021		1.1	0	19.12	4.21	1.24
0003 701-22-041	0.04	1.4	0	11.98	2.30	0.73
0004 701-22-061		1.5	0	18.37	1.90	0.93
0005 701-22-081	249.69	1.4	0	18.82	2.43	1.15
0006 701-22-101		1.5	0	16.54	2.68	1.17

ANALYSIS

0007 701-22-121	0.09	1.5	0	17.10	2.79	0.75
0008 701-22-141		1.5	0	18.81	2.32	1.21

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
SAMPLE NUMBERS						
0121 701-22-121	1.77	X	X	0.39	0.086	1.02%
0122 701-22-122	2.36	X	X	1.10	0.153	1.14%
0123 701-22-123	1.07	X	X	0.14	X	1.01%
0124 701-22-124	0.97	0.05		0.12	X	1079
0125 701-22-125	0.97	0.04		0.13	0.009	1.47%
0126 701-22-126	1.85	0.03	X	0.16	X	1.19%
0127 701-22-127	1.13	0.02		0.15	0.005	7169
0128 701-22-128	1.44	0.01		0.19	0.008	1.58%
0129 701-22-129	1.24	0.01		0.17	X	1.03%
0130 701-22-130	1.12	X	X	0.16	0.009	1.33%
0131 701-22-131	0.71	0.02		0.08	0.101	1.26%
0132 701-22-132	1.21	X	X	0.13	0.023	9907
0133 701-22-133	1.12	X		0.22	0.042	7249
0134 701-22-134	0.61	X		0.13	0.053	5455
0135 701-22-135	0.93	X	X	0.11	0.063	7254
0136 701-22-136	1.91	0.02		0.39	0.285	2.80%
0137 701-22-137	1.46	0.04		0.38	0.224	4.19%
0138 701-22-138	1.71	0.02		0.55	0.108	3.51%
0139 701-22-139	2.19	X		0.77	0.037	2.22%
0140 701-22-140	1.97	0.02	X	0.42	0.039	2.96%
0141 701-22-141	1.79	X		0.25	0.083	2.64%
0142 701-22-142	1.67	X		0.43	0.037	1.98%
0143 701-22-143	1.58	0.02		0.26	0.451	3.64%
0144 701-22-144	0.71	X		0.13	0.022	2.60%
0145 701-22-145	0.53	0.05		0.07	0.051	1.17%
0146 701-22-146	0.95	0.01	X	0.10	0.087	1.34%
0147 701-22-147	1.35	X	X	0.21	0.190	1.57%
0148 701-22-148	0.24	0.01	X	0.04	0.023	2.17%
0149 701-22-149	1.94	0.02		0.26	0.332	3.28%
0150 701-22-150	1.51	0.01		0.23	0.081	2437
CHECKS						
0001 701-22-001	1.73	X	X	0.44	0.572	3.88%
0002 701-22-021	0.16	0.02		0.63	0.419	2.18%
0003 701-22-041	1.18	X	X	0.15	0.065	1.06%
0004 701-22-061	1.54	X		0.18	0.409	3.74%
0005 701-22-081	1.08	0.16	X	0.21	0.182	2.36%
0006 701-22-101	0.97	X		0.58	0.379	3.49%

ANALYSIS

0007 701-22-121	1.80	X	X	0.43	0.085	1.22%
0008 701-22-141	1.76	X		0.26	0.088	2.66%

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	19.8	36.18	9.0	0.178	1368	20.21
0122 701-22-122	30.9	36.31	10.0	0.487	1183	96.17
0123 701-22-123	6.1	24.28	0.5	0.094	952	8.82
0124 701-22-124		15.71	1.2	0.088	229	
0125 701-22-125		28.10	0.2	0.077	206	
0126 701-22-126	8.4	27.44	0.3	0.123	97	6.74
0127 701-22-127		22.50	0.3	0.111	119	
0128 701-22-128		35.72	0.4	0.134	130	
0129 701-22-129		31.39	0.2	0.125	123	
0130 701-22-130	11.9	19.02	0.4	0.107	124	13.60
0131 701-22-131		24.22	0.3	0.073	149	
0132 701-22-132	5.7	25.62	0.5	0.120	115	6.12
0133 701-22-133		30.95	0.5	0.138	459	
0134 701-22-134		43.05	0.7	0.065	104	
0135 701-22-135	8.8	32.65	0.5	0.073	102	4.22
0136 701-22-136		32.43	0.8	0.203	1621	
0137 701-22-137		17.95	3.6	0.185	2952	
0138 701-22-138		44.42	13.9	0.231	3446	
0139 701-22-139		62.28	11.3	0.329	2179	
0140 701-22-140	16.1	52.44	3.6	0.188	3028	73.63
0141 701-22-141		45.96	5.4	0.145	2728	
0142 701-22-142		54.69	6.7	0.220	1621	
0143 701-22-143		26.77	3.1	0.150	2980	
0144 701-22-144		17.96	0.4	0.054	134	
0145 701-22-145		12.34	0.2	0.048	55	
0146 701-22-146	1.1	21.18	0.4	0.082	68	7.44
0147 701-22-147	10.6	19.17	0.9	0.122	754	46.10
0148 701-22-148	1.3	22.22	0.3	0.024	70	3.86
0149 701-22-149		36.01	3.5	0.152	2423	
0150 701-22-150		31.12	1.6	0.143	164	
CHECKS						
0001 701-22-001	17.1	36.19	5.1	0.174	4068	6.18
0002 701-22-021		37.44	15.8	0.203	4675	
0003 701-22-041	8.9	24.76	1.2	0.092	539	16.43
0004 701-22-061		30.02	0.2	0.115	2058	
0005 701-22-081	21.5	24.69	2.8	0.124	2011	40.09
0006 701-22-101		30.44	0.8	0.241	2692	

ANALYSIS

0007 701-22-121	19.6	34.93	8.8	0.190	1465	20.49
0008 701-22-141		45.86	5.7	0.142	2762	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
SAMPLE NUMBERS						
0121 701-22-121	27	0.12		1.1	1.25	17
0122 701-22-122	34	0.73		1.5	0.54	36
0123 701-22-123	34	X		4.3	11.94	62
0124 701-22-124	45			2.3		8
0125 701-22-125	31			4.3		98
0126 701-22-126	36	0.08		4.4	2.45	68
0127 701-22-127	29			5.3		54
0128 701-22-128	33			3.9		94
0129 701-22-129	40			4.9		68
0130 701-22-130	35	0.18		5.4	8.21	56
0131 701-22-131	28			3.1		76
0132 701-22-132	18	0.04		7.9	1.55	48
0133 701-22-133	37			2.4		30
0134 701-22-134	76			2.5		42
0135 701-22-135	107	0.08		1.7	1.63	59
0136 701-22-136	246			1.5		3
0137 701-22-137	43			1.4		73
0138 701-22-138	57			1.4		23
0139 701-22-139	45			1.4		24
0140 701-22-140	38	2.11		1.2	1.06	38
0141 701-22-141	51			1.6		38
0142 701-22-142	29			0.6		3
0143 701-22-143	46			1.8		77
0144 701-22-144	20			1.4		354
0145 701-22-145	61			1.3		815
0146 701-22-146	16	0.74		1.4	2.63	300
0147 701-22-147	38	2.71		2.0	0.96	118
0148 701-22-148	19	0.58		46.8	1.43	408
0149 701-22-149	81			1.9		62
0150 701-22-150	31			1.4		176
CHECKS						
0001 701-22-001	164	1.27		1.1	0.07	31
0002 701-22-021	4662			1.2		74
0003 701-22-041	44	0.67		1.2	0.12	197
0004 701-22-061	99			0.9		44
0005 701-22-081	41	0.31		1.2	0.59	217
0006 701-22-101	38			4.7		162

ANALYSIS

0007 701-22-121	38	0.11	1.1	0.18	19
0008 701-22-141	49		1.6		39

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
SAMPLE NUMBERS						
0121 701-22-121	697	145.5	11	2.9	7	12
0122 701-22-122	663	164.3	12	2.9	7	33
0123 701-22-123	1071	23.8	0	7.1	0	52
0124 701-22-124	417		1	6.8	0	2
0125 701-22-125	1815		13	4.6	0	96
0126 701-22-126	1468	32.1	9	4.5	0	67
0127 701-22-127	1233		6	4.7	0	51
0128 701-22-128	1965		11	4.5	0	92
0129 701-22-129	1141		5	4.7	0	66
0130 701-22-130	1718	57.0	6	4.5	0	55
0131 701-22-131	1456		6	4.5	0	75
0132 701-22-132	993	27.3	5	4.8	0	46
0133 701-22-133	632		0	5.9	0	27
0134 701-22-134	937		4	5.3	0	40
0135 701-22-135	2035	18.3	6	5.0	0	56
0136 701-22-136	391		1	6.6	0	-2
0137 701-22-137	478		22	2.7	16	77
0138 701-22-138	460		15	2.7	11	20
0139 701-22-139	454		17	2.6	12	21
0140 701-22-140	435	40.2	30	2.4	24	37
0141 701-22-141	474		24	2.4	19	35
0142 701-22-142	383		4	4.9	0	-2
0143 701-22-143	762		45	2.4	38	77
0144 701-22-144	2620		193	2.4	178	356
0145 701-22-145	1705		533	2.3	493	822
0146 701-22-146	2150	6.5	162	2.4	149	301
0147 701-22-147	845	51.5	81	2.3	74	115
0148 701-22-148	2568	4.6	236	2.3	216	409
0149 701-22-149	550		42	2.3	35	62
0150 701-22-150	626		143	2.2	133	178
CHECKS						
0001 701-22-001	1480	14.6	4	5.4	0	34
0002 701-22-021	1197		35	3.6	7	61
0003 701-22-041	779	46.1	166	2.2	153	196
0004 701-22-061	716		1	4.4	0	43
0005 701-22-081	890	64.3	181	2.2	166	219
0006 701-22-101	1553		127	2.2	114	160

ANALYSIS

0007 701-22-121	728	143.8	12	2.9	7	14
0008 701-22-141	480		25	2.6	20	35

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	5.05	22.86	0.9	X	138	X
0122 701-22-122	4.75	27.49	3.1	0.18	530	0.9
0123 701-22-123	1.43	16.05	1.6	X	405	X
0124 701-22-124	1.34	9.76	0.7		192	
0125 701-22-125	1.20	19.91	1.4		552	
0126 701-22-126	2.78	18.85	X	X	582	X
0127 701-22-127	2.37	18.04	X		620	
0128 701-22-128	2.69	25.80	X		598	
0129 701-22-129	1.69	20.60	1.5		517	
0130 701-22-130	1.60	15.02	X	X	517	X
0131 701-22-131	0.92	15.54	0.8		470	
0132 701-22-132	2.34	15.81	X	X	589	X
0133 701-22-133	1.74	20.36	1.3		584	
0134 701-22-134	0.99	22.42	X		784	
0135 701-22-135	0.83	21.97	X	X	792	X
0136 701-22-136	3.25	19.27	0.7		515	
0137 701-22-137	2.90	9.58	11.9		627	
0138 701-22-138	4.08	27.11	3.9		480	
0139 701-22-139	4.92	40.86	1.8		408	
0140 701-22-140	4.38	32.23	6.0	1.18	287	X
0141 701-22-141	3.63	31.37	4.7		508	
0142 701-22-142	3.60	43.44	4.0		1214	
0143 701-22-143	3.54	11.18	7.0		287	
0144 701-22-144	2.00	13.82	1.8		654	
0145 701-22-145	1.51	9.08	4.5		363	
0146 701-22-146	2.25	14.35	8.3	0.19	506	2.6
0147 701-22-147	2.91	11.52	8.2	0.29	705	1.7
0148 701-22-148	0.65	14.07	14.6	0.12	574	0.9
0149 701-22-149	4.30	17.29	10.6		290	
0150 701-22-150	4.08	22.32	13.0		727	
CHECKS						
0001 701-22-001	4.26	22.24	26.1	X	753	X
0002 701-22-021	3.27	27.75	12.5		863	
0003 701-22-041	1.22	17.67	9.1	0.07	807	X
0004 701-22-061	2.59	18.47	1.9		555	
0005 701-22-081	7.84	20.15	98.3	1.89	339	0.5
0006 701-22-101	1.15	16.85	9.4		577	

ANALYSIS

0007 701-22-121	5.05	22.31	1.1	X	168	X
0008 701-22-141	3.71	31.51	5.2		523	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
SAMPLE NUMBERS						
0121 701-22-121	19.0	X	5.1		6.456	55.88
0122 701-22-122	50.5	X	4.1		7.444	52.21
0123 701-22-123	71.1	X	7.9		4.573	1.97
0124 701-22-124	101.5		7.6	3.8	2.826	2.06
0125 701-22-125	146.7		7.3		5.343	1.84
0126 701-22-126	137.7	1.8	6.8		5.278	1.56
0127 701-22-127	300.2		6.8		4.817	1.29
0128 701-22-128	149.3		7.2		7.126	1.98
0129 701-22-129	100.8		7.3		6.013	1.71
0130 701-22-130	116.0	3.2	7.3		4.221	1.85
0131 701-22-131	121.8		7.0		4.424	2.00
0132 701-22-132	143.3	1.0	6.7		4.439	2.50
0133 701-22-133	76.4		6.8		5.807	15.41
0134 701-22-134	160.9		7.1		6.625	1.75
0135 701-22-135	124.4	0.8	6.7		6.059	2.64
0136 701-22-136	37.4		7.0		5.505	110.84
0137 701-22-137	252.2		2.8		2.785	123.21
0138 701-22-138	56.9		4.2		7.610	140.88
0139 701-22-139	18.6		4.7		11.334	87.11
0140 701-22-140	25.1	X	3.8		9.102	117.20
0141 701-22-141	62.8		4.3		8.901	98.43
0142 701-22-142	9.3		5.9		11.540	69.96
0143 701-22-143	181.7		3.0		3.527	111.76
0144 701-22-144	173.7		3.0		3.807	2.73
0145 701-22-145	82.2		2.7		2.489	2.00
0146 701-22-146	51.2	0.6	3.1		4.059	1.68
0147 701-22-147	54.7	0.5	3.4		3.233	38.16
0148 701-22-148	70.0	0.5	3.3		4.072	2.22
0149 701-22-149	68.4		3.3		5.368	115.42
0150 701-22-150	22.2		3.2		5.820	3.17
CHECKS						
0001 701-22-001	327.8	1.6	5.1		6.432	159.65
0002 701-22-021	157.2		5.8	2.6	7.324	93.84
0003 701-22-041	107.6	X	5.4		4.918	26.80
0004 701-22-061	23.4		4.1		5.302	131.00
0005 701-22-081	134.8	11.0	2.7		5.232	118.94
0006 701-22-101	44.4		3.8		4.935	106.37

ANALYSIS

0007 701-22-121	19.3	0.6	5.5	6.326	55.21
0008 701-22-141	65.3			8.853	101.27

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
SAMPLE NUMBERS						
0121 701-22-121	X	0.55	4757	96.6	0.42	0.07
0122 701-22-122	0.002	1.19	9578	294.5	0.59	0.26
0123 701-22-123	0.002	2.04	1.90%	25.8	X	0.70
0124 701-22-124	X	0.25	1955		X	0.11
0125 701-22-125	X	3.20	2.94%		X	1.06
0126 701-22-126	X	2.22	2.25%	27.6	X	0.57
0127 701-22-127	X	1.77	1.44%		X	0.25
0128 701-22-128	X	3.06	3.04%		X	0.92
0129 701-22-129	X	2.23	1.98%		X	0.68
0130 701-22-130	X	1.82	2.59%	44.8	0.30	0.83
0131 701-22-131	X	2.49	2.45%		X	0.81
0132 701-22-132	X	1.58	1.83%	18.8	0.05	0.42
0133 701-22-133	X	0.97	8216		X	0.22
0134 701-22-134	0.003	1.36	1.14%		X	0.20
0135 701-22-135	X	1.93	1.72%	16.5	X	0.30
0136 701-22-136	X	0.10	1126			0.04
0137 701-22-137	0.006	2.39	2.65%		0.71	0.58
0138 701-22-138	X	0.75	7422		0.53	0.13
0139 701-22-139	X	0.80	7696		0.60	0.09
0140 701-22-140	X	1.24	1.24%	198.0	0.94	0.12
0141 701-22-141	X	1.24	1.21%		1.07	0.09
0142 701-22-142	X	0.10	903			0.05
0143 701-22-143	0.003	2.50	2.94%		1.52	0.40
0144 701-22-144	0.003	11.56	11.44%		5.58	1.39
0145 701-22-145	X	26.63	22.05%		18.95	1.19
0146 701-22-146	X	9.82	8.52%	261.9	4.84	0.70
0147 701-22-147	X	3.84	3.99%	247.9	2.81	0.30
0148 701-22-148	0.044	13.32	12.46%	242.3	7.94	1.17
0149 701-22-149	0.003	2.03	2.21%		1.69	0.25
0150 701-22-150	X	5.75	5.38%		4.00	0.34
CHECKS						
0001 701-22-001	X	1.01	1.06%	27.2	X	0.39
0002 701-22-021	0.009	2.42	2.75%			0.11
0003 701-22-041	0.002	6.44	6.19%	47.4		0.31
0004 701-22-061	X	1.44	1.74%			1.06
0005 701-22-081	X	7.08	7.06%	416.3		0.49
0006 701-22-101	0.039	5.28	5.14%			0.49

ANALYSIS

0007 701-22-121	X	0.61	5693	98.9	0.07
0008 701-22-141	X	1.26	1.24%		0.10

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	0.51	0.05	5.8	X	2.6	0.09
0122 701-22-122	1.05	0.04	8.4	X	5.9	0.13
0123 701-22-123	3.63	1.27	3.7	3.9	1.7	3.71
0124 701-22-124	3.35		1.8	5.7		6.19
0125 701-22-125	1.53		5.2	1.8		1.28
0126 701-22-126	4.34	0.35	8.0	0.8	1.2	0.78
0127 701-22-127	2.90		8.1	1.0		1.09
0128 701-22-128	2.72		6.2	5.5		4.79
0129 701-22-129	2.92		3.7	3.2		3.08
0130 701-22-130	7.63	1.88	4.9	5.1	1.4	4.73
0131 701-22-131	3.13		3.8	5.3		4.77
0132 701-22-132	5.15	0.34	6.2	1.4	1.1	1.30
0133 701-22-133	0.72		6.8	3.9		3.02
0134 701-22-134	3.55		4.6	3.5		2.94
0135 701-22-135	1.19	0.54	6.3	4.2	1.0	4.04
0136 701-22-136	0.62		10.6	X		0.49
0137 701-22-137	0.31		13.7	X		0.26
0138 701-22-138	0.26		9.9	0.5		0.21
0139 701-22-139	0.29		14.3	X		0.10
0140 701-22-140	0.22	0.02	10.3	X	2.7	0.25
0141 701-22-141	0.54		8.4	X		0.24
0142 701-22-142	0.21		9.3	X		0.02
0143 701-22-143	0.62		11.7	1.3		1.22
0144 701-22-144	0.87		6.3	1.0		0.51
0145 701-22-145	2.22		2.2	2.7		2.88
0146 701-22-146	2.54	0.14	6.2	1.5	2.8	1.01
0147 701-22-147	0.75	0.14	8.2	3.0	7.9	3.12
0148 701-22-148	1.55	0.27	7.6	2.4	10.4	2.61
0149 701-22-149	1.16		9.5	1.2		1.19
0150 701-22-150	1.35		10.2	2.3		1.71
CHECKS						
0001 701-22-001	0.38	X	9.2	0.9	1.3	0.53
0002 701-22-021	0.59		16.8	0.9		1.01
0003 701-22-041	0.46	0.34	9.1	2.7	2.8	2.34
0004 701-22-061	0.69		7.5	1.0		0.91
0005 701-22-081	2.58	0.47	11.9	0.8	3.2	0.97
0006 701-22-101	0.36		8.1	4.8		4.77

ANALYSIS

0007 701-22-121	0.51	0.04	5.8	X	2.8	0.12
0008 701-22-141	0.48		8.5	X		0.26

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
SAMPLE NUMBERS						
0121 701-22-121	3.95	0.8	X	40.02	13.17	0.41
0122 701-22-122	4.44	1.0	X	369.97	76.16	0.39
0123 701-22-123	2.43	10.6	X	249.34	256.35	0.13
0124 701-22-124	1.42	5.9		123.17		0.10
0125 701-22-125	3.21	7.6		338.37		0.11
0126 701-22-126	3.10	4.3	X	185.87	225.98	0.23
0127 701-22-127	3.31	3.8		237.45		0.19
0128 701-22-128	4.33	8.6		394.60		0.24
0129 701-22-129	3.62	8.5		520.91		0.16
0130 701-22-130	2.53	13.1	0.1	560.48	183.34	0.15
0131 701-22-131	2.31	4.8		380.29		0.08
0132 701-22-132	2.82	2.2	X	189.88	157.63	0.23
0133 701-22-133	3.51	1.7		173.53		0.15
0134 701-22-134	3.53	4.8		527.27		0.10
0135 701-22-135	3.30	1.8	X	576.39	94.23	0.09
0136 701-22-136	3.33	1.4		709.90		0.29
0137 701-22-137	1.79	0.5		129.28		0.25
0138 701-22-138	4.43	0.8		89.43		0.32
0139 701-22-139	7.00	0.8		120.71		0.40
0140 701-22-140	5.24	0.6	X	81.29	31.02	0.35
0141 701-22-141	4.61	0.5		121.60		0.30
0142 701-22-142	7.68	0.5		131.86		0.32
0143 701-22-143	1.52	0.8		67.83		0.30
0144 701-22-144	2.42	1.4		548.88		0.16
0145 701-22-145	1.63	5.2		209.14		0.13
0146 701-22-146	2.24	3.9	X	562.61	26.04	0.21
0147 701-22-147	2.16	1.3	X	329.72	65.53	0.25
0148 701-22-148	1.63	5.5	X	451.39	40.84	0.05
0149 701-22-149	2.54	0.8		109.22		0.54
0150 701-22-150	4.06	2.2		367.62		0.35
CHECKS						
0001 701-22-001	3.65	0.7	X	76.36	10.04	0.34
0002 701-22-021	5.08	0.8		284.38		0.21
0003 701-22-041	3.13	1.2	X	451.23	41.67	0.09
0004 701-22-061	2.97	0.8		49.23		0.23
0005 701-22-081	3.59	5.2	X	278.45	30.25	0.56
0006 701-22-101	2.97	1.5		183.97		0.10

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0007 701-22-121	4.01	0.8	X	40.40	11.73	0.41
0008 701-22-141	4.64	0.6		125.61		0.31

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
SAMPLE NUMBERS						
0121 701-22-121	0.370	600	0.15	22.14	0.024	1967
0122 701-22-122	0.596	1355	0.06	20.60	0.223	2039
0123 701-22-123	0.169	183	0.26	11.64	0.011	626
0124 701-22-124	0.107		0.09	9.26		690
0125 701-22-125	0.186		0.14	13.13		551
0126 701-22-126	0.224	205	0.16	13.89	0.027	1390
0127 701-22-127	0.236		0.19	16.07		1023
0128 701-22-128	0.257		0.31	16.07		1409
0129 701-22-129	0.253		0.36	13.92		785
0130 701-22-130	0.182	403	0.33	13.24	0.200	816
0131 701-22-131	0.110		0.78	12.78		318
0132 701-22-132	0.199	149	8.89	19.49	0.033	795
0133 701-22-133	0.279		0.41	18.51		696
0134 701-22-134	0.213		0.68	24.88		508
0135 701-22-135	0.161	126	0.37	19.68	0.010	301
0136 701-22-136	0.410		0.52	25.25		1496
0137 701-22-137	0.301		0.22	19.99		1576
0138 701-22-138	0.492		0.19	25.26		2334
0139 701-22-139	0.744		X	32.63		3217
0140 701-22-140	0.461	966	0.20	28.69	0.582	2475
0141 701-22-141	0.262		0.13	28.40		2037
0142 701-22-142	0.490		X	27.88		1991
0143 701-22-143	0.181		0.60	23.40		2074
0144 701-22-144	0.195		0.20	8.05		1396
0145 701-22-145	0.104		0.77	6.95		600
0146 701-22-146	0.150	879	0.70	12.25	37.361	958
0147 701-22-147	0.226	961	1.30	22.25	10.119	1674
0148 701-22-148	0.060	810	0.48	11.55	3.034	405
0149 701-22-149	0.226		1.08	25.83		2569
0150 701-22-150	0.316		0.90	23.72		2301
CHECKS						
0001 701-22-001	0.440	196	0.06	21.33	0.025	2266
0002 701-22-021	0.559		0.78	14.42		3087
0003 701-22-041	0.249	348	0.87	11.18	0.021	800
0004 701-22-061	0.219		0.66	17.81		929
0005 701-22-081	0.261	1486	1.36	14.85	18.376	3114
0006 701-22-101	0.229		0.65	21.64		685

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0007 701-22-121	0.405	629	0.13	22.33	0.049	1881
0008 701-22-141	0.263		0.12	28.78		2083

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ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
SAMPLE NUMBERS						
0121 701-22-121	0.33	0.17	3.66	1.198	41	X
0122 701-22-122	0.37	0.49	16.98	930.896	55	X
0123 701-22-123	0.02	0.07	2.62	3.510	34	X
0124 701-22-124	0.02	0.07	2.12		8	
0125 701-22-125	X	0.07	3.02		54	
0126 701-22-126	X	0.09	3.65	0.247	53	X
0127 701-22-127	X	0.08	4.26		71	
0128 701-22-128	X	0.11	4.20		89	
0129 701-22-129	0.02	0.10	3.92		43	
0130 701-22-130	0.03	0.08	3.32	0.332	57	X
0131 701-22-131	X	0.05	2.58		76	
0132 701-22-132	0.04	0.07	3.94	0.179	72	X
0133 701-22-133	0.18	0.11	4.08		61	
0134 701-22-134	0.04	0.05	3.96		58	
0135 701-22-135	0.04	0.06	2.85	0.186	65	X
0136 701-22-136	1.01	0.19	5.78		93	
0137 701-22-137	1.44	0.21	6.78		103	
0138 701-22-138	1.38	0.24	4.98		88	
0139 701-22-139	0.69	0.31	5.36		125	
0140 701-22-140	0.86	0.17	5.40	44.866	90	X
0141 701-22-141	0.97	0.12	5.32		80	
0142 701-22-142	0.69	0.18	3.54		89	
0143 701-22-143	1.18	0.13	4.61		94	
0144 701-22-144	0.04	0.04	2.64		74	
0145 701-22-145	0.10	0.04	1.56		37	
0146 701-22-146	0.06	0.05	3.07	25.166	68	X
0147 701-22-147	0.48	0.10	4.94	43.285	98	X
0148 701-22-148	0.07	0.02	0.88	7.741	73	X
0149 701-22-149	1.38	0.13	5.02		80	
0150 701-22-150	0.30	0.10	6.99		104	
CHECKS						
0001 701-22-001	1.84	0.16	3.64	0.111	84	X
0002 701-22-021	1.23	0.23	1.75		146	
0003 701-22-041	0.36	0.06	4.07	4.718	84	X
0004 701-22-061	1.32	0.08	3.53		64	
0005 701-22-081	1.26	0.11	2.96	89.824	99	0.07
0006 701-22-101	1.83	0.27	3.57		62	

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0007 701-22-121	0.32	0.18	3.68	1.523	48	X
0008 701-22-141	1.02	0.12	5.31		78	

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ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
SAMPLE NUMBERS						
0121 701-22-121	1.0	10.52	1.16	18	0.02	49.4
0122 701-22-122	1.5	38.62	3.07	27	0.44	78.5
0123 701-22-123	5.1	3.78	0.50	4	X	32.5
0124 701-22-124	5.6	3.11	0.51	5		33.2
0125 701-22-125	2.4	3.09	0.52	4		29.4
0126 701-22-126	3.8	3.66	0.71	2	X	53.7
0127 701-22-127	1.9	3.79	0.62	3		36.3
0128 701-22-128	6.2	4.88	0.92	4		46.1
0129 701-22-129	6.7	4.60	0.85	5		43.0
0130 701-22-130	6.2	3.96	0.65	3	X	37.6
0131 701-22-131	2.8	2.10	0.35	4		23.4
0132 701-22-132	1.6	3.08	0.73	2	X	42.6
0133 701-22-133	0.9	6.14	0.84	18		36.5
0134 701-22-134	1.4	2.91	0.41	6		21.9
0135 701-22-135	0.9	2.86	0.46	7	X	30.0
0136 701-22-136	1.6	9.79	1.67	17		60.4
0137 701-22-137	1.8	10.00	1.24	368		48.3
0138 701-22-138	1.3	13.94	1.57	194		50.7
0139 701-22-139	2.4	18.33	2.25	35		71.3
0140 701-22-140	1.4	9.69	1.22	29	1.56	59.9
0141 701-22-141	1.4	5.86	0.86	39		50.7
0142 701-22-142	1.0	9.99	1.31	37		48.8
0143 701-22-143	1.6	6.85	0.95	87		46.4
0144 701-22-144	4.1	2.85	0.37	5		23.7
0145 701-22-145	4.3	1.77	0.31	6		17.5
0146 701-22-146	2.1	2.68	0.46	3	0.55	30.7
0147 701-22-147	1.6	5.47	0.74	18	3.56	40.0
0148 701-22-148	2.7	1.11	0.16	3	0.32	7.0
0149 701-22-149	2.2	6.84	0.93	33		58.1
0150 701-22-150	6.8	5.22	0.73	13		49.3
CHECKS						
0001 701-22-001	1.6	9.31	1.07	67	0.29	53.8
0002 701-22-021	0.7	18.24	1.50	671		10.5
0003 701-22-041	0.5	3.52	0.51	39	0.69	38.2
0004 701-22-061	1.5	5.05	0.63	31		48.6
0005 701-22-081	2.6	5.44	0.81	16	1.01	40.3
0006 701-22-101	1.1	6.28	1.62	20		32.7

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0007 701-22-121	1.1	11.68	1.28	22	0.02	51.4
0008 701-22-141	1.3	6.00	0.92	40		51.3

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ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.20		7.87%			14.7
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.31		6.47%			16.8
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				0.04		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	X		6.20%			0.8
0022 AMIS0167	0.92		1.39%			158.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.30		6.15%			128.8
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	29.30		3.48%			1060.5
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0001 NGL-27		X				
0002 OREAS 45d				184.6		0.83
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		22				
0009 OREAS 45e				254.8		0.72
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			
0015 Control Blank						
0016 OREAS 45e		24				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				822.0		0.29
0022 AMIS0167				90.5		0.47
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		11				
0029 GTS-2a				183.4		0.85
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		X				
0035 CCU-1c						
0036 MPL-5				607.7		17.58
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		0.34			1873	
0003 OREAS 45e				0.55		
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d				1.05		
0008 OREAS 45d						
0009 OREAS 45e		0.28			637	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96				0.16		
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		0.03			11.52%	
0022 AMIS0167		1.07			1021	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1				12.56		
0028 AE21						
0029 GTS-2a		0.28			3.60%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3				8.68		
0034 Au5						
0035 CCU-1c				0.09		
0036 MPL-5		40.49			4.41%	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.07		36.50		29.6	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.04		24.59		57.5	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank				X		
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.09		18.06		29.3	
0022 AMIS0167	0.42		46.41		37.7	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.43		25.29		22.9	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	3.21		587.02		138.4	
0037 OREAS 97.01						
0038 PD-1						

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ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		539		3.83	373.5	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		983		1.24	787.0	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank			X			X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		237		0.45	106.8	
0022 AMIS0167		404		1.10	64.4	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		132		1.65	78.7	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		604		24.33	2028.5	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.18		1.32	0.61		15.45
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.18		1.22	0.58		26.02
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank					X	
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.97		1.59	1.24		4.87
0022 AMIS0167	5.88		2.87	0.74		2.50
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	2.17		1.33	1.12		7.01
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	8.64		2.18	4.97		3.89
0037 OREAS 97.01						
0038 PD-1						

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ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d				21.84	2.38	1.55
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e				17.14	1.99	0.57
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	X					
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1				12.30	3.01	1.80
0022 AMIS0167				3.20	4.77	0.93
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a				21.13	3.43	0.50
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5				32.42	23.30	15.92
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0001 NGL-27		0.01				
0002 OREAS 45d	3.69			0.44	0.097	4391
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d		0.04				
0009 OREAS 45e	3.37			0.41	0.096	3457
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e		X				
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.99			0.59	0.061	8790
0022 AMIS0167	1.95			1.00	0.006	4681
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21		X				
0026 RTS-2						
0027 STSD-1						
0028 AE21		X				
0029 GTS-2a	2.83			0.43	0.119	1.83%
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5		0.19				
0035 CCU-1c						
0036 MPL-5	1.28			1.08	21.017	1.21%
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

0039 RTS-2	
0040 BSL13	0.02

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d		16.99	18.2	0.196	2206	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e		11.46	5.9	0.177	1382	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank	0.1					X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1		8.43	42.9	0.190	5.38%	
0022 AMIS0167		23.91	4.2	0.288	1427	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a		10.33	24.0	0.272	2.05%	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5		326.54	34.1	0.167	8923	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	503			2.6		
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	548			2.4		
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		X				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1129			0.7		
0022 AMIS0167	217			3.9		
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1332			4.1		
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2342			20.0		
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	1039					
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	629					
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank		0.1				
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.68%					
0022 AMIS0167	669					
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	5690					
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	5877					
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	12.44	14.56	204.2		376	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	6.69	9.72	399.3		314	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank				X		X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	5.92	10.68	74.6		366	
0022 AMIS0167	3.46	19.21	104.6		165	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.28	17.24	67.5		802	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	36.44	239.38	2487.9		739	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	22.5				3.789	43.00
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	18.5				2.628	22.47
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	8.4				2.337	19.98
0022 AMIS0167	247.4				5.068	17.48
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	20.0				3.581	58.43
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2101.3				64.600	367.62
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	X		617			
0003 OREAS 45e		0.06				
0004 OREAS 97.01						
0005 PD-1						4.62
0006 PD-1					3.18	
0007 OREAS 45d		0.07				
0008 OREAS 45d						
0009 OREAS 45e	X		526			
0010 OREAS 97.01						
0011 PD-1						4.47
0012 RTS-2					1.41	
0013 Control Blank						
0014 Control Blank				0.1		
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96		4.13				
0018 OREAS 97.01						
0019 PD-1						4.47
0020 PD-1					3.70	
0021 WGB-1	X		385			
0022 AMIS0167	X		8375			
0023 OREAS 97.01						
0024 PD-1						4.37
0025 PL-21						
0026 RTS-2					1.23	
0027 STSD-1		0.25				
0028 AE21						
0029 GTS-2a	X		2971			
0030 OREAS 97.01						
0031 PD-1						4.40
0032 PD-1					3.48	
0033 STSD-3		0.19				
0034 Au5						
0035 CCU-1c		32.40				
0036 MPL-5	1.601		1.18%			
0037 OREAS 97.01						
0038 PD-1						4.51

ANALYSIS

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ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.77		47.5	2.7		
0003 OREAS 45e						
0004 OREAS 97.01						0.67
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.05		88.2	2.8		
0010 OREAS 97.01						0.70
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						0.65
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.24		42.3	0.5		
0022 AMIS0167	7.59		2.8	0.7		
0023 OREAS 97.01						0.70
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	1.19		30.6	0.9		
0030 OREAS 97.01						0.72
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	353.34		48.0	126.6		
0037 OREAS 97.01						0.72
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	3.07	2.7		34.03		0.92
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	2.37	1.3		16.87		0.53
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	2.82	3.9		113.82		0.33
0022 AMIS0167	4.84	1.5		22.69		1.36
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	4.65	1.2		93.07		0.08
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	38.21	8.2		428.66		74.89
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.383		0.12	14.40		6554
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.329		0.16	12.71		5079
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.464		X	0.91		5191
0022 AMIS0167	0.890		0.19	50.87		713
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.631		1.31	1.23		1081
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	2.191		29.82	93.62		2405
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	0.29	0.19	2.61		236	
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	0.17	0.19	2.39		320	
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank						X
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	0.36	0.23	0.62		230	
0022 AMIS0167	0.18	0.39	479.51		64	
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	0.36	0.23	0.35		135	
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	6.29	0.24	10.50		205	
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0001 NGL-27						
0002 OREAS 45d	2.2	9.84	1.29	40		133.6
0003 OREAS 45e						
0004 OREAS 97.01						
0005 PD-1						
0006 PD-1						
0007 OREAS 45d						
0008 OREAS 45d						
0009 OREAS 45e	1.0	8.48	1.25	40		104.0
0010 OREAS 97.01						
0011 PD-1						
0012 RTS-2						
0013 Control Blank						
0014 Control Blank					0.04	
0015 Control Blank						
0016 OREAS 45e						
0017 OREAS 96						
0018 OREAS 97.01						
0019 PD-1						
0020 PD-1						
0021 WGB-1	1.4	14.28	1.40	36		27.4
0022 AMIS0167	0.9	20.58	2.44	170		64.9
0023 OREAS 97.01						
0024 PD-1						
0025 PL-21						
0026 RTS-2						
0027 STSD-1						
0028 AE21						
0029 GTS-2a	19.5	9.96	1.68	182		97.1
0030 OREAS 97.01						
0031 PD-1						
0032 PD-1						
0033 STSD-3						
0034 Au5						
0035 CCU-1c						
0036 MPL-5	28.9	22.52	1.40	1314		39.3
0037 OREAS 97.01						
0038 PD-1						

ANALYSIS

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ANALYSIS

ELEMENTS	Ag	Ag	Al	Al	ANC	As
UNITS	ppm	ug/l	ppm	mg/l	kgH2SO4/t	ppm
DETECTION LIMIT	0.05	0.01	50	0.01	1	0.5
DIGEST	4A/		4A/		ANCx/	4A/
ANALYTICAL FINISH	MS	/MS	OE	/OE	VOL	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		
0044 Control Blank						
0045 OREAS 24b	X		8.28%			8.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				2.01		
0051 AlcoaHi4-OES				50.68		
0052 SOLN-001				50.01		
0053 Alcoa18-MS		5.23				
BLANKS						
0001 Control Blank	X	X	X	X		X
0002 Control Blank	X		X			0.7
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		67			X

ANALYSIS

ELEMENTS	As	B	B	Ba	Ba	Be
UNITS	ug/l	ppm	mg/l	ppm	ug/l	ppm
DETECTION LIMIT	0.1	10	0.01	0.1	0.05	0.05
DIGEST		AR01/		4A/		4A/
ANALYTICAL FINISH	/MS	OE	/OE	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			
0044 Control Blank						
0045 OREAS 24b				737.0		2.09
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			1.03			
0051 AlcoaHi4-OES			19.22			
0052 SOLN-001			X			
0053 Alcoa18-MS	34.6				5.32	

BLANKS						
0001 Control Blank	X	X	X	0.1	0.06	X
0002 Control Blank				0.7		X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				X		X

ANALYSIS

ELEMENTS	Be	Bi	Bi	C	Ca	Ca
UNITS	ug/l	ppm	ug/l	%	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.005	0.01	50	0.01
DIGEST		4A/			4A/	
ANALYTICAL FINISH	/MS	MS	/MS	/CSA	OE	/OE
STANDARDS						
0041 CCU-1d				0.09		
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b		0.59			1.13%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						50.83
0051 AlcoaHi4-OES						984.13
0052 SOLN-001						194.49
0053 Alcoa18-MS	5.1		5.125			
BLANKS						
0001 Control Blank	X	X	X	X	X	0.02
0002 Control Blank		X			X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X			X	

ANALYSIS

ELEMENTS	Cd	Cd	Ce	Cl	Co	Co
UNITS	ppm	ug/l	ppm	mg/l	ppm	ug/l
DETECTION LIMIT	0.02	0.02	0.01	2	0.1	0.1
DIGEST	4A/		4A/		4A/	
ANALYTICAL FINISH	MS	/MS	MS	/COL	MS	/MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank				X		
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.07		84.62		16.2	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.90				565.6
BLANKS						
0001 Control Blank	X	X	0.08	X	X	X
0002 Control Blank	X		0.08		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X		X		X	

ANALYSIS

ELEMENTS	ColourChange	Cr	Cr	Cs	Cu	Cu
UNITS	NONE	ppm	mg/l	ppm	ppm	mg/l
DETECTION LIMIT	0	1	0.01	0.05	0.5	0.01
DIGEST	ANCx/	4A/		4A/	4A/	
ANALYTICAL FINISH	QUAL	OE	/OE	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank			X			X
0044 Control Blank						
0045 OREAS 24b		105		10.50	40.6	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES			0.49			0.54
0051 AlcoaHi4-OES			19.92			2.51
0052 SOLN-001			X			0.05
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank		1	X	X	X	X
0002 Control Blank		1		X	0.7	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X		X	0.8	

ANALYSIS

ELEMENTS	Dy	EC	Er	Eu	F	Fe
UNITS	ppm	uS/cm	ppm	ppm	mg/l	%
DETECTION LIMIT	0.01	10	0.01	0.01	0.1	0.01
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/MTR	MS	MS	/SIE	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank					X	
0045 OREAS 24b	4.18		2.21	1.35		4.84
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	0.11	X	X	X	X	0.01
0002 Control Blank	X		X	X		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.10		0.05	X		X

ANALYSIS

ELEMENTS	Fe-Sol	Final-pH	Fizz-Rate	Ga	Gd	Ge
UNITS	mg/l	NONE	NONE	ppm	ppm	ppm
DETECTION LIMIT	0.01	0.1	0	0.05	0.01	0.05
DIGEST		ANCx/	ANCx/	4A/	4A/	4A/
ANALYTICAL FINISH	/OE	MTR	QUAL	MS	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					
0044 Control Blank						
0045 OREAS 24b				20.74	5.80	1.34
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	2.08					
0051 AlcoaHi4-OES	100.93					
0052 SOLN-001	50.19					
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X			X	0.10	X
0002 Control Blank				0.10	X	X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank				0.11	0.05	X

ANALYSIS

ELEMENTS	Hf	Hg	Hg	Ho	In	K
UNITS	ppm	ppm	ug/l	ppm	ppm	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.01	0.005	20
DIGEST	4A/	AR01/		4A/	4A/	4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	3.89			0.78	0.071	3.07%
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			4.8			

BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X			X	X	X
0003 Control Blank		X				
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X			0.02	X	X

ANALYSIS

ELEMENTS	K	La	Li	Lu	Mg	Mg
UNITS	mg/l	ppm	ppm	ppm	ppm	mg/l
DETECTION LIMIT	0.1	0.01	0.1	0.005	20	0.01
DIGEST		4A/	4A/	4A/	4A/	
ANALYTICAL FINISH	/OE	MS	MS	MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank	X					X
0044 Control Blank						
0045 OREAS 24b		43.55	46.9	0.334	1.66%	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES	3.9					50.29
0051 AlcoaHi4-OES	484.3					202.55
0052 SOLN-001	101.2					193.81
0053 Alcoa18-MS						

BLANKS						
0001 Control Blank	X	0.09	X	X	X	X
0002 Control Blank		0.02	X	X	X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank		X	X	X	X	

ANALYSIS

ELEMENTS	Mn	Mn	Mn-Rp1	Mo	Mo	MPA
UNITS	ppm	mg/l	ppm	ppm	ug/l	kgH2SO4/t
DETECTION LIMIT	1	0.01	10	0.1	0.05	1
DIGEST	4A/		4AH/	4A/		
ANALYTICAL FINISH	OE	/OE	OE	MS	/MS	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	484			4.1		
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381			2.40%			
0050 Alcoa12-OES		0.50				
0051 AlcoaHi4-OES		19.88				
0052 SOLN-001		0.01				
0053 Alcoa18-MS					6.40	
BLANKS						
0001 Control Blank	4	X		0.1	X	
0002 Control Blank	X			X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	5			X		

ANALYSIS

ELEMENTS	Na	Na	NAG	NAGpH	NAG(4.5)	NAPP
UNITS	ppm	mg/l	kgH2SO4/t	NONE	kgH2SO4/t	kgH2SO4/t
DETECTION LIMIT	20	0.1	1	0.1	1	1
DIGEST	4A/		NAGx/	NAGx/	NAGx/	
ANALYTICAL FINISH	OE	/OE	VOL	MTR	VOL	/CALC
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank		X				
0044 Control Blank						
0045 OREAS 24b	8998					
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES		249.0				
0051 AlcoaHi4-OES		2051.3				
0052 SOLN-001		496.6				
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	33	X	3	5.0	0	
0002 Control Blank	X					
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X					

ANALYSIS

ELEMENTS	Nb	Nd	Ni	Ni	P	P
UNITS	ppm	ppm	ppm	mg/l	ppm	mg/l
DETECTION LIMIT	0.05	0.01	0.5	0.01	50	0.1
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	OE	/OE	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank				X		X
0044 Control Blank						
0045 OREAS 24b	13.67	38.25	61.6		729	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES				0.51		1.1
0051 AlcoaHi4-OES				20.55		49.3
0052 SOLN-001				X		X
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	X	0.5	X	X	X
0002 Control Blank	X	0.05	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.33	0.02	X		X	

ANALYSIS

ELEMENTS	Pb	Pb	pH	pH Drop	Pr	Rb
UNITS	ppm	ug/l	NONE	NONE	ppm	ppm
DETECTION LIMIT	0.5	0.5	0.1	0.1	0.005	0.05
DIGEST	4A/		Ws/	ANCx/	4A/	4A/
ANALYTICAL FINISH	MS	/MS	MTR	MTR	MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	23.0				9.967	168.78
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		6.3				
BLANKS						
0001 Control Blank	X	X	5.8		X	X
0002 Control Blank	0.7				0.012	0.18
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	1.1				0.007	0.07

ANALYSIS

ELEMENTS	Re	S	S	S	S	S-SO4
UNITS	ppm	%	ppm	mg/l	%	%
DETECTION LIMIT	0.002	0.01	50	0.1	0.04	0.01
DIGEST	4A/		4A/		SCR/	S71/
ANALYTICAL FINISH	MS	/CSA	OE	/OE	VOL	OE
STANDARDS						
0041 CCU-1d		31.55				
0042 Control Blank						
0043 Control Blank				0.3		
0044 Control Blank						
0045 OREAS 24b	X		2234			
0046 OREAS 97.01						
0047 PD-1						4.32
0048 PD-1					3.48	
0049 BCS381						
0050 Alcoa12-OES				21.1		
0051 AlcoaHi4-OES				265.3		
0052 SOLN-001				499.1		
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	0.01	X	X		X
0002 Control Blank	X		X			
0003 Control Blank						
0004 Control Blank						0.63
0005 Control Blank						
0006 Acid Blank	X		X			

ANALYSIS

ELEMENTS	Sb	Sb	Sc	Se	Se	Se
UNITS	ppm	ug/l	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.05	0.01	0.1	0.5	0.5	0.01
DIGEST	4A/		4A/	4A/		SE1/
ANALYTICAL FINISH	MS	/MS	MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	1.00		15.7	X		
0046 OREAS 97.01						0.69
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS		5.74			31.3	
BLANKS						
0001 Control Blank	X	X	X	X	X	X
0002 Control Blank	X		0.3	X		
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						X
0006 Acid Blank	X		0.3	X		

ANALYSIS

ELEMENTS	Sm	Sn	Sn	Sr	Sr	Ta
UNITS	ppm	ppm	ug/l	ppm	ug/l	ppm
DETECTION LIMIT	0.01	0.1	0.1	0.05	0.02	0.01
DIGEST	4A/	4A/		4A/		4A/
ANALYTICAL FINISH	MS	MS	/MS	MS	/MS	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	7.34	4.3		125.44		1.01
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS			5.8		529.55	
BLANKS						
0001 Control Blank	0.09	X	X	0.05	0.04	X
0002 Control Blank	X	X		X		0.01
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.02	X		0.15		0.02

ANALYSIS

ELEMENTS	Tb	TDSEva	Te	Th	Th	Ti
UNITS	ppm	mg/Kg	ppm	ppm	ug/l	ppm
DETECTION LIMIT	0.005	20	0.05	0.01	0.005	5
DIGEST	4A/		4A/	4A/		4A/
ANALYTICAL FINISH	MS	/GR	MS	MS	/MS	OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						
0044 Control Blank						
0045 OREAS 24b	0.798		X	16.94		4249
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						
0051 AlcoaHi4-OES						
0052 SOLN-001						
0053 Alcoa18-MS					5.692	
BLANKS						
0001 Control Blank	X		X	X	X	X
0002 Control Blank	X		X	0.03		X
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	0.011		X	0.01		26

ANALYSIS

ELEMENTS	Tl	Tm	U	U	V	V
UNITS	ppm	ppm	ppm	ug/l	ppm	mg/l
DETECTION LIMIT	0.02	0.01	0.01	0.005	1	0.01
DIGEST	4A/	4A/	4A/		4A/	
ANALYTICAL FINISH	MS	MS	MS	/MS	OE	/OE
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank						X
0044 Control Blank						
0045 OREAS 24b	0.84	0.38	3.11		105	
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES						0.50
0051 AlcoaHi4-OES						20.30
0052 SOLN-001						X
0053 Alcoa18-MS				5.313		
BLANKS						
0001 Control Blank	X	X	X	X	1	X
0002 Control Blank	X	X	X		X	
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	X	X		X	

ANALYSIS

ELEMENTS	W	Y	Yb	Zn	Zn	Zr
UNITS	ppm	ppm	ppm	ppm	mg/l	ppm
DETECTION LIMIT	0.1	0.05	0.01	1	0.01	0.1
DIGEST	4A/	4A/	4A/	4A/		4A/
ANALYTICAL FINISH	MS	MS	MS	OE	/OE	MS
STANDARDS						
0041 CCU-1d						
0042 Control Blank						
0043 Control Blank					X	
0044 Control Blank						
0045 OREAS 24b	3.9	19.98	2.11	107		135.6
0046 OREAS 97.01						
0047 PD-1						
0048 PD-1						
0049 BCS381						
0050 Alcoa12-OES					0.48	
0051 AlcoaHi4-OES					20.57	
0052 SOLN-001					X	
0053 Alcoa18-MS						
BLANKS						
0001 Control Blank	X	X	X	4	X	X
0002 Control Blank	0.2	0.06	0.01	X		0.3
0003 Control Blank						
0004 Control Blank						
0005 Control Blank						
0006 Acid Blank	X	0.57	0.04	2		0.3

METHOD CODE DESCRIPTION

/CALC Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Results Determined by calculation from other reported data.

/COL Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by UV-Visible Spectrometry.

/CSA Intertek Genalysis Perth

Induction Furnace Analysed by Infrared Spectrometry

/GR Intertek Genalysis Perth

Analysed by Gravimetric Technique.

/MS Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Inductively Coupled Plasma Mass Spectrometry.

/MTR Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed with Electronic Meter Measurement

/OE Intertek Genalysis Perth

Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

/SIE Intertek Genalysis Perth

No digestion or other pre-treatment undertaken. Analysed by Specific Ion Electrode.

4A/MS Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Mass Spectrometry.

4A/OE Intertek Genalysis Perth

Multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids in Teflon Tubes. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

4AH/OE Intertek Genalysis Perth

Modified (for higher precision) multi-acid digest including Hydrofluoric, Nitric, Perchloric and Hydrochloric acids. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

ANCx/MTR Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed with Electronic Meter Measurement

ANCx/QUAL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Qualitative Inspection

ANCx/VOL Intertek Genalysis Perth

Acid Neutralizing Capacity Digestion Procedure. Analysed by Volumetric Technique.

METHOD CODE DESCRIPTION

AR01/MS Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Mass Spectrometry.

AR01/OE Intertek Genalysis Perth

Aqua-Regia digest. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

NAGx/MTR Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed with Electronic Meter Measurement

NAGx/VOL Intertek Genalysis Perth

Net Acid Generation Extraction of samples with H2O2 Analysed by Volumetric Technique.

S71/OE Intertek Genalysis Perth

Digestion to eliminate sulphides. Analysed by Inductively Coupled Plasma Optical (Atomic) Emission Spectrometry.

SCR/VOL Intertek Genalysis Perth

Chromium Reducible Suplhur Analysed by Volumetric Technique.

SE1/MS Intertek Genalysis Perth

Aqua-Regia digest followed by Precipitation and Concentration. Specific for Selenium. Analysed by Inductively Coupled Pl

Ws/MTR Intertek Genalysis Perth

Water Extraction using a sample:water ratio of 1:5 or to client request. Analysed with Electronic Meter Measurement

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APPENDIX K

Air Quality, Noise and Vibration Modeling

Knight Piésold CONSULTING

MYANMAR WANBAO COPPER MINING LIMITED
LETPADAUNG PROJECT





AIR QUALITY, NOISE AND VIBRATION MODELING LETPADAUNG PROJECT

PREPARED FOR:

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DRAFT

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AIR QUALITY, NOISE AND VIBRATION MODELING

DRAFT REPORT

KP Job No. LI201-00239/05

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PROPOSAL APPROVED PEL-0225-2013

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Merra Monthly History Data Collections – Giovanni Project

APPENDIX B
Maximun 24 hour mean concentrations for PM_{10} impacts during dry-cold, dry-hot and wet seasons

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1. INTRODUCTION

The Letpadaung Copper Project is located at Letpadaung in the Sagaing Division and is part of a larger project known as the Monywa Copper Project, which is developing the Sabetaung & Kyisintaung (S&K) deposits within the Monywa Copper Geological Complex. Myanmar Wanbao Mining Copper Limited (MWMCL), which will be responsible for the complete development of the Letpadaung deposit, has adopted the Environmental and Social assessments reviewed by AATA International Inc. in 1996.

As part of the Environmental Impact Assessment (EIA) of the Letpadaung Project, particulate matter dispersion as well as noise and vibration propagation have been modelled, which has allowed quantifying impacts caused by the project within the environmental baseline area. This area has been delimited in coordination with Knight Piésold Pty. Ltd and comprises the sites of the noise, vibration and air quality sampling stations.

The input information used for estimating particulate matter, noise and vibration emissions, and specific for this project was provided by the company Myanmar Wanbao Mining Copper Limited in coordination with Knight Piésold Pty. Ltd (Knight Piésold Australia). In terms of methodology, the computer programs used for modelling air quality dispersion (particulate matter) as well as noise and vibration propagation were AERMOD View, version 8.2, and SoundPLAN, version 7.2; which allowed a quantification of impacts produced by project activities during the construction and operation phases.

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2. OBJECTIVES

The specific objectives of this study are presented below:

- To prepare an inventory of particulate matter, noise and vibration emissions produced by the project's construction and operation phases.
- To quantify impacts on air quality caused by the project's construction and operation phases; this is to be achieved by modelling particulate matter dispersion (PM_{10}).
- To quantify impacts on noise and vibration quality induced by activities to be executed during the project's construction and operation phases; this is to be accomplished by modelling noise and vibrations.

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3. LETPADAUNG PROJECT DESCRIPTION

The Letpadaung Project is located 5.3 km from the city of Monywa, on the western bank of the Chindwin River and south of the Yama Stream, a Chindwin tributary. The company Myanmar Wanbao Mining Copper Limited (MWMCL) is responsible for developing the project. This project is part of the Monywa Copper Project, which is developing the Sabetaung and Kyisintaung copper deposits, located 6 km northwest from the Letpadaung deposit.

The project's construction phase will include the execution of all activities required for the operation, as well as the construction and operation of complementary facilities. Construction activities will take place during the day; these activities consist of earthworks, land grading, facility construction, facility assembly, drilling and blasting, excavations, materials transportation, consumables transportation, and road improvement.

The project's operation phase is the one during which copper ore exploitation, processing and dressing take place. Figure 1 shows the location of the project and the facilities considered during year 5 of the mining plan, which include the execution of an open pit, waste rock dumps, crushing facilities, pump station, conveyor belt, and heap leach piles. During this phase, typical operation activities and improvements are considered, which will ensure their normal execution through implementation of mitigation measures for dust and noise control, in order to comply with MWMCL's environmental standards. According to information provided by the company Knight Piésold Pty. Ltd in coordination with MWMCL, Table 1 presents the project-related production of copper ore concentrate and waste rock throughout the first 10 years.

Table 1: Letpadaung Project Mining Plan

Mining plan	Material handling (1)		
	Ore	Waste rock	Total
Year 1	27,600	41,400	69,000
Year 2	27,000	42,000	69,000
Year 3	28,000	41,000	69,000
Year 4	33,000	36,000	69,000
Year 5	30,000	39,000	69,000
Year 6	32,000	37,000	69,000
Year 7	30,000	39,000	69,000
Year 8	30,100	39,200	69,300
Year 9	30,700	38,700	69,400
Year 10	30,200	38,800	69,000

Source: MWMCL
Note :(1) Units in kt (kiloton)

4. METHODOLOGY

4.1 NOISE AND AIR QUALITY BACKGROUND

This section provides a brief summary of results obtained through air and noise quality samplings, which were executed as part of the Environmental Baseline section of the Letpadaung Copper Project's Environmental and Social Impact Assessment (ESIA), performed by the company Knight Piésold Pty.

4.1.1 Air Quality Baseline

In order to characterize environmental baseline conditions for Letpadaung Project's EIA, 8 air quality stations were sampled during the dry and wet season of 2013. The samplings comprised measurements of particulate matter (PM_{10} and $PM_{2.5}$) and gases (SO_2, NO_2 and CO), which were determined with an Environmental Perimeter Air Monitoring Station (EPAS – Haz-Scanner) equipment.

Based on results shown in Table 2, it was determined that background concentrations for PM_{10} vary between 7.1 and 20 µg/m^3, depending on each air quality station's location.

The measurement lasted 24 hours; this period presents continuous hourly records measured at a height of 3 m above ground level, a height that was chosen in order to obtain values that represent the human exposure level. Figure 1 shows the location of air quality sampling stations.

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Table 2: Summary of pollutant concentration - Air quality baseline

Pollutant (µg/m^3)		Season (2013)	Sampling period	Points of air quality sampling								AQS according to WHO (µg/m^3)			
				Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	IT-1	IT-2	IT-3	AQG
Particulate matter	Small particles less than 10 micrometers - PM_{10}	Dry	24 hour average	14.3	12.7	11.4	17.6	22.3	9.5	19.2	10.4	150	100	75	50
		Wet	24 hour average	8.3	2.7	4.2	11.0	17.7	4.7	10.8	4.4	150	100	75	50
		Average	**24 hour average**	**11.3**	**7.7**	**7.8**	**14.3**	**20.0**	**7.1**	**15.0**	**7.4**	150	100	75	50
	Fine particles less than 2,5 micrometers - $PM_{2,5}$	Dry	24 hour average	11.0	8.5	8.2	11.1	14.2	8.5	11.3	7.8	75	50	37,5	25
		Wet	24 hour average	6.0	1.7	2.4	5.6	8.8	2.6	5.2	2.6	75	50	37,5	25
		Average	**24 hour average**	**8.5**	**5.1**	**5.3**	**8.4**	**11.5**	**5.5**	**8.3**	**5.2**	75	50	37,5	25
	Inhalable coarse particles - $PM_{10\text{-}2.5}$	Dry	24 hour average	3.3	4.15	3.2	6.5	8.1	1	7.9	2.6	-	-	-	-
		Wet	24 hour average	2.3	1.0	1.8	5.3	8.9	2.1	5.6	1.8	-	-	-	-
		Average	**24 hour average**	**2.8**	**2.6**	**2.5**	**5.9**	**8.5**	**1.6**	**6.8**	**2.2**	-	-	-	-
Gases	Carbone monoxide - CO	Dry	Maximum 8 hour mean	0.3	0.3	0.4	0.4	0.5	0.4	0.4	0.4	-	-	-	10 000
		Wet	Maximum 8 hour mean	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	10 000
		Average	**Maximum 8 hour mean**	**0.3**	**0.3**	**0.4**	**0.4**	**0.5**	**0.4**	**0.4**	**0.4**	-	-	-	10 000
	Nitrogen dioxide - NO_2	Dry	1 hour average	28.1	25.2	32.7	28.7	23.1	20.7	9.7	14.6	-	-	-	200
		Wet	1 hour average	26.0	24.1	34.8	29.3	22.0	19.7	9.5	13.2	-	-	-	200
		Average	**1 hour average**	**27.1**	**24.7**	**33.7**	**29.0**	**22.6**	**20.2**	**9.6**	**13.9**	-	-	-	200
	Sulphur dioxide - SO_2	Dry	24 hour average	2.6	2.3	2.5	2.4	3.0	2.5	2.5	2.5	125	50	-	20
		Wet	24 hour average	2.5	2.4	2.5	2.4	2.5	2.5	2.5	2.5	125	50	-	20
		Average	**24 hour average**	**2.6**	**2.4**	**2.5**	**2.4**	**2.8**	**2.5**	**2.5**	**2.5**	125	50	-	20

Elaborated by Knight Piésold.

Source: MWMCL

Notes:

"AQS": Air Quality Standards.

"WHO": World Health Organization.

"AQG": Air Quality Guideline.

"IT": Interim Target. According to Vahlsing, C., & Smith, K. R. (2011) developing countries, with higher levels of air pollution, could select an interim target level achievable based on their own air quality management infrastructure, and progress towards the AQG value.

Pollutant concentrations greater than Air quality Standards:

IT-1

IT-2

IT-3

AQG

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According to information provided by the company Knight Piésold Pty. Ltd, results obtained during measurements at the 8 air quality stations (Table 2) present particulate matter (PM_{10} and $PM_{2.5}$) and gas (CO, NO_2 and SO_2) concentrations that do not exceed air quality standards established by World Health Organization (WHO). Furthermore, measurement results for meteorological parameters were also obtained during air quality samplings, which are shown in Table 3.

Table 3: Meteorological conditions during air quality sampling

Parameters	Season (2013)	
	Dry	Wet
Temperature	31ºC	26ºC
Relative humidity	56%	86%
Wind speed	10 km/hr	10 km/hr
Wind direction	104º (ESE)	106º (ESE)

Source: MWMCL

4.1.2 Noise Quality Baseline

For the purpose of characterizing the environmental baseline conditions of the Letpadaung Project's EIA, 10 noise stations were sampled during the dry and wet seasons of 2013, whose locations are shown in Figure 1. Based on information provided and shown in Table 4, noise equivalent values have been determined per period (daytime and night-time); consequently, during the dry season, noise levels for the daytime period varied between 41.3 and 46.6 dB(A), while they varied between 41.5 and 46.3 dB(A) for the night-time period. It is important to point out that, except for the value determined for Station 3 during the night-time period, the remaining recorded values do not exceed international noise standards established by the IFC (2007).

On the other hand, values exceeding IFC standards were recorded during the wet season. These values range from 59.9 to 85.5 dB (A) during the daytime period, and from 66.7 to 74.6 dB(A) during the night-time period.

The criterion considered for assessing the results obtained at sampling stations close to vehicle traffic and built-up areas was the one established by the OECD (Organisation for Economic Cooperation and Development). This standard considers a value below 65 dB(A) to be an acceptable noise level for the daytime period, and a value below 55 dB(A) to be acceptable for the night-time period.

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Table 4: Noise quality baseline around area of Letpadaung Project

Period	Time	Noise level measured in $L_{Aeq(1h)}$ dB(A)																			
		Dry season										Wet season									
		Nº Stations										Nº Stations									
		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Daytime	07:00-08:00	45.7	47.7	43.7	45.7	43.7	44.5	46.5	41.2	39.4	40.3	65.0	73.0	61.0	49.1	82.0	65.0	97.0	74.0	61.0	55.0
	08:00-09:00	41.5	44.3	44.3	44.7	41.3	46.6	46.6	41.6	40.7	41.7	67.0	76.0	56.0	49.1	74.0	69.0	78.0	75.0	56.0	55.0
	09:00-10:00	43.2	43.5	45.1	50.5	42.4	42.4	48.4	45.4	47.8	43.8	74.0	79.0	61.0	73.0	71.0	61.0	70.0	72.0	58.0	50.0
	10:00-11:00	45.1	40.1	43.1	48.1	48.1	46.1	47.1	42.1	45.3	45.3	67.0	78.0	62.0	62.0	63.0	64.0	53.0	68.0	56.0	44.1
	11:00-12:00	45.1	42.9	42.9	45.9	44.7	44.7	44.7	44.7	44.7	41.3	71.0	73.0	62.0	61.0	68.0	65.0	67.0	61.0	78.0	46.1
	12:00-13:00	38.7	41.8	44.8	45.8	45.8	45.8	45.8	44.8	42.8	42.8	67.0	71.0	55.0	53.0	84.0	67.0	61.0	62.0	71.0	37.6
	13:00-14:00	40.1	40.6	45.6	46.6	46.6	46.5	46.5	41.5	41.5	42.1	67.0	69.0	55.0	54.0	75.0	68.0	73.0	65.0	67.0	54.0
	14:00-15:00	41.2	43.5	42.5	42.5	42.5	42.5	42.5	42.5	39.5	39.5	69.0	71.0	52.0	50.1	64.0	61.0	74.0	66.0	62.0	53.0
	15:00-16:00	45.6	44.2	47.2	45.2	45.2	40.3	40.3	40.3	40.3	39.4	65.0	70.0	44.0	74.0	74.0	67.0	62.0	61.0	60.0	68.0
	16:00-17:00	39.5	39.2	44.0	47.5	43.8	43.8	43.8	39.8	39.8	40.6	64.0	74.0	47.0	69.4	60.0	56.0	54.0	64.0	58.0	59.0
	17:00-18:00	39.0	41.7	45.7	47.7	42.3	42.3	47.3	42.3	39.0	39.0	66.0	65.0	46.0	66.2	53.1	47.5	81.0	53.0	63.0	60.0
	18:00-19:00	40.5	39.8	43.8	43.8	40.8	41.8	41.8	41.8	41.8	41.8	56.2	55.1	54.0	61.0	60.0	44.4	54.0	43.6	51.0	64.0
	19:00-20:00	38.0	40.9	43.9	47.9	39.3	37.8	38.7	38.7	38.7	38.7	66.0	47.4	56.0	62.4	58.0	45.9	51.1	42.6	58.0	61.0
	20:00-21:00	39.4	42.5	47.5	43.5	36.5	41.2	41.2	41.2	41.2	38.1	51.6	46.8	68.0	61.8	50.2	43.4	43.2	49.1	39.2	59.0
	21:00-22:00	37.5	41.3	43.1	47.1	42.1	42.1	38.1	38.1	38.1	36.8	58.1	61.0	59.0	62.1	58.0	45.8	48.3	41.4	38.4	60.0
	LAeq-Daytime	**42.2**	**42.8**	**44.7**	**46.6**	**43.9**	**43.8**	**45.0**	**42.2**	**42.3**	**41.3**	**67.5**	**72.9**	**59.9**	**66.5**	**75.4**	**63.8**	**85.5**	**67.9**	**67.8**	**60.0**
	Noise Level Guidelines [(1)]	**65**	**65**	**55**	**55**	**65**	**55**	**55**	**55**	**55**	**55**	**65**	**65**	**55**	**55**	**65**	**55**	**55**	**55**	**55**	**55**
Night-time	22:00-23:00	38.5	41.5	42.5	43.6	47.5	47.5	44.5	41.5	41.5	39.4	64.0	70.0	76.0	59.0	47.6	63.0	42.7	42.8	38.7	76.0
	23:00-24:00	40.3	39.8	45.8	45.8	45.8	45.8	45.8	38.8	38.8	38.8	64.9	67.0	56.0	68.0	63.0	66.0	44.9	45.4	60.0	56.0
	24:00-01:00	40.5	43.9	43.9	43.9	43.9	43.9	43.9	43.1	43.1	40.5	69.0	68.0	58.0	66.0	69.0	62.0	56.0	63.0	61.0	63.0
	01:00-02:00	41.2	42.9	42.9	42.9	42.9	41.7	47.7	41.7	41.7	37.9	75.0	69.0	63.0	74.0	61.0	64.0	58.0	60.0	68.0	51.0
	02:00-03:00	46.7	43.3	43.3	43.3	43.3	43.3	43.3	43.3	44.3	44.3	69.0	70.0	67.0	74.0	60.0	81.0	58.0	65.0	71.0	67.0
	03:00-04:00	39.8	41.6	39.6	45.6	42.6	42.6	42.6	42.6	42.6	42.6	73.0	70.0	57.0	82.0	69.0	72.0	77.0	62.0	72.0	56.0
	04:00-05:00	42.7	41.1	45.1	42.7	45.1	43.5	43.5	43.5	43.5	43.5	74.0	46.8	56.0	75.0	62.0	74.0	76.0	63.0	49.1	58.0
	05:00-06:00	43.7	43.2	49.2	45.2	45.2	45.2	38.2	38.2	38.2	38.2	72.0	70.0	63.0	69.0	73.0	73.2	77.0	75.0	53.1	62.0
	06:00-07:00	41.7	42.5	51.5	41.5	42.5	42.8	42.8	42.8	42.8	42.8	67.0	70.0	67.0	63.0	42.8	74.1	73.0	74.0	69.0	62.0
	LAeq-Night time	**42.4**	**42.4**	**46.3**	**44.0**	**44.6**	**44.4**	**44.2**	**42.0**	**42.2**	**41.5**	**71.2**	**68.9**	**67.9**	**74.6**	**66.7**	**74.0**	**72.5**	**68.7**	**67.0**	**67.6**
	Noise Level Guidelines [(1)]	**55**	**55**	**45**	**45**	**55**	**45**	**45**	**45**	**45**	**45**	**55**	**55**	**45**	**45**	**55**	**45**	**45**	**45**	**45**	**45**

Prepared by Knight Piésold.

Source: MWMCL

Notes:

[(1)] Noise Level Guidelines according to IFC (2007). Noise impacts should not exceed the levels or result in a maximum increase in background levels of 3 dB at the nearest location off-site.

Noise level guidelines according to WHO (1999):

Receptor	Daytime / Night-time	Noise exceedance
Residential (IFC criteria)	55 / 45	
Residential close to highway (OECD criteria)	65 / 55	

Furthermore, the samplings also provided measurement results for meteorological parameters, which are shown in Table 5.

Table 5: Meteorological conditions during noise quality sampling

Season (2013)	Station	Parameters			
		Temperature ºC	Relative humidity (%)	Wind speed (m/s)	Wind direction
Dry	1	29-31	41-63	2.5-3.3	167 (S)
	2	29-31	40-64	2.6-3.5	178 (S)
	3	26-42	41-63	2.5-3.4	158 (S)
	4	25-42	41-63	2.4-3.8	169 (S)
	5	26-45	41-60	2.8-3.9	175 (S)
	6	23-40	40-61	2.3-3.5	164 (S)
	7	23-38	40-65	2.3-3.5	165 (S)
	8	23-37	40-68	2.3-3.5	172 (S)
	9	23-41	40-66	2.5-3.6	164 (S)
	10	24-41	41-67	2.6-3.8	172 (S)
Wet	1	29.9-30.4	36-93	0.5-3.3	177 (S)
	2	30.4-31.1	40-91	0.6-3.5	174 (S)
	3	34.8-41.7	41-83	0.5-3.4	168 (S)
	4	34.8-41.9	41-83	0.4-3.8	175 (S)
	5	34.8-42.4	41-90	0.8-3.9	176 (S)
	6	35.8-44.6	40-81	0.3-3.5	168 (S)
	7	37.6-39.4	40-85	0.3-3.5	167 (S)
	8	35.3-37.8	40-90	0.3-3.5	173 (S)
	9	35.1-36.9	40-96	0.5-3.6	166 (S)
	10	37.4-41	41-87	0.6-3.8	177 (S)

Source: MWMCL

4.1.3 Vibration Quality Baseline

Vibration measurements conducted within the project's environmental baseline area were recorded in mm/s and are given in Table 6.

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Table 6: Vibration levels around Letpadaung Project area

Location	Vibration levels (mm/s)						Safe level according to DIN 4150-3 (mm/s)[1]		
	Hot dry season			Wet season			MSB	RB	IB
	Mean	Max	Min	Mean	Max	Min			
Station 1	0.371	1.400	0.000	0.360	1.500	0.000	3	5	20
Station 2	0.510	3.000	0.100	0.515	3.000	0.100	3	5	20
Station 3	1.383	4.800	0.400	1.410	5.900	0.400	3	5	20
Station 4	0.298	0.800	0.100	0.294	0.700	0.100	3	5	20
Station 5	0.229	1.200	0.100	0.225	1.200	0.100	3	5	20
Station 6	0.958	4.500	0.200	0.990	4.500	0.200	3	5	20
Station 7	0.360	1.500	0.000	0.373	1.500	0.000	3	5	20
Station 8	0.329	1.400	0.100	0.338	1.500	0.100	3	5	20
Station 9	0.279	1.300	0.100	0.271	1.200	0.100	3	5	20
Station 10	0.233	1.100	0.100	0.223	1.200	0.100	3	5	20

Prepared by Knight Piésold.
Source: MWMCL
Notes:
(1) Safe level for frequency less than 10 Hz
(2) MSB = More sensitive buildings
(3) RB = Residential buildings
(4) IB = Industrial buildings. Commercial, Industrial or Similar
Legend:

x	Values greater than MSB standard
x	Values greater than RB standard
x	Values greater than IB standard

In order to assess the mean records obtained at stations close to roads (stations 1, 2, 3 and 5), it has been considered to compare them to standards established by the Federal Transit Administration (FTA) of the U.S. Department of Transit. Based on mean vibration level records, expressed in mm/s, the velocity level was determined in $Lv_{ref\ 1\ \mu inches}$ (VdB) units. The velocity level (L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref1:\frac{micro\ in.}{sec}} = 20 \times \log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is the RMS (Root Mean Square) of velocity amplitude, and v_{ref} is the reference velocity amplitude.

Table 7: General assessment of vibration levels recorded close to roads

Location	Vibration levels in VdB ref 1 micro inch/sec		General assessment according to FTA(1)		
	Season		Category		
	Hot dry	Wet	C1(2)	C2(3)	C3(4)
Station 1	**83.3**	**83.0**	65	72	75
Station 2	**86.1**	**86.1**	65	72	75
Station 3	**94.7**	**94.9**	65	72	75
Station 5	**79.1**	**78.9**	65	72	75

Prepared by Knight Piésold.
Notes:
(1) Standard values for frequent events are defined as more than 70 vibration events of the same source per day (FTA, 2006). Most rapid transit projects fall into this category.
(2) C1 = Category 1. Buildings where vibration would interfere with interior operations
(3) C2 = Category 2. Residences and buildings where people normally sleep
(4) C3 = Category 3. Institutional land use, mainly during daytime
Legend:

x	Values greater than C1 standard
x	Values greater than C2 standard
x	Values greater than C3 standard

According to results shown in Table 7, vibrations are clearly felt by inhabitants who are close to the referred stations. According to FTA criteria (2006), the area close to these stations is suitable for dwellings that present resistant structures rather than for sensitive buildings.

4.2 METEOROLOGICAL INFORMATION

In order to model air quality dispersion (AERMOD View v. 8.2) and noise propagation (Sound PLAN v. 7.2), weather data generated by the MM5 model[1] has been used. This model contains hourly ground-level and vertical data. This data comprises the period from January 2010 to December 2012 and is representative for an area of 144 km^2 (MM5 model grid area), which is where the Letpadaung Project lies. The information generated by the MM5 model is based on global reanalysis climate data provided by the National Center for Environmental Protection (NCEP). This information has a resolution of 2.5 degrees for the entire planet, with records for every 6 hours. Table 8 shows the characteristics of information generated by the MM5 model.

[1]Developed by Pennsylvania State University (PSU) and National Center for Atmospheric Research (NCAR). MM5 meteorological model is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation.

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Table 8: Surface & Upper air met data pre-processed from MM5 meteorological model

Met data information	
Met data type:	AERMET-Ready (Surface &Upper air data)
Star-End date:	Jan 01, 2010 – Dec 31, 2012
Latitude:	22.084864 N
Longitude:	95.090047 E
Datum:	WGS84
Site time zone	UTC/GMT UTC + 6 hour(s)
Place:	Letpadaung Project
Calculated pseudo met station parameters	
Anemometer height:	14 m
Station base elevation:	98 m
Upper air adjustment:	-6 hour(s)
MM5-Processed grid cell	
Grid cell center (Lat, Lon):	22.084864 N, 9.090047 E
Grid cell dimension:	12 km x 12 km
Information of MM5 model:	http://www.mmm.ucar.edu/mm5/mm5-home.html
Hourly surface met data (*.sam)	
Format:	SAMSON (surface met data for preprocessing by AERMET)
Output interval:	Hourly
File format description:	http://www.webmet.com/MetGuide/Samson.html
Upper air data (*.ua)	
Format:	TD-6201 – Fixed Length (upper air met data for pre-processing by AERMET).
Data reported:	UTC/GMT
Output interval:	00Z and 12Z
File format description:	http://www.webmet.com/MetGuide/TD6200.html

Prepared by Knight Piésold
Source: Lakes Environmental Software

The hourly surface parameters that have been pre-processed by AERMET are:

- Total cloud cover (tenths)
- Dry bulb temperature (ºC)
- Dew point temperature (ºC)
- Relative humidity (%)
- Station pressure (mb)
- Wind direction (deg)
- Wind speed (meter/second)
- Ceiling height (m): 77777 = unlimited ceiling height
- Hourly precipitation quantity (hundreds of inches)

Graph 1 shows the variations of each meteorological parameter throughout the period 2010-2012, where one can see each parameter's variation. It also allows distinguishing the dry[2] (November to April) and wet season (May to October). Considering the information period 2010-2012, one can observe that temperatures vary between 10 and 35 °C; relative humidity, between 40 and 100%; atmospheric pressure, between 985 and 1005 mbar; wind speed, between calms (0 m/s) and 9 m/s; cloud cover, between partly clear sky (2-5 tenths) and cloudy sky (6-10 tenths); and cloud altitude is higher during the dry season (3,000-9,000 m) and lower during the wet season (2,500 m approximately).

Regarding wind speed (Graph 2), one can see that 2 directions predominate: the northern winds (September to May) and the southern ones (June to September); this behaviour seems to be influenced by monsoons, due to transportation of moist air masses that come from the south and dry air masses from the north. With respect to precipitation, Graph 3 shows the variation of this parameter throughout the months between 2010 and 2012; one can make out that monthly cumulative precipitation is higher during July, reaching a maximum of 384.81 mm in 2012. Table 9 shows daily precipitation values throughout the assessment period (2010-2012).

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[2] The dry season is divided into a cold-dry period (November to February) and a warm-dry one (March to April).

Graph 1: Hourly surface met data from January 2010 to December 2012

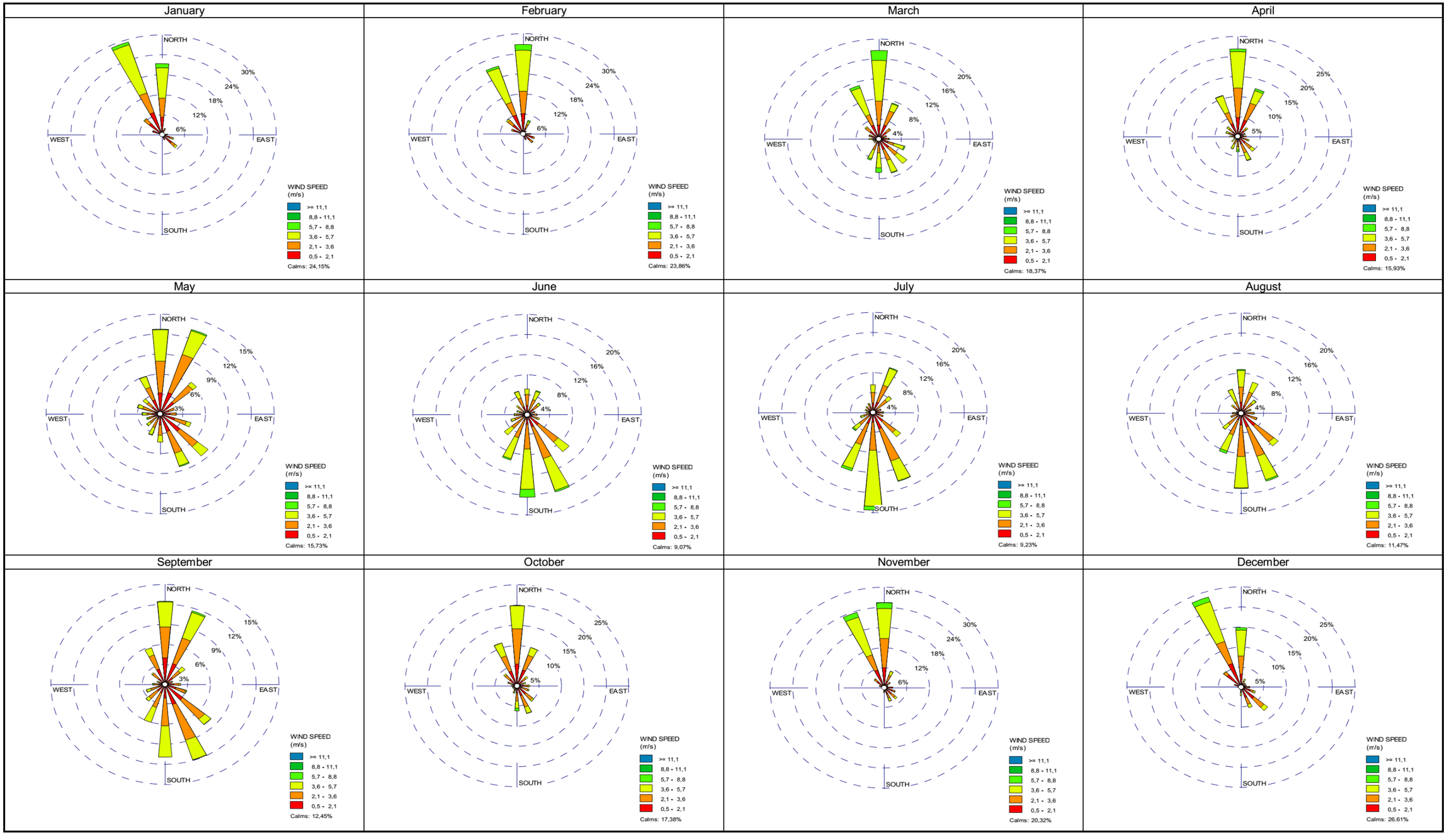
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Dry bulb temperature (°C)
40
35
30
25
20
15
10
5
Relative humidity (%)
120
100
80
60
40
20
Station pressure (mb)
1010
1005
1000
995
990
985
980
975
Wind speed (m/s)
10
9
8
7
6
5
4
3
2
1
0
Total cloud cover (tenths)
10
9
8
7
6
5
4
3
2
1
Ceiling height (m)
10000
9000
8000
7000
6000
5000
4000
3000
2000

Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

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Graph 2: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold.
Sources: Lakes Environmental Software.

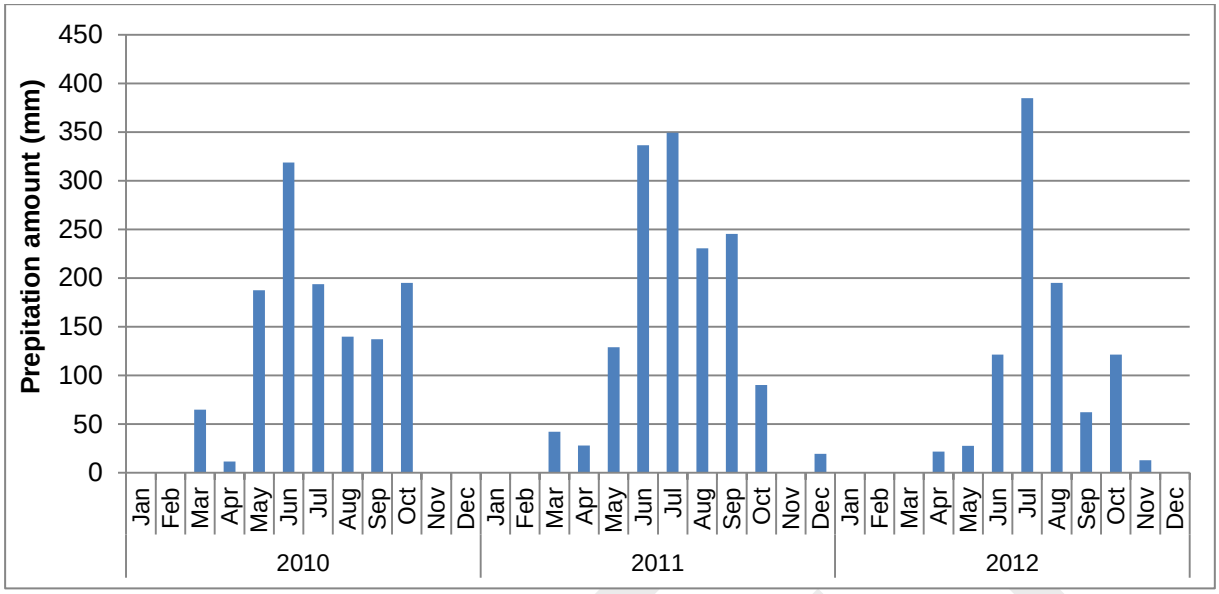
Table 9: Daily precipitation amount (mm) by year (2010 - 2012) - Letpadaung Project

Day	2010												2011												2012											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	2.79	0	0	13.46	1.524	0	0	0	0	0	0	0	0	0	32.5	5.08	1.02	0	0	0	0	0	0	0	0	9.65	13.7	2.54	7.37	0	0.76	1.27	0
2	0	0	0	0	0	0	12.45	2.794	4.826	0	0	0	0	0	0	0	0	0	3.05	5.84	0	0	0	0	0	0	0	0.51	0	7.11	2.29	7.87	0	0.25	0	0
3	0	0	0	0	3.302	0	3.556	28.45	61.47	2.032	0	0	0	0	0	0	0	0	1.02	0	0	3.81	0	0	0	0	0.51	0	0	8.38	2.29	0	0	0	0	0
4	0	0	0	0	0	0	0	57.66	2.286	3.048	0	0	0	0	0	0	0	0	3.3	7.11	0	1.02	0	0	0	0	0	0	0	1.02	3.56	31.8	27.7	0	0	0
5	0	0	0	0	0	0.254	3.81	1.27	1.016	0	0	0	0	0	0	0	0	0	7.11	5.84	12.7	0	0	0	0	0	0	3.56	0	0	1.78	0.51	2.03	3.3	0	0
6	0	0	0	0	0	2.794	0	1.524	0	12.45	0	0	0	0	0	0	2.29	4.57	2.54	2.29	14	16.5	0	0	0	0	0	0	0	0	2.79	10.7	1.52	0	0	0
7	0	0	0	0	0	0	0	5.588	0	7.874	0	0	0	0	0	0	0	2.79	0	16.8	20.6	7.62	0	0	0	0	0	0.51	0	0	5.33	12.2	14	28.7	0.25	0
8	0	0	0	0	0	0	0.508	0	0.762	13.72	0	0	0	0	0	0	0.25	24.6	0	37.1	14.2	6.6	0	0	0	0	0	2.54	0	0	4.83	1.27	5.59	4.06	4.32	0
9	0	0	0	0	0	40.13	0	0	7.62	25.4	0	0	0	0	0	0	0	24.9	0	20.6	0	0	0	0	0	0	0	7.62	0	5.33	8.13	4.32	3.56	3.56	2.29	0
10	0	0	0	0	0	2.286	0	0	0.508	6.35	0	0	0	0	0	0	0	0	0	32	20.3	0	0	0	0	0	0	0.51	0	3.56	2.54	8.64	0	22.6	0	0
11	0	0	0	0	0.254	44.96	9.398	0	0	19.3	0	0	0	0	0	0	0	0	0	2.29	0	0	0	0.76	0	0	0	2.54	0	0	2.03	15.5	0	52.8	0	0
12	0	0	0	0	0.254	27.94	0.254	0	0	0	0	0	0	0	0	0	0	0	4.57	8.64	0	0	0	0.76	0	0	0	1.02	0.51	1.52	3.05	15	0	0.76	0	0
13	0	0	0	0	0	7.366	5.08	0	7.874	0	0	0	0	0	0	0	0	0	0	13.7	10.7	0	0	0	0	0	0	0	0	0	2.54	7.37	0	0	0	0
14	0	0	0	0	0	5.842	1.27	1.524	1.778	2.54	0	0	0	0	0	0	0	5.59	0	1.52	6.6	0	0	0	0	0	0	0	0.51	0.25	4.83	2.54	0	0	0	0
15	0	0	0	0	0	23.62	2.54	0.254	0	11.68	0	0	0	0	0	0	0	24.9	0	0	12.7	0	0	0	0	0	0	0	0.25	0	26.2	4.83	0	0	0	0
16	0	0	0	0	2.032	11.43	0	1.016	4.318	0.762	0	0	0	0	0.76	0	0.25	9.14	15.5	1.02	22.1	4.83	0	0	0	0	0	0	0	1.52	0	0	0	0	0	0
17	0	0	0	0	0	22.1	0.254	0	0	1.27	0	0	0	0	0	0	0	13.2	2.29	0	42.7	14.2	0	0	0	0	0	0	0	1.52	2.29	0.76	0	4.57	0	0
18	0	0	0	0	0	2.794	0	0	1.27	0	0	0	0	0	0	0	4.32	64	2.29	0	5.33	25.7	0	0	0	0	0	0	0	6.35	4.83	0	0	0	3.3	0
19	0	0	0	0	8.636	35.31	0	6.858	26.16	2.54	0	0	0	0	0	0	0	3.3	24.1	3.81	2.03	0	0	0	0	0	0	0	0	0	6.86	5.84	0	0	0	0
20	0	0	0	0	36.07	1.27	5.334	2.54	0	6.858	0	0	0	0	0	0	1.27	41.7	102	0	0	6.86	0	0	0	0	0	0	0	30.5	0	24.9	0	0	0.51	0
21	0	0	0	7.62	11.68	2.54	0	0	0	0.762	0	0	0	0	0	14.2	0	0.25	87.1	0.76	56.4	0.25	0	0	0	0	0	0	0	0.76	0	9.14	0	0	0.76	0
22	0	0	0	0	1.016	0	0	0	0	22.61	0	0	0	0	0	0	0	1.27	19.1	10.2	5.08	0	0	0	0	0	0	0	0	2.03	0	1.52	0	0	0	0
23	0	0	0	0	3.556	5.334	3.048	0	0.508	24.13	0	0	0	0	0	0.25	0	0	0.51	0	0	0	0	0	0	0	0	0	0	9.65	3.81	1.27	0	0	0	0
24	0	0	0	0	39.37	25.91	0	1.778	7.62	4.572	0	0	0	0	0	0.76	0	0	33.8	0	0	0	0	0	0	0	0	0	0	7.87	4.06	0	0.25	0	0	0
25	0	0	0	1.02	29.97	38.35	0	10.16	0	0	0	0	0	0	0	9.91	0	3.05	26.4	0	0	0	0	0	0	0	0	0	0.25	4.32	9.4	7.11	0	0	0	0
26	0	0	0	0	4.318	0.508	0	2.032	8.89	0.254	0	0	0	0	3.81	1.02	0.51	30.7	9.4	1.78	0	0	0	0	0	0	0	0	0	4.32	13	0	4.57	0	0	0
27	0	0	3.3	0	12.95	10.41	2.286	0.508	0	0	0	0	0	0	2.03	0	5.84	9.65	0.25	27.4	0	0	0	9.4	0	0	0	0	0	4.83	62.2	0	0	0	0	0
28	0	0	23.6	0	5.08	7.62	13.46	4.318	0.254	0	0	0	0	0	19.6	1.78	4.57	16	0	1.78	0	2.79	0	8.38	0	0	0	2.79	0.76	0.25	29.5	2.29	1.02	0	0	0
29	0		19.8	0	3.302	0	88.9	3.556	0	0.508	0	0	0		4.06	0	21.3	20.1	0	5.59	0	0	0	0	0	0	0	0	0	0	106	5.84	0	0	0	0
30	0		8.13	0	22.86	0	22.1	5.08	0	26.42	0	0	0		11.7	0	34	4.06	0	8.38	0	0	0	0	0		0	0	13.7	6.6	57.4	6.6	1.78	0	0	0
31	0		9.91		2.794		6.096	1.27		0		0	0		0		54.1		0	15		0		0	0		0		1.78		10.9	0		0		0
Total	**0**	**0**	**64.8**	**11.4**	**187.5**	**318.8**	**193.8**	**139.7**	**137.2**	**195.1**	**0**	**0**	**0**	**0**	**41.9**	**27.9**	**129**	**336**	**349**	**230**	**245**	**90.2**	**0**	**19.3**	**0**	**0**	**0.51**	**21.6**	**27.4**	**121**	**385**	**195**	**62**	**121**	**12.7**	**0**

Prepared by Knight Piésold.

Source: Lakes Environmental Software.

Graph 3: Monthly wind rose plot (2010 - 2012)



Prepared by Knight Piésold
Source: MWMCL

As part of complementary information to estimate the inventory of emissions due to wind erosion, weather data shown in Table 10 was used. This weather data was recorded between July 1995 and April 2007 by the weather station located in the project area.

Table 10: Maximum wind speed (July 1995 to April 18, 2007)

Month	Year/ maximum wind speed[(1)]									Maximum
	1995	1996	1997	2001	2003	2004	2005	2006	2007	
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6

Prepared by Knight Piésold
Source: MWMCL
Notes:
[(1)] Weather station collapsed and broke into pieces due to strong wind (April 18, 2007, 16:35 hr).

4.3 AIR QUALITY DISPERSION MODELING

Air quality dispersion modelling took place for the project's construction and operation phases, taking into account the influence of changes caused by the dry and wet season (mainly wind speed variations due to monsoon influence).

Considering the project's extractive characteristics, dust emissions (PM_{10} and $PM_{2.5}$) have been inventoried; of these emissions, it was considered modelling PM_{10} emission dispersion, given that it is seen as an air quality impact indicator for extractive open pit mining activities (Vallero, 2008).

4.3.1 Particulate Matter Emission Inventory

Estimation of emission factors[3] (*EF*) for particulate matter ($PM_{10}$and $PM_{2.5}$), based on each assessed activity, was performed by applying standardized methods approved by the United States Environmental Protection Agency (USEPA), which are published in the AP-42 Guide, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources (USEPA, 1995-2011). Moreover, the parameters used for estimating the *EF* were based on the specific project characteristics for the construction and operation phases. These parameters were provided by MWMCL, while meteorological parameters were based on weather data generated by the MM5 model and weather station records about maximum wind speed:

- Total blast area (m^2)
- Relative humidity content of material (%)
- Material drop height from excavators (m)
- Fine particle content of material (%)
- Mean vehicle weight (Mg)
- Fines load on paved road surface (g/m^2)
- Mean wind speed in project area (m/s)
- Number of days and hours with precipitation above 0.254 mm

[3]According to USEPA, an emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity linked with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per megagram of material handled).

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- Sulphur content in diesel fuel[4]
- Vehicle fleet power in kW units

After estimating *EF* per activity, PM_{10} and $PM_{2.5}$ (units: kg/year and g/s) were estimated by applying the general emission estimation equation (USEPA, 1995-2011):

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where *E* is emission, *A* is activity rate, *EF* is emission factor, and *ER* is overall emission reduction efficiency in percent. Estimation of activity levels (A) was based on available project-related information for the construction and operation phases:

- Area of each component
- Number of drilling and blasting events per month
- Material volume obtained per blast
- Number of front loaders (loader and dozer), trucks (light and heavy) and vehicles (pickup trucks)
- Load capacity of loaders and trucks, in tons
- Tons of topsoil removed (tons/month)
- Machinery operation time per day (hours)
- Kilometres covered by machinery per day
- Monthly excavated material volume
- Material hauling by trucks (tons/month)
- Material unloading by trucks (tons/month)
- Length of paved and unpaved roads (km)
- Mean annual evaporation level in inches
- Frequency of hours watering unpaved roads
- Watering intensity on unpaved roads (gallons per square yard)
- Maximum monthly wind speed (m/s)
- Soil texture characteristics and fines content at surface (%)
- Waste rock dump sizes (m^2)

[4]A sulfur content value of 2,000 ppm has been assumed, based on information from the United Nations Environment Programme (UNEP) – Diesel Fuel Sulphur Levels: Global Status December 2012, available at: www.unep.org/transport/pcfv

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The construction phase includes activities that will be performed within the area comprising the mine, access roads, and the road close to the project site. Table 11 shows a list of activities that will be carried out during the construction phase.

Table 11: Activities during construction phase

Component	Activity
Mining area	Drilling Blasting Bulldozing (removing topsoil) Bulldozing (travel mode) Crawler dozer and grading Digging Loading trucks Unloading trucks in waste rock dumps Fuel consumption (diesel)
Unpaved roads	Travel of mining dump truck from digging area to waste rock dumps Travel of light trucks Fuel consumption (diesel)
Paved roads (highway near to mining area)	Travel of light vehicles Fuel consumption (diesel)

Prepared by Knight Piésold

The operation phase includes activities that will take place within the area comprising the pit, material haul roads, waste rock dumps, crushers and road close to project area. Table 12 shows a list of activities that will be performed during this phase.

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Table 12: Activities during operation phase

Component	Activity
Open pit	Drilling Blasting Earthmoving in blast area (loader, crawler dozer and ballgrader) Loading of dump trucks delivering ore and waste rock Loader travel in blast area Fuel consumption by equipment (trucks, dozer, and others) Haul truck travel in blast area to crushers (dust from wheeled) Haul truck travel in blast area to crushers (dust from exhaust)
Road from open pit to waste rock areas	Haul truck travel to waste rock storage area (dust from wheeled) Haul truck travel to waste rock storage area (dust from exhaust)
Waste rock storage areas (WRD1 and WRD2)	Haul truck unloading at waste rock areas Dozer activity in waste rock areas Wind erosion in WRDs, applied to maximum wind speed
Crushers semi-mobile	Unloading to each semi-mobile crusher Primary crushing (High-moisture ore) Material handling and transfer for each point (High-moisture ore)
Highway near to mining area	Light duty vehicles (dust from wheeled) Light duty vehicles (dust from exhaust)

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Construction Phase

During the construction phase, activities related to drilling and blasting, earthworks (topsoil removal, excavations and land grading), loading and unloading of materials by trucks, and light and heavy vehicle traffic on paved and unpaved roads will take place.

Table 13 shows the assessed activities and their emission factors, for which equations including a scaling factor representing a particle-size dependent emission magnitude have been used. Based on an activity-level assignment, emissions have been determined according to their source. Table 14 shows emissions according to source type.

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Table 13: Emission factors during construction phase

Activity	Description	Scaling Factors (k)		Emission factor equations by activity [1, 2, 3]		Emission factor (EF)			Reference [1]
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Drilling for blasting	-	0.52	0.03	EF = k*0.59	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
Blasting	-	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	0.10349	0.00597	kg/blast	AP-42 Blasting - Section 11.9
Earthmoving (overburden, removing topsoil)	Bulldozing (removing top soil)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	1.67006	1.83253	kg/hr	AP-42 Dozer equation - Section 11.9
	Bulldozing travel mode	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	3.00776	0.30078	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Crawler dozer and grading	0.25	0.025	EF = k*0.029	EF	0.00725	0.00073	kg/Mg	AP-42 Dozer equation - Section 11.9
	Excavator	0.75	0.017	$k*0.0029\ (d)^{0.7}/(M)^{0.3}$	$k*0.0046\ (d)^{1.1}/(M)^{0.3}$	0.00547	0.00012	kg/m^3	NERDDC (1988) & SPCC (1983), cited by NPI (2012)
	Fuel consumption - earthmoving	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]
Trucks loading	Digging area	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Loading equation - Section 13.2.4
Trucks unloading	Waste dump	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00003	0.00000	kg/Mg	AP-42 Unloading equation - Section 13.2.4
Material transport - roads	Unpaved roads - Mining dump truck	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.28337	0.12834	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Unpaved roads - Light trucks	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.65094	0.06509	kg/VKT	AP-42 Travel on unpaved roads - Section 13.2.2
	Paved roads	0.62	0.15	$EF = [k\ (sL)^{0.91}*(W)^{1.02}]*(1-1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.1
	Fuel consumption - light truck and light duty vehicles	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF-S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor [2]
	Fuel consumption - Mining dump truck	1	0.97	$EF_{adj(PM)} = 0.1316*TAF*0.473-S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor [2]

Prepared by Knight Piésold.

[1] Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).

[2] Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

[3] Symbols for equations:	Value	Description
A: Area per blast (m^2)	93.5	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	10	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	21.1	Moisture content of overburden, material handling by excavator and bulldozers.
M: Material moisture content (%)	17	Moisture content of overburden, material handling by loading and unloading.
d: drop height (m)	13.8	Excavator.
s: Material silt content (%)	10	Silt content of material on unpaved roads.
s: Material silt content (%)	50	Silt content of material overburden.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer
W: Mean vehicle weight (Mg)	113	Dump Truck (TR100, TEREX). Average weight between net weight and net load.
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Representative value, source: Table 13.2.1-3, Section 13.2.1 Paved Roads.
P: Precipitation with at least 0,254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0,254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 14: Construction phase – Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Mining area	116,354.3	3.6896	67,658.0	2.1454
Line	Paved roads – Highway	30,212.9	0.9580	11,170.1	0.3542
	Unpaved roads - Mining Dump truck	105,052.2	3.3312	40,190.2	1.2744
	Unpaved Roads - Light trucks	16,392.3	0.5198	4,637.8	0.1471
Total		268,011.6	8.4986	123,656.0	3.9211

Prepared by Knight Piésold.

Below, calculation of PM_{10} and $PM_{2.5}$ emissions is detailed for each activity.

Drilling and Blasting

Drilling and blasting activities are considered for extracting construction materials, rock removal and preparing the land for setting up facilities and/or building infrastructure. Calculation of particulate matter emissions due to drilling considers the number of drilling events to be performed, while the calculation corresponding to blasting events considers the number of blasting events to be conducted and the horizontal area removed by each blast. It is worth highlighting that no particulate matter emission reduction control measures have been considered for these activities. Table 15 shows emission estimation results for drilling and blasting activities. Equations considered for emission estimation are the following:

$$E = EF \times N$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor, and *N* is the number of drilling events performed per year.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is a scaling factor based on size of emitted particles, *N* is the number of blasting events per year, and *A* is the horizontal area removed by blasting (m^2). Total blasting area considered was 24,693.08 m^2 per year, while 22 blasting events equivalent to a volume of 180,000 m^3 were considered per month. Based on this information, a value of *A* = 93.5 m^2 per blast was determined.

Table 15: Construction phase - Drilling, blasting, earthmoving and handling

Activity	Installation/Sub activity	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
Drilling	Mining area	10,800	hole/yr	0.30680	0.01770	kg/hole	3 313.4	0.105	191.2	0.006
Blasting	Mining area	264	blast/yr	0.10349	0.00597	kg/blast	27.3	0.001	1.6	0.000
Bulldozing (removing top soil)	Mining area	29,200	hr/yr	1.67006	1.83253	kg/hr	48,765.9	1.546	53 509.8	1.697
Bulldozing travel mode	Mining area	3,650	VKT/yr	3.00776	0.30078	kg/VKT	10,978.3	0.348	1 097.8	0.035
Crawler dozer and grading	Mining area	3 600,000	Mg/yr	0.00725	0.00073	kg/Mg	26,100.0	0.828	2 610.0	0.083
Digging by excavator	Mining area	3 000,000	m^3/yr	0.00547	0.00012	kg/m^3	16,413.9	0.520	372.0	0.012
Loading trucks	Mining area	12 000,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	378.1	0.012	57.3	0.002
Unloading trucks	Waste Dump	9 600,000	Mg/yr	3.15E-05	4.77E-06	kg/Mg	302.5	0.010	45.8	0.001
Fuel consumption (diesel)	Drilling and blasting	16 060,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,916.4	0.092	2 828.9	0.090
	Bulldozing (loader, dozer, crawler and grader)	26 280,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	4,772.2	0.151	4 629.1	0.147
	Excavator in mining area	13 140,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	2,386.1	0.076	2 314.5	0.073
Total							**116,354**	**3.690**	**67,658**	**2.145**

Prepared by Knight Piésold.

Data input used to estimate activity rates:

Description	Value	Notes	Source
Number of hole by month	900	Depth of 10,350 m	Myanmar Wanbao Mining Copper Limited
Number of blast by month	22	Quantity = 180,000 m^3	Myanmar Wanbao Mining Copper Limited
Number of loader and dozer for bulldozing	10	Models: LW800K, ZL50G, MD32	Myanmar Wanbao Mining Copper Limited
Removing topsoil (tonnes/month)	300,000	2 Grader and 6 crawler dozer.	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Kilometer travelled per loader	1	km/day from 8:00 a.m. - 6:00 p.m.	Value estimated by extension area of the project.
Material handling	250,000	Volume of material in m^3/month for digging.	Myanmar Wanbao Mining Copper Limited
Material handling	1000,000	Material loading tonnes/month.	Myanmar Wanbao Mining Copper Limited
Material handling	800,000	Material unloading tonnes/month.	Myanmar Wanbao Mining Copper Limited

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Earthmoving

Estimation of particulate matter emission due to earthmoving activities comprises piling up and arranging materials, stripping, filling, machinery traffic, grading and excavation. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 15 shows emission results for the mentioned activities.

Equations considered for estimating emissions based on each activity are detailed below.

Bulldozing (Removing Topsoil)

Equations from USEPA's Guide AP-42, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation that determines PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation to calculate $PM_{2.5}$ emissions is the one below:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is the scaling factor based on size of emitted particles, *s* is fine particle content (%), *M* is the material's moisture content (%) and *T* is machinery operation time (hours). Values assigned are *s* = 50%, *M* = 21.1% and *T*= 29,200 h/year.

Bulldozing Travel Mode

Particulate matter emissions caused by earthmoving machinery travel were estimated through the following equations (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is the emission factor in kg/VKT units, *VKT* is total kilometres covered by machinery per year (km/year), *k* is a scaling factor constant based on size of emitted particles in lb/VMT units, *s* is fine particle content (%), *W* is mean weight of all machinery (tons), and *P* is number of days with

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precipitation above 0.254 mm per year. Values assigned are *VKT* = 3,650 km/year, *s* = 50%, *M* = 21.1% and P= 110 days/year (Lakes Environmental, 2013).

Crawler Dozer and Grading

Particulate matter emissions generated by using machinery for grading and moving topsoil were estimated through the following equation (USEPA, 1995-2011):

$$E = A \times k \times EF$$

Where *E* is PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/Mg units, and *k* is scaling factor based on size of emitted particles. Values assigned are *EF* = 0.029 kg/Mg (Table 11.9-4, Section 11.9, AP-42, USEPA) and *A* = 3600,000 Mg/year equivalent to 300,000 tons/month.

Excavating

PM_{10} emissions generated by excavator use were estimated through the following equation:

$$E = k \times 0.0029 \times \frac{d^{0.7}}{M^{0.3}} \times V$$

While the equation that determines $PM_{2.5}$ emissions is as follows:

$$E = k \times 0.0046 \times \frac{d^{1.1}}{M^{0.3}} \times V$$

Where E are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *d* is material drop height (m), *M* is the material's moisture content (%), and *V* is material volume to be removed. Values assigned are *d* = 13.8 m, *M* = 21.1% and *V* = 3,000,000 m^3/year, equivalent to 250,000 m^3/month.

Loading and Unloading of Material

Activities related to loading and unloading of material take place in different project execution areas. Haul trucks are loaded with power shovels, while the material is directly unloaded at the work fronts and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 15 shows emission estimation results for the mentioned activities.

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Emissions due to loading and unloading of material were based on USEPA's Guide *AP-42*. It is worth pointing out that the same equation is used for estimating both activities' emissions:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *k* is scaling factor based on size of emitted particles, *U* is mean wind speed (m/s), *M* is the material's moisture content (%), and *Q* is quantity of material that will be loaded or unloaded per year. Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 17% and *Q* = 12,000,000 Mg/yr (loading) and 9,600,000 Mg/yr (unloading).

Vehicle Traffic on Paved and Unpaved Roads

Considerations are that particulate matter emissions produced by vehicle traffic will have its origin in unpaved haul roads, as well as in light vehicle traffic on paved roads close to the project area. Table 16 shows particulate matter emission results.

Below, criteria considered for estimating emissions are detailed.

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Table 16: Construction phase - Material transporting

Activity	Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
Travel of mining dump truck on unpaved roads	Digging area to waste dump	105,495	Vehicles/yr	1 265,934	VKT/yr	1.28337	0.12834	kg/VKT	96	70 932	2.249	7,093	0.225
Travel of light trucks on unpaved roads	Mining area	37,960	Vehicles/yr	455,520	VKT/yr	0.65094	0.06509	kg/VKT	96	12 946	0.411	1,295	0.041
Travel of light duty vehicles on paved roads	Highway near to mining area	58,400	Vehicles/yr	876,000	VKT/yr	0.02844	0.00688	kg/VKT	-	24 910	0.790	6,027	0.191
Fuel consumption (diesel)	Digging area to waste dump	105,495	hr/yr	110 769,231	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	34 121	1.082	33,097	1.049
	Mining area	37,960	hr/yr	18 980,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	3 447	0.109	3,343	0.106
	Highway near to mining area	58,400	hr/yr	29 200,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	-	5 302	0.168	5,143	0.163
Total										**142 908**	**4.532**	**47 511**	**1.507**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	35	Route from digging area to waste dump. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Number of other trucks	13	Refuelling truck, light truck, truck with crane, and maintenance truck.	Myanmar Wanbao Mining Copper Limited
Number of light duty vehicle by hour	20	Weight vehicle between1.8 to 20 tonnes.	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	91	91 tonnes per dump truck. Model TR100, brand TEREX.	Myanmar Wanbao Mining Copper Limited
Length of unpaved roads (km)	6	Digging area (open pit) to waste dumps, averaged value.	Value estimated by extension area of the project.
Length of paved roads (km)	15	Paved roads near to mining area.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	36	Vehicles per hour for dump truck	Value calculated.
Time between water application in hours (T)	3	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.2	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

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Dust Entrainment from Unpaved Roads

Different routes are considered for hauling material between work fronts and WRDs. Particulate matter emissions caused by hauling material on considered routes were based on Section 13.2.2, Unpaved Roads of USEPA's AP-42 Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by trucks per year (km/year), *k* is scaling factor constant based on size of emitted particles lb/VMT units, *s* is fine particle content (%), *W* is mean weight (tons) of heavy trucks or light vehicles, and *P* is number of days with precipitation above 0.254 mm per year. Values assigned were *VKT* = 1,265,934 km/year for heavy trucks and 455,520 km/year for light vehicles, *s* = 10%, *W* =113 Mg (heavy trucks) and 25 Mg (light vehicles) and P= 110 days/year (Lakes Environmental, 2013). Length of assigned road route was 6 km and includes the area between the excavation area and WRDs. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (TEREX T100).

On the other hand, as a mitigation measure on dirt roads that will be used for hauling material, road watering by tank trucks is considered. Efficiency percentage of emission reduction, *ER*, has been determined by applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Where *ER* is dust reduction efficiency of watering roads with tank trucks, *A* is annual evaporation level (inches), *D* is mean vehicle traffic per hour, *T* is time between two road watering events (hours), and *I* is watering intensity (gal/yd^2). Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 36 trucks/hour, *T* = 3 hours, *I* = 2.2 gal/yd^2. Using these values in the above dust emission reduction equation yields an *ER* value of 96%.

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Dust Entrainment from Paved Roads

Paved roads closest to the study area have been considered as possible routes for construction material transportation and light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1000}$$

Where *E* are PM_{10} or $PM_{2.5}$ emissions, *EF* is emission factor in kg/VKT units, *VKT* is total kilometres covered by vehicles per year (km/year), *k* is scaling factor constant based on size of emitted particles in g/VKT units, *sL* is road surface fines load (g/m^2), *W* is mean vehicle weight (tons), and *P* is number of hours with precipitation over 0.254 mm per year. Values assigned are *VKT* = 876,000 km/year, *sL* = 2 g/m^2 (conservative value), *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons.

Fuel Consumption by Equipment and Vehicles

Emissions due to fuel consumption have been assumed to depend on percentage of sulfur in fuel, fuel type, machinery and vehicle power, load factor, and mean machinery and vehicle lifespan. Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to the following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Where $EF_{adj(PM)}$ is a sulfur content-adjusted emission factor, *AR* is the activity level (hp-hr/yr), EF_{ss} is zero-hour steady-state emission factor (g/hp-hr), *TAF* is transient adjustment factor (unitless), *DF* is deterioration factor (unitless), and S_{PMadj} is the emission factor's adjustment factor, which depends on fuel sulfur content (g/hp-hr).

Values assigned for determining emission factor are EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery) and 2.37 (heavy trucks), *DF* = 1.116, S_{PMadj} = 0.03438 (vehicles and machinery) and 0.040167 (heavy trucks).

Operation Phase

During the operation phase, activities related to drilling and blasting, earthmoving, material loading and unloading, heavy vehicle traffic on paved roads between the pit and the WRDs (haul roads), wind erosion of stockpiles at WRDs, unloading at semi-mobile crushers, materials crushing, ore handling, ore transfer to heap leach piles (HLPs), and vehicle traffic along paved roads will take place.

Table 17 shows assessed activities and their emission factors, for which equations that include a scaling factor representing emission magnitude based on particle size, have been used. According to activity level assignment, emissions were determined based on their source. Table 18 shows emissions based on source type.

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Table 17: Emission factors for mine operations

	Activity	Scaling factors (k)		Equations of emission factor by activity (1, 2, 3)		Emission factor (EF)			Reference (1)
		k ≤ 10 µm	k ≤ 2,5 µm	PM_{10}	$PM_{2,5}$	EF-PM_{10}	EF-$PM_{2,5}$	Units	
Open pit									
1	Drilling	0.52	0.03	$EF = k*0.59$	EF	0.30680	0.01770	kg/hole	AP-42 Drilling - Section 11.9
2	Blasting	0.52	0.03	$EF = k*0.00022(A)^{1.5}$	EF	3.61765	0.20871	kg/blast	AP-42 Blasting - Section 11.9
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	1.16153	kg/hr	AP-42 Dozer equation - Section 11.9
4	Loading of dump trucks delivering ore and waste rock	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Loading equation - Section 13.2.4
5	Loader travel in blast area	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	0.70659	0.07066	kg/VKT	AP-42 Travel on unpaved roads - Section 13
6	Fuel consumption by equipment (trucks, dozer, and others)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
7	Haul truck travel in blast area to crushers (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
8	Haul truck travel in blast area to crushers (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.30803	0.29879	g/hp-hr	Nonroad model emission factor (2)
Road from open pit to waste rock areas (waste road)									
9	Haul truck travel to waste rock storage area (dust from wheeled)	1.5	0.15	$EF = k(s/12)^{0.9}(W/3)^{0.45}*0.2819*[(365-P)/365]$	EF	1.47112	0.14711	kg/VKT	AP-42 Travel on unpaved roads - Section 13
10	Haul truck travel to waste rock storage area (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)
Waste rock storage areas (WRD1 and WRD2)									
11	Haul truck unloading at waste rock areas	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.00040	0.00006	kg/Mg	AP-42 Unloading equation - Section 13.2.4
12	Dozer activity in waste rock areas	0.75	0.105	$k*0.45(s)^{1.5}/(M)^{1.4}$	$k*2.6(s)^{1.2}/(M)^{1.3}$	2.58945	2.31756	kg/hr	AP-42 Dozer equation - Section 11.9
13	Wind erosion in WRDs, applied to maximum wind speed.	0.5	0.075	$EF = k\sum_{1}^{N}P_i$ $P = 58(u^*-u_t^*)^2 + 25(u^*-u_t^*)$; $P = 0$ if $u^* \le u_t^*$	EF	0.014	0.0011	$g/m^2.hr$	AP-42 Industrial wind erosion - Section 13.2.
Crushers semi-mobile									
14	Unloading to each crusher semi-movil	0.35	0.053	$EF = k*0.0016*(U/2.2)^{1.3}/[(M/2)^{1.4}]$	EF	0.0004	0.0001	kg/Mg	AP-42 Unloading equation - Section 13.2.4
15	Primary crushing (High-moisture ore)	-	0.2	$EF = 0.004$	k*EF	0.004	0.0008	kg/Mg	AP-42 Primary crushing - Section 11.24
16	Material handling and transfer for each point (High-moisture ore)	-	0.3	$EF = 0.002$	k*EF	0.002	0.0006	kg/Mg	AP-42 Material handling and transfer - Secti
Highway near to mining area									
17	Light duty vehicles (dust from wheeled)	0.62	0.15	$EF = [k(sL)^{0.91}*(W)^{1.02}]*(1\text{-}1.2P/N)/1000$	EF	0.02844	0.00688	kg/VKT	AP-42 Travel on paved roads - Section 13.2.
18	Light duty vehicles (dust from exhaust)	-	0.97	$EF_{adj(PM)} = 0.1316*TAF*DF\text{-}S_{PMadj}$	$k*EF_{adj(PM)}$	0.18159	0.17614	g/hp-hr	Nonroad model emission factor (2)

Prepared by Knight Piésold.

(1)Source: Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, AP-42 Fifth Edition (USEPA, 1995-2011).

(2) Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition Report Nº NR-009d. EPA, Office of Transportation and Air Quality. July 2010.

(2) Symbols for equations:	Value	Description
A: Area per blast (m^2)	1,000	Horizontal area with blasting depth ≤ 21 m. Not for vertical face of a bench.
M: Material moisture content (%)	2.75	Moisture content average of the blasted material and roads.
M: Material moisture content (%)	2.75	Moisture content of overburden, material handling by loading and unloading.
s: Material silt content (%)	10	Silt content in % by weight.
U: Wind speed (m/s)	2.41	Average annual from January 2010 to December 2012 (Lakes Environmental, 2013).
W: Mean vehicle weight (Mg)	30	Bulldozer and loader.
W: Mean vehicle weight (Mg)	153.1	Dump Truck TEREX (TR100, NTE260). Average weight (net weight and net load).
W: Mean vehicle weight (Mg)	25	Light truck, truck with crane, maintenance truck, and others.
sL: Road surface silt loading (g/m^2)	2	Assumed as conservative value (AP-42, Table 13.2.1-3, Section 13.2.1 Paved Roads).
P: Precipitation with at least 0.254 mm	110	Number of days in a average year (Lakes Environmental, 2013).
P: Precipitation with at least 0.254 mm	617	Number of hour in a average year (Lakes Environmental, 2013).
N: Number of hours in the averaging period	8,760	Number of hours for 1 year.
Diesel fuel sulfur level	2,000	Value assumed from www.unep.org/transport/pcfv.
Horsepower by equipment	500	Representative value for earthmoving equipment and light vehicles (load factor = 0,59)
Horsepower by equipment	1,050	Mining dump truck (load factor = 0.59)

Table 18: Operation phase - Source emission summary

Type	Sources	PM_{10} Emissions		$PM_{2.5}$ Emissions	
		kg/year	g/s	kg/year	g/s
Area	Open pit	157,889	5.0066	56,488	1,7912
Line	Open pit	202,039	6.4066	57,178	1,8131
Line	Open pit to WRD#1	46,949	1.4887	4,746	0,1505
Line	Open pit to WRD#2	4,107	0.1302	436	0,0138
Area	WRD#1	28,884	0.9159	15,118	0,4794
Area	WRD#2	2,512	0.0796	1,315	0,0417
Area	WRD#1 - wind erosion	22,241	0.7053	1,668	0,0529
Area	WRD#2 - wind erosion	1,820	0.0577	136	0,0043
Area	Crushed ore #1	14,862	0.4713	2,906	0,0922
Area	Crushed ore #2	14,862	0.4713	2,906	0,0922
Area	Transfer #1	13,500	0.4281	4,050	0,1284
Area	Transfer #2	13,500	0.4281	4,050	0,1284
Line	Highway 1	25,069	0.7949	6,181	0,1960
Line	Highway 2	35,097	1.1129	8,653	0,2744
Total		583,333	18.4974	165,832	5.2585

Prepared by Knight Piésold.

Open Pit

In the pit area, considerations are that activities related to drilling, blasting, earthmoving, material loading, truck and machinery travel along roads, and fuel consumption will take place. Tables 19 and 20 show calculation results for particulate matter emissions from the pit.

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Table 19: Emission sources in open pit - Drilling, blasting, earthmoving and loading

Activity		Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
		Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
1	Drilling	13,416	hole/yr	0.30680	0.01770	kg/hole	4 116.0	0.131	237.5	0.008
2	Blasting	604	blast/yr	3.61765	0.20871	kg/blast	2 185.1	0.069	126.1	0.004
3	Earthmoving in blast area (loader, crawler dozer and ballgrader)	43,800	hr/yr	2.58945	1.16153	kg/hr	113 418.0	3.596	50 875.0	1.613
4	Loading of dump trucks delivering ore and waste rock	69 000,000	Mg/yr	0.00040	0.00006	kg/Mg	27 853.9	0.883	4 217.9	0.134
5	Loader travel in blast area	14,600	VKT/yr	0.70659	0.07066	kg/VKT	10 316.3	0.327	1 031.6	0.033
6	Fuel consumption by equipment (trucks, dozer, and others)	21 900,000	hp-hr/yr	0.18159	0.17614	g/hp-hr	3 976.9	0.126	3 857.6	0.122
Total							**157,889**	**5.007**	**56,488**	**1.791**

Prepared by Knight Piésold.
Source: Myanmar Wanbao Mining Copper Limited.
Parameters used:

Description	Value	Notes
Number of hole by month	1,118	Total depth of 19 000 m (17 m per hole)
Number of blast by year	604	Quantity = 3.5 million tonne/month
Number of loader	5	Model: LW800K, ZL50G (XCMG).
Number of dozer	5	Model: MD32 (Inner Mongolia)
Number of crawler dozer	3	Model: CAT D9R and D475A-EO (KOMATSU).
Number of ballgrader.	2	Model: 14M (CAT).
Kilometre travelled per loader in blast area	1	km/day from 8:00 a.m. - 6:00 p.m.
Material handling in kt (kilo tonne by year)	69,000	Mining plan for year 5 (ore and waste rock).
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0.59)
Bulldozing - material moving operation	8	Hour/day from 8:00 a.m. - 6:00 p.m.

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Table 20: Emission sources in open pit - Haul truck travel in open pit

Activity		Line sources	Data		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
7	Haul truck travel in blast area to crushers (dust from wheeled)	Blast area	559,964	Vehicles/yr	1 119,928	VKT/yr	1.47112	0.14711	kg/VKT	90	159.540	5.059	15,954	0.506
8	Haul truck travel in blast area to crushers (dust from exhaust)	Blast area	8	worked hrs/Veh-day	137 970,000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	42.499	1.348	41,224	1.307
Total											**202,039**	**6.407**	**57,178**	**1.813**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10 trucks).	Myanmar Wanbao Mining Copper Limited
Haulage routes average per truck (km)	1	Material transport on unpaved roads in open pit.	Myanmar Wanbao Mining Copper Limited
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	128	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

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Drilling and Blasting

During the operation phase, drilling and blasting activities are considered necessary for ore extraction. Calculation of particulate matter emissions due to drilling considers the number of drilling events, which was estimated based on information provided by MWMCL related to drilling depth for each blasting event (17 m per hole) and total drilling distance per month (19,000 m). Furthermore, for the calculation corresponding to blasting events, MWMCL information has been taken into account, which considers a total blasting area of 603,900 m^2 per year, equivalent to a quantity of 3.5 million tons per month. It is worth noting that no particulate matter emission reduction control measures have been considered for these activities. Table 19 shows emission results for the mentioned activities.

Equations considered for estimating emissions were the following:

$$E = EF \times N$$

Value assigned for emission calculation was for *N* = 13,412 holes/yr.

$$E = k \times N \times 0.00022 \times A^{1.5}$$

According to information provided by MWMCL, total blasting area amounts to 603,900 m^2 per year and generates 3.5 million tons per month. Based on this information, the following values were determined: *A* = 1,000 m^2 per blast and *N* = 604 blasting events per year.

Earthmoving

Estimation of particulate matter emissions due to earthmoving activities comprises material stockpiling and arrangement, stripping, filling, machinery traffic, and grading. Pieces of machinery linked to this type of activity are caterpillar tractors and graders. Table 19 shows emission results for the mentioned activities.

Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) – representing topsoil removal – have been considered. The equation for calculating PM_{10} emissions is the following:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the equation used for calculating $PM_{2.5}$ emissions is as follows:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are *s* = 10%, *M* = 2.75% and *T*= 43,800 h/year.

Loading of Dump Trucks Delivering Ore and Waste Rock

Trucks are loaded with material at the pit. These materials are then transported to crusher or WRDs. Truck loading is performed by power shovels, while unloading takes place directly at semi-mobile crushers and/or waste rock dumps (WRD 1 and 2), as appropriate. Table 19 shows emission results for material loading activities.

Material loading emissions were based on USEPA's *AP-42* Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 69,000 kt/yr (load).

Loader Travel in Blast Area

Equation considered for estimating front loader emissions within blasting area is the following:

$$E = EF \times VKT$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0{,}2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned are *VKT* = 14,600 km/year, *s* = 10%, *M* = 2.75% and P= 110 days/year (Lakes Environmental, 2013). Table 19 shows emission results for activities related to machinery traffic.

Fuel Consumption by Equipment

Emissions have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010), according to the following equations:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

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Values assigned for determining the emission factor are *NA* = 21,900,000 hp-hr/yr, EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), *DF* = 1.116, S_{PMadj}= 0.03438 (vehicles and machinery).

Haul Truck Travel in Blasting Area to Crushers

Particulate matter emissions caused by hauling material between blasting area and crushers were based on Section 13.2.2, Unpaved Roads, of USEPA's *AP-42* Guide.

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

Values assigned were *VKT* = 1 119,928 km/year, *s* = 10%, *W* =153.1 Mg and P = 110 days/year (Lakes Environmental, 2013). Assigned road route length was 1 km. Truck number was determined based on the quantity of material that has to be transported and the heavy truck's load capacity (123 tons).

Emission estimation was also considered, due to the trucks' fuel consumption. This estimation was made by applying the equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

On the other hand, as a mitigation measure for dirt roads that will be used for hauling materials, road watering using tank trucks is considered. The efficiency percentage of emission reduction, *ER*, has been determined applying the following empirical equation (Cowherd *et al.*, 1988; MDAQMD, 2000):

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 128 trucks/hour, *T* = 2 hours, and *I* = 2.34 gal/yd^2. Applying these values in the above dust emission reduction equation one obtains *ER* = 90%. Emission estimation results are shown in Table 20.

Road from Open Pit to Waste Rock Areas

Roads that go from the pit boundary to waste rock dumps 1 and 2 (WRDs) generate emissions due to re-suspension of particulate matter from unpaved road surface, as well as particulate matter emissions due to the trucks' fuel combustion. These emission sources have been estimated using the following equations:

$$E = EF \times VKT \times \left(1 - \frac{ER}{100}\right)$$

$$EF = k \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45} \times 0.2819 \times \left(\frac{365 - P}{365}\right)$$

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

As control measure, it has been considered to water the roads using tank trucks. Emission reduction efficiency has been determined through the equation below:

$$ER = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

Values assigned to each parameter were *A* = 73.85 inches, equivalent to 1,876 mm/yr, *D* = 72 trucks/hour, *T* = 2 hours (8:00-10:00 a.m., 3:00-5:00 p.m.), and *I* = 2.34 gal/yd^2. Inserting these values in the above dust emission reduction equation yields *ER* = 95%.

Table 21 shows calculation results for particulate matter emissions generated along the route between pit boundary and waste rock dumps (WRDs).

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Table 21: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

Activity		Line sources	Length	Data (conservative value)		Activity rate		Emission factor (EF)			Control efficiency	PM_{10} Emissions		$PM_{2,5}$ Emissions	
			km	Value	Value	Value	Units	PM_{10}	$PM_{2,5}$	Units	%	kg/year	g/s	kg/year	g/s
9	Haul truck travel to waste rock storage area (dust from wheeled)	Open pit to WRD #1	1	291 181	Veh/yr	582 362	VKT/yr	1.47112	0.14711	kg/VKT	95	46 891	1.487	4 689	0.149
		Open pit to WRD #2	1	25 320	Veh/yr	50 640	VKT/yr	1.47112	0.14711	kg/VKT	95	4 077	0.129	408	0.013
10	Haul truck travel to waste rock storage area (dust from exhaust)	Open pit to WRD #1	1	4	worked hrs/Veh-day	189 000	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	58	0.002	56	0.002
		Open pit to WRD #2	1	2	worked hrs/Veh-day	94 500	hp-hr/yr	0.30803	0.29879	g/hp-hr	-	29	0.001	28	0.001
Total												**51 056**	**1.619**	**5 182**	**0.164**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Load capacity of mining dump truck (t)	123	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Number of mining dump truck	45	TEREX: TR100 (35 trucks) and NTE260 (10).	Myanmar Wanbao Mining Copper Limited
Horsepower of equipment	1,050	Representative value for mining dump truck (load factor = 0.59)	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	39,000	Mining plan for year 5 (WRD 1 & 2).	Myanmar Wanbao Mining Copper Limited
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Average annual evaporation in inches (A)	73.85	Pan evaporation annual equivalent to 1 876 mm/yr	Site characterisation, climate (knight Piésold, 2000)
Average hourly traffic rate (D)	72	Vehicles per hour for dump truck	Myanmar Wanbao Mining Copper Limited
Time between water application in hours (T)	2	8:00 - 10:00 a.m., 3:00 - 5:00 p.m.	Myanmar Wanbao Mining Copper Limited
Water application intensity (I)	2.34	Gallons per square yard	Myanmar Wanbao Mining Copper Limited

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Waste Rock Storage Areas (WRD1 and WRD2)

At the waste rock dumps, activities related to material unloading, earthmoving, and wind erosion exposure will take place.

Below, details of the calculation conducted for estimating emissions are provided (Table 22).

Haul Truck Unloading at Waste Rock Areas

Material unloading activities consist of directly unloading trucks at areas where waste rock dumps are located (WRDs). Table 22 shows emission results for material unloading activities. Calculation for estimating emissions generated by material unloading is based on USEPA's AP-42 Guide, applying the following mathematical expression:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q$$

Values assigned are U = 2.41 m/s (Lakes Environmental, 2013), M = 2.75% and Q = 35,880 kt/yr (WRD1) and 3,120 kt/yr (WRD2).

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Table 22: Emission sources on roads from Open Pit to Waste Rock Dumps (WRDs)

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
11	Haul truck unloading at waste rock areas	WRD #1	35 880,000	Mg/yr	0.00040	0.00006	kg/Mg	14,484.0	0.4593	2,193.3	0.0695
		WRD #2	3 120,000	Mg/yr	0.00040	0.00006	kg/Mg	1,259.5	0.0399	190.7	0.0060
12	Dozer activity in waste rock areas	WRD #1	5,373	hr/yr	2.58945	2.31756	kg/hr	13,912.6	0.4412	12,451.8	0.3948
		WRD #2	467	hr/yr	2.58945	2.31756	kg/hr	1,209.8	0.0384	1,082.8	0.0343
	Dozer activity in waste rock areas (dust from exhaust)	WRD #1	2 686,400	hp-hr/yr	0.18159	0.17614	g/hp-hr	487.8	0.0155	473.2	0.0150
		WRD #2	233,600	hp-hr/yr	0.18159	0.17614	g/hp-hr	42.4	0.0013	41.1	0.0013
Total								**31 396**	**0,9956**	**16 433**	**0.5211**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	35,880	Waste Rock Dump #1 (92%)	Value estimated from extension area.
Material handling in kt (kilo tonne by year)	3,120	Waste Rock Dump #2 (8%)	Value estimated from extension area.
Number of dozer	4	Model: MD32 (Inner Mongolia)	Myanmar Wanbao Mining Copper Limited
Bulldozing - material moving operation	4	Hour/day from 8:00 a.m. - 6:00 p.m.	Myanmar Wanbao Mining Copper Limited
Horsepower by equipment	500	Representative value for earthmoving equipment (load factor = 0,59)	Myanmar Wanbao Mining Copper Limited

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Dozer Activity in Waste Rock Areas

Machinery linked to this type of activity for earthmoving is caterpillar tractors and graders. Table 22 shows emission results for the mentioned activities. Equations from USEPA's AP-42 Guide, Section 11.9 (1995-2011) have been considered.

Calculation of PM_{10} emissions is based on the following expression:

$$E = k \times 0.45 \times \frac{s^{1.5}}{M^{1.4}} \times T$$

While the expression below has been used for calculating $PM_{2.5}$ emissions:

$$E = k \times 2.6 \times \frac{s^{1.2}}{M^{1.3}} \times T$$

Values assigned are s = 10%, *M* = 2.75% and *T*= 5,373 hr/year (WRD1) and 467 hr/year (WRD2).

Moreover, emissions generated by fuel consumption have been estimated through the following equation:

$$E = EF_{adj(PM)} \times NA$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Values assigned for determining emission factor are *NA* = 2 686,400 hp-hr/yr (WRD1) and 233,600 hp-hr/yr (WRD2), EF_{ss}= 0.1316 g/hp-hr (Tier 4), *TAF* = 1.47 (vehicles and machinery), and *DF* = 1.116, and S_{PMadj}= 0.03438 (vehicles and machinery).

Wind Erosion in WRDs

Estimation of emissions caused by wind erosion has been determined based on monthly weather data recorded by the weather station located in the study area between July 1995 and April 2007. Based on this information, friction velocity values have been determined, which are influenced by roughness height of the surface to be eroded. The procedure for calculating particulate matter emissions was based on USEPA's AP-42 Guide, Section 13.2.5, Industrial Wind Erosion.

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Friction velocity has been estimated using the following equation (USEPA, 1995-2011):

$$u(z) = \frac{u^*}{0{,}4} \ln \frac{z}{z_o} (z > z_o)$$

Where *u* is wind speed, *u** is friction velocity, *z* is height above test surface, and z_o is roughness length. Upon calculating friction velocity, erosion potential was determined based on exposed surface (fine material) by applying the following expression (USEPA, 1995-2011):

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 0 \text{ for } u^* \leq u_t^*$$

Where *P* is erosion potential in g/m^2, and u_t^* is threshold friction velocity, which depends on the type of exposed material. A value of 0.58 m/s was considered for u_t^*, which represents fine material for *s* = 10%. Furthermore, based on a frequency distribution analysis of weather data generated by the MM5 model, it was determined that wind speeds above 5.7 m/s present a frequency of 2.4% (Lakes Environmental, 2013). Table 23 shows calculation results for monthly erosion potential based on wind speed frequency.

Subsequently, emissions were estimated by applying the following equation:

$$E = k \times \sum_{i=1}^{N} P_i \times A$$

Where *N* is number of perturbations, P_i is potential erosion corresponding to maximum speed for period *i* between perturbations, and *A* is surface area that presents wind-erodible material. It should be pointed out that according to hourly weather data generated by MM5 model, maximum mean wind speeds correspond to 8.8 m/s; hence, it is estimated that wind speed perturbations above 11 m/s occur for time periods of less than 1 hour. Table 24 shows calculation results for emissions due to wind erosion events at waste rock dumps.

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Table 23: Erosion potential emission factors

Month	Maximum wind speed (January 1995 to 18-Apr-2007) [1]									Max - u (m/s)	Friction velocity u* (m/s)	Erosion potential - P (g/m^2)	Emission factor $g/(m^2.hr)$	
	1995	1996	1997	2001	2003	2004	2005	2006	2007			PM	EF - PM_{10}	EF - $PM_{2,5}$
Jan	No Data	3.80	5.07	5.08	5.56	5.33	5.02	5.31	4.32	5.6	0.29	0.00	0.00	0.00
Feb	No Data	4.90	5.34	6.84	5.78	5.53	6.28	5.26	5.87	6.8	0.36	0.00	0.00	0.00
Mar	No Data	8.14	8.11	5.81	7.93	6.32	7.10	5.53	5.41	8.1	0.43	0.00	0.00	0.00
Apr	No Data	10.30	9.75	8.71	10.31	9.76	8.78	7.43	7.82	10.3	0.54	0.00	0.00	0.00
May	No Data	11.60	10.06	10.34	7.41	9.76	7.58	6.79	-	11.6	0.61	0.82	0.01	0.00
Jun	No Data	9.06	8.44	8.56	7.79	9.48	10.18	5.19	-	10.2	0.54	0.00	0.00	0.00
Jul	9.1	7.86	8.64	6.65	6.52	6.33	7.01	5.82	-	9.1	0.48	0.00	0.00	0.00
Aug	6.8	7.42	7.55	6.19	6.98	6.25	6.58	5.10	-	7.6	0.40	0.00	0.00	0.00
Sep	5.7	6.58	11.83	5.93	4.90	6.36	5.78	6.58	-	11.8	0.62	1.17	0.01	0.00
Oct	5.4	5.50	No Data	5.71	6.03	5.97	5.18	4.55	-	6.0	0.32	0.00	0.00	0.00
Nov	4.8	4.40	No Data	5.35	4.83	4.85	4.60	6.20	-	6.2	0.33	0.00	0.00	0.00
Dec	4.5	6.58	No Data	5.19	6.04	5.23	4.74	4.99	-	6.6	0.35	0.00	0.00	0.00

Prepared by Knight Piésold.

Notes:

[1] Weather station was fall down and damaged into pieces by strong wind (18 April 2007, 16:35 hr).

Parameters	Value	Units	Source
Threshold friction velocity - u_t* (m/s)	0.58	m/s	AP-42, Table 13.2.5-1 (Tyler sieve No. 32)
Roughness height for open terrain (m)	0.005	m	AP-42, Industrial wind erosion.
Scaling factor k ≤ 10 µm	0.5	-	AP-42, Table 13.2.5-2
Scaling factor k ≤ 2,5 µm	0.075	-	AP-42, Table 13.2.5-3
Hourly wind class frequency distribution > 5,7 m/s	2.4	%	Lakes environmental (2013).

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Table 24: Wind erosion emissions in Waste Rock Dumps (WRDs)

Month	Emission factor g/(m^2.hr)		Emissions (g/s)				Scaling factor
			WRD #1		WRD #2		
	EF - PM_{10}	EF - $PM_{2,5}$	PM_{10}	$PM_{2,5}$	PM_{10}	$PM_{2,5}$	
Jan	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0
May	0.0098	0.0007	0.290	0.022	0.024	0.002	0.4
Jun	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0
Sep	0.0140	0.0011	0.416	0.031	0.034	0.003	0.6
Oct	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0
Total			**0.705**	**0.053**	**0.058**	**0.004**	**1**

Prepared by Knight Piésold.

Assumptions:

Control efficiency for water spray assumed to be 50% (NPI, 2012).

2.4% of time that wind speed is greater than 5.7 m/s (Lakes Environmental, 2013).

Disturbed area for WRDs assumed to be 10% of silt content, due to soil texture analysis (Gravel Clay Silty Sandy) according to Knight Piésold (2000).

Parameters	Value	Disturbed area	Units
Total area of WRD #1 - 92.44%	2 132,700	213,270	m^2
Total area of WRD #2 - 17.45%	174,500	17,450	m^2
Total area - 100%	2 307,200	230,720	m^2

Semi-Mobile Crushers

Considerations are that activities related to material unloading, material crushing and transfer from conveyor belt to heap leach piles will take place at crusher area. Table 25 shows calculation results for particulate matter emissions resulting from the mentioned activities.

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Table 25: Emission sources at semi-mobile crushers - Unloading, Crushing and Material Handling

Activity		Area source	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
			Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
14	Unloading to each crusher semi-movil	Crushed ore #1	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
		Crushed ore #2	15 000,000	Mg/yr	0.0004	0.00006	kg/Mg	1,362	0.0432	206	0.0065
15	Crushing ore and wet suppression systems (spray nozzles)	Crushed ore #1	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
		Crushed ore #2	15 000,000	Mg/yr	0.004	0.0008	kg/Mg	13,500	0.4281	2,700	0.0856
16	Material handling and transfer for each point	Transfer #1	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
		Transfer #2	30 000,000	Mg/yr	0.002	0.0006	kg/Mg	13,500	0.4281	4,050	0.1284
Total								**56,725**	**1.7987**	**13,913**	**0.4412**

Prepared by Knight Piésold.

Parameters used:

Description	Value	Notes	Source
Material handling in kt (kilo tonne by year)	30,000	Mining plan for ore (year 5).	Myanmar Wanbao Mining Copper Limited
Controlled emissions by wet suppression systems (spray nozzles)	77.5	Percentage (controlled EF by wet suppression/uncontrolled EF)	AP-42, Section 11.19.2, Table 11.19.2-1.

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Unloading of Material

Materials will be directly unloaded from trucks at areas where crushers are located. Emissions generated by unloading material were based on USEPA's AP-42 Guide:

$$E = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned are *U* = 2.41 m/s (Lakes Environmental, 2013), *M* = 2.75% and *Q* = 30,000 kt/yr. Moreover, application of water-spraying systems (spray nozzles) has been considered as emission reduction measure. These systems achieve emission reduction (*ER*) efficiency close to 77.5% (USEPA AP-42, Section 11.19.2, Table 11.19.2-1).

Primary Crushing

Estimation of emissions caused by crushing material was based on the following equation:

$$E = k \times 0.004 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Values assigned for calculating emissions are *Q* = 30,000 kt/yr and *ER* = 77.5%.

Material Handling and Transfer (Conveyors)

Estimation of emissions due to ore transfer to conveyor belt was based on following equation:

$$E = N \times k \times 0.002 \times Q \times \left(1 - \frac{ER}{100}\right)$$

Where *N* is number of transfer points. Values assigned to each parameter were *N* = 2, *Q* = 30,000 kt/yr and *ER* = 77.5%.

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Highway near to Mining Area

Paved roads closest to the study area have been considered as possible routes for light vehicle traffic. Emissions generated by vehicle traffic on paved roads are represented by the following equation (USEPA, 1995-2011):

$$E = EF \times VKT$$

$$EF = [k \times (sL)^{0.91} \times (W)^{1.02}]\left(1 - \frac{1.2 \times P}{N}\right) \times \frac{1}{1{,}000}$$

Values assigned are *VKT* = 2,102,400 km/year, *sL* = 2 g/m^2, *W* = 25 Mg and *P* = 617 h/year (Lakes Environmental, 2013). Assigned road route length is 15 km. Number of vehicles considered is 34 (20 light and 14 heavy ones), whose mean weights can vary between 1.8 and 25 tons. Furthermore, emissions due to fuel consumption have been calculated by applying the NONROAD Update 2008 model (USEPA, 2010) according to following equation:

$$E = EF_{adj(PM)} \times AR$$

$$EF_{adj(PM)} = EF_{ss} \times TAF \times DF - S_{PMadj}$$

Table 26 shows calculation results for particulate matter emissions produced by the mentioned activities.

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Table 26: Emission sources on road close to mining area

Activity		Line sources	No. of vehicle passes/year	Length [(1)]	Activity rate		Emission factor (EF)			PM_{10} Emissions		$PM_{2,5}$ Emissions	
				km	Value	Units	PM_{10}	$PM_{2,5}$	Units	kg/year	g/s	kg/year	g/s
17	Light duty vehicles (dust from wheeled)	Highway 1	58,400	15	876,000	VKT/yr	0.02844	0.00688	kg/VKT	24,910	0.790	6,027	0.191
		Highway 2	58,400	21	1 226,400	VKT/yr	0.02844	0.00688	kg/VKT	34,875	1.106	8,437	0.268
18	Light duty vehicles (dust from exhaust)	Highway 1	58,400	15	876,000	VKT/yr	0.18159	0.17614	g/hp-hr	159	0.005	154	0,005
		Highway 2	58,400	21	1 226,400	VKT/yr	0.18159	0.17614	g/hp-hr	223	0.007	216	0,007
Total										**60,167**	**1.908**	**14,834**	**0.470**

Prepared by Knight Piésold.

[(1)] Length of paved roads until boundary environmental baseline area.

Parameters used:

Description	Value	Notes	Source
Nº of light duty vehicle by hour	20	Representative value.	Myanmar Wanbao Mining Copper Limited
Average daily traffic (ADT)	160	Assumed equivalent to 34 vehicles.	-
Horsepower of equipment	187.7	Value for light duty vehicle (load factor = 0.59).	Myanmar Wanbao Mining Copper Limited

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4.3.2 AERMOD Model Configuration

Assessment of emission sources corresponding to different activities during the construction and operation phases has been performed using the AERMOD model, which can simulate atmospheric dispersion of particle and gas emissions from one or several sources on flat and complex terrain. To this effect, hourly weather data is used (surface and altitude data), as well as the ground's geophysical characteristics, together determining parameters that characterize the atmospheric stability of the area of interest and are included in the equations governing the model (Cimorelli *et al.*, 2005). Parameters included in dispersion calculations have been determined by AERMOD pre-processors (AERMET for meteorological and ground parameters, and AERMAP for parameters related to terrain relief).

Surface and altitude weather data obtained as results from MM5 meteorological model (Lakes Environmental, 2013) has been entered in AERMET meteorological pre-processor. Regarding topographic information, it corresponds to the end of the construction phase and year 5 of the operation phase (Stage I).

Sectors and Surface Parameters for Letpadaung Project Area

Among the setup options represented by ground characteristics, the AERMET processor requires surface parameters such as Albedo, Bowen ratio[5] (H/λE), and roughness length (m). These parameters are considered in AERMET's processing since they influence atmospheric turbulence characterization and, hence, pollutant dispersion (Cimorelli *et al.*, 2005).

With regard to the Letpadaung Project, surface parameter information entered in AERMET's pre-processor comes from NASA reanalysis satellite data generated by the Giovanni[6] Interactive Visualization and Analysis project - GES DISC (Goddard Earth Sciences, Data and Information Services Center). Downloaded information corresponds to the period between January 2010 and December 2012; the selected area comprises southeast (SE) and northwest coordinates (NW): latitude (22.06379, 22.10488) and longitude (95.0636, 95.112749). Table 27 shows mean values throughout the months entered in AERMET's pre-processor, which were determined

[5] The Bowen ratio is used to describe the type of heat transfer. It is calculated by the equation $B = H/\lambda E$; where H is sensible hating and λE is latent heating.
[6] Retrieved in http://disc.sci.gsfc.nasa.gov/giovanni

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based on information downloaded from the Giovanni project – GES DISC (Appendix A and Table 28).

Table 27: Mean surface parameters for Letpadaung Project area

Month	Albedo	Bowen ratio	Roughness length (m)
January	0.175	0.646	0.618
February	0.178	1.383	0.525
March	0.175	3.254	0.391
April	0.169	1.434	0.316
May	0.166	0.649	0.342
June	0.165	0.099	0.422
July	0.164	0.065	0.497
August	0.163	0.051	0.540
September	0.159	0.043	0.569
October	0.160	0.079	0.609
November	0.166	0.189	0.641
December	0.167	0.307	0.646

Prepared by Knight Piésold
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences, Data and Information Services Center.

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Table 28: Surface parameters for Letpadaung Project

Year	Month	Roughness length (m)		Latent heat flux (λE) from land (W/m^2)	Sensible heat flux (H) from land (W/m^2)	Bowen ratio (H/λE)	Surface albedo (fraction)
		Sensible heat	Momentum				
2010	January	0.6	0.635	50.5	45.2	0.89	0.175
	February	0.482	0.567	35.9	69.6	1.94	0.178
	March	0.322	0.46	14.9	90.7	6.10	0.175
	April	0.237	0.394	30.5	84.2	2.76	0.168
	May	0.267	0.418	83.9	52.0	0.62	0.165
	June	0.357	0.486	131.6	12.5	0.09	0.165
	July	0.447	0.546	130.3	8.4	0.06	0.164
	August	0.501	0.579	129.2	6.2	0.05	0.164
	September	0.537	0.601	107.6	5.4	0.05	0.16
	October	0.587	0.63	95.5	4.0	0.04	0.157
	November	0.629	0.652	98.5	20.0	0.20	0.167
	December	0.636	0.656	69.8	21.5	0.31	0.167
2011	January	0.6	0.635	66.7	32.7	0.49	0.176
	February	0.482	0.567	56.4	58.1	1.03	0.178
	March	0.323	0.46	59.4	58.1	0.98	0.174
	April	0.238	0.394	88.7	37.1	0.42	0.169
	May	0.267	0.418	125.2	22.6	0.18	0.167
	June	0.357	0.486	135.6	11.5	0.08	0.165
	July	0.448	0.546	134.7	7.2	0.05	0.165
	August	0.501	0.579	130.3	7.0	0.05	0.163
	September	0.537	0.601	117.2	6.0	0.05	0.16
	October	0.587	0.63	105.4	9.8	0.09	0.161
	November	0.629	0.652	95.2	21.0	0.22	0.168
	December	0.636	0.656	72.6	20.3	0.28	0.166
2012	January	0.6	0.636	64.1	35.4	0.55	0.175
	February	0.482	0.567	49.6	58.6	1.18	0.179
	March	0.322	0.46	31.4	84.3	2.68	0.175
	April	0.238	0.394	56.3	63.2	1.12	0.169
	May	0.266	0.418	62.1	71.2	1.15	0.166
	June	0.357	0.486	130.3	15.3	0.12	0.166
	July	0.447	0.546	141.7	10.9	0.08	0.164
	August	0.501	0.579	130.3	6.6	0.05	0.163
	September	0.537	0.601	98.1	2.5	0.03	0.158
	October	0.587	0.63	108.1	11.1	0.10	0.163
	November	0.629	0.652	89.6	12.7	0.14	0.163
	December	0.637	0.656	69.9	23.4	0.34	0.169

Prepared by Knight Piésold.
Source: Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences. Data and Information Services Center.

Notes:
The MERRA is a NASA reanalysis for the satellite era using a major new version (V5) of the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS). The MERRA focuses on historical analyses of the hydrological cycle on a broad range of weather and climate time scales. This MERRA Instance of Giovanni focuses on visualizing and analysing the MERRA hourly 2D data from the MERRA HISTORY COLLECTIONS. All data used here are at GEOS-5 native resolution of 2/3 longitude by 1/2 latitude degrees.
Selected time period: Jan 2010 - Dec 2012
Selected area for averaging: Lat (22.06379. 22.10488). Lon (95.0636. 95.112749).

Receptor Locations

Points for which the model calculates concentration level contributions resulting from emissions generated by the different assessed activities are called receptors.

PM_{10} dispersion modeling used a total of 9 discrete receptors located within the study area; of which 8 correspond to air quality sampling sites, while 1 is located in the city of Monywa (Table 29).

Table 29: Discrete Cartesian receptors of air quality modeling

Location	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	715,252.18	2,442,082.56	127
Station 2	719,251.74	2,438,468.46	80
Station 3	713,421.56	2,444,860.13	90
Station 4	715,622.86	2,448,138.15	78
Station 5	709,895.01	2,450,963.14	83
Station 6	711,883.05	2,440,896.18	120
Station 7	707,251.93	2,438,634.96	149
Station 8	705,617.76	2,442,419.11	175
Monywa	720,911.88	2,446,350.66	81

Prepared by Knight Piésold.

Moreover, a Cartesian receptor grid was set up, comprising an area of 216 km^2 (Table 30), which considers the final range of PM_{10} dispersion generated by construction activities. Figure 2 shows the receptor grid entered in the model corresponding to the project's construction phase.

Table 30: Uniform Cartesian grid receptor network – Construction phase

Description	X Axis	Y Axis	Units
Origin (SW corner) (X, Y)	705,529.84	2,437,860.72	UTM WGS84 (m)
No. of points	65	55	-
Spacing (Dx, Dy)	250	250	m
Length	16	13.5	km
Number of receptors	3,575		-

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In relation to the operation phase, a nested receptor grid comprising an area of 506.25 km^2 (22.5 km x 22.5 km) has been set up, shown in Table 31. Figure 3 shows the receptor grid considered for the project's operation phase.

Table 31: Nested receptor grids – Operation phase

Bounding box		
Origin (SW corner) (X, Y)	714,759.58 m	2,441,933.91 m
Size (Width, Height)	2,500 m	2,500 m
Receptor spacing	150 m	
Number of receptors	1,804	
Nested grids		
Number of nested grid	**Distance from Bounding Box**	**Receptor spacing**
1	2,500 m	300 m
2	5,000 m	500 m
3	20,000 m	2,000 m

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4.4 NOISE AND VIBRATION MODELLING

Noise level propagation during construction and operation activities was determined with the computer simulation program SoundPLAN, version 7.2, which includes physical variables and acoustic characteristics of sound sources. Regarding the determination of projections of vibrations caused by activities (blasting, machinery and vehicle traffic) towards the location of sensitive receptors, mathematical formulations proposed by Devine (1962; quoted by López Jimeno *et al.*, 2003) and the Federal Transit Administration (FTA) of the U.S. Department of Transit (2006) have been used.

4.4.1 Noise Modelling Input

Modelling methodology is based on ISO 9613 standard, which uses divergent attenuation principles along with extra attenuation caused by obstacles and air attenuation. The model's input variables are the sound powers of noise sources for each considered phase. The exclusive contribution generated by assessed project sources was modelled; this contribution was based on information related to the sources' spatial geometry.

Temperature was set at 25°C and relative humidity at 80%, which are considered meteorological values that are representative for the study area. Also, wind speed has been assumed to vary between 1 and 5 m/s, according to what is established in ISO 9613, Part 2, and the noise propagation direction is towards the receptors.

During the construction and operation phases (Stage 1), activities will take place that are categorized into stationary, linear, and impulsive (blasting), depending on the noise sources.

Noise Emission Inventory

Stationary and Linear Sources in Mining Area

The noise emission characteristics in L_{AeqT} dB(A) of each piece of machinery are based on values published by the British Standard (BS 5228) "Update of Noise database for prediction of noise on construction and open sites" (contained in Annex C) (DEFRA; 2005, 2008). Table 32 shows global acoustic powers assigned to each piece of machinery that will be used, determined through the equation that relates a stationary noise emission source to a specific distance [L_{AeqT} in dB(A)] and acoustic power (Lw), which applies for an obstacle-free ground-level propagation direction:

$$Lw = Lp + 20\log(r) + 8$$

Where Lw is projected acoustic power, Lp is sound pressure level in L_{Aeq} dB(A), and r is the distance between receptor and source.

Upon assigning powers to each piece of machinery, the global acoustic power level representing a noise emission area was determined, for which the following mathematical expression was used:

$$L_T = 10\log\sum_i^n 10^{\frac{L_i}{10}}$$

Where L_T is the sum of all sound radiation sources, n is the number of sources, and L_i are each source's noise levels, expressed in dB(A).

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Table 32: Acoustic power (Lw) in dB(A) of equipment used during construction and operation phases - Stationary sources

Scenario	Operating Route	Designation[1]	Model[1]	Amount[1]	Engine power (kW)	Operation weight (tons)	Octave band sound pressure levels @ 10 m (Hz)[2]								A-weighted sound pressure level, LAeq, dB @ 10 m[2]	Acoustic power level
							63	125	250	500	1k	2k	4k	8k		
Construction & Operation (Stage I)	Blasting Zone	Hole Pumping Truck	PP-150	1	199	17	77	83	82	84	85	85	84	79	91	119
		Hole Stemming Machine	ZL50F-II	2	162	17	77	83	82	84	85	85	84	79	91	119
	Drilling Area	Drilling Rig	T35	1	142	15.1	83	84	79	85	82	79	75	71	87	115
		Drilling Rig	ROC L6 (25)	2	287	21.7	94	95	90	91	87	85	80	73	92	120
		Drilling Rig	HCR1500-20 II	1	261	17.3	77	83	82	84	85	85	84	79	91	119
	Digging Area	Excavator	EX1900-6BH	1	810	383	82	78	82	81	81	78	72	64	85	113
		Excavator	EX1200-6LD	2	567	223	82	78	82	81	81	78	72	64	86	114
		Excavator	PC2000-8	5	728	204.1	89	92	83	81	82	78	73	65	86	114
	Mining Area	Excavator	XE370C	1	184	36.6	81	80	80	83	82	79	76	73	86	114
		Loader	LW800K	2	250	28.5	91	81	73	71	71	72	62	59	77	105
		Loader	ZL50G	3	162	16	86	82	77	74	70	66	62	55	76	104
		Dozer	MD32	5	235	45	89	90	81	73	74	70	68	64	80	108
		Roller	W2601	2	174	18	80	75	77	72	67	62	54	46	73	101
		Crawler Dozer	CAT D9R	6	350	48	80	84	76	77	79	81	69	59	85	113
		Ballgrader	14M	2	221	25	88	87	83	79	84	78	74	65	86	114
		Refuelling Truck	ND5318GJYZ(20T)	2	235	20	91	81	76	77	73	72	70	62	79	107
		Light Truck	BJ1138VJPHG	2	140	13.2	84	81	74	73	72	68	61	53	76	104
		Truck with Crane	ND1250A50J	2	235	13.6	85	73	67	71	72	69	63	56	76	104
		Fire-Fighting Truck	ND1310D35J	2	235	20	85	80	77	72	74	70	65	58	78	106
		Maintenance Truck	ND1160A45J	2	235	10	85	73	67	71	72	69	63	56	76	104
		Sprinkler Truck	TR50W	3	392	45	92	91	86	85	84	85	77	77	90	118
		AN Mixing-Loading Truck	NCHA-15	2	247	15	85	73	67	71	72	69	63	56	76	104
		Heavy ANFO Mixing-Loading Truck	NCHZ-15	2	447	15	88	93	84	84	83	81	79	69	88	116
	Digging area to WRD	Mining Dump Truck	TR100	35	783	113	89	94	89	85	83	81	76	71	89	117
Operation (Stage I)	Digging Area	Excavator (front shovel)	PC4000	2	1,400	391	91	86	80	81	80	78	77	70	85	113
	Drilling Area	Rotary Rig	DML	5	460	27.2	86	92	85	88	84	83	78	77	90	118
	Mining Area	Crawler Dozer	D475A-EO	1	728	108.4	80	84	76	77	79	81	69	59	85	113
	Digging area to WRD and Leaching Pad	Mining Dump Truck	NTE260	10	1,865	236	97	95	91	91	86	84	79	75	92	120
	Crushing area	Tracked Semi-Mobile Crusher	--	2	310	90	91	91	88	87	85	83	78	68	90	118

Prepared by Knight Piésold
[1] Source: Mining Plan according to Myanmar Wanbao Mining Copper Limited
[2] Sound levels according to DEFRA (2005, 2008)

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Linear Sources on Paved Roads

During construction and operation phases, noise generation due to vehicle traffic on roads close to project has been considered. For this reason, in a conservative approach a flow of 20 light vehicles and 14 heavy vehicles has been considered per hour, equivalent to 816 vehicles per day during 24 hours. For this linear source, it has been considered to set up the model by applying the noise propagation method based on the German RLS 90 standard[7], which considers that noise emission on a road corresponds to a point located 25 m from the centerline (called LM25) and 4 m above ground level. Thus, the speeds considered are a maximum vehicle speed of 48 km/h and a speed of 40 km/h when vehicles pass built-up areas.

Subsequently, the RLS 90 method calculates sound propagation from the emission line using the LM25 value.

Blasting

Modelling methodology is based on sound field propagation standard ISO 9613, Part I & II, "Attenuation of sound during propagation outdoors", which uses divergent attenuation principles along with extra attenuation caused by obstacles and attenuation due to air effects. The used software is SoundPLAN, version 7.2, which includes all physical variables related to the noise sources' geomorphology and sound power.

Table 33 shows the octave frequency band spectrum (Hz) that corresponds to noise emission for a surface blasting event. This information is representative for blasting activities in mining projects and has been used as part of the environmental impact assessments conducted by Knight Piésold for open pit mining projects (Knight Piésold; 2010, 2011).

Table 33: Acoustic power (Lw) in dB(C) for blasting events

Source	Central Frequency in Octave Bands (Hz)								Lw in dB(C)
	63	125	250	500	1k	2k	4k	8k	
Surface blast	144.0	137.0	133.0	129.0	124.0	116.0	110.0	107.0	145.0

Prepared by Knight Piésold
Source: Data measured by Control Acústico Ltda for blasting events in northern Chile during 2003

[7]German Noise Classification System

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Acoustic power shown in Table 33 is related to SEL (Sound Exposure Level), a parameter that represents the total energy produced by a single noise event with a duration of 1 second, a time period considered representative for blasting events (Afeni & Osasan, 2009).

Receptor Locations

The SoundPLAN v. 7.2 model receptors were set up considering a calculation area that comprises the noise sampling stations, whose locations are shown in Table 34.

Table 34: Discrete Cartesian receptors of noise quality modeling

Description	Coordinates UTM WGS 84 Zone 46N		Altitude (m)
	East (m)	North (m)	
Station 1	713,421.56	2,444,860.13	91
Station 2	716,226.37	2,444,500.06	81
Station 3	719,184.44	2,443,299.27	79
Station 4	719,251.74	2,438,468.46	78
Station 5	717,231.75	2,445,136.04	81
Station 6	715,622.86	2,448,138.15	82
Station 7	709,895.01	2,450,963.14	89
Station 8	711,883.05	2,440,896.18	120
Station 9	707,251.93	2,438,634.96	148
Station 10	705,617.76	2,442,419.11	81

Prepared by Knight Piésold

4.4.2 Vibration Modeling Input

The main activities of interest capable of generating major impact due to vibrations during the construction and operation phases are blasting events, truck and construction machinery traffic (drills, vibratory roller, grader, bulldozer). Such activities have been assessed in this study by applying mathematical models that project vibration at a given point, for which available formulations related to each activity were revised.

Blasting

In order to forecast vibrations produced by blasting, the mathematical formulation proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) for representing vibration behaviour in open pit mining operations was proposed.

$$PPV = K \times \left(\frac{d}{W^{1/2}}\right)^{-\alpha}$$

Where *PPV* is particle peak velocity (mm/s), *W* is explosive charge weight (kg), *d* is the distance between detonation area and receptor of interest (m), *K* is velocity factor, and α is attenuation factor. It is worth mentioning that the values *K* and α are variables that have been statistically determined and depend on the soil's geological conditions. Thus, the mean factors considered were the theory-based *K* = 357 and α = 2.07, which had been proposed by Devine (1962; as cited in López Jimeno *et al.*, 2003) and determined from field measurements and theoretical calculations based on studied soil type.

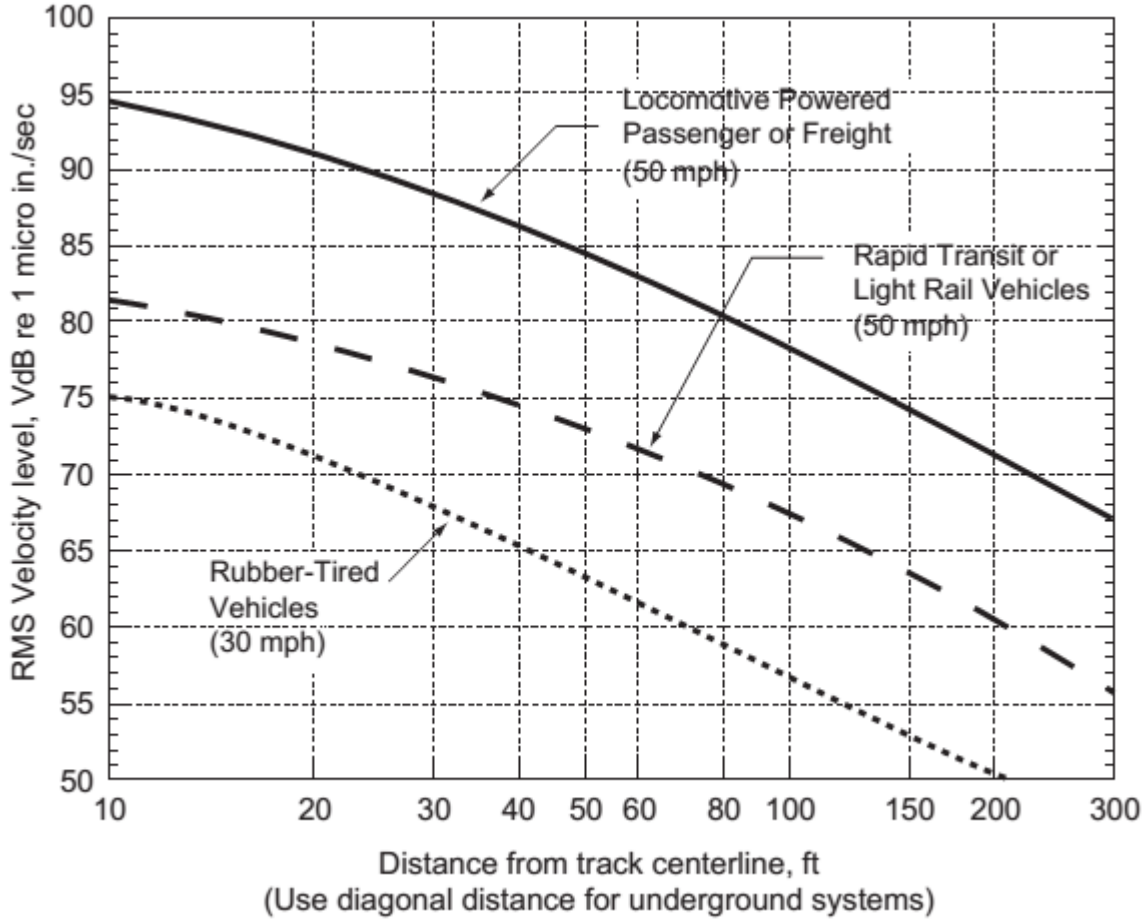
Regarding this study, it has been considered to use between 600 and 1,200 kg of explosive charge for each blasting event during the project's construction and operation phases. It should be pointed out that when an explosive charge is detonated, a pressure wave that displaces particles surrounding the detonation area is generated. The elasticity of the transmitted wave is directly proportional to the particle's velocity. The same amount of explosive charge detonated and measured at a fixed distance does not necessarily produce the same vibration magnitude if performed at different sites. In general, blast-induced vibrations take very short time according to the short duration of typical production blast at less than 2 seconds (Kuzu, 2008; Afeni & Osasan, 2009). Human reactions to blast-induced vibration start at particle velocities of generally about 10 mm/s (Siskind *et al.*, 1980 as cited in Kuzu, 2008).

Truck Traffic

Vibrations generated by truck traffic within the study area have been estimated by using criteria proposed by the Federal Transit Administration (FTA) of the U.S. Department of Transit in 2006, which are based on maximum vibration levels for one-time events. According to Graph 4, maximum vibration level values expected at each receptor are estimated, based on the distance between the track's centerline and the receptor. In this case, it corresponds to the graph's lower dotted curve (rubber-tired vehicles).

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Graph 4: Generalized ground surface vibration curves



Source: FTA (2006)

The velocity level (RMS L_V) is defined as (FTA, 2006):

$$RMS\ Velocity\ Level = Lv_{ref1:\frac{micro\ in.}{sec}} = 20\log\left(\frac{v}{v_{ref}}\right)$$

Where Lv is in VdB, v is RMS (Root Mean Square) of velocity amplitude, and v_{ref} is reference velocity amplitude. Projections of vibration levels Lv at a distance (D) have been estimated through the following mathematical expression (FTA, 2006):

$$L_v(D) = L_v(25\ ft) - 30\log\left(\frac{D}{25}\right)$$

According to the FTA (2006), background vibrations in residential areas are usually 50 VdB or less, far below the human perception threshold, which is around 65 VdB. Larger vibrations that exceed 70 VdB generate significant responses, such as a reaction of discomfort.

According to the abovementioned, it has been considered to assess vibrations generated by truck traffic based on the FTA criterion shown in Table 35.

Table 35: Ground-borne vibration (GBV) impact criteria for general assessment

Land Use Category	GBV Impact levels (VdB ref. 1 micro-inch/sec)	
	Frequent events(1)	Infrequent events(2)
Category 1:Buildings where vibration would interfere with interior operations	65 VdB	65 VdB
Category 2: Dwellings and buildings where people normally sleep	72 VdB	80 VdB
Category 3: Institutional land primarily with daytime use	75 VdB	83 VdB

Source FTA (2006)
Notes:
(1) "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.
(2) "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

In this case, receptors located within the project area correspond mainly to dwellings, which is why the criterion for Category 2 will be applied.

Construction Machinery

For the case of construction machinery, the FTA criterion establishes a maximum of 100 VdB for fragile buildings, or 95 VdB for fragile historical buildings.

Vibration level sources[8] corresponding to equipment used during the construction phase vary between 86 L_v (front loader) and 94 L_v (vibratory roller), for which from a conservative point of view a value of 94 L_v was chosen. Furthermore, for modelling the vibrations of vehicles travelling close to the roads, a maximum speed of 48 km/h has been considered (30 mph).

[8] RMS velocity in decibels (VdB) ref 1 micro-inch/second at 25 ft

5. MODELING RESULTS

The results produced by the AERMOD View v. 8.2 and SoundPLAN v. 7.2 modelling systems allowed quantifying the impact produced by project activities. Moreover, these results have been added to the information provided by baseline sampling related to air and noise quality.

5.1 PARTICULATE MATTER CONCENTRATIONS - PM_{10}

5.1.1 Construction Phase

In Figures 4 and 5 one can see the impact of dispersion of PM_{10} emissions generated by construction activities. Table 36 shows the results generated by the model (PM_{10} impacts) at each receptor depending on sampling station location. These results were added to the background concentrations obtained during baseline sampling. Hence, total PM_{10} concentration results that do not exceed international standards established by the WHO were obtained.

Table 36: Impact analysis of PM_{10} concentration – Construction phase

Receptor	Impacts of PM_{10} ($\mu g/m^3$)		Background concentration of PM_{10} ($\mu g/m^3$)(1)		Total PM_{10} ($\mu g/m^3$)	
	Annual	24 hours(2)	Annual	24 hours(2)	Annual	24 hours(2)
Station 1	1.5	13.3	11.3	14.3	12.8	27.6
Station 2	0.3	11.4	7.7	12.65	8	24.05
Station 3	2.2	21.4	7.8	11.4	10	32.8
Station 4	0.4	12.8	14.3	17.6	14.7	30.4
Station 5	0.2	3.7	20.0	22.3	20.2	26
Station 6	0.2	5.1	7.1	9.5	7.3	14.6
Station 7	0.1	1.8	15.0	19.2	15.1	21
Station 8	0.1	1.9	7.4	10.4	7.5	12.3
Monywa	0.2	11.9	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.1.2 Operation Phase

In Figures 6 and 7 one can see the impact of dispersion of PM_{10} emissions generated by mine operation activities. Table 37 shows the results provided by the model (PM_{10} impacts) for each receptor depending on sampling station location. These results have been added to the background concentrations obtained during

baseline sampling. Thus, total PM_{10} concentration results that do not exceed international standards established by the WHO have been obtained.

Table 37: Impact analysis of PM_{10} concentration – Operation phase

Receptor	Impacts of PM_{10} ($\mu g/m^3$)		Background concentration of PM_{10} ($\mu g/m^3$)[(1)]		Total PM_{10} ($\mu g/m^3$)	
	Annual	24 hours[(2)]	Annual	24 hours[(2)]	Annual	24 hours[(2)]
Station 1	2.3	33.3	11.3	14.3	13.6	47.6
Station 2	1.2	15.6	7.7	12.65	8.9	28.3
Station 3	2.7	29.3	7.8	11.4	10.5	40.7
Station 4	1.0	14.4	14.3	17.6	15.3	32.0
Station 5	0.8	19.2	20.0	22.3	20.8	41.5
Station 6	0.4	10.3	7.1	9.5	7.5	19.8
Station 7	0.1	6.6	15.0	19.2	15.1	25.8
Station 8	0.2	6.1	7.4	10.4	7.6	16.5
Monywa	0.3	6.1	-	-	-	-

Prepared by Knight Piésold
Notes:
(1) Results from air quality sampling
(2) Maximum 24 hour average concentrations

Appendix B shows the results generated by the model (PM_{10} impacts) considering wet and dry season wind scenarios.

5.2 NOISE AND VIBRATIONS

5.2.1 Noise

This section shows results provided by SoundPLAN v. 7.2 noise modelling system related to noise propagation in the study area and noise levels at receptors. It is worth mentioning that the shown noise levels represent an exclusive contribution generated by noise sources considered by the project.

Construction Phase

Figure 8 shows propagation of noise generated by noise sources considered during the construction phase. Tables 38 and 39 show projected noise levels at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC. Subsequently, the total noise of the evaluated stations was determined by the energetic sum of noise generated by the project and the background noise, applying the following mathematical expression:

$$L_T = 10 \log \sum_i^n 10^{\frac{L_i}{10}}$$

According to the results of total noise, for all sampling stations the noise background increment is lower than 10.2 dB (A). The largest increases of noise were observed for station 1 and 2, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

Table 38: Assessment of noise modelling results for construction phase – Daytime

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.2	67.5	52.4	67.6	65 (4)
Station 2	49	42.8	72.9	49.9	73.0	65 (4)
Station 3	29.2	44.7	59.9	44.9	59.9	55 (5)
Station 4	16	46.6	66.5	46.6	66.5	55 (5)
Station 5	31.6	43.9	75.4	44.1	75.4	65 (4)
Station 6	20.7	43.8	63.8	43.9	63.8	55 (5)
Station 7	4.4	45.0	85.5	45.0	85.5	55 (5)
Station 8	35.5	42.2	67.9	43.0	67.9	55 (5)
Station 9	0	42.3	67.8	42.3	67.8	55 (5)
Station 10	1	41.3	60.0	41.3	60.0	55 (5)

Prepared by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 65 dB(A) according to OECD.
(5) Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

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Table 39: Assessment of noise modelling results for construction phase – Night-time

Location	Predicted Noise Level dB(A) (1)	Background noise dB(A) (2)		Total noise (3)		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 (4)
Station 2	49	42.4	68.9	49.9	68.9	55 (4)
Station 3	23.7	46.3	67.9	46.4	67.9	45 (5)
Station 4	16	44.0	74.6	44.0	74.6	45 (5)
Station 5	27.7	44.6	66.7	44.7	66.7	55 (4)
Station 6	16.5	44.4	74.0	44.4	74.0	45 (5)
Station 7	4.4	44.2	72.5	44.2	72.5	45 (5)
Station 8	35.5	42.0	68.7	42.9	68.7	45 (5)
Station 9	0	42.2	67.0	42.2	67.0	45 (5)
Station 10	1	41.5	67.6	41.5	67.6	45 (5)

Elaborated by Knight Piésold.
Notes:
(1) Results from noise modelling using SoundPLAN v. 7.2
(2) Results from noise quality sampling for environmental baseline.
(3) Total noise = background noise + predicted noise level.
(4) Acceptable standard for Leq < 55 dB(A) according to OECD.
(5) Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

Table 40 shows noise levels projected at receptors due to blasting events within the mine area, which do not exceed reference values according to the North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901"., which in Section 901.109 establishes a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Furthermore, Figure 9 shows the propagation of noise produced by blasting events in the study area in LeqT units in dB(C) for T = 24 hours.

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Table 40: Assessment of noise modelling results for construction phase - Blasting events

Location	Sound Exposure level (SEL) for 1 second[(1)]	Standard - SEL in dB(C)	
		Class A	Class B
Station 1	85.2	107.0	112.0
Station 2	104.8	107.0	112.0
Station 3	99.8	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	103.6	107.0	112.0
Station 6	95.7	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
[(1)]Values determined based on values in L_{eqT} units in dB(C), where T = 1 hour.

Operation Phase

Figure 10 shows propagation of noise generated by noise sources considered during the operation phase. Tables 41 and 42 show noise levels projected at sensitive receptors, which comply with noise standards for both vehicle traffic according to the OECD (stations 1, 2 and 5) and residential places according to the IFC.

According to the results of total noise, for all sampling stations, the noise background increment is lower than 11.3 dB (A). The largest increases of noise were observed for station 1, 2 and 5, which correspond to the levels recorded during the dry season; however these increases do not exceed the OECD standard.

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Table 41: Assessment of noise modeling results for operation phase – Daytime

Location	Predicted Noise Level dB(A) [1]	Background noise dB(A) [2]		Total noise [3]		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	53.2	42.2	67.5	53.5	67.6	65 [4]
Station 2	51.7	42.8	72.9	52.2	73.0	65 [4]
Station 3	48.4	44.7	59.9	50.0	60.2	55 [5]
Station 4	16.5	46.6	66.5	46.6	66.5	55 [5]
Station 5	52.1	43.9	75.4	52.7	75.4	65 [4]
Station 6	16.5	43.8	63.8	43.9	63.8	55 [5]
Station 7	4.4	45.0	85.5	45.0	85.5	55 [5]
Station 8	43.2	42.2	67.9	45.7	67.9	55 [5]
Station 9	Not perceptible	42.3	67.8	42.3	67.8	55 [5]
Station 10	1	41.3	60.0	41.3	60.0	55 [5]

Elaborated by Knight Piésold.
Notes:
[1] Results from noise modeling using SoundPLAN v. 7.2
[2] Results from noise quality sampling for environmental baseline.
[3] Total noise = background noise + predicted noise level.
[4] Acceptable standard for Leq < 65 dB(A) according to OECD.
[5] Acceptable standard for Leq < 55 dB(A) according to IFC and WHO.

Table 42: Assessment of noise modeling results for operation phase – Night-time

Location	Predicted Noise Level dB(A) [1]	Background noise dB(A) [2]		Total noise [3]		Standard
		Dry season	Wet season	Dry season	Wet season	
Station 1	52	42.4	71.2	52.4	71.3	55 [4]
Station 2	49	42.4	68.9	49.9	68.9	55 [4]
Station 3	45	46.3	67.9	48.7	67.9	45 [5]
Station 4	16	44.0	74.6	44.0	74.6	45 [5]
Station 5	28.5	44.6	66.7	44.7	66.7	55 [4]
Station 6	16.5	44.4	74.0	44.4	74.0	45 [5]
Station 7	4.4	44.2	72.5	44.2	72.5	45 [5]
Station 8	35.5	42.0	68.7	42.9	68.7	45 [5]
Station 9	Not perceptible	42.2	67.0	42.2	67.0	45 [5]
Station 10	1	41.5	67.6	41.5	67.6	45 [5]

Elaborated by Knight Piésold.
Notes:
[1] Results from noise modeling using SoundPLAN v. 7.2
[2] Results from noise quality sampling for environmental baseline.
[3] Total noise = background noise + predicted noise level.
[4] Acceptable standard for Leq < 55 dB(A) according to OECD.
[5] Acceptable standard for Leq < 45 dB(A) according to IFC and WHO.

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Table 43 shows noise levels projected at receptors due to blasting events in mine area, which do not exceed reference values according to North American standard "Measurement Procedures for the Enforcement, Chapter I: Illinois Pollution Control Board, Part 910, Title 35: Environmental Protection, Subtitle H: Noise Of 35 Ill. Adm. Code 900 & 901," which establishes in Section 901.109 a methodology for the specific noise type *Highly-Impulsive Sound From Explosive Blasting*, defining maximum SEL levels (Sound Exposure Level) allowed at receptors for blasting events. Moreover, Figure 11 shows the propagation of noise produced by blasting events in the study area in L_{eqT} units in dB(C) for T = 24 hours.

Table 43: Assessment of noise modelling results for operation phase - Blasting events

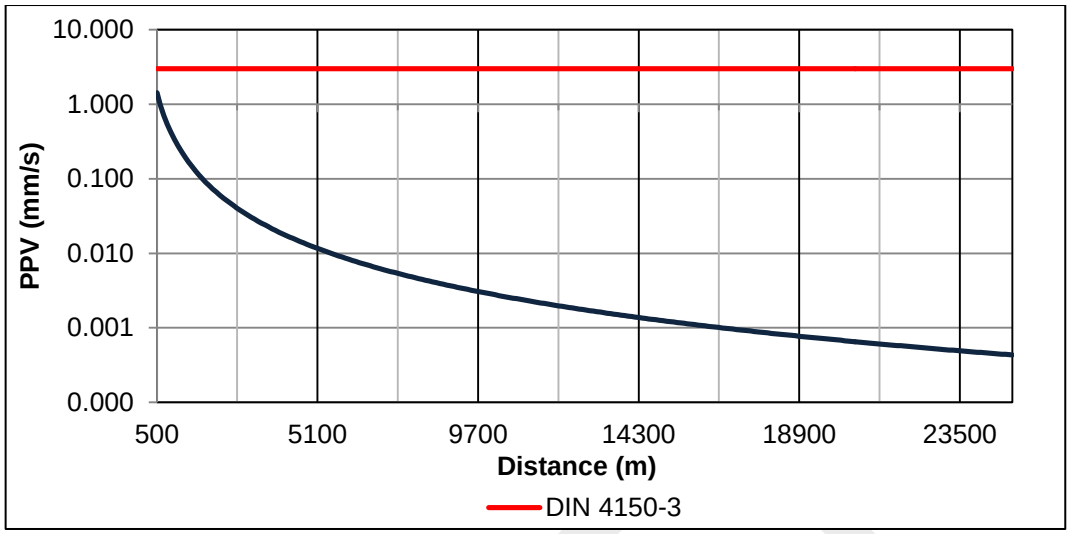
Location	Sound Exposure level (SEL) for 1 second (1)	Standard - SEL in dB(C)	
		Class A	Class B
Station 1	93.5	107.0	112.0
Station 2	94.0	107.0	112.0
Station 3	83.5	107.0	112.0
Station 4	Not perceptible	107.0	112.0
Station 5	102.4	107.0	112.0
Station 6	95.8	107.0	112.0
Station 7	Not perceptible	107.0	112.0
Station 8	Not perceptible	107.0	112.0
Station 9	Not perceptible	107.0	112.0
Station 10	Not perceptible	107.0	112.0

Prepared by Knight Piésold
(1) Values determined based on values in LeqT units in dB(C), where T = 1 hour.

5.2.2 Vibrations

Graph 5 shows PPV values for distances ranging from 0.5 km to 250 km, considering a blasting event. These PPV values were calculated by applying the mathematical expression proposed by Devine (1962; quoted by López Jimeno *et al.*, 1987). Furthermore, it shows a 3 mm/s protection standard corresponding to sensitive buildings based on German DIN standard No. 4150-3 (DIN = Deutsches Institut für Normung). According to Kuzu (2008), human reactions due to vibrations caused by blasting events start at particle peak velocities close to 10 mm/s. For this reason, the 3 mm/s standard proposed by the DIN 4150-3 standard is considered the most demanding one.

Graph 5: Prediction of blast-induced vibration level



Prepared by Knight Piésold

Table 44 shows modelling results for vibrations caused by blasting events at nearby sensitive receptors. These vibrations do not exceed safety limits suggested by German DIN standard No. 4150-3.

Table 44: Modelling results of vibrations caused by blasting at receptor sites

Location	Distance from blasting area to receptor (km)	PPV (mm/s)	Safe level according to DIN 4150-3 (mm/s)
Station 1	2.5	0.0508	3
Station 2	1.13	0.2629	3
Station 3	2.67	0.0443	3
Station 4	5.03	0.0120	3
Station 5	1.96	0.0841	3
Station 6	4.71	0.0137	3
Station 7	9.39	0.0033	3
Station 8	3.67	0.0229	3
Station 9	8.84	0.0037	3
Station 10	9.54	0.0032	3

Prepared by Knight Piésold

Vibrations caused by vehicle traffic along paved roads do not exceed the FTA's allowed limit of 65 VdB. Table 45 shows results for vibration levels projected at the distance where dwellings are located with regard to the vehicle's route.

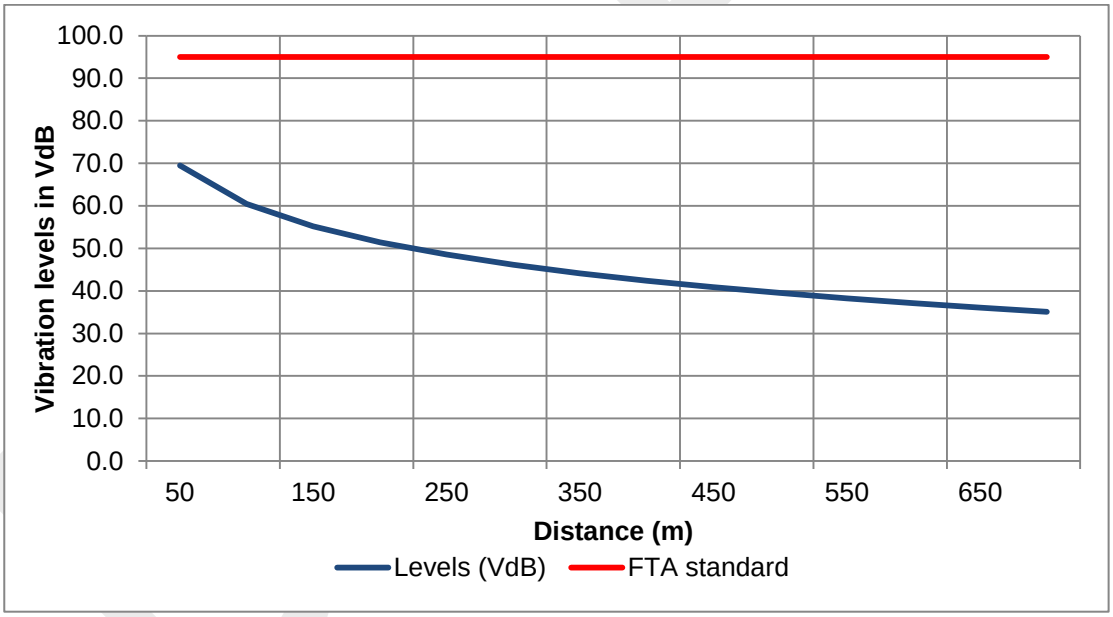
Table 45: Modeling results of vibrations caused by vehicles on road close to receptor sites

Location	Distance from track centerline (m)	Lv (ref 1 micro-inches/s) (VdB)	FTA Standard Category I
1	14	64	65 VdB
2	16	63	
3	199	26	
5	22	59	

Prepared by Knight Piésold

Regarding activities resulting from heavy machinery operation during the construction phase, Graph 6 shows Lv values projected at a specific distance. According to the results, the vibration levels generated by machinery do not exceed the limit of 95 VdB recommended by the FTA for sensitive structures.

Graph 6: Modelling results of vibrations caused by construction equipment at receptor sites



Prepared by Knight Piésold

6. CONCLUSIONS

Inventories of particulate matter (PM_{10} and $PM_{2.5}$), noise and vibrations were developed for construction and operation phases. According to results, it is evident that operation phase generates more dust and noise than construction phase.

According to results provided by computer programs Aermod View 8.2 and SoundPLAN 7.2, the impact caused by emissions of particulate matter, noise and vibrations during the construction and operation phases does not exceed environmental quality standards established by the IFC/WHO and OECD. The sites that present the highest concentrations of particulate matter, as well as the highest noise and vibration levels are within project area facilities, such as the pit and the waste rock dumps.

Regarding the impact on air quality, during the construction phase Station 3 (air quality) is the one receiving the highest contributions of PM_{10} concentration (21.4 $\mu g/m^3$ for mean maximum 24-hour value and 2.2 $\mu g/m^3$ for mean maximum annual value) resulting from dispersion of particulate matter. Furthermore, during the operation phase, stations 1 and 3 receive larger PM_{10} concentration contributions, which range from 29.3 to 33.3 $\mu g/m^3$ (mean maximum 24-hour value) and from 2.3 to 2.7 $\mu g/m^3$ (mean maximum annual value).

With regard to impact on noise quality, one can see that during the construction and operation phases the stations 1, 2, 3, 5 and 8 are the ones receiving the largest noise contributions, due to the proximity of these stations to vehicle traffic on the roads surrounding the project area.

Finally, vibrations caused by project activities during its various phases comply with standards established by DIN standard 4150-3 and by FTA criteria.

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7. RECOMMENDATIONS

Regarding the impact on air quality, it is recommended to permanently monitor PM_{10} and $PM_{2.5}$ at stations 1 and 3 during the project's construction and operation phases, as part of the environmental monitoring plan.

Regarding the impact on noise quality due to the proximity of urban areas and roads surrounding the project area, it can be reduce to some extent by adopting mitigation measures such the implementation of noise barriers and suitable traffic management. According to FTA (2006), Section 6.8.1 Noise Mitigation Measures, noise barriers are effective in mitigating noise when they break the line-of-sight between source and receiver. Where the barrier is very close to the transit vehicle or where the vehicles travel between sets of parallel barriers, barrier effectiveness can be increased by as much as 5 decibels by applying sound-absorbing material to the inner surface of the barrier (FTA, 2006). The normal minimum requirement is a surface density of 4 pounds per square foot (FTA, 2006).

Finally, it is recommended to permanently monitor noise and vibration at stations 1, 2, 3, 5 and 8 during the project's construction and operation phases considering a quarterly frequency, as part of the environmental monitoring plan to verify the mitigation actions implemented.

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FIGURES

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APPENDIX A

Merra Monthly History Data Collections – Giovanni Project

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APPENDIX B

Maximun 24 hour mean concentrations for PM_{10} impacts during dry-cold, dry-hot and wet seasons

APPENDIX L

Conceptual Closure Plan

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LTD
LETPADAUNG COPPER PROJECT





CONCEPTUAL CLOSURE PLAN

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MYANMAR WANBAO MINING COPPER LTD (MWMCL)

LETPADAUNG COPPER PROJECT

CONCEPTUAL CLOSURE PLAN

KP Report No. PE701-00022/04

CONTRACT

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REV	DESTINATION	HARD COPY	ELECTRONIC COPY
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EXECUTIVE SUMMARY

The Letpadaung Copper Project site is located near Monywa in the Salingyi Township, approximately 600 km north-northwest of Yangon in Myanmar. It is planned that approximately 1 Bt of ore will be extracted at a rate of 30 Mtpa over a 30 year mine life. The copper will be extracted from the ore using a heap leach pad system with recovery of the copper from the leachate solution.

Knight Piésold (KP) was appointed by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake an Environmental and Social Impact Assessment (ESIA) for the scheme as well as complete initial design work for the facility.

As part of the design development to aid preparation of the ESIA, a concept closure plan for the site has been developed which addresses closure and rehabilitation of the following areas:

- Open Pit
- Waste Dumps
- Heap Leach Pads
- Plant, Equipment and Infrastructure
- Process and Stormwater Ponds
- Accommodation Camps

The Mine Closure Management Plan:

- Outlines the regulatory and good practice standards with regards to mine closure (both national and international standards) with which Letpadaung will comply;
- Defines Letpadaung objectives and procedures to guide Letpadaung management and contractors;
- Defines mitigation programmes to manage and minimise adverse impacts;
- Identifies the opportunities for trials to research methods for achieving closure criteria; and
- Defines monitoring and reporting procedures.

In developing the concept closure plan reference has been made to Myanmar regulations as well as international standards, guidelines and best practice including IFC Guidelines, Chinese standards, European Commission 'Best Available Techniques' and Western Australian guidelines.

Letpaduang's short-term closure and reclamation objectives (during construction and operations) can be summarised as follows:

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- Progressively reclaim disturbed areas as soon as they are no longer active;
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment - including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;
- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment.
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;

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- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

The Conceptual Closure Plan presented here allows integration with the design concepts and ensures that the design and operation of the site are compatible with the closure plan. After commissioning a Detailed Closure Plan will be developed.

An outline closure land-use plan has been developed for the site. On closure the open pit will remain as a void with a permanent pit lake. The remaining areas will be rehabilitated to one of four land-use categories, namely:

i. Scrub/grazing
ii. Agriculture
iii. Pond or wetland areas
iv. Landfill

Progressive rehabilitation will be undertaken wherever possible. All equipment and infrastructure will be removed from site unless there is a beneficial use to the community such as buildings or roads.

Due to the potential for long-term environmental pollution, both the waste dumps and heap leach pads are to be covered with low or very low permeability capping systems to reduce infiltration.

Surface water run-off and leachate from waste dumps and heap leach pads will be controlled via a surface water management system that separates clean from potentially contaminated

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water, provides settling areas to reduce suspended load prior to discharge, and allows treatment of water which doesn't reach the necessary standards before release from the site.

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

If it is possible to reuse a waste either on site or for a different application in the local community then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that two landfills will be constructed on the site so that wastes are contained within the site boundary. One facility will accept inert/non-hazardous waste whilst the other will be a hazardous waste landfill.

As the Closure Plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

Closure costs will be developed concurrent with the Closure Plan and financial provision will be made to ensure that adequate funds are available for final closure.

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1. INTRODUCTION

The Letpadaung Copper Project site is located near Monywa in the Salingyi Township, approximately 600 km north-northwest of Yangon in Myanmar. It is planned that approximately 1 Bt of ore will be extracted at a rate of 30 Mtpa over a 30 year mine life. The copper will be extracted from the ore using a heap leach pad system with recovery of the copper from the leachate solution.

Knight Piésold (KP) was appointed by Myanmar Wanbao Mining Copper Ltd (MWMCL) to undertake an Environmental and Social Impact Assessment (ESIA) for the scheme as well as complete initial design work for the facility.

As part of the design development to aid preparation of the ESIA, a closure plan for the site needs to be developed.

Closure and rehabilitation of the following areas will be required:

- Open Pit.
- Waste Dumps.
- Heap Leach Pads.
- Plant, Equipment and Infrastructure.
- Process and Stormwater Ponds.
- Accommodation Camps.

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This report presents the concept closure plan for the whole site.

The Mine Closure Management Plan:

- Outlines the regulatory and good practice standards with regards to mine closure (both national and international standards) with which Letpadaung will comply;
- Defines Letpadaung objectives and procedures to guide Letpadaung management and contractors;
- Defines mitigation programmes to manage and minimise adverse impacts;
- Identifies the opportunities for trials to research methods for achieving closure criteria; and
- Defines monitoring and reporting procedures.

The Mine Closure Management Plan will cover the full range of closure events which include:

- Unexpected mine closure (either temporary or permanent);
- Progressive rehabilitation through the life of the mine; and
- Permanent closure.

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2. MYANMAR REGULATORY REQUIREMENTS

2.1 EXISTING ENVIRONMENTAL LEGISLATION

Though Myanmar does have some legislation related to protecting people and the environment, the country lacks the necessary adequate administrative and legal structures, standards, safeguards and political will to enforce such provisions. In addition, while Myanmar is party to several international treaties such as the Convention on Biological Diversity (CBD), in the past, Myanmar has not incorporated the provisions contained in these agreements into domestic law. For example, national laws did not require specific environmental and social impact assessments (ESIA) or public participation by local communities in the decision-making processes of large-scale development projects. However, to address the environmental expectations of the laws described below, an ESIA would be required to establish the mechanisms for preventing such actions from occurring. There are no specific laws that comprehensively regulate pollution, no standards to adequately protect biodiversity, develop resettlement plans, or provide compensation. There are, however, the 1995 Community Forest Instructions (CFI), the March 2012 Environmental Conservation Law, the November 2012 Foreign Investment Law, Rules and Notification by Myanmar Investment Commission (2013), Rules of the Conservation of Water Resources and Rivers Law (2013) and the Land Acquisition Act that, if systematically enforced, would improve environmental protection and the land-based rights of local populations. Myanmar became a party to the CBD in 1994. Article 14(1)(a) of the Convention requires an EIA and Article 8(j) mandates indigenous participation where there is a significant impact on biodiversity. Section 54 of the 2012 Foreign Investment Law provides that “If any provision of this Law is contrary with any matter of the International Treaty and Agreement adopted by the Republic of the Union of Myanmar, the matters contained in the International Treaty and Agreement shall be abided by.

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2.2 THE ENVIRONMENTAL CONSERVATION LAW 2012 (ECL)

2.2.1 Objectives

The ECL, the landmark law specifically dedicated to address environmental conservation, was enacted:

a) to implement the national environmental policy;

b) to lay down basic principles and provide guidance to systematically integrate environmental conservation matters with the sustainable development works;

c) to build a healthy and clean environment and to conserve natural and cultural heritage for the benefit of current and future generations;

d) to restore the deteriorating and disappearing ecosystem to the fullest extent possible;

e) to enable to manage and implement for the decrease and loss of natural resources and for enabling the benefits of sustainable use;

f) to enable promotion of public awareness and cooperation in the matters of environmental conservation;

g) to enable promotion of international, regional, and bilateral cooperation in the matters of environmental conservation; and

h) to co-operate with the government departments and organisations, international organisations, non-governmental organisations and private individuals on environmental conservation matters.[1]

2.2.2 Current Position

Though the ECL paves the way for the use of EIA and/or SIA in evaluation of issuing a prior permission for prescribed businesses, the prior permission scheme itself is discretionary and there is currently no basis in the law for the Ministry to determine whether or not to issue a permit, and whether to impose environmental compliance conditions on the user. Also, some of the Ministry of Environmental Conservation and Forestry's (MOECAF) broad powers granted under the law require the approval of the Union Government and the Environmental Conservation Council (ECC) but without the clear power and basis of the approval.

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There are no regulatory guidelines and rules specified to enable the ECL to be operable in practice: such as setting the environmental quality standards, emission standards, and classes of hazardous waste and substances. In addition, there is a need to cover the non-point sources of pollution that is not discussed in the ECL.

The ECL provides for integration with sectoral policies and co-ordination amongst the Ministries and departments.[2] It is expected that the Environmental Conservation Rules (ECR) of the ECL which is underway would provide regulatory guidelines to implement the ECL.

2.2.3 Obligations of Business Owners and Occupiers

The polluter at source has obligations to clean, discharge, dispose, or keep pollutants in accordance with the prescribed standards[3].

[1] ECL Section 3
[2] ECL Section 18
[3] ECL Section 14

The owner or occupier of business activities, materials or places that are source of the pollution must install or use an on-site facility or controlling equipment in order to monitor, control, manage, reduce or eliminate environmental pollution. If this is not possible, it must be arranged to dispose the wastes in accordance with environmentally sound methods[4].

The individuals or organisations carrying on the businesses in the industrial zones, or special economic zones or businesses set by the government ministries have responsibilities to contribute either in cash or in kind and carry out the management of pollutants and environmental conservations including the treatment of wastes collectively[5]; must give the fees for the usage and expenses incurred in connection with management of environmental conservation by the relevant industrial zones, special economic zones and business organisations[6]; and must comply with the environmental conservation directives published by the relevant industrial zone, special economic zone or the business organisations[7].

2.3 FOREIGN INVESTMENT LAW 2012 (FIL)

The FIL, in its Basic Principles, states that the investment shall be allowed based upon principles including "protection and conservation of the environment"[8].

The duties of the investor requires the carrying out of business in a manner not to cause environmental pollution or damage in accord with existing laws in respect of investment business[9].

2.4 NOTIFICATION OF MIC 1/2013

The list of Economic Activities under Prohibition includes:

- Installation of Factory in Myanmar utilizing of the imported wastes
- Manufacturing of hazardous material which are not in compliance with the Environmental and Conservation Law, Rules and Procedures promulgated from time to time.
- Activities which may emit hazardous chemicals, minerals, rays, noise, particles etc., and may cause earth/water/air pollution which affect public health.
- Exploitation of minerals including gold in the revering and water way.

[4] ECL Section15
[5] ECL Section 16(a)
[6] ECL Section 16(b)
[7] ECL Section 16(c)
[8] Fill Clause 8(l)
[9] Fill Clause 17(h)

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The list of Economic Activities Permitted with Specific Conditions includes at No (3) includes Economics activities which required Environmental Impact Assessment.

Exploration and production of minerals, manufacturing of iron, steel and minerals and operation in cultural heritage, archaeological and prominent geographical symbolical sites, etc., all require that it will be allowed subject to the need for Environmental Impact and Social Impact, or Environmental Impact, alone being carried out for initial study of environment.

Clause 37 of the Rules of the FIL states “In order to scrutinize accepted proposals sector by sector, a Proposal Review Group, composed of high ranking officers from the Environmental Conservation Department, is to be formed to perform preliminary scrutiny.

Section 47 states that the Commission shall scrutinise investment proposals in the following manners:

- Scrutinising remarks from the Ministry of Environmental Protection and Forestry on the protection measures of social and environmental impact.

Notification No 1/2013 of MIC dated 29th January, 2013 List of Economic Activities requiring environmental impact assessments:

- Exploration and production of minerals – Depending upon the business activity, to avoid environmental and social impacts, or to minimise environmental and social impacts, it will be allowed only after conducting initial study and assessment upon environmental and social impacts.

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2.5 MINES LAW (1994) (MML) AND ASSOCIATED MINES RULES

The Mines Law (1994) aims to protect the environment from mining operations that may be detrimental to conservation of environmental quality.

Section (3) of the Mine Law states the objectives as follows:

- To carry out for the development of conservation, utilisation and research works of mineral resources;
- To protect the environmental conservation works that may have detrimental effects due to mining operations.

Under duties of the holder of Permit, it is stated that the holder of permit shall comply with the rules prescribed under this Law in respect of the following matters:

- Making provisions for safety and the prevention of accidents in a mine and their implementation;

- Making and implementation of plans relating to the welfare, health, sanitation and discipline of personnel and workers in a mine;
- Making provisions for the environmental conservation works that may have detrimental effects due to mining operation;
- Reporting of accidents, loss of life and bodily injury received due to such accidents in the mine; and
- Submission to the inspection of the Chief Inspector and inspectors[10].

Rules 69 to 73 govern the rights of utilisation of land and water for mineral production which includes the provisions of the responsibility of the mineral permit holder so that there is no pollution of the environment due to the use of land and water.

The holder of a mineral exploration permit or a mineral production permit must backfill or otherwise make safe bore holes, excavations, surface of land damaged during the course of underground mining operations to the satisfaction of the Ministry or the Department. The holder must also establish forest plantations or pay compensation to the Ministry of Forestry, if trees were cut and cleared for mineral exploration or mineral production within a forest land or in a land area covered with forests.

In disposing of liquids, wastes, tailings and fumes which have resulted from mineral production, the holder of a mineral production permit must undertake laboratory tests as may be necessary for the prevention of pollution of water, air and land in the environment and for the safety of living beings. If toxic materials are found in the waste products, which are harmful to living beings, degradation shall be made by chemical means and systematic disposal shall be made only when it is assured that there is no danger.

The holder of a permit for mineral production within an area under the Ministry's administrative control or which does not lie within the Mineral Reserve Area or Gemstone Tract, shall carry out such production only after co-ordinating and receiving agreement from the individual or organisation having the right of cultivation, right of possession, right of use and occupancy, beneficial enjoyment, right of succession or transfer of the said land[11].

Chapter XXI of the Myanmar Mining Rules (MMR) describes "making provisions to prevent detrimental effects due to mining operations on the environmental conservation works". The requirements include:

[10] MML Section 13
[11] MML Section 14

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- Backfilling or making safe bore holes, excavations or surface of the land damaged during the course of underground mining[12]; and
- Undertaking laboratory tests, as necessary, to prevent pollution of water, air and land[13].

2.6 ENVIRONMENTAL POLICIES

A national environmental policy was drafted by the NCEA in 1994. The National Environment Policy is as follows:

"To establish sound environment policies, utilisation of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy: The wealth of the nation is its people, its cultural heritage, its environment and its natural resources."

The objective of Myanmar's environmental policy is aimed at achieving harmony and balance between people, the environment, heritage and natural resources through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilise its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interests of present and future generations.

The development of the environmental policy was followed by the drafting of 'Myanmar Agenda 21' in 1997, which follows a UN framework for a multi-pronged approach to sustainable development. The Myanmar Agenda 21 recognises the need for Environmental Impact Assessments. Myanmar, in its Agenda 21, calls for integrated management of natural resources and provides a blueprint for achieving sustainable development.

The ECL provides more institutional space to regulate environmental quality and conduct EIA's and SIA's for infrastructure and investment projects funded by the government and private sector.

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[12] MML Section 105
[13] MML Section 106

2.7 MYANMAR INVESTMENT COMMISSION (MIC)

The MIC issued a Notification on 30 June 1994 on Protection of Environment stating that:

1. The Myanmar Investment Commission, at its meeting 8/94 held on 17 June 1994 has resolved that all projects established with the permission of the Commission shall be responsible for the preservation of the environment at and around the area of the project site. The enterprises are entirely responsible that they shall be able to control pollution or air, water and land, and other environmental degradation, and that they can keep the project site environmentally friendly.
2. Consequently, it is hereby notified that treatment plant, industrial waste water treatment plant and other pollution control procedures should be promptly implemented and abide with the sanitary and hygienic rules and regulations set by the authorities concerned.
3. In the future proposals that are to be submitted to the Commission, either under the Union of Myanmar Foreign Investment Law or the Myanmar Citizens Investment Law, shall incorporate the provision in their contracts that they shall undertake proper sewage and industrial wastewater treatment systems and other environmental control systems. The system so used shall be in accordance with the rules and regulations specified by the respective development committees and local authorities.

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3. INTERNATIONAL GUIDELINES AND STANDARDS

3.1 GENERAL

In addition to adherence with applicable local legal obligations, Letpadaung is committed to conducting project mine closure and reclamation activities in line with international good practices. Relevant standards and guidelines consulted during the development of the Letpadaung Concept Closure Plan are outlined below.

3.2 INTERNATIONAL FINANCE CORPORATION GUIDELINES

3.2.1 General

The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines relevant to the Letpadaung project comprise general environmental guidelines as well as mining-specific guidelines.

3.2.2 Environmental

IFC EHS General Environmental Guidelines[14] include a number of sections relevant to closure and rehabilitation of the site. These sections include:

- Waste Water and Ambient Water Quality.
- Waste Management.

Relevant best practice recommendations from these guidelines include:

- Plan and implement the segregation of liquid effluents in order to limit the volume of water requiring specialized treatment.
- Assess compliance of wastewater discharges with the applicable discharge standards.
- Establish waste management priorities at the outset of activities based on an understanding of potential Environmental, Health, and Safety (EHS) risks and impacts and considering waste generation and its consequences.
- Where waste cannot be recovered or reused, it should be treated, destroyed, and disposed of in an environmentally sound manner.
- Where offsite disposal in not possible, facilities should be constructed that will provide for the environmental sound long-term storage of wastes on-site.

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[14] Environmental Health & Safety Guidelines: Environmental, International Finance Corporation

3.2.3 Mining

IFC EHS Guidelines for Mining[15] include the following best practice recommendations for mine closure:

- The Mine Reclamation and Closure Plan should incorporate both physical rehabilitation and socio-economic considerations.
- Preparation of a Mine Reclamation and Closure Plan in draft form prior to the start of production with annual updates during the mine life.
- Finalise the plan during the last five years of forecasted operations.
- The Mine Reclamation and Closure Plan will be designed so that:
  - Future public health and safety are not compromised;
  - The after-use of the site is beneficial and sustainable to the affected communities in the long term; and
  - Adverse socio-economic impacts are minimised and socio-economic benefits are maximised.

The Mine Reclamation and Closure Plan will clearly identify allocated and sustainable funding sources to implement closure at any stage in the mine life including the provision for early or temporary closure. Funding should be by either cash accrual or a financial guarantee.

Closure and post closure plans will include appropriate aftercare and continued monitoring of the site, pollutant emissions, and related potential impacts. The duration of post closure monitoring will be defined on a risk basis. However, site conditions typically require a minimum period of five years after closure or longer.

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3.3 CHINESE STANDARDS

In preparing this closure plan, reference has been made to the Code for Waste Dump Design of Nonferrous Metal Mines[16]. The standard is assumed to apply to waste dumps and heap leach pads as well as application of general principles to overall site closure. Amongst others, it requires that:

- The reclamation plan for the waste dump be prepared at the same time as the waste disposal plan;

[15] IFC (2007). Environmental Health & Safety Guidelines for Mining, International Finance Corporation, 10 December 2007

[16] Code for Waste Dump Design of Nonferrous Metal Mines (2007). National Standard of the People's Republic of China, GB 504421-2007. Implemented 01 October 2007.

- The final landform be in keeping with the local natural environment with vegetation coverage no less than the original coverage;
- The end land use of arable or agricultural land be the main priority;
- Slopes be slackened appropriately for stability, development and utilisation of the site;
- Reclamation be completed within three years of completion of waste disposal (one year for engineering and two years for habitat/vegetation establishment);
- The design shall include measures to prevent waste residue, dust and water pollution influencing the environment; and
- Waste dumps containing heavy metals, sulfides or other toxic soluble waste shall have waterproof and leakproof measures to prevent release of contaminants to the environment.

3.4 EUROPEAN COMMISSION BEST AVAILABLE TECHNIQUES (BAT)

The European Commission Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities (January 2009) provides details of current good practice relating to waste rock management. Recommendations relevant to the Letpadaung project include:

- The site should be designed for closure. This implies that the closure of the site is taken into account in the feasibility study of a new mine site and is then continuously monitored and updated during the life cycle of the mine.
- Closure costs are included in the assessment of alternatives.
- Facilities are designed to facilitate premature closure if necessary.
- After-care design should minimise the need for active management.
- Life-cycle management: A reduction of the risk of any failures can be assisted by a commitment of the operator to the adequate and rigorous application of appropriate available engineering techniques for the design, operation and closure of tailings and waste rock management facilities over the entire period of their operating life. Some tools elemental to good engineering are the establishment of an environmental baseline, the characterisation of tailings and waste-rock, the use of dam safety manuals and audits, as well as applying planning for closure from the outset.
- Upon closure, ARD generating .waste-rock heaps should be covered with engineered dry covers that aim to prevent ARD generation.

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- Progressive restoration/revegetation: Heaps and dams are often restored/revegetated during operation. Amongst other advantages, this allows a shorter closure period.
- Development of a monitoring plan that includes inspections and audits.

3.5 WESTERN AUSTRALIA MINE CLOSURE GUIDELINES

The Guidelines for Preparing Mine Closure Plans, produced by the Government of Western Australia (June 2011) provide further good practice guidance. Recommendations include:

- At all stages, from the project approval stage onwards, the Mine Closure Plan should demonstrate that ecologically sustainable mine closure can be achieved consistent with agreed post-mining outcomes and land uses, and without unacceptable liability.
- Planning for mine closure should be fully integrated in the life of mine planning, and should start as early as possible and continue through to final closure and relinquishment. For new projects, closure planning should start in the project feasibility stage (before project approvals).
- Mine closure plans must be site-specific. Generic “off-the-shelf” closure plans will not be acceptable.
- Closure planning should be risk-based taking into account results of materials characterisation, data on the local environmental and climatic conditions, and consideration of potential impacts through contaminant pathways and environmental receptors.
- Consultation should take place between proponents and stakeholders which should include acknowledging and responding to stakeholder’s concerns. Information from consultation is central to closure planning and risk management.
- Post-mining land uses should be identified and agreed upon through consultation before approval of new projects. This should take into account the operational life span of the project, and should include consideration of opportunities to improve management outcomes of the wider environmental setting and landscape, and possibilities for multiple land uses. For existing mining projects, post-mining land uses should be agreed as soon as practicable.
- Characterisation of materials needs to be carried out prior to project approval to a sufficient level of detail to develop a workable closure plan. This is fundamental to effective closure planning. Characterisation of materials should

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include the identification of materials with potential to produce acid, metalliferous or saline drainage, dispersive materials, fibrous and asbestiform materials, and radioactive materials, as well as benign materials intended for use in mine rehabilitation activities.

- Closure planning should be based on adaptive management. Closure plans should identify relevant experience and research, and how lessons learned from these are to be applied.
- Closure plans should demonstrate that appropriate systems for closure performance monitoring and maintenance, and for record keeping and management are in place.

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4. CLOSURE CONSIDERATIONS

4.1 DEFINITIONS

For the purposes of this closure plan, the following terminology has been adopted:

CLOSURE – Life of mine process which culminates in tenement relinquishment. It includes decommissioning and rehabilitation.

DECOMMISSIONING – The process that begins near, or at, the cessation of mineral production and ends with the removal of all unwanted infrastructure and services.

REHABILITATION – The return of disturbed land to a stable, productive, and self-sustaining condition.

RELINQUISHMENT – Formal approval by the regulating authority that completion criteria have been achieved.

4.2 CLOSURE PRINCIPLES

Current good mining practice suggests that mine planning should be undertaken with mine closure at the forefront of consideration. Some key principles and elements related to mine closure include:

- Integrate sustainable development considerations within the corporate decision-making process,
- Plan, design, operate and close operations that enhance sustainable development;
- Implement risk management strategies based on valid data and sound science,
- Consult with interested and affected parties in the identification, assessment and management of all social, health, safety, environmental and economic impacts associated with closure activities, and
- Inform potentially affected parties of significant risks from mining, minerals and metals operations and of the measures that will be taken to manage potential closure risks effectively;
- Seek continual improvement in environmental performance,
  - Assess the positive, negative, indirect and cumulative impacts of new projects from exploration through closure,
  - Rehabilitate land disturbed or occupied by operations in accordance with appropriate post-mining land uses, and
  - Design and plan all operations so that adequate resources are available to meet closure requirements of operations;

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- Contribute to the social, economic and institutional development of the communities in which the project operates,
- Contribute to community development from project development through closure in collaboration with host communities and their representatives; and,
- Implement effective and transparent engagement, communications and independently verified reporting arrangements with stakeholders.

4.3 SHORT-TERM OBJECTIVES

Letpaduang's short-term closure and reclamation objectives (during construction and operations) can be summarised as follows:

- Progressively reclaim disturbed areas as soon as they are no longer active;
- Minimise the risk and impact of wind and water erosion and sediment transportation;
- Stabilise slopes;
- Restore drainage; and
- Cover ground to prevent soil drifting/dust.

4.4 LONG-TERM OBJECTIVES

The long-term closure and reclamation objectives are to:

- Reclaim the land to a condition where long-term environmental degradation does not take place;
- Reduce care and maintenance requirements;
- Restore the natural drainage patterns as far as practicable to the original conditions;
- For areas which cannot be restored to the original conditions, rehabilitate the areas to create landforms which are physically and chemically stable in the long-term, and where possible, are in keeping with the prevailing topography in the area;
- Prevent physical or chemical pollutants from entering and subsequently degrading the downstream environment - including surface and ground waters;
- Develop the site to achieve the long term land use goals developed in consultation with the community and government;
- Reclaim/rehabilitate the land to a condition where safety risks and environmental associated with the mine to the public are minimised;

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- Restore the local environment to a natural, balanced ecosystem typical of the area, or leave it in such a state so as to encourage and enable the natural rehabilitation and/or reintroduction of a biologically diverse, stable environment.
- Seek to establish flora and fauna communities which are dynamic and resilient to disturbance from external influences (such as rain, wind, drought, harvesting, for example);
- Reclaim the land to a condition where local communities can use the site without inheriting significant future liability;
- To the extent practical, create an aesthetically pleasing environment;
- Ensure public health and safety is protected;
- Minimise adverse socio-economic impacts and provide positive social-economic benefits;
- Agree success/completion criteria with relevant stakeholders. Monitor achievement against those criteria and report results to the stakeholders;
- Ensure at all stages of operations there are adequate and readily available funds to implement the closure plan.

As part of the closure plans, a set of rehabilitation standards will be developed and agreed with the relevant authorities, which when achieved will demonstrate successful rehabilitation. They will be inclusive of legislative requirement, recognitions of final land use requirement and quantified through consultation with relevant stakeholders.

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4.5 SOCIAL CONSIDERATIONS

During development of the closure plan, consideration should be given to the impact that the scheme will have on the local population. Issues to be addressed include (DITR, 2006b):

- Ensuring future public health and safety of the community is not compromised;
- An early and effective communication strategy should be established and the community engaged throughout the life of the operation, including through decommissioning and closure;
- Community development should include strategies for sustaining the socio-economic state of the community without the support of the mine;
- Develop capacity to maintain certain infrastructure services and facilities for future community or local government ownership or as part of arising business development opportunities;

- Provide appropriate skills transfer and employment opportunities through the development of local business enterprises;
- Community development should be driven by the needs of the community with the aim of contributing to the building of the long-term strength of community viability; and
- Develop the formal and informal processes, systems, structures and relationships within the community that actively supports the capacity of current and future generations to create a range of healthy and liveable communities.

It should be noted that consultations have not yet commenced but will be undertaken in later stages of the feasibility design. The concept closure plan presented here provides an engineered solution for land use that has been adopted on similar schemes elsewhere. Refinement of the design will be completed following the consultation process.

4.6 PRE-CLOSURE STUDIES AND CONSULTATIONS

In order to develop the closure plan from the concept level to detailed design stage, a number of consultations and studies will be undertaken during the mine operation to refine the plan. These are likely to include:

- Consultation with the local population to determine preferred final land use options;
- Consultation with government to establish final land use parameters;
- Rehabilitation trials to assess most appropriate resoiling and revegetation strategies for each key area on the site.
- Ongoing investigation and reviews of available rehabilitation materials and new technologies to improve rehabilitation outcomes.

4.7 DEVELOPMENT OF THE CLOSURE PLAN

A dynamic rehabilitation plan will be developed which has the flexibility to evolve as results from investigations, research, on-site trials and detailed mine planning become available. The development schedule for the closure plan will consist of the following stages:

1. The Conceptual Closure Plan will be prepared during the design stage (this report). This will allow integration with the design concepts and ensure that the design and operation of the site are compatible with the closure plan.
2. After commissioning the Detailed Closure Plan will be developed which incorporates the following:

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a) A closure plan for each specific area / type of facility and structure on site.

b) Rehabilitation completion standards for approval with the regulators.

c) Testing program for assessment of short term and long term physical and chemical stability of waste dump and heap leach materials.

d) Rehabilitation trials to assess the viability of the closure concept plan.

e) Progressive rehabilitation plans for areas of the site which are no longer required for the ongoing operation.

3. During mine operation the closure plan will be updated every five years based on the results of the testwork programme and the changes in the operation and mine planning.

4. A minimum of five years before closure of the mine, a Final Closure Plan will be developed and approved with the regulators.

Key activities that will be undertaken to develop the Plan include:

- **Options workshops**: to identify closure options and develop a strategy to identify and develop the preferred closure option taking into account social, environmental and economic implications;
- **Risk assessment workshops**: to identify risks associated with the preferred closure option(s) and to develop a mitigation programme to manage risks to acceptable levels;
- **Closure cost estimation**: to develop an estimate of mine closure costs, including the construction, demobilisation, demolition, removal and remediation of all plant facilities as well as all other ongoing remediation activities.

An outline of the level of detail to be included in the closure plan in relation to the time before closure works commence is provided in Table 4.1 (Government of WA Guidelines for Closure Plans).

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Table 4.1: Anticipated level of closure detail

Life of Mine	Post-mining Land use	Identification and Management of Key Environmental Issues	Closure Outcomes	Closure Costing	Closure Implementation and Monitoring Plans
Long term (25+ years)	Provisional targets unless agreed to by all key stakeholders as being final	High risk components completed	Indicative except for high risk operations	Indicative	Preliminary except for high risk operations
Medium term (10 to 25 years)	Well advanced	Completed	Well advanced	Increased accuracy	Well advanced
Short term (Up to 10 years)	Well advanced to Completed	Completed	Well advanced to Completed	Accurate	Completed
Existing operations	Determined on a case by case basis depending on mine life and risk	Completed	Determined on a case by case basis depending on mine life and risk	Determined on a case by case basis depending on mine life and risk	Determined on a case by case basis depending on mine life and risk

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5. CONCEPTUAL CLOSURE DESIGN

5.1 OVERVIEW

The following sections describe the conceptual design for the key physical elements of the mine site. The closure concepts for each component are based on the best engineering interpretation of the data available currently with verification of the assumptions to be part of the ongoing closure plan testing program.

A closure land-use plan is provided as Figure 5.1 which shows the principal mine areas and proposed final land-uses.

5.2 TOPSOIL RECOVERY

As part of the site clearance and preparation prior to construction of the mine, topsoil and other suitable subsoils will be recovered from all areas to be disturbed with sufficient volume recovery to ensure effective rehabilitation of the site on closure. The soils will be stockpiled at various locations around the site and will be protected throughout the mine life. The recovery and storage of the soils will conserve valuable nutrients and enhance the future viability of native seed and micro-organisms. As such efficient recovery and management of the resource is critical to rehabilitation.

Initial assessments of ground conditions suggest that some 7 Mm^3 of topsoil and subsoil can be recovered from the disturbed footprint of the mine with an average thickness of 400 mm. The stockpiles will have a maximum height of 4 m which is a balance between optimising storage volumes whilst trying to maintain low stockpile heights which assists with preserving viability of the soils. Preliminary stockpile locations are shown on Figure 5.1.

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5.3 OPEN PIT

5.3.1 General

The key factor in closure of the open pit is the maintenance of the safety of the public and the environment.

The key risks are:

- Steep sloping side walls of the pit;
- Collapse of sides and creation of zones of instability; and
- Accumulation of water in the pit which will generally be of poor water quality due to acid rock drainage and accumulation of metals and salts in the water associated with evaporation and/or changes in water chemistry.

The closure design will ensure that the risk of harm to humans, fauna or domestic animals is reduced as far as reasonably practicable. Measures will also be included to reduce the likelihood of contamination of groundwater or surface water by the mine pit after closure.

5.3.2 Post-Closure Land-Use

The mine pit will be partially backfilled during the later stages of operation as waste rock from one section of the pit is placed in other sections where resources have been fully exploited. It is not practical to completely backfill the pit and a void will be left on completion of mining operations.

Due to the potential for acid generation in the pit walls and waste rock within the pit, it is proposed that the pit be flooded to reduce oxygen exposure to the potentially reactive rock.

The mine pit area will not have a post-closure use other than to act as a sump for potentially contaminated contact surface run-off from the site. Some non-contaminated water from the waste dump areas may also be routed to the pit in order to maintain pit lake levels sufficiently high to reduce acid generation in the base of the pit.

5.3.3 Decommissioning and Reclamation

On closure, all equipment will be removed from the Open Pit and any areas with a high risk of ongoing instability will be backfilled and/or re-profiled. Access to the pit will be blocked at the access ramps.

The dewatering system will be decommissioned and the Open Pit will be allowed to fill with inflows from direct rainfall, runoff from pit walls, groundwater inflows, and surface water inflows from the upslope catchment areas which will include potentially contaminated contact water from the waste dumps.

An abandonment bund wall, constructed of NAF mine waste to a minimum height of 2 m, will be constructed around the full pit perimeter outside of the area of potential future instability in order to restrict access to the pit. Warnings signs will also be installed.

5.3.4 Water Management

The pit lake will be managed through a combination of adjusting surface run-off inflows and evaporation areas to ensure acid-generating materials are continuously below the waterline and not subject to oxidation whilst also maintaining the pit lake water levels below the pit rim baseline groundwater level to reduce seepage to local groundwater.

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Surface water discharges from the Open Pit will be prevented in perpetuity unless the water is demonstrated to be consistently of a suitable quality for release.

Pit Lake water quality will be monitored after closure, and any requirements for passive or active water treatment of Pit Lake inflows will be determined according to water use objectives.

5.4 WASTE ROCK DUMPS

5.4.1 General

The waste rock dumps (WRDs) will be constructed during operations to provide structures which are safe and stable whilst also providing landforms that are appropriate for rehabilitation and the final land use. Due to the significant quantities of PAF waste that will be produced from the pit, the dumps will be constructed to encapsulate the PAF waste concurrent with mining and also allow progressive rehabilitation of the dumps.

It is noted that geochemistry evaluations have not yet been fully completed and therefore the concepts presented herewith are based on the available data which suggest a significant potential for acid generation and metals leaching.

5.4.2 Post-Closure Land-Use

Whilst there will be a large area of revegetated land on closure, the elevation of the WRDs compared to the surrounding topography combined with minimal flat areas and low rainfall experienced in the area are unlikely to make the WRDs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

5.4.3 Decommissioning and Reclamation

The waste rock dumps will be constructed as a series of lifts with seven metre wide benches every 12.5 m of height gain. The external walls of the waste dumps will have local slopes of 1V:2.5H and overall angles of 1V:2.9H. Some reprofiling may be required to reduce slope angles to enable effective rehabilitation and for the slopes to be grazed by animals. This will be confirmed during detailed design. The outer walls will be finished with a cover system (described below).

The top of the waste rock dump will be shaped to shed water to drainage channels located on the final top surface that direct flows to drop drains. The benches of the waste rock dump will be graded to direct water also to the drop drains. The drop drains will be lined with heavy fresh benign NAF rock with drain stop boards constructed every five metres down the slope to control the flow speed of the water down the slope. At

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the base of each drop drain an energy dissipater and sediment trap with the capacity to hold runoff from a 1 in 10 year storm of 1 hour duration will be constructed to control flows and contain runoff prior to release to the general site surface water management system.

After all the batter slopes have been covered, they should be seeded/planted with a mixture of local grass seed and the seeds or plants of shrubs and trees local to the area.

The rehabilitation of waste rock dump batters should occur progressively during the mining process, after each berm is established and the outer walls shaped, to enable the success of the rehabilitation techniques to be reviewed and refined. This will allow a fully developed and assured method of revegetation and batter treatment, as well as drainage structures, to be developed and minimise the level of maintenance required after closure works are complete.

5.4.4 Cover System

Cover systems are an integral design component for the successful reclamation and closure of the Project. At the surface of the cover system, direct precipitation will either run off the cover, be removed through evapotranspiration or infiltrate into the active zone. Water that infiltrates is typically stored in the active zone and can exfiltrate to the surface and evaporate. A portion of the water that infiltrates can also percolate into the underlying waste, which is intended to be reduced by the placement of the cover system. The objectives of the cover systems considered for the Project include:

- Physical stabilization to provide dust and erosion control, particularly wind and water erosion of waste materials, and to act as a barrier to prevent direct contact of the waste by flora and fauna
- Chemical stabilization through control of oxygen or water ingress; and contaminant release control through reduced infiltration, and
- Meeting land use objectives and other societal values by providing a growth medium for establishment of sustainable vegetation; and reclaiming the area for post-closure land uses.

A combination of cover system efficiency and saturation conditions can help to reduce oxygen ingress and the subsequent oxidization of waste materials which typically results in ARD production.

The proposed cover system concept aims to maximize use of the climate, cover material characteristics, cover material availability, hydrogeologic setting and waste

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material physical properties to minimize potential effects related to the waste material chemical properties.

In consideration of the anticipated chemistry of the waste rock combined with the varying proximity of the waste materials to watercourses that are used for domestic, drinking, irrigation and livestock watering uses, a low Infiltration cover system (50-90 % reduction of net infiltration) is proposed for the WRDs in order to reduce the risk of acid generation in the waste dumps and the associated release of low-pH leachate to the environment. Release of solubilised heavy metals will also be reduced.

A low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-8} m/s would be required to construct a cover system capable of reducing net infiltration to approximately 50 to 90% of the infiltration rate expected for a bare surface. Considering the characteristics and availability of materials on site, the cover system would be constructed from a minimum 1 m thick compacted low permeability soil layer, overlain by a 2 m thick gravelly store and release layer, and finished with a re-vegetated subsoil/topsoil layer some 400 mm thick comprising 250 mm of subsoil over which 150 mm of topsoil is place. A typical section through the cover system is provided on Figure 5.2.

Additionally, prior to placement of the cover system, some localised grading may be required to promote positive surface drainage thereby minimizing the likelihood of standing water and saturation of the materials in the cover system. Sloped areas must be protected from surface erosion through re-vegetation and development of drainage structures, to reduce infiltration and to prevent breakthrough of flow into the underlying tailings.

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It is anticipated that the low permeability materials and the store and release layer will be sourced from overburden strip from the mine pit during operations. Alternatively borrow areas may need to be established if insufficient material is available locally and/or mine scheduling isn't compatible with the waste dump construction.

5.4.5 Water Management

A surface water management system will be progressively established concurrent to waste dump development. Major flowpaths are shown on Figure 5.1. Provision is made in the design for separate systems to manage non-contaminated contact water and potentially contaminated contact water. Non-contaminated contact water will be suitable for release into watercourses downstream of the site following basic settling to reduce suspended sediment loads. Potentially contaminated contact water will be directed initially to the mine pit dewatering system and, once the pit is

decommissioned, the water will flow to the pit lake to prevent release of the potentially-contaminated water to the wider environment.

Runoff and drainage water from the waste dumps will be analysed during the closure phase to determine the water quality characteristics. It is anticipated that the surface runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated, while seepage from the waste rock may be of poorer quality. If water treatment is found to be necessary, a suitably designed passive water treatment wetland system will be designed to enable improvement of water quality to be undertaken prior to release into the environment.

5.4.6 Rehabilitation

The construction of the closure cover system will provide a landform suitable for revegetation with native plants. Seeding and planting across the finished surface will provide long-term erosion protection.

5.5 HEAP LEACH PADS

5.5.1 General

The heap leach pads (HLPs) will contain acid-generating material as well as residual acidity from the leaching process. The HLPs must be closed and rehabilitated in such a way that the waste is not exposed to the environment and that infiltration of water is reduced to a level where long-term leachate generation is negligible.

The HLPs should also be reshaped to provide landforms that are stable in the long-term and do not pose a hazard to personnel undertaking rehabilitation or the local population post-closure.

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5.5.2 Post-Closure Land-Use

Whilst there will be a large area of revegetated land on closure, the elevation of the HLPs compared to the surrounding topography combined with the low rainfall experienced in the area are unlikely to make the HLPs suitable as agricultural land. Some grazing of livestock may occur but large scale farming is not expected. The current intent is to revegetate the landforms to prevent erosion of the soil and thereby ensure long-term protection of the cover system.

5.5.3 Decommissioning and Reclamation

Once all viable resource has been recovered from the HLPs, the pads are to be flushed with fresh water to reduce the amount of free acid in the heaps.

The principal aspects of the outline HLP closure are:

- Perimeter slopes to be reshaped to a grade that ensures long-term stability and that is appropriate for machinery to safely operate during the rehabilitation and future maintenance works.
- Surplus material is to be placed as fill between HLP 1 and 2 to infill the valley and create a single large landform for rehabilitation.
- Final top surface to be reshaped to provide positive drainage to the closure surface water management system.
- Placement of an appropriate cover system to reduce infiltration into the HLPs and provide a growing medium suitable for rehabilitation.
- Revegetation of the closure surface.

The reshaping and filling exercise is illustrated on Figure 5.3.

5.5.4 Cover System

In consideration of the anticipated chemistry of the HLP material on closure, combined with the varying proximity of the waste materials to watercourses that are used for domestic, drinking, irrigation and livestock watering uses very low infiltration cover systems (>90 % reduction of net infiltration) are proposed for the HLPs. Reducing infiltration into the heaps will reduce further acid generation and quantities of leachate produced.

A very low permeability layer with a saturated hydraulic conductivity of less than or equal to 1×10^{-9} m/s would be required to construct a cover system capable of reducing net infiltration to greater than 90% of the infiltration rate to be expected for a bare waste rock surface.

The main elements of the cover will be:

- Low permeability soil (1 m thick) or synthetic liner to prevent ingress of water;
- Protective fill layer (0.6 to 1.5 m thick depending on liner system adopted) which may also act as ‘store and release’ capping;
- Topsoil to allow revegetation (approximately 400 mm).

The cover options are illustrated in Figure 5.2. Studies into the most appropriate cover system shall be undertaken during the operational phase of the mine. Considerations in the studies will include availability of suitable fill materials.

5.5.5 Water Management

The HLPs should be reshaped to positively drain all run-off to perimeter channels that convey the non-contaminated contact water to the site surface water management system with subsequent release in to watercourses downstream of the site.

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Any leachate generated from the heaps will be routed into a closed (potentially-contaminated contact water) system for treatment prior to release. During initial drawdown, the leachate will be passed through the process plant to ensure that the water quality is suitable for discharge. Once the drawdown phase is complete and leachate quantity and quality have reduced to manageable levels, leachate will be passed through passive treatment systems to render the water suitable for release.

The passive treatment systems will be developed during operations when leachate chemistry is better understood. Possible options, which may be combined, include sediment control, wetlands, or limestone-filled 'polishing' channels.

5.5.6 Rehabilitation

The construction of the closure cover system will provide a landform suitable for revegetation with grasses and small native plants. Seeding and planting across the finished surface will provide long-term erosion protection.

5.6 PLANT, EQUIPMENT AND INFRASTRUCTURE

5.6.1 General

All plant, equipment and infrastructure on the site shall be recovered, removed and re-used wherever possible. The primary objective is to ensure the site is safe and does not generate hazards for the community.

As a general rule, where facilities are of no use to the community:

- All structures shall be removed;
- All waste shall be buried at least three metres below a finished surface;
- Concrete should be broken up and buried;
- All batters should be flattened to at least a 1V:4H slope for public safety;
- All areas should be ripped, scarified, topsoiled and then seeded to encourage a vegetated cover, unless otherwise agreed with the local community.

5.6.2 Post-Closure Land-Use

Buildings on the site should be made available to the local community, if they have no value and cannot be economically removed and re-used elsewhere. Such opportunities can assist communities to adjust the socio-economic effects of closure and allow the development of new enterprises and provision of alternative local employment.

Where practicable, areas that are rehabilitated will be returned to the pre-mine land use. Discussions may be held with regulatory agencies and stakeholders to determine

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the potential to create small water storage structures to improve water availability for post-closure land use in agriculture and livestock rearing.

The future of any water supply bores associated with the project should be discussed with local authorities and the community. The presence of a water supply may provide much needed infrastructure to the community as well as providing commercial and industrial opportunities which are not currently available, due to the cost of establishing such facilities. Transfer of these assets to the community may also offset some of the socio-economic losses that arise due to closure of the mine.

5.6.3 Decommissioning and Reclamation

All process tanks, pipes and water lines should be flushed free of any solids or residual fluids prior to removal. Materials that constituted these facilities should be recovered for reuse or recycling or otherwise buried at least three (3) metres deep within the site. Opportunities for burial may arise in some of the process water ponds to be closed.

All fixed and mobile equipment with marketable value will be removed from site and sold. Equipment that cannot be sold or is deemed to be hazardous will be disposed of in an appropriate manner.

Fuels and lubricants will be required during the closure phase. Additional fuels will only be provided on an as-needed basis to reduce the materials remaining on site. Fuels remaining at the end of the active closure phase will be returned to the original supplier or possibly sold to a third party user. Fuel storage tanks and associated pipework should be recovered for reuse or recycling or otherwise be disposed of as hazardous waste.

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Unused explosives and detonation devices stored on site will be checked for condition and either returned to the supplier for credit, shipped to another third party user, or destroyed through appropriate procedures. In all cases the explosives will be handled, transported and disposed of in compliance with the appropriate legislation. The explosives magazines will be returned to the supplier or to a third party.

During the initial closure stage, power generation requirements will be reduced and only those generators required for on-going activities will remain operational. Excess generators will be removed from the power plant and poles and distribution lines will be salvaged or buried in a landfill. At the end of the closure phase when the mine no longer has any power requirements, the remaining generators will be removed from the site and the remaining poles distribution lines will be salvaged or buried in the landfill.

Roads required for access during the rehabilitation phase and for post-closure monitoring and maintenance will be left in place. After these roads are no longer

required for Project use, they will be left in place for use by local communities. Site roads not needed for the closure works will be broken up, resoiled and re-vegetated unless the local communities would prefer that the roads are left in place.

Where buildings and structures are to be removed, they should be demolished with reusable or recyclable waste removed from site. Rubble and other inert waste can be buried in designated locations at least three (3) metres below final ground surface. Any contaminated soils will be treated and disposed of appropriately. Hazardous waste is to be disposed of in an on-site hazardous waste facility.

Reuse of items, such as HDPE pipe, should be considered as part of the closure plan. HDPE pipe, for example, can be used as fence posts for barricading areas with public safety issues or used as posts for fencing associated with local cropping and grazing activities.

5.6.4 Water Management

Following demolition, the disturbed areas will be shaped to prevent ponding of water and to provide positive drainage into the site surface water management system.

5.6.5 Waste Management

Reusable or recyclable waste should be removed from site. Non-hazardous waste can be buried in designated disposal areas with a minimum of three metres of cover. Any hazardous waste should be encapsulated in a purpose-built facility within the site boundary for permanent storage.

5.6.6 Rehabilitation

Disturbed areas will be reshaped for drainage, topsoil applied and will then be re-vegetated using grass and shrub species native to the region to encourage vegetation to re-establish in the area.

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5.7 PROCESS AND WASTE WATER PONDS

5.7.1 General

There are a number of ponds located to the east and south east of the site. These include HLP stormwater ponds, process water ponds and surface water stormwater ponds. It is proposed that these ponds be used on closure for treatment of run-off and storage of wastes.

5.7.2 Post-Closure Land-Use

Uses of the former ponds include:

- Settling ponds for uncontaminated surface run-off water to reduce sediment loads prior to discharge off site.

- Wetlands and/or polishing ponds for the passive treatment of water with low levels of contamination prior to discharge.
- HDPE-lined ponds to be utilised for the construction of a hazardous waste landfill to store decommission wastes.

Any pond areas not required for the above uses should be infilled and returned to agricultural use.

5.7.3 Decommissioning and Reclamation

Process and waste water ponds shall be completely drained until only residual solids/sludge are present.

Once drained, any residual sludge is to be sampled and tested. Sludges which are considered 'hazardous' should be disposed of in the site hazardous waste landfill. Inert or non-hazardous wastes will either be disposed of in an appropriate storage area or, if physical and chemical characteristics are suitable, be used as fill in the reclamation process.

The pond base will then be prepared according to the final end use. Any HDPE liner, or similar, where not required will be removed and disposed of. Clay liners for ponds will be retained unless the area is to be used for agriculture in which case the liner will be ripped prior to backfilling to promote through drainage.

Where ponds are to be retained as ponds or wetlands, hydraulic control structures will be built to control flows in and out as well as retained water levels.

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5.7.4 Water Management

The former pond areas will be used to manage run-off water from the site with collection channels routed to the pond areas. Hydraulic control structures will be constructed as necessary to maintain or prevent ponding of water.

5.7.5 Waste Management

Non-hazardous waste can be buried in designated disposal areas with a minimum of three metres of cover. Any hazardous waste should be encapsulated in a purpose-built facility within the site boundary for permanent storage.

5.7.6 Rehabilitation

Disturbed areas will be reshaped where necessary for drainage, topsoil applied and will then be re-vegetated. Wetland areas will either be re-vegetated with reed beds or, if water chemistry is acceptable, be provided to the local community as rice paddies. Areas designated for agriculture should be handed over to the local community to vegetate.

5.8 SURFACE WATER MANAGEMENT

5.8.1 Routing

At closure, contaminated mine contact water will continue to be allowed to drain to the open pit, and non-contaminated water will be directed to the surrounding natural aquatic environment. Diversion and collection ditches that are no longer required will be decommissioned (backfilled) and re-vegetated. In general, collection ponds accepting non-contact water will be reclaimed through re-vegetation and allowed to collect and store water for use by the local communities. Collection ponds accepting mine contact water will not be decommissioned directly after closure, and will continue to function to direct mine-contact water into the Pit.

The operational surface water management system will be adjusted to convey flows generated by the closure land forms and land uses.

It is envisaged that the majority of run-off generated post closure will be uncontaminated and will only require settlement to reduce suspended loads prior to discharge. It is the intention that as much water as possible is returned to the surrounding environment. However there is provision in the design to direct some of the run-off water to the open pit. A pit lake will need to be maintained to reduce acid generation in the pit walls and buried waste. If the detailed hydrogeological modelling, and/or experience on site, shows that recharge of the pit lake is insufficient to maintain appropriate water levels then run-off from Waste Rock Dump 1 can be directed to the pit.

An outline design for surface water routing is provided on Figure 5.1.

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5.8.2 Chemistry

It is envisaged that during initial stages of HLP drawdown, a substantial volume of contaminated leachate will still be produced by the heaps. The process plant, potentially with adaptions, will be used to treat this water until concentrations reach a level where other, less onerous, treatment options can be successfully adopted.

Runoff collected in the collection ponds will be analysed in the closure phase to determine if water quality characteristics meet applicable standards. It is anticipated that the surface runoff water quality will be similar to baseline runoff once the surfaces are re-vegetated. When water quality meets acceptable standards, the mine contact collection ponds will be backfilled and re-vegetated.

Where surface run-off and/or leachate from areas such as the waste rock dumps and heap leach pads is not suitable for release then treatment systems should be implemented.

The first level of treatment is sedimentation through sedimentation ponds or wetland areas to reduce the suspended load. In many cases this is likely to be sufficient to improve the water to meet the relevant release criteria.

Water treatment methods used to eliminate or reduce acidity and heavy metals precipitation from impacted waters can be grouped into two types: (1) active and (2) passive treatment:

Active treatment involves neutralising acid-polluted waters with alkaline chemicals. However, the chemicals can be expensive and the treatment facility is expensive to construct and operate.

Passive treatment involves the construction of a treatment system that employs naturally occurring chemical and biological reactions that aid acid rock drainage treatment and which require little maintenance. Passive control measures include anoxic drains, limestone rock channels, alkaline recharges of groundwater, and the diversion of drainage through man-made wetlands or other settling structures.

There is also a possibility to combine active and passive treatment techniques (e.g. liming and constructed wetlands)

An evaluation of water chemistry, potential environmental impacts, and whether or not water treatment will be required will be undertaken as part of the ongoing closure planning during the mine life. If necessary the design will be updated to include additional water treatment.

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5.9 WASTE MANAGEMENT

5.9.1 Waste Streams

Some materials arising from clearance of the site will have a commercial use and value. These may include generators, pumps and pre-fabricated buildings. Where possible these will be removed from site and either sold or reused elsewhere. Any materials which cannot be handled in this manner are considered wastes for the purposes of this closure plan.

Waste generated by the decommissioning and rehabilitation of the site will be one of three different categories of waste:

Inert Waste. This is waste which is neither chemically or biologically reactive and will not decompose. It includes concrete, bricks and uncontaminated sediment/sludge from stormwater ponds.

Non-Hazardous Waste. This is waste which is not inert but does not have properties that pose a substantial threat to public health or the environment (and therefore

classifies as hazardous waste). Types of waste will include plastic liner, plastic pipes, metals, and timber.

Hazardous Waste. This is waste that poses substantial or potential threats to public health or the environment by exhibiting one or four of the following properties:

i. Ignitability
ii. Reactivity
iii. Corrosivity
iv. Toxicity

Hazardous wastes are likely to include fuels, oils, contaminated soils and sludges, and components of equipment and machinery.

5.9.2 Hierarchy of Waste Management

Waste generated from the decommissioning activities will be managed to reduce the environmental impact. MWMCL will seek to treat the wastes in the following order of priorities:

i. Reuse
ii. Recycle
iii. Dispose

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If it is possible to reuse a waste either on site or for a different application in the local community then this should be adopted. Possible options include using old plastic pipework for fencing or corrugated metal sheeting as roofing on community buildings.

Where the wastes cannot be reused, attempts will be made to recycle those materials through off-site merchants and processing facilities. Types of waste that could be recycled include crushed concrete which can be used as aggregate and steelwork that can be sold as scrap metal.

If the waste cannot be reused or recycled then it should be disposed of in an appropriately-constructed landfill facility. It is intended that landfills will be constructed on the site so that wastes are contained within the site boundary. Disposal options are discussed in more detail below.

5.9.3 Disposal Options

Two landfill facilities will be constructed to handle decommissioning wastes. An inert and non-hazardous facility will be constructed on the western side of Waste Rock Dump No. 3. The facility will be constructed in cells to separate different types of waste

and also to reduce the exposed tip head to a manageable size. The waste will be regularly covered with a soil cover to reduce dust generation. On completion the whole landfill will be capped with a 1 m thick low permeability soil cover, 2 m of store and release fill and finished with topsoil. The cover will be shaped to shed water.

The HDPE-lined base of the HLP stormwater pond will form the basis of the hazardous waste landfill. After draining and de-sludging, the HDPE liner will be inspected and repaired if necessary. Intermediate bund walls will be constructed to provide cells for different waste types, a leachate collection system will be installed and a second HDPE liner placed to provide double containment of the wastes.

As waste is placed, daily cover will be applied to reduce dust and minimise the risk of release of hazardous material to the environment. The landfill cover will comprise a very low permeability (HDPE or similar) cover to reduce infiltration and associated soil and topsoil cover. The landfill area will be revegetated with grass, fenced to restrict access and signage erected to warn the local population of the hazard.

Monitoring of the landfills will form part of the overall site monitoring programme with maintenance undertaken as necessary. It is envisaged that satisfactory closure and handover of the landfills will be one of the closure criteria adopted.

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6. SOCIO-ECONOMIC INITIATIVES AT CLOSURE

The Mine Closure Management Plan will set out:

- Initiatives with local communities;
- Broader economic initiatives; and
- Plans to maximise local and regional opportunities at closure.

These initiatives will be developed during the mine life in consultation with the relevant stakeholders and local communities.

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7. CLOSURE SCHEDULE

A detailed Closure Schedule will be developed during the mine life to manage the various stages of decommissioning and rehabilitation. The following summary schedule highlights the key areas of work anticipated:

Period	Activity
Yr 1 to 20	Stage 1 Mining Ongoing recovery of topsoil and rehabilitation materials from the disturbed footprint with construction and progressive rehabilitation of WRDs 1 to 3. Heap Leach Pads 1 and 2 in operation.
Yr 21 to 30	Stage 2 Mining Completion of WRD rehabilitation (Yr 23). Mine waste deposited in-pit. HLP 3 in operation.
Yr 31 to 35	Decommissioning and Rehabilitation Decommissioning of pit and ore recovery/processing infrastructure. Flushing of HLPs, installation of cover system and rehabilitation. Removal of copper recovery plant and conversion of waste water ponds to closure land-use.
Yr 36 to 40	Monitoring and Maintenance Ongoing performance monitoring of the site. Relinquishment of lease when closure criteria are achieved.

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8. PROGRESSIVE CLOSURE AND REHABILITATION

Progressive restoration/revegetation during operation has the following advantages:

- Costs are spread over a longer period and may be recovered from mining revenues.
- Closure activities can be integrated into the daily operational activities of the mine.
- A shorter closure implementation period will result.
- Monitoring programmes are integrated into routine environmental management
- Techniques can be trialled and refined in localised areas with successful techniques can be incorporated into the final closure plan.
- Potential for better rehabilitation outcomes through the use of recently disturbed topsoil.
- Adverse environmental effects such as dust generation and contamination are minimised.
- The amount of time required for monitoring and maintenance post mine life is reduced.

The closure plan will be developed to enable progressive rehabilitation during the mine life. The principal focus will be rehabilitation of the waste rock dumps as capping and revegetation can be implemented throughout the WRD development. Because of in-pit disposal in Stage 2 of the mining plan, no further waste is to be placed in the dumps after about Year 20 allowing ample time to fully close the dumps during the operational period of the open pit.

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9. CARE AND MAINTENANCE PLAN

Whilst design of the closure landforms will seek to reduce care and maintenance requirements, there will be ongoing aftercare liabilities for a number of years. A care and maintenance plan will be developed as part of the Closure Plan to ensure that closure objectives are achieved and so that efficient and relatively rapid rehabilitation can take place.

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10. POST-CLOSURE MONITORING

As the Closure Plan is developed during the mine life, a set of completion criteria for rehabilitation, which are consistent with overall site closure objectives, will be determined and agreed with the regulator and relevant stakeholders. Through long-term monitoring of the site, it will be demonstrated that the development of rehabilitated areas is consistent with completion criteria.

The Monitoring Plan will include as a minimum:

- Physical stability monitoring:
  - Open pit and subsidence area;
  - Mine site and disturbed areas;
  - Waste rock dumps;
  - Heap leach pad;
  - Site security features.
- Chemical stability:
  - Open pit and subsidence area;
  - Mine site and disturbed areas;
  - Waste rock dumps; and
  - Heap leach pad.
- Water Quality:
  - Pit lake
  - Surface run-off
  - Leachate generation.
- Environmental impacts and anticipated mitigation, management measures and associated monitoring;
- Expected maintenance requirements;
- Monitoring of community initiatives;
- Monitoring of community health and safety;
- Monitoring of socio-economic activities; and
- Land resettlement, use and management.

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11. PROVISIONS FOR EARLY OR TEMPORARY CLOSURE

Mining operations may be forced to close prematurely (referred to as *early* closure) or on care and maintenance (referred to as *temporary* closure).

In the event of *early* closure, the closure process should be accelerated. Immediate review of the pre-existing Mine Closure Plan to include a detailed Decommissioning Plan would be undertaken.

If a *temporary* closure is imminent, a detailed Care and Maintenance Plan would be prepared and implemented, based on the pre-existing Mine Closure Plan. The Care and Maintenance Plan would demonstrate that on-going environmental obligations will be met during the period of temporary closure.

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12. RISKS AND OPPORTUNITIES

12.1 RISKS

In preparing this concept closure plan a number of risks were identified. As the closure plan is developed over the mine life these risks will be mitigated where possible. Potential risks at the current time include:

i. Insufficient topsoil and subsoil recovered from disturbed areas, and stored appropriately, for adequate rehabilitation of the disturbed areas.

ii. Insufficient low permeability soil sources on site for WRD liner system.

iii. Insufficient NAF waste and/or borrow sources within the site area for adequate cover depth to WRDs and HLPs.

iv. Restricted footprints for WRDs and HLPs resulting in steep slopes that are difficult and expensive to cover and revegetate.

v. Lack of agreement of closure objectives and end land-use between the operator, regulatory authorities and other relevant stakeholders.

vi. Difficult to manage acid and metals generation from WRDs and HLPs and thereby ensure protection of the downstream environment.

vii. Ongoing liabilities for MWMCL in regards to treatment of run-off prior to discharge if chemical concentrations in surface water remain higher than release criteria.

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12.2 OPPORTUNITIES

With the development of the closure plan during the mine life, operational designs can be adapted to reduce the work required to close the site thereby saving time and cost on closure. Potential opportunities to be explored include:

i. Optimising HLP design, potentially through use of the valleys between the heaps, to reduce footprint, increase leaching efficient and adopt closure batter angles for operational purposes.

ii. Optimise HLP stacking and leaching to exhaust cells and allow progressive rehabilitation rather than operating all the HLPs simultaneously until closure.

iii. Optimise WRD design to adopt closure batter angles for operational purposes and reduce the volume of earthworks needed to achieve the necessary profiles on closure.

13. CLOSURE COSTS AND FUNDING PROVISION

13.1 GENERAL

Closure costs will be accounted for in line with the corporate accounting practices. Letpadaung will estimate mine closure costs throughout the operational life of the Project and will accrue mine closure cost provisions on an annual basis. This will ensure that the accrued closure provision meets the costs of a planned closure event, whether permanent or otherwise, at such time as it occurs. In the event of temporary and/or unplanned mine closure, Letpadaung will develop and agree with the applicable Myanmar regulatory authorities a care and maintenance regime, the costs for which would be covered by Letpadaung's own cash reserves and cash flows.

The closure cost estimate, as reported in the Project financial statements, will be updated annually during the operational life to reflect known developments, including scope changes, the effect of a further year's inflation, exchange rate differentials and new regulatory requirements. Closure cost estimation procedures will ensure that identified post-closure costs, whether ongoing or one-off, are realistically estimated and incorporated into the estimate.

Progressive rehabilitation will be built into operations plans and budgets and will also be subject to annual planning, budgeting and permitting.

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13.2 COST PROVISIONS FOR FINAL MINE CLOSURE

Letpadaung's approach to the estimation and management of costs related to the final closure of the Letpadaung copper mine at the end of the operational mine life comprises the following:

- A provision for mine closure costs on Letpadaung's balance sheet to be determined in accordance with International Financial Reporting Standards including appropriate actuarial assumptions;
- A Letpadaung commitment to review, monitor and update mine closure plans and costs on a yearly basis (Annual Mine Closure Assessment¨). The Annual Mine Closure Assessment will provide (i) an ongoing estimated date of closure (Mine Closure Date) (ii) an update of the estimated cost of mine closure (Mine Closure Cost¨) and (iii) as presented further below an assessment of the date by which Letpadaung will start setting aside cash contributions against the Mine Closure Cost (Closure Contribution Date);
  - The Closure Contribution Date will be the earlier of (i) 7 years before the Mine Closure Date and (ii) the date on which Letpadaung forecasts

aggregate post finance cash flows from such date to the Mine Closure Date falls below twice the Mine Closure Costs; and

- From the Closure Contribution Date, Letpadaung will commit to making cash contributions in priority to shareholder dividend payments ensuring that a dedicated mine closure reserve account is funded by the Mine Closure Date in an amount equal to the Mine Closure Cost by making equal annual cash contributions (the determination of which will take account of interest on the funds in the mine closure reserve account). To the extent that cash flow in any year is insufficient to meet the required annual contribution, any shortfall shall be made up in the following year. The cash contribution shall also be adjusted to reflect any change to the Mine Closure Cost.

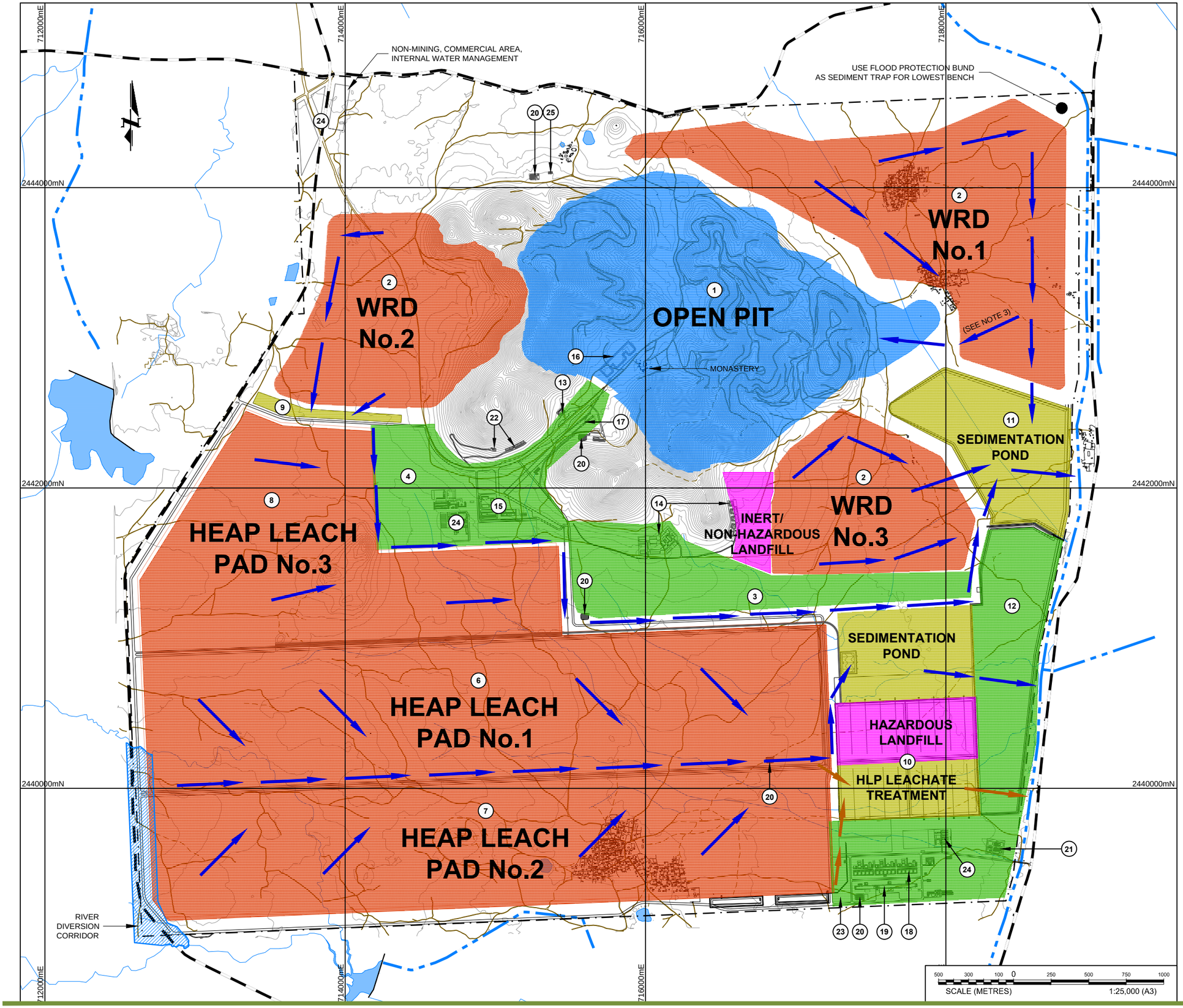
13.3 TEMPORARY/ UNPLANNED MINE CLOSURE

Letpadaung will give a commitment to comply with an agreed care and maintenance regime if there is an unplanned closure of the mine at any time. From a financial perspective, it is expected that there will be sufficient cash within Letpadaung (e.g. from cash balances and payments received on sales made before closure) not only to cover care and maintenance obligations but also, together with proceeds from the sale of Letpadaung's realisable assets, to meet any closure costs. Letpadaung will ensure that any spending on care and maintenance and closure costs is prioritised, ahead of other costs, in the event of an unplanned closure.

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FIGURES

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LEGEND:

- EXISTING CANAL
- EXISTING MAIN ROAD (SEALED)
- EXISTING ROAD/TRACK (UNSEALED)
- LEASE BOUNDARY
- RIVER DIVERSION CORRIDOR
- CLOSURE SURFACE WATER FLOWS
- CLOSURE HLP LEACHATE POLISHING

LAND USE LEGEND:

- PIT AND PIT LAKE
- SCRUB/GRAZING
- LANDFILL (FENCED OFF GRASS COVER)
- PONDS (INITIALLY - MAY BECOME AGRICULTURAL USE OVER TIME)
- AGRICULTURAL USE

NOTES:

1. ALL COORDINATES SHOWN IN UTM (WGS84) ZONE 46.
2. 5m CONTOUR INTERVALS SHOWN.
3. IF REQUIRED TO MAINTAIN OPEN PIT LAKE LEVELS, SURFACE WATER RUN-OFF FROM WRD No.1 TO BE DIRECTED INTO THE PIT.

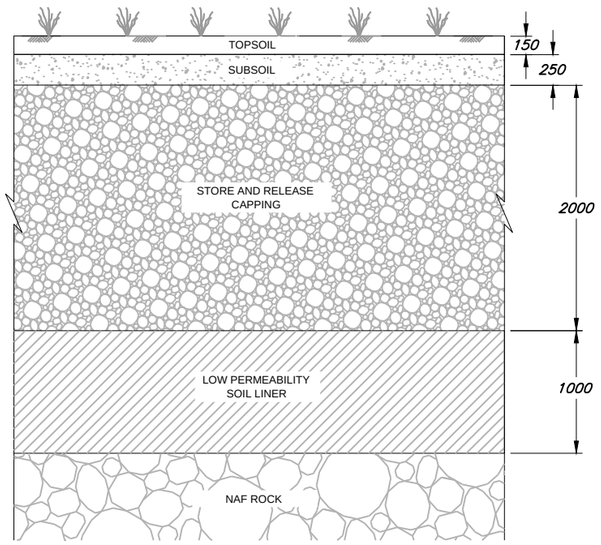
KEY:

1. PIT
2. WASTE DUMP
3. TOPSOIL STOCKPILE
4. LOW GRADE ORE STOCKPILE
5. RESERVE ORE STOCKPILE
6. HEAP LEACH PAD No.1
7. HEAP LEACH PAD No.2
8. HEAP LEACH PAD No.3
9. WASTE WATER COLLECTION POND - CLAY
10. HEAP LEACH STORM WATER POND - HDPE
11. WASTE WATER RESERVOIR (NORTH) - CLAY
12. WASTE WATER RESERVOIR (SOUTH) - CLAY
13. FUEL STATION
14. EXPLOSIVES AREA
15. OFFICES/ WAREHOUSES/ MAINTENANCE AREA
16. MOBILE CRUSHER FOR QUARRY
17. CONVEYOR FOUNDATIONS
18. EXTRACTION PLANT
19. ELECTROWINNING PLANT
20. 33Kv SUBSTATION
21. 230kV SUBSTATION
22. WATER PURIFICATION AREA
23. ACID STORAGE AREA
24. STAFF ACCOMMODATION
25. 2Mw DIESEL POWER STATION

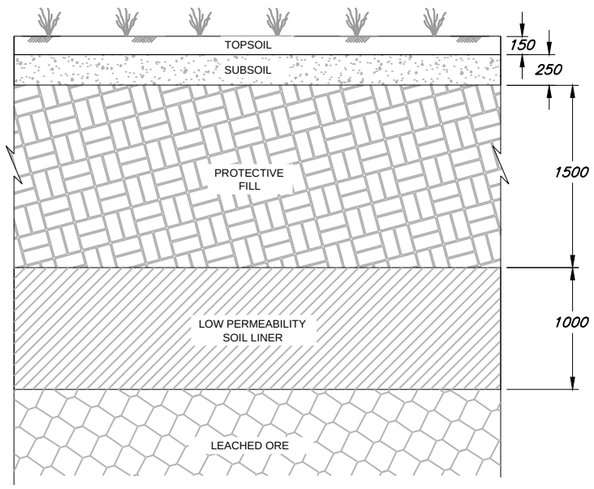
Knight Piésold CONSULTING

LETPADUANG PROJECT
CONCEPT CLOSURE PLAN
LAND-USE AND SURFACE WATER MANAGEMENT

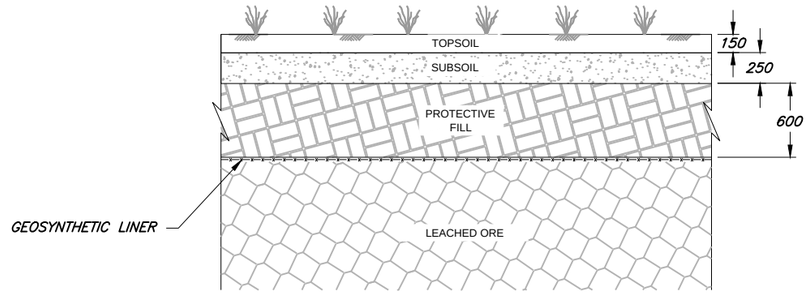
Ref: PE701-00022/20
Figure 5.1



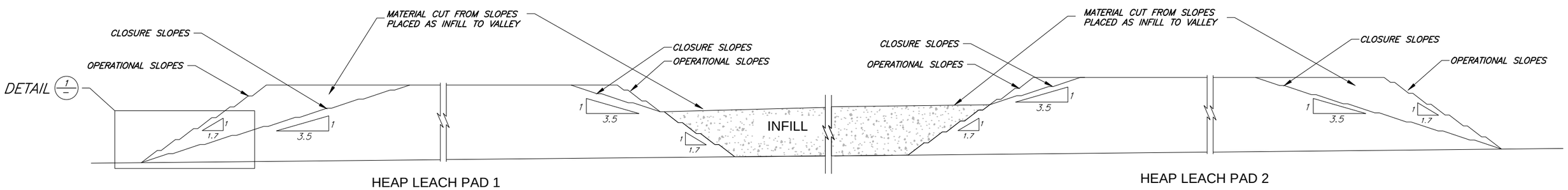
WASTE ROCK DUMPS



HEAP LEACH PADS
(LOW PERMEABILITY SOIL LINER)

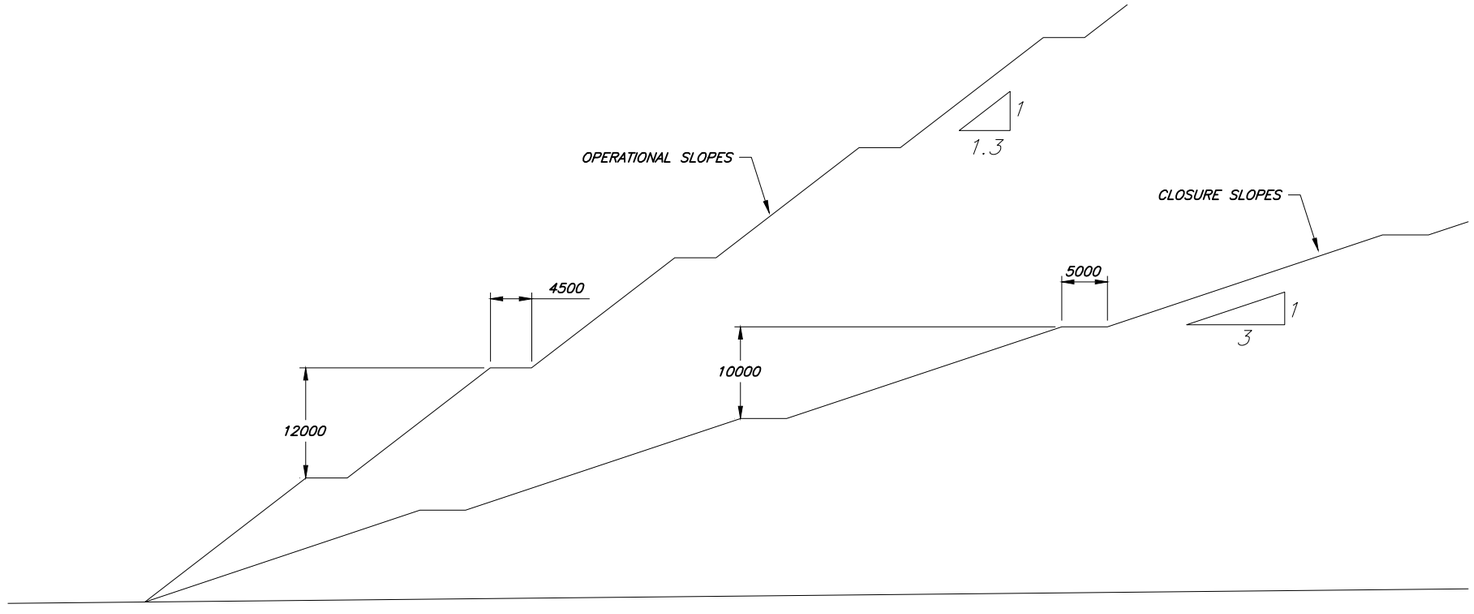


HEAPS LEACH PADS
(GEOSYNTHETIC LINER)



HEAP LEACH PAD 1

HEAP LEACH PAD 2



DETAIL 1 BATTER PROFILE
SCALE N.T.S.

APPENDIX M

Resettlement Action Plan

Prepared by Myanmar Wanbao Mining Copper Limited

Knight Piésold CONSULTING

MYANMAR WANBAO MINING COPPER LIMITED (MWMCL)
LETPADAUNG COPPER PROJECT



RESETTLEMENT ACTION PLAN

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1. INTRODUCTION

1.1 BACKGROUND

This Resettlement Action Plan for the Environmental and Social Impact Assessment (ESIA) for the Letpadaung Copper Mine Project (hereafter referred to as "the Project") has been prepared to assist in developing the ESIA, establishing the direct Social Impacts on the 4 villages requiring relocation within the Letpadaung Lease Area.

1.2 PROJECT LOCATION

Letpadaung Copper Mine is located in the south of Sagaing Division, Myanmar. The project is approximately 26 km by road from Monywa, the largest township of the division. Monywa is 110 km west of Mandalay which is the economic centre of central Myanmar and 722 km north of Yangon.

Travel to Monywa from the project site can be undertaken by road or by river transport. From Monywa, ongoing travel and transport can be undertaken by road, rail and air. The Project location within Myanmar is shown at Figure 1.1.

The Project site is located around the geographic location $22^{o}07'$ N, $95^{0}02'$ E and occupies an area of 32.73 km^2. The site location is shown at Figure 1.2 and the project area is shown at Figure 1.3.

The Project is one of four copper deposits in the Monywa area, namely Sabetaung, Sabetaung South, Kyisintaung and Letpadaung. The Letpadaung deposit is the largest of the 4 deposits in terms of resource, accounting for 75% of the resource from all 4 deposits (China Nerin Engineering, 2011).

1.3 PROJECT OWNERSHIP

Wanbao Mining Ltd. (Wanbao Mining) was established on 16 March 2005 and is a subsidiary company of China North Industries Corporation. Wanbao Mining is a professional mining company approved by the Chinese Government with a registered capital of 1,300 million RMB. The headquarters is in Beijing and overseas subsidiaries are established to run overseas projects.

Myanmar Wanbao Mining Copper Ltd (MWMCL) is registered in Myanmar and wholly owned by Hong Kong Wanbao Mining Copper Ltd. which itself is a wholly owned subsidiary of Wanbao Mining Ltd. With a registered capital of USD 10 million, MWMCL is the operational entity to develop the Letpadaung Project.

The Myanmar partner in the project contributes the mining rights while Wanbao is responsible for project investment development and management. Both parties will share project benefits based on the production sharing contract for Letpadaung Copper Mine. The large scale mineral production permit for Letpadaung is currently held by Myanmar Economics Holding Limited (MEHL).

1.4 PROJECT HISTORY

Copper mining and smelting started in the Monywa copper district several centuries ago. The British discovered the mineral wealth of the Salingyi district in the 1930's and the Myanmar Geological Department visited and investigated this site in the 1950's together with a Yugoslavian geological team. This visit resulted in the implementation of an exploration programme. Myanmar Geological Bureau and relevant institutions of the United Nations (UN), Japan and Yugoslavia carried out a series of exploration programmes after the initial programme.

Mining Enterprise No 1 (ME-1) of Myanmar and Bor Institute of Yugoslavia signed an agreement in 1978 to jointly develop Sabetaung and Kyisintaung deposits and a processing plant with the capacity of 8000 t/d was built in 1984. Production was difficult to maintain and co-operation stopped soon afterwards due to low recovery and poor economic benefits.

ME-1 signed a Feasibility Study agreement with Ivanhoe Myanmar Holdings Limited in 1994 to jointly develop Sabetaung and Kyisintaung deposits. A 1 t/d copper pilot plant was built in 1995 and detailed exploration started. Myanmar Ivanhoe Copper Corporation Limited (MICCL) was formed in 1996. Mining only took place at Sabetaung and Sabetaung South while Kyisintaung and Letpadaung deposits remained untouched. MICCL design capacity was 25 kt/a cathode copper. The plant was put into production in 1998 and the capacity was expanded to 39 kt/a in 2004. The mine essentially ceased operating between April 2008 and August 2010, with only sporadic production continuing. Some production was resumed in September 2010 but only on a small scale.

Wanbao Mining Ltd. organised an expert group to visit the Monywa copper mines and investigate the resources and production there in July 2007. The expert group recommended purchase of the project following the visit.

Wanbao Mining Ltd. organised another expert group to visit the site in December 2008. Data relating to previous exploration programmes, feasibility study reports and mine production conditions were collected. The experts also collected 200 basic assay samples of drill core from the Kyisintaung and Letpadaung deposits and processed them in the MICCL laboratory to 75 micron size. One hundred grams of each sample was sent to The National Geologic Test Centre of China for testing and the test results confirmed the presence of a primary ore body.

Wanbao Mining Ltd. reached a draft co-operative development agreement with the Myanmar Government in March 2010 preliminarily acquiring the mining right of the Letpadaung deposit. The formal co-operative development agreement was signed on 3 June 2010. At present, Myanmar Wanbao Mining Copper Ltd. (MWMCL) is in the process of preparing to develop the Letpadaung deposit.

In May 2010, Myanmar Wanbao Mining Copper Ltd. selected China Nerin Engineering Co., Ltd. (NERIN) to complete the Feasibility Study, Basic Design and Detail Design for this project.

NERIN completed the Feasibility Study Report for the Myanmar Monywa Letpadaung Copper Project (100 kt/a cathode Cu) in September 2010 and completed the Project Application Report in October 2010. The Basic Design was submitted for review in February 2011 and was approved by MWMCL in May 2011.

2. OBJECTIVES

MWMCL's Resettlement Action Plan (RAP) is the outline of responsibilities for resettlement of the Letpadaung Project, specifying the procedures it will follow and the actions it will take to properly resettle and compensate affected people and communities. This RAP is MWMCL's commitment to the Implementation Committee, Government affiliated Agencies and to the affected people that it will meet its obligations arising from voluntary and involuntary resettlement.

This RAP will identify the full range of people affected by the project and justify their displacement. This RAP outlines eligibility criteria for affected parties, establishes rates of compensation for lost assets, and describes levels of assistance for relocation and reconstruction of affected households. This RAP's planning protects MWMCL against unanticipated or exaggerated claims from individuals who have false eligibility for resettlement benefits.

The ultimate goal of this RAP is to enable those displaced by the Letpadaung Mining Project to improve their standard of living—a goal that requires an examination of social, environmental, and economic conditions beyond simple physical inventories.

3. IDENTIFICATION OF PROJECT IMPACTS AND AFFECTED POPULATIONS

The MWMCL RAP will identify all people affected by the project and all adverse impacts on their livelihoods associated with the project's land acquisition. Typical effects include breakup of communities and social support networks; loss of dwellings, farm buildings, and other structures (wells, boreholes, irrigation works, and fencing), agricultural land, trees, and standing crops; impeded or lost access to community resources such as water sources, pasture, forest and woodland, medicinal plants, game animals, or fisheries; loss of business; loss of access to public infrastructure or services; and reduced income resulting from these losses.

Consultation with officials of local government, community leaders, and other representatives of the affected population will be conducted as it is essential to gaining a comprehensive understanding of the types and degrees of adverse project effects.

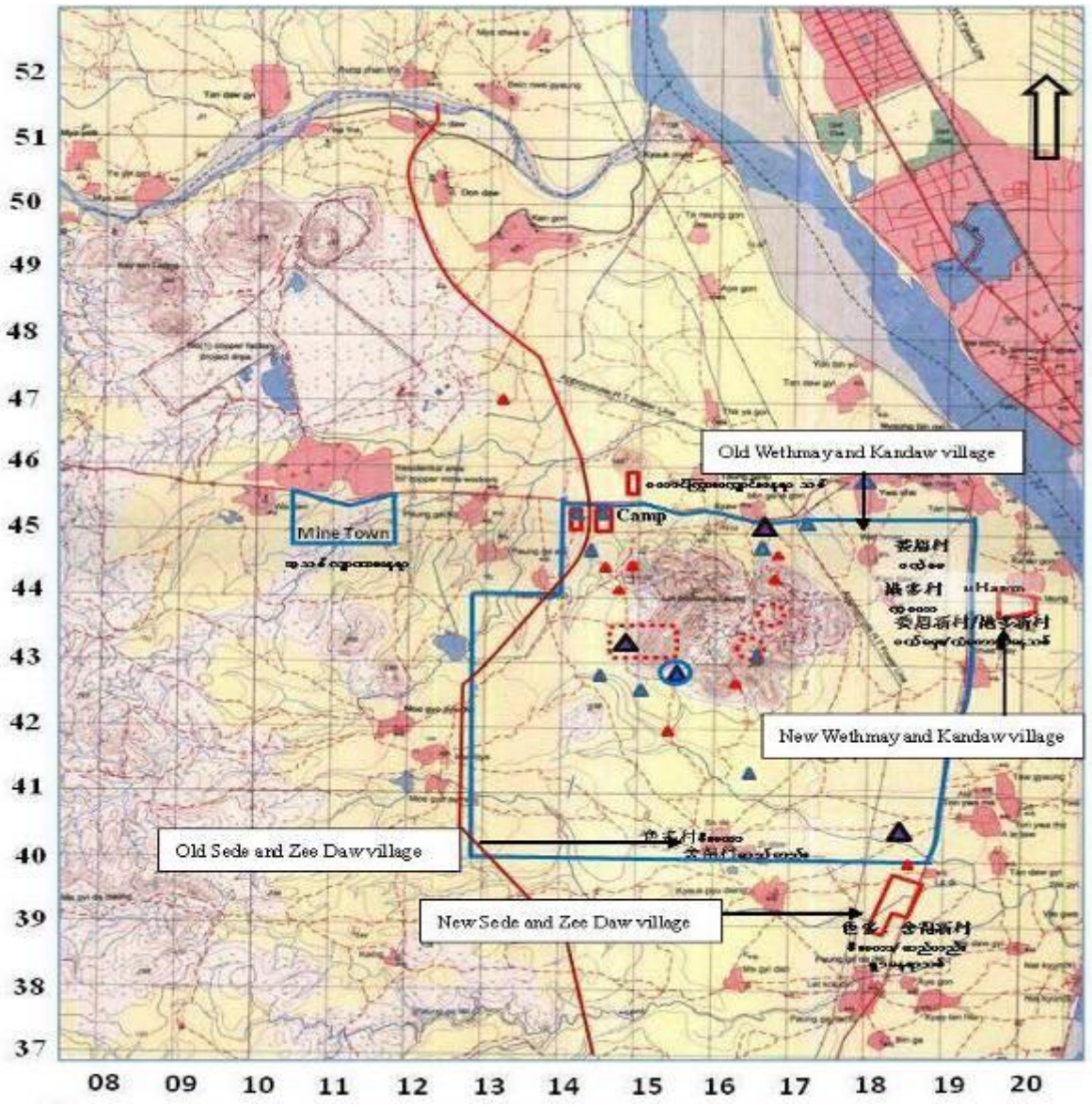
The Regional authorities and MEHL have considered the physical relocation of affected populations to the new 4 village sites and have also conducted an environmental and social assessment of the resettlement site utilizing the local indigenous leaders of the villages.

Affected populations and impacts have been identified through a series of steps:

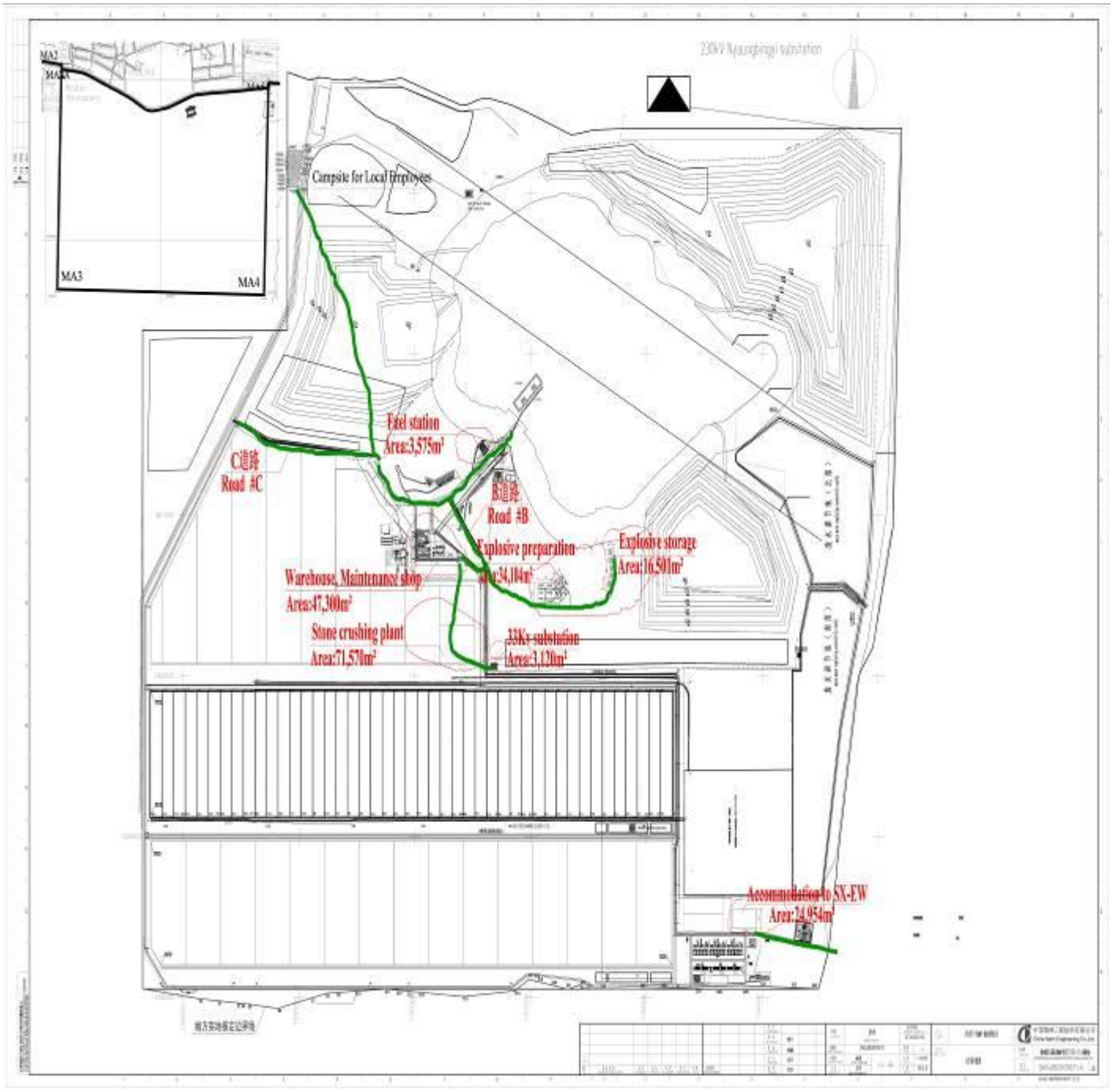
1. Thematic maps that identify such features as population settlements, infrastructure, soil composition, natural vegetation areas, water resources, and land use patterns;
2. A **census** that enumerates the affected people and registers them according to location;
3. An **inventory** of lost and affected assets at the household, enterprise, and community level;
4. Socioeconomic surveys and studies of all affected people (including seasonal, migrant, and host populations), as necessary;
5. Analysis of surveys and studies to establish compensation parameters, to design appropriate income restoration and sustainable development initiatives, and to identify baseline monitoring indicators; and
6. Consultation with affected populations regarding mitigation of effects and development opportunities

3.1 Mapping

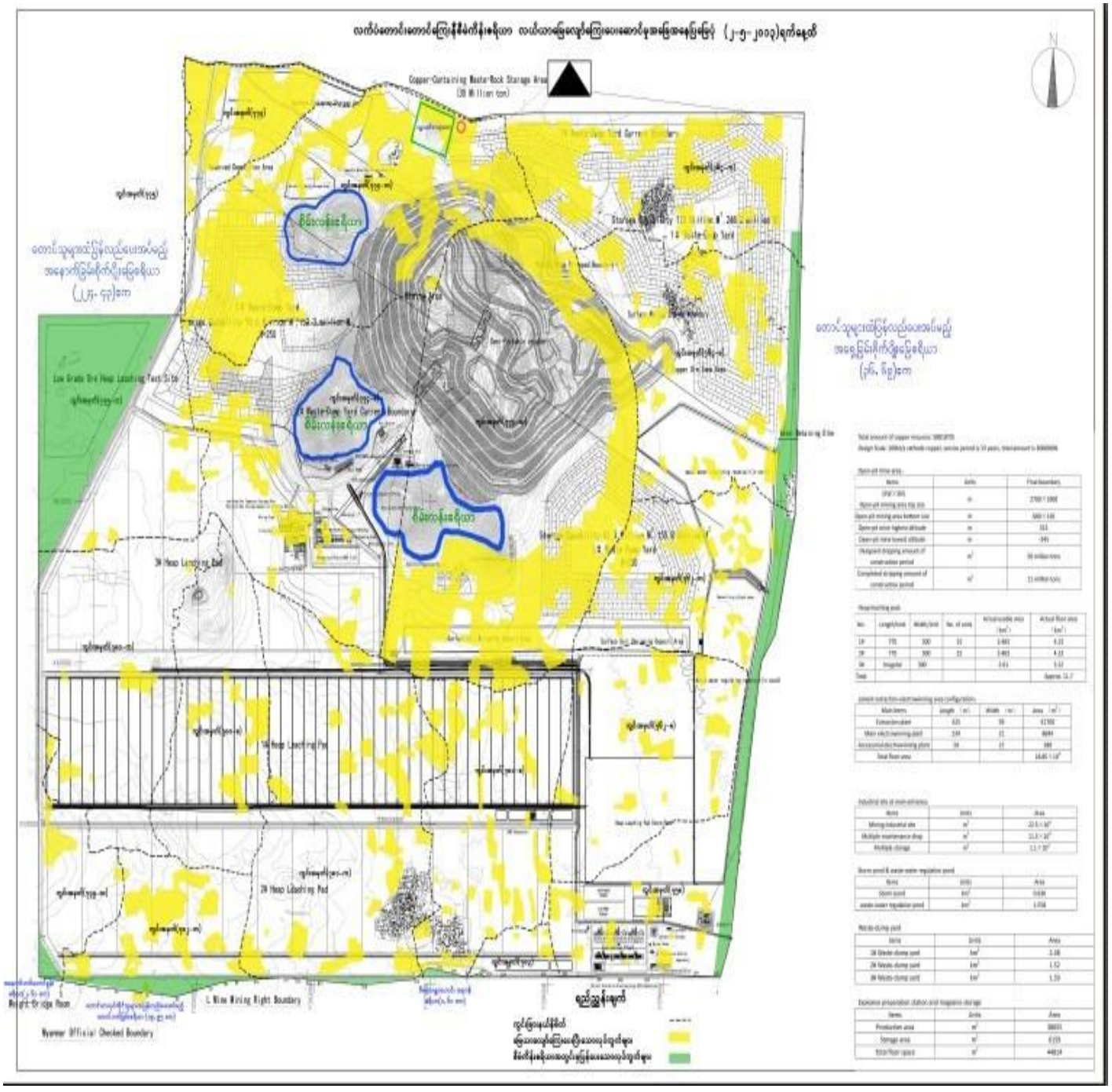
MWMCL's Resettlement Action Plan (RAP) has been mapped to indicate the locations of the 4 old villages of Wethmay, Kandaw, Sede and Zee Daw, as well as their established new locations outside of the perimeter of the Letpadaung Lease area.



3.1.1 Land Access Mapping Early Works Stage 1



3.1.2 Land Compensation Completion Mapping



3.2 Census

The census for MWMCL encompasses all people adversely affected by the project, regardless of their legal status—landowner, holder of land rights, tenant, illegal squatter—or whether they are actually living on an affected site at the time of the census. The lack of legal land title does not disqualify people from resettlement assistance.

The census serves five important and interrelated functions:

- enumerating and collecting basic information on the affected population;
- registering the affected population by residence or locality;
- establishing a list of legitimate beneficiaries **before the project's onset** that counters spurious claims from those moving into the project area solely in anticipation of benefits;
- laying a framework for subsequent socioeconomic research needed to establish fair compensation rates and to design, monitor, and evaluate sustainable income restoration or development interventions; and
- providing a baseline for monitoring and evaluation.

Sr	Group of villager	Sr	villager	Quantity of house	Family unit	Population		
						Man	Woman	Total
1	Ton	1	Ton Ywa Ma	171	175	318	403	721
	_	2	A Le Taw	62	63	153	196	349
	_	3	Ton Ywa This	83	84	160	211	371
	_	4	Le Di	59	59	141	169	310
	Total		**(4)village**	**381**	**381**	**772**	**979**	**1751**
2	Let Pa Daung	5	Let Pa Daung	136	143	329	395	724
	_	6	Ma Soe Yein	32	33	68	92	160
	_	7	Shwe Hlay	216	220	563	620	1183
	_	8	Taw Gyung	118	120	254	336	590
	Total		**(4)village**	**502**	**516**	**1214**	**1443**	**2657**
3	Ywa She	9	Ka Do Gon	84	84	247	273	520
	_	10	Pa Laung	145	145	449	507	956
	_	11	Kan Daw	97	97	239	254	493
		12	Wet Hmay	110	110	214	243	457
	Total		**(4)village**	**436**	**436**	**1149**	**1277**	**2426**
4	Nyaung Bin Gyi	13	Aung Chan Si	93	97	312	358	670
	_	14	Min Ga La Gon	29	31	70	84	154

	Total		**(2)village**	**122**	**128**	**382**	**442**	**824**
5	Moe Gyo Bin	15	Moe gyo pyin(N)	172	175	462	489	951
	_	16	Moe gyo pyin(M)	90	93	244	267	511
	_	17	Moe gyo pyin(S)	142	145	353	381	734
	_	18	Poung Ga(N)	211	217	576	648	1224
	_	19	Poung Ga(M)	142	146	371	428	799
	_	20	Poung Ga(S)	65	65	205	216	421
	Total		**(6)village**	**802**	**841**	**2211**	**2429**	**4640**
6	Paung Ga Da	21	Paung Ga Da(s)	165	168	420	533	953
	_	22	Kyuk Pyu Daung	176	221	497	579	1076
	_	23	Zi Daw	60	67	144	168	312
	_	24	Se De	166	168	371	475	846
	Total		**(4)village**	**567**	**624**	**1432**	**1755**	**3187**
7	Taung Ba Lu	25	Taung Ba Lu	145	149	413	451	864
	_	26	Kyaw Ywa	56	63	163	182	645
	Total		**(2)village**	**201**	**212**	**576**	**633**	**1209**
	(7)Group		**(26)village**	**3005**	**3138**	**7736**	**8958**	**16694**

Private landowners and holders of rights to land as well as any person currently occupying lease land for shelter, business purposes, or other sources of livelihood (caretakers, squatters, scavengers) have been included in the census. While landless people or squatters may not be eligible for land compensation, they may be eligible for resettlement assistance, compensation for assets (such as shelters and standing crops, orchards, or woodlots), and, where practicable, the benefits of development interventions, which may include provision of land.

MWMCL has given particular attention to vulnerable groups living in the project area. These groups include households headed by women or children, people with disabilities, the extremely poor, the elderly, and groups that suffer social and economic discrimination, including indigenous peoples and minorities. Members of vulnerable groups may require special or supplementary resettlement assistance because they are less able to cope with the physical and/or economic displacement than the affected population in general. MWMCL will consult World Bank Group Operational Directive OD 4.20, on Indigenous Peoples.

3.3 Inventory of Affected Assets

MWMCL has undertaken a detailed survey of all losses that will result for each household, enterprise, or community affected by the Letpadaung Project. The survey accounts for land acquisition and loss of physical assets as well as loss of income—temporary or permanent—resulting from displacement of household members from employment or income-generating resources. The Village Tract, Name of Village, Quantity of Farmers and the Land Area by Acre is recorded below to be within the Letpadaung Lease Area.

Sr.	Name of Village-tract	Name of Village	Quantity of Farmers	Land Area (Acre)
1	Moe Kyo Pyin	Phaung Kar (Ta)	111	624.52
		Phaung Kar (Ma)	17	108.3
		Phaung Kar (La)	53	112.87
		Moe Kyo Pyin (Ta)	71	372.93
		Moe Kyo Pyin (Ma)	48	188.63
		Moe Kyo Pyin (La)	86	533.59
2	Taung Palu	Taung Palu	23	126.45
		Kyaw Village	72	272.4
3	Tone	Tone	80	336.52
		Taw Kyaung	23	85.38
		Ahlaltaw	10	18.33
		Leti	5	6.62
		Ywarthit	30	95.09
		Ahlalywa	16	52.62
4	Phaung Ka Tar	Sel Tee	252	1783.72
		Zee Taw	74	426.6
		Kyauk Phyu Tai	48	199.16
		Ma Kyee Tan	3	4.73
		Phaung Ka Tar	3	4.44

Sr.	Name of Village-tract	Name of Village	Quantity of Farmers	Land Area (Acre)
5	Ywa Shae	Wet Hmay	75	367.33
		Kantaw	90	404.96
		Htan Taw	9	28.43
		Ywa Shae	5	9.55
		Ku Toe Kone	2	7.49
		Pa Laung	4	12.76
6	Nyaung Pin Gyi	Nyaung Pin Gyi	3	10.54
		Aung Chan Si	13	28.9
		Htan Taw Gyi	6	14.37
7	Letpadaung	Shwe Hlay	140	543.25
		Masoeyein/We Gyi	2	4.26
		Letpandaung	1	1.34
	Total		1375	6786.08

3.4 Socioeconomic Studies

The socioeconomic studies are linked closely with the census and inventory of assets to provide comprehensive information on household economic resources, including common property resources. This information provides MWMCL resettlement planners with an understanding of household income streams and of how these streams can be restored after resettlement is complete. It also provides a baseline for evaluating the success of livelihood restoration and sustainable development measures. This is the community data of Salingyi Township, Monywa District, Sagaing Region concerning with Administration, Security, Law Enforcement, Economy, Social Affair, and Regional Development activities collected from 2012 April to 2012 December.

Administration Sector

1. Location, Area, Boundary and Topography

(a)Location

(1) Longitude from94´ 54' to 95´ 8' E
(2) Latitude from21´ 49' to 22´ 9' N
(3) Attitude 332' (Above Sea level)

(b)Area

(1) As Square Mile 263.017 sq. Miles
(2) As Acre 168331 Acre

(c)Neighbouring Townships

(1) To the North Yin Mar Bin Township
(2) To the East Monywa and Chaung Oo Township
(3) To the South Ye Sagyo and Myaing Township (Magway Region)
(4) To the West Yin Mar Bin and Pale Township

(d)Topography

About 50% of Salingyi Township is hilly. There are some plains along the Chindwin riverside and West, South West and South of the town, Salingyi. The highest Mount is Letpadaung and its attitude is (1057) ft. above Sea Level.

2. Climate

(a)Annual Average Temperature from 42'F to 100' F
(b)Annual Average Rainfall from 10 inch to 30 inch

3. Rainfall

The condition of Rainfall in Salingyi Township is described as follows-

Sr.	Month	Regular		2010		2011		2012	
		Rainy Day	Inch	Rainy Day	Inch	Rainy Day	Inch	Rainy Day	Inch
1	January	-	-	-	-	-	-		
2	February	-	0.02	-	-	-	-		
3	March	-	0.16	-	-	3	1.29		
4	April	2	0.69	2	0.2	5	1.48	4	1.13
5	May	8	4.88	6	2.82	4	3.26		
6	June	5	3.62	9	3.2	5	4.59	2	1.66
7	July	5	2.56	9	3.35	2	1.25	3	0.61
8	August	6	3.97	7	5.7	10	12.17	4	1.58
9	September	10	8.15	6	5.29	4	2.74	7	7.98
10	October	7	5.34	11	21.19	11	11.1	2	2.54
11	November	1	0.76	-	-	-	-		
12	December	-	0.23	-	-	1	0.24		
Annual Rainfall		44	30.38	50	41.75	45	38.12	22	15.5

4. Mineral Resources

In Salingyi Township, Copper is being produced from Sabetaung and Kyisintaung Copper Mine. In 2010-2011, Letpadaung Copper Mine was started operation by Production Sharing Contact (PSC) between Myanma Economic Holdings Limited (MEHL) and Myanmar Wanbao Mining Copper Limited (MWMCL). Land Grant (Long Term 60 years) for the area of (7867.78) acres has already issued to MEHL for the Mining Purposes.

5. Population

Population in Salingyi Township is shown in following table-

Description	No. of Houses	No. of Families	Over (18)year			Under (18)year			Total Population		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban (3)Quarters	939	1027	4439	5599	10038	1964	1998	3962	6403	7597	14000
(39) Villages Tracts and (152)Villages	20543	21550	45643	49852	95495	37121	43384	80505	82764	93236	176000
Total	**21482**	**22577**	**50082**	**55451**	**105533**	**39085**	**45382**	**84467**	**89167**	**100833**	**190000**

6. District, Township, Town, Quarter, Village Tracts and Villages

(a) District - Monywa
(b) Township - Salingyi
(c) Quarter - (3) Quarters
(d) Village Tracts - (39) Tracts
(e) Villages - (152) Villages

Security Sector

7. Territory Security

Security Plans for Salingyi Township are as follows -

(a) Municipal Area Security Plan
(b) Territory Security Plan (Urban/Rural)
(c) Bomb Prevention Plan
(d) Prevention Plan for Natural Disasters
(e) Plan to Arrest the absconders
(f) Security plan for farm lands
(g) Security plan for Tourist
(h) Security plan for Roads and Bridges
(i) Security plan for Inland Water Transport
(j) Security plan for Famous Pagodas

8. Following Important infrastructures are guarded to safe with high level security-

(a) No.(6) Textile Mill, Salingyi
(b) Nyaung Bin Gyi Electrical Power Substation.
(c) Nyaung Bin Gyi Electrical Power River Water Utilization Works
(d) Copper Mine Projects
(e) Moe Gyo Sulphuric Acid Plant.

Activities for Rule of Law

9. Regular Patrolling is being performed by Salingyi Township Police Force.

10. For the prevention and alleviation the crimes in Salingyi Township, Criminal Prevention Talk in public, taking action for law enforcement and distributing pamphlets about criminal prevention are performed in rural and urban.

11. Regular Police Patrolling are performed by out-posted Police Stations two times a week for "Crime Free Week"

12. Taking the Action upon various complaint letters

Sr.	Types of Complaints	2011 1st (9)months			2012 1st (9)months			Remark
		Complaints	Inspected	Remain	Complaints	Inspected	Remain	
1	Administration	5	5	-	10	7	3	
2	Land Use Case	3	3	-	3	2	1	
3	Abuse Case	3	3	-	1	1	-	
4	Social Case	2	2	-	2	2	-	

Registration and Issuing the National Identity cards by Immigration and National Identity Department

13. Salingyi Immigration and National Identity Department issued 1620 identity cards in 2011-2012 financial year and 4077 identity cards in 2012-2013 financial year.

Criminal Condition

14. Criminal condition of Salingyi Township are shown in table

Comparison of Criminal Cases In Salingyi Township (2007-2012)

Sr.	Descriptions	2007	2008	2009	2010	2011	2012
1	Murder	2	1		1	2	
2	Dacoit (Asian Gangs)						
3	Robbery						
4	Kidnapping						
5	Rape		2				6
6	Burglary						
7	Theft (Animal)						
8	High Treason						
9	The Temporary Amendment Act(Arms)						
10	Unlawful Association						
11	Public Properties Protection Act (6-1)	5	3	3	1	2	3
12	Theft(Bicycle)						
13	Theft(Pick-Pocket)						
14	Theft (382)	1					
15	Theft (Ordinary)	2	1			2	7
16	Accident (Ordinary)	3	3	4	4	8	4
17	Accident (Vehicle)	7	12	15	14	17	23
18	Others	43	23	14	18	22	73
19	The Arms Act (1878)	1	1	1			
20	Gambling	4	12	3	1	7	
21	Prostitute						
22	Act (54)	1	1				
23	Unlawful Drugs and Liquor	11	22	21	2	3	23
24	Police Act	224	215	305	321	258	59
25	Police Act (Breaching the Pledge)	4	8	1		4	2
26	Narcotic						
27	Obscene Movies						
28	Emergency Act (5-Nya)						
	Total	**308**	**304**	**367**	**362**	**325**	**200**

Fire Prevention

15. (a) Fire engine and machinery list

Sr.	Location	Type of vehicle	No. of Vehicle	Remark
1	No.2 Quarter (Fire Brigade)	Fire Engine	2	
2	No.6 Textile Mill	Fire Engine	1	

3	Sulphuric Acid Plant	Fire Engine	1	
4	MEHL	Fire Engine	2	
5	Letpadaung Copper Mine	Fire Engine	2	
6	Kan Gone Village	Light Fire Engine	1	
7	Salingyi Fire Brigade	Portable Fire Extinguisher	3	

(b) Preparation

Salingyi Fire brigade always prepare the followings to be ready in case of fire-

(1) Daily test run of fire engines and machine
(2) Weekly maintenance and inspection
(3) Monthly drilling the troops, rehearsal and maintenance of Pipes and Hoses
(4) Training the new volunteer
(5) Checking and filly the water to all receivers.

(c) Fire Prevention Performance

In Salingyi Township, government fire fighter and volunteer fire fighter give the public lecture for fire prevention. Especially they patrol around quarters and villages and arrange the security at the night times.

In summer, the time for fire wage is limited. All combustibles within the villages or housing are removed. All lines and streets in quarter and villages are maintenance to be able to enter the fire engines.

(d) Organization of Volunteer Fire Brigade

Sr.	Quarter		Village		Total	
	Platoon	Crews	Platoon	Crews	Platoon	Crews
1	3	105	42	1480	45	1585

Agricultural Sector

16. Land Utilization

Land utilization in Salingyi Township is as follows-

Sr.	**Type of Land**	**Utilization Area**	
		2011-2012	**2012-2013**
1	Cultivable Land Area	11417	111445
	Paddy field	6227	6196
	Farm Land	99631	99680
	Seasonal farm land on the river bank	5520	5530
	Garden	39	39
2	Net cultivable level	111662	111255
	Paddy field	6196	6296
	Farm Land	99418	99570
	Seasonal farm land on the river bank	5409	5450
	Garden	39	39

17. Condition of Agriculture is as follows-

Sr.	**Name of Crop**	**Actual Cultivated (Acre)(2010-2011)**	**Plan to Cultivate (Acre)(2011-12)**	**Comparison (Acre)**		**Cultivated (%)**
				Last Year	**This Year**	
1	**Paddy (Rainy Season)**	**13016**	**14000**	**13016**	**4435**	**31.68**

2	**Various Kinds of Pea**	**35682**	**35285**	**35682**	**33106**	**93.56**
	(a) Pigeon Pea	19473	19000	19473	18890	
	(b) Green Gram	16209	16285	16209	13195	
	-Before Rainy Season	847	885	847	851	
	-After Rainy Season	15362	15400	15362	12344	
	(c) Blue Phascolus	-	-	-	1021	
3	**Oil-Crops**	**29707**	**30172**	**29707**	**32148**	**103.13**
	(a) Ground Nut	447	500	447	286	
	(b) Sesame	25244	25650	25244	22651	
	(c) Sun Flower	3944	3950	3944	3018	
	(d) Long Term Sesame	-	-	-	6121	
	(d) Other oil crops	72	72	72	72	
4	**Spice**	**614**	**658**	**614**	**516**	**78.42**
	(a) Red Chilli	614	658	614	516	
5	**Cotton**	**8427**	**7005**	**8427**	**4211**	**60.77**
	(a)Before Rainy Season	30	35	30	42	91.77
	(b) Rainy Season	1152	1110	1152	418	
	(c) After Rainy Season	7245	5860	7245	3751	
6	**Other Crops and Harvests**	**52331**	**51751**	**52331**	**47487**	
	(a) Millet and Corns	22806	22369	22806	18204	
	-Millet	21459	20959	21459	17260	
	-Corns	1347	1410	1347	944	
	(b) Other Harvests	29525	29382	29525	29283	
	-Vegetables	3552	3550	3552	3288	
	-Food for Oxen and Cows	19844	19700	19844	19866	
	-Others (not edible)	2218	2218	2218	2218	
	-Toddy	1249	1249	1249	1249	
	-Banana	152	155	152	152	
	-Coconut	150	150	150	150	
	-Betel Leaves	142	142	142	142	
	-Fruit Plant	2218	2218	2218	2218	
7	**Castor Oil Plant**	**24080**	**24080**	**24080**	**19264**	**80.00**
	Total	163857	162951	163857	141167	**86.15**

Sufficiency of Provision

18. Sufficiency of Provision in Salingyi Township are indicated in following tables-

(a) Local Rice Sufficiency

Sr.	Description	Unit	2010-11	2011-12	2012-13
1	**Population**	**Herd**	**190000**	**190000**	**19000**
	-Urban	/	14000	14000	14000
	-Rural	/	176000	176000	176000
2	**Total Paddy Production**	**(Tin) Myanmar Unit)**	**1333189**	**1276887**	**1464072**
	-Rainy Season Paddy	/	1119434	1052887	1193215
	-Summer Paddy	/	223755	214000	270857
3	**Utilization**	/	2890500	2849248	2890000
	-Seed kept for the next year	/	33000	28000	32800
	-Waste	/	49500	46248	48200
	-Requirement for Consuming	/	2808000	2775000	2808000
4	**Remaining for Consuming**	/	1250689	1229945	1382072
5	**Surplus**	/	1557311	1545055	1425928
6	**Sufficiency (%)**	%	46	44	49

(b) Vegetable Oil Sufficiency

Sr.	Description	Unit	2010-11	2011-12	2012-13

1	Ground Nut Oil Production	Ton	662	673	713
2	Sesame Oil Production	/	3070	3320	3446
3	Sunflower Oil Production	/	2120	2143	2225
4	Other Oil Production	/	50	50	52
5	Total Oil Production	/	5912	6186	6436
6	Total Population	Pax	190000	190000	190000
7	Requirement for Consuming	Ton	1860	1360	1397
	Oil Sufficiency	%	317	455	460

19. Communication Facilities of Salingyi Township are as follows-

Communication Sector of Salingyi Township

Sr.	Description	2011-12	2012-13
1	Main Post Office	2	2
2	Mini Post Office	1	1
3	Mail Box	2	2
4	Telegraph Office	1	1
5	Telephone Exchange(Auto)	1	1
6	GSM Tower	-	2

Electrical Power Sectors

20. Electrical Power Substations and Transmission Lines in Salingyi Township are as follows-

Electrical Power Installation for Industries

Sr.	Department	Installed Capacity	Type of Cable	Length of Cable (miles)
1	S&K Copper Mine (1)	10MVA	ACSR 95mm^2	3.95
2	S&K Copper Mine (2)	10MVA	ACSR 95mm^3	3.95
3	No.(6) Textile Mill	10MVA	ACSR 185mm^4	10
4	Temporary Power line of LPD	3.15MVA	ACSR 95mm^3	2
4	Sulphuric Acid Plant	1.5 MVA	ACSR 95mm^5	3.5
5	Nyaung Bin Gyi River water Electrical Pump	7.5 MVA	ACSR 95mm^6	3
	Total	**39 MVA**		**26.4**

Industrial Sector

21. There is no industrial zone or industrial commercial production.

22. Salingyi Township has annual Tax and Revenue as follows-

(a)Revenue From Township General Administration Department (Kyat in Lakh)

Sr.	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Revenue from Liquor	60	67.11	111.85	60	67.61	112.68
2	Land Revenue	2.7	2.73	101.11	2.72	31.05	1141.54
3	Revenue for Water and Dam	-	-	-	-	-	-
4	Revenue for Mineral	0.5	2.22	444.00	1.5	1.11	74.00
	Total	63.2	72.06	114.02	64.22	99.77	155.36

(b) Revenue From Internal Revenue Department (Kyats in Lakh)

Sr.	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%

1	Income Tax	350	305.713	87.35	1000	1003.012	100.30
2	Commercial Tax	450.56	222.79	49.45	350	471.829	134.81
3	Revenue for Stamp	8	9.729	121.61	20	98.882	494.41
4	State Lottery Tax	315.8	232.72	73.69	310	254.424	82.07
	Total	1124.36	770.952	68.57	1680	1828.147	108.82

(c) Revenue From Township Development Committee Under Ministry of Border Affairs(Kyats in Lakh)

Sr.	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Revenue	77.249	32.93	42.63	47.249	35.59	75.32
2	Tender Tax	1018.558	257.54	25.28	1073.558	980.87	91.37
3	Fine and Others	20.192	4.73	23.43	20.192	50.52	250.20
	Total	1115.999	295.2	26.45	1140.999	1066.98	93.51

(d) Revenue From Forestry Department (Kyats in Lakh)

Sr	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Revenue from Private business	13.33	10.02	23.43	10.73	10.73	23.43
2	Selling Timber	0.94	4.34	23.43	1	3.03	23.43
3	Fine and Others	0.85	0.1	23.43	0.6	2.18	23.43
	Total	15.12	14.46	95.63	12.33	15.94	129.28

(e) Revenue From Post and Telecommunication Department (Kyats in Lakh)

Sr	Type of Revenue	2011-12			2012-13		
		Planned	Collected	%	Planned	Collected	%
1	Income From Mail	1	2.4	23.43	1	0.77	23.43
2	Income From Telegraph	0.3	0.29	23.43	1	0.77	23.43
3	Income From Telephone Tax	38.52	78.56	23.43	135.96	82.65	23.43
	Total	39.82	81.25	204.04	137.96	84.19	61.02

(f) Comparison of Individual Income in Salingyi Township from 2007 to 2012

Sr.	**Description**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**
1	Population (thousands)	117	181	183	185	190
2	Income (Kyats)	533171	593318	652408	724538	802416

Net Gross Products and Services of Salingyi Township in (2012-2013) Financial Year up to (2012 November) based on Local Price in (2011-2012)

Kyats in Million

Sr.		Description	2011-12			2011-12			Development (%)
			Planned	Obtained	%	Planned	Obtained	%	
1		2	3	4	5	6	7	8	9
1		**Gross Products**	**109772.70**	**67591.20**	**61.6**	**113415.90**	**60206.30**	**53.1**	**-10.90**
	1	Agriculture	57511.60	22719.00	**39.5**	60032.70	19652.80	**32.7**	-13.50
	2	Meat and Fish	7745.80	5319.90	**68.7**	8171.90	5443.10	**66.6**	2.30
	3	Forest	36.50	41.50	**113.7**	36.70	36.40	**99.2**	-12.30
	4	Energy							
	5	Minerals	11709.00	30723.00	**262.4**	9023.90	25058.80	**277.7**	-18.40
	6	Industry	30036.40	6551.00	**21.8**	33039.70	7554.60	**22.9**	15.30

	7	Electrical Power	825.00	707.90	**85.8**	850.20	865.60	**101.8**	22.30
	8	Construction	1908.40	1528.90	**80.1**	2260.80	1595.00	**70.6**	4.30
2		**Gross Services**	**6279.00**	**4410.10**	**70.2**	**7087.80**	**5013.70**	**70.7**	**13.70**
	1	Transportation	1707.50	1385.80	**81.2**	1895.40	1496.80	**79.0**	8.00
	2	Communication	86.40	36.10	**41.8**	60.80	42.80	**70.4**	18.60
	3	Finance	18.50	4.10	**22.2**	21.20	7.20	**34.0**	75.60
	4	Social and Management	1732.80	1100.30	**63.5**	1958.00	1296.20	**66.2**	17.80
	5	Rental Fee and Others	2733.80	1883.80	**68.9**	3152.40	2170.7	**68.9**	15.20
3		**Trade**	**28363.8**	**15149.5**	**53.4**	**28701.7**	**14588.2**	**50.8**	**-3.7**
4		**Net Gross Product and Services**	**144415.50**	**87150.80**	**60.3**	**149205.40**	**79808.20**	**53.5**	**-8.40**

Education Sector

23. Education Sector of Salingyi Township is presented as follows-

(a) Number of Teachers (Basic Education)

Sr.	Rank	2011-2012			2012-2013		
		Permitted	Appointed	Vacant	Permitted	Appointed	Vacant
1	High School Head Master	2	2	0	3	3	0
2	Middle School Head Master	7	7	0	7	6	1
3	Primary School Head Master	99	94	5	98	97	1
4	High School Assistant Teacher	65	64	1	86	79	7
5	High School Teacher (Sports)	2	2	0	2	2	0
6	Middle School Assistant Teacher	235	228	7	226	223	3
7	Middle School Teacher (Sports)	7	5	2	7	5	2
8	Middle School Teacher (Grade-II)	175	173	2	170	168	2
9	Primary School Teacher	316	312	4	239	231	8
	Total	**908**	**887**	**21**	**838**	**814**	**24**

(b) Number Of Students
(Basic Education)

Sr.	Standard	(2011-12)			(2011-12)		
		Boys	Girls	Total	Boys	Girls	Total
1	Grade 11	438	482	920	449	515	964
2	Grade 10	563	574	1137	562	911	1473
	Total High School Students	**1001**	**1056**	**2057**	**1011**	**1426**	**2437**
3	Grade 9	658	668	1326	658	744	1402
4	Grade 8	715	798	1513	792	798	1590
5	Grade 7	896	870	1766	889	951	1840
6	Grade 6	988	1030	2018	1011	1041	2052
	Total Middle School Students	**3257**	**3366**	**6623**	**3350**	**3534**	**6884**
7	Grade 5	1121	1185	2306	1152	1195	2347
8	Grade 4	1197	1232	2429	1276	1202	2478
9	Grade 3	1271	1257	2528	1256	1135	2391
10	Grade 2	1315	1158	2473	1204	1180	2384
11	Grade 1	1468	1425	2893	1587	1529	3116
	Total Primary School Students	**6372**	**6257**	**12629**	**6475**	**6241**	**12716**
Total Students		**10630**	**10679**	**21309**	**10836**	**11201**	**22037**

(c) Ratio of Teacher and Student

Standard	2011-12			2011-12		
	Teacher	Student	Ratio	Teacher	Student	Ratio
High School	65	2057	1:32	79	2137	1:27

Middle School	221	6614	1:30	223	6884	1:30
Primary School	588	12617	1:24	571	12716	1:22
Total	**874**	**21288**	**1:24**	**873**	**21737**	**1:24**

(d) Distinction Winners of Matriculation in 2011-12

4 Distinctions Winner	4-Persons
3 Distinctions Winner	4-Persons
2 Distinctions Winner	18-Persons
1 Distinctions Winner	66-Persons
Total	92-Persons

(e) Number of Basic Education Schools

Basic Schools in Salingyi Township										
Year	Main Schools			Sub Schools			Associate School			Extended Primary School
	High	Middle	Primary	High	Middle	Primary	High	Middle	Primary	
2011-2012	2	1	73	5	15	2	1	1	1	10
2012-2013	2	1	73	5	15	3	-	1	-	11

Health Sector

24. Health Sector consists as follows-

(a)Hospitals and Clinics

Sr	Description of Health Centre	Numbers		Progress	Remark
		2011-12	2012-13		
1	(25) Bedded Township Hospital	1	1	-	
2	(16)Bedded Town Hospital	1	1	-	
3	Rural Health Care Centre	4	4	-	
4	Sub Rural Health Care Centre	21	22	1	
5	Maternal and Child Clinic	1	1	-	
6	Traditional Clinic	2	2	-	
7	Private Clinic	3	3	-	

(b)Medical Officers and Staffs

Sr.	Description	Permitted	Appointed	Vacant	Associate
1	Township Medical Officer	1	1	0	
2	Assistant Doctor	4	2	2	
3	Dentist	1	1	0	
4	Doctor for Town Hospital	1	1	0	
5	Medical Assistant	1	0	1	
6	Second Medical Assistant	4	4	0	
7	Senior Nurse (Grade-1)	1	1	0	
8	Nurse (Upper Class)	6	5	1	
9	Nurse	11	6	5	
10	Mid-Wife	5	5	0	
11	Paramedic Grade 1	2	2	0	
12	Paramedic Grade 2	9	6	3	
13	Others	73	47	26	
	Total	**119**	**81**	**38**	

(c) Ratio of Medical Employees and Population

Sr.	Description	Medic	Population	Ratio
1	Doctor	5	137196	1:72439
2	Nurse	11	137196	1:22472

(d) Total Patients In Medical Centres

Sr.	Description	2011-12		2012-13	
		In-Patient	Out-Patient	In-Patient	Out-Patient
1	Township Hospital	649	971	1029	1572
2	Town Hospital	479	768	938	1983
3	Rural Health Care Centre		13375		12026

Religious Sector

25. Religious Sector consists as follows-

Condition of Monasteries, Monk, Novices and Nuns

Sr.	Name of Group	Monastery	Monk	Novice	Nun
1	Shwe Kyin	25	45	66	-
2	Sudama	216	489	563	28
Total		**241**	**534**	**629**	**28**

Environmental Sector

26. For the Environmental Sector, Salingyi Local Authorities made public environmental Education lectures to distribute environmental protection aspects to the people as follows-

Public Lecture for Environmental Management

Sr.	Titles of Public Lecture	No. of Ceremony	Attendees	No. of Families
1	Public Lecture for Flora and Fauna	3	669	191
2	Prevention of Air Pollution	2	446	191
3	Fire Prevention	3	669	194
4	Systematically usage of Fertilizer and Insecticide	1	236	191
5	Elimination of Climactic Change	6	1338	191
6	Management of Waste	1	223	191

3.5 Analysis of Surveys and Studies

Analysis of the data collected in the census, assets inventory, and socioeconomic studies serves three ends: 1) it provides information needed to establish an entitlement matrix for household- and community-level compensation; 2) it yields basic economic and social information needed to design appropriate livelihood restoration and development interventions; and 3) it provides quantifiable demographic, economic, educational, occupational, and health indicators for future monitoring and evaluation of RAP implementation.

To date, analysis of surveys and studies are being conducted by the CSD Team and through the Baselines studies completed by EMC and reported by Knight Piésold.

3.6 Consultation with Affected People Concerning

Community Consultation & Social Development (CSD) Program

The CSD Program began on the 28th of March 2013, establishing a team composed of 1 village representative from each of the 35 surrounding villages.(Inclusive of the 4 new villages) Of these 35 villages 29 members volunteered for employment as a CSD Team representative. The water festival in April allowed for a 2 week break in training activities, and on the 21st of April a professional Myanmar National from World Vision Myanmar joined the team as Project Manager. (CSD Team List 6.1.1)

Following an accelerated training program, including on the job training, this team began to engage the villagers in a friendly manner. Considerations were taken to leave the disturbed villages alone for the time being. Community consultation began to take form. The CSD Team entered each village only with written prior consent from the Village Administrator or representative.

It became immediately clear that the information regarding the Letpadaung Project had been misconstrued by outside forces (students), and in truth, the villagers were hungry for jobs, while at the same time having great concern for the status of land compensation and permanent employment to replace farming activities and livelihood. Many villagers have been threatened if they cooperate with MWMCL and have asked for police protection.

Key Issues have been identified through initial engagements. The priorities being: job opportunities, water, electricity, road repair, hospital facilities and assistance for the aged.

Below are some particulars gathered through the CSD Team engagements:

Key Issues:

1) Land compensation from Kangone Village is a serious issue.
2) Job opportunities: priority and transparency
3) Acid Plant is running without permission from the Government (The activist went and met with some representatives from the Acid plant) which against the commission report.
4) The Minister Col. Kyi Naing is going around the villages but met strong opposition by the Old Sae Tae villagers when he visited Zee Taw and Sae Tae villages.
5) The “Farmers Protection” group was formed by the farmers from 14 villages and the group will persuade other villages to be involved in the group. The purpose of this group is:
   a) Not losing any lands b) Cooperative farming in this rainy season.

Village Engagement:

1) Household visiting
2) Consultation with Village Head and villagers
3) Consultation with EIA/SIA activists from Done Taw, Gone Taw, Kan Kone
4) Providing feedback to community’s request

Villages Refusing CSD Engagement:

1) Wethmay (Old)
2) Sede (Old)
3) Zidaw (Old)
4) Tawgyaung
5) Aleywa
6) Ton Ywathit
7) Ton Ywama
8) Moe Gyoe Pyin (Middle)

Villages:

No	Village	Project Area
1	Wethmay	Wanbao Area
2	Kan Taw	Wanbao Area
3	Pa Laung	Wanbao Area
4	Nyaung Pin Gyi	Wanbao Area
5	Ywar Shae	Wanbao Area
6	Kyaut Phyu Tie	Wanbao Area
7	Taung Pa Lu	Wanbao Area
8	Shwe Hlae	Wanbao Area
9	Lae Ti	Wanbao Area
10	Phaung Ka Tar	Wanbao Area
11	Kyaw Ywar	Wanbao Area
12	Zee Taw	Wanbao Area
13	Sae Tae	Wanbao Area
14	Ton/Ywar Thit	Wanbao Area
15	Taw Kyaung / Aleywa	Wanbao Area
16	Done Taw	Yang Tse Area
17	Phoung Kar(N)	Yang Tse Area
18	Shwe Pan Khing	Yang Tse Area
19	Kan Kone	Yang Tse Area
20	The Taw Gyi	Yang Tse Area
21	Yey Kyi Pin	Yang Tse Area
22	War Tann	Yang Tse Area
23	Tel Pin Kan	Yang Tse Area
24	Goan Taw	Yang Tse Area
25	Ywar Thar	Yang Tse Area
26	Phaung Kar (M)	Yang Tse Area
27	Phaung Kar (S)	Yang Tse Area
28	Moe Gyo Pyin(N)	Yang Tse Area
29	Moe Gyo Pyin(S)	Yang Tse Area
30	Moe Gyo Pyin(M)	Yang Tse Area

Note: Yon Pin Yoe is not to be listed in our future plan.

NGOs Identified:

1) Cesvi / Pack Myanmar for micro finance and mother and child health activities in Yin Mar Pin Tsp., villages (Thae Taw Gyi, Shwe Pan Khaing, Tel Pin Kan)

Community Consultation Methodology:

1) Pamphlet distribution
2) Construction plan in next two months
3) Complaint and feedback provision
4) Community's need are listed
5) Job opportunity transparency

Community Engagement and CSD Projected Timeline:

Action Plan	Month					
	May	June	July	Aug	Sep	Oct
Completed questionnaire						
Need Assessment with community						
Collaboration with HR for job opportunity/selection						
Collaboration with PR on how to prioritize the support based on need assessment information						
Classify the donor sources (gov, mehl, mytcl, mwmcl)						
Provide community's urgent need that has to be done before Wet Season.						
Provide community's urgent need that can be done in rainy season						
Assign CSD to facilitate the villagers to participate in implementation and to take ownership						
Assign CSD to do monitoring the implementation						
Assign CSD to listen community's voices						

4. ASSISTANCE BENEFITS AND DEVELOPMENT OPPORTUNITIES

With the information provided by the surveys and studies, resettlement planning has been engaged in informed and constructive consultations with the affected community regarding the RAP strategy for livelihood restoration. A committee of community representatives liaising with the CSD Team serves as a focal point for consultations on the types of assistance proposed by MWMCL resettlement planners as well as for subsequent participation of the community in RAP implementation. Where host communities are affected by resettlement decisions, representatives of these communities have been included in these consultations.

S/N	Village Name	Books & furniture	Medical Service Hospital & Mobile Unit	Electricity Power Lines to the villages	Drinking Water	Road Repairing	Playground	Kinder-gartens	School Repairing	TOTAL
1	Shwe Pann Khine	650,000	16,800 USD/month for medical services . The average expense for medicine is approx. 5,000 USD/month Total Costs of: 21,800 USD/month or 261,600 USD/year	Long distance to install						650,000
2	Ywar Thar	650,000								650,000
3	Goan Taw	650,000								650,000
4	Doan Taw	650,000								650,000
5	War Tann	650,000		111,300,000	20,160,000	14,150,000				146,260,000
6	Tel Pin Kan	650,000		83,670,000	37,670,000	14,810,000				136,800,000
7	Kan Kone	650,000							40,000,000	40,650,000
8	Phaung Kar (North)	650,000								650,000
9	Phaung Kar (Middle)	650,000								650,000
10	Phaung Kar (South)	650,000								650,000
11	Moe Kyo Pyin(North)	650,000			72,840,000	1,930,000				75,420,000
12	Moe Kyo Pyin(Middle)	650,000								650,000
13	Moe Kyo Pyin(South)	650,000								650,000
14	Yey Kyi Pin	650,000		Long distance to install						650,000
15	Thel Taw Kyi	650,000		Long distance to install						650,000
16	Taung Pa Lu	650,000							30,000,000	30,650,000
17	Kyaw Ywar	650,000							8,880,000	9,530,000
18	Nyaung Pin Kyi	650,000							30,000,000	30,650,000
19	Ywar Shay	650,000								650,000

20	Pal Laung	650,000								650,000
21	Wet Mhay (New)	650,000					11,850,000	65,500,000		78,000,000
22	Kan Taw (New)	650,000								650,000
23	Sae Tae (New)	650,000								650,000
24	Zee Taw (New)	650,000						65,500,000		66,150,000
25	Ton/YwarThit	650,000								650,000
26	Taw Kyaung	650,000								650,000
27	A Lel Taw/ Lae Ti	650,000		20,520,000						21,170,000
28	Phaung Ka Tar	650,000								650,000
29	Kyauk Phyu Tai	650,000		61,950,000						62,600,000
30	Shwe Hlay	650,000		60,200,000						60,850,000
	TOTAL Cost (Kyats)	19500000	222,360,000	337640000	130,670,000	30,890,000	11,850,000	131,000,000	108,880,000	992,790,000
	TOTAL Cost (FEC)	22,941	261,600	397,224	153,729	36,341	13,941	154,118	128,094	1,167,988

Community Donations and Opportunities

All Donations of Myanmar Yang Tse and Myanmar Wanbao Mining Copper Limited.

1- Educational donation to Wet Mhay/KanTaw new villages (1.4 million kyats)
2- Primary school building donation to MaGyiTaHtaung village (3.0 Million kyats)
3- Computer set donation to primary school of Phaungkar village (0.3 Million kyats)
4- Bridge donation to Zeetaw-Kyauk Phyu Taing village (0.8 Million kyats)
5- Bridge donation to Taung Pa Lu-Thar Yar Kone Taing village (0.85 Million kyats)
6- Retaining wall construction for Ywar Thar Village (2012-June) 150.0million kyats.
7- Dam Construction at Moe Kyo Pyin Village (2012-June) 14.0 million kyat
8- Dam Construction at Phaung Kar Village (2012-June) 10.0 million kyats.
9- Dam Construction at War Tann Village (2012-April) 10.0 million kyats.
10- Dam Construction at Tae Pin Kan Village (2012-May) 10.0 million kyats.
11- Road Repairing For Aye Kone Village (Cost 4.5 Million kyats)July-2012
12- Construction of Pagoda & Road Repairin For Shwe Pann Khine Village(Cost 22 Million kyats) Sept-2012
13- Road Repairing For Taung Pa Lu Village (Cost 4 Million kyats) Sept-2012
14- Road Repairing For Thar Yar Kone –Taungpalu Village (Cost 8.5 Million kyats) Sept-2012
15- Road Repairing For Hta Naung Kone Village (Cost 8.5 Million kyats) Sept-2012
16- Road Repairing For Kan Kone Village (Cost 5.5 Million kyats) Oct-2012
17- Pond Reconstruction For Sar Linn Gyi Town(Cost 2.5 Million kyats) May-2012
18- Road Repairing For Doan Taw Village (Cost 3.1Million kyats) Dec-2012
19- ShwePannKhine village road Construction Cost(6.5 million kyats) Feb-2013
20- ShwePannKhine-Telpinkan village road Construction Cost(23 million kyats) Feb-2013
21- Telpinkan New village extension Construction Cost(3.1 million kyats) Feb-2013
22- Water Tube well donation to Ma Gyi Ta Htaung Village (Cost 3.8 million kyats)
23- Water Pipe line Construction to Kyauk Myet-Taung Kyar Monastery (Cost 2.5 million kyats)
24- Water Tube well & Purifier Donation to Kan Kone Village (Cost 8.0 million kyats)
25- Donation for Earth quake Victims (30,000,000 kyats) Nov-2012
26- Donation for Fire Victim Moegyopyin Village 4.2 million kyats 16-2-2013
27- Donation DaMarYone Building for Kyauk Myet village Monastery Cost 24 million kyats (Feb-2013)
28- Cash Donation to Taungkyar Monastery for Electrical Installation (480000 Kyats)4-3-2013
29- Construct electricity supply facility for Myaypyinthar monastery cost 37.49 million kyats）
30- Let Pa Taung Pagoda Construction (cost 12.7 Million kyats)
31- Kyartwintaung Monastery Road Construction (cost 1.8 Million kyats)
32- Road Repairing in War Tan Village (1-5-2013 to 6-5-2013) 15.0 Million kyats.
33- Access Road Repairing between Mine town and Moe Kyo Pyin Village (8-5-2013) 20.7 Million kyats.
34- Access Road Repairing between Shwe Pann Khine and The Taw Gyi Village (28-4-2013 to 9-5-2013) 6.0 Million kyats.
35- Country Hospital, near Kankone village Construction cost will be over 200 million kyats
36- Tailing Reclamation from War Tan vIllage Total cost over 45 million kyats.
37- Primary School Repairing in Kyaw Ywar Village (26-4-2013) Cost 8.8 million kyats.
38- Water Line Installation in War Tann Village (26-4-2013) Cost 18.6 million kyats.
39- Books & Furniture Donation to Local 30 villages (7-5-2013) Total cost 19.5 million kyats.
40- Housing construction for fire victim in Moe Kyo Pyin (mid) Village(15-5-2013)Cost 29.7 million kyats

5. LEGAL FRAMEWORK

The public consultations regarding resettlement identified in this document conform to the following legislations and standards:

- Myanmar regulations

- Guidelines established by international financing institutions, specifically the World Bank Group

5.1 INSTITUTIONAL, LEGISLATIVE AND REGULATORY FRAMEWORK

International, regional, and local treaties, laws, regulations, and standards dealing with environmental quality, health and safety, protection of sensitive areas, endangered species, facilities siting, lease/exploration license/concession agreements, and land use control will be identified and evaluated for each of the construction, operation, and decommissioning phases of the project.

IFC guidelines and government legislation relating to transport infrastructure, water resources, mineral resources development, and industrial facilities will be addressed, together with the health and safety requirements specific to the proposed activities. Relevant Myanmar regulations and IFC guidelines dealing with indigenous peoples, wildlife, cultural resources, land tenure, etc. will be addressed for the proposed activities. A general listing of legislative and regulatory considerations is provided in Section 4 - Legal and Policy Framework.

World Bank Group Requirements and Guidelines

The Letpadaung project has voluntarily undertaken the intent to be consistent with the World Bank/International Finance Corporation (WB/IFC) Policies, Procedures, and Guidelines. The World Bank Group's Environmental Assessment Policy (OP 4.01, January 1999) provides that project-affected groups and local non-governmental organizations (NGOs) should be consulted about the project's potential environmental and social impacts during the ESIA process. This consultation's purpose is to consider local views when designing the environmental and social management plans as well as in the project structure.

Emphasis is placed on the engagement of local stakeholders, namely those likely to experience the day-to-day impacts of a proposed project.

Other relevant World Bank Group policies with provisions for public consultation include:

- Operational Policy 4.04: Natural Habitats
- Operational Policy 4.11: Safeguarding Cultural Property
- Operational Policy 4.12 Resettlement
- Revised Draft Operational Policy 4.10 Indigenous People (replaces Operational Directive

4.20 on Indigenous Peoples)

- Operational Policy 14.70: Involving Non-Government Organizations in Bank-Supported Activities

The World Bank Group requirements focus on:

- Early consultation with affected people and NGOs
- Early information disclosure
- Providing information in a way that allows informed consultation with stakeholders

In addition to the requirement for consultation with stakeholders, the World Bank Group has specific requirements for disclosure of documentation resulting from the ESIA process. These include preparation and publication of a Public Consultation Disclosure Plan (PCDP) for consultation, as well as disclosure of the draft ESIA in public places.

6. COMPENSATION FRAMEWORK

The RAP compensation framework specifies all forms of asset ownership or use rights among the population affected by the Letpadaung Project and the project's strategy for compensating them for the partial or complete loss of those assets. The compensation framework includes a description of the following: 1) any compensation guidelines established by the host government; 2) in the absence of established guidelines, the methodology that the Letpadaung Project will use to value losses; 3) the proposed types and levels of compensation to be paid; 4) compensation and assistance eligibility criteria; and 5) how and when compensation will be paid.

Brief on Land Occupation Procedures of Letpadaung Copper Mine

1. Issuing of Farm Land Nationalization Act (39) (La Na -39) for the utilization of farm lands as mining purpose.
2. Preparation for compensation.
   (a) Organization of compensation committee
   (b) Field-work for the confirmation of farm lands and farmers
   (c) Defining the rate of compensation for farm land and trees
   (d) Reporting and waiting for confirmation for the compensation rate from the government.
   (e) Compensation
3. Submission to the Ministry of Home affairs for land grant
4. Receiving the land grant for the mining purpose.

Issuing of La Na (39) for utilization of farms lands for the mining purpose.

1. Ministry of Mines received La Na (39) for utilization of farm lands for the mining purpose (No.1 Mining Enterprise) Oct 18th January 2001 with reference No. 5/41-5(130)/Oo 6 from Sagaing Division Peace and Development Council. No.1 Mining Enterprise handed over La Na (39) to the Myanma Economic Holdings Limited (MEHL) on 5th March 2010. According to La Na (39), the total area (7867.78) acre include the following-

(a)	Registered permanent farm land	4826.70 Acre
(b)	Temporary farm land	230.80 Acre
(c)	Other land (Including mountain area, road and etc.,)	2810.28 Acre
	Total	7867.78 Acre

Preparation for compensation

2. Before carrying out the compensation work, MEHL (Copper Mine) studied the ground condition of the farm land with the help of local authorities and local Settlement and Land Record Department. Then MEHL submitted a letter to the regional authorities to organize a committee for compensation work with the letter of Ref No. 2/3/AhKhYa/Paing (3200/2012), dated on 12.10.2010.

(a) **Organization of Compensation Committee**

Regional authorities organized a committee for compensation of Letpadaung Copper Mine Project and it included two parts. One is Leading Committee and one is Acting Committee. In Leading Committee, the members are Regional Level officials and in Acting Committee, the members are district and township level officials including village heads of respective areas.

(b) **Field-work for the confirmation of farm lands and farmers**

Salingyi Township authority set up (3) teams for the field-work to check, confirm and record the ground situation of farm lands. According to the records of the (3) teams, the farm lands are increased up to (5487.27) Acre within ten years (2001 to 2010).

(c) **Defining the rate of compensation**

For the land compensation, 12 to 20 times of revenue is legal for compensation. But that amount is very little (only 5 to 20 kyats). So, compensation committee considered two ways for land compensation. One is to give the compensation according to the local average current price of land. It was approximately cost about (200,000 Ks to 400,000 Ks). Another way is to give the additional compensation depending on the type and selling price of the crops for (3) times (or) three year profit. It was cost about (525,000 Ks to 550,000 Ks) for one acre.

For the Land Compensation of the new villages' area, the compensation procedures are the same as in mine lease area, but the rate is not the same for two reasons. First reason is that areas are outside of mine lease. Second reason is that areas have better fertility than most areas in mine lease area. But the rates of trees compensation are the same for all areas.

(d**) Reporting and waiting for confirmation for the compensation rate from the government**

After defining the rate of compensation, compensation committee reported to the regional authority to get the confirmation. Regional Authority confirmed the rate of compensation as follows-

Approved rate of farm land compensation in Letpadaung Copper Mine based on (1) Acre

Sr.	Name of crop	Production rate (Myanmar Unit)				Annual Local Current price (Kyats)				Cost for (1) Acre	(3)Time of Cost
		Max	Fair	Poor	Average	Min	Fair	Max	Average		
1	Sesame	11	8	5	8	20000	23000	26000	23000	184000	552000
2	Sunflower	33	25	17	25	5000	7000	9000	7000	175000	525000
3	Pigeon pea	15	10	5	10	13000	18000	23000	18000	180000	540000

Explanation (1) Production Rate is based on the Local average production rate

(2) Current Price is based on the average annual price of local market

Compensation Committee calculated the amount of compensation for each farm depending on the land class and type of crops as mentioned above and total compensation was the sum of land revenue 20 times and 3 times selling prices of the crops as shown in annex-4.

Approved rate of compensation rate of trees in Letpadaung Copper Mine

Toddy Tree	=	5000 Kyat
Mango Tree	=	8000 Kyat

Explanation Toddy trees are compensated with minimum height (9)ft.
Mango trees are also compensated when they have fruits

Note: Even the compensation rate was defined as above, at actual compensation it is done with rate of 1000 Kyats for Toddy trees and 16,000 Kayts for Mango trees.

(e) **Compensation**

Land and Trees Compensation for new village area

Four Villages were located inside mine lease area and they have to be needed to shift outside. Two place were selected as a new village area and land compensation was also done in (19.2.2011 to18.12.2012) as follows-

(1)	New Taungyar Monastery Area	- (6.55) Acre	4,387,322.25	Kyats
(2)	Wet Hmay – Kan Daw Village area	- (54.67) Acre	37,095,410.55	Kyats
(3)	Sete- Ze Daw	- (58.25) Acre	39,493,045.05	Kyats
	Total	- (119.97) Acre	80,975,777.85	Kyats

Kan Daw village was already relocated in new village with (97) houses and one monastery. Wet Hmay village shifted (67) houses and one monastery and (43) houses were remained to shift. Ze Daw village shifted (29) houses and (37) and one monastery were remained. Sete Village shifted (28) houses and (140) houses and one monastery are remained.

Tree compensation had already done for the new villages are as follow-

(1)	New Taungyar Monastery Area	(10) Toddy trees,	100,000	Kyats
(2)	Wet Hmay – Kan Daw village	(2722) toddy trees	13,610,000	Kyats
(3)	Sete – Ze Daw village	(1542) toddy trees	7,710,000	Kyats
		(2) Mango trees	16,000	Kyats
	Total	(4274) toddy trees and (2) Mango trees	21,436,000	Kyats

Some farmers did not receive the additional compensation for toddy trees (5000ks/tree) yet. Therefore some toddy trees in Wet Hmay- Kandaw village area are compensated in the rate of (5000ks/tree).

Total compensation for the new villages' area is 21,436,000Kyats and it was already done on (18.12.2012).

Land and Trees Compensation for mine lease area

(a) Land Compensation

Compensation farm land Area

Permanent Registered farm land	-	4826.70	Acre	compensation must be done according to land
Temporary Registered farm land	-	230.86	Acre	

Unlawful farm according to the instruction of Authorities	-	1725.37	Acre	compensation was done
Total compensation Area	-	6782.93	Acre	
Remaining Other Area	-	1084.85	Acre	Area including Mountains, village, Roads, Canals Monasteries etc.

Notes: Although Farmers cultivated unlawfully within mine lease area over (1700) acre within (2001 to 2010), Chairman of MEHL and Local Authorities instruct to compensate that lands with the same rate of previous compensation.

The first compensation for farmlands in mine lease area had done within (5-4-2011 to19-8-2011) and area is (5487.27) Acres and total compensation is (3,000,153,745) kyats.

After the first compensation, some farmers complained to the government to get the compensation for their un registered farm lands. Then regional government made the regional land record department to investigate the complained land whether they are actually farm lands or not. According to the report of land record department (1298.81) acre are to be compensated.

Therefore, the second compensation had done within (30-1-2012 to 6-11-2012), area is (1298.81) acre and compensation was (707,775,034) kyats. Finally all compensation was done on (6-11-2012) and total compensated area was (6786.08) acre and total compensation became (3,707,928,779) Kyats i.e.; over (3.7) billion kyats. And only (1081.7) acre remained. That means that the project shows its kindness to the native farmers even they were absent to register for their farmlands and even they were absent to give the land revenue to the government, they happily received the compensations, (at that time).

(b) Trees Compensation

Trees compensation for the mine lease area had done as follows-

(1) Toddy Trees	- (35815)No's	(358,150,000) Kyats
(2) Mango Trees	- (188) No's	(3,008,000) Kyats
(3) Thanakhar Trees	- (one Garden)	(1,900,000) Kyats
Total		**(363,058,000) Kyats**

(c) Auxiliary Compensation

Before land compensation finished, auxiliary or additional compensation were done for the survey works, drilling works in the beginning of mine developing period and some construction works as follows-

(1)	Compensation for the geological survey works	1,572,125	Kyats
(2)	Compensation for the electrical power line construction	355,142	Kyats
(3)	Compensation for the construction of workshop	2,120,575	Kyats

Total **4,047,842 Kyats**

Total Compensation of the Project

4. Total Compensation of the Letpadaung Copper Project is as follows-

(a) Farm Land Compensation of for mine lease area (6786.80) acre3,707,928,779.00 Kyats

(b) Trees Compensation of mine lease area 363,058,000.00 Kyats

(c) Land Compensation of New Villages area (119.97)Acre 80,975,777.85 Kyats

(d) Trees Compensation of New Village area 21,436,000.00 Kyats

(e) Auxiliaries Compensation for Mine Developing Works 4,047,842.00 Kyats

Total Compensation for the Project **4,177,446,398.85 Kyats**

Sample Acknowledgement of compensations are attached with annex (1 to 3)

Submission to Ministry of Home Affairs for the land grant

3. After all compensation was finished, submission procedures we performed to get the long term land grant from the Ministry of Home Affairs.

Receiving the land grant for the Ministry Purpose

4. 60 years Long term land grant for Letpadaung Copper Mine was issued to MEHL by Ministry of Home Affairs on 3rd August 2012.

Annex-1

(SAMPLE)

Acknowledgement of receiving the compensation fee and giving up the farm land

Date: . .20--

Hereby, I ---------- sign and acknowledge that I give up my farm land to utilize as copper mine situated in the Letpadaung Taung Copper Mine Project Area at ---------- group of village, ----------village and I receive the compensation as follows-

(a) Field No. ----------

(b) Land Mark No. ----------

(c) Area (Acre) ----------

(d) Type of Land ----------

(e) Additional compensation of crops ----------Ks
Including (20) times of land revenue ( )

(Finger Print)

Payer (signature) Payee (signature)

Name ---------- Name ----------

Rank ---------- Father's name ----------

Dept. ---------- NRC No. ----------

In The Presence of

Annex-2

(SAMPLE)

Acknowledgement of receiving the compensation fee and giving up the Trees

Date: . .20--

Hereby, I ---------- sign and acknowledge that I give up my trees for copper mine situated in the Letpadaung Taung Copper Mine Project Area at ---------- group of village, ----------village and I receive the compensation as follows-

(a) Type of Trees ----------

(b) Number of Trees. ----------

(c) Rate of Compensation ----------

(d) Total Compensation ----------kyats

(----------)kyats

(Finger Print)

Payer (signature)
Name ----------
Rank ----------
Dept. ----------

Payee (signature)
Name ----------
Father's name ----------
NRC No. ----------

In The Presence of

Annex-3

(SAMPLE)
Acknowledgement of receiving the compensation

Date: . .20--

I am ---------- who is living in ---------- group village,----------village, Letpadaung Taung Copper Mine Project had done ---------- work on my farm land. For that purposes, Letpadaung Copper Mine project gave and I received ---------- Kyats as compensation.

(Finger Print)

Payer (signature)
Name ----------
Rank ----------
Dept. ----------

Payee (signature)
Name ----------
Father's name ----------
NRC No. ----------
Date. ----------

In The Presence of

7. RESETTLEMENT ASSISTANCE AND LIVELIHOOD

Wherever possible, MWMCL has planned to avoid or minimize the displacement of people by exploring alternative project designs. Where displacement is unavoidable, MWMCL has planning to execute resettlement as a development initiative that provides displaced persons with opportunities to participate in planning and implementing resettlement activities, as well as to restore and improve their livelihood.

Sagaing Region, Monywa District, Sar Lin Gyi Township, Township Level Business Planning of Conveniently Moving 5 Monasteries and 4 Villages that are included in the LetpadaungHill Copper Mining Reject.

Introduction

1. Sar Lin Gyi Township, LetpadaungHill Copper Minning Project is implemented in Copper ration between Union of Myanmar Wan Bao Mining Copper Ltd. The 5 Mouasteries include in the Project and Wet Hmay Village shall be moved in a short time to New Accepted Buildings with the Quality Checked and this Business shall be started. In order that the Reverauds and Family Members of the 4 Villages may conveniently moved and placed to the New Places, this Planning is drawn.

News

2. At present Valley Wai Lu Wun Monastery is completed (100%) and wet Hmay. Kan Taw New Housing Project is completed (100%) and the Qualities have been already checked and when the needed repairs businesses are completed, the moving /placing businesses are known to be completed in levels.

So that the moving /placements Arrangements may be able to be systematically accomplished in business levels, Hse Te-Zee Taw Housing Project (Including Monastery Construction.) has already been completed to (76.76%) and it is constructed up to the 100% completion.

Therefore , as the first level of Moving/placements, and when the facts found out by the quality inspection team of valley Wai Lu Wun New Monastery and Wet Hmay, Kan Taw New Housing are repaired, and when these are handed area to District General Administration Department by Union of Myanmar, Myanmar Economic Holdings Limited, the systematic moving and placements shall be accomplished.

Aim

3. In order to be able to accomplish the moving placements conveniently and systematically in Business Levels.

Rough Planning

4. Is as follows;-

(1.) Fixing the Arrangements of 5 Moving Monasteries concerning Business to be accomplished Before / During / or After it.

(2) For Moving Family Members, Buildings, Materials, Animals, Before/During/After Businesses, Arrangements are fixed.

Detail Planning

5. Concerning the 5 Monasteries to be moved, Business Accomplishment Arrangement fixed in Levels are as follows –

(a) Businesses before Moving

(1) Township Sangha Nayake Reverend, Reverends from Monasteries to be moved must firstly be invited on a suitable date and enquire, negotiate the needs wanted by the reverends.

(2) To record the words of the reverends by the Township Religious Officer.

(3) Taking the Record of Remaining Materials for making the list of material by Union of Myanmar Economic Holding Limited and Township Religious Officer together with the list billeting tem.

(4) In the piling of materials, Pre arrangements are made with the case Management of Township Religious Officer and staff so as to cause least damages.

(5) Offering the supporting Money by Union of Myanmar, Myanmar Economic Holding Limited and negotiate and present the Department of Transportation program of the whole planning to the leading Committee.

(6) According to the preferential arrangement of moving/placement of 5 Monasteries the Recording of the Decision of the Lecturing Reverends.

(7) Report of Township Police Officer to Regional/District Police Officer to keep security Forces in advance.

(8) After Consideration of Project Director in all aspects of Moving 5 Monasteries to present The Leading Committee in concern with supply of vehicles, diesel/petrol and Finance.

(9) To present Ability of Financial Support Receipt of Permission Participation in the Business by Union of Myanmar, Myanmar Economic Holding Limited.

(b) **Business to be accomplished During Moving**

(1) When the vehicles, Machineries, Man Power Finance are at readiness for Moving by Union of Myanmar Myanma Economic Holdings Ltd and the Fixed date is received, the Detailed Arrangement for moving has to be addressed to the monastery reverends, to be moved according to Myanmar Buddhist Traditions by Township Administration Officer, Township Religious Officer, Township Police Officer, Township Sangha Nayaka and record the opinions of the reverend.

(2) To present the moving date through Monywa District General Administration Department to Regional Governmental Body and accept the Directives.

(3) In moving and transporting to the fixed new monastery from the original monastery, so that Man power, vehicles, Machineries may suit with the original place and new Monastery, Union of Myanmar, Myanmar Economic Holdings Limited has to arrange in advance.

(4) In transporting the Materials to be transported for old Monastery to new monastery the representatives who can take responsibility by township Religious office, Township Police Force, Union of Myanmar, Myanmar Economic Holdings Limited to scrutinize the materials.

(5) If difficulties are met on arrival at new monastery, concerning departments and Union of Myanmar, Myanmar Economic Holdings Ltd. has to fulfil it.

(6) Only after the satisfactory accomplishment for the Reverends of the monastery, to stop the business.

(c) **Accomplishment after business completion**

(1) In order to be smoothly solve the problems met during the use of moving transportation news, the business committee member have to go to the new monastery in turns and accomplish the needs of the Reverends.

(2) Each and every assigned responsible persons shall have report the business accomplishment reports to the leading team.

(3) According to the directive of regional governmental body and with the management District General Administration Department, to accomplish it by keeping on the watch.

Business arrangements concerning the moving family members, buildings, materials, animals

6. Fixed facts are as follows:-

(1) As the Union of Myanmar, Myanmar Economic Holdings Limited has already recorded the buildings of each moving family, the committees already formed have to check with the recorded photos whether the differentiated 4 types are in accordance (or) not and to record systematically and draw the detailed arrangement of placements.

(2) After checking according to the 4 types, the formed committee members with the management of Monywa District General Administration Department meet the Head of the families to be moved and village elders of that village and by explaining the moving/ placement arrangements in detail and accomplish the placement at the new building place and transfer according to law and record it.

(3) The arrangements for accomplishment of administration, support matters by the responsible persons assigned for financial support, transportation arrangements in moving the buildings to be moved which was given by Union of Myanmar, Myanmar Economic Holdings Ltd. Must be presented in detail.

(4) The formed committee members shall have to negotiate with the moving village elders, head of family and announce the fixed moving date and if there are needs in moving to solve them by combined negotiation.

(5) Before 10 days from the moving date, to widely distribute the announcement letter of administration's office to make moving arrangements by the families to be moved and to issue each and every house head of family for moving information.

(6) Township Police Officer leading team, Township information team, administration officers, and headmen in cooperation has to announce continuously in mornings, afternoons, nights by warning them.

(7) The Sub Committee that takes Responsibility in for Transportation in moving to the New Buildings, it has to calculate according to Houses and the Need of Vehicle in advance and negotiate in advance with Union of Myanmar, Myanmar Economic Holdings Limited.

(8) According to Houses to be moved and with the Management of Committees formed for the Pre-calculated Financial Supports, Union of Myanmar, Myanmar Economic Holdings Ltd has to give the Financial Support in advance.

(9) On the Proposal put up by the Transportation Committee, in order to systematically transport the Moving Family Member and Buildings, it has to present to the Leading be supported by the Union of Myanmar, Myanmar Economic Holdings Ltd, with Man Power, Vehicle Strength, Retrial/ Diesel Strength.

(10) In order to pile the Original Building and Materials, to form the Material List Collection/ Maintenance/ Transportation team in advance.

(11) Because these are Government Departments it has to request the Directives of the Upper Levels of offices by the Concerning Department Head of Township Level and present the facts wanted to be accomplished to the Planning Heads.

(b) **Business Accomplishments to be made are as follows : -**

(1) So that the Piled Materials may not be remained, to record by the List Collection Maintenance / Transportation Team and accomplish by separately giving duties so that there shall be no loss.

(2) In transporting by Transporting Vessels, it has to be managed by Business it has to be managed by Business Committed so that it may be systematic.

(3) In order not to lost Piled Materials, Township Police officer has to make the Security Planning separately and accomplish systematically.

(4) On the day of Starting to Transport Piled Materials, Economic Holding Ltd has to arrange in advance at the Original Place and the Fixed Housing Place so that the Vehicle, Manpower may be enough.

(5) With the Strength of Township Development Committee, Township Public Works Corporation and Departmental Strength, to mark whether the list of Piled Materials and Materials arrived at the New Housing are the same (or) not and help in the transfer / acceptance.

(6) By systematically accept the moved Family Members and Materials and the Difficulties of the Family Members have to be reported to Fire Brigade Force, Red Cross and Township Veterans Organizations.

(7) If the Moving Families have Difficulties that are met, in order to be able to settle it, the Business Committee Members have to go in turns and settle it at the suitable Convenience.

(c) Business Accomplishments after Moving

(1) Family Members who have moved to New Houses shall be issued as the Special Matter by Township Immigration Department, National Registration Department and issue Citizen Scrutiny Cards and Form (66/6) Household Member Lists.

(2) Moving Family Members, as Arrival at the New Housing, So that there should be no disturbance by Unwanted Elements Security shall be taken by leading Team of Township Police Force.

(3) Only to stop the Accomplishments of Security Arrangements of the Family Members after receiving the Directive of the Leading Committee of the Whole Planning.

(4) All those Assigned Persons have to make reports of Business Accomplishments to the Leading Committee with Facts / Tables as well as to the Own Department Head.

(5) Moving Families and Materials are Moved and Place by the Township, Final Report has to be compiled and put up to Regional Governmental Body through District General Admin Dept.

Forming Respective Committees

7. (a) Committee for moving the monasteries and 4 villages included in Letpadaung Hill Copper Project is formed as the following.

1.	All Township Sangha Nayaka Reverend	Chairman
2	Reverands of monasteries from 4 Villages	Chairman
3	U Khin Maung Hsan District	Chairman
4	U Zaw Min Han, Township Admin	President
5	U Nay Lin Kyaw, Factory Manager (Sar Lin Gyi)	Member

6	Township Police Office	Member
7	Project Incharge	Member
8	Staff Officer (Project)	Member
9	Staff Officer (Immigration)	Member
10	Staff Officer (Co-op)	Member
11	Township Manager (Cotton)	Member
12	Township Manager (Bank)	Member
13	Township Medical Officer	Member
14	Township Education Officer	Member
15	Post Office Sipin (Communication)	Member
16	Township Manager (Agri)	Member
17	Staff Officer (Mechanised Agri)	Member
18	Staff Officer (Land Records)	Member
19	Staff Officer (Infor)	Member
20	Executive Officer (Sipin)	Member
21	Township Engineer (Pa Has Nga)	Member

Business Duties are fixed as follows: -

(1) To cooperate and negotiate so that the moving monks, novices, religious buildings, family members, buildings may conveniently be transferred can be done conveniently, smoothly and with full contentment.

(2) Directed to draw planning for security matters by Township Police Force.

(3) Before/ during/ After moving and placements periods, to cooperate timely with business committees.

(4) If urgent matter happens to cooperate and combine with the above/below forces and planning made by the Township Police Officer.

(5) In order that the whole planning may be succeeded, the financial need must be calculated in advance and negotiate with Union of Myanmar Economic Holdings Ltd. is advances.

The moving and placement committee for monasteries and religious buildings

8. It is formed as the following

1.	Township Religious Officer	President
2	Factory Manager (Cotton and Cloths Factory)	Member
3	Staff Officer (Co-op)	Member
4	Staff Officer (Forest)	Member
5	Staff Officer (Project)	Member
6	Staff Officer (Fire Bridge)	Member
7	Township Electrical Engineer	Member
8	Union of Myanmar Myanmar Economic Holding Ltd.	Member
9	Staff Officer (Greening)	Member
10	Staff Officer (Industrialized Agri)	Member
11	Township Manager (Bank)	Secretary

Fixing business duties

1. To implement according to directives of Township Leading Committee
2. As it is the matter of building religion whenever accomplishments are made, to accept the words of the Township Sangha Nayaka Reverand and make accomplishments.
3. Before/During/After moving, the businesses to be accomplish must be done without any gap and make accomplishments by taking the departmental staff.

4. If there are business and financial difficulties in business accomplishments to present in advance to leading committee.
5. To manage so that there may be no injury lost during transportation with vehicles
6. To accomplish the loading up/down system systematically on arrival at new village.
7. Make aim to the contentment and happiness of the reverends that have to move.

Settlement Committee for the families, buildings, properties and animals to be transferred

9. It is formed and assigned as below -

(1) U THAUNG MYINT: Executive Officer, Development Committee: Chairman

(2) U SOE SHWE: Head of Department, Land Records : Member

(3) DR.KHIN KHIN TUN Head of Township Health Department Member

(4) DAW SAN SAN YEE Audit Officer, Township Accountancy Office Member

(5) DAW MYINT MYINT KYI Township Education Officer Member

(6) DAW KHIN WIN KYI Head of Dept, Information/Public Relation Member

(7) DAW THEIN THEIN MYINT Engineer, Public Work Member

(8) U TINT WAI Head of Post Office Member

(9) U NYI NYI HTWE Tactic Master, Sport/Physical Education Member

(10) U TUN AUNG Telephone Member

(11) Captain AUNG KYAW KYAW(retd.) UMEHL Member

(12) DR. THAUNG SEIN Veterinary/Husbandry Member

(13) All rural clerks Member

(14) All surveyors (Site In-charge) Member

(15) Heads of Village Administration concerned Member
(Ywashae, Phaungkatar)

(16) U AUNG THAN OO Township Manager, Cotton/Sericulture Joint Secretary

(17) Dy. Police Commander TUN OO Head of Township Police Force, Secretary
Myanmar Police Force

Assignment

It is assigned as follows –

(1) To implement the instructions of Leading Committee.

(2) To carry out systematically the works to be performed before transfer, while transfer and after transfer without any gap and to help extracting employees from the department concerned.

(3) To present ahead to Leading Committee if found difficulty in work and financial problems.

(4) To schedule the families, buildings, properties and animals to be transferred currently and present to Leading Committee.

(5) To control not to happen any injury and loss while carrying with vehicles.

(6) To coordinate ahead with Holding in order to fulfil requirement of vehicles and labour power and plan to be fair power in the housings to transfer.

(7) To control loading in/off while reaching new village.

(8) To solve the problems of families arrived in new housing and to fulfil what they require.

(9) To carry out for the families to be transferred to be running smooth everything in peace.

(10) To serve the duties assigned separately.

Transport Committee

10. It is formed and assigned as follows -

(1) Sub-Inspector of Police TUN OO	Head of Township Police Force		Chairman
(2) U TIN AUNG MOE	Head of Dept, Township Fire Services Dept.		Member
(3) U HLA WIN	Asst.Factory Manager Thread and Textile Factory (Sarlingyi)		Member
(4) Captain WIN NYUNT OO (retd.)	Thunder Salphurid Acid Factory		Member
(5) U KYAW NYUNT	Chairman (MaHtaTha)		Member
(6) U AUNG MYINT TUN	MaHtaTha		Member
(7) U ZAW WIN	Engineer, Nyaungbingyi Power Station		Member
(8) U THEIN ZAW	In-charge, Water Resources (Nyaungbingyi)		Member
(9) U KYAW THU LAT	HTOO Construction Company		Member
(10) Captain AUNG KYAW KYAW (retd.)	UMEHL		Secretary

Assignment

It is assigned as follows -

(1) To draw a plan and report back for receiving vehicles enough for properties and animals of (5) monasteries and (4) villages to be transferred.

(2) To calculate financial requirement for transport and present to Leading Committee.

(3) To solve the duties assigned separatly by Leading Committee.

Security Committee

11. It is formed and assigned as follows -

(1) Dy.Superintendent of Police TUN OO	Head of Township Police Force		Chairman
(2) DAW WAH WAH SWE	Township Judge		Member
(3) DAW KHIN SWE TUN	Township Law Officer		Member
(4) U TIN AUNG MOE	Head of Dept, Tsp Fire Services		Member
(7) U KYAW SOE OO	Security Officer, UMEHL		Member
(8) U WIN OO TIN	Company Commander, Township Reserved Fire Services		Member
(9) Sub-Inspector of Police THEIN AUNG	Station Officer, Nyaungbingyi Police Station		Member
(10) Heads of Village Administration (Ywashae, Phaungkatar)			Member
(11) Heads of ten/hundred-house concerned			Member
(12) Inspector of Police HLA NGWE	Station Officer, Sarlingyi		Secretary

Assignment

It is assigned as follows -

(1) To take security with enough security power in former places and new housings and religious buildings for transferring (4) villages.

(2) Head of Township Police Force is to preview destruction and harassment to be appeared up in transferring houses paying attention up to use power and act in accord with the laws.

(3) To coordinate ahead with armed forces in accord with police procedure to have power of armed forces, if necessary.

(4) To pay special attention not to appear any unnecessary case absolutely because Letpadaung Hill Copper Project is the work of good-will between Republic of the Union of Myanmar and People's Republic of China.

(5) To serve the duties separately assigned.

Information Committee

12. It is formed and assigned as follows –

(1) DAW KHIN WIN KYI	Head of Information/Relation	Chairman
(2) Sub-Inspector of Police THEIN AUNG	Station Officer, Nyaungbingyi Police Station	Member
(3) Telecommunication Officer from UMEHL		Member
(4) Heads of Village Administration (Ywashae, Phaungkatar)		Member
(5) Heads of Hundred-House from (4) villages		Member
(6) U TIN SAUNG	Elder of town	Member
(7) U NAY WIN AUNG	Elder of town	Member
(8) U TIN WIN	Asst.Education Officer	Secretary

Assignment

It is assigned as follows -

(1) To implement the instructions of Leading Committee.

(2) To carry out systematically the works to be performed before transfer, while transfer and after transfer without any gap and to help extracting employees from the department concerned.

(3) To draw information letter (draft) for transferring (4) villages and present to Leading Committee.

(4) To announce in a row day and night as stated in announcement with effect from the instructing date of Leading Committee after confirming Announcement (draft).

(5) To plan head for receiving hand-horns and walking talkies enough.

(6) To demarcate as necessary for information and Holding is to plan for receiving loudspeakers enough.

(7) To present ahead to Leading Committee if found difficulty in work and financial problems.

(8) To serve the duties separately assigned.

Forming office staff

13. Office staff is formed as follows for exactly recording with right schedules and lists and running fast in performing works -

(1) DAW SAN SAN YEE	Auditing Officer	Head of Office
(2) U SOE THU	Dy.Head of Dept.(General/Admin)	Dy.Head of Office
(3) Sub-Inspector AUNG NAING MYINT	Office of the Head of Township Police Force	Member
(4) U WAI PHYO AUNG	Township Planning	Member

(5) U NGWE AUNG Development Bank Member

(6) U KO KO GYI Land Records Member

(7) 2 staff-members from Holding Member

(8) U KYAW ZIN LAT Township Dy.Asst.Engineer Member

(9) U AUNG KYI SOE Township Engineer Member

(Development Committee)

(10) U SAN NAUNG Education Member

Assignment

(1) To successfully implement the instructions of Township Leading Committee.

(2) Giving necessary advices, preparing chief accounts, making chief accounts for the whole project in each village, preparing in time and presenting to Leading Committee in time.

(3) To present difficulties in work and financial problems to Leading Committee.

(4) To record stores in ledger/cash book.

(5) To prepare account clearance statement

Administration

14. Head of Township Administration shall control and supervise under the instructions of the Cabinet of Region and Monywa District General Administration Department.

Telecommunication

15. Telecommunication shall be done as below -

(1) Head of Township Administration 09-47095456
071-70099

(2) Lt.Col. MYINT AUNG (Retd.) 09-6452262

(3) Deputy Superintendent of Police TUN OO, 09-49232254
Head of Township Police Force

(4) U THAUNG MYINT, Executive Officer, Development Committee 09-47058398

(5) U SWE YEE, Manager, Development Bank 09-6450942

(6) U AUNG THAN OO, Manager, Cotton and Sericulture 09-47058326

(7) U THEIN KYAING, Head of Staff, Forest 09-49216251

(8) U AUNG SOE, Head of Staff, IMPD and National Registration 09-6451423

(9) Captain KYAW HLA MOE (Retd.), Holding 09-47053728

(10) Captain AUNG KYAW KYAW (Retd.), Holding 09-49291189

(11) U SAW WIN CHIT (Holding) 09-47054737

(12) U KYAW THU LAT 09-43041212

(13) Walking talkies (10) Nos.

Project Period

16. Project period is fixed with effect from 27th November 2011 till successful completion.

Conclusion

17. Letpadaung Copper Project is a joint venture business between Myanmar Economic Holding Limited and Myanmar Wanbao Mining Copper Ltd. It is the biggest copper project in Myanmar. It will make good income for the State and more job opportunities for local people. As it is also the work of good-will between Republic of the Union of Myanmar and People's Republic of China, it is reported that all staff-members inclusive in project will serve in balance in each step of project considering as a National Task for the monks, novices and families to be transferred.

8. BUDGET AND IMPLEMENTATION SCHEDULE

MWMCL's budget and implementation schedule for the Resettlement Action Plan of the 4 old villages of Wethmay, Kandaw, Sede and Zee Daw is outlined in this section.

Accomplished Arrangements Condition

In moving to the new villages

1. Depending on the houses resided in the old village compensation support for the damaged building is calculated at 1 sq.ft. Rate of the building.

   (Minimum K 35000/- to maximum K 1000000/- ten lakhs)

2. If there are needs in the houses of the new village, so as to be able to repair on own satisfaction, the support money K 10 lakhs (A-type), K 8 lakhs (B-type), K 6 lakhs (C-type) and K 4 lakhs (D-type) is given depending on the type of houses.

4. Plastic round table (3ft diameter), mesh cover for covering food donated by the project at 1 set each for every family.

5. The electric meter cost fitted at the houses in the new village and the fitting cost K 85500/- was supported to family members who moved into the new village.

6. The dismantling and moving and sale of houses in the old village was accomplished according to the wilful contempt of the villagers.

7. Arrangements were made with motor vehicles for transportation of materials, buildings in the old houses in moving the villages, without any labour charge for loading up/down of materials.

General Expenses List of

Land Compensation, Perennial Crops Compensation, Moving of Villages,

Up to 15.3.2013 for

Letpadaung Hill Copper Mining Project

*	Land and crops compensation of (6786.08) acres of Agriculture land and other land	370, 7928,779.20
*	Compensation for new valley monastery and perennial Crops of 2 new villages	21,436,000.00
*	Land/Crop compensation for new valley monastery and 2 new villages	80,975,777.85
*	Compensation for perennial crops within mine area	363,058,000.00
*	Building compensation for (3) monasteries and (4) New Villages	71,171,800.00
*	Construction Expense of New Monastery and (2) New Villages	5,776,192,852.00
*	Transportation expenses of moving villages	15,391,900.00
*	Support for moving and building renovation expenses	125,200,000.00
*	The giving condition to monasteries and families in New villages (meter costs) and (metre assemblies)	19,579,500.00
*	Expenses for religious and social accomplishments	660,617,860.00 and FEC 9,651.48
*	Compensation for the land included in construct of road from Kye Sin Hill, Sabei Hill Copper Mines to Letpadaung Hill Copper Mine Connection of 16.21 acres of land ----------	8,948,065.20
	Total kyats	10,850,500,534.25 and FEC 9,651.48

This is only up to 15.3.2013 and the expenses after Investigation Commission report are not included. The expenses during Implementation Committee period is still on on-going process.

9. ORGANIZATIONAL ROLES & RESPONSIBILITIES

Activity Description	MEHL & Government	MWMCL Corporate Management	Community Relations Manager	Community & Stakeholders
Develop RAP and implement	R	A	I	C
Construct and install new villages and facilities (schools etc.)	R	A	I	C
Construct new monasteries	R	A	I	C
Manage Land Compensation payments	R	A	I	C
Monitor Relocation Process	R	A	A	C
Manage Grievance Process	C	C	R	A
Consultation with Affected people	C	C	R	A
Manage Village Assistance Benefits & Programs	C	R	C	C

R = Responsible / Accountable: The person(s) who is ultimately answerable for the execution and results of the activity.

A = Assisting / Attending: The person(s) who assists in the execution of the task and/or attends a meeting.

C = Consulted: The person(s) to be consulted during the decision making process. A two-way communication.

I = Informed: The person(s) who need to be informed after a decision is made or action taken. A one-way communication.

Overall responsibility for the implementation of this Management Plan shall rest with the Project Environment Manager who shall report on progress to the Project General Manager.

10. CONSULTATION AND PARTICIPATION

Goals and Key Objectives

The primary goal of the Public Consultation and Disclosure Plan (PCDP) for early works and full scale production selection was to engage key stakeholders in the decision-making process for accepting determined sites, and to reach consensus with key stakeholders on the most appropriate sites with respect to environmental, social, and health issues for the Letpadaung Project. The key objectives of the site selection PCDP were to:

- Introduce the Letpadaung Project
- Demonstrate the Letpadaung project's commitment to PCDP
- Lay the foundation for future stakeholder participation
- Identify key issues, concerns, and expectations for future phases of the project
- Manage stakeholder expectations

The site selection PCDP was split into two rounds of consultation. The key objectives of the first round of consultations were to:

- Share Letpadaung Project information
- Discuss location options
- Collect feedback on the site selection process

The key objectives of the second round of consultations were to:

- Explain in clear and sufficient detail the nature of the project
- Confirm or validate the information gathered in the previous consultation rounds and survey work
- Deliver further information on the potential environmental, social, and health impacts of the project
- Explore the key issues and concerns of stakeholders regarding potential project impacts that are relevant for site selection
- Based on the information gathered and studied, discuss the preferred site for the project

10.1 Project Information & Grievance Centre Planning

Project Information Centres are currently in the planning stages to be set up in several locations surrounding the Sabetaung, Kyisintaung and Letpadaung mine areas. Due to the large number of villages, 35 independent collectives, there will be a unification of some of the villages that have current friendly dispositions towards each other.

Ideal planning of these centres would be to locate 2 full capacity Information Centres, individual

for each mine. One will be located at the main gates of MYTCL and the other at the main gates of MWMCL. Open daily from 09:00 to 12:00 and 14:00 to 17:00 five days a week (Sunday to Thursday), the Centres will employ five full-time workers to provide information about the projects to visitors to the centres. Visitors can submit questions in writing, receiving written responses in both Myanmar and English languages.

Information at the Letpadaung Centre is anticipated to experience the most number of visitors, and in particular, grievances. In order to accommodate this Project Information Sheets and News Updates, as well as a Project brochure will be available. There will be a sequential poster displayed on the wall explaining the Project's activities, an exhibit of the Copper Mine's products, and if possible a model of the potential mine. Information in the form of a PowerPoint Presentation or a video documenting the potential social and environmental impacts and benefits of the Project will be developed for viewing at the Wanbao Centre.

A visitor's book will be made available for personal comments on the project, and again it is anticipated that this will be the basis for much of the grievances. Issues based on compensation, employment and environment will most likely be the common denominator for reply.

Village Based Information & Grievance Centre Planning

Due to the distances of many of the villages from these centralized Centres, it would be in our best interest to provide smaller unmanned stations for the collection of grievances or inquiries. Planning for Drop-boxes at safe locations within the villages are a possibility.

All Information Centre Planning is still in the planning stages.

Currently the CSD Team is the open channel of communication to retrieve complaints, requests and even gratitude towards the Projects. All are being documented daily.

10.2 Project Information Sheets

An information pamphlet (10.2.1) was designed to address the immediate issues that were raised on a general basis from the villages surrounding the Letpadaung Mine. It was also distributed to the S&K mine villages to give a universal message.

Available in the local Myanmar language, the pamphlets were distributed by the CSD Team along with a questionnaire (10.2.2) (10.2.3) regarding demographic individual information, job status, income levels, housing, as well as needs for basic necessities such as water, electricity and job opportunities. These pamphlets were distributed village by village upon a personal invitation letter composed by the CSD Team.

The process of distribution was as follows.

1. Letter of invitation sent out with corresponding CSD Team member from each of the 29 existing and cooperating villages.
2. Letter returned, signed by the village administrator or representative.
3. Appointment arranged through the CSD Team member.
4. Visit engagement.
5. Record of grievances and collection of survey questionnaires.
6. Creation of database.

This first pamphlet also provided a brief of the early works stages and overview of the Project, aimed at promoting the Project through detailing potential benefits, and showing commitment to keeping stakeholders informed of the Project's development through the provision of answering frequently asked questions. A list of potential job opportunities also was included to inspire acceptance of the restart to the Letpadaung Project.

10.2.1 CSD Pamphlet 1.

ENGAGE

COMMUNICATE

PARTICIPATE

WORKING TOGETHER

ACHIEVING A COMMON GOAL

BUILDING OUR FUTURE

HELPING EACH OTHER

GROWING FOR A BETTER TOMORROW

THE LETPADAUNG MINING PROJECT
&
OUR COMMUNITY & SOCIAL DEVELOPMENT PLANNING
CSD TEAM

INTRODUCING THE CSD TEAM

It is our pleasure to introduce to you the CSD Team consisting of 40 members that will begin consultations with the villages surrounding the S&K&L Projects.

FIRST CONTACT

One representative from each of the neighboring 30 villages have been hand selected by the communities to create this team who will engage in direct communications with our village friends. We will first come to your villages by invitation, and we are very happy that you will accept us to come and speak to you about the future of your village, our mining company and how we will grow together towards a better tomorrow.

WE WILL COME IN A SMALL GROUP OF 5 OR 6 PERSONS

Our CSD Team wants to make contact with you to hear what you really have to say from your heart, and not from the mouths of those people who do not live in your village. We want to speak to all of you... women, children and men both young and old. We want to open the channels of communication between us so that we understand how we can help each other through the times ahead of us all.

The Letpadaung Project will move forward. There is no question about this truth. As a community we must now understand how it will affect us all, and what we must do to make certain that the environment, the people of all the communities and the businesses in our areas continue to grow after the mine has completed operations years from today.

TODAY WE MUST SPEAK TO EACH OTHER ABOUT TOMORROW

The future ahead of us is very promising in many ways. With the mine will come job opportunities, business opportunities, education, infrastructure, funding to government facilities and community projects so very needed such as water, electricity, medicine and so much more. There is nothing to fear.

How the CSD Team Will Work For You

The CSD Team is part of your community. They are the people from your villages. They are your family, neighbors and trusted friends. They are going to come and speak to you and are there to listen... to take back the information you give to them... to discuss with the company your questions or needs... and they will return to you with answers as quickly as possible. They will then work together with you to accomplish your goals. The CSD Team works for you too.

Construction Will Begin June 15

We want you to know our every move from this point forward, and if, or how it might affect you, and what we are going to do if it does. On June 15th there are 6 areas where we will begin construction works on a small scale. These will mostly be out of sight as they are within the middle of the mountain range. They are just normal construction works as you see all the time. We have completed the intital Environmental Impact Assessment on these areas, and we know that there will be no impact to the Baseline Study that is now being conducted by a third part and the International Environmental Engineering Company of Knight Piesold Australia. **Knight Piesold is creating Environmental Management Plans for these areas of Early Works for us to follow.**

Construction Plans

1. **Fuel Station**
2. **Explosives Bunker Buildings and Safety Area**
3. **Offices/Warehouses/ Maintenance Area**
4. **Mobile Crusher for Quarry**
5. **Access Roads**
6. **Conveyor Foundation Blocks**

We have given a map to the CSD Teams to show you the locations of these areas.

Job Opportunities

With the beginning of the construction works we will have a wide variety of jobs that will become available. Our CSD Team has a questionairre to help us find those people to fit the new job opportunities. There are many construction jobs that everyone can do, and there are some jobs that require higher levels of education. Here is a list of how many jobs and what types will become available once construction period begins June 15th.

After Restarting in the Construction Period

	Q1	Q2	Q3	Q4
Administration	3135	36	37	
Logistic	283	298	332	326
Technicians	48	50	50	51
Operators	679	759	804	837
Repairmen	113	140	152	299
Labour	492	709	766	667
Securities	200	207	217	201
Others	87	103	103	94
Total	1933	2301	2460	2512

Our Future Together

We hope that you have as much hope for the future as we do, and we thank you for taking the time to welcome our CSD Team into your village, into your home and into your life as we begin our work together to making a sustainable future.

Thank You :)

10.2.2 Job Opportunity Questionnaire 1.

NO.

Date: 2013

(Village No: 01-34; Household No. 001-999; Individual No. 1-9)

Job Opportunities Questionnaire

Consent for Job opportunity questionnaire

We are collecting data from the villages in order to know your interests, your current job opportunities and your suggestion that can enhance our project's staff recruitment process, and also any other areas that need to be improved.

This questionnaire usually takes only a few minutes to complete. Any information that you provide will be kept strictly confidential. Your participation is voluntary and you can choose not to answer any or all of the questions if you choose. However, your participation is very much important for the company to do further improvement to give sustainable benefits to the villages.

Note: Only those who are interested in applying for jobs at MYTCL and MWMCL are requested to complete this questionnaire.

Respondent Name…….. **Gender……..**

Age……..…….. **Village……..**

House Type…… **Address……**

Telephone ……..……

Q1) What are family member's education status?

(A)Primary School …… (B)Middle School ……. (C)High School …….

(D)College, Diploma, Graduate ……

Q2) Respondent's Marital Status……..

(A) Single (B) Married (C) Divorce (D) Widow

Q3) Choose one of your most professional skills?

(A) a plumber; (B) Electrician (C) Mechanic (D)Logistics & Maintenance

(E) Gardener (F) Construction Worker (G) Welder (H)Unskilled Labour

(I) Cleaner; （J）Bricklayer; (K) Machine repairer; (L) Others ……

Q4) How long have you been working that professional?

(A) 0 - 1 Years (B)1 - 2 Years (C)2 – 3 Years (D) 3 Years and above

Q5) What are the types of work for income in your family?

(A) Agriculture (B) Daily wages worker (C) Monthly wages worker (unskilled)

(D) Monthly wages worker (professional) (E)Others …….

Q6) What is your family's total monthly income?

(A）10000 – 50000 (B) 50000 – 100000 (C) 100000 – 150000 (D) 150000 and above

Q7) Are you satisfied with the project's basic salary (FEC 110)? (Note: The basic salary may be varied from rank by rank)

(A) Yes (B) No

Q8) What is your suggestion on project job opportunity? (Use other side to comment)

10.2.3 Village Situation Analysais Questionnaire 1.

NO.

Date: **2013**

(Village No: 01-34; Household No. 001-999; Individual No. 1-9)

Villages Situation Analysis Questionnaire

Consent for Village Situation Analyses Questionnaire

We are conducting survey of the village situation and community's concerns on the mine project that going to be implemented soon. We also would like to ask some questions about your family livelihood situation. The gathered information will be given to the company for further consideration.

This questionnaire usually takes 15 – 20 minutes to complete (adjust as appropriate). Any information that you provide will be kept strictly confidential and will not be shown to other people. Your participation is voluntary and you can choose not to answer any or all of the questions if you want. However, your participation is very much important for the company to do further improvement to give the best benefit to the villages.

……

Respondent Name **……..**
Household head Name **……..**
Relationship of Respondent and HH head **…….**
Marital Status **…….**
Age (year) **…….**
Village Name **…….**
Contact Way **…….**

Q1) How many members are in your family? ……..

Q2) How many children and adults are living in your household?

Age	Male	Female
0-6		
7-18		
19-60		
Above 60		

Q3) Did all school age children attend regularly in the past academic year?

(A) Yes (B) No

Q4) If no, what was the main reason for these children not attending school?

(A) Sickness / Handicap

(B) Can't afford to pay school fees, uniform, textbook

(C) Can't pay transportation / far away

(D) No boarding school available

(E) Children work for the family

Q5) Type of house

(A) Brick wall and zinc roof (B) two story's wooden house with zinc roof

(C) One wooden storey with zinc roof (D) Bamboo sheet house with zinc roof

(E) Bamboo sheet house (F) Toddy Palm house

Q6) –Are you satisfied with the new built houses?

(A) Satisfied
（B） Basically Satisfied
(C) Not Satisfied
(D) Do not care

Q7) What is your average monthly income?

(A)	10000 – 50000
(B)	50000 – 100000
(C)	100000 – 150000
(D)	150000 and above

Q8) What is your main source of income?

(A)	Daily wages
(B)	Vendor
(C)	Monthly wages
(D)	Farming
(E)	Animal Husbandry
(F)	Trading
(G)	Other ……

Q9) How many family members work at Myanmar Yang Tse and Myanmar Wanbao?

(A) 0 (B) 1 (C) 2 (D) More than 2

Q10) If no one works for the company, what is the reason?

(A) No trust of company (B) Low salary (C) No knowledge to apply (D) Failed Interview

(E) Other ……

Q11) What is the land area that was occupied?

Acre_____

Q12) How much land do you have left?

Acre_____

Q13) Have you received land compensation?

(A) Yes (B) No

Q14) If not yet received it, what is the reason?

(A) In the process of land ownership evaluation

(B) Less than the market price

(C) Not compensated according to the type of land

(D) Different perceptions among the villagers (pressure not to)

Q15) Please give some suggestions about the project development (environmentally and socially) to improve project surrounding areas;

(A) investment in community aid
(B) investment in living infrastructure
(C) investment in public service
(D) investment in environmental protection

Q16) Do you think the transparency is enough? What is the best way to improve transparency?

(A) linkman to inform regularly
(B) improve public consultation
(C) report to local authorities regularly
(D)

Q17) What is the biggest difficulty in your village?

(A) power
(B) water
(C) medicine
(D) education
(E) hygiene
(F) entertainment
(G) cultural life

(H) other

Q18) What is your acceptance of these mine projects?
(A) Understand and accept
(B) Not Understand but accept
(C) Understand but not accept
(D) Not accept
(E) Other……..

Q19) What are your friends and relatives' acceptance on these mine projects?
(A) 100% understand and accept
(B) 50% understand and accept
(C) 30% understand and accept
(D) Not agree
(E) Other……

Q20) How much do you know about these mine projects' environmental and social impact in your villages?
(A) A little
(B) Some
(C) Well enough
(D) Don't know

Q21) Do you have any other suggestions? If yes, please describe.

……

……..

……

……..

……

……..

10.3 Attitudes towards the Project

In the early consultation and fieldwork stages, directly affected people were initially in support of the Project, this was mainly due to a clouded vision that the Letpadaung Mine would ever go into full production. This attitude took a very abrupt turn once activities escalated, and mining progress began to infringe on farmlands without free and prior consent.

Fair compensation for lands became the primary concern, and due to an uprising Myanmar Wanbao Mining Copper Limited chose to halt all activities and to consult with the government authorities to find a solution.

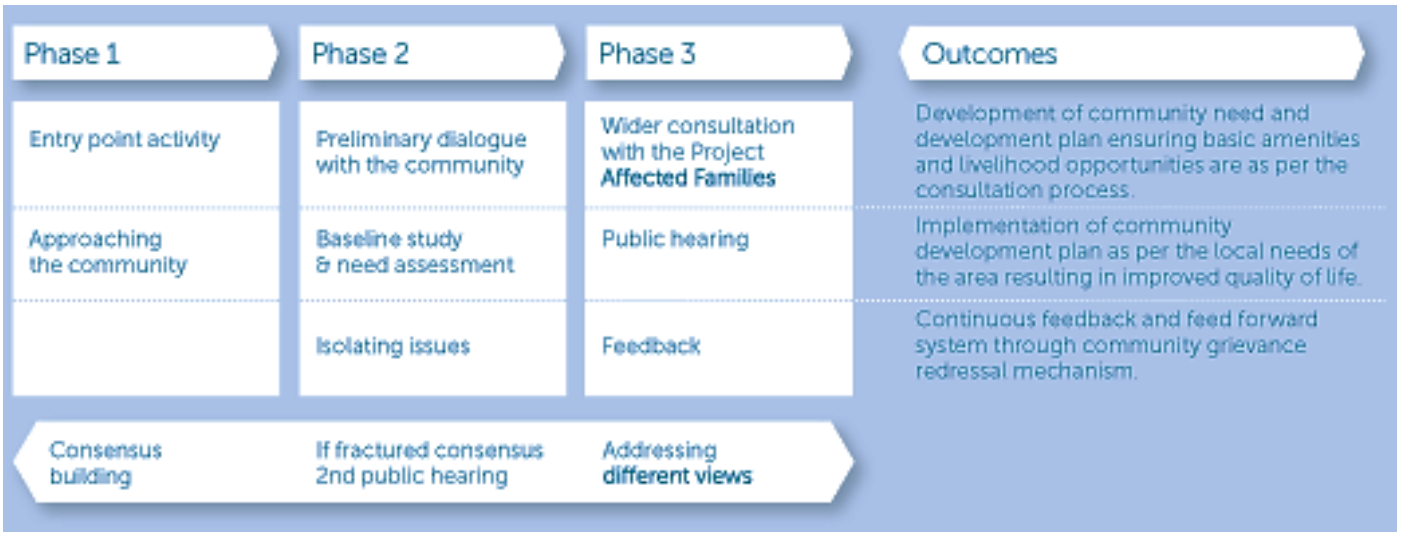
Through interactions with the CSD Team the consensus has been that the Project is a benefit to the locals, providing high paying job opportunities and upgrading their current way of life. Industrialization is an accepted idealism.

More recently some discontent around the Project has become evident amongst a sector of students provoking the halt to the entire project. Organized through undetermined committees, activities have been in disruptive as well as peaceful and legal demonstrations. Distribution of pamphlets, organized public meetings and refusals by households to relocate to newly constructed villages have interfered with the resettlement planning.

Community opposition occurs in any large-scale development, those with substantial resettlement components typically being particularly contentious. In response to the recent display of discontent, MWMCL has increased levels of consultation on all appropriate levels, and particularly with those who seem most concerned about Project developments, including community leaders and government officials of the Implementation Committee (IC).

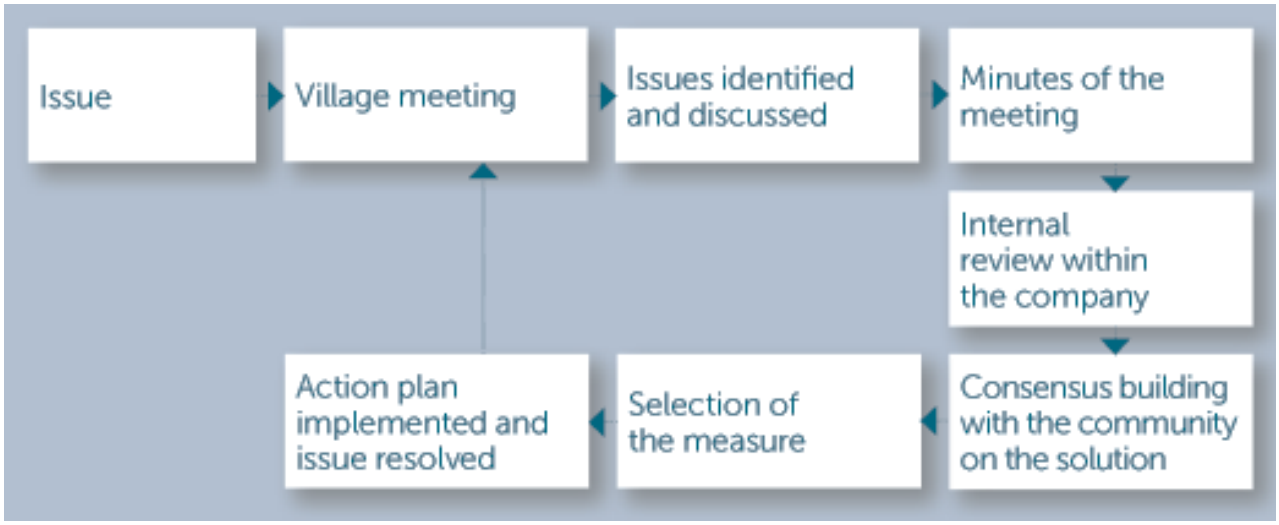
Regular meetings have been set in place to report all progress to the IC, following a detailed timeline to complete an ESIA simultaneously with early works of construction that will not interfere with any Baseline data collection, nor interfere with any environmental aspects.

10.4 Consultation with Host Area Communities



Our consultation approach: building community understanding

Both Myanmar Yang Tse and Myanmar Wanbao Mining operations are very well established, and have a consistent and open dialogue process in place through various platforms, and building and nurturing relationships with communities near our ongoing operations will continue. We continue to work to understand the concerns of our neighbouring communities and endeavour to closely manage them. We also work to ensure that all consultations occur in a culturally sensitive manner, in local languages where possible and in a collaborative and open manner. As shown in the diagram on below, the process is one of continuous consultation, which is ongoing throughout the life of the project, and its closure.



How we resolve issues

10.5 Resettlement

We firmly believe in avoiding forced evictions or involuntary resettlements whenever possible.

While the planning and implementation of mitigation measures for resettlement and rehabilitation cannot guarantee complete success on each occasion, we are committed to minimizing the negative impacts, such as stress generated by the land acquisition and resettlement processes, by adopting such project design and location alternatives that reduce the number of people potentially affected and that minimize the severity of potential impacts.

To guide all future resettlements we have put in place a Land and Resettlement Management Standard, which obliges all our operations to adhere to common processes, including:

- All operations shall undertake project specific social impact assessment studies and, where appropriate, prepare a Resettlement Action Plan aligned with applicable national regulatory and policy framework as well as international standards.
- Where households need to be physically displaced then we will ensure that such households are provided with alternative housing which is culturally appropriate. We aim to find resettlement sites in suitable locations chosen in consultation with the people to be resettled. Our goal is always to make sure the housing and access to infrastructure and amenities will be of an improved standard compared to that prior to displacement. To the extent possible people will be given options for resettlement.
- All the people that are within the area of impact of our operations will be assessed for long-term rehabilitation assistance and programmatic support to help them restore their livelihoods and

overall quality of lives to at least pre-project levels and where possible we hope it will be considerably better.

For our Myanmar projects, we use public consultation to gauge the needs of the communities and address any concerns. By way of example, surrounding our S&K&L operations, we have constructed 4 resettlement villages for displaced families with supporting physical infrastructure, including roads, drainage, electricity and new water supply, and social infrastructure, including schools, childcare centres, temples and playgrounds. We plan to continue throughout the future of our mining enterprise to be a suitable source of assisting the local and regional governments in restructuring the rural communities of our region.

10.6 Plans for Disclosures and Consultation

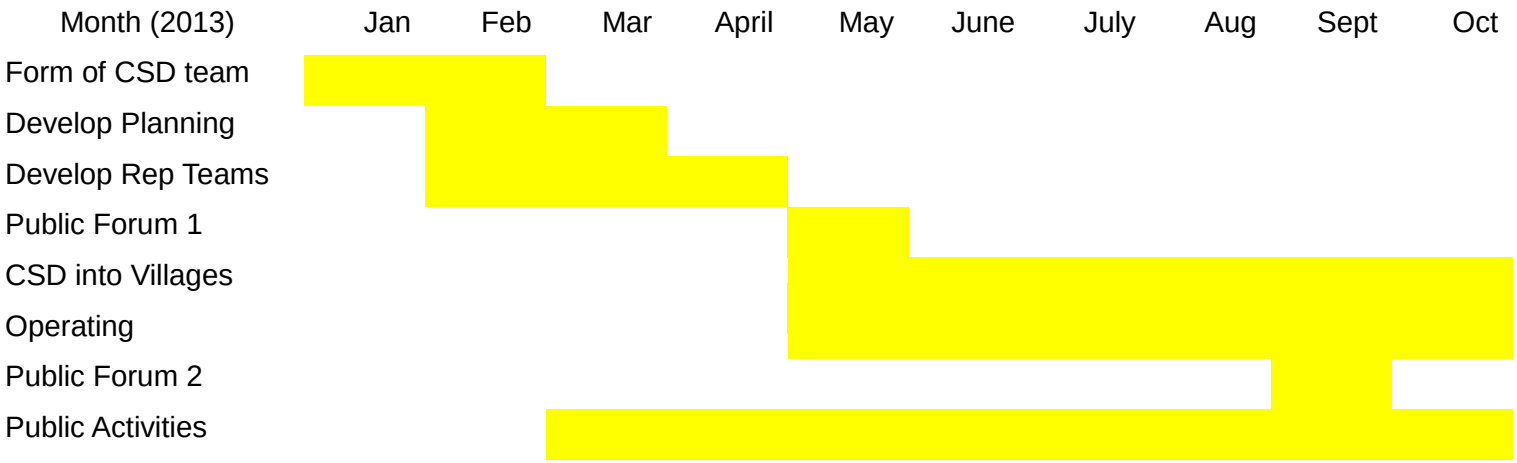
Consultation for each phase of the project will focus around a specific topic and will utilize different consultation strategies and result in different ESIA related outputs as summarized in Table 1.

Table1: Key Phases of the PCDP Process

Project Phase	Topics for Discussion During Consultation	Consultation Strategy	ESIA Outputs
Site Selection	Details of the early works sites	■ Face-to-face meetings, workshops, and group meetings	Scoping consultation supporting document Announcement of preferred site selected
Preconstruction Studies Land Clearing	Scoping Phase Supporting Document	■ Face-to-face meetings and workshops, group meetings ■ Written comments ■ Appointment of Community Liaison Officer (CLO) ■ Web-site disclosure (www.myanmaryangte.com.mm)	Scoping report and terms of reference for ESIA
Early Works in Non-affected Areas (Baseline Study – ESIA) June –July 2013	Baseline Study, engineering design and impact assessment and management planning	■ Surveys/questionnaires ■ Interviews ■ Working groups ■ Communication centre ■ CLO ■ Web-site disclosure and commenting procedure	Draft ESIA Report
	Draft ESIA Report	■ Open public meetings and hearings ■ Workshops ■ Written comments ■ Communication centre ■ CLO ■ Web-site disclosure and	Final ESIA Report and project approval

Project Phase	Topics for Discussion During Consultation	Consultation Strategy	ESIA Outputs
		commenting procedure	
Construction and Operation	Project Implementation Plans	■ CLO ■ Communication centre ■ Grievance mechanism ■ Newsletter	Management report

Figure 1: Schedule for Public Consultations utilizing the CSD Team during ESIA Process



Consultations for the basic design, and early works site selection phase of the PCDP commenced on April 2013, and are ongoing. The baseline Study phase of the PCDP was initiated in February 2013 with the socioeconomic household, business, construction, and aquatic, flora and fauna, traffic, noise and air surveys in the Letpadaung area. Scoping Study and the Terms of Reference for the ESIA have been accepted by the governing group of the Implementation Committee, established through the instruction of the President's office to monitor the progress and Environmental and Social implications. The PCDP will continue throughout the ESIA, as well as through the project construction, commissioning, and operation phases.

10.7 Stakeholder Identification and Analysis

Stakeholders are identified to determine all of the organizations and individuals who may be directly or indirectly affected (positively and negatively) by the project and related activity. It also includes anyone who may be able to contribute to the program of work due to their expert knowledge of and/or experience in the region. It is an ongoing process requiring regular review and updating.

The stakeholder identification and analysis process for the Letpadaung Project is in its infancy stages. Recognizing the strategic importance of the project, a diverse range of stakeholders is currently being identified that could be involved in the PCDP process:

- Authorities, including members of national, regional, and local government entities
- International, national, and local non-governmental organizations (NGOs) with a direct interest in the project that may have useful data or insight into the project's national and local challenges
- Other groups including media, academics, institutions, foundations, community, and business groups
- Residents, landowners, and land users in the areas around the potential sites considered for the project, or that could potentially be impacted by the project
- Bilateral and multilateral organizations
- Wanbao Mining project participants
- Businesses and potential employees
- Media

Beginning at early works selection, the Letpadaung Project initiated work with consultants to identify the key stakeholders to consult at various project stages. The stakeholders are broadly categorized into primary and secondary groups:

- Primary stakeholders: Individuals or groups who may be directly affected by the project

- Secondary stakeholders: Individuals or organizations with an influence, interest, or expertise to offer the project, even if the project does not directly involve or affect them

To develop an effective stakeholder involvement program, it is necessary to determine exactly who the stakeholders are. This is partially due to the different methods that may be required to involve various stakeholder groups effectively.

Also, different issues are likely to be vital concerns for each stakeholder group. For example, an international NGO may be concerned with how the proposed project will affect more global issues such as climate change, while a local resident is much more likely to be concerned about the immediate effects upon health, economy, and the environment.

Table 2 presents the list of stakeholder groups identified and categorized according to the primary and secondary stakeholder categories. Appendix A contains a full list of identified stakeholders.

Table 2: Preliminary List of Stakeholder Groups

Primary Stakeholders	Secondary Stakeholders
■ Project participants (management and employees) ■ Community leaders ■ Local community members, including vulnerable subgroups (e.g. disabled peoples, ethnic minorities, women, and children) ■ Actual and potential suppliers and contractors ■ Fuel suppliers ■ Local businesses and co-operatives (e.g. fishing) ■ Local churches/monasteries and civic organizations ■ Local government	■ Myanmar National government ■ Sagaing Divisional government ■ MOECAF ■ Ministry of Mines ■ International and national environmental, social, health, and human rights groups ■ Universities and other academic groups ■ Actual and potential customers ■ Other upstream companies ■ Trade associations, industrial bodies, and other opinion formers ■ Labor unions ■ Political parties ■ International financial community ■ International, national, regional, and local media

The project established a database utilizing the CSD Team to identify the stakeholders and capture their potential interests or concerns. The database serves as a tool to decide what party to consult based on the understanding of:

- Who will be affected by the project and the decisions made
- Who has NOT been involved up to now but should be in the future

10.8 Issue Identification and Analysis

Issue identification and analysis is closely tied to stakeholder analysis. It is important to understand who key stakeholders are and their interest in each issue as well as the risks and opportunities associated with them.

The range of issues identified and analysed includes political, socioeconomic, ethical, and environmental issues associated directly with the project and with the wider strategic context of the project.

This activity places particular attention on any gaps between stakeholder expectations, project commitments, project performance, and stakeholder awareness during the process of identification of potential new issues and assessment of the manageability of issues.

The issue analysis will enable those involved in the project to understand:

- The key issues for each stakeholder group through stakeholder dialogue
- The historical background
- What is important to those who are involved and/or affected
- Stakeholders' priorities
- Stakeholders' concern

A site-selection evaluation tool was developed for the early works study. This tool analysed the socioeconomic and environmental resources and receptors with the potential to influence the future location of the Letpadaung project and/or to be affected by it. The tool was used to identify issues and conduct analyses for the early works phase of the PCDP. Table 3 presents the list of socioeconomic and environmental resources and receptors that were pertinent to the site selection process for the Letpadaung Project.

Table 3: Environmental and Socioeconomic Resources and Receptors

Criteria	Resources and Receptors
Environment	Habitats and species (terrestrial and marine flora and fauna, including fish) Agriculture and processes Water quality
Socioeconomic	Planning and development Land based livelihoods and recreation Settlements and buildings Framing-based livelihood and water-borne transport Cultural sites Community health and safety

Appendix B provides a list of the issues identified to date. This includes issues associated directly with the project, the wider strategic issues referred to as themes, and issues relevant to the Letpadaung Project commitments to community development.

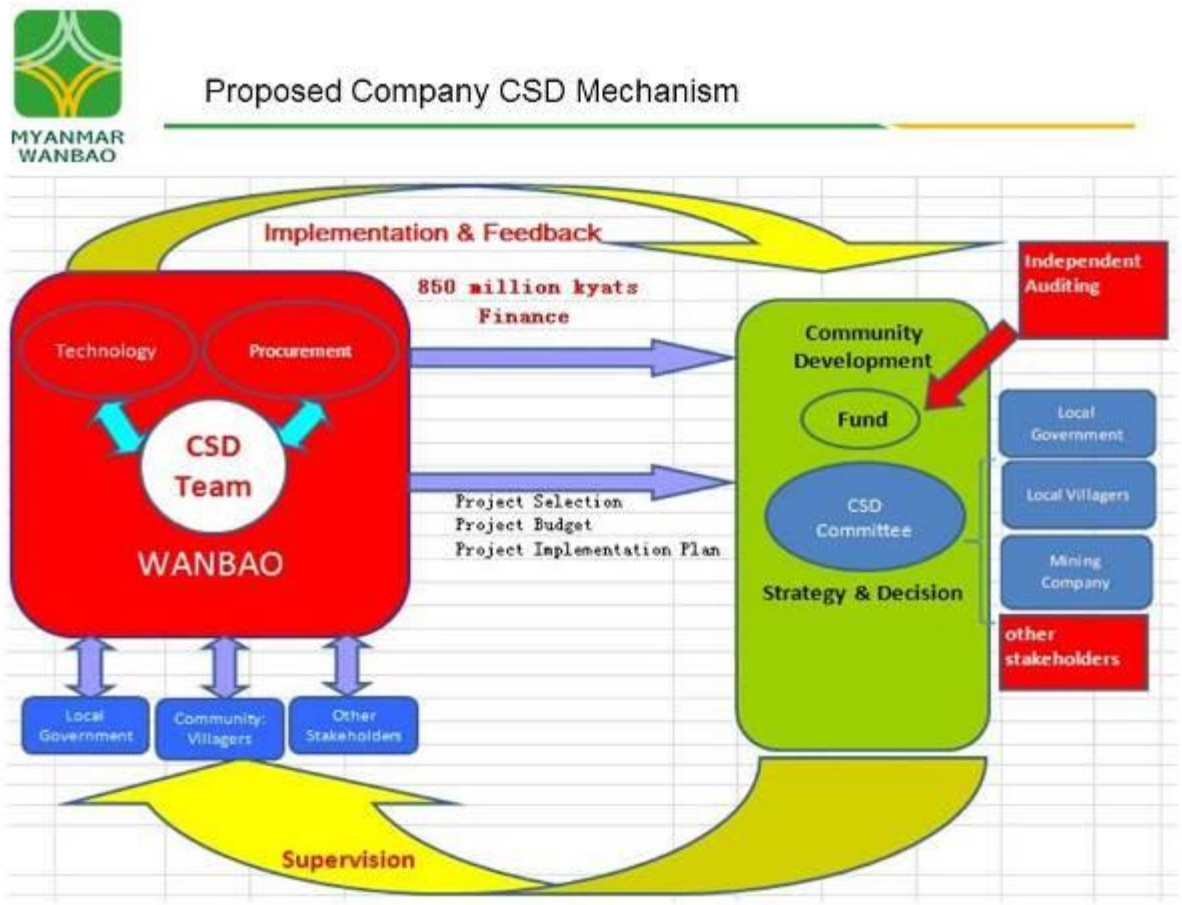
More issues will likely be identified during each phase of the PCDP. The feedback from the PCDP may also require the manageability of some issues to be reassessed; this could add new dimensions to the discussion, and require changes in plans. The list in Appendix B will be regularly updated and the issues will be re-analysed at the end of each phase of the PCDP

10.9 Methodology

Overview

The Letpadaung Project has an established program of stakeholder involvement from work completed during the early works phase. The goal during the next phase, operations, is to build upon the work already undertaken, and to develop a strategy that provides opportunities for all stakeholders to contribute to the development.

Figure 2: Letpadaung Project Public Consultation and Disclosure Plan for ESIA



10.9.1 Review and Analysis of Consultation Prior to Operations Phase

The various methods of stakeholder involvement available to the project during the early works phase were analysed to determine:

- Their suitability for reaching different stakeholder groups
- Positive and negative aspects associated with their implementation based on previous results from the site selection consultations or general experience
- Ways each method could be improved or developed to ensure greater success during the Operations Phase

Consultation during the early works will use the following forms of communication:

- Public awareness meetings and focus groups
- Face-to-face discussions with local people and national and international NGOs
- An environmental, social, and health exhibition featuring posters, brochures (non-technical summary reports), and safety video on site
- Dissemination of the Scoping Study and Terms of Reference Supporting Document and non-technical summary to libraries and other public venues

10.9.2 Action Tracking and Monitoring Of Issues and Stakeholders

The Letpadaung Project will maintain a database for managing issues and stakeholder information. This tool will be used to manage ongoing project issues, and for stakeholder identification and analysis processes. The database stores the items below.

- Stakeholder profiles
- Consultation tracking sheets for each stakeholder (a group, in some cases)
- Issues register
- Issues sheets
- Action register

10.9.3 PCDP Stakeholder Process

The Letpadaung project stakeholder database was used as the reference document for the stakeholder identification process. The stakeholders were classified into two primary categories in the database:

- Primary stakeholders: Individuals or groups who may be directly affected by the project.

- Secondary stakeholders: Individuals or organizations with an influence, interest, or expertise to offer the project, even if the project does not directly involve or affect them

Key stakeholder groups were identified and prioritized on the basis of the specified goal and objectives of this particular phase of the PCDP.

For the first round of consultations, the primary stakeholders were placed into the following three categories:

- Key national decision makers: Individuals with the power to influence decision making, or those who can provide information to support site selection decision making (IC)

- Key regional and local decision makers and representatives: Regional and local administrators, traditional leaders, information holders, and representative groups and committees

- Respected knowledge holders: Trusted and respected organizations that can inform the decision-making process (e.g. academic institutions and some non-governmental organizations)

For the second round of consultations, the primary stakeholders were placed into the following three categories:

- Communities potentially directly affected by any of the three site options under consideration. This included communities that customarily own or use land that would be required for each potential location and local farmers.

- Key regional and local decision makers and representatives, including consultation with the Letpadaung technical staff and the Letpadaung Administrators, and a second meeting with the head of the traditional leaders and his advisors.

- Respected knowledge holders, influencers, and local businesses including Myanmar-based NGOs, businesses, and church leaders.

10.9.4 Stakeholder Dialogue Process

Two rounds of consultations will be conducted during the early works phase of the PCDP :

- The first round, conducted from June 10, 2013
- The second round, conducted from July 10th, 2013

Preparation and Disclosure of Project Information

Information for disclosure and in support of the consultations was prepared before the dialogue began. Table 4 lists the material prepared and used for the site selection PCDP (first round) and Table 5 (second round).

Table 4: Consultation Materials (First Round)

Document	Audience	Description	Languages
Slide Presentation	Decision makers, local representatives, information holders	Introduces the project, the ESIA, and site selection	English, Myanmar
Question and answer sheet	Letpadaung project, appointed local and international consultants	Set responses to key questions	English and Myanmar
List of questions and scripts	Consulters	Lists of questions and scripts for use during consultation meetings	English
Consultation tracking database	appointed local and international consultants	For entering key information from consultation meeting	English
Meeting minute Proforma	appointed local and international consultants	For writing up meeting notes	English

Table 5: Consultation Materials (Second Round)

Tool	Description
Pictorial Presentation	Large A1 format pictorial presentation including photographs and diagrams of the following issues: ■ Reasons for the construction and uses ■ Previous consultation undertaken during initial visit ■ Work completed to date, including social and environmental studies ■ Health and safety
Map & symbols- participative meeting tool	Large Ao format satellite image of the study areas and surrounding land. This includes the map to depict known settlements and cultural sites, and stick-on symbols placed on the map by participants to indicate where particular activities or sites are located. Symbols depict activities such as fishing, agriculture areas, recreation areas, cultural sites, pathways/walkways, etc.
Power Point Presentation	Detailed presentation of project and potential impacts, translated into Myanmar. This provides in-depth information on certain aspects (e.g. visual layouts of project and diagrams of potential water quality impacts), and will be used mainly in meetings where literacy and existing understanding of issues were already high.
Question & Answers (Q & A)	A List of standard Questions and Answers was developed with Letpadaung Project and used as a guide and prompt for all meetings. Questions will range from project and potential impacts to wider development issues. The questions were translated into Myanmar.

The slide presentation will be used to provide a summary of the project and the key environmental and socioeconomic issues, including:

- A broad overview of the proposed project (e.g. why it is needed, who is involved, what it involves, where it is).
- A broad overview of the ESIA process (e.g. what it is, who is involved) and proposed timetable for consultation.
- Detailed description of the site selection process the project was utilizing.

Methods of Consultation

The preferred methods for consultations during early works phase were face-to-face meetings and workshops. For the first round of consultations, each meeting will follow a similar agenda, commencing with a slide presentation followed by a series of questions and a general discussion about the project. The participants were provided with specific information regarding the actual sites under construction.

10.9.5 Recording and Reporting

The PCDP will be updated throughout the ESIA. The update will include a review of the activities and findings and the evaluation of the effectiveness of the previous PCDP phase together with any lessons learned and plans for the next phase.

A written record will be made of each meeting and consultation event. Any concerns will be entered into the issue register and in the stakeholder profiles, and used to amend the issues sheets as required. Any actions agreed will be entered into the consultation tracking sheets and into the action register.
Some issues may require feedback or responses to questions, comments, proposals, concerns, and stakeholder expectations. The format and deadline for the delivery of the feedback/response for each phase of the PCDP will be clearly communicated to the stakeholders at the outset of each meeting. The Meeting Minutes Proforma, as outlined in Appendix C, will be used to capture feedback.

Additionally, feedback can be provided by contacting the Myanmar Wanbao Mining Copper Limited office in Yangon, and through the website. www.myanmarwanbao.com.mm

10.9.6 Evaluation of Effectiveness

The effectiveness of the individual initiatives and the overall PCDP program for each phase will be assessed .
The key measures of the PCDP's effectiveness are:

- Adequate and timely disclosure of information to project-affected stakeholders.
- Adequate provision of opportunities for stakeholders to voice their opinions, expectations, and concerns.
- Demonstrable evidence that stakeholder opinions, expectations, and concerns have been taken into account in the ESHIA and project decision-making processes.

11. GRIEVANCE REDRESS

The Letpadaung Project developed a formal grievance process for the developmental process of the CSD Team. Wanbao Management will manage this process. Its primary objective will be to ensure that people affected by the project can present their grievances to the CSD project team for consideration and correction if appropriate. The local community stakeholders will be informed of the intention to implement the grievance mechanism, and the procedure will be communicated and disclosed accordingly. The grievance process will also ensure all complaints from local communities are addressed in an appropriate and timely manner, with corrective actions being implemented if appropriate and the complainant being informed of the outcome. It will be applicable to all complaints from communities affected by the Letpadaung Project.

11.1 Responsibilities

The CSD Project Manager will be responsible for collating written complaints and coordinating responses to all complaints. These responses to complaints will be in writing.

11.2 Procedure

General Complaints

All complaints received verbally or in writing shall be recorded in a grievances log. It will be kept in a shared drive, and accessible to the CSD Project Manager and the Environmental Systems and Operational Development Manager (ESODM).

Upon receiving a complaint, all employees and contractor personnel shall refer the complaint to the CSD Manager, the Public Relations Manager, or to the ESODM Manager. The form shall then be forwarded to the Deputy General Manager who will assign it a number.

The community liaison officer (PR Officer) shall ensure that appropriate action is taken to respond to a compliant. If the CSD Project Manager is unable to respond to or deal with a complaint directly, he or she will refer the complaint to the appropriate manager, through the Manager of Local Issues and Government Relations and Government Relations. The CSD Project Manager remains responsible for tracking the complaint and ensuring that it is addressed.

Grievance Log

The CSD Project Manager ensures that each complaint has an individual number, and is appropriately tracked and recorded actions are completed. It also contains a record of the person responsible for an individual complaint, and records dates for the following actions:

- Date the complaint was reported
- Information on proposed corrective action sent to complainant (if appropriate)
- The date the complaint was closed out
- Date response sent to complainant

Grievance Action Form

This specifies the information required to ensure the complaint is addressed appropriately. The form consists of these five parts:

1. Information about the complainant, and the complaint number (taken from the Grievance Log)
2. The complaint section where all the details relevant to the complaint are recorded
3. For recording the appropriate immediate action to be implemented and identifies appropriate long-term action
4. Corrective action to be implemented. If a complaint is related to any physical issue, a photo should be taken and attached to the Grievance Action Form.
5. Details how corrective action, if any, shall be verified and signed off

Responding to a Compliant

Response to complaints must be in writing, though a verbal response will be provided if this is more appropriate under the circumstances (e.g. where the complainant cannot read). All complaints must be responded to within two weeks of being received, even if the response is just a summary of what is planned and when it is likely to be implemented. Further correspondence should be given once the complaint is closed (within 28 days).

Monitoring Complaints

The CSD Manager will be responsible for:

- Providing the Project Team with a weekly report detailing the number and status of complaints.
- Any outstanding issues to be addressed.
- Monthly reports, including analysis of the type of complaints, levels of complaints, and actions

12. MONITORING AND EVALUATION

Potential Impacts and Recommendations for MitigatingImpacts

Discussion regarding potential impacts of the Project and recommendations regarding mitigation measures was relatively limited during the first consultation round. A number of stakeholders noted that they require further information regarding the Project to enable them to provide considered input into the identification of potential impacts. It was notable that many potential impacts that were raised by stakeholders were positive rather than negative in nature, in line with the strong overall vision of the Project as being positive for the Letpadaung region.

The main potential issues and areas of recommendation raised by stakeholders were:

- environmental stewardship
- resettlement
- in-migration and development
- potential local benefits

MEHL has also implemented a monitoring system within 2 of the villages.
1 officer and 1 staff member are available for monitoring the MEHL internal complaints systems.
Liaison Officers are placed in Whetmay and Kandaw Villages.

Evaluation of Effectiveness

Following the Early Works consultations, The Letpadaung project will conduct an evaluation using the Proforma in Appendix B. Issues that will be highlighted include:

- status of resolution of commitments from this Phase
- integration of these activities with those of Government and Public Affairs
- recommendations for amendments to system of recording
- stakeholder fatigue
- geographical scope and focus