SURFACE HYDROLOGY STUDY:
MT PORTER GOLD PROJECT,
MT PORTER, NORTHERN TERRITORY.

NOVEMBER 2006

PREPARED FOR

ARAFURA RESOURCES NL

BY

MBS ENVIRONMENTAL

4 Cook Street
West Perth WA 6005
Australia

Telephone: (618) 9226 3166
Facsimile: (618) 9226 3177
Email: info@mbsenvironmental.com.au

Martinick Bosch Sell Pty Ltd
ABN 60 102 614 479
MBS Environmental
environmental and water resource consultants

MARTINICK BOSCH SELL PTY LTD

ABN 60 102 614 479

MBS ENVIRONMENTAL

environmental and water resource consultants

SURFACE HYDROLOGY STUDY: MT PORTER GOLD PROJECT, MT PORTER, NORTHERN TERRITORY.

PREPARED FOR

ARAFURA RESOURCES NL

This report has been prepared for **Arafura Resources NL** on the basis of instructions and information provided by **Arafura Resources NL** and therefore may be subject to qualifications which are not expressed.

No other person may use or rely on this report without confirmation in writing from MBS Environmental. MBS Environmental has no liability to any other person who acts or relies upon any information contained in this report without confirmation.

This report has been checked and released for transmittal to **Arafura Resources NL**.

PREPARED BY:
Michael Dufty Signature: Date: 27-11-2006
Senior Environmental Engineer

CHECKED BY:
Kristy Sell Signature: Date: 27-11-2006.
Director-Environmental Science

TABLE OF CONTENTS

TABLES

FIGURES

PLATES

APPENDICES

Appendix 1: Streamflow Calculations

Appendix 2: Laboratory Water Analysis Results

1. INTRODUCTION

Arafura proposes to develop the Mt Porter Gold Project located 20 kilometres north of the town of Pine Creek in the Northern Territory. The project will involve 'campaign' mining the recoverable mineral resources using conventional open-cut methods from a single pit over a period of one year. Mining will be conducted during the dry season and rehabilitation completed prior to the onset of the wet season. Ore will be transported offsite using road trains along existing transport corridors to the Union Reef Mill located approximately 10 kilometres south west of Mt Porter where it will be processed.

Infrastructure required for the project will include:

- Access road from the Frances Creek Road.
- Mine office including electricity generator and ablution facilities.
- Contractor lay-down areas and workshops including generator.
- Fresh water dams/bores.
- Bulk fuel storage areas.
- Magazine and explosives store.
- Waste rock dump.

Twenty four hectares of land will need to be disturbed for extraction of ore and construction of infrastructure associated with mining operations.

2. OBJECTIVES

The objective of this report is to provide relevant surface water information to meet the requirements of the Public Environmental Report document being prepared for the Mt Porter Gold project. Specifically this report will:

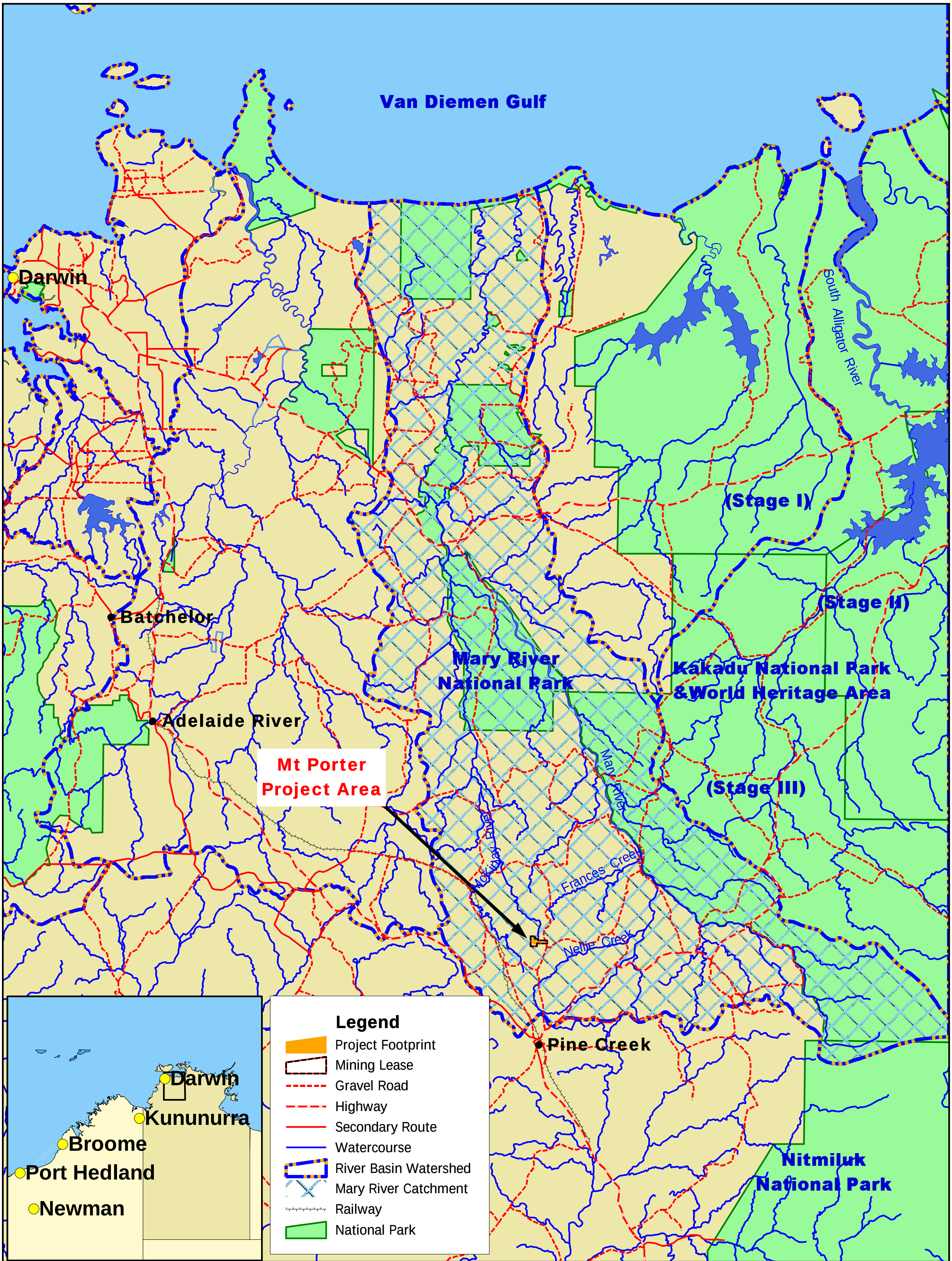
- Describe the site and regional surface water systems including rivers, creeks and streamlines.
- Discuss the significance, current uses and beneficial uses of all surface water systems.
- Acquire available regional and local data on stream flows.
- Estimate average and flood flows for surface water systems associated with the project using local data and regional methods.
- Discuss water quality based on field observations, sampling and historical data where available.
- Describe potential impacts of the project on water quality, water quantity, diversion of waters and aquatic flora and fauna.
- Describe current downstream water users and their requirements.
- Document requirements for water licensing.
- Propose management measures for treatment, and disposal of water, separation of clean and contaminated water and management of extreme rainfall events.
- Identify water monitoring requirements before, during and after mining.

3. CATCHMENT DESCRIPTION

The Mt Porter project area is located in the headwaters of Nellie Creek in the upper Mary River catchment. The Mary River catchment covers an area of 8,000 square kilometres, draining north-west into the ocean at Van Diemen Gulf, about 100 kilometres east of Darwin (Figure 1). Approximately 1,300 square kilometres of the catchment is upstream of the confluence of Harriet Creek and the Mary River. The upper catchment of Mary River is defined as that upstream of its major tributary, the McKinlay River, which joins Mary River about 100 kilometres from the ocean. The upper Mary River catchment is characterised by channel flow, while the lower catchment is dominated by sheet flow, with large areas of floodplain seasonally inundated, during the wet season, receding to a series of large pools of permanent water "Billabongs" in the dry season.

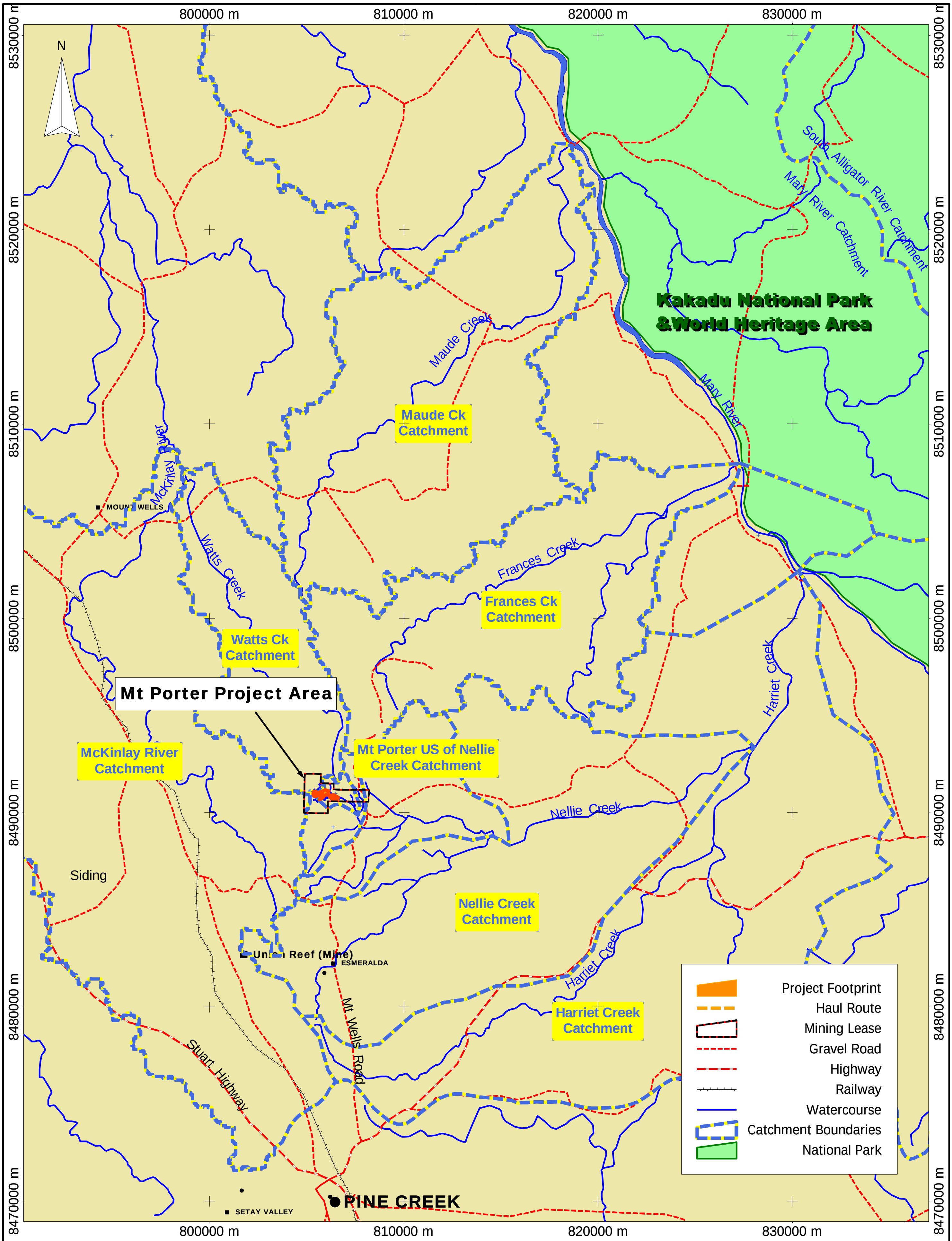
Mt Porter is located about 15 kilometres north of the southern boundary of the Mary River catchment and the discharge point of Mary River to the ocean is 155 kilometres north of Mt Porter. The mining tenement includes the drainage divide between the McKinlay River, Watts Creek and Nellie Creek catchments, but all planned mining activity is within the Nellie Creek Catchment. The project area is within the headwaters of a northern tributary of Nellie Creek (Figure 2). Nellie Creek catchment is around 25 kilometres in length from Mt Porter to Harriet Creek. It joins Harriet Creek about 10 kilometres upstream of Harriet Creek's confluence with the Mary River. It has a catchment area of 270 square kilometres, of which 54 square kilometres is upstream of the tributary (including Mt Porter). Plate 1 shows the bed of Nellie Creek early in the 2005 wet season, about 3.5 kilometres downstream of Mt Porter. The summit of Mt Porter is on the divide between the McKinlay River catchment and Upper Mary River Catchment. The northern most tip of the tenement is in the catchment of Watts Creek, a major tributary of the McKinlay River.

Plate 1: Nellie Creek at Frances Creek Road Culvert, 3.5 kilometres downstream of Mt Porter, December 2005



Environmental + Water Resource Consultants MBS ENVIRONMENTAL 4 Cook St West Perth WA 6005 Telephone: + 618 9226 3166 Facsimile: + 618 9226 3177 info@mbsenvironmental.com.au	Scale 1:1000000 Original Size: A4 0 20 km	Arafura Resources Mt Porter	Location Plan - Mary River Catchment Figure 1

W:\Arafura Resources\Mt Porter\Surface Water\Drawings\F1 Location-Mt Porter SHS.map 16/11/2006



MBS ENVIRONMENTAL
Environmental + Water Resource Consultants

4 Cook St
West Perth WA 6005
Telephone: + 618 9226 3166
Facsimile: + 618 9226 3177
info@mbsenvironmental.com.au

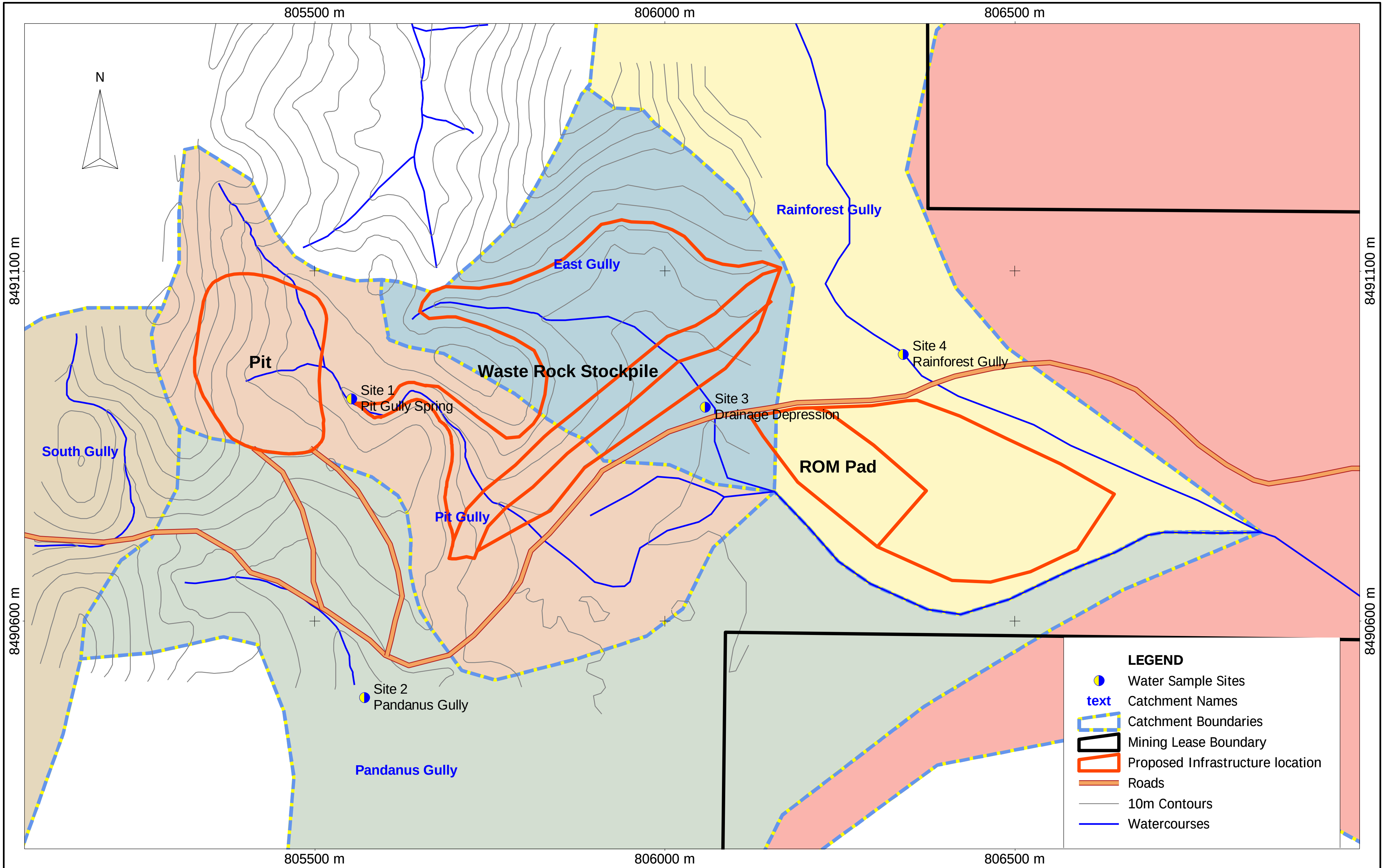
Scale: 1:250000
Original Size: A4
Datum:
Australian Geocentric 1994 (GDA94)
0 6 km

Arafura Resources
Mt Porter

Location Plan - Nellie Creek Catchment

Figure 2

W:\Arafura Resources\Mt Porter\Surface Water\Drawings\F2 local catch -MtPorter SHS.map 16/11/2006 Figure 2 A4



MBS ENVIRONMENTAL

Environmental + Water Resource Consultants
4 Cook St
West Perth WA 6005
Telephone: + 618 9226 3166
Facsimile: + 618 9226 3177
info@mbsenvironmental.com.au

Scale: 1:7000
Original Size: A4
Datum: Australian Geocentric 1994 (GDA94)

0 200 m

Arafura Resources

Mt Porter

Site Catchments & Monitoring Sites

Figure 3

W:\Arafura Resources\Mt Porter\Surface Water\Drawings\F3-SiteLayout-SW.map 16/11/2006

All of the proposed mining activity at Mt Porter lies within the catchment of Nellie Creek. The highest point in the project area is the summit of Mt Porter at 292 metres AHD (Australian Height Datum). The lowest point is downstream of the workshop and office area at around 175 metres AHD.

The pit and waste rock stockpile locations overlie a gully system as shown in Figure 3 with two branches referred to as Pit Gully (Plate 2) and East Gully. There is a small spring (Pit Gully Spring, Plate 3) located between the pit and the proposed waste rock stockpile. Pit Gully has a catchment area of 0.17 square kilometres, and East Gully 0.15 square kilometres. Very low flows have been observed here as late as June when most watercourses are dry. To the east and south of the proposed operations respectively are Rainforest Gully (Plate 4) and Pandanus Gully which both contains small spring fed pools which persist into the dry season.

Plate 2: Pit Gully at Access Track, June 2006

Plate 3: Pit Gully Spring, Sample Site 1, June 2006

Plate 4: Rainforest Gully Pool, Sample Site 4, June 2006

4. DOWNSTREAM WATER USERS

Three main Beneficial Uses of surface water in the Mary River catchment have been declared under Beneficial Uses legislation under the *NT Water Act (1992)*. These are:

- Cultural (including aesthetic and recreational).
- Environmental (the maintenance of healthy aquatic ecosystems).
- Riparian use (public rights to extract water for domestic/stock purposes).

These uses are the basis for waste discharge licences and water quality planning - potential waste discharge or water extraction which detrimentally impacts on these Beneficial Uses will not be permitted under the *Water Act*.

There are no townships within the Mary River Catchment, and the resident population was estimated at less than 200 in 2002 (Armstrong *et al*, 2002). The main uses within the project area are environmental. The area is not currently used for grazing, but as it is part of Mary River West Pastoral lease, potential exists for riparian use for stock purposes.

Immediately downstream of the project area, Nellie Creek passes through Mary River West and Mary River East Pastoral Leases. The major uses in these leases are also environmental and riparian for stock use. Nellie Creek joins the Mary River via Harriet Creek six kilometres upstream of Mary River Station and Mary River Roadhouse. This is the nearest residence downstream of the project area.

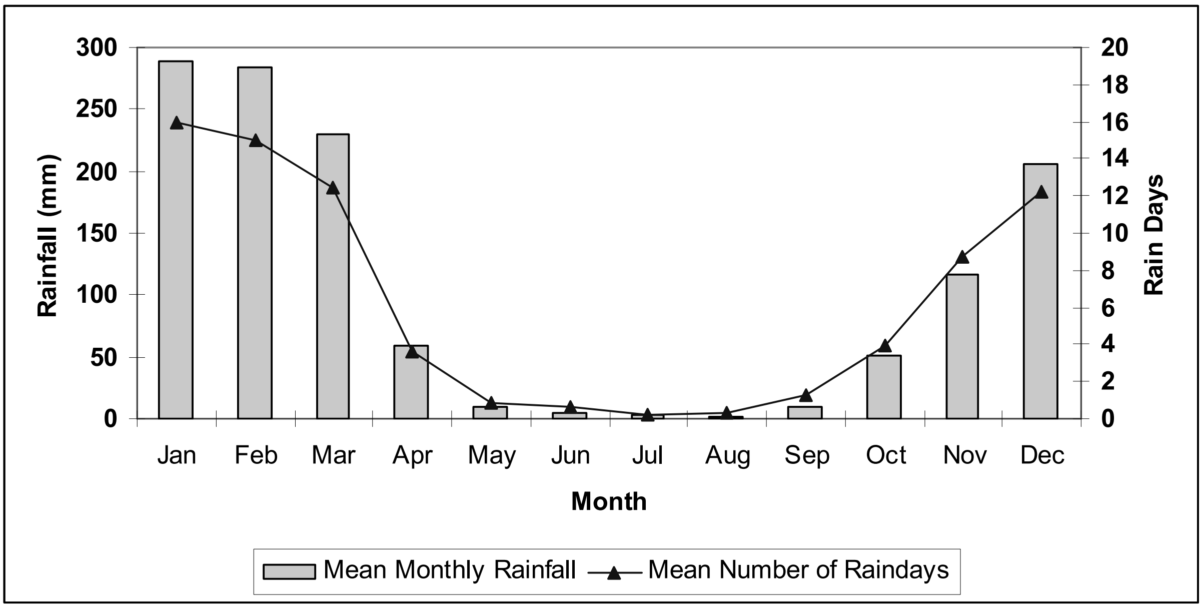
The Mary River forms a portion of the boundary of Kakadu National Park where Harriet Creek joins it, about 35 kilometres downstream of the project area. The Kakadu National Park diverges from the Mary River about 46 kilometres further downstream, and Mary River does not flow into the park, so there is minimal use of Mary River water in Kakadu. Mary River National Park covers the majority of the Mary River downstream of Kakadu. The final 40 kilometres before the ocean includes some pastoral and leasehold land. Fishing and boating are promoted as major recreational attractions of the National Park so recreation use as well as environmental use is significant in Mary River National Park.

5. RAINFALL AND CLIMATE

The climate of the Mt Porter area is tropical monsoonal, with a pronounced wet season consisting of a hot, humid summer from November to March. Conditions are typically cooler and dry from May to September. October and April are transitional months with some rainfall.

Average rainfall in the region is 1,100 to 1,300 millimetres and falls mainly during the period between October and April, especially during the months of January to March, when the area is subject to tropical cyclones and associated tropical low pressure systems and monsoon troughs. The nearest long term rainfall records available are from Burrundie Railway Station (17 kilometres north-west of the project area) and averages from this location are shown in Chart 1 and Table 1.

Chart 1: Burrundie Railway Station Monthly Rainfall Data (1889-1974)



Mean annual average rainfall for Burrundie Railway Station is 1,263 millimetres, over 98% of which falls between October and April. The highest average monthly rainfall occurs in January (288 millimetres). Pine Creek, 21 kilometres south of the project area, has slightly lower rainfall, with an average annual rainfall of 1,149 millimetres for the period 1874 to 2000.

Mining operations are scheduled to be carried out between April and November, with some preparation and rehabilitation work possibly extending into March and December. Table 1 shows rainfall statistics from the nearest monitoring site, with the period of mining operations highlighted. Average rainfall is low for the April to October period, with median monthly rainfall of less than 33.4 millimetres in each month. Significant rainfall can still occur during this period. The maximum recorded rainfall in July of 114 millimetres indicates that rainfall events of this magnitude are possible throughout the year. The highest recorded monthly rainfall for April is 690.5 millimetres, enough to prevent mining operations commencing at Mt Porter. A similar situation occurred in 2006 when late season cyclones resulted in monthly rainfall of 413.5 millimetres in Pine Creek. Monthly rainfalls of over 200 millimetres have been recorded in October.

November is at the transition to the wet season and with a median rainfall of over 100 millimetres, so significant rain can be expected, although runoff is likely to be low due to the dry state of catchments. December is the start of the wet season proper with a median rainfall of 187.8 millimetres and maximum recorded rainfall of 591.9 millimetres.

Table 1: Rainfall Average Data for Burrundie Railway Station (62 years record).

	Lowest Monthly Rainfall	10th Percentile Monthly Rainfall	Median monthly rainfall	Mean Monthly Rainfall	90th Percentile Monthly rainfall	Highest Monthly Rainfall	Highest Daily Rainfall	Mean Number of Raindays
Jan	82.8	149.8	258.2	288.6	469.7	721.7	294.9	16
Feb	60.2	107.2	272.1	284.2	495.6	614.4	167.6	15
Mar	6.3	59.8	196	229.9	472.9	654	174.5	12.5
Apr	0	0	23.1	59.1	157.8	690.5	393.7	3.6
May	0	0	0	9.2	19.9	144.8	69.9	0.8
Jun	0	0	0	4	13.1	49	41.9	0.6
Jul	0	0	0	3	2.1	114.1	104.1	0.2
Aug	0	0	0	1.7	2.6	30.5	30.5	0.3
Sep	0	0	3.4	10.1	34.2	70.8	64.5	1.3
Oct	0	4.1	33.4	51	126.6	212.1	114.3	3.9
Nov	0	46.9	101.4	116.7	211.5	282	100.6	8.7
Dec	46.6	88.2	187.8	205.2	352.2	591.9	158.8	12.2
Annual		826.8	1225.3	1262.7	1812.6		393.7	75

Shading of table indicates the period of proposed mining operations.

Air temperatures are relatively high and consistent from year to year. During the coolest time of the year (June to July), the mean monthly temperature for Pine Creek ranges from a minimum of 10 to 13 degrees Celsius to a maximum 20 to 32 degrees Celsius. In the hottest part of the year (October to November) the mean monthly temperature ranges from a minimum of 24 to 27 degrees Celsius to a maximum of 37 to 41 degrees Celsius. The lowest recorded overnight temperatures are below five degrees Celsius.

Humidity measured at Pine Creek averaged 49% in September 2004 and 79% in February 2005 (Bureau of Meteorology, 2006). Evaporation at Pine Creek is estimated at 2,775 millimetres per year (Bureau of Meteorology, 2003). Average evaporation is therefore more than double the average rainfall.

Rainfall intensity-frequency-duration (IFD) data for design can be derived from the data and methods in Australian Rainfall and Runoff (Pilgrim, 1998). Values for Mt Porter were calculated using the computer program AUSIFD version 2.0 from the rainfall factors published in Pilgrim (1987). Table 2 summarises the rainfall depths for standard design storm durations and probabilities for the project area.

Table 2: Design Rainfall Intensity-Frequency-Duration Values for Mt Porter

Duration (hrs)	1 Year ARI (mm)	2 Year ARI (mm)	5 Year ARI (mm)	10 Year ARI (mm)	20 Year ARI (mm)	50 Year ARI (mm)	100 Year ARI (mm)
0.5	30.0	38.0	47.0	52.5	60.0	70.0	78.0
1.0	42.2	54.0	66.0	73.0	83.0	97.0	108.0
3.0	54.6	69.3	85.2	94.8	108.3	126.6	141.0
6.0	63.6	81.0	99.6	111.0	126.6	148.2	165.6
12.0	73.9	94.4	116.5	129.6	148.8	174.0	194.4
24.0	95.0	122.4	154.3	174.2	201.6	239.3	268.8
48.0	119.0	154.6	199.7	228.5	267.4	320.6	363.8
72.0	132.5	172.8	226.1	260.6	307.4	372.2	424.8

6. AVERAGE AND FLOOD FLOWS

Watercourses in the project area are ephemeral and cease to flow during the dry season, but have regular flows during the wet season. Small springs or seepages are present at three locations (monitoring sites 1, 3 and 4, Figure 3) which result in the presence of isolated shallow pools of surface water during the dry season. Observed flows in these pools in June 2006 were only a trickle (Plate 3) and the streambeds were dry within 100 metres downstream of these springs (Plate 2).

6.1 REGIONAL STREAMFLOW DATA

The nearest recorded flow monitoring station was located on Frances Creek near the Frances Creek minesite about six kilometres north-east of Mt Porter and operated from 1961 to 1967. Six years of water level data were collected, but a reliable rating curve is not available to translate the level measurements to flow measurements. There are four other flow gauging sites within a 60 kilometre radius of the project area. One of these is on Harriet Creek, of which Nellie Creek is a tributary, but the gauging station is upstream of the confluence of Nellie Creek and Mt Porter so it is not monitoring runoff from the project catchment.

The available stream gauging data is summarised in Table 3.

Table 3: Stream Gauging Data Summary

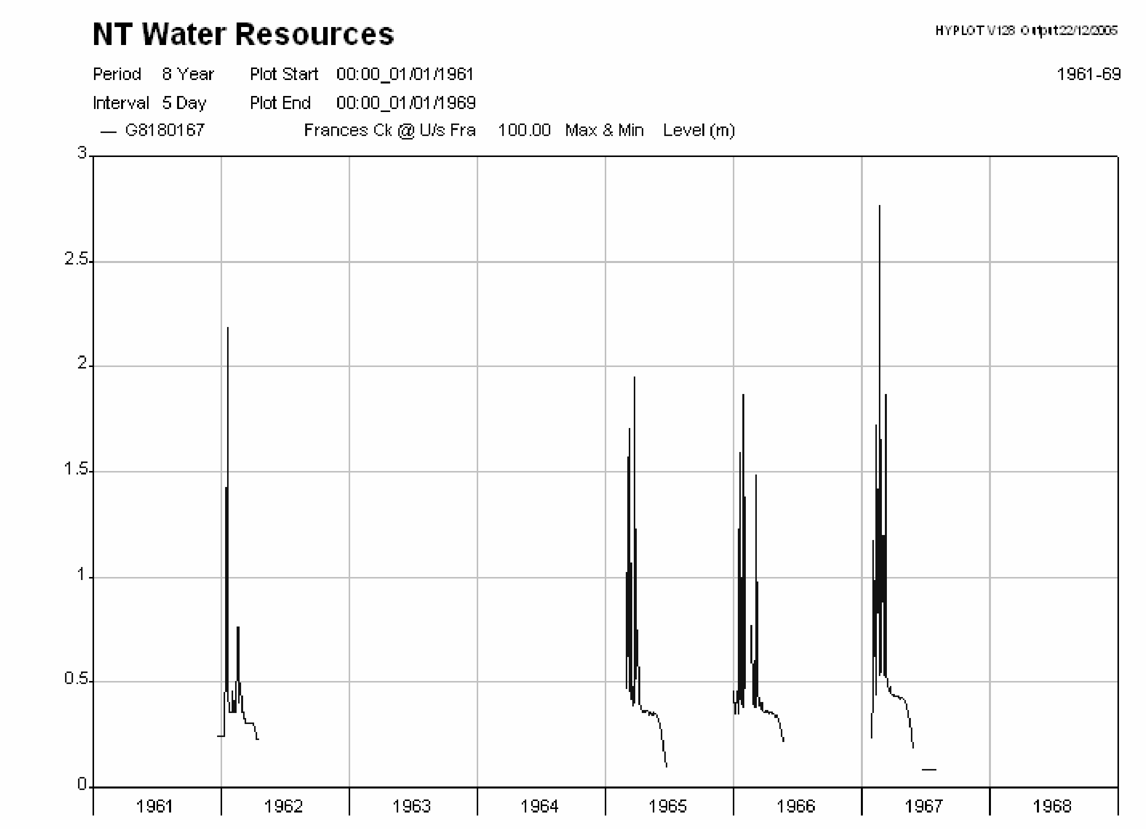
Gauging Station	Distance (km)	Start Year	End Year	Period (Years)	Catchment Area (km^2)	Bad Records	MGA94 Zone	Easting	Northing
G8180026 - Mary River At El Sherana Road Crossing	43	1960	2005	45	466	5.7%	53	199180	8494660
G8180069 - Mckinlay River At Near Burrundie	16	1957	2005	48	352	12.4%	52	794186	8502406
G8180167 - Frances Creek At Upstream Frances Creek Mine	6	1961	1967	6	7*	76.6%	53	278309	8497580
G8180252 - Harriet Creek At Downstream El Sherana Road	18	1965	2005	40	122	40.3%	52	823159	8486119
G8200044 - Goodparla Creek At Coirwong Gorge	57	1973	1993	20	161	26.2%	53	191244	8535458

* Estimated catchment area, no record of precise site location could be found.

6.1.1 Frances Creek Streamflow Data

Chart 2 shows the water level data available for Frances Creek. Reasonably complete wet season records were only obtained for 1962, 1965, 1966 and 1967. Of these 1962 was a very dry year (741.4 millimetres - less than 10th percentile), and 1965 to 1967 were about average rainfall. The highest water level recorded was 2.766 metres in February 1967. Around two metres appears to be a typical wet season maximum flow depth prior to construction of the Frances Creek Dams.

Chart 2: Water Levels in Frances Creek 1962 to 1967



Relatively complete records for the 1961-62 and 1965-1967 wet seasons indicate Frances Creek flowing consistently from December to May. These years had close to average rainfall except 1961 to 1962 which was a very low rainfall year. Annual rainfall figures from 1961 to 1967 are shown in Table 4.

Table 4: Pine Creek Annual Rainfall Records 1961 to 1965 (Bureau of Meteorology)

Year	Annual Rainfall	Rainfall Description
1961	939.9	below average
1962	741.4	very low
1963	1286.2	above average

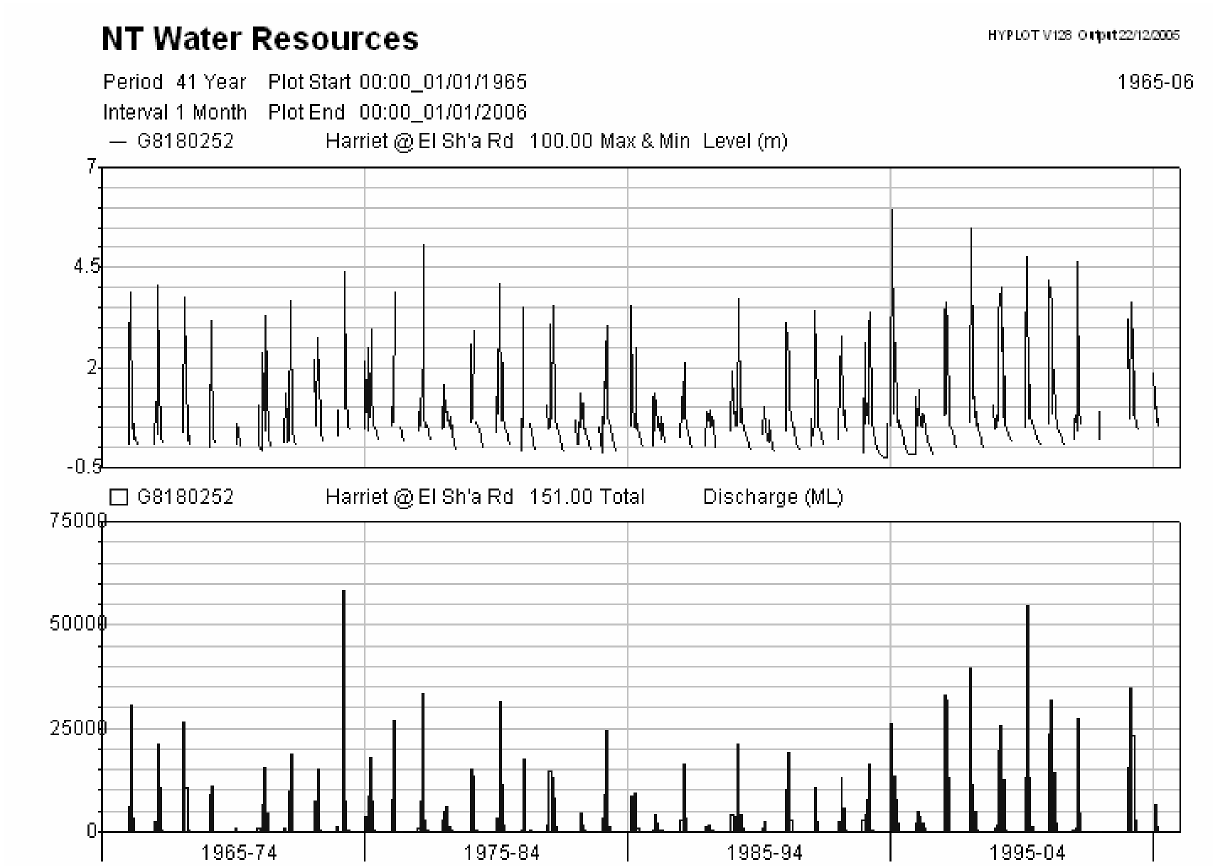
Year	Annual Rainfall	Rainfall Description
1964	1376.8	well above average
1965	1105.7	average
1966	1253.4	above average
1967	1082.1	below average

The missing streamflow years of 1963 to 1964 had relatively high rainfall. It is possible that damage or access issues associated with flooding contributed to the lack of records for those years.

6.1.2 Harriet Creek Streamflow Data

Chart 3 shows the stream flow and volume data from Harriet Creek gauging station G8180252. The expected seasonal pattern of high flows in the wet season and no flow in the dry season can be seen, with substantial flows in almost all years.

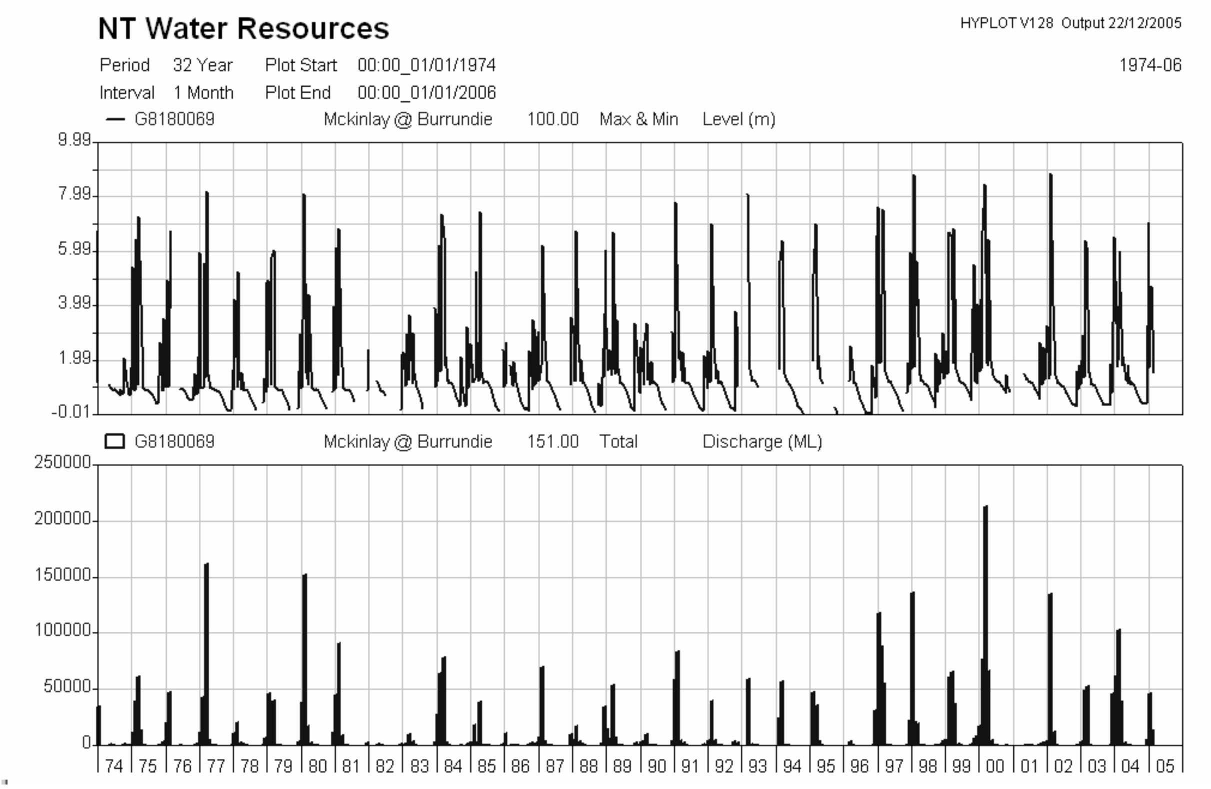
Chart 3: Flow and Volume Records from Harriet Creek Downstream El Sharana Road Gauging Station (G8180252).



6.1.3 McKinlay River Stream Flow Data

Chart 4 shows the stream flow and volume data from McKinlay River gauging station G8180069. As for Harriet Creek, the expected seasonal pattern of high flows in the wet season and no flow in the dry season can be seen, with substantial flows in almost all years.

Chart 4: Flow and Volume Records from McKinlay River at Burrundie Gauging Station (G8180069)



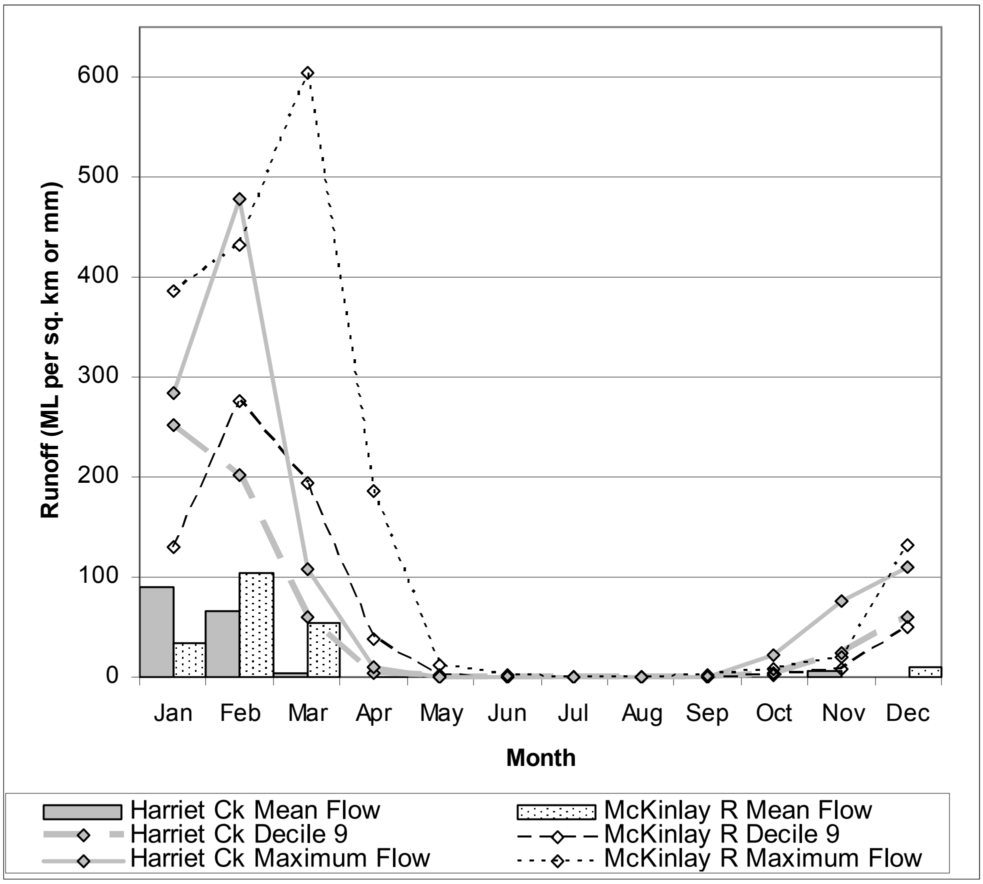
6.1.4 Average Streamflow Data for Region

Chart 5 shows flow statistics per square kilometre for the McKinlay River (Burrundie, G8180069) and Harriet Creek (El Sharana, G8180252) gauging stations. The units are megalitres per square kilometre, which are equivalent to millimetres of rainfall runoff. The statistics shown include mean, maximum, and decile 9 monthly flows. Decile 9 flows are equivalent to 90th percentile, and can be interpreted as the flow which is exceeded on average only once in ten years.

It can be seen from Chart 5 that very little runoff occurs between May and September. Runoff is consistently high in January and February in Harriet Creek and from January to March in the larger McKinlay Catchment. Substantial runoff events have also occurred in the months of October, November, March and April. The highest recorded flow on McKinlay River occurred in the month of March. Since this data was extracted a late cyclone in April 2006 created very high April flows in the district.

The records available for Frances Creek, the nearest monitoring station to Mt Porter, indicate a closer match with the McKinlay River catchment, as Frances Creek flows regularly extend into April and May. This is most likely due to higher rainfall in Frances Creek compared to Harriet Creek.

Chart 5: Mean, Decile 9 and Maximum Monthly Runoff per square kilometre of Catchment for Harriet Creek (downstream El Sharana Road) and McKinlay River (Burrundie) Catchments.



6.2 ESTIMATED AVERAGE AND FLOOD FLOWS FOR PROJECT AREA

Based on the available stream flow data and regional flood estimation methods, estimates have been made of average peak flows and annual volumes, and flood peak flows for relevant catchments within the project area. The locations of these catchments are shown in Figure 4.

Results of these calculations are shown in Table 5 and Table 6. The figures in Table 5 for annual volumes are derived by scaling monitoring data from McKinlay river at Burrundie by catchment area.

Table 5: Estimated Annual Flow Volumes for Mt Porter Catchments

	Catchment Area (km^2)	10th Percentile Annual Flow (ML)	Median Annual Flow (ML)	Mean Annual Flow (ML)	90th Percentile Annual Flow (ML)	Maximum Annual Flow (ML)
Pit Upstream	0.038	0.4	2.0	10.2	11.9	22.0
Upstream of ROM	0.734	6.9	39.1	198.7	231.2	428.4
Rock Drain North	0.138	1.3	7.3	37.3	43.5	80.5
Rock Drain South	0.085	0.8	4.5	23.0	26.7	49.5
Total at Watercourse Junction Downstream of ROM	2.740	25.8	145.7	741.4	862.8	1598.6

The peak flows in Table 6 were calculated by the method developed for the Alice Springs to Darwin Railway design by Weeks *et al* (2002). Details of calculations are given in Appendix A.

Table 6: Estimated Peak Flow Rates for Mt Porter Catchments

	Catchment Area (km^2)	5 Year ARI Peak Flow (m^3s^{-1})	10 Year ARI Peak Flow (m^3s^{-1})	20 Year ARI Peak Flow (m^3s^{-1})	50 Year ARI Peak Flow (m^3s^{-1})
Pit Upstream	0.038	0.5	0.7	0.9	2.1
Upstream of ROM	0.734	4.4	6.2	8.1	15.1
Rock Drain North	0.138	1.3	1.8	2.4	4.9
Rock Drain South	0.085	0.9	1.3	1.7	3.6
Total at downstream Junction	2.740	11.7	16.4	21.4	36.2

Table 5 shows that the mean annual stream flows for all drains on site are less than 75 megalitres. Average annual streamflow of the Nellie Creek tributary immediately downstream of the site is over 740 megalitres, so any stormwater runoff from disturbed areas will be diluted by about 90% before leaving the mineral lease. Table 6 shows the maximum flows that diversion structures will be required to cope with will be of the order of five cubic metres per second.

7. WATER QUALITY

7.1 REGIONAL WATER QUALITY.

Table 7 is a summary of water quality information for the Mary River Catchment extracted from the report Water Quality of the Rivers and Streams of the Mary River Catchment (N.T.) (Schultz *et al*, 2002*)*. The water quality data in this report does not represent only natural background water, but also includes data from several monitoring sites downstream of active mines, towns and agriculture.

Table 7: Water Quality Characteristics of 40 sites in the Mary River Catchment

Element	Units	Number of sites	Median	Range	10th percentile	90th percentile	ANZECC 95% trigger
pH		40	6.3	6.1 - 7.8	6.2	6.8	6.0-7.5
EC(2000)	µS/cm	40	53	12 - 342	32	119	20-250
Nitrate & Nitrite	mg/L	35	<0.001	<0.001-0.006	<0.001	0.004	0.030
NH_3 Nitrogen	mg/L	40	<0.01	<0.01-0.02	<0.01	0.01	na
Total Kjeldahl Nitrogen	mg/L	40	0.06	0.03 - 0.32	0.03	0.12	na
Total Nitrogen	mg/L	35	0.06	<0.03 - 0.32	0.03	0.13	0.15
Total Phosphorus	mg/L	40	0.007	0.004-0.013	0.005	0.011	0.01
Filterable Reactive Phosphorus	mg/L	35	0.001	<0.001-0.009	<0.001	0.003	0.005
Turbidity	NTU	40	5.7	0.7 - 15.0	3.8	13	2 - 15
Total Suspended Particulates	mg/L	40	1.95	0.40 - 8.76	0.85	4.46	

Table 7 shows that the catchment in general has slightly low pH compared to the relevant ANZECC trigger values for protection of aquatic ecosystems (ANZECC, 2000). `The electrical conductivity is towards the upper end of the ANZECC trigger value range. Other studies confirm the upper Mary River catchment has elevated conductivity compared to the upper Katherine and East Alligator Rivers, (which have electrical conductivities of 38 and 22 microsiemens per centimetre respectively), but is low in comparison to other rivers in the top end of the NT such as the Daly and Roper Rivers (conductivities of approximately 600 and 1000 microsiemens per centimetre respectively). The higher conductivity is likely to be due to different geology (Schultz *et al*, 2002). Nutrients (nitrogen and phosphorous) are low, generally below ANZECC trigger values. Turbidity is within the range of ANZECC trigger values.

Table 8 shows electrical conductivity and turbidity from Schultz *et al* (2002) for the catchments in the study area containing active mines. It can be seen that both are significantly higher in these catchments. This may be contributed to by the mineralised geology of the catchments and/or discharge from mining operations.

Table 8: Water Quality Characteristics of Active Mine Catchments of the Mary River Catchment

Element	Units	Number of sites	Median	Range	10th percentile	90th percentile	ANZECC 95% trigger
EC(Active Mines)	mg/L	2	163	115 - 210	125	201	21
Turbidity-Active mines	NTU	2	7.2	2.3 - 12.0	3.3	11	2 - 10

Table 9 contains a summary of metal concentrations for the Mary River Catchment extracted from the report "Water Quality of the Rivers and Streams of the Mary River Catchment (N.T.) (Schultz *et al*, 2002). Water samples were taken from 42 sites and a second sampling taken at five of these sites for a total of 47 samples.

Table 9: Metal concentrations (µg/L) at 42 sites in the Mary River Catchment

Element	% of sites with measurable concentrations	Median	Range	10th percentile	90th percentile	ANZECC trigger
Aluminium	96	**60**	<5-**260**	12.6	150	55
Arsenic	55	1	<1-18	<1	3.32	24(AsIII)
Cadmium	6	<1	<1-**3**	<1	<1	0.2
Cobalt	4	<1	<1-5.9	<1	<1	-
Chromium	0	<1	<1-<1	<1	<1	1
Copper	11	<1	<1-**12**	<1	0.44	1.4
Iron	100	620	44-1200	186	954	-
Magnesium	100	2700	460-17000	1048	8100	-
Manganese	100	27	3.8-390	9.6	119.4	1900
Molybdenum	2	<1	<1-15	<1	<1	-
Nickel	30	<1	<1-**16**	<1	4.62	11
Lead	0	<1	<1-<1	<1	<1	3.4
Selenium	0	<1	<1-<1	<1	<1	-
Uranium	2	<1	<1-1.3	<1	<1	-
Vanadium	2	<1	<1-1.2	<1	<1	-
Zinc	60	1.6	<1-**200**	<1	**84.8**	8

Note: Bold text indicates values exceeding ANZECC 2000 trigger values.

It can be seen from Table 9 that the median aluminium concentration is above the ANZECC trigger value. The median concentrations of all other metals analysed are below trigger values, but at least one sample exceeded the trigger value for each of cadmium, copper, nickel and zinc.

Further analysis focusing on upper tributaries within the Pine Creek Geosyncline such as Mt Porter indicates significantly higher concentrations of metals in runoff from these areas (Schultz *et al*, 2002).

The high concentrations of aluminium observed suggest that biota in the area has had an extended period to adapt to the high aluminium concentrations in the area (Schultz *et al*, 2002). The ANZECC trigger values are therefore likely to be too conservative to be applied to protection of ecosystems in the Mary River catchment. More appropriate limits will need to be developed based on the local natural water quality.

A number of water samples were collected in the Frances Creek Catchment, about six to ten kilometres north of Mt Porter as part of the environmental approval process for the Frances Creek Iron Ore project (MBS Environmental, August 2006). Table 10 summarises results for the filtered streamflow samples from Frances Creek, Maude Creek and tributaries from December 2005, samples M3 to M8 and Helene 9 from MBS Environmental (August 2006). These results exclude sampling of open pit lakes, but does include surface runoff downstream of some areas mined before 1975.

Table 10: Frances Creek Area Water Quality Results, December 2005

Element	units	ANZECC trigger	Median	Lowest - Highest	10th Percentile	90th Percentile
EC	µS/cm	20-250	45	26 - 596	32	317.6
pH		6.0-7.5	6.7	6.0 - 7.5	6.06	7.14
NO3_N	mg/L	0.03	0.075	0.025 - 0.115	0.039	0.109
NH3_N	mg/L	-	0.050	0.005 - 0.185	0.020	0.161
Cl	µg/L	-	3700	1100 - 13400	1400	9020
Aluminium	µg/L	55	340	10 - 550	17.08	532.6
Arsenic	µg/L	24(AsIII)	1.35	0.4 - 1.75	0.46	1.66
Cadmium	µg/L	0.2	<0.02	<0.02 - <0.02	<0.02	<0.02
Cobalt	µg/L	1.4L	0.16	0.04 - 1.15	0.088	0.67
Chromium	µg/L	3.3L	0.50	0.2 - 0.9	0.2	0.78
Copper	µg/L	1.4	1.63	0.82 - 4.18	0.844	3.214
Iron	µg/L	-	300	80 - 600	152	480
Manganese	µg/L	1900	7.38	0.68 - 291	1.67	135.06
Nickel	µg/L	11	1.44	0.36 - 2.17	0.438	1.924
Lead	µg/L	3.4	0.20	0.03 - 0.52	0.042	0.418
Sulphate	µg/L	-	1400	400 - 172000	640	80920
Thallium	µg/L	0.03L	0.02	0.01 - 0.03	0.012	0.028
Uranium	µg/L	0.5L	0.07	0.01 - 0.659	0.0394	0.3308
Zinc	µg/L	8	1.80	0.2 - 5.3	0.68	3.5

L indicates Low reliability values for metals and radicals

Table 10 indicates that the Frances Creek area has similar water quality to the Mary River catchment generally, the main notable differences being higher nitrates and aluminium and lower zinc.

7.2 PROJECT AREA WATER QUALITY

7.2.1 Project Area Water Quality

Surface water samples were taken within the project area on 20 June 2006 and 19 April 2005, and May 2004. Samples were taken nearby in the Frances Creek Catchment in April, November, and December 2005. The samples taken in May 2005 were collected in pre-acidified glass bottles and not filtered. This resulted in excessively high values being recorded for a number of elements, particularly aluminium and iron. The samples taken in June 2006 were collected in plain bottles, filtered at the laboratory, and acidified after filtering where necessary for analysis. The unfiltered results are not applicable to the relevant ANZECC guidelines, but may give an indication of potential problem areas. The May 2004 sample was taken in a non-acidified bottle, but was not filtered before analysis.

All samples were between April and June, which is early dry season. Most watercourses had ceased to flow at the time of sampling so samples were only collected from locations with more permanent flows related to groundwater. Four sampling sites were chosen, shown in Figure 3. No water was present at site 3, so no sample was collected. The May 2004 sample was taken from Pit Gully (Site 1) which was flowing due to rainfall at the time. The four sampling sites were:

1. Pit Gully spring.
2. Pandanus Gully watercourse.
3. East Gully drainage depression.
4. Rainforest Gully watercourse.

Water analysis results are included in Appendix 2

Table 11 summarises the notable results for the filtered samples collected in 2006 and shows relevant water quality guidelines.

In both samples the pH is close to neutral, the water is fresh with a moderate electrical conductivity for the area. Nitrate and nitrite levels are low. The only elements that exceed guidelines are phosphorus, thallium at Site1 and zinc at Site 4, which were slightly in excess of aquatic ecosystem trigger values, but comparable with local district values where carbonaceous shales are present. Zinc was well within both livestock and drinking water guidelines. Arsenic was well below the trigger for freshwater ecosystems, but at Site 1 close to the drinking water limit.

Table 11: Surface Water Quality - Mt Porter Filtered Samples 20 June 2006

Element	Units	Method	ANZECC Drinking water guidelines	ANZECC Aquatic Ecosystems Trigger	ANZECC Livestock Trigger	Site 1 Spring Below Pit	Site 4 Rainforest Creekline
EC	µS/cm	ALK1	-	20-250	-	220	242
pH	-	ALK1	6.5 - 8.5	6.0-7.5	-	7.2	6.7
Turbidity	NTU		-	2-15	-	3	<1
Nitrate & Nitrite	mg/L	FIA_4	50	0.030	400	0.010	0.015
NH3 Nitrogen	mg/L	FIA	(50)	-	(430)	0.01	<0.005
PO4 Phosphorus	mg/L	FIA_4	-	0.01*	-	**0.02**	**0.02**
Aluminium	µg/L	W100M	(200)	55	5000	14.90	2.00
Arsenic	µg/L	W100M	7	24(AsIII)	500	5.40	1.65
Cadmium	µg/L	W100M	2	0.2	10	0.02	0.10
Cobalt	µg/L	W100M	None	1.4 L	1000	0.43	0.38
Chromium	µg/L	W100M	50	3.3 L	1000	<0.1	<0.1
Copper	µg/L	W100M	2000	1.4	500	0.82	0.55
Iron	µg/L	W100M	(300)	-	None	20.0	40.0
Manganese	µg/L	W100M	500	1900	None	59.0	51.2
Nickel	µg/L	W100M	20	11	1000	1.35	1.76
Lead	µg/L	W100M	10	3.4	100	0.05	0.67
Sulphate	mg/L	W108I	500	-	1000	18.3	12.6
Thallium	µg/L	W100M	None	0.03 L	None	**0.05**	0.02
Uranium	µg/L	W100M	20	0.5 L	200	0.36	0.22
Zinc	µg/L	W100M	(3000)	8	20000	3.20	**20.6**

Table Notes:

*guideline for total phosphorus

Guidelines in brackets are aesthetic, not health values.

L indicates low reliability values for metals and radicals.

Numbers in **bold** indicate values exceeding ANZECC trigger values for aquatic ecosystems.

Table 12 summarises the results of water quality analysis of samples taken in April 2005. As these samples were unfiltered, the totals include significant amounts of elements which are not bio-available and the trigger values shown in Table 9 cannot be applied directly to most of these results. The electrical conductivity is somewhat higher than in the 2006 samples at Sites 1 and 4. This may be attributable to very heavy late wet season rainfall in May 2006. The pH is also slightly higher. At Site 1 it is very slightly outside the range of the aquatic ecosystem trigger values, but still near neutral and within the range of observed values at other sites in the Mary River catchment (Table 7).

Table 12: Surface Water Quality - Mt Porter Unfiltered Samples 19 April 2005

Element	Units	Method	Site 1 Spring Below Pit	Site 2 Pandanus Watercourse	Site 4 Rainforest Watercourse
EC	µS/cm	ALK1	330	387	262
pH	-	ALK1	7.6	7.3	6.6
Nitrate & Nitrite	mg/L	FIA_3	0.285	<0.005	0.06
NH_3 Nitrogen	mg/L	FIA	<0.005	0.87	0.09
Aluminium	µg/L	W200I	20800	21000	160
Arsenic	µg/L	W200M	88.5	152	98.5
Cadmium	µg/L	W200M	1.1	1.54	0.12
Cobalt	µg/L	W200I	25	25	10
Chromium	µg/L	W200I	60	40	<20
Copper	µg/L	W200I	90	50	<5
Iron	µg/L	W200I	51500	56500	21500
Manganese	µg/L	W200I	-	3440	-
Nickel	µg/L	W200I	50	40	<10
Lead	µg/L	W200M	375	133	4.33
Sulphate	mg/L	W100I	7	14.8	66.5
Thallium	µg/L	W200M	0.67	0.7	0.06
Uranium	µg/L	W200M	2.81	4.05	0.14
Zinc	µg/L	W200I	580	555	105

Table 13 summarises the results of water quality analysis of the single sample of rainfall runoff taken from pit gully in late 2005. As this sample was unfiltered, the total may include significant amounts of elements which are not bio-available and the trigger values shown in Table 9 cannot be applied directly to most of these results. The electrical conductivity and pH are very similar to the June 2006 samples. It appears that the effect of not filtering is much less in this non-acidified sample than in the acidified dry season samples. Aluminium is much lower than the May 2005 samples, and closer to the filtered values from June 2006. Zinc and thallium concentrations are also very similar to the June 2006 samples, comparable with local district values and just in excess of aquatic ecosystem trigger values.

Table 13: Surface Water Quality - Mt Porter Unfiltered Sample May 2004

Element	Units	Method	Site 1 Pit Gully, flowing.
EC	µS/cm	ALK1	248
pH	-	ALK1	7.1
Aluminium	µg/L	W200M	24.8
Arsenic	µg/L	W200M	3.35
Cadmium	µg/L	W200M	0.02
Cobalt	µg/L	W200M	0.1700
Chromium	µg/L	W200M	0.6
Copper	µg/L	W200M	57.5
Iron	µg/L	W200M	60
Manganese	µg/L	W200M	29.3
Nickel	µg/L	W200M	1.07
Lead	µg/L	W200M	0.3
Thallium	µg/L	W200M	0.05
Uranium	µg/L	W200M	1.97
Zinc	µg/L	W200M	8.6

Overall data from the natural waters indicate that prior to any mining taking place, the 'background' water available to flora and fauna populations:

- Is close to neutral, mainly in the pH range from 6.5 to 7.5.
- Is low in nitrate, but may contain relatively high phosphate for the region.
- Contains moderate levels of arsenic, aluminium, copper, lead, thallium, vanadium and zinc plus significant traces of other metals and sulphate.
- May contain aluminium and iron in colloidal suspension, based on unfiltered sample results.

Arsenic, aluminium, zinc, copper and iron are present in the soil in significant quantities and may be mobilised if acid drainage was to occur.

8. PROJECT IMPACTS

8.1 WATER DIVERSION

The proposed open pit is located high in the landscape within 50 metres of the summit of Mt Porter and will not require diversion of surface water. Runoff from a small catchment of about 7.7 hectares including the pit (4.0 hectares) will be captured by the pit, slightly reducing runoff to the local area.

The Waste Rock Stockpile (WRS) will also be located relatively high in the landscape. The pit will intercept about half the runoff from above the WRS. A small catchment of adjacent hillslopes can be diverted around the WRS. This will involve diversion of runoff from 2.1 hectares to the south of the WRS and a separate diversion of runoff from 5.0 hectares to the north of the WRS (Figure 4).

The WRS will surround a small hill, and runoff from this hill should be directed over the top surface of the WRS to the side diversion drains. The WRS will be designed to be free draining and direct all surface runoff to the sides of the stockpile and away from the Potential Acid Forming material cell in the centre of the stockpile.

At the front face of the WRS, water from the diversion drains needs to descend to rejoin the natural drainage channel. This can be achieved by construction of rock lined drainage channels at the interface of the WRS and the hillside.

Sedimentation basins will need to be constructed downstream of the WRS on each watercourse branch to reduce levels of sediments in runoff from the WRS.

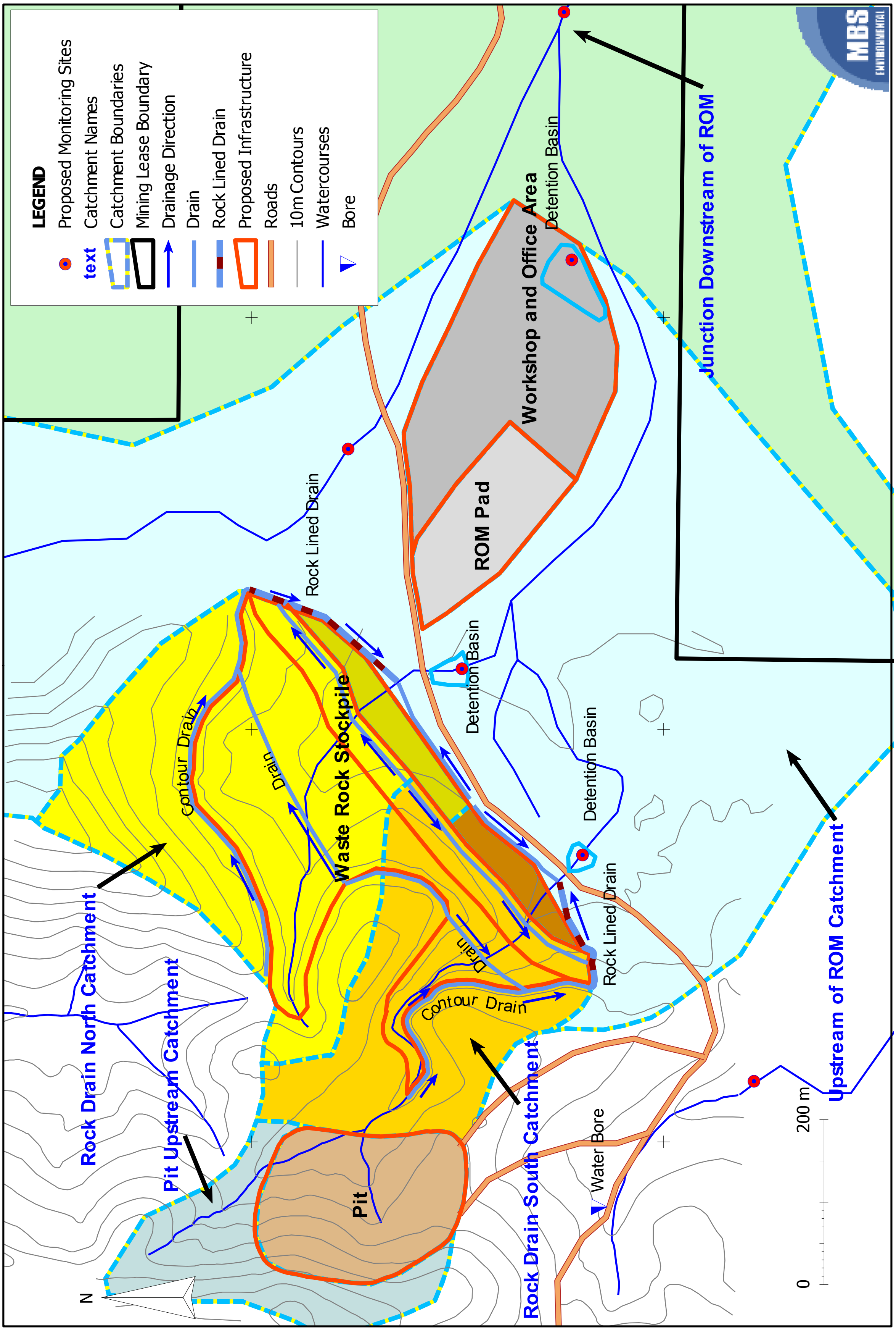
The southern diversion channel can be constructed downstream of the small spring, allowing spring flows to be diverted around the WRS, although it is likely the spring will stop flowing once the pit is excavated.

8.2 RUNOFF FROM DISTURBED AREAS

Haul roads will generate higher runoff than natural surfaces. Road runoff will have elevated levels of sediments. It is recommended that sedimentation basins are constructed on roadside drains to reduce sediment load to water courses.

Until rehabilitation and revegetation are complete, the WRS is likely to generate higher sediment loads than naturally vegetated areas. It is recommended that runoff collection bunds or drains are installed at the toe of the WRS to slow runoff and allow settling of suspended sediments.

Figure 4: Proposed Water Management Measures and Monitoring Locations



The Mt Porter Wastes Characterisation and ARD Management Report (MBS Environmental, November 2006) indicates that leachate from the stockpiles may contain enhanced levels of copper, iron, manganese and zinc, but provision of shallow detention basins downstream of the dumps will be sufficient to allow precipitation of these metals via dilution, aeration, and ferrous iron oxidation to ferric.

The majority of mining will take place during the relatively dry months of May to October. The available climate data shows that while it is probable that little or no runoff will occur during these months, rainfall events of up to 100 millimetres are possible at any time (Section 5). Infrastructure required only during the dry period can be served adequately with diversion structures and sediment basins sized to a 100 millimetre rainfall event. Any infrastructure remaining in October will need to have suitable control measures installed for the upcoming wet season. Infrastructure in place in March to April at the commencement of the project will also require drainage management structures able to cope with major rainfall events, including those associated with tropical cyclones, which can still occur at that time of year.

8.3 DEWATERING

No water quality analysis of pit groundwater has been carried out, but it can be expected to be similar to that from the Pit Gully Spring (monitoring site 1). Water sampled from this site was of generally good quality, and very similar to early wet season rainfall runoff at the same site. The only characteristics of any concern were very slightly elevated thallium, zinc and phosphorus. Although slightly exceeding the ANZECC default trigger values for protection of aquatic ecosystems they are naturally occurring levels in the area and should not be of any environmental concern.

Dewatering quantities have not yet been determined in detail, but it is considered likely the bulk of dewatering will be utilised for dust suppression on site. It is estimated that dewatering in excess of mine water requirements will only be required in the final four to six weeks of the project duration. If a dewatering requirement of double the water use requirement of 500 kilolitres per day was disposed of for the final six weeks, the total discharge would be around 20,000 kilolitres. Any excess would need to be discharged to the watercourses after passing through a detention basin to reduce sediment. Discharges would be required to meet water quality criteria to ensure it will not cause environmental damage.

As all operations will be carried out during the dry season, it is likely any discharges would evaporate or infiltrate into the watercourse within a short distance downstream and may not leave the mineral lease. Local watercourses typically do not start to flow until December, after cessation of mining and dewatering activities. A waste discharge licence will be required to permit discharge, if there is any possibility of discharges leaving the mining lease.

Further investigation of groundwater will be carried out to better define likely dewatering quantities prior to mining.

8.3.1 Pit Stormwater Discharge

As all mining will be carried out during the dry season, stormwater inflow to the pit is expected to be low. Any flow that occurs will be pumped out with dewatering discharge and managed in the same way. Average rainfall to the pit for the mining period totals about 10,000 kilolitres over eight months, this is equivalent to 20 days water requirement for dust suppression. About half of the likely rainfall would occur in November. Average rainfall for November is 116.7 millimetres, this would result in about 4,500 kilolitres of stormwater in the pit, which is about nine days water requirement for dust suppression. The worst case for stormwater would be an extremely wet November, combined with high dewatering requirements. The 90th percentile rainfall for November is 352.2 millimetres, which would result in 45 kilolitres runoff, or 17 days water requirement. If such rainfall occurred it is very likely some discharge of combined stormwater and dewatering from the pit would need to be discharged from the site. Stormwater is expected to be of equal or better quality than groundwater, but may be higher in suspended sediments.

Very heavy rainfall (over 400 millimetres) has occasionally occurred in April, although the 90th percentile runoff for April is only 157.8 millimetres. Contingency plans need to be in place for such rainfall events. It is likely such an event would result in temporary suspension of mining operations due to flooding of access roads.

8.4 PIT VOIDS

The proposed pit extends below the water table and is likely to have a final pit lake. Observation of other open pits in the region indicates it is unlikely the pit lake will overflow and impact on surface waters. Evaporation from the pit may cause cessation of dry season spring flows currently observed in Pit Gully. The area affected will be buried by the waste rock stockpile so the additional impact of reduced dry season streamflow will be insignificant.

9. LICENSING REQUIREMENTS

Use storage, discharge and management of water within the mining tenements is covered by the conditions of the Mining Management Plan under the *NT Mining Management Act 2001,* administered by the Department of Primary Industries, Fisheries and Mines.

If combined dewatering and stormwater quantities are such that there is likely to be discharge from the mining tenements via Nellie Creek tributaries, a waste discharge licence will be required under the sections 74 and 75 of the *NT Water Act*. Such a licence should be applied for following approval of the PER.

10. WATER MANAGEMENT MEASURES

The following water management measures are recommended:

- Any dewatering or surface discharge to the environment should be directed to detention basins to remove sediment prior to discharge.
- Water for dust suppression should be sourced from dewatering in preference to other sources to minimise the requirement for discharge.
- The Waste Rock Stockpile should have shallow detention basins constructed on both gullies to allow settling of sediments and mixing and aeration of runoff and leachate.
- Waste Rock Stockpile should be progressively rehabilitated to reduce the amount of un-vegetated area contributing to runoff at any time.
- Culverts and/or floodways should be installed as required where roads cross watercourses and drains. Water diversion structures will be armoured, where necessary, to reduce the velocity and erosion potential, of surface flows.
- Hydrocarbon storage should be in accordance with Australian Standard *AS1940 Storage and Handling of Flammable and Combustible Liquids*.
- No water discharge outside the mining lease should occur without an approved Waste Discharge Licence. Discharges must meet approved water quality criteria.
- Any dewatering discharge should be monitored and treated if necessary to meet agreed release criteria before release to the environment.
- Post-mining monitoring of surface water quality down stream from the project area should be undertaken for at least 12 months after mine closure. If deemed necessary, further monitoring of surface water will be conducted.
- Water management measures for temporary structures present only between May and October can reasonably designed to cope with a rainfall event of only 100 millimetres. Any infrastructure present in April or after October should include water management structures designed to handle larger rainfall events.

Figure 4 shows suggested locations of diversions, culverts and settlement basins to manage water on the site.

11. WATER MONITORING REQUIREMENTS

Water quality should be monitored up and downstream of impacts. Suggested monitoring locations are shown in Figure 4. Water quality analysis should include elements known to occur at high levels naturally in the area and those likely to be impacted by mining. These would include pH, electrical conductivity, arsenic, nitrate, phosphate, iron, copper, lead, thallium, uranium, vanadium, nickel and zinc. All samples must be filtered prior to any addition of preservatives.

Water in locations likely to require discharge to the environment (dewatering and pit stormwater) should be analysed before release is imminent to ensure discharge requirements will be met.

Quantity of water discharge should be monitored. Flow meters should be installed on dewatering and stormwater discharge pipelines and daily records kept of discharge volumes. Water volumes taken from the dewatering or groundwater for site use should also be monitored.

Frequency of monitoring will be determined by the type and purpose of monitoring. Dewatering and dust suppression water quality should be monitored regularly during operations. As operations will be occurring in the dry season, it is likely there will be little opportunity to monitor stormwater and natural streamflow during operations, but procedures should be developed to allow opportunistic monitoring of any runoff events that occur. Post mining monitoring will involve regular monitoring during the wet season when water is likely to be present.

12. REFERENCES

Armstrong, M., Woinarski, J., Hempel, C., Connors, G. and Beggs, K. (2002). A Plan for the Conservation of Biodiversity in the Mary River Catchment, Northern Territory. Department of Infrastructure, Planning and Environment, Darwin, NT.

Bureau of Meteorology (2003), Annual Average Evaporation Map of Australia. Retrieved 16/07/2006, from http://www.bom.gov.au/climate/map/evaporation/evap_ann.shtml. Last Updated 03/11/2003

Bureau of Meteorology (2006), On-line climate data. Retrieved 23/01/2006 from http://www.bom.com.au.

ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand.

Jenkins, G. A. 2005 AUSIFD Version 2.0.1 Computer Program. URL

http://www.ens.gu.edu.au/eve/research/AusIfd

MBS Environmental (November 2006) Mt Porter Wastes Characterisation and ARD Management. Unpublished report prepared for Arafura Resources NL.

MBS Environmental (May 2006). Frances Creek Project, Northern Territory: Wastes Characterisation. Unpublished report prepared for Territory Iron Limited.

MBS Environmental (August 2006). Frances Creek Project, Northern Territory, Public Environmental Report. Unpublished report prepared for Territory Iron Limited.

Pilgrim, D.H. (1998). Australian Rainfall and Runoff, A Guide to Flood Estimation. Volume 1 (Revised Edition). Institute of Engineers, Australia.

Pilgrim, D.H. (1987). Australian Rainfall and Runoff, A Guide to Flood Estimation. Volume 2. Institute of Engineers, Australia.

Schultz, T. J., Townsend, S. A. and Edwards, C. A. (2002). *Water quality monitoring in the Mary River catchment*. Tech. Report 41/2002. Department of Infrastructure, Planning and Environment, Darwin, NT

Weeks WD, Teakle IA, Gondinoudis S, and Doherty HM (2002), *Alice Springs to Darwin Railway Regional Flood Frequency Assessment*, Hydrology and Water Resources Symposium. Institution of Engineers Australia, Melbourne.

APPENDIX 1
STREAMFLOW CALCULATIONS

Streamflow Calculations

A1. Peak Flow Calculations

Peak flow estimates were made using the regional techniques described in Weeks *et al.* (2002). These methods were developed by statistical analysis from gauged catchments, and used in design of the Alice Springs to Darwin Railway.

For the Katherine area the relationships developed are:

$Q_5 = 6.43A^{0.627}$
$Q_{10}=9.20\ A^{0.63}$
$Q_{20}=10.2A^{0.737}$
$Q_{50}=18.5\ A^{0.657}$

Where Q_Y is the peak discharge in cubic metres for a Y year average recurrence interval rainfall event, and A is the catchment area in square kilometres.

Application of the above equations to catchments in the Mt Porter project area provides the results shown in Table A1.

Table A1: Estimated Peak Flows for Mt Porter Catchments

	Catchment Area (km^2)	5 Year ARI Peak Flow (m^3s^{-1})	10 Year ARI Peak Flow (m^3s^{-1})	20 Year ARI Peak Flow (m^3s^{-1})	50 Year ARI Peak Flow (m^3s^{-1})
Pit Upstream	0.038	0.5	0.7	0.9	2.1
Upstream of ROM	0.734	4.4	6.2	8.1	15.1
Rock Drain North	0.138	1.3	1.8	2.4	4.9
Rock Drain South	0.085	0.9	1.3	1.7	3.6
Total at downstream Junction	2.740	11.7	16.4	21.4	36.2

A2. Volume Calculations

Comparison of the limited available flow records for Frances Creek with nearby gauging stations indicated that monitoring data from station G8180069 on the McKinlay River at Burrundie was the most representative of flows in the Mt Porter area. Estimated annual flow volumes for Frances Creek have been calculated by scaling the statistical data available for McKinlay River at Burrundie by catchment area.

The calculations are a rough approximation; especially as the Mt Porter catchments are a hundred times smaller than the catchment of G8180069. No local data is available for very small catchments however, so the data used is the best available.

The results of these calculations are shown in Table A2.

Table A2: Estimated Annual Flow Volumes for Mt Porter Catchments

	Catchment Area (km^2)	10th Percentile Annual Flow (ML)	Median Annual Flow (ML)	Mean Annual Flow (ML)	90th Percentile Annual Flow (ML)	Maximum Annual Flow (ML)
Pit Upstream	0.038	0.4	2.0	10.2	11.9	22.0
Upstream of ROM	0.734	6.9	39.1	198.7	231.2	428.4
Rock Drain North	0.138	1.3	7.3	37.3	43.5	80.5
Rock Drain South	0.085	0.8	4.5	23.0	26.7	49.5
Total at Watercourse Junction Downstream of ROM	2.740	25.8	145.7	741.4	862.8	1598.6

APPENDIX 2
LABORATORY WATER ANALYSIS RESULTS

WATER QUALITY ANALYSIS PERFORMED MAY 2004 AT PIT GULLY												
IDENT	Job number	Project code	pH	EC	Ag_T	Al_T	As_T	Au_T	B_T	Ba_T	Be_T	Bi_T
UNITS			units	µS/cm	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SCHEME			ALK1	ALK1	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M
POWERADE BOTTLE	EL03509	ICPMS SCANS	7.1	248	<0.05	24.8	3.35	<0.01	14	54.4	<0.05	<0.05

	WATER QUALITY ANALYSIS PERFORMED MAY 2004 AT PIT GULLY													
Br_T	Ca_T	Ca_T	Cd_T	Ce_T	Co_T	Cr_T	Cs_T	Cu_T	Dy_T	Er_T	Eu_T	Fe_T	Ga_T	Gd_T
µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
W200M	W200M	W200I	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M
36	>LWR	18.6	0.02	0.04	0.17	0.6	0.04	57.5	0.01	0.01	<0.01	60	0.01	0.01

		WATER QUALITY ANALYSIS PERFORMED MAY 2004 AT PIT GULLY												
Ge_T	Hf_T	Hg_T	Ho_T	I_T	In_T	La_T	Li_T	Lu_T	Mg_T	Mg_T	Mn_T	Mo_T	Nb_T	Nd_T
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200I	W200M	W200M	W200M	W200M
<0.1	<0.01	0.02	<0.01	5	<0.01	0.03	1.3	<0.01	>LWR	16.4	29.3	0.45	<0.02	0.03

			WATER QUALITY ANALYSIS PERFORMED MAY 2004 AT PIT GULLY											
Ni_T	Os_T	Pb_T	Pd_T	Pr_T	Pt_T	Rb_T	Re_T	Sb_T	Sc_T	Se_T	Sm_T	Sn_T	Sr_T	Ta_T
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M
1.07	<0.1	0.3	<0.05	0.01	<0.01	3.97	<0.05	<0.05	7	0.2	0.01	<0.1	77.7	<0.05

				WATER QUALITY ANALYSIS PERFORMED MAY 2004 AT PIT GULLY								
Tb_T	Te_T	Th_T	Ti_T	Tl_T	Tm_T	U_T	V_T	W_T	Y_T	Yb_T	Zn_T	Zr_T
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M	W200M
<0.01	<0.1	<0.01	4	0.05	<0.01	1.97	1.2	<0.05	0.07	<0.01	8.6	<0.05

WATER QUALITY ANALYSIS PERFORMED APRIL 2005										
IDENT	EC	pH	TDS	Cl	F	NH3_N	NO3_N	SO4_F	Al_T	As_T
UNITS	µS/cm	units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
PANDANA WATERHOLE	387	7.3	280	4.8	0.6	0.865	<0.005	14.8	21	152
PIT GULLY SPRING	330	7.6	240	2.2	0.3	<0.005	0.285	7	20.8	88.5
TS4 SWAMPY MEADOW	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
TS5 RAINFOREST	262	6.6	190	4.7	0.5	0.085	0.06	66.5	0.16	98.5

WATER QUALITY ANALYSIS PERFORMED APRIL 2005											
IDENT	B_T	Ba_T	Be_T	Bi_T	Ca_T	Cd_T	Co_T	Cr_T	Cu_T	Fe_T	K_T
UNITS	mg/L	mg/L	µg/L	µg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PANDANA WATERHOLE	0.04	0.1	2.4	1.7	41.9	1.54	0.025	0.04	0.05	56.5	5.7
PIT GULLY SPRING	0.03	0.075	1.25	0.5	30.3	1.1	0.025	0.06	0.09	51.5	2.4
TS4 SWAMPY MEADOW	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
TS5 RAINFOREST	<0.01	0.08	0.15	<0.05	11.3	0.12	0.01	<0.02	<0.005	21.5	3.1

WATER QUALITY ANALYSIS PERFORMED APRIL 2005											
IDENT	Li_T	Mg_T	Mn_T	Mo_T	Ni_T	P_T	Pb_T	S_T	Se_T	Si_T	Sr_T
UNITS	µg/L	mg/L	mg/L	µg/L	mg/L	mg/L	µg/L	mg/L	µg/L	mg/L	mg/L
PANDANA WATERHOLE	41	29.4	3.44	0.5	0.04	0.4	133	5.86	1	57.7	0.085
PIT GULLY SPRING	30.5	28.5	--	0.45	0.05	0.3	375	2.42	1.2	46.1	0.135
TS4 SWAMPY MEADOW	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
TS5 RAINFOREST	7.1	18	--	0.5	<0.01	0.1	4.33	22	0.4	12.8	0.045

WATER QUALITY ANALYSIS PERFORMED APRIL 2005				
IDENT	Tl_T	U_T	V_T	Zn_T
UNITS	µg/L	µg/L	mg/L	mg/L
PANDANA WATERHOLE	0.7	4.05	0.06	0.555
PIT GULLY SPRING	0.67	2.81	0.18	0.58
TS4 SWAMPY MEADOW	L.N.R.	L.N.R.	L.N.R.	L.N.R.
TS5 RAINFOREST	0.06	0.142	<0.01	0.105

WATER QUALITY ANALYSIS PERFORMED JUNE 2006																
IDENT	Job number	Project code	pH	EC	Alkalinity	CO3	HCO3	OH	Turbidity	TSS	TDS	NO2_N	NO2	NO3_N	NO3
UNITS			units	µS/cm	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SCHEME			ALK1	ALK1	ALK1	ALK1	ALK1	ALK1	TURB	TSSTDS	TSSTDS	FIA_4	FIA_4	FIA_4	FIA_4
M1 SPRING	EL06064	WATER SAM	7.2	220	94	<1	94	<1	3	<10	180	<0.005	<0.02	0.01	0.04
M4 RAINFOREST	EL06064	WATER SAM	6.7	242	110	<1	110	<1	<1	<10	190	<0.005	<0.02	0.015	0.08

WATER QUALITY ANALYSIS PERFORMED JUNE 2006																	
Cl	PO4_P	NH3_N	F	Ca_F	K_F	Mg_F	Na_F	SO4_F	SiO2	Al_F	As_F	B_F	Ba_F	Be_F	Bi_F	Cd_F	Co_F
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
FIA_4	FIA_4	FIA	FISE1	W108I	W108I	W108I	W108I	W108I	W108I	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M
1.3	0.02	0.005	0.3	14.7	1.2	13.8	12.1	18.3	43.8	14.9	5.4	11	42.2	<0.05	<0.05	0.02	0.43
2.3	0.015	<0.005	0.2	16.3	2.2	17.5	10.7	12.6	45.6	2	1.65	12	57.2	<0.05	<0.05	0.1	0.38

WATER QUALITY ANALYSIS PERFORMED JUNE 2006															
Cr_F	Cu_F	Fe_F	Li_F	Mn_F	Mo_F	Ni_F	Pb_F	Sb_F	Se_F	Sr_F	Th_F	Tl_F	U_F	V_F	Zn_F
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M	W100M
<0.1	0.82	20	2.1	59	0.4	1.35	0.05	<0.05	0.4	57.2	<0.01	0.05	0.357	1.3	3.2
<0.1	0.55	40	4.7	51.2	0.25	1.76	0.67	0.05	0.2	49.8	<0.01	0.02	0.222	0.6	20.6