

TOMS GULLY WDL APPLICATION

Justification Document Attachment 1

Prepared for:

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Primary Gold (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
680.30163-R01-v1.0	27 September 2022	Emmanuelle Aliotti	Jill Woodworth	Jill Woodworth

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) were engaged by Primary Gold Ltd (PGO) to provide environmental services support for the application of a Waste Discharge Licence (WDL) to reduce the water level in the Toms Gully Pit.

Toms Gully Pit is located within the Toms Gully Project Area (MLN1058, ML29812 and ML29814) currently operated in a care and maintenance programme by PGO under authorisation 0740-01. Toms Gully Pit and all other existing mine infrastructure resides on MLN 1058. Active pastoral activities such as cattle grazing, track maintenance and clearing continuously occur around the mineral leases including Mount Bunday Creek.

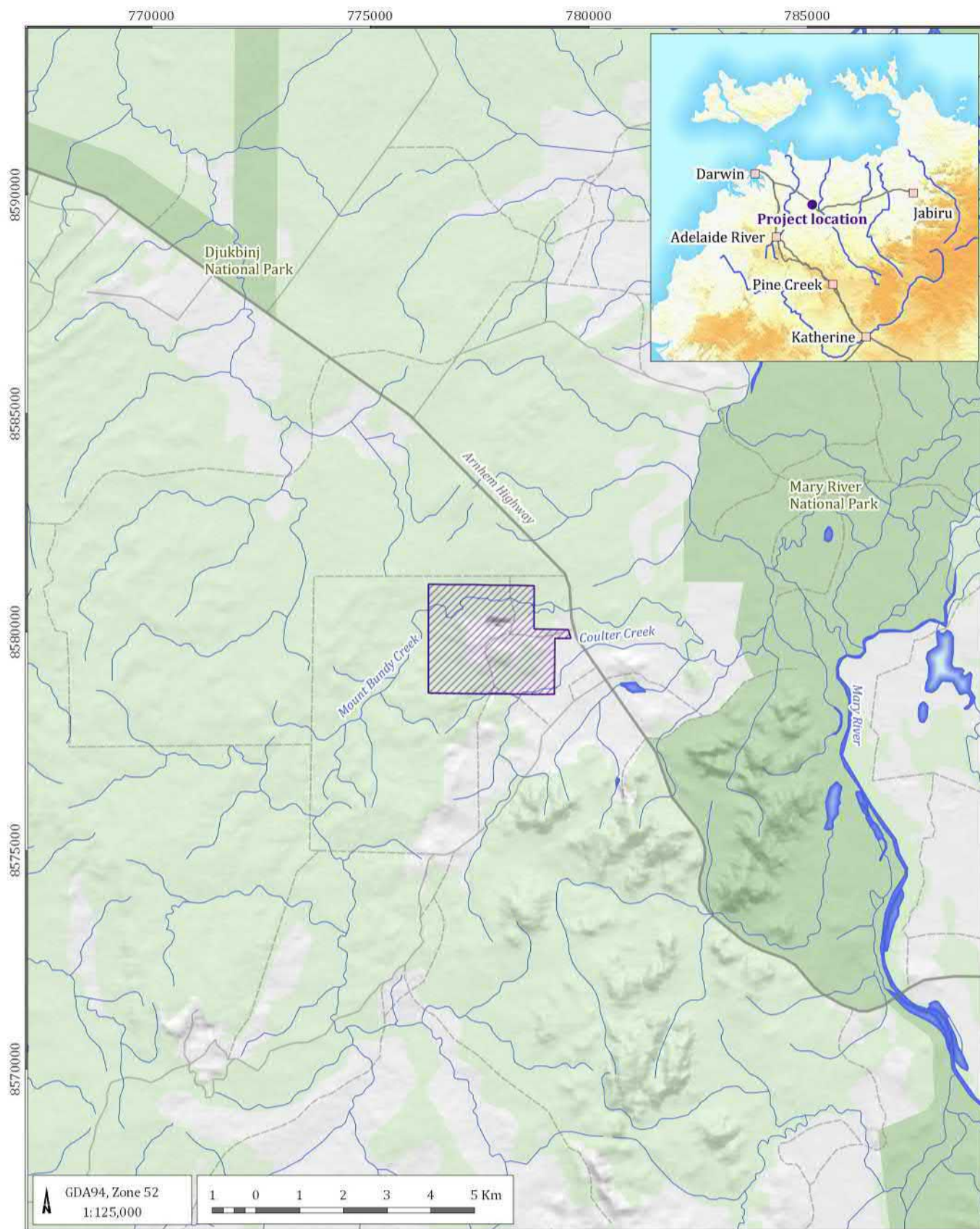
Toms Gully Pit is nearing its maximum capacity and PGO is concerned that, if appropriate mitigation measures to reduce the volume of pit water are not implemented, there is a risk of the pit overtopping in the 2022/23 wet season. PGO is planning to reduce the water level in the Toms Gully Pit to prevent overtopping occurring and will require a Waste Discharge Licence (WDL) to manage and regulate the discharge to the receiving environment. PGO propose to discharge reverse osmosis (RO) treated water from the Toms Gully Pit to Mount Bunday Creek during the 2022/23 and 2023/24 wet seasons. This report provides supporting documentation for the WDL application of the Toms Gully Pit treated water discharge (dewatering project) and is set up in Sections to provide information requested in the NT EPA Water Act *Application for a Waste Discharge Licence* Pursuant to Section 74 of the *Water Act 1992*. Sections not covered in this report are provided with the application form and other documentation accompanying this application.

1.1 Project Description

The TGO Project is located on the Old Mount Bunday Station (PPL 1163, NT Portion 4937), approximately 90 km south-east of Darwin (**Figure 1**). The mine site is located within the Mount Bunday and Coulter Creek catchments, both part of the broader Mary River Catchment. The mine site consists of Mining Leases MLN 1058, ML29812 and ML29814. Open cut mining commenced in 1988 establishing most of the existing mine features and later progressing to underground operations under various owner and operators. Since November 2010 the site has been in a care and maintenance phase.

Toms Gully Pit and all other existing mining infrastructure resides on MLN 1058. Toms Gully Pit has been utilised as a repository to store poor quality water from other onsite mine features since 2013 including capturing runoff from adjacent landforms, pits and dams to prevent uncontrolled discharge during wet season months. Surface water quality data from Toms Gully Pit and onsite and offsite downstream monitoring sites is shown in **Table 1**. To re-commence mining at Toms Gully, PGO propose to control the discharge of treated water from the Open Pit to Mount Bunday Creek, during wet season creek flows. Currently the pit is at or near capacity and PGO intend to drop the water level in the pit to create a 1 to 3m freeboard to avoid overtopping in the 2022/23 Wet Season. This will require 130 ML to 390 ML of pit water to be removed from the pit. However, to take into account rainfall and catchment runoff to the pit, approximately double this amount will need to be removed, up to ~800 ML. To ensure that the poor quality of the pit water does not adversely impact the receiving environment, PGO propose to only discharge RO treated water to the environment.

Whilst this activity is part of a two-year water management strategy to prevent overtopping, PGO intend to invest in an ongoing sustainable water management programme for Mount Bunday operations.



LEGEND

- Road
- - - Track
- Drainage
- ▨ MLN1058
- Water area
- Reserve
- Vegetation

Toms Gully - Mine Inflows Update (G1743B)

Project location



DATE
10/06/2019

FIGURE No:
1

Figure 1: Project location

1.2 Toms Gully Pit

The Toms Gully Pit comprises of a surface area of 9 ha with a catchment area of 34.65 ha. The pit has a depth of 88 m and the current volume is 4,700 ML. PGO propose to discharge approximately 800 ML of the RO treated pit water during 2022/23 Wet Season. PGO may also need to discharge the RO treated pit water during the 2023/24 Wet Season depending on the water level in the pit and the rainfall occurring in the 2022/23 Wet Season. PGO propose to discharge RO treated pit water to Mount Bunday Creek via the Oxbow Wetland.

1.2.1 Pit Quality

As shown in **Table 1**, the water quality in the pit has low pH and elevated EC when compared to the wetland oxbow and the Mount Bunday Creek downstream site formerly used as the compliance site. The pit also has elevated sulfate and dissolved metals when compared to the oxbow exit (SWTG12) and the downstream site (SWTG2). Cadmium, zinc and copper exceed the (ANZG 2018) 95% species protection default guideline values at the Mount Bunday Creek downstream site (SWTG2). As the level of the water in the pit is proposed to be lowered, the risk of the poor quality pit water entering the environment will be reduced.

Table 1 Current Pit and Downstream Quality (2016-2022)

Analyte	TG Pit n=12		Oxbow exit (SWTG12) n=22		Downstream (SWTG2) n=31		ANZG 95% GV _s
	Median	Range	Median	Range	Median	Range	
pH	3.3	2.8-3.8	4.3	3.5-6.2	6.3	4.6-7.5	6-9
EC (µS/cm)	2,127	2,274 - 2,429	268	109-553	50	11-385	250
SS (mg/L)	<5	<5-20	5	<5-30	24	9-74	-
Turbidity (NTU)	0.65	0.3-19	1	0.3-95	25	1.7-840	-
Major ions (mg/L)							
Calcium	200	130-211	14	6.6-49	2.6	0.5-30	-
Potassium	7.8	5.4-8.3	3.2	1.6-5.5	1.4	0.6-4.1	-
Sodium	21	13-22	3	0.7-8.9	2.9	0.6-9.4	-
Magnesium	145	96-161	14	4.2-8.9	1.9	0.7-20	-
Sulfate	1,300	800-1,420	100	3-1,400	8	1-175	-
Chloride	6	5-10	2	1-100	3	<1-11	-
Metals (µg/L)							
Aluminium	20,000	18,000- 24,000	1,300	132-5,300	70	<10-6,400	-
Arsenic	5	3-21	4	2-140	<1	<1-120	13
Cadmium	51	36-68	4.2	0.1-13	0.4	<0.1-8.3	0.2
Cobalt	265	190-313	57	0.26-180	1	<1-53	13
Chromium	1	1-2	<1	<1-2	<1	<1-1	1

Analyte	TG Pit n=12		Oxbow exit (SWTG12) n=22		Downstream (SWTG2) n=31		ANZG 95% GV _s
	Median	Range	Median	Range	Median	Range	
Copper	210	180-279	28	3.1-130	5	<1-36	1.4
Iron	1,350	930-2,700	160	30-1,200	178	6-810	300
Lead	7	6-7.4	1.5	<1-0.4	<1	<1	3.4
Manganese	11,000	800-12,000	1,200	12-5,400	74	1-3,620	1,900
Nickel	1,100	4 ^a -1,320	110	1-260	4	<1-96	11
Uranium	28	18-34	<0.5	<0.5-12	<0.5	<0.5	-
Zinc	6,350	4,800-7,620	610	25-1,300	28	<1-367	8.0
^a Suspected error in spreadsheet							

1.2.2 RO Treatment, Quality and Management

The RO treatment involves pre-treatment of the pit water to remove aluminium where the pH of the pit water will be raised to pH 9 in tanks. The pH will then be reduced to 7-7.5 prior to being treated through the RO filters. Metals, magnesium and sulfate will be removed with reductions up to 99%. The quality of the concentrate and permeate (discharge) are shown in **Table 2**. The ion concentrations shown in **Table 2** have been modelled and provided by the RO manufacturer and the metal concentrations have been calculated based on the efficiency of the RO process. PGO expect that the discharge water will meet the ANZG (2018) 95% default guidelines and SSTVs at the outfall of the Oxbow Wetlands (STG12). PGO will analyse the permeate to validate the concentrations listed in **Table 2** and confirm the metal concentrations prior to discharge to the Oxbow Wetland.

Table 2 RO Water Chemistry and upstream chemistry (2016-20)

Ions (mg/L)	Raw water	pH adjusted water	Concentrate	Discharge (Permeate)	Upstream SWTG1a Median (range) n=20
Na	273	273	900	3.9	2.9 (0.7-6.6)
Ca	210	210	693	3.0	1.5 (0.5-2.4)
Mg	160	160	528	2.3	1.2 (0.25 -2.0)
K	8.0	8.0	26	0.1	1.4 (0.7-3.3)
Ba	BDL	BDL	BDL	BDL	-
Sr	BDL	BDL	BDL	BDL	-
NH ₄	BDL	BDL	BDL	BDL	-
Cl	300	300	990	4.3	2.3
CO ₃	BDL	BDL	BDL	BDL	BDL
HCO ₃	6.9	6.9	23	0.1	-

Ions (mg/L)	Raw water	pH adjusted water	Concentrate	Discharge (Permeate)	Upstream SWTG1a Median (range) n=20
F	BDL	BDL	BDL	BDL	-
NO ₃	BDL	BDL	BDL	BDL	-
SO ₄	1,300	1,300	4,290	19	1 (0.5-3)
SiO ₂	BDL	BDL	BDL	BDL	-
CO ₂	44	44	44	44	-
B	BDL	BDL	BDL	BDL	-
TDS	2,258	2,258	7,450	33	-
pH	5.5	5.5	6.0	4.3	6.7 (6.3-7.2)
EC (µS/cm)	-	-	-	-	36 (11-70)
Turbidity (NTU)	-	-	-	-	74 (6-310)
TSS (mg/L)	-	-	-	-	44 (8-140)
Dissolved metals (µg/L)¹					
Al	20,000	-	-	200	147 (20-720)
As	5	-	-	0.05	1.0 (0.65-3)
Cd	51	-	-	0.51	BDL (BDL-0.2)
Co	265	-	-	2.65	BDL (BDL-0.22)
Cr	1	-	-	0.01	BDL (BDL-0.4)
Cu	210	-	-	2.1	1.0 (BDL – 11)
Fe	1,350	-	-	14	285 (164-550)
Pb	7	-	-	0.07	BDL (BDL-3.1)
Mn	11,000	-	-	110	BDL (BDL – 39)
Ni	1,100	-	-	11	BDL (BDL – 4.0)
Zn	6,350	-	-	64	7.0 (BDL – 120)
BDL = below detection limits					
¹ Raw water based on median concentrations from TG Pit Table 1					
Metal permeate concentration based on Qdais and Moussa (2004). Average of 99% metals removal					

1.2.2.1 Discharge Regime

The RO plant will treat the pit water 24 hours per day and discharge directly to the Oxbow Wetland once the Northern Rainfall Onset commences (when 50 mm of rainfall or greater is recorded at site) and flow through to Mount Bunday Creek. PGO propose to discharge the treated water throughout the Wet Season at between 13 - 100 L/sec until the end of the wet season. As discussed in Steele (2019) the abrupt cessation of flows into Mount Bunday Creek will cause changes to aquatic assemblages over time and that natural flow-related cues should be used to allow a stepped approach to ceasing discharge (**Attachment F**). PGO will reduce the discharge volume slowly over time at the end of the wet season to mimic natural cessation of creek flows. This process will assist with maintaining natural cues for aquatic populations.

PGO is proposing to discharge the RO treated water at maximum of 100 L/sec. This will result in 8.64 ML/day being discharged to the Oxbow Wetland. At the maximum discharge rate, up to 800 ML can be discharged over 93 days. However, the volume and daily rate of discharge can be modified if required. During periods of no or low flow in Mount Bunday Creek, the treated water will be stored on site until the flow is sufficient for discharge.

Modelling conducted by GHD (2019) (**Attachment A**) for treated water discharges from 150 ML/month to 450 ML/month showed that these discharges could occur throughout the Wet Season only and no discharges needed to be conducted during the Dry Season. GHD (2019) stated that the discharges modelled were simulated to cease by June. The modelling conducted by GHD (2019) was conservative as it factored in the dilution of the discharge water in Mount Bunday Creek. As PGO will be discharging RO treated water with similar characteristics to the upstream water quality, no dilution factors will need to be taken into account.

1.2.2.2 Waste stream - Concentrate

PGO is aware that the RO process does create a waste stream of poor water quality, in this case, the waste will consist of ions and metals. The RO waste stream (Concentrate) will be returned to the pit via a pipe discharging on the western side of the pit, approximately 20 m below the surface, at the deepest part of the pit. **Table 2** shows the water chemistry of the raw water, pH adjusted water, concentrate and discharge water.

1.2.3 Oxbow Wetlands

The Oxbow Wetland has a relatively large catchment size and is designed to passively overflow into Mount Bunday Creek through the weir shown in **Figure 2**. Mount Bunday Creek also often backflushes into the Oxbow Wetlands during peak flows. Currently the Oxbow Wetlands receives runoff from around the mine site and acts to improve water quality through adsorption and precipitation of metals by wetland filtration.

Figure 2 Oxbow Wetlands weir gate



There is a water quality monitoring location (SWTG12) at the site where the Oxbow Wetlands discharges prior to entering Mount Bunday Creek. The median values for Oxbow Wetland discharge water from April 2016 to March 2022 are above the ANZG (2018) guideline values for dissolved cadmium, cobalt, copper, nickel and zinc (**Table 1**). By discharging the RO treated pit water to the Oxbow Wetland, it is considered that the water quality leaving the wetland will improve as concentrations of contaminants should reduce.

There is also a sediment monitoring site (MBC01A) that is downstream of the Oxbow Wetland and Toms Gully Mine Tailings Dam 2 (TSF2) that will detect impacts to sediment quality from the mine site and the Oxbow Wetland. **Table 3** shows that the sediment results sampled from monitoring site directly downstream from the Oxbow Wetland were below the ANZG (2018) sediment quality guidelines (SGV). However, the sediment at the far downstream site (SWTG2) recorded an arsenic concentration above the low-SGV that was not related to the upstream concentrations. Cobalt, copper, nickel and zinc were also elevated at the far downstream site when compared to the site downstream of the Oxbow Wetland. The downstream elevated concentrations may be due to remobilisation of sediments by cattle accessing the creek, and the construction of a pastoral track crossing.

Table 3 Mount Bunday Creek Sediment Results 2022

Analyte (mg/kg)	MBC01A	SWTG2	SGV- Low	SGV- High
TOC (%)	1.3	0.3	-	-
Metals (1M HCl extractable)				
Aluminium	680	400	-	-
Arsenic	<4	45	20	70
Cadmium	<0.5	<0.5	1.5	10
Cobalt	3.2	7.1	-	-
Chromium	1	<1	80	370
Copper	4	6	65	270

Analyte (mg/kg)	MBC01A	SWG2	SGV- Low	SGV- High
Iron	2,000	1,500	-	-
Lead	11	5	50	220
Manganese	200	200	-	-
Nickel	1	4	21	52
Zinc	7	26	200	410
TOC = total organic carbon				

2 Section 4: Previous Waste Discharge Licences

PGO has no previous WDL for the Toms Gully Mine. PGO has a current WDL for the Rustlers Roost Project area located upstream of the Toms Gully Mine site. Crocodile Gold held a WDL for Toms Gully in 2010; however, that WDL was for discharge from the evaporation ponds under a dilution method and not for discharge of treated water from the pit. **Table 4** shows the historical WDLs applied to the site (GHD 2015).

Table 4 Historical Waste Discharge Licences

Licence ID	Period	Discharge Locations	Compliance Point and Values	Details
131	12/12/2005 – 31/11/2007	Release Site 1 Evaporation pond discharge (Open Pit water).	Not detailed.	Discharge flow to be $\geq 1:100$ of Mount Bunday Creek.
		Release Site 2 Artificial wetland retention water (oxide waste dump runoff) discharge.		Mount Bunday Creek flow to be ≥ 3.8 m ³ /s. Gauging station height at SWTG2 to be ≥ 1.06 m.
-	2008 and 2009 Wet Season	Release Site 1 Evaporation pond discharge (Open Pit water).	SWTG2 ANZECC 80% Guideline Values (Crocodile Gold, 2009).	Crocodile Gold was granted an extension to Licence No. 131 and undertook sampling in accordance with the licence requirements (Crocodile Gold, 2009).
		Release Site 2 Artificial wetland retention water (oxide waste dump runoff) discharge.		
131-01	01/02/2013 – 31/08/2014	SWTG12 Concrete weir at wetland oxbow overflow point.	SWTG2 ANZECC 80% Guideline Values (NT EPA, 2013)	Draft licence issued based on treatment prior to discharge from site restricted to SWTG12 and compliance with ANZECC 80% at SWTG2.
*Annual Monitoring Report, Toms Gully Mine Waste Discharge License No. 131: 2008-2009 Wet Season. October 2009. *NT EPA Draft Waste Discharge License No. 131-01, Commencement Date February 2013 to 31 August 2014. 2013.				

3 Section 6: Location of Premises

3.1 Site Maps

The following figures provide the location and site boundaries of the Toms Gully Mine site:

- **Figure 3** shows the mine's tenements, site layout and water quality monitoring points.
- **Figure 4** shows Toms Gully catchments, and watercourses.
- **Figure 5** shows the Toms Gully water management layout.
- **Figure 6** shows the surrounding land use.
- **Figure 7** shows the proposed location of the RO plant, discharge path and discharge location into the Oxbow Wetlands.

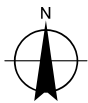
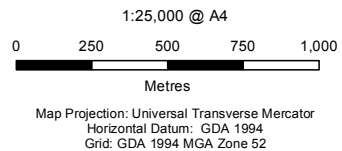
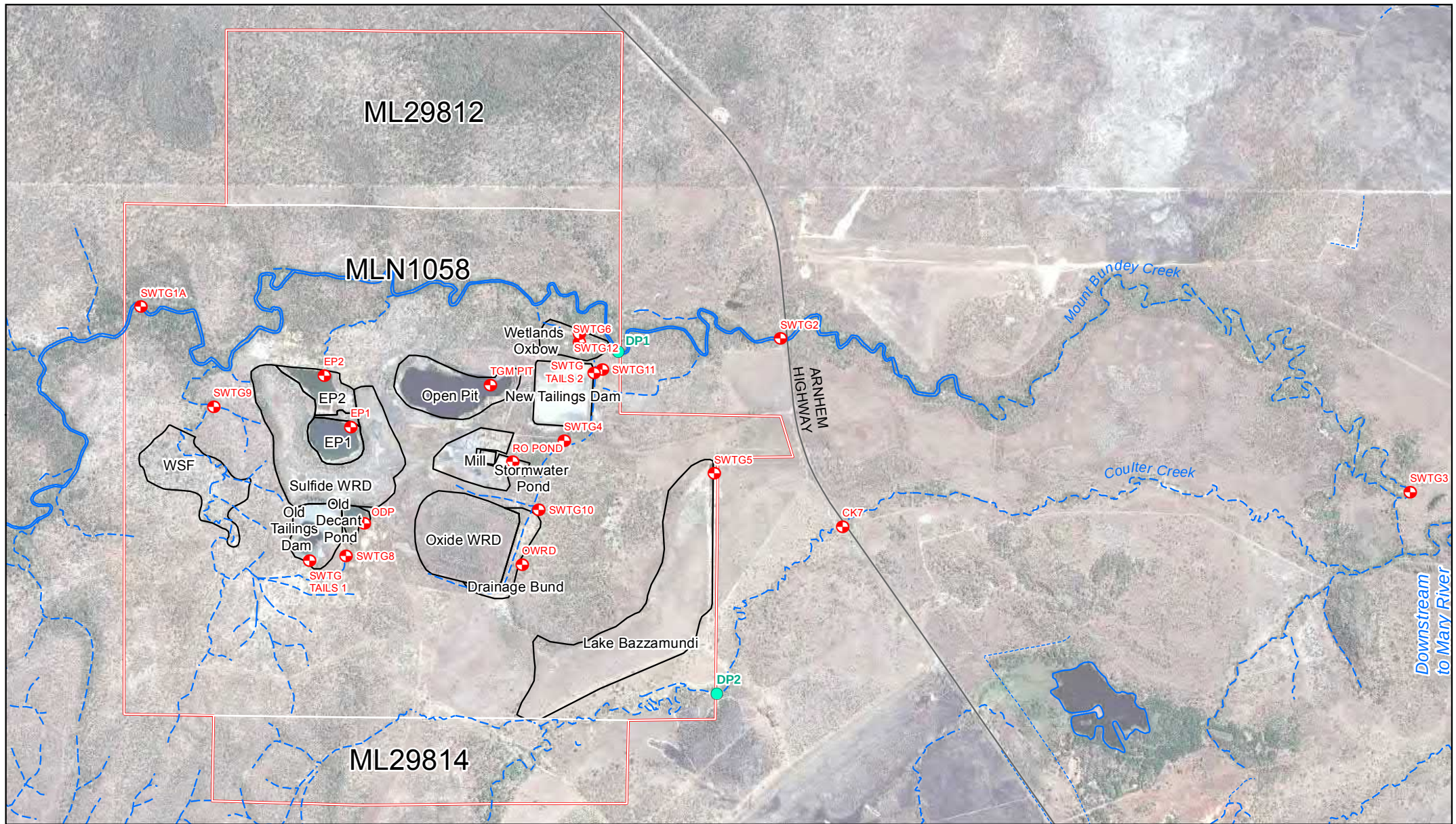
3.1.1 Surrounding Land Use

The area surrounding the Toms Gully site is pastoral with cattle accessing all waterways and the mine site. Therefore, any sensitive aquatic ecosystems will be severely compromised due to the impacts from cattle and feral pests. The NT Government¹ states that feral cattle cause the following damage to the environment:

- Land degradation by trampling
- Soil compaction and erosion
- Increased nutrient loading
- Spreading of weeds
- Sedimentation of waterways

Even though the NT Government has stated that feral cattle create these environmental issues, domestic cattle will also have the same impacts to unfenced areas as discussed in Yapp *et al.* (2001). Anecdotal evidence from the trained water quality samplers at Toms Gully has indicated that the Mount Bunday Creek site (SWG2) is severely influenced by cattle access. In addition to the influence of cattle, the pastoral lease holder has installed access tracks traversing Mount Bunday Creek near to SWG2 which were built with waste rocks from the Toms Gully Mine site.

¹ <https://nt.gov.au/environment/animals/feral-animals/feral-cattle>



LEGEND

- Discharge Points
- Surface Water Sampling Locations
- Mine Site Layout
- Site Boundary

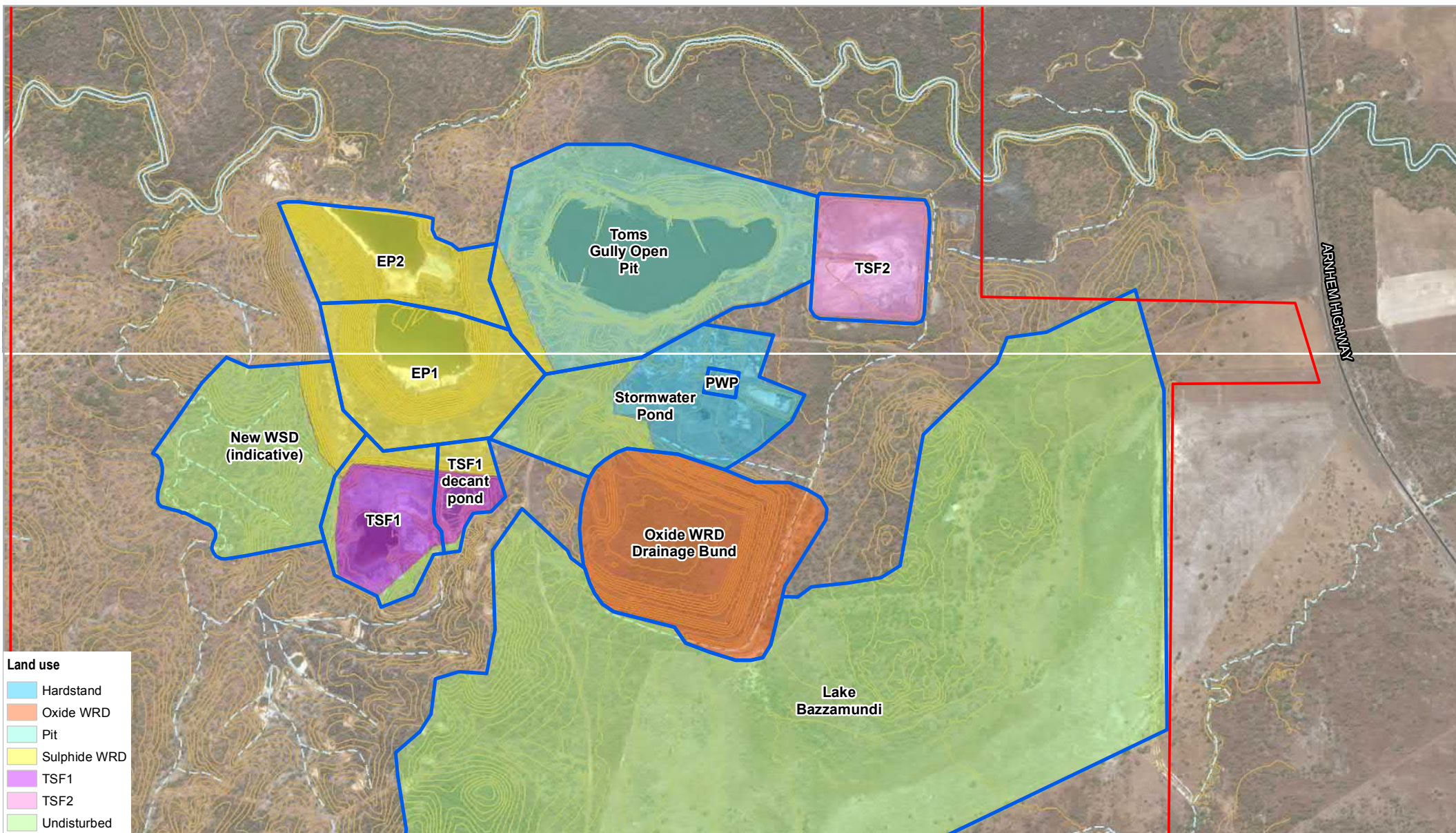


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Toms Gully WMP

Job Number | 4322295
Revision | B
Date | 27 Aug 2015

Figure 3: Surface Water Sampling Locations



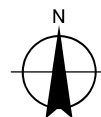
Legend

- Site Boundary
- Water Body Perennial
- Watercourse Intermittent
- Roads

- 2m contours
- Surface water catchments

Paper Size ISO A4
0 100 200 300 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



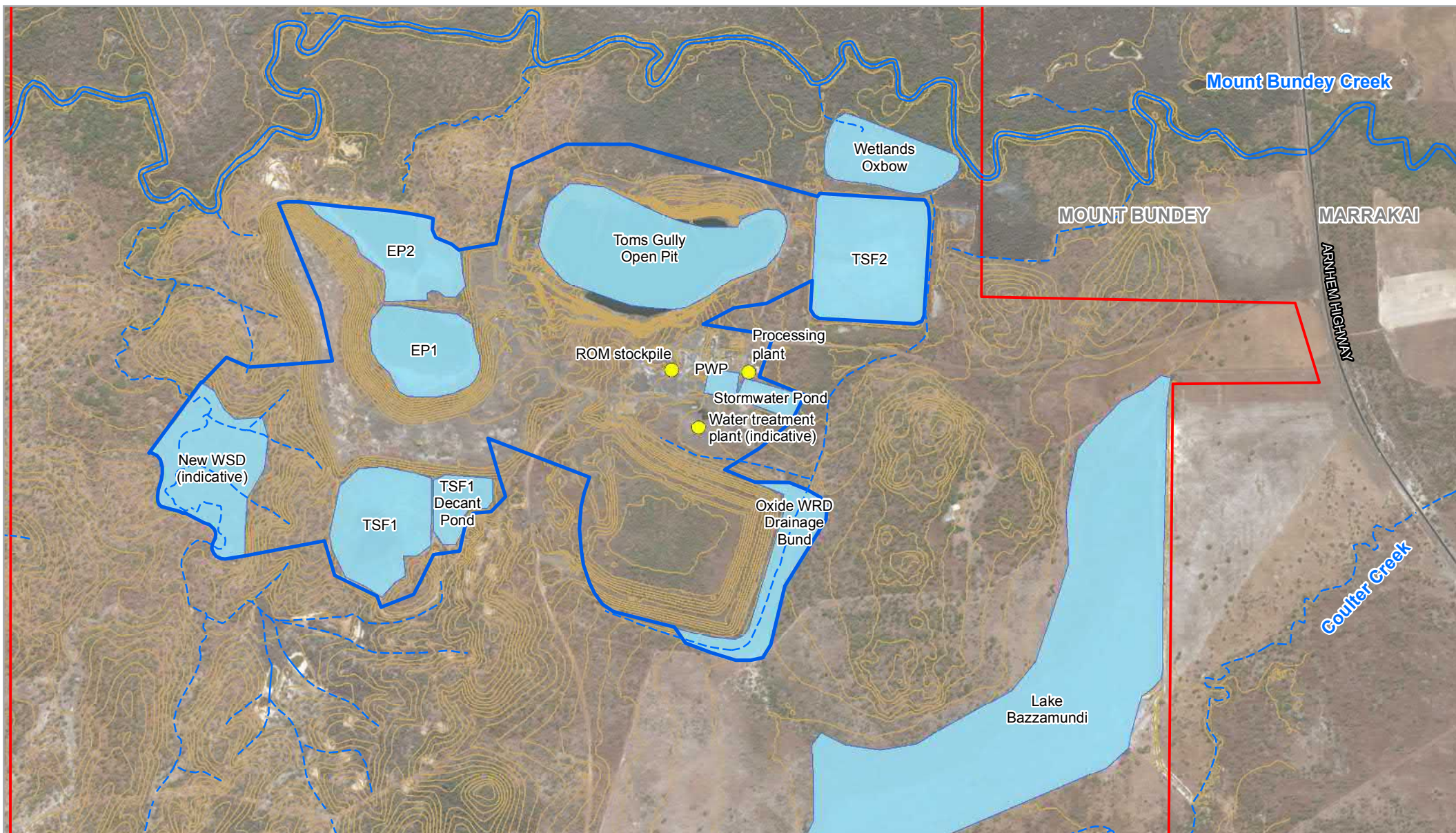
Primary Gold Ltd.
Toms Gully Gold Project
Site Water Balance

Project No. 4322623
Revision No. 1
Date 29 Jun 2018

Catchments and watercourses

FIGURE 4

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: kpsroba



Legend

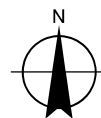
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SUB_CLASS

- Water Body Perennial
- - - Watercourse Intermittent

- 2m contours
- Study catchment
- Site feature
- Water storage

Paper Size ISO A4
0 100 200 300 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



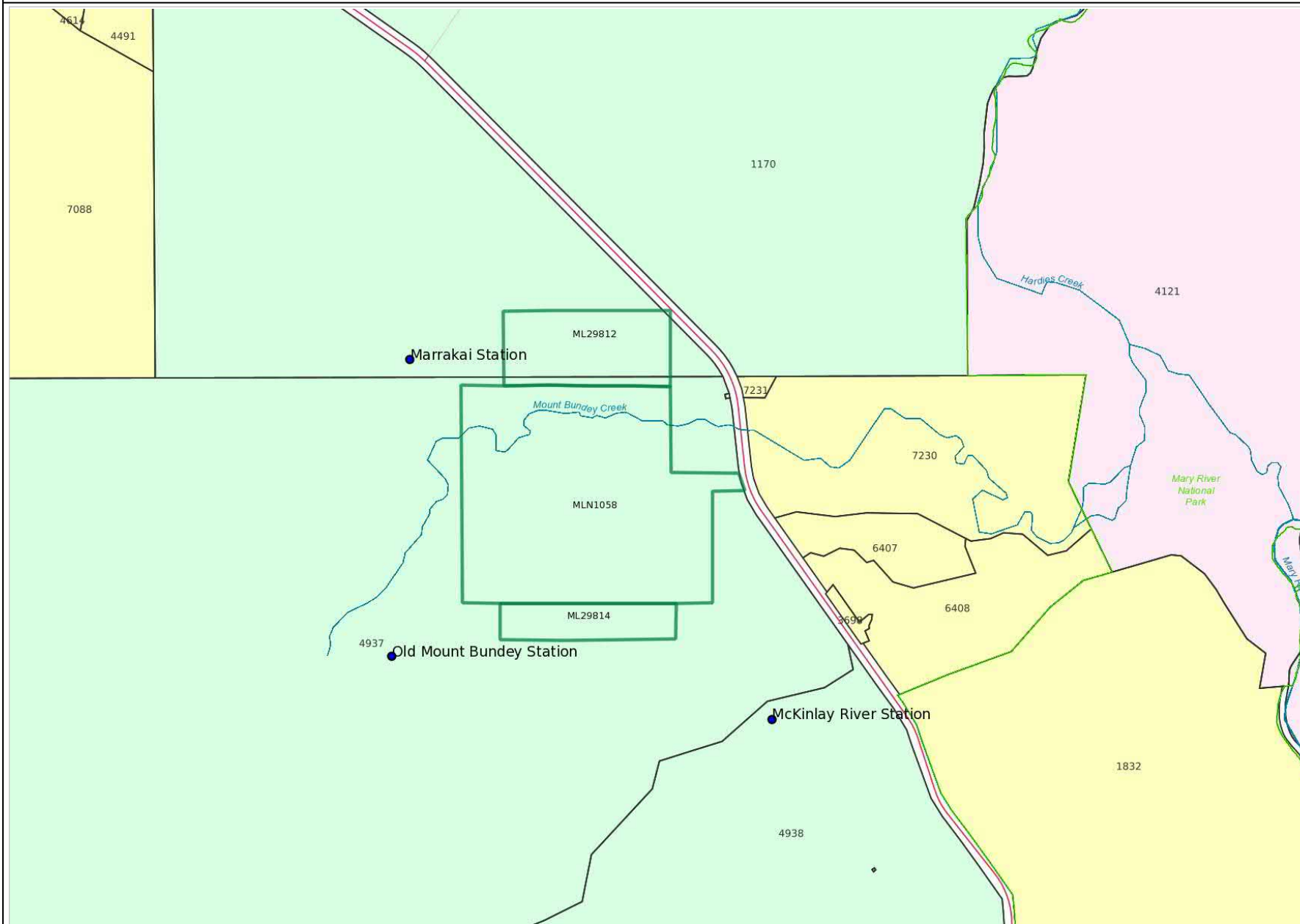
Primary Gold Ltd.
Toms Gully Gold Project
Site Water Balance

Project No. 4322623
Revision No. 1
Date 29 Jun 2018

Water management layout

FIGURE 5

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: kpsroba



LEGEND TENURE TYPES

PGO Mineral Titles Granted



Freehold



Perpetual Pastoral Lease



Crown Lease Perpetual
(Mary River National Park)



Metres 1,000 2,000

nrmmaps.nt.gov.au

Geospatial Services Branch



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Department of Environment,
Parks and Water Security
© Northern Territory Government

Figure 7 Discharge and flow path



4 Section 8: Activity

The management of the discharge of RO treated pit water is described in Section 1.2.2.

4.1 Receiving Environment Monitoring

The receiving environment will be monitored following the Water Management Plan (WMP) (**Attachment B**) monitoring program, pre-discharge, during discharge and post discharge. The WMP has been developed to obtain a greater understanding of potential impacts to the surrounding environment. In addition to a water quality monitoring program PGO carries out an aquatic macroinvertebrate, fish and sediment monitoring program annually. The 2022 reports showed that despite exceedances in some water quality parameters, macroinvertebrate community health metrics showed very little difference between sites upstream and downstream on Mount Bunday Creek. The report of the 2022 ecological survey is provided as **Attachment C**.

5 Section 10: Mixing zone

5.1 Mixing Zone

CSIRO (2018) states that “an appropriate treatment before discharge will mean that the 90 or 95% species protection values could be achieved in Mount Bunday Creek and discharges can occur without the need for a mixing zone.” As shown in **Table 2**, the discharge quality for some analytes meets the ANZG (2018) 95% species protection guideline value (DGV); therefore, no mixing zone will be required as the 95% species protection guidelines are met at the end of pipe. However, for any analytes above the 95% DGVs and SSTVs at the end of pipe, PGO expect these analytes will meet the 95% DGV and SSTVs at SWTG12 prior to entering Mount Bunday Creek. In this case the Oxbow Wetland will act as the mixing zone.

6 Section 11: Supporting Documentation

Table 5 shows the locations of the supporting documents required to support the WDL Application.

Table 5 Supporting documents

Document	Location
Water Balance (2019)	Attachment A
Water Management Plan (2019)	Attachment B
Aquatic Ecology Study Report (2022)	Attachment C
NT EPA Environmental Impact Assessment Approval (2020)	Attachment D
Mine Management Plan 2013	Attachment E
Aquatic Ecology Technical Memorandum (2019)	Attachment F
WDL Justification Document	This document
Improvement Plan	Section 6.2 of this document
Discharge specifications	Section 2.2.2 of this document
Beneficial Uses	Attachment G
Stakeholder consultation	Attachment H
Emergency Response Plan	Attachment I
Environmental aspects and impacts register	Attachment J
Conceptual Site Model	Figure 10 of this document
CSIRO SSTV Review	Attachment K
Mining Authorisation	Attachment L
Land owner Authorisation	Attachment M

6.1 Environmental Impact Assessment and Environmental Approval

NT EPA Assessment Report 91 was issued on 21 February 2020 based on submission by PGO of the following documentation:

- Notice of Intent
- Draft Environmental Impact Statement (EIS)
- Supplement to the EIS (August 2018)
- Addendum to the Supplement to the EIS (July 2019)
- Further Information (January 2020)

6.2 Water Improvement Plan

As discussed in the CSIRO (2019) report, water treatment will enable the 95% species protection level to be met within Mount Bunday Creek. By using RO treatment, PGO will discharge treated water of a quality similar to background quality with low EC and ionic concentrations. PGO consider that the discharge of this high-quality treated water will improve the water quality within Mount Bunday Creek.

6.3 Monitoring Plan

Section 5 of the Water Management Plan (**Attachment B**) contains the monitoring plan for the Toms Gully Mine site and surrounding waterways. The plan provides the sample locations, monitoring frequency and analytes with site specific trigger values (SSTVs) derived by CSIRO (2019).

6.3.1 Compliance Point Monitoring

The compliance point is proposed to be SWTG2 in Mount Bunday Creek to the west of the Arnhem Highway Crossing. However, previous sampling at the site had shown that the site had inherent safety issues. A telemetry station has been set up to overcome these issues and provide real time data and collects hourly field parameters that include electrical conductivity (EC), pH, turbidity and dissolved oxygen (refer to **Figure 8**). By monitoring EC and pH in real time, any potential variations from the SSTV can be immediately identified and any action required can be implemented. Water quality of concern that can be identified by real time monitoring is the presence of low pH which may result in metals becoming more bioavailable, or elevated EC indicating that the RO treatment may not be optimized. Increases in turbidity in Mount Bunday Creek can be related to cattle activity and rainfall in the catchment, therefore, turbidity should not have a SSTV associated with it (Smith *et al.* 2020).

Figure 8 Telemetry at Compliance Point



6.3.2 Discharge monitoring

In 2021 PGO installed a Xylem YSI at the designated compliance sites and the Aqua Troll data logger installed at the end of pipe to record continuous EC and flow (m^3) measurements during discharge events (**Figure 9**) for the Rustlers Roost WDL 247 pit water discharge

Figure 9 Data logger in discharge pipe (Rustlers Roost WDL 247 Project infrastructure)



6.3.3 Site Specific Trigger Values

CSIRO (**Attachment K**) calculated SSTVs based on the ANZG (2018) water quality guidelines 90% species protection guidelines and the 80th percentile of the Mount Bunday Creek upstream monitoring site (SWTG1A). The application of a SSTV is used to compare with the median results of the compliance point (ANZG 2018). As shown in **Table 6** the Mount Bunday Creek upstream water quality varies considerably and comparing the SSTVs with a single compliance water quality sample will result in exceedances at least 20% of the time.

Table 6 Mount Bunday Creek SSTVs

Analyte	SSTV ¹	Comments/Recommendations for this WDL
pH	5.8-8.0	The real time monitoring will enable changes in pH to be identified rapidly. Recommendation: Maintain
EC (µS/cm)	41	Having a low number for EC does not take into account the increase of EC as the water flows through the creek system. As the distance between SWTG1A (upstream control site) and compliance point SWTG2 (downstream of mine site) is approximately 5 km, it would expected that the EC would increase with distance as surface water runoff will increase the dissolved ions in the creek. Smith et al. (2020) discuss the spatial variation in temporary waterways and, in this case an EC concentration is recommended to better recognize the water quality at SWTG2. Given that the maximum EC measured at SWTG2 was 385 µS/cm and the discharge of RO treated water will lower the EC downstream of the discharge point, a recommended SSTV for SWTG2 would be the ANZG (2018) default guideline of 250 µS/cm. Recommendation: 250 µS/cm
Turbidity (NTU)	87	Smith et al. (2020) discuss the problematic nature of applying guidelines to turbidity as many causes of turbidity are out of the control of the mine site eg. Access by cattle and other hard footed pests. Upstream turbidity has been recorded as high as 310 NTU (Table 2). Recommendation: Remove SSTV for turbidity
TSS (mg/L)	54	As above, similar responses for TSS Recommendation: Remove SSTV for TSS.
Total cyanide (mg/L)	0.018	ANZG (2018) 80% species protection Recommendation: Maintain
Sulfate (mg/L)	210	Recommendation: Maintain
Ammonia (pH 8) (mg/L)	1.4	Recommendation: Maintain
Dissolved metals (µg/L)		
Aluminium	295	Recommendation: Maintain
Arsenic (total)	42	Recommendation: Maintain
Cadmium	0.4	Recommendation: Maintain
Chromium	6.0	Recommendation: Maintain
Copper	1.8	Recommendation: Maintain
Iron	2,700	Recommendation: Maintain
Lead	5.6	Recommendation: Maintain
Manganese	2,500	Recommendation: Maintain
Molybdenum	34	PGO does not have data for this analyte, it is not expected to be present in the treated RO discharge. Low reliability guideline (ANZG 2018) Recommendation: Remove
Nickel	13	Recommendation: Maintain
Zinc	15	Recommendation: Maintain

Analyte	SSTV ¹	Comments/Recommendations for this WDL
¹ WMP Attachment B EC = Electrical conductivity TSS = Total suspended solids		

6.3.4 Exceedances of SSTVs

Currently, WDLs generally include the following Conditions to identify non-compliances:

- Exceedance of a trigger value on three consecutive sampling occasions or;
- Exceedance of three times or more the concentration of a trigger value;
- The licensee must notify the Administering Agency of any non-compliance as soon as practicable after becoming aware of the non-compliance.

Using real time water quality monitoring provides a more accurate indication of water quality within the creek and if a decreasing trend in pH or an increasing trend in EC is observed, management actions can be implemented according to the actions listed in the trigger action response plan (TARP).

This TARP is designed as a tool to monitor risks from the discharge of the RO treated water from the Toms Gully mine site and provide responses that are able to be implemented rapidly and result in effect management of the issue. Triggers have been developed for each of the risks associated with the treatment and discharge of treated Toms Gully Pit water not already covered within the Water Management Plan (**Attachment B**) and to initiate investigations into unexpected impacts.

Table 7 Trigger Action Response Plan for active discharge of treated pit water

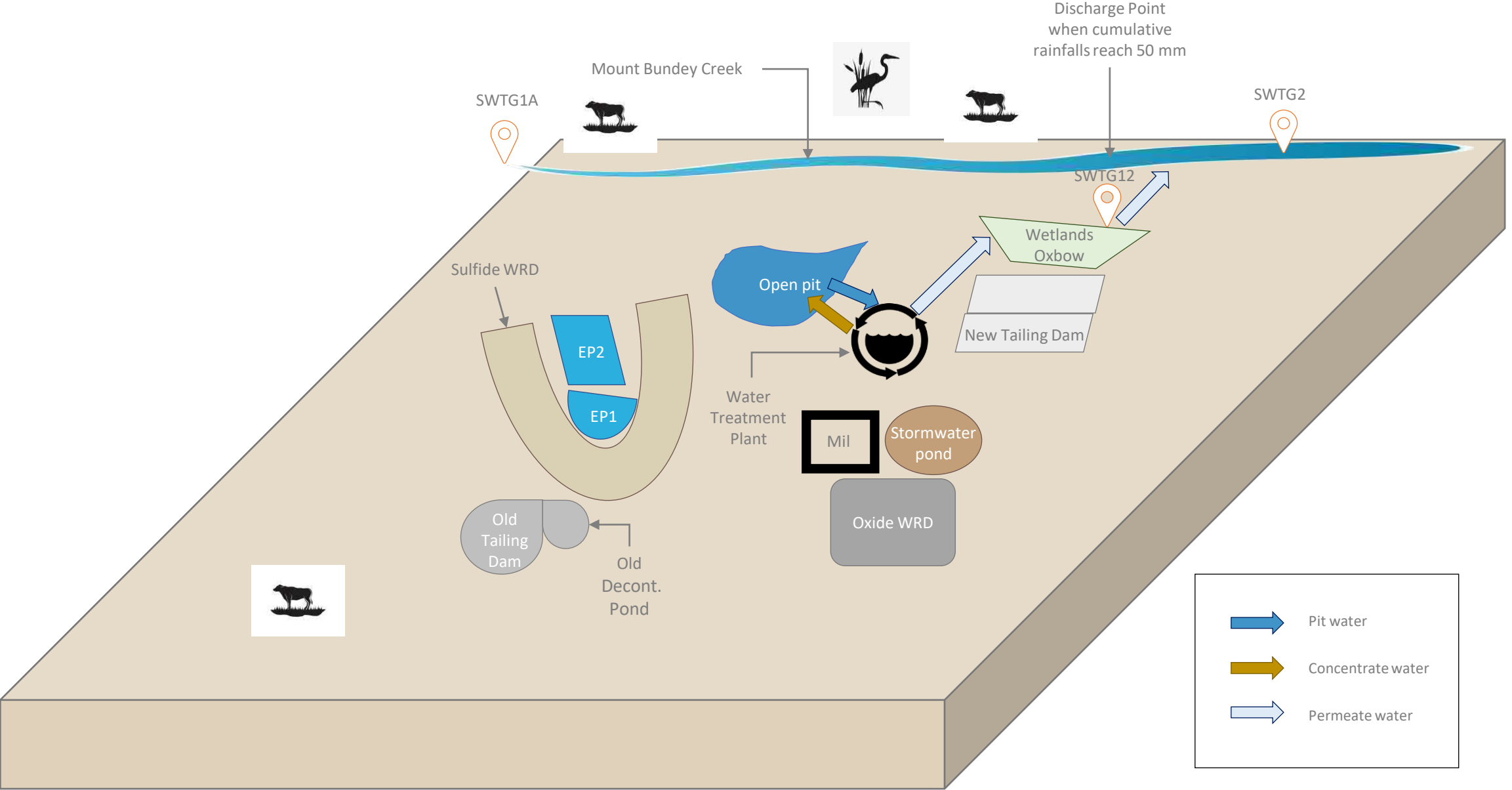
Description	Monitoring	Trigger	Response
Ineffective water treatment	Monitoring occurs in the discharge pipe and at SWTG6, SWTG12 and SWTG2	Increasing trend in EC and decreasing trend in pH at SWTG2 and/or discharge pipe. Exceedance EC or pH of SSTV at SWTG2 (14 day rolling average)	Optimisation of water treatment. Options to be considered include the feed water total dissolved solids, operating pressure, temperature and recovery ratio and any other factors influencing RO processes.
Variable water treatment results	Monitoring occurs in the discharge pipe and at SWTG6, SWTG12 and SWTG2	Increasing trend in EC and decreasing trend in pH at SWTG2 and/or discharge pipe. Exceedance EC or pH of SSTV at SWTG2 (14 day rolling average) and other SSTVs	Optimisation of water treatment. Optimisation of water treatment. Options to be considered include the feed water total dissolved solids, operating pressure, temperature and recovery ratio and any other factors influencing RO processes or activities on site and upstream of TGPA.

Description	Monitoring	Trigger	Response
Chemical changes to treated water upon discharge into the Oxbow Wetlands resulting in increased water toxicity	Monitoring occurs in the discharge pipe and at SWTG6, SWTG12 and SWTG2GA	Changes in pH, redox, dissolved oxygen, and quasi conservative tracers between the Oxbow Wetlands (SWTG12) and SWTG2	Increased or decreased analyte mobility, toxicity or concentration (not accounted for by other means) between the discharge monitoring locations and the compliance point will be investigated through rigorous chemical assessment and necessary adjustments to discharge practices introduced into SOPs.
Heightened sensitivity of ecosystem components compared to those used to derive DGVs, or the presence of toxic compounds that are not monitored	Macroinvertebrate sampling, and observations made during sample collection	Significant differences between upstream and downstream sampling locations indicating deterioration in core ecosystem functions, combined with no evidence of SSTV exceedances or confounding influences at the compliance point.	Undertake direct toxicity tests on receiving environment water quality with and without the contribution of treated water. Adjust discharge rate to ensure ecosystem protection.
The influence of uncontrolled or passive discharge is underestimated	Monitoring throughout the mine site, especially at SWTG2	Exceedances of SSTVs at SWTG2 that cannot be associated with treated water discharge which may include isolated spills and the liberation of toxicants from sediments or natural events, pastoral activities affecting land surfaces.	Management practices for active discharge to the Oxbow Wetlands will be reviewed and updated to reduce the volume or toxicity of the water leaving site via passive discharge from the Oxbow Wetlands.

The risks listed above are based on the sources, pathways and receptors described in the conceptual site model (CSM) (**Figure 10**). The CSM has been designed to identify the key environmental risks posed by the site and inform management strategies for these risks. The management strategies detailed in **Table 7** above, are designed to be, specific, measurable, attainable, relevant and timely (SMART) such that they can be implemented and reviewed as part of the site's environmental management system (EMS).

6.4 Conceptual Site Model

The CSM, **Figure 10**, shows the site's potential environmental influences and the proposed monitoring sites to determine compliance with the guideline values listed in **Table 6**.



-  Pit water
-  Concentrate water
-  Permeate water

7 References

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Attachment A:

Water Balance



Primary Gold Ltd

Toms Gully EIS - Baseline Studies Site water balance

July 2019

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1. Introduction

1.1 Background

Toms Gully mine, located near Mount Bunday in the Northern Territory, first commenced operations in 1988. The Toms Gully resource was discovered in 1986 by the Carpentaria Exploration Company. Following its discovery the project area has been operating intermittently under the ownership of several different operators, most recently Crocodile Gold, until 2010. Then, after a period of care and maintenance, it was divested to Primary Gold Ltd (Primary Gold). Operating conditions at Toms Gully Mine have been subject to obligations outlined in the Public Environmental Review (PER) and associated documents that were released in 1988 and a series of waste discharge licences (WDLs). Primary Gold Limited, the new lease owner, proposes to recommence underground mining and ore processing at the Toms Gully Mine (the project).

The NT EPA determined that the project required assessment under the Environmental Assessment Act at the level of an Environmental Impact Statement (EIS). A draft EIS document was lodged with the NT EPA in 2015.

Primary Gold engaged GHD Pty Ltd (GHD) to prepare a site water balance for the purpose of updating the 2015 water balance from the EIS to support the EIS Supplement (SEIS). In December 2018, subsequently Primary Gold submitted a Section 14A amendment under the NT Environmental Assessment Administrative Procedures, notifying the NT EPA of proposed changes to mine layout and orebody access at Toms Gully.

The consolidated amendment proposal includes:

- Placement of all existing and future tailings into the Toms Gully mine void.
- Placement of all future waste rock from the boxcut, decline and development drives into the Tom's Gully mine void; unless it is inert oxide in which case beneficially reuse it as capping material on the oxide and sulfide waste rock dumps.
- Alternate access to the underground ore body via a new boxcut of approximately two hectares in area and a new decline.
- Retaining a mine pillar of approximately 100 m thickness between the proposed underground mine and the existing workings to negate the need to dewater the existing pit in its entirety.
- Construction of a new water storage dam (New WSD).
- Refurbishment and upgrade of the processing circuit.
- Establish a water treatment plant.

The water balance used in the SEIS has been further updated to reflect more recent data and studies, including further groundwater modelling and geochemical baseline and conceptual site model updated (GHD 2019). Where there is an absence of detailed site information, the site water balance draws on the previously prepared *Toms Gully Underground Project: Water Balance Model* (Coffey 2015).

1.2 Purpose of this report

The purpose of this report is to update the site water balance for the Toms Gully mine consistent with the revised mine plan within the Section 14A lodged with the NT Government in December 2018.

The site water balance has been analysed using a site water balance model. This report describes input data, the model methodology and presents and interprets the results of the model.

1.3 Scope

The scope of the work GHD were commissioned was to develop a site water balance model to estimate the response of the water management system in response to the current operational and climatic conditions. The site water balance also includes a coupled acidity mass balance, for the purpose of estimating the relative risk of acidic conditions forming in surface water storages.

2. Water management

2.1 Overview

Toms Gully mine is located within the Mount Bunday Creek catchment. The land surface comprises a series of small ridges and dissected hills drained by small stream channels which flow north into Mount Bunday Creek. Mount Bunday Creek flows through the northern portion of the project site from west to east, about 300 m north of Toms Gully open pit, before discharging into Hardies creek, approximately 7 km east of the project area. Coulter Creek is a tributary of Mount Bunday Creek which flows through the south-eastern corner of the project area discharging to Mount Bunday Creek about 5 km downstream of the project area. All of the creeks and drainage lines on, or surrounding the site, are ephemeral and only flow during the wet season after rainfall events. Surface elevation reaches 51 m Australian Height Datum (AHD) in the south-west corner of the mining lease and falls to 16 m AHD in the low-lying areas.

The inflows to Toms Gully mine are:

- Direct rainfall and catchment runoff.
- Groundwater inflows.
- Run-of-mine (ROM) ore moisture.

The outflows from Toms Gully mine are:

- Evaporation and seepage losses from surface storages.
- Off-site discharges or potential supply of treated water to third party (as identified in the Section 14A application).
- Losses from dust suppression.

The key water features at Toms Gully mine are shown in Figure 2-1. Toms Gully mine includes an open pit, a processing plant, two waste rock dumps (WRD) and two tailings storage facilities (TSF). The open pit (Toms Gully Open Pit) is currently filling with water and Primary Gold proposes to dewater the pit as waste rock and tailings are progressively emplaced. As part of the management of the water that would need to be removed from Toms Gully Open Pit, Primary Gold propose to construct a new offline water storage dam (New WSD) on the western side of the site and a water treatment plant. Primary Gold proposes to transfer, potentially following processing, tailings from the existing TSF1 and TSF2 and emplace them in the open pit.

Water for the processing plant can be supplied by the existing turkey's-nest style Process Water Pond. Runoff from the processing plant area and ROM pad reports to the Stormwater Pond. The sulfide WRD to the north west of the site encloses a pair of cascading storages known as Evaporation Pond 1 (EP1) and Evaporation Pond 2 (EP2). The oxide WRD to the south east of the site is skirted on the east by a drainage bund.

Overflows from the Stormwater Pond and oxide WRD drainage bund report to an area known as the Wetland Oxbow before entering Mount Bunday Creek. As no active management (by pumping) of the Wetland Oxbow is proposed, it is not considered within the site water balance.

Discharge of treated water is proposed to Lake Bazzamundi, a shallow water storage formed by an embankment through part of the flood plain of Coulter Creek. The New WSD is expected to be available to store treated water in order to manage the timing of discharges.

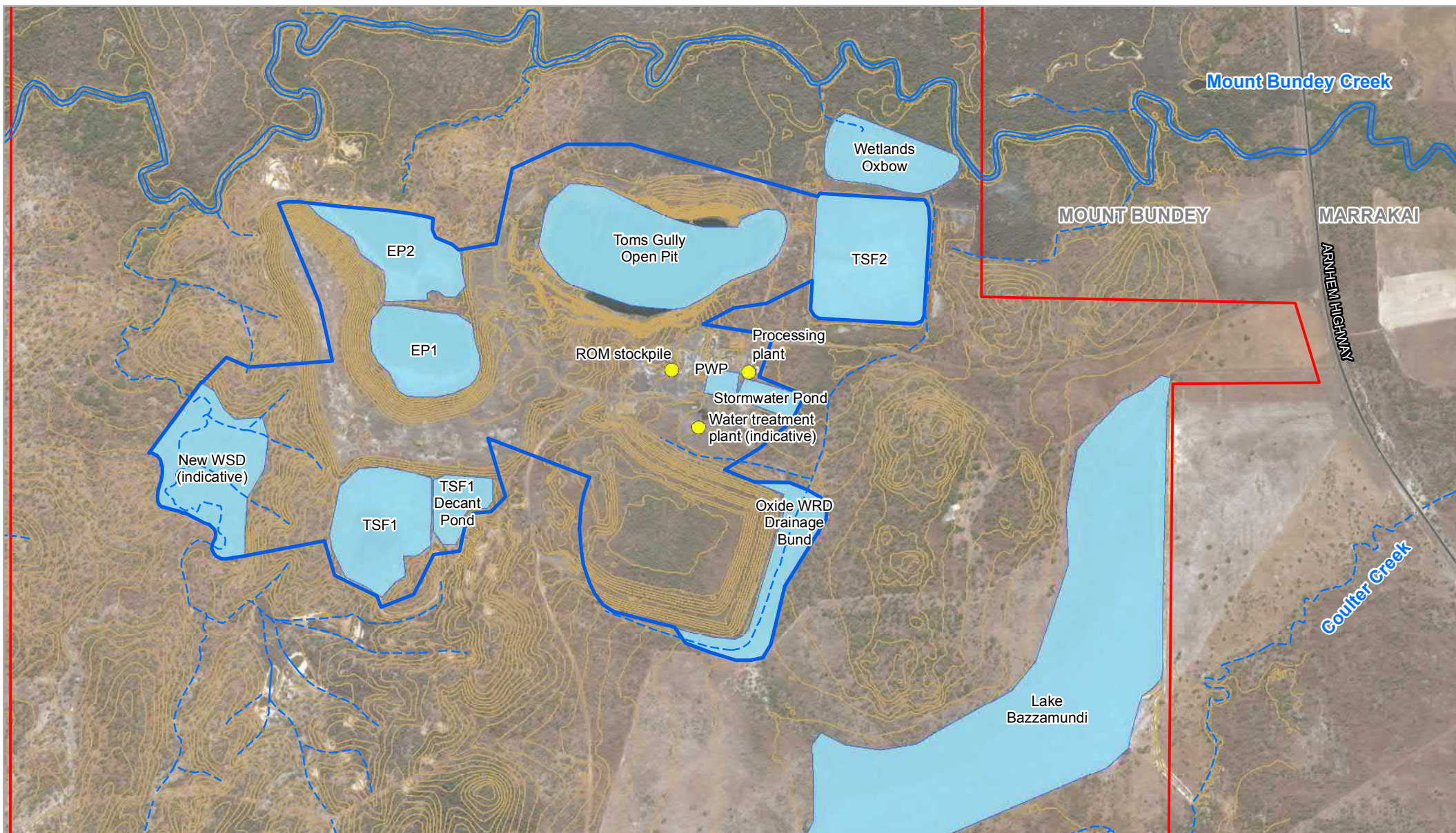
2.2 Water management features

The water management system at Toms Gully mine was conceptualised as a network of water management features representing surface water storages, operational processes and receiving waters. Each water management feature was defined by its connection to other water management features by inflows and outflows of water. The water management features considered are summarised in Table 2-1. The site water features are shown spatially in Figure 2-1 and site water management is summarised schematically in Figure 2-2. The downstream confluence of Mount Bunday Creek and Coulter Creek is outside of the model extent and therefore not shown in Figure 2-1 or Figure 2-2.

Table 2-1 Water management features

Feature	Inflows	Outflows
Evaporation Pond 1 (EP1)	Direct rainfall and catchment runoff	Evaporation and seepage losses Dewater to Pit <i>Overflow to EP2[#]</i>
Evaporation Pond 2 (EP2)	Direct rainfall and catchment runoff <i>Overflow from EP1[#]</i>	Evaporation and seepage losses Pump to Process Water Pond Dewater to Pit <i>Overflow to Mount Bunday Creek[#]</i>
Oxide WRD drainage bund	Direct rainfall and catchment runoff	Evaporation and seepage losses Dewater to Pit Overflow to wetland Oxbow
Process Water Pond (PWP)	Direct rainfall and catchment runoff Pump from Pit	Evaporation and seepage losses Use in processing plant <i>Overflow to Mount Bunday Creek[#]</i>
Processing plant	Supply from PWP ROM ore moisture	Tailings moisture (bleed water and retained in tailings)
TSF1 (including decant pond)	Direct rainfall and catchment runoff Bleed water from tailings	Evaporation and seepage losses Dewater to Pit <i>Overflow to Mount Bunday Creek[#]</i>
TSF2	Direct rainfall and catchment runoff Bleed water from tailings	Evaporation and seepage losses Decant to Pit Dewater to New WSD via WTP <i>Overflow to Mount Bunday Creek[#]</i>
New Water Storage Dam (New WSD - once constructed)	Direct rainfall and catchment runoff Pump from WTP	Evaporation and seepage losses Discharge to Lake Bazzamundi Creek Dust suppression <i>Overflow to Mount Bunday Creek[#]</i>
Stormwater pond	Direct rainfall and catchment runoff	Evaporation and seepage losses Dewater to Pit Overflow to wetland Oxbow
Toms Gully Open Pit	Direct rainfall and catchment runoff	Evaporation Dewater to New WSD (via WTP) <i>Overflow to Mount Bunday Creek[#]</i>
WTP	Pump from Pit Underground dewatering	Pump to New WSD Discharge to Lake Bazzamundi

[#] indicates that, although considered hydrologically possible for the purpose of completeness, such overflows are unlikely given the inherent geometry and hydrology of these water storages.



Legend

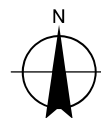
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- - - Watercourse Intermittent

- 2m contours
- Study catchment
- Site feature
- Water storage

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Metres

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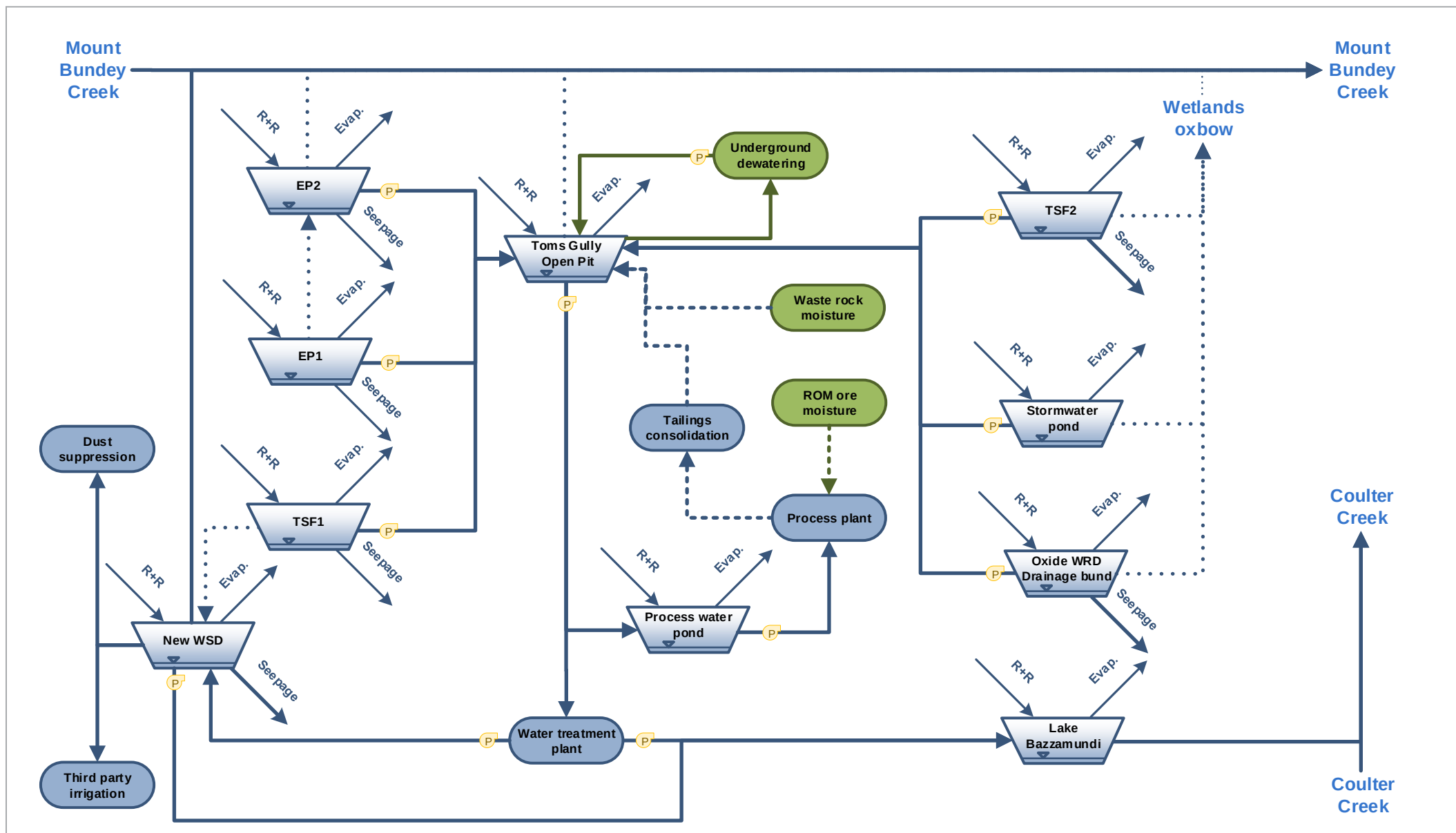
Primary Gold Ltd.
Toms Gully Gold Project
Site Water Balance

Project No. 4322623
Revision No. 1
Date 29 Jun 2018

Water management layout

FIGURE 2-1

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: kpsroba



Legend

	Surface process		Surface water flow
	Underground process		Groundwater flow
	Surface storage		Entrained moisture
	Pump		Overflow path



Primary Gold Ltd
Toms Gully Gold Project
Site water balance

Project No. 4322623
Revision No. 5
Date 05/07/2019

Water management schematic

FIGURE 2-2

Created by: Tyler Tinkler

2.3 Discharges from Lake Bazzamundi

Flooding modelling was undertaken as part of the EIS Baseline Studies (GHD 2019a). The results of the flood modelling shows that Lake Bazzamundi overflows only into Coulter Creek (within the mining lease boundary). Given the small capacity of Lake Bazzamundi compared to its catchment area, Lake Bazzamundi is expected to overflow into Coulter Creek in any flood condition and is effectively part of the Coulter Creek floodplain.

3. Data

The development of the water balance for Toms Gully mine involved the collation and interpretation of data from various sources. The purpose of this section is to summarise the data used. The sources of data used are shown in Table 3-1.

Table 3-1 Summary of data sources

Data	Source
Historical rainfall and evaporation record	SILO (DSITI, 2017)
Catchment areas and land use	Develop from aerial imagery and site contours provided by Primary Gold
Storages	Coffey (2015)
Groundwater	Coffey (2015)
Operations	Conceptualised in consultation with Primary Gold
Geochemistry	Derived from GHD (2018)

3.1 Rainfall and evaporation

A historical record of daily rainfall, evaporation and evapotranspiration depths was obtained in the form of a patched point data set from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Science, Information Technology and Innovation (DSITI). SILO patched point data is based on observed historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' by interpolating with data from nearby stations (DSITI 2017).

For this assessment, SILO data was obtained for the Middle Point Rangers station (station number 014090), which is located approximately 39 km north-east of the site. This station was chosen based on proximity to the site and similarity of elevation. The period of rainfall data used for this assessment extended from 1 January 1957 to 1 January 2018 (a total of 61 years).

Figure 3-1 shows the distribution of annual rainfall and evaporation totals near Toms Gully mine. Annual rainfall totals vary between from about 1,000 mm to about 2,200 mm, with an average of about 1,430 mm. Annual pan evaporation totals are about 2,100 mm, resulting in annual potential evaporation of about 1,500 mm.

Figure 3-2 shows the average monthly rainfall and evaporation totals near Toms Gully mine. The climate of the Darwin-Katherine region is tropical and experiences two distinct seasons. The monsoonal wet season occurs from around November to April and is typified by high humidity, temperature and evaporation. The cooler, less humid dry season occurs from around May to October.

Figure 3-3 shows the average distribution of daily rainfall totals near Toms Gully mine. On average, daily rainfall totals exceeding 0.1 mm occur on about 30 % of days, while daily rainfall totals exceeding 50 mm occur on less than 1 % of days.

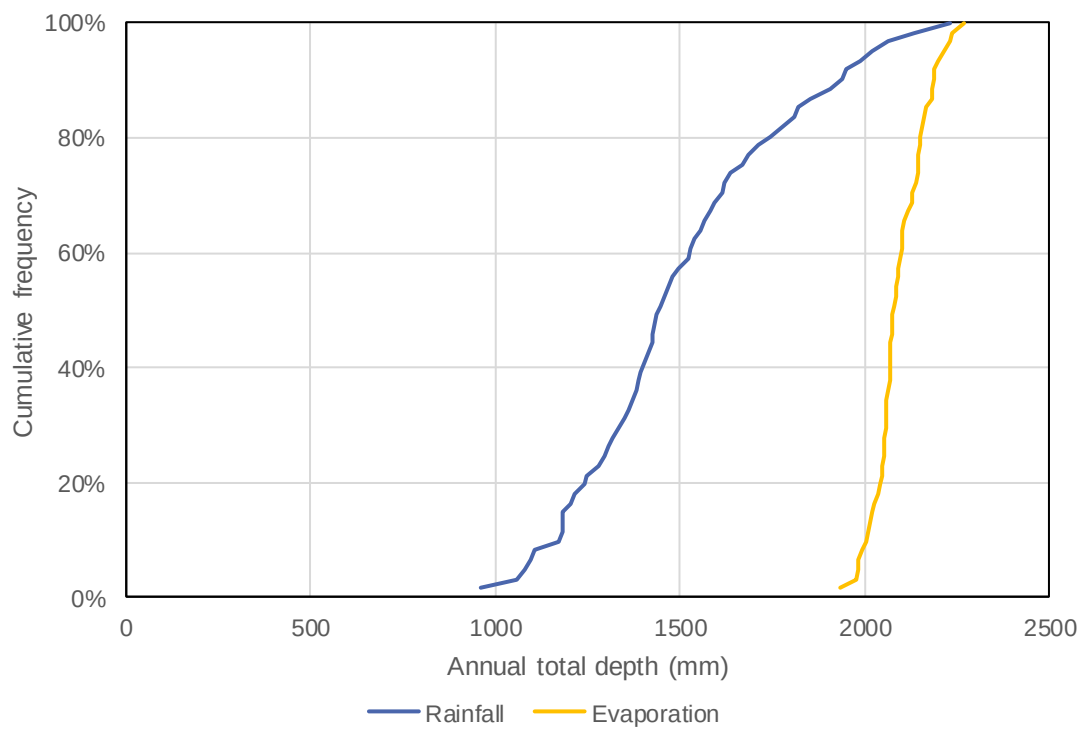


Figure 3-1 Annual rainfall and evaporation totals

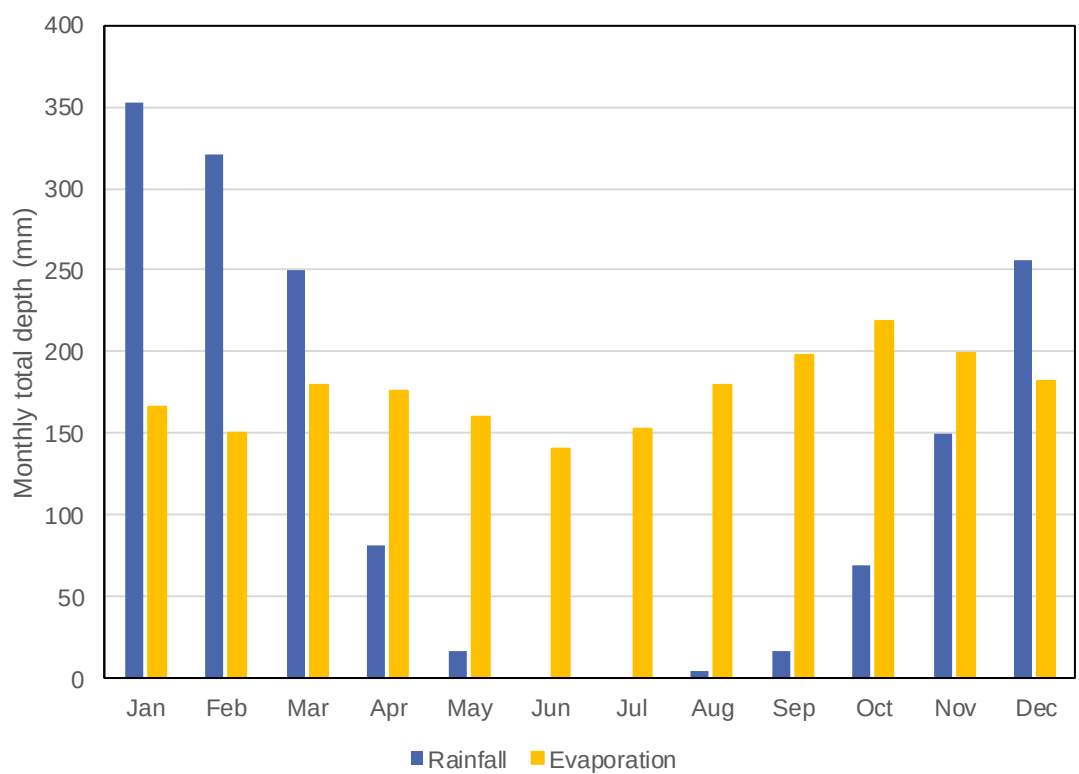


Figure 3-2 Monthly rainfall and evaporation totals

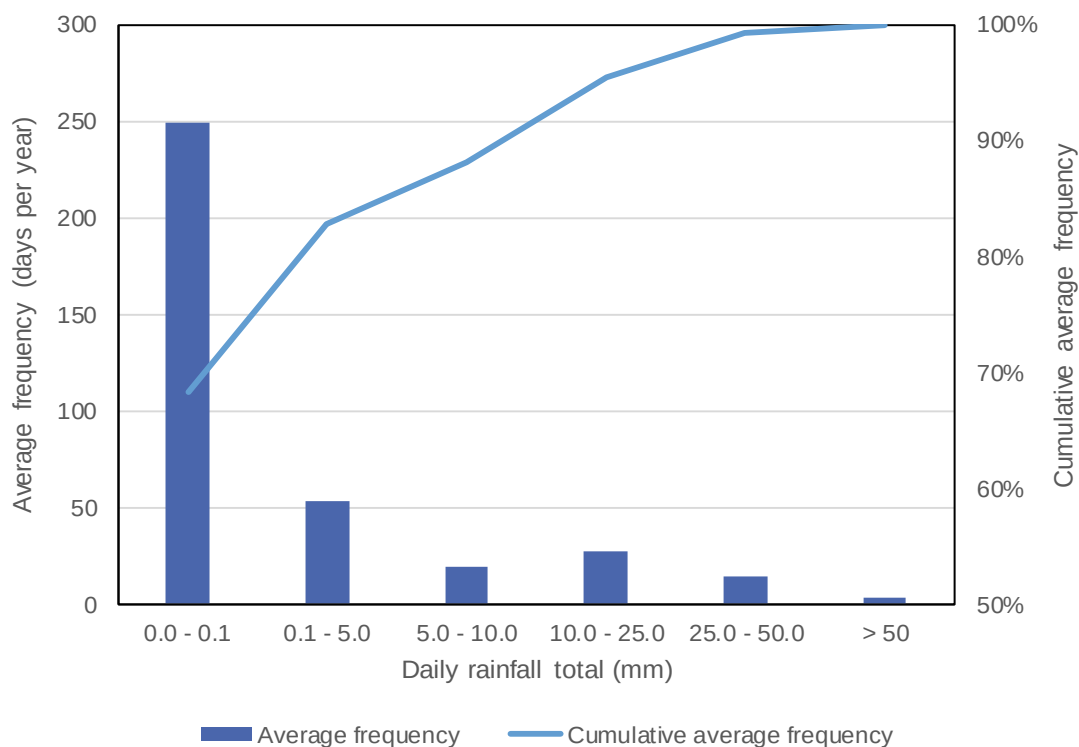


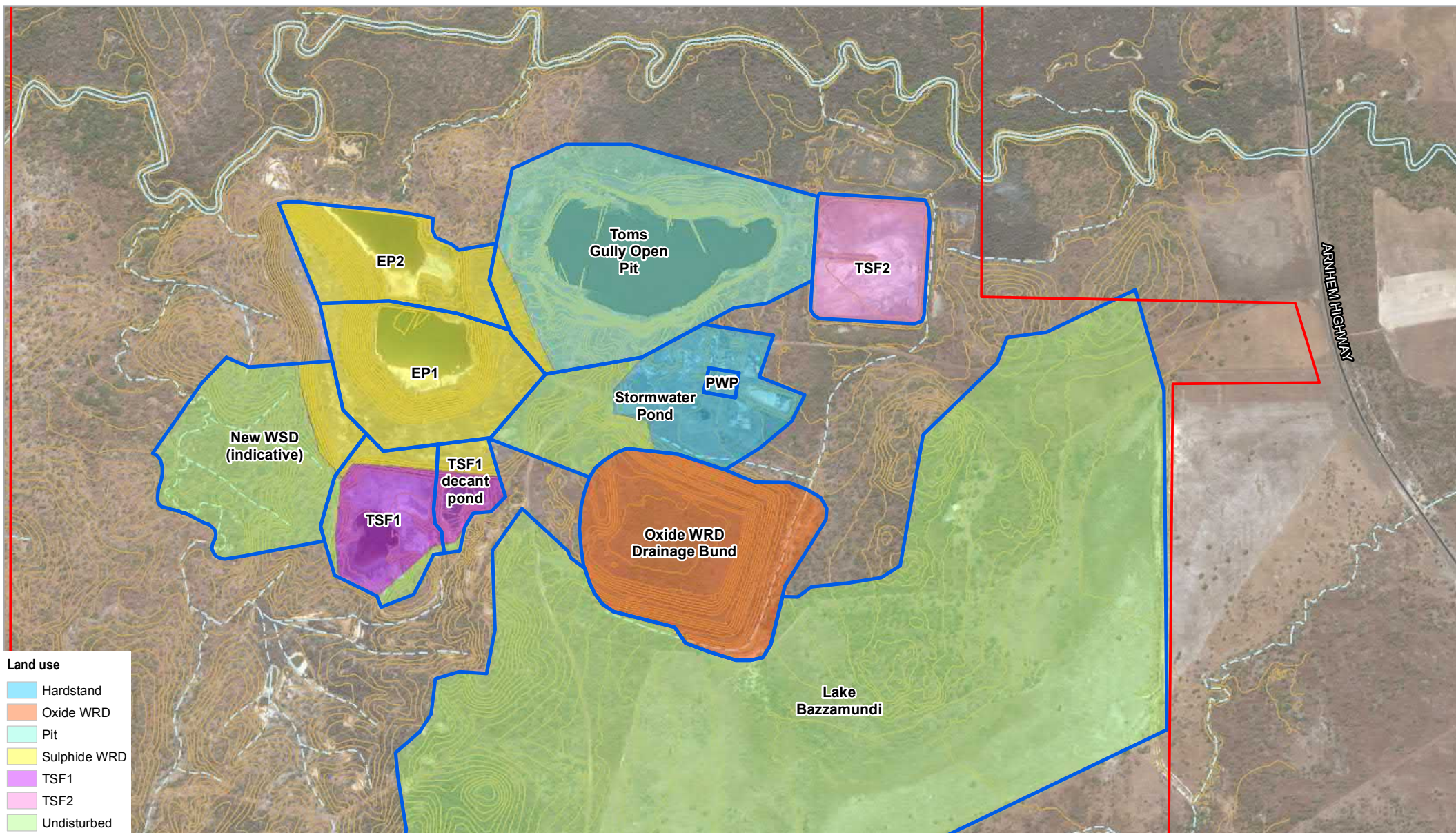
Figure 3-3 Daily rainfall totals

3.2 Catchments

The catchment areas of each water management feature were delineated based on topographic information. The land use of site, for the purpose of the site water balance, was delineated based on aerial imagery and site observations. The catchment area and land use distributions for each water management feature are summarised in Table 3-2. Catchments and land uses are shown in Figure 3-4. Additionally, the flows in Mount Bunday and Coulter Creek were estimated based on the upstream catchment area of 11,280 and 1,300 ha respectively.

Table 3-2 Catchment areas

Catchment	Hardstand (ha)	Oxide WRD (ha)	Pit (ha)	Sulfide WRD (ha)	TSF (ha)	Undisturbed (ha)
EP1	-	-	-	15.0	-	-
EP2	-	-	-	10.6	-	-
Lake Bazzamundi	-	-	-	-	-	226.8
New WSD	-	-	-	2.4	-	15.7
Drainage Bund	-	22.5	-	-	-	-
PWP	0.03	-	-	-	-	-
Stormwater Pond	10.4	-	-	-	-	6.7
Toms Gully Open Pit	-	-	24.8	1.6	-	-
TSF1 (including decant pond)	-	-	-	2.2	8.6	1.5
TSF2	-	-	-	-	8.7	-

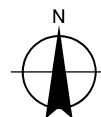


Legend

- Site Boundary
- Water Body Perennial
- Watercourse Intermittent
- Roads
- 2m contours
- Surface water catchments

Paper Size ISO A4
0 100 200 300 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52



Primary Gold Ltd.
Toms Gully Gold Project
Site Water Balance

Project No. 4322623
Revision No. 1
Date 29 Jun 2018

Catchments and landuse

FIGURE 3-4

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: kpsroba

3.3 Storages

The capacity of surface water storages and the maximum surface areas were provided by Primary Gold. Compared to the previous water balance report (Coffey 2015), the design of the New WSD has been reduced to suit the revised water management system and its offline configuration. The geometric properties of the surface water storages are summarised in Table 3-3. In the absence of detailed survey, a shape factor was selected based on industry experience and used to characterise a power law relationship, as discussed in Section 4.4.

Table 3-3 Water storages

Water management feature	Capacity (ML)	Spill level (m RL)	Maximum inundated area (ha)	Shape factor
EP1	346	1,029.35	4.67	5
EP2	354	1,025.76	4.79	5
Lake Bazzamundi	50	Unknown	16.8	5
New WSD	1,000 (once constructed)	Unknown	16.0	2
Drainage bund	5.0	Unknown	7.4	2
PWP	1.4	Unknown	0.03	3
Stormwater pond	12.5	Unknown	0.6	2
Toms Gully Open Pit	4,660	1,019.0	14.1	NA, stage storage based on survey
TSF1 (including decant pond)	135.2	Unknown	7.4	5
TSF2	408.9	1,026.5	8.7	5

3.4 Groundwater

The inflows into the underground workings were based on AGE (2019). The predicted groundwater inflows were divided into two categories: inflow from pit and inflow from groundwater. The simulated net inflows to underground workings are shown in Figure 3-5.

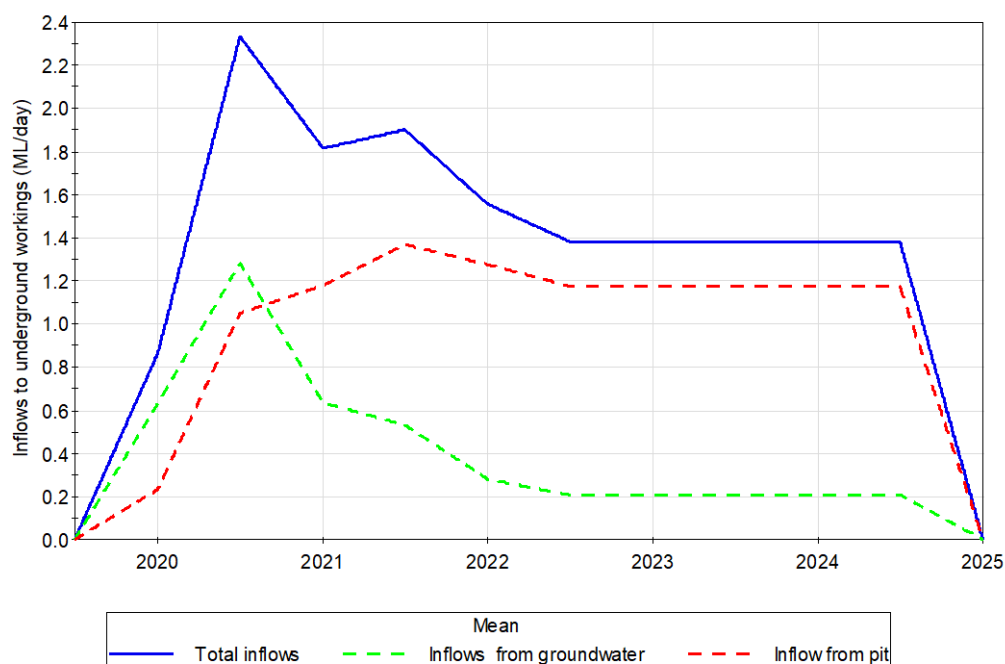


Figure 3-5 Inflows to underground workings

Figure 3-5 shows that the total inflow to underground workings is predicted to peak at a maximum of 2.34 ML/day by the end of June 2020.

3.5 Seepage

Potential seepage losses, as included in the previous water balance modelling (Coffey 2015) are summarised in Table 3-4.

Table 3-4 Potential seepage

Water management feature	Potential seepage losses (kL/day)
EP1	10
EP2	10
New WSD	398
Drainage bund	10
PWP	0
Stormwater pond	0
TSF1	10
TSF2	15
New TSF	0

Part of the rainfall that falls on the sulfide and oxide WRDs is likely to infiltrate and seep through the WRDs. Most of this water is collected by the adjacent surface water storages: the sulfide WRD reports to EP1, EP2, open pit and New WSD (once constructed) while the oxide WRD reports to the drainage bund. This seepage is accounted for in the site water balance as part of the catchment runoff to the surface water storages. A relatively minor portion of seepage is likely to report offsite, especially in the north west corner of the sulfide WRD. The quantity of this off site seepage has not been estimated in the site water balance, but it is considered minor, relative to the surface water flows.

3.6 Mine schedule

Primary Gold provide an indicative mining and production schedule, as shown in Figure 3-6. The production rate was used to estimate the water demand at the processing plant, and the displacement of water in the pit, based on the net particle density (after allowing for entrained moisture) indicated in Table 3-5.

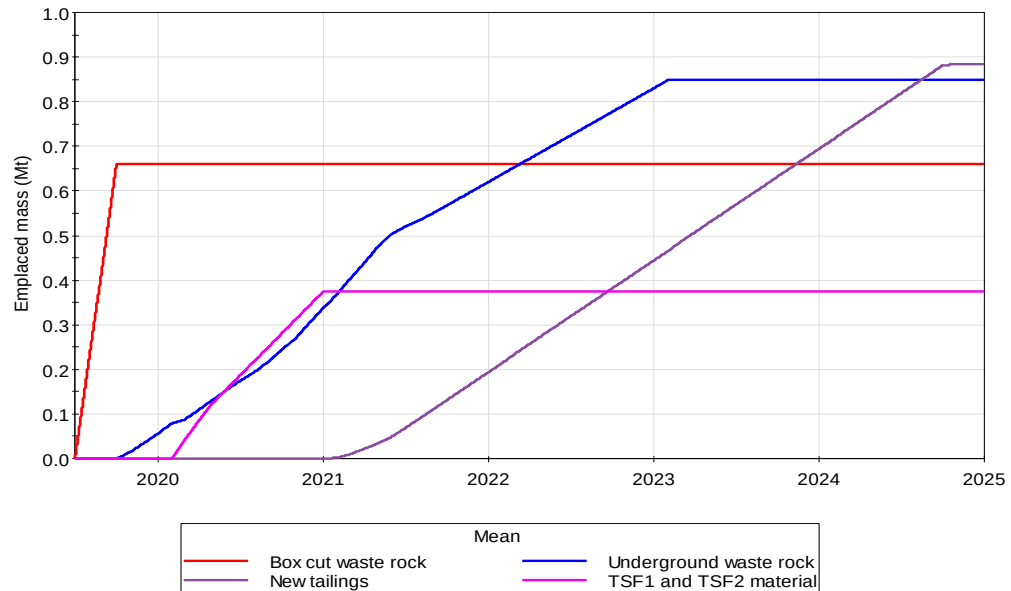


Figure 3-6 Indicative mine schedule

Table 3-5 Indicative material properties

Material	Net particle density (tonne/m ³)	Bulk dry density (tonne/m ³)
Box cut waste rock	2.2	1.8
Underground waste rock	3.0	1.8
New tailings	1.5	1.2
TSF1 and TSF2 material	1.5	1.2

3.7 Operations

Operational rules were developed to approximate the operations and pumping at Toms Gully mine. The operational processes and pumping rules adopted for the purpose of the site water balance model are summarised in Table 3-6. It is expected that the operational rules will be refined as the design of water management infrastructure is further developed.

The controlled discharges to Lake Bazzamundi (and hence to Coulter Creek) and to Mount Bunday Creek were simulated to occur during the wet season. The wet season was defined to begin with the northern rainfall offset, which is 50 mm of rainfall after 1 September (BOM 2019). The wet season was defined to end at the earliest of:

- When the New WSD was dewatered to its low operating level after 1 March, or
- 1 June.

Discharges were simulated to be proportional to the flow in Coulter Creek and Mount Bunday Creek respectively, and targeted a dilution of at least 50%.

Potential scenarios where the Project does not proceed, is substantially delayed, has early closure or proceeds in a modified manner that results in the pit water (and other contaminated waters) not being treated are assessed in Section 5.6. In the case of care and maintenance, it would be expected that the contaminated water would continue to be actively managed and the proposed operations would be representative of care and maintenance.

Table 3-6 Operational pumping

Pumped transfer	Pump rate	Pump trigger on	Pump trigger off
Dewater Toms Gully Open Cut to WTP	60 L/s	Maintain the water level in the pit at 15 m AHD	
Dewater underground workings to Toms Gully Open Cut	Transfer all inflows into the underground workings to maintain a dewatered state during mining.		
Dust suppression	30 kL/day	At all times from New WSD	
Process water makeup from Pit	1 ML/day	PWP less than 0.2 ML	PWP greater than 0.6 ML
Processing demand (less ore moisture of 0.05 ML/day = 5 % @ 0.35 Mtpa)	1,044 kL/RoM tonne (1,000 kL/day @ 0.35 Mtpa)	During ore processing	
Dewater EP1, EP2, TSF1 and TSF2 to Pit	100 L/s	Maintain freeboard for the 1,000 year ARI design flood event	
Dewater Oxide WRD drainage bund to Pit	50 L/s	Drainage bund is not empty	Drainage bund is empty
Dewater Stormwater Pond to Pit	50 L/s	Stormwater pond is not empty	Stormwater pond is empty
WTP to Lake Bazzamundi	Transfer all treated water during the wet season, up to 50% of the daily simulated flows in Coulter Creek.		
WTP to New WSD	Transfer all treated water outside of the wet season.		
New WSD to Lake Bazzamundi	200 L/s	Dewater during the wet season, up to 50% of the daily simulated flows in Coulter Creek, less the transfers directly from the WTP to Lake Bazzamundi. Retain 400 ML for drought security.	
New WSD to Mount Bunday Creek	200 L/s	Dewater during the wet season, up to 50% of the daily simulated flows in Mount Bunday Creek. Retain 400 ML for drought security.	
New WSD to Third Party Irrigation	200 ML/year	During dry season for irrigation	

4. Model methodology

4.1 Water balance

The site water balance for Toms Gully mine was modelled as a semi-distributed mass balance, considering the water management features described in Section 2.2. A site-specific water balance equation was derived from the catchment scale water balance equation described by Ladson (2008). The water balance equation applies conservation of mass to derive an ordinary differential equation that describes how the volume of water V changes over time t :

$$\frac{dV}{dt} = R + C + G_{in} + P_{in} + Q_{in} - E - P_{out} - Q_{out}$$

The water balance considered the inflows into each storage:

- Direct rainfall R , estimated from the simulated water surface area of the storage and the simulated rainfall intensity.
- Catchment runoff C , using the Australian Water Balance model (AWBM) (Boughton & Chiew, 2003) and accounting for the change in simulated water surface area.
- Groundwater inflow G_{in} , estimated from the separate groundwater modelling.

The water balance considered the outflows from each storage:

- Evaporation E , estimated from the simulated water surface area of the storage. A pan factor of 0.9 was adopted to the pan evaporation to estimate both potential evaporation and potential evapotranspiration from simulated pan evaporation.

The water balance considered transfers between storages:

- Pumped transfers P_{in} and P_{out} , according to site-specific operating rules and pump rates.
- Overland channel and gravity pipe flow Q_{in} and Q_{out} , according to site-specific operating rules and flow rates and due to overflows from one storage to another.

4.2 Rainfall variability

Rainfall variability was considered in the site water balance by sampling simulated rainfall from the historical rainfall record (refer to Section 3.1). A series of simulations were performed, each beginning in a different year of the historical rainfall record and proceeding consecutively through the record (and looped where required). This approach includes the very wet and very dry conditions observed in the historical record.

4.3 Hydrologic model

The Australian Water Balance Model (AWBM) (Boughton & Chiew, 2003) was used to estimate the runoff contributing to the surface water storages. The AWBM was adopted as it:

- Is widely used throughout Australia, especially for mining applications.
- Has been verified through comparison with large amounts of recorded streamflow data.
- Has literature available to assist in estimating input parameters.
- Considers soil moisture retention state when determining runoff.

The AWBM is a soil moisture water balance model that calculates runoff from rainfall after allowing for losses and storage. A schematic of the model is included in Figure 4-1, which shows that the model consists of three storage elements (with surface areas A_1 , A_2 and A_3) representing soil moisture.

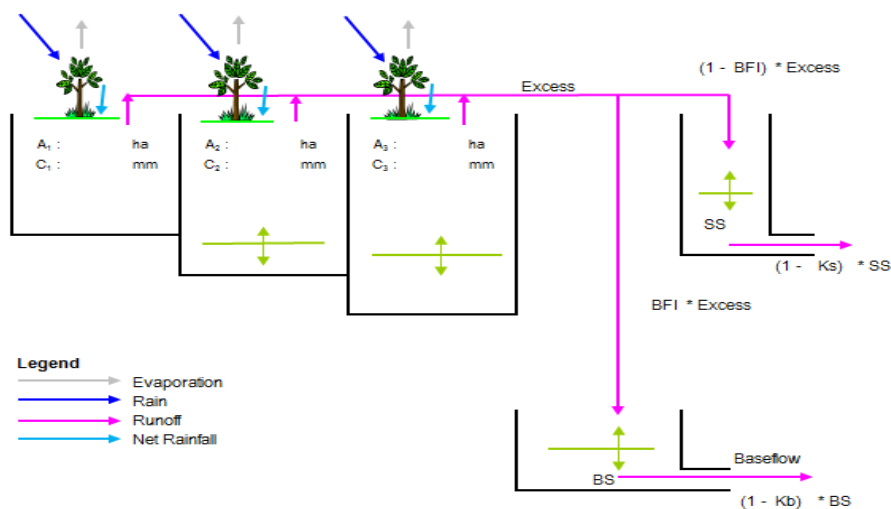


Figure 4-1 Australian water balance model schematic

Rainfall enters these storages and when a storage element is full, any additional rainfall is considered to be excess rainfall. Of this excess rainfall a proportion is routed to the baseflow storage (BS) while the remainder is routed to the surface storage (SS). The discharge from the baseflow storage and surface storage is estimated as a proportion of the volume of the storages at the end of each day. The total runoff is the combined volume of water discharged from these two storages. The parameters of the AWBM are summarised in Table 4-1.

Table 4-1 Australia water balance model parameters

Parameter	Description
A1, A2, A3	The partial areas of the overall catchment contributing to each storage.
C1, C2, C3	The capacity of storages 1, 2 and 3 respectively.
BFI	The proportion of excess rainfall flowing to the baseflow.
Kb	The proportion of the volume of the baseflow storage remaining in the storage.
Ks	The proportion of the surface storage remaining in the storage.

The site-specific land uses (refer to Section 3.2) were characterised with different sets of AWBM parameters. The AWBM parameters adopted for the water balance model are summarised in Table 4-2.

Table 4-2 Site parameterisation of Australian water balance model

Parameter	Hardstand	Oxide WRD	Pit	Sulfide WRD	TSF	Undisturbed
A1, A2, A3	0.134, 0.433, 0.433					
Cave	35.4	100.2	35.4	100.2	14.3	120
C1, C2, C3	0.01, 0.33, 0.66					
BFI	0	0	0	0	0.01	0.3
Kb	0	0	0	0	0.81	0.98
Ks	0	0	0	0	0	0

4.4 Geometric approximation

In the absence of survey or design stage storage relationships, the geometry of the surface water storages was estimated using a power law approximation after Brooks (2002), where the depth d of a solid of revolution was related to its volume V as:

$$d = d_{max} \left(V \frac{1 + 2/p}{A_{max} d_{max}} \right)^{\frac{p}{p+2}}$$

where d_{max} was the maximum depth, V_{max} was the capacity of the storage, A_{max} was the maximum surface area of the storage and p was dimensionless shape parameter.

4.5 Numerical implementation

The water balance model was implemented in GoldSim (version 12.1) (GTG 2017). A basic time step of 0.5 day was used, with additional time steps dynamically inserted were required. GoldSim uses the forward Euler method to solve the mass conservation equations described in Section 4.1.

5. Model forecasts

The site water balance model for Toms Gully was used to estimate the site water balance for a range of potential rainfall sequences starting from existing conditions at 1 July 2018. The initial conditions are summarised in Table 5-1, based on Coffey (2015) and GHD (2018).

Table 5-1 Initial conditions

Water management feature	Initial volume (ML)
EP1	150
EP2	150
New WSD	0
Oxide WRD drainage bund	0
PWP	0.5
Stormwater pond	2
Toms Gully Open Pit	4,100
TSF1 (including decant pond)	10
TSF2	10

The model was simulated from 1 July 2019 to 1 July 2025, assuming that the first month of the mine schedule corresponded to July 2019.

5.1 Interpretation of results

To consider potential rainfall variability, a total of 61 different rainfall patterns were simulated (as described Section 4.2). The results presented show the average, 10th percentile and 90th percentile values. The purpose of displaying the three results is to indicate both the average value and the likely possible range. The 10th percentile represents the value at which 10% of the modelled outputs were less than this value. Similarly, the 90th percentile represents the value at which 90% of the modelled outputs were less than this value.

The 10th and 90th percentile values have been used rather than minimum and maximum values to characterise likely very wet and very dry conditions. The set of 10th or 90th percentile values do not necessarily all correspond to the same rainfall series, that is, they do not correspond to a 10th percentile “dry” or 90th percentile “wet” year.

The AMD mass balance has been developed for the purpose of quantitatively comparing the relative risk of acidity in different surface water storages on site and the absolute quantities should be considered order of magnitude estimates only. The model provides a framework for further refinement as the additional site observations and design details become available and, if appropriately validated, may ultimately serve as an operational management tool.

5.2 Water balance

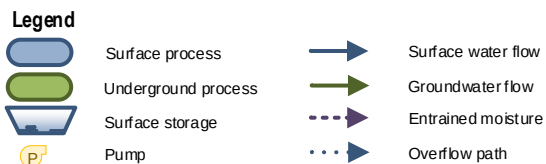
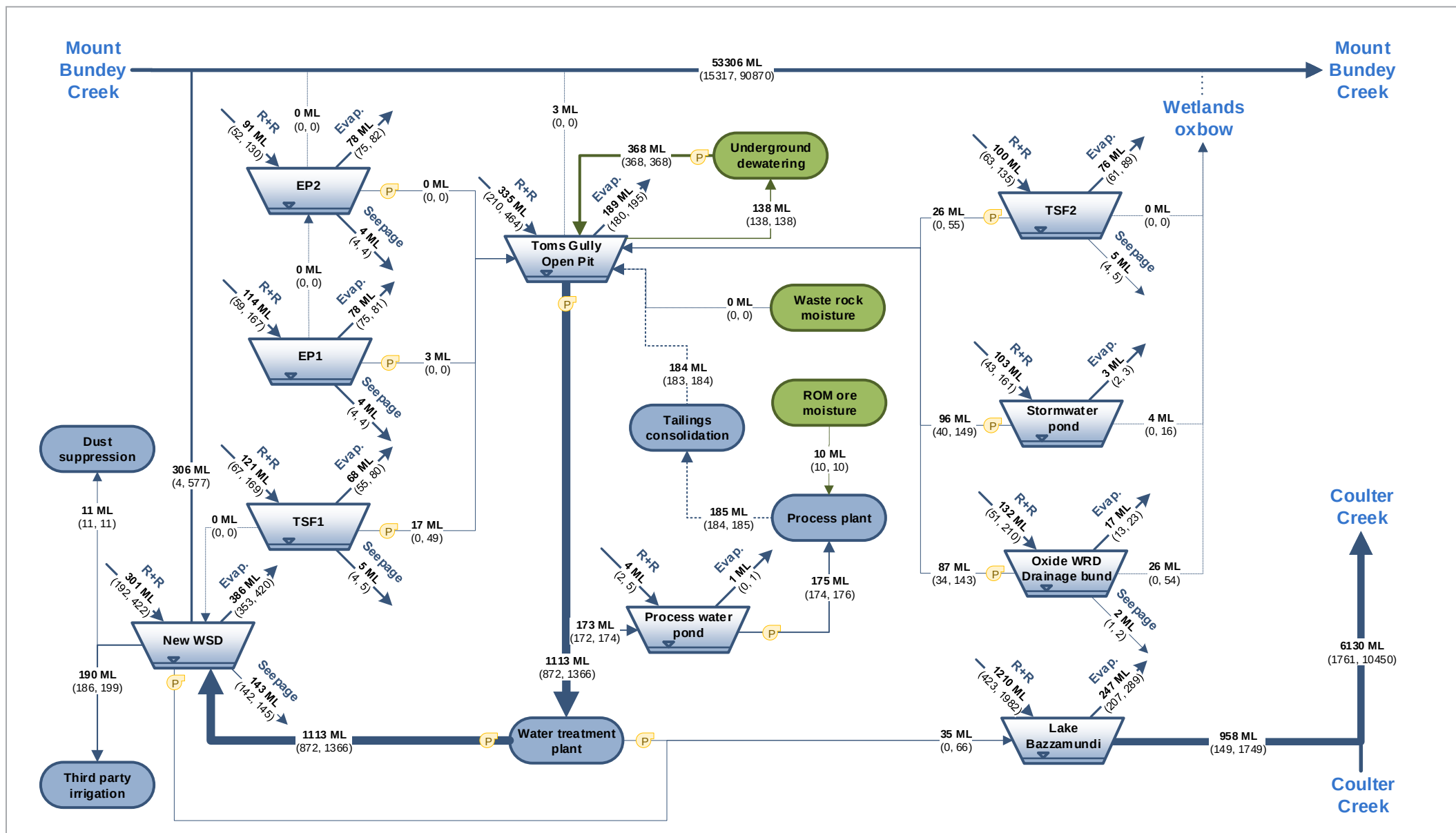
The forecast average annual water balance for Toms Gully mine is summarised in Table 5-2.

Table 5-2 Average annual site water balance

Water flux	Year ending June 2020 (ML)	Year ending June 2021 (ML)	Year ending June 2022 (ML)	Year ending June 2023 (ML)	Year ending June 2024 (ML)
Inputs					
Direct rainfall onto storages and catchment runoff	1,301	1,379	1,328	1,307	1,294
Groundwater inflows	232	282	119	76	76
ROM ore moisture	10	14	13	13	13
<u>Total inputs</u>	<u>1,543</u>	<u>1,675</u>	<u>1,460</u>	<u>1,396</u>	<u>1,383</u>
Outputs					
Evaporation	895	1,035	964	929	900
Uncontrolled off site discharge	35	34	34	35	35
Discharges via Lake Bazzamundi	35	57	35	29	26
Discharges to Mount Bunday Creek	306	498	302	249	225
Third party supply	190	200	202	200	198
Seepage losses	164	164	164	160	155
Dust suppression losses	11	11	11	11	10
<u>Total outputs</u>	<u>1,636</u>	<u>1,999</u>	<u>1,712</u>	<u>1,613</u>	<u>1,549</u>
Change in storage					
Surface water storages	-93	-325	-252	-216	-166
<u>Total change in storage</u>	<u>-93</u>	<u>-325</u>	<u>-252</u>	<u>-216</u>	<u>-166</u>

Table 5-2 shows that on average, the model forecasts that Toms Gully mine will be in water excess, with no requirement for external water supply. The dominant inflows to Toms Gully mine is expected to be catchment runoff, while the main outflow is evaporation. The total volume of water stored at Toms Gully mine is forecast to decrease on average over the mine life, mainly due to the displacement of water as material is emplaced within.

Water management schematics, showing the mean, 10th and 90th percentile annual flows for each year are shown in Figure 5-1 to Figure 5-5.



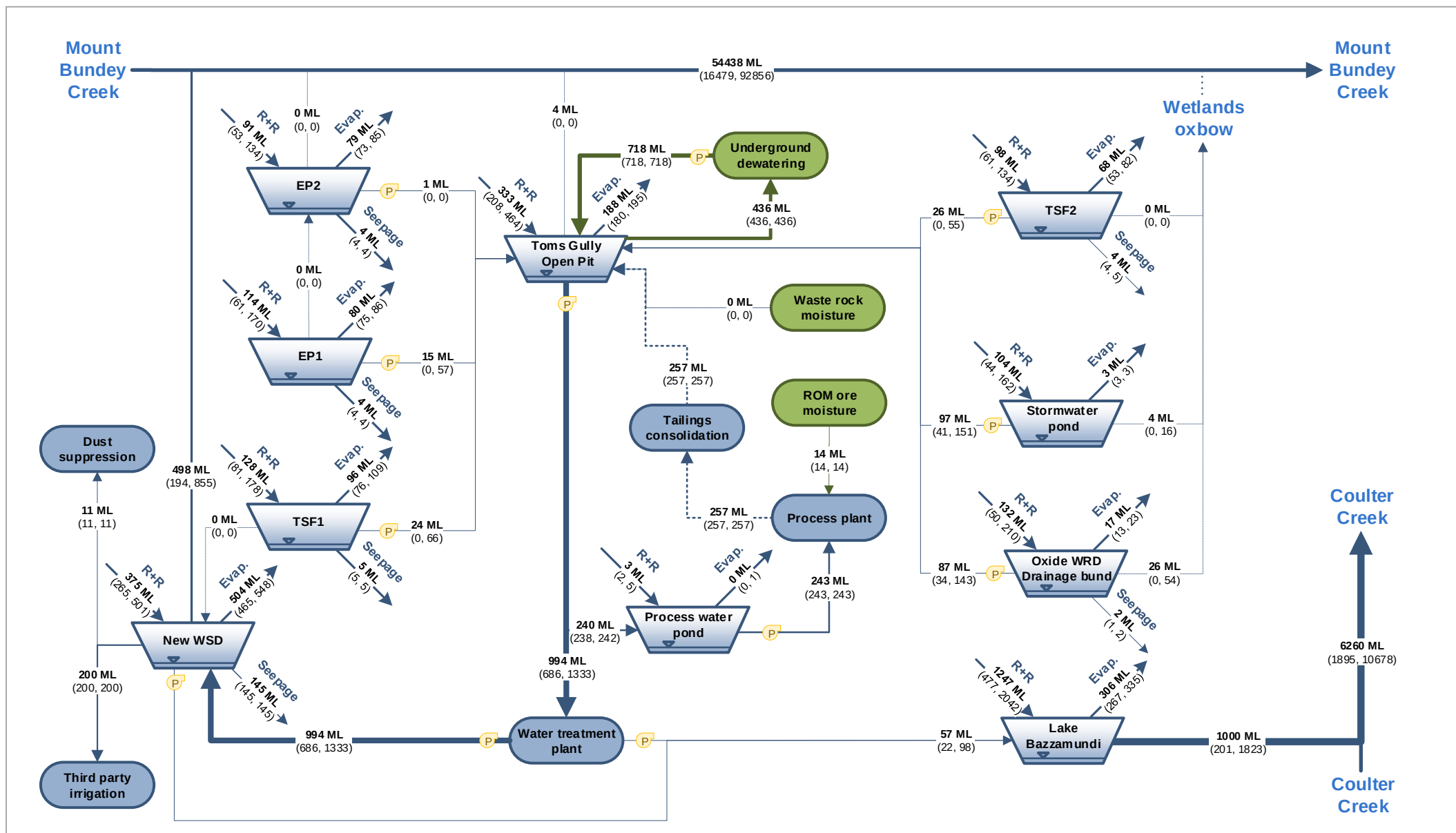
Primary Gold Ltd
Toms Gully Gold Project
Site water balance

Project No. 4322623
Revision No. 5
Date 05/07/2019

Water management schematic
Year ending June 2020

FIGURE 5-1

Created by: Tyler Tinkler



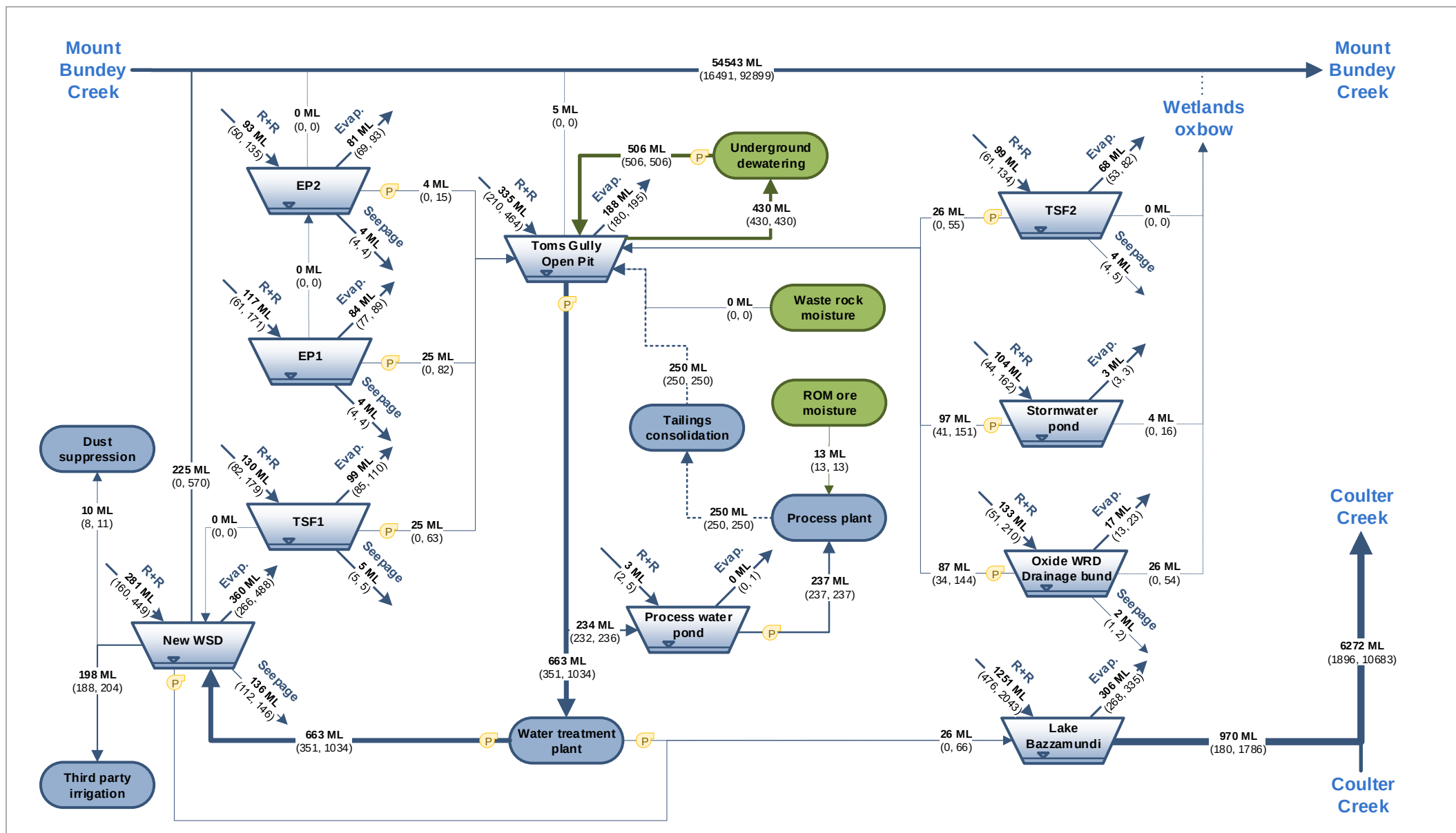
Primary Gold Ltd
Toms Gully Gold Project
Site water balance

Project No. 4322623
Revision No. 5
Date 05/07/2019

Water management schematic
Year ending June 2021

FIGURE 5-2

Created by: Tyler Tinkler



Legend

- Surface process
- Underground process
- Surface storage
- Pump
- Surface water flow
- Groundwater flow
- Entrained moisture
- Overflow path



Primary Gold Ltd
Toms Gully Gold Project
Site water balance

Project No. 4322623
Revision No. 5
Date 05/07/2019

Water management schematic
Year ending June 2024

FIGURE 5-5

Created by: Tyler Tinkler

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Printdate: 05/07/2019 09:52

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5.3 Water inventory

The median (50th), 10th and 90th percentile daily water volumes in EP2, New WSD and Toms Gully Open Pit are shown in Figure 5-6, Figure 5-8 and Figure 5-7 respectively. The results shown for EP2 are very similar to EP1.

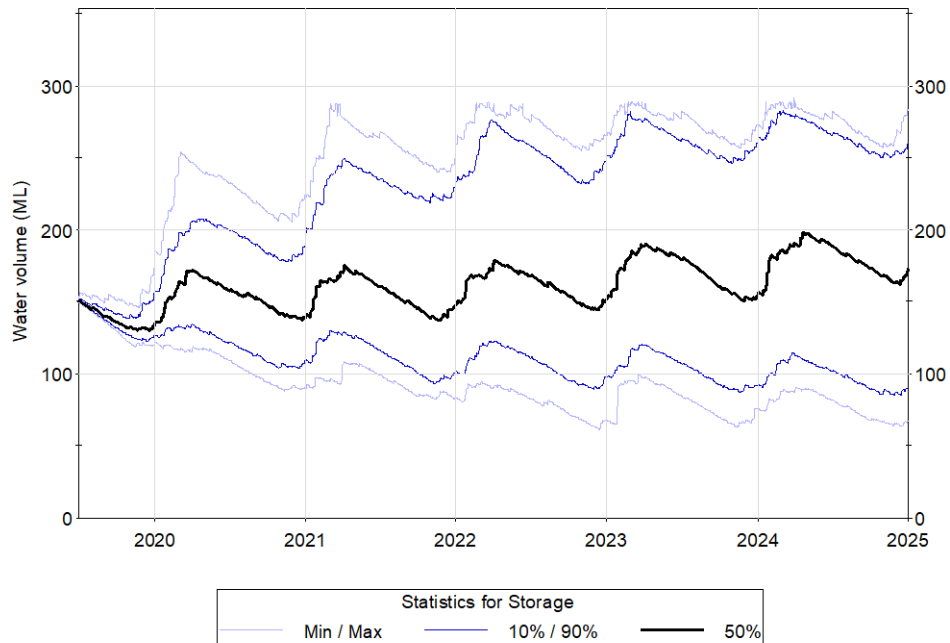


Figure 5-6 Forecast volume of water in EP2

Figure 5-6 shows that average volume of water in EP2 is likely to be about 200 ML over the mine life, varying seasonally and with above and below average rainfall. The results for EP2 are characteristic of the other contaminated water storages on site: EP1, TSF1, TSF2, Drainage Bund and Stormwater Pond. The results indicate that dewatering these storages to the pit allows the water volume to be managed and minimises the likelihood of offsite discharge (refer to Section 5.4).

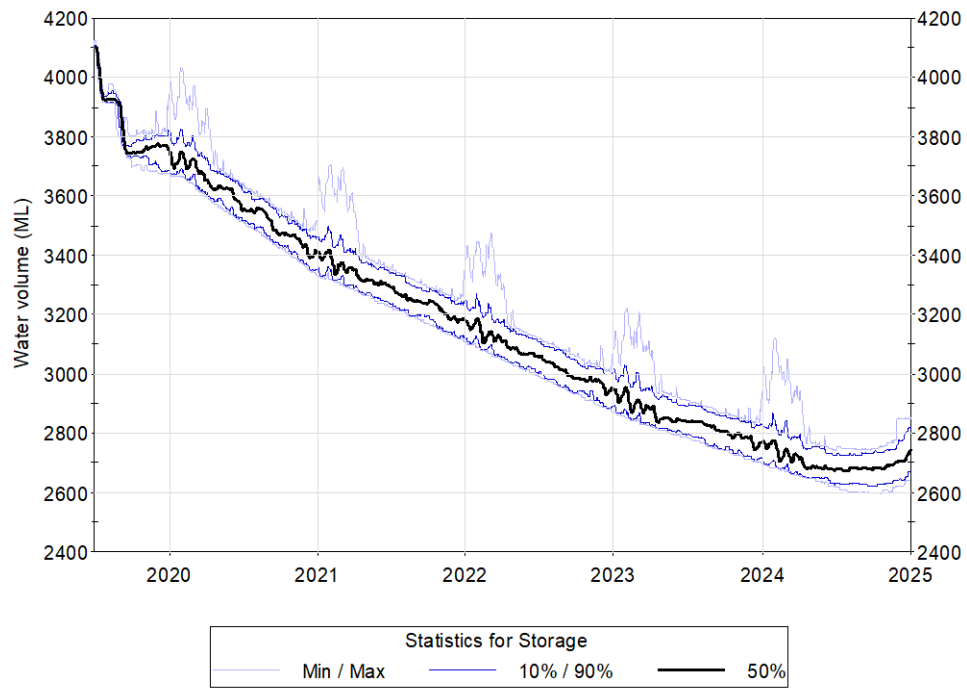


Figure 5-7 Forecast volume of water in Toms Gully Open Pit

Figure 5-7 shows that the volume of water in Toms Gully Open Pit is expected to decrease on average as material emplacement begins and dewatering commences. Although the volume of water in the pit will fall, the elevation of the water surface is expected to remain the same, as the water volume is displaced by waste rock and tailings volume.

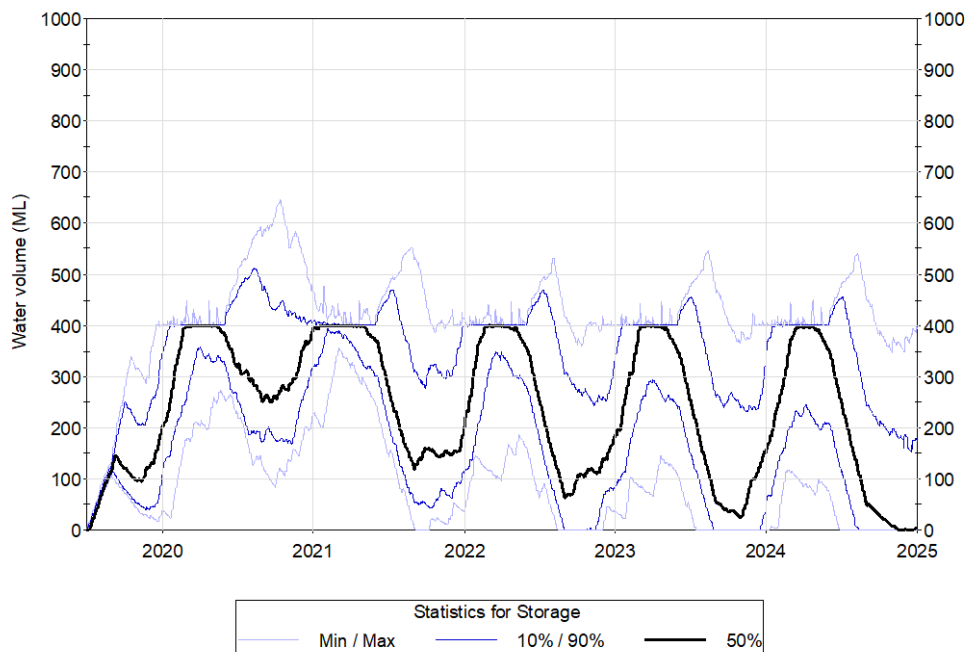


Figure 5-8 Forecast volume of water in New WSD

Figure 5-8 shows that, on the average, the volume of treated water in the New WSD is forecast to generally vary seasonally between about 100 ML and 500 ML . The New WSD provides capacity to storage treated water during the dry season, so that is can be discharged during the wet season, thereby reducing the required maximum treatment capacity.

5.4 Discharge regime

The requirements for discharge of excess water during operations is expected to be mitigated by storage of water in the New WSD during the dry season for use by third party irrigation. The modelling results indicate that these measures will allow discharges to be constrained to the wet season when dilution is available for the natural flows in Mount Bunday Creek and Coulter Creek. With its larger catchment area, Mount Bunday Creek is expected to provide the greatest dilution of wet season discharges, however some discharges to Coulter Creek via Lake Bazzamundi are still expected to occur, depending on day to day operations.

Modelled monthly controlled discharges from the New WSD directed towards Mount Bunday Creek and Coulter Creek are shown in Figure 5-9 and Figure 5-10 respectively.

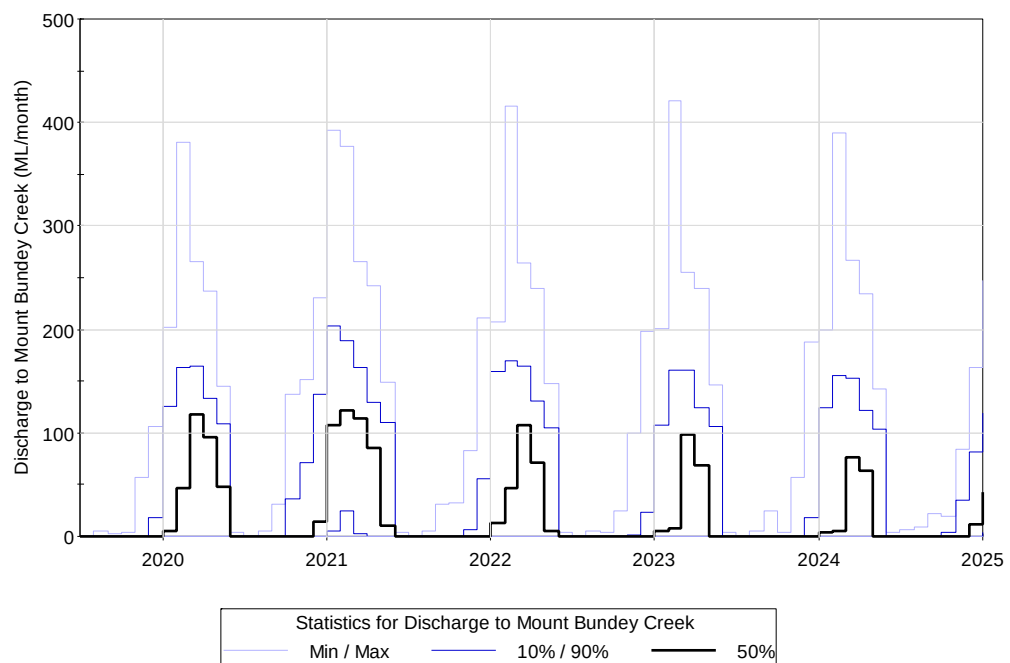


Figure 5-9 Forecast monthly discharges to Mount Bunday Creek

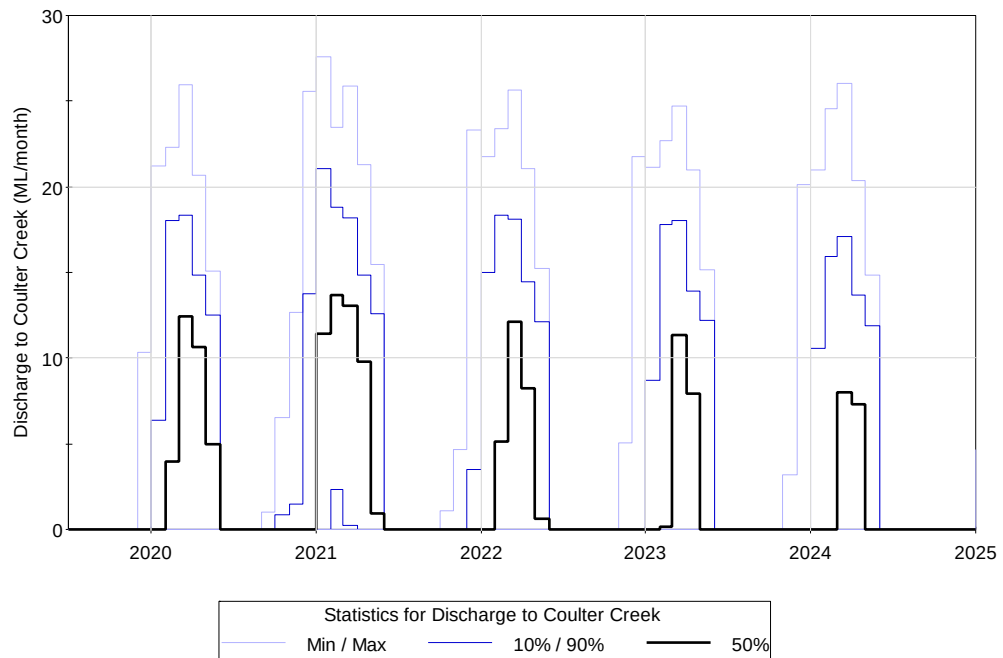


Figure 5-10 Forecast monthly discharges to Coulter Creek

Figure 5-9 shows that by adopting the discharge regime based on the operating rules described in Section 143.7, which includes maximising discharges during the wet season and using the pit and the New WSD to store and manage contaminated and treated water during the dry season, discharges are expected to only occur during the wet season. All discharges were simulated to cease by June, which was forecast to provide sufficient time to discharge excess treated water accumulated through the wet season. Median monthly discharges during the wet season were about 150 ML/month, varying up to about 450 ML/month.

5.5 Uncontrolled discharges and environmental freeboard

Despite the water management system proposed for the Project, there inevitably remains an inherent possibility of uncontrolled discharges due to rare rainfall events. The likelihood of this occurrence was assessed using the site water balance model. Figure 5-11 shows the modelled probability of uncontrolled discharge from the Stormwater Pond and Oxide WRD drainage bund occurring in any given month over the mine life. No discharges from the other surface water storages were forecast by the model simulations.

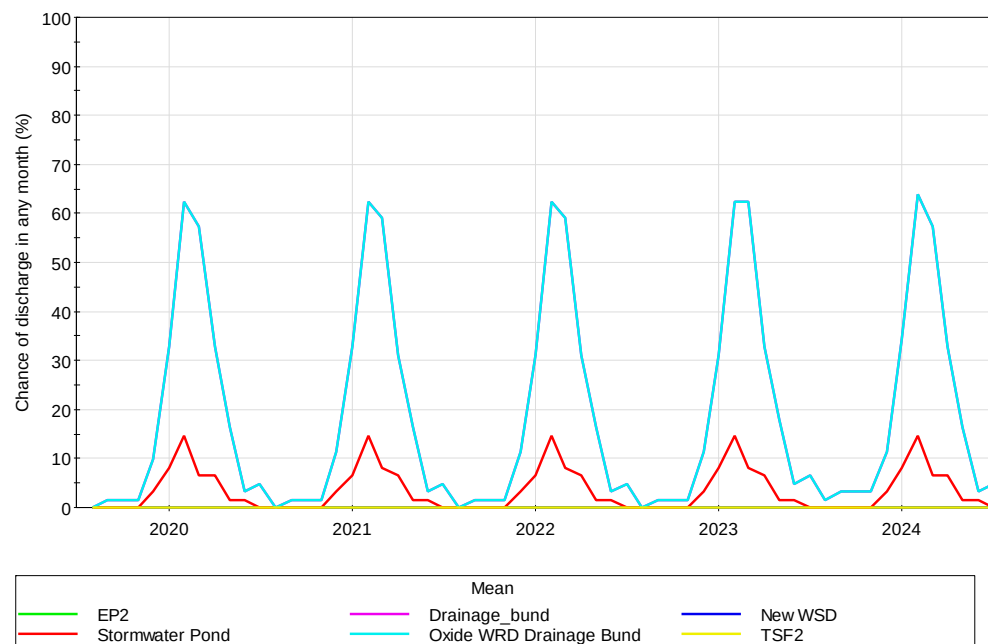


Figure 5-11 Forecast monthly probability of uncontrolled discharges

Figure 5-11 shows that the probability of discharge is, as expected, highest during the wet season. The likelihood of discharge from the Stormwater Pond and Drainage Bund is up to 15 % and 60 % respectively in any one month during the wet season, due to insufficient storage capacity to capture runoff from the surface water catchment.

The annual probability of discharge from Stormwater Pond and Drainage Bund are summarised in Table 5-3. These forecast probability of offsite discharge of mine affected water are significantly higher than 1 %, which is the generally accepted design criteria for new mining projects. This forecast probability of discharge includes consideration of the pumping from these storages to the pit that reduces the probability of discharge.

Table 5-3 Forecast annual probability of uncontrolled discharge

Water storage	Annual probability of discharge
Drainage bund	90%
Stormwater pond	34%

In order to achieve a particular design criteria, mine affected water storages are generally required to have at least the capacity to contain runoff from the design rainfall event. The design containment freeboard was estimated for the 1 % annual exceedance probability (AEP) and 1 in 1,000 AEP (72 hour duration) design rainfall depth, using a volumetric runoff coefficient of 0.5 for undisturbed areas and 0.9 for disturbed areas. The design containment freeboard for each storage is summarised in Table 5-4.

Table 5-4 shows that most storages have sufficient capacity to include the design containment freeboard, except for Stormwater Pond and Oxide WRD drainage bund; which are underlined for highlighting purposes. This reflects that, although these storages are proposed to be managed by pumping to the pit, there storage capacity relative to their catchment means that regular discharges are still expected. The design containment freeboard required for Stormwater Pond could be reduced by diverting upslope catchment around the processing area if the upslope catchment was not mine affected.

Table 5-4 Design freeboard

Storage	Design containment freeboard for 72 hour duration design depth (ML)		Capacity (ML)
	1 in 100 AEP	1 in 1,000 AEP	
EP1	62	92	346
EP2	44	65	354
New WSD	46	69	1,000
Oxide WRD Drainage bund	93	138	<u>5</u>
PWP	0.2	0.3	1.4
Stormwater Pond	59	86	<u>12.5</u>
TSF1 (including decant pond)	51	76	135.2
TSF2	36	53	409

5.6 Long term water volumes

The long term water volumes in key water management features were forecast by extending the simulation water balance model until 2050 and assuming no active management of the site from 2025 onwards. These results are also representative of potential scenarios where the Project does not proceed, is substantially delayed, has early closure or proceeds in a modified manner that results in the pit water (and other contaminated waters) not being treated. In the case of care and maintenance, it would be expected that the contaminated water would continue to be actively managed and the results presented above would be representative of this case.

The results for the pit, TSF1 and TSF2 are shown in Figure 5-12, Figure 5-13 and Figure 5-14 respectively.

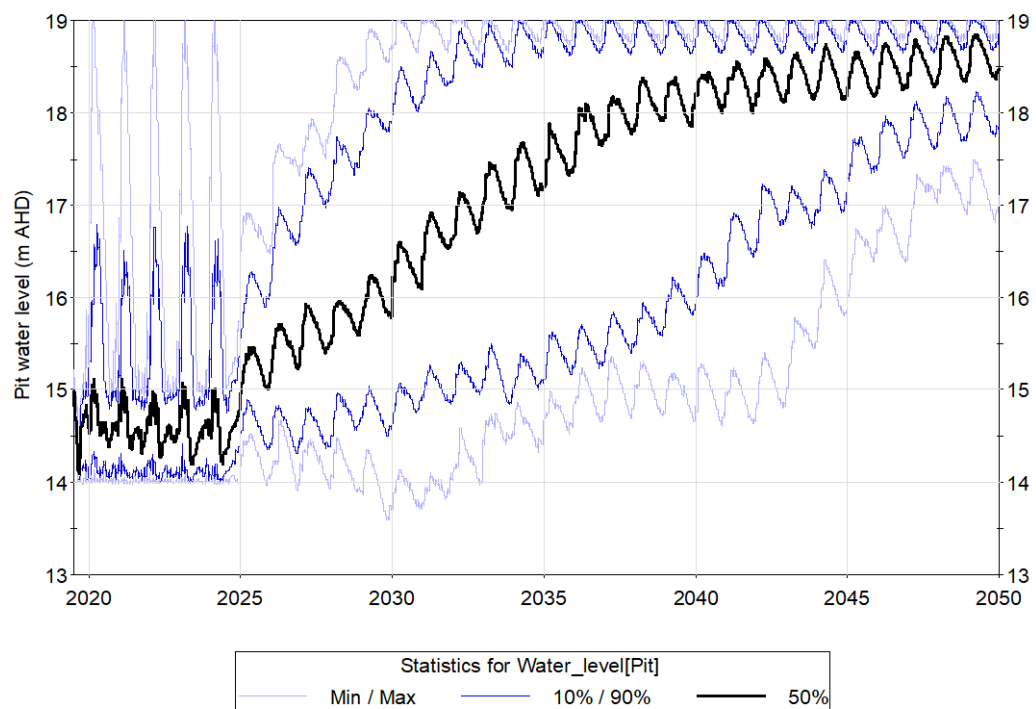
**Figure 5-12 Long term pit water levels**

Figure 5-12 shows the following the end of active management (simulated from 2025 onwards), the water levels in the pit are expected to increase over time, with the potential to reach the spill level after about 5 wet seasons. Thereafter, the pit water level was modelled to increase on average, with seasonal variation, before nearing an equilibrium by 2050.

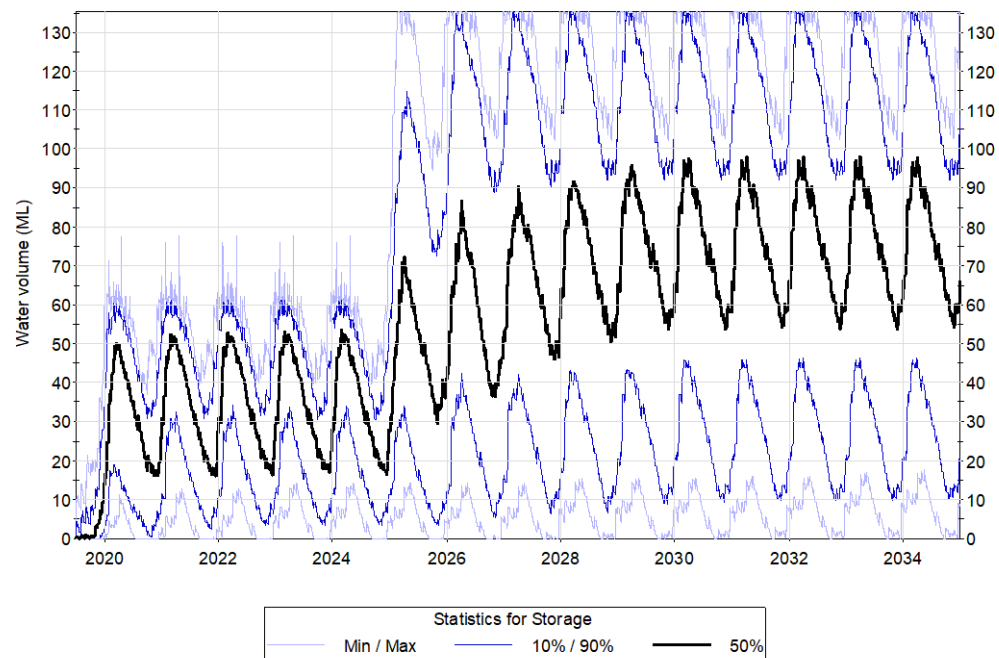


Figure 5-13 Long term TSF1 water volume

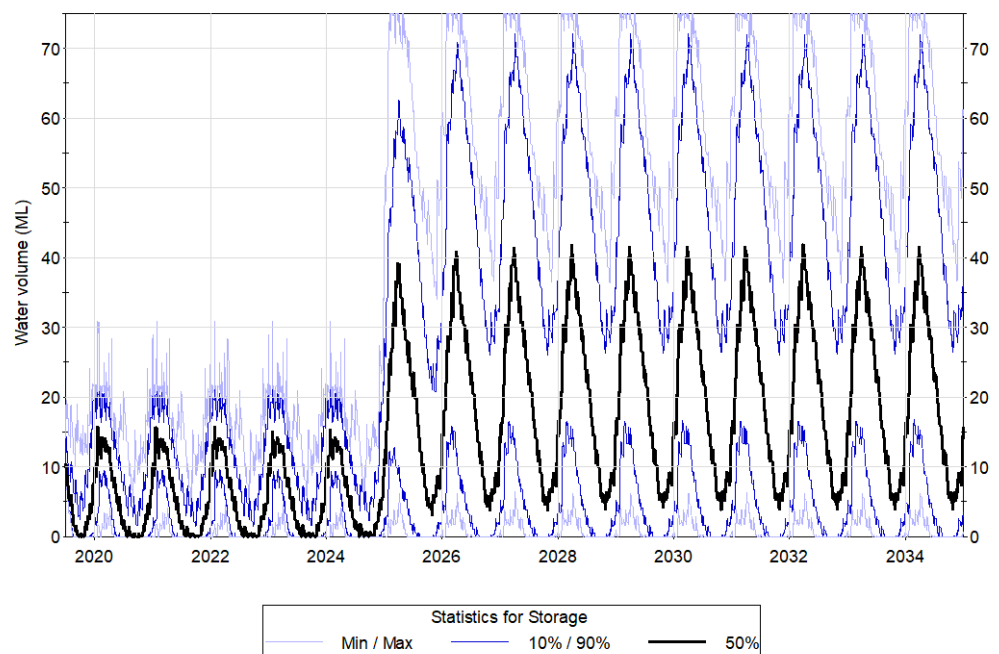


Figure 5-14 Long term TSF2 water volume

Figure 5-13 and Figure 5-14 indicate that there is the potential for the water level to exceed the water storage capacity of TSF1 and TSF2 without active management by dewatering, particularly during the wet season.

6. Conclusion and recommendations

The site water balance for Toms Gully mine has been updated, building on the previous water balance report prepared by Coffey (2015) and more recent work by GHD (2018), and considering the groundwater inflows predicted by AGE (2019). The results of the modelling indicate that the proposed discharge regime can limit discharges to the wet season during period when flows in Mount Bunday Creek and Coulter Creek can provide dilution of discharges.

The probability of offsite discharge of mine affected water of 90 % in any given year for the Oxide WRD drainage bund, which is significantly higher than is generally acceptable for new mining projects in Australia. The probability of discharge from the pit and TSFs was found to be less than 1%, based on proposed water management.

The modelled performance of the site water management system may be improved by:

- Increasing the capacity of the drainage bund and Stormwater Pond.
- Diverting any non-mine affected catchment upslope of the RoM pad around the processing area to reduce inflow into, and subsequent discharges of mine affected water from the Stormwater Pond.

7. Limitations

This water balance considers the effect of rainfall variation on the results of the model, based on a historical rainfall record. This approach assumes that the historical rainfall record is characteristic of future rainfall variability and does not consider inter-annual climate patterns such as the El Niño Southern Oscillation, Indian Ocean Dipole, or long term trends such as climate change.

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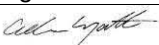
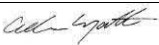
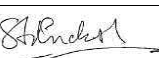
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Attachment B:

Water Monitoring Plan

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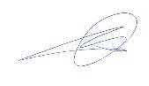
TOMS GULLY UNDERGROUND PROJECT

Water Management Plan

July 2019

Document Control Record

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Abbreviations

Term	Description
AHD	Australia Height Datum
AMD	Acid and Metalliferous Drainage
AMDMP	Acid and Metalliferous Drainage Management Plan
ANCOLD	Australian National Committee on Large Dams
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Annual Recurrence Interval
CIL	Carbon in Leach
CWDB	Clean Water Diversion Bund
DLRM	Department of Land and Resource Management
DME	NT Department of Mines and Energy
DTA	Direct Toxicity Assessment
EIS	Environmental Impact Statement
EP	Evaporation Pond
GDE	Groundwater Dependent Ecosystem
GL	Gigalitre
kg	Kilogram
L	Litre
LOM	Life of Mine
µg	Microgram
µS	Microsiemens
mg	Milligram
MAW	Mine Affected Water
ML	Mining Lease
mL	Megalitre
MMP	Mining Management Plan
NAF	Non-acid Forming
NMD	Neutral Mine Drainage
NTEPA	Northern Territory Environmental Protection Agency
OWRD	Oxide Waste Rock Dump
PAF	Potentially Acid Forming
PG	Primary Gold Limited
PWP	Process Water Pond
ROM	Run of Mine
SD	Saline Drainage
SOCS	Site of Conservation Significance

Term	Description
SSTV	Site specific trigger value
SWRD	Sulfide Waste Rock Dump
TGU	Toms Gully Underground Project
TSF	Tailings Storage Facility
WDL	Waste Discharge Licence
WMP	Water Management Plan
WSD	Water Storage Dam

1. Introduction

The Tom's Gully Mine Project (the Project) is located approximately 90 km southeast of Darwin and 1.6 km west of the Arnhem Highway on Old Mount Bunday Station (PPL 1163, NT Portion 4973). The mine was operational on occasions from 1988 and has been in Care and Maintenance since November 2010 (Figure 1).

Primary Gold Ltd (PGO) acquired the Project in 2013 and proposes to re-commence mining at Toms Gully. The Toms Gully Underground Project (TGU Project) includes the following works to recommence underground mining and ore processing on site:

- Construction of a new 1 GL water supply dam;
- Standalone water treatment plant;
- Retention of the flooded mine pit and decline for tailings and waste rock deposition;
- Underground mining for approximately four years with all waste rock stored underground or in-pit;
- Potential reprocessing of tailings in TSF1 and TSF2 if deemed economic;
- Placement of all existing and future tailings into the existing flooded pit;
- Placement of future waste rock into the existing flooded pit;
- Reuse of the TSF2 if suitable for water storage; and
- Upgrade of the processing circuit.

Project activities have the potential to adversely impact surface water and groundwater quality and quantity. This Water Management Plan (WMP) has been prepared to support the Environmental Impact Statement (EIS) for the project and to address the requirements of the Mining Management Act for TGU. The WMP has reviewed historical information where available and summarises the proposed strategy of the TGU. In addition, it provides a monitoring regime which will be undertaken to gain greater understanding of potential impacts to the surrounding environment. The Project's mining lease numbers are presented in Table 1.

Table 1: Project Tenements

Mineral Lease Number	Area (ha)	Details
MLN1058	681	Centrally located the ML spans previously established Project infrastructure including the pit, underground portals, TSF1, TSF2, SWRD, OWRD and process related infrastructure. Proposed infrastructure will occur on this lease.

ML29812	158	Situated to the north of MLN1058, no mining activities proposed within this ML during the phase of this plan.
ML29814	84	Situated to the south of MLN1058, no mining activities are proposed within this ML during the phase of this plan.

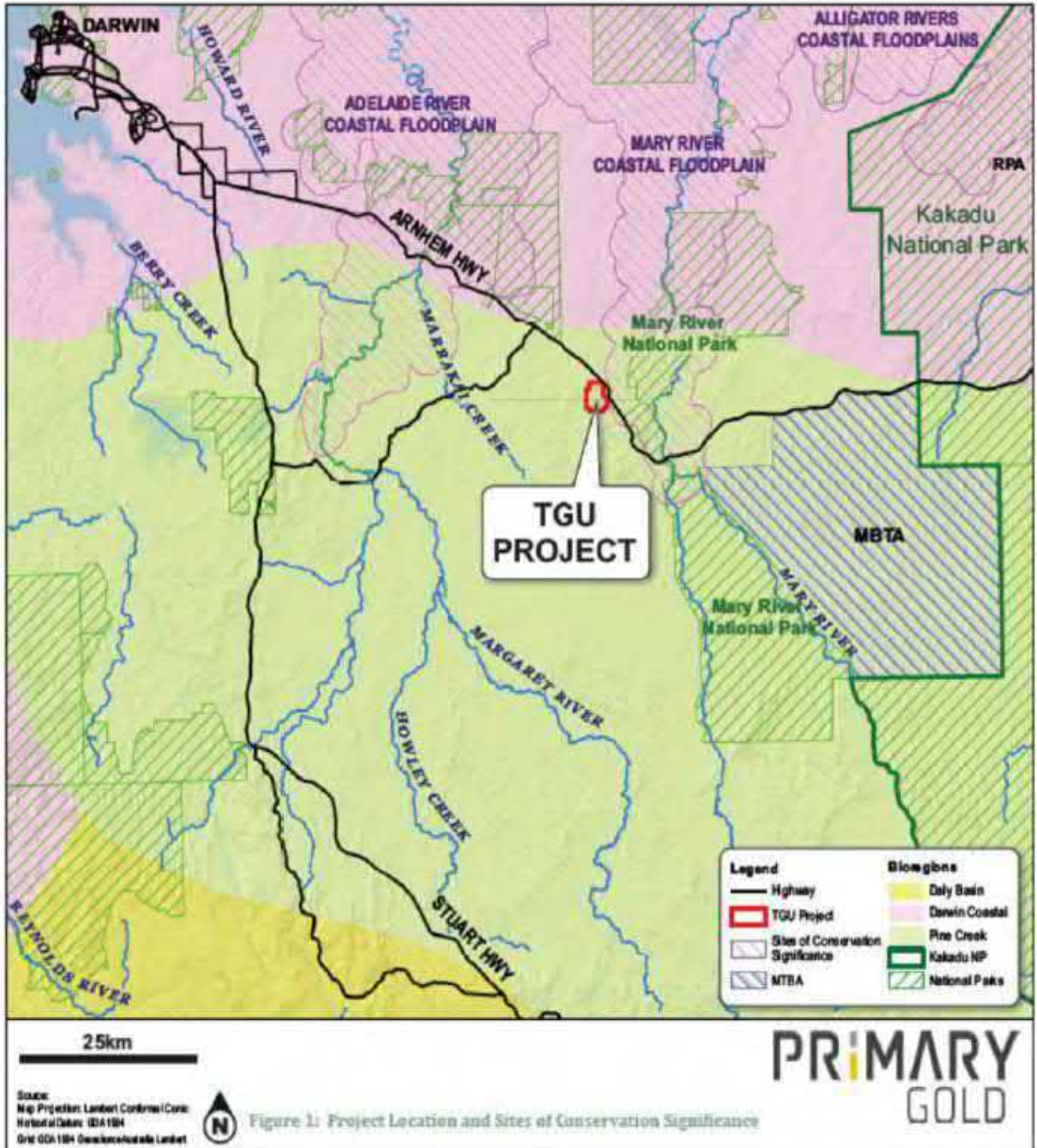


Figure 1: Site Location

1.1. Objectives

The objectives of the WMP at the TGU include the following:

- Managing site waters in accordance with its authorisation to operate under the Mining Management Act. In particular, the Tom's Gully Project Area Authorisation 0740-01.
- Address the knowledge gaps as identified in the NT EPA's comments from the EIS process;
- Define management requirements to reduce potential risk associated with water discharge at the TGU Project including meeting SSTVs for Mount Bunday Creek and Lake Bazzamundi.
- Define the water management requirements for the operational phase of the TGU Project to minimise risk of water discharge from site not meeting SSTVs for Mount Bunday Creek and Lake Bazzamundi.
- Identify the planning requirements for water management for the closure phase of the TGU Project.
- Establish surface water, mine affected water (water in storage onsite), groundwater, mitigation measures and sediment and biological sampling regimes and processes.
- Provide a management process of surface and mine affected water across the TGU to monitor potential impacts and inform management decisions.

1.2. Approach

The WMP forms a key component of the TGU management documentation series. The Plan details strategy and standards for managing different aspects of surface water and groundwater. It is related to plans that deal with general environmental management, rehabilitation, closure and, most particularly, acid mine drainage management. The structure of key Primary Gold documentation is provided in Figure 2.

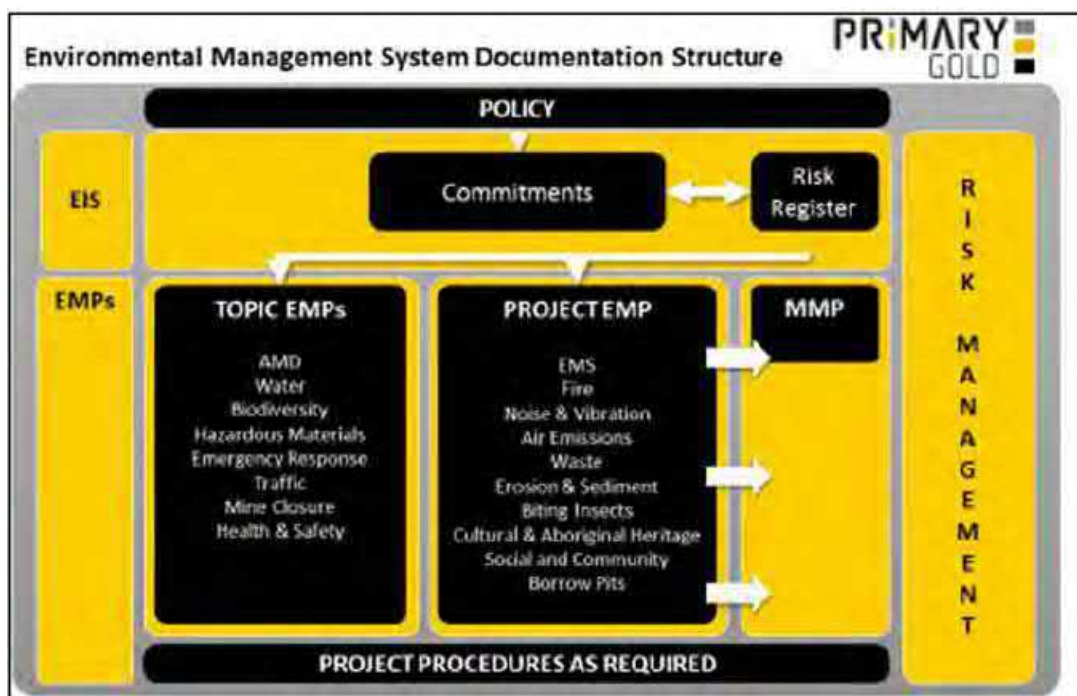


Figure 2: PG Environmental Management Documentation Structure

Reference is provided in Table 2 to the water-related items listed in the Toms Gully EIS terms of reference.

1.3. Term of Plan

Monitoring detailed within the WMP is designed to be undertaken through the life of mine (i.e. locations are to remain consistent and outside of LOM infrastructure). The plan will be continually modified/updated following interpretation of monitoring results and identified knowledge gaps are reduced through actions detailed in Section 3.

1.3.1. Activities during Period

The activities to be undertaken during the first year of operation/construction are detailed in Table 2 below.

Table 2: Summary of Activities Proposed

Activities	Details
WSD construction	Construction of a new water storage dam to contain 1 GL
Standalone Water Treatment plant	Construction of standalone Water treatment plant dedicated to ongoing water treatment during operations
Management and Discharge of excess water	The installation of pumps and treatment facility. Continuously pumping to transfer water from the pit to water treatment plant, evaporation ponds, WSD and eventual discharge to the creeks.
Southern	The conceptual site model highlighted that the southern diversion to

Diversion Bund at Oxide Waste Rock Dump	the south of the Oxide Waste Rock Dump may overtop. Further modelling is required to determine specific levels for construction of the southern bund once completed the bund will be upgraded.
Extraction and Processing	Extraction of gold ore from underground workings and processing through a refurbished plant.
Placement of mine waste rock and process tailings	Deposition of waste rock and tailings produced during operations into the base of the flooded pit.

1.4. Waste Discharge Licenses

PGO understands that a waste discharge license is required in order to discharge waste water into the Mt Bunday Creek, Lake Bazzamundi and beyond the mineral lease boundary. These licenses will be sought prior to recommencement of operations. Table 3 provides a summary of historical licenses sought for the TGU Project.

Table 3: Historical Waste Discharge Licenses

Licence ID	Period	Discharge Locations	Compliance Point and Values	Details
131	12/12/2005 – 31/11/2007	Release Site 1 Evaporation pond discharge (Open Pit water). Release Site 2 Artificial wetland retention water (oxide waste dump runoff) discharge.	Not detailed.	Discharge flow to be $\geq 1:100$ of Mount Bunday Creek. Mount Bunday Creek flow to be ≥ 3.8 m ³ /s. Gauging station height at SWTG2 to be ≥ 1.06 m.
-	2008 and 2009 Wet Season	Release Site 1 Evaporation pond discharge (Open Pit water). Release Site 2 Artificial wetland retention water (oxide waste dump runoff) discharge.	SWTG2 ANZECC 80% Guideline Values (Crocodile Gold, 2009).	Crocodile Gold was granted an extension to Licence No. 131 and undertook sampling in accordance with the licence requirements (Crocodile Gold, 2009).
131-01	01/02/2013 – 31/08/2014	SWTG12 Concrete weir at wetland oxbow overflow point.	SWTG2 ANZECC 80% Guideline Values (NT EPA, 2013)	Draft licence issued based on treatment prior to discharge from site restricted to SWTG12 and compliance with

Licence ID	Period	Discharge Locations	Compliance Point and Values	Details
				ANZECC 80% at SWTG2.

*Annual Monitoring Report, Toms Gully Mine Waste Discharge License No. 131: 2008-2009 Wet Season. October 2009.

*NT EPA Draft Waste Discharge License No. 131-01, Commencement Date February 2013 to 31 August 2014. 2013.

2. Current Site Conditions

2.1. Climate

The climate of the Darwin–Katherine region is broadly classified as tropical monsoonal. Two distinct seasons can be identified, with two transitional periods between them. The dry season occurs from May to September. The hot, ‘dry-wet’ transition period from October to November has high humidity. The wet season occurs from December to March. The hot, ‘wet-dry’ transition period of April has variable winds, though dominantly westerly. Virtually all rainfall occurs in the wet season and rainfall intensities are high, being typical of the wetter portions of the north western regions of Australia. Over half the cyclones generated in the northern region of Australia move either southwest or southeast into adjoining region. Therefore the Tom’s Gully project area is an area where cyclone activity is probable.

As site-specific climatic records (except for rainfall) do not exist, regional data was obtained from the Bureau of Metrology (BoM) Middle Point Rangers monitoring station (BoM station no. 014090) (BoM 2018) located approximately 33 km north of the project area. The monthly mean maximum temperature or the region is 33.1 °C with the mean minimum temperature at 20.9°C. The mean rainfall in the region during the wet season is 1423.3 mm. Maximum rainfall occurs between January and March (BoM 2018).

2.2. Surface Water

The site is located within the Mount Bunday and Coulter Creek catchments, both part of the broader Mary River Catchment. Historically, Mount Bunday Creek receives the majority of water released from the site. Generally the surrounding catchment comprises a series of small ridges and dissected hills that are drained by small, steep rivulets, which converge into Mount Bunday Creek. The majority of Mount Bunday Creek upstream of the Project area consists of outcropping rock with thin soil cover and shallow alluvium within drainage lines.

Mount Bunday Creek flows west to east along the northern section of the project area. Coulter Creek is a tributary of Mount Bunday Creek and flows southwest to east (to the south of the project area). Coulter Creek flows into Mount Bunday Creek downstream of the project area and monitoring point SWTG2 (Figure 6).

Surface water from the site ultimately flows from Mount Bunday Creek and Coulter Creek to Hardies Creek to the Mary River. A summary of distances from the two discharge points from site are provided in Table 4.

Table 4: Surface Water Flow Distances

Location		Distance (m)	Details
Point A	Point B		
Mount Bunday Creek			
DP1	SWG2	1,320	Lease boundary location for onsite flows transferred into Mount Bunday Creek (DP1) to sampling location SWTG2 at the Arnhem Highway crossing of Mount Bunday Creek.
SWG2	SWG3	6,186	Arnhem Highway crossing to the furthest downstream monitoring location on Mount Bunday Creek (SWG3) receiving discharge from DP1 only.
SWG3	Mount Bunday / Coulter Creek Confluence	1,410	Furthest monitoring point (SWG3) to the confluence with Coulter Creek and DP2 discharged water.
Coulter Creek			
DP2	CK7	1,420	Lease boundary location for onsite flows transferred into Coulter Creek (DP2) to sampling location CK7 at the Arnhem Highway crossing of Coulter Creek.
CK7	Mount Bunday / Coulter Creek Confluence	3,127	Arnhem Highway crossing to confluence with Mount Bunday Creek.
Hardies Creek and Mary River			
Mount Bunday / Coulter Creek Confluence	Hardies Creek	2,861	Confluence of the Mount Bunday Creek and Coulter Creek to Hardies Creek.

Hardies Creek	Mary River Floodplain	15,800	Hardies Creek to where its flow levels out and discharges into the Mary River Floodplain
Mary River Floodplain	Mary River Flow Channel	1,625	Mary River Floodplain to the main Mary River Flow Channel.

Site of Conservation Significance

Downstream of Toms Gully the Northern Territory Parks and Wildlife Commission have designated the Mary River Coastal Floodplain a Site of Conservation Significance (SOCS). The SOCS encompasses an area of approximately 1,674 km² and is predominantly a seasonally inundated freshwater floodplain. The site shares boundaries with the Adelaide River coastal floodplain to the west and the Alligator Rivers coastal floodplain to the east. The floodplains of the Adelaide, Mary and Alligator Rivers form a large interconnected wetland system each wet season (DLRM, 2015b). The SOCS is also listed as a wetland of national significance in the Directory of Important Wetlands in Australia (DLRM, 2015a).

A summary of the SOCS declarations is provided in Table 5.

Table 5: Mary River Coastal Floodplain SOCS

Land Use	Significance Rating	Ecological Values	Management Issues	Distance from Lease Boundary
Mainly pastoral operations with minor conservation, recreation, tourism and mining. Approximately 30% of this site is managed as conservation reserves.	International significance	The floodplain is the most significant and reliable breeding site for Magpie Goose in the NT, and numbers exceed 400 000 birds in some years. The floodplain Environments provide a major breeding area for many fish species, notably Barramundi. 12 threatened species occur on the floodplain, including the Vulnerable Yellow	Spread of environmental weeds (including Mimosa pigra, olive Hymenachne and para grass) and saltwater intrusion (in lower portion)	Designated SOCS boundary is located adjacent to SWTG2 and the lower section of Coulter Creek prior to CK7 is located within the area.

		Chat (Alligator Rivers subspecies).		

Declaration of Beneficial Uses

Mount Bunday Creek is approximately 30 km long, with approximately 13 km upstream of the mine site. The creek has several tributaries upstream of the Project area and ultimately drains into Hardies Creek then the Mary River. The *Water Act* provides a framework for the declaration of beneficial use and objectives in the Northern Territory. Currently the Mount Bunday Creek Beneficial Use Declaration (1997) states that stock water supply is the beneficial use extending from the Arnhem Highway Crossing approximately 3 km downstream (i.e. downstream of SWTG2).

The remainder of Mount Bunday Creek has aquatic ecosystem protection objectives defined as fresh waters aquatic ecosystem protection guidelines (ANZECC, 1992). However, this guideline has been superseded by ANZECC (2000).

2.3. Local Flood Modelling

An initial Flood Risk Study was completed in September 2015 to establish potential 1 in 100 year Annual Recurrence Interval (ARI) storm event or 72-hour duration storm. This flood modelling used a rainfall-runoff model (XPRAFTS) and hydraulic flood routing model (HECRAS) (GHD 2015). This flood modelling was updated in 2018 and 2019 to include more detailed two dimensional (2D) flood modelling to gain an improved estimate of flood regimes within the vicinity of the mine and review the new Boxcut potential to flood (Appendix L in Toms Gully EIS Addendum to the Supplement - GHD 2019).

2.3.1. Methods

In 2018, the two-dimensional flood model was developed for the site using the TUFLOW modelling package. The TUFLOW model included a digital elevation map (DEM) that was derived from detailed airborne LiDAR survey (LiDAR) of the site and some of the surrounding area conducted in 2017. The LiDAR survey allowed for the inclusion of dams, channels and other hydraulic features in the TUFLOW model. The TUFLOW model was used to estimate the flood response of Mount Bunday Creek in response to the 10 year, 50 year, 100 year, and 1000 year average recurrence interval (ARI) design storm events, with durations ranging from 30 minutes to 72 hours ((Appendix L - GHD 2019)).

The TUFLOW model was also used to estimate the probable maximum flood (PMF) in response to the probable maximum precipitation (PMP). The PMP was estimated using the Revised Generalised Tropical Storm Method (GTSMR), with durations from 12 hours to 120 hours.

2.3.2. Results

The modelling indicates that flood events within Mount Bunday Creek up to and including the 1000 year

ARI design event are not expected to overtop the flood protection measures associated with the existing open cut pit and TSF2. However, the Probable Maximum Flood (PMF) is expected to result in flood inrush into the existing open cut pit and is at a level that appears to be close to flooding TSF2 (Appendix L - GHD 2019).

The modelling indicates that the flooding during the 1000 year ARI flood event within Mount Bunday Creek is not expected to result in overtopping of the dam wall associated with Evaporation Pond 2. Similarly, local runoff is expected to be generally contained within EP2 for the 1000 year ARI flood event. The modelling indicates that the wetlands oxbow is expected to be inundated during the 10 year ARI flood event, with depths during the 100 year ARI flood event exceeding three metres at some locations within the wetlands oxbow albeit with relatively low velocities. The modelling indicates that the natural dam wall that forms Lake Bazzamundi is expected to overtop, with elevated flow velocities at the ends of the dam wall (GHD 2018).

The new Boxcut is located outside of the maximum modelled flood extents.

In order to ensure the mine features remain unaffected by flooding, existing flood protection measures Regular inspections and maintenance of flood protection levees, dam walls and hydraulic structures will be undertaken prior to recommencement of mining operations.

2.4. Surface Water Infrastructure

2.4.1. Existing

Surface water on site is stored within several structures which have been constructed during the mine's previous operating periods. A summary of existing water management infrastructure is provided in Table 6 and the infrastructure is illustrated in Figure 3.

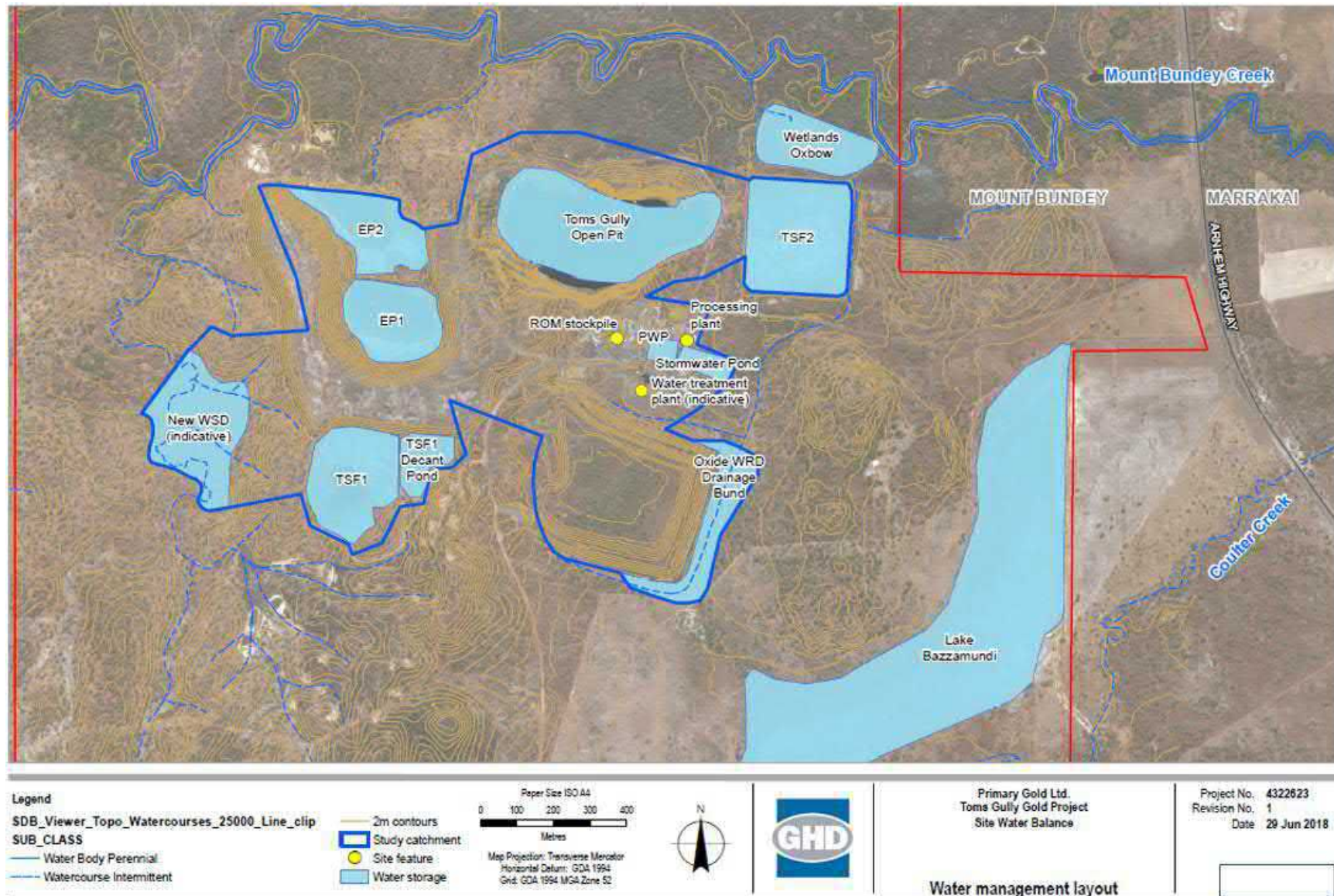


Figure 3: Location of Surface Water Structures

The estimated volumes stored in each structure were calculated by Coffey in May 2015 (Coffey 2015a). Current volume estimates are adopted based on data reported by Crocodile Gold Australia Operations Water Management Plan 2012-2013 and adjusted by Primary to take into consideration the filling of the pit since 2015.

The largest volume of water onsite is contained within the Open Pit and when combined with the underground operations volume these total approximately 4,400 ML.

Table 6: Existing Water Management Infrastructure

Structure	Max Volume (ML)	Current Volume (ML)	Surface Area (m ²)	Depth (m)	Catchment Area (m ²)	Sample Point ID
Open Pit	4,660	4,400	90,000	88.3	346,500	TGM Pit
Underground Operations	140	140	-	-	-	-
Evaporation Pond 1	346	69	46,700	8	162,800	EP1
Evaporation Pond 2	354	71	47,900	8	98,000	EP2
Tailings Storage Facility 2	75.3	15	75,300	1	91,400	SWTG TAILS 2
Proposed Water Storage Dam	1000	NA	160,000	7.5	160,000	TBA
Stormwater Overflow Pond	12.5	-	6,000	3	57,100	-
Drainage Bund	5	-	74,400	0.3	100,000	-
Wetlands Oxbow	30	3	29,900	1	550,100	SWTG11 (entrance) SWTG6 (middle) SWTG12 (discharge)
Mill Process Water Pond	1.4	-	400	8	0	RO Pond
Tailings Storage Facility 1	88.9	6	59,300	1.5	230,800	SWTG TAILS 1
Old Decant Pond	46.3	1	11,600	4	40,000	ODP

Structure	Max Volume (ML)	Current Volume (ML)	Surface Area (m ²)	Depth (m)	Catchment Area (m ²)	Sample Point ID
Oxide Waste Rock Dump	No data	No data	No data	No data	No data	OWRD
Lake Bazzamundi	50	20	167,500	1	1,712,500	SWTG5

2.4.1. Proposed

The water storage dam (WSD) is proposed to be constructed. WSD will be constructed to the west of the existing SWRD. The positioning of the WSD has been established based on the location of competent ground (i.e. not situated on the fault window and/or over historical resource drilling locations). Details are provided in Table 7.

In addition to the WSD, the remediation of TSF1 and TSF2 and repurposing to a sediment basin and water storage dam respectively, and rehabilitation of the Process Water Pond (PWP) will be undertaken.

Table 7: Design Details for Proposed and Amended Infrastructure

Catchment Area (m ²)	Surface Area (m ²)	Max Volume (mL)	Depth (m)	Overflow	Sample Point ID
WSD					
160,000	160,000	1,000	7.5	The structure will have an emergency overflow to Mount Bunday Creek	WSD
Commitment 1	PGO will complete the detailed design for the WSD and provide it to the Department of Primary Industry and Resources for review and approval prior to construction.				
				Date:	tbc
TSF1 and TSF2					
Commitment 2	The tailings management strategy (including tailings removal) and, TSF1 and TSF2 remediation and reuse design will be completed and provided to the Department of Primary Industry and Resources for review and approval prior to modification and use.				
				Date:	tbc

2.5. Water Infrastructure Flow Transfers

The majority of infrastructure onsite will be managed with pumped transfers to structures with sufficient capacity prior to discharge. A summary of surface water management for the operation and during emergency situations is provided in Table 8.

In general, the water currently stored in the Open Pit and Underground Mine will be treated (insitu) using

either lime, caustic or Virtual Curtain. Water displaced through the placement of tailings and waste rock will be processed through a water treatment facility then stored in the WSD. The treatment will be the Bioaqua Process technology developed by Global Aquatica (or contingency option - Caustic Soda and Reverse Osmosis) that increases the pH and reduce metal loads to the site-specific target values and water quality levels in Appendix Q Toms Gully EIS Addendum to the Supplement.

A detailed site water balance is provided in Appendix O in Toms Gully EIS Addendum to the Supplement

Table 8: Water Transfers Management

Structure	Operational		Emergency Spillway Level (m AHD)
	Input	Output	
Open Pit / Underground Mine	Seepage or displaced water	Pumped to treatment plant then WSD or discharged.	n/a
		Pumped to Lake Bazzamundi (treatment if required).	
WSD (proposed)	Pumped treated water from the Open Pit, stormwater pond, evaporation pond 1 and 2 (following treatment).	Pumped to PWP. Seepage. Evaporation. Controlled discharge to Mount Bunday Creek or transferred to third party. Dust Suspension.	n/a
Evaporation Pond 1	SWRD seepage and runoff. SWRD Sump.	Pumped to PWP. Pumped for treatment and to WSD. Seepage. Evaporation.	1029.35
Evaporation Pond 2			1025.76
TSF2	Pumped tailings from process circuit.	Pumped to PWP. Pumped for treatment and to WSD. Seepage. Evaporation.	n/a
Process Water Pond	Pumped transfer from WSD EP1, EP2 and TSF2 (i.e. repurposed water storage).	Pumped to process circuit. Evaporation.	n/a
Wetlands Oxbow	OWRD runoff from OWRD diversion	Passive overflow to Mount Bunday Creek	n/a

Structure	Operational		Emergency Spillway Level (m AHD)
	Input	Output	
	bund.	or pumped for treatment. Seepage.	
Lake Bazzamundi	Dewatering bores.	Passive overflow to Coulter Creek.	n/a

2.5.1. Removal of Displaced Water Toms Gully Pit Methodology and Operational Underground dewatering.

PGO requires the displaced water from the pit to be removed during operations. The main method of removal will be to pump the pit water for treatment or the evaporation ponds then to the new water storage dam or evaporation ponds. At these points, the water balance can be managed as required with the assistance of a combination of assisted evaporation, treatment and discharge.

PGO is planning to establish a combination of temporary and whole mine life infrastructure that will be installed prior to and during operations.

Temporary infrastructure includes:

- Pumps in the pit depending on the stage of water removal
- Generators for the pumps
- HDPE pipes

Pumping will utilise pontoon mounted, diesel/electric pumps of up to 20 litres per second capacity to provide sufficient volume for high intensity monsoonal events. Pumped water will be reticulated to the evaporation ponds and water treatment plant using 110mm PN16 HDPE pipeline.

Operational underground dewatering will utilise electric submersible on positive displacement pumps of up to 35 litres per second capacity. Pumped water will be reticulated to the evaporation ponds and water treatment plant or discharged (if quality meets SSTVs) using 150mm PN16 HDPE pipeline.

Permanent infrastructure includes:

- New Water Storage Dam
- Water Treatment Plant

Primary will construct the WSD when required. While the WSD is being constructed temporary infrastructure will be installed to enable pumping to the evaporation ponds and treatment via the water treatment plant.

2.5.2. Offsite Compliance Points

Discharge points are the lease boundary for watercourses passing through the lease. Mine affected water is collected in the Open Pit, EP1, EP2, TSF1, TSF2 and stormwater pond. Water captured within these

locations will be assessed through the monitoring program (Section 5.1) and is to be treated if required. Non-mine affected water is transferred through the site via clean water levees and/or waterways. For the transfer of water to a third party compliance monitoring will be at the pipe discharge point (i.e. for when it is transferred to the pastoralist).

For the purpose of the future waste discharge licence, discharges from storm water ponds and site will be regulated at two locations as per Table 9.

Table 9: Compliance Monitoring Points

Location ID	Description	Coordinates	
		Easting	Northing
DP1	Situated on the Mount Bundey Creek at the lease boundary The majority of flow transferred offsite flows through DP1. Including the proposed WSD controlled discharge and passive Wetland Oxbow discharge.	778737	8580370
DP2	Situated on Coulter Creek at the lease boundary. DP2 does not receive surface water flows from the site.	779217	8578700

2.6. Groundwater

A summary of the groundwater at the site has been referenced from AGE Groundwater Assessment and Modelling of inflow into the underground workings and consequential pumping out of the mine. The report has been provided in Appendix R in Toms Gully EIS Addendum to the Supplement. A summary of historical groundwater investigations is provided in Table 10.

Table 10: Summary of Hydrogeological Investigation Reports

Source	Title	Date	Details
Coffey & Partners Pty Ltd	Geotechnical and hydrogeological investigation for proposed mine at Toms Gully, NT	1988	Coffey & Partners Pty Ltd, (1988) provide a geotechnical and hydrogeological assessment of the Project site to allow design of the mine, plant, and tailings storage facilities. The assessment included geotechnical examination of the site and an assessment on the likely groundwater inflows into the pit.
Dames & Moore Pty Ltd	Toms Gully Gold Mine - water quality monitoring,	1991	Dames & Moore Pty Ltd, (1991) provide details on establishing a water quality monitoring network. The investigation includes the installation of ten groundwater monitoring bores, nine of which are to be incorporated

	installation phase		into the water quality monitoring network. In total the network consists of 13 groundwater sampling points and seven surface water sites.
Dames & Moore Pty Ltd	Toms Gully Gold Mine - water quality monitoring, April 1993 site visit	1993	Dames & Moore Pty Ltd, (1993) presents and interprets surface water and groundwater quality data and provides recommendations for future monitoring of groundwater at the Project site.
Rockwater Pty Ltd	Results of dewatering investigation - Toms Gully Gold Mine, Northern Territory	1993	Rockwater Pty Ltd (1993) presents an assessment of the dewatering requirement of the open cut. The assessment includes a single pumping test (DB2) to estimate hydraulic parameters. A Numerical groundwater model using MODFLOWEM was then used to simulate pit dewatering.
Rockwater Pty Ltd	Initial report on groundwater supply - Toms Gully Gold Mine, Northern Territory	1994	Rockwater Pty Ltd (1994a) provides an initial assessment of the groundwater regime based on existing data and proposes drilling and testing program for developing and testing the groundwater supplies.
Rockwater Pty Ltd	Predictions of pump age required to dewater pit in three months - Toms Gully Gold Mine, Northern Territory	1994	Rockwater Pty Ltd (1994b) outline the pumping requirements required to dewater the existing pit within three months. The predictions were based on a numerical model to simulate the dewatering requirements.
Rockwater Pty Ltd	Bore completion report - Toms Gully Gold Mine, Northern Territory	1995	Rockwater Pty Ltd (1995) installed six groundwater exploration holes (WB1 to WB6), and four production bores (WB1P, WB4P, WB5P, and WB6P). A 48 hour constant rate pumping test was completed on each production bore to determine hydraulic properties for the groundwater system.
Evantech Pty Ltd	Disposal of excess water and dewatering of Toms Gully	1997	Evantech Pty Ltd (1997) provide a short summary of issues surrounding disposal of excess water at the Project site.
Water Studies Pty Ltd	Toms Gully Gold Mine - Pit dewatering assessment	2000	Water Studies Pty Ltd (2000) completed a groundwater inflow assessment for the Open Pit and water balance simulations to assess the potential to dewater the pit during the 2000 dry season.
H2O Pty Ltd	Rehabilitation Report	2001	H2O Pty Ltd (2001) completed a rehabilitation program on four bores, DB2, P62, P68, and P73 which included jetting and surging or airlifting each bore between four hours and 11 hours.
Australasian Groundwater	Hydrogeological	2004	Australasian Groundwater and Environmental Consultants

and Environmental Consultants Pty Ltd	- dewatering study, Toms Gully Gold Mine, NT Dewatering requirements for underground development, Toms Gully Gold Mine, NT		Pty Ltd (2004a, and 2004b) completed two reports providing a hydrogeological assessment of the proposed area with the objective of dewatering the underground workings. The assessments include proposed dewatering volumes and recommendations for installing a groundwater monitoring network and testing regime.
Coffey	Toms Gully Gold Mine Water Balance Model	2015	Water balance
Australasian Groundwater and Environmental Consultants Pty Ltd	Toms Gully review	2015	Review of groundwater inflow data collected since 2005. The previous numerical model was updated to provide groundwater inflow estimates to the existing and proposed underground mine areas.
Australasian Groundwater and Environmental Consultants Pty Ltd	Toms Gully second review	2015	Review of previous reports, updating of conceptual hydrogeological model, development of updated monitoring network to define baseline conditions and assess future impacts on water levels and chemistry and assessment of impacts from dewatering, surface water, tailings and waste rock storage. The report included a description of baseline geochemistry and hydraulic properties
GHD	Toms Gully EIS – Baseline Studies Groundwater Assessment & Modelling	2018	Define the current baseline hydrogeology of the site and provide a basis from which to identify existing conditions including hydrogeological impacts from previous mining operations, and against which to measure future hydrogeological impacts of the proposed mining operations

2.6.1. Geology

Soil cover is generally thin (0.5 to 4m) and alluvial sediments are confined to present day drainage features and not laterally extensive. The surface elevation of the Project site reaches 51 m Australian Height Datum (AHD) in the southwest corner of the ML and falls to 16 AHD in the low-lying areas.

A summary of the local geology is provided in Table 11.

Table 11: Summary of Local Geology

Area	Description
Geology	
Alluvium	Mount Bundey Creek crosses the Project area approximately 300 m north of the Toms Gully Pit. The thickness or presence of alluvium associated with this water course is unknown. A review of aerial photography suggests, if present, it is confined to the present day channel and not laterally extensive.
Wildman Siltstone	The Wildman Siltstone part of the Mount Partridge Group and the Woodcutters Supergroup consists of predominantly banded, dark grey siltstone, and black, silty shale, with beds of quartz sandstone. The sediments were deposited in a shallow marine, prodelta or mid-shelf depositional setting during the Orosirian (2029 Ma to 1890 Ma) geologic period. The Wildman Siltstone is the host rock at the site.
Cullen Supersuite	The Cullen Supersuite comprises of a number of I-type granitic plutons which formed approximately 1835 Ma to 1820 Ma. The Mount Bundey Suite is part of the Cullen Supersuite and comprises of the Mount Bundey Granite and the Mount Goyder Syenite. The Mount Goyder Syenite outcrops to the east of the Open Pit and the Crabb Fault. The intrusion was intersected by the decline. The intrusion has produced an approximately 500 m wide hornfelsed aureole in the siltstone which is generally more resistant to weathering compared to the intrusion.
Lamprophyre Dykes	Lamprophyre dykes have been identified within pre-existing structures at Toms Gully Mine. Although the dykes intrude both members of the Mount Bundey Suite, they are thought to be co-genetically and temporally related to the granitoids.
Geological Structures	
Folding	A series of gentle folds are mapped across the Project site including a fold in the pit wall. The fold axes trend north-northeast and plunge gently to the south, parallel to the plunge of the quartz vein.
Crabb Fault	The Crabb Fault is a south-southwest trending fault which dips to the west at approximately 80 degrees. The Crabb fault intersects the eastern

Area	Description
	end of Toms Gully Open Pit and represents the eastern extent of gold mineralisation. Although the apparent displacement of the Crabb Fault is small, the quartz vein steepens significantly to the east of the fault and changes in strike from east- west to northeast-southwest. The nature of the Crabb Fault zone is highly variable, at the Open Pit high wall the fault is a fractured rock mass up to 15 m wide and has resulted in slope failures during mining. However, at the low wall there is little evidence of the fault. Where the fault has been intruded by dykes, the material is often highly weathered and of very low strength.
Williams Fault	The Williams Fault is located approximately 400 m west of the Crabb Fault and is believed to be the western extent of the ore zone. Previous investigations suggest that there is approximately 15 m displacement along the Williams Fault at the Project site. Dyke intrusions have been identified at random locations along the fault trace, with localised quartz infilling.

2.6.2. Groundwater Distribution

Previous reports indicate three groundwater systems are present within the Project site:

- **Upper weathered profile (within the Wildman Siltstone).**

The weathered profile extends to a depth of 40 m below ground with enhanced primary porosity and higher storage due to the weathering of the siltstone (Coffey & Partners Pty Ltd, 1988).

- **Fresh Wildman Siltstone.**

Groundwater within the fresh siltstone is contained within the secondary porosity of the unit. The degree of fracturing is highly heterogeneous with the most intensive fractures along the fold axes of a series of gentle open folds which trend approximately north-south across the Project site. Where the siltstone is relatively flat bedded, there is minimal fracturing and the siltstone is either dry or produces low yield. Previous studies have noted that water inflows during drilling increased significantly when the ore zone was intersected (Coffey & Partners Pty Ltd, 1988).

- **Orebody and the Crabb Fault.**

The Crabb Fault zone, which defines the eastern extent of the ore zone and consists primarily of quartz

laminated with black shale and sulphides, is highly permeable near the Open Pit (Rockwater, 1995). However, the hydraulic nature of the fault is considered variable due to localised changes in geology.

Recharge, Flow, and Discharge

Groundwater levels are between ground level and 50 m below ground, although generally less than 20 m. Previous reports indicate that seasonal variation in groundwater levels appears to be in the range 1 m to 2 m (Coffey and Partners, 1988).

During previous mining, dewatering in the Open Pit and underground formed a significant groundwater sink and mounding below the tailings storage facilities will result in outward migration of groundwater below these sites. Groundwater contours from a recent survey indicate groundwater now flows from southwest to northeast.

Recharge to the weathered sandstone is via direct surface infiltration of rainfall. Recharge to the sandstone fractured groundwater system, and the ore zone and Crabb Fault is via direct infiltration where it outcrops and via seepage from the overlying weathered siltstone.

Yield and Use

The overlying siltstone/shale sequence is an aquifer with generally moderate to poor yield of between about 0.5 L/s to 3 L/s. The ore zone is the primary aquifer producing yields near the Open Pit of up to 20 L/s. Previous studies indicate the hydraulic conductivity of the ore zone reduces with depth where it is more hornfelsic and siliceous, and less fractured.

A review of the NT Water Data Portal (Department of Land Resource Management, 2015) indicates a total of 39 registered bores within 5 km of the Project site. Twenty of these are bores which are within the mine lease and are associated with the mine. The remaining 19 bores consist of 13 production bores, one irrigation bore, one domestic bore, and four bores which are classified as abandoned, investigation, or not in use due to low yield.

Groundwater Dependent Ecosystems

GDEs are areas that potentially access subsurface groundwater to meet all or some of the GDE water requirements. The potential GDEs include terrestrial vegetation, subsurface fauna communities (e.g. burrowing crayfish), and vegetation associated with surface water bodies.

The areas which show a moderate to high GDE potential are associated with existing creek channels, flood plain areas or shallow alluvium.

2.6.3. Groundwater Infrastructure

Groundwater infrastructure at the site comprises monitoring bores and production bores which are also included within the monitoring program. A summary of installation details are provided in Table 12 and displayed in Figure 4.



Figure 4: Existing Groundwater Bores

A series of proposed monitoring bores have been identified to address potential information/monitoring gaps. These locations proposed include:

- **MB1A and B**
Nested (shallow and deep) bores to monitor northern boundary including alluvial sediments and potential offsite migration of mine affected groundwater.
- **MB2A and B**
Nested (shallow and deep) bores to monitor northern boundary including alluvial sediments and potential offsite migration of mine affected groundwater.
- **MB3A and B**
Nested (shallow and deep) bores to monitor southern boundary and east of Crabb Fault. The location is considered to form the up-gradient monitoring bores.
- **MB4A**
Bore to monitor southern boundary and west of Crabb Fault. The location is considered to form the up-gradient monitoring bores.
- **MB5A and B**
Nested (shallow and deep) bores to monitor potential downstream impacts of Lake Bazzamundi irrigation field.
- **MB6A and B**
Nested (shallow and deep) bores to monitor potential downstream impacts of TSF2.

Table 12: Groundwater Infrastructure

Monitoring Bore	Coordinates		Elevation at TOC (m AHD)	Depth (m BGL)	Screen Interval (m BTOC)		Date Installed
	Easting	Northing			Top	Bottom	
Current Monitoring Bores							
WB1P (Ridge Bore)	777559	8579124	50.45	-	-	-	-
WB5P	776808	8579425	31.82	106.88	58.8	106.9	19/11/94
BORE 11	777288	8579016	48.42	-	-	-	-
OB11	777186	8580322	23.41	-	-	-	-
G1	777009	8580348	26.34	15.5	13.5	15.5	18/09/91
G2	777683	8579727	45.23	21.5	19.5	21.5	18/09/91
G8	777021	8580019	38.06	26	22	26	20/09/91
G9	777663	8580478	24.25	30.5	28.5	30.5	21/09/91
RN29694 (WB4)	776935	8580080	31.35	95.83	42	95.8	21/11/94

Monitoring Bore	Coordinates		Elevation at TOC (m AHD)	Depth (m BGL)	Screen Interval (m BTOC)		Date Installed
	Easting	Northing			Top	Bottom	
P100	778275	8580155	20.73	-	-	-	-
Proposed Monitoring Bore							
MB1A	777865	8580644	tbc	tbc	tbc	tbc	tbc
MB1B			tbc	tbc	tbc	tbc	tbc
MB2A	778239	8580626	tbc	tbc	tbc	tbc	tbc
MB2B			tbc	tbc	tbc	tbc	tbc
MB3A	776856	8578628	tbc	tbc	tbc	tbc	tbc
MB3B			tbc	tbc	tbc	tbc	tbc
MB4A	777557	8578613	tbc	tbc	tbc	tbc	tbc
MB5A	779518	8580024	tbc	tbc	tbc	tbc	tbc
MB5B			tbc	tbc	tbc	tbc	tbc
MB6A	778713	8580344	tbc	tbc	tbc	tbc	tbc
MB6B			tbc	tbc	tbc	tbc	tbc
Historic Monitoring Bore							
S01	777477	8579112	51.29	-	-	-	27/04/15
W6	777330	8579561	43.85	55	40	55	14/06/88
No. 1	777330	8579561	43.85	79	67	79	15/11/87
WB2 (Oxide dump bore)	777680	8579480	45.2	-	-	-	10/11/94
WB6P (Tailings bore)	777316	8579631	45.47	108.32	60.6	108.3	24/11/94
DB2	777879	8579910	34.47	110	95	110	18/07/93
DB1	777746	8579911	46.95	132	78	132	14/07/93
W7	776930	8579990	32.94	93	78	93	16/06/88
W4	776930	8580160	32	73	63	73	9/06/88
W5	776930	8580300	27.13	65	50	65	12/06/88
RN035637	777580	8580319	28.34	-	-	-	22/02/07
W01	778353	8580376	21.4	-	-	-	17/06/05
W02	778354	8580441	21.76	-	-	-	17/06/05
WB3	778340	8580420	21.55	-	-	-	13/11/94
P90	778124	8580051	26.8	-	-	-	-
P62	777751	8580001	35.04	-	-	-	-
P68	777782	8579972	38.97	-	-	-	-
P73	777850	8579991	30.21	-	-	-	-
Gully Bore	777385	8579183	48.05	-	-	-	-

Monitoring Bore	Coordinates		Elevation at TOC (m AHD)	Depth (m BGL)	Screen Interval (m BTOC)		Date Installed
	Easting	Northing			Top	Bottom	
G3	777352	8580420	22.52	18	12	18	18/09/91
G4	777373	8580051	31.72	42	30	42	18/09/91
G5	778253	8579448	32.05	10.5	8.5	10.5	19/09/91
G6	777182	8579325	38.9	42.5	36.5	42.5	19/09/91
G7a	777246	8580558	22.72	18.5	16.5	18.5	20/09/91
G7b	777246	8580541	22.72	38	32	38	22/09/91
G10	777546	8579602	45.23	-	-	-	21/09/91
OB10	777296	8580330	23.6	~30	-	-	-
RN034537	778581	8579656	37.98	242	84	242	7/05/05
RN034538	778581	8579656	37.98	187.7	44	187.7	12/05/05

Note: Not all bores indicated above are present.

TOC: Top of Internal Casing

BTOC: Below top of internal casing.

Commitment 3

Monitoring bore census to review the monitoring network and establish depth of screens, condition and potential rehabilitation plan. The census will inform locations of additional monitoring bores to provide effective coverage.

Due Date **TBC**

Commitment 4

Installation and/or rehabilitation of groundwater monitoring bores to provide upstream, mid and downstream coverage of infrastructure and underground operation. The installation will include MB1A, MB1B, MB2A, MB2B, MB3A, MB3B, MB4, MB5A, MB5B, MB6A and MB6B.

Due Date **TBC**

Commitment 5

Installation of flow meters and water storage gauges to validate the water balance model. Weekly readings will be collected on all transfers across site and storage levels.

Due Date **TBC**

3. Information/Knowledge Gaps

The following information and knowledge gaps have been identified and provided in Table 13.

Table 13: WMP Knowledge Gaps

Area	Details	Priority	Timeframe
Surface Water	Water Treatment Strategy Five treatment options were investigated with the selected treatment option being selected. The preferred option was the Bioaqua Process supplied by Global Aquatica (or contingency option). Approval has been gained for a field trial using a pilot plant. Proposed water quality is intended to meet Site Specific Trigger Values. Discharge Management Plan Discharge management has not been determined as part of this WMP and will be established based on the feedback of the pilot plant field trials. In general, • <i>Water Treatment Strategy</i> As above. • <i>Mixing Zone Modelling</i> Monitor at the discharge point and monitor the mixing zone to assess trends over time and to detect changes in water quality.	High	Pre-mining
Groundwater	Groundwater Bore Census and Installation The census will inform locations of additional monitoring bores to provide effective coverage and confirm groundwater bores to be installed with automated water level loggers. Installation and/or rehabilitation of groundwater monitoring bores to provide upstream, mid and downstream coverage of infrastructure and underground operation. The installation will include MB1A, MB1B, MB2A, MB2B, MB3A, MB3B, MB4, MB5A, MB5B, MB6A and MB6B.	Medium	Pre-mining
	Groundwater Modelling Ongoing modelling to assess the post-closure risks and impacts associated with the Toms Gully Site. The model should be used to assess long term closure options for the site. Model will include tailings and waste rock in the pit.	Medium	Operation

Area	Details	Priority	Timeframe
	Contaminant Transport Modelling Ongoing work on contaminate modelling using additional information from the bores to be established (as above). The data will be utilised to enable the model to be further refined to assess groundwater plumes, sources, mitigation measures for long term site remediation and closure planning. The model will include the positioning of the tailings and waste rock within the pit.	Medium	Operation
	Lake Bazzamundi Impacts Lake Bazzamundi will be utilised as an irrigation field for pit dewatering bores. Monitoring at the discharge point will occur.	Medium	Operation

3.1. Water Account

A site water balance has been established using an OPSIM model for the two phases of the Project (dewatering and operations) by Coffey (2015b) and this was updated in 2019 by GHD (2019). The water balance has relied upon historical data and existing water levels at the site. A copy of the GHD 2019 water balance update is provided in Appendix O in Toms Gully EIS Addendum to the Supplement.

Dewatering Existing Pit and Underground

The Toms Gully Open Pit currently contains approximately 4.4 GL of mine affected water (MAW). As waste rock and tailings are placed into the pit the displaced water will be treated and disposed of by either pumping into the water storage dam during the dry season or directly into My Bundey creek during the wet season.

During operations the removal of water from the pit will be a reflection of the water displaced by the tailings and waste rock deposition in the aqueous pit environment. It is anticipated that 1,113 ML per annum will be directed to the new WSD via a water treatment plant, at a maximum assumed rate of 35 L/s.

Controlled discharges would only occur from WSD (treated water). A detailed site water balance is provided in Toms Gully EIS Addendum to the Supplement in Appendix O.

4. Risk Management

4.1. Identified Hazards and Risks

The highest risk at Toms Gully is from acid and metalliferous drainage (AMD). Baseline work has demarcated the sources of AMD across the site. This work has allowed the development of a contaminant transport model for this risk to be understood to a sufficient standard allowing for there to be confidence in the remediation strategies for the waste rock dumps that are to be developed.

The remediated tailings storage facilities are based on tailings removal (with or without retreatment) and then current industry practice for managing acid producing tailings by placing tailings in an aqueous environment below the pit water level. The operation of the site is likely to reduce the risk of offsite migration of contaminated groundwater with the drawdown and treatment of water in the pit and underground collecting groundwater contaminant plumes during operations.

Primary Gold plan to empty the Evaporation Ponds and Pit (i.e. only the amount of pit water to allow for the deposition of waste rock and tailings), treating the water to SSTVs or required water quality prior to storing in the newly constructed WSD. The water is intended to be utilised on site where required and excess water released to Mount Bunday Creek or transferred to a third party.

A summary of key interactions with surface and groundwater during construction and operation are considered to be:

- Insitu pit water treatment, dewatering the open pit (to allow for the deposition of tailings) and transferring to a new 1 GL Water Storage Dam (WSD). Water from the Open Pit is likely to have been impacted by historical mining activities and is considered to be Mine Affected Water (MAW) with low pH and elevated metal loads. This water will be treated using the Bioaqua Process (or contingency option). The WSD has the potential to interact with groundwater through seepage and Mount Bunday Creek via controlled discharge. Treatment of the insitu pit water will use either caustic, lime or virtual curtain to lower the pH and remove metals from the water column
- Removal of tailings from TSF2 and repurposing as a water storage dam if meets geotechnical and seepage mitigation requirements. The operation of TSF2 as a water dam has the potential to impact on groundwater through seepage and Mount Bunday Creek via flooding or an overflow event. As part of repurposing TSF2 an assessment and upgraded to comply with ANCOLD 2012 guidelines with seepage addressed dependent on assessment findings. TSF1 will have tailings removed with the empty facility used for the capture and containment of water and sediment liberated from the Sulfide Waste Rock Dump.
- Rehabilitation of both TSF1 and TSF2 by levelling of embankments and ripping. In the case of TSF1 the area levelled and rehabilitated will be a function of the area retained for the purpose of sediment and

water capture.

- Installation of pumps and pipeline to manage water transfers across the site. The installation of pumps will allow active management of infrastructure and reduce the potential for uncontrolled discharges to Mount Bunday Creek.
- Evaporation Pond 1 and 2 (EP1 and EP2) currently store MAW from historical activities onsite. The ponds collect runoff from the Sulfide Waste Rock Dump (SWRD). They will continue to be utilised for water storage during operation. MAW stored within EP1 and EP2 has the potential to impact on groundwater through seepage.
- Long-term storage of waste rock generated by PGO activities will involve placing at the base of the Open Pit. Waste storage in this location has less potential to impact groundwater than above ground storage.
- Dewatering underground operations has the potential to cause local drawdown of groundwater and potentially restrict recharge to the potential Mount Bunday Creek groundwater dependent ecosystems for the duration of mining (4 to 5 years).

A summary of key Project risks relating to water management is presented in Table 14. The full risk assessment is provided in Appendix G in Toms Gully EIS Addendum to the Supplement - Toms Gully Risk Framework 2018 of the Toms Gully Supplement (Primary Gold, 2018).

Table 14: Water Management Risk Assessment

	Water Management	
Risk Level	No. of Inherent Risks	No. of Residual Risks
Extreme	3	0
High	6	0
Moderate	5	5
Low	0	9
Total	14	14

4.2. Actions and Mitigation for Identified Risks

The risk assessment has established Project risks associated with the operation of TGU. The control and associated mitigation measures include the following.

4.2.1. AMD Management Plan

Implementation of AMD Management Plan including ore and waste rock controls and tailings controls (Primary, 2018). The controls include:

- all waste rock is assumed to be PAF and is to either remain underground or placed in the pit;
- all of the ore unit is considered to be PAF and shall only be stockpiled underground or on the ROM

pad;

- no waste rock is to be used for construction purposes;
- no waste rock from the existing sulfide or oxide waste rock dumps is to be used for construction purposes;
- the existing SWRD and OWRD are to be maintained to ensure their integrity;
- all metallurgical tailings to be treated as PAF and placed in the pit;
- the existing TSF1 and TSF2 are to be maintained to ensure their integrity until removal of tailings and rehabilitation;
- maintaining a minimum freeboard on TSF1 and TSF2 for water management purposes prior to tailings removal;
- tailings from TSF1 and TSF2 will be placed in the flooded pit (whether reprocessed or not) within 18 months from the commencement of the Boxcut.
- All future tails and waste rock will be placed in the flood pit.
- Monitoring the pit water and if required adjust water quality by the use of lime, caustic or virtual curtain.

4.2.2. Water Management Plan

Implementation of this Water Management Plan including monitoring the surface water, groundwater and biological impacts. The WMP includes a series of additional commitments and summarises knowledge gaps which require further work to establish additional mitigation methods are required.

These include:

- Discharge Management Plan
- Groundwater Bore Census
- Continuing Groundwater Modelling
- Continuing Contaminant Transport Modelling
- Lake Bazzamundi Monitoring

Further detail on these works is included in Table 13.

4.2.3. Engineering / Onsite Management Controls

A series of engineering controls will be included in addition to the AMDMP and WMP. The engineering controls include:

- Detailed ANCOLD compliant design for WSD;
- Develop manual detailing appropriate tailings and water management;
- Undertake regular routine and intermediate surveillance inspections;
- Establish sufficient freeboard to contain excess water and pump infrastructure to transfer

excess water to alternative locations;

- EP1 and EP2 to maintain a freeboard of 4m RL and 3m RL respectively; and
- Annual post-wet season water inventory and water usage strategy to manage freeboard prior to subsequent Wet Season.

5. Monitoring

5.1. Water Management Strategy

The overall strategy for the management of surface water and groundwater is provided below:

1. Water removal phase where plant treatment of pit water (allow tailings and waste rock deposition) and evaporation ponds to SSTV's and/or water quality levels, storage of the treated water in the WSD release of treated water to Mount Bundey Creek, Lake Bazzamundi or third party;
2. During operation, discharge of fresh groundwater (treated if required) from dewatering bores to Lake Bazzamundi;
3. Separation of clean water and dirty water through the mine site;
4. Best practice storage of tailings and waste rock to minimise contamination risks; and
5. Review and investigation of waste rock dumps to determine long term remedial options.

5.2. Monitoring Programs

The monitoring program has been designed to provide sufficient data to assess impacts from the proposed operation. The data will be supplemented with additional works as required and detailed in Section 4.2.

The monitoring program detailed below will apply for the term of the WMP. Table 15 outlines the monitoring frequency adopted for the monitoring programs. The sampling program has been developed based on analysis of historical data, focusing on parameters of concern likely to be encountered at the site.

Table 15: Summary of Water Monitoring Program 2019

Monitoring	Number of Locations	Frequency
Surface Water	18	Fortnightly
Groundwater	9*	Quarterly
Sediment	13	Annual
Macroinvertebrate	13	Annual
Fish	13	Annual

*Groundwater sampling locations will increase to 21 following the bore census and installation of proposed monitoring bores

5.2.1. Quality Control

A comprehensive Quality Assurance/Quality Control (QA/QC) program for the WMP will be implemented. Details of the QA/QC program are presented in Section 6.

Laboratory Quality Control

Samples will be analysed at a NATA accredited laboratory. The laboratory quality assurance processes include reagent blanks, matrix spikes, internal standards and surrogate spikes. A full description of Laboratory Quality Control is presented in Section 6.

Field Quality Control

The QC program is to be undertaken in accordance with the general relevant requirements set out in the Australian Standard AS4482.1 (2005). QC samples provide information that discounts or potentially identifies any errors due to possible sources of cross contamination, inconsistencies in sampling and analytical techniques used. The QC program to be completed includes a split duplicate. Descriptions of quality assurance sampling and their collection frequency is provided in Section 6.

5.3. Surface Water

Surface water and mine affected water will be monitored fortnightly and monthly respectively. The monitoring program is based on assessing the baseline (SWTG1A), onsite locations and downstream impact site (SWTG2) across the WMP period. The monitoring program is detailed in Table 17 and locations provided on Figure 5 and 6.

Mine affected waters and the receiving environment (i.e. Mount Bundey Creek) will be sampled on a daily basis if basins overflow and/or during a pumped discharge.

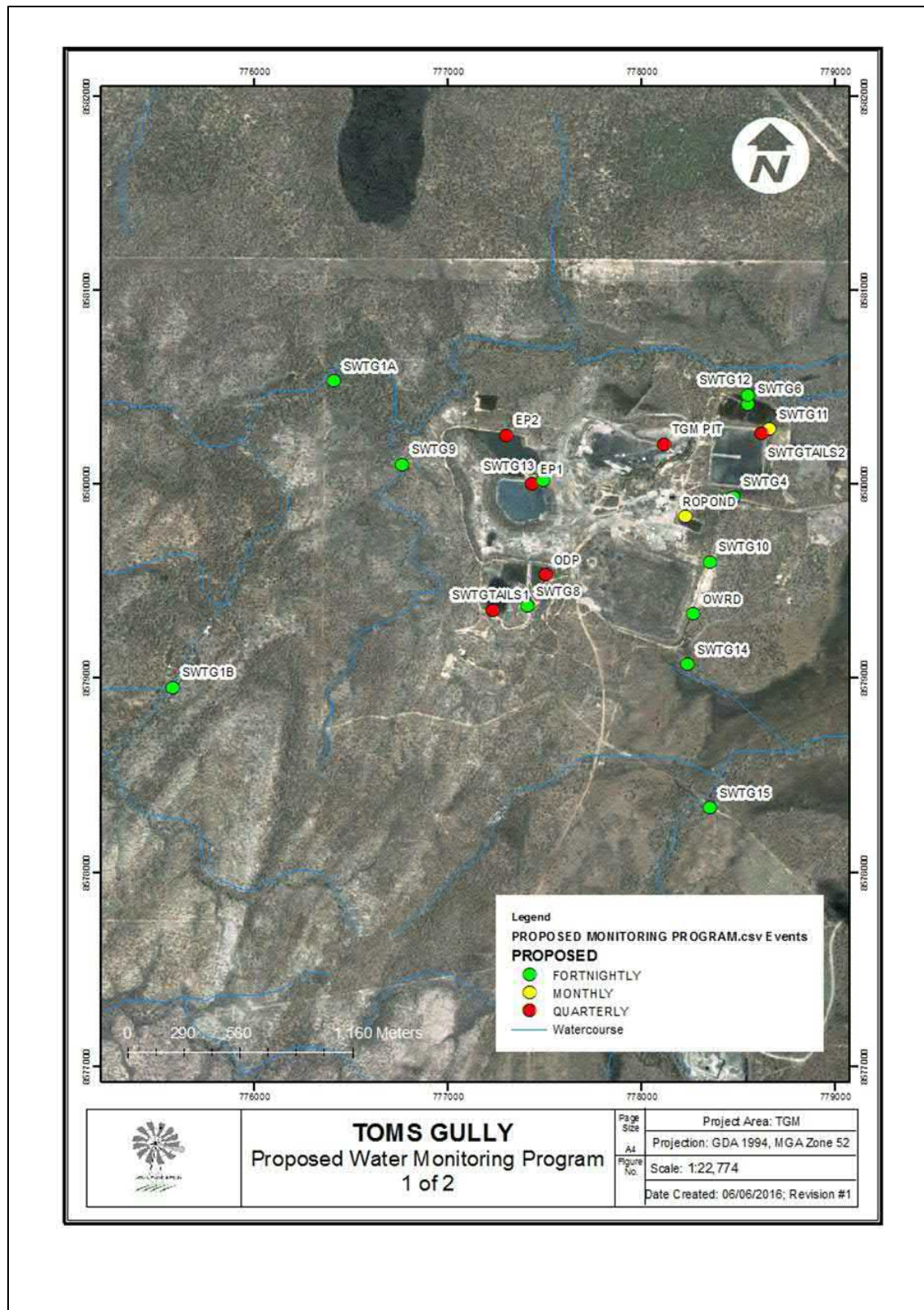


Figure 5: Location of Toms Gully Surface Water Sample Sites (Map 1)

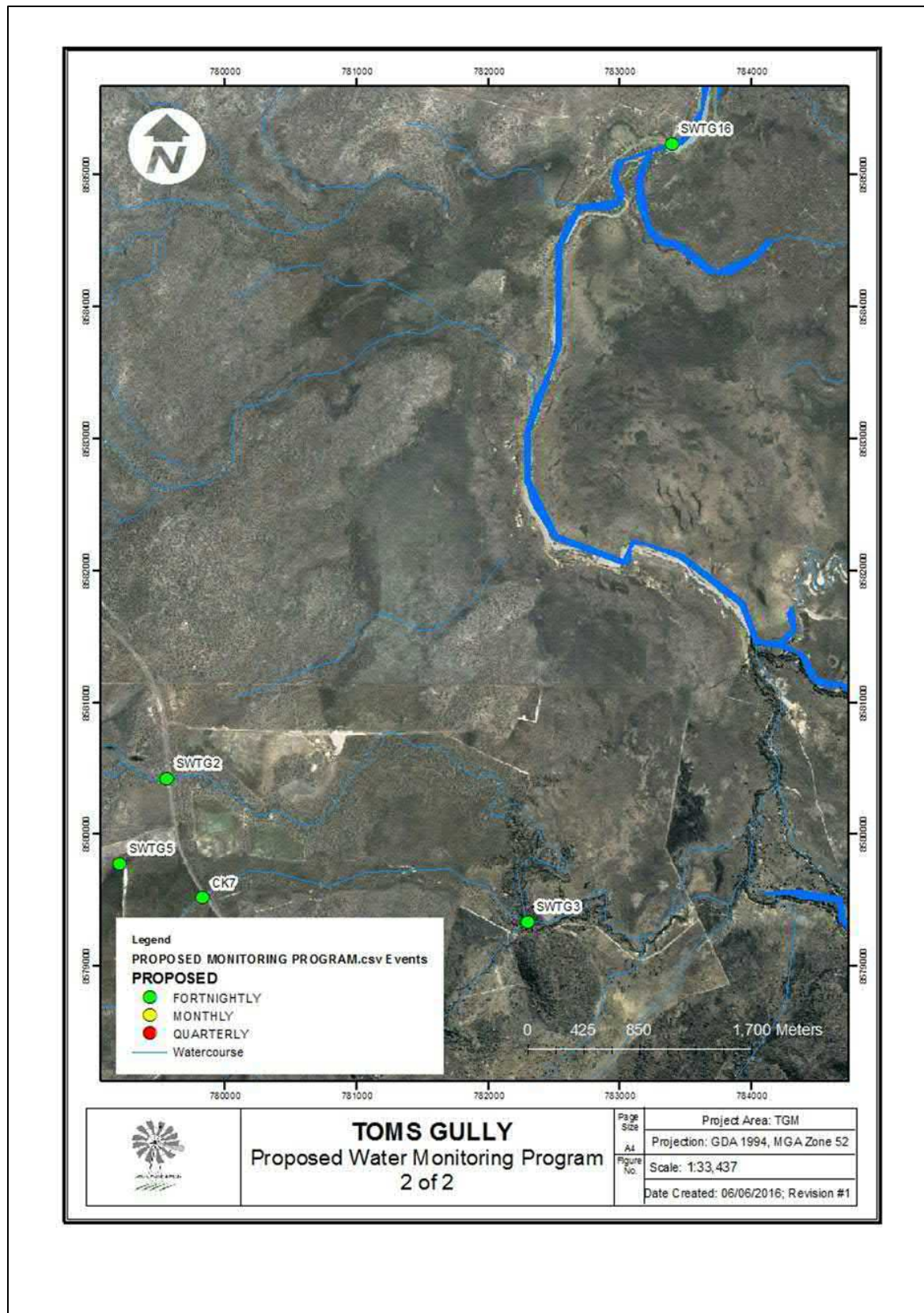


Figure 6: Location of Toms Gully Surface Water Sample Sites (Map 2)

5.3.1. Assessment Guideline Values

SSTVs have been derived from the upstream site SWTG1A on Mount Bundey Creek and the ANZECC & ARMICANZ (2000) guidelines. The SSTVs have been designed to facilitate assessment of water quality at the downstream monitoring location SWTG2. A summary of the SSTVs is provided in Table 16.

The SSTVs reference ANZECC & ARMICANZ 2000 trigger values for 90% aquatic ecosystem protection and local background conditions. Further details on the SSTVs are provided in CSIRO Site Specific Trigger Values Report, Appendix U in Toms Gully EIS Addendum to the Supplement.

Table 16: Surface Water Assessment Guideline Values

Analyte	Units	SSTV
pH	pH	5.8-8.0
Electrical Conductivity	µS/cm	41
Turbidity	NTU	87
Total Suspended Solids	mg/L	54
Total Cyanide	mg/L	0.018
Sulphate	mg/L	210
Ammonia (pH 8)	mg/L	1.4
Aluminium	µg/L	295
Arsenic (total)	µg/L	42
Cadmium	µg/L	0.4
Chromium	µg/L	6
Copper	µg/L	1.8
Iron	µg/L	2,700
Lead	µg/L	5.6
Manganese	µg/L	2,500
Molybdenum	µg/L	34**
Nickel	µg/L	13
Zinc	µg/L	15

5.3.2. Sample Locations

A summary of surface water and mine affected water locations to be sampled is provided in Table 17 and displayed on Figure 5 and 6.

5.3.3. Water Sampling Procedure

All samples will be analysed using a National Association of Testing Authorities (NATA) accredited laboratory. Surface water samples will be collected in accordance with the Australian Standard Surface Water Sampling Guidelines by trained environmental personnel. The Australian Standards used include:

- Australian/New Zealand Standard, Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples. AS/NZS

5667.1, 1998;

- Australian/New Zealand Standard, Water Quality – Sampling Part 4: Guidance on sampling from lakes, natural and man-made. AS/NZS 5667.4, 1998; and
- Australian/New Zealand Standard, Water Quality – Sampling Part 6: Guidance on sampling from rivers and streams. AS/NZS 5667.6, 1998.

See Appendix T in Toms Gully EIS Addendum to the Supplement for Water Sampling Procedure.

Table 17: Surface and Mine Affected Water Sampling Locations

		POSITION			Analysis Type *					
Site Code	Sample Location / Description	GRID: UTM DATUM: WGS84			0	1	2	3	4	5
		Zone	EASTING	NORTHING	Frequency					
Surface Water										
SWTG1A	Mt Bundy Creek, upstream of TGM and it's Influences - Control	52L	776407.65	8580531.93	F	F	F	F	F	
SWTG 2	Mt Bundy Creek, at Arnhem Hwy bridge, downstream of TGM	52L	779558.33	8580421.83	F	F	F	F	F	
SWTG 3	Mt Bundy Creek, further downstream of SWTG 2	52L	782298.33	8579333.18	F	F	F	F	F	
SWTG 4	Wetlands area on mine site access road. Downstream of plant runoff pond (spillway)	52L	778473.44	8579934.30	F	F	F	F	F	
SWTG 5	Artificial Wetlands contiguous to the pastoral property (Lake Bazzamundi).	52L	779203.50	8579773.54	F	F	F	F	F	
SWTG 6	Wetlands Oxbow (WO) middle of wetland area Nth of Tailings dam#2	52L	778547.75	8580411.80	F	F	F	F	F	
CK 7	Spillway at Arnhem Hwy (runoff from Lake Bazzamundi)	52L	779828.93	8579516.25	F	F	F	F	F	
OWRD	Seepage/runoff collected in diversion drain around Oxide Waste Rock Dump	52L	778266.14	8579330.55	F	F	F	F	F	
SWTG 8	Mixing overflow of runoff and ODP, to be sampled when overflowing	52L	777408.00	8579371.00	F	F	F	F	F	
SWTG 10	Seepage/runoff collected in diversion drain from Oxide Waste Rock Dump, water diversion flow to WO.	52L	778348.13	8579597.32	F	F	F	F	F	
SWTG 11	Entrance to Wetland Oxbow	52L	778657.11	8580282.09	M	M	M	M	M	
SWTG 12	Weir gate at wetland-discharge point #2, monitored when discharge occurs	52L	778547.75	8580458.61	F	F	F	F	F	
RO POND	Runoff Pond down gradient of Mill site, RoM and Workshop	52L	778222.00	8579831.00	F	M	M	M	M	
SWTG TAILS#2	New Tailings storage facility (NTD)	52L	778617.50	8580264.04	F	Q	Q	Q	Q	Q
SWTG TAILS#1	Old Tailings storage facility (OTD)	52L	777232.10	8579348.91	F	Q	Q	Q	Q	Q
EP 1	Evaporation Pond 1 (Upper Pond)	52L	777432.33	8580000.64	F	Q	Q	Q	Q	Q

Site Code	Sample Location / Description	POSITION			Analysis Type *					
		GRID: UTM DATUM: WGS84			0	1	2	3	4	5
		Zone	EASTING	NORTHING	Frequency					
EP 2	Evaporation Pond 2 (Lower Pond)	52L	777301.09	8580251.19	F	Q	Q	Q	Q	Q
ODP	Old Decant Pond, next to Old Tailings storage facility #1	52L	777498.87	8579531.24	F	Q	Q	Q	Q	Q
SWTG 9	Runoff from Sulfide Waste Rock Dump, prior to joining creek.	52L	776764.00	8580100.00	F	F	F	F	F	
TGM PIT	Tom's Gully Open Pit	52L	778111.80	8580205.30	M	Q	Q	Q	Q	
SWTG14	Downstream of the Oxide WRD, before entry to Lake Bazzamundi.	52L	778237	8579070	F	F	F	F	F	
SWTG1B	Mount Bundey Creek, further upstream to SWTG1A (2.8km)	52L	775576	8578950	F	F	F	F	F	
SWTG13	Surface water runoff from the Sulfide WRD prior to it flowing into the Evap. ponds.	52L	777491	8580016	F	F	F	F	F	
SWTG16	Hardy's Lagoon, approx. 15km downstream from TGM.	52L	783391	8585230	F	F	F	F	F	
SWTG15	Creek line upstream of influence from the OWRD.	52L	778353	8578330	F	F	F	F	F	

*F = Fortnightly, M = Monthly, Q = Quarterly, B = Biannual (first flow: Oct/Nov and recessional flow: April/May)

Type Analytes

Type 0 Water Height Level Reading (Particularly for wet season and during wet season discharge, also to gauge evaporation levels in dry season).

Type 1 Field parameters (pH, EC, Temp, Flow)

Type 2 Total and Filtered Metals (Al, As, Cd, Co, Cr, Cu, Fe, Pb, Mn, Ni, U & Zn)

Type 3 Major Cations (Ca, K, Na & Mg) Anions (Cl, SO₄) – Filtered

Type 4 Titratable Acidity, Alkalinity, Hardness (CaCO₃) & Total Suspended Solids (TSS) & Turbidity

Type 5 WAD CN, Total CN, Free CN

Type 6 Total Phosphorus (P), Total Nitrogen (N), Ammonia, Nitrogen Oxides & Filterable Reactive Phosphorus

Type 7 Australian Drinking Water Guidelines (Total Coliforms, E. Coli and Total Viable Bacteria)

Type 8 Total Petroleum Hydrocarbons (TPH)

5.4. Groundwater

Groundwater levels and quality will be monitored at quarterly intervals at several production and monitoring bores located upstream, within and downstream of the site. The data and information gathered during these monitoring programs will be used to assess potential impacts of mining operations on local groundwater resources (level and quality).

The monitoring program is provided in Table 19. Groundwater monitoring locations are shown in Figure 4. Nine groundwater bores will be monitored for the term of this WMP. Additional monitoring bores will be installed and sampled through the term of this plan (Table 13).

5.4.1. Assessment Guideline Values

The majority of surrounding land use comprises pastoral leases used for cattle farming with the likely

future land use the continuation of pastoral activities. PGO acknowledges good water quality is essential for successful livestock production with poor water quality likely to reduce animal production and impair fertility. High contaminant loads may produce residues within animal products and adversely affect saleability and/or create human health risks (ANZECC, 2000). Therefore, as a minimum the ANZECC Stock water trigger values have been adopted to assess groundwater quality.

A summary of groundwater assessment guideline values are provided in Table 18.

Table 18: Groundwater Assessment Guideline Values

Analyte	Units	ANZECC Livestock Trigger Value
Physiochemical Characteristics		
pH	pH	6.0-8.0
Electrical Conductivity	µS/cm	3,000
Total Suspended Solids	mg/L	5,000
Environmental Indicators		
Sulphate	mg/L	1,000
Calcium	mg/L	1,000
Metals/Metalloids		
Aluminium	µg/L	5,000
Arsenic (total)	µg/L	500
Cadmium	µg/L	10
Chromium	µg/L	1,000
Cobalt	µg/L	1,000*
Copper	µg/L	1,000
Iron	µg/L	
Lead	µg/L	100
Manganese	µg/L	
Molybdenum	µg/L	150
Nickel	µg/L	1,000
Uranium	µg/L	200
Zinc	µg/L	20,000

Notes: *Cobalt livestock value for cattle (ANZECC & ARMICANZ 2000. Chapter 4.3.4); and n/a Indicates insufficient toxicity data.

5.4.2. Sample Locations

A summary of groundwater locations to be sampled is provided in Table 19 and displayed on Figure 4.

5.4.3. Groundwater Sampling Procedure

Groundwater sampling will be conducted in accordance with DME Advisory Note on the Methodology for the Sampling of Ground Waters (AA7-024) and in accordance with the site Sampling Procedure. In general sampling will comprise:

- Gauging water levels relative to Top of Casing (TOC) using an electronic interface meter to determine the relative elevation of the water table.

- Groundwater to be developed using low flow methodology prior to sampling. During development, field parameters including Electrical Conductivity (EC), pH, Dissolved Oxygen (DO), redox potential (Eh) and temperature will be monitored. Bores will be developed until these parameters have stabilised for three consecutive readings, indicating that groundwater representative of the target aquifer has been obtained. The parameters will be considered stable when three consecutive readings are within:
 - 0.05 for pH
 - 3% for EC
 - 10% for DO
 - 0.2 C for temperature
 - 10 mV for Eh.
- Samples to be collected in pre-prepared laboratory supplied bottles containing appropriate preservatives for each proposed analyte. The integrity of groundwater samples to be analysed for heavy metals will be maintained through field filtration using a 0.45-micron filter followed by acidification.
- All relevant sampling equipment will be decontaminated between samples and sample locations using a phosphate free detergent and final rinse with deionised water.

Table 19: Groundwater Sampling Locations

		POSITION			Analysis Type *					
Site Code	Sample Location / Description	GRID: UTM DATUM: WGS84			0	1	2	3	4	5
		Zone	EASTING	NORTHING	Frequency					
Groundwater										
RIDGE BORE	Monitoring Bore Sth of Old Tailings	52L	777559.48	8579124.35	Q	Q	Q	Q	Q	
BORE 11	Monitoring Bore Sth of Old Tailings	52L	777288.15	8579016.12	Q	Q	Q	Q	Q	
OB11	Observation Bore Nth EP 2	52L	777186.74	8580322.90	Q	Q	Q	Q	Q	
G1	NW Corner of EP2, other side of gate	52L	777009.00	8580348.00	Q	Q	Q	Q	Q	
G2	West of OWRD alongside road	52L	777683.00	8579727.00	Q	Q	Q	Q	Q	
G8	Monitoring Bore West EP 1 over SWRD on road side	52L	777021.95	8580019.42	Q	Q	Q	Q	Q	
G9	Observation Bores Nth TGM Pit	52L	777663.99	8580478.41	Q	Q	Q	Q	Q	
RN29694	Down gradient of G8, B/W SWRD and Mt Bunday Creek	52L	776935.00	8580080.00	Q	Q	Q	Q	Q	

*F = Fortnightly, M = Monthly, Q = Quarterly, B = Biannual (first flow: Oct/Nov and recession flow: April/May)

Type Analytes

Type 0 Water Height Level Reading (Particularly for wet season and during wet season discharge, also to gauge evaporation levels in dry season).

Type 1 Field parameters (pH, EC, Temp, Flow)

Type 2 Total and Filtered Metals (Al, As, Cd, Co, Cr, Cu, Fe, Pb, Mn, Ni, U & Zn)

Type 3	Major Cations (Ca, K, Na & Mg) Anions (Cl, SO ₄)– Filtered)
Type 4	Titrateable Acidity, Alkalinity, Hardness (CaCO ₃) & Total Suspended Solids (TSS) & Turbidity
Type 5	WAD CN, Total CN, Free CN
Type 6	Total Phosphorus (P), Total Nitrogen (N), Ammonia, Nitrogen Oxides & Filterable Reactive Phosphorus
Type 7	Australian Drinking Water Guidelines (Total Coliforms, E. Coli and Total Viable Bacteria)
Type 8	Total Petroleum Hydrocarbons (TPH)

5.5. Sediment

Sediment sampling will be undertaken to augment the water quality sampling on an annual basis. The purpose of sediment sampling will be to characterise the quality of sediments within the flow channels. Sediment sampling will be undertaken along both Mount Bunday Creek and Coulter Creek. Sediment sampling locations are proposed to coincide with the above-mentioned surface water monitoring locations in the vicinity of the Project site. The monitoring program is detailed in Table 20 and 21 and locations provided on Figure 5 and 6.

5.5.1. Assessment Guideline Values

The environmental systems adjacent to the Project are considered to be highly disturbed systems and a precautionary approach to applying Interim Sediment Quality Values (ISQG) has been adopted (i.e. utilising the upper and lower guideline values). The assessment includes sediment quality in the receiving environment but also physical habitat changes from the operation (i.e. deposition of fine sediment). A summary of adopted sediment assessment guideline values are provided in Table 20.

Table 20: Sediment Assessment Values

Analyte	Units	ISQG-Low*	ISQG-High*
Metals/Metalloids			
Antimony	mg/kg	2	25
Arsenic	mg/kg	20	70
Cadmium	mg/kg	1.5	10
Chromium	mg/kg	80	370
Copper	mg/kg	65	270
Lead	mg/kg	50	220
Mercury	mg/kg	0.15	1
Nickel	mg/kg	21	52
Silver	mg/kg	1	3.7
Zinc	mg/kg	200	410

* values normalised to 1% organic carbon

5.5.2. Sample Locations

A summary of surface water and mine affected water locations to be sampled for sediment is provided in Table 21 and displayed on Figure 5 and 6.

5.5.3. Sediment Sampling Procedure

Sampling of river bed sediments will be based on the Australian Standard - Guide to the investigation and sampling of sites with potentially contaminated soil (AS 4482.1-2005). The general procedure is:

- Sediment samples taken from reasonably straight river reaches;
- Where the waterway features multiple channels, sampling should be undertaken from the primary or low flow channel;
- Nitrile gloves worn while sampling and disposal of gloves at the completion of each sampling event to avoid cross contamination;
- Collection of 5 sub-samples of approximately 1 kg each from within the cross-section of the bed profile between the surface and a depth of 200 mm;
- Sub-samples evenly spaced across the primary channel at the sampling location;
- Combine and mix the sub-samples thoroughly in a clean decontaminated bucket;
- 1 kg sample placed into a polyethylene zip lock bag or sample container as provided by the laboratory, two 250 mL glass jar for the particle size distribution analysis and two 250 mL glass jars for the remaining general analytical suites; and
- Label the laboratory sample bag and jars clearly indicating the site code.

Table 21: Sediment Sampling Locations

Site Code	Easting	Northing	Sample Location/Description	Frequency	Analysis
SWTG1A	776407	8580531	Mount Bundey Creek, upstream of the mine site – control site	Annual	Laboratory Analysis Electrical Conductivity and pH. Metals (Al, As, Ag, Cd, Co, Cr, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Sb, Zn and U) Major Cations and Anions (Na, K, Ca, Mg, Cl, SO ₄ , CO ₃ , HCO ₃ , NH ₃ , NO ₃) Particle Size Distribution (sieve and hydrometer) Total Organic Carbon
SWTG2	779558	8580421	Mount Bundey Creek, at Arnhem Hwy bridge, downstream of the mine site	Ditto	Ditto
SWTG3	782298	8579333	Mount Bundey Creek, further downstream of SWTG2	Ditto	Ditto
SWTG4	778473	8579934	Wetlands area on mine site access road. Downstream of plant runoff	Ditto	Ditto

Site Code	Easting	Northing	Sample Location/Description	Frequency	Analysis
			pond (spillway)		
SWTG5	779203	8579773	Artificial wetlands contiguous to the pastoral property (Lake Bazzamundi)	Ditto	Ditto
SWTG6	778547	8580411	Wetlands Oxbow – middle of wetland area	Ditto	Ditto
SWTG8	777408	8579371	Overflow of runoff from ODP, to be sampled when overflowing	Ditto	Ditto
SWTG9	776764	8580100	Runoff from Sulfide Waste Rock Dump, prior to joining creek	Ditto	Ditto
SWTG10	778348	8579597	Seepage/runoff collected in diversion drain from Oxide Waste Rock Dump, water diversion flow to Wetlands Oxbow	Ditto	Ditto
SWTG11 Entrance to Wetlands Oxbow	778657	8580282	Entrance to Wetlands Oxbow	Ditto	Ditto
SWTG12	778547	8580458	Weir gate at wetland-discharge point. Monitored when discharge occurs	Ditto	Ditto
CK7	779828	8579516	Spillway at Arnhem Hwy (receives runoff from Lake Bazzamundi)	Ditto	Ditto
CC02	778299	8578355	Upstream of Lake Bazzamundi on Coulter Creek (i.e. Coulter Creek control site).	Ditto	Ditto

5.6. Biological Monitoring

Biological monitoring comprises annual macroinvertebrate, fish, habitat assessment and insitu water quality testing (GHD, 2018a). The monitoring will be undertaken during receding wet season flows and includes:

- Macroinvertebrate Survey (Northern Territory AUSRIVAS methodology).
- Fish Survey – Fish sampling was carried out primarily using a mixture of backpack electrofishing and bait trapping.
- Selected camera monitoring for native and feral fauna species (including water monitors)
- Habitat Assessment – Habitat assessments include the whole reach (100 m section of the river), the habitats sampled, and the surrounding terrestrial environment. This included information on:
 - Site description
 - Water Quality
 - Characteristics of macroinvertebrate habitat

- Instream physical characteristics (flow velocity and depth, instream habitat characteristics, bank height, riparian width)
 - Riparian vegetation characteristics (types, %cover, exotic species, erosion, land use),
 - Water quality observations (clarity, odour, oils, foam/scum, plume, sediment oils, sediment odours) and
 - Sketch of the site and cross section.
- Insitu water quality –water quality measured using a YSI 650 MDS multi-parameter water quality meter and laboratory analysis of water samples at each site covering physico-chemical parameters, major anions, major cations, metals (dissolved and total) and cyanide.

5.6.1. Sample Locations

A summary of biological sampling locations to be sampled are provided in Table 22 and displayed on Figure 7.

Table 22: Macroinvertebrate Sampling Sites and Camera Monitoring Sites

Site	Coordinates		Altitude (m)	Location	Category
	Easting	Northing			
Mount Bunday Creek Catchment					
SWG1A	776351	8580503	27	Mount Bunday Creek upstream of mine at lease boundary.	Control
SWG1	776825	8580290	25	Mount Bunday Creek at confluence of tributary draining EP1 and EP2	Adjacent to
SWG2	779453	8580428	20	Compliance monitoring point at Arnhem Highway Crossing	
SWG3	782278	8579366	16	300 m upstream of confluence between Mount Bunday Creek and Coulter Creek	Potentially Impacted
SWG09	776766	8580098	26	Tributary adjacent to EP1 and EP2	Potentially Impacted
MBC01	778724	8580370	21	Mount Bunday Creek at confluence of tributary draining TSF2 area	Potentially Impacted
MBC02	779638	8580520	20	Mount Bunday Creek 300 m downstream of compliance monitoring site SWTG2*	Potentially Impacted
MBC03	780604	8580044	19	Mount Bunday Creek 500 m downstream of MBC02	Potentially Impacted
MBC06	777293	8580350	22	Mount Bunday Creek on downstream tributary draining EP1 and EP2	Potentially Impacted
MBC0	777606	8580736	24	Mount Bunday Creek	

Site	Coordinates		Altitude (m)	Location	Category
	Easting	Northing			
				upstream of tributary draining EP1 and EP2	
Coulter Creek Catchment					
CC01	779293	8578801	21	Coulter Creek. Approx. 1 km upstream	Reference
CC02	778299	8578355	26	Coulter Creek. Approx. 2 km upstream from CK7	Reference
CC03	780166	8579675	17	Coulter Creek. ~750 m downstream of CK7	Reference
CK7	779807	8579538	17	Coulter Creek. Existing monitoring site located at highway crossing	Reference
Camera Monitoring Locations					
M1	778691	8580427	21	-	Camera
M2	780604	8580044	19	Located at site MBC03	Camera
M3	776351	8580503	27	Located at AE site SWTG1A	Camera
M4	780126	8580212	19	-	Camera
M5	779453	8580428	20	Located upstream at site SWTG2	Camera
M6	779377	8580450	21	-	Camera

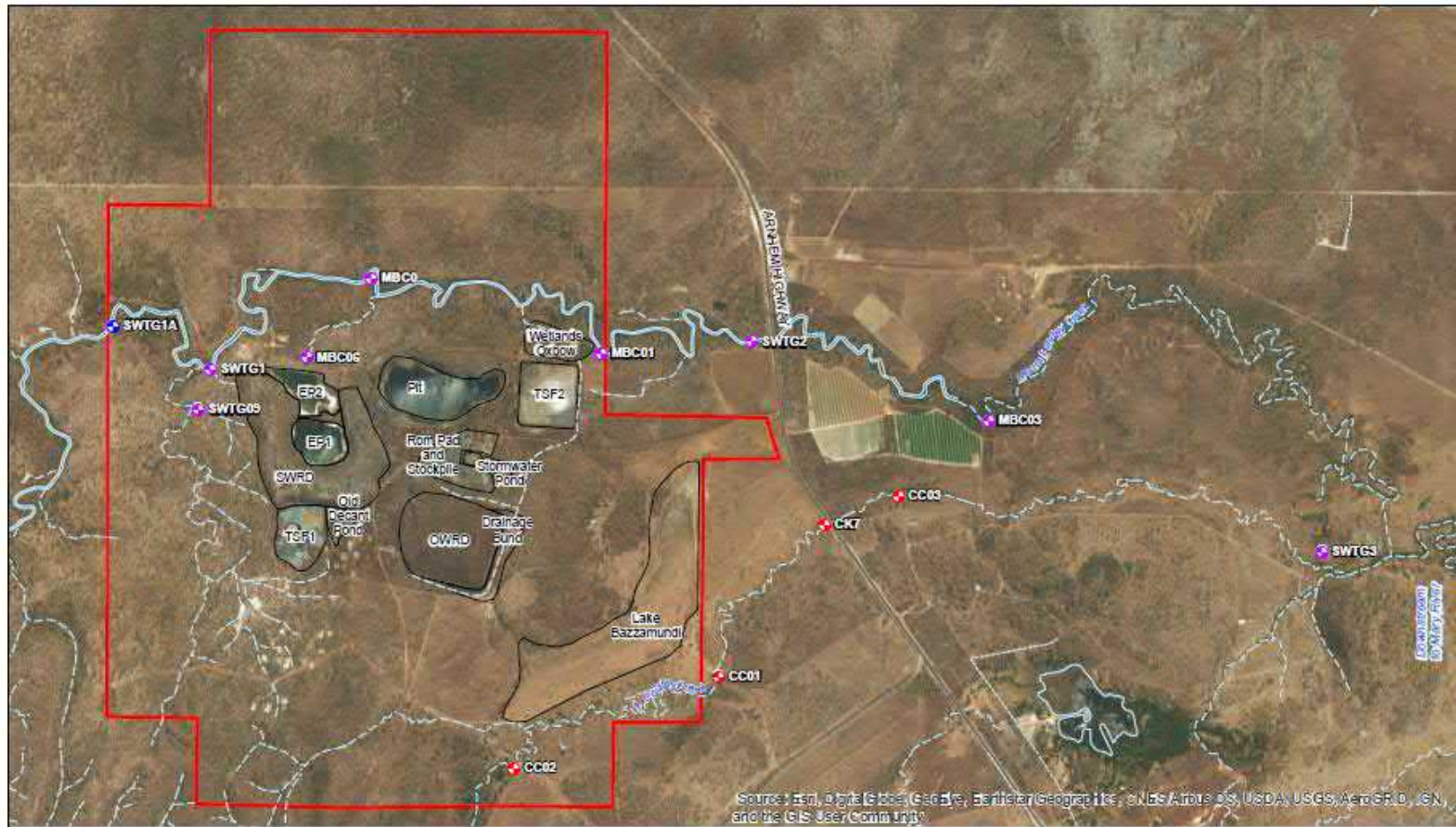


Figure 2-3

Figure 7: Aquatic Ecology Monitoring Sites

6. Monitoring Program – Quality Assurance and Quality Control

Quality Assurance (QA) involves all of the actions, procedures, checks and decisions, undertaken to ensure the representativeness and integrity of samples and accuracy and reliability of analytical results (National Environmental Protection Council, 1999). Quality Control (QC) involves protocols to monitor and measure the effectiveness of QA procedures.

The QA/QC procedures outlined in the following Sections have been based on AS 5567.1 – 1998.

6.1. Data Quality Indicators

To minimise the potential for unrepresentative data, the following Data Quality Indicators (DQIs) will be used to evaluate sampling techniques and laboratory analysis of collected samples:

- Data representativeness - expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples in an appropriate pattern across the Site, and by using an adequate number of sample locations to characterise the site. Consistent and repeatable sampling techniques and methods are utilised throughout the sampling.
- Completeness - defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study. If there is insufficient valid data, then additional data are required to be collected.
- Comparability - is a qualitative parameter expressing the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples and ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- Precision - measures the reproducibility of measurements under a given set of conditions. The precision of the data is assessed by calculating the Relative Percent Difference (RPD) between duplicate sample pairs.

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where

Co = Analyte concentration of the original sample

Cd = Analyte concentration of the duplicate sample

- Primary has adopted nominal acceptance criteria of 30% RPD for field duplicates and splits for inorganics, however it is noted that this will not always be achieved, particularly in heterogeneous soil or fill materials, or at low analyte concentrations:

- Accuracy - measures the bias in a measurement system. Accuracy can be undermined by such factors as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analysis techniques by the analysing laboratory. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes, laboratory blanks and analyses against reference standards. The nominal “acceptance limits” on laboratory control samples are defined as follows:
 - Laboratory spikes – 70-130% for metals/inorganics 60-140% for organics.
 - Laboratory duplicates – <30% for metals/inorganics, <50% for organics.
 - Laboratory blanks – <practical quantitation limit.

Accuracy of field works is assessed by examining the level of contamination detected in field and equipment blanks. Blanks should return concentrations of all organic analytes as being less than the practical quantitation limit of the testing laboratory.

The individual testing laboratories will conduct an internal assessment of the laboratory QC program; however the results will also be independently reviewed and assessed.

6.2. Summary of Data Quality Acceptance Criteria

Data quality acceptance criteria adopted for this Project are set out in Table 23. These are generally based on the minimum requirements detailed in the Australian Standard AS4482.1- 2005.

Table 23: Data Quality Acceptance Criteria

Measurement	Sediment	Water	Frequency	Acceptance Criteria	
				RPD (%)	Recovery (%)
Quality control samples to be prepared or taken on site (field)					
Blind field duplicate (BFD) samples (primary laboratory)	Yes	Yes	1 in 20 samples collected or 1 per batch	30 or 50	-
Quality control samples to be prepared laboratory					
Laboratory blanks	Yes	Yes	1 per batch	-	-
Laboratory duplicates	Yes		1 in 10 samples collected or 1 per batch (whichever is smaller)	30	-
Matrix spike recoveries	Yes		1 per batch	-	70 to 130
Laboratory control sample spike recoveries	Yes		1 per batch	-	70 to 130
Surrogate spikes	Yes	Yes	Each analysis done by GC-MS (all organics except TPH C _{>10})		

6.3. Field Program

All field work will be conducted with reference to the advisory note of the DME for the sampling of surface waters and groundwaters. Key requirements of these procedures are as follows:

- Decontamination procedures - including the use of new disposable gloves for the collection of each sample, decontamination of all multiple use sampling equipment between each sampling location (using a phosphate free detergent and potable water rinse for augers, de-ionised water for the IP) and the use of dedicated sampling containers provided by the laboratory.
- Sample identification procedures - collected samples will be immediately transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers to be clearly labelled with a sample number, sample location, sample depth and sample date. The sample containers are then transferred to an ice filled cooler for sample preservation prior to and during shipment to the testing laboratory.
- Chain of custody protocols - a chain-of-custody form is to be completed and forwarded to the testing laboratory with each discrete batch of samples.
- Sample duplicate frequency - field duplicates (blind) to be collected and analysed at a rate not less than ten per cent (i.e. not less than one duplicate per ten primary samples).

6.3.1. Field Quality Control

Field quality control procedures will include the collection and analysis of the following:

- **Blind field duplicates or BFDs:** Comprise a single sample that is divided into two separate sampling containers. Both samples are sent anonymously to the primary Project laboratory. Blind duplicates provide an indication of the analytical precision of the laboratory, but are inherently influenced by other factors such as sampling techniques and sample media heterogeneity.

7. Data Review and Interpretation

7.1. Surface Water

7.1.1. Onsite Surface Water

Onsite water quality data has been recorded from approximately January 2007 to current. From this data a subset was selected from December 2016 to March 2018 that covers two wet seasons and one dry season. The purpose of using this data set is that it represents the more recent site conditions. To assess the surface water dataset the median values for samples analysed between December 2016 and March 2018 were selected. These values were assessed against the updated SSTVs (Stauber and Batley 2018). A comparison against median values provides a more conservative assessment than using the ANZECC/ARMCANZ (2000) recommended 95th percentile value for the data sets. The locations are provided on Figure 5. Future assessment of water quality onsite will be referenced to the SSTV values where relevant (i.e. Wetland Oxbow, Lake Bazzamundi, WSD).

Analysis

Median exceedances against the updated SSTVs (Stauber and Batley 2018) have been presented in Table 25 with exceedances highlighted in red. A discussion of the surface water quality across the Tom's Gully site is discussed below.

Median data from the two background sample locations SWTG1A and SWTG1B indicate that all analysed parameters were below their respective SSTVs. Sample location SWTG15, located on Coulter Creek upstream of influences from the OWRD, also returned water quality results reflective of background concentrations, with the exception of EC (75 $\mu\text{S}/\text{cm}$) which was above the SSTV of 41 $\mu\text{S}/\text{cm}$.

Water quality sampling of mining features across the site highlighted that TSF1 and TSF2 exceeded the SSTVs for all analysed water quality parameters with the exception of lead (TSF1 and TSF2) and manganese (TSF1). Median acidity levels of 1,100 and 1,600 mg/L CaCO_3 equivalents respectively for TSF1 and TSF2 would indicate sulfide and metal acidity in both structures. Median data from SWTG13, being surface water runoff from the Sulfide Waste Rock Dump (SWRD) prior to it entering the evaporation ponds showed water quality consistent with sulfidic waste rock contact. This included an acidic pH value (4.0), elevated EC (1,145 $\mu\text{S}/\text{cm}$), acidity (274 mg/L CaCO_3 equivalents), sulfate (960 mg/L), and dissolved metal concentrations above respective SSTVs for aluminium, cadmium, cobalt, copper, manganese, nickel, uranium and zinc. Median surface water quality collected within the Oxide Waste Rock Dump bund (location OWRD) exceeded all respective SSTVs with the exception of arsenic, chromium and iron. Of note is the median pH value of 3.4, dissolved aluminium concentrations of 34.5 mg/L, manganese at 6.3 mg/L, zinc at 6.15 mg/L, sulfate at 620 mg/L and acidity of 200 mg/L CaCO_3 equivalents indicating water quality

consistent with oxidising sulfidic mine waste.

Median surface water quality in Evaporation Ponds (EP) 1 and 2 exceeded all respective SSTVs with the exception of arsenic and lead (EP1 and EP2), and iron in EP1. High concentrations of dissolved metals including aluminium (675 mg/L), copper (12.15 mg/L), manganese (36.5 mg/L), nickel (17 mg/L) and zinc (34.5 mg/L) in EP2 provide both a source of acidity and environmentally deleterious elements. Sulfate and acidity are both significantly elevated in both EP1 and EP2 reflecting the sulfidic source of the dissolved analytes. Median surface water quality in the pit lake (TGM Pit) exceeded all respective SSTVs with the exception of arsenic, chromium, iron and lead. An acidic pH value (3.3), and elevated sulfate (1,350 mg/L) and acidity (190 mg/L CaCO₃ equivalents) reflect the sulfidic source of the dissolved analytes.

The Old Decant Pond (ODP) returned median surface water quality concentrations that exceeded respective SSTVs for all analytes except arsenic, chromium, iron, lead, manganese and sulfate. Median surface water quality at the runoff pond that drains the RoM Pad, mill and workshop areas (RO Pond) exceeded all respective SSTVs with the exception of arsenic, chromium, iron, lead and manganese. A median pH value of 4.0 and median sulfate value of 170 mg/L is reflective of contact with sulfidic ore and waste stockpiled on the RoM Pad. It needs to be noted that the TSFs, EPs, pit lake and the decant pond are structures that retain surface water and prevent cross surface flow thus preventing potential release to surface water bodies.

7.1.2. Offsite Surface Water (SWTG2 and Downstream)

The Toms Gully downstream water quality monitoring site SWTG2 is located approximately 1km downstream of the MLN1058 boundary. The location is provided on Figure 6. This location has previously been selected by NT EPA to be the compliance point for meeting ANZECC (2000) 80% species protection trigger values. PGO propose to meet the updated SSTV at SWTG2 following the application for a WDL and commencement of controlled discharges.

Assessment against Site Specific Trigger Values

From the 2016 to 2018 dataset once surface water leaves site, it passes via SWTG2 on Mt Bunday Creek at the Arnhem Highway Bridge. The median water quality data for this sample location indicates that it is entirely compliant with all SSTVs, with the exception of copper (0.002 mg/L). The median pH value is 6.4, dissolved aluminium is the same as the baseline site (SWTG1A) at 0.11 mg/L and less than the second baseline site (SWTG1B) of 0.16 mg/L (Table 24). Sulfate is 2.5 mg/L, consistent with baseline, as is acidity at <5 mg/L CaCO₃ equivalents. Data from the aquatic survey sampling event showed that pH (5.7), EC (270 µS/cm), cobalt (0.03 mg/L), copper (0.02 mg/L), nickel (0.07 mg/L) and zinc (0.31 mg/L) exceeded their respective SSTVs. These data would appear to be in the upper quartile of the December 2016 to

March 2018 dataset and may not therefore representative of longer term trends at SWTG2 (n = 22 for the 2018 dataset).

Further downstream of SWTG2 on Mt Bundey Creek is SWTG3. The median water quality data for this sample location indicates that it is entirely compliant with all SSTVs, with the exception of copper (0.002 mg/L as against the SSTV of 0.0018 mg/L) and zinc (0.039 mg/L against the SSTV of 0.0015 mg/L). This may indicate zinc inputs into the system from influences other than Tom's Gully. The median pH value is 6.5, dissolved aluminium is below baseline at 0.045 mg/L, sulfate is 5.5 mg/L and acidity is <5 mg/L CaCO₃ equivalents. The furthest surface water sampling location is SWTG16, located some 15 kms downstream in Hardy's Lagoon. Interestingly, water quality in Hardy's Lagoon shows that EC (42 µS/cm) and copper (0.003 mg/L) exceed their respective SSTVs. This may indicate influences other than Tom's Gully, given the lack of sulfate in the water (1 mg/L); a value which is below the upstream baseline of 2 mg/L recorded at both SWTG1A and SWTG1B.

Table 24: Surface Water Data Assessment

Location	Description	Count	pH	EC	Al	As	Cd	Co	Cr	Cu	Fe	Pb	Mn	Ni	U	Zn	SO ₄	Acidity
Units		No.	pH units	µS/cm	mg/L													CaCO ₃ equiv. (mg/L)
SSTV (Stauber and Batley 2018)		-	5.8-8.0	41	0.295	0.042	0.0004	0.0014	0.006	0.0018	2.7	0.0056	2.5	0.013	0.0005	0.015	210	-
EP1	Evaporation Pond 1	5	3.4	2,700	170	0.02	0.23	1.3	0.018	2.6	1.3	0.001	15	5.4	0.14	16	2,100	840
EP2	Evaporation Pond 2	6	3.1	7,350	675	0.034	0.64	3.2	0.092	12.15	8.3	0.0015	36.5	17	0.445	34.5	7,950	975
TSF1	Tailings Storage Facility 1	3	2.3	2,800	69	3.8	0.32	0.12	0.1	2.1	110	0.003	0.83	0.39	0.016	4.4	2,000	1,100
TSF2	Tailings Storage Facility 2	4	2.9	4,400	142	0.58	0.285	1.505	0.2585	9.0	37.9	<0.001	28	3.05	0.0795	12.35	2,900	1,600
TGM Pit	Pit lake	6	3.3	2,350	22	0.005	0.0585	0.27	0.001	0.205	1.4	0.007	12	1.2	0.0285	7.4	1,350	190
ODP	Old Decant Pond	7	4.5	200	0.51	0.022	0.0135	0.0375	<0.001	1.9	0.055	<0.001	0.945	0.082	0.0012	0.39	67	10
OWRD	Seepage / runoff collected in diversion drain around Oxide Waste Rock Dump	16	3.4	1,150	34.5	0.008	0.0425	0.36	0.001	0.56	1.1	0.019	6.3	1.415	0.09	6.15	620	200
RO Pond	Runoff Pond down gradient of Mill site, RoM and Workshop	18	4.0	425	2.7	0.025	0.017	0.089	<0.001	0.13	0.2	<0.001	1.9	0.19	0.0095	1.4	170	30
SWTG1A (background)	Mt Bundy Creek, upstream of TG (Background)	29	6.5	26	0.11	0.002	<0.0001	<0.001	<0.001	<0.001	0.2	<0.001	<0.001	<0.001	<0.0005	<0.001	2	<5
SWTG1B (background)	Mount Bundey Creek, further upstream from TG than SWTG1A (~2.8 km)	21	6.6	30	0.16	<0.001	<0.0001	<0.001	<0.001	<0.001	0.2	<0.001	<0.001	<0.001	<0.0005	<0.001	2	<5
SWTG2	Mt Bundy Creek, at Arnhem Hwy bridge, downstream of TG	22	6.4	33	0.11	0.001	<0.0001	<0.001	<0.001	0.002	0.2	<0.001	0.014	0.003	<0.0005	0.013	2.5	<5
SWTG3	Mt Bundy Creek, further downstream of SWTG2	4	6.5	37	0.045	<0.001	<0.0001	<0.001	<0.001	0.002	0.1	<0.001	0.003	<0.001	<0.0005	0.039	5.5	<5
SWTG4	Wetlands area on mine site access road. Downstream of RO sample location	21	3.8	400	3.0	0.011	0.007	0.095	<0.001	0.069	0.37	0.003	1.9	0.22	0.0098	0.98	150	35
SWTG5	Artificial Wetlands contiguous to the pastoral property (Lake Bazzamundi).	18	5.7	170	0.41	0.003	0.0012	0.017	<0.001	0.009	0.09	<0.001	0.5	0.07	0.0011	0.23	64	7
SWTG6	Oxbow Wetland (middle of wetland area Nth of TSF2)	13	4.3	270	1.4	0.003	0.0026	0.054	<0.001	0.021	0.12	<0.001	1.4	0.12	0.0026	0.42	100	20
SWTG9	Runoff from Sulfide Waste Rock Dump, prior to joining Mt Bundey Creek feeder tributary	5	6.2	30	0.17	<0.001	<0.0001	<0.001	<0.001	<0.001	0.15	<0.001	0.02	<0.001	<0.0005	0.004	4	<5
SWTG10	Seepage/runoff collected in diversion drain from OWRD; water diversion flow to Oxbow Wetland	12	3.6	630	13.5	0.007	0.015	0.225	<0.001	0.144	1.06	0.007	3.4	0.62	0.046	2.45	255	100
SWTG11	Entrance to Oxbow Wetland	7	3.7	370	2.9	0.005	0.007	0.069	<0.001	0.047	0.38	0.001	1.4	0.16	0.0056	0.73	125	31
SWTG12	Weir gate at Oxbow Wetland Licenced Discharge Point	21	4.7	200	0.3	0.003	0.003	0.046	<0.001	0.014	0.08	<0.001	0.9	0.096	0.0007	0.39	71	10



Location	Description	Count	pH	EC	Al	As	Cd	Co	Cr	Cu	Fe	Pb	Mn	Ni	U	Zn	SO ₄	Acidity
SWTG13	Surface water runoff from the SWRD prior to it flowing into the Evap. Ponds.	2	4.0	1,145	41.3	0.009	0.0723	0.28	0.004	0.45	0.55	0.003	3.8	1.27	0.029	8.63	960	274
SWTG14	Downstream of the OWRD, before entry to Lake Bazzamundi	15	3.7	750	22.5	0.005	0.034	0.27	<0.001	0.39	0.7	0.016	4.2	0.795	0.076	4.1	380	110
SWTG15	Creek line upstream of influence from the OWRD	15	6.6	75	0.07	0.005	<0.0001	<0.001	<0.001	<0.001	0.38	<0.001	0.034	0.001	<0.0005	0.004	11	<5
SWTG16	Hardy's Lagoon, approx. 15 km downstream of TG	5	6.7	42	0.12	0.001	<0.0001	<0.001	<0.001	0.003	0.42	<0.001	0.01	<0.001	<0.0005	0.003	1	<5

7.2. Groundwater

The Project has an established mining history with mining first occurring in 1988 which include the excavation of the pit and construction of the sulphide WRD, OWRD, TSF1, EP1 and EP2.

Baseline

The earliest available baseline sampling was undertaken in September 1987. The bores sampled (TGD74 and TGD81) were situated within the now Open Pit. Chemistry did exceed SSTV at TGD74 for electrical conductivity, turbidity, Total Suspended Solids, arsenic and iron. While at TGD81 SSTVs were exceeded for pH, electrical conductivity and iron. A summary of the groundwater quality in 1987 is provided in Table 25.

Table 25: Baseline Groundwater Analysis

Analyte	Units	Monitoring Bores		State Specific Trigger Trigger Values
		TGD74	TGD81	
Physiochemical Characteristics				
pH	pH	7.1	5.4	5.8-8.0
Electrical Conductivity	µS/cm	146	77	41
Turbidity	NTU	225	1.0	87
Total Suspended Solids	mg/L	1,670	0.36	54
Environmental Indicators				
Chloride	mg/L	8.2	3.0	
Calcium	mg/L	5.7	4.3	
Magnesium	mg/L	8.3	2.7	
Potassium	mg/L	5.5	3.1	
Sodium	mg/L	8.1	3.0	
Sulfate	mg/L	6.2	2.9	210
Nitrate	mg/L	4.0	5.4	
Chloride	mg/L	8.2	3.0	
Metals/Metalloids (Filtered)				
Arsenic (total)	µg/L	45	2.1	42
Iron	µg/L	4,500	28,000	2700

Note: Bold figures indicate an exceedance of the Site Specific Trigger Values (Stauber and Batley 2018).

Operation (2010 onwards)

The earliest samples undertaken/recorded for the Project were collect in December 2010. A summary of groundwater sampling at the site are provided in Table 19 and locations are illustrated on Figure 4 and 8, Appendix T. These sites are located as follows:

- OB11 approximately 20m north of EP2;
- G9 approximately 100m north of Open Pit;

- G8 adjacent to western boundary of SWRD;
- Bore 11 approximately 400m south of TSF1;
- Ridge Bore approximately 300m south of TSF1; and
- RN29694 approximately 80m west of SWRD.

Groundwater has been assessed against ANZECC Stockwater trigger values. Dewatering of the new Underground operation area will use underground pumping. Dewatering from the underground will be discharged to Lake Bazzamundi or the new WSD after treatment to below trigger values.



Figure 8: Groundwater Geochemistry Summary

Analysis

Generally, the groundwater was circumneutral to slightly acidic, with the exception of G8, which had a pH between 3.9 and 5.61. The elevated sulfate (and metals where analysed), but neutral pH in the shallow bores OB10 (-8.76 mAHD), OB11 (3 mAHD) and G1 (9.2 mAHD) suggests there has been impact from oxidised sulfides with neutralisation of acidity. This is likely to be due to seepage from the adjacent evaporation pond EP2. Based on the chemistry of these bores and an area of white staining, suggesting a salt scald around G1, it is possible there is some local shallow discharge to Bundy Creek, 100 m to the northwest of G1. G8 had the highest elevated concentrations of several metals (aluminium, cadmium, cobalt, copper and nickel) in comparison to multiple guidelines as well as the surrounding bores. This suggests groundwater in the area is impacted by the immediately adjacent waste rock dump. The groundwater results were compared against ANZECC & ARMCANZ Protection of Freshwater Ecosystem Values 90% that align to the SSTVs, the results are shown in Table 26

Table 26: Groundwater Geochemical Assessment

		Field		Alkalinity				Acidity		Inorganics		Major Ions					Metals													
		Electrical Conductivity (Field)	pH (Field)	Carbonate	Bicarbonate	Alkalinity (total) as CaCO3		Hardness as CaCO3/L	Hydroxide	Acidity (as CaCO3)	Total Suspended Solids	Calcium (Filtered)	Chloride	Magnesium (Filtered)	Potassium (Filtered)	Sodium (Filtered)	Sulphate	Aluminium (Filtered)	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (B+V) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Iron (Filtered)	Lead (Filtered)	Manganese (Filtered)	Nickel (Filtered)	Zinc (Filtered)		
						µS/cm	pH Units																						mg/L	mg/L
ANZECC FAE80%																														
Bore	Sample Date																													
BORE 11	9/05/2011	4.69	6	<1	180	180	3100	<1	<2	20	480	8	480	6.6	22	3000	440	11	66	<1	760	5	44,000	<1	31,000	1400	3100			
	22/11/2011	270	7.12	<1	120	120		<1			21	9	11	5.8	5.9	2														
	30/01/2012	278.4	7.86	<1	120	120	95	<1	<2	18	17	9	13	6.4	6.5	3	<10	<1	<0.1	<1	<1	<1	310	<1	200	<1	<1			
	22/04/2012	241.6	6.65	<5	110	110	79	<5	<2	<5	13	7	11	6.8	6.5	<1	3	<1	<0.1	<1	<1	<1	410	<1	250	1	8			
	22/08/2012	241.4	8.03	<5	110	110	73	<5	<5	9	11	7	11	6.1	6.3	<1	27	<1	<0.1	<1	<1	<1	32	<1	94	2	1			
	3/04/2013	238.1	7.3	<5	100	100	64	<5	<5	9	9.3	7	9.9	7.2	6.9	<1	<10	<1	<0.1	<1	<1	<1	920	<1	210	<1	7			
	26/12/2013	175	7.9	11	66	77					6.7	8	8.3	6.1	5.9	<1														
	20/02/2014	164.8	7.3	15	69	83	49	<5	<2	<5	6.7	8	7.9	6.5	6.2	<1	30	<1	<0.1	<1	<1	1	77	<1	80	1	8			
	11/04/2014	163.9	7.62	<5	66	66		<5			7.4	8	9.3	6.5	6.4	<1														
	7/12/2014	160	7.4	<1	63	63		<1			6.2	8.4	7.2	6.2	6.2	0.9														
G8	13/02/2015	146.2	7		60	41.7		<1	<1	<10	5.8	9.8	6.6	6.2	5.2	1.1	5.6	0.1	<0.02	<0.1	0.04	0.06	<2	0.01	17.3	1800	<0.1			
	13/03/2015	158.4	7.46		58	41		<1	<1	<10	5.8	10.5	6.5	6.8	6.4	1.3	5.3	0.1	<0.02	<0.1	0.05	0.09	4	<0.01	23.8	0.17	2.9			
	10/04/2015	162.3	7.8		67	41.5		<1	<1	<10	5.7	10	6.6	5.8	6	0.7	2.2	0.15	<0.02	<0.1	0.03	0.13	12	<0.01	25.4	0.12	0.9			
	1/09/2015	154.4	8.67		59	40.4		<1	<1	<10	5.7		6.4	6.4	6.8	0.8	6	0.15	0.08	0.1	0.06	3.64	14	0.25	22.6	0.58	12.5			
	11/12/2015	154	8.1		53	39.4		<1	<1	<10	5.6	10.6	6.2	6.5	6.8	0.9	6.8	0.2	0.02	<0.1	0.08	1.22	8	0.06	17.2	1.49	2.8			
	3/02/2016	8.7			51	38.4		<1	<1	<10	5.6	10.9	5.9	6.3	6.1	0.8	7.2	0.15	<0.02	<0.1	0.06	0.57	8	0.03	18.9	0.28	0.9			
	11/05/2016	148	8.7		68	38.1		<1	<1	<10	5.6	10.4	5.9	6.1	6.2	0.7	1.8	0.15	<0.02	<0.1	0.05	0.13	28	0.04	24.1	0.21	0.7			
	2/09/2016				62	38.4		<1	<1	<10	5.7	9.9	5.9	6.2	5.8	0.7														
	11/01/2017	120	8.8		63	42		<5	<5	6	6.3	9	6.3	6.2	6.1	<1	<10	<1	<0.1	<1	<1	<1	40	<5	32	<1	2			
	26/03/2017	150	8.8		66	42		<5	<5	6.7	10	6.2	6.3	5.8	<1	<1	<10	<1	<0.1	<1	<1	<1	30	<1	67	<1	<1			
26/08/2017	230	8.5		73	59		<5	<5	10	10	8.3	6.3	6.2	19	260	<1	<1	<1	<1	<1	<1	20	<1	230	13	10				
10/09/2017	180	8.7		73	48		<5	<5	7.4	10	7.1	6.5	6.4			<10	<1	<0.1	<1	<1	<1	340	<1	60	<1	9				
G9	3/12/2010	1568	4.69	<0.1	<0.1	<0.1	680	<0.1	<2	23	98	34	110	5	15	740	9100	12	90	<1	1200	830	1400	8	18,000	1800	6000			
	2/11/2010	1630	4.74	<0.1	<0.1	<0.1		<0.1			98	31	110	5.1	16	820														
	25/01/2011	1152	4.75	<0.1	<0.1	<0.1	17	<0.1	130	380	52	47	62	3.7	21	420	8100	<1	46	<1	860	1600	100	83	13,000	1400	4000			
	9/05/2011	1166	4.37	<1	<1	<1	420	<1	93	<5	57	50	68	3.8	22	570	11,000	4	45	<1	830	1200	75	5	17,000	1400	3700			
	22/11/2011	1167	4.7	<1	<1	<1		<1			61	45	76	3.6	17	510														
	30/01/2012	1098	4.13	<1	<1	<1	430	<1	180	58	57	36	70	3.7	14	460	8000	<1	58	1	770	1500	400	8	14,000	1300	4100			
	11/04/2012	1082	5.61	<5	<5	<5		<5			54	34	59	3.1	14	330														
	27/04/2012	1808	4.74	<5	<5	<5	430	<5	170	<5	60	36	68	3.9	17	460	8100	<1	43	<1	810	1700	28	5	14,000	1300	3700			
	22/08/2012	1484	4.26	<5	<5	<5	610	<5	240	26	84	24	96	4.9	14	670	13,000	10	74	<1	1100	1500	2200	7	20,000	1900	6400			
	3/04/2013	850	3.9	<5	<5	<5	310	<5	100	8	45	31	49	5.1	13	330	5800	4	36	<1	690	1500	89	4	12,000	1200	3300			
26/12/2013	1075	4.3	<5	<5	<5		<5			64	26	74	4.6	14	440															
11/04/2014	1022	4.64	<5	<5	<5		<5			70	32	84	4.2	18	430															
7/12/2014	955	5.1	<1	<1	<1		<1			64.5	33.5	77	6.4	16.8	524															
OB11	20/02/2014	930	4.3	<5	<5	<5	390	<5	170	5	53	36	63	3.8	16	370	7500	6	38	<1	720	1300	63	9	13,000	1300	3700			
	13/02/2015	1055	5.3		<1	474		117	20	65.1	36.2	75.7	6.5	15.5	529	3440	0.3	54	0.1	905	1310	8	3.9	15,400	1590	4680				
	13/03/2015	941	4.96		<1	409		103	<10	57	35.6	64.8	4.1	14.5	486	8400	0.2	48	0.2	835	1480	94	6.95	14,200	1450	4350				
	10/04/2015	1008	4.47		<1	425		182	<10	58.6	30.6	67.8	3.4	12.9	481	7880	<0.05	51.6	0.1	867	1230	134	6.05	14,000	1410	4260				
	1/09/2015	1206	4.6		<1	559		125	20	82.3	85.9	5.2	13.6	621	7620	1.4	60.8	<1	1070	776	3060	10.9	16,800	1650	5690					
	11/12/2015	1120	4.5		<1	560		80	20	83	25.3	85.7	5.4	13	623	6960	0.05	96.8	0.1	1010	1									

7.3. Sediment

Sediment samples were collected for the geochemical baseline survey the findings from this survey are presented in GHD (2018b). Future sampling events will include the collection of sediment samples on an annual frequency at surface water locations.

7.4. Biological Monitoring

An aquatic ecology survey including 13 sites was carried out in May 2017. A total of nine sites are situated on Mount Bunday Creek and four sites on Coulter Creek. The sites are situated upstream, mid and downstream of potential historical influence from the Toms Gully Project site.

7.4.1. Macroinvertebrate Survey

A total of 55 families were collected during the 2017 sampling event. The distribution of those taxa were across 14 Orders. Taxa at sites in both Mount Bunday Creek and Coulter Creek were dominated by Diptera (flies) and Ephemeroptera (mayflies). Coleoptera (beetles) and Trichoptera (caddisflies) were also common across all sites. A noticeable difference in the community at MBC01 could be seen, where the samples were lacking Ephemeroptera, as was a sample from MBC03. A sample from MBC06 followed a similar pattern. Site SWTG9 displayed relatively greater abundances of Gastropoda (snails).

Overall, community composition of samples was similar for sites across Coulter Creek and Mount Bunday Creek with some exceptions.

7.4.2. Fish Survey

A total of 471 individuals belonging to 13 species of fish were recorded during the May 2017 sampling event. Additionally, 6 freshwater crabs and 12 freshwater yabbies were collected from bait traps. Flow was present at most sites along Mount Bunday Creek, which aided in the use of backpack electrofishing as an efficient capture method where conditions allowed entry to the water. Seine netting was also used successfully. Conductivity of waters within both Coulter Creek and Mount Bunday Creek were variable, and through alterations in settings, backpack electrofishing was effective wherever utilised.

Of the thirteen identifiable species of fish recorded in May 2017, Eastern Rainbowfish made up the largest number of those collected during sampling, followed by Sailfin Glassfish. Spangled Perch and Eastern Rainbowfish were the most widely distributed fish, being found at nine and eight sites across the study area respectively. SWTG3 recorded the highest number of fish species in May 2017, closely followed by the farthest upstream sites on Mt Bunday Creek (SWTG1A and SWTG1).

Mount Bunday Creek sites recorded a higher diversity of fish species compared with Coulter Creek. There was little difference between the control site, and sites adjacent and downstream of the mine area on

Mount Bunday Creek. Diversity was generally low on Coulter Creek, and sites upstream of the Arnhem Highway recorded the lowest diversity of any sites on that watercourse, with only one species being caught at both sites. Fish found in both watercourses included Sailfin Glassfish, Spangled Perch, Eastern Rainbowfish, Northern Trout Gudgeon and Seven-spotted Archerfish, the remaining eight species were found exclusively in Mount Bunday Creek in May 2017. A short-finned Eel was caught at MBC01 in May 2017.

Physical Condition

Fish caught in Coulter Creek did not show any signs of stress or external damage and appeared to be in good health. Within Mount Bunday Creek, fish collected were for the most part in good condition, with no signs of stress or parasites noted. At site MBC01, several Spangled Perch were recorded as having lesions identified as most likely being Tropical Ulcerative Syndrome (red spot disease). A number of Seven-spot Archerfish were observed swimming sluggishly at the site, which could be collected using a dip net without using the electrofishing unit.

7.5. Cumulative Assessment of Historical Monitoring

Onsite groundwater is significantly impacted at OB11 (adjacent to the north of EP2). Insufficient down-gradient data is available to assess the extents of impact to groundwater. G8 has low pH (~4.4) and elevated metal loads against the adopted trigger values including aluminium, cadmium, copper and nickel. OB11 has elevated electrical conductivity (~3,600 $\mu\text{S}/\text{cm}$) and elevated sulphate (~2,350 mg/L). Most recent results from September 2017 confirm this.

Groundwater generally flows to the northwest across the Project site. The closest downstream bore with available quality data is G9 which has one exceedance of pH and lead adopted trigger values. Through the sampling period it is likely groundwater was flowing to the Open Pit and therefore G9 was not downstream of G8 or OB11.

EP1 and EP2 have low pH, high sulphate and elevated metal loads including aluminium, cadmium, cobalt, copper, nickel and zinc. An assessment of water quality data indicates an upward trend for metal loads, sulphate and electrical conductivity. A downward trend occurs for pH. It is likely this water body is the source of impacted groundwater at G8 and OB11.

Historical impacts to offsite water quality (considered to be SWTG2) have been generally good from July 2002 to September 2017. The trends are considered to be due to reductions in offsite disposal of waste water.

Biological data within Mount Bunday Creek indicates the highest abundances of macroinvertebrate

populations in 2015 at SWTG1a (upstream). However, SWTG2 is at the lower abundance. This could potentially be a function of uncontrolled discharges from the Project or several additional factors.

The operation of the Project is likely to create a cone of groundwater depression and capture of impacted groundwater within the underground operation. In addition, water treatment onsite will treat water quality on transfer from the underground operation to the update Site Specific Trigger Values reducing metal loads and pH.

7.6. Management

7.6.1. Remedial or Corrective Management Actions

Mine Affected Surface Water

The majority of mine affected surface water stored onsite is acidic with elevated electrical conductivity, sulphate and metals. EP1 and EP2 have consistent upward trends for electrical conductivity, sulphate and metals and downward trends of pH. Management of onsite water for the period of this WMP includes water treatment, an increased sampling frequency, quarterly assessment of trends and transfers across site to reduce potential for uncontrolled discharges.

The reopening of the Project requires two phases in terms of water management. The first phase is the construction of the WSD and dewatering of the Open Pit to create capacity for tailings and waste rock placement. The second phase is the operation of the Project and controlled discharges to Mount Bunday Creek, Lake Bazzamundi and/or transfer of water to a third party.

In order to identify management actions the following studies/actions are required to inform mitigation measures:

- Discharge Management Plan including:
 - Ecotoxicology Assessment
 - Water Quality Monitoring and flow metering.
- Ongoing Contaminant Transport Modelling
- Ongoing Groundwater Modelling

Groundwater

Areas of the groundwater shows signs of being impacted at TGU. In order to identify management actions the following studies/actions are required to inform mitigation measures:

- Installations and monitoring of bores(MB1A to MB6B);
- Lake Bazzamundi surface water quality monitoring;
- Ongoing Contaminant Transport Modelling; and

- Ongoing Groundwater Modelling.

7.6.2. Water Treatment

Pit Water

Approximately 1.7 GL will to be removed from the Toms Gully Pit over the life of the mining operation. Water treatment will comprise the Bioaqua Process (or contingency option – Caustic Soda/Reverse Osmosis) to lower pH, remove sulfur and mixed metal oxides. The water will be treated to the define SSTVs or water quality vales and then pumped into WSD for containment. The water will either be utilised for processing or discharged to Mount Bundey Creek, Lake Bazzamundi or passed to a third party for use. Discharge to Mount Bundey Creek and Lake Bazzamundi will require a Waste Discharge Licence which will be investigated. In addition, the remaining water in the pit will be treated insitu using lime, caustic or virtual curtail to manage water chemistry.

Commitment 6

A water treatment plan will be established and provided for review as part of the Waste Discharge Licence Application and Mining Management Plan.

Due Date

TBC

Potable and Sewage and Oily Water

The existing mine site will have a reverse osmosis water treatment system for potable water supply. An existing septic tank system in place that will be utilised. The site will have an oily water separator reestablished to capture and treat any contaminated water generated from workshop areas. The integrity of the existing sewage system shall be inspected prior to use and upgraded where required to meet regulatory / health standards.

7.7. Proposed Actions and their Potential to Impact on Water Quality

The site is currently in a care and maintenance phase with Primary Gold currently undertaking an Environmental Impact Assessment of the proposed reopening of Toms Gully Underground Project. The approval process and subsequent submission of Mining Management Plan (MMP) and associated documents are dependent upon an adequate EIS and subsequent approval.

7.7.1. Commitment Summary

In addition to the surface and mine affected water, groundwater, sediment and biological monitoring the following commitments are made.

Commitment 1

PGO will complete the detailed design for the WSD and provide it to the Department of Primary Industry and Resources for review and approval prior to construction.

Date:

tbc

Commitment 2		
The tailings management strategy (including tailings removal) and, TSF1 and TSF2 remediation and reuse design will be completed and provided to the Department of Primary Industry and Resources for review and approval prior to modification and use.		
	Date:	tbc
Commitment 3		
Monitoring bore census to review the monitoring network and establish depth of screens, condition and potential rehabilitation plan. The census will inform locations of additional monitoring bores to provide effective coverage.		
	Due Date	TBC
Commitment 4		
Installation and/or rehabilitation of groundwater monitoring bores to provide upstream, mid and downstream coverage of infrastructure and underground operation. The installation will include MB1A, MB1B, MB2A, MB2B, MB3A, MB3B, MB4, MB5A, MB5B, MB6A and MB6B.		
	Due Date	TBC
Commitment 5		
Installation of flow meters and water storage gauges to validate the water balance model. Weekly readings will be collected on all transfers across site and storage levels.		
	Due Date	TBC
Commitment 6		
A water treatment plan will be established and provided for review as part of the Waste Discharge Licence Application and Mining Management Plan.		
	Due Date	TBC

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Attachment C:

Monitoring Report

Toms Gully Aquatic Ecology Baseline Studies

Final Report



This report has been prepared for Hanking as a technical document to continue baseline data collection and assist with future impact assessment.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. As a result, not all relevant site features and conditions may have been identified in this report.

Rainfall data were obtained from external sources. Aquatic Ecology Services has made the assumption that all data has been validated and is correct.

Version	Prepared by	Reviewed by	Review Date
Draft 1.0	T Steele	C Hastie	22/08/2022
Final 2.0	T Steele		

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1. Introduction

1.1 Background

Toms Gully Mine, located near Marrakai in the Northern Territory, has been in operation intermittently since 1988. The project area has operated under the ownership of several different operators, most recently Crocodile Gold until 2013; then after a period of Care and Maintenance, it was divested to Primary Gold. Primary Gold was acquired by Hanking and gained environmental approvals for an underground mining operation at the site in 2020.

Aquatic ecology monitoring has been undertaken at Toms Gully Mine in 2015, and 2017-2021. The surveys to date have gathered data on fish and macroinvertebrate communities as well as habitat information and water quality for Mount Bunday and Coulter Creeks. This resulted in a body of data that was used for the assessment of the impact of a proposed treated mine water release regime. Aquatic ecology monitoring has continued at the site to provide a continuous and robust data set. Data gathered during the baseline monitoring phase will assist in understanding aquatic ecosystem health changes that may result from operations at the Toms Gully Mine Site.

1.2 Catchment

The Toms Gully Mine is located adjacent to Mount Bunday Creek, which flows into Hardies Creek, a tributary of the Mary River Floodplain. The Mary River Coastal Floodplain is unusual in Northern Australia as it is lacking a single major river channel through the floodplain to the ocean. As a result, the floodplain is poorly drained and the inflow channel diffuses into vast seasonal swamps before reaching the sea through a number of tidal channels. The Mary River crossing at the Arnhem Highway is a convenient delineation between the upper (southern) catchment and the floodplains of the lower (northern) catchment. The crossing marks the approximate change in patterns of wet season river flow from channel to sheet flow (Schultz *et al.* 2002).

Coulter Creek is a low order stream, and a tributary of Mount Bunday Creek. The confluence of the two creeks is located approximately 4km downstream of the Arnhem Highway. The Creek originates upstream on the Old Mount Bunday Station, and previous studies have observed impacts at sites on Coulter Creek as a result of cattle access. The riparian zone along Coulter Creek is not continuous, and the greater catchment area has also been cleared for grazing. Mount Bunday Creek is a higher order stream, draining north to Hardies Creek and on to the Mary River. The Riparian zone of Mount Bunday Creek is more intact than Coulter Creek, and clearing of land beyond the riparian zone is more intensive surrounding Toms Gully Mine and downstream than in the upstream area that has been monitored. Although during sampling events there were observable breaks in surface water, where dry sand was present in the creek bed, surface water flow was recorded at most sites. Alluvial groundwater and surface water interact along Mount Bunday Creek, and there is likely an extended period of sub-surface flow in the dry season through the sandy substrates.



1.3 Scope

Aquatic Ecology Services was engaged by Hanking to undertake baseline surveys at the Toms Gully Mine to characterise the existing aquatic health and condition of the receiving environment. The survey included:

- A study design that incorporates locations upstream, within and downstream of the Toms Gully Mine Lease (ML), and as a minimum, assessment of Primary sites SWTG1 (control site) and SWTG2 (potential impact site downstream of Toms Gully Mine).
- Macroinvertebrate sampling and aquatic habitat assessment carried out in accordance with the NT AUSRIVAS Darwin-Daly Region Manual (Lamche 2007)
- Fish community sampling
- Water and sediment quality sampling

This report presents the results of the above monitoring conducted in April 2022.



2. Study design

2.1 Sampling Sites

Aquatic ecology sampling was undertaken at 8 sites in April 2022 (Table 1, Figure 1). Six sites were sampled on Mount Bunday Creek, consisting of three sites upstream of the mine and three sites downstream of the mine. Two sites were sampled on the reference system Coulter Creek. Site CC04 could not be accessed in 2022 and therefore was not sampled.

Table 1 – Sample site locations visited in May 2022

Site	Site Type	Location	Easting	Northing
SWTG1C	Upstream	Mount Bunday Creek approximately 2.5 km upstream of SWTG1A.	775674	8579115
SWTG1	Upstream	Mount Bunday Creek at confluence of tributary adjacent to EP1 and EP2	776825	8580290
MBC0	Adjacent	Mount Bunday Creek upstream of tributary draining EP1 and EP2, downstream of WRD	777606	8580736
MBC01A	Downstream	Mount Bunday Creek downstream of wetland oxbow and Toms Gully Mine Tailings Dam 2 (TSF2).	778787	8580437
SWTG2	Downstream	Compliance monitoring point at Arnhem Highway Crossing	779453	8580428
SWTG3	Downstream	300 m upstream of confluence between Mount Bunday Creek and Coulter Creek	782278	8579366
CC02	Reference	Coulter Creek. Approx. 2 km upstream from CK7	778299	8578355
CK7	Reference	Coulter Creek. Existing monitoring site located at highway crossing	779807	8579538

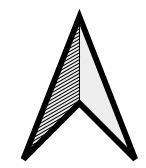
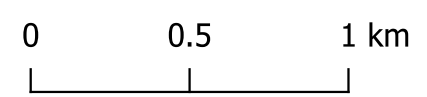
2.2 Survey timing

Sampling has routinely been conducted in the post-wet season during the recessional flow period, to capture data representative of the time of year when compliance monitoring would be undertaken. In 2022, sampling was undertaken in late April to target adequate water availability at all sites.



Aquatic Ecology Sites

-  Adjacent
-  Downstream
-  Upstream



3. Methods

3.1 Habitat assessment

At each site, descriptions of habitat characteristics were recorded following the criteria listed in the Northern Territory AUSRIVAS "Darwin-Daly Region Model" field sheets (Lamche, 2007). Habitat assessments were undertaken in consideration of the whole reach sampled, including:

- Site description
- Water quality
- Instream physical characteristics (flow velocity and depth, instream habitat characteristics, bank height, riparian zone width)
- Riparian vegetation characteristics (types, %cover, exotic species, erosion, land use)
- Water quality observations (clarity, odour, oils, foam/scum, plumes etc.)
- Sketches of the site, including a cross - section of the reach

The information recorded was used to assist interpretation of biological data and to provide input data for the Northern Territory AUSRIVAS model. Data recorded is also used in conjunction with the biological community information as the basis of the overall health assessment.

Photos were taken of upstream and downstream portions of the reach sampled, as well as bank habitat and other key habitat features. This further characterises the habitat conditions at each site, serving as a pictorial record of site conditions that can be tracked over time using photos taken from the same photo points.

3.2 Water and sediment quality sampling

3.2.1 *In situ water quality*

The physico-chemical parameters of the water at each site was measured using a calibrated multi-parameter water quality meter. The following parameters were recorded:

- Water temperature (°C)
- Dissolved oxygen (DO) concentrations (mg/L and % saturation)
- pH
- Electrical conductivity (EC) (µS/cm)
- Turbidity



3.2.2 Water and sediment grab sampling

Water and sediment sampling methods utilised at each site were in accordance with those outlined in ANZECC (2000) and Simpson and Batley (2016) and involved:

- Collection of water samples from below the water surface in the centre of the creek where possible
- The collection of multiple sub-samples of sediment using a spade of inert material and sieving of samples to collect the $\leq 2\text{mm}$ fraction.
- Compositing the sediment sub-samples into a receptacle (also composed of inert material) and mixing the contents.
- The collection of one QA/QC duplicate sample per project area to validate results.
- Collecting a sediment sub-sample from the mixture and placing it into a laboratory-supplied container, labelled with site and sample details.
- Keeping samples in chilled eskies for onward delivery to a NATA accredited laboratory for testing.

Analyses performed on surface waters are detailed in Table 2. Bioavailable metals data (from 1M HCl dilute acid digestion analysis) were analysed for the parameters shown in Table 3.

Table 2 - Testing parameters for water collected at Toms Gully

Suite	Analytes
Physico-chemical	Total dissolved solids (TDS), total suspended solids (TSS), turbidity
Major anions	Alkalinity, chloride, sulfate
Major cations	Calcium, magnesium, sodium, potassium
Metals (dissolved and total)	Aluminium, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, uranium, zinc
Cyanide	Free cyanide, weak acid dissociable (WAD) cyanide, total cyanide

Table 3 – Testing parameters for sediments collected at Toms Gully

Lab Analyses	Analytes
1M HCl extractable metals	Aluminium, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, uranium, zinc.
Total recoverable metals	Mercury
Cyanide	Free cyanide, weak acid dissociable (WAD) cyanide, total cyanide
Other parameters	Particle size distribution (PSD), total organic carbon (TOC), moisture content.

Updated guideline values are not yet available for the Timor Sea Drainage Division (ANZG 2018). Therefore, *in situ* results were compared against ANZECC (2000) Tropical Australia guideline values for slightly-



moderately disturbed ecosystems (95% species protection). This aligns with the recommendations made by the NT EPA in the Assessment Report (NT EPA 2020).

3.3 Macroinvertebrates

3.3.1 Field sampling

Macroinvertebrate sampling and processing followed procedures outlined in the Northern Territory AUSRIVAS Manual for the Darwin-Daly Region (Lamche, 2007). Sampling involved one field team member scraping submerged root matter associated with the lower bank to agitate and remove macroinvertebrates into the water column, while the other field team member swept a dip net through the water column downstream of the edge habitat, to collect the dislodged animals. Areas of riffle or fast flowing habitat, Pandanus roots and severe bank undercuts were avoided when collecting edge habitat samples.

Once collected, the samples were washed through 10 mm and 250 µm mesh sieves. The coarse mesh sieve was examined for large, conspicuous taxa, and these were placed in the labelled sample container. The sample collected in the fine mesh sieve was also placed in the labelled sample container and filled with 70% ethanol. All samples were sent to the macroinvertebrate laboratory for further processing and identification.

3.3.2 Laboratory processing

Samples were washed through a series of sieves (10 mm, 500 µm and 250 µm mesh sizes). Any large, conspicuous taxa identified in the 10 mm mesh sieve were added to the contents of the large mesh fraction retained in the field. The contents of the 500 µm mesh sieve were retained for macroinvertebrate identification and enumeration, while the 250 µm fraction was retained as sample residue for quality assurance purposes. The contents of the 500 µm mesh fraction was poured into a Marchant sub-sampler (Marchant, 1989) and extractions made randomly from cells (aliquots) in this apparatus. These extractions were placed under a microscope and the taxa identified and counted. This process continued until either all aliquots were examined, or a total of 200 individuals had been counted and identified. The number of aliquots required to be processed to obtain a minimum 200 individual sub-sample was recorded in order to be able to calculate abundance. A Leica stereo-dissection microscope was used to examine specimens.

Taxa were identified to family level where possible, with the exception of key taxa identified in Lamche (2007), requiring identification to order level (e.g. Conchostraca). Quality assurance processes were followed as per Lamche (2007). Five percent of samples were sent to an external laboratory and checked for correct identification by an AUSRIVAS accredited Senior Taxonomist.

3.3.3 Data presentation

Prior to 2021, biological monitoring programs commonly utilised the NT AUSRIVAS Darwin-Daly Early (dry season) Family level Edge habitat model. New guidance on the use of these models in the NT to understand impacts of point source pollution have been published (ANZG 2021). The updated guidance states that the models are not useful in understanding aquatic ecosystem health outside of the large rivers where

macroinvertebrates have been collected, and therefore the use of AUSRIVAS modelling has not taken place on the data collected for this project from 2021.

Macroinvertebrate community indices were calculated for each sample at each site. A summary of the univariate macroinvertebrate indices assessed as part of this study are provided below:

- Taxa richness – Total number of taxa present at the site used as a measure of diversity.
- PET richness – total number of families from orders Plecoptera, Ephemeroptera and Trichoptera. PET taxa are generally more sensitive to disturbance.
- SIGNAL-2 – a biotic index that allocates a value to each macroinvertebrate family based on their sensitivity to pollution. The metric is calculated by averaging the index of all families collected. Lamche (2007) cautions against the use of the SIGNAL-2 index for assessing the status of Northern Territory macroinvertebrate communities. This measure is however, considered appropriate for this study as the number of pollution-sensitive versus pollution-tolerant families does provide some insight to the level of stress that the macroinvertebrate community is experiencing.

In addition to univariate analysis of metrics, an assessment of differences in the macroinvertebrate community composition will be undertaken. NMDS Ordination provides a representation of the relative similarity of entities (i.e. samples) based on their attributes (i.e. macroinvertebrate community composition) within a reduced dimensional space. This process was completed for samples collected on Mount Bunday Creek in 2022.

3.4 Fish Community

Fish sampling was carried out primarily using backpack electrofishing. Electrofishing is a proven technique capable of capturing the majority of taxa present, as it is not size or species specific (as compared to gill nets for instance). Further, it is a nonlethal means of sampling when applied properly and can be used in a way that can provide quantitative data where required. However, at some sites electrofishing was not possible due to safety concerns regarding steep banks, deep pool habitat and the potential presence of estuarine crocodiles. Wherever instances such as these occurred, the field team recorded visual observations (to the best of their ability) regarding fish species present.

Where electrofishing was completed, a single pass from downstream to upstream was completed. All caught fish were identified in the field using appropriate keys (Allen et al. 2003) and counts for each species captured were recorded. The total number of fish captured at each site was derived from that information. All macrocrustaceans (Palaemonidae and Atyidae) caught at a site were also counted. Notes were also taken of any evidence of external lesions, parasites or deformities among the fish specimens collected at each of the study sites.



4. Results and Discussion

The majority of sites were accessible in May 2022, and Table 4 details sampling carried out at each site. A single site downstream of Toms Gully Mine (SWTG3) was considered too dangerous to sample for macroinvertebrates, and so a sediment and water quality sample were collected. The site acts as a downstream recovery site, and capturing data on sediment and water quality is important in demonstrating the spatial impact of any passive or active discharges from Toms Gully Mine.

Table 4 – Sampling completed at each site in May 2022

Site	Macroinvertebrate sampling	Fish sampling	Habitat assessment	Water/ Sediment quality
SWTG1C	✓		✓	✓
SWTG1	✓	✓	✓	✓
MBC0	✓	✓	✓	✓
MBC01A				✓
SWTG2	✓	✓	✓	✓
SWTG3				✓
CC02	✓		✓	✓
CK7	✓		✓	✓

4.1 Site Conditions

4.1.1 Climate

Rainfall recorded at the closest available weather station (Cooinda Airstrip, Station no. 14256) is presented in Figure 2. Rainfall data was recorded approximately 70km from the Toms Gully site. A total of 1439.5mm of rain was recorded in 2021-2022, which was greater than the long-term average for the station (1382.5mm) and rainfall was above average in the months of November and December, and below average for the following three months, before a slightly above average rainfall record for April.

It is acknowledged that rainfall in the NT can be patchy, and rainfall recorded at Cooinda Airstrip is indicative of climate, but may not accurately represent conditions on site at the Toms Gully Mine.

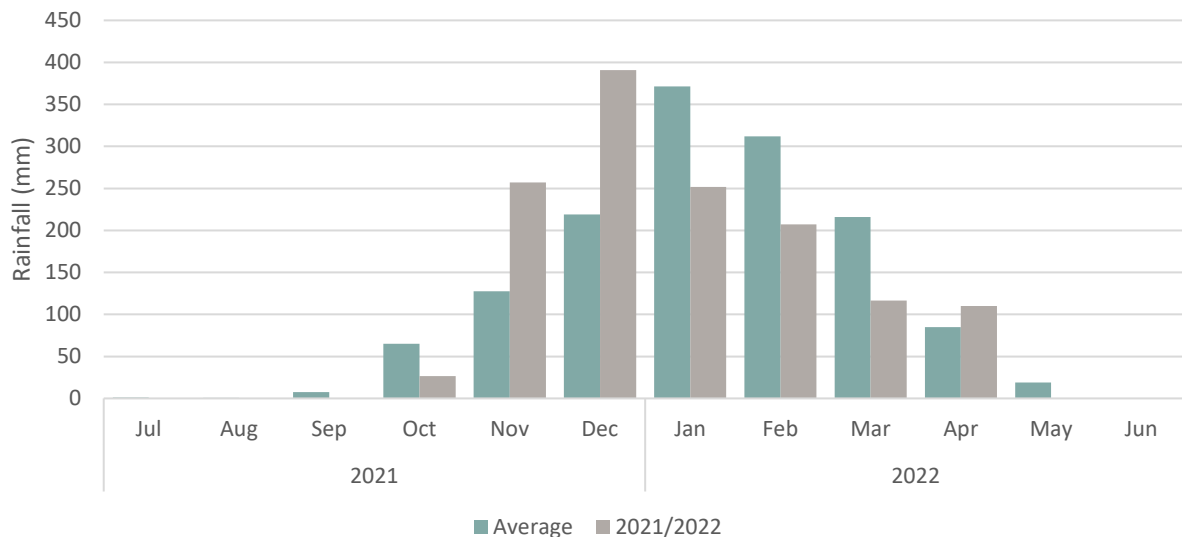


Figure 2 – Monthly Rainfall recorded at Cooina Airstrip July 2021-June 2022 (BOM 2022)

4.1.2 Site descriptions

A description of habitat characteristics associated with monitoring sites sampled in April 2022 are presented in Table 5 and Table 6, along with site photographs taken at the time of sampling.

Table 5 – Aquatic ecology sampling site descriptions on Mount Bunday Creek, April 2022

Site description	Site photo
SWTG1C - Upstream The site was made up of a number of pools connected by shallow runs. Pools were bound by bedrock. Water was clear. Bed material was a mixture of bedrock, cobbles and sand. The riparian zone was continuous, and overhanging vegetation trailed in water. Exposed roots and undercut banks were common, along with leaf packs and sticks. A large pool located upstream showed evidence of crocodiles inhabiting the area.	

Site description	Site photo
SWG1 – Upstream The site is made up of two large, deep pools, connected by a run. The substrate of both pools was made up of sand and gravel, and the connecting run has substrate made up of pebbles, cobbles and sand. Both banks of the pool are lined by continuous riparian vegetation providing shade and exposed roots. Undercut banks were prevalent, along with leaf packs and small log jams.	
MBC0 – Adjacent The site is located approximately 100m upstream of the confluence between a small, unnamed tributary that drains passive discharge from mining infrastructure. The site was well shaded due to a continuous riparian zone, and presence of trees along banks allowed for exposed roots, large woody debris and leaf packs to be common through the site. The majority of substrate at the site was made up of sand and pebbles. Long gliding pools were connected by shallow runs. And riffles	
SWG2 - Downstream The site is made up two gliding pools connected by runs, and is intersected by a stock crossing. The stock crossing has undergone significant upgrades, which have resulted in erosion and a change in flow through the site from previous years. Downstream of the crossing, the site was a wide, shallow pool. Substrate along the entire reach was a mixture of cobbles, pebbles and sand, with clay banks.	

Site description	Site photo
SWG3 - Downstream The site is the furthest downstream on Mount Bunday Creek, downstream of its confluence with Coulter Creek. The site was characterised by a long, shallow run with large woody debris and undercut banks. Substrate was mostly sand, and the substrate was covered for most of the reach by detritus. The riparian zone was continuous and consisted of trees and bamboo. As a result, shading was very high.	

Table 6 - Aquatic ecology sampling site descriptions on Coulter Creek, April 2022

Site description	Site photo
CC02 - Reference The site is intersected by a ford made of, cobbles and clay. Upstream of the ford was a large, deep pool. Downstream of the ford was a series of pools connected by shallow runs. The creek was shaded by a dense, 5 m wide, native riparian strip on both banks. Beyond the riparian zone was cleared and the land used for grazing and horticulture (mango plantation).	
CK7 - Reference The site is located downstream of the Arnhem Highway and is a routine water quality monitoring location. The surrounding area is made up of cropping and grazing land. The riparian zone and creek itself were in relatively good condition, and included undercut banks, high shading and leaf litter. Algae was observed in shallow areas, which suggests some nutrient enrichment.	

4.2 Water and sediment quality

4.2.1 In situ water quality

In situ water quality data is compiled and presented in Table 7, with comparisons made to ANZECC (2000) guideline values. The following observations about the results can be made:

- Temperatures were very similar between sites and ranged between 27.4 and 30.2°C
- All pH results were within the guideline value range, the lowest reading was recorded at MBC01, but all values were circumneutral.
- Dissolved oxygen varied. High shading within both creeks is likely the cause of lower dissolved oxygen than the guideline range at sites on both creeks. Alternatively, a reading above the guideline value was recorded at SWTG2, which is likely due to the presence of a riffle at the site creating oxygen-rich water.
- Electrical conductivity was within the guideline value range for all sites.
- Water clarity was high at all sites, and turbidity was below the guideline value at all sites.

Table 7 – In situ water quality data collected at aquatic ecology sites in 2022. Guideline exceedances shaded grey

Site Code	Time	Temp (°C)	pH	DO (%)	DO (mg/L)	EC (µS/cm)	Turbidity (NTU)
Guideline Value (ANZECC 2000)		-	6 - 8	85 - 110		20 – 250	50
SWTG1C	9:45	27.5	7.11	75	5.74	39	15.8
SWTG1	11:10	27.8	6.82	103.1	7.89	37.9	16.1
MBC0	14:35	28.1	6.57	110	8.52	40.1	6.61
MBC01A	12:50	28.8	6.10	82.7	7.89	168	4.9
SWTG2	13:45	27.5	6.27	110.3	8.21	144	4.4
SWTG3	16:05	27.4	6.68	80.5	7.85	85	3.4
CC02	12:40	30.2	7.09	54.6	4.26	159.4	5.11
CK07	13:36	29.6	7.14	61.4	4.64	124.7	6.91

4.2.2 Laboratory water quality

Results of laboratory analysis of water quality grab samples from Mount Bunday Creek are presented in Table 8. The following observations are made about the results:

- There were no major differences between alkalinity results at sites upstream and downstream of Toms Gully Mine.
- Elevated dissolved iron concentrations were a feature of surface water quality at a number of sites. The concentration of dissolved iron did not appear to have any clear pattern based on position of sites in the catchment. Local geology is likely to be iron-rich and is therefore dissolved in the waters of Mount Bunday Creek.
- A number of dissolved metal concentrations were elevated at downstream sites on Mount Bunday Creek and exceeded guideline values. The highest value for any analyte was recorded at MBC01A. Elevated dissolved metals are likely to be linked to the location of the site in the catchment relative to a tailings storage (TSF2) and downstream of a tributary that drains from the toe of an evaporation pond. Several of the dissolved metals continued to exceed the guideline value downstream at SWTG2. All metals, besides zinc, had reduced below the guideline value further downstream at SWTG3. The majority of dissolved metal concentrations had reduced to levels similar to sites upstream of the Toms Gully Mine at SWTG3, except for Manganese.
- It is likely that during the wet season, rainfall/runoff and discharges occurring to Mount Bunday Creek upstream had combined to ameliorate poor water quality that may be present as a result of passive discharge from Toms Gully Mine infrastructure. For this reason, the results of this sampling event must be reviewed in the context of previous results from the wet season. The results of this sampling are consistent with previous sampling events, which have shown poor water quality downstream of Toms Gully Mine during the recessional flow period.

Results of laboratory analysis of water quality grab samples from Coulter Creek are presented in Table 9. There was very little variation in results from all sites, but an exceedance of dissolved nickel was recorded at both sites. An exceedance of dissolved nickel was recorded in both catchments in 2022.



Table 8 – Laboratory derived water quality results from sites within Mount Bunday Creek

Analyte	Units	LOR	Upstream		Adjacent	Downstream			Default Guideline Value
			SWG1C	SWG1	MBC0	MBC01A	SWG2	SWG3	
Physicochemical parameters									
TSS	mg/L	5	26	22	25	120	100	52	NA
TDS	mg/L	5	28	43	6	150	79	85	NA
Major ions									
Bicarbonate alkalinity	mg/L	5	16	15	13	10	10	15	NA
Carbonate alkalinity	mg/L	5	<5	<5	<5	<5	<5	<5	NA
Total alkalinity as CaCO ₃	mg/L	5	16	15	13	10	10	15	NA
Sulfate as SO ₄	mg/L	1	1	2	4	43	51	20	210
Chloride	mg/L	1	1	3	2	2	2	3	NA
Calcium	mg/L	0.5	1.4	1.6	2.1	8.5	10	5.1	NA
Magnesium	mg/L	0.5	1.2	1.3	1.4	5.9	7.3	4	NA
Potassium	mg/L	0.5	1.3	1.1	0.7	1.4	1.5	1.4	NA
Sodium	mg/L	0.5	4.2	3.4	2.6	3.9	4.2	4.1	NA
Dissolved metals									
Aluminium	mg/L	10	37	21	10	18	12	<10	55
Arsenic	mg/L	1	1.4	<1	<1	<1	<1	<1	13
Cadmium	mg/L	0.1	<0.1	<0.1	<0.1	2.2	2.2	0.12	0.2
Cobalt	mg/L	1	<1	<1	<1	15	13	<1	1.4
Copper	mg/L	1	<1	<1	<1	15	9	1.9	1.4
Iron	mg/L	2	160	170	160	1000	300	690	-
Manganese	mg/L	0.5	96	53	53	770	870	130	1900
Nickel	mg/L	1	<1	<1	<1	27	29	2.6	11
Zinc	mg/L	1	1.3	3.3	<1	120	130	7.9	8



Table 9 – Laboratory derived water quality results from sites within Coulter Creek

Analyte	Units	LOR	CC02	CK7	Default Guideline Value
Physicochemical parameters					
TSS	mg/L	5	170	130	NA
TDS	mg/L	5	130	110	NA
Major ions					
Bicarbonate alkalinity	mg/L	5	21	19	NA
Carbonate alkalinity	mg/L	5	<5	<5	NA
Total alkalinity as CaCO ₃	mg/L	5	27	22	NA
Sulfate as SO ₄	mg/L	1	53	24	210
Chloride	mg/L	1	3	2	NA
Calcium	mg/L	0.5	9.4	6.5	NA
Magnesium	mg/L	0.5	<5	<5	NA
Potassium	mg/L	0.5	9.4	6.8	NA
Sodium	mg/L	0.5	3.1	2.8	NA
Dissolved metals					
Aluminium	µg/L	10	<10	<10	55
Arsenic	µg/L	1	<1	<1	13
Cadmium	µg/L	0.1	<0.1	<0.1	0.2
Chromium	µg/L	1	<1	<1	3.1*
Cobalt	µg/L	1	<1	<1	1.4
Copper	µg/L	1	1.2	1.2	1.4
Iron	µg/L	2	850	630	-
Manganese	µg/L	0.5	160	60	1900
Nickel	µg/L	1	110	28	11
Uranium	µg/L	0.5	<1	<1	-
Zinc	µg/L	1	<0.5	<0.5	8

4.2.3 Sediment quality

Laboratory derived sediment quality results are presented in Table 10. Given the higher concentration of dissolved metals at sites downstream of TSF2, it was expected that some accumulation in sediments of those contaminants might be seen, but this did not materialise for the majority of metals. There does appear to be some precipitation of metals to sediments downstream at SWTG3, which coincide with lower dissolved metal concentrations in surface waters. These concentrations remain below the lower guideline values for sediment.



A single exceedance of the arsenic SQGV-low was recorded in sediments at SWTG2. Acid-extractible arsenic at the site has been elevated compared to other sites previously (AES 2021) and follows an increasing trend of arsenic accumulation in sediments at the site (Figure 2). The pH result from SWTG2 was circumneutral and therefore the risk of bioavailability of metals from sediments is low and will remain low if pH values do not reduce. The trend appears to be isolated to SWTG2, and acid-extractible arsenic values returned to below the LOR downstream at SWTG3, in line with sites sampled upstream of Toms Gully Mine.

There were no exceedances of guideline values on Coulter Creek, but a number of acid-extractible metals were at higher concentrations at the downstream site.

Table 10 – Sediment quality results from aquatic ecology monitoring sites, April 2022. All results presented in mg/kg

Sample	LOR	SWTG1C	SWTG1	MBC0	MBC01A	SWTG2	SWTG3	CC02	CK7	GV-low	GV-high
Total Organic Carbon (mg/kg)	100	1000	2000	1000	13000	3000	21000	3000	9000	-	-
Total Organic Carbon (%)	-	0.1	0.2	0.1	1.3	0.3	2.1	0.3	0.9	-	-
Aluminium	2	110	110	68	680	400	740	240	330	-	-
Arsenic	4	<4	<4	<4	<4	45	<4	<4	<4	20	70
Cadmium	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	1.5	10
Cobalt	1	<1	1.1	<1	3.2	7.1	12	2.6	13	-	-
Chromium	1	<1	<1	<1	1	<1	<1	<1	<1	80	370
Copper	1	<1	<1	<1	4	6	12	1	3	65	270
Iron	2	610	800	460	2000	1500	3600	1100	1600	-	-
Lead	2	3	3	3	11	5	10	13	16	50	220
Manganese	1	100	90	100	200	200	590	260	390	-	-
Nickel	1	<1	<1	<1	1	4	8	<1	8	21	52
Zinc	1	2	2	2	7	26	44	4	37	200	410

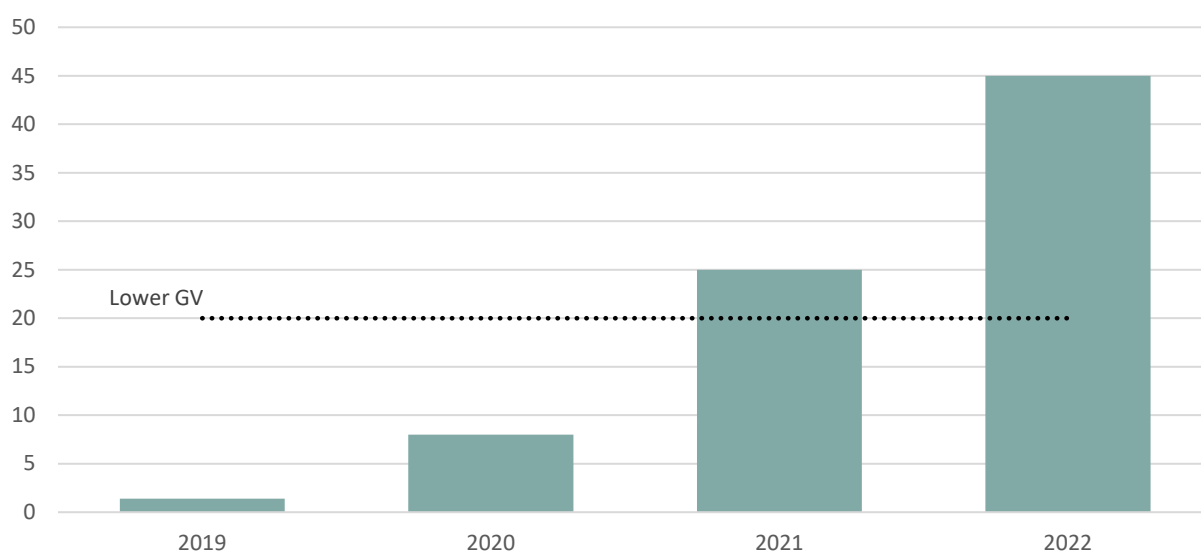


Figure 2 – Acid-extractible arsenic concentrations in sediments at SWTG2 2019-2022

4.3 Macroinvertebrates

4.3.1 Taxa richness

Taxa richness results for all sites sampled in April 2022 are presented below in Figure 3. In general, taxa richness increased with distance downstream on Mount Bunday Creek. TControl sites showed similar taxa richness at both sites, and downstream samples contained a slightly higher number of taxa.

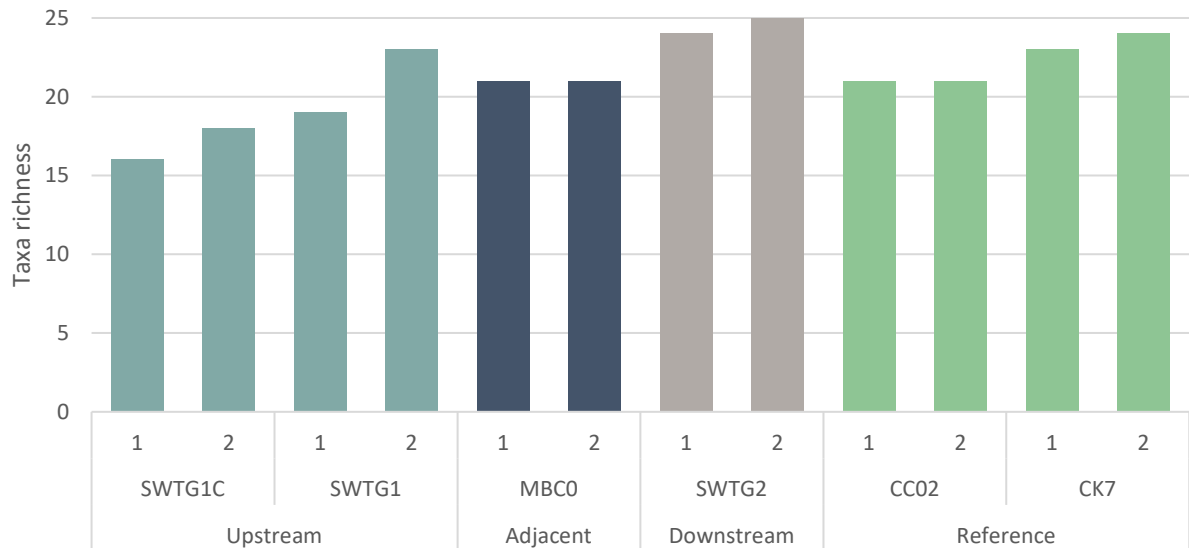


Figure 3 – Taxa richness at sites sampled in April 2022

4.3.2 PET richness

The PET richness results for all sites sampled in April 2022 are presented below in Figure 4. PET richness was the same at all sites on Mount Bunday Creek. There was a separation in PET richness between sites upstream and downstream of the Arnhem Highway. Lower numbers of PET taxa were found at sites upstream. This indicates some differences in community composition, given that taxa richness at Coulter Creek sites were similar.

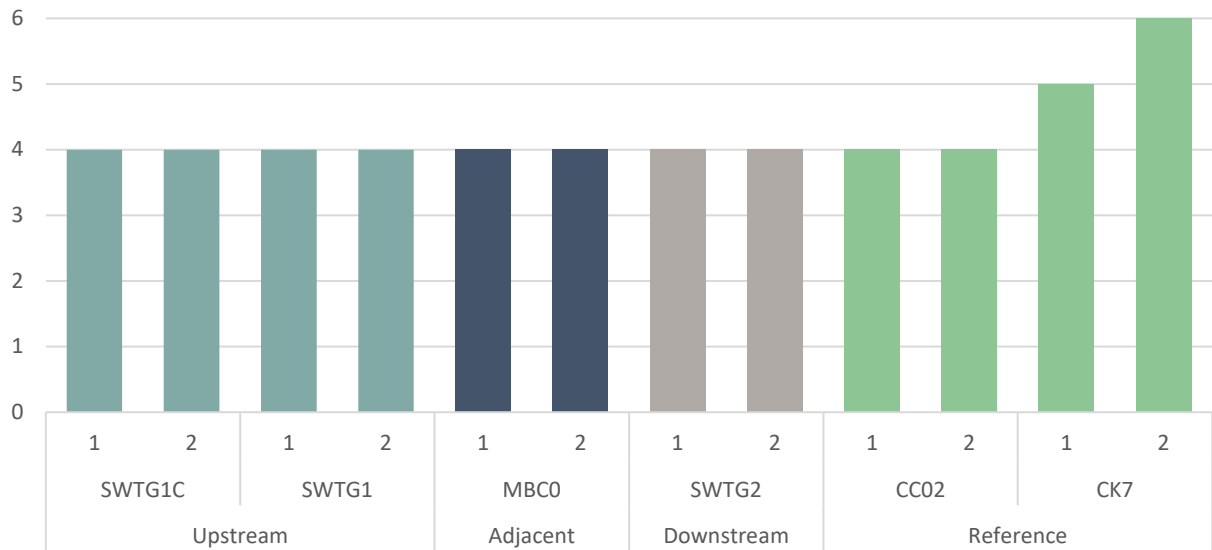


Figure 4 – PET richness at sites sampled in April 2022

4.3.3 SIGNAL-2

SIGNAL-2 scores for all samples collected in April 2022 are presented in Figure 5. There was very little variation in SIGNAL-2 scores between site types on Mount Bundey Creek (3.43-4.38). There was no major differences in pollution sensitivity of taxa, but there was a weak trend of decreasing sensitivity with distance downstream. Coulter Creek also showed very little variability in SIGNAL-2 scores, with the upstream site achieving the highest score. The SIGNAL score range at the sites are well within the pollution tolerant end of the scale (Marshall *et al.* 2001). The macroinvertebrate community surrounding Toms Gully Mine is made up of a community tolerant of intermittent flows and poorer water quality, which is in line with previous findings (AES 2021).

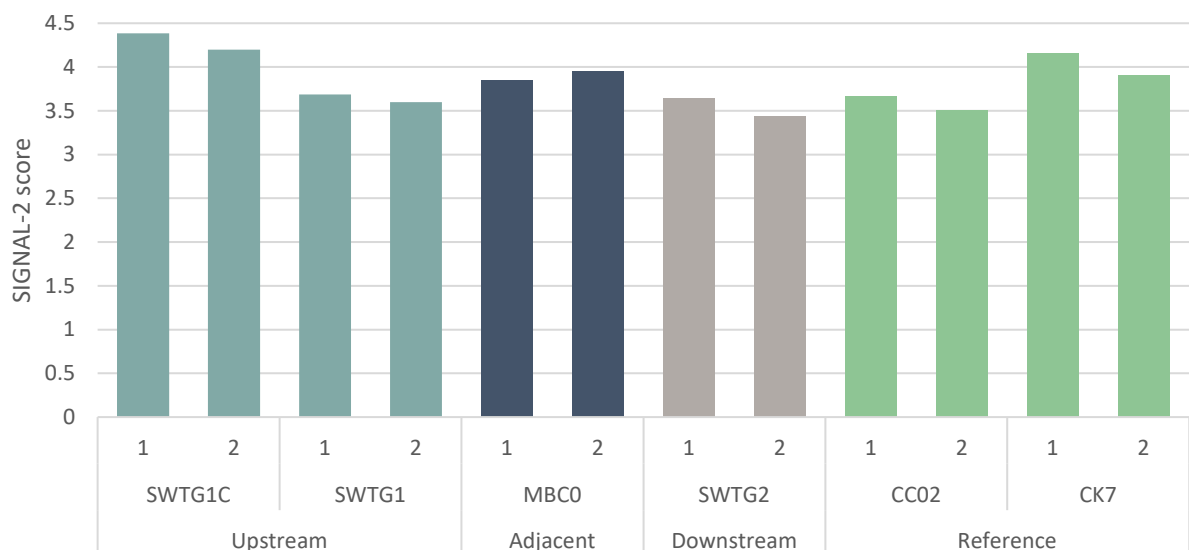


Figure 5 – SIGNAL-2 scores at all aquatic ecology sites visited in April 2022

4.3.4 Community composition

The non-metric MDS plot displayed in Figure 6 provides an indication of the relative similarity in the macroinvertebrate community composition between samples collected on Mount Bunday Creek in April 2022. There was at least 50% similarity between all sites on Mount Bunday Creek in 2022, and at least 70% similarity between sites SWTG1 and SWTG2, which are located upstream and downstream of Toms Gully Mine.

A feature of community composition across all sites was the relative similarity of samples collected at each site, which indicates that habitat is likely to be a driver in the presence of certain taxa at sites on Mount Bunday Creek. In the context of historical results, these differences will be an important feature of baseline data when mine water discharges commence.

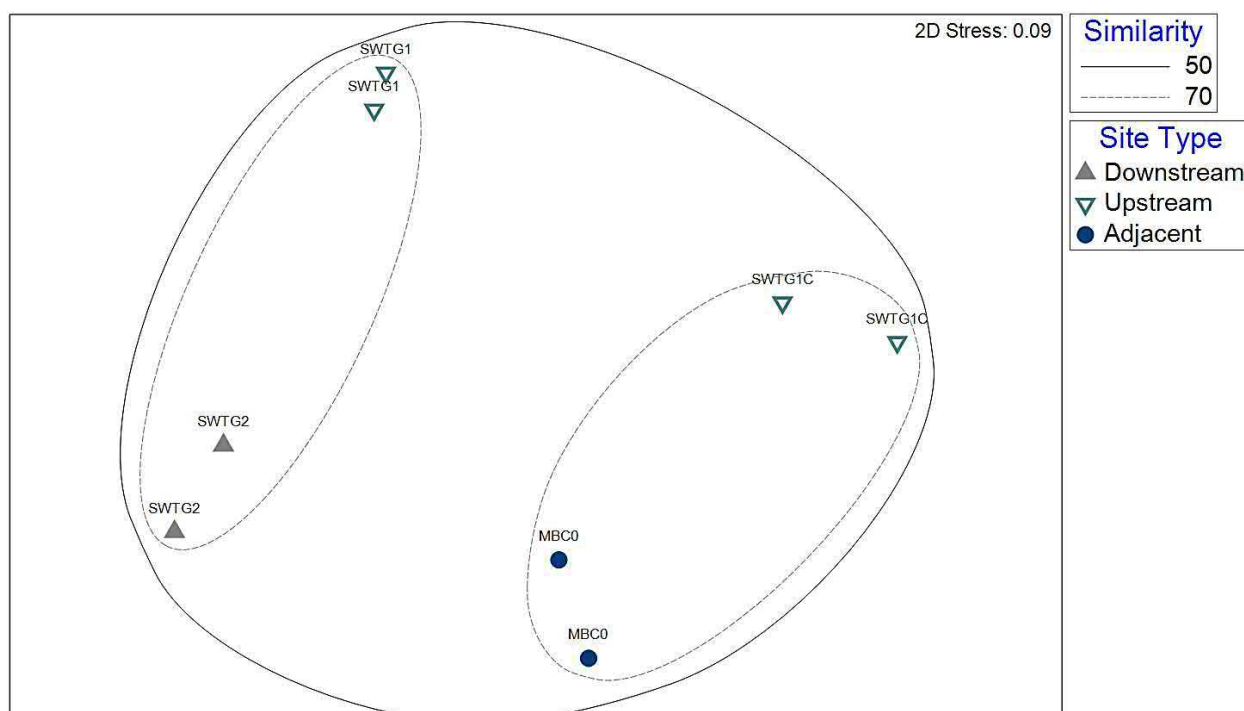


Figure 6 - NMDS demonstrating relative similarity of macroinvertebrate communities in samples collected on Mount Bunday Creek in April 2022

4.4 Fish community

Fish sampling was possible at key sites on Mount Bunday in 2022, and the results of electrofishing at each site are presented below in Table 11. A total of 86 fish were captured across three sites on Mount Bunday Creek. Twelve species were recorded, and the highest abundance of fish were captured at MBC0, with the same diversity of fish were captured at SWTG2. Although previous studies have found fish in poor health (lesions etc.) downstream of Toms Gully Mine, there were no visible injuries or illness recorded in fish at any site in 2022.

Table 11 – Fish sampling results for all sites on Coulter and Mount Bunday Creek, April 2022

Species Name	Common name	SWTG1	MBC0	SWTG2
<i>Ambassis agrammus</i>	Sailfin Glassfish	1	0	1
<i>Amniataba percooides</i>	Banded Grunter	0	1	0
<i>Glossogobius giuris</i>	Tank Goby	2	3	1
<i>Hepaphagus fuliginensis</i>	Sooty Grunter	0	2	3
<i>Leiopatheron unicolor</i>	Spangled Perch	7	8	5
<i>Melanotaenia splendida</i>	Eastern Rainbowfish	3	9	1
<i>Mogurnda mogurnda</i>	Northern Purple-spotted Gudgeon	9	12	2
<i>Neosilurus hyrtlii</i>	Hyrtls Tandan	0	6	0
<i>Neosilurus ater</i>	Black Catfish	0	0	1
<i>Oxyleotris lineolata</i>	Sleepy Cod	1	0	0
<i>Oxyleotris selheimi</i>	Giant Gudgeon	0	1	1
<i>Toxotes chatareus</i>	Seven-spotted Archerfish	1	1	1
Diversity		7	9	9
Abundance		24	43	16



5. Conclusions

5.1 Overview

Aquatic ecology surveys were successfully completed at Toms Gully Mine in 2022. All components were completed at sites where access, sufficient water and safety allowed. The following conclusions are made in regards to 2022 monitoring:

- Surface water quality sampling identified potential point source pollution related to an existing tailings storage facility (TSF2), which extended downstream for around 1km to compliance monitoring point SWTG2. Exceedances of the dissolved metal guideline values have been recorded during previously close TSF2. These results present a single sample in time, and should be viewed in the context of historical water quality monitoring, including results of sampling over the 2021-2022 wet season. There was a single exceedance of water quality guidelines in Coulter Creek, which was recorded at both sites and corresponded to the same metal that returned an exceedance at downstream sites in Mount Bunday Creek.
- There was some accumulation of metals in sediments, and a repeated exceedance of the lower guideline value for arsenic at SWTG2. Metals in sediments are not considered to have the potential to be released in concentrations which could be ecotoxic, should waters remain circumneutral at the site. The exceedance of surface water guideline values, but not sediment guideline values at MBC01 is possibly due to low pH allowing metals to remain dissolved in surface waters close to the TSF. Downstream of TSF2 where pH was circumneutral, sediments were accumulating some metals, but most remained below guideline values.
- Despite exceedances in some water quality parameters, macroinvertebrate community health metrics showed very little difference between sites upstream and downstream on Mount Bunday Creek. The macroinvertebrate community on Coulter Creek was disturbed by ongoing cattle grazing, this did not appear to cause any major variability in the macroinvertebrate community across both sites.
- All macroinvertebrate community data should be viewed in the context of historical data when operations begin at Toms Gully Mine. Historical context will allow for environmental influences (such as wet season rainfall variability) to be considered when interpreting impacts associated with mining operations.
- Although previous surveys have recorded poor fish health which may have been associated with poor water quality, this did not occur in 2022. All fish captured were found to be in good health, regardless of their position in the catchment relative to Toms Gully Mine.

5.2 Recommendations

An uninterrupted data set is the most robust way to analyse conditions in the receiving environment surrounding Toms Gully Mine should operations commence. Therefore, aquatic ecology monitoring should continue in 2023. Due to ongoing safety issues at SWTG3, biological sampling is no longer recommended at the site. Water and sediment quality should continue to be undertaken at the site. Because sediment cannot be reliably collected at SWTG1C, this site should be archived and replaced with SWTG1A, which has been sampled previously, can be accessed easily.

In order for more accurate interpretation of results, and to generate more comparable data for the Toms Gully Mine Site, it is recommended that a rain gauge be installed close to the site in order to collect more locally relevant rainfall data for the 2022-2023 wet season and beyond.

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Appendix A. Certificates of Analysis



CERTIFICATE OF ANALYSIS 280664**Client Details**

Client	Primary Gold Ltd
Attention	Charles Hastie
Address	PO Box 1311, SUBIACO PO, WA, 6904

Sample Details

Your Reference	<u>Water Analysis</u>
Number of Samples	17 Water, 17 sediment
Date samples received	27/04/2022
Date completed instructions received	27/04/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	05/05/2022
Date of Issue	05/05/2022
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Results Approved By

Heram Halim, Operations Manager
Lien Tang, Assistant Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Client Reference: Water Analysis

Miscellaneous Inorganics							
Our Reference			280664-1	280664-2	280664-3	280664-4	280664-5
Your Reference	UNITS	PQL	SWG1C	SWG1	MBC0	MBC01A	SWG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Dissolved Organic Carbon	mg/L	1	4	2	3	2	2
pH	pH Units		6.7	6.6	6.5	6.1	6.2
Electrical Conductivity (EC)	µS/cm	1	43	37	42	140	160
Total Dissolved Solids (grav)	mg/L	5	26	22	25	120	100
Total Suspended Solids	mg/L	5	<5	<5	7	12	<5
Turbidity	NTU	0.1	15	5.7	4.6	1.1	1.7
Ferrous Iron - Fe ²⁺	mg/L	0.05	0.12	0.07	0.12	0.34	0.099

Miscellaneous Inorganics							
Our Reference			280664-6	280664-7	280664-8	280664-9	280664-10
Your Reference	UNITS	PQL	SWG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Dissolved Organic Carbon	mg/L	1	3	3	4	2	4
pH	pH Units		6.6	7.0	7.0	6.4	6.7
Electrical Conductivity (EC)	µS/cm	1	87	170	130	16	32
Total Dissolved Solids (grav)	mg/L	5	52	130	110	10	19
Total Suspended Solids	mg/L	5	<5	5	6	<5	<5
Turbidity	NTU	0.1	4.3	1.3	3.2	7.9	5.0
Ferrous Iron - Fe ²⁺	mg/L	0.05	0.15	0.17	0.15	0.08	0.11

Client Reference: Water Analysis

Miscellaneous Inorganics							
Our Reference			280664-11	280664-12	280664-13	280664-14	280664-15
Your Reference	UNITS	PQL	RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Dissolved Organic Carbon	mg/L	1	3	1	2	2	2
pH	pH Units		7.1	7.0	6.8	6.7	6.6
Electrical Conductivity (EC)	µS/cm	1	72	25	37	200	44
Total Dissolved Solids (grav)	mg/L	5	43	15	22	160	26
Total Suspended Solids	mg/L	5	10	<5	5	<5	11
Turbidity	NTU	0.1	16	6.4	16	3.0	5.6
Ferrous Iron - Fe ²⁺	mg/L	0.05	0.26	<0.05	0.26	0.1	0.07

Miscellaneous Inorganics				
Our Reference			280664-16	280664-17
Your Reference	UNITS	PQL	Q29SW8	Q29SW4
Date Sampled			22/04/2022	25/04/2022
Type of sample			Water	Water
Date prepared	-		27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022
Dissolved Organic Carbon	mg/L	1	3	2
pH	pH Units		7.5	6.9
Electrical Conductivity (EC)	µS/cm	1	180	27
Total Dissolved Solids (grav)	mg/L	5	150	16
Total Suspended Solids	mg/L	5	<5	<5
Turbidity	NTU	0.1	2.1	9.1
Ferrous Iron - Fe ²⁺	mg/L	0.05	0.17	0.11

Client Reference: Water Analysis

Ionic Balance							
Our Reference			280664-1	280664-2	280664-3	280664-4	280664-5
Your Reference	UNITS	PQL	SWG1C	SWG1	MBC0	MBC01A	SWG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		04/05/2022	04/05/2022	04/05/2022	04/05/2022	04/05/2022
Date analysed	-		04/05/2022	04/05/2022	04/05/2022	04/05/2022	04/05/2022
Calcium - Dissolved	mg/L	0.5	1.4	1.6	2.1	8.5	10
Potassium - Dissolved	mg/L	0.5	1.3	1.1	0.7	1.4	1.5
Magnesium - Dissolved	mg/L	0.5	1.2	1.3	1.4	5.9	7.3
Sodium - Dissolved	mg/L	0.5	4.2	3.4	2.6	3.9	4.2
Bicarbonate HCO ₃ ⁻ as CaCO ₃	mg/L	5	16	15	13	10	10
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	16	15	13	10	10
Chloride	mg/L	1	1	3	2	2	2
Sulphate	mg/L	1	1	2	4	43	51
Ionic Balance	%		-0.57	-4.3	-5.5	-2.0	0.81
Hardness as CaCO ₃	mg/L	3	8	10	11	45	56

Ionic Balance							
Our Reference			280664-6	280664-7	280664-8	280664-9	280664-10
Your Reference	UNITS	PQL	SWG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		04/05/2022	04/05/2022	04/05/2022	04/05/2022	04/05/2022
Date analysed	-		04/05/2022	04/05/2022	04/05/2022	04/05/2022	04/05/2022
Calcium - Dissolved	mg/L	0.5	5.1	9.4	6.5	<0.5	1.0
Potassium - Dissolved	mg/L	0.5	1.4	3.1	2.8	<0.5	0.9
Magnesium - Dissolved	mg/L	0.5	4.0	9.4	6.8	0.5	1.6
Sodium - Dissolved	mg/L	0.5	4.1	6.5	5.6	2.2	2.8
Bicarbonate HCO ₃ ⁻ as CaCO ₃	mg/L	5	15	21	19	8	14
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	15	21	19	8	14
Chloride	mg/L	1	3	3	2	2	3
Sulphate	mg/L	1	20	53	24	<1	<1
Ionic Balance	%		-0.18	-0.39	12	-21	-5.0
Hardness as CaCO ₃	mg/L	3	29	62	44	<3	9

Client Reference: Water Analysis

Ionic Balance							
Our Reference			280664-11	280664-12	280664-13	280664-14	280664-15
Your Reference	UNITS	PQL	RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		04/05/2022	04/05/2022	04/05/2022	04/05/2022	04/05/2022
Date analysed	-		04/05/2022	04/05/2022	04/05/2022	04/05/2022	04/05/2022
Calcium - Dissolved	mg/L	0.5	1.3	<0.5	0.9	9.2	2.0
Potassium - Dissolved	mg/L	0.5	0.9	1.4	1.3	1.9	1.1
Magnesium - Dissolved	mg/L	0.5	1	<0.5	0.9	7.3	2.3
Sodium - Dissolved	mg/L	0.5	12	3.8	4.0	16	2.5
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	24	11	14	27	17
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	24	11	14	27	17
Chloride	mg/L	1	3	2	2	3	2
Sulphate	mg/L	1	5	<1	2	34	1
Ionic Balance	%		0.92	-16	-8.7	16	0.67
Hardness as CaCO ₃	mg/L	3	7	<3	6	53	14

Ionic Balance				
Our Reference			280664-16	280664-17
Your Reference	UNITS	PQL	Q29SW8	Q29SW4
Date Sampled			22/04/2022	25/04/2022
Type of sample			Water	Water
Date prepared	-		04/05/2022	04/05/2022
Date analysed	-		04/05/2022	04/05/2022
Calcium - Dissolved	mg/L	0.5	18	<0.5
Potassium - Dissolved	mg/L	0.5	1.8	1.3
Magnesium - Dissolved	mg/L	0.5	11	0.5
Sodium - Dissolved	mg/L	0.5	5.4	3.7
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	91	12
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	91	12
Chloride	mg/L	1	3	2
Sulphate	mg/L	1	3	<1
Ionic Balance	%		2.0	-11
Hardness as CaCO ₃	mg/L	3	89	<3

Client Reference: Water Analysis

Cyanides in Water							
Our Reference	UNITS	PQL	280664-1	280664-2	280664-3	280664-4	280664-5
Your Reference			SWTG1C	SWTG1	MBC0	MBC01A	SWTG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Free Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	µg/L	4	<4	<4	<4	<4	<4

Cyanides in Water							
Our Reference	UNITS	PQL	280664-6	280664-7	280664-8	280664-9	280664-10
Your Reference			SWTG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Free Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	µg/L	4	<4	<4	<4	<4	<4

Cyanides in Water							
Our Reference	UNITS	PQL	280664-11	280664-12	280664-13	280664-14	280664-15
Your Reference			RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022	27/04/2022	27/04/2022	27/04/2022
Free Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total Cyanide	µg/L	4	<4	<4	<4	<4	<4

Cyanides in Water				
Our Reference	UNITS	PQL	280664-16	280664-17
Your Reference			Q29SW8	Q29SW4
Date Sampled			22/04/2022	25/04/2022
Type of sample			Water	Water
Date prepared	-		27/04/2022	27/04/2022
Date analysed	-		27/04/2022	27/04/2022
Free Cyanide	mg/L	0.004	<0.004	<0.004
WAD Cyanide	mg/L	0.004	<0.004	<0.004
Total Cyanide	µg/L	4	<4	<4

Client Reference: Water Analysis

Total Metals in water							
Our Reference	UNITS	PQL	280664-1	280664-2	280664-3	280664-4	280664-5
Your Reference			SWG1C	SWG1	MBC0	MBC01A	SWG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Water	Water	Water	Water	Water
Date digested	-		03/05/2022	03/05/2022	03/05/2022	05/05/2022	05/05/2022
Date analysed	-		03/05/2022	03/05/2022	03/05/2022	05/05/2022	05/05/2022
Aluminium-Total	µg/L	10	210	63	69	210	51
Arsenic-Total	µg/L	1	2.2	1.1	1.3	<1	<1
Cadmium-Total	µg/L	0.1	<0.1	<0.1	<0.1	2.1	2.3
Cobalt-Total	µg/L	1	<1	<1	<1	15	13
Chromium-Total	µg/L	1	<1	<1	<1	<1	<1
Copper-Total	µg/L	1	<1	<1	<1	3.7	13
Iron-Total	µg/L	10	1,300	800	870	<10	320
Lead-Total	µg/L	1	<1	<1	<1	<1	<1
Manganese-Total	µg/L	5	110	120	68	790	890
Nickel-Total	µg/L	1	<1	<1	<1	27	31
Uranium-Total	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc-Total	µg/L	1	3.0	5.0	2.8	120	130

Total Metals in water							
Our Reference	UNITS	PQL	280664-6	280664-7	280664-8	280664-9	280664-10
Your Reference			SWG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Water	Water	Water	Water	Water
Date digested	-		05/05/2022	05/05/2022	05/05/2022	03/05/2022	03/05/2022
Date analysed	-		05/05/2022	05/05/2022	05/05/2022	03/05/2022	03/05/2022
Aluminium-Total	µg/L	10	66	48	71	62	88
Arsenic-Total	µg/L	1	1.1	1.0	1.0	<1	3.3
Cadmium-Total	µg/L	0.1	0.15	<0.1	<0.1	<0.1	2.5
Cobalt-Total	µg/L	1	<1	<1	<1	<1	2.8
Chromium-Total	µg/L	1	<1	<1	<1	2.7	3.0
Copper-Total	µg/L	1	2.5	<1	<1	<1	3.3
Iron-Total	µg/L	10	860	1,100	820	470	890
Lead-Total	µg/L	1	<1	<1	<1	<1	2.6
Manganese-Total	µg/L	5	150	130	39	15	54
Nickel-Total	µg/L	1	3.2	<1	1.0	1.3	2.9
Uranium-Total	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	2.5
Zinc-Total	µg/L	1	12	2.0	2.2	<1	10

Client Reference: Water Analysis

Total Metals in water							
Our Reference			280664-11	280664-12	280664-13	280664-14	280664-15
Your Reference	UNITS	PQL	RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Water	Water	Water	Water	Water
Date digested	-		05/05/2022	03/05/2022	05/05/2022	05/05/2022	05/05/2022
Date analysed	-		05/05/2022	03/05/2022	05/05/2022	05/05/2022	05/05/2022
Aluminium-Total	µg/L	10	180	72	220	18	51
Arsenic-Total	µg/L	1	9.1	<1	1.5	4.3	18
Cadmium-Total	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt-Total	µg/L	1	2.0	<1	<1	<1	<1
Chromium-Total	µg/L	1	<1	<1	<1	<1	<1
Copper-Total	µg/L	1	<1	<1	<1	2.4	<1
Iron-Total	µg/L	10	1,400	180	1,000	400	400
Lead-Total	µg/L	1	<1	<1	<1	<1	<1
Manganese-Total	µg/L	5	92	9.0	42	51	180
Nickel-Total	µg/L	1	<1	<1	<1	1.0	1.0
Uranium-Total	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc-Total	µg/L	1	3.3	1.3	2.1	3.0	3.7

Total Metals in water				
Our Reference			280664-16	280664-17
Your Reference	UNITS	PQL	Q29SW8	Q29SW4
Date Sampled			22/04/2022	25/04/2022
Type of sample			Water	Water
Date digested	-		05/05/2022	05/05/2022
Date analysed	-		05/05/2022	05/05/2022
Aluminium-Total	µg/L	10	17	73
Arsenic-Total	µg/L	1	16	1.9
Cadmium-Total	µg/L	0.1	<0.1	1.2
Cobalt-Total	µg/L	1	<1	1.5
Chromium-Total	µg/L	1	<1	1.5
Copper-Total	µg/L	1	<1	1.9
Iron-Total	µg/L	10	430	420
Lead-Total	µg/L	1	<1	1.6
Manganese-Total	µg/L	5	72	27
Nickel-Total	µg/L	1	<1	1.6
Uranium-Total	µg/L	0.5	<0.5	1.2
Zinc-Total	µg/L	1	7.5	2.3

Client Reference: Water Analysis

Dissolved Metals in Water							
Our Reference			280664-1	280664-2	280664-3	280664-4	280664-5
Your Reference	UNITS	PQL	SWG1C	SWG1	MBC0	MBC01A	SWG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		03/05/2022	03/05/2022	03/05/2022	05/05/2022	05/05/2022
Date analysed	-		03/05/2022	03/05/2022	03/05/2022	05/05/2022	05/05/2022
Aluminium-Dissolved	µg/L	10	37	21	10	18	12
Arsenic-Dissolved	µg/L	1	1.4	<1	<1	<1	<1
Cadmium-Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	2.2	2.2
Cobalt-Dissolved	µg/L	1	<1	<1	<1	15	13
Chromium-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	1	<1	<1	<1	15	9.0
Iron-Dissolved	µg/L	10	160	170	160	1,000	300
Lead-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Manganese-Dissolved	µg/L	5	96	53	53	770	870
Nickel-Dissolved	µg/L	1	<1	<1	<1	27	29
Uranium-Dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc-Dissolved	µg/L	1	1.3	3.3	<1	120	130

Dissolved Metals in Water							
Our Reference			280664-6	280664-7	280664-8	280664-9	280664-10
Your Reference	UNITS	PQL	SWG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		05/05/2022	05/05/2022	05/05/2022	03/05/2022	03/05/2022
Date analysed	-		05/05/2022	05/05/2022	05/05/2022	03/05/2022	03/05/2022
Aluminium-Dissolved	µg/L	10	<10	<10	<10	18	19
Arsenic-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Cadmium-Dissolved	µg/L	0.1	0.12	<0.1	<0.1	<0.1	<0.1
Cobalt-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Chromium-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	1	1.9	1.2	1.2	<1	<1
Iron-Dissolved	µg/L	10	690	850	630	79	260
Lead-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Manganese-Dissolved	µg/L	5	130	110	28	13	32
Nickel-Dissolved	µg/L	1	2.6	<1	<1	<1	<1
Uranium-Dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc-Dissolved	µg/L	1	7.9	<1	<1	1.0	4.7

Client Reference: Water Analysis

Dissolved Metals in Water							
Our Reference			280664-11	280664-12	280664-13	280664-14	280664-15
Your Reference	UNITS	PQL	RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		05/05/2022	03/05/2022	05/05/2022	05/05/2022	05/05/2022
Date analysed	-		05/05/2022	03/05/2022	05/05/2022	05/05/2022	05/05/2022
Aluminium-Dissolved	µg/L	10	<10	31	43	<10	<10
Arsenic-Dissolved	µg/L	1	4.1	<1	1.2	2.4	11
Cadmium-Dissolved	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt-Dissolved	µg/L	1	1.6	<1	<1	<1	<1
Chromium-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Copper-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Iron-Dissolved	µg/L	10	880	45	730	390	310
Lead-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Manganese-Dissolved	µg/L	5	75	7.1	41	49	81
Nickel-Dissolved	µg/L	1	<1	<1	<1	<1	<1
Uranium-Dissolved	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc-Dissolved	µg/L	1	<1	<1	<1	1.3	1.4

Dissolved Metals in Water				
Our Reference			280664-16	280664-17
Your Reference	UNITS	PQL	Q29SW8	Q29SW4
Date Sampled			22/04/2022	25/04/2022
Type of sample			Water	Water
Date prepared	-		05/05/2022	05/05/2022
Date analysed	-		05/05/2022	05/05/2022
Aluminium-Dissolved	µg/L	10	<10	43
Arsenic-Dissolved	µg/L	1	8.4	<1
Cadmium-Dissolved	µg/L	0.1	<0.1	<0.1
Cobalt-Dissolved	µg/L	1	<1	<1
Chromium-Dissolved	µg/L	1	<1	<1
Copper-Dissolved	µg/L	1	<1	<1
Iron-Dissolved	µg/L	10	400	290
Lead-Dissolved	µg/L	1	<1	<1
Manganese-Dissolved	µg/L	5	64	21
Nickel-Dissolved	µg/L	1	<1	<1
Uranium-Dissolved	µg/L	0.5	<0.5	<0.5
Zinc-Dissolved	µg/L	1	<1	<1

Client Reference: Water Analysis

Nutrients in Water							
Our Reference			280664-1	280664-2	280664-3	280664-4	280664-5
Your Reference	UNITS	PQL	SWG1C	SWG1	MBC0	MBC01A	SWG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		05/05/2022	05/05/2022	05/05/2022	05/05/2022	05/05/2022
Date analysed	-		05/05/2022	05/05/2022	05/05/2022	05/05/2022	05/05/2022
Total Nitrogen	µg/L	100	390	260	230	160	210
Total Phosphorus	µg/L	10	14	<10	<10	<10	<10
NOx as N	mg/L	0.005	0.013	0.022	0.010	0.015	0.029
Ammonia as N	mg/L	0.005	0.024	<0.005	0.005	0.028	0.025

Nutrients in Water							
Our Reference			280664-6	280664-7	280664-8	280664-9	280664-10
Your Reference	UNITS	PQL	SWG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		05/05/2022	05/05/2022	05/05/2022	05/05/2022	05/05/2022
Date analysed	-		05/05/2022	05/05/2022	05/05/2022	05/05/2022	05/05/2022
Total Nitrogen	µg/L	100	320	290	430	140	280
Total Phosphorus	µg/L	10	<10	<10	<10	<10	<10
NOx as N	mg/L	0.005	0.096	0.088	0.11	0.006	<0.005
Ammonia as N	mg/L	0.005	0.012	0.017	0.012	<0.005	<0.005

Nutrients in Water							
Our Reference			280664-11	280664-12	280664-13	280664-14	280664-15
Your Reference	UNITS	PQL	RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		05/05/2022	05/05/2022	05/05/2022	05/05/2022	05/05/2022
Date analysed	-		05/05/2022	05/05/2022	05/05/2022	05/05/2022	05/05/2022
Total Nitrogen	µg/L	100	280	130	280	120	150
Total Phosphorus	µg/L	10	12	<10	<10	<10	<10
NOx as N	mg/L	0.005	<0.005	<0.005	0.010	<0.005	<0.005
Ammonia as N	mg/L	0.005	0.005	<0.005	0.024	0.006	<0.005

Client Reference: Water Analysis

Nutrients in Water				
Our Reference			280664-16	280664-17
Your Reference	UNITS	PQL	Q29SW8	Q29SW4
Date Sampled			22/04/2022	25/04/2022
Type of sample			Water	Water
Date prepared	-		05/05/2022	05/05/2022
Date analysed	-		05/05/2022	05/05/2022
Total Nitrogen	µg/L	100	210	180
Total Phosphorus	µg/L	10	<10	<10
NOx as N	mg/L	0.005	<0.005	0.006
Ammonia as N	mg/L	0.005	0.006	<0.005

Client Reference: Water Analysis

External Testing

Our Reference	UNITS	PQL	280664-18	280664-19	280664-20	280664-21	280664-22
Your Reference			SWTG1C	SWTG1	MBC0	MBC01A	SWTG2
Date Sampled			25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample			Sediment	Sediment	Sediment	Sediment	Sediment
Sediment			Report attached	Report attached	Report attached	Report attached	Report attached

External Testing

Our Reference	UNITS	PQL	280664-23	280664-24	280664-25	280664-26	280664-27
Your Reference			SWTG3	CC02	CK7	RRMCUS2	RRMCDS
Date Sampled			23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample			Sediment	Sediment	Sediment	Sediment	Sediment
Sediment			Report attached	Report attached	Report attached	Report attached	Report attached

External Testing

Our Reference	UNITS	PQL	280664-28	280664-29	280664-30	280664-31	280664-32
Your Reference			RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Date Sampled			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample			Sediment	Sediment	Sediment	Sediment	Sediment
Sediment			Report attached	Report attached	Report attached	Report attached	Report attached

External Testing

Our Reference	UNITS	PQL	280664-33
Your Reference			Q29SW8
Date Sampled			22/04/2022
Type of sample			Sediment
Sediment			Report attached

Client Reference: Water Analysis

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode base on APHA latest edition, Method 4500-H+. Please note that the results for water analyses may be indicative only, as analysis can be completed outside of the APHA recommended holding times. Soils are reported from a 1:5 water extract unless otherwise specified.
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
INORG-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180±10°C
INORG-019	Suspended Solids - determined gravimetrically by filtration of the sample. The solids are dried at 104±5°C
INORG-022	Turbidity - measured nephelometrically using a turbidimeter, in accordance with APHA latest edition, 2130 B.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-076	Ferrous Iron determination by colourimetrically using APHA latest edition 3500-Fe B.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Determination of various metals by ICP-AES.
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Water Analysis

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	280664-2
Date prepared	-			27/04/2022	1	27/04/2022	27/04/2022		27/04/2022	27/04/2022
Date analysed	-			27/04/2022	1	27/04/2022	27/04/2022		27/04/2022	27/04/2022
Dissolved Organic Carbon	mg/L	1	INORG-110	<1	1	4	3	29	102	99
pH	pH Units		INORG-001	[NT]	1	6.7	6.7	0	103	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	<1	1	43	41	5	102	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	<5	1	26	25	4	101	[NT]
Total Suspended Solids	mg/L	5	INORG-019	<5	1	<5	<5	0	97	[NT]
Turbidity	NTU	0.1	INORG-022	<0.1	1	15	[NT]		87	[NT]
Ferrous Iron - Fe ²⁺	mg/L	0.05	INORG-076	<0.05	1	0.12	0.11	9	99	107

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	4	27/04/2022	27/04/2022		[NT]	[NT]
Date analysed	-			[NT]	4	27/04/2022	27/04/2022		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	4	2	[NT]		[NT]	[NT]
pH	pH Units		INORG-001	[NT]	4	6.1	[NT]		[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	4	140	[NT]		[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	4	120	110	9	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	4	12	[NT]		[NT]	[NT]
Turbidity	NTU	0.1	INORG-022	[NT]	4	1.1	[NT]		[NT]	[NT]
Ferrous Iron - Fe ²⁺	mg/L	0.05	INORG-076	[NT]	4	0.34	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	6	27/04/2022	27/04/2022		[NT]	[NT]
Date analysed	-			[NT]	6	27/04/2022	27/04/2022		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	6	3	[NT]		[NT]	[NT]
pH	pH Units		INORG-001	[NT]	6	6.6	[NT]		[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	6	87	[NT]		[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	6	52	[NT]		[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	6	<5	[NT]		[NT]	[NT]
Turbidity	NTU	0.1	INORG-022	[NT]	6	4.3	4.2	2	[NT]	[NT]
Ferrous Iron - Fe ²⁺	mg/L	0.05	INORG-076	[NT]	6	0.15	[NT]		[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	27/04/2022	27/04/2022		[NT]	[NT]
Date analysed	-			[NT]	11	27/04/2022	27/04/2022		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	11	3	2	40	[NT]	[NT]
pH	pH Units		INORG-001	[NT]	11	7.1	7.1	0	[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	11	72	72	0	[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	11	43	43	0	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	11	10	[NT]		[NT]	[NT]
Turbidity	NTU	0.1	INORG-022	[NT]	11	16	[NT]		[NT]	[NT]
Ferrous Iron - Fe ²⁺	mg/L	0.05	INORG-076	[NT]	11	0.26	0.25	4	[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	16	27/04/2022	27/04/2022		[NT]	[NT]
Date analysed	-			[NT]	16	27/04/2022	27/04/2022		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	16	3	[NT]		[NT]	[NT]
pH	pH Units		INORG-001	[NT]	16	7.5	[NT]		[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	16	180	[NT]		[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	16	150	[NT]		[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	16	<5	[NT]		[NT]	[NT]
Turbidity	NTU	0.1	INORG-022	[NT]	16	2.1	2.2	5	[NT]	[NT]
Ferrous Iron - Fe ²⁺	mg/L	0.05	INORG-076	[NT]	16	0.17	[NT]		[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Ionic Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	280664-2
Date prepared	-			04/05/2022	1	04/05/2022	04/05/2022		04/05/2022	04/05/2022
Date analysed	-			04/05/2022	1	04/05/2022	04/05/2022		04/05/2022	04/05/2022
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	1.4	1.5	7	103	104
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	1.3	1.3	0	101	101
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	1.2	1.3	8	103	103
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	4.2	4.3	2	104	102
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	<5	1	16	16	0	101	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	<5	1	<5	<5	0	101	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	INORG-006	<5	1	16	16	0	101	[NT]
Chloride	mg/L	1	INORG-081	<1	1	1	1	0	114	[NT]
Sulphate	mg/L	1	INORG-081	<1	1	1	1	0	108	[NT]
Hardness as CaCO ₃	mg/L	3	METALS-008	<3	1	8	9	12	[NT]	[NT]

QUALITY CONTROL: Ionic Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	04/05/2022	04/05/2022		[NT]	[NT]
Date analysed	-			[NT]	11	04/05/2022	04/05/2022		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	1.3	1.4	7	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	0.9	0.8	12	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	1	0.99	1	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	12	12	0	[NT]	[NT]
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	[NT]	11	24	25	4	[NT]	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	INORG-006	[NT]	11	24	25	4	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	3	3	0	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	11	5	5	0	[NT]	[NT]
Hardness as CaCO ₃	mg/L	3	METALS-008	[NT]	11	7	8	13	[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Cyanides in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	280664-2
Date prepared	-			27/04/2022	1	27/04/2022	27/04/2022		27/04/2022	27/04/2022
Date analysed	-			27/04/2022	1	27/04/2022	27/04/2022		27/04/2022	27/04/2022
Free Cyanide	mg/L	0.004	INORG-014	<0.004	1	<0.004	<0.004	0	106	102
WAD Cyanide	mg/L	0.004	INORG-014	<0.004	1	<0.004	<0.004	0	105	101
Total Cyanide	µg/L	4	INORG-014	<4	1	<4	<4	0	94	92

QUALITY CONTROL: Cyanides in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	27/04/2022	27/04/2022		[NT]	[NT]
Date analysed	-			[NT]	11	27/04/2022	27/04/2022		[NT]	[NT]
Free Cyanide	mg/L	0.004	INORG-014	[NT]	11	<0.004	<0.004	0	[NT]	[NT]
WAD Cyanide	mg/L	0.004	INORG-014	[NT]	11	<0.004	<0.004	0	[NT]	[NT]
Total Cyanide	µg/L	4	INORG-014	[NT]	11	<4	<4	0	[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Total Metals in water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	280664-2
Date digested	-			03/05/2022	1	03/05/2022	03/05/2022		03/05/2022	03/05/2022
Date analysed	-			03/05/2022	1	03/05/2022	03/05/2022		03/05/2022	03/05/2022
Aluminium-Total	µg/L	10	METALS-022	<0.01	1	210	220	5	96	#
Arsenic-Total	µg/L	1	METALS-022	<0.001	1	2.2	2.2	0	103	105.378
Cadmium-Total	µg/L	0.1	METALS-022	<0.0001	1	<0.1	<0.1	0	100	103.228
Cobalt-Total	µg/L	1	METALS-022	<0.001	1	<1	<1	0	102	104.803
Chromium-Total	µg/L	1	METALS-022	<0.001	1	<1	<1	0	104	106.094
Copper-Total	µg/L	1	METALS-022	<0.001	1	<1	<1	0	107	110.908
Iron-Total	µg/L	10	METALS-022	<0.01	1	1300	1300	0	118	#
Lead-Total	µg/L	1	METALS-022	<0.001	1	<1	<1	0	102	102.718
Manganese-Total	µg/L	5	METALS-022	<0.005	1	110	120	9	99	119.558
Nickel-Total	µg/L	1	METALS-022	<0.001	1	<1	<1	0	103	107.23
Uranium-Total	µg/L	0.5	METALS-022	<0.0005	1	<0.5	<0.5	0	99	102.223
Zinc-Total	µg/L	1	METALS-022	<0.001	1	3.0	3.3	10	103	108.746

QUALITY CONTROL: Total Metals in water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	11	05/05/2022	05/05/2022		[NT]	[NT]
Date analysed	-			[NT]	11	05/05/2022	05/05/2022		[NT]	[NT]
Aluminium-Total	µg/L	10	METALS-022	[NT]	11	180	160	12	[NT]	[NT]
Arsenic-Total	µg/L	1	METALS-022	[NT]	11	9.1	8.9	2	[NT]	[NT]
Cadmium-Total	µg/L	0.1	METALS-022	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Cobalt-Total	µg/L	1	METALS-022	[NT]	11	2.0	2.0	0	[NT]	[NT]
Chromium-Total	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Copper-Total	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Iron-Total	µg/L	10	METALS-022	[NT]	11	1400	1300	7	[NT]	[NT]
Lead-Total	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Manganese-Total	µg/L	5	METALS-022	[NT]	11	92	88	4	[NT]	[NT]
Nickel-Total	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Uranium-Total	µg/L	0.5	METALS-022	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
Zinc-Total	µg/L	1	METALS-022	[NT]	11	3.3	2.6	24	[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Dissolved Metals in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	280664-2
Date prepared	-			03/05/2022	1	03/05/2022	03/05/2022		03/05/2022	03/05/2022
Date analysed	-			03/05/2022	1	03/05/2022	03/05/2022		03/05/2022	03/05/2022
Aluminium-Dissolved	µg/L	10	METALS-022	<0.01	1	37	34	8	87	76.651
Arsenic-Dissolved	µg/L	1	METALS-022	<0.001	1	1.4	1.4	0	98	99.39
Cadmium-Dissolved	µg/L	0.1	METALS-022	<0.0001	1	<0.1	<0.1	0	97	99.261
Cobalt-Dissolved	µg/L	1	METALS-022	<0.001	1	<1	<1	0	96	95.62
Chromium-Dissolved	µg/L	1	METALS-022	<0.001	1	<1	<1	0	97	96.757
Copper-Dissolved	µg/L	1	METALS-022	<0.001	1	<1	<1	0	99	100.327
Iron-Dissolved	µg/L	10	METALS-022	<0.01	1	160	160	0	117	88.159
Lead-Dissolved	µg/L	1	METALS-022	<0.001	1	<1	<1	0	97	96.832
Manganese-Dissolved	µg/L	5	METALS-022	<0.005	1	96	93	3	94	90.288
Nickel-Dissolved	µg/L	1	METALS-022	<0.001	1	<1	<1	0	97	96.534
Uranium-Dissolved	µg/L	0.5	METALS-022	<0.0005	1	<0.5	<0.5	0	90	91.507
Zinc-Dissolved	µg/L	1	METALS-022	<0.001	1	1.3	<1	26	98	100.763

QUALITY CONTROL: Dissolved Metals in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	05/05/2022	05/05/2022		[NT]	[NT]
Date analysed	-			[NT]	11	05/05/2022	05/05/2022		[NT]	[NT]
Aluminium-Dissolved	µg/L	10	METALS-022	[NT]	11	<10	<10	0	[NT]	[NT]
Arsenic-Dissolved	µg/L	1	METALS-022	[NT]	11	4.1	4.2	2	[NT]	[NT]
Cadmium-Dissolved	µg/L	0.1	METALS-022	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Cobalt-Dissolved	µg/L	1	METALS-022	[NT]	11	1.6	1.6	0	[NT]	[NT]
Chromium-Dissolved	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Copper-Dissolved	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Iron-Dissolved	µg/L	10	METALS-022	[NT]	11	880	880	0	[NT]	[NT]
Lead-Dissolved	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Manganese-Dissolved	µg/L	5	METALS-022	[NT]	11	75	74	1	[NT]	[NT]
Nickel-Dissolved	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]
Uranium-Dissolved	µg/L	0.5	METALS-022	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
Zinc-Dissolved	µg/L	1	METALS-022	[NT]	11	<1	<1	0	[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Nutrients in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	280664-2
Date prepared	-			05/05/2022	1	05/05/2022	05/05/2022		05/05/2022	05/05/2022
Date analysed	-			05/05/2022	1	05/05/2022	05/05/2022		05/05/2022	05/05/2022
Total Nitrogen	µg/L	100	INORG-110	<100	1	390	360	8	97	95
Total Phosphorus	µg/L	10	INORG-060	<10	1	14	11	24	112	107
NOx as N	mg/L	0.005	INORG-055	<0.005	1	0.013	0.014	7	102	109
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.024	0.024	0	81	107

QUALITY CONTROL: Nutrients in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	05/05/2022	05/05/2022		[NT]	[NT]
Date analysed	-			[NT]	11	05/05/2022	05/05/2022		[NT]	[NT]
Total Nitrogen	µg/L	100	INORG-110	[NT]	11	280	290	4	[NT]	[NT]
Total Phosphorus	µg/L	10	INORG-060	[NT]	11	12	10	18	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	0.005	0.008	46	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.	
Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2	

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Sediment analyses conducted by Envirolab Services Pty Ltd, NSW, report reference 294181 attached.

Percent recovery not available due to sample matrix.

CERTIFICATE OF ANALYSIS 294181

Client Details

Client	Primary Gold Limited
Attention	Meredith Conroy
Address	Level 26 140 St George Terrace, Perth, WA

Sample Details

Your Reference	<u>280664, Primary Gold - Toms Gully</u>
Number of Samples	16 Sediment
Date samples received	27/04/2022
Date completed instructions received	27/04/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
 Samples were analysed as received from the client. Results relate specifically to the samples as received.
 Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	04/05/2022
Date of Issue	04/05/2022
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Results Approved By

Diego Bigolin, Inorganics Supervisor
 Giovanni Agosti, Group Technical Manager
 Steven Luong, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Client Reference: 280664, Primary Gold - Toms Gully

Misc Soil - Inorg						
Our Reference	UNITS	294181-1	294181-2	294181-3	294181-4	294181-5
Your Reference		SWTG1C	SWTG1	MBC0	MBC01A	SWTG2
Sample ID		280664-18	280664-19	280664-20	280664-21	280664-22
Date Sampled		25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Weak Acid Dissociable Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Free Cyanide in soil	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Misc Soil - Inorg						
Our Reference	UNITS	294181-6	294181-7	294181-8	294181-9	294181-10
Your Reference		SWTG3	CC02	CK7	RRMCUS2	RRMCDS
Sample ID		280664-23	280664-24	280664-25	280664-26	280664-27
Date Sampled		23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Weak Acid Dissociable Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Free Cyanide in soil	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Misc Soil - Inorg						
Our Reference	UNITS	294181-11	294181-12	294181-13	294181-14	294181-15
Your Reference		RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Sample ID		280664-28	280664-29	280664-30	280664-31	280664-32
Date Sampled		22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Total Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Weak Acid Dissociable Cyanide	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Free Cyanide in soil	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Misc Soil - Inorg		
Our Reference		294181-16
Your Reference	UNITS	Q29SW8
Sample ID		280664-33
Date Sampled		22/04/2022
Type of sample		Sediment
Date prepared	-	28/04/2022
Date analysed	-	28/04/2022
Total Cyanide	mg/kg	<0.5
Weak Acid Dissociable Cyanide	mg/kg	<0.5
Free Cyanide in soil	mg/kg	<0.5

Client Reference: 280664, Primary Gold - Toms Gully

Metals 1M HCl extractable						
Our Reference	UNITS	294181-1	294181-2	294181-3	294181-4	294181-5
Your Reference		SWTG1C	SWTG1	MBC0	MBC01A	SWTG2
Sample ID		280664-18	280664-19	280664-20	280664-21	280664-22
Date Sampled		25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	02/05/2022	02/05/2022	02/05/2022	02/05/2022	02/05/2022
Date analysed	-	02/05/2022	02/05/2022	02/05/2022	02/05/2022	02/05/2022
Aluminium 1M HCl extract	mg/kg	190	110	68	680	400
Arsenic 1M HCl extract	mg/kg	<4	<4	<4	<4	45
Cadmium 1M HCl extract	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt 1M HCl extract	mg/kg	1.2	1.1	<1	3.2	7.1
Chromium 1M HCl extract	mg/kg	<1	<1	<1	1	<1
Copper 1M HCl extract	mg/kg	<1	<1	<1	4	6
Iron 1M HCl extract	mg/kg	880	800	460	2,000	1,500
Lead 1M HCl extract	mg/kg	5	3	3	11	5
Manganese 1M HCl extract	mg/kg	140	90	100	200	200
Nickel 1M HCl extract	mg/kg	<1	<1	<1	1	4
Zinc 1M HCl extract	mg/kg	2	2	2	7	26

Metals 1M HCl extractable						
Our Reference	UNITS	294181-6	294181-7	294181-8	294181-9	294181-10
Your Reference		SWTG3	CC02	CK7	RRMCUS2	RRMCDS
Sample ID		280664-23	280664-24	280664-25	280664-26	280664-27
Date Sampled		23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	02/05/2022	02/05/2022	02/05/2022	02/05/2022	02/05/2022
Date analysed	-	02/05/2022	02/05/2022	02/05/2022	02/05/2022	02/05/2022
Aluminium 1M HCl extract	mg/kg	740	240	330	660	460
Arsenic 1M HCl extract	mg/kg	<4	<4	<4	<4	<4
Cadmium 1M HCl extract	mg/kg	0.8	<0.5	<0.5	<0.5	<0.5
Cobalt 1M HCl extract	mg/kg	12	2.6	13	2.6	<1
Chromium 1M HCl extract	mg/kg	<1	<1	<1	<1	<1
Copper 1M HCl extract	mg/kg	12	1	3	2	<1
Iron 1M HCl extract	mg/kg	3,600	1,100	1,600	1,700	580
Lead 1M HCl extract	mg/kg	10	13	16	4	2
Manganese 1M HCl extract	mg/kg	590	260	390	120	74
Nickel 1M HCl extract	mg/kg	8	<1	8	<1	<1
Zinc 1M HCl extract	mg/kg	44	4	37	<1	<1

Metals 1M HCl extractable						
Our Reference	UNITS	294181-11	294181-12	294181-13	294181-14	294181-15
Your Reference		RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Sample ID		280664-28	280664-29	280664-30	280664-31	280664-32
Date Sampled		22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	02/05/2022	02/05/2022	02/05/2022	02/05/2022	02/05/2022
Date analysed	-	02/05/2022	02/05/2022	02/05/2022	02/05/2022	02/05/2022
Aluminium 1M HCl extract	mg/kg	430	79	240	140	460
Arsenic 1M HCl extract	mg/kg	<4	<4	<4	5	16
Cadmium 1M HCl extract	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Cobalt 1M HCl extract	mg/kg	1.5	<1	1.9	1.5	7.1
Chromium 1M HCl extract	mg/kg	1	<1	<1	1	4
Copper 1M HCl extract	mg/kg	2	<1	1	3	6
Iron 1M HCl extract	mg/kg	2,800	460	1,300	880	2,300
Lead 1M HCl extract	mg/kg	3	4	6	58	37
Manganese 1M HCl extract	mg/kg	75	33	140	75	320
Nickel 1M HCl extract	mg/kg	<1	<1	<1	<1	2
Zinc 1M HCl extract	mg/kg	<1	<1	2	3	11

Metals 1M HCl extractable			
Our Reference	UNITS	294181-16	294181-17
Your Reference		Q29SW8	SWG1C - [TRIPLICATE]
Sample ID		280664-33	280664-18
Date Sampled		22/04/2022	25/04/2022
Type of sample		Sediment	Sediment
Date prepared	-	02/05/2022	02/05/2022
Date analysed	-	02/05/2022	02/05/2022
Aluminium 1M HCl extract	mg/kg	400	110
Arsenic 1M HCl extract	mg/kg	14	<4
Cadmium 1M HCl extract	mg/kg	<0.5	<0.5
Cobalt 1M HCl extract	mg/kg	6.7	<1
Chromium 1M HCl extract	mg/kg	2	<1
Copper 1M HCl extract	mg/kg	8	<1
Iron 1M HCl extract	mg/kg	3,000	650
Lead 1M HCl extract	mg/kg	55	3
Manganese 1M HCl extract	mg/kg	320	110
Nickel 1M HCl extract	mg/kg	2	<1
Zinc 1M HCl extract	mg/kg	14	2

Client Reference: 280664, Primary Gold - Toms Gully

Misc Inorg - Soil						
Our Reference	UNITS	294181-1	294181-2	294181-3	294181-4	294181-5
Your Reference		SWTG1C	SWTG1	MBC0	MBC01A	SWTG2
Sample ID		280664-18	280664-19	280664-20	280664-21	280664-22
Date Sampled		25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Total Organic Carbon (Walkley Black)	mg/kg	1,000	2,000	1,000	13,000	3,000

Misc Inorg - Soil						
Our Reference	UNITS	294181-6	294181-7	294181-8	294181-9	294181-10
Your Reference		SWTG3	CC02	CK7	RRMCUS2	RRMCDS
Sample ID		280664-23	280664-24	280664-25	280664-26	280664-27
Date Sampled		23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Total Organic Carbon (Walkley Black)	mg/kg	21,000	3,000	9,000	8,000	4,000

Misc Inorg - Soil						
Our Reference	UNITS	294181-11	294181-12	294181-13	294181-14	294181-15
Your Reference		RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Sample ID		280664-28	280664-29	280664-30	280664-31	280664-32
Date Sampled		22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Total Organic Carbon (Walkley Black)	mg/kg	8,000	3,000	3,000	1,000	8,000

Misc Inorg - Soil		
Our Reference	UNITS	294181-16
Your Reference		Q29SW8
Sample ID		280664-33
Date Sampled		22/04/2022
Type of sample		Sediment
Date prepared	-	28/04/2022
Date analysed	-	28/04/2022
Total Organic Carbon (Walkley Black)	mg/kg	12,000

Client Reference: 280664, Primary Gold - Toms Gully

Moisture						
Our Reference	UNITS	294181-1	294181-2	294181-3	294181-4	294181-5
Your Reference		SWTG1C	SWTG1	MBC0	MBC01A	SWTG2
Sample ID		280664-18	280664-19	280664-20	280664-21	280664-22
Date Sampled		25/04/2022	25/04/2022	24/04/2022	23/04/2022	25/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	29/04/2022	29/04/2022	29/04/2022	29/04/2022	29/04/2022
Moisture	%	18	19	19	23	19

Moisture						
Our Reference	UNITS	294181-6	294181-7	294181-8	294181-9	294181-10
Your Reference		SWTG3	CC02	CK7	RRMCUS2	RRMCDS
Sample ID		280664-23	280664-24	280664-25	280664-26	280664-27
Date Sampled		23/04/2022	23/04/2022	23/04/2022	24/04/2022	23/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	29/04/2022	29/04/2022	29/04/2022	29/04/2022	29/04/2022
Moisture	%	37	17	23	24	19

Moisture						
Our Reference	UNITS	294181-11	294181-12	294181-13	294181-14	294181-15
Your Reference		RRSW23	Q29SW11	Q29SW2	Q29SW1	Q29SW6
Sample ID		280664-28	280664-29	280664-30	280664-31	280664-32
Date Sampled		22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
Type of sample		Sediment	Sediment	Sediment	Sediment	Sediment
Date prepared	-	28/04/2022	28/04/2022	28/04/2022	28/04/2022	28/04/2022
Date analysed	-	29/04/2022	29/04/2022	29/04/2022	29/04/2022	29/04/2022
Moisture	%	24	17	18	8.7	7.7

Moisture		
Our Reference	UNITS	294181-16
Your Reference		Q29SW8
Sample ID		280664-33
Date Sampled		22/04/2022
Type of sample		Sediment
Date prepared	-	28/04/2022
Date analysed	-	29/04/2022
Moisture	%	18

Method ID	Methodology Summary
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjusted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hypochlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-036	Total Organic Carbon or Matter - A titrimetric method that measures the oxidisable organic content of soils.
Metals-020/021	1M HCl extractable (Bioavailable) metals - The sample is extracted with 1M HCl for one hour at room temperature. The extract is analysed by ICP-OES for all metals except Mercury which is tested by CV-AAS.

Client Reference: 280664, Primary Gold - Toms Gully

QUALITY CONTROL: Misc Soil - Inorg					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	294181-2
Date prepared	-			28/04/2022	1	28/04/2022	28/04/2022		28/04/2022	28/04/2022
Date analysed	-			28/04/2022	1	28/04/2022	28/04/2022		28/04/2022	28/04/2022
Total Cyanide	mg/kg	0.5	Inorg-014	<0.5	1	<0.5	<0.5	0	84	94
Weak Acid Dissociable Cyanide	mg/kg	0.5	Inorg-014	<0.5	1	<0.5	<0.5	0	99	93
Free Cyanide in soil	mg/kg	0.5	Inorg-014	<0.5	1	<0.5	<0.5	0	99	91

QUALITY CONTROL: Misc Soil - Inorg					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	28/04/2022	28/04/2022		[NT]	[NT]
Date analysed	-			[NT]	11	28/04/2022	28/04/2022		[NT]	[NT]
Total Cyanide	mg/kg	0.5	Inorg-014	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
Weak Acid Dissociable Cyanide	mg/kg	0.5	Inorg-014	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
Free Cyanide in soil	mg/kg	0.5	Inorg-014	[NT]	11	<0.5	<0.5	0	[NT]	[NT]

Client Reference: 280664, Primary Gold - Toms Gully

QUALITY CONTROL: Metals 1M HCl extractable					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	294181-2
Date prepared	-			02/05/2022	1	02/05/2022	02/05/2022		02/05/2022	02/05/2022
Date analysed	-			02/05/2022	1	02/05/2022	02/05/2022		02/05/2022	02/05/2022
Aluminium 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	190	110	53	106	#
Arsenic 1M HCl extract	mg/kg	4	Metals-020/021	<4	1	<4	<4	0	116	110
Cadmium 1M HCl extract	mg/kg	0.5	Metals-020/021	<0.5	1	<0.5	<0.5	0	113	122
Cobalt 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	1.2	<1	18	109	122
Chromium 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	<1	<1	0	106	121
Copper 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	<1	<1	0	108	122
Iron 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	880	610	36	110	##
Lead 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	5	3	50	106	120
Manganese 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	140	100	33	109	125
Nickel 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	<1	<1	0	107	121
Zinc 1M HCl extract	mg/kg	1	Metals-020/021	<1	1	2	2	0	111	124

QUALITY CONTROL: Metals 1M HCl extractable					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	02/05/2022	02/05/2022		[NT]	[NT]
Date analysed	-			[NT]	11	02/05/2022	02/05/2022		[NT]	[NT]
Aluminium 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	430	410	5	[NT]	[NT]
Arsenic 1M HCl extract	mg/kg	4	Metals-020/021	[NT]	11	<4	<4	0	[NT]	[NT]
Cadmium 1M HCl extract	mg/kg	0.5	Metals-020/021	[NT]	11	<0.5	<0.5	0	[NT]	[NT]
Cobalt 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	1.5	1.4	7	[NT]	[NT]
Chromium 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	1	<1	0	[NT]	[NT]
Copper 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	2	2	0	[NT]	[NT]
Iron 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	2800	2400	15	[NT]	[NT]
Lead 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	3	3	0	[NT]	[NT]
Manganese 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	75	77	3	[NT]	[NT]
Nickel 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	<1	<1	0	[NT]	[NT]
Zinc 1M HCl extract	mg/kg	1	Metals-020/021	[NT]	11	<1	<1	0	[NT]	[NT]

Client Reference: 280664, Primary Gold - Toms Gully

QUALITY CONTROL: Misc Inorg - Soil					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			28/04/2022	1	28/04/2022	28/04/2022		28/04/2022	[NT]
Date analysed	-			28/04/2022	1	28/04/2022	28/04/2022		28/04/2022	[NT]
Total Organic Carbon (Walkley Black)	mg/kg	1000	Inorg-036	<1000	1	1000	1000	0	93	[NT]

QUALITY CONTROL: Misc Inorg - Soil					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	28/04/2022	28/04/2022		[NT]	[NT]
Date analysed	-			[NT]	11	28/04/2022	28/04/2022		[NT]	[NT]
Total Organic Carbon (Walkley Black)	mg/kg	1000	Inorg-036	[NT]	11	8000	7000	13	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.	
Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2	

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Acid Extractable Metals in Soil:

- The laboratory RPD acceptance criteria has been exceeded for 294181-1 for Al. Therefore a triplicate result has been issued as laboratory sample number 294181-17.
- # Percent recovery is not possible to report due to the inhomogeneous nature of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.
- ## Percent recovery is not applicable due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Appendix B. Raw Macroinvertebrate Data

Order	Lowest Taxon	SWG2	SWG2	SWG1C	SWG1C	MBC0	MBC0	SWG1	SWG1	CC02	CC02	CK7	CK7
Replicate		1	2	1	2	1	2	1	2	1	2	1	2
Acarina	Acarina	317	171	200	180	217	200	1350	1100	83	60	425	433
Coleoptera	Dytiscidae	33	14	0	20	0	0	100	50	17	20	0	0
Coleoptera	Elmidae	17	14	120	40	33	20	50	50	33	0	25	0
Coleoptera	Gyrinidae	0	0	20	0	0	0	0	0	0	20	0	0
Coleoptera	Hydraenidae	17	29	0	0	0	20	50	50	0	20	25	67
Coleoptera	Hydrochidae	17	29	0	0	0	20	0	0	0	0	0	0
Coleoptera	Hydrophilidae	33	14	0	0	17	0	100	50	17	20	0	33
Decapoda	Atyidae	17	0	0	0	17	20	250	100	17	20	100	67
Decapoda	Palaemonidae	0	14	20	20	33	20	0	50	17	0	0	0
Decapoda	Parathelphusidae	17	14	0	0	17	0	50	50	17	20	0	0
Diptera	Ceratopogonidae	50	14	260	200	150	300	750	700	817	820	100	33
Diptera	Chironominae	983	871	1880	1760	567	540	3100	2750	1450	1840	275	667
Diptera	Culicidae	0	14	0	0	33	20	0	0	50	40	0	0
Diptera	Orthoclaadiinae	33	0	140	300	117	180	100	500	17	0	150	267
Diptera	Tabanidae	0	14	0	0	0	0	0	0	0	0	0	0
Diptera	Tanypodinae	417	314	140	320	250	240	400	100	350	400	450	767
Diptera	Tipulidae	17	0	0	0	17	0	0	0	0	0	25	0



Order	Lowest Taxon	SWTG2	SWTG2	SWTG1C	SWTG1C	MBC0	MBC0	SWTG1	SWTG1	CC02	CC02	CK7	CK7
Ephemeroptera	Baetidae	100	71	20	40	233	160	500	250	33	120	250	433
Ephemeroptera	Caenidae	983	857	920	780	1550	1760	2750	3350	267	240	2125	2567
Ephemeroptera	Leptophlebiidae	0	0	60	40	17	20	0	0	0	0	25	33
Gastropoda	Planorbidae	0	0	0	20	0	0	0	0	33	20	150	267
Hemiptera	Gerridae	17	0	0	0	50	60	0	100	0	0	25	33
Hemiptera	Mesoveliidae	17	14	20	0	17	40	0	0	0	0	0	0
Hemiptera	Micronectidae	33	29	20	40	0	20	100	150	67	100	50	100
Hemiptera	Nepidae	0	0	0	0	0	0	0	50	0	0	0	33
Hemiptera	Pleidae	0	0	0	0	0	0	0	0	0	0	25	0
Hemiptera	Veliidae	0	29	0	0	0	20	50	50	0	0	0	33
Arhynchobdellida	Arhynchobdellida	0	0	0	0	17	0	0	0	0	0	0	0
Hydrazoa	Hydridae	17	14	0	20	0	0	0	0	0	0	0	0
Nematoda	Nematoda	0	0	240	240	0	0	200	100	17	20	25	0
Odonata	Coenagrionidae	0	0	0	0	0	0	0	0	0	0	50	33
Odonata	Gomphidae	17	29	0	0	0	0	0	0	0	20	0	33
Odonata	Libellulidae	0	14	0	20	17	40	0	0	50	20	25	33
Oligochaeta	Oligochaeta	300	214	160	200	50	100	200	150	200	160	475	400
Trichoptera	Calamoceratidae	0	0	0	0	0	0	0	0	0	0	50	33
Trichoptera	Hydroptilidae	17	14	0	0	0	0	100	50	33	20	0	33
Trichoptera	Leptoceridae	167	114	20	20	267	240	650	450	83	80	250	267
Turbellaria	DugesIIDae	17	14	0	0	0	0	0	50	0	0	25	33





Good science at a fair price

Attachment D:

NT EPA EIS Assessment Report



Northern Territory
Environment Protection Authority

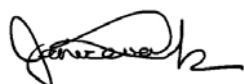
ASSESSMENT REPORT 91

Toms Gully Underground Project Primary Gold Limited

February 2020

Environmental Impact Assessment Process Timelines

Date	Chronology	Relevant clause under the EAAP*
28/02/2014	Notice of Intent received	6
23/04/2014	NT EPA decision and statement of reasons issued - Environmental Impact Statement (EIS) required	8(2)(a)
13/09/2014	Draft Terms of Reference (TOR) released for public comment	8(3) and 8(4)
06/10/2014	Final TOR issued to Proponent	8(5)(b) and 8(6)
26/09/2015	Draft EIS released for public comment for six weeks	9(1)
18/11/2015	NT EPA directed Proponent to prepare EIS Supplement	11A(3)(a)
12/06/2018	Receipt of notification of alterations to the Proposal	14A(1)(a)
24/07/2018	NT EPA decision on altered Proposal: EIS still required	14A(3)(b)
15/08/2018	EIS Supplement received	12(3)
05/09/2018	Further information requested	14(2)(a)
25/10/2018	Further information requested	14(2)(a)
14/12/2018	Receipt of notification of alterations to Proposal	14A(1)(a)
8/02/2019	NT EPA decision on altered Proposal: EIS still required	14A(3)(b)
17/07/2019	Addendum to the Supplement received	14(2)(a)
7/08/2019	Further information requested	14(2)(a)
6/01/2020	Further information received	14(2)(a)
21/02/2020	Assessment Report issued	14(3) & 14(4)



Ms Janice van Reyk
Delegated Member

21 February 2020

Northern Territory Environment Protection Authority

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Important Disclaimer

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Abbreviations and glossary

AAPA	Aboriginal Areas Protection Authority
Addendum	part of the EIS, addressing further information requested by the NT EPA following the Supplement
Advisory bodies	NT Government agencies having expertise and/or administrative responsibilities in respect of the Proposal
AFANT	Amateur Fishermen's' Association of the Northern Territory
AMD	acid and/or metalliferous drainage (including neutral mine drainage, and/or saline drainage)
ANCOLD	Australian National Committee on Large Dams
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resources Management Council of Australia and New Zealand
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPIR	Department of Primary Industry and Resources
Draft EIS	the initial part of the EIS, subject to public exhibition
EA Act	<i>Environmental Assessment Act 1982</i>
EAAP	Environmental Assessment Administrative Procedures 1984
EIA	environmental impact assessment
EIS	Environmental Impact Statement – comprises the Draft EIS, Supplement, Addendum and Further Information
Environment	All aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects (section 3 of the <i>Environmental Assessment Act 1982</i>)
EP	evaporation pond
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESD	ecologically sustainable development
Further Information	the final part of the EIS, as requested by the NT EPA following the Supplement and Addendum
MM Act	<i>Mining Management Act 2001</i>
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
responsible Minister	Northern Territory Minister for Primary Industry and Resources
ROM	run-of-mine pad – for storing/mixing ore prior to processing

SOCS	site of conservation significance
SSTVs	site specific trigger values
Supplement	the second part of the EIS, addressing comments on the Draft EIS and the Proposal as altered in 2018
the Minister	Minister for Environment and Natural Resources
the Proposal	Toms Gully Underground Project
the Proposal area	Toms Gully mine site, as defined by Mining Lease North (MLN) 1058
the Proponent	Primary Gold Limited
the / this Report	Assessment Report 91, for the Toms Gully Underground Project
TSF	tailings storage facility
WDL	Waste Discharge Licence
WRD	waste rock dump
WSD	water storage dam

Units and symbols

%	percent
GL	gigalitre = 1×10^9 litres = 1×10^6 m ³
g/t	grams per tonne (metric)
km	kilometre
km ²	square kilometre
kV	kilovolt
L	litre
L/s	litres per second
m	metre
m ³	cubic metre
mm	millimetre
ML	megalitre = 1×10^6 litres or 1×10^3 m ³
MWh	Megawatt hours
oz	ounces
t	tonne
tpa	tonnes per annum

Summary and recommendations

Environmental impact assessment (EIA) is a process for identifying potential environmental impacts and risks of a proposed action, evaluating the significance of those impacts and risks, and determining appropriate avoidance, minimisation and mitigation measures to reduce those impacts and risks to acceptable levels.

This Assessment Report (this Report) examines the environmental impacts and risks of the Toms Gully Underground Project (the Proposal), proposed by Primary Gold Limited (the Proponent). This Report concludes the assessment process by the Northern Territory Environment Protection Authority (NT EPA).

The Report is provided to the Northern Territory Minister for Environment and Natural Resources (the Minister) and to the Minister for Primary Industry and Resources (the responsible Minister) for consideration in the development of conditions and approvals for the Proposal under the *Mining Management Act 2001* (MM Act). This Report is not an environmental approval although it will guide the decision by the Responsible Minister.

The Proponent proposes to recommence underground mining and on-site processing of gold ore within granted Mining Lease North (MLN) 1058, Toms Gully, approximately 100 km south-east of Darwin. The Proposal is a brownfield site previously mined for gold between 1988 and 2011. The total mining lease area is 628 ha and is located on Old Mount Bunday Station (Perpetual Pastoral Lease 1163).

The Proposal involves the refurbishment and upgrade of existing infrastructure and the development of new infrastructure (including a water storage dam (WSD), boxcut and water treatment plant) within a disturbance footprint of 196 ha. The Proposal also involves the rehabilitation of legacy mining structures. Ore would be mined from underground using room and pillar mining methods. Ore would be processed using the upgraded Carbon In Leach plant to produce 315,000 oz of gold for export. The proposed mine life is five years.

The NT EPA identified potential impacts and risks to: soil, surface water and groundwater quality, due to contamination from mining wastes; downstream aquatic ecosystems in the Mary River as a result of surface water contamination; and downstream social, economic and cultural values. Consequently, the NT EPA assessed the Proposal against the NT EPA's objectives for the key environmental factors of:

- Inland water environmental quality
- Aquatic ecosystems
- Social, economic and cultural surroundings

The Proposal is located in the Mary River catchment, close to recognised ecological values in the Mary River and associated floodplains. These ecological values also contribute significantly to important social, economic and cultural values in the region. In recognition of these values, the NT EPA has recommended that the Mary River downstream from the Proposal is to be protected at all times from mine related and legacy impacts, and that the Proponent publicly report on the health of water and ecosystems in the river and its tributaries.

Historical mining at the site has resulted in the generation of acid and metalliferous drainage (AMD) and there is considerable potential in existing landforms for further generation of AMD. This presents a risk of contaminants being discharged to the environment, including towards the Mary River. As the Proposal includes the rehabilitation of legacy mining landforms, the NT EPA considers that the Proposal presents an opportunity to lower the potential for future discharge of contaminants from the site. The NT EPA has made recommendations (4 to 6) for the safe and effective

rehabilitation of legacy landforms including tailings storage facilities and waste rock dumps.

The Proposal includes the subaqueous deposition of waste rock and tailings in the existing pit lake to limit oxidation and the generation of AMD. The NT EPA is supportive of this approach but also recognises that there are uncertainties around the placement and potential reactivity of this material, such that the long term water quality is unknown. The NT EPA has recommended further studies and an adaptive management approach to ensure that waste materials remain in the anoxic water layer at all times.

The pit lake is already used to store water that has come into contact with historical mining components and is filling annually due to runoff from adjacent landforms. It currently contains about 4 GL of acidic, saline water containing high levels of metals. As pit lake water will be displaced by the deposition of mining waste material, and water must be removed from the underground workings to enable mining, a fundamental part of the Proposal is to treat water for controlled discharge to the environment. This would be subject to a Waste Discharge Licence in accordance with the *Water Act 1992*, which would also take into consideration all uncontrolled untreated discharges from the Proposal.

The NT EPA has recommended that, to protect values in the Mary River and tributaries, 95% species protection level is the appropriate target for water quality at compliance points and for all water to be discharge to land or a third party. As the water treatment methodology is also uncertain, the NT EPA has recommended independent validation to demonstrate that the final chosen water treatment methodology can meet target water quality at the required scale.

To avoid future overflow of the pit lake, the Proposal includes the addition of bunds and drains to direct runoff from adjacent landforms entering the pit lake. Modelling by the Proponent indicated that with these changes, the pit is unlikely to overflow in the future. However, there is also potential for seepage from the pit lake via groundwater towards surface waters in Mount Bunday Creek, and this could contain contaminants if pit lake water quality declines into the long term future. The NT EPA has recommended that additional monitoring of groundwater in the vicinity of the pit lake be conducted, with results to inform the adaptive management approach and the Mine Closure Plan.

To address the risk of uncontrolled discharge of mine affected water from all sources, the NT EPA has made recommendations relating to an AMD Management Plan and requiring that there is no net increase in contaminant mass loads to the Mary River and its tributaries compared to the current situation.

The NT EPA recognises that the Proposal could provide local economic and employment benefits and reduce the risk of environmental impacts that could have negative consequences for social, economic and cultural values downstream of the Proposal. In recognition of the importance of these values, the NT EPA has made recommendations for engagement with and reporting to stakeholders and the community, including custodians of Sacred Sites.

The Proponent intends to fully decommission the mine and complete rehabilitation during a 10-year closure period. The NT EPA has made recommendations relating to closure objectives and the final Mine Closure Plan to prevent significant environmental impacts.

The NT EPA has made 18 recommendations as an outcome of the EIA. These recommendations are for the Proponent to consider in undertaking the action and decision-makers to consider in development approval conditions for the proposed action.

The NT EPA recommends that the environmental commitments, safeguards and recommendations outlined in the EIS, this Report and in management plans, must be

implemented by the Proponent, and reviewed and enforced by the relevant regulators throughout the life of the Proposal to deliver acceptable environmental outcomes.

The NT EPA considers that, subject to the implementation of all recommendations, the Proposal can be managed in a manner that is likely to meet the NT EPA's objectives, reduce the current impacts and risks from historical mining activities on the site and avoid significant or unacceptable environmental impacts and risks in the future.

List of Recommendations

Recommendation 1

That approvals and decisions for the Proposal impose binding legal obligations on the Proponent or Operator to implement the Proposal in accordance with all environmental commitments and safeguards which are:

- **identified in the final Environmental Impact Statement for the Toms Gully Underground Project, including Draft Environmental Impact Statement (EIS), Supplement to the Draft EIS, Addendum and Further Information**
- **recommended in this Assessment Report 91**

Where there is conflict between the commitments in the EIS and the recommendations in this report, the latter are to take precedence.

Recommendation 2

That the Proponent or Operator provides written notice in advance to the Northern Territory Environment Protection Authority and the Responsible Minister if it alters or proposes to alter the Proposal, environmental commitments or safeguards in the Environmental Impact Statement in such a manner that the environmental significance of the action may change, in accordance with clause 14A of the Environmental Assessment Administrative Procedures 1984.

Recommendation 3

That the commitments and safeguards listed in the Environmental Impact Statement for the Proposal and recommended in this Assessment Report 91 are implemented in a manner and to the extent that protects the environmental values of the Mary River downstream from the Proposal site at all times from mine related impacts, whether from the Proposal or from historical mining operations. This includes during any period of inactivity or care and maintenance. This is the overarching environmental outcome that is required to be achieved in respect of the Proposal.

Recommendation 4

That relevant approvals and decisions in relation to the Proposal include a condition that requires sufficient freeboard be maintained in the existing tailings storage facilities to prevent overtopping, until such time that all tailings have been removed and the facilities repurposed or rehabilitated.

Recommendation 5

That approvals and decisions for the Proposal require that:

- **water dams be designed by, and constructed under the supervision of, a suitably qualified, independent and experienced person, approved by the**

regulator, in accordance with the requirements of the Australian National Committee on Large Dams (ANCOLD) guidelines

- water dams be designed, constructed and maintained to ensure that the integrity would not be compromised by flood waters or erosion from floodwaters from any watercourse or drainage line
- water dams be designed and constructed to prevent or minimise the passage of any entrained contaminants through either the floor or sides of the dam during the operational life of the dam and for any period of decommissioning and rehabilitation of the dam
- certification of compliance with ANCOLD guidelines, by a suitably experienced, independent and qualified person who has supervised the construction, be provided to the relevant regulator on completion of construction of a water dam.

Recommendation 6

That approvals and decisions for the Proposal have conditions that require the Proponent to develop an Acid and Metalliferous Drainage (AMD) Management Plan to the satisfaction of the relevant regulator prior to mining that:

- is prepared in accordance with leading practice AMD management recommended in the Australian Government guidelines for preventing acid and metalliferous drainage (DIIS, 2016)
- requires the transfer of tailings and any contaminated material present in dam walls and bases to the existing pit lake
- requires the capping of the Waste Rock Dumps (WRDs) and lining of the evaporation ponds (EPs) with an engineered seal constructed from benign compacted material with limited permeability; the design and construction is to be reviewed by an independent certifying engineer
- incorporates measures for assessing the physico-chemical suitability of boxcut material (potentially during excavation) for capping the WRDs
- incorporates measures to assess the effectiveness of the WRD covers in restricting rainfall infiltration and limiting the creation of acid and/or metalliferous drainage and mobilisation of contaminants
- incorporates measures to ensure that the quality of water stored in the water storage dam (WSD) will meet water quality targets
- incorporates measures, consistent with the site water management plan, to monitor and assess density driven outflow from the pit lake on surrounding groundwater quality and surface expression
- includes mechanisms for adaptive management of potentially acid forming materials and AMD consistent with the Northern Territory Environment Protection Authority Guidance on Adaptive Management (NT EPA, 2018b).

Recommendation 7

That approvals and decisions for the Proposal require that reactive material in the pit lake will remain in the anoxic zone, and water quality will be stable, at all times

after closure. The adaptive management approach to achieve this, addressed in Recommendation 10, must be informed by further studies to be undertaken through the life of the mine and closure period, including:

- further analyses of the settling process of tailings, pit lake water stratification, limnology, water quality and water levels
- trials of potential long-term passive water treatment options
- a prediction of long-term water quality and water levels based on monitoring data.

Recommendation 8

That approvals and decisions for the Proposal specify that water quality at the compliance points in Mount Bunday Creek and Coulter Creek meet 95% species protection level. The site specific trigger values (SSTVs) for discharge water quality must be appropriate to achieve this.

Recommendation 9

That approvals and decisions for the Proposal shall include a requirement for the Proponent to:

- provide written validation by an independent qualified person, demonstrating that the final chosen water treatment methodology can meet water quality criteria at the required scale
- provide a plan for the onsite storage and regular offsite disposal, sale and/or recycling of any liquid or solid waste (including mixed metal oxide) from the water treatment plant, to be approved by the relevant authority on advice from the NT EPA.

Recommendation 10

That before approvals or decisions are given or made for the Proposal, the Proponent provides to the relevant regulator and the Northern Territory Environment Protection Authority an Adaptive Management Plan consistent with the NT EPA Guidance on Adaptive Management (NT EPA, 2018b).

Recommendation 11

That approvals and decisions for the Proposal require that any water to be discharged to land or to a third party (for example; for dust suppression, irrigation, or any other purpose):

- be accounted for in the Water Management Plan
- meet the site specific trigger values specified in the Waste Discharge Licence, consistent with Recommendation 8.

Recommendation 12

That approvals or decisions for the Proposal require that the Proponent or Operator's adaptive management approach (Recommendation 10) is to be informed by monitoring additional bores between the pit lake and Mount Bunday

Creek and the oxbow wetlands. These are to be monitored for water levels and chemistry to inform the post closure pit lake water targets.

Recommendation 13

That approvals or decisions for the Proposal require no net increase in contaminant mass loads to the Mary River following closure, compared to the current situation, from the Proposal site.

Recommendation 14

That before approvals or decisions are given or made for the Proposal, the Proponent provides to the relevant regulator a Community and Stakeholder Engagement Plan providing for:

- maximising local employment opportunities
- publication of a community complaints telephone contact number and email to allow community members to contact the Proponent regarding any issues or concerns
- development and implementation of a complaints management procedure that requires complaints to be recorded, investigated and abatement measures to be carried out if required, for handling community complaints and grievances for the duration of the Proposal, and broadly accepted by stakeholders
- reporting to stakeholders and the community on the health of the Mary River and tributaries monitored as part of the proposal, including contaminant mass loads
- effective ongoing stakeholder engagement and consultation on agreed post-mining closure, rehabilitation, land uses and access
- annual reporting to the relevant regulator of local employment, any community benefits, details of complaints and action taken and details of stakeholder engagement and consultation
- planning to minimise negative impacts of mine closure on surrounding communities
- publication of the Mine Closure Plan, as updated from time to time, together with monitoring data, by the Proponent.

Recommendation 15

That approvals and decisions for the Proposal require the Proponent or Operator to:

- conduct works in accordance with an Authority Certificate within the meaning of the *Northern Territory Sacred Sites Act 1984*
- communicate with custodians of Sacred Sites in the vicinity and downstream of the Proposal site.

Recommendation 16

That approvals and decisions for the Proposal require that closure of the Proposal achieve the following objectives:

- be safe to humans and animals and able to sustain an agreed post-mining land use
- be stable and not have potential to cause environmental harm
- improved environmental condition, compared with the pre-Proposal state, for all pre-existing mine components to be used by the Proposal
- maintained environmental condition, compared with the pre-Proposal state, for any new components
- post-mining land use (including potential re-use of mine infrastructure) that has been agreed with the landholder prior to relinquishment
- present no long term impacts or costs for the local community or the taxpayer at the end of the Proposal's economic life.

Recommendation 17

That before approvals or decisions are given or made for the Proposal, the Proponent provides plans to the relevant regulator for avoiding the discharge of mine affected water to the environment during wet periods into the long term future.

Recommendation 18

That the Proponent update the Mine Closure Plan prior to mining commencing to include:

- specific, measurable, auditable targets to demonstrate that performance is consistent with closure objectives
- provision for the management of declared weeds and exotic plants with high fuel loads until closure criteria are met, consider weed status and fire resistance of revegetated areas in closure criteria and manage fire until the majority of the woody revegetation is likely to survive the typical fire regime for the region
- active management of water and sources of acid and/or metalliferous drainage during the closure period and during any period of care and maintenance
- provision for the appropriate disposal of offices and other infrastructure during closure, by means other than placement in the pit lake
- a requirement for independent periodic external audits by suitably qualified and experienced auditors of any subaqueous deposition of waste materials in the pit lake including reactivity, compaction, drainage and settlement of material layers.

It is further recommended that the relevant regulator consult with the Northern Territory Environment Protection Authority on the Mine Closure Plan prior to mining commencing.

1 Introduction

1.1 Purpose of this Report

Primary Gold Limited (the Proponent) proposes to recommence underground mining and on-site processing of gold ore at the Toms Gully Underground Project (the Proposal), located approximately 100 km south-east of Darwin.

The Proposal has been assessed by the NT EPA at the level of an EIS under the *Environmental Assessment Act 1982* (EA Act). The NT EPA has prepared this Assessment Report (this Report) in accordance with section 7(2)(g) of the EA Act and clause 14(3) of the Environmental Assessment Administrative Procedures 1984 (EAAP).

The purpose of this Report is to ensure that matters with the potential to affect the environment to a significant extent are fully examined and reported. This Report is provided to the Northern Territory Minister for Environment and Natural Resources (the Minister) who will provide the Report to the Minister for Primary Industry and Resources (the Responsible Minister) to be taken into account in decisions made by the Northern Territory (NT) Government.

This Report is not an environmental approval, however it will guide the decisions and approvals relating to the Proposal.

1.2 Scope of the assessment

The NT EPA assessed the potentially significant environmental impacts and risks associated with the Proposal in line with the NT EPA's environmental factors and objectives (NT EPA, 2018a) and in accordance with the requirements under the EA Act.

The matters relating to the environment that the NT EPA considered necessary to be dealt with in the EIS for the Proposal were identified in the Terms of Reference (NT EPA, 2015), which were developed in accordance with clauses 8(3) to (6) of the EAAP.

The Proponent supplied details of alterations to the Proposal in accordance with clause 14A of the EAAP on 8 June 2018 and 14 December 2018. The NT EPA determined on both accounts that the Proposal had been altered in such a manner that its environmental significance had not changed and assessment at the level of an EIS was still necessary with respect to the proposed action (NT EPA, 2018c) (NT EPA, 2019).

Based on the Notice of Intent, and the notices of alteration to the Proposal under clause 14A of the EAAP, the NT EPA identified the following potential environmental impacts and risk categories that contributed to the decision to assess the Proposal at the level of an EIS:

- existing legacy acid and/or metalliferous drainage (AMD) issues from historic mining
- contamination of surface water, groundwater and soils
- impacts to hydrological processes and groundwater dependent ecosystems through altered surface water and groundwater flows
- impacts to downstream aquatic ecosystems in Mount Bunday Creek and Mary River National Park as a result of surface water contamination
- impacts to social, economic and cultural surroundings.

The Draft EIS for the Proposal was placed on public exhibition for six weeks between 26 September 2015 and 6 November 2015. A total of 13 submissions were received, 10 from NT Government advisory bodies, two from non-government organisations and one from the public.

1.3 Information before the NT EPA

In making this Report, the NT EPA had regard to:

- the Notice of Intent (February 2014)
- the Terms of Reference (October 2014)
- the EIS, comprising:
 - o the Draft EIS (September 2015)
 - o the Supplement to the Draft EIS (August 2018)
 - o the Addendum to the Supplement (July 2019)
 - o Further Information (January 2020)
- notices to alter the Proposal (June and December 2018)
- comments from NT Government advisory bodies on the Draft Terms of Reference, Draft EIS, Supplement, Addendum and Further Information
- comments from the public on the Draft Terms of Reference and the Draft EIS
- technical and other reports and guidelines that are noted in the References (section 8) of this Report.

1.4 Approval and regulatory framework

The Proposal will require approval and regulation by the NT Government. The framework for the approvals and conditions relevant to the Proposal are summarised below.

The NT EPA provides this Report to the Minister. The Minister is required to provide a copy of this Report to the Responsible Minister, together with any written comments made by the Minister in relation to this Report. If the Minister makes a comment in relation to this Report, the Minister must comply with reporting obligations to the NT EPA, under section 8B of the EA Act.

The Proposal was not referred by the Proponent to the Australian Department of the Environment and Energy (DOEE) for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The MM Act is the primary legislation for the authorisation of mining activities and the regulation of mining sites in the NT. The Responsible Minister, taking into consideration this Report, will decide whether to grant an authorisation under the MM Act and the conditions that may be applied.

Section 8A(2) of the EA Act requires the Responsible Minister to give the NT EPA notice of the decision as soon as practicable, but within seven days, after making the decision. Alternatively, if the decision by the Responsible Minister is contrary to this Report, the Responsible Minister must comply with reporting obligations to the NT EPA and the Legislative Assembly in accordance with section 8A(3) of the EA Act.

For operation of the Proposal, the Proponent will require a Waste Discharge Licence (WDL) under Section 74 the *Water Act 1992* to permit discharges of polluted water or water that has come into contact with waste. This will require an application to the Controller of Water Resources in the prescribed manner and form. Information on the application process can be found at <https://ntepa.nt.gov.au/waste-pollution/approvals-licences/how-to-apply>. Other regulatory approvals may also be required for clearing native vegetation, impacting heritage sites or sacred sites, building accommodation facilities, and/or storing or transporting hazardous chemicals.

The provision of this Report to the Minister concludes the examination of the EIS by the NT EPA. The EIS and supporting documents can be viewed on the NT EPA website at: <https://ntepa.nt.gov.au/environmental-assessments/register/toms-gully-underground-project>.

1.5 Background to the Proposal

The Proposal area (Toms Gully mine site) has previously been subject to open cut and underground mining by various operators.

1.5.1 History of existing mine

The Toms Gully gold deposit was discovered in 1986 and the open pit mine was developed and operated by Carpentaria Gold until 1991. Development included two waste rock dumps (WRDs), evaporation ponds (EPs), a tailings storage facility (TSF), and the initiation of an underground mine. Since 1991, at least five other operators have been responsible for the mine site. The mine was reopened twice and ceased operations after brief periods. A second TSF and a Carbon In Leach plant were developed by Kakadu Resources during the 1990s. Details are provided in section 1.2 of the Draft EIS.

1.5.2 Environment condition at existing mine and surrounds

This section of the Report evaluates the current condition of the environment, as a basis for quantifying and assessing the significance of any potential future impacts from implementation of the Proposal. The site has a number of legacy environmental issues, including significant AMD from existing landforms containing acid producing material. These issues have affected the quality of groundwater and surface water, and indicators of aquatic health in Mount Bunday Creek, Coulter Creek and the Mary River National Park as outlined below.

Historical landforms and sediments

Historical infrastructure and landforms are shown in Table 1. The layout of existing mine infrastructure is shown in Figure 1.

Table 1 Existing components at the Toms Gully mine site

Component	Size/capacity	Reference
Toms Gully Open Pit (water filled) Top water level = 15 m AHD, rising at ~0.9 m per year Freeboard/spill level = 4 m/19 m AHD	15 ha 4.66 ML	Further Information
TSF1	10 ha 135 ML	Addendum Appendix O
TSF2	9 ha 409 ML	
Oxbow Wetland	4 ha	
EPs	14 ha 700 ML	
Lake Bazzamundi ¹	~ 17 ha 50 ML	
Processing area	10 ha	Draft EIS
Arterial infrastructure (including roads, power reticulation, drill pads and sumps, bores, pipelines and site drainage)	4 ha	
Oxide WRD Vegetated, with minor erosion. Mineral leaching has occurred, evident by staining of the surface and dead vegetation downslope. Seepage/runoff is collected in the diversion drain around the Oxide WRD. Water diversion flows via a channel to the Oxbow Wetland.	25 ha 4.0 million m ³	Supplement Appendix A

Sulfide WRD The western edge of the Sulfide WRD has been capped and revegetated. Surface runoff to the west passively discharges towards Mount Bunday creek. Other runoff from the Sulfide WRD is captured in TSF1 (to the south), the EPs (to the north) and the pit lake (to the east).	29 ha 3.3 million m ³	Supplement Appendix A
Total area of existing disturbance	137 ha	

¹ Lake Bazzamundi is a seasonal, shallow artificial wetland that was not included in the Proponent's calculations of existing infrastructure. Lake Bazzamundi has previously been used to store mine-affected water with quality appropriate for stock drinking water.



Figure 1 Layout of existing infrastructure. SWRD = Sulfide WRD; OWRD = Oxide WRD.
Source: Supplement Appendix A

Material stored in the WRDs, TSFs and run-of-mine (ROM) pad stockpiles is a known source of AMD. The bulk of potential and retained acidity is in the WRDs and TSFs. Compared to the TSFs, the Sulfide WRD and Oxide WRD have relatively slow rates of acid generation (Supplement Appendix A). Acidic and saline drainage has been transported from the WRD, TSFs and ROM pad stockpiles to water storages across the site (Old Decant Pond, EPs, Stormwater Pond and Oxbow Wetland) (Supplement Appendix A). As a result, water and sediments in these storages contain contaminants including sulfides, metals and acid.

Geotechnical assessment of the existing TSFs, WRDs and processing area found all to be physically stable. The Oxide WRD was found to have minor erosion and drainage problems but otherwise stable. The processing area also has minor erosion (Draft EIS Appendix 10). The geotechnical stability of the pit and other infrastructure is uncertain.

The surrounding land has been subject to pastoral activity which has resulted in some compaction and erosion from land clearing and cattle. This has led to sediment deposition in and downstream from the Proposal area impacting water quality.

Groundwater

Previous monitoring found that the quality of groundwater at the mine site prior to mining (1987) was poor and did not meet the Proponent's proposed site specific trigger values (SSTVs) developed for surface water (Addendum Appendix F).

Contemporary groundwater monitoring has been undertaken across a network of nine bores on site. The Proponent concluded that contamination of at least shallow groundwater has occurred around the WRDs, EPs and TSFs, based on monitoring results exhibiting localised areas of elevated sulfate or low pH and elevated metals. Monitoring from bores located to the north and west of the Sulfide WRD and EP2 suggests contamination extends from the Sulfide WRD and EP2 through shallow aquifers towards Mount Bunday Creek, approximately 130 m to 300 m to the north-west. Based on current groundwater elevations, the hydraulic gradient is towards the pit, which is likely to capture contaminated seepage from beneath the polluting components on site (outlined above) (Addendum Appendix C).

There are 20 registered bores in the mine lease (and associated with the mine) and an additional 19 registered bores are located within 5 km of the Proposal site, owned by surrounding users, and primarily used for stock and domestic supplies (Addendum Appendix F). Evidence suggests that there is no connection in terms of chemistry between the bores located on site and neighbouring bores (Supplement Appendix C).

Groundwater recharge is via direct infiltration, via seepage from the overlying weathered siltstone and direct contact with the mine voids. Other than in the near-mine area, shallow groundwater is likely to discharge to local creeks.

Surface Water

The Proponent reported on surface water quality within the mine site as part of the geochemical assessment (Supplement Appendix A). On site, water quality in water storages where surface water had interacted with the AMD-generating landforms (outlined above) did not comply with the SSTVs. Most sites had low pH (3.0 – 4.7) and elevated levels of many metals except arsenic, chromium, iron and lead. The NT EPA notes that the water level of the pit is presently rising at about 0.9 m per year (Further Information page 15), and is currently 4 to 5 metres below the spill level (Further Information page 21).

Historically, contaminated runoff from the Sulfide WRD that is captured in the EPs has discharged into Mount Bunday Creek along the drainage line to the north of EP2. AMD from the Oxide WRD has historically overtopped the Oxide WRD drainage bund and discharged into Lake Bazzamundi during periods of extended rainfall and/or wet season storm events (Addendum Appendix C).

In streams, the Proponent undertook water quality assessments at 14 sites in conjunction with aquatic ecology assessments between 2015 and 2019 (Further Information Appendix 4; Figure 2). In Mount Bunday Creek, the site adjacent to the mine site (MBC06) had the highest concentrations of contaminants and salinity, followed by downstream site SWTG2. Some SSTVs were exceeded at these two sites. Contaminant concentrations were elevated compared with control and reference sites upstream and in

Coulter Creek. Sites further downstream contained comparatively reduced concentrations of metals except for aluminium (Further Information Appendix 4).

In 2017 all monitoring sites recorded low dissolved oxygen (DO) levels (below the SSTV range). In some cases, DO was very low (Addendum Appendix E). In 2019, DO was higher but still below SSTVs at all sites except Coulter Creek. This is likely to be due to the higher flows at all sites in 2019 compared to 2017. DO was low upstream of the mine. Low DO could reflect the reduced flow conditions and the general abundance of organic matter present (Draft EIS).

The elevated concentrations of contaminants adjacent to and downstream of the mine site were attributed to contaminated seepage from the WRDs and TSFs discharging to streams and potential influence from runoff from the mine site during wet conditions (Further Information Appendix 4). The report concluded that impacts from the mine site on water quality were localised, but did not address the elevated concentrations of aluminium downstream from the mine site.



Figure 2 Water quality monitoring sites. Source: Further Information Appendix 4, Figure 3-1

Aquatic Ecosystems

Historical water quality monitoring data indicates that the receiving waters of Mount Bunday Creek are often subject to elevated turbidity levels and elevated dissolved concentrations of metals such as cobalt, copper and zinc. These potentially affect the health of the aquatic communities downstream. While the area is naturally acidic to neutral, low pH readings are most likely a reflection of historic, occasional high rainfall events which have caused AMD runoff from the Proposal site (Draft EIS).

Monitoring of indicators of aquatic ecosystems health was undertaken across 14 sites in Mount Bunday and Coulter Creeks in 2015, 2017, 2018 and 2019 (Further Information Appendix 4). Monitoring included macroinvertebrate community sampling, fish community sampling water quality sampling and aquatic habitat assessment.

Macroinvertebrates

The 2017 and 2019 aquatic ecosystem studies concluded that the macroinvertebrate community of Mount Bunday Creek and Coulter Creek comprised disturbance-tolerant macroinvertebrate families including Diptera (flies) and Ephemeroptera (mayflies), and in

2019, Hemiptera (bugs, aphids and cicadas). The number of families recorded was 55 in 2017 and 49 in 2019.

The 2017 study reported that community composition reflected water quality, such that ecosystem health metrics were poorer at sites adjacent and directly downstream of Toms Gully Mine. Sites further downstream were considered similar to those upstream of the mine.

In 2019, the macroinvertebrate community was reported as being in good condition at most sites in the study area. The exception was MBC06 (adjacent EP2) which exhibited poor macroinvertebrate community condition, likely due to the poor water and sediment quality observed.

Fish

Thirteen fish species were recorded in 2017, but only two species in 2019. Eastern Rainbowfish were the most commonly recorded, followed by Sailfin Glassfish. Spangled Perch and Eastern Rainbowfish were the most widely distributed fish.

The 2017 study concluded that the fish species of Mount Bundey Creek and Coulter Creek were indicative of moderately disturbed ephemeral streams in the area. A higher diversity of fish species was recorded in Mount Bundey Creek compared with Coulter Creek (Supplement Appendix E). This is likely due to the smaller size and lower flow of Coulter Creek, and nearby intensive cattle grazing and associated erosion such that turbidity and nutrient enrichment have resulted in poorer quality conditions for fish.

Species richness was correlated with distance downstream of the mine site. The monitoring site furthest downstream (SWTG3) had the most fish species (10); slightly more than the baseline site upstream of the Proposal (SWTG1A) (eight). This observation parallels the water quality data, which shows poorer water quality adjacent to the mine and water quality similar to baseline conditions at SWTG3 (Supplement Appendix A).

The physical condition of fish was found to be poorest at the site on the boundary of the mining lease (MBC01), which would be the most impacted by any discharges from the site. This was indicated by several Spangled Perch showing signs of Tropical Ulcerative Syndrome (red spot disease) and Seven-spot Archerfish swimming sluggishly (Supplement Appendix E).

Water Monitors

In 2017, one Mertens' Water Monitor (*Varanus mertensi*) was recorded upstream of the mine on Mount Bundey Creek. Three sightings of Mertens' Water Monitors were recorded in 2019 at two sites, including one site upstream and one site far downstream. No Mertens' Water Monitors were observed at any site adjacent to the mine or immediately downstream.

1.6 The Proponent

The Proponent is Primary Gold Limited (ABN: 42 122 726 283). Since June 2018 it is fully owned by Hanking Australia Investments Pty Ltd (ABN: 24 613 858 843), a company with several mineral investments in Australia. It is a subsidiary of China Hanking Holdings Limited, listed on the Hong Kong Stock Exchange and owner of an iron ore mine in Fushun, Liaoning, China.

2 The Proposal

A summary of the Proposal is presented in the Further Information provided 6 January 2020, with additional details provided in the Addendum and Supplement. The following section provides an overview of the Proposal.

2.1 Overview

The Proposal includes the following key activities:

- construction of a boxcut and decline to access the underground ore body; year 1
- construction of a new 1 GL WSD; year 1
- clearing 76 ha of native vegetation for the WSD, boxcut, borrow pits and associated access tracks; year 1
- establishment of a standalone water treatment plant; year 1
- upgrade and recommissioning of the existing processing plant; year 1
- capping of existing WRDs (including lining of the EPs); year 1
- removal and rehabilitation of existing TSFs 1 and 2; years 1 to 2
- placement of all tailings and waste rock via a stacker into the existing pit lake; historical tailings to be deposited in years 1 to 2
- underground mining; from year 2
- processing of ore; years 2 to 5
- new tailings to be deposited in the existing pit lake as soon as they are generated from ore processing; years 2 to 5
- rehabilitation and closure; years 6 to 15.

2.2 Location

The Proposal is located 100 km south-east of Darwin business centre and 66 km south-east of Humpty Doo (Figure 3). The nearest community is Marrakai, 18 km to the north-east. Access is via the Arnhem Highway to the Toms Gully Mine turn-off and then via an established haul road 1 km to the mine.

The Proposal lies entirely within granted MLN 1058 within Old Mount Bunday Station (Perpetual Pastoral Lease 1163). MLN 1058 covers an area of 682 ha. ML 29812 and ML 29814, directly north and south of MLN 1058 are also held by the Proponent and have an area of 158 ha and 84 ha respectively. The combined area of the mineral leases is 924 ha.

2.3 Regional context

The climate of the region is tropical, characterised by distinct wet and dry seasons with an average rainfall of 1394 mm. The majority of rainfall occurs in the wet season (October to April). Annual average pan evaporation is 2400 mm.

The Proposal lies within the Pine Creek Bioregion which consists of hilly to rugged ridges with undulating plains. The Proposal area contains small ridges and dissected hills drained by small stream channels and lower lying areas. Surface elevation reaches 51 m Australian Height Datum (AHD) in the south-west corner of the Proposal area and falls to 16 m AHD in the low-lying areas.



Figure 3 Proposal location (source: Draft EIS)

2.4 Key components and footprint

The components of the Proposal are summarised in Table 2 and their location is shown in Figure 5.

Table 2 Key components of the Proposal

	Component	Size/capacity
Whole of Proposal	Total area of mineral leases (MLN 1058, MLN 29812, MLN 29814)	924 ha
	Total area of disturbance (existing ¹ and proposed)	195 ha
	Life of mine	5 years
	Operational workforce	104 workers
	Closure period	10 years
Mining	Ore to be extracted	900,000 t
	Waste rock to be extracted from underground	850,000 t
	Waste rock to be extracted from the boxcut	660,000 t
Processing	Gold to be extracted	315,000 oz
	New tailings generated – to be placed in pit lake	900,000 t

	Component	Size/capacity
	Existing tailings ² – to be placed in pit lake	250,000 t – TSF1 130,000 t – TSF2
Proposed new Infrastructure (maximum)	WSD (for treated water)	16 ha 1 GL
	Boxcut for new access to underground	2 ha
	Borrow pits and associated access tracks required for dam embankments	58 ha
Rehabilitation of existing WRDs and TSFs	Once emptied of tailings TSF1 will be rehabilitated	No additional footprint
	Once emptied of tailings TSF2 will be kept if suitable as temporary water storage and rehabilitated during closures	No additional footprint
	Existing WRDs will be capped, including lining of the EPs	No additional footprint
Waste rock and tailings management	Boxcut material to be used to cap the WRDs. All other waste rock and tailings are to be deposited in the pit as described in section 2.7	
Water Management (Addendum Appendix A)	Dry season discharge of water from the WSD to Mount Bunday Creek, Lake Bazzamundi or third party in first 59 months	1.7 GL to Mount Bunday Creek and third parties 3 GL remains in pit
	Treatment process - treat to SSTVs. "Brutus" process. Refer to Section 2.8	26 ML/day
	Operational water discharge to Lake Bazzamundi, Mount Bunday Creek or third party for use	1.1 GL
	Two future WDL compliance points proposed at the eastern lease boundary	DP1 - Mount Bunday Creek DP2 - Lake Bazzamundi

¹Does not include Lake Bazzamundi (17 ha); see section 1.5.2.

²Tailings material from TSF1 and/or TSF2 may be reprocessed to extract gold. Whether reprocessed or not, all tailings would be placed in the pit lake.

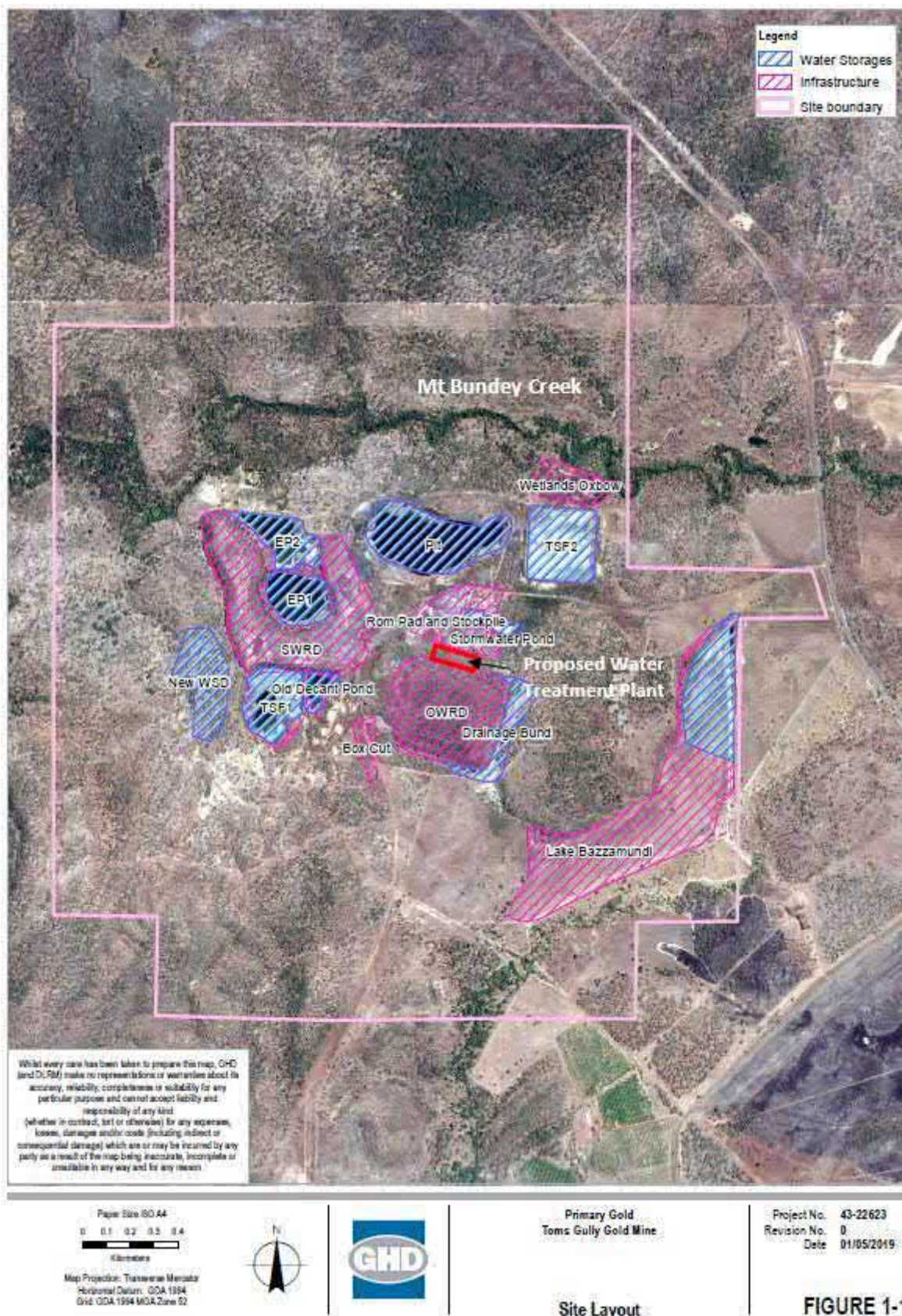


Figure 4 Mine site footprint and layout (source: Addendum Appendix K)

2.5 Historical tailings

As outlined in section 1.5.2 (existing environment), historical tailings are a known source of AMD and contaminants entering groundwater and surface water. In order to remove this source of contamination from the site the Proponent has committed to relocating all existing tailings material from TSF1 and TSF2 (380,000 t; whether processed or unprocessed) into the pit within 18 months of the boxcut excavation starting. This will inhibit oxidation. Tailings will be placed into the bottom of the pit via a floating head pipe arrangement as detailed in the Addendum.

Existing tailings from the TSFs will be pumped via a small dredge to the pit as a slurry. Some of these tailings may be reprocessed through the processing plant if the gold grade and recovery is found suitable.

Once emptied of tailings, TSF1 will be rehabilitated with uncontaminated material from the walls of the dam spread over the area the tailings were situated. The dam footprint will have topsoil spread over the footprint and this will be ripped to encourage re-growth.

Pending an assessment of suitability, after tailings have been removed, the empty TSF2 may be kept intact to use it as a short term water storage facility as part of the water treatment process. Water from underground mine dewatering will be stored in the dam and treated with caustic/lime to bring the pH up to at least 7, prior to being sent to the water treatment plant.

2.6 Mining and ore processing

Mining will be conducted using a room and pillar approach by use of conventional jumbo development drills, underground loaders and underground trucks.

Processing will be by use of crushing, grinding, flotation and Carbon In Leach extraction process. A wet slurry of ground concentrate will be subject to gold adsorption using 3000 g/t carbon over a residence time of 14 hours. Gold will be eluted with an acid wash and carbon will be regenerated for reuse.

The Proponent estimated 900,000 t of ore will be processed by the processing plant at a rate of up to 350,000 t/year. Ore processing will remove less than 0.05% of this in gold ore, such that the quantity of tailings is almost equal to the quantity of ore (900,000 t).

2.7 Disposal of waste rock and tailings

New tailings from the processing plant will be deposited subaqueously in the pit using the same method as for historical tailings deposition.

The boxcut waste rock will be placed on the existing waste dumps and used to line the EPs to reduce the ingress of water through the WRD and EP profile. If any of the boxcut material is found to be acid-producing it will be placed into the pit using the same method as for underground waste rock.

The underground waste will be deposited in the existing pit lake to limit oxidation. It will be trucked to the south side of the pit edge. A front end loader will place the waste onto a stacker conveyor belt that will convey the waste towards the middle of the pit, 60 m from the pit edge within 48 hours of extraction (Figure 5). The Proponent intends to leave some underground waste (50,000 to 200,000 t) underground in mined out areas, depending on geotechnical safety and scheduling. This would reduce the volume of waste to be placed into the pit.

The volume of the pit is sufficient to store all waste rock and tailings material beneath a 26 m deep layer (Further Information page 13). Previous studies indicate that at least 1 to 5 m of water cover is required to limit oxidation of waste materials (Addendum Appendix D).

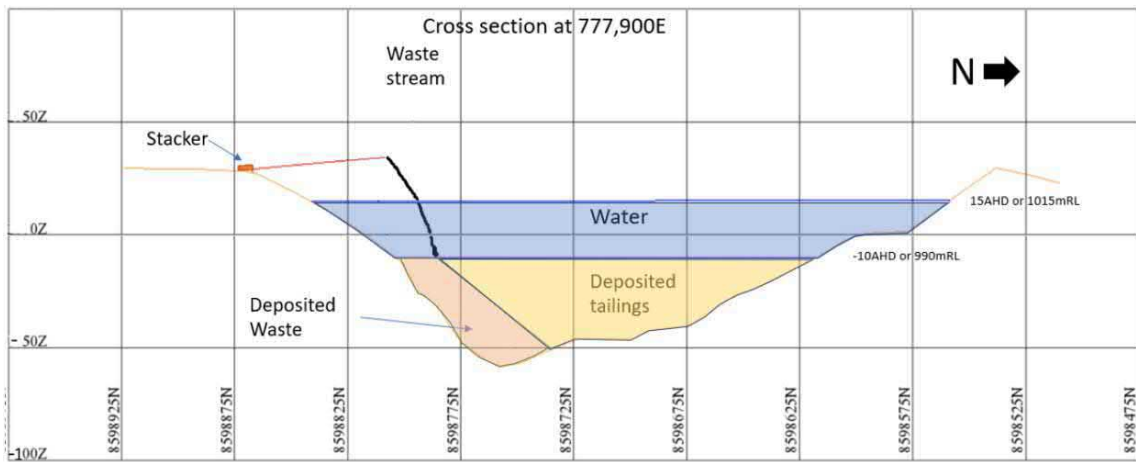


Figure 5 Indicative positioning of the waste rock and tailings in the pit (source: Addendum)

2.8 Water management

Surface water storage infrastructure on site is illustrated in Figure 4. All infrastructure is existing with the exception of the new WSD and water treatment plant that are to be constructed in the first year of the Proposal. All water storages do or will contain or capture mine-affected water, with the exception of the new WSD that will contain treated water, and Lake Bazzamundi that will capture potentially mine-affected runoff.

The intent of the water management system is to contain all mine-affected water on site and also to contain clean water over the dry season so that it can be discharged from the WSD to the environment when natural creek flows are occurring in the wet season. Volumes in each storage will be managed using pumped transfers between the storages, in accordance with the water management schematic at Figure 6. The primary mine-affected water storage is the pit lake.

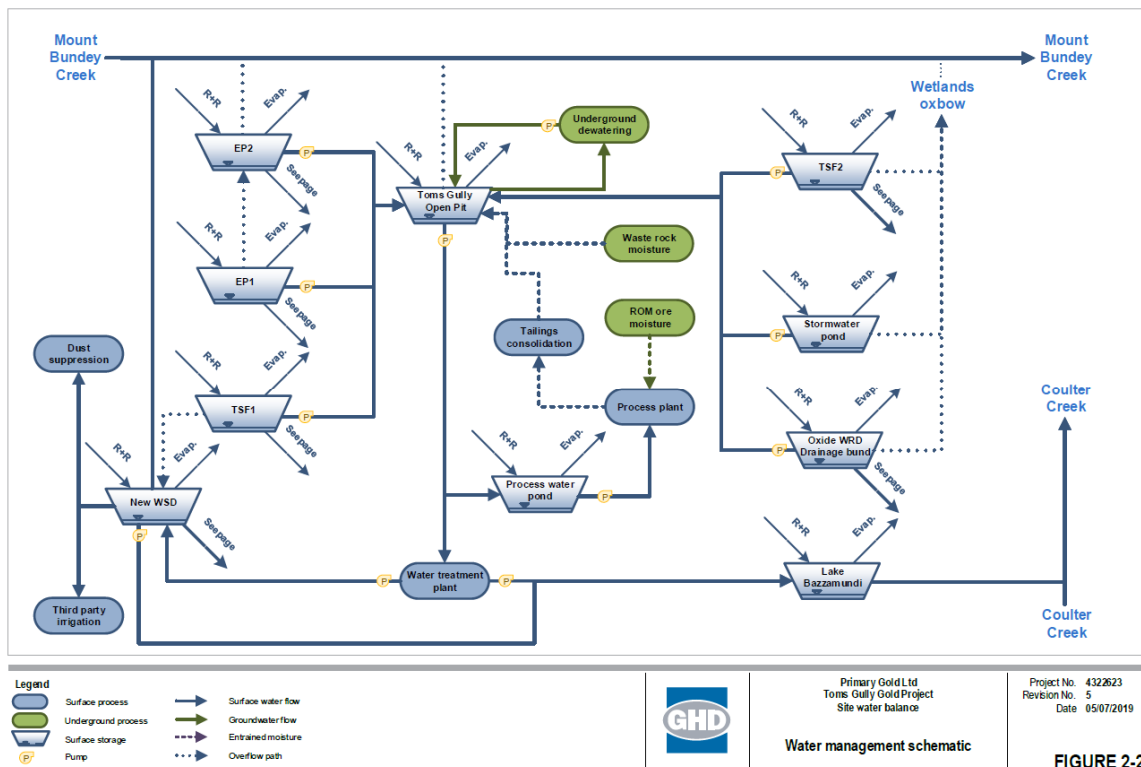


Figure 6 Water management schematic (source: Addendum Appendix O)

Throughout operations the Proponent proposes to progressively remove water from the pit lake to create space for the deposition of waste materials while maintaining the water level in the pit at or above the existing level. All excess water will be treated as detailed below, and stored in the WSD prior to environmental discharge in the wet season (to be licensed) or diversion to a third party user (Pastoralist) for use during the dry season.

The process for treating and discharging this excess water will be as follows:

- Prior to the placement of tailings and waste rock into the pit, pit water will be treated insitu using lime/caustic to keep the pH of the pit water at 8.5 and assist the precipitation of dissolved heavy metals in the water.
- The preferred final treatment process is the Brutus treatment plant developed by WaterX (Further Information page 8). This is a bacterial leach based treatment plant that converts all impurities into products that can be sold, including a mixed metal oxide, sulfur and carbonate. The Brutus system is described in Appendix Q of the Addendum (therein titled the BioAqua process). The scalability of the Brutus process requires testing. If the test plant is determined not economically scalable, then a conventional Reverse Osmosis (RO) plant will be used for the primary water treatment and the Brutus test plant will be used to treat the brine waste from the RO plant (Further Information page 5).
- Treated water will be discharged from the WSD to Mount Bunday Creek and Coulter Creek (via Lake Bazzamundi) in the wet season when streams are flowing (Addendum Appendix O). The Proponent will apply for a WDL that will facilitate regulation of this discharge in accordance with the *Water Act 1992*. Water from the WSD will also be utilised on site where required for dust suppression and it is intended that 200 ML/year will be transferred to a third party for irrigation.
- The Proponent has developed water quality targets for all discharges. Water quality targets (SSTVs) for discharge to the environment are presented in Appendix F of the Supplement. Toxicants that had SSTVs developed are:

o Aluminium	o Copper	o Nickel
o Arsenic	o Iron	o Zinc
o Cadmium	o Lead	o Total ammonia.
o Chromium	o Manganese	

SSTVs are based on the 80th percentile of water quality data collected in the wet season from the reference site SWTG1A, to take into account natural variation and background levels. For all other toxicants, the default guidelines from the Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand (ANZECC & ARMCANZ, 2000) have been used.

Water quality targets for Pastoralist use are provided in Table 6-4 of the Addendum. These are based on the (ANZECC & ARMCANZ, 2000) long term trigger values for 100-year irrigation periods. Exceptions to the ANZECC/ARMCANZ trigger values are:

- o Manganese and iron – the SSTVs are to be used instead, as these are higher than the ANZECC/ARMCANZ values
- o Sulfate and Electrical Conductivity – values derived to protect soil quality and protect plants sensitive to salinity, as these were not defined by ANZECC/ARMCANZ.

To minimise the possibility of pit water overflowing and discharging to Mount Bunday Creek in extreme rainfall events, the Proponent has proposed the following (Further Information pages 16 and 21):

- construction of bunds and drains to divert upstream runoff from the Sulfide WRD away from entering the pit
- additional bunds to increase the capacity of the pit (creating a freeboard of 5.7 m in the 1000 year extreme rainfall event), noting that the pit is currently filling due to wet season rainfall and runoff
- removal of the two TSFs so that pumping to the pit is not required.

2.9 Energy use and transport

The Proposal will utilise the existing mains 22 kV power supply to the mine and processing facility. The Proponent estimated power usage at approximately 2500 MWh per month. Diesel fuel consumption (mostly for underground mining equipment) is estimated to be approximately 50,000 L per month. Back-up power generators will be in place in the event of power loss to the site. The Proponent does not propose to offset its greenhouse gas emissions which the NT EPA has estimated to be 10,200 t CO₂-e over a five year life of mine (refer Appendix 1).

The Proponent estimated that construction traffic would comprise on average three trucks and 10 light vehicles a day travelling to and from site (Draft EIS). Estimated traffic during operations is for five delivery trucks per week, up to six bus trips daily and ten light vehicles daily. Peak traffic times would be between 5 am to 10 am and 3 pm to 7 pm. As there have been substantial changes to the Proposal since the Draft EIS, the NT EPA considers that actual traffic will differ from these estimates.

2.10 Workforce

The Proposal would provide approximately 104 jobs. This includes underground, processing plant, maintenance, administration and contractors. The workforce would comprise mainly local residents but would likely also include some fly-in fly-out workers. No accommodation camp is proposed as workers would be local residents or accommodated locally and would travel to and from the Proposal area for each shift.

2.11 Rehabilitation and closure

Closure will occur over approximately 10 years, with the primary aim to return as much of the Proposal area as possible to a state suitable for pastoralism, and to significantly reduce environmental impacts for the future.

The draft Mine Closure Plan outlines the closure precincts of 1) livestock exclusion (where remediation is not possible), and 2) pastoral. The exclusion zone (pit, boxcut, WRDs and all associated runoff/EPs) will have restricted access while water is being treated, the landscape stabilises and is revegetated, and while investigations conducted to ensure rehabilitation is safe and sustainable to support pastoral grazing. The Proponent's plans for the two major closure domains are summarised in Table 3.

Table 3 Proposed closure activities (source: Further Information Appendix B1)

	Domain	Closure activities
Livestock exclusion precinct	Pit lake	The pit lake will contain ~1.5 Mt of waste rock and tailings submerged under ~26 m of water. Water will have a pH of 8.5 due to active management during operations. The spill level will be 22 m AHD. An abandonment bund or fence with signage installed outside of the theoretical zone of potential pit instability (as per the Western Australian guideline Safety Bund Walls Around Abandoned Open Pit Mines (DMIRS, 1997) to prevent public entry.
	Processing Area (including ROM Pad)	Infrastructure and waste will be removed from site (unless required by a third party taking a controlling interest in the lease). The ground surface will be ripped and seeded with native species.
	TSF1 and TSF2	TSF1 – see section 2.5. If TSF2 is used for water storage during operations (see section 2.5), it will be decommissioned and rehabilitated during closure. Uncontaminated material from the walls will be flattened and spread over the dam area. Topsoil will be spread over the top and ripped to encourage re-growth.
	Oxide and Sulfide WRDs	These will remain in situ at closure, having been capped within four months of starting operations. The bunds and drains diverting runoff from the top of the Sulfide WRD running into the pit will remain in situ.
	EPs	The EPs will remain in situ at closure. A fence around the EPs will be maintained to exclude unauthorised personnel and livestock. During closure, water within the EPs will be treated using a water treatment process that removes metals and lowers sulfate. The long term rehabilitation of the EPs will be included in the further closure planning.
	Arterial Infrastructure (roads, pipelines, power reticulation)	These will be either: - retained for post closure site management - transferred to the Pastoralist - rehabilitated.
	Boxcut and Decline	Groundwater will fill the base of the portal, stabilising at about 30 m below the natural ground surface. The entrance will be sealed. The seal will prevent public/wildlife access to the decline. Eventually the seal will be underwater. A bund will be established around the boxcut to prevent the inflow of surface runoff and to prevent public/wildlife access.
	Oxbow wetlands	This will be retained. The wetlands are stable and considered to have more ecological value than if they were rehabilitated.

	Domain	Closure activities
Pastoral precinct	Surface and Groundwater bores	Production bores may be retained by the Pastoralist for future use by written agreement and have a fenced enclosure installed around them. Monitoring bores will be sealed.
	Proposed WSD	This will be retained as an available water store for pastoral grazing if water quality meets ANZECC livestock guidelines (ANZECC & ARMCANZ, 2000). If ANZECC livestock guidelines are not met or the Pastoralist does not wish to retain the WSD, the area will be included in the livestock exclusion precinct and be remediated as follows: • transfer remaining water to the open pit in the dry season • embankments used for rehabilitation or construction material to remediate existing infrastructure • base of dam ripped, scarified, topsoil re-spread (if available) and seeded with native species.
	Lake Bazzamundi	Will continue to be available as a water storage for pastoral grazing. The management of Lake Bazzamundi is expected to revert to the pastoralist at closure.
	Offices, workshops and sheds	These are likely to be retained for the Pastoralist. If not required, the Proponent intends to take them offsite to an approved landfill or demolish and submerge them in the pit lake. Remediation of the workshop footprint will be undertaken if deemed necessary by a contamination assessment following the cessation of operations. The ground surface will be ripped and seeded with native species.

3 Consultation

The Draft EIS for the Proposal was on public exhibition for six weeks between 26 September 2015 and 6 November 2015. A total of 10 submissions were received from NT Government advisory bodies, two from non-government organisations and one from a member of the public. All submissions were forwarded to the Proponent.

In preparing this Report, the NT EPA has considered each submission in relation to the Proposal's potential environmental impacts and risks.

3.1 Proponent consultation

The Proponent has consulted with the owners of Old Mount Bunday Station on a number of matters including the transfer of water for potential irrigation and the return of land to pre-existing pastoral land use. The Proponent stated that the pastoralist wishes to obtain water during the dry season and may wish to retain sheds, workshops and water storage assets post closure, pending further consultation.

3.2 Public submissions

There were two formal opportunities for public comment under the environmental assessment process. The first opportunity was to inform the development of the EIS Terms of Reference and secondly to comment on the Draft EIS.

The draft Terms of Reference were advertised for comment between 25 October 2014 and 7 November 2014. The Amateur Fisherman's Association NT (AFANT) provided comment.

The Draft EIS for the Proposal was on public exhibition for six weeks between 26 September and 6 November 2015. Comments were received from AFANT and the Environmental Defenders Office and one anonymous commenter.

The key concerns expressed by AFANT were:

- potential impacts to the health of downstream ecosystems resulting from inappropriate management of water quality and quantities
- potential impacts from AMD and/or saline drainage due to inadequate management of waste rock
- potential impacts from erosion and sedimentation during clearing
- the financial risk and the rehabilitation bond not being sufficient to address management requirements in the event of an emergency shut down or failure.

The key concerns expressed by the Environmental Defenders Office were:

- that elevated cyanide levels in TSF2 could impact on Gouldian finch drinking water and that a method for appropriately managing this risk was not proposed
- the lack of an appropriate closure or rehabilitation plan, or timeline for such plans to be submitted for the Sulfide WRD, the Oxide WRD and TSF1.

The anonymous commenter expressed their opinion regarding the lack of certainty regarding species presence or absence on site as no on-ground fauna survey had been undertaken in the area.

The Proponent responded to these issues in section 6 of the Supplement.

In preparing this Report, the NT EPA has considered each submission in relation to the Proposal's potential environmental impacts and risks.

The NT EPA acknowledges that the Proponent proposes to continue to engage with relevant stakeholders during implementation of the Proposal.

3.3 Consultation by the NT EPA

The NT EPA consulted with eleven NT government advisory bodies in respect of the Draft EIS, Supplement and Addendum to the Supplement when preparing this Report. The agencies consulted include Department of Environment and Natural Resources, Department of Infrastructure, Planning and Logistics, Department of Primary Industry and Resources (DPIR), Department of Tourism and Culture, NT Police, Fire and Emergency Services, Department of Health, Department of Trade, Business and Innovation, Department of the Attorney-General and Justice, Department of the Chief Minister, Aboriginal Areas Protection Authority and Power Water Corporation.

The NT EPA consulted with the Proponent and visited the Proposal site on 9 October 2018 during NT EPA Meeting 36. Further consultation with the Proponent was held at the NT EPA Meeting 37 on 6 December 2018.

Following submission of the Supplement, the NT EPA engaged the DPIR to provide additional technical information in respect of the EIS. The NT EPA also consulted with DPIR regarding the recommendations made in this Report.

The NT EPA has considered relevant environmental issues raised by stakeholders in making this Report.

4 Key environmental factors

Having regard to the Notice of Intent, the Draft EIS, Supplement and Addendum to the Supplement, further information received and comments from the public and advisory bodies during the EIS review, the NT EPA assessed the Proposal for its potential impacts on the NT EPA's factors and objectives. The NT EPA has identified the following key environmental factors that may be significantly impacted by the Proposal, and that are assessed in this Report (Table 4):

Table 4 Key environmental factors

Theme	Key environmental factor	Objective
Water	Inland water environmental quality	Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.
	Aquatic ecosystems	Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the ecological functions they perform.
People and communities	Social, economic and cultural surroundings	Protect the rich social, economic, cultural and heritage values of the Northern Territory.

The NT EPA has considered the importance of other environmental factors during the course of its assessment. Those factors that were not identified as key environmental factors that may be significantly impacted by the Proposal, or that were addressed through consideration of the above factors, are summarised at Appendix 1 of this Report.

The key environmental factors are discussed in Section 5 of this Report. The description of each factor shows why it is relevant and how it would potentially be affected by the Proposal. The assessment of each environmental factor contains recommendations for implementing the Proposal in a manner which protects the values associated with the factor. It concludes with a judgement by the NT EPA about whether or not the Proposal can meet the NT EPA's environmental objective for each factor.

5 Assessment of environmental factors

5.1 Overview

This section evaluates the Proposal and presents the views of the NT EPA on the environmental acceptability of the Proposal. The environmental acceptability of this Proposal was considered with regard to the principles of Ecologically Sustainable Development (ESD), through analysis of:

- the Proposal (particularly which components or activities are likely to significantly impact the environment)
- the existing environment (particularly environmental values and sensitivities)
- the potential environmental impacts and risks of the Proposal and the evaluation of the significance of those impacts and risks
- the proposed avoidance or minimisation / mitigation measures to reduce potential impacts and risks to acceptable levels and to meet NT EPA objectives.

Recommendations are made in this Report to add, emphasise or clarify any commitments made by the Proponent, where the proposed avoidance or minimisation/mitigation measures are considered insufficient, or where a safeguard is deemed particularly important. In this Report, the recommendations (in **bold**) are

preceded by text that identifies issues and undertakings associated with the Proposal. For this reason, the recommendations should not be considered or read in isolation.

The NT EPA acknowledges that detailed design and operational plans for the Proposal have not been finalised. Minor and insubstantial changes are expected in the design specifications of the Proposal following the conclusion of the EIA process. It is necessary for approval mechanisms to accommodate subsequent changes to the environmental safeguards described in the EIS and recommendations in this Report. The NT EPA considers that the application of conditions associated with the statutory approvals governing the Proposal will give effect to such safeguards. However, if future proposed changes to the Proposal could increase potential impacts on the environment, further environmental assessment may be required.

The NT EPA considers that this assessment is valid for five years from the date of this Report. If the Proposal has not substantially commenced in this period, the NT EPA requests that it be notified in writing by the Proponent.

The NT EPA considers that commitments made by the Proponent in the EIS are binding and must be fulfilled for the duration of the Proposal. The NT EPA makes Recommendations 1 and 2.

Recommendation 1

That approvals and decisions for the Proposal impose binding legal obligations on the Proponent or Operator to implement the Proposal in accordance with all environmental commitments and safeguards which are:

- **identified in the final Environmental Impact Statement for the Toms Gully Underground Project, including Draft Environmental Impact Statement (EIS), Supplement to the Draft EIS, Addendum and Further Information**
- **recommended in this Assessment Report 91**

Where there is conflict between the commitments in the EIS and the recommendations in this report, the latter are to take precedence.

Recommendation 2

That the Proponent or Operator provides written notice in advance to the Northern Territory Environment Protection Authority and the Responsible Minister if it alters or proposes to alter the Proposal, environmental commitments or safeguards in the Environmental Impact Statement in such a manner that the environmental significance of the action may change, in accordance with clause 14A of the Environmental Assessment Administrative Procedures 1984.

The remainder of this section identifies and discusses, in relation to each key environmental factor (NT EPA, 2018a), the environmental values and potential impacts and risks to these values based on the likely significance of potential impacts, the Proponent's investigations and studies, and the Proponent's commitments to identify, avoid, mitigate, monitor and manage the potential impacts and risks.

In defining its environmental objectives, the NT EPA also had regard to the principles of ESD articulated in the Intergovernmental Agreement on the Environment (DoEE, 1992). The NT EPA has summarised its consideration of ESD in Appendix 2.

The NT EPA considers it essential that good mine closure planning for each individual mine domain be integrated into mine development and operations planning, particularly as the proposed life of mine is short. The NT EPA's assessment of the Proponent's proposed Mine Closure Plan is discussed in Section 6.

5.2 Inland water environmental quality and aquatic ecosystems

5.2.1 Environmental objectives

Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.

Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the ecological functions they perform.

5.2.2 Environmental values

Groundwater

Groundwater at the mine site occurs in three aquifer systems that have heterogeneous porosity. The conceptual hydrogeological model (Supplement Appendix C) indicates that the hydraulic gradient of groundwater beneath existing mine infrastructure is inwards towards the pit. Other than in the near-mine area, shallow groundwater is likely to discharge to local creeks.

The Declared Beneficial Uses of Mary River groundwater are environmental, riparian and cultural under the *Water Act 1992*.

The earliest available baseline groundwater quality sampling was undertaken in 1987, prior to the commencement of mining. The bores sampled were situated within the now open pit. Several parameters were elevated in comparison to the SSTVs developed for surface water quality. These included electrical conductivity, turbidity, total suspended solids, arsenic and iron and acidity (Addendum Appendix F). These results were attributed to natural background values of the mineralised area (Draft EIS).

Historical mining has resulted in the generation of AMD from several sources within the Proposal site. Contemporary groundwater sampling on site has shown that generally groundwater is slightly acidic to slightly alkaline with a pH between 6.3 and 8. The exception is bore G8 near the Sulfide WRD which is acidic (pH 4.5) (Supplement Appendix A). Contamination of at least shallow groundwater has occurred around existing mine components. Some contamination may extend through shallow aquifers to Mount Bunday Creek to the north-west of the EPs (Supplement Appendix C). Further details are provided in section 1.5.2 of this Report.

Surface Water

The Proposal site is located in the Mary River catchment between two ephemeral streams: Mount Bunday Creek to the north and Coulter Creek to the south; both flow eastwards into Hardies Creek before joining the Mary River. The catchments of Mount Bunday Creek and Coulter Creek are about 120 km² and 40 km² respectively, totalling about 2% of the 8000 km² Mary River Catchment (sourced from maps supplied by the Proponent).

Surface water values are recognised under the *Water Act 1992* with the Declared Beneficial Uses of environmental, riparian and cultural for the Mary River. Mount Bunday Creek has a Declared Beneficial Use of ecosystem protection (including for the section running through the mineral lease), with the exception of a section downstream of the Proposal site (from about the Arnhem Highway crossing downstream for ~3 km to approximately the confluence with Hardies Creek), which is livestock water supply (NT Government, 1997).

Surface waters in the vicinity have relatively good water quality, with the exception of the section immediately downstream of the site that has had (at times) poorer water quality,

as described in section 1.5.2 of this report. While this is mostly due to seepage from legacy components at the Proposal site, it is also influenced by other activities in the local catchments. The quality of water in the storages on the Proposal site is generally poor (see section 1.5.2).

Aquatic Ecosystems

The Mary River system has significant conservation values related to its aquatic ecosystems. The Mary River coastal floodplain site of conservation significance (SOCS) and the Mary River National Park are downstream of the Proposal site, within 100 m and 3 km, respectively, of the site boundary (Figure 7). Combined with adjacent SOCS, the Mary River floodplain forms part of an extensive interconnected wetland system (NRETAS, 2009). This system is rich in biodiversity and is significant nationally and internationally. The proximity of the Proposal site to the SOCS and the Mary River National Park indicates that the site is very close to recognised ecological values that are downstream of the Proposal.

The Mary River is the most significant and reliable breeding habitat for magpie geese in the Northern Territory, and is an important breeding and feeding ground for other important water, shore and sea-birds. The Mary River floodplains are a major breeding area for fish species, including barramundi. Seasonal and semi-permanent waterholes in Mount Bunday and Coulter Creek are considered ecologically important, serving as refuges for fish and aquatic reptiles during the dry season. The Mary River system's aquatic ecosystems and terrestrial biodiversity also have socio-economic and cultural values as outlined in section 5.3.

5.2.3 Potential impacts

Water quality in the vicinity may be affected by contaminants (including sediments) entering surface water or groundwater from:

- AMD arising from historical and new mine components
- active water discharge to Mount Bunday Creek or Coulter Creek (via Lake Bazzamundi)
- active water discharge to a third party (e.g. for irrigation)
- uncontrolled discharges of mine-affected water via surface water or groundwater seepage, during operations and following closure
- uncontrolled discharge of liquids or materials stored on site, including from the water treatment plant.

Any contaminants discharged from the Proposal that impact downstream water quality could have adverse impacts on the downstream aquatic ecosystems. This could occur during implementation of the Proposal, during any period of inactivity or care and maintenance, or following closure.

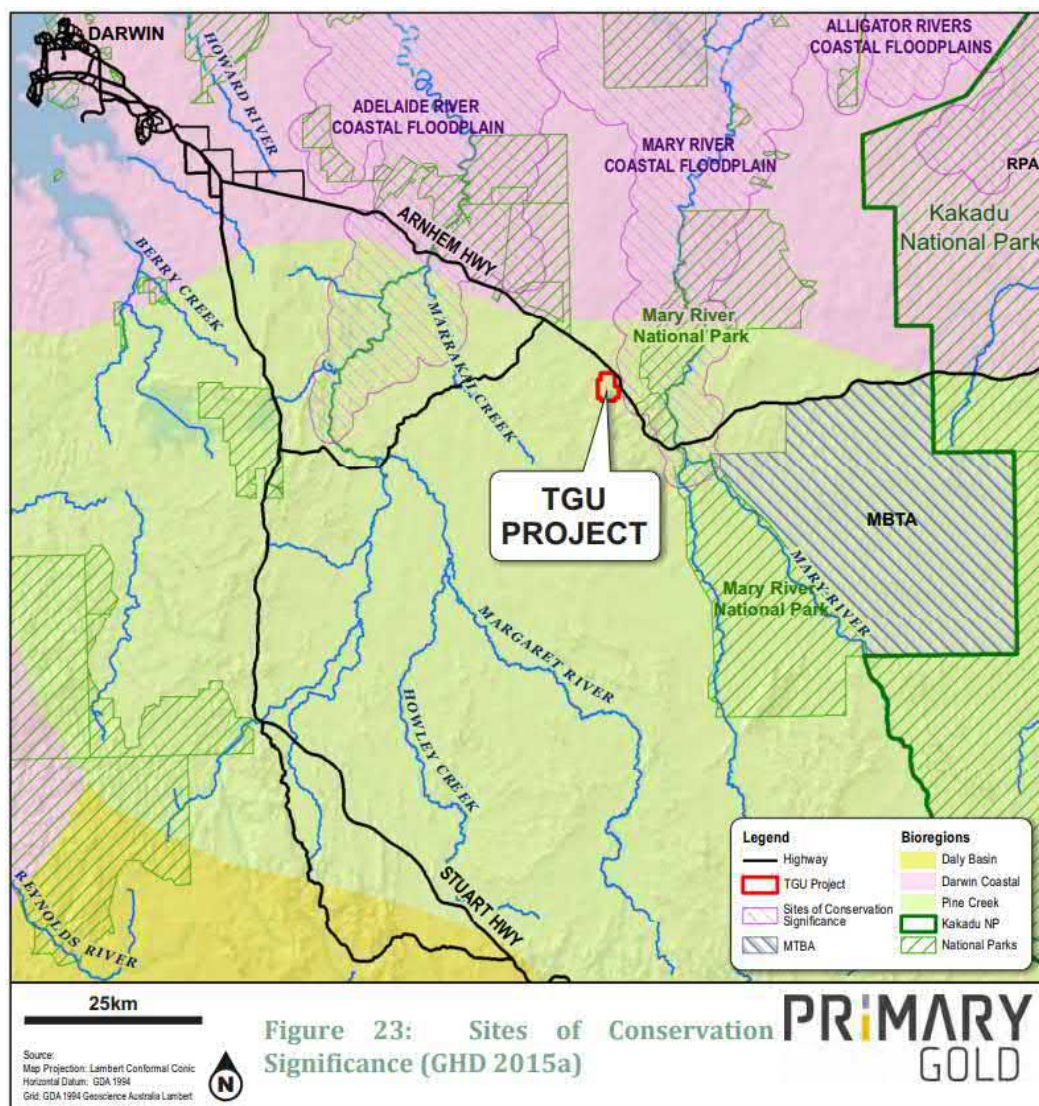


Figure 7 Sites of conservation significance (source: Draft EIS)

5.2.4 NT EPA assessment

Overarching protection of the Mary River

The Mary River and associated floodplains, and the values they support are the critical elements of the receiving environment for the Proposal that must be protected from site-related degradation. The NT EPA considers that to meet its environmental objectives across environmental factors, and the principles of ESD, the Proposal must meet the following overarching environmental objectives for the Mary River:

- protect the water quality and environmental health of the Mary River downstream of the Proposal site at all times from mine related impacts, including after closure
- reduce the impacts and risks to the Mary River from the legacy mine site.

To support this, the NT EPA makes Recommendation 3 to guide the Proponent in implementing the Proposal and to guide approvals and decisions for the Proposal. This will require effective contaminant source control as discussed below.

Recommendation 3

That the commitments and safeguards listed in the Environmental Impact Statement for the Proposal and recommended in this Assessment Report 91 are implemented in a manner and to the extent that protects the environmental values of the Mary River downstream from the Proposal site at all times from mine related impacts, whether from the Proposal or from historical mining operations. This includes during any period of inactivity or care and maintenance. This is the overarching environmental outcome that is required to be achieved in respect of the Proposal.

This recommendation also supports the requirement under the *Water Act 1992* for the Proponent to do all things reasonable and practicable to ensure the Proposal does not adversely affect the Declared Beneficial Uses and Objectives: Mary River surface water (environment, riparian and cultural); Mary River groundwater (environment, riparian and agricultural); Mount Bunday Creek, upper and lower sections (aquatic ecosystem protection); Mount Bunday Creek, mid-section (stock water supply).

In addition, the Proponent should publicly report on the health of water and ecosystems of the streams from the mine site downstream to, and within, the Mary River, and at reference sites upstream of the site to keep stakeholders and the community informed in accordance with Recommendation 15 (in section 5.3).

Sources of AMD

The two existing TSFs (TSF1 and TSF2) are currently the major sources of AMD on the Proposal site. The Proponent has committed to moving all tailings material from these facilities to the pit lake for subaqueous storage within 18 months of commencement of the Proposal and removal and rehabilitation of the TSFs. This would significantly reduce these sources of contamination and eliminate the long-term risk of a dam-break scenario that would deposit AMD-producing sediments in floodplain or flood fringe areas (Supplement Appendix K). The NT EPA supports this amelioration of historical site contamination.

In the short term, the NT EPA notes that the risk of contaminated materials being discharged to the downstream environment may be slightly increased while the material (tailings and dam walls) is being removed, and this risk could be reduced by transferring materials in the dry season. This can be managed by the Proponent and the relevant regulator. Before all material is removed, it will continue to be important to maintain sufficient freeboard in TSF1 and TSF2 to reduce the potential for overflow that could carry contaminants to the environment or destabilise the facilities. The NT EPA makes Recommendation 4.

Recommendation 4

That relevant approvals and decisions in relation to the Proposal include a condition that requires sufficient freeboard be maintained in the existing tailings storage facilities to prevent overtopping, until such time that all tailings have been removed and the facilities repurposed or rehabilitated.

The Proponent proposes to repurpose TSF2 as a water storage dam with a capacity of 80 ML and will assess the feasibility of this after it has been emptied of tailings. It would only proceed if deemed suitable by an independent assessment of stability, water retention capacity and suitability for water storage, in accordance with the Australian National Committee on Large Dams (ANCOLD) 2012 guidelines. The Proponent has committed that if TSF2 is retained as a structure for water storage during operations, that it will meet ANCOLD requirements for management. The NT EPA notes that management in accordance with ANCOLD would be appropriate for avoiding dam break

and potential impacts from any remaining contamination in the base or walls of the facility, and makes Recommendation 5.

Recommendation 5

That approvals and decisions for the Proposal require that:

- **water dams be designed by, and constructed under the supervision of, a suitably qualified, independent and experienced person, approved by the regulator, in accordance with the requirements of the Australian National Committee on Large Dams (ANCOLD) guidelines**
- **water dams be designed, constructed and maintained to ensure that the integrity would not be compromised by flood waters or erosion from floodwaters from any watercourse or drainage line**
- **water dams be designed and constructed to prevent or minimise the passage of any entrained contaminants through either the floor or sides of the dam during the operational life of the dam and for any period of decommissioning and rehabilitation of the dam**
- **certification of compliance with ANCOLD guidelines, by a suitably experienced, independent and qualified person who has supervised the construction, be provided to the relevant regulator on completion of construction of a water dam.**

The two WRDs, the Oxide WRD and Sulfide WRD (which includes the EPs), are currently sources of contamination and predicted to be sources for the long-term future (see section 1.5.2). The Proponent proposes to cap both WRDs (top and sides) and the base of the EPs with 660,000 t of uncontaminated material from the boxcut within four months of commencement of operations. The average thickness of waste rock material applied to the WRDs and EPs will be 0.54 m and compacted in layers to achieve the stated objective of preventing water from infiltrating.

The NT EPA notes that capping of the existing WRDs would require the removal of existing vegetation on those landforms, but considers that this is a positive trade-off for reducing the potential for AMD generation. Reducing the capacity for oxygen and water to enter and preventing the generation of AMD is an important objective to reduce the contaminant loads in runoff and seepage and protect the downstream values in accordance with Recommendation 3. This is even more important due to the Proposal's inclusion of bunds and drains that will divert runoff from the Sulfide WRD away from the pit lake and towards the external environment.

The NT EPA is supportive of the Proponent's commitment to cap WRDs to limit further generation of AMD. However, the NT EPA considers that the Proponent has not provided sufficient evidence that the proposed covers would reduce AMD generation to the extent of preventing contaminated runoff. The reasons for this are outlined below:

- The Proponent identified priority areas for capping as the top of the Sulfide WRD and the western side of the Oxide WRD (where the sulfide rock appears on the surface), as it is unsure if there will be adequate boxcut waste material for full capping. The Proposal does not include an alternative for capping the remainder of the Oxide WRD.
- The Proponent assessed the boxcut material for its geochemical risk (Addendum Appendix J). The study found that over 95% of the tested samples (from two cores; one of which was within the boxcut footprint) were non-acid forming and the remainder were uncertain. The report concluded that the samples posed a low risk for metalliferous (neutral) and saline drainage. While there was a small

risk of aluminium and zinc leaching at low concentrations, these were within acceptable dilution factors. The NT EPA considers that while the sample material was considered benign, as this was based on limited samples, there is potential for some of the material to be unsuitable.

- The Proponent also conducted erosion modelling to assess the long term stability of the WRDs including the capping layer (Further Information Appendix 1). However this assessment was based on use of material from the Oxide WRD rather than boxcut material, so the long term stability of a cap constructed of boxcut waste rock is uncertain.
- An effective cap would require the incorporation of suitable clayey material in an engineered layer to seal the WRDs against oxygen ingress and rainfall infiltration; however it is unclear if the boxcut waste rock contains such clayey material.

The NT EPA considers that while the proposed WRD covers would improve runoff quality and reduce the volume of AMD produced, they will not completely prevent infiltration. It is likely the WRDs will continue to produce some AMD, so some management of runoff water is likely to be required. This is discussed below in relation to the uncontrolled discharge of mine affected water. The NT EPA makes recommendation 6 below for the management of AMD.

The Proponent will need to control all sources of potential contamination to minimise contaminated drainage from the site and protect downstream values in the Mary River and its floodplains in accordance with Recommendation 3. To ensure AMD is avoided and managed appropriately, the NT EPA makes Recommendation 6.

Recommendation 6

That approvals and decisions for the Proposal have conditions that require the Proponent to develop an Acid and Metalliferous Drainage (AMD) Management Plan to the satisfaction of the relevant regulator prior to mining that:

- **is prepared in accordance with leading practice AMD management recommended in the Australian Government guidelines for preventing acid and metalliferous drainage (DIIS, 2016)**
- **requires the transfer of tailings and any contaminated material present in dam walls and bases to the existing pit lake**
- **requires the capping of the Waste Rock Dumps (WRDs) and lining of the evaporation ponds (EPs) with an engineered seal constructed from benign compacted material with limited permeability; the design and construction is to be reviewed by an independent certifying engineer**
- **incorporates measures for assessing the physico-chemical suitability of boxcut material (potentially during excavation) for capping the WRDs**
- **incorporates measures to assess the effectiveness of the WRD covers in restricting rainfall infiltration and limiting the creation of acid and/or metalliferous drainage and mobilisation of contaminants**
- **incorporates measures to ensure that the quality of water stored in the water storage dam (WSD) will meet water quality targets**
- **incorporates measures, consistent with the site water management plan, to monitor and assess density driven outflow from the pit lake on surrounding groundwater quality and surface expression**

- **includes mechanisms for adaptive management of potentially acid forming materials and AMD consistent with the Northern Territory Environment Protection Authority Guidance on Adaptive Management (NT EPA, 2018b).**

The pit lake currently contains AMD due to storing water that has come into contact with historical mining components. Since 2010 the pH has averaged 3.3 and has high salinity and levels of metal contaminants (Further Information Appendix 1). The Proponent intends to reduce the current acidity in the pit lake through the addition of alkaline materials during operations, allowing heavy metals to precipitate and drop to the base of the pit. However, the final pit lake could also potentially create a new source of AMD as it will also contain acid-producing material from tailings and waste rock and this could generate AMD into the future.

The Proponent conducted geochemical modelling to determine pit water quality after the addition of this material and into the long term following closure (Addendum Appendix D). This report indicated that, once all material had been deposited in the pit (including boxcut waste rock), it would be 21.9 m below surface, overlapping the oxic layer of water (25 m below surface) and therefore reactive. The predicted water quality at the time of closure was poor; with pH, salinity, sulfate, cadmium, copper, nickel and zinc all exceeding SSTVs. However, the report concluded that due to the highly conservative assumptions included in the model, the resultant water quality might be better than the modelled predictions.

Since the publication of that report, the Proponent has stated that boxcut waste rock will not be placed into the pit, and therefore the tailings and waste rock material will be at a significantly lower level in the pit (26 m below surface; Further Information page 13) and therefore not reactive. The NT EPA considers that there is still uncertainty regarding the potential for ongoing generation of AMD within the pit into the long term future, especially if the material is unevenly spread and protrudes into the oxic layer of water. Therefore, the NT EPA makes Recommendation 7.

Recommendation 7

That approvals and decisions for the Proposal require that reactive material in the pit lake will remain in the anoxic zone, and water quality will be stable, at all times after closure. The adaptive management approach to achieve this, addressed in Recommendation 10, must be informed by further studies to be undertaken through the life of the mine and closure period, including:

- **further analyses of the settling process of tailings, pit lake water stratification, limnology, water quality and water levels**
- **trials of potential long-term passive water treatment options**
- **a prediction of long-term water quality and water levels based on monitoring data.**

Controlled water discharge

The Proposal will require the discharge of water during operations due to the extraction of water from dewatering the underground mining operation and from displacement of water from the pit lake due to the deposition of tailings and waste rock. Therefore, a fundamental part of the Proposal is to treat water to an appropriate quality for controlled discharge to adjacent waterways. The treated water will be stored in the WSD for discharge at appropriate times when there is flow in the creeks.

This controlled discharge would be subject to the conditions in a WDL to be issued by the Controller of Water Resources in accordance with the *Water Act 1992*. The Proponent developed SSTVs for the quality of this water (Supplement Appendix F).

These SSTVs have been peer-reviewed and revised by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The SSTVs for physico-chemical parameters are based on the 80th percentile of wet season monitoring data from the reference site SWTG1A, to take into account natural background levels.

For toxicants such as metals, the default guidelines for 90% aquatic ecosystem protection (ANZECC & ARMCANZ, 2000) were used, as these are based on actual ecotoxicological effects. CSIRO recommended that 90 or 95% species protection should be achieved in Mount Bunday Creek 1 to 2 km downstream of the discharge point at the proposed compliance point SWTG2 (Supplement Appendix F).

The NT EPA considers that to meet Recommendation 3 above, and protect the declared beneficial uses of Mount Bunday Creek, the Mary River and other downstream values, 95% species protection for aquatic ecosystems is the appropriate target for the compliance points. The NT EPA notes that this would take into consideration all sources of contamination, both controlled (treated) and uncontrolled (untreated). The NT EPA makes Recommendation 8.

Recommendation 8

That approvals and decisions for the Proposal specify that water quality at the compliance points in Mount Bunday Creek and Coulter Creek meet 95% species protection level. The site specific trigger values (SSTVs) for discharge water quality must be appropriate to achieve this.

For the WDL application process, the Proponent will need to provide proposed water quality trigger values at the discharge point and the proposed compliance points in Mount Bunday Creek and Coulter Creek. The Proponent may also need to apply for mixing zone for the dilution of discharge water with streamflow.

The Proposed water treatment methodology to achieve the water quality targets is the 'Brutus' process. A purpose-built plant would be constructed on site and could potentially be combined with conventional reverse osmosis (see section 2.2.8). As there is some uncertainty regarding the final treatment process and the disposal of waste generated by it, the NT EPA makes Recommendation 9.

Recommendation 9

That approvals and decisions for the Proposal shall include a requirement for the Proponent to:

- **provide written validation by an independent qualified person, demonstrating that the final chosen water treatment methodology can meet water quality criteria at the required scale**
- **provide a plan for the onsite storage and regular offsite disposal, sale and/or recycling of any liquid or solid waste (including mixed metal oxide) from the water treatment plant, to be approved by the relevant authority on advice from the NT EPA.**

The Proposal includes the use of adaptive management to ensure SSTVs are met by the proposed water treatment (Addendum Appendix C). The NT EPA makes Recommendation 10 for the application of an adaptive management approach.

Recommendation 10

That before approvals or decisions are given or made for the Proposal, the Proponent provides to the relevant regulator and the Northern Territory

Environment Protection Authority an Adaptive Management Plan consistent with the NT EPA Guidance on Adaptive Management (NT EPA, 2018b).

The NT EPA notes that the WSD will capture runoff from the Sulfide WRD and TSF1. It will be important for the Proponent/Operator to effectively manage AMD in accordance with Recommendation 6 to ensure that the quality of water stored in the WSD will meet the water quality targets specified in the WDL.

The Proponent has stated that the WSD will also be the water supply for dust suppression. As the intention is for this water to meet the SSTVs, the NT EPA considers that this would be appropriate for dust suppression around the Proposal site. However, as this is not explicitly stated in the EIS, the quality of water to be used for dust suppression is addressed below in Recommendation 11.

The Proponent also intends to transfer up to 200 ML per year to the adjacent Pastoralist for irrigating hay, pasture and mangoes. The proposed water quality targets for this are provided in Table 6-4 of the Addendum. These were derived conservatively with the aim of minimising the build-up of contaminants in surface soils. They are based on ANZECC & ARMCANZ (2000) guideline long term trigger values for 100-year irrigation periods with the exception of:

- manganese and iron – the SSTVs are to be used instead, as these are higher than the guidelines values
- sulfate and electrical conductivity – trigger values were derived with the aim of protecting soil quality and protecting plants sensitive to salinity, as these were not defined in the guideline.

While the NT EPA supports the intent of these water quality targets, it notes that there is no mechanism for regulating this transfer of water from a mine site to a third party nor for regulating use of that water. There is uncertainty about the potential discharge of water with lower quality than controlled discharges to the environment and the impact it could have on the declared beneficial uses of adjacent waterways and other downstream environmental values. . Therefore the NT EPA makes Recommendation 11.

Recommendation 11

That approvals and decisions for the Proposal require that any water to be discharged to land or to a third party (for example; for dust suppression, irrigation, or any other purpose):

- **be accounted for in the Water Management Plan**
- **meet the site specific trigger values specified in the Waste Discharge Licence, consistent with Recommendation 8.**

Potential for uncontrolled discharge of untreated mine affected water

Currently seepage and wet season runoff from the Proposal site is poor quality, as described in section 1.5.2. There is potential for the Proposal to improve or exacerbate this.

During operation of the Proposal, mine-affected runoff captured in water storages will be directed to the pit lake for containment. For example, the EPs will be managed to maintain freeboard for the 1000 year average recurrence interval flood event. The pit lake water level will be managed (using controlled (treated) discharge) for sufficient freeboard (5.7 m beneath spill level) for the maximum predicted rainfall year (Further Information Appendix 2). The NT EPA supports this approach to contain mine-affected surface water onsite including during any periods of very high rainfall.

However, not all mine-affected runoff will be captured in water storages. For example, as the Proposal incorporates new bunds and drains to divert runoff from the Sulfide WRD entering the pit lake, this runoff will be directed towards Mount Bunday Creek. As described above, there is uncertainty about the effectiveness of the WRD capping for limiting AMD and it is likely that this runoff will contain some contaminants. It is likely that some form of management will be required to meet water quality targets of the WDL. The Proponent will be required to address these matters in accordance with its adaptive management approach (Recommendation 10).

There is also potential for water from the pit lake to enter Mount Bunday Creek and as discussed above, the current water quality in the pit is poor. The long term water quality in the pit is uncertain. The potential pathways for discharge of pit lake water are overflow (spill) and seepage to groundwater. The pit lake water quality at closure is discussed further in section 6.1 of this Report.

The pit is currently filling such that it could overflow within about five years without further management (see section 1.5.2). This has been addressed by the Proponent by the incorporation in the Proposal of bunds and drains to prevent rainfall runoff entering the pit lake by minimising its catchment area (Further Information pages 14 to 17). With these landform changes, the long-term (1000-year) water balance simulated by the Proponent showed that the pit would not overflow under an average future climate nor a wetter climate (5% increase in average annual rainfall; Further Information Appendix 2).

The Proponent modelled a worst-case scenario of the pit overflowing (Further Information Appendix 2), even though this is a highly unlikely event. Modelling predicted that some constituents in water at the SWTG2 would exceed SSTVs for aluminium, cadmium, cobalt, copper, lead, nickel, uranium, zinc, calcium and magnesium. However, at existing monitoring points further downstream, SSTVs would not be exceeded. The NT EPA is supportive of the proposal to manage runoff entering the pit lake so that the potential for overflow is reduced.

There is also potential for seepage from the pit lake via groundwater, as density-driven outflow will occur, at least locally. The Proponent's modelling indicated that the pit lake was a groundwater sink (Further Information Appendix C). However, a more recent report indicated that although water in the pit is not well connected with surrounding groundwater at present levels, this would not be the case if the water level rises. It estimated that groundwater levels surrounding the pit would rise alongside pit water levels, resulting in the surface expression of groundwater. From a pit-lake level of approximately 17 m AHD there would be seepage from the pit towards the oxbow wetlands (Further Information Appendix 1).

The NT EPA notes that there is potential for seepage from the pit lake towards surface waters in Mount Bunday Creek, and given that the future pit-lake water quality is uncertain, it could contain contaminants. Therefore the NT EPA considers that to ensure the protection of downstream environmental values (Recommendation 3) from potential seepage from the pit lake, there is a need for greater understanding to inform long term management options and makes Recommendation 13. This is considered necessary to inform the mine closure plan.

Recommendation 12

That approvals or decisions for the Proposal require that the Proponent or Operator's adaptive management approach (Recommendation 10) is to be informed by monitoring additional bores between the pit lake and Mount Bunday Creek and the oxbow wetlands. These are to be monitored for water levels and chemistry to inform the post closure pit lake water targets.

In further support of Recommendation 3 to protect the environmental values of the Mary River, the NT EPA considers that the Proposal should result in a net reduction in contaminant base loads discharged to surface water and groundwater, and makes Recommendation 13. This would require the Proponent/Operator to provide a summary of current baseline loads prior to Authorisation being granted, as a basis for comparing with future loads. The Proponent will also need to continue building their understanding of contaminant loading from all sources at the Proposal site.

Recommendation 13

That approvals or decisions for the Proposal require no net increase in contaminant mass loads to the Mary River following closure, compared to the current situation, from the Proposal site.

5.2.5 Conclusion against the NT EPA objective

With the implementation of relevant management plans and recommendations identified above, the NT EPA considers that the Proposal could be conducted in such a manner that its objective for Inland water environmental quality is likely to be met.

5.3 Social, economic and cultural considerations

5.3.1 Environmental objective

Protect the rich social, economic, cultural and heritage values of the Northern Territory.

5.3.2 Environmental values

Social and economic values

The Alligator and Humpty Doo statistical areas have a combined population of 13,968 (ABS, 2019). These areas are likely to be a key source of labour and services for the Proposal. Humpty Doo, located 66 km north-west of the Proposal, is the nearest regional population centre. The rural subdivision of Marrakai, 18 km north-west, is the nearest community, and is predominantly comprised of small dwellings occupied by rural residents, recreational fishers and holiday makers. Proximal infrastructure includes the Corroboree Park Tavern and roadhouse approximately 15 km north-west and the Mary River Wilderness Retreat 17 km south-east of the Proposal.

Horticulture, mining and tourism are the principal contributors to the economy of the Alligator and Humpty Doo statistical areas. The area around Toms Gully has been used for long-term pastoral purposes, with Old Mount Bunday, Marrakai and McKinley River pastoral tenure underlying or nearby. Historic and active gold mines occur extensively throughout the area. There has been historical gold mining at Quest 29, 13 km to the south of Toms Gully and Rustlers Roost, 12 km to the south-west. Granite quarrying is currently undertaken approximately 5 km east of the Proposal.

The region hosts a significant proportion of the Top End's tourist attractions, with Kakadu and Mary River National Parks identifying as iconic locations for tourism. The Adelaide River and Mary River systems are popular locations for four wheel driving, hunting, camping, wildlife watching and recreational fishing. Recreational fishing locations downstream within the Mary River system include Hardies Creek (approximately 10 km downstream from the Arnhem Highway crossing), Corroboree Billabong (approximately 20 km downstream) and Shady Camp (approximately 60 km downstream). The Mary River is known as one of the most important recreational fishing sites in the Northern Territory (PWCNT, 2015), attracting local and visiting fishers year round.

Recreational fishing is an important social and cultural component of the NT lifestyle as well as being a major tourism drawcard and a significant contributor to the economy. The fishing tourism industry's total economic contribution is estimated at \$26 million per year,

with \$22 million of this generated by interstate or international visitors to the NT. Seventy percent of recreational fishing occurs in regional areas, where recreational fishing is the primary economic and development driver (Tourism NT, 2015). Fish stocks that support the social and economic values of the area are intrinsically dependent on healthy aquatic ecosystems in the whole Mary River system.

The Arnhem Highway is the major arterial road into Kakadu National Park and the East Arnhem Land area. For the year ending June 2018, tourism from Darwin into the Arnhem Kakadu area was approximately 176,000 overnight visitors (Tourism NT, 2019). Local residents, pastoral stations and existing mining operations also contribute to vehicle traffic along the Arnhem Highway.

Cultural and heritage values

No registered Aboriginal sacred sites were identified within the Proposal area.

An archaeological survey was completed (Addendum Appendix M) over the area proposed for clearing. No archaeological material was found.

While there are no registered Aboriginal sacred sites within the Proposal area, a number of sacred sites are found in the vicinity and downstream of the Proposal in the Mary River catchment. A number of these sites are water feature sites that could potentially be impacted by any alterations to downstream water quality as a result of the Proposal.

There are no declared heritage places within the Proposal area.

5.3.3 Potential impacts

Social and economic impacts

The following changes to the social and economic surroundings may occur as a result of implementation of the Proposal and could lead to positive and/or adverse outcomes for stakeholders and/or community members:

- opportunities for employment and training and increased economic activity
- increased levels of monitoring and management of the site could improve environmental conditions at the mine site, lessening risks to the downstream social, economic and cultural values
- potential impacts to recreation values of the Mary River system if contaminated water impacts aquatic ecosystems, fish stocks or amenity, and subsequent impacts on economic values
- potential impacts to the local supply and quality of water resources for human use
- increased heavy traffic in the region, with potential impacts on road infrastructure, tourism activity and community amenity
- increased pressure on local accommodation
- a downturn in employment and economic benefits following a short mine life.

Cultural and heritage impacts

The following impacts to cultural and heritage surroundings may occur as a result of implementation of the Proposal:

- potential impacts to sacred sites protected under the *Northern Territory Aboriginal Sacred Sites Act 1989* downstream of the Proposal area.

5.3.4 NT EPA assessment

Social and economic assessment

Increased employment, training and economic activity

The Proponent estimated in the Draft EIS (2015) its capital expenditure would be \$24 – 27 million during construction with revenue of \$220 – 225 million generated. The estimated total operational expenditure was estimated to be at least \$100 million with project cash flow of \$47 - 52 million. Tax payable over the life of the Proposal was estimated by the Proponent to be \$6.3 million and mineral royalties payable to the NT government approximately \$11.6 million. As these estimates were based on modelling subject to assumptions, the actual economic benefits realised are likely to differ.

The implementation and operation of the Proposal could provide local economic benefits to businesses as well as employment opportunities within the Alligator and Humpty Doo statistical areas. It is estimated that a total workforce of 104 personnel will be required during commissioning and operations, equivalent to a 15.1% increase in mining sector jobs in the combined Alligator and Humpty Doo statistical areas (ABS, 2019). The Proponent intends to source staff locally where possible.

The NT EPA supports the Proponent's commitment to advertise employment opportunities in the local community but notes that there may be negative economic and social impacts from releasing employees at the end of the mine life. The NT EPA considers that the Proponent should plan for minimising such negative impacts.

Increased levels of site monitoring and management

The mine has been under care and maintenance since 2010 and is operating under a Care and Maintenance Mine Management Plan (Authorisation 0740 01, 28 May 2013). The site has existing infrastructure that has been subject to closure and rehabilitation planning that has resulted in a partially rehabilitated site, with residual AMD from WRDs and TSFs, and a pit containing poor quality water.

The NT EPA considers that the resumption of underground mining, water treatment, tailings upgrades, rehabilitation of existing mining infrastructure and subsequent closure has the potential to improve the existing conditions and reduce future risks to the environment. The alternative of not mining is likely to result in the site continuing as is with ongoing AMD issues and no clear long-term strategy for closure of the key infrastructure such as WRDs and TSFs. The Proposal includes increased monitoring and management and, if implemented according to the EIS, would improve the environmental condition of the mine. This would reduce impacts to the downstream environment.

Impacts to the recreation and economic values of the Mary River National Park

The Proponent has consulted with AFANT and other stakeholders concerned with water management throughout the life of the Proposal in accordance with a communication schedule (Draft EIS) and has committed to continue stakeholder engagement prior to implementing closure of the Proposal as per the Stakeholder Engagement Strategy (Addendum Appendix B). The Proponent proposes to maintain a complaints register and reporting in the annual Mine Management Plan on complaints received and how they have been addressed. This will partly address the requirement under the MM Act and Regulations for the Proponent to report all environmental incidents to DPIR. To minimise adverse impacts arising from the Proposal, the NT EPA makes Recommendation 14 for continual engagement with and reporting to stakeholders and the community.

Recommendation 14

That before approvals or decisions are given or made for the Proposal, the Proponent provides to the relevant regulator a Community and Stakeholder Engagement Plan providing for:

- **maximising local employment opportunities**
- **publication of a community complaints telephone contact number and email to allow community members to contact the Proponent regarding any issues or concerns**
- **development and implementation of a complaints management procedure that requires complaints to be recorded, investigated and abatement measures to be carried out if required, for handling community complaints and grievances for the duration of the Proposal, and broadly accepted by stakeholders**
- **reporting to stakeholders and the community on the health of the Mary River and tributaries monitored as part of the proposal, including contaminant mass loads**
- **effective ongoing stakeholder engagement and consultation on agreed post-mining closure, rehabilitation, land uses and access**
- **annual reporting to the relevant regulator of local employment, any community benefits, details of complaints and action taken and details of stakeholder engagement and consultation**
- **planning to minimise negative impacts of mine closure on surrounding communities**
- **publication of the Mine Closure Plan, as updated from time to time, together with monitoring data, by the Proponent.**

The Proposal has been amended during the EIA process to reduce the potential risk associated with all phases of the Proposal, especially in reducing the requirement for dewatering and including defined SSTVs for discharge to Mount Bunday Creek. The NT EPA is of the view that potential impacts to downstream recreation and economic values will be addressed by meeting the objectives of factors assessed above and through meeting WDL requirements and including biological monitoring.

Impacts to the supply and quality of water resources for human use

There are 19 registered bores, primarily for stock and domestic use, within 5 km of the Proposal and external to the mining tenements owned by the Proponent (mapped in Addendum page 64). There is potential for the Proposal to reduce yields from these bores due to groundwater drawdown resulting from dewatering of the underground mine.

The Proponent modelled potential groundwater inflow into the Proposals decline access (Addendum Appendix R). The Report found that the cone of depression is mainly contained in the Proposal's mining tenements and it is therefore unlikely that mine dewatering would affect bores outside the Proponents mining tenements. The Old Mount Bunday homestead bore RN027956 is the bore most at risk of being affected by dewatering. However, any impact at this bore would be offset by the Proponent's agreement with the Mount Bunday Pastoralist to supply the homestead and associated orchard with treated water up to quantity of 200 ML per year or 6.3 L/s.

As discussed in Section 6.3.3.2 of the Draft EIS and the Supplement (Appendix C), external bores are located away from the main fractured rock systems associated with the faults bounding the mineralisation and the mineralised zone. As the Proposal does not share any connection in terms of chemistry with these bores, impacts to groundwater quality of neighbouring users are not expected.

The Proponent addressed concerns regarding impacts to groundwater in the Water Management Plan (Addendum Appendix F). Groundwater levels and quality will be monitored at quarterly intervals at several production and monitoring bores located upstream, within and downstream of the Proposal site. The data and information gathered during these monitoring programs will be used to assess potential impacts of mining operations on local groundwater resources (level and quality).

Additionally, in the instance water levels at the bores outside the mining tenements, and within 5 km of the mine, drop below agreed levels the Proponent will (Addendum):

1. Supply a bore pump and additional rising main piping to lower the bore pump, if depth of bore allows; or
2. Drill a deeper bore and supply pumping gear for that bore; or
3. Pump treated water to the affected landowner for the duration of the mine. Normal approvals to dispose of water will be sought if pumping is required.

The NT EPA is of the view that implementation of the measures outlined above and ongoing stakeholder involvement will mitigate impacts to the supply and quality of water resources for human use.

Increased heavy vehicle traffic

The transport of materials and personnel to and from site on the Arnhem Highway has the potential to impact on other road users. While an increase in traffic along the Arnhem Highway is expected, the Economic and Social Impact Assessment (Draft EIS Appendix 8) states that there will be a negligible increase (0.2% to 0.3%) to current traffic volumes. Further, the proposed processing capacity of 350,000 tpa is expected to produce 65,000 oz of gold dore per annum. The Proponent also plans to bus employees to and from site on a daily basis to minimise the generation of additional traffic and improve road safety.

As per the Traffic Management Plan (Draft EIS Appendix 14) road signage will be installed on both northern and southern approaches on the Arnhem Highway warning of slow turning trucks entering and exiting the Proposal site. Signage will also be installed along the site entrance road warning of the upcoming intersection with the Arnhem Highway to minimise the potential for vehicle collisions. A stop sign will also be installed at the site exit intersection with the Arnhem Highway. This signage shall be in accordance with Austroads requirements and to the satisfaction of the Department of Infrastructure, Planning and Logistics.

The NT EPA considers that implementation of the Traffic Management Plan will address potential impacts associated with increased heavy vehicle traffic generated by the Proposal. Given the expected negligible increase in traffic volumes, the NT EPA does not expect the Proposal to significantly impact tourist activity or road user safety along the Arnhem Highway.

Increased pressure on local accommodation

No on-site workers accommodation is proposed. While workers are expected to be primarily sourced locally, existing accommodation facilities in the region are expected to be used to accommodate short term visitors and specialist staff that cannot be recruited locally.

The local area is serviced by a limited number of food and accommodation facilities (Corroboree Park Inn and the Mary River Wilderness Retreat). While use of local accommodation by workers has the potential to limit accommodation for tourists, the increased demand associated with the Proposal's operations is likely to have a positive effect by raising occupancy rates and assist in smoothing out the effects of seasonality.

Given the majority of the workforce is expected to be sourced locally, the NT EPA considers that the additional demand for food and accommodation services created by the Proposal is within the region's current capacity and can provide a short-term positive economic stimulus to the local economy.

Cultural heritage assessment

Much of the Proposal area has been subject to previous disturbance and land clearing. Survey and assessment consistent with NT Government requirements has determined that there are no nominated, provisional or declared heritage places or sacred sites located on site. In September 2018, an archaeological survey was undertaken over the area proposed for clearing. The area proposed to be cleared is located within a few hundred metres of a watercourse - where Aboriginal archaeological sites are commonly located. No archaeological sites were found on site. The Proponent has developed appropriate measures to ensure, if archaeological sites are encountered during clearing, they will be managed correctly.

Twenty-nine sacred sites have been recorded and registered by the Aboriginal Areas Protection Authority (AAPA) in the vicinity and downstream of the Proposal in the Mary River catchment. There is potential for impacts to these sites if downstream water quality is altered as a result of the Proposal. The Draft EIS indicates several unsuccessful attempts to liaise with Traditional Owners through the Northern Land Council and Local Management Committees of the Mary River and Djukbinj National Parks, in their capacity as Traditional Owners and managers of the land.

While NT EPA considers that impacts to downstream sacred sites can be avoided by addressing the recommendations in this Report, it is important that the Proponent engage with Traditional Owners to communicate how sacred sites downstream will be protected. The NT EPA makes Recommendation 15.

Recommendation 15

That approvals and decisions for the Proposal require the Proponent or Operator to:

- **conduct works in accordance with an Authority Certificate within the meaning of the *Northern Territory Sacred Sites Act 1984***
- **communicate with custodians of Sacred Sites in the vicinity and downstream of the Proposal site.**

In March 2019, the AAPA received an Authority Certificate application (201901769) for mining and processing on MLN 1058 (NT Portion 4937). The AAPA is liaising with the Proponent to ensure that the proposed activities in its Authority Certificate application match the proposed works in the Addendum. Updated AAPA Authority Certificates and heritage surveys will be provided to DPIR as part of the mine authorisation process.

5.3.5 Conclusion against the NT EPA objective

With the implementation of relevant management plans and recommendations identified above, the NT EPA considers that the Proposal could be conducted in such a manner that its objective for social, economic and cultural surroundings is likely to be met.

6 Whole of environment considerations

6.1 Closure and rehabilitation

6.1.1 Closure objectives

The Proponent's Mine Closure Plan (Further Information Appendix B1) outlines 'two key overall closure objectives':

1. *To reduce the long term environmental risks posed by the Proposal; and*
2. *Make environmental improvements to the site so as to have a lower liability'.*

The Proponent refers to the 2016 Leading Practice Sustainable Development in Mining handbooks for mine closure (Australian Government, 2016). The NT EPA supports the use of these handbooks and also suggests the Proponent refers to WA Government Guidelines for Preparing Mine Closure Plans.

The Mine Closure Plan states that the Proponent will aim to return as much of the land as possible to a condition that enables pastoralism (the predominant land use in the area) to continue and also significantly reduce the environmental impact for the future. The Proponent has consulted with the landholder on this matter (see section 3.1) and defined two closure precincts (see section 2.11). The NT EPA considers that the post-mining land use and potential use of mine infrastructure should be reviewed, on consultation with the landholder, prior to relinquishment.

The NT EPA considers that for all existing mine components used, managed or rehabilitated as part of implementing the Proposal, environmental condition is to be improved; and for all other legacy or new components the environmental condition is to be maintained or improved. An improvement would mean that there is lowered potential for the discharge of contaminants to the surrounding environment. The NT EPA expects that the site must not have potential to cause environmental harm, and that this must be demonstrated prior to relinquishment to the NT Government. The NT EPA makes Recommendation 16.

Recommendation 16

That approvals and decisions for the Proposal require that closure of the Proposal achieve the following objectives:

- **be safe to humans and animals and able to sustain an agreed post-mining land use**
- **be stable and not have potential to cause environmental harm**
- **improved environmental condition, compared with the pre-Proposal state, for all pre-existing mine components to be used by the Proposal**
- **maintained environmental condition, compared with the pre-Proposal state, for any new components**
- **post-mining land use (including potential re-use of mine infrastructure) that has been agreed with the landholder prior to relinquishment**
- **present no long term impacts or costs for the local community or the taxpayer at the end of the Proposal's economic life.**

The proposed life of the mine is only five years, whereas, mine legacy issues have the potential to be borne by the community and government (in the future for much longer than the proposed life of the mine). The NT EPA considers that ensuring the Closure Objectives are met and there are no unacceptable long term impacts/costs for the local community or the taxpayer at the end of the site's economic life, prior to relinquishment, would align with the principles of ESD, and take into account community objectives.

6.1.2 Water Management

It is likely that the existing Oxide WRD bund would continue to overflow in wet years following the cessation of active water management during operations (see Further Information page 2) as this structure will not be modified by the Proposal. While the capping of the Oxide WRD may assist in isolating AMD producing material, the effectiveness of this is uncertain at this stage, and stormwater runoff from the Oxide WRD would likely still contain contaminants (see section 5.2.4). The capacity of the Oxide WRD drainage bund may need to be increased in future to direct runoff towards the oxbow wetland for filtration.

The EPs are also predicted to overflow in the future (Further Information Appendix 2). Prior to the commencement of mining the EPs will be drained and contaminated soil/sediments will be removed and deposited subaqueously in the pit. The EPs will then be lined with a cover of boxcut waste material and compacted (Further information page 29). As outlined in section 5.2.4, there is uncertainty regarding the effectiveness of this capping and there is potential for this runoff water to be contaminated. If so, there may be a need for future passive filtration of overflow water from the EPs.

Another existing source of AMD is the ROM pad and processing area, which have contributed contaminants towards Mount Bunday Creek via the stormwater pond during previous high rainfall events. The Proponent intends to fill the stormwater pond with clean fill and fully clean up the processing area by removing AMD producing material, ripping the surface, and seeding with native species. The NT EPA is generally supportive of this approach, but notes there is potential for contaminants to continue to enter surface runoff if this is not done properly.

To account for these uncertainties the NT EPA makes Recommendation 17. The NT EPA notes that the prevention of the discharge of contaminants from the Proposal site in seepage and runoff will require effective management of AMD in accordance with Recommendation 6.

Recommendation 17

That before approvals or decisions are given or made for the Proposal, the Proponent provides plans to the relevant regulator for avoiding the discharge of mine affected water to the environment during wet periods into the long term future.

The Proponent's expectation is for the pit lake to have reasonable water quality with a pH of 8.5 at the time of closure. The Mine Closure Plan states that pit water will be monitored and treated (if necessary) for five years after closure. The Proponent has proposed to investigate the potential to establish an in situ sulfide bioreactor in the pit for water treatment in line with defined water quality. The NT EPA considers that it is not appropriate for long term treatment to occur and asserts that pit lake water quality must be stabilised before relinquishment.

The NT EPA also notes that the Proponent has not specified the target water quality for the pit lake, and that it may not be necessary to apply the surface water quality targets, as overflow to surface water is not likely. As seepage to groundwater is possible, the NT EPA suggests the Proponent could develop SSTVs for groundwater based on data from reference bores.

Considering the uncertainty regarding pit chemistry changes over time, it will be important for the Proponent to conduct further investigations during operations, as outlined in Recommendation 7, and adapt the AMD Management Plan and Mine Closure Plan accordingly.

6.1.3 Mine Closure Plan

The Proponent intends to achieve its key closure objectives by the activities outlined in its Mine Closure Plan (and summarised in table 3 of this report). The Proponent's conceptual Mine Closure Plan (Further Information Appendix B1) is dynamic and intended to be updated as further information relevant to mine closure planning is obtained. The closure period is anticipated to be 10 years and, in general, all monitoring during this period will occur six monthly or annually until relinquishment, or until data is trending towards completion criteria/baseline.

The NT EPA considers that while the Proponent's planned closure activities offer environmental improvements, they may not meet Recommendation 3 for long term protection of downstream values. Issues of concern have been discussed in sections 5.2 and 5.3 of this report. In addition, the NT EPA considers that the submerging of offices and other infrastructure into the pit lake (see table 3 of this report) is not an appropriate form of disposal. If this infrastructure is not to be used on site in future by the landholder, it must be removed from site and disposed at a suitable landfill facility.

The NT EPA supports the Proponent's commitment to fully decommission the mine and complete rehabilitation during the closure period. The NT EPA also considers that, in the event that the Proponent or Operator is unable to complete the implementation of the Proposal (including closure), the impacts of mine legacy issues and/or the costs of rectifying them could be borne by the community and government for a much longer period than the life of mine. The NT EPA expects that such future liabilities will be addressed through the mining security bond, and that this security will account for meeting closure objectives to the extent provided for in the MM Act. The NT EPA also expects that the security will account for the cost of rehabilitating the historical mining structures to be disturbed as part of the Proposal (waste rock dumps and tailings storage facilities) as committed in the EIS.

The NT EPA acknowledges the importance of the Mine Closure Plan for preventing potential future legacy environmental issues. It is noted that the DPIR, as the regulator of mine closure, has minimum expectations for a Mine Closure Plan to include:

- a system of quality assurance/quality control
- addressing all aspects of rehabilitation and mine closure, including post-mining land use and rehabilitation objectives as agreed with stakeholders, landform designs, schedules for rehabilitation, completion criteria and monitoring of rehabilitation success
- a plan for identifying a closure strategy during operations for achieving the objective of no increase in baseline contaminant loads (in accordance with Recommendation 13)
- provision for ongoing monitoring and maintenance of the site post-mining, in accordance with an approved monitoring and maintenance program that includes a trajectory to achieving closure criteria, until closure criteria are achieved and the site has been relinquished
- details of reporting requirements to the relevant regulator on any investigations that will inform decision making to ensure successful post-mining rehabilitation.

To support the DPIR in ensuring the Mine Closure Plan also addresses specific potential significant impacts identified in this Report, The NT EPA recommends the DPIR consult

with it in relation to the Mine Closure Plan prior to mining commencing and makes recommendation 18.

Recommendation 18

That the Proponent update the Mine Closure Plan prior to mining commencing to include:

- **specific, measurable, auditable targets to demonstrate that performance is consistent with closure objectives**
- **provision for the management of declared weeds and exotic plants with high fuel loads until closure criteria are met, consider weed status and fire resistance of revegetated areas in closure criteria and manage fire until the majority of the woody revegetation is likely to survive the typical fire regime for the region**
- **active management of water and sources of acid and/or metalliferous drainage during the closure period and during any period of care and maintenance**
- **provision for the appropriate disposal of offices and other infrastructure during closure, by means other than placement in the pit lake**
- **a requirement for independent periodic external audits by suitably qualified and experienced auditors of any subaqueous deposition of waste materials in the pit lake including reactivity, compaction, drainage and settlement of material layers.**

It is further recommended that the relevant regulator consult with the Northern Territory Environment Protection Authority on the Mine Closure Plan prior to mining commencing.

7 Conclusion

The NT EPA has considered the Proposal by Primary Gold Limited to develop the Toms Gully Underground Project. The NT EPA's assessment of the Proposal identified potentially significant environmental impacts and risks associated with the environmental factors of inland water environmental quality, aquatic ecosystems and social, cultural and economic surroundings.

The NT EPA considers that, subject to the implementation of the 18 recommendations in this Assessment Report and the commitments and safeguards listed by the Proponent in the EIS, the Proposal can be implemented and managed in a manner that is likely to meet the NT EPA's objectives and avoid significant or unacceptable environmental impacts and risks.

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Appendix 1– Assessment of the NT EPA’s environmental factors

The NT EPA assessed the environmental impact of the Proposal in line with its environmental factors and objectives (NT EPA, 2018a). The following table presents environmental factors for the Proposal which, based on current knowledge, were assessed as not significant. The NT EPA considers it unlikely that implementation of the Proposal would have a significant impact on these factors and they can be managed to meet the NT EPA’s environmental objective.

Environmental factor	Assessment of the potential impacts on the environmental factor	Explanation of why the factor is not a key environmental factor
LAND		
Terrestrial Environmental Quality Objective: Maintain the quality of land and soils so that environmental values are protected.	There is potential for erosion and sediment deposition in and downstream from the Proposal area due to potential instability of landforms (existing and new). The Proposal could increase or decrease the potential for significant impacts to downstream values. The site is has been unavailable for other uses while it has been in Care and Maintenance. This would continue during any future unplanned closure of the Proposal.	The stability of the site was assed using the RUSLE and CAESAR-LisFlood erosion models. Results show that erosion on site is similar to what occurs in the surrounding environment. The Proponent has committed to developing and implementing an Erosion and Sediment Control Plan (ESCP) to ensure that sediment and erosion are no greater that surrounding environs. The ESCP will be cross-referenced with the Mine Closure Plan to align it with closure objectives. The Mine Closure Plan states that the Proponent will aim to return as much of the land as possible to a condition that enables pastoralism to continue and also significantly reduce the environmental impact for the future. The NT EPA considers that if the proposed management measures are implemented and the key environmental factors are addressed, the Proposal is unlikely to have a significant impact on terrestrial environmental quality.
Terrestrial Flora and Fauna Objective: Protect the NT’s flora and fauna so that biological diversity and ecological integrity are maintained.	Removal of habitat due to clearing (approximately 76 hectares). Loss or alteration of habitat due to weeds (introduction and/or spread) or fire (inappropriate fire regime). Degradation of habitat due to potential impacts on water quality and downstream ecosystems. Dust generation from mining activities resulting in reduced vegetation health and condition.	One plant species (<i>Helicteres macrothrix</i>) listed as endangered under the EPBC Act is known to occur in the vicinity of the Proposal and could be impacted by clearing or disturbance associated with the Proposal. A targeted survey for this species demonstrated that the species was not present in the areas proposed to be disturbed (Addendum Appendix M), and is therefore unlikely to be impacted. Results from field surveys undertaken on site concluded that the Proposal was unlikely to significantly impact any of the ten fauna species listed under the <i>Territory Parks and Wildlife Conservation Act 1976</i> or EPBC Act. No fauna species of conservation significance were recorded on site. A trained fauna handler will be present during clearing on site to relocate any fauna found. The Proponent has committed to developing and implementing a Biodiversity Management Plan as well as an Environmental Management Plan to for avoiding and minimising potential

Environmental factor	Assessment of the potential impacts on the environmental factor	Explanation of why the factor is not a key environmental factor
		impacts and risks to biodiversity. The Proponent has committed to ensuring the plans include the appropriate avoidance/mitigation measures and performance indicators. Gamba grass (Class A; Weed of National Significance) and three other Class B weed species have been recorded on site. The Proponent recognises the densely infested areas of NT Portion 4937, particularly those infested with gamba grass, and is proposing measures to reduce the impact of these weeds. These measures would involve seasonal control, vehicle hygiene protocols, monitoring for incursions, and, if needed, liaison with appropriate government agencies to ensure conformity with the <i>Weed Management Act 2001</i>. The EIS and supporting documentation identifies that these measures will apply during the construction, operational, closure and post closure rehabilitation phases of the Proposal. The Department of Environment and Natural Resources Weeds Branch considered the weed identification and proposed management measures to be appropriate. Weed management and the fire regime are intrinsically linked. Sensitive/significant vegetation communities have been identified adjacent to the Proposal site (riparian vegetation Mount Bunday Creek and wetlands). The Proponent intends to avoid this vegetation and would ensure that appropriate buffers are maintained. Degradation of downstream habitat would be avoided by addressing Inland water environmental quality and Aquatic ecosystems assessed in this Report. The NT EPA considers that if the proposed management measures are implemented and the key environmental factors are addressed, the Proposal is unlikely to have a significant impact on terrestrial fauna and flora.
WATER		
Hydrological processes Objective: Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	Altered flows entering Mount Bunday and Coulter Creek from: - Discharges, especially from dewatering of the Toms Gully Open Pit to Mount Bunday Creek and Lake Bazzamundi via the WSD - positioning of new infrastructure.	The Proponent has reduced the quantity of water to be treated and discharged compared to the original Proposal. Only water displaced by the addition of mining waste and tailings will need to be removed from the pit and treated to SSTVs before being discharged to Mount Bunday Creek or Lake Bazzamundi. Discharge of treated water to Mount Bunday Creek and Coulter Creek (via overflow from Lake Bazzamundi) is expected to take place only in the wet season when ephemeral streams have natural flows. This will reduce impacts on aquatic ecosystem processes.

Environmental factor	Assessment of the potential impacts on the environmental factor	Explanation of why the factor is not a key environmental factor
	Alterations to groundwater movement due to dewatering for operations. Potential impacts to the health of aquatic ecosystems from an increase in the volume of water entering Mount Bunday and Coulter Creeks.	The TSFs will not be reused, reducing the hydraulic water head and lower potential seepage that could create groundwater mounding. The potential impacts to this factor can be mitigated through addressing the key environmental factors and through standard management plans. The NT EPA does not consider that hydrological processes will be significantly impacted by the Proposal.
AIR		
Air quality and greenhouse gases Objective: Maintain air quality and minimise emissions and their impact so that environmental values are protected.	The clearing of vegetation, mining activities and vehicle transportation is likely to generate dust, which may reduce air quality and impact sensitive receptors. Implementation of the Proposal would result in emission of greenhouse gases from land clearing, combustion of diesel for onsite power generation and operation of mining equipment and vehicles.	The clearing of approximately 76 hectares for project infrastructure is unavoidable and is unlikely to contribute significantly to emissions from a national perspective. The nearest sensitive receptors are a small cottage owned by land owner (1.3 km south-east) and the station manager's residence (2.8 km south-south-east). The nearest community is Marrakai (18 km north-west). The Proposal is considered to be of a distance where dust is unlikely to impact sensitive receptors. Dust generation would be limited by the placement of tailings subaqueously in the pit, watering unsealed tracks and open areas, wet crushing and use of sprays and not burning on site. The Proposal would source power from the existing mains 22kV power supply. Diesel generators will be in place in the event of power loss to the site. Monthly power usage is estimated to be approximately 2500 MWh. A standard vehicle and machinery fleet would operate to support the transport of personal and to undertake mining operations. Diesel fuel consumption is estimated to be approximately 50,000L per month. It is unlikely that the emissions would be significant from a national perspective. The NT EPA calculated that the total estimate greenhouse gas emissions from the Proposal (10,200 t CO₂-e.) equates to 0.06% of the total emissions produced in the NT in 2017 (DoEE, 2019) All plant and equipment will be regularly inspected and maintained to minimise exhaust emissions. A complaints register will be implemented and regularly reviewed to identify if there are potential trends in the number, frequency and type of air quality complaints being recorded. The NT EPA considers that if the proposed management measures are implemented and the key environmental factors are addressed, the Proposal is unlikely to have a significant impact on air quality and greenhouse gases.

Appendix 2 – Principles of Ecologically Sustainable Development

Under the *Northern Territory Environment Protection Authority Act 2012*, ecologically sustainable development (ESD) means using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quantity of life now and in the future can be increased.

In December 1992, the NT Government endorsed the 'National Strategy for Ecologically Sustainable Development' and agreed, along with all other States and Territories, to the 'Intergovernmental Agreement on the Environment' (IGAE) (Australian Government, 1992).

The NT EPA uses the four principles contained in the IGAE to demonstrate that it has considered ESD in its assessment of the Proposal and in its fulfilment of its objectives under the NT EPA Act 2012.

ESD Guiding principle	NT EPA assessment
The precautionary principle <i>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i> <i>In application of this precautionary principle, decisions should be guided by:</i> a) <i>careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i> b) <i>an assessment of the risk-weighted consequences of various options.</i>	In considering this principle, the NT EPA notes that Inland water environmental quality, Aquatic ecosystems and Social, economic and cultural surroundings could be significantly impacted by the Proposal. The assessment of these impacts is provided in this Report. The NT EPA notes that the Proponent has identified measures to avoid or minimise impacts. The EPA has considered these measures during its assessment. The Proponent's investigations into the biological, physical and cultural environment have provided sufficient certainty to enable assessment of the risks and potential impacts and to identify measures to avoid or minimise those impacts and risks. The NT EPA has made recommendations to ensure these measures are implemented by the Proponent. From its assessment of the Proposal, the NT EPA concludes that if its recommendations are implemented and managed as approval conditions of the Proposal, significant or unacceptable environmental impacts and risks are likely to be avoided.
The principle of intergenerational equity <i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i>	The NT EPA notes that the Proponent has taken measures to avoid and minimise impacts of the Proposal on the environment. Additionally, the NT EPA has made recommendations to manage impacts to the key environmental factors identified during the course of this assessment. In particular, the NT EPA has recommended that the overarching environmental outcome of protecting the Mary River at all-times from mine related impacts be the primary consideration for management. From its assessment of this Proposal, the NT EPA has concluded that provided its recommendations are imposed as conditions on the implementation of the Proposal,

ESD Guiding principle	NT EPA assessment
	environmental values will be protected and that the health, diversity and productivity of the environment will be maintained for the benefit of future generations.
The principle of the conservation of biological diversity and ecological integrity <i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i>	In considering this principle, the NT EPA notes that the Proposal will result in impacts and risks to Inland water environmental quality and Aquatic ecosystems. In assessing this Proposal, the NT EPA has considered these impacts and risks and taken into consideration measures proposed by the Proponent to avoid and minimise impacts to the affected values. The NT EPA has concluded that, provided its recommendations in this Report are imposed as conditions, the Proposal will not compromise the biological diversity and ecological integrity of the affected areas.
Principles relating to improved valuation, pricing and incentive mechanisms a) <i>environmental factors should be included in the valuation of assets and services.</i> b) <i>the polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i> c) <i>the users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</i> d) <i>environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimize costs to develop their own solution and responses to environmental problems.</i>	In considering this principle, the NT EPA acknowledges that the Proponent would take responsibility for preventing, managing and mitigating any adverse environmental impacts during all stages of the Proposal including clearing, construction, operation, decommissioning, closure and rehabilitation. The NT EPA notes that this responsibility includes: (a) valuing the Proposal's water resources (b) accounting for the costs of residual risks associated with the Proposals final landforms (WRDs, TSF, pit lake, boxcut, WSD, EPs) (c) preventing, managing and mitigating waste and pollution, including contamination of soils, groundwater and surface waters through accidental spills, uncontrolled discharges and tailings seepage (d) ensuring rehabilitation and closure are consistent with agreed outcomes and public scrutiny (reporting) without ongoing unacceptable liability to the NT.

Attachment E:

Toms Gully Mine Management Extracts

See attachment B

Attachment F:

Aquatic Ecosystem Impacts

Technical Memorandum

10/07/2019

Dear Charles,

The following document contains an assessment of impacts to aquatic ecosystems as a result of Primary Gold's proposed mining operations and site water management.

Background

Aquatic ecology monitoring has been undertaken at Toms Gully Mine in 2015, 2017 and 2018. The surveys to date have gathered data on fish, and macroinvertebrate communities as well as habitat information and water quality for Mount Bunday and Coulter Creeks. In 2017 and 2018, remote camera trapping was included to understand the spatial distribution of Mitchell's and Mertens Water Monitors along Mount Bunday Creek. This work has resulted in a body of data that can be used for the assessment of the impact of the proposed release regime. A summary of the results of aquatic ecology monitoring are as follows:

- Coulter Creek is a low order stream, and a tributary of Mount Bunday Creek. The confluence of the two creeks is located approximately 4 km downstream of the Arnhem Highway. The Creek originates upstream on the Old Mount Bundy Station, and previous studies have observed impacts at sites on Coulter Creek as a result of cattle access. The riparian zone along Coulter Creek is not continuous, and the greater catchment area has also been cleared for grazing. Although to date there has not been remote camera monitoring on Coulter Creek, freshwater crocodiles and turtles have been observed at sites along the creek during aquatic ecology monitoring. Anecdotally, a large saltwater crocodile was previously removed from Coulter Creek close to the cattle yards at Old Mount Bundy Station.
- Mount Bunday Creek is a higher order stream, draining north to Hardies Creek and on to the Mary River. The Riparian zone of Mount Bunday Creek is more intact than Coulter Creek, and clearing of land beyond the riparian zone is more intensive surrounding Toms Gully Mine and downstream than in the upstream area that has been monitored. Although during sampling events there were observable breaks in surface water, where dry sand was present in the creek bed, surface water flow was recorded at most sites. Alluvial groundwater and surface water interact along Mount Bunday Creek, and there is likely an extended period of sub-surface flow in the dry season through the sandy substrates found there. The presence of reptiles such as turtles and monitors in Mount Bunday Creek indicate that refugial pools are likely to occur along the watercourse. Although not observed in camera trapping or during monitoring, large saltwater crocodiles have been seen from helicopters in Mount Bunday Creek between the Arnhem Highway and Hardys Creek.
- Water quality has been poorest in Mount Bunday Creek adjacent to Toms Gully Mine. This is likely caused by connectivity between stored tailings, groundwater and surface water in Mount

Bundey Creek. Elevated conductivity and concentrations of some metals have been recorded over the previous two monitoring events compared with background water quality. This was particularly evident in 2017, coinciding with substantial rainfall being recorded over the wet season. Elevated conductivity has also been observed at sites along Coulter Creek, which are more likely associated with agricultural land use at Old Mount Bundy Station.

- The macroinvertebrate community of Mount Bundey Creek and Coulter Creek is made up of pollution/disturbance tolerant families. The macroinvertebrate community of Coulter Creek showed very little variability in composition across all sites, owing to similarities in habitat availability and water quality at all sites. Mount Bundey Creek on the other hand, showed more variation. Sites adjacent to and directly downstream of Toms Gully Mine showed variation in the community and health metrics between samples at the same site, denoting an uneven distribution of macroinvertebrate families. Surrounding land use (mining and grazing) also varied along the watercourse, and where these disturbances were greatest, the macroinvertebrate community showed the greatest amount of variability. This coincided with changes in water chemistry noted above. Any impact associated with water quality and habitat availability were confined to sites adjacent and directly downstream of Toms Gully Mine. Sites further downstream did not show the same type of variability in the community and were considered similar to those upstream of the mine.
- The fish communities of Mount Bundey Creek and Coulter Creek are indicative of moderately disturbed ephemeral streams in the area. Although no barramundi were caught during sampling, anecdotally they are caught from the bridge passing over Mount Bundey Creek directly downstream of Toms Gully Mine in the wet season.
- Mertens water monitors have been recorded upstream and adjacent to Toms Gully Mine, along with a number of birds and mammals. The population of Mertens water monitors in the vicinity of the mine site is thought to be sparse, with only a single individual captured from a combined 540 days of camera deployment in a given year. There have been no Mitchell's water monitors observed during sampling or recorded on remote cameras to date. Introduced species such as cane toads, pigs and wild dogs were recorded at all sites where remote cameras were deployed.
- There have not been any observations of submerged aquatic plants growing at any site, which is expected in intermittent stream environments. However there has been some emergent fringing aquatic vegetation observed at some sites on Mount Bundey Creek, but growth is sparse.
- Additional observed aquatic fauna recorded during surveys included northern snapping turtles and freshwater crocodiles.

Proposed Site Water Management

The proposed mining activity is set out in the Section 14A Amendment dated 14 December 2018. Primary Gold seeks to undertake mining by accessing ore outside of the current open cut pit via a box cut on the southern side of the mine site. Rather than requiring tailings to be stored above ground and capped, it is proposed that tailings will be deposited at the base of the existing pit with a depth of cover of water being maintained to prevent the oxidisation of tailings. Tailings currently stored above ground will be reprocessed, and any residual tailings also placed within the pit. During tailings deposition, water displaced from the pit will be treated and discharged to Mount Bunday Creek and Lake Bazzamundi. Water pumped to Lake Bazzamundi will overflow, at capacity, to Coulter Creek and flow downstream to Mount Bunday Creek. Dewatering of the box cut is also required to allow for mining and will take place throughout the year. Where pumped groundwater quality does not meet site-specific trigger values (SSTVs), it will be treated and then pumped to a New Water Storage Dam (WSD).

Proposed changes to the tailings deposition, water treatment and construction of the new WSD are projected to result in a reduction of water discharged from the site by 3 gigalitres over the life of the project, i.e. compared with the proposed activity set out in the EIS. Based on the updated water balance model (GHD 2019), the discharge of treated water to Lake Bazzamundi and Mount Bunday Creek is expected to take place in from the Northern Rainfall Onset (when 50 mm of rainfall or greater is recorded at site) and continue through the wet season. Discharges to both creeks will be relative to flow, and reduce in proportion to reductions in flow recorded in Mount Bunday and Coulter Creeks towards the end of the wet season. The intention of discharges is to empty the new WSD in order to allow for storage of water through the dry season.

Environmental Objectives

The following section considers the objectives of environmental factors identified by NT EPA for water (NT EPA 2018). Where appropriate, suggested mitigation measures and recommendations for future monitoring have been included.

Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and ecological functions they perform

The aquatic ecosystems of Mount Bunday Creek and Coulter Creek are characterised by flora and fauna commonly found in highly disturbed intermittent streams. Very low coverage of aquatic plants has been recorded due to the seasonal drying of the majority of the system. Although Mount Bunday Creek maintains sub-surface flow through sandy substrates, this would occur for a much shorter period of time in Coulter Creek due to the comparative smaller size of the catchment. Under the proposal specified in the EIS, complete dewatering of the pit would have been required, resulting in continuous discharge of water into Mount Bunday Creek (and likely Coulter Creek) through the entire dry season. The revised plan, including increased water storage on-site has reduced the volume requirement to dewater the pit by 3 gigalitres, thus allowing for discharges to cease during the dry season. The drying

of intermittent streams is a natural and important component in the ecology of these environments (Steward *et al.* 2012), and the proposed discharge strategy allows for this to occur. This presents a better outcome for the aquatic ecosystems of both creeks, as natural intermittent flow patterns can be maintained (although modified), compared with a previous proposal to continue discharges for at least one entire dry season.

Inter-annual rainfall variability has been a climatic feature of the Project Area during baseline aquatic ecology monitoring, which has in turn varied flow magnitude and duration in Mount Bunday and Coulter Creeks. As the Northern Rainfall Onset varies with prevailing climate each year, the discharge regime will allow for natural variability in length of the wet season. The slowing and ceasing of flows result in ecological processes (including laying of eggs, aestivation and downstream migration) that are extremely important to the aquatic communities of intermittent streams (Boulton and Suter 1986). Abruptly ceasing discharges are not likely to allow this process to occur, and this may negatively impact fauna of all trophic levels, further exacerbating any impacts associated with rapid drying. As above, if this process is repeated over several years, localised alterations to population structure may occur, with the likelihood increasing closer to the discharge, where drying is likely to occur fastest. Water balance modelling by GHD (GHD 2019) has stipulated that flow will decrease in volume at the end of the wet season in line with flow conditions upstream of Toms Gully Mine. This will allow natural ecological processes related to intermittent streams to occur in the early dry season, and assist in the maintenance of flow-related cues.

While discharges will be proportional to flow, the volume of water in the receiving environment will be greater than in upstream areas of both creeks. Surface water connection between Mount Bunday Creek and Coulter Creek will be present for a longer period than would be expected under natural conditions, and there is also the likelihood of isolated pools on Mount Bunday Creek persisting into the early dry season. As previously mentioned, discharges will be reduced and ceased according to flow conditions upstream of Toms Gully Mine. This is likely to delay some natural ecological processes associated with the early dry season, but will not impede them.

Baseline monitoring has confirmed the presence of Mertens water monitors in Mount Bunday Creek upstream and adjacent to Toms Gully Mine, suggesting that refugial pools are likely to persist along the watercourse well into the dry season. The proposed water management and discharge regime is not likely to have an impact on populations of Mertens water monitors, as wet and dry season water availability will remain similar to baseline conditions.

Mount Bunday Creek flows via Hardies Creek to the Mary River Floodplain, a Site of Conservation Significance (SOCS) (DNREAS 2017). The proposed discharge regime will result in a greater volume of water reaching The Floodplain via Mount Bunday Creek. Given the volume of water received by the Mary River Floodplain during the wet season, the additional water discharged to Mount Bunday Creek

is not likely to be consequential. Connectivity associated with increased water volume is not likely to be extensive enough to result in any changes to the upstream fish or reptile communities as a result of migration.

Mitigation

The abrupt cessation of flows as a result of concluded pumping to Lake Bazzamundi and Mount Bunday Creek is likely to cause changes to aquatic assemblages over time, should measures not be taken to allow for natural flow-related cues to take place. A stepped approach to decrease mine water discharges towards the end of wet season e.g. reducing discharge slowly over time is proposed in the current water balance model (GHD 2019). This process will assist with maintaining natural cues and thus reduce the mortality of fish in Mount Bunday and Coulter Creek. The drying of isolated pools is a natural process that occurs annually in both Mount Bunday and Coulter Creeks. It is expected that there will be some morbidity and deaths as a result of this, but should stepped releases be undertaken at the end of wet season releases, it is not likely to result in higher than normal rates of mortality or impact on the aquatic ecosystem of the catchment.

Pulsed discharges of higher than average volumes should also be avoided after a stepped decrease in wet season flows have been instigated. Pulsed water flows derived from the mine water can result in ecological cues such as upstream migration and spawning, which may result in negative impacts on species assemblages when higher flows do not continue.

Monitoring recommendations

Continued aquatic ecology monitoring should be undertaken to maintain an unbroken record of aquatic ecosystem health surrounding Toms Gully Mine. Continued remote camera monitoring for water monitors will have the indirect outcome of also monitoring any introduced species and their presence downstream of the Project Area. Currently remote camera monitoring does not extend to the section of Mount Bunday Creek to be affected by discharges, including the site furthest downstream on Mount Bunday Creek (SWTG3). This site was added to remote camera monitoring in 2019, and should be considered for ongoing monitoring to assist with an understanding of these potential impacts.

Currently remnant pools that naturally occur in Mount Bunday Creek through to the end of the dry season (if any) are not mapped. Understanding the location of these pools, if they are present will assist in placement of fauna cameras in these locations to monitor terrestrial and aquatic fauna densities in these locations.

Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and welfare and amenity of people are protected.

During baseline surveys, interaction between stored tailings, groundwater and surface water were detected after an above average wet season in 2017. Poor water quality in the area adjacent to tailing storages resulted in declines in ecological health of the aquatic community adjacent to the tailing storage area. The emplacement of tailings below water (including reprocessing and emplacement of tailings currently stored above-ground) within the pit reduces the opportunity for oxidisation of tailings material and also removes the risk of above-ground storages becoming compromised due to above average rainfall. The planned storage of tailings within the pit therefore represents a lower risk of impacts to environmental values. Further, in-pit treatment of water will allow for the precipitation of metals out of solution, resulting in lower dissolved metal concentrations that may interact with groundwater or surface water.

Water discharged to Lake Bazzamundi and Mount Bunday Creek will be treated to meet the SSTVs set out by Stauber and Batley (2018). The SSTVs generated for the Toms Gully Project are based on water quality upstream in Mount Bunday Creek and have been designed to protect the receiving environment from changes to water quality associated with mine water discharge. Although Coulter Creek is a much smaller and lower order stream, the SSTVs calculated for Mount Bunday Creek are considered sufficient to protect aquatic ecological health. Monitoring data collected during baseline surveys have shown poor water quality results for a number of parameters at sites on Mount Bunday Creek and Coulter Creek adjacent to Toms Gully Mine. The introduction of treated water to both watercourses is likely to counteract some of the influences of agriculture and mining on water quality through dilution, lowering conductivity and dissolved metals.

Coulter Creek has been previously impacted by cattle access, road building and irrigation, resulting in erosion. High turbidity water has been observed previously within Coulter Creek downstream of the Arnhem Highway, and been attributed to livestock access. Although fish species found in Coulter and Mount Bunday Creek are tolerant of very turbid conditions (Pusey *et al.* 2004), increased flows may further erode Coulter Creek and result in further degradation of remaining habitat within the Coulter Creek for aquatic fauna.

Mount Bunday Creek has a much more intact riparian zone, and very little erosion beyond what would be expected to occur naturally. The Creek is not likely to be impacted by any increase in flow, as it is resilient to high flows experienced through the wet season annually.

Mitigation

Erosion and sediment control within Coulter Creek is problematic, given the external influence of grazing on the catchment. Under the proposed water balance model (GHD 2019), discharges will be

lower in Coulter Creek compared with Mount Bunday Creek relative to the size of the watercourse. This will not decrease susceptibility to erosion but will assist with limiting erosion within the creek.

Monitoring recommendations

The release of treated water to Coulter Creek via Lake Bazzamundi is likely to result in the requirement for a new Licence Discharge Point (LDP). In addition, a compliance monitoring point should be established on Coulter Creek to capture data during periods of flow (both natural and during discharges). This will assist in understanding changes (if any) to water chemistry and aquatic ecosystem health as a result of water management at Toms Gully Mine. The monitoring point should be located on Coulter Creek in the mine lease between the discharge point at the spillway from Lake Bazzamundi and the Mount Bunday Creek confluence.

The revised SSTV document suggests the use of ecotoxicity testing to establish an additional line of evidence that current SSTVs are sufficient to protect the aquatic fauna of soft waters. It is recommended that ecotoxicity testing take place during the wet season, and at the ceasing of wet season flows, when water discharged to Mount Bunday and Coulter Creek will make up 50% of flow being received by the catchment. This will assist in assessing the effectiveness of water treatment and the discharge regime to protect aquatic ecological values.

Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

The influences of higher flows in Coulter Creek coupled with its already modified channel are likely to result in exacerbated geomorphological processes, such as erosion, transport and deposition of sediments downstream. As mentioned above, this has the capacity to alter habitat for fish and macroinvertebrates, as well as affecting water quality, increasing turbidity and dissolved solids.

Mitigation

An erosion and sediment control plan should be put in place during mining activities that includes measures to reduce erosion processes in Coulter Creek. Current areas susceptible to erosion should be identified, and control measures taken to decrease erodibility.

Monitoring recommendations

Monitoring at erosion-susceptible locations on Coulter Creek should be undertaken during discharges to measure effectiveness of erosion control measures and impacts of increased flows.

Conclusion

Short-term changes to habitat availability, water availability and connectivity within Coulter and Mount Bunday Creeks are expected as a result of increased water volume in received during discharges. These short-term modifications to the ecosystem are considered a better outcome for the aquatic ecology of

both creeks, compared with previously proposed strategies that would have likely required a permanent discharge over several years.

Although the wet season flows in both creeks will be altered, provided a decrease in discharges is undertaken during the conclusion of wet season dewatering each year, it is unlikely that long-term impacts on the aquatic ecology of the receiving environment will occur. Coulter Creek is susceptible to erosion given that the catchment is highly disturbed. Where appropriate erosion and sediment control is in place and regular monitoring is undertaken, modifications to the channel of Coulter Creek are less likely to be such that habitat availability or water quality are negatively impacted.

Ongoing monitoring of the receiving environment will be the most effective tool in adaptive management of the discharge strategy, should negative impacts be observed.

Warm Regards,

A handwritten signature in grey ink, appearing to read 'Tara Steele', with a stylized, overlapping circular flourish at the end.

Tara Steele (BSc BA MEnv)
Aquatic Ecologist

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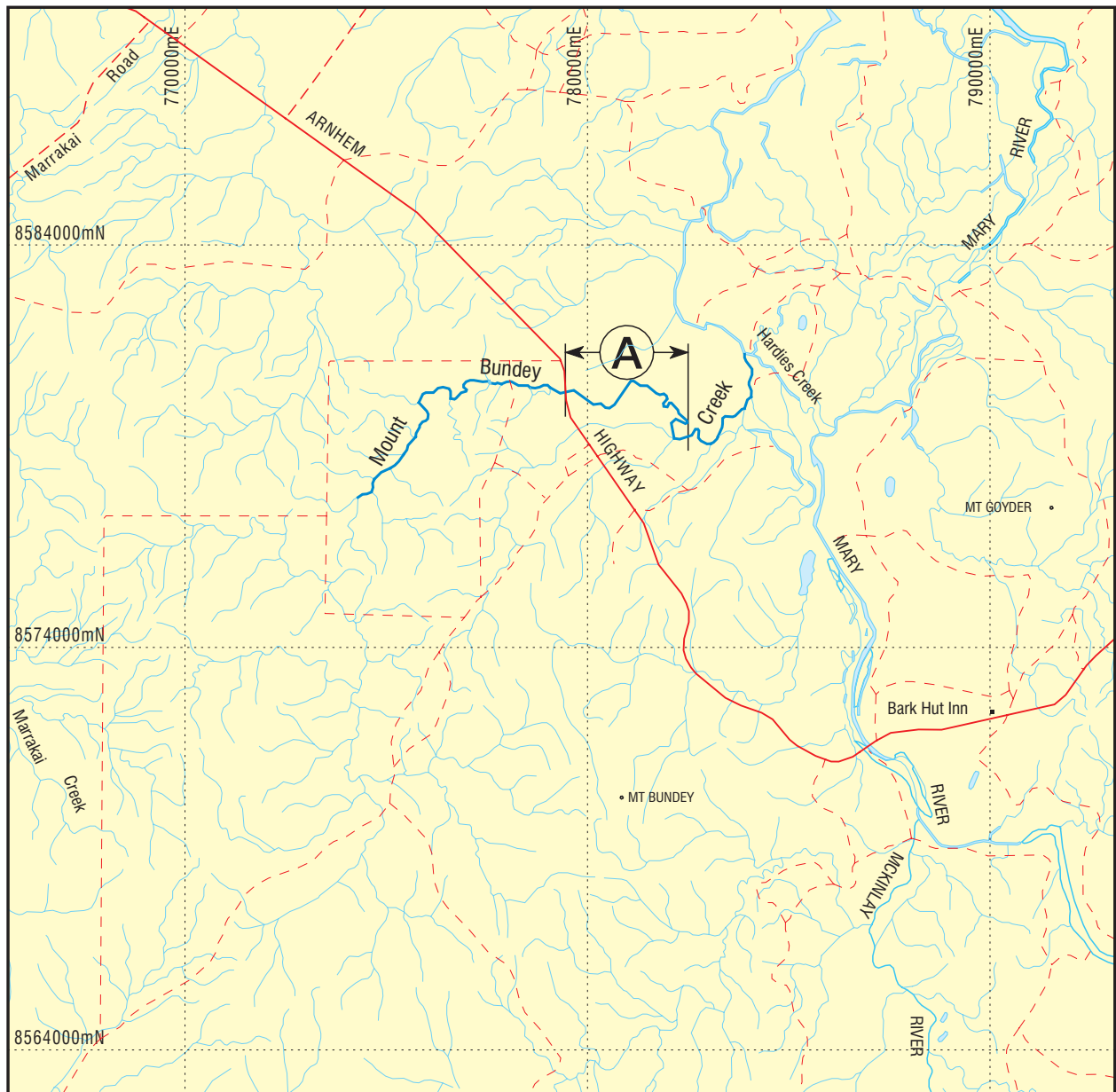
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Attachment G:

Beneficial Uses



km 0 5 10 15

Design File: Mt-Bunday-Ck_BU_a52
Plot File: Mt-Bunday-Creek_Beneficial-Use

LEGEND

- Mount Bunday Creek
- Road - sealed
- - - - - Road - unsealed
- - - - - Track

MAP LOCALITY



Notes:

- 1; Beneficial Uses are stock water supply for that part of the waterway shown as **A** on the plan and aquatic ecosystem protection applies to the remainder of the waterway.
- 2; For declaration and description see Northern Territory Government Gazette No. G23, 11 June 1997.
- 3; Prepared by Natural Resources Division, September 1999.

NATURAL RESOURCES



DECLARATION OF BENEFICIAL USES AND OBJECTIVES OF WATER MOUNT BUNDEY CREEK

Attachment H:

Stakeholder Engagement

15.2 Identification of community groups

The Toms Gully Mine project albeit located adjacent a major highway and only about 100km from the capital city of Darwin is in an isolated location. Section 13.6 of this report documents that the project is situated within the unincorporated top end region, within this region there is insufficient population to form any local administrative body or council. There is no specific population centre other than Marrakai (Section 13.7) and subsequently whilst the land holders and business operators in the region are a community of stake holders they have no collective representative body.

There are no identified indigenous communities within the general area of the project. The community group is comprised of pastoral lease holders, local business owners (two roadhouses, two tourist villages) and three quarry operating companies.

As there is a very small group of stakeholders comprising the community within the vicinity of the project there is an opportunity for PGO to engage directly on a one-on-one basis with the stakeholders.

PGO will engage in discussion with individuals and community groups in order to document the issues / concerns arising from the discussions. Thereby identifying and recording the specific concerns of communities / individuals who feel they may be impacted upon by the project.

PGO will seek the support of the local community and endeavour to facilitate a periodic series of updates and meetings in order to provide all stake holders with a means of direct contact with the proponent and its management.

15.3 Community stakeholder consultation

Given the small number of people likely to be impacted upon by the project PGO anticipates being able to deal with any issues arising on a consultative and co-operative basis. There are currently no known activist or disaffected community groups with issues arising from the previous operational period of project. Therefore PGO does not anticipate any particularly vexatious issues arising and considers that periodic community consultation via face to face meetings is the most effective and efficient means of community stakeholder consultation.

Table 25 on the following page presents a summary of the consultation conducted to date with the community, government and local business stakeholders along with broad descriptions of the matters discussed.

Table 25 Community, government and local business stakeholder consultation

Stakeholder	Description of matters for discussion
Environmental Protection Agency	- EIS Approach & process - Clarifications w.r.t EIS requirements
Department of Mines and Energy	- MMP process w.r.t EIS assessment - MMP requirements
Amateur Fishers Association of NT	- General Company and site information - EIS process
Department Lands and Planning and Environment	NT Heritage register search
Northern Land Council	- General Company and site information - Establish cooperation (including employment opportunities)
NT Worksafe	- Covering letter and Risk Management Plan submission explanation - Primary Gold H&S Policy certified March 2015 - Primary Gold Risk Management Plan certified 1'5'15 - Primary Gold H&S Management System certified March 15 - Primary Gold Whole of Project Risk Assessment Report certified 1'5'15
Department of Business	As above
Government Ministers and Advisors	- Chief Minister and various Ministers responsible for Environment, Mines and Energy, Treasury, and Lands and Planning - General Company and site information - Authorisation process
Old Mount Bundy Station	- Access agreement - Location of new infrastructure - Fire management - Water sampling - General pastoral operations
Neighbouring Pastoralists	- Marrakai Station - General Company and site information - EIS process
AAPA	Sacred site survey and certificate
Bushfire NT (Arafura region) & Point Stuart Volunteer Bushfire Brigade	- General site information - donations

Local businesses	• H&R Quarry, Boral Quarry and, Ostoic Quarry • Bark Hut Inn, Corroboree Park and Mary River Retreat • General site and company information • Provision of accommodation services • Provision of quarry products

Source: PGO

15.4 Identified impacts

The paucity of residential communities in proximity to the project provides a natural and effective social impact barrier. A key design factor of the project has been to enhance this natural social isolation characteristic by deciding not to construct any form of residential camp facility at the project site.

The decision to recruit locally from within the Alligator SA2, Humpty Doo SA2 and greater Darwin area and transport them to site from residential hubs contributes greatly to limiting the potential for negative social impact. As potential employees will be already resident within established communities it is expected that their employment at the project site will not distort the current prevalent social fabric of the communities in which they currently live and economically interact. This approach is favoured as it does not introduce any new demand for housing or services and will therefore have a minimal social footprint. This approach will therefore assist in minimising the impact on house prices, availability and residential rents attributable to the development of the project (Section 13.10).

The projects proximity to the Arnhem highway and the decision to transport the work force by bus on a shift basis from their current residential centres addresses matters related to road usage. Section 13.8 of this report explains how this approach minimises the amount of additional traffic, integrates with current road usage patterns and directly addresses matters of road safety such as driver fatigue, speeding and affiliated road safety issues.

The second component of road usage that needs to be considered is the increase in general freight haulage demand created by the project and what likely impacts on current road usage profiles will be. The Arnhem highway is the major service corridor for the mining projects in the Alligator SA2 region including ERA's Ranger Uranium project. The general freight logistics needs of the Toms Gully project will be similar to any other mine project in the NT albeit the volumes of materials required generally lower than the average sized operation in the region.

The economies of scale already operating in the transport logistic sector of the NT economy should ensure that only nominal increases in overall traffic volumes on the Arnhem Highway are attributable to the Toms Gully Mine project. As general freight logistics companies servicing the general freight sector compete for contracts there is a high likelihood that demand for general freight transport arising from the project will be accommodated by increased utilisation of current services by operators on the Arnhem Highway freight routes. This will tend to minimise any distortion to the levels of supply and demand for general freight services along the delivery route.

Attachment I:

Emergency Response Plan

TOMS GULLY MINE EMERGENCY AND CRISIS MANAGEMENT PLAN

Revision: 0

Document Owner **MD Primary Gold Ltd**

Date Originated	June 2015	Approval Date	September 2015
Deployment Date	Site restart	Next Revision Date	Annual

REVISION INFORMATION

This Emergency & Crisis Management Plan will be reviewed annually to ensure it remains up to date. The review will be based on an analysis of the types of incidents that are likely to occur and the appropriate emergency response required.

Use this section to describe what has changed since issue of subsequent revision of manual (once initial final version issued).

Revision Number: New Document

Revision Number		New Document	
Old Section Reference	New Section Reference	Description	
Prepared by	Bendan Australia; Peter Crooks		
Reviewed by			
Approved by	Primary Gold MD; Clay Gordon	Date Approved	15 Sept 2015

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1 INTRODUCTION

This document, the “**Toms Gully Mine Emergency & Crisis Management Plan**” forms part of the documentation of the Toms Gully Mine Emergency & Crisis Management system, standards, and processes.

2 PURPOSE

The aim of this document is to provide the Toms Gully Mine management with detailed guidance on how to respond to various emergency situations that could occur during normal operations. That is:

- What type of incident could occur;
- What general type of emergency response is required; and
- Any special response requirements.

The information contained in this document has been prepared to act as a guide only and may require some additional responses, depending on the circumstances of the individual emergency situation.

3 SCOPE

The Toms Gully Mine Emergency & Crisis Management Plan applies to all aspects of our operations including Exploration, Mining, Processing and Administration.

All PGO Toms Gully Mine team members and contractor team members are required to comply with the requirements of the Toms Gully Mine Emergency & Crisis Management System.

Emergency incidents that require a response from the Toms Gully Mine management could occur either on or off site and may involve PGO Toms Gully Mine team members or contractor team members or even members of the public. The impacts could include injury to team members, disruption to production, damage to assets, environmental damage or poor company image.

4 IMPLEMENTATION

4.1 Who Has Responsibilities - Training Required

Each **Department Head** is responsible for the effectiveness of emergency response within his or her area of responsibility. This includes responsibility for ensuring Emergency Plans and Procedures are periodically tested and reviews conducted to ensure they remain effective.

Area or Section Team Leaders are responsible for ensuring the development and implementation of a local Area Emergency procedures as appropriate to ensure compliance with this document.

The **Area or Section Team Leader** is also likely to act as the *Incident Controller* (i.e. leader of the area or site Incident Control Team) should a local emergency occur. This person will be required to have an understanding of the various responses that may be used to help manage an emergency situation.

The **Toms Gully Mine Emergency Response Coordinator** is responsible for maintaining and up-dating the Emergency & Crisis Management System, including this Plan and associated Procedures. This includes communicating any changes to Department Heads as soon as practicable and assisting in the training of site team members in effective emergency response.

Team Members assigned particular roles or tasks under the Toms Gully Mine Emergency & Crisis Management System (e.g. emergency procedures) is responsible for carrying out those roles or tasks to the best of their ability.

4.2 Who Else Should Know - Awareness Required

This information is important to the safety of everyone associated with the Toms Gully Mine and is to be used by all team leaders. This information must be communicated to any new team leaders through formal induction or instruction so the various requirements are understood and acknowledged.

5 DETAILS

5.1 Applicable Legislation & Standards

This document has been developed to help ensure compliance with applicable NT acts, regulations and requirements as well as the NT Worksafe act as well as key requirements of the EPA. Toms Gully Mine, as the principal employer, is responsible to prepare an emergency plan that:

- identifies the hazards that might cause an emergency;
- assess the risk of an emergency occurring; and
- Includes means for dealing with such emergencies.

This plan must also consider the means for managing and controlling an emergency situation including the provision of training, equipment, facilities, team members and procedures.

The development of the Toms Gully Mine Emergency & Crisis Management System was also undertaken to help ensure compliance with PGO Management System.

6 POTENTIAL EMERGENCY INCIDENTS

6.1 Emergency Risk Analysis

An analysis to determine the types of probable on and off site incidents that could occur at Toms Gully Mine has been undertaken. This included:

- A review of PGO Toms Gully Mine risk assessments to identify potential emergency response requirements; and
- A qualitative risk assessment was conducted to identify and assess probable “high risk” incidents that might require formal emergency response.

The risk assessment was conducted as part of a review of the Toms Gully Mine Emergency & Crisis Management System.

This analysis identified 97 incidents with “extreme” or “high” residual risks (based on PGO and AS 4360:1999 “Risk management” classification). Each of these was then reviewed to determine the type of response required.

The specific responses to these incidents form the basis of the Toms Gully Mine Emergency & Crisis Management Plan that is given in Section 8. Each incident is numbered accordingly.

The results of the Toms Gully Mine Emergency Response Risk Assessment are summarized in Figure 1.

This Chart shows the following information:

- a) Potential incidents identified from the above analysis;
- b) Types of impacts that could be detrimental to the Toms Gully Mine, including:
 - assets (A)
 - earnings (E)
 - Team member safety and health (SH)
 - environment (En)
 - other people e.g. community, family/ friends of team members (OP)
 - company image, reputation, public perception etc (CI)
- c) Estimated likelihood of the event occurring (based on PGO Toms Gully Mine Risk Matrix);
- d) Estimated maximum reasonable consequences (based on PGO Toms Gully Mine Risk Matrix);
- e) Level of risk (based on PGO Toms Gully Mine Risk Matrix and AS 4360: 1999)

7 TOMS GULLY MINE PROBABLE EMERGENCY INCIDENTS CHART

Figure 1 – Potential Incident, Impacts & Risk

(Page 1 of 2)

POTENTIAL INCIDENT	Main Impacts	Likelihood*	Consequence*	LEVEL OF RISK	RISK RANK	COMMENTS
Natural Disasters						
Major Earthquake/ Seismic Event	A, E, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	
Severe Animal/ Insect Infestation	A, E, SH, CI	Rare (E)	Catastrophic (5)	High (H)	11	E.g. bees, red-backs
Cyclone	E, SH, En	Unlikely (D)	Major (4)	High (H)	12	
Severe Electrical Storm	A, E, SH, En	Moderate (C)	Moderate (3)	High (H)	13	Struck by lightning
Flood	E, SH	Moderate (C)	Moderate (3)	High (H)	13	General flood
Infectious Disease Outbreak	CI, SH, OP	Rare (E)	Major (4)	High (H)	16	E.g. legionaries, salmonella
Off-site Incidents						
Light Vehicle Accident	SH, CI, OP	Unlikely (D)	Catastrophic (5)	Extreme	7	
Bus Accident	SH, CI, OP	Unlikely (D)	Catastrophic (5)	Extreme	7	
Heavy Vehicle Accident	CI, SH, En, OP	Unlikely (D)	Catastrophic (5)	Extreme	7	E.g. road train hauling cons
Reagent Truck Accident	CI, SH, En, OP, E	Unlikely (D)	Catastrophic (5)	Extreme	7	E.g. cyanide truck
Explosives Truck Accident	CI, SH, OP, En	Rare (E)	Catastrophic (5)	High (H)	11	Fire/ explosion
Major Bush Fire	A, E, En, SH, OP	Rare (E)	Major (4)	High (H)	16	
On-site Surface						
Light Vehicle Accident	SH	Unlikely (D)	Catastrophic (5)	Extreme	7	
Heavy Vehicle Accident	CI, SH, En, CI	Unlikely (D)	Catastrophic (5)	Extreme	7	

POTENTIAL INCIDENT	Main Impacts	Likelihood*	Consequence*	LEVEL OF RISK	RISK RANK	COMMENTS
On-site Surface continued						
Hazardous Substance Release	CI, SH, En, E, OP	Unlikely (D)	Catastrophic (5)	Extreme	7	E.g. chemical, toxic gas
Fixed Plant Incident	A, E, CI, SH, En	Unlikely (D)	Catastrophic (5)	Extreme	7	E.g. conveyor, crusher
Aircraft Crash	SH, OP	Rare (E)	Catastrophic (5)	High (H)	11	E.g. survey plane, domestic
Armed Hold-up/ Hostage	A, CI, SH	Rare (E)	Catastrophic (5)	High (H)	11	E.g. gold room robbery
Plant Explosion	A, E, CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	
Bulk LPG Leak/ Fire/ Explosion	A, E, CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	
Surface Magazine Fire/ Explosion	CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	
Fall/ collapse into Old Workings	CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	
Tails Dam Wall Failure	A, E, CI, En	Rare (E)	Catastrophic (5)	High (H)	11	
Building Collapse	A, E, CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	
Working At Height Incident	CI, SH	Unlikely (D)	Major (4)	High (H)	12	
Tyre Fire/ Explosion	A, E, SH, En	Unlikely (D)	Major (4)	High (H)	12	
Building/ Plant Fire	A, E, CI, SH, En	Unlikely (D)	Major (4)	High (H)	12	
Malicious Damage (Arson etc)	A, E, CI, SH, En	Rare (E)	Major (4)	High (H)	16	
Inrush Into Open Pit	A, E, CI, SH, En	Rare (E)	Major (4)	High (H)	16	
Pit Wall/ Ramp Failure	E, CI, SH, En	Rare (E)	Major (4)	High (H)	16	
Bomb Threat	CI, E, SH	Rare (E)	Major (4)	High (H)	16	Threat only (no explosion)
On-site Underground						
Rockfall/ Rock-burst or Ground Collapse	E, CI, SH	Moderate (C)	Catastrophic (5)	Extreme	4	
UGME/ LV Accident	CI, SH	Unlikely (D)	Catastrophic (5)	Extreme	7	
Major Underground Fire	A, E, CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	E.g. major equipment fire

POTENTIAL INCIDENT	Main Impacts	Likelihood*	Consequence*	LEVEL OF RISK	RISK RANK	COMMENTS
On-site Underground cont'd						
Major Underground Fuming	A, E, CI, SH	Rare (E)	Catastrophic (5)	High (H)	11	E.g. from fire, fumes, gas etc
Major Underground Explosion/ Air-blast	A, E, CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	E.g. explosives, tyre, major collapse
Person/s Trapped	CI, SH, E	Rare (E)	Catastrophic (5)	High (H)	11	Due to collapse, fire etc
Fall Down Open Hole/ Stope	CI, SH	Rare (E)	Catastrophic (5)	High (H)	11	
Major Flooding/ Inrush	A, E, CI, SH, En	Rare (E)	Catastrophic (5)	High (H)	11	

* LIKELIHOOD, CONSEQUENCES AND RISK BASED ON PGO TOMS GULLY MINE RISK RANKING MATRIX

8 EMERGENCY & CRISIS MANAGEMENT PLAN

This Emergency & Crisis Management Plan describes the detailed response to the potential critical incidents identified in Section 8. Each of these detailed responses includes the following information:

- The main “threats” associated with the incident
- How the incident may be notified (aside from emergency telephone/ radio call)
- Alarms or methods to alert persons of an emergency
- The management response required (i.e. who should be notified, what action should be taken)
- Any special instructions
- Possible contacts for specialist advice

Detailed procedures for responding to emergency situations (e.g. Emergency Team Call-out, Evacuation, Establishing an Incident Control Emergency Centre, Initiating Duty Cards etc) are contained in the ***“Toms Gully procedures”***.

The detailed response to each potential incident is described in Section 8 below.

These should be used as a guide only and are not “all inclusive”. That is, there may be additional response steps or the steps may be in a different order of execution, depending on the circumstances of the individual emergency situation.

8.1 NATURAL DISASTERS

8.1.1 Major Seismic Event/ Earthquake

A major earthquake or seismic event is one that causes damage to mine infrastructure and results in a significant disruption to operations.

Main Threats:	• Collapse of mine infrastructure (e.g. Tails Dam, underground workings, pit walls, mine access ways, surface buildings or structures) • Loss of access to mine (loss of ramps, portal etc) • Induces major fire/ explosion (e.g. LPG or fuel storage) • Disruption to security/ communications

Likely Alarms: Earthquake likely to trigger security/ other site alarms

Response:	• Initiate affected area/s Evacuation Alarms • Initiate Emergency Duty Card system • Assess likely impact • Call-out Emergency Response Team • Secure access to all areas using Emergency Response Team • Initiate appropriate emergency response (e.g. first-aid, fire, persons trapped underground, explosion etc) • Notify General Manager • GM to initiate Crisis Management, if required • Advise Local Darwin Authorities & Mutual Aid Providers, if require assistance • Secure PGO Toms Gully Mine Gold Room, if safe. • Conduct damage assessment of entire site using competent team members (e.g. Geotech Team Leader for underground/ open-pit). • Report to Government Authorities: □ Dept of Minerals & Energy (if injury/ damage) □ Dept of Environmental Protection (only if environmental impact results) • The internet BOM may have information on after shocks etc • Notify contractors & team members of proposed actions

External Help: State Emergency Service (via Darwin Police)

8.1.2 Severe Animal/ Insect Infestation

A plague of animals (e.g. mice, snakes) or infestation of insects (e.g. wasps, red-back spiders, bees) can cause damage to mine infrastructure and results in injury to team members through bites or stings. Infestations by bees have previously resulted in serious injury to team members due to allergic reactions to stings.

- Main Threats:**
- Team member being bitten or stung
 - Allergic reaction to bee/ wasp sting
 - Damage to equipment (particularly electrical e.g. could trigger failure of computers)

Likely Alarms: None

- Response:**
- Assess likely impact of infestation
 - Call-out Emergency Services to provide first aid (if required)
 - Ensure supplies of adrenaline and other anti-allergy/ anti-venom drugs are available at Darwin Regional Hospital
 - Notify Local Doctor or Darwin Hospital, if required assistance
 - Notify General Manager, if serious
 - GM to initiate Crisis Management, if required
 - If animal infestation, contact pest controllers or CALM for advice
 - Report to Government Authorities:
 - Dept of Minerals & Energy (if injury results)

External Help: Darwin Hospital
Dept. of Environmental Protection (EPA)
Local Pest Controllers

Refer to "Emergency Telephone Directory" for Contact Numbers

8.1.3 Cyclone

A cyclone is likely to form a rain-bearing depression and may result in high winds. Most likely from November through to April. Can result in considerable rainfall.

- Main Threats:**
- **Loss of access to mine (flooded/ impassable roads)**
 - **Loss of essential supplies (fuel, reagents, consumables etc)**
 - **Medical emergency (inability to evacuate ill or injured team members)**

Notification: Likely to be notified through media reports (i.e. television news/ weather, radio, and newspaper). If severe cyclone, may get some prior notification from local Police or SES.

Likely Alarms: Cyclone alert issued by Bureau of Meteorology (BOM)
Cyclone alerts issued on TV & radio

- Response:**
- **Obtain up-to-date information from Bureau of Meteorology or Darwin Police**
 - **Assess likely impact**
 - **Check status of site essential supplies (fuel, reagents etc) with Stores Team members**
 - **Notify General Manager**
 - **If likely to be severe consider suspension of all operations**
 - **Prepare for possible flooding**
 - **Notify contractors & team members of proposed action**
 - **Notify suppliers of proposed action, if required**
 - **If medical emergency occurs and cannot evacuate by usual means, contact Darwin Regional Hospital/ RFDS or State Emergency Service via Darwin Police for assistance**
 - **If cyclone/ strong winds hits site, evacuate persons "cyclone evacuation points" (e.g. inside suitable building/ structure**
 - **Check availability of tarpaulins with Emergency Services**
 - **Consider call-out of Emergency Response Team to control damage, if required.**

Refer to "Emergency Telephone Directory" for Contact Numbers

8.1.4 Severe Electrical Storm

Electrical storms are common events during summer and early autumn. All critical equipment should be properly earthed or protected by lightning arrestors. Activities in the open (e.g. pit sampling, charging etc) should be stopped. If struck by lightning, cardiac arrest is likely, so quick response is essential.

Some hazardous activities (e.g. unloading explosive trucks) should also be checked. Explosive trucks should be parked up in a safe (well-earthed) area such as a workshop.

- Main Threats:**
- Team members struck by lightning
 - Lightning initiating fire or explosion
 - Disruption to power/ security systems

Notification: May get some advance warning from Bureau of Meteorology of severe lightning strikes/ almost instantaneous thunder
Could be some major power disturbances/ security alarms going off?

Alarms: Site Evacuation Alarm (if fire/ explosion)
Radio call (to stop work & evacuate area)

- Response:**
- Notify all production team members of approaching storm/s
 - Initiate evacuation alarms, if fire or explosion
 - Call-out Emergency Services, if support required
 - Initiate appropriate emergency response (first-aid/ medical/ fire)
 - Isolate any energy sources or hazardous substances (e.g. power, gas, diesel, reagents etc)
 - Notify Local Doctor or Darwin Hospital, if required assistance (e.g. for cardiac arrest)
 - Consider shut-down of surface operations, if storm/s severe
 - Notify General Manager
 - GM to initiate Crisis Management, if required
 - Secure access to areas using Emergency Services Team members (including Toms Gully Mine Gold Room)
 - Inspect affected areas to assess damage (once safe)
 - Report any injuries/ major damage Dept of Minerals & Energy
 - If rubber-tyred equipment struck by lightning, park up in secured/ isolated area for 24 hours
 - Maintain security of affected areas until Incident Controller gives "All Clear"

Refer to "Emergency Telephone Directory" for Contact Numbers

8.1.5 Flood

A flood is likely to result from a rain-bearing depression, particularly if associated with a cyclone.

Main Threats:	• Mine or pit in-rush • Loss of access to mine site and Toms Gully Mine (flooded/ impassable roads) • Loss of essential supplies (fuel, reagents, consumables etc) • Medical emergency (inability to evacuate ill or injured team members) • Wet/ slippery roads increase potential for heavy equipment & light vehicle accidents on / off site

Notification: Likely to be notified through media reports (i.e. television news/ weather, radio, and newspaper). If severe cyclone, may get some prior notification from local Police or SES.

Likely Alarms: Cyclone alert issued by BOM and on television & radio

Response:	• Obtain up-to-date information from Bureau of Meteorology or Darwin Police • Notify all production team members of approaching rains/ flood • Assess likely impact • Monitor local creeks/ drainage/ access roads/ haul roads and pit/ ramp road conditions • Consider closing/ barricading access roads, haul roads or pit/ ramp roads, if affected • Call-out Emergency Services, if support required • Check status of site essential supplies (fuel, reagents etc) • If flooding likely to be severe or road conditions hazardous, consider closure of all operations • Notify General Manager • GM to initiate Crisis Management, if required • Notify contractors, team members and suppliers of proposed action • If medical emergency occurs and cannot evacuate by usual means, contact SES via Darwin Police for assistance • If flooding of open-pit/ mine likely then withdraw workforce and stop operations • If inrush occurs, refer to 3.6.18 (open pit) and 3.7.8 (underground)

External Help: Pump/ hire contractors, Mutual Aid Providers

8.1.6 Infectious Disease Outbreak

Infectious diseases can be introduced through poor hygiene, contaminated water or food, or contact with other infected persons. They include Legionnaires disease, Influenza, various types of food poisoning, Hepatitis, etc.

As this could involve diseases of a “sensitive” nature, it is important to maintain confidentiality and avoid undue panic. The NT Health Department must be notified of any “reportable” diseases.

Main Threats:	• Team member illness • Adverse reaction/ panic by other team members

Notification:	Team members reporting sick/ severely ill

Alarms:	None

Response:	• Notify Darwin Regional Hospital (local doctor) • Initiate appropriate medical response using infectious disease protocol • Isolate infected persons from other team members • If medical emergency occurs, contact RFDS via Darwin Regional Hospital • Notify General Manager • GM to initiate Crisis Management, if required • Consider independent advice from external medical source (e.g. Carepoint Health Services) • Notify WA Health Department - Disease Control, if it could be reportable (can also provide advice) • Advise Darwin Hospital if major outbreak and need to evacuate team members to hospital • Assess situation and consider Team member briefing (using accurate medical information)

External Help:	Mutual Aid Providers Darwin Hospital NT Health Department (a/h medical emergencies)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.2 OFF-SITE INCIDENTS

8.2.1 Light Vehicle Incident

Accidents involving team members or members of the public on roads around Toms Gully Mine may require response from site team members. Light vehicle accidents are more likely to occur at early morning or evening or during wet weather due to reduced traction and visibility.

The presence of leaking fuel and possibility of having to cut persons out using hydraulic cutting equipment may require an Emergency Response Team call-out or Darwin Fire Brigade.

Main Threats: • **Injury to Team Member/s or other person/s**

Alarms: None

Response:

- **Call-out Emergency Services team members**
- **Initiate appropriate emergency response (first-aid/ medical/ fire/ vehicle extrication)**
- **Notify Darwin Regional Hospital (local doctor)**
- **Notify Darwin Police**
- **Consider Emergency Response Team call-out, if required**
- **Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance**
- **Secure area using Emergency Services or Emergency Response Team members**
- **Notify General Manager (e.g. if Team Member/s involved)**
- **GM to initiate Crisis Management, if required**
- **Maintain security of affected area until Police give "All Clear"**

External Help: Mutual Aid Providers
Royal Flying Doctor Service (Medical Evacuation)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.2.2 Bus Accident

A bus accident involving team members or members of the public on Toms Gully Mine area or on the Arnhem highway may require response from site team members.

As a bus is likely to be carrying a large number of people (up to 20), a major medical emergency could result.

The presence of leaking fuel and possibility of having to cut persons out using hydraulic cutting equipment may require an Emergency Response Team or Darwin Fire Brigade call-out.

- Main Threats:**
- Injury to Team Member/s or other person/s
 - Impact on other team members/ public/ local Community

Alarms: None

- Response:**
- Call-out Emergency Services team members
 - Initiate appropriate emergency response (first-aid/ medical/ fire/ triage/ vehicle extrication)
 - Notify Darwin Regional Hospital (local doctor)
 - Notify Darwin Police
 - Consider Emergency Response Team call-out, if required
 - Advise Darwin St. Johns Ambulance and Fire Brigade
 - Advise Darwin Hospital and RFDS of possible need for assistance (if large numbers of casualties)
 - Secure area using Emergency Services or Emergency Response Team members
 - Notify General Manager
 - GM to initiate Crisis Management, if required
 - Notify Mutual Aid providers, if require additional assistance with transporting injured persons
 - Maintain security of affected area until Police give "All Clear"

External Help: Mutual Aid Providers
RFDS (Medical Evacuation)
Darwin Regional Hospital

Refer to "Emergency Telephone Directory" for Contact Numbers

8.2.3 Heavy Vehicle Accident

An accident involving a heavy vehicle in the Toms Gully Mine area or on Arnhem Highway may require some response from site. This type of incident has potential to result in multiple casualties; e.g. if truck collides with light vehicle/s. An accident involving a road train carrying Toms Gully deliveries or other mine related transport is also likely to have an impact on Company image, particularly if fatalities occur.

Main Threats:	• Injury to truck driver/ members of the public • Environmental impact (e.g. if road train carting hazardous materials) • Impact to Company image/ reputation (if PGO Toms Gully Mine truck or delivery truck involved)

Alarms: None

Response:	• Call-out Emergency Services team members • Initiate appropriate emergency response (first-aid/ medical/ fire/ triage/ vehicle extrication) • Notify Darwin Regional Hospital (local doctor) • Notify Darwin Police • Consider Emergency Response Team call-out, if required • Advise Darwin St. Johns Ambulance and Fire Brigade • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Determine what cargo was being carried (e.g. if any chemicals, Dangerous Goods, ore/waste etc) • Secure area using Emergency Services or Emergency Response Team members • Notify General Manager (if PGO Toms Gully Mine truck or fatalities result) • Notify Environmental Team Leader (if any likely environmental impact) • GM to initiate Crisis Management, if required • Notify Mutual Aid providers, if require additional assistance with transporting injured persons or clean-up • Report to Government Authorities □ Dept of Minerals & Energy (if Dangerous Goods involved) □ Dept of Environmental Protection (if environmental impact results) • Maintain security of affected area until Police give "All Clear"

External Help: Mutual Aid Providers
Chemical Supplier/ Transport Company (for information)

8.2.4 Reagent Truck Accident

An accident involving a reagent truck or truck carrying significant quantities of hazardous substances or Dangerous Goods (e.g. caustic, sodium cyanide, diesel fuel, acid etc) in the Toms Gully Mine area is likely to require some response from the Toms Gully Mine.

The presence of leaking chemicals and possibility of fire/ explosion and having to cut persons out using hydraulic cutting equipment may require an Emergency Response Team and Darwin Fire Brigade call-out. Accurate identification of the type/s and quantities of chemicals involved is essential.

Main Threats:	• Injury to truck driver/ members of the public • Injury to team members responding to accident • Environmental impact (e.g. if road train carting ore/waste) • Impact to Company image/ reputation (if PGO Toms Gully Mine truck involved)

Alarms: None

Response:	• Call-out Emergency Services team members • Consider Emergency Response Team call-out • Initiate appropriate emergency response (first-aid/ medical/ fire/ triage/ Hazchem/ vehicle extrication) • Notify Darwin Regional Hospital (local doctor) • Notify Darwin Police • Advise Darwin St. Johns Ambulance and Fire Brigade • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Determine quantities/ types of chemicals & status (e.g. if on fire, leaking, intact etc) • Contact Chemical Supplier/ Transport Company for advice on how to treat spill & refer to MSDS • Secure area using Emergency Services or Emergency Response Team members • Notify General Manager • Notify Environmental Team Leader • GM to initiate Crisis Management, if required • Notify Mutual Aid providers, if require additional assistance with transporting injured persons, controlling situation or clean-up • Report to Government Authorities □ Dept of Minerals & Energy (if Dangerous Goods involved) □ Dept of Environmental Protection (if environmental impact results)

- **Maintain security of affected area until Police give “All Clear”**

External Help: Mutual Aid Providers
Chemical Supplier/ Transport Company (for information)
NT Fire Brigade (Hazardous Materials)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.2.5 Explosives Truck Accident

Explosives are being delivered to the Toms Gully Mine on a weekly basis from suppliers. An accident involving a truck carrying explosives has the potential to result in a fire and major explosion. This could occur in the Toms Gully Mine area on a public road and require a response from the Toms Gully Mine.

The main response is to evacuate and ensure access to the truck is completely secured at a safe distance. Expert advice should then dictate what action should be taken. Accurate identification of the type/s and quantities of explosives involved is essential.

Main Threats:	• Injury to truck driver/ members of the public • Injury to team members responding to accident • Impact to Company image/ reputation (if injury occurs)

Alarms: Nil

Response:	• Call-out Emergency Services team members • Notify Darwin Police • Report to Dept of Minerals & Energy (Explosives Branch) • Initiate Emergency Response Team call-out • Establish access control points at least 1 km from truck • Evacuate and secure area using Emergency Services and Emergency Response Team members • Access situation and identify status of explosives (e.g. on fire, intact etc) • Determine quantities/ types of explosives & type/s • Initiate appropriate emergency response (first-aid/ medical/ fire/ triage/ vehicle extrication) only if certain no potential for explosion • Contact Explosives Supplier for advice on how to treat (also refer to MSDS) • Advise Darwin St. Johns Ambulance and Fire Brigade • Notify General Manager • GM to initiate Crisis Management, if required • Maintain security of exclusion zone area until Expert (e.g. DMPR Explosives Branch) or Police gives "All Clear"

External Help: Explosives Supplier/ Transport Company (for information)
DMPR Explosives Branch
Fire Brigade (Hazardous Materials)

8.2.6 Major Bush-Fire

A major bush-fire in the Toms Gully Mine area could have a significant impact on the pastoralist and local community. In some areas, it could also result in damage to company assets. If a major bush-fire occurred, it is possible that the Toms Gully Mine would be requested to provide assistance through the provision of fire-fighting equipment/ team members and heavy earthmoving equipment (e.g. dozers, loaders, water trucks etc).

Any operation would be under the control and direction of the local Fire Brigade/ Country Fire Authority and Police. This should include what resources are required and the designated muster point.

Main Threats:	• Injury to members of the public/ local Community • Injury to team members fighting the bush-fire • Damage to town infrastructure, houses etc • Impact on families, local Community (loss of housing etc)

Notification: Request from Darwin Police or Fire Brigade to assist

Alarms: Town fire siren

Response:	• Call-out Emergency Services team members • Initiate Emergency Response Team call-out, if major fire • Muster team members at designated Muster Point (under the control of Local Authorities) • Notify contractors and request provision of any equipment required • Evacuate and secure affected area using Emergency Services and Emergency Response Team members • Notify General Manager • Advise Darwin St. Johns Ambulance (if not already aware) of potential for casualties • GM to initiate Crisis Management, if required • Maintain involvement until "All Clear/ Stand-down" given by Local Authorities

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3 ON-SITE SURFACE INCIDENTS

8.3.1 Light Vehicle Incident

Accidents involving light vehicles on site will require response from site team members. The presence of leaking fuel and possibility of having to cut persons out using hydraulic cutting equipment may require an Emergency Response Team call-out or Darwin Fire Brigade.

Main Threats: • Injury to Team Member/s

Alarms: None

Response:

- Call-out Emergency Services team members
- Initiate appropriate emergency response (first-aid/ medical/ fire/ vehicle extrication)
- Initiate Emergency Response Team call-out, if required
- Notify Darwin Regional Hospital (local doctor)
- Notify Darwin Police
- Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance
- Secure area using Emergency Services or Emergency Response Team members
- Notify General Manager
- GM to initiate Crisis Management, if required
- Notify Contractor Team Leader, if involves contractor team members
- Report to Department of Minerals & Energy
- Maintain security of affected area until Police or DMPR give "All Clear"
- Initiate appropriate investigation (may need to maintain security of area until completed)

External Help: Royal Flying Doctor Service (Medical Evacuation)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.2 Heavy Vehicle Accident

Accidents involving heavy vehicles (e.g. trucks, cranes, loaders, dump trucks, buses etc) on site will require response from site emergency team members.

An accident involving a bus or heavy vehicle-light vehicle collision has the potential for multiple injuries. If heavy equipment is carrying hazardous substances, environmental impacts may also occur.

The presence of leaking fuel and possibility of having to cut persons out using hydraulic cutting equipment may require Emergency Response Team call-out or Darwin Fire Brigade.

Main Threats:	• Injury to truck driver/ other team members • Environmental impact (e.g. if carrying hazardous substances) • Impact to Company image/ reputation

Alarms: None

Response:	• Call-out Emergency Services team members • Consider Emergency Response Team call-out, if required • Consider initiating Emergency Duty Card system (if major incident) • Initiate appropriate emergency response (first-aid/ medical/ fire/ triage/ Hazchem/ vehicle extrication) • Isolate any energy sources or contain hazardous substances (e.g. power if hit power line, gas, diesel, reagents etc) • Notify Darwin Regional Hospital (local doctor) • Notify Darwin Police • Advise Darwin St. Johns Ambulance and Fire Brigade • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Secure area using Emergency Services or Emergency Response Team members • Notify General Manager • Notify Contractor Team Leader, if involves contractor team members • Notify Environmental Team Leader (if any likely environmental impact) • GM to initiate Crisis Management, if required • Notify Mutual Aid providers, if require additional assistance with transporting injured persons (e.g. if bus involved) • Report to Government Authorities □ Dept of Minerals & Energy (if Dangerous Goods

involved)

- ❑ Dept of Environmental Protection (if environmental impact results)
- If rubber-tyred equipment strikes power line or tyres subject to heating or fire, park up in secured/ isolated area for 24 hours (refer Section 4.3.9 “Tyre Fire/ Explosion”)
- Maintain security of affected area until Incident Controller or Police/ DMPR give “All Clear”
- Initiate appropriate investigation (may need to maintain security of area until completed)
- Arrange clean-up using crane, low-loader etc

External Help: Mutual Aid Providers
Chemical Supplier/ Transport Company (for information)
WA Fire Brigade (Hazardous Materials)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.3.3 Hazardous Substance Release

A release of a hazardous substance can impact people over a wide area, particularly those working down-wind of the release. Common hazardous substances that could be released are Hydrogen Cyanide gas, Sulphur Dioxide gas, etc. If a major release, an area evacuation should be the initial response.

Main Threats: ● Injury to team members

Alarms: Area Evacuation Alarms

Response:

- Call-out Emergency Services team members with full BA gear
- Consider Emergency Response Team call-out, if required
- Initiate Area Evacuation Alarm
- Consider initiating Emergency Duty Card system (if major incident)
- Initiate appropriate emergency response (first-aid/ medical/ fire/ / Hazchem/ assisted evacuation)
- Determine likely location and source of release, if safe
- Determine likely quantity of hazardous substance
- Check MSDS for treatment & control advice
- Isolate any energy sources or hazardous substances release (if safe)
- Notify General Manager
- GM to initiate Crisis Management, if required
- Notify Darwin Regional Hospital (local doctor)

- **Notify Darwin Police (if potential fatality)**
- **Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance**
- **Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties)**
- **Secure area using Emergency Services or Emergency Response Team members**
- **Notify Contractor Team Leader, if involves contractor team members**
- **Notify Environmental Team Leader (if any likely environmental impact)**
- **Report to Government Authorities**
 - **Department of Minerals & Energy**
 - **Dept of Environmental Protection (if environmental impact results)**
- **Maintain security of affected area until incident Controller and DMPR give “All Clear”**
- **Initiate appropriate investigation (may need to maintain security of area until completed)**
- **Arrange clean-up or neutralization based on MSDS or supplier’s instructions**

External Help: Mutual Aid Providers
Chemical Suppliers
WA Fire Brigade (Specialist Fire Fighting Section)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.3.4 Fixed Plant Accident

Accidents involving fixed plant typically occur during maintenance. Examples of fixed plant at the Toms Gully Mine are gyrator crusher, conveyors, ball mills, compressors, feeders, etc.

The first response is to isolate the power source so it is safe for rescue team members to commence work. The possibility of entrapment or having to cut persons out using hydraulic cutting equipment may require Emergency Response Team call-out or Darwin Fire Brigade.

Main Threats: • **Injury to team members**

Alarms: None

Response:

- **Call-out Emergency Services team members with Rescue Trailer**
- **Consider Emergency Response Team call-out, if required**
- **Consider initiating Emergency Duty Card system (if major incident)**

- Isolate any energy sources or hazardous substances (e.g. turn off power/ reagents, secure falling rocks in crusher etc)
- Initiate appropriate emergency response (first-aid/ medical/ fire/ entrapment rescue/ HAZMAT procedure etc)
- Notify General Manager
- GM to initiate Crisis Management, if required
- Notify Darwin Regional Hospital (local doctor)
- Notify Darwin Police (if potential fatality)
- Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance
- Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties)
- Secure area using Emergency Services or Emergency Response Team members
- Notify Contractor Team Leader, if involves contractor team members
- Report to Department of Minerals & Energy
- Maintain security of affected area until incident Controller and DMPR give "All Clear"
- Initiate appropriate investigation (may need to maintain security of area until completed)
- Maintain security of affected area until Incident Controller and DMPR give "All Clear"
- Initiate appropriate investigation (may need to maintain security of area until completed)

External Help: Mutual Aid Providers
Crane Contractor (heavy lifting)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.5 Aircraft Crash

An aircraft crash at the Toms Gully Mine could result in damage to mine infrastructure and team members as well as persons travelling in the aircraft itself. Aircraft conducting low level work (e.g. geophysical surveys, aerial surveys) are the most likely to crash however this application would be rare.

Any immediate response is likely to be by site team members with back up from local authorities. In most cases, the police will be the controlling body through LEMAC. Once the initial response has been undertaken, securing of the area for investigation by government authorities (i.e. Bureau of Air Safety) is essential.

Main Threats:	• Injury to team members • Damage to site infrastructure/ facilities/ equipment • Intense media attention

Alarms: None

Response:	• Call-out Emergency Services team members • Consider Emergency Response Team call-out, if required • Consider initiating Emergency Duty Card system (if crash has impact on mine infrastructure) • Notify Darwin Police • Notify Bureau of Air Safety • Isolate any energy sources or hazardous substances (e.g. turn off power/ reagents, gas etc) • Initiate appropriate emergency response (first-aid/ medical/ fire/ entrapment rescue/ BA rescue etc) • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) • Advise Darwin St. Johns Ambulance and Fire Brigade • Advise Darwin Hospital and RFDS of possible need for assistance (if multiple casualties) • Secure area using Emergency Services or Emergency Response Team members • Report to Department of Minerals & Energy • Maintain security of crash area until cleared by DMPR/ Bureau of Air Safety

External Help: Bureau of Air Safety (Accident Notification)
Civil Aviation Authority

8.3.6 Armed Hold-Up/ Hostage Situation

An armed hold-up at the mine may result in a hostage situation. In all cases, site team members should cooperate with demands made and not attempt to aggravate or apprehend armed robbers. The key aspect here is to remain calm and try to record as much detail as possible about the offenders.

- Main Threats:**
- Injury/ harm to team members
 - Impact on company image/ reputation

Notification: Possible triggering of Gold Room security/ duress alarm

Alarms: None (should not be used)

- Response:**
- Instruct team members to remain calm and not resist demands
 - Notify Darwin Police
 - Notify Gold Stealing Detention Unit (GSDU)
 - Notify General Manager or Department Head
 - Initiate appropriate emergency response (e.g. first-aid, evacuate), depending on location of armed offenders
 - Do not turn on evacuation siren (may distress armed offenders)
 - Secure area at safe distance using Emergency Services Team members
 - Allow armed offenders to depart site (i.e. do not attempt to apprehend or hinder)
 - Await Police arrival/ instructions
 - Isolate and treat/ comfort those involved (while awaiting Police arrival)
 - GM to initiate Crisis Management, if required
 - Notify Darwin Regional Hospital (local doctor) if persons injured
 - Advise Darwin St. Johns Ambulance if require assistance
 - Arrange counseling for affected person/s
 - Maintain security of area until cleared by Police

External Help: Occupational Services Counseling Service
Police Armed Robbery Squad

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.7 Plant Explosion

An explosion at the PGO Toms Gully Mine Gold Plant could occur as a result of leaking LPG or acetylene gas, over-pressured pressure vessels or air receivers or exploding flammable materials. It may also be the result of a fire or itself trigger a fire. In any case, the initial response is to evacuate the area and await the arrival of the Emergency Response Team.

Main Threats:	• Injury to team members • Loss of company assets • Disruption to production • Adverse impact on Company image

Alarms: Area Evacuation Alarms

Response:	• Call-out Emergency Services team members • Call out Emergency Response Team with full BA gear • Initiate Area Evacuation Alarm • Initiate Emergency Duty Card system (if major incident) • Initiate appropriate emergency response (first-aid/ medical/ fire/ / Hazchem/ assisted evacuation) • Determine likely location and source of explosion, if safe • Secure affected area/s at safe distance using Emergency Response Team members • Isolate any energy sources or hazardous substances release (if safe) • Determine quantities/ types of other hazardous substances in area • Check MSDS for treatment & control advice • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) • Notify Darwin Police (if potential fatality) • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Advise Mutual Aid partners, if require assistance • Notify Contractor Team Leader, if involves contractor team members • Notify Environmental Team Leader (if any likely environmental impact) • Report to Government Authorities □ Department of Minerals & Energy □ Dept of Environmental Protection (if environmental

impact results)

- **Maintain security of affected area until Incident Controller and DMPR give “All Clear”**
- **Initiate appropriate investigation (may need to maintain security of area until completed)**
- **Arrange clean-up of affected area**

External Help:

Mutual Aid Providers
Chemical Suppliers
WA Fire Brigade (Specialist Fire Fighting Section)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.3.8 Bulk LPG Storage Incident

A leak at Bulk LPG Storage (“gas bullets”) at the Toms Gully Mine could result in a fire and major explosion. For any fire or gas leak, expert advice should be obtained before any attempt is made at to extinguish the fire or repair the leak. Gas bullet explosions can be devastating; so total evacuation to a safe distance should be the initial response.

Main Threats:

- **Injury to team members**
- **Loss of company assets**
- **Disruption to production**

Alarms:

Area Evacuation Alarms

Response:

- **Call-out Emergency Services team members**
- **Call out Emergency Response Team**
- **Initiate Area Evacuation Alarm**
- **Initiate Emergency Duty Card system (if major incident)**
- **Secure exclusion zone from bullets (at least 1 kilometer radius) using Emergency Services & Emergency Response Team members**
- **Initiate appropriate emergency response (first-aid/ medical/ assisted evacuation) but do not attempt to fight major gas fire**
- **Notify General Manager**
- **GM to initiate Crisis Management, if required**
- **Determine quantity of gas in bullets, if possible. If cannot determine, assume they are full.**
- **Contact Gas Supplier for advice on how to proceed**
- **Determine likely impact of any explosion and ensure affected area is evacuated**
- **Secure affected area/s at safe distance using Emergency Response Team members**

- **Notify Darwin Regional Hospital (local doctor) if any injuries**
- **Notify Darwin Police (if potential fatality)**
- **Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance**
- **Advise Darwin Hospital and RFDS of possible need for assistance (if multiple casualties)**
- **Advise Mutual Aid partners, if require assistance**
- **Notify Contractor Team Leader, if involves contractor team members**
- **Notify Environmental Team Leader (if any likely environmental impact)**
- **Report to Government Authorities**
 - **Department of Minerals & Energy**
 - **Dept of Environmental Protection (if environmental impact results)**
- **Maintain security of affected area until Incident Controller and DMPR give “All Clear”**
- **Initiate appropriate investigation (may need to maintain security of area until completed)**
- **Arrange clean-up of affected area**

External Help:

Mutual Aid Providers
WA Fire Brigade (Specialist Fire Fighting Section)
Gas Supplier (e.g. Kleenheat)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.3.9 Surface Magazine Fire/ Explosion

A fire in a surface explosive magazine has the potential to result in a major explosion. Magazines should be located so that any such explosion has minimal impact on local area operations or mine. The initial response should be to evacuate the area to a safe distance and wait for expert assistance.

Main Threats:	• Injury to team members • Damage to mine infrastructure (depends on location) • Adverse impact on Company image

Alarms: Area Evacuation Alarms (if Magazine nearby)

Response:	• Call-out Emergency Services team members • Initiate evacuation alarms, if Magazine located within one kilometer of working areas • Call out Emergency Response Team, if required • Initiate Emergency Duty Card system (if major impact) • Secure area at safe distance (at least 1 km) using Emergency Services or Response Team members • Maintain <i>exclusion zone</i> of at least 1 kilometer radius (do not attempt to extinguish fire) • Initiate appropriate emergency response (first-aid/ medical/ assisted evacuation) • Refer to Magazine Manifest/ MSDS for relevant information (assume maximum quantity of explosives present until sure of exact amount) • Contact Explosives Supplier for advice on how to respond • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Notify Darwin Police (if potential fatality) • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Department of Minerals & Energy • Maintain security of affected area until Incident Controller and DMPR give "All Clear" (and fire extinguishes itself)

8.3.10 Collapse/ Fall Into Old Workings

Old workings could include abandoned shafts; remnant stopes or voids encountered during the mining or exploration.

A collapse or fall could involve equipment (e.g. drill rigs, trucks, light vehicles) or individual persons. The possibility of having to extract injured persons (possibly using rope rescue) will require Emergency Response Team call-out.

Main Threats:	• Injury to team members • Adverse impact on Company image (if serious injury)

Alarms: None

Response:	• Call-out Emergency Services team members • Call out Emergency Response Team • Initiate Emergency Duty Card system (if major incident) • Initiate appropriate emergency response (first-aid/ medical/ search/ rope rescue/ call for back-up equipment etc) • Notify General Manager • GM to initiate Crisis Management, if required • Notify Geotechnical Team Leader (for void/ old workings collapse) • Notify Darwin Regional Hospital (local doctor) if injuries occur • Notify Darwin Police (if potential fatality) • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Department of Minerals & Energy • Maintain security of affected area until Incident Controller and DMPR give "All Clear" • Initiate appropriate investigation (may need to maintain security of area until completed)

External Help:	Mutual Aid Providers Royal Flying Doctor Service (Medical Evacuation) Open Pit Mining Contractor (Help Extract Equipment) Geotechnical Expert (Independent Advice/Assist With Recovery Plan)

8.3.11 Tailings Dam Wall Failure

A tailings dam wall breach or failure can result in a major tailings spill. The location of the tailings dams near open pits can pose a further risk, depending on the location and nature of the failure. A wall failure may be preceded by cracking and minor leakage (i.e. “wet spots”) that may be visible. Regular monitoring of dam walls may help identify any potential failures.

Main Threats:	• Disruption to production • Environmental impact • Adverse impact on Company image (if environmental impact)

Alarms: None

Response:	• Call-out Emergency Services team members • Notify Mill team members to immediately isolate tailings line/s • Initiate Emergency Duty Card system (if major incident) • Consider call out Emergency Response Team, if likely to impact Team member safety (e.g. inrush into adjoining pit) • Initiate appropriate emergency response (first-aid/ medical/ rope rescue/ pit evacuation, call for heavy equipment etc) • Notify General Manager • GM to initiate Crisis Management, if required • Notify Metallurgy Team Leader • Notify Geotechnical Team Leader • Notify Environment Team Leader • Notify Darwin Regional Hospital (local doctor) if injuries occur • Notify Darwin Police (if potential fatality) • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Advise Darwin Hospital and RFDS of possible need for assistance (if multiple casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Government Authorities □ Department of Minerals & Energy □ Dept of Environmental Protection (if environmental impact results) • Commence containment operations to reduce impact • Maintain security of affected area until Incident Controller and DMPR give “All Clear”

- **Arrange for assistance with clean-up**
- **Initiate appropriate investigation (may need to maintain security of area until completed)**

External Help:

Mutual Aid Providers

Open Pit Mining Contractor (provision of equipment to help contain spill)

Geotechnical Expert (independent advice/ assist with recovery plan)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.12 Building Collapse

Building collapse can be the result of a seismic event, explosion or major structural failure. The areas most at risk are the Admin buildings (e.g. PGO Toms Gully Mine Admin Office). The initial response should be to evacuate the area to a safe distance and wait for expert assistance.

Main Threats:	• Injury to team members • Damage to infrastructure/ assets • Adverse impact on Company image

Alarms: Area Evacuation Alarms

Response:	• Call-out Emergency Services team members • Initiate Emergency Duty Card system (if a PGO significant event) • Initiate area evacuation alarms & evacuate to safe locations (e.g. designated Muster points may be too close) • Call out Emergency Response Team • Secure area at safe distance using Emergency Services or Response Team members • Initiate appropriate emergency response (first-aid/ medical/ assisted evacuation/ fire fighting/ rescue) • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Notify Darwin Police • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Department of Minerals & Energy • Arrange for expert assistance (e.g. collapse building search) through Darwin Police/ SES • Maintain security of affected area until Incident Controller and DMPR give "All Clear"

External Help: Mutual Aid Providers
RFDS (Medical Evacuation)
Darwin Hospital

8.3.13 Working At Height Incident

Team members work at heights on a daily basis, particularly around processing plants. Should a person fall, it may be necessary to undertake "height rescue" using site team members.

This type of event could involve a person being suspended from fall arrest equipment and being seriously injured or otherwise incapacitated. The possibility of having to extract injured persons (possibly using rope rescue) will require Emergency Response Team call-out.

Main Threats:	• Injury to team members/ emergency response team members • Adverse impact on Company image (if serious injury)

Alarms: None

Response:	• Call-out Emergency Services team members • Call out Emergency Response Team • Initiate Emergency Duty Card system (if a significant event) • Assess situation to identify appropriate rescue method (e.g. rope rescue, use of crane with man-basket/ cherry picker etc) • Isolate any energy sources (e.g. power) or hazardous substances, if required • Initiate appropriate emergency response (first-aid/ medical/ rope rescue/ call for back-up equipment etc) • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Notify Darwin Police (if potential fatality) • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Department of Minerals & Energy • Maintain security of affected area until Incident Controller and DMPR give "All Clear" • Initiate appropriate investigation (may need to maintain security of area until completed)

External Help: Mutual Aid Providers
Royal Flying Doctor Service (Medical Evacuation)
Crane Contractor

8.3.14 Potential Tyre Fire/ Explosion

Tyre fires or explosions can result when equipment or vehicle tyres are heated due to welding/ cutting, an equipment or vehicle fire, contact with power lines or heating due to mechanical failure or damage (e.g. operating with deflated tyre, brake failure, rubbing on guards etc).

A tyre explosion can cause devastating results, particularly for large earthmoving equipment tyres. Tyre explosions are unpredictable and may occur even if tyres are deflated and there are no visible signs of fire or heating. Evacuation of team members to a safe distance (at least 500 metres) and sealing off the area for 24 hours should occur if there is any likelihood of tyre fire or explosion. Where possible, special areas should be identified and designated as “emergency park-up areas” in case equipment or vehicles hit power lines or are suspect of having over-heated tyres.

Main Threats:	• Injury to team members • Loss of company assets (if explosion occurs) • Disruption to production

Alarms: None

Response:	• Refer to Tyre Fires Procedures • Instruct equipment operator/ driver to park-up equipment/ vehicle in designated safe location (if possible) and leave area immediately • Call-out Emergency Services • Call out Emergency Response Team • Evacuate area inside “safe” distance (at least 500 metres) • If underground, consider evacuation of mine due to impact on ventilation (i.e. fire produces toxic fumes, air-blast from explosion, etc) • Secure area using Emergency Services or Emergency Response Team (control points at least 500 metres away) • Isolate any energy sources (e.g. power if equipment has hit power line) • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) if any injuries • Report to Department of Minerals & Energy • Maintain secure access to park-up site or tyre location for 24 hr • Develop “safe approach” strategy • Initiate appropriate investigation (may need to maintain security of area until completed)

8.3.15 Building/ Plant Fire

A surface building fire can occur at any location where fuel and ignition sources exist. The greatest impact of a surface fire is at the Concentrator and Gold Plant, where any fire is likely to cause a disruption to production. Locations for significant fire potential are conveyors, electrical control rooms, workshops and reagent/ fuel storage areas.

Main Threats:	• Injury to team members • Loss of company assets • Adverse impact on Company image • Disruption to production

Alarms: Area Evacuation Alarms

Response:	• Call-out Emergency Services • Call-out Emergency Response Team call-out with full BA • Initiate Emergency Duty Card system • Initiate appropriate emergency response (first-aid/ medical/ assist evacuation/ BA rescue etc) • Isolate any energy sources or hazardous substances (e.g. power, gas, diesel, reagents etc) • Secure area using Emergency Services or Emergency Response Team • Notify General Manager • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Notify Darwin Police (if potential fatality) • Advise Mutual Aid partners, if require assistance (e.g. additional fire fighting equipment etc) • Advise Darwin Hospital and RFDS of possible need for assistance (if multiple casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Government Authorities □ Department of Minerals & Energy □ Dept of Environmental Protection (if environmental impact results) • Maintain security of affected area/s until Incident Controller and DMPR give "All Clear" • Initiate appropriate investigation (may need to maintain security of area until completed)

External Help: Mutual Aid Providers
WA Fire Brigade (Specialist Fire Fighting Section)
Chemical/ Reagent Suppliers (for specific fire fighting advice)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.16 Malicious Damage

Malicious damage can involve any intentional act by a Team member, contractor or member of the public that is intended to disrupt operations or damage equipment or property.

Examples are setting fires (arson), sabotaging equipment, opening valves to waste reagents or other chemicals, initiating explosives etc. Malicious intent is often difficult to identify as the deliberate act may be well concealed. Any suspicion that acts may be deliberate should be notified to the police for formal investigation.

Main Threats:	• Injury to team members • Loss of company assets (if fire/ explosion occurs) • Disruption to production

Alarms: None

Response:	• Call-out Emergency Services • Consider Emergency Response Team call-out, if required • Initiate Emergency Duty Card system (if major incident occurs) • If fire or explosion, evacuate affected area/s • Initiate appropriate emergency response (first-aid/ medical/ fire/ Hazchem response/ assisted evacuation etc) • Isolate any energy sources or hazardous substances (e.g. power, gas, diesel, reagents etc) • Secure area using Emergency Services or Emergency Response Team • Notify General Manager or senior site Team Leader of possible malicious intent • GM to initiate Crisis Management, if required • Notify Darwin Police • Await Police instructions/ arrival to investigate • Assist Police with investigation • Report any injuries to Department of Minerals & Energy • Maintain security of affected area/s until Police give "All Clear"

External Help: Mutual Aid Providers

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.17 Inrush Into Open Pit

An inrush of water, mud or tailings into an open pit is only likely to occur following a major flood event or tailings dam wall failure. Establishment of an evacuation process in case of major rainfall may alleviate the need for an emergency response.

If a sudden inrush does occur, evacuation from the pit or moving to a safe place within the pit itself is the best course of action. This will depend on the location of the inrush and volume of material involved. Egress from the pit can then be made once the inrush has stabilized. The possibility of having to evacuate injured persons quickly over the pit wall (if no vehicle access) may require Emergency Response Team call-out.

Main Threats:	• Injury to team members • Adverse impact on Company image • Disruption to production

Alarms: None

Response:	• Call-out Emergency Services • Consider Emergency Response Team call-out, if required • Initiate Emergency Duty Card system (if major incident occurs) • Initiate appropriate emergency response (first-aid/ medical/ search/ pit evacuation/ rope rescue, etc) • Secure area using Emergency Services or Emergency Response Team • Notify General Manager and Mining Team Leader • GM to initiate Crisis Management, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Notify Darwin Police (if potential fatality) • Advise Mutual Aid partners, if require assistance (e.g. additional pumps, etc) • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Dept of Minerals & Energy • Maintain security of affected area/s until Incident Controller and DMPR give "All Clear" • Initiate appropriate investigation (may need to maintain security of area until completed)

External Help: Mutual Aid Providers

Equipment Hire Companies (pumps to de-water pit)
Open Pit Mining or Ore Haulage Contractor (provision of dozer, etc to help cut access track)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.3.18 Open Pit Wall/ Ramp Failure

Open Pit wall or access ramp failures are often preceded by cracking and ground movements, which may be visible. Regular monitoring of pit walls, crests and berms may help identify any potential failures.

If a sudden failure occurs, evacuation to a safe place within the pit itself is usually the best course of action. Egress from the pit can then be made once an access way is re-cut. The possibility of having to evacuate injured persons quickly over the pit wall (if no vehicle access) may require Emergency Response Team call-out.

Main Threats:	• Injury to team members • Adverse impact on Company image • Disruption to production

Alarms: None

Response:	• Call-out Emergency Services • Consider Emergency Response Team call-out, if required • Initiate Emergency Duty Card system (if major incident occurs) • Initiate appropriate emergency response (first-aid/ medical/ search /pit evacuation/ rope rescue etc) • Secure area using Emergency Services or Emergency Response Team • Notify General Manager • GM to initiate Crisis Management, if required • Notify Mining Team Leader and Geotechnical Team Leader • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance and Fire Brigade, if require assistance • Notify Darwin Police (if potential fatality) • Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment etc) • Advise Darwin Hospital and RFDS of possible need for assistance (if several casualties) • Notify Contractor Team Leader, if involves contractor team members • Report to Department of Minerals & Energy

- **Maintain security of affected area/s until Incident Controller and DMPR give “All Clear”**
- **Initiate appropriate investigation (may need to maintain security of area until completed)**

External Help:

Mutual Aid Providers
Royal Flying Doctor Service (Medical Evacuation)
Open Pit Mining or Ore Haulage Contractor (provision of dozer, etc to help cut access track)
Geotechnical Expert (independent advice/ assist with recovery plan)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.3.19 Bomb Threat

Bomb threats are usually made to administration staff by telephone and must be taken seriously. The key aspect here is to remain calm and try to record as much detail as possible about the threat itself.

Main Threats:	• Potential for injury to team members • Impact on person receiving the call/ threat • Disruption to production

Alarms: Area Evacuation Alarms

Response:	• Person receiving call to remain calm and record information regarding the threat using the “Bomb Threat Check-list” • Call-out Emergency Services • Initiate Emergency Duty Card system (if area evacuation required) • Initiate area evacuation, if required (but keep people calm) • Notify General Manager or senior site Team Leader • Notify Darwin Police • Initiate appropriate emergency response (first-aid/ medical/ search / assisted evacuation, etc) • Secure affected area at safe distance using Emergency Services Team members • GM to initiate Crisis Management, if required • Await Police arrival/ instructions • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance and Fire Brigade that potential for assistance exists • If bomb detonates, treat as “Explosion” • Notify Contractor Team Leader, if involves contractor team members • Report to Department of Minerals & Energy • Arrange counseling for affected persons, including person who received Bomb Threat • Maintain security of affected area/s until Incident Controller and Police give “All Clear” • Assist Police with investigation

External Help: Police Bomb Squad

8.4 ON-SITE UNDERGROUND INCIDENTS

8.4.1 Rock-Fall/ Rock-Burst or Ground Collapse

An underground rock-fall or major ground collapse is likely to result in significant injury, equipment damage and disruption to mine production.

The initial response should be to get all team members to a safe place (e.g. FABs) and conduct a formal head count. Safe evacuation to surface should then be conducted.

Main Threats:	• Potential for injury to team members • Impact on Company image (if serious injury) • Disruption to production

Alarms: Emergency Underground Radio Call

Response:	• Call-out Emergency Services • Call-out Emergency Response Team • Initiate Emergency Duty Card system (if persons injured/ trapped or major collapse) • Initiate evacuation to FABs/ Refuge Chambers, if required • Notify General Manager • GM to initiate Crisis Management, if required • Initiate appropriate emergency response (first-aid/ medical/ account for all team members/ search/ rescue/ entrapment, etc) • Notify Mining Team Leader and Underground Team Leader • Notify Geotechnical Team Leader • Assess situation/ damage & develop Recovery Plan • Isolate any hazardous energy sources (e.g. power), if required • Notify Darwin Police (if potential fatality) • Secure mine area using Emergency Services Team members, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance if require assistance • Notify Contractor Team Leader, if involves contractor team members • Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment, etc) • Report to Department of Minerals & Energy • If persons trapped, consider initiating "Prolonged

Event” Procedure (refer “Toms Gully procedures”)

- **Maintain security of affected area/s until Incident Controller and DMPR give “All Clear”**
- **Initiate appropriate investigation (may need to maintain security of area until completed)**

External Help:

Mutual Aid Providers
Underground Mining Contractor (provision of equipment to assist rescue)
Geotechnical Expert (independent advice/ assist with recovery plan)
Southern Mines Rescue, NSW (entrapment advice)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.4.2 Underground Mobile Equipment/ Light Vehicle Accident

Accidents involving mobile equipment (e.g. trucks, bidders, ITs, jumbos) or light vehicles underground may result in serious injury or pose a fire risk.

The presence of leaking fuel and possibility of having to cut persons out using hydraulic cutting equipment may require Emergency Response Team call-out.

Main Threats:

- **Potential for injury to team members**
- **Impact on Company image (if serious injury results)**

Alarms:

None

Response:

- **Call-out Emergency Services**
- **Initiate Emergency Duty Card system, if potential for fire or multiple injuries**
- **Consider Emergency Response Team call-out, if require rescue response**
- **Consider evacuation to FABs/ Refuge Chambers if potential for major equipment fire**
- **Notify General Manager**
- **GM to initiate Crisis Management, if required**
- **Notify Mining Team Leader and Underground Team Leader**
- **Initiate appropriate emergency response (first-aid/ medical/ fire/ vehicle extrication/ evacuate if potential fire risk, etc)**
- **Isolate any energy sources or hazardous substances (e.g. power if hit power cables, diesel leaks, explosives, compressed air, etc)**
- **Notify Darwin Police (if potential fatality)**
- **Secure area (stop traffic, etc) using Emergency Response Team or site team members**

- If rubber-tyred equipment strikes power cables, park up in secured/ isolated area (in return airway) for 24 hours (refer “Tyre Fires/ Explosion”)
- Notify Darwin Regional Hospital (local doctor) if injuries occur
- Advise Darwin St. Johns Ambulance if require assistance
- Notify Contractor Team Leader, if involves contractor team members
- Report to Department of Minerals & Energy
- Maintain security of affected area/s until Incident Controller and DMPR give “All Clear”
- Arrange clean-up using bogger, truck etc
- Initiate appropriate investigation (may need to maintain security of area until completed)

External Help: Mutual Aid Providers
Royal Flying Doctor Service (Medical Evacuation)
Darwin Fire Brigade (for hydraulic cutting equipment)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.4.3 Major Underground Fire

A major underground fire is likely to result due to a small equipment or light vehicle fire getting out of control. The impacts of a fire on the mine will depend on the location of the fire, the mine ventilation and the quantity of fuel available. Fires involving heavy rubber-tyred equipment located in fresh air intakes are likely to have a major impact and affect the ability to safely evacuate the mine.

The initial response should be to get all team members to a safe place (e.g. FABs) and then evacuate the mine, once the fire is under control. Fighting the fire will require an Emergency Response Team call-out.

Main Threats:

- Potential for injury to team members
- Impact on Company image (if serious injury results)

Alarms: Emergency Underground Radio Call
Stench Gas

Response:

- Call-out Emergency Services
- Call-out Emergency Response Team (full U.G. BA response)
- Initiate Emergency Duty Card system
- Initiate evacuation to FABs/ Refuge Chambers by activating Stench Gas/ emergency radio call
- Notify General Manager

- GM to initiate Crisis Management, if required
- Notify Mining Team Leader and Underground Team Leader
- Notify Underground Ventilation Engineer/ Officer
- Assess situation/ damage & develop Response Plan
- Initiate appropriate emergency response (first-aid/ medical/ contact FABs/ account for all team members/, evacuate mine/ fight fire using BG-4s etc)
- Isolate any hazardous energy sources (e.g. power), if required
- Notify Darwin Police (if potential fatality)
- Secure mine area using Emergency Services Team members, if required
- Notify Darwin Regional Hospital (local doctor) if injuries occur
- Advise Darwin St. Johns Ambulance if require assistance
- Notify Contractor Team Leader, if involves contractor team members

- If persons trapped, consider initiating “Prolonged Event” Procedure (*refer “Toms Gully procedures”*)
- Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment, back-up teams etc)
- Report to Department of Minerals & Energy
- Maintain security of affected area/s until Incident Controller and DMPR give “All Clear”
- Initiate appropriate investigation (may need to maintain security of area until completed)

External Help:

Mutual Aid Providers
 Ventilation expert (advice on ventilation aspects)
 Underground Fire fighting expert (advice on how to fight fire)
 Southern Mines Rescue, NSW (entrapment advice)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.4.4 Significant Underground Fuming

A major fuming could be the result of re-entering areas after blasting which still contain significant amounts of blast fumes, from the release of noxious gases such as carbon monoxide, carbon dioxide or methane or from a ventilation system failure.

The presence of toxic fumes or lack of breathable air will require Emergency Response Team call-out utilizing Breathing Apparatus and Gas Detection equipment. A major fuming may require total evacuation of the mine until sustainable, breathable air can be established.

Main Threats:	• Potential for injury to team members • Impact on Company image (if serious injury results)

Alarms:	Emergency Underground Radio Call Stench Gas

Response:	• Call-out Emergency Services • Call-out Emergency Response Team (full U.G. BA response & gas detectors) • Initiate Emergency Duty Card system • Consider evacuation of other team members to safe locations (i.e. FABs/ Refuge Chambers) by activating Stench Gas/ emergency radio call • Notify General Manager • GM to initiate Crisis Management, if required • Notify Mining Team Leader and Underground Team Leader • Notify Underground Ventilation Engineer/ Officer • Assess situation/ damage & develop Response Plan • Initiate appropriate emergency response (re-entry with BA/ first- aid/ medical/ fire/ search & rescue/ evacuate mine if major risk, etc) • Notify Darwin Police (if potential fatality) • Secure mine area using Emergency Services Team members, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance if require assistance • Notify Contractor Team Leader, if involves contractor team members • Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment etc) • Report to Department of Minerals & Energy • Maintain security of affected area/s until Incident Controller and DMPR give "All Clear"

- **Initiate appropriate investigation (may need to maintain security of area until completed)**

External Help: Mutual Aid Providers
Ventilation expert (advice on ventilation aspects)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.4.5 Major Underground Explosion

An explosion underground could result from a fire in underground explosives Magazine, an ignition of gas or dust, or the initiation of explosives following a vehicle accident. A major air-blast could result from a major ground collapse or inrush. Such an explosion or air-blast has the potential to affect mine ventilation and normal access via declines or emergency escape ways.

The most likely source of a Magazine fire is from equipment accessing magazines or other introduced ignition sources (e.g. smoking). Magazines must be located and constructed so that any such fire or explosion has minimal impact on the mine operations.

- Main Threats:**
- **Team members injured as a result of explosion**
 - **Mine closure/ impact on production**
 - **Damage to mine infrastructure (decline access, escape ways etc)**
 - **Impact on Company image (if serious injury results)**

Alarms: Emergency Underground Radio Call
Stench Gas

- Response:**
- **Call-out Emergency Services**
 - **Initiate Emergency Duty Card system**
 - **Initiate evacuation to FABs/ Refuge Chambers by activating Stench Gas/ emergency radio call**
 - **Call-out Emergency Response Team (full U.G. BA response & gas detectors)**
 - **Consider evacuation of other team members to safe locations (i.e. FABs/ Refuge Chambers) by activating Stench Gas/ emergency radio call**
 - **Notify General Manager**
 - **GM to initiate Crisis Management, if required**
 - **Notify Mining Team Leader and Underground Team Leader**
 - **Assess likely impact of explosion (based on how many persons U.G. & known locations, known size of explosion, likely location, likely impact on escape ways/ mine access etc)**
 - **Assess situation/ damage & develop Response Plan**

- Initiate appropriate emergency response (re-entry with BA/ first-aid/ medical/ fire/ search & rescue/ evacuate mine, etc)
- Notify Darwin Police (if potential fatality)
- Report to Department of Minerals & Energy
- Secure mine area at using Emergency Services Team members, if required
- Maintain *exclusion zone* of at least 500 m from all mine openings (portal, shafts, vent raises etc)
- If Magazine explosion:
 - Initiate Magazine fire suppression system, where available
 - Evacuate team members working above Magazine & on surface
 - Refer to Magazine Manifest/ MSDS for relevant information
(assume maximum quantity of explosives present until sure of exact amount)
 - Contact Explosives Supplier for advice on how to proceed
- Notify Darwin Regional Hospital (local doctor) if injuries occur
- Advise Darwin St. Johns Ambulance if require assistance
- Notify Contractor Team Leader, if involves contractor team members
- Evacuate remaining underground team members, if safe
- If persons trapped, consider initiating “Prolonged Event” Procedure (refer “Emergency Management Guidelines”)
- Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment, back-up teams, etc)
- Maintain security of affected area/s until Incident Controller and DMPR give “All Clear”
- Initiate appropriate investigation (may need to maintain security of area until completed)

External Help:

Explosive Suppliers
Mutual Aid Providers
Southern Mines Rescue, NSW (entrapment advice)

Refer to “Emergency Telephone Directory” for Contact Numbers

8.4.6 Trapped Person/s

A trapped person/s incident may be the result of a rock-fall or explosion and will require Emergency Response Team call-out. The potential presence of toxic fumes or lack of breathable air may require the use of Breathing Apparatus.

- Main Threats:**
- Potential for injury to team members
 - Impact on Company image (if serious injury/ prolonged event results)

Alarms: Emergency Underground Radio Call
Stench Gas

- Response:**
- Call-out Emergency Services
 - Call-out Emergency Response Team
 - Initiate Emergency Duty Card system, if required
 - Consider evacuation of other team members to safe locations (i.e. FABs/ Refuge Chambers) by activating Stench Gas/ emergency radio call
 - Notify General Manager
 - GM to initiate Crisis Management, if required
 - Notify Mining Team Leader and Underground Team Leader
 - Assess situation/ damage & develop Response/ Recovery Plan
 - Initiate appropriate emergency response (re-entry with BA/ first- aid/ medical/ fire/ search & rescue/ evacuate mine if major risk, etc)
 - If likely to be prolonged rescue, consider initiating "Prolonged Event" Procedure (refer "Emergency Management Guidelines")
 - Notify Darwin Police (if potential fatality)
 - Secure mine area using Emergency Services Team members, if required
 - Notify Darwin Regional Hospital (local doctor) if injuries occur
 - Advise Darwin St. Johns Ambulance if require assistance
 - Notify Contractor Team Leader, if involves contractor team members
 - Report to Department of Minerals & Energy
 - Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment or back-up teams etc)
 - Maintain security of affected area/s until Incident Controller and DMPR give "All Clear"
 - Initiate appropriate investigation (may need to maintain security of area until completed)

External Help:

Mutual Aid Providers

Underground Mining Contractor (provision of equipment to assist rescue)

Geotechnical Expert (independent advice/ assist with recovery plan)

Southern Mines Rescue, NSW (entrapment advice)

Refer to "Emergency Telephone Directory" for Contact Numbers

8.4.7 Fall Down Open Hole

A fall into an open hole or open stope could involve equipment (e.g. drill rigs, trucks, light vehicles) or individual persons. The possibility of having to extract injured persons will require Emergency Response Team call-out. Extraction from within open stopes will require careful consideration to minimize risks to emergency team members.

Main Threats:	• Potential for injury to team members • Impact on Company image (if serious injury/ prolonged event results)

Alarms: None

Response:	• Call-out Emergency Services • Call-out Emergency Response Team • Initiate Emergency Duty Card system, if required • Notify General Manager • GM to initiate Crisis Management, if required • Notify Mining Team Leader and Underground Team Leader • Notify Contractor Team Leader, if involves contractor team members • Assess situation/ damage & develop Response/ Recovery Plan • Initiate appropriate emergency response (first-aid/ medical/ rope rescue/ call for back-up equipment/ additional lighting, etc) • Consider evacuating team members to FABs/ Crib Rooms/ Refuge Chambers to keep decline/ access-ways clear for emergency vehicles • If likely to be prolonged rescue, consider initiating “Prolonged Event” Procedure (refer “<i>Toms Gully procedures</i>”) • Notify Darwin Police (if potential fatality) • Secure mine area using Emergency Services Team members, if required • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance if require assistance • Report to Department of Minerals & Energy • Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment etc) • Maintain security of affected area/s until Incident Controller and DMPR give “All Clear” • Initiate appropriate investigation (may need to maintain security of area until completed)

8.4.8 Underground Mine Flooding/ Inrush

Inrushes of water, mud or fill material into an underground mine is likely to have a significant impact on the safety of persons in the mine. Rapid evacuation of the mine and accounting for all persons must be the focus of initial response.

Main Threats:	• Potential for injury to team members • Disruption to production • Impact on Company image (if serious injury results)

Alarms:	Underground Radio emergency call

Response:	• Call-out Emergency Services • Initiate Emergency Duty Card system • Evacuate mine by initiating emergency evacuation radio call (all persons to surface) • Call-out Emergency Response Team, if required • Notify General Manager • GM to initiate Crisis Management, if required • Notify Mining Team Leader and Underground Team Leader • Notify Geotechnical Team Leader • Notify Contractor Team Leader, if involves contractor team members • Assess situation/ damage & develop Response/ Recovery Plan • Initiate appropriate emergency response (first-aid/ medical/ search & rescue/ call for back-up equipment, pumps, etc) • Check surface for source of inrush/ attempt to stabilize or monitor • Notify Darwin Police (if potential fatality) • Secure mine area using Emergency Services Team members • Notify Darwin Regional Hospital (local doctor) if injuries occur • Advise Darwin St. Johns Ambulance if require assistance • Report to Department of Minerals & Energy • If likely to be prolonged rescue, consider initiating "Prolonged Event" Procedure (refer "Toms Gully procedures") • Advise Mutual Aid partners, if require assistance (e.g. additional rescue equipment or back-up teams, etc) • Maintain security of affected area/s until Incident Controller and DMPR give "All Clear" • Initiate appropriate investigation (may need to

maintain security of area until completed)

External Help:

Mutual Aid Providers
Equipment Hire Companies (pumps to de-water mine)
Underground Mining Contractor (equipment to assist recovery)
Police Divers, Perth

Attachment J:

Impacts Register

APPENDIX G

Environmental Aspects and Impacts Register

Activity	Toms Gully Pit	
Environmental Aspect		Environmental Impact
Emission to air	Exhaust fumes from water pumps	Generation of greenhouse gases and deterioration of air quality
Releases to surface water	Uncontrolled release of polluted water to waterways	Water quality and its affects on the health of ecological communities to downstream environments
Releases to sediments		Contamination to stream sediments
Releases to groundwater	Seepage to groundwater	Impacting on beneficial use of groundwater to community and pastoral lease owner
Releases to land	Release of polluted water to land	Destruction of habitat
Use of products and materials	Use of PVC pipelines for water transfer	Use of non recyclable or reusable materials
		Generation of waste and disposal to landfill
Use of energy	Diesel use from pumps and generators	Generation of greenhouse gases and deterioration of air quality
Use of raw materials and natural resources	None identified	
Energy emitted	None identified	
Waste and by-products	Damaged pipes	Generation of waste and disposal to landfill
Community	Release of polluted water to environment	Potential impact to pastoral lease owner and downstream communities.
Heritage	none identified	
Land displacement	Footprint of pit shell	Area of land removed is unavailable for grazing to the underlying pastoral lease owner
Biodiversity Displacement	Maintaining polluted water in the pit	Contamination to biodiversity, stock, birds, native terrestrial animals as a drinking water source
Financial Costs (ARO)	Rehabilitation and closure	Large costs for rehabilitation and closure requirements

Environmental Aspects and Impacts Register

Activity	Legacy Issue - Old and New Tailings Dam Management	
Environmental Aspect		Environmental Impact
Emission to air	Exhaust fumes from water pumps	Generation of greenhouse gases and deterioration of air quality
Emission to air	Un vegetated land surfaces	dust generation and paticulates in the air
Releases to surface water	Uncontrolled release of polluted water to waterways	Water quality and its affects on the health of ecological communities to downstream environments
Releases to surface water	Seepage Control	Water quality and its affects on the health of ecological communities to downstream environments
Releases to surface water	failure of OTD walls	Water quality and its affects on the health of ecological communities to downstream environments
Releases to sediments	Uncontrolled release of polluted water to waterways	Contamination to stream sediments
Releases to sediments	failure of OTD walls	Contamination to stream sediments
Releases to groundwater	Seepage Control	Impact to beneficial use of water to community and pastoral lease holder
Releases to land	failure of OTD walls	Potential erosion of impacted soils
Community	failure of OTD walls	Impact to beneficial use of water to community and pastoral lease holder
Community	Release of impacted surface water runoff to environment	Impact to beneficial use of water to community and pastoral lease holder
Waste and by-products	Diesel use from pumps and generators	Generation of waste and disposal to landfill
Use of energy	Diesel use from pumps and generators	Generation of greenhouse gases and deterioration of air quality
Energy emitted	None identified	
Waste and by-products	None identified	
Heritage	None identified	
Land displacement	Creation of Tailings dam on land surface	Land unavailable to the underlying pastoral lease owner
Biodiversity Displacement	Maintaining polluted water in the tailings dams	Contamination to biodiversity, stock, birds, native terrestrial animals as a drinking water source
Financial Costs (ARO)	Rehabilitation and closure	Large costs for rehabilitation and closure requirements

Environmental Aspects and Impacts Register

Activity	Oxide and Sulphide WRD management	
Environmental Aspect		Environmental Impact
Emission to air	Hazard reduction burns	Air pollution (Co2 and CH4 emission and partuclate)
Emission to air	Acid Metaliferrous Drainage and Metalliferous Drainage	Dust generation and paticulates in the air
Releases to surface water	Weed spraying (Herbicide use)	Herbicide impact to aquatic flora and fauna species
Releases to surface water	Hazard reduction burns	sedimentation to surface water bodies and waterways.
Releases to surface water	Acid Metaliferrous Drainage and Metalliferous Drainage	Pollution to surface water and water ways
Releases to surface water	Surface water runoff	Pollution to surface water bodies and waterways
Releases to surface water	Vehicle movement	Sedimentation in surface water and water ways
Releases to sediments	Acid Metaliferrous Drainage and Metalliferous Drainage	Contamination to stream sediments
Releases to groundwater	Acid Metaliferrous Drainage and Metalliferous Drainage	Pollution to groundwater
Releases to land	Stock impact on rehabilitated areas	land degradation (soil compaction, erosion, weed dispersal)
		Weed dispersal
Releases to land	Weed spraying (Herbicide use)	Herbicide impact to terrestrial flora and fauna species
		Potential for erosion if removing large areas of weeds
Releases to land	Hazard reduction burns	land degradation
Releases to land	Acid Metaliferrous Drainage and Metalliferous Drainage	Breakdown of soil structure
Use of products and materials	None identified	
Use of energy	Diesel fuel use	Generation of greenhouse gases and deterioration of air quality
Energy emitted	None identified	
Waste and by products	None identified	
Community	Release of impacted surface water runoff to environment	Impact to beneficial use of water to community and pastoral lease holder
Heritage	None identified	
Land Displacement	Weed spraying (Herbicide use)	Impact to land surface by vehicles
Land displacement	Acid Metaliferrous Drainage and Metalliferous Drainage	Impact to beneficial use of water to community and pastoral lease holder
Land displacement	Vehicle movement	soil erosion from wheel impact
biodiversity displacement	Stock impact on rehabilitated areas	biodiversity/ habitat displacment
biodiversity displacement	Hazard reduction burns	biodiversity/ habitat displacement
Biodiversity displacement	Acid Metaliferrous Drainage and Metalliferous Drainage	Impacts to Flora and fauna
Biodiversity displacement	Vehicle movement	weed seed transfer by vehicles
Financial Costs (ARO)	Rehabilitation and closure	Large costs for rehabiltiation and closure requirements

Environmental Aspects and Impacts Register

Activity	Dewatering and water pumping	
Environmental Aspect		Environmental Impact
Emission to air	Exhaust fumes from pumping of water	Generation of greenhouse gases and deterioration of air quality
	Exhaust fumes from earth moving equipment	Generation of greenhouse gases and deterioration of air quality
Releases to surface water	Release of water to environment	Potential impacted water entering waterways
		Potential impact to fauna from impact to drinking water sources
Releases to surface water	Vehicle movement	Sedimentation in surface water and water ways
	Construction of diversion drains and bunds	Potential for erosion
		Potential sedimentation of waterways
Releases to groundwater	Seepage	Impact to beneficial use of water to community and pastoral lease holder
Releases to land	Release of water to environment	Potential impact to flora from impacted water release
		Potential impact to flora from evaporation mist
Use of products and materials	Materials for construction of pipes	Depletion of natural resources
	Diesel fuel use	Depletion of natural resources
Use of raw materials and natural resources		
Use of energy	Diesel fuel use	Generation of greenhouse gases and deterioration of air quality
Energy emitted	None identified	
Waste and by-products	Damage to pipes	Generation of waste and disposal to landfill
	Water monitoring	Generation of waste and disposal to landfill
Community	Release of water to environment	Impact to beneficial use of water to community and pastoral lease holder
Heritage	non Identified	
Land displacement	Vehicle movement	soil erosion from wheel impact
Biodiversity displacement	Vehicle movement	weed seed transfer by vehicles
Financial Costs (ARO)	Purchase of pumps, generators and pipes	Over spend of materials

Activity		Lake Bazzamundi
Environmental Aspect		Environmental Impact
Emission to air	non identified	
Releases to surface water	Discharges to Mount Bunday Creek during the dry season	Water quality and its affects on the health of ecological communities to downstream environments
Releases to sediments	Discharges to Mount Bunday Creek during the dry season	Contamination to stream sediments
Releases to groundwater	Seepage to groundwater	Impacting on beneficial use of groundwater to community and pastoral lease owner
Releases to land	Release of polluted water to land	Destruction of soil structure with in creased salt loads
Use of products and materials	non identified	
Use of raw materials and natural resources	non identified	
Use of energy	non identified	
Energy emitted	non identified	
Waste and by-products	non identified	
Community	Release of polluted water to environment	Potential impact to pastoral lease owner and downstream communites.
Heritage	non identified	
Land displacement	non identified	
Biodiversity Displacement	Maintaining polluted water in the Lake	Contamination to biodiversity, stock, birds, native terestrial animals as a drinking water source
Financial Costs (ARO)	Rehabilitation	Large costs for rehabiltiation

Activity	Ox Bow Wetlands	
Environmental Aspect		Environmental Impact
Emission to air	non identified	
Releases to surface water	Discharges to Mount Bunday Creek during the dry season	Water quality and its affects on the health of ecological communities to downstream environments
Releases to sediments	Discharges to Mount Bunday Creek during the dry season	Contamination to stream sediments
Releases to groundwater	Seepage to groundwater	Impacting on beneficial use of groundwater to community and pastoral lease owner
Releases to land	Release of polluted water to land	Destruction of soil structure with in creased salt loads
Use of products and materials	non identified	
Use of raw materials and natural resources	non identified	
Use of energy	non identified	
Energy emitted	non identified	
Waste and by-products	non identified	
Community	Release of polluted water to environment	Potential impact to pastoral lease owner and downstream communites.
Heritage	non identified	
Land displacement	non identified	
Biodiversity Displacement	Maintaining polluted water in the wetlands	Contamination to biodiversity, stock, birds, native terestrial animals as a drinking water source
	Stock using wetlands for a drinking water source	Stock disturbance to aqautic flora
Financial Costs (ARO)	Rehabilitation	Large costs for rehabiltiation

Activity	Mill/Process Plant Area	
Environmental Aspect		Environmental Impact
Emission to air	Dust emissions from old ROM area	Impact to flora from dust settlement
Emission to air		Sedimentation in waterways
Releases to surface water	Surface water runoff from closed mill areas	Potentially impacted water entering waterways
		Potential impact to fauna from impact to drinking water sources
Releases to surface water	Storage of surface water run-off in the run-off collection pond	Spills to waterways
Releases to sediments	Storage of surface water run-off in the run-off collection pond	Contamination to stream sediments
Releases to groundwater	Storage of surface water run-off in the run-off collection pond	Seepage to groundwater
Releases to land	Dust settling on open ground	Dust loads prevent vegetation growth
Use of products and materials	Mill parts replacements as part of care and maintenance	Increased waste to landfill
Use of raw materials and natural resources	non identified	
Use of energy	Use of electricity form the grid to fill water tanks	Generation of greenhouse gases and deterioration of air quality
Energy emitted	non identified	
Waste and by-products	Mill parts replacements as part of care and maintenance	Increased waste to landfill
Community	non identified	
Heritage	non identified	
Land displacement	Footprint of process plant area	Area of land removed is unavailable for grazing to the underlying pastoral lease owner
Biodiversity Displacement	Footprint of process plant area	Area of land removed is unavailable for grazing to the underlying pastoral lease owner
Financial Costs (ARO)	Removal, Rehabilitation and closure	Large costs for plant removal, rehabilitation and closure requirements

Evap ponds

Activity	Evaporation Ponds	
Environmental Aspect		Environmental Impact
Emission to air	Exhaust fumes from water pumps	Generation of greenhouse gases and deterioration of air quality
Releases to surface water	Uncontrolled release of polluted water to waterways	Water quality and its affects on the health of ecological communities to downstream environments
Releases to surface water	Seepage Control	Water quality and its affects on the health of ecological communities to downstream environments
Releases to surface water	Failure of Evap pond walls	Water quality and its affects on the health of ecological communities to downstream environments
Releases to sediments	Uncontrolled release of polluted water to waterways	Contamination to stream sediments
Releases to sediments	Failure of Evaporation Pond Walls	Contamination to stream sediments
Releases to groundwater	Seepage Control	Impact to beneficial use of water to community and pastoral lease holder
Releases to land	Failure of Evaporation Pond Walls	Potential erosion of impacted soils
Use of products and materials	non identified	
Use of raw materials and natural resources	non identified	
Use of energy	Diesel use from pumps and generators	Generation of greenhouse gases and deterioration of air quality
Energy emitted	non identified	
Waste and by-products	Diesel use from pumps and generators	Generation of waste and disposal to landfill
Community	failure of evap pond walls	Impact to beneficial use of water to community and pastoral lease holder
Community	Release of impacted surface water runoff to environment	Impact to beneficial use of water to community and pastoral lease holder
Heritage	non identified	
Land displacement	Creation of polluted evap area on land surface	Land unavailable to the underlying pastoral lease owner
Biodiversity Displacement	Maintaining polluted water in the Evap ponds	Contamination to biodiversity, stock, birds, native terrestrial animals as a drinking water source
Financial Costs (ARO)	Rehabilitation and closure	Large costs for rehabilitation and closure requirements

Activity	Land Management (hazard reduction burning, weed and pest control, consultation)	
Environmental Aspect		Environmental Impact
Emission to air	Exhaust fumes from vehicles	Generation of greenhouse gases and deterioration of air quality
		Emissions of particulates to air, deterioration of air quality and generation of greenhouse gases
	Hazard reduction burning	Potential impact to flora and fauna
	Refueling	Spills to waterways
Releases to surface water	Use of chemicals for weed spraying	Spills to waterways
Releases to sediments	Use of chemicals for weed spraying	Spills to waterways
Releases to groundwater	None identified	
	Refueling	Spills to soils
		Spills to soils
		Chemical residues to land
		Herbicide impact to terrestrial flora and fauna species
	Use of chemicals for weed spraying	Potential for erosion if removing large areas of weeds
Releases to land	Vehicle movement	Transport and spread of weeds
Use of products and materials	Use of chemicals for weed spraying	Disposal to landfill
Use of raw materials and natural resources	Water use	Depletion of natural resource
Use of energy	Diesel fuel use	Generation of greenhouse gases and deterioration of air quality
Energy emitted	Heat from fire	Potential impact to fauna
Waste and by-products	Generation of chemical containers	Disposal to landfill
Community	Consultation with stakeholders and the community	Inadequate / inappropriate consultation generating negative community views
Heritage	non identified	
Land displacement	Appropriate land management practices	Creation of areas unsuitable for Pastoral use
Biodiversity Displacement		Weed spread
		disturbance to soil surface
	Feral animal control	Destruction of rehabilitated areas
Financial Costs (ARO)	Rehabilitation and closure	Large costs for plant rehabilitation and closure requirements

Attachment K:

CSIRO SSTVs Report

Review of Site-Specific Trigger Values for Toms Gully Mine, NT

Jenny L. Stauber and Graeme. E. Batley

January, 2018

Report prepared for Primary Gold Limited

Commercial-in-confidence

Citation

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Executive Summary

Primary Gold Limited is planning to reopen the Toms Gully mine which has been in care and maintenance since November 2010. The site is characterised by acid mine drainage produced through pyrite and chalcopyrite in the pit walls, waste rock and tailings. In addition, there are a number of water storages from previous operations that contain poor quality water, including two evaporation ponds and the larger water storage in the open pit. It is proposed to discharge treated water into Mount Bundey Creek during either the wet season (when there is sufficient dilution capacity) or the dry season and/or provide water to a third party for potential agricultural and horticultural uses, both of which will require water treatment prior to discharge to meet agreed beneficial uses and water quality guidelines.

Primary Gold requested that CSIRO assess the suitability of the site-specific trigger values (SSTVs) derived by GHD in 2015 and, if required, re-derive trigger values for physical and chemical indicators appropriate to the proposed range of beneficial uses of on-site water. The aim was to assist Primary Gold with their water management strategy, particularly to help maintain a neutral water balance and appropriately dispose of any legacy wastewaters.

For physico-chemical parameters, SSTVs for wet season use only were recalculated using the most recent wet season water quality monitoring data from 2015-2017. The revised SSTVs were similar to previous values, with marginally lower 50th and 80th percentile values for conductivity, and higher values (less conservative) for TSS, turbidity, dissolved iron and dissolved aluminium. No SSTVs could be derived for the dry season due to lack of flow, and hence a lack of monitoring data. If discharges are likely to occur in the dry season, then currently only wet season or default ANZECC/ARMCANZ (2000) Guideline Values (GVs) for physico-chemical parameters can be used.

For sulfate, for which no GV exists, chronic ecotoxicity data from the study by Elphick et al. (2011) in soft waters was used to re-derive an 80% species protection value for sulfate of 316 mg/L. This value was higher than the more conservative 95% species protection value of 129 mg/L from Elphick et al. (2011) that was used by GHD (2015).

For toxicants such as metals, default ANZECC/ARMCANZ (2000) GVs should be used. If an 80% species protection level is chosen at the discharge point, then there should be commitment for continuous improvement such that 90 or 95% species protection is achieved at the end of the 1-2 km mixing zone.

If an appropriate treatment before discharge will likely mean that 90 or 95% species protection values could be achieved in Mount Bundey Creek then discharges in both the wet and dry seasons can occur, without the need for a mixing zone, and assuming no additional contamination from seepage or groundwater infiltration. Minimal impacts could be confirmed using direct toxicity assessment with relevant tropical species and this would help to ensure that there is no chronic toxicity of the discharge beyond the compliance point.

For other beneficial uses, such as stock watering or irrigation, lower levels of treatment may be satisfactory, as defined in ANZECC/ARMCANZ (2000) as these GV's are less stringent than for aquatic ecosystem protection. Monitoring of sulfate and other ions in soils, as proposed by Primary Gold, will be required to ensure that there is no build-up of these ions in soils over the longer term.

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1 Introduction

Primary Gold Limited is planning to reopen the Toms Gully mine which has been in care and maintenance since November 2010. The Toms Gully Underground project will utilise the existing Toms Gully mine footprint, dewatering the existing pit to gain access to historic underground workings. The site is characterised by acid mine drainage produced through pyrite and chalcopyrite in the pit walls, waste rock and tailings. In addition, there are a number of water storages from previous operations that contain poor quality water, including two evaporation ponds and the larger water storage in the open pit. Release of untreated water would require dilutions of up to 250:1 to meet aquatic ecosystem water quality objectives for cobalt and zinc, based on the pit water quality in 2012 (EIS, 2015). Therefore, it was proposed to discharge **treated** water into Mount Bunday Creek during either the wet season (when there is sufficient dilution capacity) or the dry season, both of which will require water treatment prior to discharge to meet agreed beneficial uses and water quality guidelines.

The only discharges into Mount Bunday Creek since November 2010 have been:

1. passive discharges via surface water runoff in the wet season, and groundwater
2. licenced discharges from SWTG12 (concrete weir at wetland oxbow overflow point) from 1/2/13 to 31/8/14.

Primary Gold lodged a draft Environmental Impact Statement document (EIS) as required by the Northern Territory Environmental Protection Authority (NT EPA). Since the EIS, Primary Gold has been investigating a number of water treatment options including liming and Virtual Curtain technology to improve water quality prior to discharge. Rather than storing poor quality water in an evaporation dam on site, it was hoped to discharge the water offsite either by a stream discharge (into the ephemeral Mount Bunday Creek) or by supplying the water to local pastoralists to either flood irrigate pastures or to water a mango plantation. The purpose of disposing of water is to maintain a neutral water balance and reduce water management resourcing and the requirement for engineered water-holding structures.

The current compliance site is SWTG2, slightly upstream of the Arnhem Highway Crossing, although this may move slightly further upstream in future, to be further away from road runoff. For a short section downstream from the Arnhem Highway Crossing (approximately 3 km), the beneficial use of the water is for stock drinking. However, for all other parts of Mount Bunday Creek, upstream and downstream, including at the SWTG2 compliance point, the beneficial uses of Mount Bunday Creek are environmental, riparian and cultural, and this applies to all tributaries of the Mary River. Given that water quality guideline values (GVs) for aquatic ecosystem protection are more stringent than for other beneficial uses, these are the values that should apply to Toms Gully.

In previous waste discharge licences for Toms Gully, there had been agreement that the 80% species protection GV be applied as Mount Bunday Creek is considered to be a highly disturbed environment. For future discharges, this level of species protection has not yet been agreed to by the NT EPA, as the regulator is now requesting comparison of these GV's with those for higher levels of protection, i.e. 90% and 95% (See Table 1). As a general rule, continual improvement from such a highly disturbed state is recommended in the existing water quality management framework (ANZECC/ARMCANZ, 2000).

Table 1. ANZECC/ARMCANZ (2000) default guideline values for aquatic ecosystem protection

Toxicant	Guideline value for different % species protection, µg/L		
	95%	90%	80%
Al (pH>6.5)	55	80	150
As	13	42	140
Cd ^a	0.2	0.4	0.8
Cr	1	6	40
Cu	1.4	1.8	2.5
Fe (total) ^b	700	950	1400
Pb ^a	3.4	5.6	9.4
Mn	1900	2500	3600
Ni ^a	11	13	17
Zn	8	15	31
Total ammonia (pH 8)	900	1430	2300

^aLow hardness value

^b New guideline under review

Primary Gold requested that CSIRO assess the suitability of the site-specific trigger values derived by GHD in 2015 and, if required, re-derive trigger values for physical and chemical indicators appropriate to the proposed range of beneficial uses of on-site water. The aim was to assist Primary Gold with their water management strategy, particularly to help maintain a neutral water balance and appropriately dispose of any legacy wastewaters.

2 Review of Site-Specific Guideline Values (Trigger Values) Derived by GHD

The assessment of the acceptability of discharges associated with the Toms Gully project area has relied primarily on the development of site-specific trigger values (SSTVs) (now referred to as GVs (Warne et al., 2015)). The ANZECC/ARMCANZ (2000) water quality guidelines discusses the use of site-specific trigger values noting: *'If background concentrations cannot be measured at a site, measurement at an equivalent high-quality reference site that is deemed to closely match the geology, natural water quality etc., of the site(s) of interest is suggested. If the background concentration has been clearly established and it exceeds the trigger value, the 80th percentile of the background concentration can be accepted as the site-specific trigger value for ensuing steps.'* Noting also that: *'Users may apply direct toxicity assessment to background or reference waters using locally adapted species, to confirm that there is no toxicity.'*

Another relevant statement from ANZECC/ARMCANZ (2000) is that: *'Toxicant concentrations may vary seasonally. Because of this and the need to be confident about the best estimate of background concentrations, it is recommended that background data be gathered on a monthly basis for at least two years. This applies to both physical-chemical stressors as well as toxicants. Until this minimum data requirement has been established, comparison of the test site median should be made with reference to the default ANZECC/ARMCANZ (2000) guidelines. For those months, seasons or flow periods that constitute logical time intervals or events to consider and derive background data, the 80th percentile of background data (from a minimum of 10 observations) should be compared with the default guideline value.'*

The derivation of SSTVs undertaken by GHD did not specifically follow all the above recommendations in ANZECC/ARMCANZ (2000) (see below). In selecting a relevant GV, a choice was made between the SSTV values and the 80% species protection default GVs from ANZECC/ARMCANZ (2000). The choice of 80% species protection (usually for highly disturbed systems) is yet to be agreed by the regulator, as at the edge of a mixing zone normally the 95% protection or at worst the 90% protection value would be expected to be used. However, there are precedents for selection of the 80% species protection level. We are aware that there is at least one other mine in the NT where the regulator has agreed to 80% species protection, with the aim to gradually improve towards higher levels of species protection.

2.1 Physico-chemical stressors

Toms Gully site is situated at approximately 40 m AHD so would be classed as a tropical lowland river ecosystem for determining default GVs for physico-chemical stressors. The climate is highly seasonal with a distinct wet season from December to April each year. Mount Bunday Creek is an ephemeral creek with limited flow and isolated pools during the dry season.

Site-specific trigger values for physico-chemical parameters (pH, DO, EC, turbidity, and TSS) were derived by GHD (April 2015). They obtained monitoring data (93 samples) for one upstream reference site (SWTG1A) collected between April, 2003 and February, 2015. It is more usual to derive SSTVs from a number of reference sites (not just one). However, Primary Gold has confirmed that no other reference sites were accessible or appropriate.

Background concentrations were derived by GHD for the Mount Bunday Creek reference site, SWTG1A, *'based on samples collected annually from 2003 to 2008 followed by intermittent sampling from 2010 to*

2015'. More frequent wet season data were collected from the 2010/11 wet season and onwards over 4 wet seasons. In the GHD report, plots are shown of sampling frequency for SWTG1A and the compliance point SWTG2, but different axis labels were used so the actual dates of sampling were not easily estimated. The actual raw data were not provided in the GHD report, with only a summary table of the minimum, median, maximum, 20th and 80th percentiles, together with plots of some data in Section 6. From these plots, it appears that both wet and dry season data were used to derive the SSTVs. Because the site is subject to wet and dry season flows, it is not appropriate to use data from both seasons in deriving SSTVs. It would be more relevant to derive separate SSTVs for each season, assuming sufficient dry season data are available.

Ideally SSTVs should be derived from the most recent data. Including data from 2003 to 2008 is not advisable unless trends in the data can be observed using control charting to show that values were not significantly changing. Ideally, a minimum requirement of 10 wet season data points should be used from the most recent monitoring data over several years.

GHD compared the 80th percentile of the monitoring data from the reference site to the ANZECC/ARMCANZ GVs for tropical lowland systems, and then usually took the least conservative of the two values as the SSTV.

- pH: The GV for pH was appropriate, with a SSTV of 5.8-8.0.
- Electrical conductivity: ANZECC/ARMCANZ recommends the lower values from the range 20-250 $\mu\text{S}/\text{cm}$ for ephemeral rivers in NT, but recognises that values can be higher during the wet season first flush. GHD quoted this range as the SSTV, but we are unsure of whether the upper or lower limit will be used for compliance and whether this differs between seasons. The 80th percentile of the monitoring data was much lower, 57 $\mu\text{S}/\text{cm}$, and hence would be a more conservative value.
- Total suspended solids (TSS): There is no ANZECC/ARMCANZ GV for TSS (only a value for turbidity), so the 80th percentile of the combined monitoring data from both the wet and dry seasons was used (32 mg/L).
- Turbidity: GHD selected the upper ANZECC/ARMCANZ value of 15 NTU as the GV because there were too few data from the monitoring program to derive a SSTV. It is unclear if this would be applied to the wet season only.

2.2 Nutrients

No SSTVs were derived due to limited historical monitoring data, so default ANZECC/ARMCANZ GVs for tropical lowlands would apply. It is not known how agricultural land use in the area may contribute to nutrient levels in Mount Bunday Creek.

2.3 Toxicants

For toxicants, including metals, it is usual to apply the ANZECC/ARMCANZ (2000) GVs as these are based on a toxicological response of freshwater biota, rather than a statistical distribution of the background chemical monitoring data from a reference site. In this way, ecosystem protection is related to the chemical concentrations that would have no chronic toxicity to freshwater biota. Note that GVs for some toxicants are currently being revised and these new guidelines should be released in 2018. However, for the purposes of this report, we have used the current 2000 toxicant GVs (Table 1), except for iron, for which a new GV based on total iron, is under peer review.

For most toxicants, GHD have used the ANZECC/ARMCANZ (2000) GV appropriately, where values exist. Exceptions include:

- Sulfate (for which no ANZECC/ARMCANZ GV exists): GHD used a GV of 129 mg/L based on a chronic ecotoxicity study with temperate organisms in soft water (temperatures ranged from 11 to 25°C) by Elphick et al. (2011). This value is for 95% species protection and is a reasonable conservative approach.
- Ammonia: GHD used a GV of 2.3 mg/L ammonia at pH 8.0 and 20°C for 80% species protection. The median pH of the monitoring data at the reference site was 6.5 (so ammonia toxicity is potentially less) but the 80th percentile of temperature is 31°C (so ammonia is potentially more toxic). Overall, GHD has taken a conservative value (at 31°C and pH 6.5, the GV could be up to 34.5 mg/L), but given that pH changes over a wide range, their approach is conservative and appropriate.
- Aluminium: GHD used the 80th percentile of the monitoring data (260 µg/L) rather than the more conservative and ecotoxicologically-based ANZECC/ARMCANZ (2000) value of 150 µg/L. They justified this by suggesting that there were catchment-specific characteristics that increased aluminium background concentrations, including the impacts of rainfall runoff. This approach is consistent with ANZECC/ARMCANZ (2000) which allows the use of background concentrations as GVs.
- Iron: There was no ANZECC/ARMCANZ GV for iron in freshwaters at the time, so the 80th percentile of reference site monitoring data (430 µg/L) was used. A new guideline for iron of 1400 µg/L for 80% species protection is now available (undergoing peer review) and this is based on toxicity of dissolved and particulate iron to freshwater biota, rather than a statistical distribution of iron monitoring data. However, if iron background concentrations are naturally higher, the 80th percentile of reference site monitoring data is acceptable as a GV.
- Mo, Co and U GVs were classified as low reliability by ANZECC/ARMCANZ (2000).

2.4 Historical water quality at the compliance point

2.4.1 Physico-chemical stressors

For physico-chemical stressors, the median of the monitoring data is compared to the GV (usually derived from the 80th percentile of the reference site monitoring data). A total of 215 samples were collected from the downstream compliance site SWTG2 (approximately 800 m downstream from the project area) from July, 2002 to February, 2015, with the majority collected in the wet season. Table 6-2 in the GHD report compares the median SWTG2 site data over this entire period, with their SSTVs. It is more usual to compare the annual site median with the SSTV, not a site median over 13 years, and in the case of a seasonal difference, to separate data for each season, to be consistent with the ANZECC/ARMCANZ (2000) approach. In addition, only the most recent data should have been used, as operations and discharges have changed since the site went into care and maintenance, and previous data may bear little resemblance to the proposed discharges of treated water outlined in the current EIS.

There were very wide ranges in concentrations of many parameters at SWTG1A, notably pH, hardness and alkalinity, with turbidity, and occasionally EC, elevated above SSTVs. This may have potential impacts on aquatic biota downstream. An aquatic macroinvertebrate, fish and habitat survey in April 2015 (during a lower than usual wet season) showed that the downstream site near SWTG2 had the lowest abundance of macroinvertebrates (Primary Gold, 2015). Water quality monitored at the time showed elevated EC and low pH downstream at the site on the edge of the lease boundary. A more recent survey in May, 2017, at

the end of a more typical wet season, showed similar results, with the macroinvertebrate community characterised by pollution-tolerant families. Limited fish data suggested poor fish condition, and low abundance and diversity immediately downstream of the new tailings dam discharge (Primary Gold Ltd, 2017).

2.4.2 Toxicants

For toxicants, action is triggered if the 95th percentile of the monitoring data exceeds the SSTV or default GV. The Guidelines note that this is equivalent to: *'no action is triggered if 95% of the values fall below the guideline value. The more stringent approach is recommended here because, unlike physical and chemical stressors, toxicant default values are based upon actual biological effects data and so by implication, exceedance of the value indicates the potential for ecological harm. Note that because the proportion of values required to be less than the default trigger value is very high (95%), a single observation greater than the trigger value would be legitimate grounds for action in most cases, even early in a sampling program.'*

In the GHD report, median values of the downstream monitoring site SWTG2, were compared to the SSTVs, rather than the 95th percentile. Their summary does include maximum values (from July, 2002 to February, 2015), and, if these were used, exceedances of SSTVs would occur for cyanide, sulfate, and most dissolved metals, including Al, Cd, Co, Cu, Fe, Mn, Mo, Ni, U and Zn. However, it should be noted that since August, 2014, there have been no direct discharges into Mount Bundey Creek and concentrations of metals have substantially decreased. For this reason, drawing conclusions from historical monitoring data is of limited use.

3 Derivation of Revised SSTVs for SWTG1A

3.1 Wet-season SSTVs

The SSTVs derived by GHD used combined wet and dry season historical monitoring data over 2003-2015, far longer than the two years of monitoring data recommended by ANZECC/ARMCANZ (2000). SSTVs for wet and dry seasons should be derived separately. From the more recent dataset provided by Primary Gold, SSTVs for pH, electrical conductivity (EC), total suspended solids (TSS), turbidity, sulfate, aluminium and iron were derived for reference site SWTG1a, for the wet season only and only for the period 2015 to 2017.

The revised SSTVs are shown in Table 2. The revised SSTVs were similar to previous values, with marginally lower 50th and 80th percentile values for conductivity, and higher values for TSS, turbidity, dissolved iron and dissolved aluminium. The revised SSTV for sulfate was 1.5 mg/L, similar to the previous value of 2 mg/L. In keeping with ANZECC/ARMCANZ (2000), the revised 80th percentile values should be used as SSTVs for the wet season only.

Table 2. Recalculated 50th and 80th percentile values using only wet season data for 2015-2017

	Revised 50 th percentile	Revised 80 th percentile	Old 50 th percentile ^a	Old 80 th percentile ^a
pH	6.7	6.9	6.5	7.0
EC, $\mu\text{S}/\text{cm}$	28	41	42	57
TSS, mg/L	40	54	17	32
Turbidity, NTU	51	87	22	60
Sulfate, mg/L	1.0	1.5	1	2
Al (total), $\mu\text{g}/\text{L}$	520	1680	-	-
Al (dissolved), $\mu\text{g}/\text{L}$	174	295	-	260
Fe (total), $\mu\text{g}/\text{L}$	1200	2700	-	-
Fe (dissolved), $\mu\text{g}/\text{L}$	256	492	-	430

^a Old values derived by GHD based on combined wet and dry season data for 2003-2015

Recommended revised SSTVs for Toms Gully Mine are shown in Table 3. SSTVs for all physico-chemical parameters, as well as total iron and dissolved aluminium, were based on the 80th percentile of wet season monitoring data from the reference site SWTG1A, to take into account natural backgrounds. For all other toxicants, the default guidelines from ANZECC/ARMCANZ (2000) were used as these are based on actual ecotoxicological effects.

Sulfate: The exception was sulfate, for which no ANZECC/ARMCANZ guideline exists. Sulfate toxicity is known to decrease with increasing hardness and Dunlop et al. (2016) derived a site-specific GV of 936 mg SO_4/L for 80% species protection for hard waters (550 mg/L as CaCO_3). However, as Bunday Creek at site SWTG1A has a median hardness of 9 mg CaCO_3/L (i.e. very soft), this GV is not applicable. Instead, the 95% species protection GV for soft waters from Elphick et al. (2011) of 129 mg/L was recommended in the GHD report. A more recent study by Maeys and Nordin (2013) used the data from Elphick together with data from additional species, and derived a similar value for 95% species protection for soft waters (0-30 mg

CaCO₃/L) of 128 mg SO₄/L. Neither study derived a sulfate GV for lower levels of species protection. Using the 8 chronic data points (EC10s) from Elphick et al. (2011) at their lowest hardness values (15-40 mg CaCO₃/L), we re-derived a sulfate GV for 80% species protection of 316 mg/L, and 210 mg/L for 90% species protection. Although Bunday Creek has a lower hardness, these values are recommended, if 95% species protection is not required.

Table 3. Final recommended trigger values for discharges into Bunday Creek

Parameter	Trigger Value ^a	Trigger Value (90% species protection)	Final Proposed Trigger Values for the Discharge Point or Compliance Site SWTG2 after dilution
pH	6.9	-	5.8-8.0
EC, µS/cm	41	-	41
TSS, mg/L	54	-	54
Turbidity, NTU	87	-	87
Sulfate, mg/L	316 ^b	210 ^b	210
Al (pH>6.5), µg/L	295 ^c	-	295 ^c
As, µg/L	140	42	42
Cd, µg/L	0.8	0.4	0.4
Cr, µg/L	40	6	6
Cu, µg/L	2.5	1.8	1.8
Fe, µg/L	2700 ^d	950 ^e	2700 ^d
Pb, µg/L	9.4	5.6	5.6
Mn, µg/L	3600	2500	2500
Ni, µg/L	17	13	13
Zn, µg/L	31	15	15
Total ammonia (pH 8), mg/L	2.3	1.4	1.4

^a based on 80th percentile of reference site monitoring data for pH, EC, TSS and turbidity; based on 80% species protection for toxicants

^b data for soft waters re-derived from Elphick et al. (2011) chronic toxicity study

^c based on dissolved Al from background data

^d based on total Fe from background data

^e new ANZECC/ARMCANZ GV for total Fe (under review)

3.2 Dry season SSTVs

Given that Mount Bunday Creek only flows strongly for 3-4 weeks/year, Primary Gold proposes to also discharge treated water to Mount Bunday Creek in the dry season. Examination of the dry season data for SWTG1A showed that there were data for only 3 samples from 2015 to 2017, which did not meet the minimum sample requirements for derivation of SSTVs. Therefore no SSTVs could be calculated for

physicochemical parameters specifically for the dry season. If discharges are to occur in the dry season, then wet season SSTVs, together with toxicant TVs (ANZECC/ARMCANZ, 2000), could be used.

4 Future Compliance with Guideline Values for Stock Drinking Water and Irrigation

Previous monitoring at SWTG12 (wetland oxbow onsite near Mount Bunday Creek – the onsite discharge point) showed that discharge water had low pH, elevated EC, and elevated Co, Cu and Zn concentrations. Therefore, fortnightly monitoring at 13 surface water sites, including Coulter Creek upstream and downstream, for a large range of parameters, is proposed in the Water Management Plan.

The EIS proposed that pit water be treated to meet stock water GVs, to ensure that discharges to Mount Bunday Creek meet the aquatic ecosystem 80% species protection GVs at the compliance site downstream. This means that the section of Mount Bunday Creek that flows through the mining lease would be used as a mixing zone. In this mixing zone for several km (NT EPA says 7 km), the GV for 80% of species aquatic ecosystem protection would not be met. Our understanding is that previous water discharges (2005-2007) had required dilutions of 100:1 for untreated water discharge (from the evaporation pond) into the creek during high flow, but there were no agreed GVs for aquatic ecosystem protection at the time.

Although the EIS states that the compliance point for surface water discharge for the proposed project will be DP1 on Mount Bunday Creek **at the lease boundary**, Primary Gold has suggested that the compliance point will now be a few hundred metres further upstream than SWTG2 to avoid the influence of the road on water quality. A mixing zone of 1-2 km from the point of discharge was proposed.

Table 4 summarises the ANZECC/ARMCANZ (2000) guidelines for stock drinking water. Site water currently stored in pit and evaporation ponds would require treatment before discharge at DP1 to meet stock water GVs for sulfate and a range of metals including Al, Cd, Co, Cu, Ni and Zn. With appropriate treatment technologies, discharge from these storages could meet SSTVs for 80% protection (or better). Meeting sulfate SSTVs would be the biggest challenge, but should be possible using a combination of treatments. If only treated water was discharged, then there would be no need for a mixing zone in Mount Bunday Creek, assuming no seepage or groundwater infiltration of contaminated water. The treated discharge should comply with SSTVs (Table 3) and no dilution would be required. This would mean that discharges could occur in the dry season if necessary.

Lake Bazzamundi is an artificial wetland that was previously used to store mine water and bore water that was compliant with ANZECC/ARMCANZ stock water GVs. No water has been actively pumped into the lake since cessation of underground dewatering in 2010. The lake passively overflows from the south into Coulter Creek. The second proposed compliance site will be DP2 on Coulter Creek at the lease boundary, but there will be no surface water release at this location.

Groundwater, which is assumed to flow from Lake Bazzamundi to the northwest, is fresh and slightly acidic. Water from bores near the underground workings is expected to be of suitable quality for direct release into Lake Bazzamundi, providing the pastoralist with additional water in the dry season. Most bores have groundwater is bicarbonate dominated, but several bores along the edge of the sulfide and oxide waste dumps that is sulfate-dominated, probably due to acid leachate contamination. The Water Management Plan outlines the proposed groundwater concentrations with water quality monitoring upstream, within the site, and downstream on a quarterly basis. Water quality will be assessed against ANZECC/ARMCANZ (2000) stock water GVs and if met, should enable stock watering as a beneficial use.

Table 4. ANZECC/ARMCANZ (2000) guideline values for stock drinking water and irrigation

Analyte	Stock Drinking Water GV (ANZECC/ARMCANZ, 2000)	Irrigation GV (Short-term ANZECC/ARMCANZ 2000)
Sulfate, mg/L	1000	-
EC, $\mu\text{S}/\text{cm}$	~ 3000	-
Al, $\mu\text{g}/\text{L}$	5000	20000
As, $\mu\text{g}/\text{L}$	500	2000
Cd, $\mu\text{g}/\text{L}$	10	50
Co, $\mu\text{g}/\text{L}$	1000	100
Cr, $\mu\text{g}/\text{L}$	1000	1000
Cu, $\mu\text{g}/\text{L}$	1000	5000
Fe, $\mu\text{g}/\text{L}$	-	-
Pb, $\mu\text{g}/\text{L}$	100	5000
Mn, $\mu\text{g}/\text{L}$	-	10000
Ni, $\mu\text{g}/\text{L}$	1000	2000
U, $\mu\text{g}/\text{L}$	200	100
Zn, $\mu\text{g}/\text{L}$	20000	5000

Another possible beneficial water use is for irrigation of mango crops. The ANZECC/ARMCANZ (2000) GVs for short-term irrigation (up to 20 years) are shown in Table 4. There are no GVs for sulfate, chloride or sodium specifically for mango cultivation. Generally the irrigation GVs are less stringent than the stock watering GVs for metals, except for Co, Cr and U. There were very few monitoring data for water quality in Lake Bazzamundi. Site CCO2 (a reference site on Coulter Creek below Lake Bazzamundi) had elevated EC in the April, 2015 and May, 2017 aquatic biota surveys, but all downstream sites had no GV exceedances. There were no exceedances of dissolved metals compared to stock GVs at this site or downstream.

Given the lack of GVs, Primary Gold proposed to regularly survey soils to ensure that there is no long-term build-up of sulfate or other ions in soils over time.

5 Recommendations

For physico-chemical parameters, SSTVs for wet season use only were recalculated using the most recent wet season water quality monitoring data from 2015-2017 (Table 3). No SSTVs could be derived for the dry season due to lack of flow, and hence a lack of monitoring data. If discharges are likely to occur in the dry season, then wet season SSTVs for physico-chemical parameters would have to be used.

For sulfate, for which no GV exists, chronic ecotoxicity data from the study by Elphick et al. (2011) in soft waters was used to re-derive an 80% species protection value for sulfate of 316 mg/L. This value was higher than the more conservative 95% species protection value of 129 mg/L from Elphick et al. (2011) used by GHD (2015).

For toxicants such as metals, default ANZECC/ARMCANZ (2000) GVs should be used. If an 80% species protection level is chosen, then there should be commitment for continual improvement such that 90 or 95% species protection is achieved at the end of the 1-2 km mixing zone.

Liming, Virtual Curtain technology or some equivalent water treatment before discharge, will be required before discharges will meet the SSTVs for physico-chemical parameters and toxicants. Sulfate, aluminium and EC remain elevated after Virtual Curtain treatment (G. Douglas, pers. comm), but could be removed with additional post-treatment, e.g. reverse osmosis. Appropriate treatment before discharge will likely mean that 90 or 95% species protection GVs could be achieved in Mount Bunday Creek with discharges in both the wet and dry seasons, without the need for a mixing zone, and assuming no additional contamination from seepage or groundwater infiltration.

While Primary Gold proposed to undertake water and sediment quality monitoring, as well as biological monitoring downstream, direct toxicity assessment (DTA) of discharges using tropical freshwater species relevant to these soft waters should also be undertaken. This will ensure that there is no chronic toxicity of the discharge beyond the compliance point and will provide a further line of evidence in the weight of evidence approach now recommended in the revised guidelines. This knowledge gap has been identified in the Water Management Plan. DTA of the treated water discharge (with upstream water as the diluent) would provide a “safe” dilution and would be undertaken prior to each wet season, with results used by NT EPA for discharge approval. However, the WMP does not currently include DTA in its monitoring plan.

For other beneficial uses such as stock watering or irrigation, lower levels of treatment may be satisfactory, as GVs are less stringent than for aquatic ecosystem protection. Monitoring of sulfate and other ions in soils as proposed by Primary Gold, will be required to ensure that there is no build-up of these ions in soils over the longer term.

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WE ASK, WE SEEK AND WE SOLVE

Attachment L:

Authorisation 0470-01

NORTHERN TERRITORY OF AUSTRALIA

Mining Management Act

AUTHORISATION 0740-01

I, **RUSSELL THOMAS BALL, Director Mining Performance**, as delegate of the Minister for Mines and Energy

HAVING HAD REGARD TO the matters referred to in section 34 of the Mining Management Act (the "Act")

BEING SATISFIED ABOUT the matters referred to in section 36(5) of the Act

IN ACCORDANCE WITH section 36(4) of the Act

AND

SUBJECT TO THE CONDITIONS set out in section 37 of the Act and in the Schedule to this Authorisation

AUTHORISE Primary Gold Limited [ACN:122 726 283] (the "Operator") to carry out mining activities:

- (a) on the mining site known as the Toms Gully Mine Project situated within ML29812, ML29814 and MLN1058 granted under the *Mineral Titles Act*; and
- (b) for the period of the grant and any renewal of the titles specified in paragraph (a).

Date 28 May 2013.



Director Mining Performance
as delegate of the
Minister for Mines and Energy

SCHEDULE

CONDITIONS OF AUTHORISATION 0740-01

- (1) The Operator must comply with the activities and commitments contained in the current mining management plan in respect of the Toms Gully Mine Project ("Mining Management Plan") as approved by the Minister.
- (2) For the purposes of compliance with section 41(1) of the Act and subject to condition (3) of this Authorisation, the Operator must at intervals not exceeding 12 months from the anniversary of the date of Authorisation (or such other date as nominated by the Operator and approved by the Minister), review the Mining Management Plan. If following a review in accordance with this condition it is necessary for the Operator to amend the Mining Management Plan, the Operator must make the necessary amendments and submit the amended Mining Management Plan for approval by the Minister.
- (3) Prior to commencing any significant changes to the approved mining activities or implementing any changes to the approved management system proposed by the Operator on the mining site, the Operator must review and amend the Mining Management Plan and submit the amended Mining Management Plan for approval by the Minister.
- (4) For the purposes of section 43 of the Act the Operator must provide the calculated security amount in the form and on the terms required by the Minister and as notified by the Delegate of the Minister.
- (5) The security provided in accordance with condition (4) will be reassessed, and may be revised, following each submission of an amended Mining Management Plan for approval by the Minister. The Operator must provide the revised security amount in the form and on the terms required by the Minister and as notified by the Delegate of the Minister.

- (6) The security referred to in conditions (4) and (5) is to be provided to the Director Mining Performance, Department of Mines and Energy, Darwin NT. This Authorisation is to be read in conjunction with the *Mining Management Act* and Mining Management Regulations.

Attachment M: Landowner Authority

**LANDOWNER'S AUTHORIZATION FOR A WASTE DISCHARGE LICENCE (WDL)
APPLICATION TO CONDUCT DISCHARGING ACTIVITIES UNDER THE NORTHERN
TERRITORY WATER ACT 1992.**

The owners and/or persons duly authorized as signatory on behalf of the landowner^{*}, hereby authorize:

NAME (please print)	Anthony Harrower	
Contact number	Ph	Mob: 043 799 0477
Gives landowner consent to for a Waste Discharge Licence (WDL) application under the Water Act 1992 to conduct discharging activities over the property described below from Mineral Lease Number (MLN) 1083:		
PERPETUAL LEASE (PPL)	PASTORAL	PPL1163
PROPERTY NAME	OLD MOUNT BURDEY	
LOCATION/TOWN	MOUNT BURDEY, ARNHEM HNV	
NT PORTION	4831	

OWNERS SIGNATURE	<i>T Harrower</i>	
NAME (please print)	T HARROWER authorized signatory for and on behalf of Old Mount Burdey	
TITLE:	OWNER	
(ie. company director/secretary)		
Contact number	Ph	Mob: 0437 990 477
DATE:	4/12/20	

OWNERS SIGNATURE		
NAME (please print)		
TITLE:		
(ie. company director/secretary)		
Contact number	Ph	Mob
DATE:		

^{*}Complete if more than one landowner

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