Northern Resource CONSULTANTS

Highway Reward

Transitional Environment Program MAN17020 - Surface water and sediment quality report

December 2016

prepared for

The Mount Windsor Joint Venture partners of Thalanga Copper Mines Pty Ltd and BML Holdings Pty Ltd

Contact Information	Details
Organisation	Northern Resource Consultants Pty Limited
Contact Person	Marty Costello
Phone	07 4772 6500
Email	marty@northres.com.au
Mail	12 Cannan Street, South Townsville QLD, 4810
ABN	55 126 894 693

Document Control	Details including responsible party and date
CLIENT RELEASE	Authorised for client release 31 December 2016 by Marty Costello.

Limitations of this Report

Client: The Mount Windsor Joint Venture partners of Thalanga Copper Mines Pty Ltd and BML Holdings Pty Ltd

Prepared by Northern Resource Consultants (NRC)

This disclaimer brings the limitations of the investigations to the attention of the reader.

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This report has been formulated in the context of published guidelines, field observations, discussions with site personnel, and results of laboratory analyses.

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They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts.

Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.

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Introduction

1. Highway Reward site Transition Environmental Program – Surface water and sediment quality report

This surface water and sediment quality report has been prepared by Northern Resource Consultants (NRC) on behalf of the Mount Windsor Joint Venture (MWJV) partners of Thalanga Copper Mines (TCM) and BML Holdings (BML) in fulfilment of Task 2 of the amended Transitional Environmental Program (TEP) MAN17020 (currently in place at the Highway Reward mine site).

1.1 TEP objectives

Following an internal site evaluation and investigation in response to continuing exceedances, the Mount Windsor Joint Venture (the JV) submitted a program notice to the Department of Environment and Heritage Protection (EHP) on 7 June 2013. The intent of the TEP is to determine the sources of contamination at monitoring locations SW5 and SW6 of the Highway Reward site.

As per the approved amended TEP, the objectives of the TEP are to prevent the release of contaminants - being low pH water and heavy metals, from the Highway Reward mine site. The release of contaminants has resulted in non-conformance with conditions of Environmental Authority (EA) EPML00550413 at designated monitoring point SW6.

TEP activities will transition the Highway Reward mine site to compliance by:

- determining the source of contamination
- carrying out earthworks
- undertaking revegetation and rehabilitation activities to prevent the further release of contaminants
- ensuring flow off-site is within compliance with the limits set in the EA and the future risk of surface water or groundwater contamination reoccurring is acceptable – if the end result scenario is one where contamination cannot be prevented through cost effective works.

1.2 TEP performance indicators

Performance indicators in relation to the TEP are presented in Table 1.

Table 1: TEP performance indicators and due dates

TASK	PERFORMANCE INDICATOR	DUE DATE	STATUS
1	Report on installation of interim water management strategy	1 November 2016	Complete
2	Completion of technical report on surface water and sediment quality monitoring program	31 December 2016	Submitted here
3	Completion of technical report on surface water flow directions and estimated rates.	30 May 2017	Pending
5	Report on required earthworks. Including schedule for completion of tasks within TEP timeframe.	30 May 2017	Pending
7	Completion of Earthworks	1 November 2017	Pending
9	Completion of final TEP performance report including completion report for earthworks undertaken by 1 November 2017.	31 December 2017	Pending

1.3 TEP activities completed 2016

In addition to monitoring requirements specified under the TEP and EA, MWJV have undertaken a number of activities during 2016 as required under the TEP:

- Completion of six monthly surface water flow sampling update (provided to EHP on 30 June 2016) (Appendix B).
- Completion of the 2016 earthworks activities program including notification to EHP on 16 November 2016 - this included completion of earthworks across the eastern side of the Reward Waste Rock Dump (Appendix C).
- Sourcing of quotes to undertake revised run-off and pit water modelling to support and inform the 2017 earthworks program.
- Continued critical review of surface water and stream sediment monitoring resulting in submission of a surface water and sediment quality report.

Other works outside the TEP scope completed during the year include erosion repairs, revegetation and drainage improvements on the waste rock dumps.

Project Overview

1. Background

The Highway Reward mine site previously operated as an open cut and underground copper mine. The site is located 40km south of Charters Towers on the Gregory Development Road and is situated within the Burdekin River Catchment. A map of the site location is provided in Figure 1 below (maps are also provided in Appendix A).

Open cut mining commenced at the site in 1997 and ceased in 2002. The operations formed a single residual void with a surface area covering 35ha.

The waste rock extracted during operations was placed within two waste rock dumps at the site. These waste rock dumps are known as the Highway Dump and the Reward Dump and are located adjacent to the open cut pit. The dumps cover an area of 132ha and were rehabilitated from 2005 onwards.

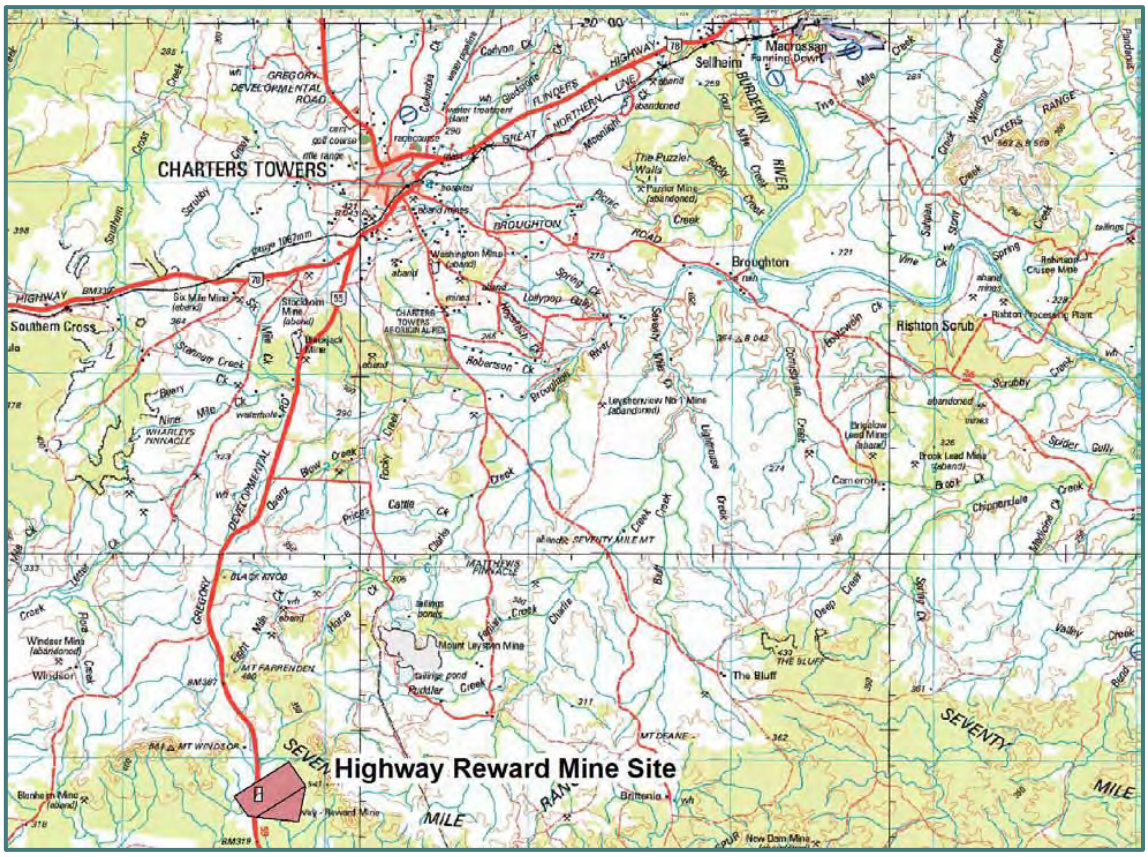


Figure 1: Highway Reward mine site location.

2. Environmental Authority breaches

The Highway Reward mine site operates as a rehabilitation project under the EA EPML00550413. Condition C1-1 of the EA (shown in the following section "Receiving Water Contaminant Limits") was subject to non-compliance in the past and resulted in the submission of the original draft TEP in 2013. A summary of the non-compliances are provided in the following sub-section as a requirement of EM1364, which states that:

- If the reason for transition is to comply with a condition of an environmental authority, "Insert specific details about the condition(s) that you are seeking to transition to, and how the activity currently does not comply with it…" (EM1364, p. 2); and
- "Insert details of how compliance with the condition will be achieved before the program ends" (EM1364, p.2).

Receiving water contaminant limits

The condition in the EA relating to receiving waters and contaminant limits (Table 3) is as follows:

"(C1-1) Receiving waters affected by the release of process water or storm water contaminated by the mining activities or both must be monitored at the locations and frequencies defined in Schedule C – Table 1 and Schedule J – Map 1 and comply with the **contaminant limits defined in Schedule C – Table 2.**" (EHP, 2015).

Summary of the non-compliances

Breaches of the EA contaminant limits for surface water receiving sites have occurred at SW5 and SW6. Application of an amended TEP in 2016 has since recommended the removal of SW5 from the TEP on the basis compliance at the site has been achieved. A map of the surface water sites and all EA compliance points is provided in Figure 2.

Surface water results collected from the EA points have been collated since 2013 and reviewed against the EA limits. A summary of exceedances of the surface water limits as per the original TEP and summarised exceedances since the submission of the TEP in 2013 is provided in Appendix F of this report.

Since 2008 and 2011, SW5 and SW6 respectively, have exceeded EA limits on various occasions for the following parameters:

- pH (SW5 and SW6)
- total copper (SW5 and SW6)
- total cadmium (SW5 and SW6)
- total lead (SW5)
- total zinc (SW5).

The downstream EA site in Policeman's Creek (SW4) has recorded no recent exceedances of EA limits since April 2013.

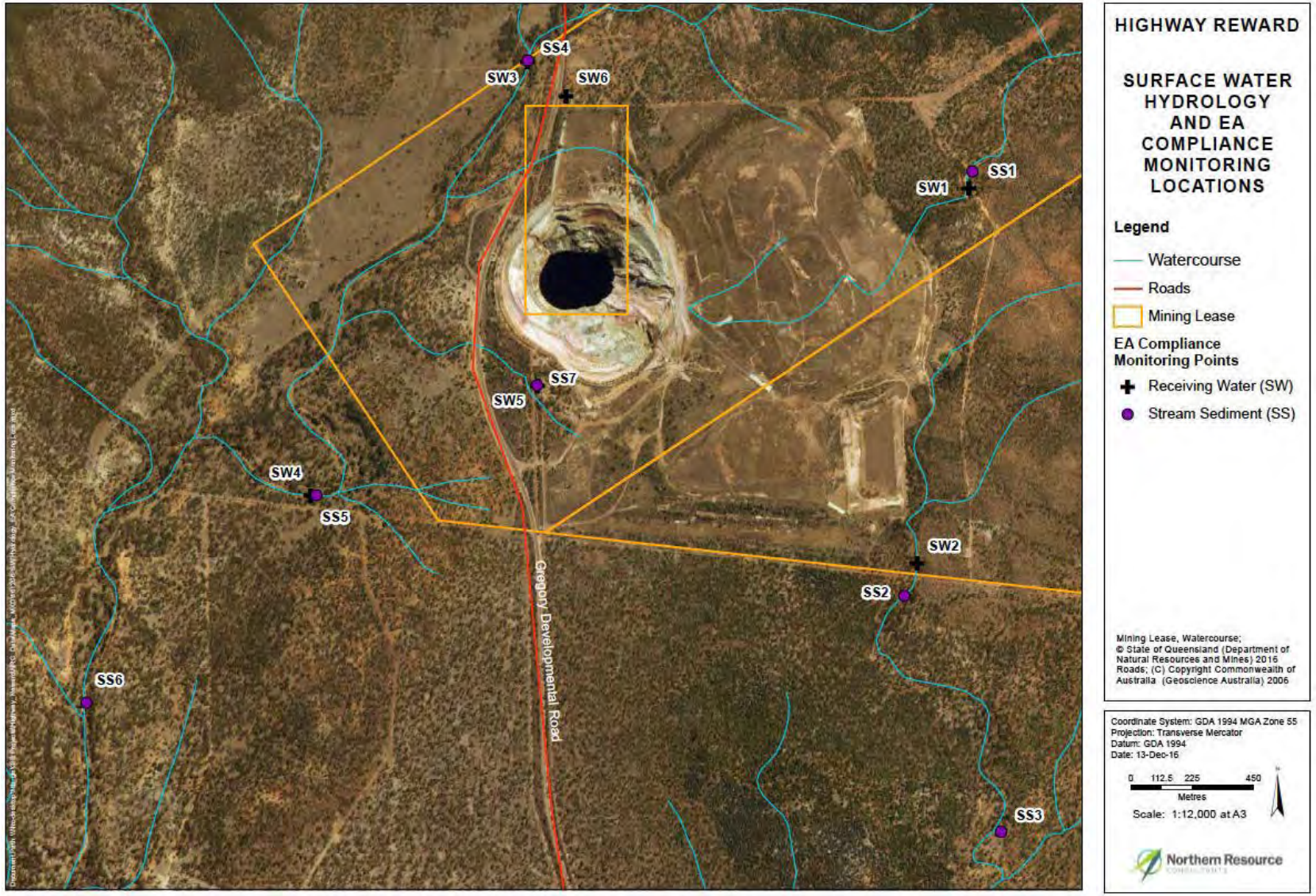


Figure 2: Surface water hydrology and EA compliance monitoring locations at the Highway Reward mine site

Background Environment

1. Climate and rainfall

The Highway Reward mine site is located within the semi-arid tropics and typically experiences hot dry summers and cooler winters. Charters Towers Post Office weather station is the nearest Bureau of Meteorology (BOM) station (station ID 034002) to the Highway Reward mine site. Climate statistics and records available for the Charters Towers Post Office range from 1893 to 1992. The average maximum temperature in summer is 33.7°C, the monthly minimum temperature in summer is 20.2°C whilst the average maximum temperature in winter is 25.3°C and the average minimum temperature in winter is 11.7°C. Figure 3 presents monthly average temperature data for the Charters Towers Post Office (BOM, 2016).

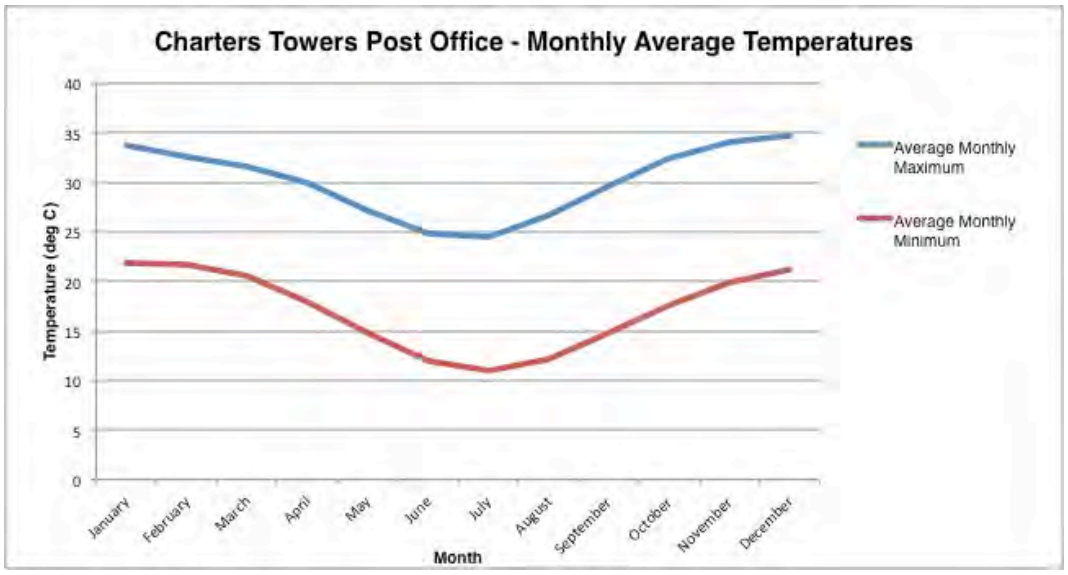


Figure 3: Monthly average temperatures at Charters Towers Post Office (BOM, 2016)

The Charters Towers Post Office weather station receives an average annual rainfall of 659.2mm. The majority of this rainfall throughout the year falls between October and April with the three months of January to March on average, experiencing the greatest volume of rainfall at 370.5mm (BOM, 2016). Figure 4 presents monthly average rainfall recorded at Charters Towers Post Office.

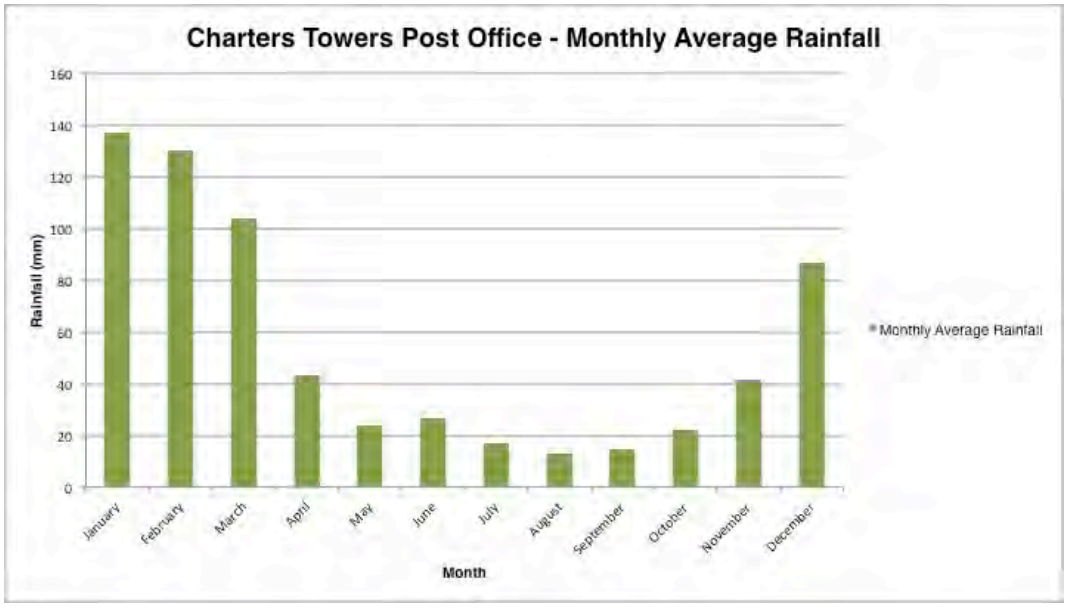


Figure 4: Monthly average rainfall recorded at Charters Towers Post Office

Site specific rainfall data was recorded for the Highway Reward mine site at monitoring location SF2 for the period of 1 January 2016 to 19 December 2016. Rainfall recorded at Highway Reward was noted to be below the annual average at 576mm. Monthly rainfall data recorded at Highway Reward is provided in Figure 5.

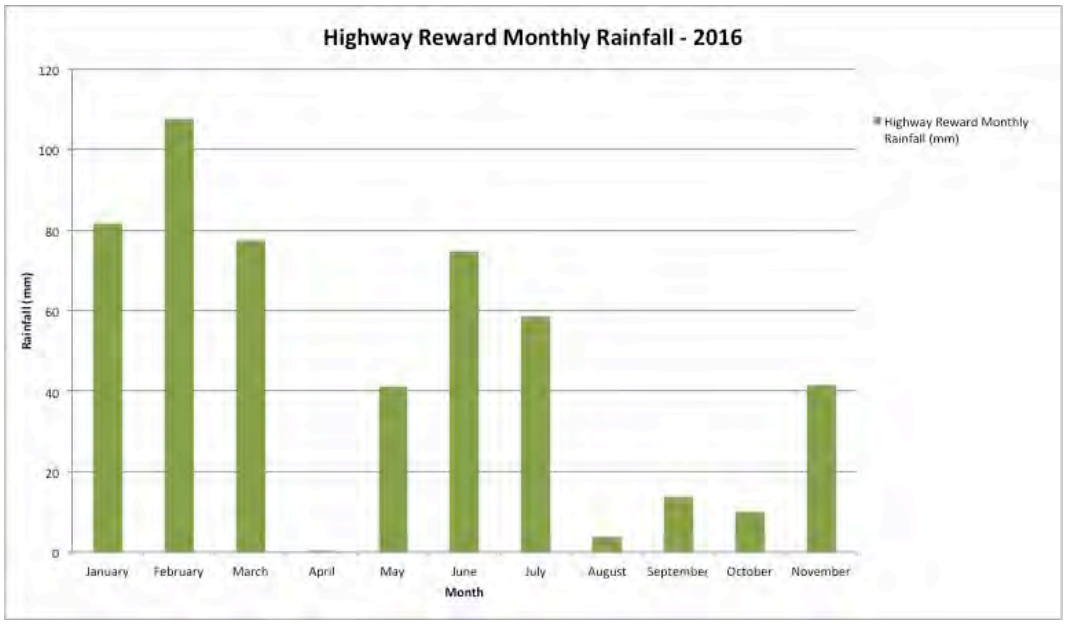


Figure 5: Monthly rainfall recorded at Highway Reward for 2016

Methodology

1. Overview

Surface water and stream sediment monitoring is required to be conducted for the duration of the TEP and in accordance with the requirements of the Highway Reward EA.

2. Surface water monitoring

2.1 EA requirements

Requirements for surface water monitoring are detailed under Schedule C – Water of the Highway Reward EA. Condition C1-1 requires that "receiving waters affected by the release of process water or storm water contaminated by the mining activities or both must be monitored at the locations and frequencies defined in Schedule C – Table 1 and Schedule J – Map 1 and comply with the contaminant limits defined in Schedule C – Table 2" (EHP, 2015). Table 2 details locations and frequencies of surface water monitoring as defined in Schedule C – Table 1 of the Highway Reward EA.

Table 2: Locations and frequencies of surface water monitoring as detailed in Schedule C – Table 1 of the Highway Reward EA

MONITORING POINT	EASTING (GDA 94 ZONE 55)	NORTHING (GDA 94 ZONE 55)	MONITORING FREQUENCY
SW1	418173	7748192	Event
SW2	417983	7746815	
SW3	416551	7748657	
SW4	415753	7747061	
SW5	416588	7747467	
SW6	416691	7748531	

Contaminant trigger levels for surface water monitoring locations detailed in Table 2 are also defined in Schedule C – Table 2 (receiving water contaminant limits). Table 3 details surface water monitoring parameters and contaminant trigger levels as defined in Schedule C – Table 2 of the Highway Reward EA.

Table 3: Surface water monitoring parameters and contaminant trigger levels as defined in Schedule C – Table 2 of the Highway Reward EA

PARAMETER	UNITS	LIMIT TYPE	CONTAMINANT TRIGGER LEVELS
pH		Acceptable range	6 - 9
Total Dissolved Solids	mg/L	Maximum	4000
Sulfate	mg/L	Maximum	1000
Copper	mg/L	Maximum	1
Molybdenum	mg/L	Maximum	0.15
Arsenic	mg/L	Maximum	0.5
Selenium	mg/L	Maximum	0.02
Mercury	mg/L	Maximum	0.002
Lead	mg/L	Maximum	0.1
Zinc	mg/L	Maximum	20
Cyanide (WAD)	mg/L	Maximum	0.01
Cadmium	mg/L	Maximum	0.01

3. Stream sediment monitoring

3.1 EA requirements

Requirements for stream sediment monitoring are also detailed under Schedule C – Water of the Highway Reward EA. Condition C2-2 requires that “the bed of the receiving waters, affected by the release of process water and stormwater contaminated by the mining activities must be monitored at the locations and frequencies defined in Schedule C – Table 3 and Schedule J – Map 2” (EHP, 2015). Table 4 details locations and frequencies of stream sediment monitoring as defined in Schedule C – Table 3 of the Highway Reward EA.

Table 4: Locations and frequencies of stream sediment monitoring as defined in Schedule C – Table 3 of the Highway Reward EA

MONITORING POINT	EASTING (GDA 94 ZONE 55)	NORTHING (GDA 94 ZONE 55)	MONITORING FREQUENCY
SS1	418188	7748255	Bi-annually (collected in October and April each year)
SS2	417937	7746693	
SS3	418293	7745825	
SS4	416553	7748662	
SS5	415776	7747063	Bi-annually (collected

MONITORING POINT	EASTING (GDA 94 ZONE 55)	NORTHING (GDA 94 ZONE 55)	MONITORING FREQUENCY
SS6	414930	7746299	in October and April each year)
SS6	416588	7747467	

Contaminant trigger levels for stream sediment monitoring locations detailed in Table 4 are also defined in Schedule C – Table 4 (receiving stream sediment contaminant trigger limits). Contaminant limits are also defined in Schedule C – Table 5 (receiving stream sediment contaminant limits). Table 5 details stream sediment monitoring parameters, contaminant trigger levels and contaminant limits.

Table 5: Stream sediment monitoring parameters, contaminant trigger levels and contaminant limits.

MONITORING POINT	PARAMETER (UNITS)	CONTAMINANT TRIGGER LEVEL	CONTAMINANT LIMIT
SS1	Cadmium (mg/kg)	0.25	0.31
	Copper (mg/kg)	31	38.7
	Lead (mg/kg)	117	146.2
	Zinc (mg/kg)	208	260
SS2	Cadmium (mg/kg)	1.6	2
	Copper (mg/kg)	67	83.7
	Lead (mg/kg)	121	151.2
	Zinc (mg/kg)	185	231.2
SS3	Cadmium (mg/kg)	1.7	2.12
	Copper (mg/kg)	41	51.2
	Lead (mg/kg)	112	140
	Zinc (mg/kg)	143	178.7
SS4	Cadmium (mg/kg)	0.25	0.31
	Copper (mg/kg)	18	22.5
	Lead (mg/kg)	15	18.7
	Zinc (mg/kg)	36	45
SS5	Cadmium (mg/kg)	3.2	4
	Copper (mg/kg)	681.6	852
	Lead (mg/kg)	30.4	38

MONITORING POINT	PARAMETER (UNITS)	CONTAMINANT TRIGGER LEVEL	CONTAMINANT LIMIT
	Zinc (mg/kg)	240	300
SS6	Cadmium (mg/kg)	0.8	1
	Copper (mg/kg)	113	141.2
	Lead (mg/kg)	31	38.7
	Zinc (mg/kg)	85	106.2
SS7	Cadmium (mg/kg)	1.6	2
	Copper (mg/kg)	824	1030
	Lead (mg/kg)	60.8	76
	Zinc (mg/kg)	203.2	254

4. Sample collection

Surface water sampling methods utilised to measure compliance with the Highway Reward EA and TEP requirements are in accordance with the most current EHP Monitoring and Sampling Manual 2009 (EHP, 2013). All samples collected are prepared and delivered to a National Association of Testing Authorities (NATA) accredited laboratory for analysis.

All stream sediment monitoring samples collected are done so in accordance with the Highway Reward EA condition C2-5 “all stream sediment sampling must be undertaken in accordance with AS 5667.12 Guidelines on Sampling of Bottom Sediments of 1998 or more recent editions as they become available” (EHP, 2015).

Results

1.1 Surface water

Review of receiving water sites and monitoring results was conducted for the period of January 2013 to July 2016. Event based water quality data for sites SW4 (downstream receptor) and SW6 (upstream receptor) was assessed. No event based monitoring was undertaken between July 2016 and November 2016 due to no flow events. Parameters reviewed include:

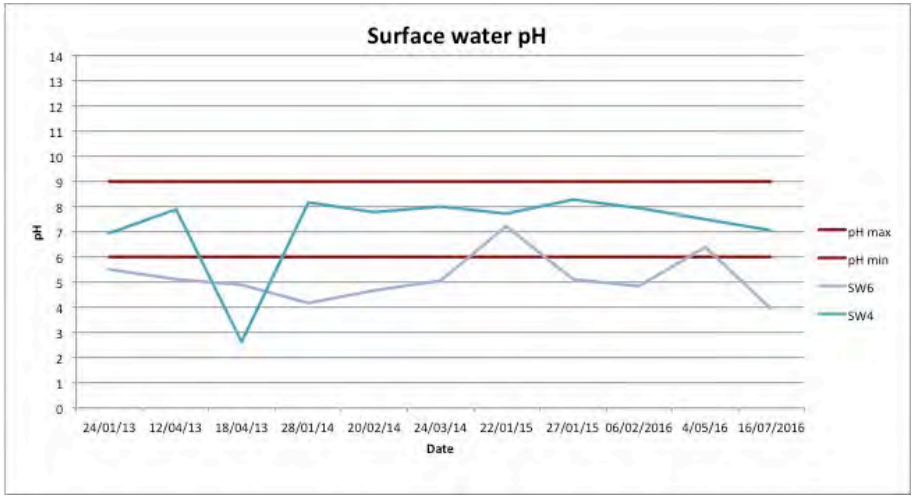
- pH
- arsenic
- cadmium
- copper
- cyanide
- mercury
- molybdenum
- selenium
- total dissolved solids
- sulphate
- zinc.

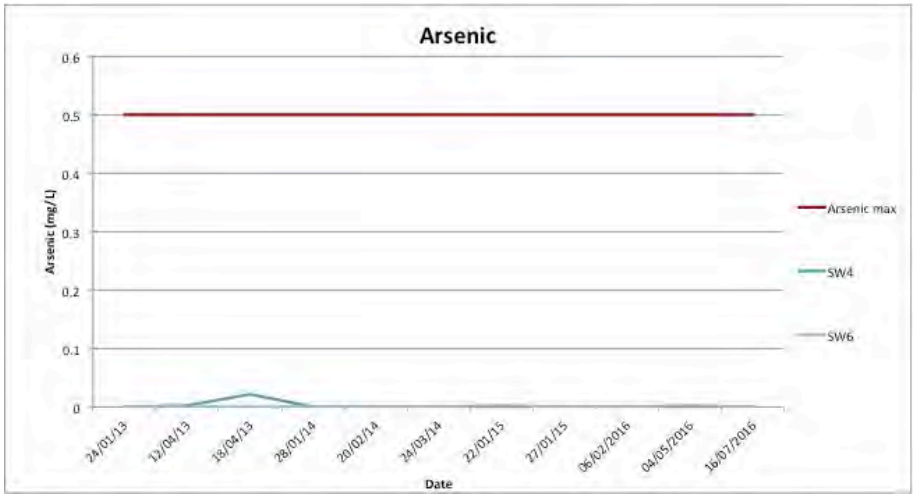
Comparison of data collected for the period was made for sites SW4 and SW6 against EA receiving water contaminant limits as required under Schedule C – Table 2. These are provided in Table 6 of this report. Primary contaminants of concern with exceedances on 16 July 2016 are noted to be:

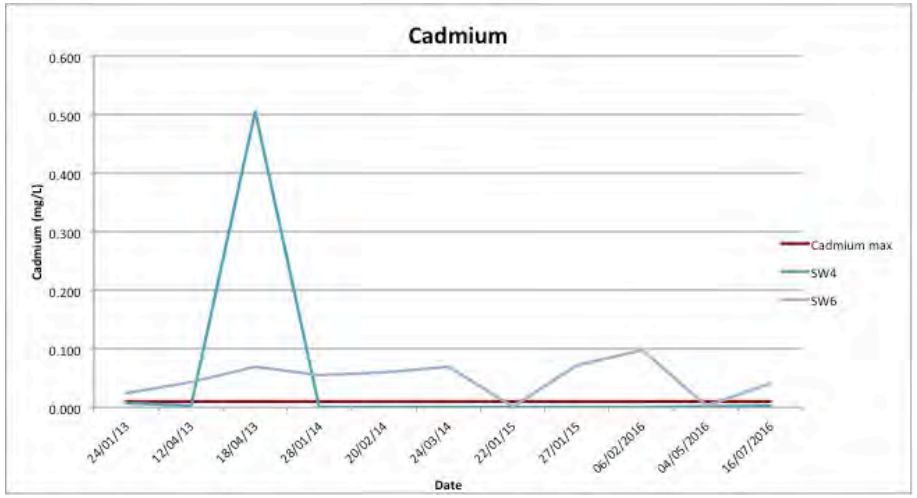
- pH (3.94)
- cadmium (0.04mg/L)
- copper (9.88mg/L).

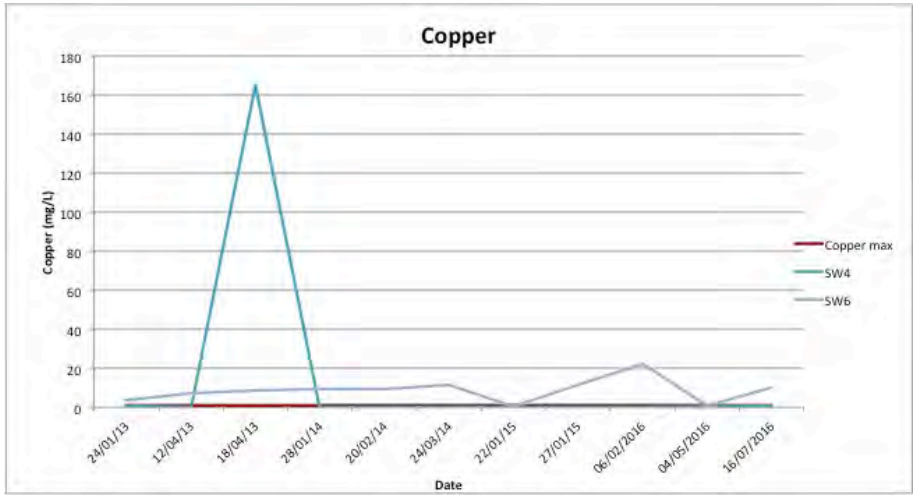
The most recent monitoring data available was received 16 July 2016 and exceedance of the above parameters was identified as exclusive to site SW6. All other parameters identified under Schedule C – Table 2 were assessed to have achieved compliance at sites SW4 and SW6.

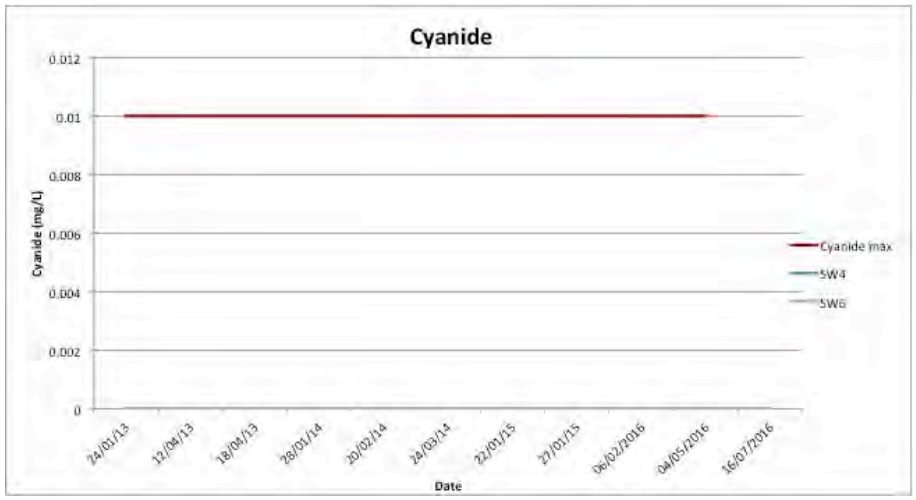
Table 6: Graphical representation of receiving water results against contaminant limits as required under Schedule C – Table 2 of the EA







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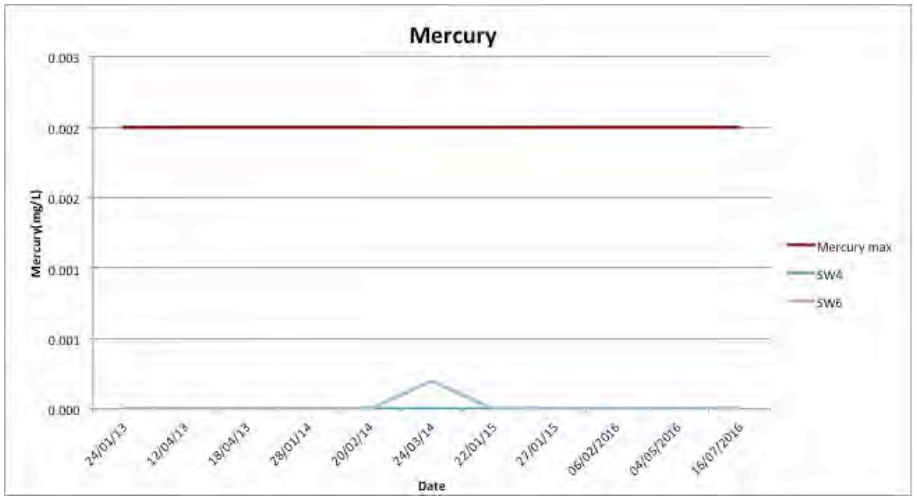
Date
Cyanide max
SW4
SW6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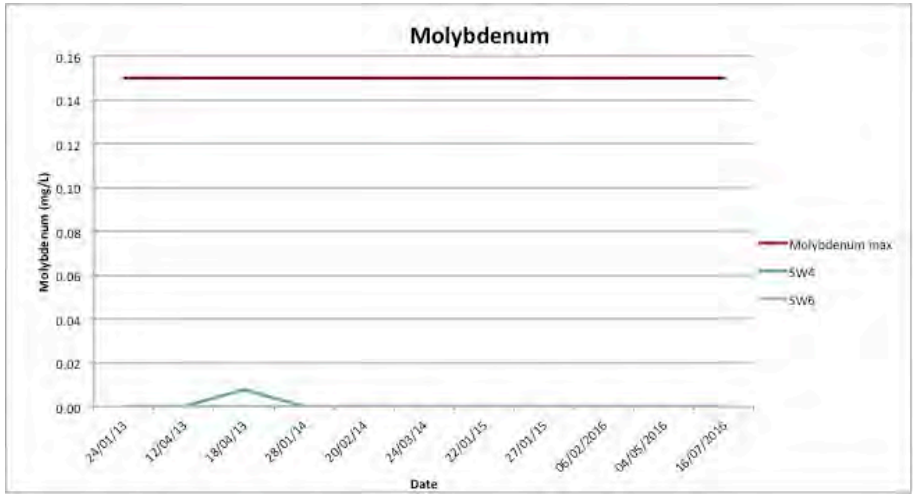
16/07/2016
Date
Mercury max
SW4
SW6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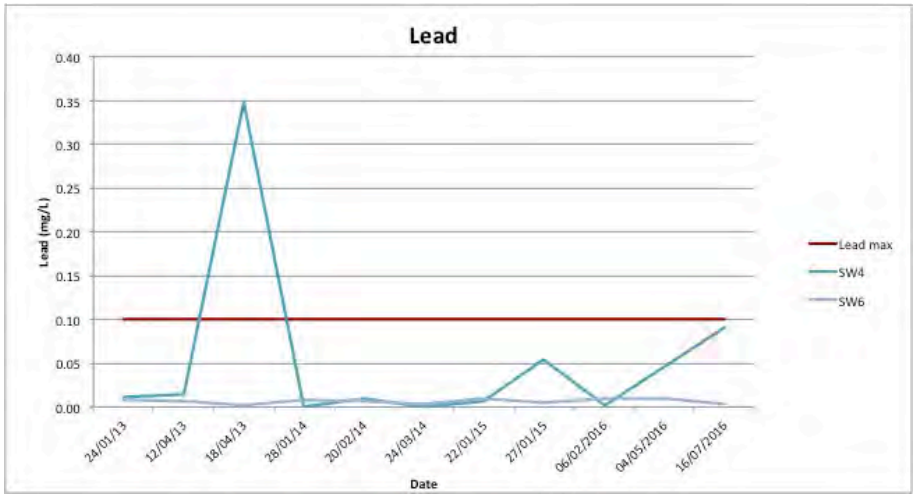
Date
Molybdenum max
SW4
SW6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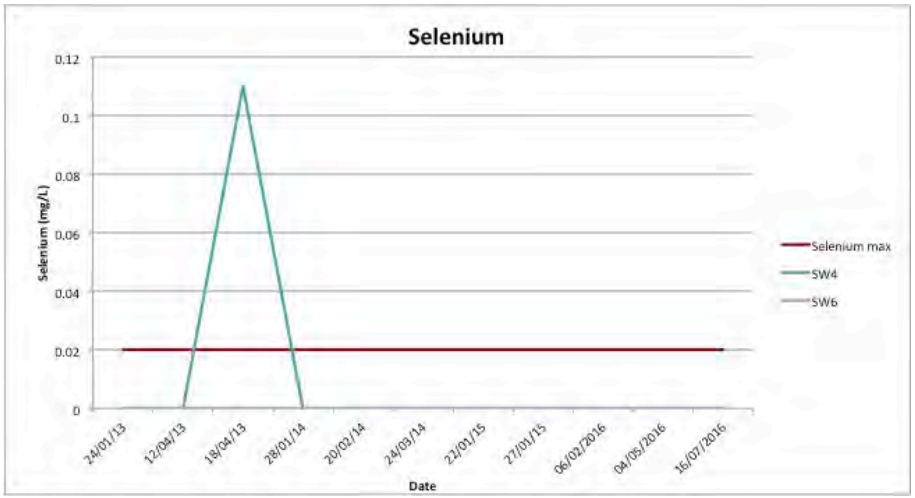
16/07/2016
Date
Lead max
SW4
SW6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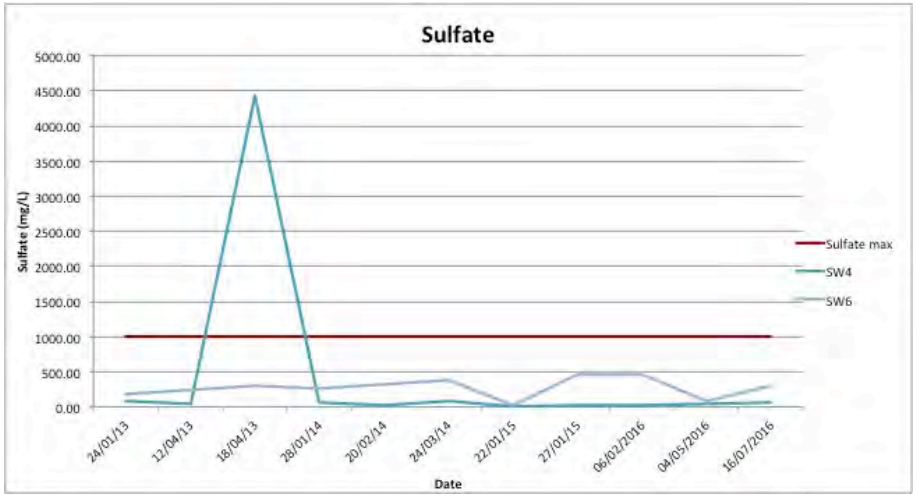
Date
Selenium max
SW4
SW6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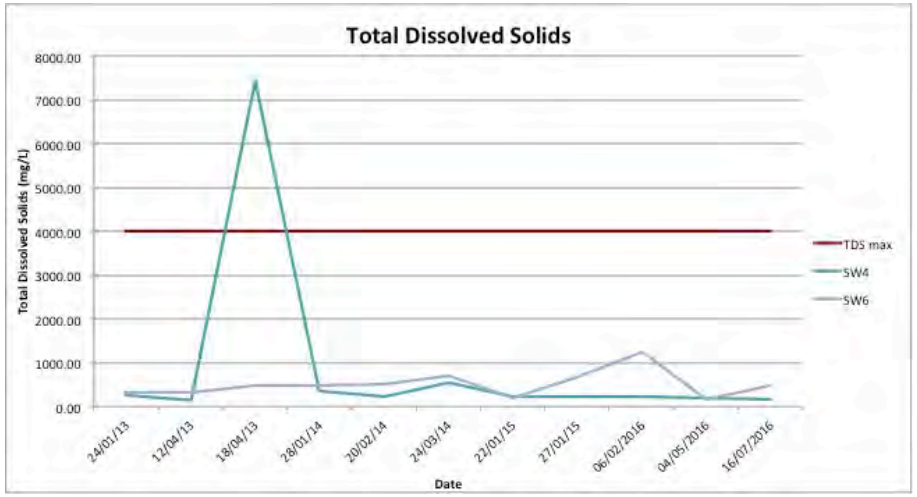
SW4
SW6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Total Dissolved Solids (mg/L)
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20/02/14
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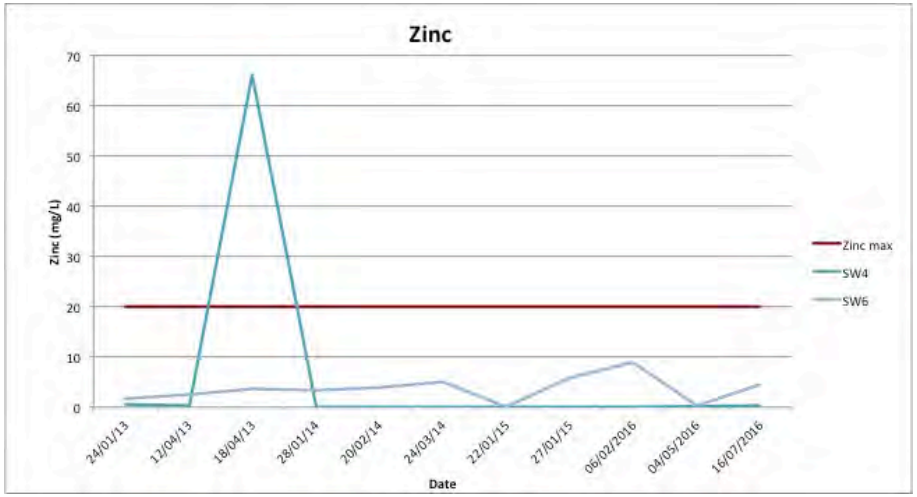
27/01/15
06/02/2016
04/05/2016
16/07/2016
Date
TDS max
SW4
SW6


Zinc
Zinc (mg/L)
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60
50
40
30
20
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20/02/14
24/03/14
22/01/15
27/01/15
06/02/2016
04/05/2016
16/07/2016
Date
Zinc max
SW4
SW6

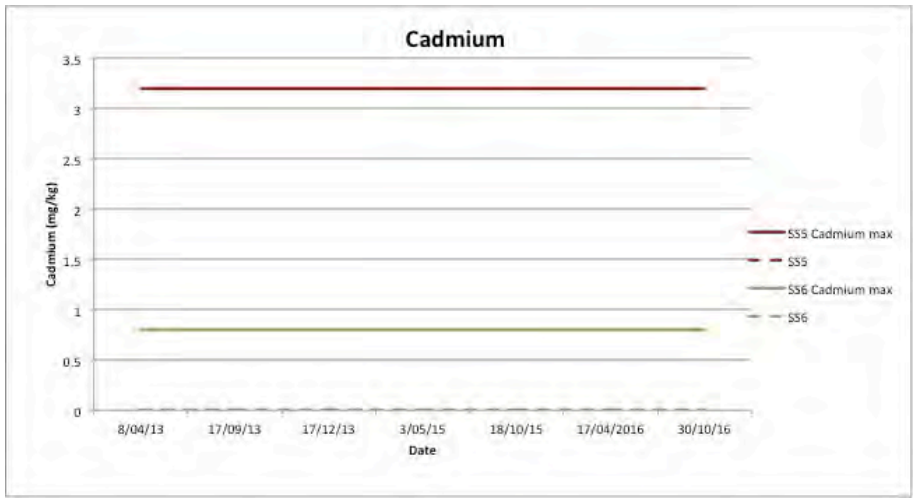
1.2 Stream sediment

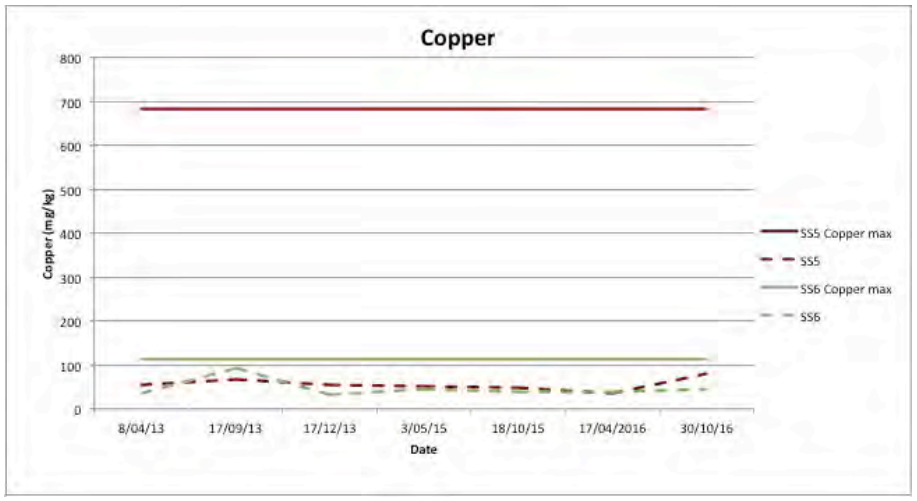
Review of stream sediment monitoring was conducted for the period of April 2013 to October 2016. Stream sediment monitoring is required to be conducted bi-annually (twice per year) at locations prescribed in Schedule C – Table 3 and for parameters prescribed under Schedule C – Table 4 of the EA. For the purpose of this report, sites SS5 (downstream of SW3 and SW6) and SS6 (downstream of SW4 and SS5) were assessed. Parameters assessed include:

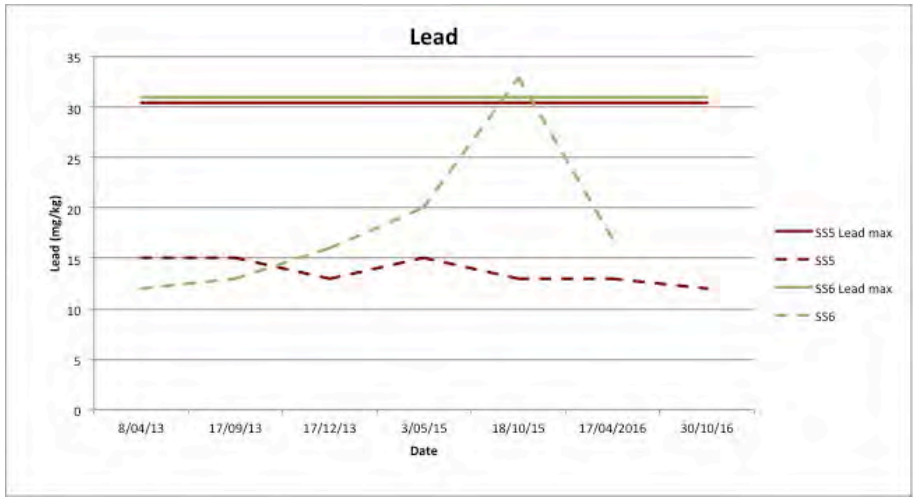
- cadmium
- copper
- lead
- zinc.

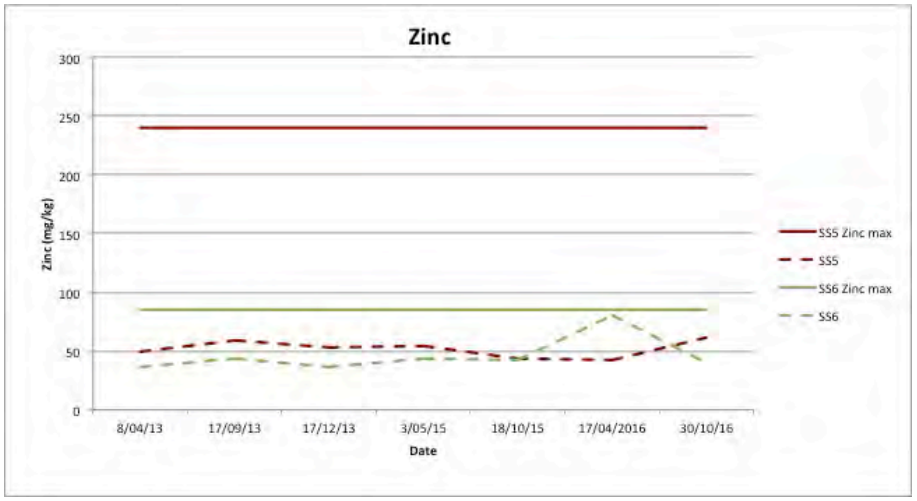
Comparison of monitoring data for sites SS5 and SS6 is provided in Table 7, which visually represents monitoring data values against contaminant trigger limits as per the EA. One trigger event was identified for lead at site SS6 on 17 April 2016 with a result of 33mg/kg. However, this is under contaminant limits for SS6 (38.7mg/kg).

Table 7: Graphical representation of stream sediment contaminant trigger levels as required the EA









Discussion

1.1 Surface water

As outlined in the results, the most recent event based monitoring data available was 16 July 2016 (this is a result of limited rainfall and no flow events occurring between July 2016 and November 2016). Exceedances identified for pH, cadmium and copper highlighted a continued release of contaminants to SW6. The 2016 earthworks program was completed by 11 November 2016 and included the following activities:

- Installation of lime rock armouring along the main drain.
- Sealing the channel of the western side of the new storage area to a level of approximately 324.7m AHD
- Diversion of the remaining 42.69ha upstream catchment into the pit via a diversion drain.

Installation of lime rock armouring is expected to deliver water quality limits (particularly pH) in compliance with EA requirements. However, leading up to November 2016, there has been insufficient rainfall to undertake event based monitoring. It is anticipated additional monitoring events will take place with the oncoming wet season.

Sealing of the western storage site was achieved with repairs to breaches in the containment wall directly south of SW6. The western storage area is now the recipient of runoff captured on the Highway Reward mine site and will prevent this water discharging off site. It is anticipated additional monitoring events will take place with the oncoming wet season and allow for further assessment of the suitability of the repairs in preventing exceedances at SW6.

Completion of diversion activities for the remaining 42.69ha upstream catchment is expected to deliver reduced flows to receiving surface water monitoring locations.

1.2 Stream sediment

A review of results has indicated stream sediment trigger level limits have been met for the period of April 2013 to October 2016 at sites SS5 and SS6 with the exception of a trigger event for lead (33mg/kg) at SS6 on 17 April 2016. The result is well below the contaminant limit of 38.7mg/kg.

Insufficient historical information is available to evaluate the cause of the trigger event. However, the monitoring site location is within approximately 500 metres of an unmined lead zinc resource.

Biannual monitoring of stream sediment sites will be undertaken in the first and third quarter of 2017 to evaluate the continued effectiveness of activities undertaken at the Highway Reward mine site.

1.3 Monitoring program

Review of the sediment monitoring program identified an opportunity to improve the overall understanding of the sources and behaviour of contaminants. Future analyses of stream sediments will include:

- pH (1:5)
- Electrical Conductivity (EC)
- Sulfate as SO_4^{2-}
- Cation Exchange Capacity
- Acidity as $CaCO_3$.

Conclusions and Recommendations

Activities undertaken to date under the Highway Reward TEP have identified significant improvements in returning to environmental compliance for the 2016 period. Surface water exceedances have been identified at SW6 for pH, cadmium and copper. However, earthworks activities undertaken are expected to mitigate future releases of contaminants. Earthworks activities undertaken in 2016 include:

- Installation of lime rock armouring along the main drain.
- Sealing the channel of the western side of the new storage area to a level of approximately 324.7m AHD.
- Diversion of the remaining 42.69ha upstream catchment into the pit via a diversion drain.

A review of stream sediment results did not identify exceedances for trigger limits specified under the EA with the exception of a trigger event for lead on 17 April 2016.

A review of the sediment monitoring program has identified an opportunity to improve the overall understanding of the sources and behaviour of contaminants. Future analyses of stream sediments will include:

- pH (1:5)
- Electrical Conductivity (EC)
- Sulfate as SO_4^{2-}
- Cation Exchange Capacity
- Acidity as $CaCO_3$.

References

Bureau of Meteorology (BOM), 2016, *Climate Statistics for Charters Towers Post Office*, Station ID 0.34002, retrieved from: http://www.bom.gov.au/climate/averages/tables/cw_034002.shtml.

Department of Environment and Heritage Protection (EHP). (n.d.). Approved form for transitional environmental program – EM1364. Retrieved from EHP website: https://www.ehp.qld.gov.au/management/compliance-guidelines.html.

Department of Environment and Heritage Protection (EHP), 2013, *Monitoring and sampling manual 2009 Environmental Protection (Water) Policy 2009*, Version 2 September 2010 (July 2013 format edits), Queensland Government.

Department of Environment and Heritage Protection (EHP), 2015, *Permit – Environmental Authority EPML00550413*, Version 1, issued 29 April 2015, Queensland Government.

Appendix summary

Appendix A

Maps

HIGHWAY REWARD

SURFACE WATER HYDROLOGY AND EA COMPLIANCE MONITORING LOCATIONS

Legend

- Watercourse
- Roads
- Mining Lease

EA Compliance Monitoring Points

- Groundwater (GW/MW)
- Receiving Water (SW)
- Stream Sediment (SS)

SS4
SW3
SW6
MW3
GW4
SS1
SW1
MW14
MW12
SS7
SW5
MW11
MW4
MW Entry
SW4
MW9
SS5
MW15
MW8
MW7
MW5
MW6
SW2
SS2
Gregory Developmental Road
SS6
SS3

Mining Lease, Watercourse;
© State of Queensland (Department of Natural Resources and Mines) 2016
Roads; (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 06-Dec-16

0 112.5 225 450
Metres

Scale: 1:12,000 at A3

N

Northern Resource CONSULTANTS

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Appendix B

Highway Reward Surface Water Trend Analysis

northern resource consultants

Highway Reward

Surface Water Trends Analysis

June 2016

prepared for

Highway Reward

Contact Information	Details
Organisation	Northern Resource Consultants Pty Limited
Contact Person	Marty Costello
Phone	07 4772 6500
Email	marty@northres.com.au
Mail	12 Cannan Street, South Townsville QLD, 4810
ABN	55 126 894 693

Document Control	Details including responsible party and date
Version 1	Issued for internal review by Reece Fraser on 29 June 2016
Version 2	Internal review – Kate Hensler, Shalika Walker, Marty Costello. Marty Costello authorised for client release 30 June 2016.
CLIENT RELEASE	Issued to client 30 June 2016

Limitations of this Report

Client: Highway Reward

Prepared by Northern Resource Consultants (NRC)

This disclaimer brings the limitations of the investigations to the attention of the reader.

The information in this report is for the exclusive use of Highway Reward. Highway Reward is the only intended beneficiary of our work.

We cannot be held liable for third party reliance on this document. The information within this report could be different if the information upon which it is based is determined to be inaccurate or incomplete.

The results of work carried out by others may have been used in the preparation of this report. These results have been used in good faith, and we are not responsible for their accuracy.

This report has been formulated in the context of published guidelines, field observations, discussions with site personnel, and results of laboratory analyses.

NRC's opinions in this document are subject to modification if additional information is obtained through further investigation, observations or analysis. They relate solely and exclusively to environmental management matters, and are based on the technical and practical experience of environmental scientists.

They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts.

Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.

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Introduction

1. Transitional Environmental Program MAN17020

The Highway Reward Mine operates as a rehabilitation project under the Environmental Authority (EA) EPML00550413. In 2013, following non-compliance with the EA and an internal site evaluation and investigation, Thalanga Copper Mines Joint Venture (TCMJV) submitted a Program Notice to the Department of Environment and Heritage Protection (EHP). As a result of this Program Notice, EHP issued a notice requiring the preparation and submission of a Draft Transitional Environmental Program (TEP).

The condition of the EA subject to non-compliance and resulting in the submission of the original draft TEP in 2013 is:

Receiving Water Contaminant Limits

(C1-1) Receiving waters affected by the release of process water or storm water contaminated by the mining activities or both must be monitored at the locations and frequencies defined in Schedule C – Table 1 and Schedule J – Map 1 and comply with the **contaminant limits defined in Schedule C – Table 2.**

Table 1: Copy of Schedule C – Table 2 (Receiving water contaminant limits)

PARAMETER	UNITS	LIMIT TYPE	CONTAMINANT TRIGGER LEVELS
pH		Acceptable range	6 - 9
Total Dissolved Solids	Mg/L	Maximum	4000
Sulfate	Mg/L	Maximum	1000
Copper	Mg/L	Maximum	1
Molybdenum	Mg/L	Maximum	0.15
Arsenic	Mg/L	Maximum	0.5
Selenium	Mg/L	Maximum	0.02
Mercury	Mg/L	Maximum	0.002
Lead	Mg/L	Maximum	0.1
Zinc	Mg/L	Maximum	20
Cyanide (WAD)	Mg/L	Maximum	0.01

PARAMETER	UNITS	LIMIT TYPE	CONTAMINANT TRIGGER LEVELS
Cadmium	Mg/L	Maximum	0.01

NOTE: It is assumed that this table of the EA contains an error and the last column is in fact contaminant “limits”.

The non compliance with condition C1-1 of the EA, the surface water contaminant limits, were specifically in regards to ongoing exceedance of the EA limits at receiving surface water sites SW5 and SW6.

On 6 August 2013 the Draft TEP was finalised and submitted to EHP for review. Subsequently the TEP was approved and a notice accepting the TEP was issued on 27 August 2013. The TEP, with statutory reference number MAN17020 was to cover a three-year period until 30 September 2016 and included a number of reporting requirements. As a result of the TEP and as per Condition 1 of the Certificate of Approval, surface water sites SW5 and SW6 have been exempt from the EA contaminant limits and notification requirements during the program period.

This surface water report has been prepared and submitted to EHP as per the reporting requirements and commitments contained within the Draft TEP prepared by Thalanga Copper Mines Pty Ltd.

Table 2 of this document provides a status update on the TEP completion and tasks as per the approved program as of June 2016.

2. TEP Requirements

The TEP aims to address three issues, including:

1. Addressing surface flow towards SW6 on the north-west side of the site.
2. Addressing surface flow towards SW5 to the west of the site.
3. Surface water-groundwater interactions which impact on the amount of contaminated water which can be directed into the pit void.

This report addresses Point 1 and Point 2.

2.1 Surface water flows towards SW6

The TEP further states that objectives of investigation and analysis of flows towards SW6 will include:

- Longitudinal sampling along the flow path after rain events.
- Measuring major drainage flows from the Highway waste rock dump at a dedicated v-notch weir.
- Measuring rainfall on site.
- Measuring flows at each potentially contaminated seep emanating or potential emanating from the Highway waste rock dump.
- Sampling standing pools of water after rainfall.

- Analysing the results of the sampling programs and flow measurements to quantify pollutant sources and fluxes and differentiate sources of contamination.
- Carrying out a program of visually inspecting the Highway and Reward waste rock dumps to identify flaws in the capping which could cause contamination.
- Assessing bare patches on waste rock dumps for growth in size which might indicate scalding and the scale of remedial works needed.

2.2 Surface water flows towards SW5

The TEP further states that objectives of investigation and analysis of flows towards SW5 will include:

- Implementing a program of surface water sampling on the western side of the mining lease including flows directed into the pit.
- Developing a record of photographic monitoring to show and accompany surface water flow sampling for identification of surface water flow or pooling.
- Analysing the result to confirm presence or absence of contaminated water flows on site towards SW5.

3. Overview and Purpose

The purpose of this report is to address the requirements of the TEP as outlined.

Visual inspection of the waste rock dumps and assessing bare patches are undertaken separately to what is outlined in this report.

The purpose of analysis of water samples as outlined in the TEP is to determine if acidity is a result of rainfall or waste rock dump seepage.

During the six-month reporting period discussed in this report there were a number of flow events recorded at SF1 and SF2. All of these flows were below 0.126m3/sec with the average flow recorded at SF1 and SF2 being 24m3/day. These flows resulted in approximately 68,752m3 of flow being recorded past the SF1 gauge and 29,310m3 past the SF2 gauge over the six-month reporting period.

There were four monitoring events during the six monthly period these were:

1. 7 January 2016
2. 6 February 2016
3. 14 February 2016
4. 13 March 2016.

Monitoring events are undertaken when there has been sufficient rainfall for flow in Policeman's Creek (SW4), which is located offsite and is therefore representative of any potential offsite impacts of the mine. The monitoring event for 7 January 2016 only incorporated two TEP sites TEP3 and TEP4 as other sites held insufficient water, for this reason an analysis of the January TEP sampling is not included in the SW5 and SW6 flow analyses sections of this report. The data of these samples is provided in Appendix B.

Table 2: TEP completion status as of June 2016

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
1. Surface Flow Sampling					
1.1	SW6 flow path drain		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.2	SW6 flow path WRD		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.3	SW5 flow path		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.4	Pit V-notch		1 November 2013 – 1 May 2014	6 monthly 'surface flow sampling update' report to DEHP by 30 December 2013	**COMPLETE**
				6 monthly 'surface flow sampling update' report to DEHP by 30 June 2014	**COMPLETE**
1.5	SW6 Flow path drain	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
1.6	SW6 flow path WRD	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**
1.7	SW5 flow path	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**
1.8	Pit V-notch	-	1 November 2014 – 1 May 2015	Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 December 2014	**COMPLETE**
				Provision of 6 monthly 'surface flow sampling update' report to DEHP by 30 June 2015	**SUBMITTED HERE**
2. Earthworks					
2.1	Remedial drainage and cap repairs	2.1.1 Remove exposed boulders containing sulphides from NW of Highway WRD to the pit 2.1.2 Cap remaining sulphidic material at Highway WRD. 2.1.3 Revegetation of bare patches on Highway and Reward WRD 2.1.4 Removal of sulphidic rocks from fence line at SW5 to pit.	17 September 2013 – 28 October 2013	Earthworks update report by 30 October 2013	**COMPLETE**

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
2.2	2014 earthworks program	-	15 May 2014 – 17 September 2014	Earthworks update report by 29 October 2014	**COMPLETE**
2.3	2015 earthworks program	-	18 May 2015 – 18 September 2015	Earthworks update report by 29 October 2015 including proposed surface water diversion assessment report	**COMPLETE**
2.4	2016 earthworks and surface diversion program	-	17 May 2016 – 5 September 2016	Earthworks update and Surface water diversion works report by 29 September 2016	**NOT YET COMPLETE** **DUE 29 SEPTEMBER 2016**
3. Groundwater / Pit Balance					
3.1	Measure surface flows at V notches	-	17 September 2013 – 20 June 2016	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
3.2	Survey pit water height	-	1 October 2013 – 14 October 2013	Runoff and pit water report by 30 December 2013	**COMPLETE**
3.3	Survey pit water height	-	1 January 2014 – 14 January 2014	Runoff and pit water report by 30 December 2014	**COMPLETE**
3.4	Survey pit water height	-	1 April 2014 – 14 April 2014		
3.5	Survey pit water height	-	1 July 2014 – 14 July 2014		
3.6	Survey pit water height	-	1 October 2014 – 14 October 2014		
3.7	Survey pit water height	-	1 January 2015 – 14 January 2015	Runoff and pit water report by 30 December 2015	**COMPLETE**
3.8	Survey pit water height	-	1 April 2015 – 14 April 2015		

TASK	ACTION ITEM	DESCRIPTION OF ACTION ITEM	DATE	PERFORMANCE INDICATOR/ REPORTING	STATUS AS OF JUNE 2016
3.9	Survey pit water height	-	1 July 2015 – 14 July 2015		
3.10	Survey pit water height	-	1 April 2015 – 14 April 2015		
3.11	Survey pit water height	-	1 July 2015 – 14 July 2015	Runoff and pit water report by 30 September 2016	**NOT YET COMPLETE** **DUE 30 SEPTEMBER 2016**
3.12	Survey pit water height	-	1 April 2016 – 14 April 2016		
3.13	Survey pit water height	-	24 June 2016 – 7 July 2016		
3.14	Groundwater model calibration	-	15 April 2015 – 7 July 2015	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
3.15	Surface water model calibration	-	15 April 2015 – 7 July 2015	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
3.16	Surface diversion assessment	-	8 July 2015 – 18 August 2015	Proposed surface water diversion assessment report by 29 October 2015	**COMPLETE**
4. Final TEP Report					
4.	Submission of Final TEP Report	-	30 September 2016	Submit final TEP report to DEHP by 30 September 2016	**NOT YET COMPLETE** **DUE 30 SEPTEMBER 2016**

Rainfall and Surface Flows

The Department of Transport and Main Roads (TMR) record rainfall on site at Highway Reward. SF2 also has the ability to record rainfall data; however, data was not available from SF2 for periods of the January – June reporting period. For this reason data from the onsite TMR gauge has been reviewed and is provided as a monthly total in Figure 1.

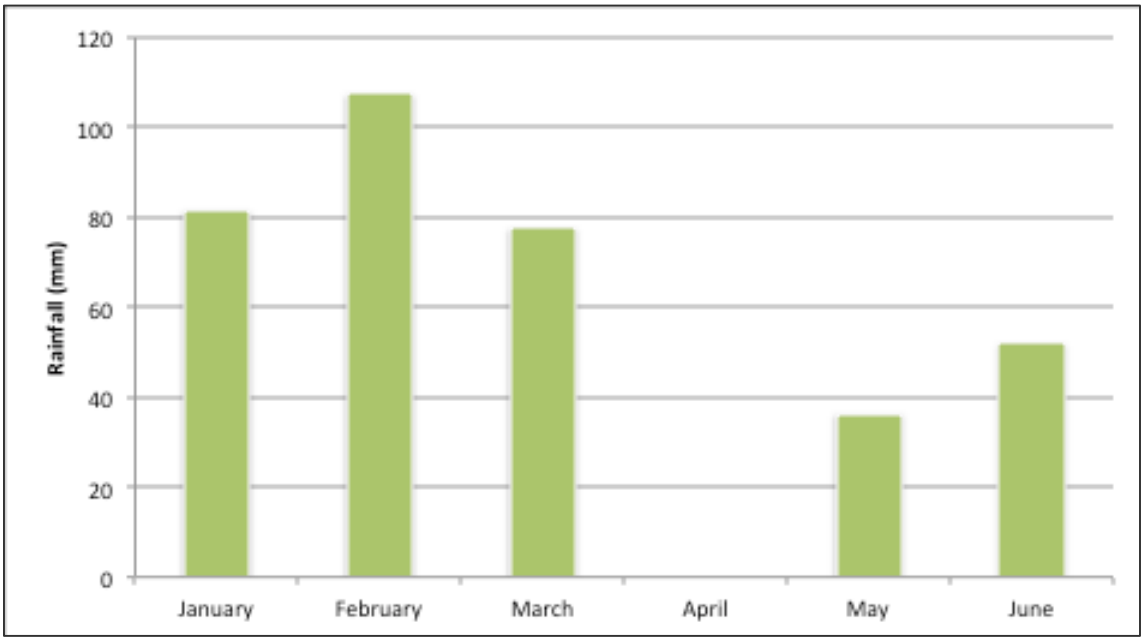


Figure 1: Monthly rainfall from Department of Transport and Main Roads onsite gauge.

There was 355.1mm of rainfall recorded at the TMR site from 1 January until 29 June 2016.

During the six-month reporting period discussed in this report there were a number of flow events recorded at SF1 and SF2. All of these flows were below 0.126m3/sec with the average flow recorded at SF1 and SF2 being 24m3/day (Figure 2). These flows resulted in approximately 68,752m3 of flow being recorded past the SF1 gauge and 29,310m3 past the SF2 gauge over the six-month reporting period (see Table 2).

Table 3: Monthly rainfall and flow volumes for SF1 and SF2

MONTH	SITE RAINFALL	SF1 FLOWS (SW5 CATCHMENT)	SF2 FLOWS (SW6 CATCHMENT)
	mm	m3	m3
January	81.6	0	4,923
February	107.5	26,327	22,050
March	77.7	39,067	614
April	0	0	0
May	36.4	3,357	756
June (to 29 Jun)	51.9	2	967
Total	355.1	68,752	29,310

There were more flow events from SF1 recorded than SF2 (Figure 2) even though SF2 has a larger catchment area. There are four flow events recorded from SF1 while there are only two major flow events recorded from SF2 (Figure 2).

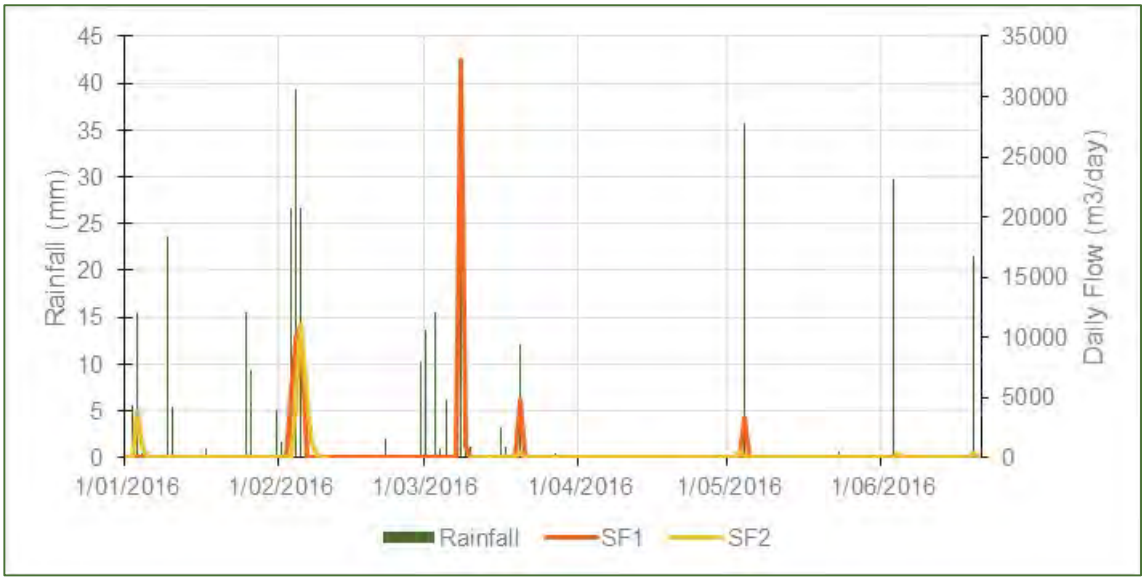


Figure 2: Daily flow values for SF1 and SF2 compared to rainfall

Rainfall values recorded for this monitoring period were multiplied by the catchment area of SF1 (approximately 17.067ha) and SF2 (approximately 31.239ha) and to determine the maximum potential volume of water that could have flowed through each V-notch weir. The cumulative total was then plotted against the cumulative total of flow that was recorded past each V-notch weir to describe the relationship between rainfall and runoff.

Values for SF1 show that there was more flow past the v-notch weir compared to what could have potentially occurred over the catchment area (Figure 3). There was a particularly large flow event contributing 30,000m^3 in the March flow event that is not picked up in the rainfall record represented by the green line in Figure 3. This discrepancy could be as a result of the DTMR gauge used for this period, malfunction of the flow gauge, or an incorrect catchment area used in calculations.

Values for SF2 show that approximately 26% of all rainfall that fell on the catchment area eventuated as runoff. However, as shown in Figure 4 the relationship between total rainfall and runoff is not linear and there are significant periods where rainfall (represented by the green line) did not result in flows past the gauge).

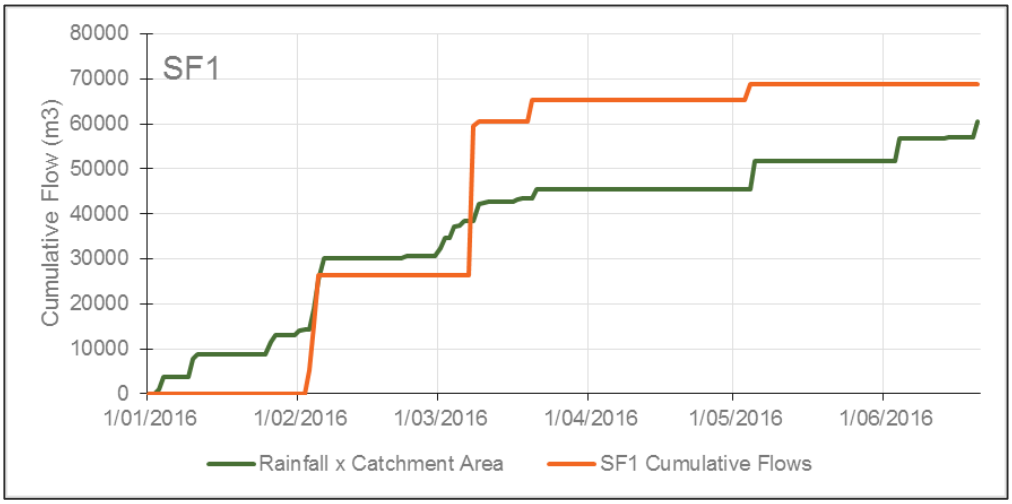


Figure 3: Cumulative flow and rainfall over the catchment of SF1

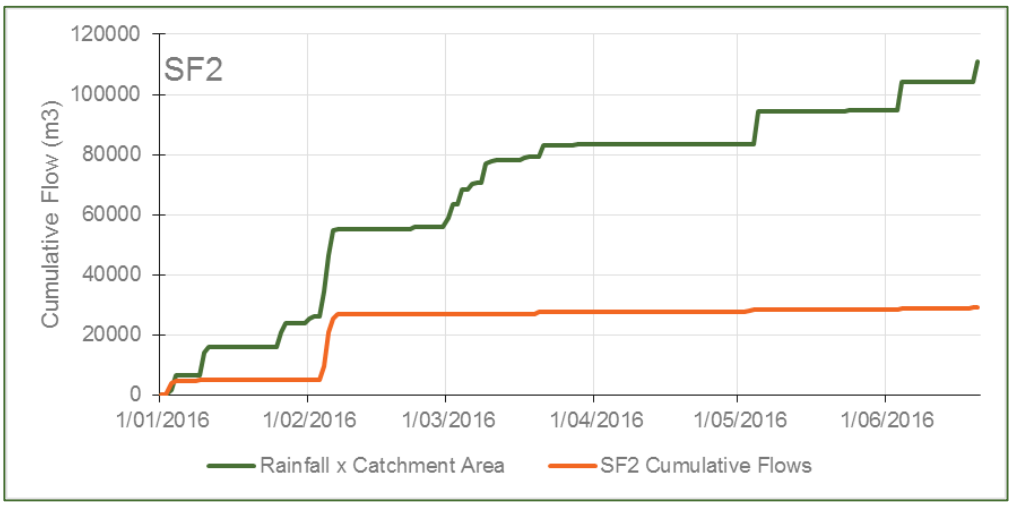


Figure 4: Cumulative flow and rainfall over the catchment of SF2

Water Quality Analyses

The number of samples available from each monitoring point is outlined below in Table 4 and represented in Figure 5 and Figure 6. As indicated above although the data from SF2 and SF1 may indicate a flow, some of these flows (most) were deemed to be insignificant and did not result in a flow in the receiving environment surface water sites.

The majority of samples are from locations draining the Highway waste rock dump (TEP 1-4, TEP6-10).

The locations of TEP and EA monitoring points are shown in Appendix A.

Table 4: Water quality samples available for the TEP reporting period

SAMPLE LOCATION	SAMPLING EVENT					
	7/01/2016	6/02/2016	14/02/2016	13/03/2016	4/05/2016	Total
Locations that flow towards SW6						
TEP 1		1				**1**
TEP 2		1				**1**
TEP 3	1	1		1		**3**
TEP 4	1	1		1		**3**
TEP 6		1	1	1		**3**
TEP 7		1	1	1		**3**
TEP 8		1	1			**2**
TEP 9		1				**1**
TEP 10		1	1	1		**3**
SW6		1			1	**2**
Locations that flow towards SW5						
TEP 5		1				**1**
TEP 11		1		1		**2**
SW5		1		1	1	**3**

Sampling times are correlated to flows in Figure 5 and Figure 6 below.

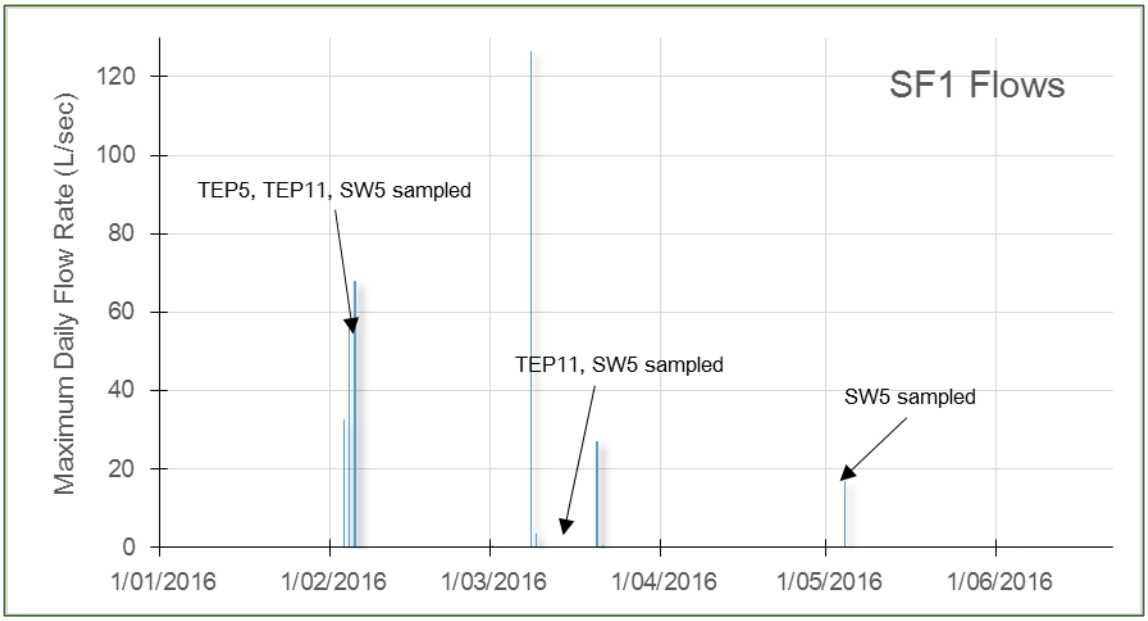


Figure 5: Flows and sampling times in SF1

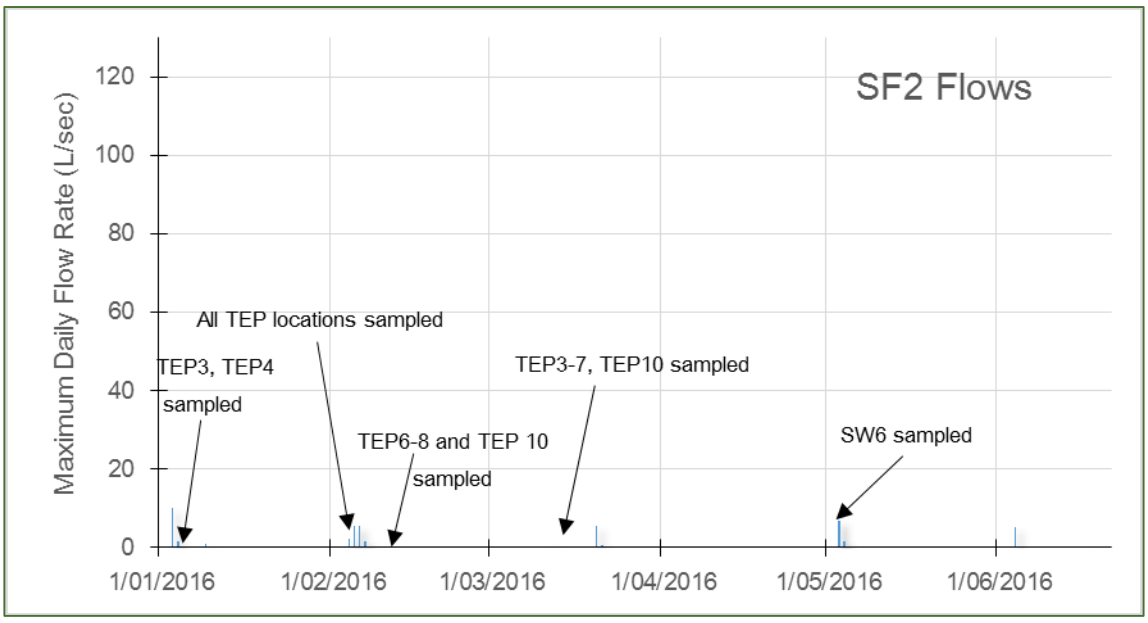


Figure 6: Flows and sampling times in SF2

Water Quality of Flows

1. Highway Waste Rock Dump Catchment

This section presents an analysis of water quality in TEP sampling points from the Highway Waste Rock Dump. Flows from Highway Waste rock Dump are towards SW6, therefore this section addressed SW6 flows as per the TEP.

These sample points are TEP01, TEP02, TEP03, TEP04, TEP06, TEP07, TEP08, TEP09 and TEP10.

During the six monthly period only 20 samples were collected from these TEP points. These samples were collected in relatively low flow conditions and therefore do not provide a true indication of any offsite release of contaminants.

Where relevant, water results from SW6 are included in each of these analyses.

The entire dataset for the TEP monitoring points is presented in Appendix B.

1.1 Sampling Event – 6 February 2016

There was much less flow in the catchment reporting to SF2 – compared to SF1.

There were several pools located throughout the catchment, particularly at TEP7, TEP8, TEP6, TEP2 and TEP1 (refer Appendix 3 for field sheets and photographs of these locations). These events were sampled on 6 February 2016.

Bar charts below show pH (Figure 7) and arsenic (Figure 8) values during this event.

The highest pH values are evident in TEP6 and TEP1, which approach neutral. Relatively acidic values (<4.5pH) are found at TEP10, TEP02, TEP03 and TEP04. Values at SW6 (the location furthest downstream) are 4.83, which is close to the median concentration (4.94) of all values along the SW6 catchment.

Arsenic values are highest at TEP02, TEP06, TEP07 and TEP09 while some of the lowest concentrations are recorded at SW6 (Figure 8). This may indicate arsenic is not a contaminant that will readily impact the receiving environment. The values are not correlated with pH.

Acidity values are shown in Figure 9 where it is evident the major sources of acidity are from TEP1 to TEP4 and TEP10. Since TEP1 is the most downstream point these values may influence the concentrations at TEP1. Acidity is not measured at SW6 so there has been no value reported.

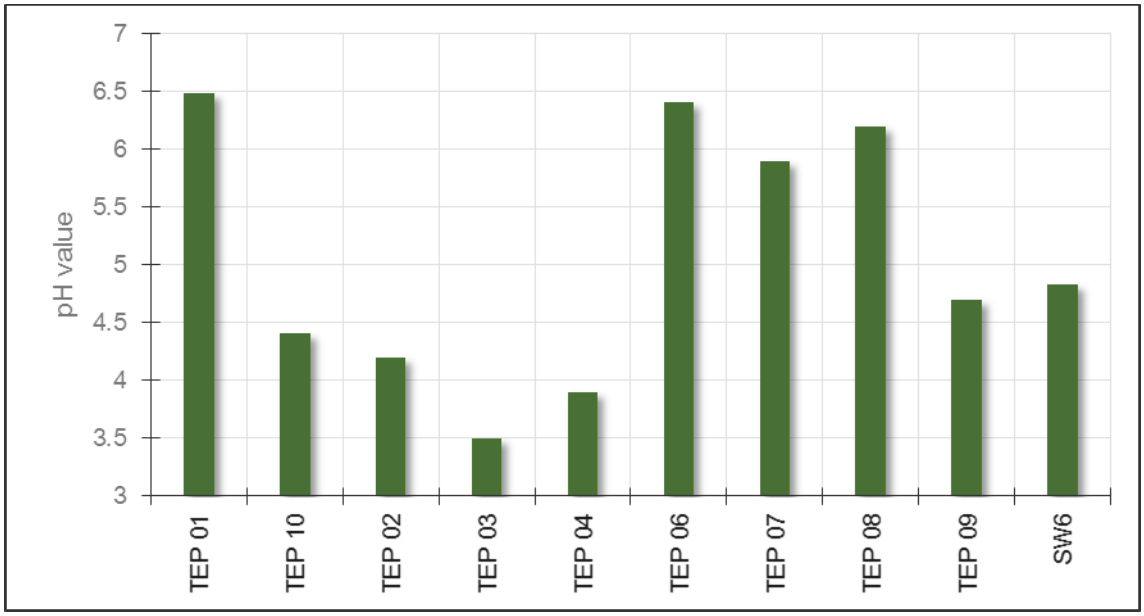


Figure 7: pH values from sample points on the Highway waste rock dump during the 6 February flow event

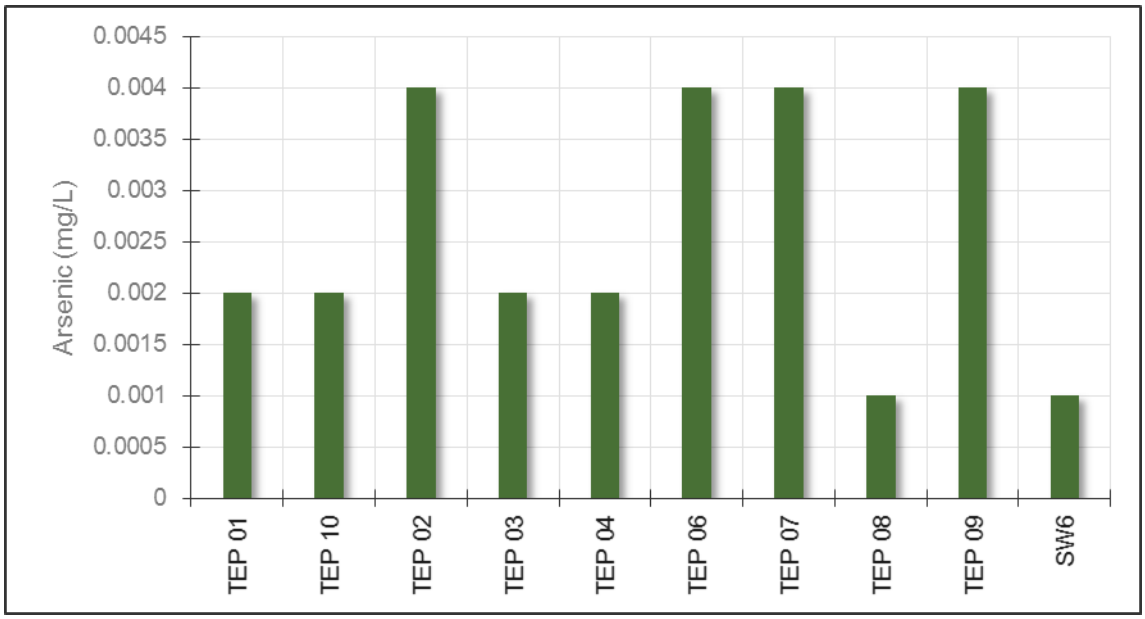


Figure 8: Arsenic values from sample points on the Highway waste rock dump during the 6 February flow event

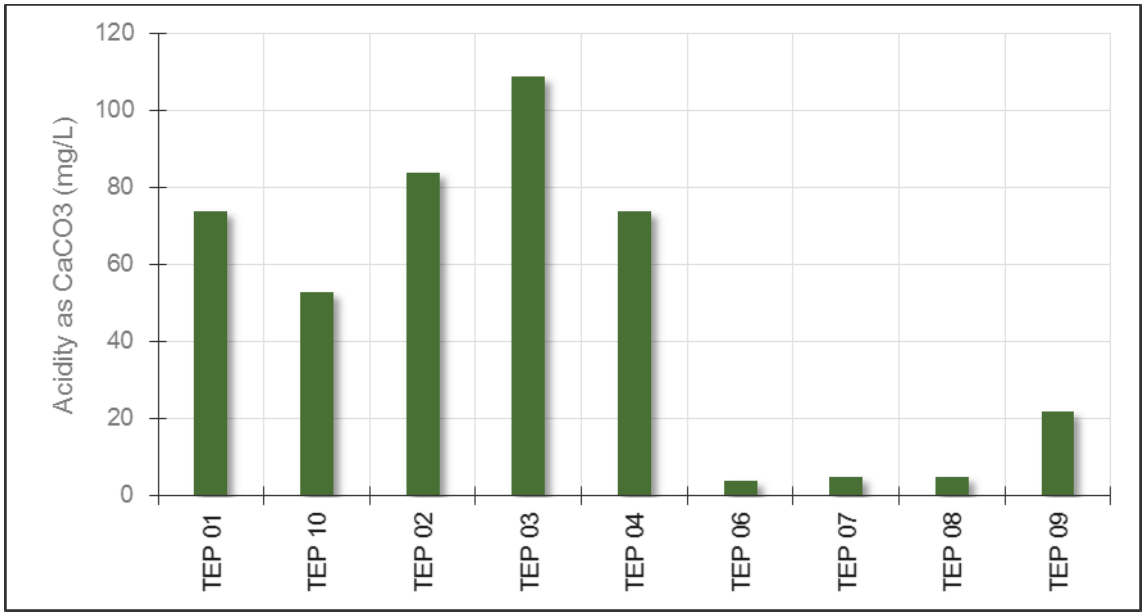


Figure 9: Acidity concentration from sample points on the Highway waste rock dump

1.2 Sampling Event - 14 February 2016

Arsenic is highest at TEP08 and TEP06 but is relatively low at TEP10 and TEP07 (Figure 10). Acidity appears to be negatively correlated with arsenic values, with TEP10 and TEP07 having the highest concentrations of acidity (Figure 11).

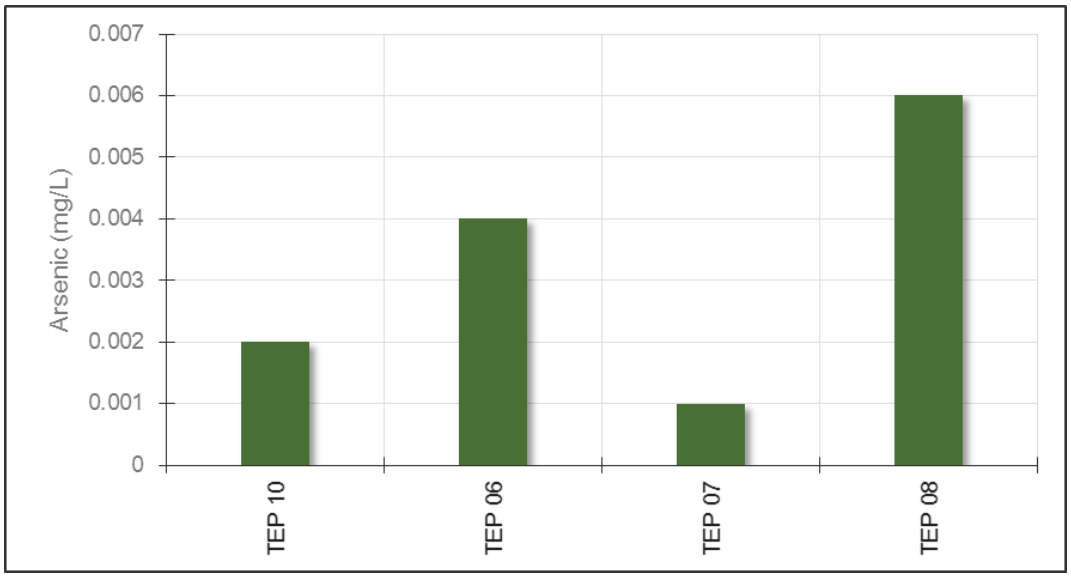


Figure 10: Arsenic from sample points on the Highway waste rock dump during the 12 February flow event

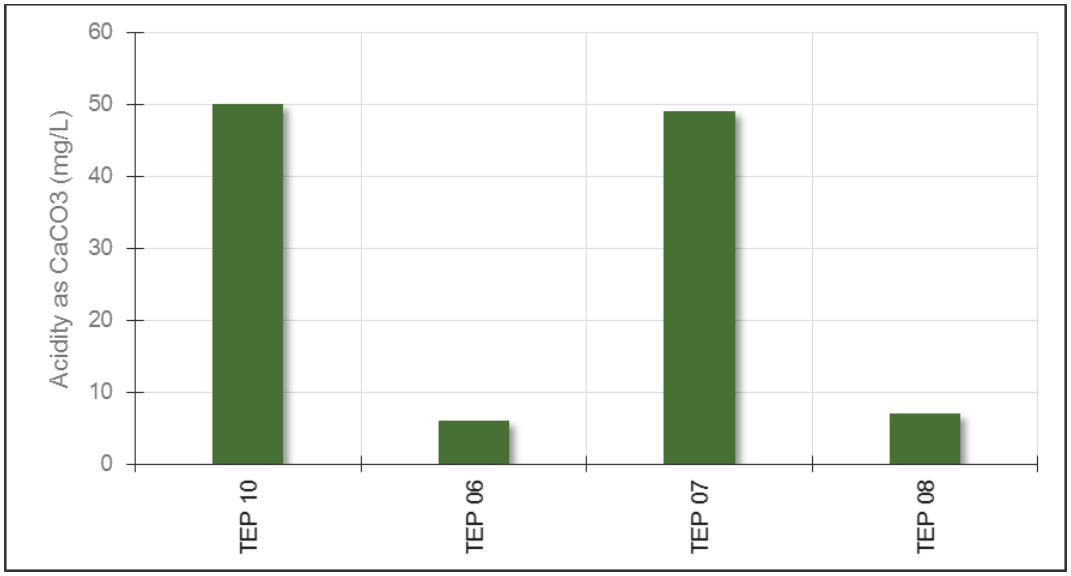


Figure 11: Acidity from sample points on the Highway waste rock dump during the 12 February flow event

1.3 Sampling Event – 13 March 2016

TEP03 and TEP04 (Figure 12) has the lowest pH values. TEP04 shows the highest arsenic concentrations (Figure 13). Acidity values were not analysed for this flow event.

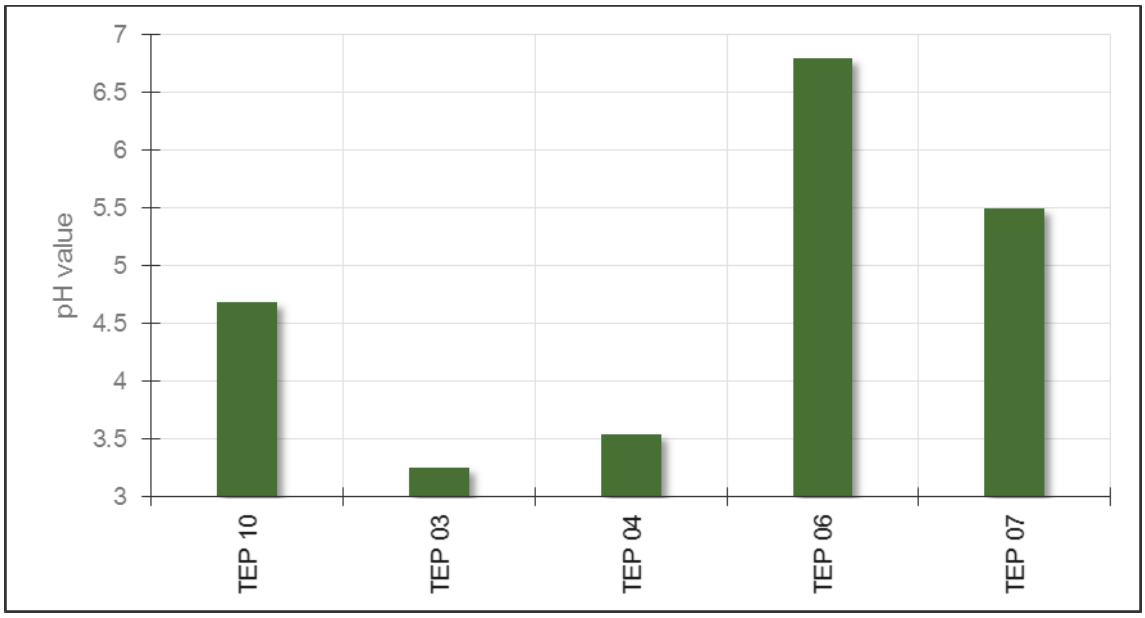


Figure 12: pH values along flow paths reporting to SW6 during the 13th March flow event

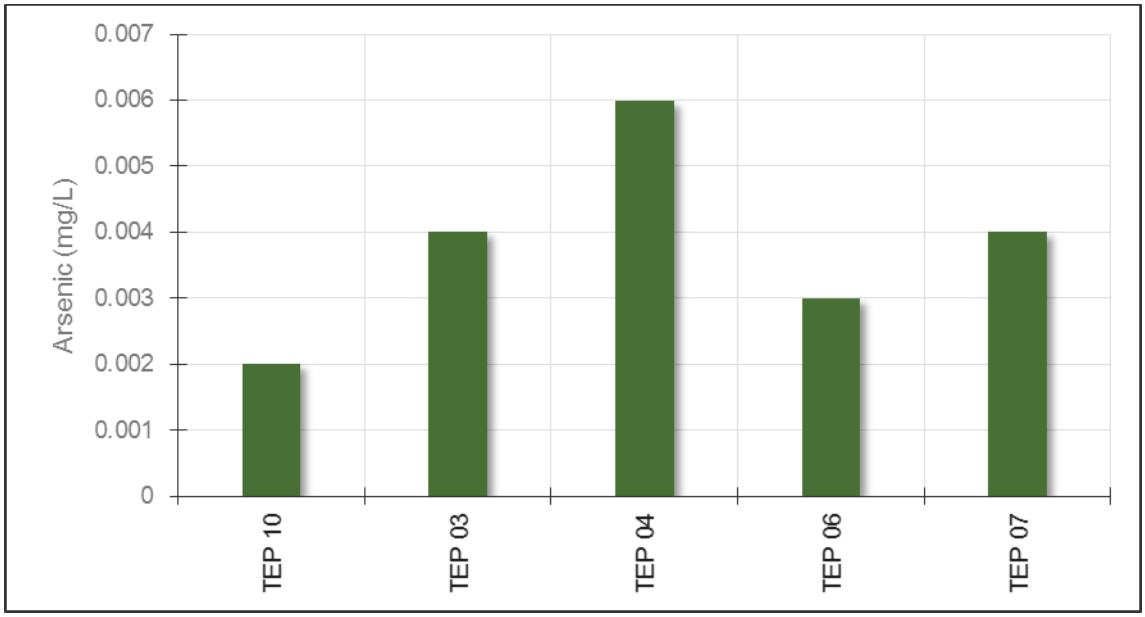


Figure 13: Arsenic concentrations from the Highway waste rock dump during the March flow event

2. Acidity flux

Acidity was measured at all TEP monitoring in the 06 February 2016 flow event and again at some TEP monitoring points in the 13 March 2016 monitoring event. It is apparent that rainfall occurring in early February resulted in the decrease in acidity at TEP03 and TEP04 (Figure 14). Following this rainfall event acidity rose at TEP06 and TEP08 at a similar rate, indicating that the same process may be affecting both points (Figure 14). Acidity also increased at TEP07 at a much greater rate than TEP06 and TEP08. Water samples collected at TEP07 were from a large, but very shallow pool approximately with approximately 0.1m depth in the 14 February monitoring event (Appendix 3). Therefore the large increase in acidity values could be the result of evaporative concentration or could reflect an ongoing source of acidity. It is likely to be a combination of both factors.

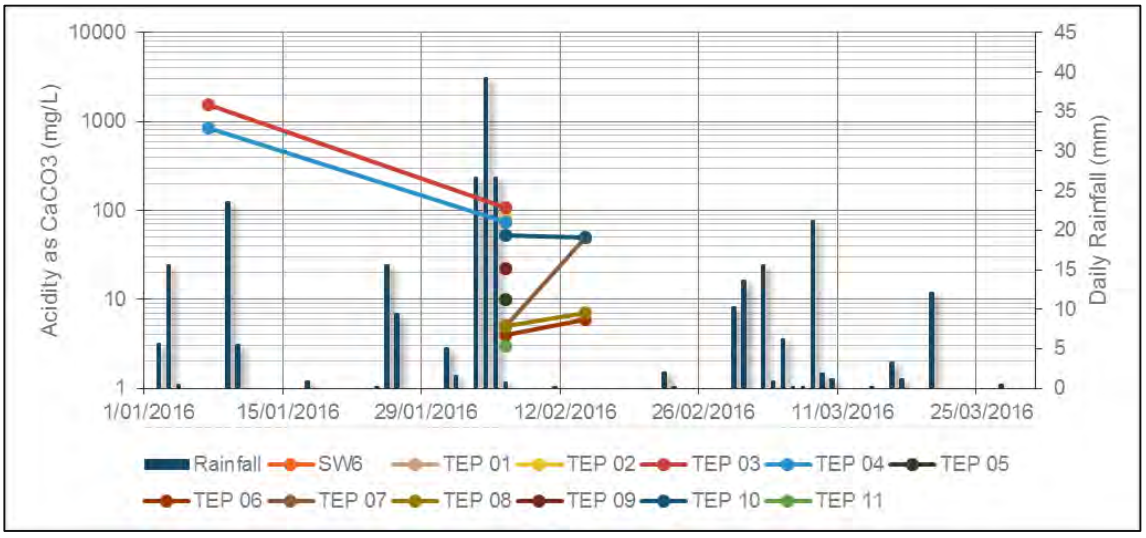


Figure 14: Changes in acidity concentrations associated with rainfall

3. Flows towards SW5

Earthworks blocked surface water flows from the mine site towards SW5 in June/July 2014 (Figure 15).

Figure 15: Diversion bund on western side of lease

Flows from mining infrastructure (Reward Dump) that did report to SW5 are now diverted into the Pit. Flows from Reward Dump diverted to the pit are discussed in the following section.

4. Flows from Reward Dump

The only sites that sample pools or water from the Reward waste rock dump are TEP11 and TEP05 with TEP05 being located the furthest downstream.

During the six month reporting period only three samples were collected from these TEP points. This sample number is deemed too insignificant to provide a true representation of potential contaminant movement. Successfully analysing the impacts flows, and any contaminant migration, further monitoring will be required over wet seasons with higher rainfall.

The entire dataset for the TEP monitoring points is presented in Appendix B.

4.1 Sampling Event – 6 February 2016

The pH values along TEP points that report to the pit are highly variable. For example, TEP11 shows a pH of 7.3 (neutral), TEP05 a field pH of 5.05 and SW5 a pH value of 7.39. Arsenic concentrations are lower at TEP11 and TEP05 compared to SW5. This possibly indicates an unknown source of arsenic within the catchment that is likely not attributed to the site as flow paths show significantly lower concentrations (Figure 17).

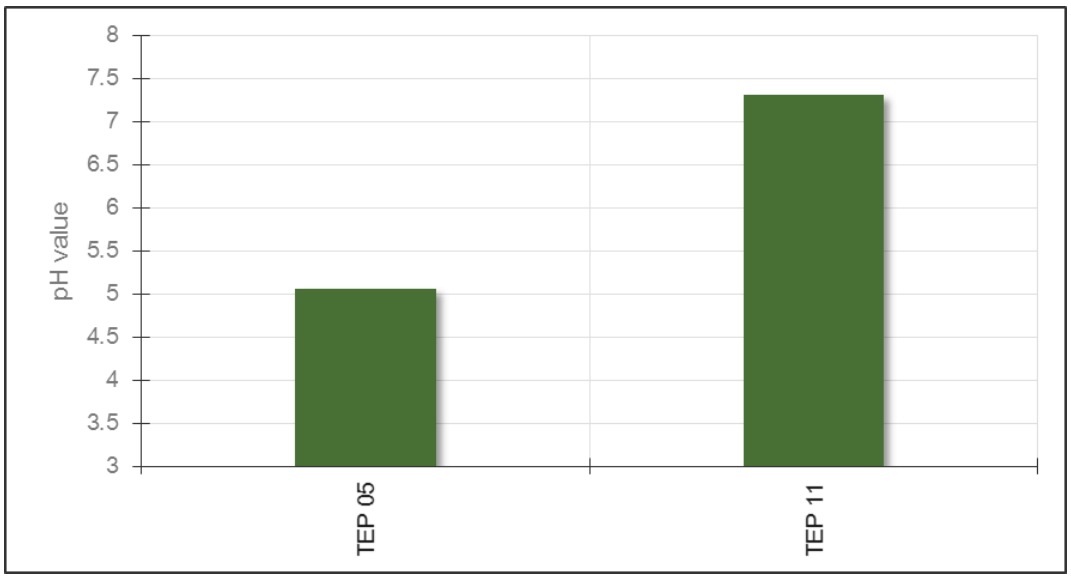


Figure 16: pH values from the TEP Points on the Reward waste rock dump during 6 February flow event

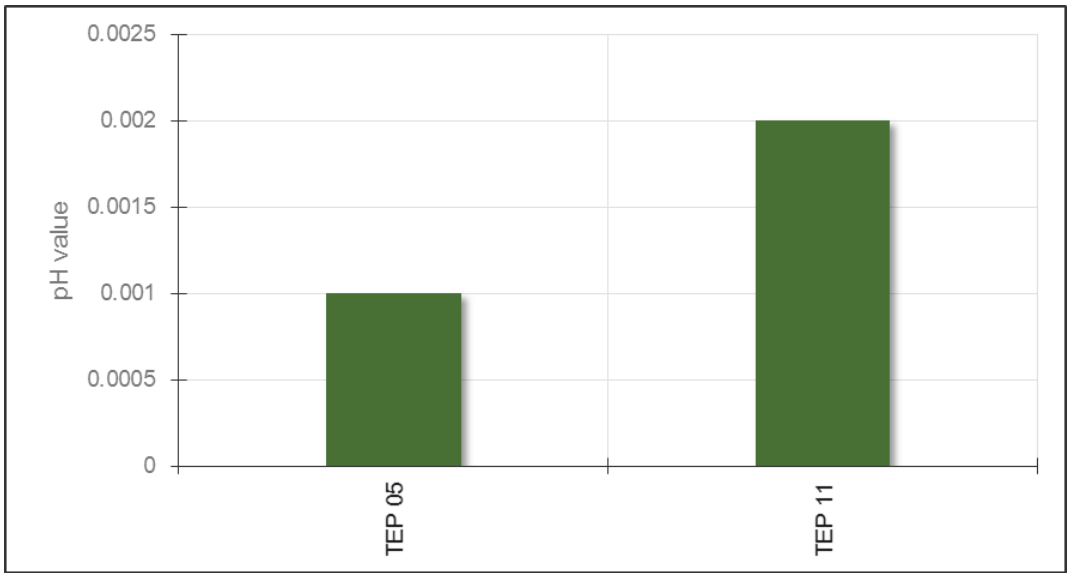


Figure 17: Arsenic from the TEP Points on the Reward waste rock dump during 6 February flow event

4.2 Sampling Event – 13 March 2016

Only one TEP site which flows to SW5 was sampled during the 13 March sample event this was TEP11. Analysis of this result was deemed to not provide any scientific basis of potential contaminant flows offsite therefore no statistical graphing or analyses was deemed beneficial. The results of this sample are provided in Appendix B.

Summary and Conclusions

The site received 355.1mm of rainfall in the reporting period between January 2016 and June 2016 (to 29 June 2016).

Approximately 68,752m3 of flow was recorded past the SF1 gauge and 29,310m3 past the SF2 gauge over the six-month reporting period. However, all of these flows had a low magnitude and were below 0.126m3/sec.

This low flow has resulted in a lack of appropriate monitoring events being triggered throughout the reporting period.

Data obtained within the reporting period does not provide a clear representation of contaminant migration offsite – as flows recorded were insufficient to result in surface water flows at offsite EA points. This is evident via the surface water monitoring undertaken as part of the EA, which included dry sample sites and no flow for certain monitoring months.

The pH values in the catchment flowing from the Highway waste rock dump show a similar trend over all sampling events during the reporting period. TEP03, TEP04, TEP10 showed consistent pH values below 4.5 while TEP01, TEP06, TEP07, TEP08 showed consistently neutral pH values above 5.

TEP11 shows a consistently neutral pH value above and below 8 while TEP5 appears to be relatively acidic with a pH value around 5 in the catchment that reports to the Pit from the Reward waste rock dump.

Data gathered over this six month period shows a slight linkage between rainfall and acidity values at some TEP points. However, the entire dataset from the beginning of the TEP should be assessed in order to characterise the correlation between rainfall and acidity generated.

There are discrepancies between the volume of water flowing past the v-notch weirs and rainfall records. Additional information is required to properly determine the runoff coefficient. Because of the non-linear relationship between rainfall and runoff it is recommended more complex methods of determining the runoff coefficient (such as AWBM rainfall-runoff methods, or an Initial Loss and Continuing Loss model) are used and incorporated into the site's water balance.

A data set longer than six months is necessary to determine any linkage between surface water concentrations and rainfall. It is recommended the sampling program be extended over additional wet seasons to allow for the collection of representative data. Without adequate flows on the Highway Reward site there is no ability to capture true representative data. Sufficient representative data is required to accurately identify impact and risk of offsite contamination.

Appendix summary

Appendix A

Map of TEP Sites

HIGHWAY REWARD

TEP MONITORING POINTS

Legend

- TEP Surface Water Locations
- V-Notch Weirs
- EA Surface Water Sites
- Mining Lease

Mine Lease boundary extracted from ml.shp, from IRTM State of Queensland.

0 75 150 300
Metres

Scale: 1:8,000 at A3

N

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 29/06/2016

nrc
northern resource consultants

Appendix B

TEP Water Quality Data for Reporting Period

DATE	SAMPLE ID	TOTAL DISSOLVED SOLIDS	ACIDITY AS CACO3	TOTAL ARSENIC	TOTAL CADMIUM	TOTAL COPPER	TOTAL LEAD	TOTAL ZINC	WAD CYANIDE	FLUORIDE	FIELD PH	FIELD EC	TEMP
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH unit	µS/cm	*C
7/01/2016	**TEP 03**	4490	1530	0.012	1.77	199	0.0005	41.3					
7/01/2016	**TEP 04**	3570	853	0.031	0.501	84.5	0.213	56.2					
6/02/2016	**TEP 01**	1160	74	0.002	0.0975	16.6	0.013	13			6.48	1285	30
6/02/2016	**TEP 02**	1220	84	0.004	0.108	18.2	0.036	15			4.2	1281	29
6/02/2016	**TEP 03**	687	109	0.002	0.152	20.1	0.02	4.77			3.5	904	27.7
6/02/2016	**TEP 04**	1040	74	0.002	0.0903	10.8	0.124	13.6			3.9	1115	27.7
6/02/2016	**TEP 05**	299	10	0.001	0.0143	2.72	0.041	1.18			5.05	47	29.3
6/02/2016	**TEP 06**	178	4	0.004	0.0006	0.125	0.011	0.162			6.41	155	28.9
6/02/2016	**TEP 07**	346	5	0.004	0.0036	0.117	0.115	0.463			5.9	655	27.6
6/02/2016	**TEP 08**	376	5	0.001	0.0026	1.29	0.012	0.826			6.2	431	28
6/02/2016	**TEP 09**	1190	22	0.004	0.0383	2.09	0.637	9.84			4.7	1826	30
6/02/2016	**TEP 10**	597	53	0.002	0.0451	5.92	0.032	14.3			4.41	842	27
6/02/2016	**TEP 11**	69	3	0.002	0.00005	0.011	0.044	0.026			7.3	18.6	27
14/02/2016	**TEP 06**	185	6	0.004	0.0017	0.064	0.002	0.022					
14/02/2016	**TEP 07**	718	49	0.001	0.0939	6.24	0.0005	11.6					

DATE	SAMPLE ID	TOTAL DISSOLVED SOLIDS	ACIDITY AS CACO3	TOTAL ARSENIC	TOTAL CADMIUM	TOTAL COPPER	TOTAL LEAD	TOTAL ZINC	WAD CYANIDE	FLUORIDE	FIELD PH	FIELD EC	TEMP
14/02/2016	**TEP 08**	1000	7	0.006	0.0073	0.074	0.003	0.552					
14/02/2016	**TEP 10**	763	50	0.002	0.0464	2.16	0.002	14.4					
13/03/2016	**TEP 03**			0.004	0.562	78.8	0.004	13.3	0.002	0.3	3.25	1572	30.1
13/03/2016	**TEP 04**			0.006	0.17	40.8	0.042	21.3	0.002	0.8	3.54	986	28.5
13/03/2016	**TEP 06**			0.003	0.0001	0.068	0.002	0.019	0.002	0.1	6.8	107.2	28.8
13/03/2016	**TEP 07**			0.004	0.316	31.2	0.012	36.6	0.002	0.5	5.5	1335	27.5
13/03/2016	**TEP 10**			0.002	0.045	2.38	0.015	13.1	0.002	0.4	4.69	882	26
13/03/2016	**TEP 11**			0.002	0.00005	0.01	0.004	0.007	0.002	0.05	8	45.2	27.7

NOTE: Values less than the Limit of Reporting have been transformed to 50% of the Limit of Reporting.

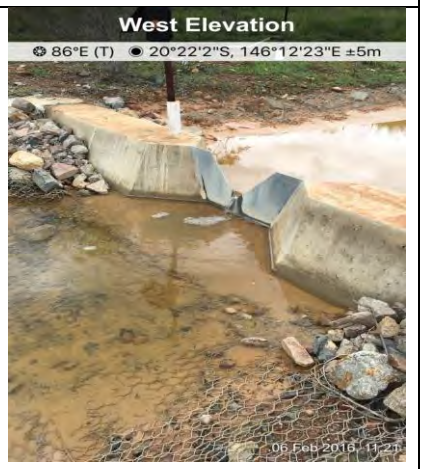
Appendix C

Field Sheets for TEP Reporting Period

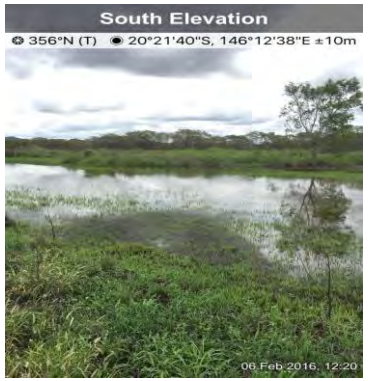
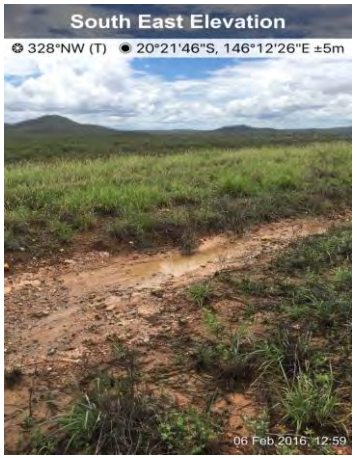
FIELD SHEET: TEP 2016 after heavy rainfall

Saturday 6 February 2016 Highway Reward Mine Site General Weather: Hot and overcast. Rain: 86mm previous week.

Area	GPS (as per photo)	Time	Flow	Turbidity	pH	EC	Temp	Field note	Picture
TEP 16 1		10.50am	Yes	Clear	6.48	1285uS	30	Clear Slow Flow Picture 2	
TEP 16 2		11.00am	Yes	Clear	4,2	1281uS	29	Clear Slow Flow Picture 3	

									2/….
TEP 163		**11.05am**	**No**	**Muddy**	**3.5**	**904uS**	**27.7**	**Picture 4 30m x 5m x .2m**	
TEP 164		**11.20am**	**Yes**	**Clear**	**3.9**	**1115.uS**	**27.7**	**Picture 5 35m x 6m x .2m**	

									3/…
Area	**GPS (as per photo)**	**Time**	**Flow**	**Turbidity**	**pH**	**EC**	**Temp**	**Field note**	**Picture**
TEP 165		**12.50pm**	**No**	**Muddy**	**5.05**	**47uS**	**29.3**	**Picture 9 35m x 6m x .2m**	
TEP 166		**12.40pm**	**No**	**Muddy**	**6.41**	**155uS**	**28.9**	**Picture 8 45m x 5m x .2m**	

									4/…
TEP 167		**12.20pm**	**No**	**Clear**	**5.9**	**655uS**	**27.6**	**Picture 6 100m x 15m x .2m**	
TEP 168		**12.30**	**No**	**Clear**	**6.2**	**431uS**	**28**	**Picture 7 30m x 7m x .2m**	
TEP 169		**1.00**	**No**	**Clear**	**4.7**	**1826uS**	**30**	**Picture 10 Small pond**	

									5/…
TEP 16 10		**1.10**	**No**	**Clear**	**4.41**	**842uS**	**27**	**Picture 11 60m x 5m .2m**	
TEP 16 11		**10.30**	**No**	**Muddy**	**7.3**	**18.6uS**	**27**	**Picture 1 15m x 5m x .1m**	
									Samples Given to Sherry Grinstead 0602016 at 18.30hrs **Don Grinstead and Noel Grinstead** **COC completed and samples refrigerated as courier does not leave till Monday 8am**

FIELD SHEET: TEP 2016 Don Grinstead and Noel Brown - Samplers

Sunday 13 March 2016 Highway Reward Mine Site General Weather: Sunny Rain: Nil Temp: 29C

Samples received in Office: 1.30pm

Are	Time	Flow	pH	EC	Temp	Field note	Field Pictures
TEP 16 1	**11.56 am**					**Dry – no seepage**	
TEP 16 2	**11.52 am**					**Dry – No seepage**	

TEP 16 3	**11.15 am**	**Nil**	**3.25**	**1572 uS**	**30.1**	**12mx 4m x .1 Muddy**	
TEP 16 4	**11.45 am**	**Nil**	**3.54**	**986 uS**	**28.5**	**5m x 3m x .1m Clear**	
TEP 16 5	**11.15 am**					**Dry**	

TEP 16 6	**11.00 am**	**Nil**	**6.80**	**107.2 uS**	**28.8**	**7m x 5m x .1 Clear**	
TEP 16 7	**10.45 am**	**Nil**	**5.5**	**1335 uS**	**27.5**	**75m x 15m x .1m Clear**	
TEP 16 8	**10.55 am**					**Dry**	

TEP 16 9	**11.30 am**					**Dry**	
TEP 16 10	**11.35 am**	**Nil**	**4.69**	**882 uS**	**26.0**	**50m x 5m x .2m** **Clear**	
TEP 16 11	**10.00 am**	**Nil**	**8.0**	**45.2 uS**	**27.7**	**15m x 5m x .1m** **Clear**	

Appendix C

Correspondence – Completion of TEP Interim Earthworks

DATE: 16 DECEMBER 2016
OUR REF: 16_115_HIGHWAY REWARD

JOHN RAINS
DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION
LEVEL 10, VERDE TOWER
445 FLINDERS STREET
TOWNSVILLE QLD 4810

RE: COMPLETION OF TEP INTERIM EARTHWORKS

Dear John,

I refer to the amended Transitional Environmental Program (TEP) MAN17020 approved by the Department of Environment and Heritage Protection (EHP) and issued to the Mt Windsor Joint Venture partners of Thalanga Copper Mines Pty Ltd (MWJV) on 19 October 2016. As part of the amended TEP, the MWJV committed to the installation of interim earthworks measures by 1 November 2016 to treat or capture all water on site and prevent a release to Environmental Authority (EA) monitoring location SW6.

EHP recently provided correspondence to Northern Resource Consultants (NRC) requesting an additional status update on outstanding works, including:

- installation of lime rock armouring along the main drain.
- sealing the channel on the western side of the new storage area to a level of approximately 324.7m AHD.
- diversion of the remaining 42.69ha upstream catchment into the pit via a diversion drain.

EHP also requested a status update on an identified non-compliance with condition C2-1 of EA EPML00550413 in regard to “potentially acid forming erosion between the two waste rock dumps”. This letter details the current status of activities in relation to the above.

Main Drain – Rock Armouring

Installation of lime rock armouring along the main drain was a commitment detailed in the approved amended TEP to address the eroded main drainage structure with exposed sulphides. NRC can confirm that the works to install lime rock armouring along the main drain were completed as of 11 November 2016. Figure 1 and Figure 2 demonstrates the completed main drain.

Figure 1: Elevated view of main drain with lime rock armouring.

Figure 2: Main drain with lime rock armouring.

Western Storage – Channel Sealing

Sealing of the western storage area channel was a requirement under the TEP which was undertaken to ensure that adequate containment of runoff could be achieved. Works included reprofile and repair of drainage to prevent water egress and were completed as of 11 November 2016. Figure demonstrates the works completed.

Figure 3: Completed reprofiling and repair works to western storage.

Upstream Catchment Diversion

Diversion of the remaining upstream catchment (42.69ha) was committed to and completed as of 11 November 2016 to ensure that flow captured is diverted to the main pit. Figure 4 demonstrates the completed diversion (circled in red).

Figure 4: Installation of diversion bund to direct flow to the main pit (circled in red).

EHP Compliance Audit

EHP conducted a site inspection at Highway Reward mine on 19 August 2016 and identified a non-compliance with condition C2-1.

Condition C2-1

"All reasonable and practicable erosion protection measures and sediment control measures must be implemented and maintained to minimise erosion and the release of sediment."

The non-compliance identified was in relation to erosion of potentially acid forming material between waste rock dumps known as Highway and Reward. NRC can advise that restoration works have been undertaken to rectify the non-compliance with evidence presented in Figure 5, Figure 6 and Figure 7.

Figure 5: Evidence of erosion protection measure restoration works to eroded areas.

Figure 6: Evidence of erosion protection measure restoration works to eroded areas.

Figure 7: Evidence of restoration works to eastern batter of dump known as Reward.

Should you require further information, please contact Scott Hayes-Stanley on 07 4772-6500 or the undersigned.

Sincerely,

Marty Costello
Principal Environmental Scientist

Appendix D

Surface water raw data

SURFACE WATER RAW DATA - SW4																			
SampleID	Date	pH Value	Electrical Conductivity @ 25°C	Total Dissolved Solids @180°C	Sulfate as SO4 Turbidimetric	Turbidity	Total Aluminium	Total Arsenic	Total Cadmium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum	Total Selenium	Total Zinc	Total Mercury	Total Cyanide	Weak Acid Dissociable Cyanide
ES1301849004	24/01/13	6.97	370	250	75	N/R	N/R	0.001	0.0074	0.956	N/R	0.011	N/R	<0.001	<0.01	0.567	<0.0001	N/R	<0.004
ES1308860004	12/04/13	7.92	327	145	34	N/R	N/R	0.002	0.0022	0.416	N/R	0.014	N/R	<0.001	<0.01	0.186	<0.0001	N/R	<0.004
ES1309329004	18/04/13	2.63	7400	7450	4420	N/R	N/R	0.022	0.505	165	N/R	0.348	N/R	0.008	0.11	66.3	<0.0001	N/R	<0.004
EB1401860004	28/01/14	8.16	540	342	56	N/R	N/R	<0.001	0.0002	0.045	N/R	<0.001	N/R	<0.001	<0.01	0.021	<0.0001	N/R	<0.004
ES1403875004	20/02/14	7.81	380	230	31	N/R	N/R	<0.001	0.0007	0.167	N/R	0.01	N/R	<0.001	<0.01	0.054	<0.0001	N/R	<0.004
EB1407228004	24/03/14	7.99	914	549	72	N/R	N/R	<0.001	<0.0001	<0.001	N/R	<0.001	N/R	<0.001	<0.01	<0.005	<0.0001	N/R	<0.004
EB1511502004	22/01/15	7.75	158	220	4	N/R	N/R	0.001	0.0001	0.032	N/R	0.006	N/R	<0.001	<0.01	0.03	<0.0001	N/R	<0.004
EB1511555004	27/01/15	8.26	342	212	25	N/R	N/R	<0.001	0.0001	0.032	N/R	0.054	N/R	<0.001	<0.01	0.031	<0.0001	N/R	<0.004
EB1603352004	06/02/2016	7.97	249	211	22	N/R	N/R	<0.001	0.0004	0.232	N/R	0.002	N/R	<0.001	<0.01	0.058	<0.0001	N/R	<0.004
ET1600210006	16/07/2016	7.09	245	169	55	N/R	N/R	<0.001	0.0027	0.952	N/R	0.091	N/R	<0.001	<0.01	0.322	<0.0001	N/R	<0.004

SURFACE WATER RAW DATA - SW6																			
SampleID	Date	pH Value	Electrical Conductivity @ 25°C	Total Dissolved Solids @180°C	Sulfate as SO4 Turbidimetric	Turbidity	Total Aluminium	Total Arsenic	Total Cadmium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Molybdenum	Total Selenium	Total Zinc	Total Mercury	Total Cyanide	Weak Acid Dissociable Cyanide
ES1301849006	24/01/13	5.5	475	328	182	N/R	N/R	0.001	0.0233	3.41	N/R	0.008	N/R	<0.001	<0.01	1.66	<0.0001	N/R	<0.004
ES1308860006	12/04/13	5.11	578	312	237	N/R	N/R	<0.001	0.0432	7.02	N/R	0.007	N/R	<0.001	<0.01	2.66	<0.0001	N/R	<0.004
ES1309329006	18/04/13	4.89	624	494	307	N/R	N/R	<0.001	0.069	8.56	N/R	0.002	N/R	<0.001	<0.01	3.68	<0.0001	N/R	<0.004
EB1401860006	28/01/14	4.16	664	492	269	N/R	N/R	0.001	0.054	9.57	N/R	0.008	N/R	<0.001	<0.01	3.24	<0.0001	N/R	<0.004
ES1403875006	20/02/14	4.7	751	496	312	N/R	N/R	0.001	0.0604	9.62	N/R	0.006	N/R	<0.001	<0.01	3.83	<0.0001	N/R	<0.004
EB1407228006	24/03/14	5.04	837	709	370	N/R	N/R	0.001	0.0692	11.5	N/R	0.004	N/R	<0.001	<0.01	4.91	0.0002	N/R	<0.004
EB1511502006	22/01/15	7.24	114	205	16	N/R	N/R	0.002	0.0009	0.384	N/R	0.01	N/R	<0.001	<0.01	0.092	<0.0001	N/R	<0.004
EB1511555006	27/01/15	5.1	948	663	451	N/R	N/R	0.001	0.0724	11.5	N/R	0.005	N/R	<0.001	<0.01	5.8	<0.0001	N/R	<0.004
EB1603352007	06/02/2016	4.83	980	1250	454	N/R	N/R	0.001	0.0973	21.9	N/R	0.01	N/R	<0.001	<0.01	8.93	<0.0001	N/R	<0.004
EB1611743005	04/05/2016	6.41	220	160	72	N/R	N/R	0.002	0.003	1.09	N/R	0.01	N/R	<0.001	<0.01	0.248	<0.0001	N/R	<0.004
ET1600210005	16/07/2016	3.94	661	464	307	N/R	N/R	<0.001	0.0404	9.88	N/R	0.004	N/R	<0.001	<0.01	4.41	<0.0001	N/R	<0.004

Appendix E

Stream sediment raw data

STREAM SEDIMENT RAW DATA - SS5					
SampleID	Date	Cadmium	Copper	Lead	Zinc
		mg/kg	mg/kg	mg/kg	mg/kg
ES1308362005	8/04/13	<1	56	15	50
EB1323120005	17/09/13	<1	66	15	59
EB1331471005	17/12/13	<1	54	13	53
EB1518056005	3/05/15	*<1*	51	15	54
EB1531970005	18/10/15	*<1*	48	13	44
EB1610190005	17/04/2016	<1	35	13	42
EB1625961005	30/10/16	<1	81	12	61

STREAM SEDIMENT RAW DATA - SS6					
SampleID	Date	Cadmium	Copper	Lead	Zinc
		mg/kg	mg/kg	mg/kg	mg/kg
ES1308362006	8/04/13	<1	36	21	37
EB1323120006	17/09/13	<1	93	12	43
EB1331471006	17/12/13	<1	31	13	36
EB1518056006	3/05/15	<1	46	16	44
EB1531970006	18/10/15	<1	40	20	42
EB1610190006	17/04/2016	<1	40	33	81
EB1625961006	30/10/16	<1	44	17	40

Appendix F

TEP 2013

Thalanga Copper Mines Pty Ltd

ACN 004 797 335 ABN 72 004 797 335

Locked Bag 1
Queenstown
Tasmania 7467

22 July 2013

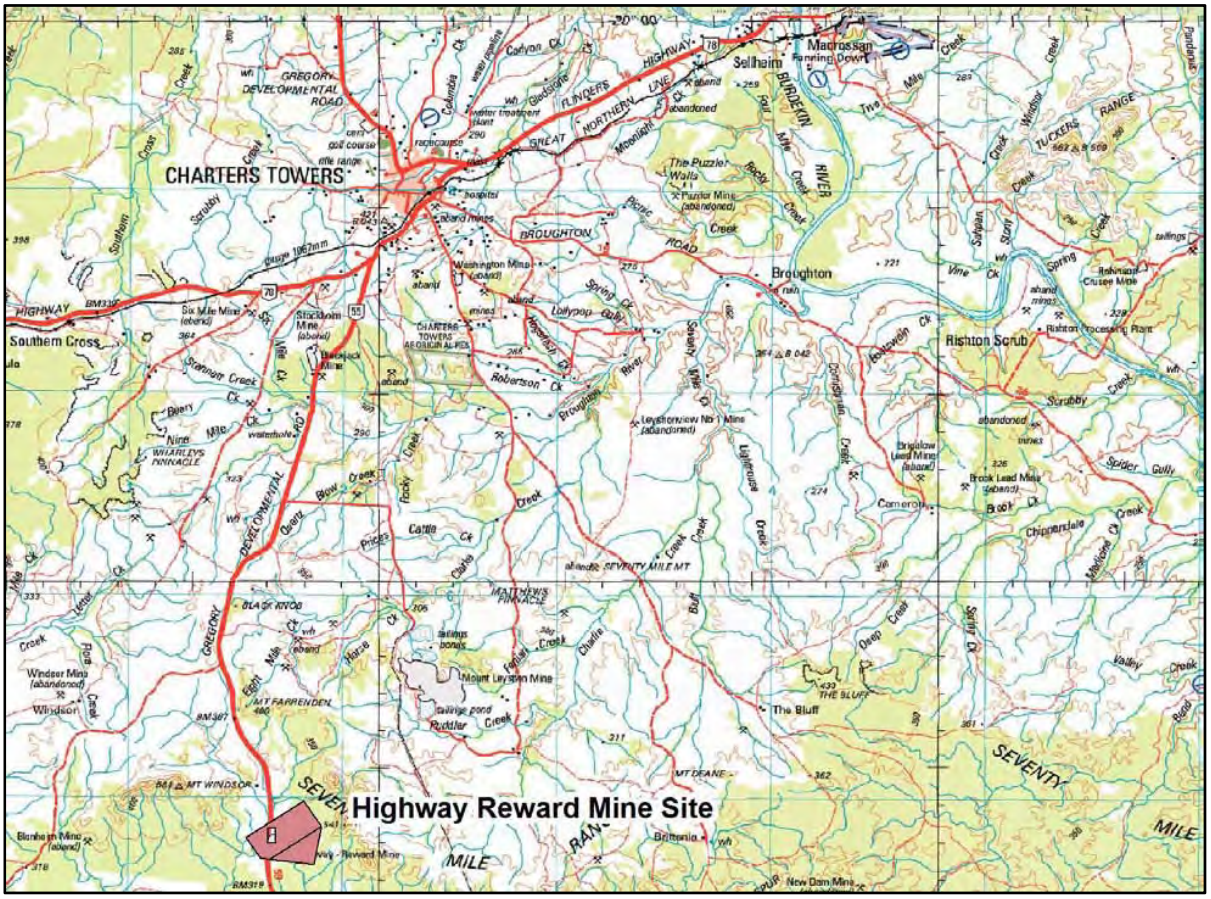
Draft Transitional Environmental Program Highway Reward Mine

Introduction

Background

The Highway Reward mine was an open cut and underground mining operation, 40 km south-west of Charter Towers, Queensland, in the Burdekin River Catchment (Figure 1). Open cut mining commenced in 1997 and ceased in early 2002. Open cut mining formed a single residual void with a surface area of 35ha. Waste rock from open pit mining was stored within two waste rock dumps on site: Highway dump and Reward dump, both adjacent to the open cut pit (Figure 2). These dumps occupied a total area of 132 ha and were rehabilitated from 2005 onwards.

Figure 1 Regional Location Highway Reward Mine



Underground mining of copper ore below the existing open cut began in July 2002. Copper ore mining was completed in June 2005. These mining operations involved underground mining of copper ore from the Reward Deeps, Lower Reward Deeps and Conviction ore bodies. Highway South was subject to mining in 2004 following dewatering from the pit into the temporary water storage. Approximately 300,000 tonnes of ore were mined up to December 2004. During this time all waste rock from the underground operations was utilised as fill or stored within the open cut pit.

Copper ore was stockpiled on site before being transported by road to be processed at the Thalanga mine site concentrator.

Environmental Authority Breaches

The Highway Reward mine operates as a rehabilitation project under Environmental Authority number EPML00550413.

Conditions of EA subject to non-compliance

Schedule C – Table 1 (Receiving water monitoring locations and frequency)

Monitoring point	**Easting**	**Northing**	**Monitoring frequency**
SW1	418050	7748020	Event
SW2	417871	7746641	Event
SW3	416430	7748344	Event
SW4	415644	7746879	Event
SW5	416340	7747350	Event
SW6	416580	7748350	Event

Schedule C – Table 2 (Receiving water contaminant limits)

Parameter	Units	Limit type	Contaminant trigger levels
pH		Acceptable range	6–9
Total Dissolved Solids	mg/L	Maximum	4,000
Sulfate	mg/L	Maximum	1,000
Copper	mg/L	Maximum	1
Molybdenum	mg/L	Maximum	0.15
Arsenic	mg/L	Maximum	0.5
Selenium (Total)	mg/L	Maximum	0.02
Mercury	mg/L	Maximum	0.002
Lead	mg/L	Maximum	0.1
Zinc	mg/L	Maximum	20
Cyanide (WAD)	mg/L	Maximum	0.01
Cadmium	mg/L	Maximum	0.01

Breaches of EA conditions relating to surface water have occurred at sites SW5 and SW6 over recent years (See Figure 2).

Since 2008, SW5 has experienced EA exceedances on 16 occasions. These are shown highlighted in rose with red font in Table 1. Exceedances were due to low pH, and high concentrations of Total Cu, Cd, Pb and Zn.

SW6 has experienced exceedances on seven occasions (Table 2). These have all occurred since January 2011 and relate to low pH, high concentrations of Total Cd and, recently, high Total Cu.

The downstream sampling site in Policemans Creek at SW4, however only shows one high reading, that being in January 2008 (Table 3). The high concentrations of Pb and Cu at this time may have been influenced by high concentrations of Total Dissolved Solids (TDS) and Sulphate at SW3 which also flows into Policemans Creek upstream of SW4 (Table 4, Figure 2).

These results indicate that although the concentrations have occasionally been high as the surface flow paths leave the site (at SW5 and SW6), the flows are sufficiently low that the exceedances do not lead to environmental harm downstream (as indicated by no corresponding EA licence limit breaches).

Table 1 **SW5 Water Quality**

Limits	6-9	1000	0.5	0.01	1.0	0.1	0.15	0.02	20
Date	pH	SO4 mg/L	Total As mg/L	Total Cd mg/L	Total Cu mg/L	Total Pb mg/L	Total Mo mg/L	Total Se mg/L	Total Zn mg/L
30-Jan-08	6.24	261	0.009	0.0006	0.07	0.061	0.001	0.01	0.12
13-Feb-08	5.06	580	0.001	0.0779	16.90	0.013	0.001	0.01	5.54
22-Jul-08	4.36	236	0.001	0.0296	9.97	0.008	0.001	0.01	4.79
28-Jan-09	5.34	415	0.025	0.0362	11.00	0.173	0.001	0.01	5.36
14-Dec-10	6.2	97	0.001	0.0694	0.39	0.004	0.001	0.01	0.29
20-Jan-11	6.23	76	0.002	0.0062	0.50	0.006	0.001	0.01	0.33
05-Feb-11	3.18	149	0.003	0.0028	3.25	0.004	0.001	0.01	0.51
22-Mar-11	5.88	106	0.002	0.0054	1.00	0.007	0.001	0.01	0.66
05-Apr-11	2.89	181	0.002	0.0028	4.22	0.008	0.001	0.01	0.59
05-Apr-11	3.19	199	0.003	0.0031	5.83	0.003	<0.001	<0.01	0.84
29-Dec-11	4.32	144	<0.001	0.0079	1.77	0.006	<0.001	<0.01	1.16
16-Jan-12	5.59	31	0.007	0.0023	1.41	0.110	<0.001	<0.01	0.33
20-Jan-12	6.23	76	0.002	0.0062	0.50	0.006	<0.001	<0.01	0.33
26-Jan-12	5.51	19	0.008	0.0017	0.98	0.120	<0.001	<0.01	0.22
04-Feb-12	6.95	93	0.002	0.0021	0.53	0.012	0.001	<0.01	0.29
09-Feb-12	3.18	149	0.003	0.0028	3.25	0.004	<0.001	<0.01	0.51
27-Mar-12	6.83	121	0.001	0.0023	0.44	0.163	<0.001	<0.01	0.31
26-May-12	6.54	11	0.003	0.0007	0.73	0.059	<0.001	<0.01	0.11
10-Jul-12	5.17	21	0.008	0.0014	1.04	0.117	0.001	<0.01	0.21
17-Jul-12	7.33	28	<0.001	<0.0001	0.00	0.004	0.069	<0.01	0.03
24-Jan-13	5.18	5	0.002	0.0004	0.35	0.030	<0.001	<0.01	0.06
17-Jul-12	7.33	28	<0.001	<0.0001	0.00	0.004	0.069	<0.01	0.03
17-Jul-12	7.33	28	<0.001	<0.0001	0.00	0.004	0.069	<0.01	0.03
12-Apr-13	5.45	9	0.003	0.0004	0.36	0.047	<0.001	<0.01	0.05

Table 2 **SW6 Water Quality**

Limits	6-9	1000	0.5	0.01	1.0	0.1	0.15	0.02	20
Date	pH	SO4 mg/L	Total As mg/L	Total Cd mg/L	Total Cu mg/L	Total Pb mg/L	Total Mo mg/L	Total Se mg/L	Total Zn mg/L
30-Jan-08	6.84	29	0.041	0.0007	0.073	0.072	0.001	0.01	0.33
13-Feb-08	6.29	85	0.004	0.0071	0.512	0.022	0.001	0.01	0.82
22-Jul-08	7.43	23	0.003	0.0004	0.086	0.005	0.001	0.01	0.04
28-Jan-09	7.11	47	0.005	0.0036	0.314	0.021	0.001	0.01	0.29
14-Dec-10	7.13	146	0.001	0.0084	0.269	0.001	0.001	0.01	0.67
20-Jan-11	7.47	127	0.001	0.1280	0.300	0.003	0.001	0.01	0.63
09-Feb-11	7.34	98	0.001	0.0023	0.108	0.002	0.001	0.01	0.12
22-Mar-11	6.40	182	0.001	0.0162	0.720	0.001	0.001	0.01	1.50
05-Apr-11	7.18	150	0.001	0.0050	0.095	0.001	0.001	0.01	0.39
05-Apr-11	7.46	15	0.003	0.0006	0.203	0.003	<0.001	<0.01	0.08
29-Dec-11	4.10	15	<0.001	0.0003	0.276	0.003	<0.001	<0.01	0.06
29-Dec-11	6.77	247	0.002	0.0171	0.987	0.007	<0.001	<0.01	1.68
16-Jan-12	7.00	101	0.004	0.0074	0.712	0.035	<0.001	<0.01	0.82
20-Jan-12	7.47	127	0.001	0.1280	0.300	0.003	<0.001	<0.01	0.63
26-Jan-12	7.28	56	0.001	0.0053	0.246	0.004	<0.001	<0.01	0.47
04-Feb-12	7.32	83	0.004	0.0041	0.783	0.035	0.001	<0.01	0.45
09-Feb-12	7.34	98	<0.001	0.0023	0.108	0.002	<0.001	<0.01	0.12
27-Mar-12	7.95	117	0.001	0.0009	0.075	0.064	<0.001	<0.01	0.07
26-May-12	7.35	40	0.001	0.0009	0.152	0.004	<0.001	<0.01	0.08
10-Jul-12	7.84	<1	0.004	0.0004	0.097	0.005	0.001	<0.01	0.10
24-Jan-13	5.18	5	0.002	0.0004	0.345	0.030	<0.001	<0.01	0.06
12-Apr-13	5.11	237	<0.001	0.0432	7.020	0.007	<0.001	<0.01	2.66

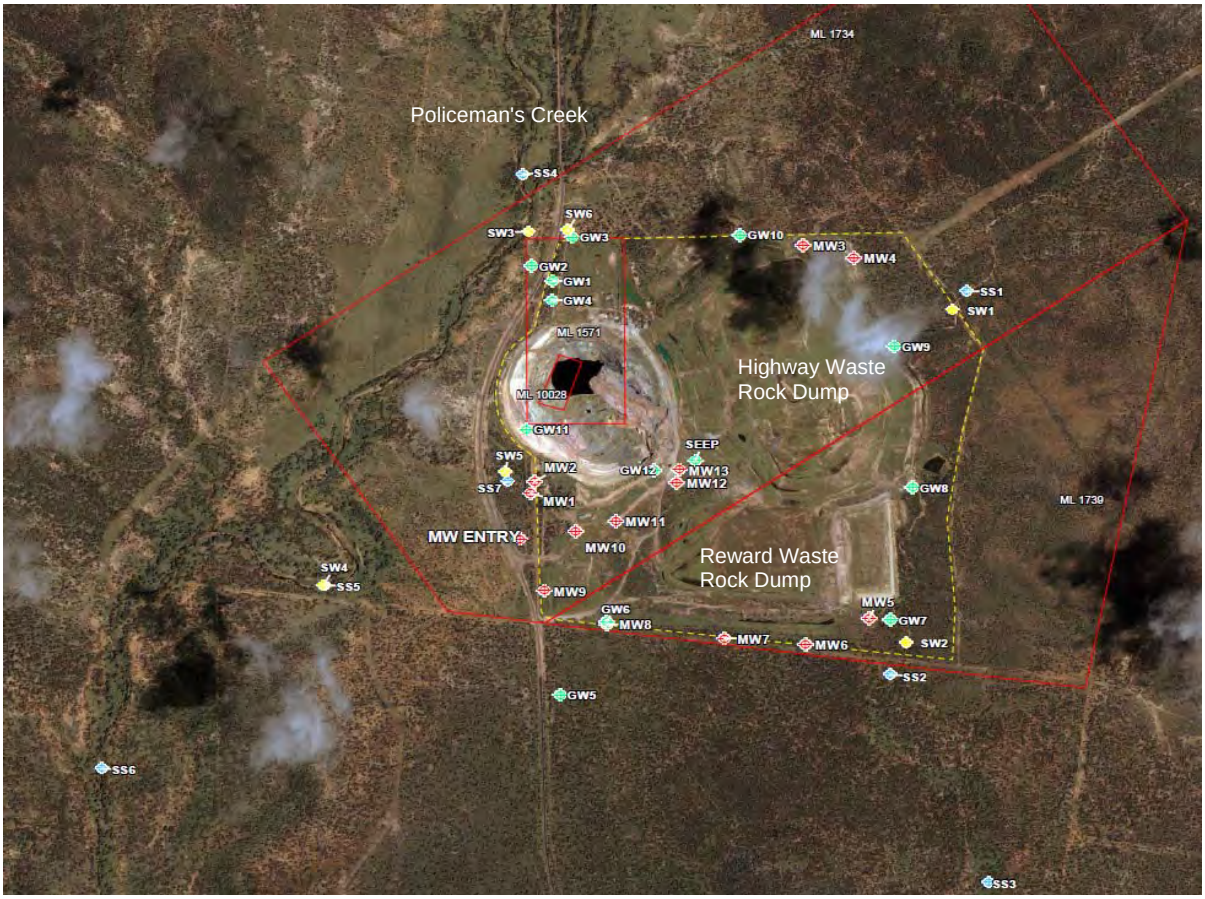
Table 3 **Downstream Water Quality at SW4**

Limits	6-9	1000	0.5	0.01	1.0	0.1	0.15	0.02	20
Date	pH	SO4 mg/L	Total As mg/L	Total Cd mg/L	Total Cu mg/L	Total Pb mg/L	Total Mo mg/L	Total Se mg/L	Total Zn mg/L
30-Jan-08	7.00	123	0.016	0.0062	2.750	0.488	0.001	0.01	0.954
13-Feb-08	7.10	14	0.001	0.0002	0.013	0.001	0.001	0.01	0.011
01-Apr-08	7.72	51	0.001	0.0001	0.005	0.001	0.001	0.01	0.005
28-Jan-09	7.46	4	0.002	0.0010	0.025	0.010	0.001	0.01	0.042
14-Dec-10	7.81	30	0.001	0.0003	0.004	0.001	0.001	0.01	0.003
20-Jan-11	8.14	31	0.001	0.0015	0.007	0.001	0.001	0.01	0.023
09-Feb-11	7.99	41	0.001	0.0002	0.005	0.001	0.001	0.01	0.031
22-Mar-11	7.97	39	0.001	0.0004	0.008	0.001	0.001	0.01	0.011
05-Apr-11	8.29	39	0.001	0.0001	0.003	0.013	0.001	0.01	0.003
05-Apr-11	7.88	67	0.001	<0.0001	0.027	0.002	0.001	<0.01	0.013
29-Dec-11	7.93	<1	<0.001	<0.0001	0.014	<0.001	0.001	<0.01	<0.005
16-Jan-12	7.91	44	<0.001	0.0001	0.030	0.003	<0.001	<0.01	0.028
20-Jan-12	8.14	31	<0.001	0.0015	0.007	<0.001	<0.001	<0.01	0.023
26-Jan-12	8.11	34	<0.001	<0.0001	0.006	<0.001	0.001	<0.01	<0.005
04-Feb-12	7.81	14	<0.001	<0.0001	0.021	0.006	<0.001	<0.01	0.017
09-Feb-12	7.99	41	<0.001	0.0002	0.005	<0.001	<0.001	<0.01	0.031
27-Mar-12	8.21	53	<0.001	<0.0001	0.002	0.019	0.001	<0.01	<0.005
26-May-12	7.98	96	<0.001	<0.0001	0.016	0.002	0.002	<0.01	<0.005
10-Jul-12	8.21	129	<0.001	<0.0001	0.023	<0.001	0.002	<0.01	0.006
12-Apr-13	7.92	34	0.002	0.0022	0.416	0.014	<0.001	<0.01	0.186

Table 4 **Jan 2008 SW Results**

Site	Date	pH	TDS mg/L	SO4 mg/L	Total As mg/L	Total Cd mg/L	Total Cu mg/L	Total Pb mg/L	Total Mo mg/L	Total Se mg/L	Total Zn mg/L
SW1	30-Jan-08	6.77	1,900	455	0.001	0.0220	0.016	0.007	0.001	0.01	0.014
SW2	30-Jan-08	6.34	732	18	0.001	0.0007	0.021	0.011	0.001	0.01	0.003
SW3	30-Jan-08	7.49	12,900	2,930	0.001	0.0002	0.005	0.001	0.001	0.01	0.003
SW4	30-Jan-08	7.00	2,160	123	0.016	0.0062	2.750	0.488	0.001	0.01	0.954
SW5	30-Jan-08	6.24	1,430	261	0.009	0.0006	0.073	0.061	0.001	0.01	0.118
SW6	30-Jan-08	6.84	3,490	29	0.041	0.0007	0.073	0.072	0.001	0.01	0.326

Figure 2 **Highway Reward Monitoring Locations**



Transitional Environmental Program

Following an internal site evaluation and investigation in response to the continuing exceedances, Thalanga Copper Mines Joint Venture (TCMJV) submitted a Program Notice on 7 June 2013. In return the Department of Environment and Heritage Protection (DEHP) served notice on the JV, requiring submission of a draft Transitional Environment Program (TEP) by 9 August 2013.

The investigation noted that several previously unknown seeps appeared to be leaching high-acidity water from the base of the Highway waste rock dump into the flow path to the SW6 sampling site (Figure 3). This contaminated water contained high concentrations of Total Cu as well as low pH water and indicated acid rock drainage formation. A recently eroded structure was also showing signs of sulphide oxidation along the drain in question (Figure 4).

Figure 3 Potential Highway Waste Rock Dump Seepage

The site in question is situated at the north-western end of the Highway waste rock dump and was exposed during maintenance works to recut a drain in late 2011. The yellow discolouration and signs of bubbling indicate exposed sulphidic material is oxidising, producing acid rock drainage (ARD). Solutions to this are to remove exposed boulders containing sulphides to the pit void and cap the remaining sulphidic material to prevent oxygen access. This would provide an effective solution if the exposed sulphidic material is the sole source of ARD. The JV is concerned however, that this may not provide a long-term solution if the waste rock dump contains stored acidity and is leaching the ARD. As a result, a TEP has been proposed to provide time for the JV to monitor water quality and flows from the site. This will enable the JV to determine whether the ARD is being produced from localised rainfall seeping over the sulphidic material or whether the ARD is from dump seepage and thus requires a different long-term solution.

Figure 4 Eroded Structure with Exposed Sulphides

The yellow discolouration above the drain again shows evidence of ARD formation. In this case the drop structure which was repaired in 2012 has eroded, exposing the sulphides. As a localised source of ARD this area is undergoing reconstruction in 2013 to provide a stable long-term solution for this problem.

Other potential sources of contamination along this drain are to be investigated during the coming wet seasons. Given the ephemeral nature of surface flows at the site and the short flow periods experienced, at least two wet seasons are proposed to allow the JV to find all sources of contamination through an on-site upstream monitoring program. This will then be followed by a works program to remedy the problems. Areas where the capping surface over the Highway and Reward waste rock dumps is known to be bare of vegetation are already scheduled for recapping and revegetation in the 2013 works program currently underway.

Figure 5 shows the previous flow path between the site and the SW5 sample site. This flow on site has already been redirected into the pit void to eliminate the possibility of contamination on site flowing overland towards SW5 and then Policemans Creek to the immediate west of the site. A line of rocks just inside the fence line appear to contain sulphides as evidenced by yellow discolouration. As such these rocks are being removed to the pit void during the 2013 works program on site to prevent environmental harm for occurring. The TEP program proposes to monitor the site to demonstrate, over the coming wet seasons, that no contaminated flow from the site now runs towards SW5.

Figure 5 SW5 Flow Path from the site

Much rehabilitation on site is structured around the pit void into which some contaminated water flows. Previous studies have indicated that the pit void will act as a sink with no adverse impact on groundwater or surface water. During the TEP the JV plans to confirm this through surface flow measurements and calibration of the site's pit water balance model and groundwater model.

Given that the JV has good knowledge of the site and its problems, and that the exceedances which led to the submission of a Program Notice are not causing environmental harm downstream, and as such are relatively low risk, the JV contends that emission limits at SW5 and SW6 should not apply for the duration of the TEP.

The draft TEP is proposed for a period of three years, notionally commencing in September 2013 with completion by September 2016.

TEP Objectives

To prevent the release of contaminants, being low pH water and heavy metals, from the Highway Reward mine which have caused breaches of conditions of Environmental Authority EPML00550413 at designated monitoring points SW5 and SW6.

The TEP activities will transition to compliance by discovering sources of contamination, carrying out earthworks and revegetation to prevent further release of contaminants and, where contamination cannot be prevented through cost-effective works, ensuring that there is no flow of contaminants off site and that the future risk of surface water or groundwater contamination re-occurring is acceptable.

TEP Proposed Program

The proposed TEP runs over three years and contains measures for three areas:

- surface flow towards SW6 on the north-west of the site.
- surface flow towards SW5 to the west of the site.
- surface water-groundwater interactions which impact on the amount of contaminated water which can be directed into the pit void.

The program is described below and presented as a project schedule in Table 5.

Surface Water Flow towards SW6

Investigation and Analysis

Carrying out a program of surface water monitoring to identifying sources of metal concentrations and low pH affecting runoff at monitoring point SW6. This will include:

- longitudinal sampling along the flow path after rain events
- measuring major drainage flows from the Highway waste rock dump at a dedicated v-notch weir
- measuring rainfall on site
- measuring flows at each potentially contaminated seep emanating or potentially emanating from the Highway waste rock dump
- sampling standing pools of water after rain
- analysing the results of the sampling programs and flow measurements to quantify pollutant sources and fluxes and differente sources of contamination
- carrying out a program of visually inspecting the Highway and Reward waste rock dumps to identify flaws in the capping which could cause contamination
- assessing bare patches on waste rock dumps for growth in size which might indicate scalding and the scale of the remedial works needed.

Monitoring to be undertaken over a two-year period from the TEP commencement - sampling will, by necessity, be restricted to flows after rain events and will coincide with the wet season between November and May each year.

Reporting to DEHP is proposed on a six monthly basis —reports provided by 30 December and 30 June for each year of the TEP.

Remedial Works

- Instigating earthworks programs to repair erosion problems which could be exposing sulphides
- Instigating earthworks programs to recap area of waste rock dump found to have thin or potentially underperforming capping
- Instigating revegetation programs to stabilise surfaces and prevent further erosion.

Initial earthworks are to be undertaken before 30 September 2013 with a report on the works to be provided to DEHP by 30 October 2013. A follow up works program is to be undertaken before 30 September 2014 with a report on the works to be provided to DEHP by 30 October 2014.

Surface water flow towards SW5

Investigation and Analysis

- Implementing a program of surface water sampling on the western side of the mining lease including flows directed into the pit
- Developing a record of photographic monitoring to show and accompany surface water flow sampling for identification of surface water flow or pooling
- Analysing results to confirm presence or absence of contaminated water flows on site towards monitoring point SW5.

Reporting to DEHP is proposed on a six-monthly basis with reports to be provided to DEHP by 30 December and 30 June for each year of the TEP.

Remedial Works

- Carrying out a program of visually inspecting the areas to the south and west of the Highway Reward pit void which could cause contamination
- Instigating earthworks programs to repair erosion problems which could be exposing sulphides
- Instigating earthworks programs to cap or dispose of exposed sulphides and redirect contaminated flows into the pit void
- Instigating revegetation programs to stabilise surfaces and prevent further erosion
- Completing earthworks and diversion programs to prevent contaminated flows from the lease towards SW5.

Surface Water - Groundwater Interaction

- Measuring surface water flows at v-notch weirs
- Assessing the flows against rainfall events
- Calculating the runoff co-efficient from various areas of the site
- Assessing the runoff expected from different areas and calculating the maximum flows expected
- Measuring the pit height and calculating the pit volume on a quarterly basis
- Calibrating the pit water balance based on the measured results and analysis
- Measuring the groundwater height and quality at dedicated groundwater bores on a quarterly basis
- Calibrating the current groundwater model
- Developing a model for surface water runoff versus evaporation.

Reporting to DEHP is proposed by 30 December in each year of the TEP.

Future Surface Water Flows

- Determining which areas of the site provide a stable contaminant-free runoff
- Determining which areas of the site do not provide a stable contaminant-free runoff

- Developing measures to prevent off-site release of contaminants, such as diverting contaminated water into the pit, maximising evaporation on site, or using earthworks and revegetation to minimise waste rock dump seepage development.

A report will be provided to DEHP by 30 September 2015 after monitoring flows for two wet seasons and assessing the interaction between surface water and groundwater. The report shall evaluate prospective earthworks which can maximise clean water flows off site and contaminated water into the pit void between October 2015 and August 2016 and commit to a works program to be completed by September 2016.

Management of Environmental Harm

The risk of environmental harm occurring is characterised by:

- the impact of low pH and high metal concentration surface water flows entering Policemans Creek
- the impact of contaminated water from the pit void either flowing from the pit into surface water systems or into regional groundwater aquifers.

The risk of environmental harm occurring during the TEP will be managed by:

- minimising flows into the pit until the surface and groundwater models have been calibrated and conservative allowances have been made for into-pit flows
- measuring flows into the pit
- initiating earthworks and revegetation works to identify and cap exposed sulphides on site as soon as practicable.

As described earlier, the poor quality water emanating from the site in recent years as sampled at SW5 and SW6 (Table 1 and Table 2) has not shown up downstream at SW4 in Policeman's Creek (Table 3).

TEP Performance Indicators

- Stable self-sustaining vegetation on waste rock dumps
- Reduction of contaminated flows off site
- No breaches of EA conditions Schedule C – Tables 1 and 2.

Monitoring and Reporting

- Reporting on surface water flows to DEHP on a six-monthly basis. Reports to be provided to DEHP by 30 December and 30 June for each year of the TEP.
- Report to DEHP on surface water - groundwater interactions by 30 December in each year of the TEP
- Report on the initial earthworks works to DEHP by 30 November 2013.
- Report on follow up earthworks program to DEHP by 30 November 2014.
- Report on final proposed remedial works to DEHP by 30 September 2015.
- Final TEP Report by 30 September 2016.

Table 5 TEP Timetable

Task Name	Start	Finish
Surface Flow Sampling	**Fri 1/11/13**	**Thu 1/05/14**
SW6 flow path drain	Fri 1/11/13	Thu 1/05/14
SW6 flow path WRD	Fri 1/11/13	Thu 1/05/14
SW5 flow path	Fri 1/11/13	Thu 1/05/14
Pit v notch	Fri 1/11/13	Thu 1/05/14
Earthworks	**Tue 17/09/13**	**Mon 5/09/16**
Remedial drainage and cap repairs	Tue 17/09/13	Mon 28/10/13
2014 earthworks program	Thu 15/05/14	Wed 17/09/14
2015 earthworks program	Mon 18/05/15	Fri 18/09/15
2016 earthworks and surface diversion pr	Tue 17/05/16	Mon 5/09/16
Groundwater / Pit water Balance	**Tue 17/09/13**	**Mon 20/06/16**
Measure surface flwos at V notches	Tue 17/09/13	Mon 20/06/16
Survey pit water height	Tue 1/10/13	Mon 14/10/13
Survey pit water height	Wed 1/01/14	Tue 14/01/14
Survey pit water height	Tue 1/04/14	Mon 14/04/14
Survey pit water height	Tue 1/07/14	Mon 14/07/14
Survey pit water height	Wed 1/10/14	Tue 14/10/14
Survey pit water height	Thu 1/01/15	Wed 14/01/15
Survey pit water height	Wed 1/04/15	Tue 14/04/15
Survey pit water height	Wed 1/07/15	Tue 14/07/15
Survey pit water height	Thu 1/10/15	Wed 14/10/15
Survey pit water height	Fri 1/01/16	Thu 14/01/16
Survey pit water height	Fri 1/04/16	Thu 14/04/16
Survey pit water height	Wed 24/06/15	Tue 7/07/15
Groundwater model calibration	Wed 15/04/15	Tue 7/07/15
Surface water model calibration	Wed 15/04/15	Tue 7/07/15
Surfacer diversion assessment	Wed 8/07/15	Tue 18/08/15
Surface Flow Sampling	**Mon 3/11/14**	**Fri 1/05/15**
SW6 flow path drain	Mon 3/11/14	Fri 1/05/15
SW6 flow path WRD	Mon 3/11/14	Fri 1/05/15
SW5 flow path	Mon 3/11/14	Fri 1/05/15
Pit v notch	Mon 3/11/14	Fri 1/05/15
DEHP Reporting	**Tue 29/10/13**	**Fri 30/09/16**
Surface flow sampling update report	Mon 30/12/13	Mon 30/12/13
Surface flow sampling update report	Mon 30/06/14	Mon 30/06/14
Surface flow sampling update report	Tue 30/12/14	Tue 30/12/14
Surface flow sampling update report	Tue 30/06/15	Tue 30/06/15
Surface flow sampling update report	Wed 30/12/15	Wed 30/12/15
Runoff & pit water report	Fri 20/12/13	Mon 30/12/13
Runoff & pit water report	Mon 21/12/15	Wed 30/12/15
2013 Eatrhworks update report	Tue 29/10/13	Wed 30/10/13
2014 earthworks update report	Thu 18/09/14	Wed 29/10/14
Surface water diversion asessment report	Wed 19/08/15	Tue 29/09/15
Final TEP Report	Tue 6/09/16	Fri 30/09/16