

Vista Gold Australia

Discharge Plan

Revision 7

February 2019

Executive Summary

This Discharge Plan has been developed for Vista Gold Australia Pty Ltd (Vista Gold) to address the requirements of Waste Discharge Licence (WDL) 178- (as amended). This Discharge Plan describes the investigations that have been conducted, in a weight of evidence approach (using multiple lines of evidence) to derive dilution factors for mine waste water discharge from site. The dilution factors have been calculated for ecosystem protection in the Edith River to meet the 80% species protection level at the downstream compliance point (SW4) and were derived from ecotoxicity testing using appropriate species following ANZECC (2000) guidelines. Investigations used to derive the dilution factors and to provide additional information on the health of the Edith River downstream from the discharge point include:

- Investigations into the toxicity of Retention Pond (RP) 7 mine water (*completed 2012*)
- Investigations into the toxicity of treated Batman Pit mine water (pilot trial and in-situ samples) (*completed 2012 - 2014*)
- Investigations into the toxicity of RP1 mine water (*completed 2012*)
- Investigations into the toxicity of Newmarket Gold Mining Operations mine water (*completed*)
- Risk assessment for the discharge of treated Batman Pit mine water at SW4 (*completed 2014*)
- Investigations into the speciation of metals due to water chemistry at the site (*completed 2014*)
- Investigations into the toxicity of surface water at SW4 (*ongoing*)
- Macroinvertebrate and sediment studies to assess downstream impacts from the mine discharge (*ongoing*)

This Discharge Plan provides results to date for the ongoing investigations listed above to address the requirements of the WDL.

This Discharge Plan provides information that is used by Vista Gold for guidance on ecosystem protection within the Edith River including:

- An 80 % species protection dilution factor obtained from 21 suites of site specific bioassays using DTA methodology that can be applied to discharges of treated Batman Pit, and, in emergency conditions and with approval from the Controller of Water Resources, untreated RP1.

Commitment 1

Vista Gold has committed to improve the quality of treated waste water leaving the site to meet the ANZECC (2000) 95% species protection trigger values at SW4 once mining operations commence

Commitment 2

Conduct screening cladoceran bioassays on SW2 and SW4 during discharge in on an annual basis

Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
ARD	Acid rock drainage
DENR	Department of Environment and Natural Resources
DOC	Dissolved organic carbon
DTA	Direct toxicity assessment
ERISS	Environmental Research Institute of the Supervising Scientist
L	Litre
Kg	Kilogram
µg	Microgram
µS/cm	Micro siemens/centimetre
mg	Milligram
NATA	National Association of Testing Authorities
NT EPA	Northern Territory Environment Protection Authority
NT	Northern Territory
%ile	Percentile
mm	Millimetre
OECD	Organisation for Economic Co-operation and Development
RP	Retention pond
SSD	Species sensitivity distribution
SSTV	Site specific trigger value
TAT	Turn-around time
TOC	Total organic carbon
TV	Trigger value
USEPA	United States of America Environmental Protection Authority
WDL	Waste Discharge Licence
WTP	Water treatment plant

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1. Introduction

1.1 Project Background

Vista Gold Australia Pty Ltd (Vista Gold) discharges treated mine water under a Waste Discharge Licence (WDL) which is authorised under the Water Act which is enforced by the Department of Environment and Natural Resources (DENR) as the Administering Agency). The WDL outlines requirements for environmental protection of the Edith River from mine wastewater discharges from the Mt Todd mine site.

On-going studies and monitoring have been conducted at the Mt Todd site in relation to the treated mine water discharge and the results of these studies have been used to update this Discharge Plan

This Discharge Plan has been developed to be used in conjunction with the relevant sections of the WDL in order to manage and minimise environmental impacts of the Mt Todd discharge.

Management of and responsibility for the various aspects of MT Todd is currently subject to an agreement between Vista Gold and the NT Department of Primary Industry and Resources (DPIR). The agreement identifies Vista Gold as the onsite operator, responsible for maintaining the site assets of the Northern Territory Government, including daily management of the site and ensuring there is no further degradation of the environmental legacy issues at the site. The NT Government is responsible for the legacy environmental liability, which includes the onsite acid rock drainage (ARD) water inventory, until production at the site is resumed.

Since 2014 on-site wet season management of ARD waters has been undertaken by Vista Gold and funded by both organisations.

1.2 Water Treatment Objectives

The treatment and discharge of Batman Pit water will allow the DPIR and Vista Gold to meet their objectives at the Mt Todd site. These objectives are:

- Reduce the risk of significant environmental harm by using historical data to predict the impact of activities
- To reduce the on-site water inventory
- To reduce the risk of an uncontrolled discharge from the site
- To meet the WDL 80% species protection site specific trigger values (SSTVs) at SW4 during dewatering

To meet the water inventory objectives, treated water from Batman Pit is discharged to Batman Creek after which it enters the Edith River via Stow Creek. The chemistry of Batman Pit water, the flow in the Edith River and the capacity of the pumps determines the amount of water able to be discharged to meet the SSTVs based on ANZECC (2000[1]) 80 percent species protection trigger values at SW4 (WDL 178).

[1] ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

Commitment 1

Vista Gold has committed to improve the quality of treated waste water leaving the site to meet the ANZECC (2000) 95% species protection trigger values at SW4 once mining operations commence

1.2.1 Discharge Management

Vista Gold discharge only from Batman Pit, with RP1 and RP7 water pumped to RP3 during the wet season if required to avoid overtopping. If transfer pumping from RP7 and/or RP1 must be carried out, then this should be done early in the year to ensure that the changed water quality in Batman Pit can be treated to a suitable standard for discharge to meet the SSTVs at SW4.

Emergency Response

Controlled discharge for the following scenarios in addition to the routine discharge from Batman Pit may be required in exceptional circumstances which override normal onsite water management actions.

The controlled release of water in the above scenarios would only be undertaken for the following reasons:

1. When there is a significant risk to the integrity of the retention pond structure, and lowering of the internal water level will contribute to a reduction in the risk of failure
2. When there is a significant risk of an uncontrolled discharge and lowering of the internal water levels will reduce the risk of uncontrolled discharge or minimise the quantity of uncontrolled discharge

1.2.2 Toxicity Assessment

Vista Gold has treated the water in Batman Pit to reduce the metal concentrations in the water to be discharged, with additional treatment conducted in late 2014, 2015 and 2016. Vista Gold intends to continue managing the environmental impacts from the mine discharge to the Edith River by meeting SSTVs at the downstream site SW4 as permitted under the WDL.

Vista Gold has sufficient ecotoxicology and chemistry data to calculate the predicted toxicity of discharge water based on the current water chemistry, and thus to determine the dilution factor required to meet SSTVs downstream at SW4.

Vista Gold calculates the volumes of treated water to be discharged from Batman Pit using an algorithm for the dilution factor, based on the chemistry at the time of discharge and the previous DTA results from both Vista Gold and other regional gold mine discharges (GHD 2016[2]). The dilution is managed by in-situ telemetry based on Edith River flows, which will determine the volume of treated Batman Pit water to be released.

The dilution algorithm was validated in During the 2014/15 and 2015/16 wet seasons the using a direct toxicity assessment (DTA) and associated chemical analysis of Batman Pit treated water. The dilution factor derived from the species sensitivity distribution (SSD) using the DTA results was compared to the results of the algorithm calculated for that water quality and confirmed the algorithm predictions, as discussed in (GHD 2015[3]).

The water quality at SW4 is routinely compared to the SSTVs and, if the SSTVs are exceeded, the dilution factor will be re-assessed and discharge stopped if necessary as the Investigation Process shown in Figure 3-1 indicates. Additional real-time data for pH and EC, provides

[2] Mt Todd Discharge Plan Revision 5 (2016)
[3] Mt Todd Waste Discharge Licence Algorithm Validation Report March 2015

operational data and an early warning system of water quality discharged from Batman Pit using mid-stream water quality loggers.

1.3 Scope of Work

This Discharge Plan addresses the following aspects of the WDL:

- Proposed water management strategy for the Mt Todd mine site discharge
- Methodology for the application of the SSTVs following ANZECC (2000) guidelines for ecosystem protection applied at SW4 for mine discharges of treated mine water from Batman Pit
- Investigation procedures triggered by an exceedance of the dilution factor at SW4
- Biological assessment methodology (i.e. macroinvertebrate population studies) and sediment studies to aid in the assessment of downstream impacts and validation of trigger values

1.4 Limitations

This Vista Gold Australia Discharge Plan 2018("Report"):

1. *has been prepared by GHD Australia Pty Ltd ("GHD") for Vista Gold Australia Pty Ltd (Vista Gold) and the DENR*
2. *may only be used and relied on by Vista Gold , DENR and DIPR*
3. *must not be, used by, or relied on by any person other than Vista Gold without the prior written consent of GHD*

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The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in section 1.3 of this Report*

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- *Current accepted practices*

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2. Discharge Management Strategy

2.1 Introduction

As discussed in Section 1, Vista Gold will to use this Discharge Plan in conjunction with the Mine Management Plan (MMP) and the WDL to enable the discharge of treated water from the Mt Todd mine site to meet DENR environmental requirements and DPIR objectives.

The Water Management Plan (Section 6) in the Mount Todd Gold Project MMP discusses all details in relation to onsite surface waters infrastructure and management. This Section of the Discharge Plan discusses the discharge management strategy only.

2.2 Water Pumping and Release Strategy

Vista Gold release treated water from Batman Pit only during wet seasons, however during unforeseen circumstances, discharges from RP1 may be required, either individually or as part of a multisource discharge. However, Vista Gold does not intend to discharge wastewater from RP1 offsite unless abnormal rainfall intensity or duration requires emergency action to prevent uncontrolled discharge as discussed in Section 1.2.

All practicable measures will be implemented to minimise the requirement for an emergency discharge. Direct discharge offsite to the Edith River from RP1 and RP7 will only be permitted with the prior approval of the Controller of Water Resources.

In order to maintain enough freeboard, water in RP1 will be pumped to RP7, and if required, water in RP7 will be pumped to Batman Pit.

Table 2-1 outlines the water management for the RPs involved in this Discharge Plan. Additional information on the water management of other RPs at Mt Todd is available in Vista Gold WMP (2017). Figure 2-1 shows the water movement and discharge locations for each RP at the Mt Todd site.

Table 2-1 Water Transfers and Monotoring Procedures (*MMP Vista Gold)*

Water Transfers	Monitoring
RP1	
Maintain freeboard by pumping untreated water to RP7 or treat water via WTP and redirect to Batman Pit or RP7. October to February – pump if freeboard is less than 2.5 metres. March to April – pump if freeboard is less than 1 metre. Dry season – pump if major rainfall is expected and freeboard is less than 0.5 metres. April to November – maximise evaporation opportunities.	RP1 level daily (during wet). Flow to Batman Pit (cumulative and instantaneous. Daily recording of WTP flow meter and pump operating times). Discharge to Edith River through siphon (cumulative and instantaneous. Daily recording of flow meter and siphon operating times). Pump infrastructure (weekly). Water quality monitoring as per WDL.

Water Transfers	Monitoring
Batman Pit	
Pump to Batman Creek when licence conditions and Edith River dilution rates can be met and authorisation is obtained from the General Manager to commit to the associated expenditure. Batman Pit can receive excess water from RP1, RP2 and the heap leach moat	Batman Pit level (daily during wet). Flow (cumulative and instantaneous. Daily flow meter recording and pump operating times). Pump infrastructure weekly. Water quality monitoring as per WDL.
RP7	
October to March – Pump untreated water to Batman Pit when water level is at base of spillway. Redirect all pumped inputs to Batman Pit. April to November – maximise evaporation opportunities. Receives water from WTP, RP1, RP2, RP5 and HLP	RP7 level (weekly). Flow to Batman Pit (cumulative and based on pump operating times) Pump infrastructure (weekly). Water quality monitoring as per WDL

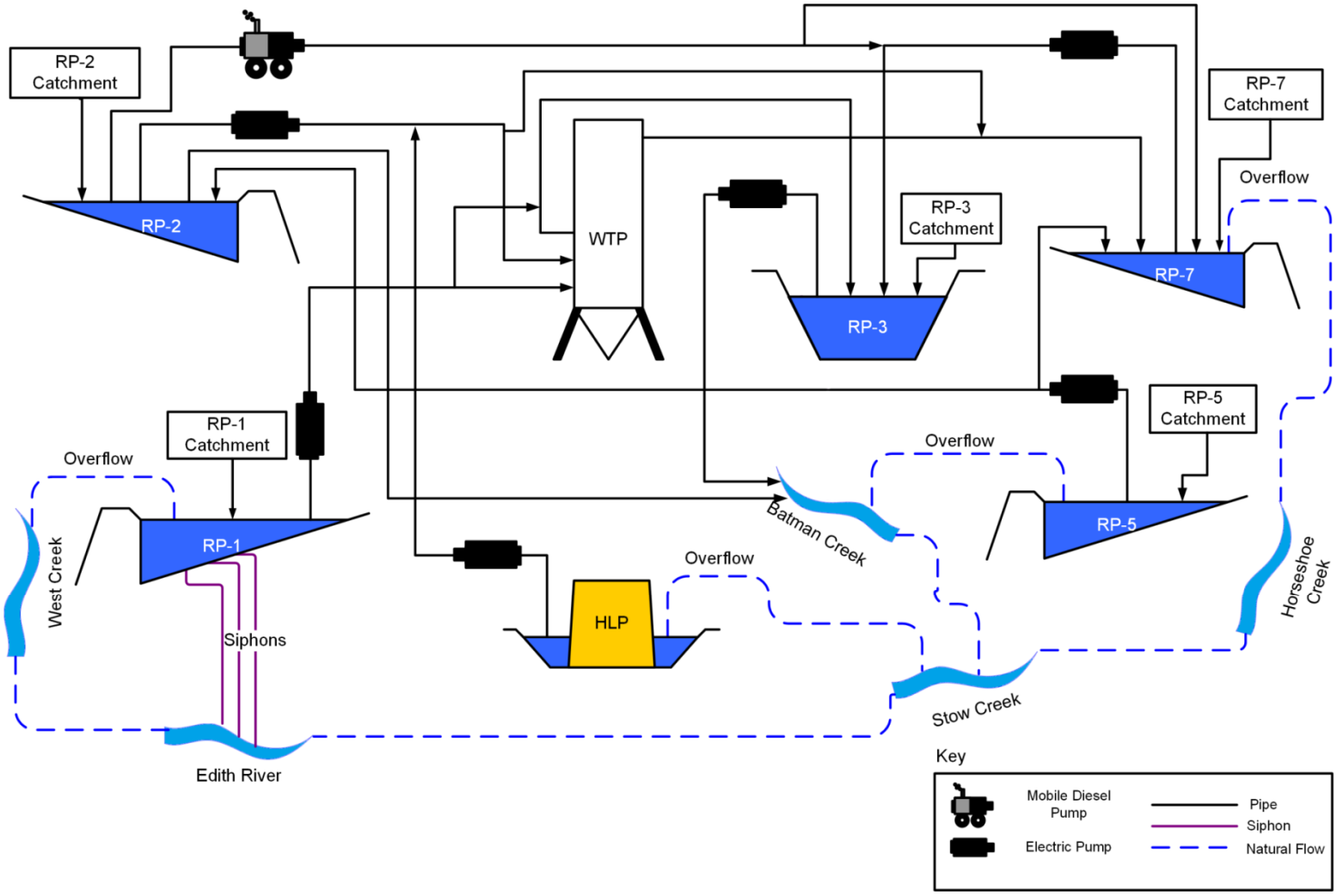


Figure 2-1 Mt Todd Mine Water Management Conceptual Site Model

2.3 Monitoring of Batman Pit

Vista Gold has installed an on-line water quality monitoring station that delivers continuous real-time pH, conductivity and temperature of the Batman Pit discharge water. Batman Pit water quality is monitored to meet the requirements of the current WDL.

The results of the Batman Pit water quality are used by Vista Gold to determine if the water being released from Batman Pit is changing and therefore may require a change in the discharge ratio. The dilution factor is programmed into the telemetry system as described in Section 4.

Samples will be collected and analysed for the parameters following the procedure in Vista Gold's Surface Water Monitoring Standard Operating Procedure and Section 3.4. All quality assurance will be conducted as outlined in the SOP.

2.4 Monitoring of SW4 and SW2

Vista Gold has installed real-time pH, EC and temperature water quality monitoring loggers to monitor the water quality at SW4. In addition to the continuous monitoring, Vista Gold samples SW4 and SW2 daily and sends the sample to a NATA accredited laboratory. Holding times and sample preservation ensure that the results obtained are representative of the respective water quality.

3. Site Specific Trigger Values for the Edith River

3.1 Trigger Values

This Discharge Plan (Revision 6) has been designed to enable calculation of the dilution factors based on direct toxicity assessments (DTA) previously conducted on RP1, Batman Pit, RP7 and various gold mine sites in the vicinity. The dilution factor, in combination with ANZECC (2000) 80 percent species protection trigger values are used to managing environmental impacts from Mt Todd mine site discharges. This approach using DTA is preferred for environmental management of a complex effluent (ANZECC 2000).

3.2 Site Specific Trigger Values

The SSTVs listed in WDL 178 are based on ANZECC (2000) 80 percent species protection trigger values to be applied at SW4. Those values listed in WDL178 are appropriate for all analytes with the exception of magnesium which uses data published by ERISS.

Table 3-1 Site Specific Trigger Values for the Edith River at SW4 (2018- 2020)

Analyte	Unit	SSTV
pH		6.0 – 8.0
EC	µS/cm	250
Dissolved oxygen	%sat	85 – 120
Aluminium - dissolved	µg/L	150
Cadmium - dissolved	µg/L	0.8
Cobalt - dissolved	µg/L	13
Copper - dissolved	µg/L	2.5
Iron - dissolved	µg/L	350
Lead- dissolved	µg/L	9.4
Manganese - dissolved	µg/L	3,600
Nickel - dissolved	µg/L	17
Zinc - dissolved	µg/L	31
Sulfate	mg/L	129
Bicarbonate	mg/L	319
Chloride	mg/L	64
Magnesium	mg/L	21

Analyte	Unit	SSTV
Cyanide (total) µg/L	µg/L	7.0

3.3 Surface Water Monitoring

Vista Gold's current Surface Water Monitoring Procedure provides water quality sampling and monitoring at Batman Pit, SW2 and SW4. The SOP provides details on sample locations and a full suite of analytes required to meet WDL requirements. The Discharge Plan provides a sampling procedure to meet water quality requirements for sampling during discharge, and monthly sampling at times of no discharge, for the suite of analytes shown in Table 3-2.

Table 3-2 Analytes for SW2, SW4 and Batman Pit Daily Sampling during Discharge

	Analytes
Field Data	Rainfall, evaporation, air temperature, pumping rate, cumulative discharge volume, River flow, water level
In-situ	DO, temperature[1], EC[4], pH[1]
Metals (dissolved 0.45 µm filtered)	Al ,B, Cd, Co, Cu, Cr, Fe, Li, Pb, Mn, Hg, Ni, Zn
Metals (total)	Al, Cd, Co, Cu, Fe, Hg
Others	TN, TP, SO_4, bicarbonate, alkalinity, hardness, TDS, TSS, Na, chloride, Ca, K, WAD cyanide[5], total cyanide, TOC, fluoride, Mg

Water quality at SW4 sampled over the last 4 wet seasons where the dilution algorithm has been used has shown that daily monitoring of SW2, Batman Pit and SW4 provides sufficient information to assess water quality upstream and downstream during discharge.

3.3.1 Surface Water Sampling

Vista Gold have installed on-line data loggers to continuously analyse pH, conductivity and temperature at Batman Pit and SW4. This system provides an early warning if water quality entering the Edith River is deteriorating. Figure 3-1 shows the location of the in-line continuous water quality monitor at Batman Pit. The loggers are maintained on a routine basis by Envirotech Monitoring who also provide routine calibration of the probes.

[4] Continuous at Batman Pit and SW4
[5] Required if total cyanide >0.004 mg/L



Figure 3-1 Batman Pit in-line water quality monitor

Vista Gold samples sites SW2, SW4 and Batman Pit on a daily basis during discharge to meet WDL requirements, however, after the first three days of continuous discharge each daily sample will be combined to form a composite sample as shown below:

- Daily sample for the first three days of continuous discharge.
- Then a composite of daily samples every seven days thereafter
- A daily sample on the last day of discharge
- A sample seven days after discharge has ceased
- Samples are dispatched weekly to a NATA accredited laboratory for analysis.

The data provided in Table 3-3 shows the water quality at SW4 during discharge from Batman Pit in the 2017/18 wet season. Table 3-4 shows that quality of treated water discharged from

Batman Pit during the 2017/18 wet season compared to the stock watering guidelines (ANZECC 2000).

Table 3-3 Summary of SW4 during discharge (2017/18)

Analyte	SSTV	n	Minimum	Median	Maximum
pH	6-8	75	5.3	6.2	6.7
EC µS/cm	250	75	17	103	146
DO %sat	85-120	75	73	94	97
Ions mg/L					
Sulfate mg/L	129	77	<1	32	43
Bicarbonate	319	21	<5	9	12
Chloride	64	30	1	2	4
Magnesium (filtered)*	2.5	30	<0.5	3.4	5.6
Metals (0.45 µm filtered)µg/L					
Aluminium	150	30	<10	<10	39
Cadmium	0.8	30	<0.1	0.3	0.4
Cobalt	13	30	<0.1	<0.1	2
Copper	2.5	30	<1	<1	3
Iron	350	30	48	86	560
Lead	9.4	30	<1	<1	<1
Manganese	3,600	30	6	27	140
Nickel	17	30	<1	2	4
Zinc	31	29	<1	22	48
Cyanide (total)	7	77	<4	<4	<4

Table 3-4 Batman Pit Water Quality 2017/18

Analyte	SWG	Count	Minimum	Median	Maximum
pH	6-8	73	6.2	6.7	7.2
EC µS/cm	2,000 (TDS)	73	2,749	2,831	3,060
DO %sat	Nil	73	52	102	104
Sulfate mg/L	1,000	30	1,600	1,800	2,100
Bicarbonate mg/L	Nil	30	14	20	26
Chloride mg/L	Nil	30	7	8	14
Magnesium mg/L	Nil	30	190	210	240
Metals (0.45 µm filtered) µg/L					
Aluminium	5,000	30	<10	30	48
Cadmium	10	30	20	23	27

Analyte	SWG	Count	Minimum	Median	Maximum
Cobalt	1,000	30	22	27	32
Copper	400	30	<1	4	10
Iron	Nil	30	<10	5	250
Lead	100	30	<1	<1	<1
Manganese	Nil	30	77	220	320
Nickel	1,000	30	150	170	200
Zinc	20,000	30	1,300	1,300	1,600
Cyanide (total)	Nil	10	<0.004	<0.004	<0.004

3.4 Monitoring Sites

Vista Gold meets the 80% species protection dilution factor at SW4 during wet seasons to meet the SSTV requirements of the WDL. Surface water monitoring locations are shown in Table 3-5.

Table 3-5 Surface Water Monitoring Sites

Site Name	Site Description	Latitude (degree, decimal) WGS84	Longitude WGS84
SW2	Edith River at bridge on Edith Falls Road	-14.17194471	132.1198981
SW4	Edith River downstream of RP1 siphon (Burrell Creek) and RP1 spillway (West Creek), near boundary of mine property	-14.17066860	132.0983470
SW13	Stow Creek above confluence of Horseshoe Creek	-14.15605200	132.0983470
RP1	Waste rock wastewater source	-14.16306406	132.1072276
RP3	Batman Pit	-14.14032773	132.1026623

3.5 SSTV Exceedance

For parameters that exceed the site specific trigger values at the downstream monitoring location (SW4), the actions described in the decision trees in ANZECC (2000) and in Figure 3-2 below are implemented for physico-chemical stressors and for toxicants.

For physico-chemical stressors and toxicants, the reporting requirements are triggered where the results of the composite sample exceed the SSTVs listed in the WDL at SW4.

Additional investigations that will be required to manage and assess the exceedances include:

- Investigate the cause and duration of the exceedance;

- Implementation of remedial actions to improve discharge water quality by increasing the dilution factor (i.e. reducing the discharge volume); and/or
- Further site-specific investigations to determine the biological effects of the elevated parameters.

Further site specific investigations may include direct toxicity assessment (DTA) following ANZECC (2000) guidelines to determine biological effects in the downstream ecosystem. A single species representative of the receiving ecosystem may also be used in an ecotoxicological assessment to provide a timelier result. The aim of this investigation would be to identify the source of the contaminants, and to determine if the elevated concentrations are adversely impacting on the waters downstream of the discharge point.

3.6 Application of 80 Percent Species Protection Dilution Factor

The dilution algorithm derived in this Discharge Plan (Section 4) has been developed to protect 80 percent of resident species from a 10 percent decrease in growth or reproduction in the Edith River ecosystem during site dewatering.

Vista Gold proposes to meet the 80 percent species protection dilution factor at site SW4 for discharge of all mine waters. Water quality data for SW4 will be compared against the SSTVs listed in the WDL and upstream concentrations if the SSTVs are exceeded.

An exceedance which triggers the investigation process as listed in the WDL and described in Section 3.5.

If any of the SSTVs are exceeded, an investigation process as detailed in Figure 3-2 will be implemented upon receipt of analytical data from the laboratory. This investigation procedure follows ANZECC (2000).

3.7 Exceedance Investigation

Should a SSTV (listed in the WDL) be exceeded at SW4 during any discharge from the mine as defined in Section 3.5, and investigations reveal that follow up sampling of the mine discharge and ambient water are required, the follow up sampling will occur as soon as practicably possible with a rapid turn-around-time (TAT).

In the meantime, Vista Gold will implement the appropriate management actions for the exceedance, which may include additional sampling at key locations to assist with the isolation of any passive contaminant sources. The DENR will be advised of an exceedance.

The risk assessment process will commence upon receipt of the follow-up sample results if they confirm the previous results. Therefore, the period from the conclusion of the investigation process to the commencement of the risk assessment process is anticipated to be approximately 1-2 days. The risk assessment will take approximately one day. Another day is required to compile the report. A total of 4 to 5 working days is required to provide a completed report to DENR. If the exceedance was not caused by a laboratory or sampling error, the report may be completed in a minimum of 4 days from initial exceedance. The days for the investigation process listed on Figure 3-2 are for indicative purposes only and may change depending on information obtained during the investigation.

3.8 Cease Discharge

Vista Gold will cease discharging from a water source (Batman Pit) if the SSTVs listed in the WDL are exceeded by a factor of 2 or more. The discharge will cease upon receipt of the laboratory results, i.e. the earliest known time of exceedance. The NATA accredited laboratory

will then be sent additional samples immediately with a rapid TAT of the samples to confirm the exceedance.

A factor of 2 was selected to be applied to the SSTVs for ceasing discharge, based on concentrations that may have the potential to cause chronic toxicity to sensitive aquatic species within the mixing zone. Acute toxicity is unlikely in the mixing zone with a 1-2 day exposure at these concentrations.

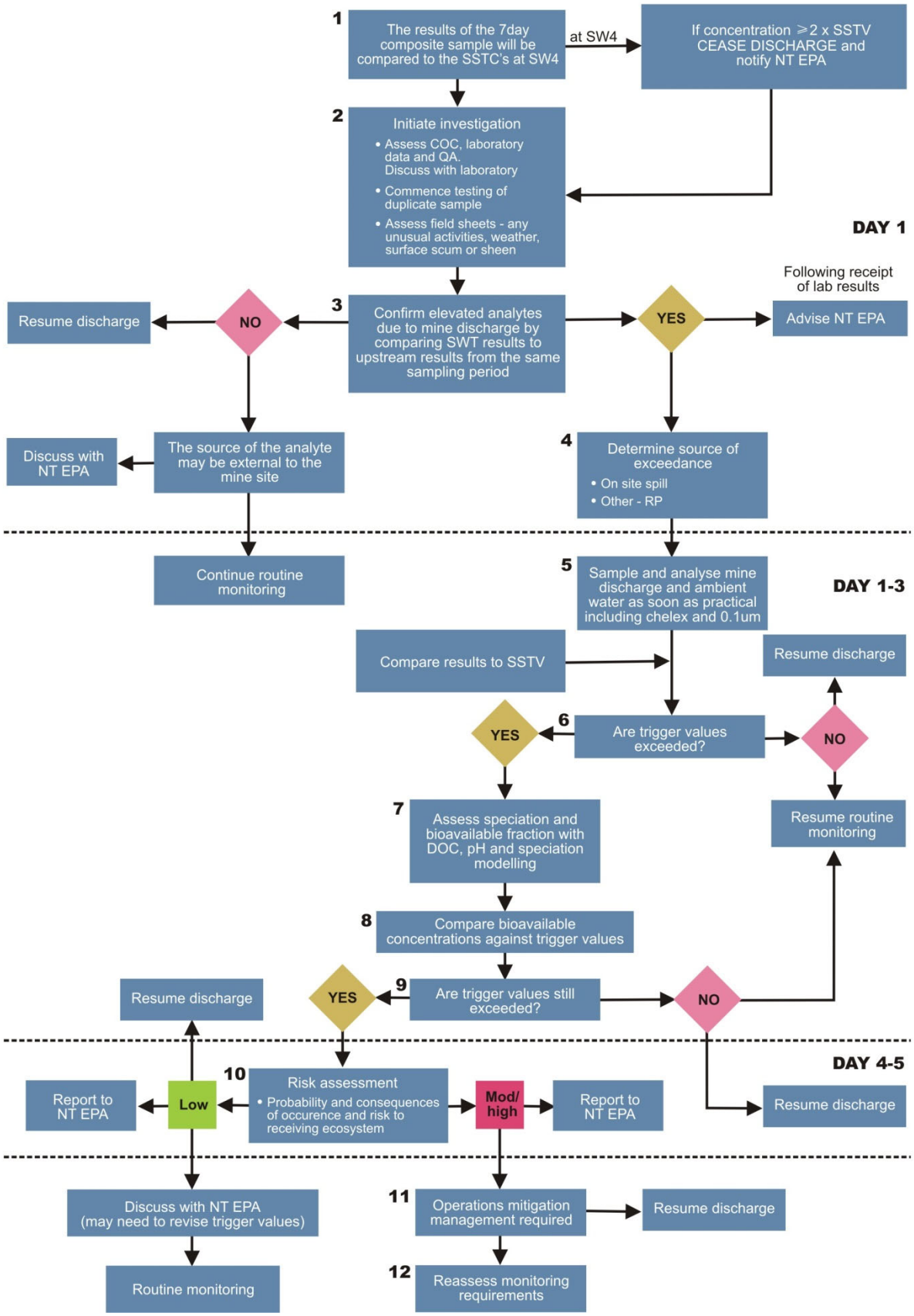


Figure 3-2 Investigation Process for Exceedance of SSTVs at SW4

4. Dilutions to meet SSTVs

4.1 Introduction

Toxicity units from historical and recent ecotox testing by ERISS, NT EPA, DENR, Newmarket Gold and Vista Gold have been used to derive a dilution algorithm that can be used to calculate the dilution factor, based on the current chemistry of discharge water. This method takes into account analysed chemicals that are considered to be contributing the majority of the measured toxicity (calculated from DTAs) within the discharge.

The following is a discussion of the development of a dilution algorithm that uses the data available at the time of testing. The dilution algorithm does not intend to determine 100% of the contributors to toxicity, as it is recognised that the physico-chemistry of the treated water and receiving waters may have ameliorating factors. This has partially been taken into account by using the upstream water as dilution water in all DTAs.

This method does not attempt to identify all contributors to the measured toxicity, but has been developed to provide a practical method for operators to modify the dilution of mine water with rapidly changing chemistry, due to operational procedures (e.g. treatment and/or input of poor quality water) for maximum discharge to meet operational objectives listed below.

Water Treatment Objectives

The treatment and discharge of Batman Pit water will allow the DPIR and Vista Gold to meet their objectives at the Mt Todd site. These objectives are:

- Reduce the risk of significant environmental harm by using historical data to predict the impact of activities
- To reduce the on-site water inventory
- To reduce the risk of an uncontrolled discharge from RP1 and Batman Pit
- Meet the SSTVs at SW4

4.2 Method

Vista Gold conduct water quality testing on Batman Pit during discharge, to monitor water quality discharged from the pit to meet WDL requirements. Samples for analysis by a NATA accredited laboratory are collected mid-stream via a sample point at the discharge manifold. These results are used to calculate a dilution factor that will allow the maximum volume of water to be discharged to the Edith River to meet the SSTVs at SW4 and to comply with the WDL.

The chemistry and the dilution factors determined for an 80 percent species protection factor using the BurrliOZ species sensitivity distribution (Campbell *et. al.* 2000[6]) derived from DTA of gold mine discharges provided by ERISS, NT EPA, DENR, Vista Gold and Newmarket Gold Northern Territory Mining Operations (NTMO) have been used to determine the correlation of chemistry and toxicity. Additional ecotoxicity data was provided by NTMO from their Pine Creek, Cosmo Howley and Brocks Creek Project Areas. This combined data was used to calculate an algorithm derived from a large number of data points that can then be applied with a greater

[6] Campbell E., Palmer M.J., Shao Q., Warne M.StJ. and Wilson D. 2000. BurrliOZ: A computer program for calculating toxicant trigger values for the ANZECC and ARMCANZ water quality guidelines. Perth, Western Australia

level of confidence (GHD 2014[7], GHD 2014[8], GHD 2016[9]) and validated in 2015 with Batman Pit treated waste water and in 2016 with treated and untreated mine water from Cosmo Howley. NTMO data were considered appropriate for use, given that the mine sites are in close proximity and the species and endpoints used in bioassays are similar in all DTAs.

A total of 21 water samples were used to calculate the dilution algorithm, all of which were obtained between 2010 - 2016. This number of data points provides an algorithm with a high level of confidence. These samples provide a wide variety of water qualities from untreated samples with poor water quality to treated samples of better quality. This data has previously been supplied to the NT EPA / DENR in various reports.

The data and algorithm are shown In Figure 4-1.

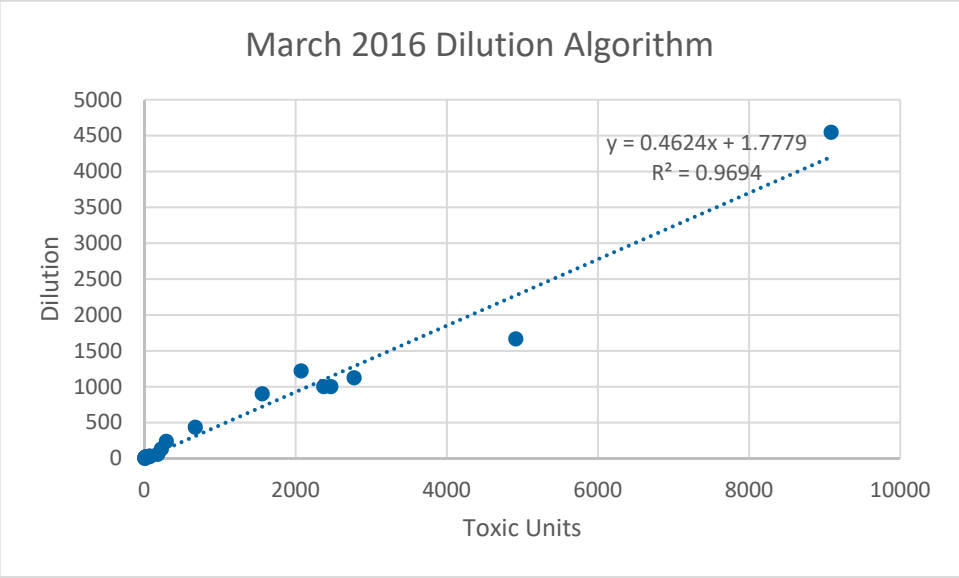


Figure 4-1 Linear Regression for Dilution Algorithm

4.3 Application Method

The algorithm shown in Figure 4-1 has been derived to apply to pumping rates based on the flow in the Edith River and the water chemistry in each pit, so that the SSTVs will be met at SW4.

This algorithm can be applied to future chemistry analysis of sulfate, aluminium, copper, nickel and zinc to derive the dilution required to meet WDL requirements for environmental protection of the Edith River:

- Total Toxicity Units (SO_4, Al, Cu, Ni and Zn): $y = 0.4624x + 1.7779$

This algorithm will provide a conservative estimation of dilution at low TUs which are expected to be found in Batman Pit after the treatment process as the minimum dilution factor that will be calculated will be >1:1.8.

[7] GHD 2014. Crocodile Gold Pine Creek Project Area. Environmental Monitoring and WDL 166-02 Report 2013-2014. August 2014. Draft

[8] GHD 2014. Crocodile Gold Cosmo Howley Brocks Creek Project Area. Environmental Monitoring and WDL 180-01 Report 2013-2014. August 2014. Draft.

[9] GHD 2016 Discharge Management Plan. Revision 5.

4.4 Validation of Method

The algorithm has been validated using a DTA conducted in February 2015 on the treated Batman Pit water and in March 2016 with treated mine water from NTMO's Cosmo Howley site.

Daily sampling will be conducted at SW4 to meet WDL requirements to ensure SSTVs are met. Screening toxicity tests will be conducted on SW4 water on an annual basis.

4.5 2018 Screening Bioassay at SW4

Vista Gold conducted a screening bioassay using the cladoceran reproduction test on a sample from SW2 and SW4 during discharge in February 2018. The SW4 results were compared to the upstream SW2 sample to determine if any significant toxicity was exhibited at SW4 that could be attributed to the discharge. The cladoceran reproduction and survival results showed increased reproduction when compared to the upstream site. Table 4-2 shows the results for the screening bioassays.

Table 4-1 Summary of Screening Ecotox Results for SW2 and SW4

Test	SW2 2015	SW2 2018	SW4 2015	SW4 2018
Cladoceran 7-day reproduction (chronic)	50 %	6 %	102 %	98 %
Cladoceran 7-day survival (acute)	90 %	0 %	100 %	100 %
Duckweed growth	Not Tested	97 %	Not Tested	97 %

4.6 Discussion

The algorithm method provides the simplest way of calculating the dilution factor based on ecotoxicology and capturing chemistry data and the contribution of each selected chemical to toxicity and has been developed for use by operations personnel.

The screening results from SW4 show that no toxicity was evident at that site, in fact the water was less toxic than that at SW2.

Commitment 2

Conduct screening cladoceran bioassays on SW2 and SW4 during discharge annually

5. Flow Control Mechanisms for Discharge to Meet the Dilution Factors

This section describes the mechanisms, including infrastructure and telemetry, installed at Mt Todd that will control discharges to meet the dilution factors at SW4.

5.1 Batman Pit Discharge

The discharge of treated Batman Pit water will occur via the following mechanism:

- Release of treated Batman Pit water via variable speed pumping system from 100 L/s to 1200 L/s capacity
- Pump flow rate controlled by automated pumping system
- Pumping rates determined from volume of water available in Edith River for discharge and applicable dilution rates
- Flow and water quality in Edith River measured by gauging station at monitoring location SW4
- Real time flow at SW4 reported via radio telemetry to pump controller
- User adjustable dilution rates are set in pump control system
- Pump control system uses river flow rates and dilution ratio to regulate the pump flow rate
- Pump flow rate from Batman Pit, Edith River flow rates and quality from SW3 and SW4 reported live to site office via radio telemetry connection
- Live telemetry data available to Vista Gold mine site and Darwin offices via internet link

5.2 RP1 Discharge

The release of untreated mine water from RP1 will only be permitted under emergency conditions, and with approval from the Controller of Water Resources. If permitted the discharge of untreated RP1 water will occur via the following mechanism:

- Release of water via existing siphon system
- Flow rate manually controlled by valves
- Flow rate reported by inline flow meter
- Discharge enters Burrell Creek
- River height, flow and water quality continuously monitored by gauging station SW4 downstream of Burrell creek confluence with Edith River
- Siphon flow rate reported live in site office by radio telemetry
- Height, flow and water quality at SW4 reported live at site office via radio telemetry
- Live telemetry data available to Vista Gold mine site and Darwin offices via internet link

6. Conclusions

This Discharge Plan provides information for the management of the Mt Todd treated water discharge to Edith Creek. This report provides 80 percent species protection trigger values to be met at SW4 to ensure that the dilution ratios calculated from ecotoxicology and chemistry results for gold mine discharges are providing the appropriate environmental protection. A risk assessment conducted for SW4 in 2014 shows that the risk to the site from Batman Creek discharge was low. This risk assessment was not repeated as no evidence of adverse environmental harm has been detected with sediment and macroinvertebrate monitoring.

This Discharge Plan (Revision 6) has been developed to meet the requirements of the WDL.

The dilution factors will be applied to the treated water discharging from the Mt Todd mine site. These dilution factors will allow the SSTVs to be met at the Edith River at monitoring location SW4.

SSTVs have been calculated to confirm that the dilution factors are being met at SW4. Several lines of investigation have been used to assess and validate the dilution factors including:

- Daily monitoring at SW4 during discharge. *On-going*
- Screening bioassays to confirm low risk of Batman Pit discharge to Edith River.
- Macroinvertebrate and sediment studies to assess downstream impacts from the mine discharge. *On-going*
- Investigations into the speciation of metals due to water chemistry at the site. *Completed*

6.1 Dilution Factors for Discharge

Ecotoxicological investigations into the toxicity of treated and untreated mine water from several sources were used to calculate a dilution algorithm for use at Mt Todd. The dilution algorithm has been developed to meet 80 percent species protection at SW4 using ecotoxicological testing. This algorithm has been validated using a DTA conducted in February 2015 on Batman Pit mine water and in 2016 with Cosmo Howley mine water. The dilutions algorithm to meet the 80 percent species protection is:

- Total Toxicity Units (SO_4, Al, Cu, Ni and Zn): $y = 0.4624x + 1.7779$

6.2 Cease Discharge

Discharge will cease upon receipt of laboratory data that shows that the water chemistry at SW4 is greater than or equal to double the SSTVs in the WDL.

6.3 Impacts on the Edith River

Sediment and macroinvertebrate monitoring programs are conducted annually at the Mt Todd site to assess the integrated effects of the discharge on the receiving environment. The results from the 2018 survey do not indicate that the discharge from the Mt Todd mine is having an impact on macroinvertebrate fauna of the Edith River.

The Edith River was assessed for aquatic ecological health to determine if treated mine water discharged through the licenced discharge point Batman Pit is having an adverse impact on the downstream ecology of the river. This assessment was undertaken through sampling of water and sediment quality, and macroinvertebrate community composition. Stow Creek, which flows through the Mt Todd mine site into the Edith River, was also assessed for aquatic health to provide Vista Gold with a further understanding of any potential impacts of mine run-off in other areas on the Mt Todd site.

The results from the 2018 monitoring round were consistent with the previous year's monitoring event, showing no discernible impact from treated mine water discharged from Batman Pit on the Edith River aquatic ecosystem. Water quality in the Edith River was found to be non-toxic at SW4 during discharge. Sediment quality along the Edith River showed no elevation of parameters above guideline levels. Macroinvertebrate results of samples from the Edith River showed no significant community change as a result of the Batman Pit discharge.

The results from the survey show that Vista Gold remain compliant with licence requirements under the WDL.

7. Commitments

Commitment 1

To meet the 95% species protection SSTVs at SW4 after mining commences

Commitment 2

Sediment monitoring program

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Level 7, 24 Mitchell Street Darwin NT 0800

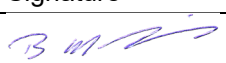
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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
7	B Murdoch			B Murdoch		05/02/2019
A	J.Woodworth	J. Hill		N.Conroy		08/08/2018

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