Anglo Coal (Dawson) Limited

Environmental Evaluation Report

Dawson Mine North Environmental Evaluation




November 2017

M30000_037

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ROCK HOLE GULLY CREEK ENVIRONMENTAL EVALUATION_REV0 - FINAL					
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Signatures					

CONTENTS

Appendices

List of Tables

List of Figures

1. INTRODUCTION

The Dawson Mine is a coal mining complex located approximately 150km south-west of Gladstone. Dawson Mine comprises of three distinct areas for their open cut operations: Dawson North, Dawson Central and Dawson South (Refer to Figure 1.1). The mining tenements and Environmental Authority (EA) for Dawson Central and North Coal Mine are held by Anglo Coal (Dawson) Limited and Mitsui Moura Investment Pty Ltd and operated by Anglo Coal (Dawson Management) Pty Ltd.

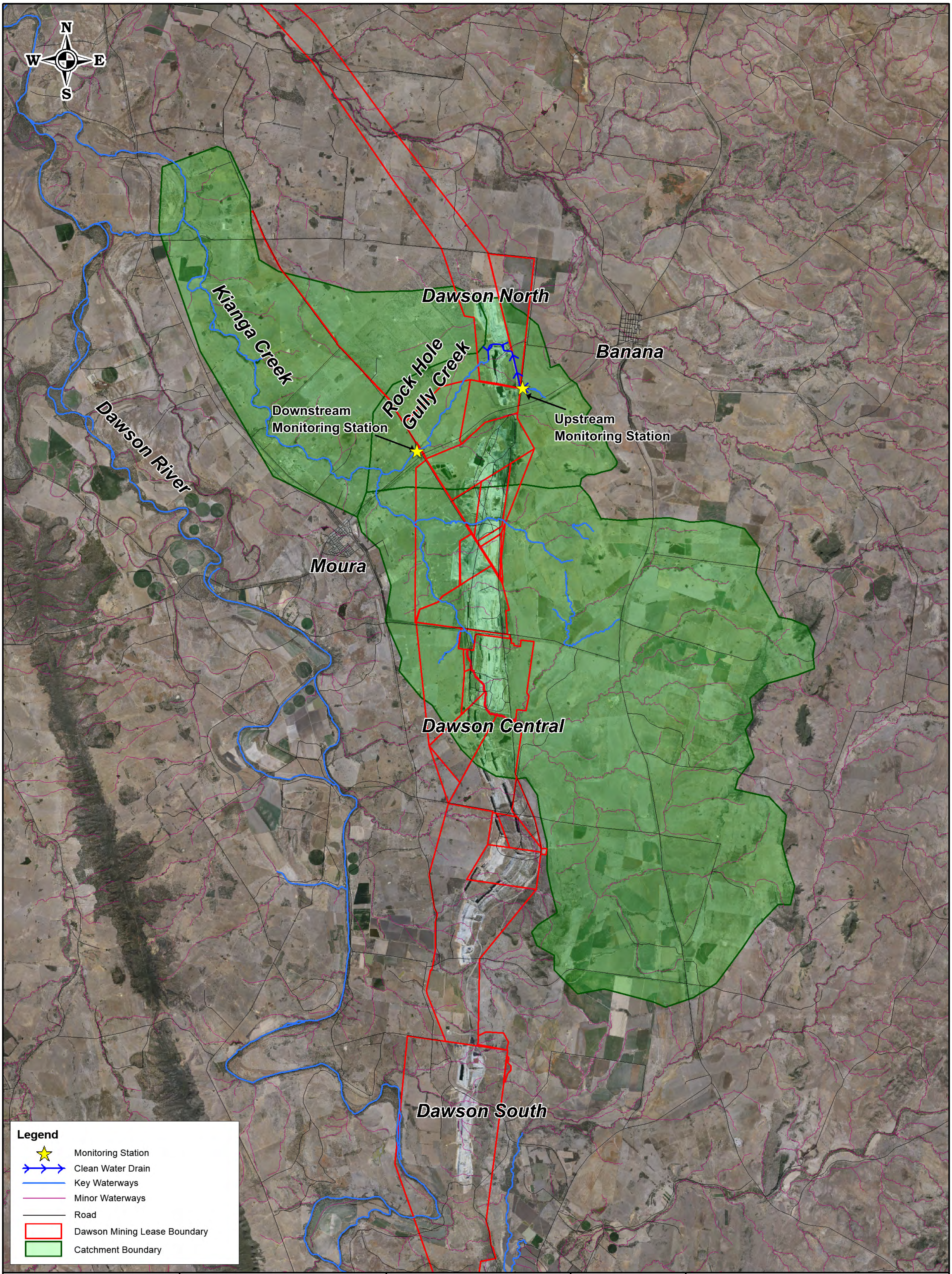
On 11 September 2017, Anglo Coal (Dawson) Limited received a notice from the Department of Environment and Heritage Protection (DEHP) to conduct an Environmental Evaluation relating to saline seepage from an out of pit dump within Dawson North.

Engeny Water Management (Engeny) was commissioned by Anglo Coal (Dawson) Limited to conduct the environmental evaluation report, including directly undertaking the site investigation, associated environmental sampling and field assessments and sub-contracting Terrestria Pty Ltd (Terrestria) to complete the assessments of the vegetation and ecological components. Both Engeny and Terrestria undertook a site visit on the 25th October 2017 with Anglo Coal (Dawson Management) Pty Ltd site personnel.

Dawson Central and Dawson North operate under EA EPML00565813 (May 2014), whereas Dawson South is operated under a separate EA. For the purposes of this report, references to 'Dawson Mine' refer to the Dawson North and Dawson Central Mine.

1.1 Background Overview

On the 21 June 2017, Dawson Mine site personnel were advised by their fencing contractors that they had observed salt crusting within the dry bed of Rock Hole Gully Creek near the boundary between Dawson ML5656 and a small section of freehold land owned by the holders of Dawson Mine (Lot 27 on FN187) that is not subject to the mining lease (Refer to the approximate location marked on Figure 1.4).



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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

DATE	15/11/2017	ANGLO COAL (DAWSON) LIMITED
DRAWN	JN	Dawson Mine Environmental Evaluation Locality Map Dawson Mine
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Upon investigation seepage water was observed to be discharging from the rehabilitated and non-rehabilitated spoil dumps at natural surface level and draining as surface flow from into the erosion and sediment control drainage system located immediately west of the Dawson North spoil dump. This source of water, despite there being no indication of sub-surface flows, is referred to as 'the seepage'.

There was a salt crust within this drain that indicated the seepage had entered the Clean Water Drain and drained into the natural downstream reaches of Rock Hole Gully Creek during periods of flow (Refer to Figure 1.2 and Figure 1.3).

Figure 1.2 (L to R) Seepage Water in Erosion and Sediment Control Drain (29/06/2017), Erosion and Sediment Control Drain Confluence with Clean Water Drain (29/06/2017)

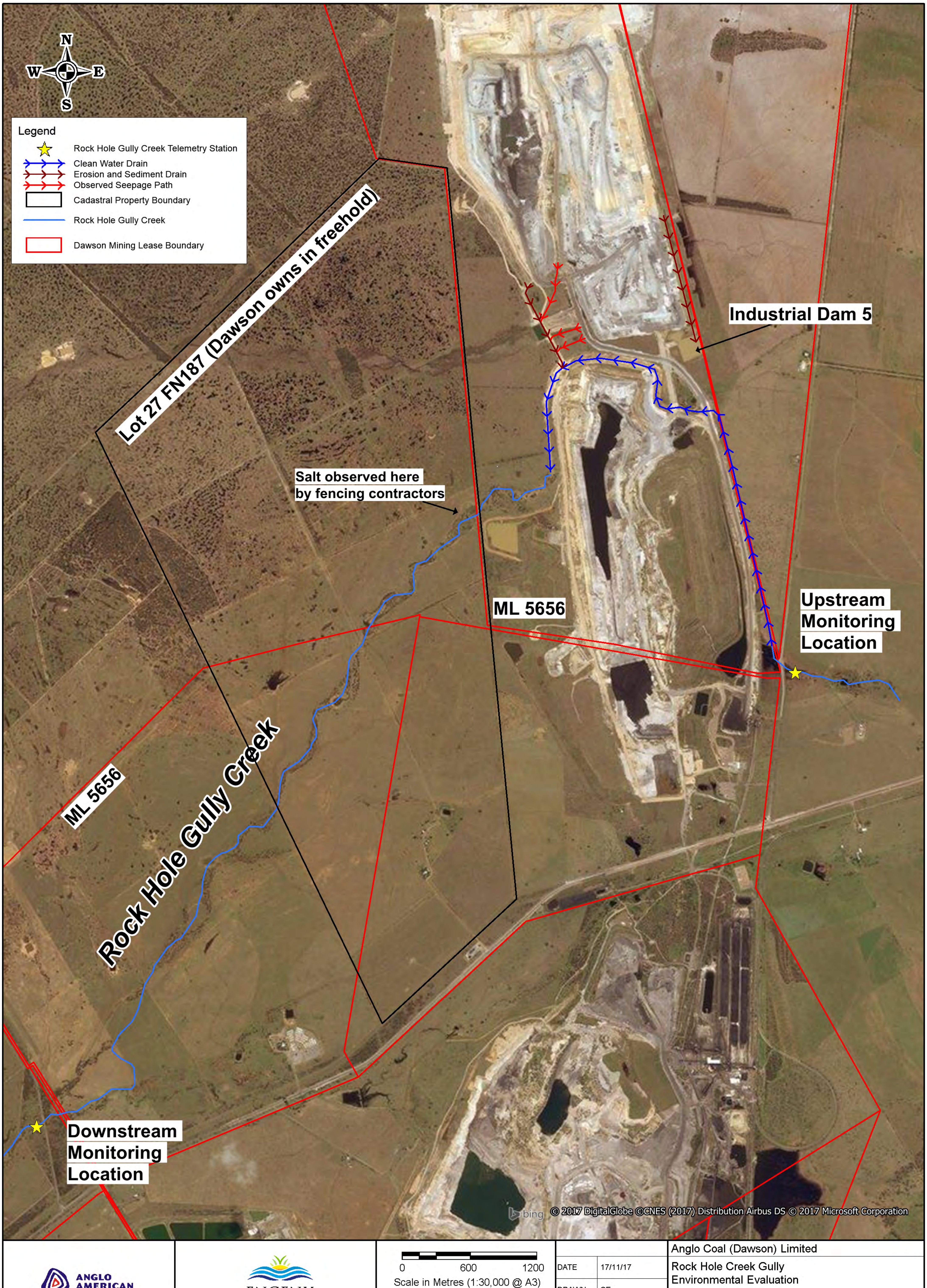
Dawson Mine site personnel took in-situ water quality probe readings from the stagnant spoil seepage pools at the base of the spoil dumps, and recorded elevated salinity with electrical conductivity (EC) readings of between 10,000 to 12,200 µS/cm. From these readings, it would be a reasonable assumption that the seepage pools had been evaporating for some considerable time, although this does not in itself indicate the exact period.

The salt crust was observed downstream for several hundred metres within the Rock Hole Gully Creek bed, across both Dawson mining lease ML5656 and a small section of Lot 27 on FN187 that is not covered by the mining lease, however is owned in freehold by Dawson Mine as buffer land. Dawson Mine has granted a licence to a neighbouring grazier to agist cattle on this freehold land. There was no salt crust observed at the Rock Hole Gully Creek Downstream monitoring station (Refer to Figure 1.3).


Figure 1.3 (L to R) ML5656 Boundary with Lot 27 on FN187 about 800m Downstream of Clean Water Drain (29/06/2017), Rock Hole Creek Gully Downstream Monitoring Station (29/06/2017)

Refer to Figure 1.4 for a visual overview of the seepage drainage.

On the 22nd of June 2017, the seepage drainage was reported to the Department of Environment and Heritage Protection (DEHP).



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Anglo Coal (Dawson) Limited

Rock Hole Creek Gully Environmental Evaluation Seepage Overview

A3 | Figure 1-4 | A

1.2 Environmental Evaluation Summary

On the 11th of September 2017, Dawson Mine received a notice from the DEHP to conduct an Environmental Evaluation under section 326B of the *Environmental Protection Act 1994.*

The report on the environmental investigation must address the following relevant matters:

1. Anglo Coal (Dawson) Limited must engage a suitably qualified person to conduct a site investigation as per the National Environment Protection (Assessment of Site Contamination) Measure as amended 2013 (ASC NEPM) (NEPC, 1999).

   The investigation must include:

   a) Identification of all sources of water seeping into Rock Hole Gully Creek from the Dawson North spoil dumps including both rehabilitated and non-rehabilitated areas;

   b) Identification of areas/locations of contamination caused by the water seeping from the Dawson North rehabilitated and non-rehabilitated spoil dumps; and

   c) An assessment of the level of impact the contamination has had on the soil, water ways and vegetation of the receiving environment. The assessment must contain a quantification of the impact represented in a kmz map format.

2. Anglo Coal (Dawson) Limited must engage a suitably qualified person to prepare a contamination action plan (CAP) which includes but is not limited to:

   a) Details of current risk controls used to mitigate soil and surface water contamination;

   b) Details of any additional mitigation measures that are required to manage or remediate contamination as a result of the water seepage, including proposed methods to monitor seepage; and

   c) Details of any procedural or structural changes that require implementation to reduce the risk of further soil and surface water contamination, including timeframes that the changes will be implemented.

1.2.1 Environmental Evaluation Conclusions Summary

Table 1.1 below summarises the conclusions of each requirement of the Evaluation Notice.

Table 1.1 Environmental Evaluation Outcomes Summary

Environmental Evaluation Notice Requirement	Conclusion
Identification of all sources of water seeping into Rock Hole Gully Creek from the Dawson North spoil dumps including both rehabilitated and non-rehabilitated areas	The source of the saline seepage was identified as the Dawson North out of pit spoil dump (both rehabilitated and non-rehabilitated areas). Refer to Section 2 for the assessment details.
Identification of areas/locations of contamination caused by the water seeping from the Dawson North rehabilitated and non-rehabilitated spoil dumps	The areas/locations were identified as extending from the out of pit spoil dump, along the Rock Hole Gully Creek waterway to the downstream monitoring station location on Rock Hole Gully Creek. Refer to Section 3 for the assessment details.
An assessment of the level of impact the contamination has had on the soil, water ways and vegetation of the receiving environment. The assessment must contain a quantification of the impact represented in a kmz map format	The assessment concluded the seepage has had a low-level of impact on the soils, water ways and vegetation of the receiving environment. Refer to Section 4 for the assessment details. A .kmz map file has been included with the submission of this report.
Details of current risk controls used to mitigate soil and surface water contamination	Dawson Mine have implemented a number of risk controls to prevent saline seepage draining into Rock Hole Gully Creek, the primary control being a seepage interception drainage system which directs seepage flows into a dedicated mine water storage. Ongoing natural flushing of Rock Hole Gully Creek as a result of future streamflow events will provide sufficient dilution to further reduce elevated salinities downstream of the Dawson North spoil dump Dawson Mine have installed shallow groundwater seepage monitoring bores immediately south and west of the out of pit spoil dump. A pump has been installed in Industrial Dam 5 to dewater stored water from Industrial Dam 5 into the seepage interception drainage system to be conveyed to the Dawson North void. The Dawson Mine water management plan has been updated to include monitoring of electrical conductivity (telemetry or in-situ probe readings) of flows entering the natural reach of Rock Hole Gully as soon as practicable after every flow event (when triggered by flow in the

Environmental Evaluation Notice Requirement	Conclusion
	downstream Rock Hole Gully Creek telemetry station) for at least one full wet season. The Dawson Mine water management plan has been updated to include a requirement for annual (pre wet season) reviews of water management practices associated with rehabilitated out of pit spoil dumps. The Dawson Mine Enablon Action Management System has been updated to include the scheduling of annual reviews as well as assignment to appropriate site personnel and tracking of the task completion.
Details of any additional mitigation measures that are required to manage or remediate contamination as a result of the water seepage, including proposed methods to monitor seepage	No additional mitigation measures are required to manage or remediate contamination as a result of the water seepage including proposed monitoring methods.
Details of any procedural or structural changes that require implementation to reduce the risk of further soil and surface water contamination, including timeframes that the changes will be implemented	No procedural or structural changes are required to reduce the risk of further soil and surface water contamination.

2. IDENTIFICATION OF SEEPAGE SOURCES

This section addresses the identification of all sources of water seeping into Rock Hole Gully Creek from the Dawson North spoil dumps including both rehabilitated and non-rehabilitated areas.

2.1 Description of Site

The Dawson mine is located in the Dawson Valley, at the southern end of the Bowen Basin in Central Queensland near the township of Moura, and approximately 150km south-west of Gladstone. The mine is located within the Fitzroy Basin and the Lower Dawson River Sub-basin.

The mining complex comprises three distinct operating areas: Dawson North, Central and South which are aligned in a north-south orientation over a distance of 50km.

Dawson North is located on the northern side of the Dawson Highway and consists of two (non-active) open cut pits (North (Top) Pit and Dawson North Pit) and adjacent rehabilitated and non-rehabilitated out of pit spoil dumps.

The site investigations and observations have indicated the source of the seepage is a portion of the out of pit spoil dump, adjacent to the North (Top) Pit void. This dump is referred to as the out of pit spoil dump.

Various structures for erosion and sediment control and water management have been implemented at Dawson North. A seepage collection drain has been constructed around the western and southern perimeter of the out of pit spoil dump directing the collected seepage into the dedicated mine affected water storage void (Refer to Section 8). This drain is referred to as the Seepage Interception Drain.

Another key feature of Dawson North is the clean water diversion of Rock Hole Gully Creek between the two pits. The clean water diversion flows in a westerly direction until the confluence with the natural downstream reach of Rock Hole Gully (Refer to Figure 1.4).

2.2 Laboratory Sample Program

To assist in identifying the saline seepage sources, samples of both the surface water and sediment profiles were taken from multiple affected and reference locations.

Figure 2.1 outlines the locations of the surface water and sediment samples taken. The location of sampling was influenced by the presence of surface waters at time of inspection. In the case of the upstream reference sites, Sample 2 was the most upstream location along the clean water drain with water present within the channel.

The most downstream sampling location (Sample 7) was assigned based on in-field EC test results being below those from nominated upstream background sites as well as there being no observed salt crusting or impact to vegetation beyond this point.

It should also be noted that water within the Sediment Dam and Seepage Interception Drain are not part of the Clean Water Drain / Rock Hole Gully Creek system and have been adopted as reference samples of spoil dump runoff and spoil dump seepage respectively.

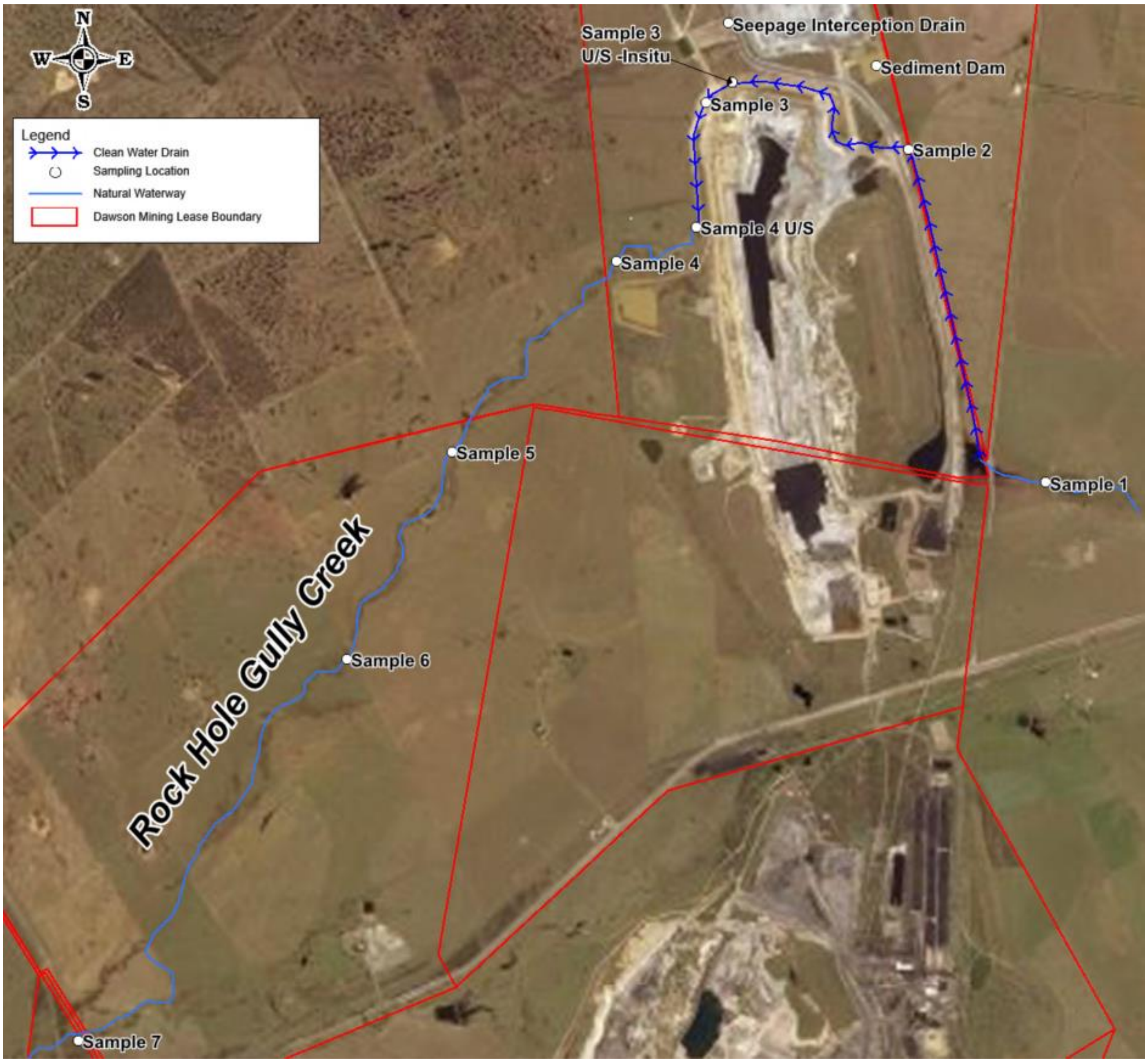


Figure 2.1 Sample Locations for Sampling Program

The electrical conductivity results of the sampling program will be analysed, in combination with the site observations, to confirm the source of saline seepage.

Figure 2.2 below graphs the EC results of the surface water samples taken as part of the sampling program. It can be seen that the EC decreases the further downstream samples are taken along Rock Hole Gully Creek.

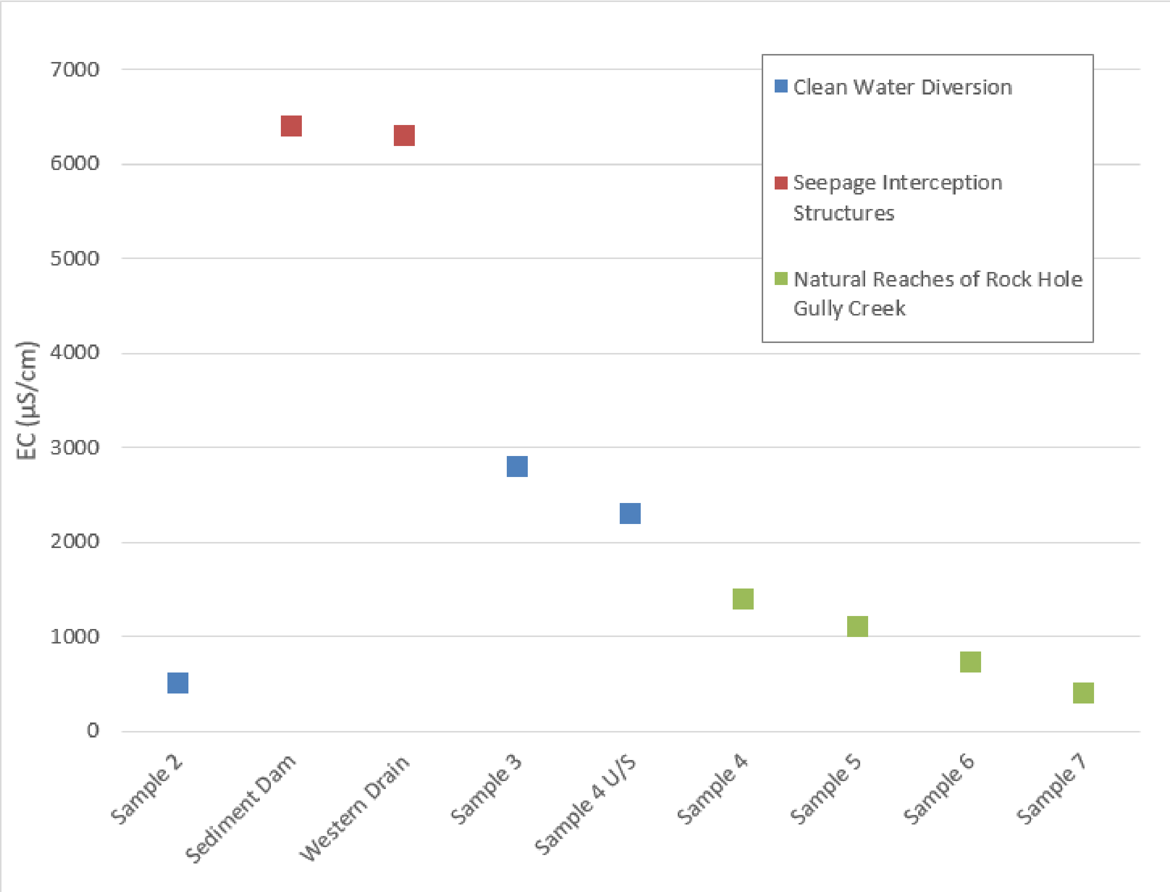


Figure 2.2 Electrical Conductivity Results for Surface Water Grab Samples

Figure 2.3 below graphs the EC results of the sediment samples taken as part of the sampling program.

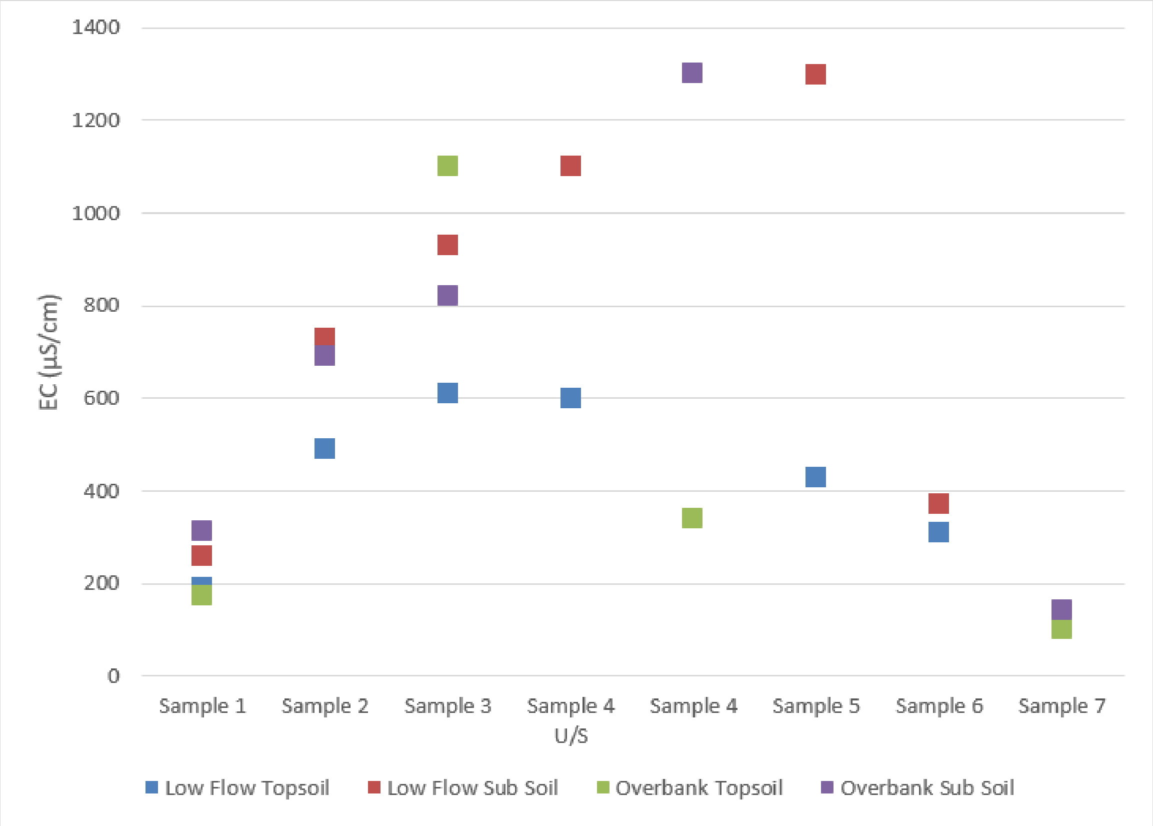


Figure 2.3 Electrical Conductivity Sediment Sample Results

The samples with the highest salinity concentration are located in close proximity to the out of pit spoil dump. The trend then generally decreases and the resultant EC is equal to or less than the upstream (Sample 1) EC by Sample 7 at the downstream monitoring station location.

Both the surface water and topsoil sediment results returned the highest electrical conductivity concentrations at the locations closest to the spoil dump (Sample 3). In comparison the reference sites (Sample 2 and Sample 1) did not return high salinity concentrations. In addition, the insitu EC reading taken at Sample 3 U/S did not indicate elevated EC, indicating the seepage has historically drained into Rock Hole Gully Creek via the western erosion and sediment control drain of which the confluence is located between the two sample locations.

2.3 Dawson North Topography

A review of the topography and elevations of the out of pit spoil dump confirms that the natural grade of Dawson North drains from east to west (Refer to Figure 2.4)

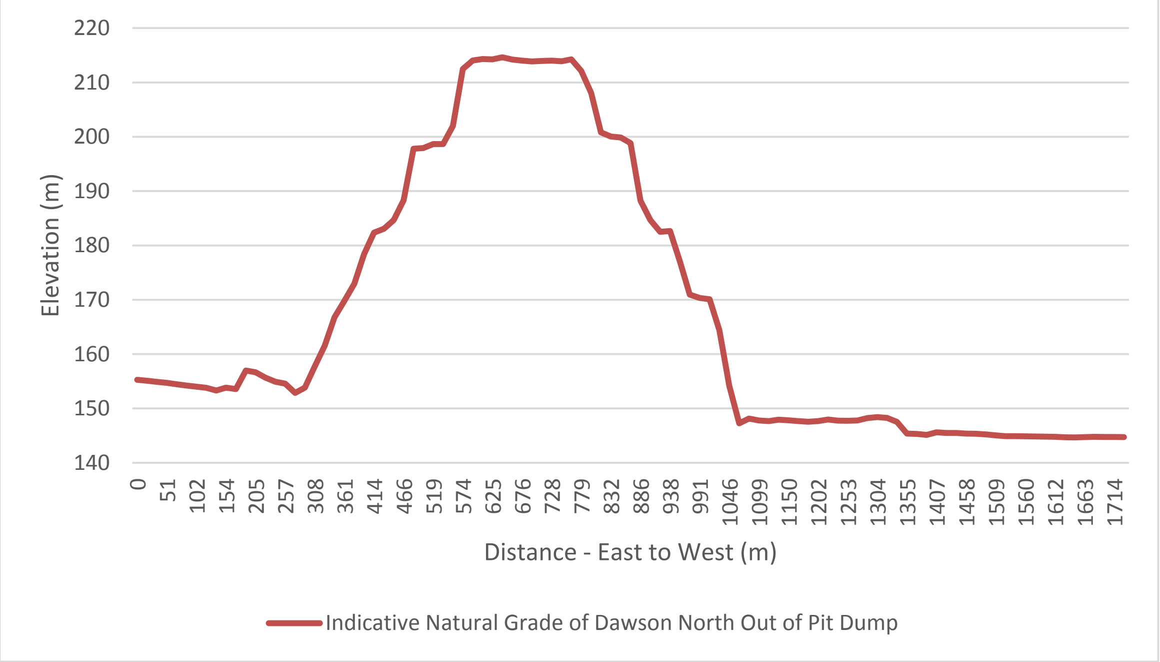


Figure 2.4 Indicative Natural Topography Grade of Dawson North Spoil Dump

2.4 Summary of Seepage Sources

Both the sampling program results and review of the site topography indicate the source of the saline seepage is the Dawson North out of pit spoil dump.

The observed seepage from the out of pit spoil dump is a result of rainfall infiltration into the dump which has then been expressed as seepage at the interface between the natural surface and the western toe of the dump (i.e. the perimeter of the dump with the lowest elevation).

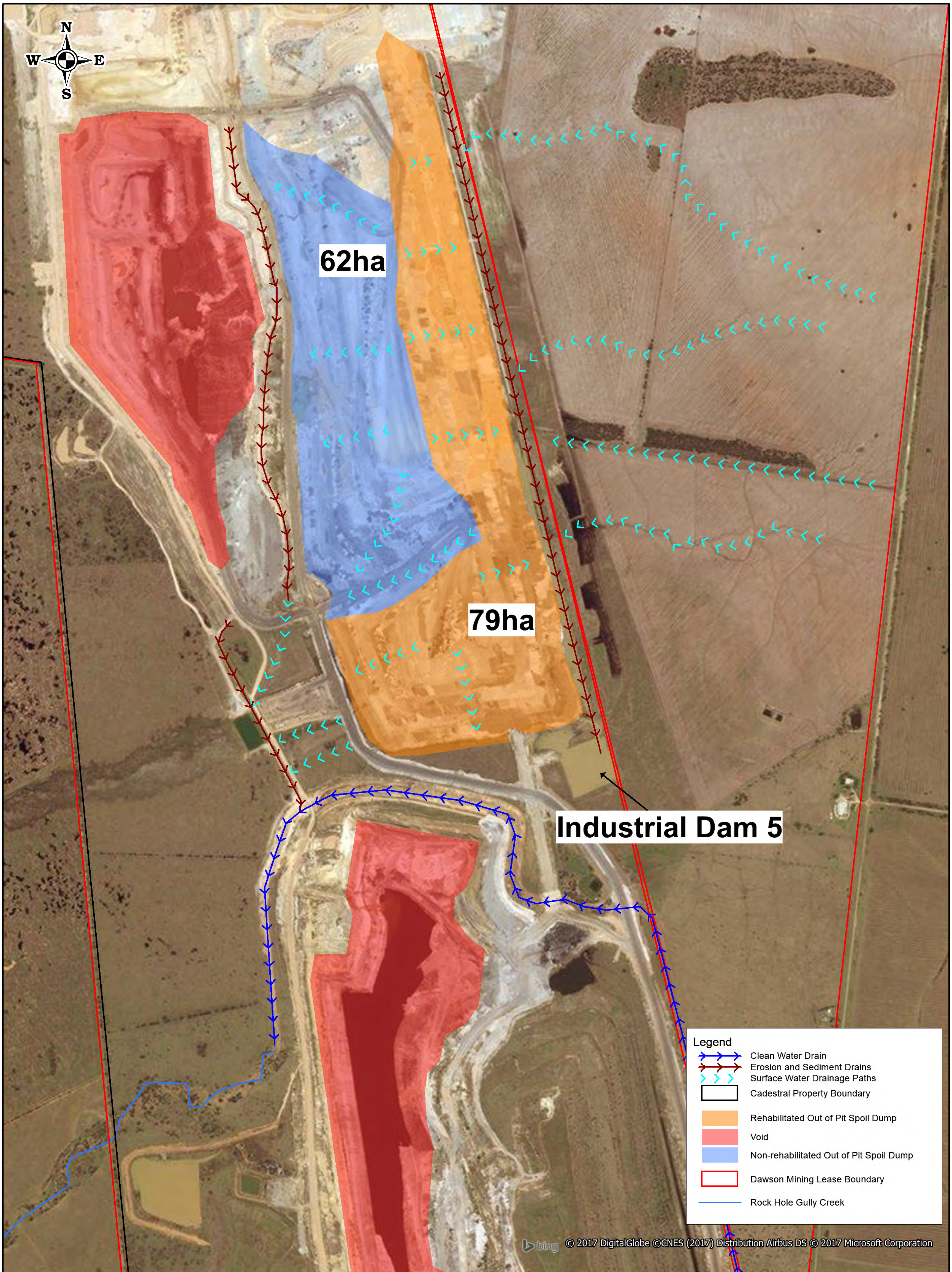
Site investigations confirmed no seepage was observed below natural surface level at the toe of the dump and as such it can be confirmed that the seepage does not originate from groundwater sources.

The portion of the out of pit spoil dump catchment that has contributed to the seepage into the erosion and sediment control drains and into the natural reach of Rock Hole Gully Creek consists of both rehabilitated and non-rehabilitated land-use areas.

It is not possible to quantify the seepage retrospectively from the individual land-use areas (i.e. rehabilitated or non-rehabilitated).

It should be noted that while the historical EC data recorded at the downstream Rock Hole Gully monitoring station cannot be directly correlated to the identified seepage source, there is no evidence of any additional primary contaminant sources within the catchment or from upstream.

Figure 2.5 displays the contributing catchment areas for both the rehabilitated and non-rehabilitated areas as well as the drainage pathways for the dump seepage.



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Scale in metres (1:15,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

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DRAWN	SE	Environmental Evaluation Identification of Seepage Sources Out of Pit Spoil Dump	
JOB NO.	M30000_037	A3 Figure 2-5	A

3. IDENTIFICATION OF LOCATIONS IMPACTED

This section addresses the identification of areas/locations of contamination caused by the water seeping from the Dawson North rehabilitated and non-rehabilitated spoil dumps.

3.1 Description of Receiving Environment

3.1.1 Receiving Environment Waterways

In order to work out a sampling program to ascertain the areas impacted, it is first necessary to identify the waterways downstream of the Dawson North erosion and sediment control drainage structure, from which the seepage water was released. After the area of impact has been identified in this section, the environmental values of the relevant impacted area are addressed in Section 4 of this report.

Rock Hole Gully Creek

Rock Hole Gully Creek enters the Dawson Mine mining lease from the east and is then diverted around and through Dawson North in a clean water drain until the confluence with the natural downstream reach of the creek (Refer to Figure 1.4). It has an upstream catchment of approximately 10km^2. Rock Hole Gully Creek continues to flow in a south-west direction for approximately 9km before the confluence with Kianga Creek just after the Dawson Highway Crossing.

The seepage first entered Rock Hole Gully Creek within ML5656, and then the gully traverses a small section of Lot 27 on FN187 that is not covered by the mining lease, but which is owned in freehold by Dawson Mine as buffer land. The owners of Lot 27 on FN187 are Anglo Coal (Dawson) Limited and Mitsui Moura Investments Pty Ltd and the land is agisted to a neighbouring grazier. After passing through this small section of land not subject to the mining lease, Rock Hole Gully Creek re-enters the mining lease. It then remains within the mining lease for the whole of its remaining length until the boundary with Moura-Baralaba Road, next to which the downstream monitoring point is accessed.

Rock Hole Gully Creek is an ephemeral waterway with no baseflow during the dry season. Rock Hole Gully Creek is not mapped as a Watercourse under the *Water Act 2000* (Qld Government, 2017).

Kianga Creek

Kianga Creek continues beyond the confluence with Rock Hole Gully Creek for approximately 23km to the confluence with the Dawson River. Kianga Creek is an ephemeral waterway with no baseflow during the dry season.

Most of Kianga Creek is mapped as a recognised Watercourse as defined by the *Water Act 2000* (Qld Government, 2017).

Dawson River

The Dawson River is a nominated receiving waterway for mine affected releases from Dawson Mine.

3.2 Conceptual Site Model

The National Environment Protection (Assessment of Site Contamination) Measure (NEPM) indicates that a conceptual site model (CSM) is an essential part of a site assessment to assist in the identification of sources of contamination and potential receptors that may be exposed.

The source of the seepage has been identified in Section 2 of this report as the Dawson North out of pit spoil dump (both rehabilitated and non-rehabilitated areas).

Based on the features and uses of the receiving environment (discussed further in Section 4 of this report), a CSM has been developed for the drainage of seepage water into Rock Hole Gully Creek from this primary source (Refer to Figure 3.1).

The CSM outcomes were used to guide the development of the sampling program and analysis required to define the extent of contamination and assess the potential impacts of the seepage from the primary contamination source.

The CSM identified two secondary sources of contamination from the seepage; the affected downstream surface waters and the soils/sediment of the Rock Hole Gully Creek waterway.

The CSM then identified the receptors that must be considered in the site investigation and assessed in terms of their exposure and level of potential impact.

In this regard, it was noted that the grazier agisting cattle on the small section of Lot 27 on FN187 has entered an agreement that cattle are agisted there at the commercial risk of the grazier and that this land is owned by Dawson North and Central Coal Mine primarily as buffer land. However, further downstream, the sampling program was designed to consider any potential impact from:

- Contaminated surface waters on downstream water users, for example: stock watering.
- Contaminated soils and/or sediment on any protected riparian vegetation and any land uses downstream of land owned by Dawson North and Central Coal Mine or subject to the mining lease.

Details of downstream land uses and environmental values considered when working out the CSM have not been duplicated in this part, as they are addressed in Section 4.

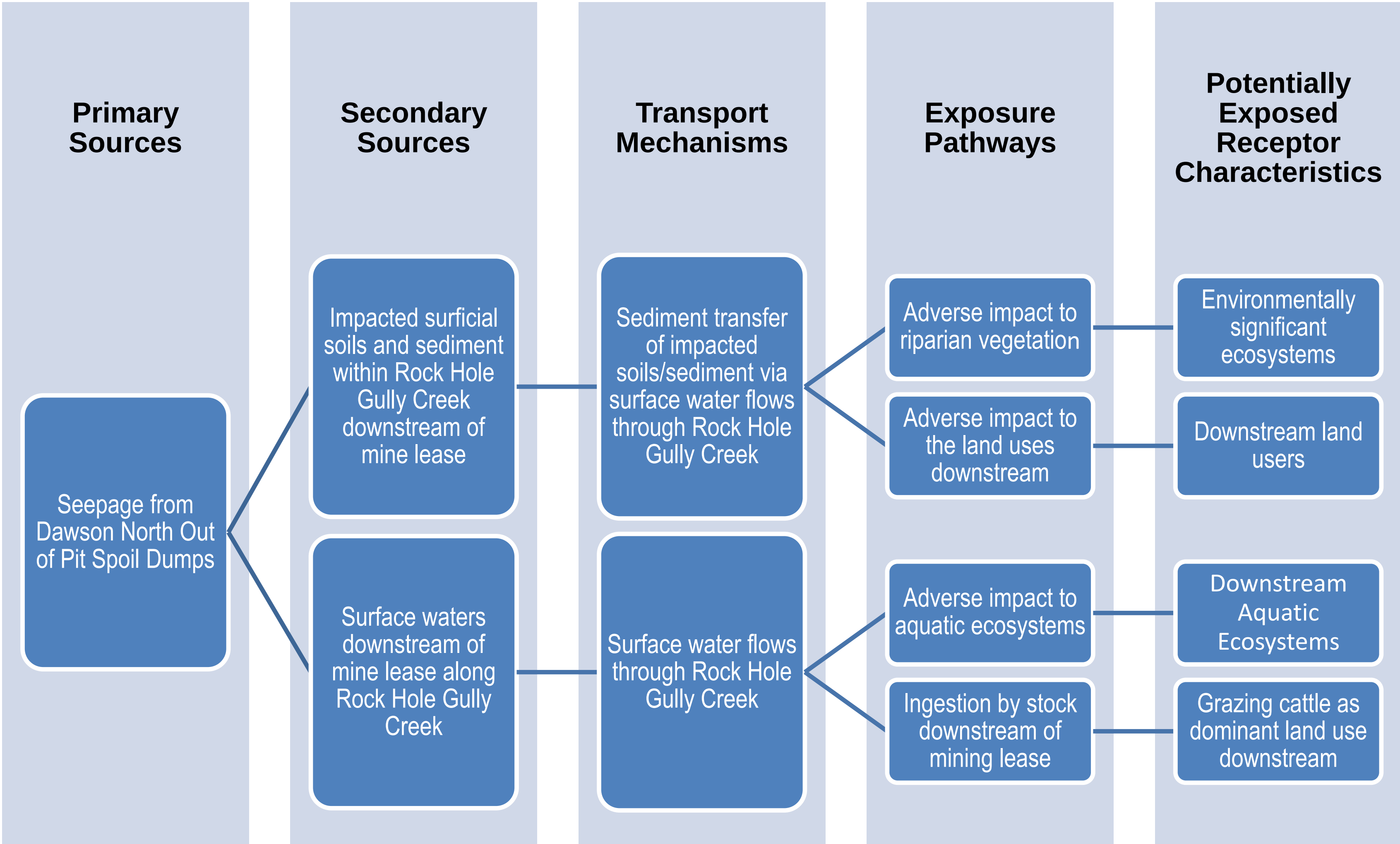

Figure 3.1 Conceptual Site Model for the Seepage Drainage into Rock Hole Gully Creek

3.3 Waterways Sampling and Analysis

The results of the sampling program for the site investigation were analysed to assist in the determination of the locations and extent of influence from the saline seepage.

Table 3.1 outlines the sampling program for surface water including locations both up and downstream of the seepage entering the Rock Hole Gully Creek. The analysis suite was assigned to encompass all relevant analytes for comparison against available relevant water quality guidelines.

Table 3.1 Surface Water Sampling Program

Sample ID	Sample Location	Sample Analysis
Sample 1	Upstream of Clean Water Drain and mining influence	Nil – site dry
Sample 2	Clean Water Drain upstream of disturbed mining catchment (Reference Sample)	pH (insitu and lab) Electrical Conductivity (insitu and lab) Total Dissolved Solids (insitu) Turbidity Total Suspended Solids Nutrients (Nitrate, Nitrite, Ammonia) Sulphate Fluoride Total and Dissolved Metals (Ag, Al, As, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Se, U, V, Zn and Mercury) Petroleum Hydrocarbons
Sediment Dam	Sediment dam (Industrial Dam 5) located on the south-eastern corner of the out of pit dump	
Seepage Interception Drain	Seepage trench, along the western toe of out of pit dump	
Sample 3	Clean Water Drain downstream of confluence with erosion and sediment control drain	
Sample 4 Upstream	At confluence of Clean Water Drain with natural downstream reach of Rock Hole Gully Creek	
Sample 4	Rock Hole Gully Creek upstream of mining lease boundary	
Sample 5	Downstream Rock Hole Gully Creek about 1.5km from mining lease boundary	
Sample 6	Downstream Rock Hole Gully Creek about 3km from mining lease boundary	
Sample 7	Downstream Rock Hole Gully Creek at downstream monitoring station location	
Sample 3 Upstream	Clean Water Drain upstream of confluence with erosion and sediment control drain	pH (insitu) Electrical Conductivity (insitu) Total Dissolved Solids (insitu)

At each surface water sampling location, sediment samples were also taken in accordance with Table 3.2. Where clearly defined by the channel geometry, Low Flow Channel samples were taken from within the low flow channel of the waterway and Overbank samples were taken from the high bank. Sediment samples were taken from both the topsoil and subsoil layers at each location.

Table 3.2 Sediment Sampling Program

Sample Location	Sediment Sample ID	Sample Analysis
Sample 1	1/1 Topsoil Low Flow Channel	pH Electrical Conductivity Fluoride Metals (Ag, Al, As, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Se, U, V, Zn and Mercury)
	1/1 Subsoil Low Flow Channel	
	1/1 Topsoil Overbank	
	1/1 Subsoil Overbank	
Sample 2	1/2 Topsoil Low Flow Channel	
	1/2 Subsoil Low Flow Channel	
	1/2 Topsoil Overbank	
	1/2 Subsoil Overbank	
Sample 3	1/3 Topsoil Low Flow Channel	
	1/3 Subsoil Low Flow Channel	
	1/3 Topsoil Overbank	
	1/3 Subsoil Overbank	
Sample 4 Upstream	1/4 US Topsoil Low Flow Channel	
	1/4 US Subsoil Low Flow Channel	
Sample 4	1/4 Topsoil Overbank	
	1/4 Subsoil Overbank	
Sample 5	1/5 Topsoil Low Flow Channel	
	1/5 Subsoil Low Flow Channel	
Sample 6	1/6 Topsoil Low Flow Channel	
	1/6 Subsoil Low Flow Channel	
Sample 7	1/7 Topsoil Overbank	
	1/7 Subsoil Overbank	

All surface water and sediment samples were taken on the 25th October 2017. Full laboratory results of the surface water and sediment samples can be found in Appendix C.

The EC for both the sediment and surface water samples at the Sample 7 location (downstream Rock Hole Gully Creek monitoring station) were found to be at or below the upstream reference values (Refer to Table 3.3).

Table 3.3 Electrical Conductivity Analysis of Surface Water and Sediment Samples

Sample Type	Sample 1	Sample 2	Sample 7
Surface Water	n/a	510 µS/cm	400 µS/cm
Sediment	170-310 µS/cm	490-690 µS/cm	100-140 µS/cm

These results indicate that the Sample 7 location (Downstream Rock Hole Gully Creek monitoring station) is representative of the extent of any influence from the saline seepage.

3.4 Vegetation and Soils Field Assessment and Analysis

3.4.1 Vegetation and Soils Assessment Methodology

An on-the-ground vegetation survey was also conducted by Terrestria on the 25th October to assess the potential impacts of the seepage event on the vegetation downstream of Dawson North Mine.

A desktop database review was used to identify sites for ground survey. Sites were selected to survey the extent of the downstream waterway and to provide upstream control sites on Rock Hole Gully Creek and nearby adjoining waterways (Refer to Figure 3.2).

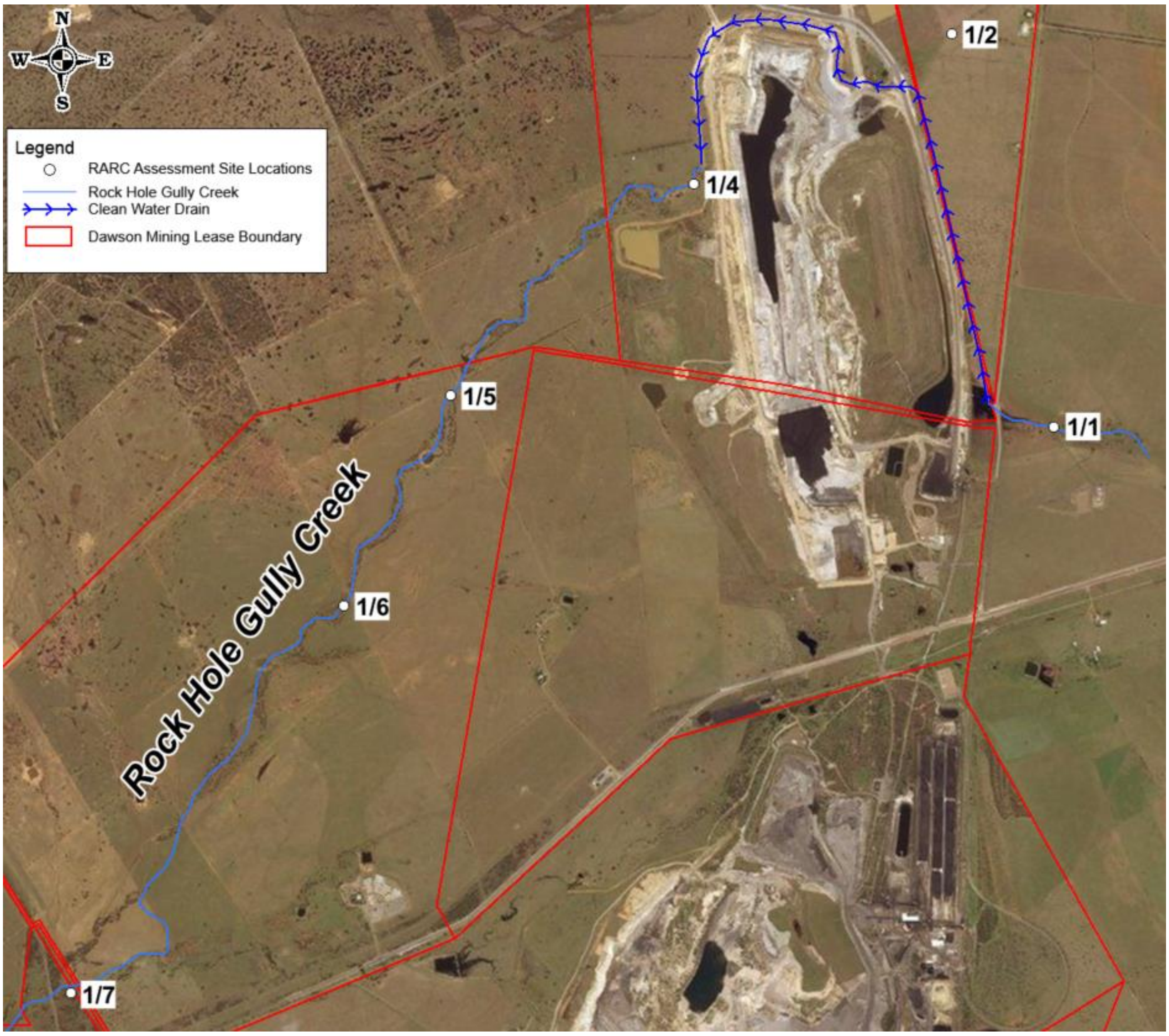

Figure 3.2 Map of RARC Assessment Site Locations

The Rapid Appraisal of Riparian Condition (RARC) assesses the ecological condition of riparian habitats using indicators that reflect functional aspects of the physical, community and landscape features of the riparian zone.

The RARC index is made up of five sub-indices, each with a number of indicators: Habitat continuity and extent (HABITAT), Vegetation cover and structural complexity (COVER), Dominance of natives versus exotics (NATIVES), Standing dead trees, hollows, fallen logs and leaf litter (DEBRIS), and Indicative features (FEATURES).

The RARC methodology was applied at six localities, including four sites along the downstream waterway (sites 1/4 (nearest to the seepage source), 1/5, 1/6 and 1/7) and two upstream sites were studied as control sites; site 1/1 and site 1/2). At each site a 100m transect was included within the RARC framework. At five of these sites a detailed analysis of cover by layer was undertaken. Site 1/3 is situated on constructed clean water drain with no vegetation and was not assessed as part of this process.

The RARC methodology was extended in this instance by adding cover analysis (point intercept method) for each vegetation strata to the 100 transect surveyed using the RARC methodology.

3.4.2 Analysis of Data

In general, all the riparian sites were characterised by patchy occurrences of regrowth brigalow *Acacia harpophylla* over highly disturbed shrub and ground layers. All sites have been disturbed by historical land clearing practises and are currently impacted by cattle grazing.

All surveyed sites were in poor to very poor condition, including the control sites (Refer to Table 3.4 and Figure 3.3). The RARC methodology assigns a condition score out of 50 with 50 being a pristine site. The highest score in the current survey was Site 1/7 (30) and the lowest Site 1/5 (11.75). All site data can be found in Appendix D.

Site 1/7 had a notably higher RARC score and was found to be floristically quite different from the other sites, being dominated by Black tea tree *Melaleuca bracteata* with emergent River red gum *Eucalyptus camaldulensis*. This site was also situated on a wider low flow channel and was contiguous with nearby remnants.

Site 1/4 was located within the mining lease and in reasonably close proximity to the seepage source however scored higher (18.25) than all other surveyed sites, with the exception of Site 1/7. This site was notably different in the number of standing dead trees and fallen logs. Six standing dead trees <20cm diameter at breast height (DBH) and 5 >20cm DBH were recorded at Site 1/4 while other sites contained only one or two. The incidence of fallen logs was also higher at Site 1/4 than all other sites. (It is noted that Engeny has been advised by Dawson Mine that there have been fallen dead trees and logs within this area (and other areas of the mining lease) for a considerable period.)

Cover by layer indicates that the Tree 1 layer at Site 1/4 (10.2%) is notably lower than at other surveyed sites, however the overall results indicate that within the context of the wider landscape Site 1/4 is of equal or better condition than the average.

The conductivity results of the sub-soil sediment sampling (20-30cm below surface) at Sites 1/4 and 1/5 (1300µS/cm) are elevated above background and correlate with canopy tree dieback at Site 1/4. It should be noted however that this site is mapped as non-remnant vegetation and is within the Anglo Coal (Dawson) Limited ML5656. No canopy tree dieback was observed at Site 1/5.

It is also evident that the subsoil samples of both the low flow channel and the overbank returned higher EC results than the topsoil. The lower salt concentrations within surface sediment samples (0 – 20cm) suggest that salts have been leached from the surface by recent rain events. This is supported by the lack of visible efflorescence within the creek channel and lack of ground vegetation scalding (Terrestria, 2017b).

Table 3.4 Summary of RARC and Cover Transect Data

Site	RARC condition score	Cover by layer (100m transect)
1/1	15.25	T1= 41.9%
1/2	14.5	E= 7.7%
		T1= 28.6%
1/4	18.25	T1 = 10.2%
		S1= 22.5%
1/5	11.75	NA
1/6	13.5	T1= 39.9%
1/7	30	E=16.2%
		T1= 36.9%
		S1= 1.6%

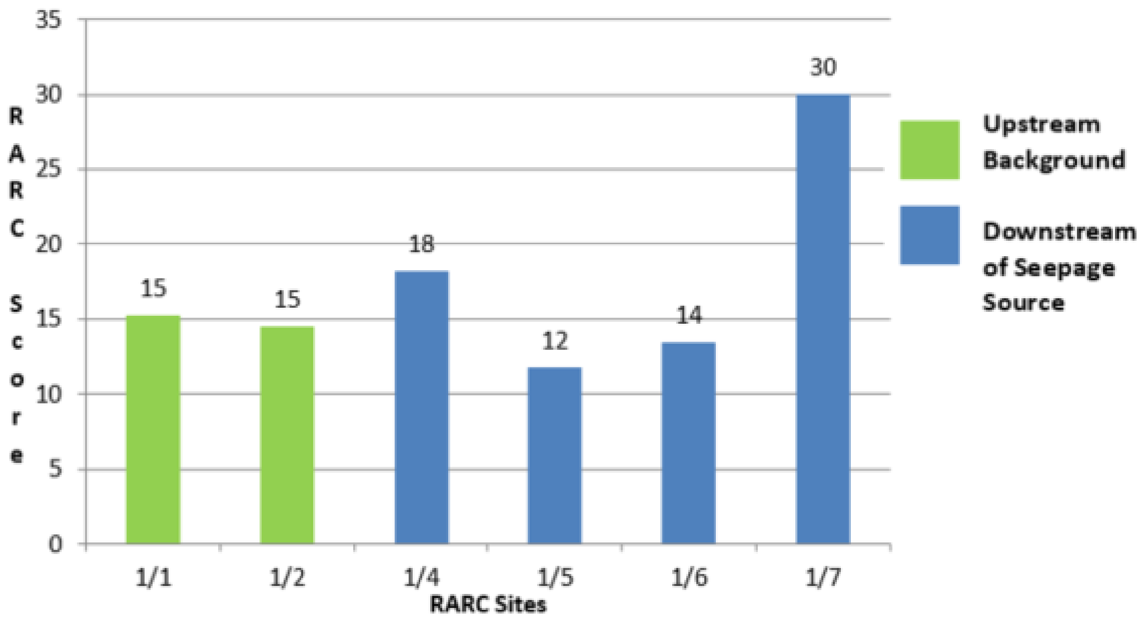

Figure 3.3 RARC Scores for Sites Along Rock Hole Gully Creek (Terrestria, 2017b)

3.5 Summary of Locations or Areas Affected by Seepage

Based on the review of the sampling program results and vegetation assessment, it can be concluded that the area of influence from the saline seepage extends from the out of pit spoil dump, along the Rock Hole Gully Creek waterway to the downstream monitoring station location on Rock Hole Gully Creek. This area is referred to as the area of influence.

4. ASSESSMENT OF LEVEL OF IMPACT

4.1 Introduction

This section addresses the assessment of the level of impact the contamination has had on the soil, water ways and vegetation of the receiving environment.

The Environmental Evaluation notice requires a site investigation in line with the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM) as amended 2013. Schedule A of Volume 1, outlines the general process for assessment of site contamination which has been adapted as per Table 4.1 to develop the framework of the site investigation for the Environmental Evaluation and assessment of level of impact.

Table 4.1 Adaption of NEPM General Process for Assessment of Site Contamination for Environmental Evaluation

Step	Tier 1 Preliminary Site Investigation (NEPM, 2013)	Site Investigation for Environmental Evaluation	Relevant Section
1	Preliminary investigation and laboratory analysis	Background overview	Section 1.1
		Description of the site and receiving environment	Section 2.1 and Section 3.1
		Develop a sampling program and determine associated criteria based on the environmental values and land uses of the identified area of influence	Section 2.2, Section 3.3 and Section 4.2
2	Develop conceptual site model (CSM)	Develop a CSM to identify all sources of contamination and associated potential impacts. The CSM will ensure the site investigation addresses all potential receptors and exposure pathways.	Section 3.2 and Section 4
3	Analyse investigation levels against levels for exceedances against intended land use	Analyse the level of impact to surface waters based on the laboratory results against the associated criteria and water quality guidelines for the relevant environmental values and/or land uses of the area of influence	Section 4.2
		Analyse the level of impact to soils and vegetation based on the laboratory results and field inspections against the associated criteria and guidelines for the	Section 4.3 and Section 4.4

Step	Tier 1 Preliminary Site Investigation (NEPM, 2013)	Site Investigation for Environmental Evaluation	Relevant Section
		relevant environmental values and/or land uses of the area of influence	
4	Where there are exceedances, develop risk-based remediation strategies. If sufficient information is not available to develop these strategies further analysis/investigation is required	Develop a Contamination Action Plan which will outline all preventative and mitigative actions..	Section 5

4.2 Assessment of Impact to Waterways

In line with the site investigation framework and in accordance with the NEPM and Environmental Evaluation, it is necessary to quantify whether the saline seepage has had a measurable impact on the waterways of the receiving environment within the identified area of influence.

The NEPM's general process for assessment of site contamination refers to the comparison of laboratory sample results with 'screening levels'. The determination of what 'screening levels' apply, is dependent on the receiving environment, associated environmental values and downstream water and land uses.

4.2.1 Environmental Values

Matters of National Environmental Significance

Matters of National Environmental Significance (MNES) are those natural matters given statutory protection under *Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act), including (DEHP, 2013a):

- World Heritage Areas properties listed for natural values.
- National Heritage Areas places listed for natural values.
- Wetlands of international importance (listed under the Ramsar convention).
- Migratory species (protected under international agreements).
- Listed threatened species.
- Listed threatened ecological communities.
- Great Barrier Marine Park.
- Commonwealth marine areas.

Use of the Australian Government Department of the Environment Protected Matters Search Tool (2014) indicates that there are no matters of national environmental significance within the area of influence.

It is noted that Dawson North was developed before the commencement of the EPBC Act and consequently it is exempted under Section 43A or 43B of the EPBC Act, in relation to the areas subject to the mining lease. It is noted that the small section of freehold land owned by Dawson North and Central Coal Mine, located between two sections of the mining lease, has also been used as a mine buffer and for grazing purposes continuously since before the commencement of the EPBC Act and consequently is also exempted. There is only a very small area of Rock Hole Gully Creek that is between the furthest boundary of the mining lease and the downstream monitoring station, which is not exempted from the EPBC Act.

Downstream Water Users

There is one known water licence for the impoundment of water along Kianga Creek just downstream of the confluence with Rock Hole Gully Creek. This licence is outside of the defined area of influence and is therefore not expected to have been impacted by the seepage. In addition, Kianga Creek's catchment is approximately 9 times larger than Rock Hole Gully Creek's and therefore any water impounded as authorised under the licence will be significantly diluted by Kianga Creek stream flows. However, the existence of this water licence was taken into account when developing the CSM.

Environmental Values

Environmental values (EVs) for the Lower Dawson River sub-basin of the Fitzroy River catchment have been determined by the Queensland Government (DEHP, 2011). The Plan showing the EVs identified for the Lower Dawson River sub-basin is included in Appendix B. The surface water EVs identified for the undeveloped parts of the Dawson River sub-basin are:

- Aquatic ecosystems
- Stock water
- Human consumer
- Primary recreation
- Secondary recreation
- Visual recreation
- Drinking water
- Cultural & Spiritual Values.

Developed areas of the Lower Dawson main channel (regulated reaches) and Eastern Tributaries have additional EV's as listed below:

- Irrigation
- Farm Supply
- Aquaculture
- Industrial Use

However, the area of influence has been identified in Section 3 of this report as not extending to the Dawson River main channel and consequently, when analysing impacts in this Section, those environmental values are not relevant.

The area of influence was identified in Section 3 as extending not further than the downstream monitoring station for Rock Hole Gully Creek. Consequently, the applicable Environmental Values for this area of influence are aquatic ecosystems and stock water.

However, when analysing the extent of impacts, as opposed to working out the area of influence, it is noted that the only stock located within the area of influence are on land owned in freehold by Dawson North and Central Coal Mine and leased to a neighbouring grazier, at the commercial risk of the grazier.

When working out the CSM for the purpose of identifying the area of influence (as opposed to the extent of impacts), it was also necessary to have regard to land uses and Environmental Values in Kianga Creek, in case the area of influence had extended into Kianga Creek. Stock may have access to this waterway and there are some water licences and farm dams associated with Kianga Creek flows. Most of Kianga Creek is mapped as a recognised Watercourse as defined by the Water Act 2000 (Qld Government, 2017) and is mapped as a Matter of State Environmental Significant watercourse.

When working out the CSM to determine the areas/locations affected, the consideration of land uses and Environmental Values was impartial to any potential impact being assessed as trivial or authorised, but rather the associated water quality guidelines can be used as a guide to define the area of influence and assess the potential level of impact to the soils, vegetation and waterways within the area of influence.

There are no High Ecological Value waters within the area of influence.

4.2.2 Relevant Screening Levels

Based on the land uses of the area of influence and environmental values, it is most applicable to assess the results of the sampling program against the available and relevant water quality objectives and water quality guidelines outlined in Table 4.2.

This comparison is not intended to imply that the seepage and any associated flows should have met or are required to have met any thresholds within the nominated guidelines/legislation, but rather they are used as a guide to assess the potential level of impact to the waterway (Rock Hole Gully Creek), soils and vegetation within the area of influence.

Table 4.2 Relevant Legislation and Guidelines for Laboratory Screening Levels

Legislation / Guideline	Applicable Water Quality Guidelines	Justification
Environmental Protection (Water) Policy 2009 - Dawson River Sub-basin Environmental Values and Water Quality Objectives	• Aquatic Ecosystem Water Quality Objectives for the Lower Dawson River Sub-basin moderately disturbed waters • Toxicants in water and sediment as per ANZECC Guideline (see below) for all freshwaters • Stock Watering Water Quality Objectives (sourced from ANZECC)	The water quality objectives for the Lower Dawson River sub-basin provide relevant water quality targets to maintain a level of quality that has been determined as sufficient for the aquatic ecosystem of the area as well as thresholds for agricultural use. As the most relevant Environmental Values for this site investigation have been determined to be Aquatic Ecosystems and Stock Watering, these thresholds will be compared to the laboratory results to guide the assessment of potential environmental harm.
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) 2000	• Water Quality Guidelines for Toxicants – Sediment quality guidelines • Primary Industries – Livestock Drinking Water Quality (cattle where applicable)	
Dawson Mine Environmental Authority (EPML00565813)	Release limits for mine affected water (Table F2 and F4) and receiving water trigger levels (Table F5)	The EA for Dawson Mine is a site-specific document that contains approved water quality release limits for mine affected water. Whilst seepage may not necessarily meet this definition, the water quality limits provide a useful comparison tool for assessing potential environmental harm.

4.2.3 Aquatic Ecosystem

Surface Water Quality

Table 4.3 outlines the laboratory results of the surface water sampling program and compares them to the associated EA limits and WQO / ANZECC Guideline trigger values.

Table 4.3 Laboratory Water Quality Results against Dawson River WQO and Site EA Release Limits

Analyte	Dawson Mine EA Mine Lease Release Limit	Dawson River WQO / ANZECC Trigger Value	Grab Sample Results								
			Sample 2	Sediment Dam	Seepage Interception Drain	Sample 3	Sample 4 U/S	Sample 4	Sample 5	Sample 6	Sample 7
Electrical Conductivity (µS/cm)	Between 1500-5000 (depending on receiving water flows)	340 (baseflow) 210 (highflow)	510	6400	6300	2800	2300	1400	1100	720	400
pH (insitu)	6.5-9.0	6.5-8.5	7.74	8.98	8.1	8.65	8.2	7.99	8.03	8.18	8.12
pH			7.9	9.5	8.4	8.7	8.7	8.1	8.1	8.2	7.9
Sulphate (mg/L)	Between 2550-9000 (depending on receiving water flows)	25	12	1100	1000	330	280	170	120	65	31
Ammonia (µg/L)	900	20	230	620	<10	<10	<10	70	30	20	30
Turbidity (NTU)	560	50	270	3.9	24	130	260	1000	890	550	600
TSS (mg/L)	-	10	130	16	65	110	250	730	170	98	96
Aluminium (µg/L)	55	55	300	11	23	58	40	590	640	1000	1800
Arsenic (µg/L)	13	13	6	7	2	20	14	5	4	<3	<3
Cadmium (µg/L)	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (µg/L)	1	1	<1	<1	<1	<1	<1	<1	1.1	<1	<1
Copper (µg/L)	2	1.4	5	<1	2	5	6	6	6	6	5
Iron (µg/L)	300	-	690	<5	<5	49	44	410	450	750	1300
Lead (µg/L)	4	3.4	2	<1	<1	<1	<1	<1	<1	<1	<1
Mercury (µg/L)	0.2	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel (µg/L)	11	11	3	<1	2	2	2	2	2	2	2
Zinc (µg/L)	8	8	<5	<5	<5	<5	<5	<5	<5	<5	<5
Boron (µg/L)	370	370	160	230	460	200	210	120	110	76	54

Analyte	Dawson Mine EA Mine Lease Release Limit	Dawson River WQO / ANZECC Trigger Value	Grab Sample Results								
			Sample 2	Sediment Dam	Seepage Interception Drain	Sample 3	Sample 4 U/S	Sample 4	Sample 5	Sample 6	Sample 7
Cobalt (µg/L)	90	-	1	<1	<1	<1	<1	<1	<1	<1	<1
Manganese (µg/L)	1900	1900	6	<5	14	<5	<5	<5	<5	6	8
Molybdenum (µg/L)	34	-	3	11	16	8	8	3	<1	1	<1
Selenium (µg/L)	10	5	<3	2	38	3	<3	<3	<3	<3	<3
Silver (µg/L)	1	0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium (µg/L)	1	-	3	11	50	11	14	8	5	2	<1
Vanadium (µg/L)	10	-	<5	7	<5	9	9	<5	5	5	7
Nitrate (µg/L)	1100	700	<5	19	12000	<5	<5	<5	42	<5	11
Petroleum Hydrocarbons (C6-C9) (µg/L)	20	-	none detected	none detected	none detected	none detected	none detected	none detected	none detected	none detected	none detected
Petroleum Hydrocarbons (C10-C36) (µg/L)	100	-	none detected	none detected	none detected	none detected	none detected	none detected	none detected	none detected	none detected
Fluoride (µg/L)	2000	-	900	1100	900	700	700	500	500	300	300

The analysis of Table 4.3, indicates that electrical conductivity and sulphate were elevated beyond that of the WQO values however the upstream reference sample also exceeded the EC guideline values, suggesting the reference catchment EC is greater than the WQO values. No samples taken within the Rock Hole Gully Creek waterway exceeded the maximum EA release limit threshold for mine-affected water (5,000µS/cm) and all samples within the natural reaches of the waterway were below the minimum EA release limit threshold for mine-affected water (1,500µS/cm).

Figure 4.1 visually maps the results of the electrical conductivity comparison against the screening levels for the surface water sampling program.

There were no pH exceedances within the natural reaches of Rock Hole Gully Creek.

Other parameters relevant to consider for the seepage include dissolved metal concentrations of which, Aluminium, Iron and Copper concentrations were found to generally exceed the EA and downstream WQO or ANZECC trigger values. However, sample results from the Seepage Interception Drain and Sediment Dam, which are most representative of the non-diluted saline seepage, returned low concentrations of Aluminium, Copper and Iron. This indicates that the elevated metals sampled within the Rock Hole Gully Creek are not indicative of the seepage water from the Dawson North spoil dump.

Uranium concentrations were also found to generally exceed the EA release limits however the concentrations are diluted further downstream and are less than the upstream sampled concentration by the Sample 6 location.

Based on the water quality data analysed, it is considered unlikely that the seepage caused any significant environmental harm to the aquatic ecosystem of the natural waterway within the area of influence.

EC	Aquatic Ecosystem Value WQO	EA	Stock Water Value WQO
Sample 2	above limits	below lower limit	below lower limit
Sediment Dam	above limits	above upper limit	within range
Western Drain	above limits	above upper limit	within range
Sample 3	above limits	within range	below lower limit
Sample 4 U/S	above limits	within range	below lower limit
Sample 4	above limits	below lower limit	below lower limit
Sample 5	above limits	below lower limit	below lower limit
Sample 6	above limits	below lower limit	below lower limit
Sample 7	above limits	below lower limit	below lower limit

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DATE	14/11/2017	ANGLO COAL (DAWSON) LIMITED
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JOB NO.	M30000-37	A3 Figure 4-1 A

Sediment Quality

The Lower Dawson River sediment Water Quality Objectives for fresh water systems refers to the ANZECC Guideline which provides recommended maximum sediment quality guidelines for some metals and organic parameters. Table 4.4 outlines the sediment sample results against the associated low trigger limits listed within the ANZECC Guideline.

Table 4.4 Sediment Metal Results against Water Quality Objectives Low Trigger Values

Analyte	ANZECC Recommended Interim Sediment Quality Guideline Low Trigger Value (mg/kg)	Sample Results																					
		Sample 1				Sample 2				Sample 3				Sample 4 U/S		Sample 4		Sample 5		Sample 6		Sample 7	
		LF TS	LF SS	OB TS	OB SS	LF TS	LF SS	OB TS	OB SS	LF TS	LF SS	OB TS	OB SS	LF TS	LF SS	OB TS	OB SS	LF TS	LF SS	LF TS	LF SS	OB TS	OB SS
Arsenic (mg/kg)	20	8.1	7.3	9.5	8.2	9.4	12	10	9.5	7.5	7.6	6.9	2.8	9.4	1.3	4.6	5.8	6.7	6.0	4.6	6.5	6.2	5.8
Cadmium (mg/kg)	1.5	0.8	0.8	0.8	0.9	1.6	1.4	3.0	3.0	0.7	0.6	0.5	0.4	1.1	1.2	0.6	0.8	1.0	0.9	1.0	1.1	0.9	0.9
Chromium (mg/kg)	80	12	12	12	14	8.1	7.9	8.3	8.0	4.0	4.1	4.7	2.1	14	11	7.2	11	16	15	21	23	14	15
Copper (mg/kg)	65	30	28	28	29	40	42	34	32	17	15	11	16	19	20	20	23	27	25	25	24	28	27
Lead (mg/kg)	50	23	21	21	22	19	26	17	17	10	8.6	10	8.3	12	14	12	20	20	19	19	16	19	19
Mercury (µg/L)	0.15	.02	0.01	<.01	<.01	0.02	0.03	0.02	0.02	<.01	<.01	<.01	<.01	<.01	<.01	0.01	<.01	<.01	<.01	<.01	<.01	0.01	0.01
Nickel (mg/kg)	21	13	13	12	12	11	11	9.5	9.1	4.1	6.3	3.2	1.4	4.4	10	5.4	9.7	12	12	12	12	10	10
Zinc (mg/kg)	200	30	25	24	24	65	69	60	59	28	25	21	12	21	30	24	23	34	27	27	29	28	25
Silver (mg/kg)	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

As Table 4.4 shows, there were only three sample results that exceeded the ANZECC low trigger values, being minor Cadmium exceedances at the Sample 2 location. These samples were taken upstream of the seepage location and it is therefore unlikely that seepage has contributed to the slightly elevated concentrations. It should also be noted that none of these low-level exceedances exceed the ‘high-trigger value’ of 10mg/kg.

For analytes without an associated trigger, ANZECC suggests applying a factor of between two and three to the upstream (background) concentration. For the additional metals tested, there was only one occurrence of high Iron concentration greater than three times the background concentration in Sample 2, however again this is not an impact of the seepage as the sample location is upstream of the seepage source.

There are no specific water quality guidelines for salinity for sediment quality for aquatic ecosystems. As shown in Figure 4.2, the conductivity of four samples do exceed three times the upstream value however the two most downstream samples taken are significantly less than twice the upstream values and seem reflective of the reference concentrations.

The dominant vegetation canopy element within the area of influence, Brigalow, is known for its salt tolerance and is therefore likely to be tolerant of the measured salinity levels in the sediment (Refer to Section 4.3).

Figure 4.3 visually maps the results of the electrical conductivity comparison against the screening values for the sediment sampling program.

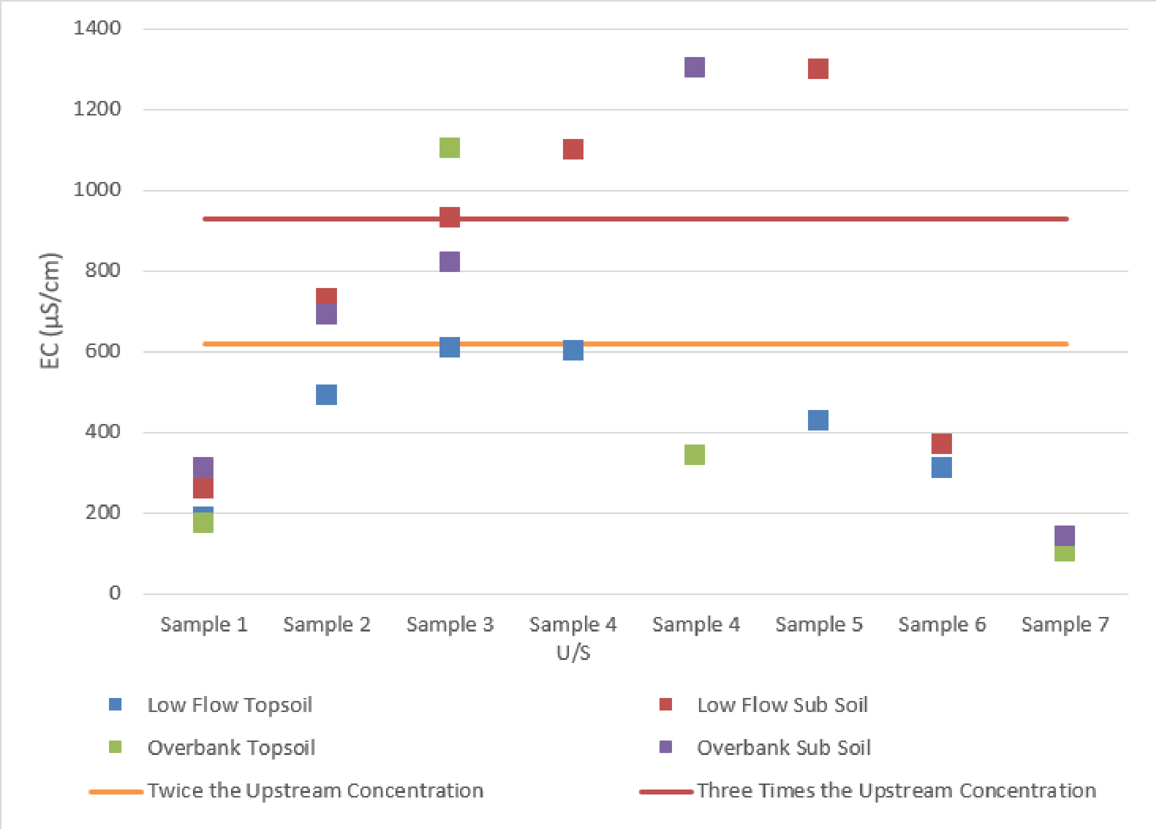

Figure 4.2 Comparison of Sediment Conductivity with Upstream Concentrations

Sample Site	EC (µS/cm)			
	Low Flow Topsoil	Low Flow Sub Soil	Overbank Topsoil	Overbank Sub Soil
Sample 1	190	260	170	310
Sample 2	490	730	690	690
Sample 3	610	930	1100	820
Sample 4 U/S	600	1100		
Sample 4			340	1300
Sample 5	430	1300		
Sample 6	310	370		
Sample 7			100	140
More than two times the order of magnitude of upstream sample				
More than three times the order of magnitude of upstream sample				

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0 500 1000

Scale in metres (1:25,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994. (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

DATE	17/11/2017
DRAWN	JN
JOB NO.	M30000-37

ANGLO COAL (DAWSON) LIMITED

Dawson North Environmental Evaluation
Sediment Electrical Conductivity Results
Dawson North Mine

A3 | Figure 4-3 | A

4.2.4 Stock Water

The main land use, apart from the mine itself, within the area of influence is cattle grazing. The Lower Dawson River EP (Water) Policy and Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) outline the water quality objectives for livestock drinking, specifically for beef cattle.

Dawson Mine has granted a licence to a neighbouring grazier, to agist cattle on Lot 27 on FN 187 (and also other land within the mining leases). Under clause 3.2 of the licence, it has been accepted that Dawson Mine does not warrant the suitability of the land for the grazing purpose. Clauses 12.2 and 12.5 release Dawson Mine from any losses caused to the stock by Dawson Mine's activities (Anglo American, 2012).

Therefore, the comparison of the laboratory results to the ANZECC water quality requirements for stock watering within the Dawson Mine leases and its freehold land has only been undertaken as a guide to further quantify the level of impact to the waterway within the area of influence, not to infer any unauthorised impact.

Table 4.5 outlines the laboratory results of the surface water sampling program against the associated water quality objectives or values listed in the ANZECC Guideline.

Table 4.5 Laboratory Water Quality Results against Stock Water Trigger Values

Analyte	Trigger Values (ANZECC Guideline unless otherwise stated)	Grab Sample Results								
		Sample 2	Sediment Dam	Seepage Interception Drain	Sample 3	Sample 4 U/S	Sample 4	Sample 5	Sample 6	Sample 7
Electrical Conductivity (µS/cm)	5970 (no adverse impacts expected)	510	6400	6300	2800	2300	1400	1100	720	400
	7462 (no loss of production)	510	6400	6300	2800	2300	1400	1100	720	400
	14925 (expected impacts but may be tolerable for short periods)	510	6400	6300	2800	2300	1400	1100	720	400
Sulphate (mg/L)	1000	12	1100	1000	330	280	170	120	65	31
Nitrate (mg/L)	400	<5	19	12000	<5	<5	<5	42	<5	11
Nitrite (mg/L)	30	<5	<5	10	<5	<5	6	<5	<5	<5
Aluminium (µg/L)	5000	300	11	23	58	40	590	640	1000	1800
Arsenic (µg/L)	500	6	7	2	20	14	5	4	<3	<3
Boron (µg/L)	5000	160	230	460	200	210	120	110	76	54
Cadmium (µg/L)	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (µg/L)	1000	<1	<1	<1	<1	<1	<1	1.1	<1	<1
Cobalt (µg/L)	1000	1	<1	<1	<1	<1	<1	<1	<1	<1
Copper (µg/L)	1000 (cattle)	5	<1	2	5	6	6	6	6	5
Fluoride (µg/L)	2000	900	1100	900	700	700	500	500	300	300
Lead (µg/L)	100	2	<1	<1	<1	<1	<1	<1	<1	<1
Mercury (µg/L)	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum (µg/L)	150	3	11	16	8	8	3	<1	1	<1
Nickel (µg/L)	1000	3	<1	2	2	2	2	2	2	2
Selenium (µg/L)	20	<3	2	38	3	<3	<3	<3	<3	<3
Uranium (µg/L)	200	3	11	50	11	14	8	5	2	<1
Zinc (µg/L)	20000	<5	<5	<5	<5	<5	<5	<5	<5	<5

As shown in Table 4.5, there is no Electrical Conductivity recorded within Rock Hole Gully Creek that would pose any adverse impact for stock watering when compared with the ANZECC guideline values.

Similarly, there are no exceedances of any nutrients or metals within Rock Hole Gully Creek when compared to the stock watering ANZECC guideline values.

Based on the water quality data analysed, it is considered unlikely that the seepage caused any adverse impact to the waterway downstream of Dawson Mine in terms of its suitability for stock watering purposes.

There are several farm dams constructed on Rock Hole Gully Creek within the defined area of influence (Refer to Figure 4.4). Based on the outcomes of the stock watering water quality assessment there is no expected adverse impact to these storages.

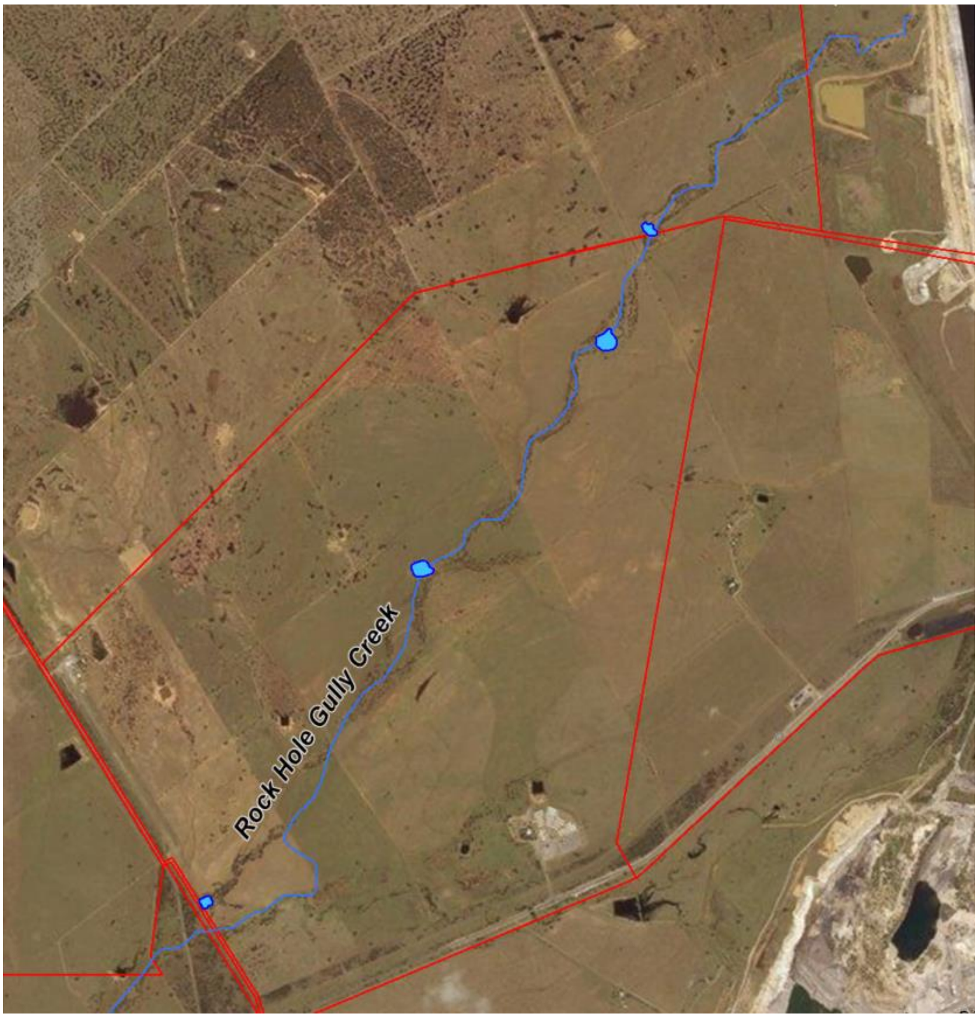


Figure 4.4 Rock Hole Gully Creek Farm Dams On or Offstream (Shaded Blue)

4.3 Assessment of Impact to Vegetation

In summary, the riparian vegetation of Rock Hole Gully Creek at background sites was assessed to be in poor ecological condition. All assessed sites have been disturbed by historical land clearing practices and are currently disturbed by cattle grazing. The riparian open-forest vegetation was narrow with reduced canopy cover and subject to impacts from cattle grazing. The results of the vegetation assessment indicate that no significant ecological impacts have resulted from the saline seepage. Furthermore, examination of the receiving environment suggests that movement of this salt is unlikely to affect any areas of ecological significance.

For the purpose of the CSM, Terrestria reviewed the preclear regional ecosystem mapping for the region generally, which suggested that the region immediately downstream of Dawson North is dominated by RE 11.4.8/11.4.9a/11.4.1 proportions 70/25/5 (Refer to Table 4.6). These communities are dominated by *Acacia harpophylla* which aligns with site inspection observations.

Standing dead trees (Refer to Figure 4.5) suggest that the community is characterised by scattered mature and regrowth brigalow with little to no upper or lower shrub layers and a ground layer dominated by Buffel grass *Pennisetum ciliare*. Other species along Rock Hole Gully Creek include regrowth of *Brachychiton rupestris*, *eremophila mitchellii*, *Bursaria incana*, *Geijera parviflora*. These species are characteristic of the preclear regional ecosystems 11.4.8, 11.4.9a.


Figure 4.5 (L to R) Standing Dead Trees within the Rock Hole Gully Creek Upstream of the initial ML5656 Mining Lease Boundary (29/06/2017), Rock Hole Gully Creek Downstream Monitoring Location (29/06/2017)

Table 4.6 Preclearance Regional Ecosystems of the Subject Area (Terrestria, 2017a)

Regional Ecosystem	Description
11.4.8	Woodland to open forest dominated by Eucalyptus cambageana and Acacia harpophylla or, sometimes in the north, A. argyrodendron. E. thozetiana is sometimes present on shallower soils. There is a moderately dense low tree layer (5m high) layer dominated by species such as Eremophila mitchellii and a low shrub layer (2m high) dominated by species such as Carissa ovata and Geijera parviflora. Occurs on level to gently undulating plains formed from Cainozoic deposits. Associated soils are usually deep texture contrast with thin loamy or sandy surface horizons overlying strongly alkaline clay subsoils. Surface or subsurface gravel is common. (BVG1M: 25a) Vegetation communities in this regional ecosystem include: 11.4.8a: Gilgai and small depressions on clay plains usually associated with Acacia harpophylla ecosystems. Generally support a range of sedges, grasses and, when wet, aquatic species. Palustrine wetland (e.g. vegetated swamp). (BVG1M: 34f)
11.4.9a	Open forest, occasionally woodland, dominated by Acacia harpophylla usually with a low tree mid-storey of Terminalia oblongata and Eremophila mitchellii. Casuarina cristata sometimes replaces Acacia harpophylla in the overstorey and Lysiphyllum cunninghamii sometimes co-dominates. Other low tree or shrub species such as Alectryon diversifolius, Carissa ovata, Pittosporum spinescens, Ehretia membranifolia, Geijera parviflora and Flindersia dissosperma may occur in the mid-storey or low shrub layer. Acacia harpophylla trees have been recorded as 11- 17m high, the mid-storey layer 2- 8m high and the low shrub layer 1-2m high. Occurs on level to gently undulating Cainozoic plains, including weathered basalt. Associated soils are predominantly moderately deep to deep cracking clays that may be brown, red-brown or grey-brown, and with much surface gravel in some areas. (BVG1M: 25a) Vegetation communities in this regional ecosystem include: 11.4.9a: Acacia harpophylla, Lysiphyllum carronii +/- Casuarina cristata open forest to woodland. (BVG1M: 25a) 11.4.9b: Acacia harpophylla, Eucalyptus thozetiana (sometimes E. cambageana) open forest to woodland. (BVG1M: 25a)
11.4.1	Semi-evergreen vine thicket +/- Casuarina cristata. May commonly include Planchonella cotinifolia, Lysiphyllum hookeri, Capparis spp. and Terminalia oblongata, with lower stratum of Elaeodendron australe, Denhamia oleaster and Pittosporum spinescens. A ground layer of Ancistrachne uncinulata, Cheilanthes spp., and Solanum ellipticum may be present. Occurs on Cainozoic clay plains including extensively weathered Tertiary basalt. (BVG1M: 7a)

Some dieback of riparian canopy trees within the vicinity of Site 1/4, located within the mining lease, has occurred, possibly partly as a result of the saline seepage. However, it is noted that Dawson Mine has advised that these trees had died back a considerable time ago and that they are not dissimilar to other areas of dieback within the mining lease.

Electrical conductivity results from sediment and water samples taken as part of the sampling program correlate with die-back within the vicinity of Site 1/4. Low salt concentrations within surface sediment samples (0 – 20cm) suggest that salts have been leached from the surface by recent rain events. This is supported by the lack of visible efflorescence within the creek line and lack of ground vegetation scalding. Longitudinally the efflorescence of salt is no longer visible and there appears to be little to no ongoing impact on canopy trees or shrub layers and almost no visible impacts to ground layers fringing the Rock Hole Gully Creek. The ground layer has recovered and no salt crusting or scalding is visible.

It is therefore apparent that vertical leaching of salts (Leteya et al, 2011) has already occurred to the point where shallow rooted ground layer species and particular Buffel *Pennisetum ciliare* can establish and proliferate. In the absence of ongoing saline seepage reporting to Rock Hole Gully Creek it is expected that salts will continue to leach vertically out of the root zone as a result of wet season streamflow events. (Leteya et al., 2011). It is likely that the high sediment salinity measured within the sub-soil sediment samples will move vertically down the profile until it reaches an interface with a horizon of low permeability soils. This interface is likely to be the subsoil generally at least 600mm in local soils (Isbell, 1957). At this point the salinity will migrate laterally down the catchment. This process is likely to be very slow due to low rainfall and low hydraulic conductivity and slope of the saturated layer or aquifer (Bartle, 2007). During this time low salinity rainfall will dilute and disperse the salt front and decrease any potentially negative impacts it may have on deeper rooted vegetation.

Brigalow *Acacia harpophylla* is the dominant canopy element within the vicinity of the measured impact. Brigalow is known to be salt tolerant (Gates, 1972; Bui and Henderson 2003; Reichman et al., 2006). For example, Brigalow seeds are also highly tolerant of salinity with 50% up to the highest germination at 30,000 µS/m and greater than 90% occurred up to an electrical conductivity of 20,000 µS/m. Furthermore, Brigalow has been shown to be tolerant of salinity levels in excess of sea water (around 54,000 µS/cm) under high insolation stress (Gates, 1972). Brigalow is therefore likely to be tolerant of the current salinity levels in the sediment. The advantage of Brigalow is that not only will it naturally regenerate from seed within the seed bank it also readily spreads through root suckering from neighbouring established individuals. Planting of canopy trees within the vicinity of site 1/4 is not recommended as this would require the disturbance of the soil profile potentially bringing salts back to the surface creating a hostile environment for plant establishment. Other locally native salt tolerant species including Wilga *Geijera parviflora* and False sandalwood *Eremophila mitchellii* are common elements of the subcanopy and shrub layers within the vicinity of site 1/4 and seedlings of these species are more likely to establish if the soil surface is left undisturbed.

4.3.1 Matters of State Environmental Significance and Regional Ecosystems

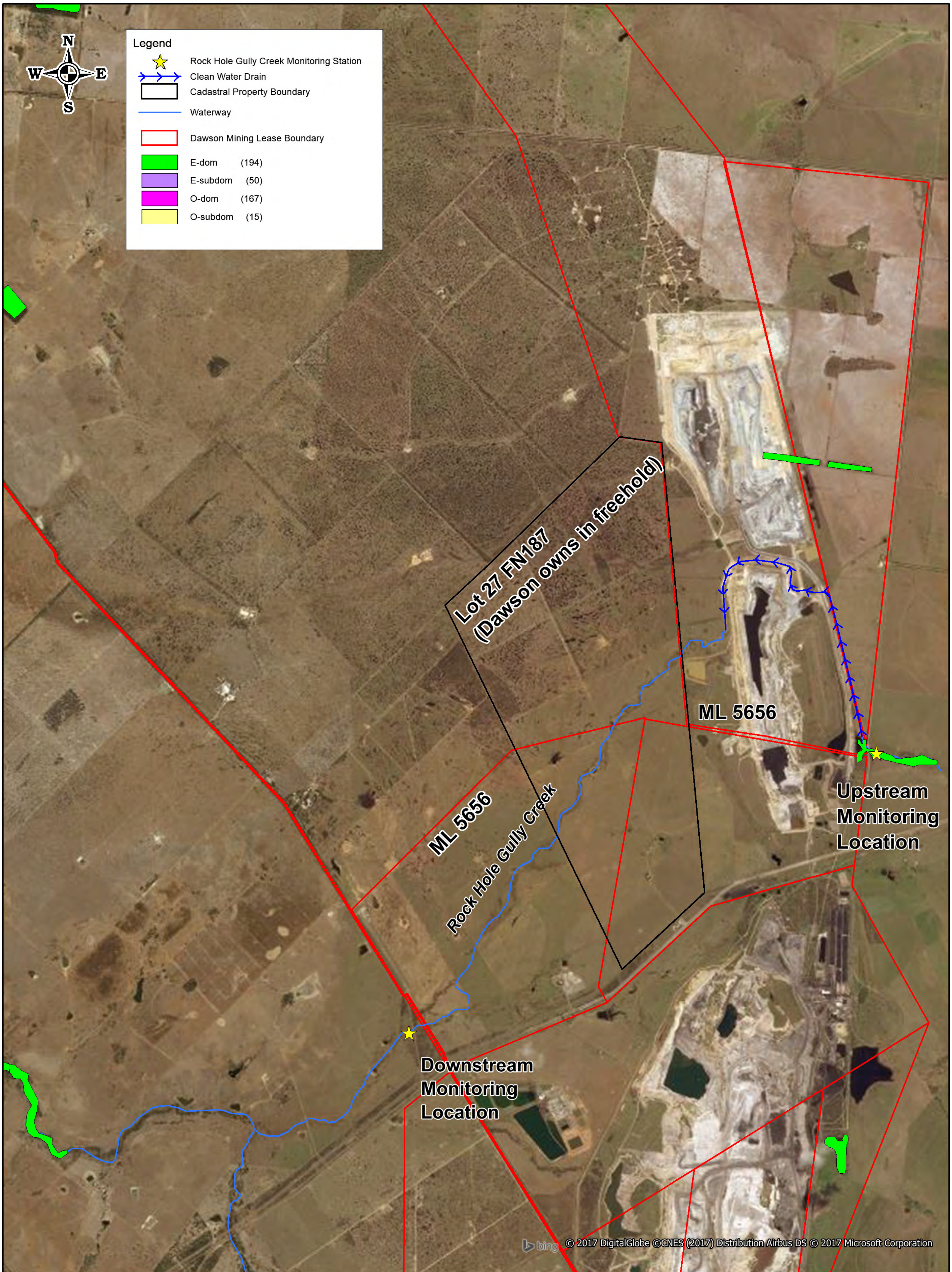
The Queensland Government has developed a database which outlines Matters of State Environmental Significance (MSES) including Regional Ecosystems (RE) which is the classification of all remnant vegetation throughout Queensland as Endangered, Of

Concern, or Not of Concern as well as providing additional supporting information on the vegetation characteristics.

Most of the Dawson North mining lease and surrounding vicinity has been cleared for grazing purposes and is not classed as significant RE. The closest regional ecosystems downstream of Dawson Mine and the seepage source are located predominantly within the riparian corridor of Kianga Creek, after the confluence with Rock Hole Gully Creek (Refer to Figure 4.6). This Endangered-Dominant vegetation is located approximately 11.4km downstream of the Dawson Mine mining lease and about 5km downstream of the Rock Hole Gully Creek downstream telemetry monitoring station location.

Most of Rock Hole Gully Creek, Kianga Creek and the surrounding land is mapped as Strategic Cropping Land which is an area of regional interest under the *Regional Planning Interests Act 2014* and represents land that is or is likely to be highly suitable for cropping (DNRM, 2016).

However, under Section 24 of the *Regional Planning Interests Act 2014,* a pre-existing resource activity is an exempt activity for regional planning interests such as strategic cropping land mapping. Additionally, Dawson Mine does not use any of this land that it owns for cropping purposes.



ANGLO AMERICAN

ENGENY WATER MANAGEMENT

0 1000 2000

Scale in Metres (1:50,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Map Grid 1984 (AGD 84)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

		Anglo Coal (Dawson) Limited
DATE	17/11/17	Rock Hole Creek Gully Environmental Evaluation Regional Ecosystem Status Map
DRAWN	SE	
JOB NO.	M30000_037	A3 Figure 4-6 A

4.4 Assessment of Impact to Soils

The purpose of the NEPM site assessment is to determine whether site contamination poses an actual or potential risk to human health and the environment (NEPM, 2013).

4.4.1 Risk to Human Health

The area of influence defines the area for the soil assessment of Rock Hole Gully Creek to be between the out of pit spoil dump and the downstream monitoring station. Most of this land is subject to a mining lease and the balance is owned in freehold by the two holders of the mining lease, i.e. Anglo Coal (Dawson) Limited and Mitsui Moura Investment Pty Ltd and licenced to a local grazier for the agistment of cattle (Anglo American, 2012).

There is no residential or commercial infrastructure located along the waterway within the area of influence. Rock Hole Gully Creek is not used for any recreational purpose within the area of influence.

Due to this, there is no relevant land use category listed in the NEPM for health-based investigation levels (HILs) and therefore no relevant HILs to assess against for the seepage assessment (Refer to Section 6 of Volume 2 of the NEPM).

However regardless of this, it is unlikely that the soils pose any risk to human health within the area of influence due to low concentrations of metals within the sampled sediment (when compared to the most stringent NEPM HILs) and no detection of petroleum hydrocarbons.

4.4.2 Risk to Environment

The NEPM has developed ecological investigation levels (EILs) for the three generic land use settings of areas of ecological significance, urban residential areas and public open space and commercial and industrial land uses.

Based on the definitions of these land uses, there is no relevant land use category listed in the NEPM for EILs and therefore no relevant EILs to assess against for the seepage assessment (Refer to Section 2.5 of Volume 2 of the NEMO).

However regardless of this, it is unlikely that the soils pose a significant risk to the environment within the area of influence based on:

- The NEPM makes reference for assessments of sediment quality screening against the ANZECC guidelines (Refer to Section 2.7 of Volume 2 of the NEPM). The assessment of the sediment sample results against the ANZECC sediment quality guidelines did not indicate any sediment samples within the area of influence exceeded the ANZECC low trigger guideline limits.

- Any elevated salts within the sub-soils of the impacted area are expected to move vertically through the profile until they reach the low permeability subsoil layer generally at least 600mm in the local area. At this point the salinity will migrate laterally down the catchment and during this time stream flows will dilute and disperse the salt front and decrease any potentially negative impacts it may have on deeper rooted vegetation.
- Brigalow *Acacia harpophylla* is the dominant canopy element within the area of influence and is known to be salt tolerant. Its dominance suggests that sub-soils within the locality are saline and sodic. Brigalow is therefore likely to be tolerant of the measured salinity levels in the sediment.

4.5 Impact Assessment Summary

The level of impact on the waterways, soils and vegetation was assessed based on field assessments and a comparison of laboratory sampling data with assigned screening levels in-line with the NEPM site investigation and Environmental Evaluation requirements. Table 4.7 summarises the assessed level of impact.

Table 4.7 Summary of Assessed Level of Impact

Impact on	Assessed Level of Impact	Justification
Soils	Low	Any elevated salts within the sub-soils of the impacted area are expected to move vertically through the profile until they reach the low permeability subsoil layer generally at least 600mm in the local area. At this point the salinity will migrate laterally down the catchment and during this time stream flows will dilute and disperse the salt front and decrease any potentially negative impacts it may have on deeper rooted vegetation. Brigalow *Acacia harpophylla* is the dominant canopy element within the area of influence and is known to be salt tolerant. Its dominance suggests that sub-soils within the locality are saline and sodic. Brigalow is therefore likely to be tolerant of the measured salinity levels in the sediment. Based on the vegetation assessment, soil and water sampling program results and analysis of the receiving environment, it is unlikely that any significant environmental impacts have resulted or will occur from the saline seepage and therefore the impact to soils is concluded to be low.
Waterways	Low	The comparison of laboratory results to the most relevant screening values did not indicate any significant environmental harm to the waterways from the seepage event is possible. The conductivity of the surface water samples was elevated, however

Impact on	Assessed Level of Impact	Justification
		samples taken within the natural Rock Hole Gully Creek were below the minimum EA release limit threshold and results from the downstream Rock Hole Gully Creek monitoring station were less than the upstream reference concentration. Other parameters relevant to the seepage (such as aluminium, iron and copper) that exceeded the screening thresholds were not found to be indicative of the sampled seepage and therefore not likely to be influenced by the seepage. Based on the water quality data analysed and the dilution of the natural catchment, it is considered very unlikely that the seepage caused any significant environmental harm to the aquatic ecosystem of the natural waterway within the area of influence. It was also found that there is no possible adverse impact on the water quality for stock watering purposes within the area of influence. Based on the screening level assessment and analysis of the receiving environment, it is very unlikely that any significant environmental impacts have resulted from the seepage and the impact to waterways is considered low.
Vegetation	Low	The riparian vegetation of Rock Hole Gully Creek at background sites was assessed to be in poor ecological condition. All assessed sites have been disturbed by historical land clearing practises and are currently disturbed by cattle grazing. The overall vegetation assessment results indicate that within the context of the overall Rock Hole Gully Creek landscape this location is in equal or better condition than the average measure condition. Longitudinally beyond site 1/4, little to no ongoing measurable impacts on canopy trees or shrub layers were observed and almost no visible impacts to ground layers fringing the creek. There is no mapped Remnant vegetation within the area of influence. It is therefore unlikely that any significant ecological impacts have resulted from the seepage and the impact to vegetation is considered low.

5. CONTAMINATION ACTION PLAN

5.1 Current Risk Controls

Ongoing natural flushing of Rock Hole Gully Creek as a result of future streamflow events will provide sufficient dilution to further reduce elevated salinities downstream of the Dawson North spoil dump.

Dawson Mine have implemented a number of risk controls to prevent saline seepage draining into Rock Hole Gully Creek, the primary control being a seepage interception drainage system including:

- Open drain excavated around the southern toe of the out of pit spoil dump and around the south-west corner of the dump (Refer to Figure 5.1 and Figure 5.2)
- Pipe culvert placed under road connecting this drain with the western drain (Refer to Figure 5.3)
- Western drain excavated to low permeability clays along the western edge of the haul road opposite the western face of the out of pit spoil dump (Refer to Figure 5.4 and Figure 5.5).
- Removed and backfilled two pipe culverts that conveyed surface runoff into the erosion and sediment control drain to prevent any surface water runoff from entering drain.

Figure 5.6 provides an overview of the seepage interception drainage system including the reporting catchment land use categories.

The following additional risk controls have been implemented to prevent saline seepage draining into Rock Hole Gully Creek:

- Installation of dewatering pump to transfer stored water from Industrial Dam 5 into the seepage interception drainage system to be conveyed to the Dawson North void.
- Installation of a shallow groundwater seepage monitoring bores immediately south and west of the out of pit spoil dump.
- The Dawson Mine water management plan has been updated to include monitoring of electrical conductivity (telemetry or in-situ probe readings) of flows entering the natural reach of Rock Hole Gully Creek (Sample Location 4 U/S) as soon as practicable after every flow event (when triggered by flow in the downstream Rock Hole Gully Creek telemetry station) for at least one full wet season.

- The Dawson Mine water management plan has been updated to include a requirement for annual (pre wet season) reviews of water management practices associated with rehabilitated out of pit spoil dumps.
- The Dawson Mine Enablon Action Management System has been updated to include the scheduling of annual reviews as well as assignment to appropriate site personnel and tracking of the task completion.

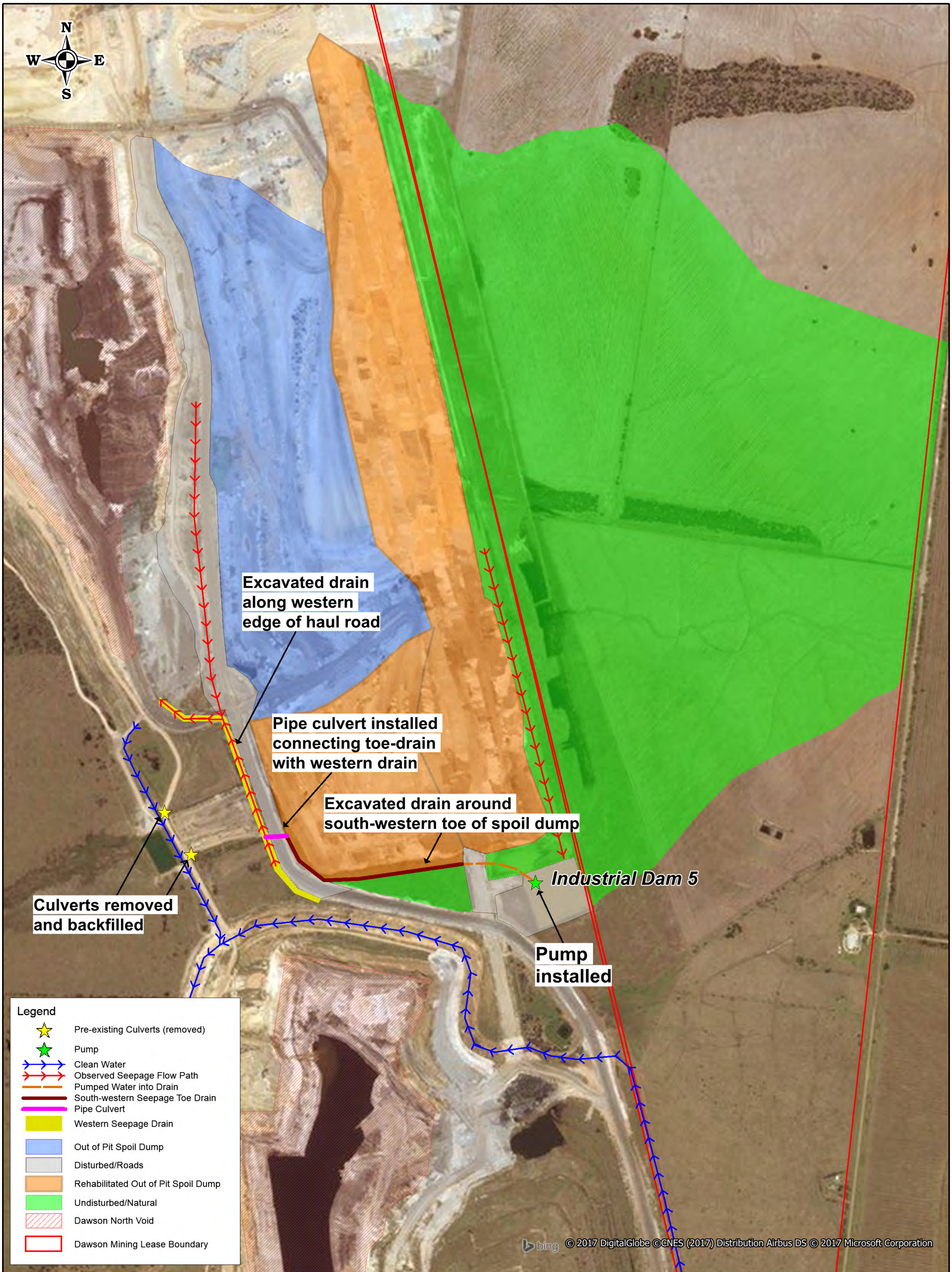
Figure 5.1 Southern Drain (Looking East) (22/11/2017)

Figure 5.2 Southern Drain Approaching South-West Corner (Looking West) (22/11/2017)

Figure 5.3 Southern Drain Approaching Pipe Culvert at the Western Dump Toe (Looking South) (22/11/2017)

Figure 5.4 Western Drain - on Western Side of Haul Road (Looking North) (22/11/2017)

Figure 5.5 Western Drain (Looking North) (25/10/2017)



ANGLO AMERICAN

ENGENY WATER MANAGEMENT

0 240 480

Scale in metres (1:12,000 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

DATE	22/11/17	ANGLO COAL (DAWSON) LIMITED
DRAWN	SE	Environmental Evaluation Contamination Action Plan Seepage Interception Drainage System
JOB NO.	M30000_037	A3 Figure 5-6 A

5.2 Additional Mitigation Measures

No additional mitigation measures are required to manage or remediate contamination as a result of the water seepage including proposed monitoring methods.

5.3 Procedural and Structural Changes

No procedural or structural changes are required to reduce the risk of further soil and surface water contamination.

6. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

c. Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

   (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

d. Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

e. This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this report.

f. If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

g. This report does not provide legal advice.

7. REFERENCES

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APPENDIX A

Statutory Declarations

Statutory Declaration

Environmental Protection Act 1994

Environmental Evaluation

Suitably qualified person

A Statutory Declaration is a written statement of facts that is sworn or declared under the Oaths Act 1867. *This Statutory Declaration must be completed by the person who conducted the environmental evaluation and accompany the environmental report submitted to the Department of Environment and Heritage Protection (the department).*

Oaths Act 1867

QUEENSLAND
TO WIT

I Aaron James Hallgath

Insert the name of the person making this declaration

of Engeny Water Management

Insert the street address of the person making this declaration

Level 7, 500 Queen Street Brisbane 4000

in the State of Queensland do solemnly and sincerely declare that:

- I am the suitably qualified person and author of an environmental report entitled

Environmental Evaluation Report - Dawson Mine North Evironmental Evaluation

Insert title of the environmental report

In accordance with the environmental evaluation issued by the department under the Act to:

Anglo Coal (Dawson) Limited (ACN: 100155342) — 11 September 2017

Insert name of recipient of the notice — Insert date of the notice

A copy of my report is attached to this statutory declaration and marked “A”.

I possess the following qualifications and experience relevant to this environmental evaluation:

Bachelor of Environmental Engineering, RPEQ, CPEng

I have not knowingly included any false, misleading or incomplete information in the report; and

I have not knowingly failed to reveal any relevant information or document to the department.

I certify that:

ABN 46 640 294 485

- The report addresses the relevant matters for the evaluation and is factually correct; and
- The opinions expressed in it are honestly and reasonably held.

I make this solemn declaration conscientiously believing the same to be true, and by virtue of the *Oaths Act 1867*.

Taken and declared before me, at Brisbane
Insert location

this 29th day of November in the year 2017
Insert day (e.g. 18th) Insert month Insert year

Signed
(Person making this declaration)

MWille
Signed
Lawyer

Michelle Patricia Wille
Printed name and registration number (if applicable)

Statutory Declaration

Environmental Protection Act 1994

Environmental Evaluation

Recipient

A Statutory Declaration is a written statement of facts that is sworn or declared under the Oaths Act 1867*. In accordance with section 326E of the* Environmental Protection Act 1994 *(the Act), this Statutory Declaration must be completed by the recipient of an environmental evaluation notice and must accompany the environmental report submitted to the Department of Environment and Heritage Protection (the department).*

Oaths Act 1867

QUEENSLAND

TO WIT

I Larry Mark Hantler

Insert the name of the person making this declaration

of Anglo Coal (Dawson) Limited

Insert the street address of the person making this declaration

Dawson Mine, Dawson Higway, Moura QLD 4718

in the State of Queensland do solemnly and sincerely declare that in accordance with section 326E of the *Environmental Protection Act 1994* (the Act), I have:

- not knowingly given any false or misleading information; and
- given all relevant information

to the person who carried out the environmental evaluation, over the period:

18/09/2017 to 27/11/2017

Insert start date — Insert end date

for the purpose of submitting a report in accordance with the environmental evaluation notice issued by the department under the Act to:

Anglo Coal (Dawson) Limited — 11/09/2017

Insert name of recipient of the notice — Insert date of the notice

ABN 46 640 294 485

A copy of the report is attached to this statutory declaration and marked "A".

I make this solemn declaration conscientiously believing the same to be true, and by virtue of the *Oaths Act 1867*.

Taken and declared before me, at Dawson Mine, Moura QLD 4718

Insert location

this 24th day of November in the year 2017

Insert day (e.g. 18th) Insert month Insert year

Signed
(Person making this declaration)

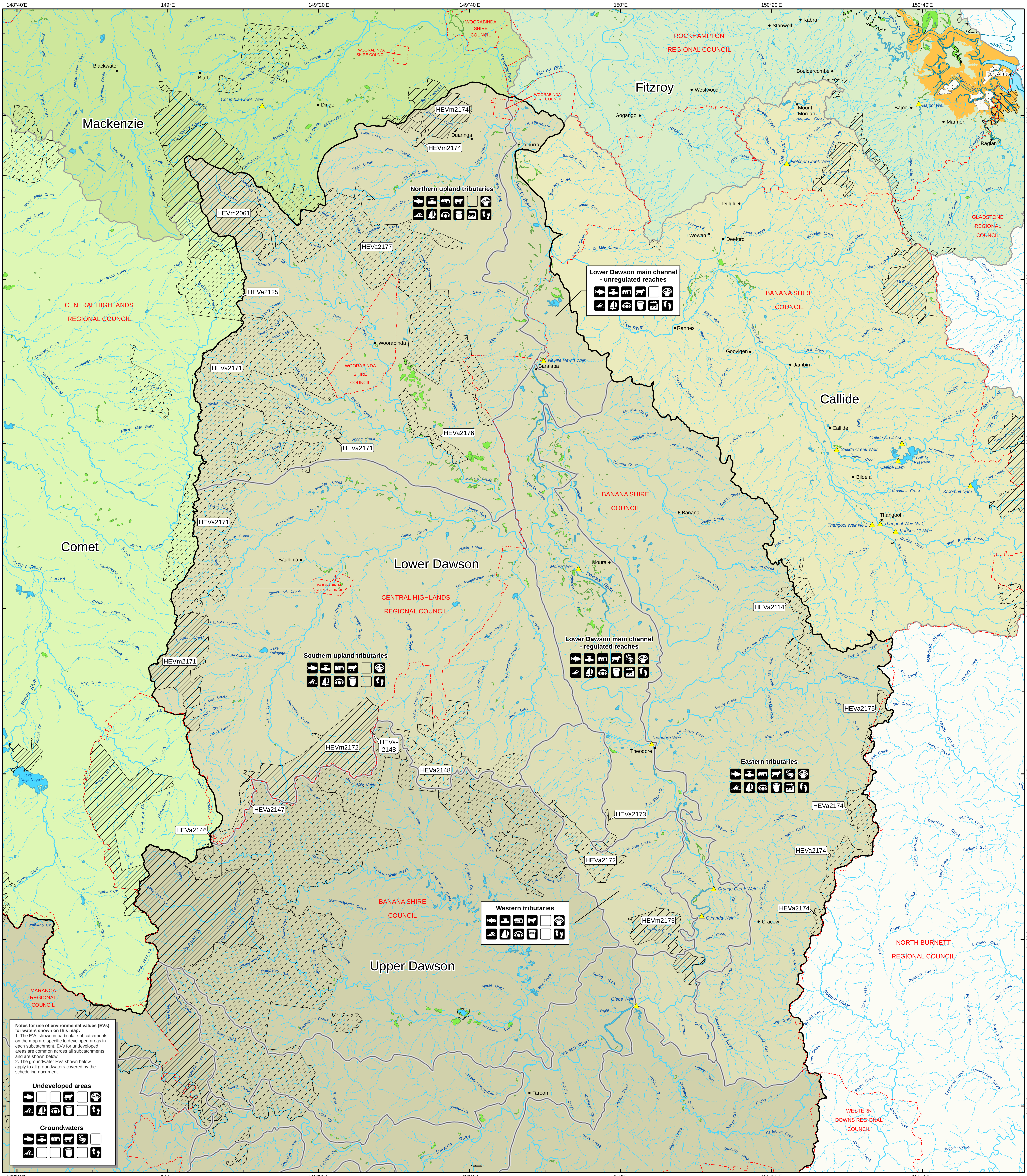
Signed
Hayden John Bennett

COMMISSIONER FOR DECLARATIONS
QUEENSLAND GOVERNMENT
Reg. No.: 80959
DEPT OF JUSTICE & ATTORNEY-GENERAL

Printed name and registration number (if applicable)

APPENDIX B

Lower Dawson River Sub-Basin Map



Legend

- Town
- Dam / weir / barrage
- Coastline
- River / creek
- Subcatchment boundary
- Boundary of waters covered by the scheduling document
- Local government boundary
- Salt evaporation pond

Management Intent for Waters

- High ecological value fresh waters (maintain)
- High ecological value marine / estuarine waters (maintain)
- High ecological value fresh waters (achieve)

Water Types

Fresh waters

- Lower Dawson River catchment fresh waters
- Upper Dawson River catchment fresh waters
- Mackenzie River catchment fresh waters
- Comet River catchment fresh waters
- Fitzroy River catchment fresh waters
- Callide Creek catchment fresh waters
- Wetlands (palustrine)
- Lakes / reservoirs

Marine / estuarine waters

- Middle estuary
- Enclosed coastal waters, lower estuary

Key to Environmental Values

Aquatic Ecosystems, Irrigation, Farm Supply, Stock Water, Aquaculture, Human Consumer

Primary Recreation, Secondary Recreation, Visual Recreation, Drinking Water, Industrial Use, Cultural & Spiritual Values

Notes:
1. For areas outside of the waters covered by the scheduling document please refer to the relevant plan.
2. Waterways in the catchment that are not shown on this map as having a management intent of high ecological values (maintain or achieve) have a **management intent of moderately disturbed.**
3. Refer to plan WQ1310 for mapping of groundwater chemistry zones.
4. Wetlands shown on this map are sourced from the Queensland Wetland Data Version 2.0 developed by the Queensland Wetlands Program. Refer to the Wetland*Info* website (www.ehp.qld.gov.au) for the most current information on Queensland wetlands.

Disclaimer
Whilst every care is taken to ensure the accuracy of this product, the Department of Environment and Heritage Protection makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you may incur as a result of the product being inaccurate or incomplete in any way and for any reason.

WQ1309 - Lower Dawson River Sub-basin

Part of basin 130

Environmental Protection (Water) Policy 2009
Central Queensland Map Series

This plan forms part of the Dawson River Sub-basin Environmental Values and Water Quality Objectives scheduling document, prepared pursuant to the *Environmental Protection (Water) Policy 2009*.

QUEENSLAND GOVERNMENT

Publication date: September 2011 (Re-published in July 2013)

N

0 10 20 30 40
Kilometres

Scale: 1:410,000 @ A1

Projection: Mercator

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

APPENDIX C

Laboratory Results

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Xanthe Willis	Manager	Jon Dicker
Client	ANGLO COAL (DAWSON MANAGEMENT) PTY LTD	Laboratory	SGS Cairns Environmental
Address	GPO BOX 1410 BRISBANE QLD 4001	Address	Unit 2, 58 Comport St Portsmith QLD 4870
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Email	xanthe.willis@angloamerican.com	Email	AU.Environmental.Cairns@sgs.com
Project	**Dawson North EE**	SGS Reference	**CE130129 R0**
Order Number	**398711**	Date Received	27 Oct 2017
Samples	9	Date Reported	07 Nov 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146).

For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.
Saline metals subcontracted to SGS Melbourne, 10/585 Blackburn Road, Notting Hill, VIC, NATA Accreditation Number 2562/14420, ME304690.
TRH subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE171974.

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Sample Matrix			Water	Water	Water	Water
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			SE Sed Dam	West Drain	1/2	1/3

pH in water Method: AN101 Tested: 27/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
pH**	pH Units	0.1	9.5	8.4	7.9	8.7

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 27/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Conductivity @ 25 C	µS/cm	2	6400	6300	510	2800

Turbidity Method: AN119 Tested: 30/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Turbidity	NTU	0.5	3.9	24	270	130

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 2/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Total Suspended Solids Dried at 103-105°C	mg/L	5	16	65	130	110

Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 27/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Fluoride by ISE	mg/L	0.1	1.1	0.9	0.9	0.7

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 30/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Ammonia Nitrogen, NH3 as N	mg/L	0.01	0.62	<0.01	0.23	<0.01

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Sample Matrix			Water	Water	Water	Water
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			SE Sed Dam	West Drain	1/2	1/3

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser   Method: AN248   Tested: 30/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.019	12	<0.005	<0.005
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.019	12	<0.005	<0.005

Nitrite in Water   Method: AN277   Tested: 1/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	0.010	<0.005	<0.005

Metals in Water (Dissolved) by ICPOES   Method: AN320   Tested: 31/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Aluminium, Al	mg/L	0.005	0.011	0.023	0.30	0.058
Boron, B	mg/L	0.005	0.23	0.46	0.16	0.20
Iron, Fe	mg/L	0.005	<0.005	<0.005	0.69	0.049
Manganese, Mn	mg/L	0.005	<0.005	0.014	0.006	<0.005
Sulfur asSulfate, SO4	mg/L	0.5	1100	1000	12	330
Vanadium, V	mg/L	0.005	0.007	<0.005	<0.005	0.009
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Metals in Water (Total) by ICPOES   Method: AN022/AN320   Tested: 31/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Total Aluminium	mg/L	0.005	0.30	1.6	8.8	5.2
Total Boron	mg/L	0.005	0.23	0.47	0.18	0.21
Total Iron	mg/L	0.005	0.17	0.54	5.4	3.3
Total Manganese	mg/L	0.005	0.023	0.027	0.63	0.13
Total Vanadium	mg/L	0.005	0.007	<0.005	0.018	0.020
Total Zinc	mg/L	0.005	<0.005	0.007	0.010	0.007

Metals in Water (Dissolved) by ICPOES-USN   Method: AN320/AN322   Tested: 31/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Arsenic, As	mg/L	0.003	-	-	0.006	0.020
Cadmium, Cd	mg/L	0.0001	-	-	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	-	-	<0.0010	<0.0010
Cobalt, Co	mg/L	0.001	-	-	0.001	<0.001
Copper, Cu	mg/L	0.001	-	-	0.005	0.005
Lead, Pb	mg/L	0.001	-	-	0.002	<0.001
Molybdenum, Mo	mg/L	0.001	-	-	0.003	0.008
Nickel, Ni	mg/L	0.001	-	-	0.003	0.002
Selenium, Se	mg/L	0.003	-	-	<0.003	0.003

Parameter	Units	LOR	Sample Number: CE130129.001 Sample Matrix: Water Sample Date: 25 Oct 2017 Sample Name: SE Sed Dam	CE130129.002 Water 25 Oct 2017 West Drain	CE130129.003 Water 25 Oct 2017 1/2	CE130129.004 Water 25 Oct 2017 1/3

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 31/10/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Total Arsenic, As	mg/L	0.003	-	-	0.006	0.022
Total Cadmium, Cd	mg/L	0.0001	-	-	<0.0001	0.0001
Total Chromium, Cr	mg/L	0.001	-	-	0.004	0.002
Total Cobalt, Co	mg/L	0.001	-	-	0.006	0.002
Total Copper, Cu	mg/L	0.001	-	-	0.009	0.007
Total Lead, Pb	mg/L	0.001	-	-	0.005	0.002
Total Molybdenum, Mo	mg/L	0.001	-	-	0.005	0.009
Total Nickel, Ni	mg/L	0.001	-	-	0.005	0.003
Total Selenium, Se	mg/L	0.003	-	-	<0.003	0.003

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 6/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Arsenic, As	mg/L	0.001	0.007	0.002	-	-
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	-	-
Chromium, Cr	mg/L	0.001	<0.001	<0.001	-	-
Cobalt, Co	mg/L	0.001	<0.001	<0.001	-	-
Copper, Cu	mg/L	0.001	<0.001	0.002	-	-
Lead, Pb	mg/L	0.001	<0.001	<0.001	-	-
Molybdenum, Mo	mg/L	0.001	0.011	0.016	-	-
Nickel, Ni	mg/L	0.001	<0.001	0.002	-	-
Selenium, Se	mg/L	0.001	0.002	0.038	-	-
Uranium, U	mg/L	0.001	0.011	0.050	0.003	0.011

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 6/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Total Arsenic	mg/L	0.001	0.007	0.002	-	-
Total Cadmium	mg/L	0.0001	<0.0001	<0.0001	-	-
Total Chromium	mg/L	0.001	<0.001	<0.001	-	-
Total Cobalt	mg/L	0.001	<0.001	<0.001	-	-
Total Copper	mg/L	0.001	0.001	0.003	-	-
Total Lead	mg/L	0.001	<0.001	<0.001	-	-
Total Molybdenum	mg/L	0.001	0.010	0.015	-	-
Total Nickel	mg/L	0.001	0.001	0.003	-	-
Total Selenium	mg/L	0.001	0.005	0.035	-	-
Total Uranium	mg/L	0.001	0.011	0.051	0.003	0.012

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
		Sample Name	SE Sed Dam	West Drain	1/2	1/3

Metals (dissolved) in Water by GF AAS Method: AN304 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Silver, Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Metals (total-acid soluble) in Water by GF AAS Method: AN022/AN304 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Total (acid soluble) Silver, Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Mercury (total) in Water Method: AN311(Perth) /AN312 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Total Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Free Cyanide in water Method: AN076/AN154 Tested: 2/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Free Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004

Low Level Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
TRH C6-C9	μg/L	20	<20	<20	<20	<20
TRH C6-C10	μg/L	20	<20	<20	<20	<20
TRH C6-C10 minus BTEX (F1)	μg/L	20	-	-	-	-

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Sample Matrix			Water	Water	Water	Water
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			SE Sed Dam	West Drain	1/2	1/3

Low Level Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017 (continued)

Surrogates

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Dibromofluoromethane (Surrogate)	%	-	89	99	100	102
d4-1,2-dichloroethane (Surrogate)	%	-	102	97	96	98
d8-toluene (Surrogate)	%	-	102	94	90	95
Bromofluorobenzene (Surrogate)	%	-	94	87	90	93

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017

Surrogates

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Dibromofluoromethane (Surrogate)	%	-	89	99	100	102
d4-1,2-dichloroethane (Surrogate)	%	-	102	97	96	98
d8-toluene (Surrogate)	%	-	102	94	90	95
Bromofluorobenzene (Surrogate)	%	-	94	87	90	93

VPH F Bands

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5

Low Level TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 3/11/2017

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
LLTRH C10-C14	µg/L	50	<50	<50	<50	<50
LLTRH C15-C28	µg/L	100	<100	<100	<100	<100
LLTRH C29-C36	µg/L	50	<50	<50	<50	<50
TRH Sum C10-C36	µg/L	100	<100	<100	<100	<100

TRH F Banding

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
LLTRH >C10-C16 (F2)	µg/L	60	<60	<60	<60	<60
LLTRH >C16-C34 (F3)	µg/L	200	<200	<200	<200	<200

TRH_F Banding

Parameter	Units	LOR	CE130129.001	CE130129.002	CE130129.003	CE130129.004
LLTRH >C34-C40 (F4)	µg/L	100	<100	<100	<100	<100

Parameter	Units	LOR	Sample Number / Sample Matrix / Sample Date / Sample Name	CE130129.005 Water 25 Oct 2017 1/4	CE130129.006 Water 25 Oct 2017 1/4 US	CE130129.007 Water 25 Oct 2017 1/5	CE130129.008 Water 25 Oct 2017 1/6

pH in water Method: AN101 Tested: 27/10/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
pH**	pH Units	0.1	8.1	8.7	8.1	8.2

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 27/10/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Conductivity @ 25 C	µS/cm	2	1400	2300	1100	720

Turbidity Method: AN119 Tested: 30/10/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Turbidity	NTU	0.5	1000	260	890	550

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Total Suspended Solids Dried at 103-105°C	mg/L	5	730	250	170	98

Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 27/10/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Fluoride by ISE	mg/L	0.1	0.5	0.7	0.5	0.3

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 30/10/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Ammonia Nitrogen, NH3 as N	mg/L	0.01	0.07	<0.01	0.03	0.02

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Sample Matrix			Water	Water	Water	Water
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			1/4	1/4 US	1/5	1/6

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 30/10/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	<0.005	<0.005	0.046	<0.005
Nitrate Nitrogen, NO3 as N	mg/L	0.005	<0.005	<0.005	0.042	<0.005

Nitrite in Water Method: AN277 Tested: 1/11/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.006	<0.005	<0.005	<0.005

Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 31/10/2017

Aluminium, Al	mg/L	0.005	0.59	0.040	0.64	1.0
Boron, B	mg/L	0.005	0.12	0.21	0.11	0.076
Iron, Fe	mg/L	0.005	0.41	0.044	0.45	0.75
Manganese, Mn	mg/L	0.005	<0.005	<0.005	<0.005	0.006
Sulfur asSulfate, SO4	mg/L	0.5	170	280	120	65
Vanadium, V	mg/L	0.005	<0.005	0.009	0.005	0.005
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 31/10/2017

Total Aluminium	mg/L	0.005	20	7.8	20	15
Total Boron	mg/L	0.005	0.14	0.23	0.13	0.092
Total Iron	mg/L	0.005	16	5.8	15	12
Total Manganese	mg/L	0.005	0.47	0.15	0.61	0.38
Total Vanadium	mg/L	0.005	0.045	0.025	0.041	0.031
Total Zinc	mg/L	0.005	0.027	0.010	0.028	0.025

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 31/10/2017

Arsenic, As	mg/L	0.003	0.005	0.014	0.004	<0.003
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	0.0011	<0.0010
Cobalt, Co	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper, Cu	mg/L	0.001	0.006	0.006	0.006	0.006
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum, Mo	mg/L	0.001	0.003	0.008	<0.001	0.001
Nickel, Ni	mg/L	0.001	0.002	0.002	0.002	0.002
Selenium, Se	mg/L	0.003	<0.003	<0.003	<0.003	<0.003

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Sample Matrix			Water	Water	Water	Water
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			1/4	1/4 US	1/5	1/6

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 31/10/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Total Arsenic, As	mg/L	0.003	0.008	0.016	0.007	0.003
Total Cadmium, Cd	mg/L	0.0001	0.0001	<0.0001	0.0002	0.0001
Total Chromium, Cr	mg/L	0.001	0.011	0.004	0.010	0.007
Total Cobalt, Co	mg/L	0.001	0.009	0.003	0.010	0.007
Total Copper, Cu	mg/L	0.001	0.024	0.011	0.021	0.018
Total Lead, Pb	mg/L	0.001	0.014	0.008	0.013	0.009
Total Molybdenum, Mo	mg/L	0.001	0.002	0.010	0.001	<0.001
Total Nickel, Ni	mg/L	0.001	0.008	0.004	0.009	0.007
Total Selenium, Se	mg/L	0.003	<0.003	<0.003	<0.003	<0.003

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 6/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Arsenic, As	mg/L	0.001	-	-	-	-
Cadmium, Cd	mg/L	0.0001	-	-	-	-
Chromium, Cr	mg/L	0.001	-	-	-	-
Cobalt, Co	mg/L	0.001	-	-	-	-
Copper, Cu	mg/L	0.001	-	-	-	-
Lead, Pb	mg/L	0.001	-	-	-	-
Molybdenum, Mo	mg/L	0.001	-	-	-	-
Nickel, Ni	mg/L	0.001	-	-	-	-
Selenium, Se	mg/L	0.001	-	-	-	-
Uranium, U	mg/L	0.001	0.008	0.014	0.005	0.002

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 6/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Total Arsenic	mg/L	0.001	-	-	-	-
Total Cadmium	mg/L	0.0001	-	-	-	-
Total Chromium	mg/L	0.001	-	-	-	-
Total Cobalt	mg/L	0.001	-	-	-	-
Total Copper	mg/L	0.001	-	-	-	-
Total Lead	mg/L	0.001	-	-	-	-
Total Molybdenum	mg/L	0.001	-	-	-	-
Total Nickel	mg/L	0.001	-	-	-	-
Total Selenium	mg/L	0.001	-	-	-	-
Total Uranium	mg/L	0.001	0.009	0.015	0.006	0.003

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Sample Number			CE130129.005	CE130129.006	CE130129.007	CE130129.008
Sample Matrix			Water	Water	Water	Water
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			1/4	1/4 US	1/5	1/6

Metals (dissolved) in Water by GF AAS Method: AN304 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Silver, Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Metals (total-acid soluble) in Water by GF AAS Method: AN022/AN304 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Total (acid soluble) Silver, Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Mercury (total) in Water Method: AN311(Perth) /AN312 Tested: 1/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Total Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Free Cyanide in water Method: AN076/AN154 Tested: 2/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Free Cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004

Low Level Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
TRH C6-C9	μg/L	20	<20	<20	<20	<20
TRH C6-C10	μg/L	20	<20	<20	<20	<20
TRH C6-C10 minus BTEX (F1)	μg/L	20	-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE130129.005 Water 25 Oct 2017 1/4	CE130129.006 Water 25 Oct 2017 1/4 US	CE130129.007 Water 25 Oct 2017 1/5	CE130129.008 Water 25 Oct 2017 1/6

Low Level Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017 (continued)

Surrogates

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Dibromofluoromethane (Surrogate)	%	-	102	103	111	100
d4-1,2-dichloroethane (Surrogate)	%	-	96	98	104	94
d8-toluene (Surrogate)	%	-	112	93	98	73
Bromofluorobenzene (Surrogate)	%	-	89	91	103	92

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017

Surrogates

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Dibromofluoromethane (Surrogate)	%	-	102	103	111	100
d4-1,2-dichloroethane (Surrogate)	%	-	96	98	104	94
d8-toluene (Surrogate)	%	-	112	93	98	73
Bromofluorobenzene (Surrogate)	%	-	89	91	103	92

VPH F Bands

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5

Low Level TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 3/11/2017

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
LLTRH C10-C14	µg/L	50	<50	<50	<50	<50
LLTRH C15-C28	µg/L	100	<100	<100	<100	<100
LLTRH C29-C36	µg/L	50	<50	<50	<50	<50
TRH Sum C10-C36	µg/L	100	<100	<100	<100	<100

TRH F Banding

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
LLTRH >C10-C16 (F2)	µg/L	60	<60	<60	<60	<60
LLTRH >C16-C34 (F3)	µg/L	200	<200	<200	<200	<200

TRH_F Banding

Parameter	Units	LOR	CE130129.005	CE130129.006	CE130129.007	CE130129.008
LLTRH >C34-C40 (F4)	µg/L	100	<100	<100	<100	<100

Parameter	Units	LOR	Sample Number: CE130129.009 Sample Matrix: Water Sample Date: 25 Oct 2017 Sample Name: 1/7

pH in water Method: AN101 Tested: 27/10/2017

pH**	pH Units	0.1	7.9

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 27/10/2017

Conductivity @ 25 C	µS/cm	2	400

Turbidity Method: AN119 Tested: 30/10/2017

Turbidity	NTU	0.5	600

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/11/2017

Total Suspended Solids Dried at 103-105°C	mg/L	5	96

Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 27/10/2017

Fluoride by ISE	mg/L	0.1	0.3

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 30/10/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.01	0.03

Parameter	Units	LOR	Sample Number: CE130129.009 Sample Matrix: Water Sample Date: 25 Oct 2017 Sample Name: 1/7

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 30/10/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.014
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.011

Nitrite in Water Method: AN277 Tested: 1/11/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 31/10/2017

Aluminium, Al	mg/L	0.005	1.8
Boron, B	mg/L	0.005	0.054
Iron, Fe	mg/L	0.005	1.3
Manganese, Mn	mg/L	0.005	0.008
Sulfur asSulfate, SO4	mg/L	0.5	31
Vanadium, V	mg/L	0.005	0.007
Zinc, Zn	mg/L	0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 31/10/2017

Total Aluminium	mg/L	0.005	14
Total Boron	mg/L	0.005	0.063
Total Iron	mg/L	0.005	10
Total Manganese	mg/L	0.005	0.30
Total Vanadium	mg/L	0.005	0.029
Total Zinc	mg/L	0.005	0.022

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 31/10/2017

Arsenic, As	mg/L	0.003	<0.003
Cadmium, Cd	mg/L	0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010
Cobalt, Co	mg/L	0.001	<0.001
Copper, Cu	mg/L	0.001	0.005
Lead, Pb	mg/L	0.001	<0.001
Molybdenum, Mo	mg/L	0.001	<0.001
Nickel, Ni	mg/L	0.001	0.002
Selenium, Se	mg/L	0.003	<0.003

Parameter	Units	LOR	Sample Number: CE130129.009 Sample Matrix: Water Sample Date: 25 Oct 2017 Sample Name: 1/7

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 31/10/2017

Total Arsenic, As	mg/L	0.003	<0.003
Total Cadmium, Cd	mg/L	0.0001	0.0002
Total Chromium, Cr	mg/L	0.001	0.007
Total Cobalt, Co	mg/L	0.001	0.006
Total Copper, Cu	mg/L	0.001	0.016
Total Lead, Pb	mg/L	0.001	0.008
Total Molybdenum, Mo	mg/L	0.001	<0.001
Total Nickel, Ni	mg/L	0.001	0.007
Total Selenium, Se	mg/L	0.003	<0.003

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 6/11/2017

Arsenic, As	mg/L	0.001	-
Cadmium, Cd	mg/L	0.0001	-
Chromium, Cr	mg/L	0.001	-
Cobalt, Co	mg/L	0.001	-
Copper, Cu	mg/L	0.001	-
Lead, Pb	mg/L	0.001	-
Molybdenum, Mo	mg/L	0.001	-
Nickel, Ni	mg/L	0.001	-
Selenium, Se	mg/L	0.001	-
Uranium, U	mg/L	0.001	<0.001

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 6/11/2017

Total Arsenic	mg/L	0.001	-
Total Cadmium	mg/L	0.0001	-
Total Chromium	mg/L	0.001	-
Total Cobalt	mg/L	0.001	-
Total Copper	mg/L	0.001	-
Total Lead	mg/L	0.001	-
Total Molybdenum	mg/L	0.001	-
Total Nickel	mg/L	0.001	-
Total Selenium	mg/L	0.001	-
Total Uranium	mg/L	0.001	<0.001

Parameter	Units	LOR	Sample Number: CE130129.009 Sample Matrix: Water Sample Date: 25 Oct 2017 Sample Name: 1/7

Metals (dissolved) in Water by GF AAS   Method: AN304   Tested: 1/11/2017

Silver, Ag	mg/L	0.0001	<0.0001

Metals (total-acid soluble) in Water by GF AAS   Method: AN022/AN304   Tested: 1/11/2017

Total (acid soluble) Silver, Ag	mg/L	0.0001	<0.0001

Mercury (dissolved) in Water   Method: AN311(Perth)/AN312   Tested: 1/11/2017

Mercury	mg/L	0.00005	<0.00005

Mercury (total) in Water   Method: AN311(Perth) /AN312   Tested: 1/11/2017

Total Mercury	mg/L	0.00005	<0.00005

Free Cyanide in water   Method: AN076/AN154   Tested: 2/11/2017

Free Cyanide	mg/L	0.004	<0.004

Low Level Volatile Petroleum Hydrocarbons in Water   Method: AN433   Tested: 3/11/2017

TRH C6-C9	µg/L	20	<20
TRH C6-C10	µg/L	20	<20
TRH C6-C10 minus BTEX (F1)	µg/L	20	-

Parameter	Units	LOR	Sample Number: CE130129.009 Sample Matrix: Water Sample Date: 25 Oct 2017 Sample Name: 1/7

Low Level Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017 (continued)

Surrogates

Dibromofluoromethane (Surrogate)	%	-	117
d4-1,2-dichloroethane (Surrogate)	%	-	109
d8-toluene (Surrogate)	%	-	106
Bromofluorobenzene (Surrogate)	%	-	104

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 3/11/2017

Surrogates

Dibromofluoromethane (Surrogate)	%	-	117
d4-1,2-dichloroethane (Surrogate)	%	-	109
d8-toluene (Surrogate)	%	-	106
Bromofluorobenzene (Surrogate)	%	-	104

VPH F Bands

Benzene (F0)	µg/L	0.5	<0.5

Low Level TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 3/11/2017

LLTRH C10-C14	µg/L	50	<50
LLTRH C15-C28	µg/L	100	<100
LLTRH C29-C36	µg/L	50	<50
TRH Sum C10-C36	µg/L	100	<100

TRH F Banding

LLTRH >C10-C16 (F2)	µg/L	60	<60
LLTRH >C16-C34 (F3)	µg/L	200	<200

TRH_F Banding

LLTRH >C34-C40 (F4)	µg/L	100	<100

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB050558	mg/L	0.01	<0.01	0 - 2%	99 - 102%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB050544	µS/cm	2	<2	0 - 1%	102%

Fluoride by Ion Selective Electrode in Water Method: ME-(AU)-[ENV]AN141

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Fluoride by ISE	LB050544	mg/L	0.1	<0.1	0%	108%	101 - 111%

Free Cyanide in water Method: ME-(AU)-[ENV]AN076/AN154

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Free Cyanide	LB050673	mg/L	0.004	<0.004	0%	120%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB050655	mg/L	0.00005	<0.00005	0%	102%	104%

Mercury (total) in Water Method: ME-(AU)-[ENV]AN311(Perth) /AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Mercury	LB050654	mg/L	0.00005	<0.00005	0 - 6%	110 - 111%	115%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals (dissolved) in Water by GF AAS Method: ME-(AU)-[ENV]AN304

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Silver, Ag	LB050649	mg/L	0.0001	<0.0001	0%	104%

Metals (total-acid soluble) in Water by GF AAS Method: ME-(AU)-[ENV]AN022/AN304

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total (acid soluble) Silver, Ag	LB050647	mg/L	0.0001	<0.0001	0%	109%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
Total Aluminium	LB050576	mg/L	0.005	0%	97%
Total Boron	LB050576	mg/L	0.005	0%	95%
Total Iron	LB050576	mg/L	0.005	1%	99%
Total Manganese	LB050576	mg/L	0.005	1%	99%
Total Vanadium	LB050576	mg/L	0.005	2%	97%
Total Zinc	LB050576	mg/L	0.005	0%	96%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Aluminium, Al	LB050575	mg/L	0.005	<0.005	1%	98%
Boron, B	LB050575	mg/L	0.005	<0.005	2%	96%
Iron, Fe	LB050575	mg/L	0.005	<0.005	2%	98%
Manganese, Mn	LB050575	mg/L	0.005	<0.005	5%	98%
Sulfur asSulfate, SO4	LB050575	mg/L	0.5	<0.5	0%	NA
Vanadium, V	LB050575	mg/L	0.005		0%	97%
Zinc, Zn	LB050575	mg/L	0.005	<0.005	0%	96%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Metals in Water (Dissolved) by ICPOES-USN   Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Arsenic, As	LB050577	mg/L	0.003	<0.003	1%	90%
Cadmium, Cd	LB050577	mg/L	0.0001	<0.0001	0%	109%
Chromium, Cr	LB050577	mg/L	0.001	<0.0010	9%	106%
Cobalt, Co	LB050577	mg/L	0.001	<0.001	0%	109%
Copper, Cu	LB050577	mg/L	0.001	<0.001	0%	97%
Lead, Pb	LB050577	mg/L	0.001	<0.001	0%	107%
Molybdenum, Mo	LB050577	mg/L	0.001	<0.001	0%	93%
Nickel, Ni	LB050577	mg/L	0.001	<0.001	0%	108%
Selenium, Se	LB050577	mg/L	0.003	<0.003	0%	99%

Metals in Water (Total) by ICPOES-USN   Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Arsenic, As	LB050578	mg/L	0.003	<0.003	9%	90%
Total Cadmium, Cd	LB050578	mg/L	0.0001	<0.0001	0%	104%
Total Chromium, Cr	LB050578	mg/L	0.001	<0.001	6%	102%
Total Cobalt, Co	LB050578	mg/L	0.001	<0.001	0%	104%
Total Copper, Cu	LB050578	mg/L	0.001	<0.001	0%	93%
Total Lead, Pb	LB050578	mg/L	0.001	<0.001	3%	102%
Total Molybdenum, Mo	LB050578	mg/L	0.001	<0.001	0%	88%
Total Nickel, Ni	LB050578	mg/L	0.001	<0.001	1%	104%
Total Selenium, Se	LB050578	mg/L	0.003	<0.003	0%	94%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser   Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB050557	mg/L	0.005	<0.005	101 - 102%

Nitrite in Water   Method: ME-(AU)-[ENV]AN277

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB050598	mg/L	0.005	<0.005	0%	98 - 101%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

pH in water   Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB050544	pH Units	0.1	5.4	0 - 2%	100%

Total and Volatile Suspended Solids (TSS / VSS)   Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Suspended Solids Dried at 103-105°C	LB050674	mg/L	5	<5	0 - 7%	95%	98%
	LB050769	mg/L	5	<5	0 - 2%	93 - 96%	91%

Trace Metals (Dissolved) in Water by ICPMS in mg/L   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Uranium, U	LB050552	mg/L	0.001	7%

Trace Metals (Total) in Water by ICPMS in mg/L   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Uranium	LB050553	mg/L	0.001	0%

Turbidity   Method: ME-(AU)-[ENV]AN119

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Turbidity	LB050564	NTU	0.5	<0.5	1 - 2%

METHOD	METHODOLOGY SUMMARY
AN022/AN304	Total (acid soluble) metals by GF AAS: Unfiltered sample is digested with nitric acid prior to analysis by Graphite Furnace AAS. Referenced to APHA3113B.
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN119	Turbidity by Nepholometry: Small particles in a light beam scatter light at a range of angles. A turbidimeter measures this scatter and reports results compared to turbidity standards, in NTU. This procedure is not suitable for very dark coloured liquids or samples with high solids because light absorption causes artificially low light scatter and low turbidity. Reference APHA 2130B.
AN141	Determination of Fluoride by ISE: A fluoride ion selective electrode and reference electrode combination, in the presence of a pH/complexation buffer, is used to determine the fluoride concentration. The electrode millivolt response is measured logarithmically against fluoride concentration. Reference APHA F- C.
AN154	A buffered distillate or water sample is treated with chloramine/barbituric acid reagents and the intensity of the colour developed is proportional to the cyanide concentration.
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.
AN304	Filtered acidified sample analysed by GFAAS, referenced to APHA3113B.

METHOD	METHODOLOGY SUMMARY
AN311(Perth) /AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions taken from unfiltered sample are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN322	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN322	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is not corrected for Naphthalene.
AN403	Additionally, the volatile C6-C9 fraction may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Petroleum Hydrocarbons (TPH) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents .
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Xanthe Willis	Manager	Jon Dicker
Client	ANGLO COAL (DAWSON MANAGEMENT) PTY LTD	Laboratory	SGS Cairns Environmental
Address	GPO BOX 1410 BRISBANE QLD 4001	Address	Unit 2, 58 Comport St Portsmith QLD 4870
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Email	xanthe.willis@angloamerican.com	Email	AU.Environmental.Cairns@sgs.com
Project	**Dawson North EE - Soil**	SGS Reference	**CE130128 R0**
Order Number	**398711**	Date Received	27 Oct 2017
Samples	22	Date Reported	09 Nov 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146).

SIGNATORIES

Anthony Nilsson Operations Manager	Jon Dicker Manager Northern QLD	Maristela Ganzan Metals Team Leader

Parameter	Units	LOR	CE130128.001	CE130128.002	CE130128.003	CE130128.004
Sample Matrix			Soil	Soil	Soil	Soil
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			1/3 OB T3	1/3 LF T3	1/3 LF SS	1/3 OB SS

pH in soil (1:5) Method: AN101 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.001	CE130128.002	CE130128.003	CE130128.004
pH	pH Units	-	9.6	9.9	8.7	8.0

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.001	CE130128.002	CE130128.003	CE130128.004
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	1100	610	930	820

Total Fluoride in Soil Method: AN142 Tested: 1/11/2017

Parameter	Units	LOR	CE130128.001	CE130128.002	CE130128.003	CE130128.004
Total Fluoride*	mg/kg	50	280	300	360	410

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.001	CE130128.002	CE130128.003	CE130128.004
Aluminium, Al	mg/kg	50	3300	4000	6200	3600
Arsenic, As	mg/kg	0.5	6.9	7.5	7.6	2.8
Boron, B	mg/kg	5	11	12	11	9
Cadmium, Cd	mg/kg	0.1	0.5	0.7	0.6	0.4
Cobalt, Co	mg/kg	0.5	2.8	1.4	2.7	<0.5
Chromium, Cr	mg/kg	0.5	4.7	4.0	4.1	2.1
Copper, Cu	mg/kg	0.5	11	17	15	16
Iron, Fe	mg/kg	50	14000	16000	15000	12000
Manganese, Mn	mg/kg	2	290	160	91	35
Molybdenum, Mo	mg/kg	0.5	0.6	0.7	<0.5	<0.5
Nickel, Ni	mg/kg	0.5	3.2	4.1	6.3	1.4
Lead, Pb	mg/kg	0.5	10	10	8.6	8.3
Selenium, Se	mg/kg	1	2	1	1	1
Vanadium, V	mg/kg	0.5	35	33	30	16
Uranium, U*	mg/kg	0.5	1.2	1.1	1.6	1.6
Zinc, Zn	mg/kg	0.5	21	28	25	12
Silver, Ag	mg/kg	1	<1	<1	<1	<1

Mercury in Soil Method: AN312 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.001	CE130128.002	CE130128.003	CE130128.004
Mercury	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01

Parameter	Units	LOR	CE130128.005 Soil 25 Oct 2017 1/2 OB SS	CE130128.006 Soil 25 Oct 2017 1/2 OB TS	CE130128.007 Soil 25 Oct 2017 1/2 LF SS	CE130128.008 Soil 25 Oct 2017 1/2 LF TS
		Sample Number	CE130128.005	CE130128.006	CE130128.007	CE130128.008
		Sample Matrix	Soil	Soil	Soil	Soil
		Sample Date	25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
		Sample Name	1/2 OB SS	1/2 OB TS	1/2 LF SS	1/2 LF TS

pH in soil (1:5) Method: AN101 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.005	CE130128.006	CE130128.007	CE130128.008
pH	pH Units	-	8.8	8.8	9.6	9.6

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.005	CE130128.006	CE130128.007	CE130128.008
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	690	690	730	490

Total Fluoride in Soil Method: AN142 Tested: 1/11/2017

Parameter	Units	LOR	CE130128.005	CE130128.006	CE130128.007	CE130128.008
Total Fluoride*	mg/kg	50	470	490	230	230

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.005	CE130128.006	CE130128.007	CE130128.008
Aluminium, Al	mg/kg	50	15000	15000	11000	12000
Arsenic, As	mg/kg	0.5	9.5	10	12	9.4
Boron, B	mg/kg	5	40	41	18	17
Cadmium, Cd	mg/kg	0.1	3.0	3.0	1.4	1.6
Cobalt, Co	mg/kg	0.5	3.9	6.7	6.9	5.6
Chromium, Cr	mg/kg	0.5	8.0	8.3	7.9	8.1
Copper, Cu	mg/kg	0.5	32	34	42	40
Iron, Fe	mg/kg	50	74000	79000	32000	37000
Manganese, Mn	mg/kg	2	1900	1900	600	1500
Molybdenum, Mo	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Nickel, Ni	mg/kg	0.5	9.1	9.5	11	11
Lead, Pb	mg/kg	0.5	17	17	26	19
Selenium, Se	mg/kg	1	2	2	<1	1
Vanadium, V	mg/kg	0.5	54	55	35	38
Uranium, U*	mg/kg	0.5	0.8	0.9	0.5	0.6
Zinc, Zn	mg/kg	0.5	59	60	69	65
Silver, Ag	mg/kg	1	<1	<1	<1	<1

Mercury in Soil Method: AN312 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.005	CE130128.006	CE130128.007	CE130128.008
Mercury	mg/kg	0.01	0.02	0.02	0.03	0.02

Parameter	Units	LOR	Sample Number: CE130128.009 Sample Matrix: Soil Sample Date: 25 Oct 2017 Sample Name: 1/5 LF TS	CE130128.010 Soil 25 Oct 2017 1/5 LF SS	CE130128.011 Soil 25 Oct 2017 1/4 OB TS	CE130128.012 Soil 25 Oct 2017 1/4 OB SS

pH in soil (1:5) Method: AN101 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.009	CE130128.010	CE130128.011	CE130128.012
pH	pH Units	-	9.0	8.0	8.3	8.2

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.009	CE130128.010	CE130128.011	CE130128.012
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	430	1300	340	1300

Total Fluoride in Soil Method: AN142 Tested: 1/11/2017

Parameter	Units	LOR	CE130128.009	CE130128.010	CE130128.011	CE130128.012
Total Fluoride*	mg/kg	50	110	76	160	150

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.009	CE130128.010	CE130128.011	CE130128.012
Aluminium, Al	mg/kg	50	13000	13000	9200	10000
Arsenic, As	mg/kg	0.5	6.7	6.0	4.6	5.8
Boron, B	mg/kg	5	13	13	12	15
Cadmium, Cd	mg/kg	0.1	1.0	0.9	0.6	0.8
Cobalt, Co	mg/kg	0.5	12	14	3.8	9.1
Chromium, Cr	mg/kg	0.5	16	15	7.2	11
Copper, Cu	mg/kg	0.5	27	25	20	23
Iron, Fe	mg/kg	50	27000	24000	16000	21000
Manganese, Mn	mg/kg	2	1500	1400	390	1300
Molybdenum, Mo	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Nickel, Ni	mg/kg	0.5	12	12	5.4	9.7
Lead, Pb	mg/kg	0.5	20	19	12	20
Selenium, Se	mg/kg	1	2	1	2	1
Vanadium, V	mg/kg	0.5	74	68	44	68
Uranium, U*	mg/kg	0.5	1.1	1.1	2.6	2.1
Zinc, Zn	mg/kg	0.5	34	27	24	23
Silver, Ag	mg/kg	1	<1	<1	<1	<1

Mercury in Soil Method: AN312 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.009	CE130128.010	CE130128.011	CE130128.012
Mercury	mg/kg	0.01	<0.01	<0.01	0.01	<0.01

Parameter	Units	LOR	CE130128.013	CE130128.014	CE130128.015	CE130128.016
Sample Matrix			Soil	Soil	Soil	Soil
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			1/1 TS Over Flow	1/1 Low Flow	1/1 OB SS	1/1 LF SS

pH in soil (1:5) Method: AN101 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.013	CE130128.014	CE130128.015	CE130128.016
pH	pH Units	-	7.0	7.3	8.4	8.1

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.013	CE130128.014	CE130128.015	CE130128.016
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	170	190	310	260

Total Fluoride in Soil Method: AN142 Tested: 1/11/2017

Parameter	Units	LOR	CE130128.013	CE130128.014	CE130128.015	CE130128.016
Total Fluoride*	mg/kg	50	130	<50	130	120

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.013	CE130128.014	CE130128.015	CE130128.016
Aluminium, Al	mg/kg	50	15000	16000	17000	16000
Arsenic, As	mg/kg	0.5	9.5	8.1	8.2	7.3
Boron, B	mg/kg	5	15	12	13	14
Cadmium, Cd	mg/kg	0.1	0.8	0.8	0.9	0.8
Cobalt, Co	mg/kg	0.5	10	13	10	13
Chromium, Cr	mg/kg	0.5	12	12	14	12
Copper, Cu	mg/kg	0.5	28	30	29	28
Iron, Fe	mg/kg	50	21000	23000	23000	22000
Manganese, Mn	mg/kg	2	1200	1400	1400	1500
Molybdenum, Mo	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Nickel, Ni	mg/kg	0.5	12	13	12	13
Lead, Pb	mg/kg	0.5	21	23	22	21
Selenium, Se	mg/kg	1	2	2	3	2
Vanadium, V	mg/kg	0.5	76	73	82	72
Uranium, U*	mg/kg	0.5	1.0	1.4	1.1	1.2
Zinc, Zn	mg/kg	0.5	24	30	24	25
Silver, Ag	mg/kg	1	<1	<1	<1	<1

Mercury in Soil Method: AN312 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.013	CE130128.014	CE130128.015	CE130128.016
Mercury	mg/kg	0.01	<0.01	0.02	<0.01	0.01

Parameter	Units	LOR	CE130128.017	CE130128.018	CE130128.019	CE130128.020
Sample Matrix			Soil	Soil	Soil	Soil
Sample Date			25 Oct 2017	25 Oct 2017	25 Oct 2017	25 Oct 2017
Sample Name			1/6 LF SS	1/6 LF TS	1/4 US LF TS	1/4 US LF SS

pH in soil (1:5) Method: AN101 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.017	CE130128.018	CE130128.019	CE130128.020
pH	pH Units	-	9.1	8.6	9.6	9.1

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.017	CE130128.018	CE130128.019	CE130128.020
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	370	310	600	1100

Total Fluoride in Soil Method: AN142 Tested: 1/11/2017

Parameter	Units	LOR	CE130128.017	CE130128.018	CE130128.019	CE130128.020
Total Fluoride*	mg/kg	50	68	150	68	220

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.017	CE130128.018	CE130128.019	CE130128.020
Aluminium, Al	mg/kg	50	10000	11000	4000	10000
Arsenic, As	mg/kg	0.5	6.5	4.6	9.4	1.3
Boron, B	mg/kg	5	15	12	19	20
Cadmium, Cd	mg/kg	0.1	1.1	1.0	1.1	1.2
Cobalt, Co	mg/kg	0.5	9.5	13	3.7	6.7
Chromium, Cr	mg/kg	0.5	23	21	14	11
Copper, Cu	mg/kg	0.5	24	25	19	20
Iron, Fe	mg/kg	50	27000	25000	30000	33000
Manganese, Mn	mg/kg	2	1200	1700	370	1000
Molybdenum, Mo	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5
Nickel, Ni	mg/kg	0.5	12	12	4.4	10
Lead, Pb	mg/kg	0.5	16	19	12	14
Selenium, Se	mg/kg	1	1	<1	1	2
Vanadium, V	mg/kg	0.5	76	75	88	79
Uranium, U*	mg/kg	0.5	0.9	0.9	1.4	2.9
Zinc, Zn	mg/kg	0.5	29	27	21	30
Silver, Ag	mg/kg	1	<1	<1	<1	<1

Mercury in Soil Method: AN312 Tested: 31/10/2017

Parameter	Units	LOR	CE130128.017	CE130128.018	CE130128.019	CE130128.020
Mercury	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01

Parameter	Units	LOR	CE130128.021	CE130128.022
Sample Number			CE130128.021	CE130128.022
Sample Matrix			Soil	Soil
Sample Date			25 Oct 2017	25 Oct 2017
Sample Name			1/7 OB SS	1/7 OB T3

pH in soil (1:5) Method: AN101 Tested: 31/10/2017

pH	pH Units	-	6.4	7.1

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 31/10/2017

Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	140	100

Total Fluoride in Soil Method: AN142 Tested: 1/11/2017

Total Fluoride*	mg/kg	50	98	92

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 31/10/2017

Aluminium, Al	mg/kg	50	13000	13000
Arsenic, As	mg/kg	0.5	5.8	6.2
Boron, B	mg/kg	5	13	13
Cadmium, Cd	mg/kg	0.1	0.9	0.9
Cobalt, Co	mg/kg	0.5	8.8	8.4
Chromium, Cr	mg/kg	0.5	15	14
Copper, Cu	mg/kg	0.5	27	28
Iron, Fe	mg/kg	50	23000	23000
Manganese, Mn	mg/kg	2	850	940
Molybdenum, Mo	mg/kg	0.5	<0.5	<0.5
Nickel, Ni	mg/kg	0.5	10	10
Lead, Pb	mg/kg	0.5	19	19
Selenium, Se	mg/kg	1	2	<1
Vanadium, V	mg/kg	0.5	69	66
Uranium, U*	mg/kg	0.5	0.9	1.1
Zinc, Zn	mg/kg	0.5	25	28
Silver, Ag	mg/kg	1	<1	<1

Mercury in Soil Method: AN312 Tested: 31/10/2017

Mercury	mg/kg	0.01	0.01	0.01

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Mercury in Soil   Method: ME-(AU)-[ENV]AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB050609	mg/kg	0.01	<0.01	0%	109 - 110%	112%

pH in soil (1:5)   Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
pH	LB050611	pH Units	-	6.0	100%

Total Fluoride in Soil   Method: ME-(AU)-[ENV]AN142

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Fluoride*	LB050646	mg/kg	50	<50	6 - 20%	NA

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES   Method: ME-(AU)-[ENV]AN040/AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB050604	mg/kg	50	<50	0 - 4%	97 - 99%	
Arsenic, As	LB050604	mg/kg	0.5	<0.5	0 - 3%	95 - 96%	97%
Boron, B	LB050604	mg/kg	5	<5	0 - 7%	95 - 96%	93%
Cadmium, Cd	LB050604	mg/kg	0.1	<0.1	5 - 10%	95 - 96%	95%
Cobalt, Co	LB050604	mg/kg	0.5	<0.5	9 - 10%	93%	90%
Chromium, Cr	LB050604	mg/kg	0.5	<0.5	1 - 2%	96%	95%
Copper, Cu	LB050604	mg/kg	0.5	<0.5	1 - 2%	92 - 93%	94%
Iron, Fe	LB050604	mg/kg	50	<50	1 - 4%	97%	
Manganese, Mn	LB050604	mg/kg	2	<2	2 - 5%	96 - 97%	86%
Molybdenum, Mo	LB050604	mg/kg	0.5	<0.5	0%	97%	97%
Nickel, Ni	LB050604	mg/kg	0.5	<0.5	0 - 5%	94%	93%
Lead, Pb	LB050604	mg/kg	0.5	<0.5	1 - 4%	93%	92%
Selenium, Se	LB050604	mg/kg	1	2	0%	93%	94%
Vanadium, V	LB050604	mg/kg	0.5	<0.5	0 - 2%	96%	95%
Uranium, U*	LB050604	mg/kg	0.5	<0.5	3 - 7%	NA	
Zinc, Zn	LB050604	mg/kg	0.5	<0.5	1 - 2%	94%	94%
Silver, Ag	LB050604	mg/kg	1	<1	0%	103 - 104%	

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN040/AN320	A portion of sample is digested with nitric acid to decompose organic matter and hydrochloric acid to complete the digestion of metals. The digest is then analysed by ICP OES with metals results reported on the dried sample basis. Based on USEPA method 200.8 and 6010C.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M $CaCl2$) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN142	Fluoride can be measured in soil as water extractable or 'total' by Ion Selective electrode. In this method the solid sample is weighed and then fused with sodium hydroxide at 600°C. The sample is carefully neutralise with hydrochloric acid and the solution of the melt is cooled and made up to volume. The final solution is then compared to synthetic Digestion Matrix standards with analysis by ISE electrode for a total fluoride result after being calculated back to original mass.
AN312	Mercury by Cold Vapour AAS in Soils: After digestion with nitric acid, hydrogen peroxide and hydrochloric acid, mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

APPENDIX D

RARC Assessment Results

APPENDIX C
RAPID APPRAISAL OF RIPARIAN CONDITION; SITE DATA

Site 1/1

Start: 56J 0202738 7289571   Finish: 56J 0202665 7289507

Cover - 100m Transect

Layer	Height (m)	Species	Start (m)	Stop (m)
T1	5	*Acacia harpophylla*	95	92
T1	8	*Acacia harpophylla*	74	67.5
T1	7	*Acacia harpophylla*	54.4	43
T1	5	*Acacia harpophylla*	40	34.5
T1	10	*Casuarina cunninghamiana*	34.5	32
T1	13	*Eucalyptus camaldulensis*	23.5	13.5
T1	8	*Eucalyptus camaldulensis*	3	0
T1= 41.9%				

RARC

Width of Riparian Canopy Vegetation

Transect	Channel Width (m)	Vegetation Width (m)	Score
1	10	15	2
2	10	10	2
3	10	15	2
4	10	15	2
Average			2

Vegetation cover

Transect	Canopy	Native Canopy	Understorey	Native Understorey	Ground Cover	Native Ground Cover	Number of Layers
1	1	1	0	0	2	0	2
2	2	2	0	0	2	1	2
3	1	1	1	1	1	0	2
4	2	2	0	0	3	1	2
Average	1.5	1.5	0.25	0.25	2	0.5	2

Debris

Transect	Leaf Litter	Native Leaf Litter	Standing Dead Trees	Hollow-bearing trees	Fallen Logs
1	1	1	0	0	0
2	1	0	0	0	1
3	1	0	1	0	1
4	1	1	1	0	1
Average	1	0.5	0.5	0	0.75

Features

Transect	Native Canopy Species Regeneration	Native Understorey Regeneration	Large Native Tussock Grasses	Reeds
1	0	0	0	0
2	0	0	0	0
3	0	0	1	0
4	0	0	1	0
Average	0	0	0.5	0

Proximity	Longitudinal continuity	Total Score
0	1	15.25


Site 1/1 Transect from beginning


Site 1/1 Transect from end

Site 1/2

Start: 56J 0202738 7289571   Finish: 56J 0202665 7289507

Cover - 100m Transect

Layer	Height (m)	Species	Start (m)	Stop (m)
T1	5	*Acacia salicina*	89.2	88.1
T1	5	*Acacia salicina*	88.5	85.5
T1	4	*Acacia salicina*	86.1	84.1
T1	3	*Geijera parviflora*	81.8	81
T1	8	*Acacia salicina*	77.2	72.6
T1	3	*Acacia salicina*	70.7	67.2
T1	5	*Acacia salicina*	69.5	65.8
T1	5	*Acacia salicina*	65.1	58.7
E	16	*Eucalyptus tessellaris*	12.1	4.4
T1	7	*Casuarina cunninghamiana*	3.5	0
E= 7.7%				
T1= 28.6%				

RARC

Width of Riparian Canopy Vegetation

Transect	Channel Width	Vegetation Width	Score
1	10	10	2
2	10	10	2
3	10	10	2
4	10	10	2
Average			2

Vegetation cover

Transect	Canopy	Native Canopy	Understorey	Native Understorey	Ground Cover	Native Ground Cover	Number of Layers
1	1	1	0	0	3	2	2
2	1	1	0	0	3	2	2
3	1	1	0	0	3	2	2
4	1	1	0	0	3	2	2
Average	1	1	0	0	3	2	2

Debris

Transect	Leaf Litter	Native Leaf Litter	Standing Dead Trees	Hollow-bearing trees	Fallen Logs
1	1	1	1	0	0
2	1	0	0	0	0
3	1	0	1	0	1
4	1	1	0	0	0
Average	1	0.5	0.5	0	0.25

Features

Transect	Native Canopy Species Regeneration	Native Understorey Regeneration	Large Native Tussock Grasses	Reeds
1	0	0	1	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
Average	0	0	0.25	0

Proximity	Longitudinal continuity	Total Score
0	1	14.5

	
Site 1/2 Transect from beginning	Site 1/2 Transect from end

Site 1/4

Start: 56J 0201116 7288583   Finish: 56J 0201189 7288624

Cover - 100m Transect

Layer	Height (m)	Species	Start	Stop
S1	4	*Acacia harpophylla*	71.8	69.8
T1	10	*Eucalyptus camaldulensis*	51.1	43.7
S1	3	*Acacia harpophylla*	46.6	46.5
S1	2	*Acacia harpophylla*	45.6	44.7
S1	4	*Flindersia dissosperma*	43.2	41.8
S1	3	*Geijera parviflora*	41.5	40.2
S1	6	*Alectryon diversifolius*	40	38.4
S1	1	*Acacia harpophylla*	35.5	34.7
S1	5	*Eremophila desertii*	32.3	29.7
S1	3	*Acacia harpophylla*	28.4	27.9
S1	4.5	*Eremophila desertii*	27.8	22.5
T1	12	*Acacia harpophylla*	18.8	16
S1	3	*Eremophila desertii*	16.3	15.1
S1	6	*Acacia harpophylla*	6.5	4.8
S1	6	*Eremophila desertii*	4.8	1.7
T1 = 10.2%				
S1= 22.5%				

RARC

Width of Riparian Canopy Vegetation

Transect	Channel Width	Vegetation Width	Score
1	2	25	3
2	2	25	3
3	2	25	3
4	2	25	3
Average	2	25	3

Vegetation cover

Transect	Canopy	Native Canopy	Understorey	Native Understorey	Ground Cover	Native Ground Cover	Number of Layers
1	2	2	2	2	2	0	4
2	2	2	2	2	2	0	3
3	0	0	0	0	3	0	0
4	0	0	0	0	3	0	0
Average	1	1	1	1	2.5	0	1.75

Debris

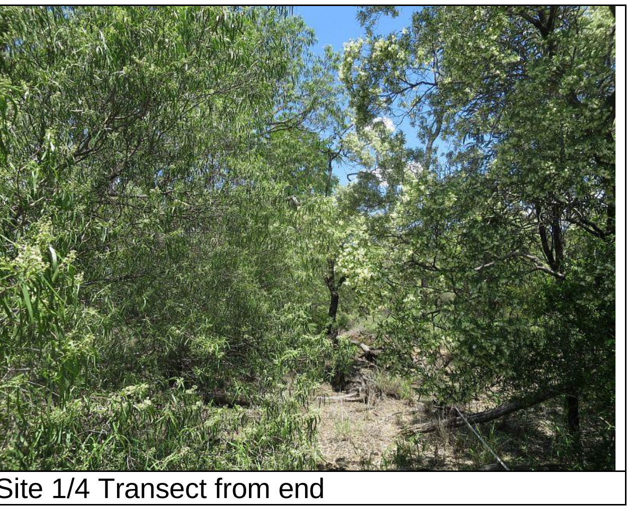
Transect	Leaf Litter	Native Leaf Litter	Standing Dead Trees	Hollow-bearing trees	Fallen Logs
1	3	0	1	0	1
2	1	0	1	0	0
3	2	0	1	0	2
4	2	1	1	1	2
Average	2	0.25	1	0.25	1.25

Features

Transect	Native Canopy Species Regeneration	Native Understorey Regeneration	Large Native Tussock Grasses	Reeds
1	1	0	0	0
2	1	0	0	0
3	0	1	0	0
4	0	0	0	0
Average	0.5	0.25	0	0

Proximity	Longitudinal connectivity	Total Score
0	2	18.25

Site 1/4 Transect from beginning



Site 1/4 Transect from end

Site 1/5

Start: 56J 0199772 7287322 Finish: 56J 0199753 7287241

RARC only conducted at this site

Width of Riparian Canopy Vegetation

Transect	Channel Width (m)	Vegetation Width (m)	Score
1	5	0	0
2	5	20	3
3	5	15	2
4	5	20	3
Average			2

Vegetation cover

Transect	Canopy	Native Canopy	Understorey	Native Understorey	Ground Cover	Native Ground Cover	Number of Layers
1	0	0	0	0	3	0	0
2	2	2	0	0	2	0	2
3	2	2	0	0	2	0	2
4	2	2	0	0	3	0	2
Average	1.5	1.5	0	0	2.5	0	1.5

Debris

Transect	Leaf Litter	Native Leaf Litter	Standing Dead Trees	Hollow-bearing trees	Fallen Logs
1	1	0	0	0	0
2	1	0	0	0	0
3	1	0	0	0	0
4	2	1	0	0	0
Average	1.25	0.25	0	0	0

Features

Transect	Native Canopy Species Regeneration	Native Understorey Regeneration	Large Native Tussock Grasses	Reeds
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	1	0	0	0
Average	0.25	0	0	0

Proximity	Longitudinal connectivity	Total Score
0	1	11.75

	
Site 1/5 Transect from beginning	Site 1/5 Transect from end

Site 1/6

Start: 56J 0199091 7286055 Finish: 56J 0199146 7286132

Cover - 100m Transect.

Layer	Height (m)	Species	Start (m)	Stop (m)
T1	4	*Acacia harpophylla*	100	98.9
T1	5	*Acacia harpophylla*	98.5	96
T1	4	*Acacia harpophylla*	96.2	94.7
T1	4	*Acacia harpophylla*	89.4	88.8
T1	4	*Acacia harpophylla*	88.9	86.9
T1	4	*Acacia harpophylla*	88	86.9
T1	4	*Acacia harpophylla*	87	86.2
T1	4	*Acacia harpophylla*	86.5	85.3
T1	6	*Lysiphyllum hookeri*	85.5	84.3
T1	5	*Acacia harpophylla*	83.2	80.8
T1	7	*Acacia harpophylla*	71.1	68.1
T1	6	*Acacia harpophylla*	67.7	65
T1	6	*Acacia harpophylla*	62	56.6
T1	5	*Acacia harpophylla*	59	56.1
T1	6	*Acacia harpophylla*	36.7	34.8
T1	6	*Acacia harpophylla*	35.7	33
T1	4	*Acacia harpophylla*	32.5	31.7
T1	5	*Acacia harpophylla*	31.2	29.6
T1	6	*Acacia harpophylla*	28.7	27.8
T1	5.5	*Acacia harpophylla*	4.3	3.5
T1	6	*Acacia harpophylla*	1.8	0
T1= 39.9%				

RARC

Width of Riparian Canopy Vegetation

Transect	Channel Width	Vegetation Width	Score
1	15	20	2
2	25	40	2
3	15	40	3
4	15	30	3
Average			2.5

Vegetation cover

Transect	Canopy	Native Canopy	Understorey	Native Understorey	Ground Cover	Native Ground Cover	Number of Layers
1	1	1	0	0	1	0	2
2	1	1	0	0	2	0	2
3	1	1	0	0	1	0	2
4	1	1	0	0	1	0	2
Average	1	1	0	0	1.25	0	2

Debris

Transect	Leaf Litter	Native Leaf Litter	Standing Dead Trees	Hollow-bearing trees	Fallen Logs
1	1	0	0	0	0
2	1	1	0	0	0
3	1	1	0	0	0
4	1	1	0	0	0
Average	1	0.75	0	0	0

Features

Transect	Native Canopy Species Regeneration	Native Understorey Regeneration	Large Native Tussock Grasses	Reeds
1	1	0	0	0
2	1	0	0	0
3	1	0	0	0
4	1	0	0	0
Average	1	0	0	0

Proximity	Longitudinal connectivity	Total Score
0	3	13.5

	
Site 1/6 Transect from beginning	Site 1/6 Transect from end

Site 1/7

Start: 56J 0197597 7283833 Finish: 56J 0197526 7283775

Cover - 100m Transect.

Layer	Height (m)	Species	Start (m)	Stop (m)
S1	3	*Santalum lanceolatum*	100	98.9
T1	8	*Melaleuca bracteata*	86.4	80
S1	1.5	*Alectryon diversifolius*	82.5	82.1
T1	8	*Melaleuca bracteata*	87.9	87.2
E	14	*Eucalyptus camaldulensis*	76.7	71.1
T1	9	*Acacia salicina*	71.1	68.5
T1	8	*Acacia salicina*	71.1	67.8
T1	10	*Acacia salicina*	67.4	64.6
T1	8	*Acacia salicina*	63.8	58.5
T1	8	*Acacia salicina*	60.2	57.4
T1	8	*Acacia salicina*	57.5	54.9
T1	7	*Melaleuca bracteata*	41.7	34
S1	5	*Melaleuca bracteata*	23.3	23.2
T1	6	*Acacia salicina*	6.1	4.4
T1	8	*Melaleuca bracteata*	3.1	2.1
E	20	*Eucalyptus camaldulensis*	10.6	0
E=16.2%				
T1= 36.9%				
S1= 1.6%				

RARC

Width of Riparian Canopy Vegetation

Transect	Channel Width	Vegetation Width	Score
1	10	20	3
2	10	30	3
3	15	25	3
4	10	40	3
Average			3

Vegetation cover

Transect	Canopy	Native Canopy	Understorey	Native Understorey	Ground Cover	Native Ground Cover	Number of Layers
1	3	3	1	1	3	1	4
2	3	3	1	1	3	1	3
3	3	3	1	0	3	0	3
4	3	3	1	1`	3	1	4
Average	3	3	1	0.75	3	0.75	3.5

Debris

Transect	Leaf Litter	Native Leaf Litter	Standing Dead Trees	Hollow-bearing trees	Fallen Logs
1	3	1	0	0	0
2	3	2	0	0	0
3	3	1	0	0	1
4	3	1	1	1	0
Average	3	1.25	0.25	0.25	0.25

Features

Transect	Native Canopy Species Regeneration	Native Understorey Regeneration	Large Native Tussock Grasses	Reeds
1	0	0	0	0
2	0	0	0	0
3	0	0	0	2
4	1	1	0	0
Average	0.25	0.25	0	0.5

Proximity	Longitudinal connectivity	Total Score
3	3	30

	
Site 1/7 Transect from beginning	Site 1/7 Transect from end