



REPORT

Mt Carbine Quarries Pty Ltd
ABN: 52 065 645 650

**Mount Carbine Mining
Stage 3 Water Management Plan**

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1 INTRODUCTION

1.1 Background

The Mount Carbine Project (the Project) is located approximately 80 km north-west of Cairns, in North Queensland. The Project currently comprises the extraction of tungsten from the mine waste that exists at the site and repurposing the resulting waste material for beneficial reuse. The mine waste is derived from the site waste emplacements formed as part of historical mining activities on the mine leases (MLs). The repurposing of the mine waste is being undertaken as a staged process. Stage 1 was the pilot study to determine the feasibility of the process and to set up the reprocessing plant. Stage 2 of the works allowed for increasing processing rates of the mine waste up to 500,000 t/year, with the plant operating seven days a week. Stage 3 will increase the processing of tungsten ore by the mining of material from the Open Cut Pit. The Stage 1 pilot study and Stage 2 increase in processing rates have been completed and the Stage 3 works are being planned. This report addresses the on-site water management for the Stage 3 works.

The mine waste extraction and screening activity is a licensed extractive activity, that is, a quarry operation that occurs under Environmental Authority (EA) Permit No. EPPR00438313, issued by the Department of Environment and Science (DES), dated 16 March 2021 [1]. This quarrying operation is separate to the mining and processing activity.

The development and operation of the ML's, held by Mount Carbine Quarries Pty Ltd (MCQ), is subject to EA Permit No. EPML00956913 [2], issued by DES, and effective from 14 April 2022. This EA relates to the mining and processing of the metal ore for quantities greater than 100,000 t per annum.

The site is located on ML 4867 and ML 4919, and includes the following key features with regards to mining activities:

- Open Cut Pit;
- Crushing Plant (quarry);
- Processing Plant and Workshop;
- Tailings Storage Facility 3 (TSF3);
- Tailings Storage Facility 4 (TSF4); and
- Clean Water Dam.

General layout plans of the Mount Carbine Project showing the location of these features for the existing site layout have been provided in **Appendix A**. The figures were reproduced from the 'Mount Carbine Tungsten Project Estimated Rehabilitation Costs (ERC)' report [3] and the project briefing document [4]. Layout plans for the proposed changes to the site operations have been included in **Appendix B**. The proposed site layout is based on the designs developed by ATC Williams Pty Ltd (ATCW) to address the requirements to recommence mining from the existing pit [5].

1.2 Purpose of the Water Management Plan

A water management plan (WMP) is required to support the application to DES to amend the EA for the recommencement of mining of the Open Cut Pit. EQ Resources, acting as MCQ, commissioned ATCW to undertake development of a WMP for the Project.

The purposes of this WMP document are to:

- Comply with the likely EA requirements and conditions;
- Outline the control measures to be implemented to prevent detrimental impact on receiving waters; and,
- Provide site personnel with a guide for effective water management.



The contents of the WMP were prepared to satisfy the conditions in the Department of Environment and Science (DES) guideline 'Preparation of Water Management Plans for Mining Activities' [6]. The WMP includes the following elements.

- Discussion of the environmental values impacted by the mining operations
- Contaminant source study
- Water management system
- Site water balance and model
- Emergency and contingency planning
- Monitoring and review

1.3 Report Structure

The structure of this report, to address the above purpose and scope, is as follows:

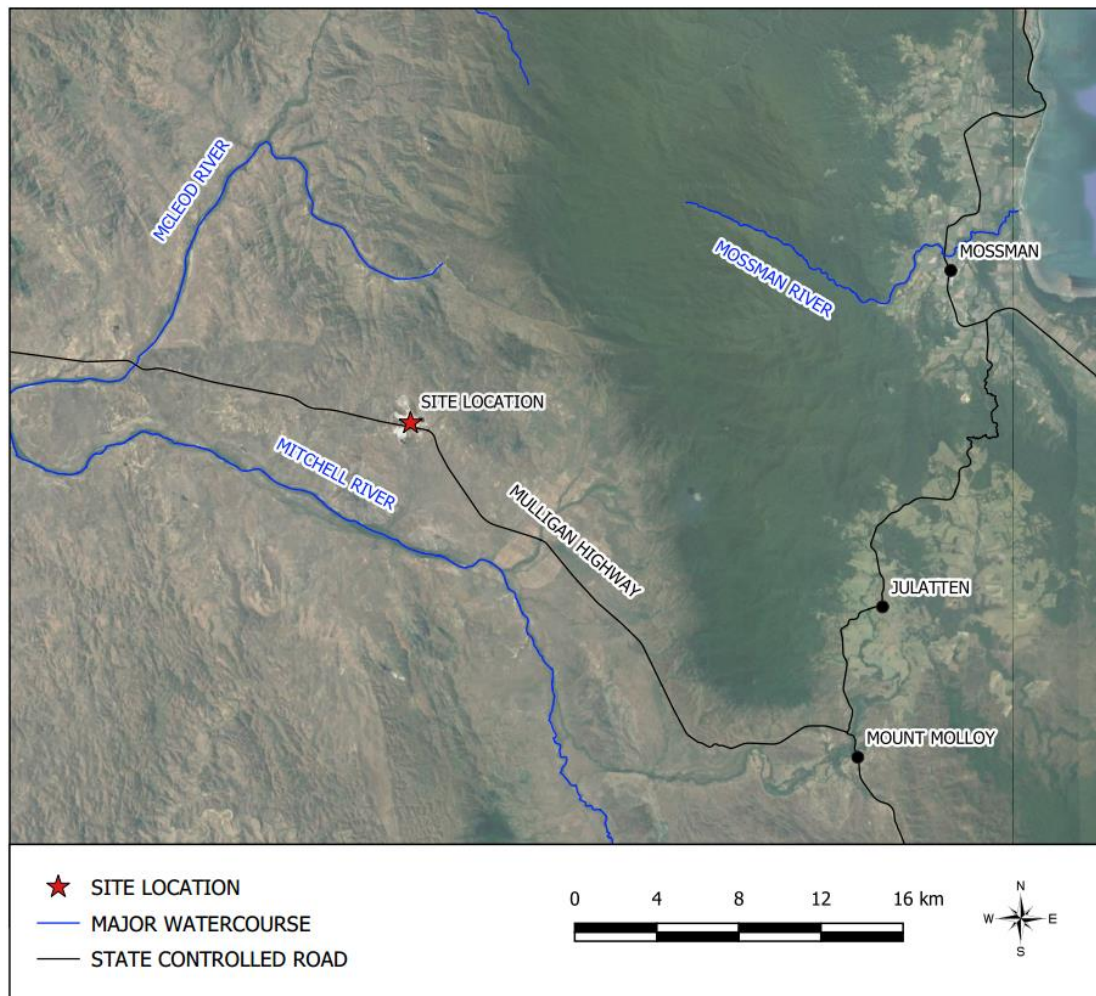
- Section 2.0** Provides a description of the Project in the context of the site climatic and hydrological conditions, the geology and water management features.
- Section 3.0** Presents a summary of the environmental values surrounding the Project site.
- Section 4.0** Presents an overview of the outcomes of the contaminant source study and the receiving environment water quality requirements.
- Section 5.0** Outlines the water management system.
- Section 6.0** Presents a summary of the site water balance modelling and reviews the overall hydrological performance based on the adopted water management layout.
- Section 7.0** Details site water monitoring and review requirements.
- Section 8.0** Provides an overview of the emergency and contingency procedures on-site.
- Section 9.0** Provides an overview of the erosion and sediment control plan developed for the site (by others).

2 PROJECT SITE

2.1 Site Location

The Mount Carbine Project is located approximately 80 km north-west of Cairns, in North Queensland. The geographical location of the project site is shown on **DIAGRAM 1**.

DIAGRAM 1: SITE LOCATION



The current land use on the site is quarrying/crushing of waste rock and tailings and processing of the crushed rock to obtain tungsten and quarry inventory. The surrounding land use is rural-urban, low-intensity grazing and conservation. The site is located within the Brooklyn Nature Refuge [7].

The Mount Carbine township, comprising some rural residences, a caravan park, a hotel and a roadhouse, are located within 5 km of the mine site. All these features are to the south or east of the site [7].

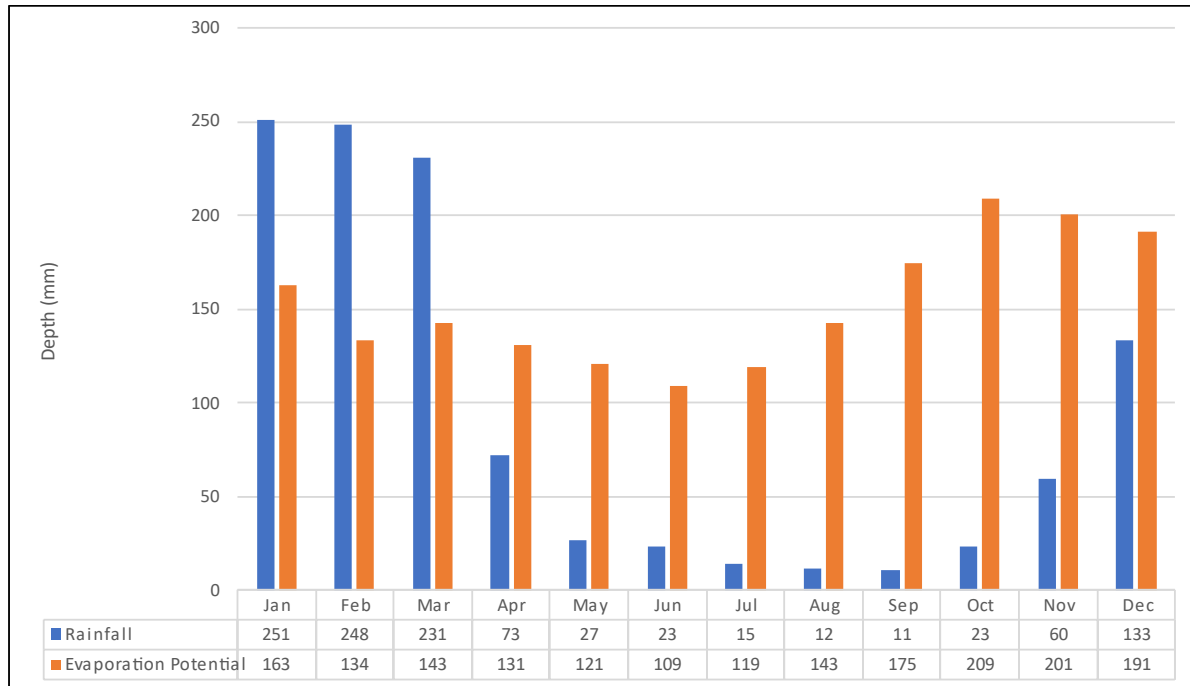
2.2 Climatic Conditions

The Mount Carbine project site is situated in the tropical monsoon belt of northern Queensland and is subject to a tropical climate associated with highly variable rainfall conditions. The closest meteorological station to the site is the Bureau of Meteorology's (BoM) Mount Carbine Township Station (No. 031180), located adjacent to the east of the site. Mount Carbine Township Station does not have a complete rainfall record and has no long term evaporation data, which is a key factor in the assessment of surface water management. Therefore, for the purpose of this assessment, evaporation data has been sourced from a SILO Data Drill [8] for Mount Carbine.



A Patched Data Drill provides an uninterrupted data record for a site, primarily based on real data. Data sourced from the BoM weather stations is utilised with missing/or suspect data supplemented with synthetically generated data based on regionally observed climatic trends. **DIAGRAM 2** summarises the average monthly rainfall and evaporation for the site for the period 1889 to 2022, based on the available period of evaporation pan data from the Patched SILO Data Drill.

DIAGRAM 2: AVERAGE MONTHLY RAINFALL AND EVAPORATION DATA



The annual rainfall and evaporation characteristics are provided in **TABLE 1**. As shown in **DIAGRAM 2** and **TABLE 1**, the annual evaporation exceeds the annual rainfall at the site, except in the wettest months of the year, between January and March. This indicates that the site needs to manage its stored and recycled water efficiently to prevent the requirement to source water from off site. Additionally, there is a requirement to manage the water resources during the wet season to minimise the risk of spills from site that would cause a loss of water for processing and the potential for a contaminant release to the external environment.

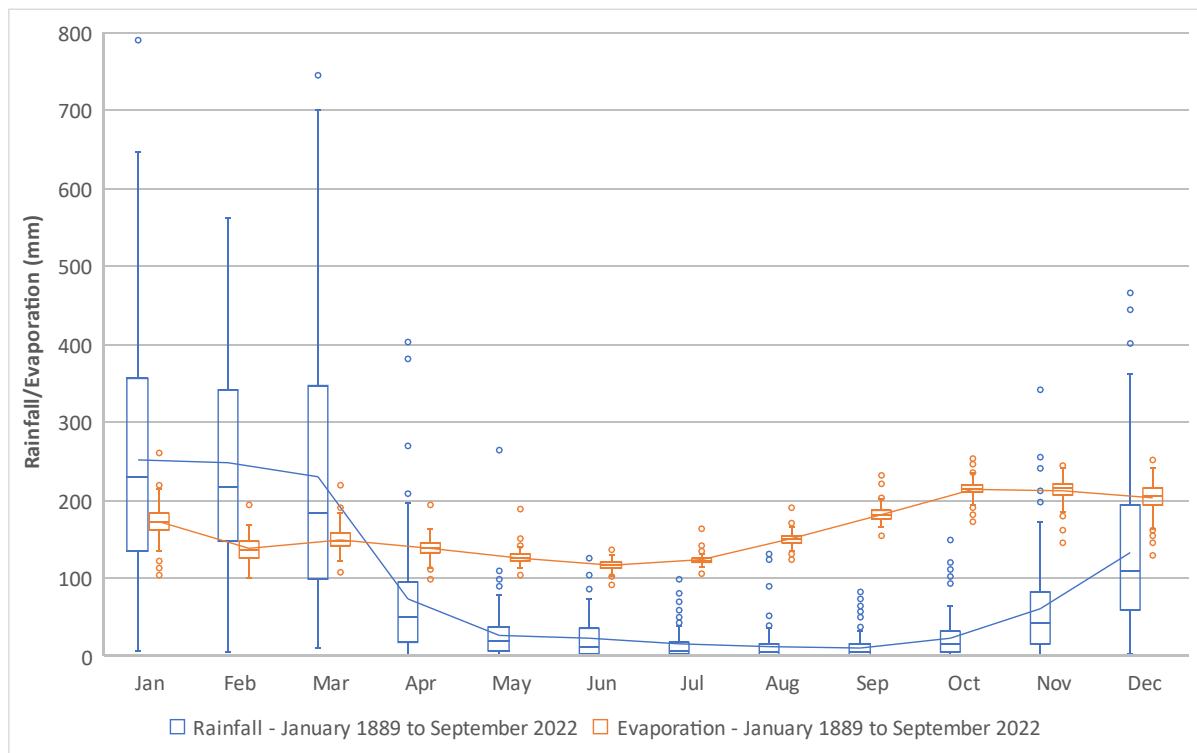
TABLE 1: ANNUAL RAINFALL AND EVAPORATION DATA FROM THE PATCHED DATA DRILL

Characteristic	Depth (mm)
Mean Annual Rainfall	1,107.3
Median Annual Rainfall	892.6
Mean Annual Evaporation	1,837.8
Median Annual Evaporation	1,789

DIAGRAM 3 presents the patched data drill in statistical format, with the whiskers representing the 10th and 90th percentile data, the boxes the 25th to 75th percentile data and the line in the box the 50th percentile (median) values. The box and whisker plot clearly shows that there is a greater range of variation in the rainfall each month than in the evaporation. The plot also indicates that when rainfall events occur, they may have total rainfall depths more than twice the upper quartile values.



DIAGRAM 3: ANNUAL MONTHLY RAINFALL AND EVAPORATION STATISTICS



2.3 Topography and Hydrology

2.3.1 Topography

The following information has been reproduced from the 2013 Erosion and Sediment Control Plan, which is an appendix of the updated 2022 report [9].

The Mount Carbine Mine Site is relatively rugged with the topography described as varying between level alluvial plains rising to short gently sloping pediments and foot-slopes to high hilly to mountainous lands with very steep slopes (Northcote et al. 1960-1968).

The existing low-grade material stockpile is the northernmost feature of the existing mine infrastructure and is located between two ridgelines, with the northern toe of the stockpile in the headwaters of several streams flowing into Holmes Creek. The tailings area is located on the southern side of the Mulligan Highway, on flatter land than the low-grade rock stockpile. The reject crushed ore stockpile is located between the northern low-grade stockpile and the southern tailings area, with drainage flowing into the tailings dam.

The TSF4 area drains to Manganese Creek, which flows to the east of the mining lease, then south to the Mitchell River.

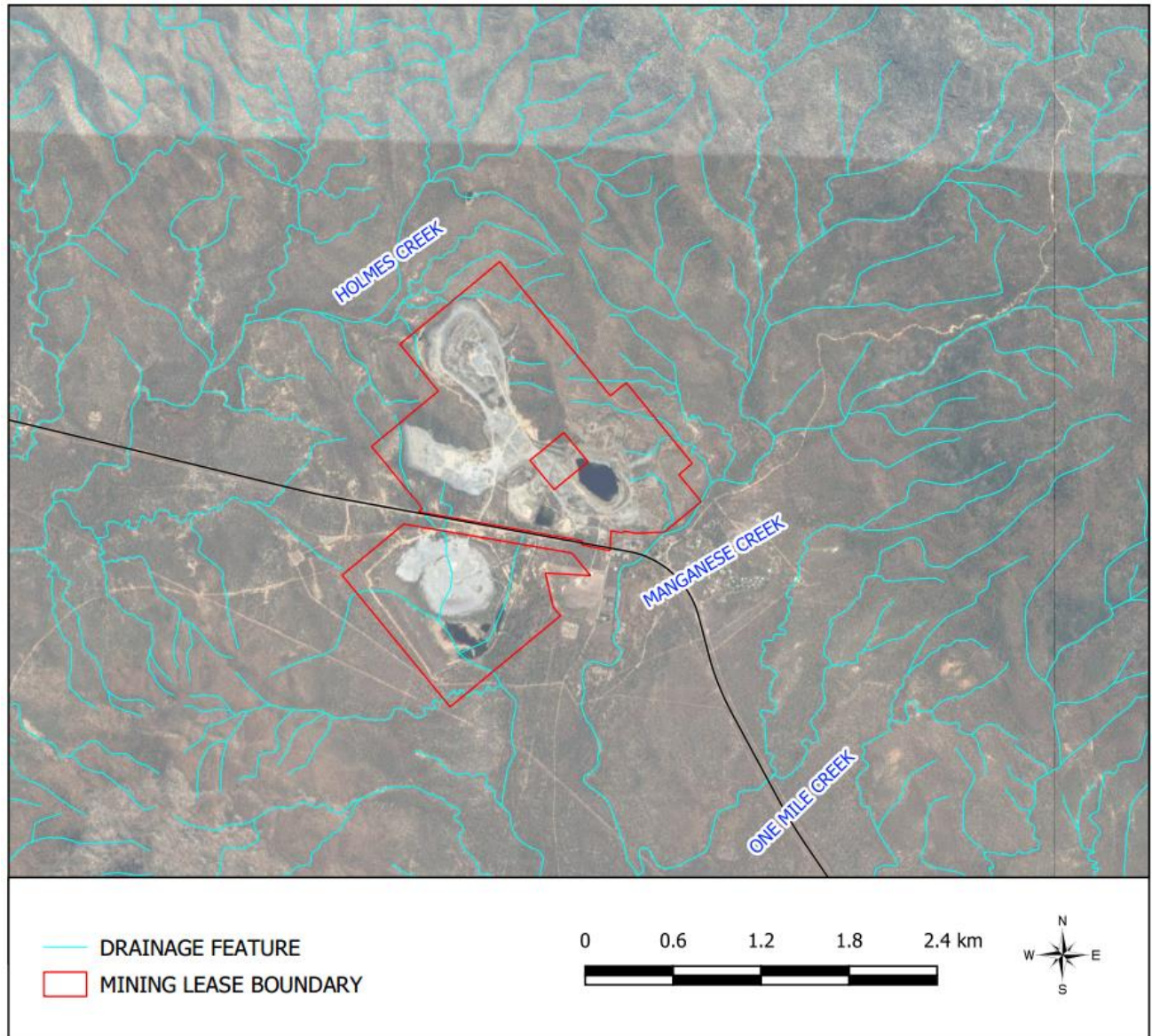
2.3.2 Hydrology

Regionally, the Project is located within the Mitchell River Basin, discharging to the Gulf of Carpentaria. The Mitchell River catchment covers an area of approximately 71,800 km² [10]. The headwaters of the Mitchell River are located on the Atherton Tableland, approximately 50 km northwest of Cairns, at an approximate elevation of RL 376 m AHD. At its closest point, the Mitchell River flows in a north-westerly direction about 5 km south of the Mount Carbine project site (refer to **DIAGRAM 1**).

Drainage within the Project area reports to the Mitchell River, via the catchments of Manganese Creek and Holmes Creek. Both Manganese Creek and Holmes Creek are ephemeral watercourses. The drainage systems relative to the Project location are depicted in **DIAGRAM 4**.

Holmes Creek is located to the west of the site, with its closest point approximately 300 m to the northwest of the low-grade material stockpile area. Water from the low grade material stockpile sump that reported to the pit void now reports to the process circuit. Clean surface water runoff from undisturbed surfaces to the east and west of the stockpile drain to Holmes Creek in clean water diversion drains, as indicated on drawing 119190-05-100-002 in **Appendix A**. Manganese Creek is located to the east of the site, with its closest point being about 300 m southeast of the Pit.

DIAGRAM 4: LOCAL DRAINAGE FEATURES



2.4 Geology

The Project site is in the Siluro-Devonian Hodgkinson sedimentary province of north-eastern Queensland. The sediments were complexly folded and regionally metamorphosed prior to and during extensive granitic intrusion in the Carboniferous and Permian periods. Based on the 1:100,000 scale Rumula geological map, the regional geology of the site is mapped as Hodgkinson Basin meta-greywackes and meta-argillites with local meta-basalts [11]. The tungsten deposits at Mount Carbine are typically associated with sheeted quartz vein systems related to hydrothermal activity from underlying intrusive granite formations [7].



2.5 Hydrogeology

2.5.1 Data Source

The following hydrogeology information has been provided by NRA Environmental Consultants.

2.5.2 Groundwater

The hydrogeology information for the Project has been taken from the Mount Carbine Operations – Revised Conceptual Groundwater Model by Rob Lait & Associates (RLA) and Hydrogeologist.com.au[13]. Components of the updated groundwater conceptual model relevant to the water management plan are set out below.

1. The primary hydro-stratigraphic unit at Mount Carbine occurs within the Hodgkinson Formation. The fractured rocks of the Hodgkinson Formation comprise a secondary porosity aquifer.
2. Groundwater within the Hodgkinson Formation is typically semi-confined to confined and drilling indicates discrete zones of moderate to high hydraulic conductivity within a generally low hydraulic conductivity bulk rock mass.
3. The potentiometric surface on the south-west of the site (i.e., southwest of the standing wall fault) is relatively flat with a low hydraulic gradient. The potentiometric surface on the north-east of site (i.e., north-east of the standing wall fault) is relatively steep with a high hydraulic gradient. This suggests separate hydro-stratigraphic domains either side of the standing wall fault/site, the groundwater chemistry data supports this concept.
4. The potentiometric surface contours south-west of the standing wall fault show that TSF4 (and associated water storage) is leaking, and a localised groundwater mound has formed around this site infrastructure.
5. The salinity and groundwater chemistry across the site is variable and does not readily present any spatial trends or obvious water types. There is a potential clustering of lower chloride / lower bicarbonate groundwater to the north-east of the standing wall fault and higher chloride / higher bicarbonate groundwater to the south-west of the standing wall fault, which supports the separate hydro-stratigraphic domain concept.

Early indications of the open pit groundwater relationship were provided by EQ Resources in October 2022 [16]. The data presented a relationship between daily groundwater inflow rate and elevation of the water surface within the pit, as shown in **TABLE 2**. As expected, the graph indicates that the groundwater inflow to the pit increases when the water surface is lower, to a maximum of approximately 232 m³/day at 225 m AHD.

TABLE 2: GROUNDWATER INFLOW RATE VERSUS PIT ELEVATION [16]

Daily Inflow (m ³ /d)	Water Surface Elevation in the Pit (m AHD)
0	365
89.58	300
232.17	225

If the water surface elevation in the Open Pit is greater than 365 m AHD, there is potential for recharge to the groundwater system.

2.5.3 Groundwater - Surface Water Interaction

RLA and Hydrogeologist.com.au (2022) [13] identified the following:

- Mining development is assessed as impacting groundwater levels beneath the TSF4 and associated water storages (localised mounding). The downgradient TSF4 monitoring bores MB4A and MB4B have observed groundwater levels approximately 4 mbGL to 7 mbGL. The downgradient TSF4 monitoring bores are located within a drainage feature, and the observed data suggests minimal interaction between groundwaters and surface waters downgradient of the TSF4.
- Groundwater is likely discharging to the sub-surface between the low-grade stockpile and Holmes Creek, with vegetation suggesting wet soil conditions. Based on the available data there is potential for groundwater surface water interaction to be occurring in the upper catchment of Holmes Creek. The groundwater level data, presence of established vegetation (Pandanus at SW20) and the monitoring carried out under the REMP suggests this potential shallow groundwater interaction is a natural, established occurrence rather than an impact of mining.
- Elsewhere, there is minimal interaction between watercourses and groundwater at the Mount Carbine project site RLA (2012). The 2022 REMP (NRA, 2022) report concluded that there is no discernible impact on the aquatic ecosystem and human use environmental values (EVs) associated with the contemporary mining activities.

2.6 Site Features

As discussed in **Section 1.1**, the existing key elements associated with mining activities undertaken on the site include the following:

- Open Cut Pit;
- Crushing Plant (quarry operational area)
- Processing Plant and Workshop;
- TSF4;
- Proposed Waste Rock Dump (WRD); and,
- Clean Water Dam.

The plans to increase production of tungsten include recommencement of mining from the Open Cut Pit. To operate the proposed mining activities, the water stored in the Pit will need to be emptied and surface runoff from the northern part of the site will have to be diverted away from the Pit. It is proposed that the capacity of TSF4 is increased by construction of a downstream embankment raise and incorporation of the existing Clean Water Dam. The existing, disused, TSF3 will also be brought back into service with a raised embankment. Where ground surface elevations allow, surface water runoff from the Low Grade Material stockpile, the Optical Sorter Reject Area and the Quarry Operational Area will be diverted from the Open Cut Pit to TSF3 (refer to the NRA Figure 1 'Project EA Mapped Domains and Quarry and Mining Disturbance Areas' in Appendix A for the layout of the existing features). When full, TSF3 will overflow to TSF4. The existing permissible release location will be retained at the southern point of TSF4 (refer to **Section 7.1.1**). The final upgrade to the water management system were corrective actions to the existing Quarry Sump at the north-eastern end of the Low Grade Material Stockpile. The drawings showing the proposed layout of the site and the upgraded features are provided in **Appendix B**.

A 2016 consequence category assessment [17] classified the existing TSF4, the Clean Water Dam and the Open Cut Pit with 'Low' consequence categories. As such, none of the existing water storages on site have regulated structure status. CCA analyses have been undertaken for the proposed designs for TSF3 and TSF 4 and re-evaluated them as 'Low' consequence structures, as reported in the 'Stage 3 Waste and Water Management Design Report' [18]. A summary of the DES CCA analyses for TSF3 and TSF4 raises from the design report has been provided in **TABLE 3**.



TABLE 3: DES CONSEQUENCE CATEGORY ASSESSMENT SUMMARY

Failure Scenario	TSF Raise
Failure to Contain – Seepage	N/A
Failure to Contain – Overtopping	Low
Failure to Contain – Dam Break	Low
Overall	Low

The Open Pit will no longer be a water storage and will store less than 2.5 ML of water, so no CCA is required. The Clean Water Dam will be demolished and the area incorporated into the raised TSF4 configuration. Remediation works have been completed on the Quarry Sump to minimise the site-specific risk of seepage, and this is also exempt from the requirements of the 'Manual for assessing consequence categories and hydraulic performance of structures' [19].

The existing and proposed water storage features are described in more detail below. The water management strategy for the construction work to be undertaken for the Stage 3 upgrades is discussed in more detail in **Section 5.2**.

2.6.1 Open Cut Pit

The Open Cut Pit is situated north of the Mulligan Highway; it has been used as a water storage and as discussed in the previous section, is not a regulated structure. The Open Cut Pit is approximately 70 m deep and has a spill elevation of RL 380.0 m AHD. The pit has a stored water surface area of about 9.7 ha at the full supply level (FSL), with an estimated capacity of approximately 3,429 ML [20]. The current (5 September 2022) water level within the pit is at RL 347.78 m [21].

The Open Cut Pit currently has upstream catchment areas reporting from quarry disturbance areas on the site. These upstream catchment areas include the Quarry Operational Area and approximately 5 ha of undisturbed land between the Quarry Operational Area and the Old Mine Workings.

In preparation for the recommencement of mining operations in the Open Cut Pit, the Pit is currently being dewatered through use of a series of spray evaporators located on the quarry site, including the haul roads for dust suppression, and by pumping to TSF4, where available capacity exists. For the purposes of water balance modelling (refer Section 6), it has been assumed that once construction of TSF3 and TSF4 raises has been completed (thereby increasing available capacity in these storages) and the Pit dewatering is complete, half of the evaporative sprayers would be transferred to TSF3 to maintain reduced water levels in that storage. When TSF3 is online, any pumping from the Open Cut Pit to TSF4 will cease and the Pit will continue to be dewatered by pumping directly to TSF3 and through use of the remaining evaporative sprayers. The details of the evaporative sprayers in use on site is provided in **TABLE 4** (based on information provided by EQR).

TABLE 4: EVAPORATIVE SPRAYERS

Date	No. of Nozzles	Pumping Rate per sprayer (m ³ /h)	Hours of Operation per day	Potential Total Evaporation Loss	
				m ³ /d	ML/d
01/09/2022	18	28	10	5,040	5.04
01/12/2022	42	28	10	11,760	11.76

Following completion of the Stage 3 upgrades, surface runoff from the re-formed Low-Grade Ore Stockpile, part of the re-formed Optical Sorter Reject Area and other areas around the Open Cut Pit will be directed to TSF3, along with pumped seepage from the Quarry Sump. The remaining surface runoff catchment draining to the Pit will comprise an area of 34.1 ha, including the Pit and the Waste Rock Dump. Surface runoff draining into the Pit will be collected in a sump where treatment for potential contaminants may occur before being pumped to TSF3 for storage. It is recommended that the water balance and water management plans are reviewed on an annual basis to assess the



routing of the surface runoff as the material stockpile areas are re-formed. This will require LiDAR data to be re-flown prior to the reviews.

The proposed mining operations in the Open Cut Pit have been planned over three stages. The proposed staging is presented in **TABLE 5** and the pit extents are shown on **DIAGRAM 5**, **DIAGRAM 6** and **DIAGRAM 7**. It should be clarified that the stages of mining in the Open Cut Pit are not the same as the stages for the site development and care should be taken when discussing either one.

The surface runoff draining to the Open Cut Pit will collect in a pit sump and will be pumped to TSF3 for storage (refer to **DIAGRAM 17**).

TABLE 5: PROPOSED STAGING OF MINING IN THE OPEN CUT PIT

Stage	Open Cut Area (ha)	Base Elevation (m AHD)	Ground Surface Elevation (m AHD)	Excavated Depth (m)	Estimated Start Date	Estimated End Date
1	10.3	310	380	70	01/02/2023	01/12/2023
2	18.6	225	435	210	01/12/2023	01/12/2025
3	20.6	225	470	245	01/12/2025	01/09/2027



DIAGRAM 5: LAYOUT OF MINING STAGE 1 (EXISTING) OPEN CUT PIT





DIAGRAM 6: PROPOSED LAYOUT OF MINING STAGE 2 OPEN CUT PIT



DIAGRAM 7: PROPOSED LAYOUT OF MINING STAGE 3 OPEN CUT PIT



2.6.2 Crushing Plant

The crushing plant is in the Quarry Operational Area to the north-west of the Open Cut Pit. As discussed in **Section 2.6.1**, the Quarry Operational Area currently drains to the Open Cut Pit. Following completion of TSF3 upgrade, the surface water runoff from the Quarry Operational Area will be directed to TSF3.

The Crushing Plant area comprises a Raw Water Tank and a dewatering system that recirculates water to the Raw Water Tank. Currently, the Raw Water Tank receives water from the Open Cut Pit at an average rate of 32.3 m³/h (9 L/s). After the Stage 3 upgrades have been completed, all the water supplied to the Raw Water Tank will be from the Process Water Tank, at a rate of 129.5 m³/h when the Crushing Plant is in operation. The Process Water Tank is supplied with water from the Process Plant Dewatering system and TSF4, which will act as the raw water dam.

The Crushing Plant will operate during the day shift.

For the purposes of the water balance modelling, the Crushing Plant has been combined with the Processing Plant into a single Retreatment Area.

A process flow diagram for the Stage 3 water usage at the Crushing Plant and Processing Plant has been provided by Jukes Todd in their May 2022 memorandum^[22]. The memo contains the key assumptions for the water balance on the site after completion of the Stage 3 upgrades. In addition, the memo provides details of the day shift (12 hours) and night shift water (12 hours) use on the site. A copy of the memo has been provided in **Appendix D** for information. The key assumptions from the



memo are replicated in **TABLE 6** and have been used to develop the water balance model (refer also to **Section 5.2.4**).

TABLE 6: KEY ASSUMPTIONS FOR THE CRUSHING AND PROCESSING PLANT WATER BALANCE FOR STAGE 3^[22]

Water Consumption	Assumed Value
Crushing Plant water requirement	129.5 m ³ /h
Crushing Plant water loss	8 m ³ /h
Process Plant water requirements	200 m ³ /h
Process Plant moisture loss	30 m ³ /h
Moisture lost from dewatering and stockpiling of process plant ROM material	6.5 m ³ /h
Fine tailings water loss (assumes 70% solids)	2.4 m ³ /h
Coarse tailings water loss (assumes 85% solids)	9.5 m ³ /h

2.6.3 Processing Plant and Workshop

The Processing Plant and Workshop area is located on the southern portion of the project site to the north of TSF4. Surface runoff from this area reports to TSF4. The Processing Plant has approval to process over 100,000 t/year [2], in a seven day working week. Process water is currently sourced from the Clean Water Dam for reprocessing operations at an average rate of 134.5 m³/h (37.4 L/s). After the Stage 3 works have been completed, the process water tank supply will be sourced from TSF4 and the Process Plant Dewatering system. Water will be supplied to the Process Plant at a rate of 85 m³/h during the day shift and 200 m³/h during the night shift, when the Crushing Plant is not operating (refer also to **Section 5.2.4**).

2.6.4 Tailings Storage Facility 4

It is understood that TSF4 was first constructed during the early stages of mining at the site, approximately 30 to 40 years ago. The TSF exists to contain tailings that have historically been generated from the mine process plant and comprises an above-ground storage facility formed by earthen embankments. In the northern portion of TSF4, tailings have been stockpiled above the crest level of the perimeter embankment, while the southern portion of the TSF consists of a tailings lagoon, bounded by perimeter embankments to the west, south and south east. At the southern corner of TSF4, a concrete lined open channel spillway exists. In October 2013 works were undertaken to reduce the catchment reporting directly to the TSF, via the construction of diversion drains. In October / November 2016, further works were undertaken to enhance the capacity of the diversion channel on the western side of TSF4. Diversion drains are currently in place to divert water around TSF4, along the western, northern and north-eastern sides of the facility.

The proposed Stage 3 upgrade works will raise and extend the TSF4 embankments to increase the storage capacity of the structure. Whilst construction of TSF3 is ongoing, stored water from the Open Cut Pit will be pumped to TSF4 where available capacity exists. The existing Clean Water Dam will be demolished and the area will be incorporated into the expanded TSF4 structure. When all construction on the site has been completed, TSF4 will function solely as a water storage facility, supplying the Process Water Tank. TSF4 will receive excess water from the Process Plant Dewatering system (11.9 m³/h) and pumped overflows and any spills from TSF3. In addition, TSF4 will receive the contaminated surface water runoff from the area of the Process Plant and Workshops south of Mulligan Highway (refer to **Figures 002 to 004**).

Spills from TSF4 occur at the permissible release point at the southern corner of the site. The spills flow overland to Manganese Creek and on to Mitchell Creek.

2.6.5 Tailings Storage Facility 3

Although TSF3 is an existing structure, it was decommissioned and currently has no function at the site. The Stage 3 upgrade will raise embankments around TSF3 for use as a water storage facility.

When TSF3 has been constructed, it will receive water pumped from the Pit as part of its dewatering process. As mentioned in **Section 2.6.1**, when TSF3 has been constructed and the Pit dewatering is complete, it is assumed that half of the spray evaporators used to dewater the Pit would be used at TSF3 to reduce the stored water volumes going forward.

Surface water runoff from part of the re-formed Optical Sorter Reject Area, part of the re-formed Low Grade Material Stockpile, the undisturbed area between the Quarry Operational Area and the Old Mine Workings, the Quarry Operational Area and the material stockpile on the west side of TSF3 will be redirected to TSF3. Surface runoff collected in the Pit sump will be pumped to TSF3. Seepage from the Low Grade Material Stockpile Quarry Sump will be pumped to TSF3. When full, excess water in TSF3 will be pumped to TSF4. Any spills from TSF3 will be routed to TSF4.

2.6.6 Low Grade Stockpile Sump (Quarry Sump)

The existing Low Grade Ore Stockpile Sump collected seepage from the Low Grade Material Stockpile for pumping to the Open Cut Pit. The Sump has been upgraded as part of the Stage 3 works and the collected seepage is pumped to TSF4 (TSF3 when available) at a maximum rate of 200 L/s when full. Layout drawing number 119190-05-000-003-A of the upgraded Sump is provided in **Appendix B**.

2.7 Surface Water Catchment Delineation

As discussed in **Section 2.6**, the catchment layouts for the surface water runoff will be altered by the Stage 3 upgrades. The delineation of the catchment land use types reporting to water storage facilities for the existing case and the three stages of mining in the pit after the construction of TSF3 and the raising of TSF4 embankments are shown on **Figures 001, 002, 003 and 004** at the end of the report. North of the Mulligan Highway, all the sub-catchments shown on the figures, except the WRD and the Pit, will drain to TSF3.

3 ENVIRONMENTAL VALUES

3.1 General

The local environmental values have been designated by the Commonwealth and Queensland Governments. The data is available from the following sources.

- Matters of National Environmental Significance (MNES) report [24]
- Matters of State Environmental Significance (MSES) report [25]
- High Ecological Value (HEV) waters set out by the Queensland Environmental Protection (Water) Policy 2009 (EPP Water) [25]
- Wetlands of general ecological significance (GES), set out on the Queensland Government referable wetland mapping site
- Riverine areas, springs or lakes and associated flora and fauna.
- Business Queensland Bore Reports (from Queensland Globe) [26]

The environmental reports for the environmental factors are provided in **Appendices E and F**.

In addition to the Queensland Government assessments, Schedule 1 of the 'Environmental Protection (Water and Wetland Biodiversity) Policy 2019' [27], which is a subordinate legislation to the 'Environmental Protection Act 1994' (EP Act) [28], documents the waters for which the legislation applies that are either enhanced or protected and specifies relevant environmental values (EV's) and Water Quality Objectives (WQO's). The MNES report in **Appendix F** provides details of the matters of environmental significance that may occur or relate to an area of 10 km around the Mount Carbine site that are protected by the Environmental Protection Biodiversity and Conservation (EPBC) Act.

3.2 Wetlands and Waterways

Review of Schedule 1 of the 'Environmental Protection (Water and Wetland Biodiversity) Policy 2019' [27] indicates that the Mitchell River Basin does not currently have gazetted and mapped EV's or WQO's. Notwithstanding, generalised assessment under the Environmental Policy can be based on the nature of the receiving environment, as described in more detail below.

The MNES report in **Appendix E** states that there were no wetlands of international importance within 10 km of the site [24].

The MNES report indicates that the site is located within a water resource planning area. A water resource plan is a scheme over a part of the State that advances the sustainable management of Queensland's water [29]. This planning area indicates that there is a system in place to allocate the use of water in the area and to provide riverine protection to the watercourses and groundwater that may be used for water supply.

The receiving environment surrounding the project site is considered 'moderately disturbed' as a result of the impacts of low intensity cattle grazing, and exploration activities in the area.

Based upon the hydrological domains downstream of the project site and potential downstream users, classification of Environmental Values (EV's) for the downstream environment may include:

- Aquatic ecosystems;
- Primary industries, including irrigation, stock drinking water, aquaculture and human consumption of aquatic foods;
- Recreation and aesthetics;
- Drinking water;
- Industrial water; and
- Cultural and spiritual values.



The MSES report [25] in **Appendix E** states that there are no wetlands or waterways in high ecological value (HEV) waters within Lot SP254833, which contains the Mount Carbine Mine site.

3.3 Groundwater

The Environmental Management Plan [7] reported environmental values for the area in the absence of definition in legislation, and these values remain applicable. The Environmental Management Plan presented information that showed that:

- Groundwater in the area is moderately alkaline.
- Shallower groundwater is generally of lower electrical conductivity than the deeper groundwater. As electrical conductivity is one measure of water salinity, the deeper groundwater is more saline than the shallower groundwater. Higher salinity groundwater is generally an indication of longer residence time within the aquifer zone. Therefore it is likely that the hydraulic conductivity of the deeper aquifer zone is less than the hydraulic conductivity of the shallower aquifer zone, with consequent lower groundwater flow velocity in the deeper aquifer zone.
- Electrical conductivity of the groundwater indicates that the water is naturally brackish and not suitable for human consumption.

Therefore, the following values have been nominated for the project:

- stock watering
- firefighting (industrial).

3.4 Protected Fauna

The MSES report (**Appendix E**) has not identified any protected special wildlife reserves, state marine parks or fish habitat areas within Lot SP254833.

The MSES did identify a number of threatened (endangered or vulnerable) wildlife within Lot SP254833. The Mount Carbine site is surrounded by an area identified as both Wildlife habitat – special least concern and endangered or vulnerable. The list of animals within each category is provided in the MSES report in **Appendix E**.

3.5 Protected Vegetation

The vegetation surrounding the Mount Carbine site is classified as Category B [25], which is remnant vegetation shown on a regional ecosystem or remnant map as an endangered regional ecosystem, an of concern regional ecosystem or a least concern regional ecosystem. The MSES report in **Appendix E** has identified this vegetation as 'Protected Areas – nature refuges'. This protected area is named the Brooklyn Nature Refuge. Map 4 in the MSES report has subdivided this protected area into different types of regulated vegetation. An extract of the map is provided in **DIAGRAM 8**. The area surrounding the mine site is identified as essential habitat. Further areas of essential habitat and endangered or of concern vegetation exist between the Mount Carbine site and the Mitchell River.

DIAGRAM 8: AREAS OF REGULATED VEGETATION



Area of Interest

- Selected Lot and Plan
- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)

Extract from MSES report in **Appendix E**.

3.6 Groundwater Aquifers

The DES Wetland Info database [29] does not hold any aquifer data in the Mareeba Shire region. There are 36 sub-artesian groundwater bores within 20 km of the Mount Carbine site. A summary of the bore locations is provided in **TABLE 7** and in **DIAGRAM 9**. The water quality data contained within the borehole records are either decades old or do not exist. As an alternative to reviewing all

the borehole water quality data, the groundwater records from the mine site have been reviewed. A figure showing the locations of the groundwater boreholes on the site is in **Appendix C**. More information on the groundwater water quality is provided in **Section 4**.

DIAGRAM 9: BOREHOLE LOCATIONS WITHIN 20 KM OF THE PROJECT



**TABLE 7: GROUNDWATER BORES WITHIN 20 KM OF MOUNT CARBINE**

Registered Number	Original Name	Latitude	Longitude	Drilled date
45276	FARM 1 BORE 5	-16.50982854	145.1719553	
45277	FARM 1 BORE 2	-16.50995882	145.1719553	
45279	FARM 1 BORE 3	-16.50982854	145.171825	
45275	FARM 1 BORE 1	-16.50982854	145.171825	
45280	FARM 1 BORE 6	-16.50995882	145.1717599	
45278	FARM 1 BORE 4	-16.50995882	145.1716947	
45287	FARM 2 BORE 7	-16.51217359	145.1704571	
45285	FARM 2 BORE 3	-16.51217359	145.1704571	
45283	FARM 2 BORE 5	-16.51217359	145.1704571	
45284	FARM 2 BORE 2	-16.51230387	145.1704571	
45286	FARM 2 BORE 4	-16.51217359	145.1703268	
45281	FARM 2 BORE 6	-16.51230387	145.1701965	
78259	VILLAGE BORE	-16.51595173	145.1435547	7-May-92
148764	MB 3	-16.51979169	145.1356174	27-Nov-11
148758		-16.53665636	145.1259379	17-Nov-11
148757	MB 4	-16.5366474	145.1259474	16-Nov-11
148732		-16.53299266	145.1315189	15-Nov-11
148733	MB 6	-16.53298371	145.1315283	15-Nov-11
148458		-16.5283333	145.0061111	8-Jul-10
78407		-16.52832723	145.1335146	12-Feb-92
148760		-16.52637676	145.1182623	20-Nov-11
148759	MB 1	-16.52636781	145.1182718	18-Nov-11
148762	MB 5	-16.52001744	145.1094722	24-Nov-11
148761	MB 5	-16.52000849	145.1094817	24-Nov-11
148763	MB 3	-16.51980064	145.135608	27-Nov-11
148457		-16.5180556	145.0066667	1-Jul-10
183803		-16.49194444	145.0008333	25-Oct-19
126037		-16.56814132	145.2015144	28-May-02
126597		-16.5676269	145.2001356	27-Feb-03
148731		-16.57732341	145.1836657	21-Nov-11
148461		-16.5280201	145.1387784	3-Jul-10
148459		-16.5279513	145.1384787	5-Jul-10
148460		-16.5276753	145.1385185	6-Jul-10
45641		-16.50087602	144.9890476	
45164		-16.49961587	144.9891621	1-Jan-70
45163		-16.49824116	144.9890476	1-Jan-66



4 CONTAMINANT SOURCE STUDY

4.1 Preamble

A contaminant source study identifies the origin and chemical composition of different types of water on the mining project. The objective of this is maintain the biological integrity of the surface waters and groundwater at the project site and to ensure the quality of the water does not adversely affect any environmental values or the health, welfare and amenity of people, fauna and land users by meeting statutory requirements and acceptable standards.

4.2 Receiving Environment

4.2.1 Catchment Conditions

The Mount Carbine mine site is in the upper reaches of the Mitchell River catchment in Far North Queensland. The site is located approximately 5 km from the Mitchell River and any surface runoff or spills have the potential to contaminate the surface water network or the local groundwater system. The Mitchell River originates on the Atherton Tableland, in the Great Dividing Range, 48 km northwest of Cairns and flows approximately 750 km northwest across the Cape York Peninsula from Mareeba Shire to the Gulf of Carpentaria. The watershed of the Mitchell River is 41,315 km² [29]. As shown on **DIAGRAM 4** and discussed in **Section 2.3.2**, the mine site is bounded by Holmes Creek to the west and Manganese Creek to the east. In this location, Homes Creek and Manganese Creek are ephemeral.

4.3 Origin and Chemical Composition of Contaminants

4.3.1 Origin of Contaminants

With reference to the NRA figure showing the EA mapped domains and quarry and mining disturbance areas [3] in **Appendix A**, the contaminant sources can be classified into mining disturbance and quarry disturbance areas. The areas of site in the different classifications are provided in **TABLE 8**.

TABLE 8: CONTAMINANT SOURCES

Contaminant Source	
Mining Disturbance	Quarry Disturbance
Open Pit	Low Grade Material Stockpile
Processing Plant and Workshop	Quarry Operational Area
Clean Water Dam	Reject Stockpile
Old mine Workings	TSF3 (not operational)
Overburden Stockpile	Process Water Pond (not operational)
Old Stockpile Area	Tailings Stockpile in TSF4
Roads around the Open Pit	Water Storage in TSF4
Core Yard and Laydown Area	
Offices and Laboratory	
Sulphide Disposal Dump	
Previous Mill and ROM Pad	



4.3.2 Chemical Composition of Contaminants from Different Sources

4.3.2.1 Tailing Storage Facility 4 [7]

The tailings geochemistry was developed from water quality monitoring from TSF4 and elemental analysis from 2001 to 2013. The monitoring data indicated that the water in TSF4 was circum-neutral to slightly alkaline. This indicates that the no significant acidification occurred in the tailings material, which reflects the composition of the non-acid forming low grade stockpile material. The chemical composition of the water in TSF4 is presented in **TABLE 9**.

TABLE 9: WATER MONITORING DATA FOR TSF4 (2001-2013) [7]

Element	Units	Median Quantity	EA Release Quality Objective
pH	-	7.15	6.0 – 7.5
Electrical Conductivity	µS/cm	230	5000
Sulphate	mg/L	31	20 x 80 th percentile of reference site concentration
Fluoride	mg/L	2.4	Default value or 20 x 80 th percentile of reference site concentration
Aluminium (total)	mg/L	0.12	1.1 or 20 x 80 th percentile of reference site concentration, whichever is higher
Antimony (total)	mg/L	<0.003	20 or 20 x 80 th percentile of reference site concentration, whichever is higher
Arsenic (total)	mg/L	0.038	0.26 or 20 x 80 th percentile of reference site concentration, whichever is higher
Cadmium (total)	mg/L	0.0001	0.004 or 20 x 80 th percentile of reference site concentration, whichever is higher
Chromium (total)	mg/L	<0.001	0.02 or 20 x 80 th percentile of reference site concentration, whichever is higher
Cobalt (total)	mg/L	0.001	0.028 or 20 x 80 th percentile of reference site concentration, whichever is higher
Copper (total)	mg/L	0.002	0.028 or 20 x 80 th percentile of reference site concentration, whichever is higher
Lead (total)	mg/L	0.0005	0.068 or 20 x 80 th percentile of reference site concentration, whichever is higher
Manganese (total)	mg/L	0.11	38 or 20 x 80 th percentile of reference site concentration, whichever is higher
Mercury (total)	mg/L	<0.0001	-
Molybdenum (total)	mg/L	0.097	0.68 or 20 x 80 th percentile of reference site concentration, whichever is higher
Nickel (total)	mg/L	<0.001	0.22 or 20 x 80 th percentile of reference site concentration, whichever is higher
Selenium (total)	mg/L	<0.003	0.02 or 20 x 80 th percentile of reference site concentration, whichever is higher
Tin (total)	mg/L	0.008	-
Tungsten (total)	mg/L	0.034	20 x 80 th percentile of reference site concentration
Zinc (total)	mg/L	0.009	0.16 or 20 x 80 th percentile of reference site concentration, whichever is higher



4.3.2.2 Low Grade Material Stockpile

Testing of samples from the low grade stockpile all indicated that the material was non-acid forming and hence generation of strongly acidic drainage was not expected to occur [7].

Testing of the sampled material from the low grade stockpile indicated that arsenic, selenium, cadmium and antimony were significantly enriched.

The 2013 Environmental Management Plan [7] also indicated that the quality of the seepage from the toes of the low grade stockpile was circum-neutral. The test results of the seepage indicated a range of elements were present in its chemical composition, as listed in **TABLE 10**.

TABLE 10: ELEMENTS IN SEEPAGE FROM THE LOW GRADE STOCKPILE (2011-2013) [7]

Element	Units	Median Value (mg/L)
pH (Lowest value reported was 6.4)	-	6.7
Electrical Conductivity	µS/cm	925
Sulphate	mg/L	435
Fluoride	mg/L	9.3
Aluminium	mg/L	1.75
Zinc	mg/L	0.18
Nickel	mg/L	0.031
Manganese	mg/L	0.018
Arsenic	mg/L	0.009
Tungsten	mg/L	0.006
Selenium	mg/L	0.004
Copper	mg/L	0.004
Cadmium	mg/L	0.0016
Cobalt	mg/L	0.0005
Chromium	mg/L	0.0005

4.3.2.3 Clean Water Dam

The Clean Water Dam receives recycled water from the processing plant and surface runoff from the upstream quarry catchment. As a result, it is expected to have similar chemical constituents to the Low Grade Material Stockpile and TSF4. The Clean Water Dam spills to TSF4 so does not directly contribute to spills to the natural environment. The Clean Water Dam will be incorporated into TSF4 as part of the raise construction.

4.3.2.4 Open Cut Pit

Results from water quality sampling in the Open Pit on 26 August 2021 were provided by MCQ site staff. The results of the testing are presented in **TABLE 11**.

**TABLE 11: WATER MONITORING DATA FOR THE OPEN PIT (26 AUGUST 2021)**

Element	Units	Median Quantity
pH	-	7.5
Electrical Conductivity	µS/cm	670
Fluoride	mg/L	6.8
Aluminium (total)	mg/L	0.020
Antimony (total)	mg/L	<0.003
Arsenic (total)	mg/L	0.1
Boron (total)	mg/L	0.023
Cadmium (total)	mg/L	<0.0001
Chromium (total)	mg/L	<0.001
Cobalt (total)	mg/L	<0.001
Copper (total)	mg/L	0.001
Lead (total)	mg/L	<0.001
Manganese (total)	mg/L	0.029
Mercury (total)	mg/L	<0.00005
Molybdenum (total)	mg/L	0.1
Nickel (total)	mg/L	0.001
Selenium (total)	mg/L	<0.003
Tungsten (total)	mg/L	0.024
Uranium	Mg/L	0.0006
Zinc (total)	mg/L	<0.005

The results indicated that at the time of sampling, the water stored in the Open Pit was circum-neutral. Fluoride levels are elevated, but no metals were detected at enriched levels in the water samples.

The water quality within the Open Pit is suitable for use within the retreatment processes on site.

4.4 Reuse of Contaminated Water

The site does not have any external water supply, so all water used in the retreatment processes is from surface runoff collected from the quarry catchments, TSF4 and the Open Pit. The water balance in **Section 6.** provides details of spill frequencies from the different storages under the proposed water management regime.

5 WATER MANAGEMENT SYSTEM

5.1 Stormwater Management Objectives

The key water management objective is to control and minimise the release of potentially mine-impacted water from the site to the extent that the current users and environmental values of the receiving environment are not detrimentally impacted. The stormwater systems that are likely to be encountered in relation to the Project can be characterised as follows:

Clean Water	-	Stormwater occurring around the project area, but not in contact with active mining/operating areas.
Site Water	-	All water generated from mine affected areas and associated operating surfaces within the project area.

Typical sources and characteristics, and the management of these waters are as follows:

- Clean water will remain unimpacted by site activities and is to be diverted around mining/operating areas and discharged via effective hydraulic controls back to the watercourse network. A key objective of stormwater management is to prevent capture or containment of any clean water.
- Site water is to be captured and managed in relation to its water quality and the source of the water. Site water is to be managed through onsite water management structures to prevent uncontrolled release from the site. The key objective for site water management is to minimise catchment areas from which site water is generated, as well as maximising the containment of site water at its source to enable direct reuse.

5.2 Water Management Strategy

5.2.1 Preamble

This section refers to the Stage 3 water management strategy, not the existing case, although some elements are unchanged.

The layout of the Stage 3 drainage channels in the Project's water management system is shown on **Figure 005** at the end of the report. The pumping regime is discussed in **Section 5.2.4**.

There is no external supply of water to the site. All water used in the Crushing Plant and Processing Plant will be sourced from site affected surface water runoff that is collected and stored on site in TSF4 for reuse.

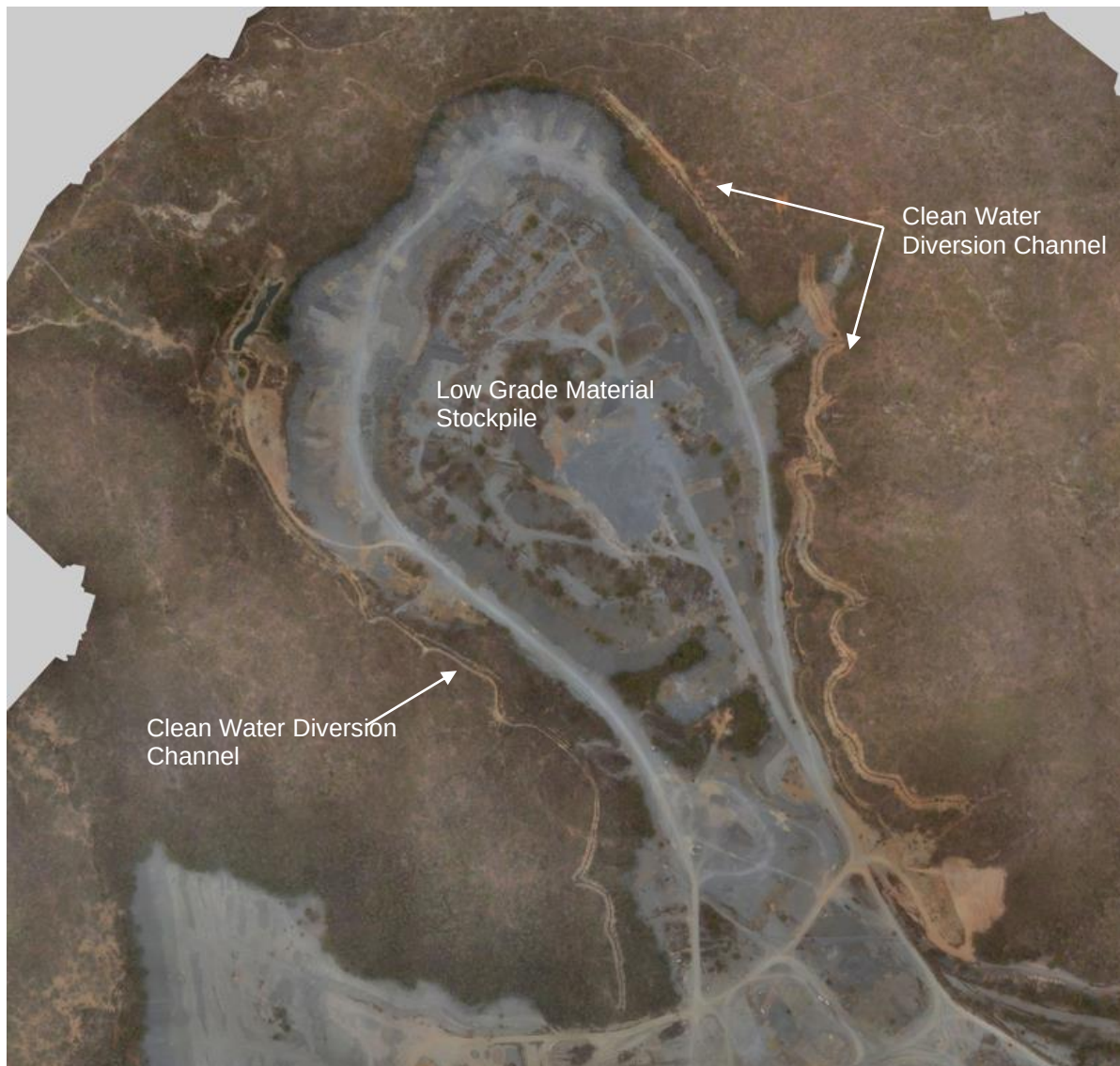
The discussion of the water management strategy has been separated into the clean water management, the site affected site water management and the pumping regime.

5.2.2 Clean Water Management

All clean water surface runoff is diverted around the mine impacted areas. The diversion drainage channel around TSF4 will divert clean surface water runoff both clockwise and anticlockwise from the surrounding sub-catchments to enter the tributary of Manganese Creek to the southeast of the site [31].

Existing clean water diversion channels are located on both the west and east sides of the low-grade stockpile and convey surface water runoff from the adjacent catchments to tributaries of Holmes Creek. These diversion channels can be seen on drawing number 119190-05-100-003A in **Appendix B** and **PHOTO 1**.

PHOTO 1: CLEAN WATER DIVERSION CHANNELS AT THE LOW GRADE STOCKPILE



5.2.3 Site Water Management

Seepage from the Low Grade Material Stockpile will be collected in the upgraded Quarry Sump and pumped to TSF3.

Surface runoff from all areas north of Mulligan Highway report to TSF3, with the exception of the Open Cut Pit sub-catchment which will be collected in the Pit sump and be pumped to TSF3.

Surface runoff from the processing plant and workshop area will report to TSF4.

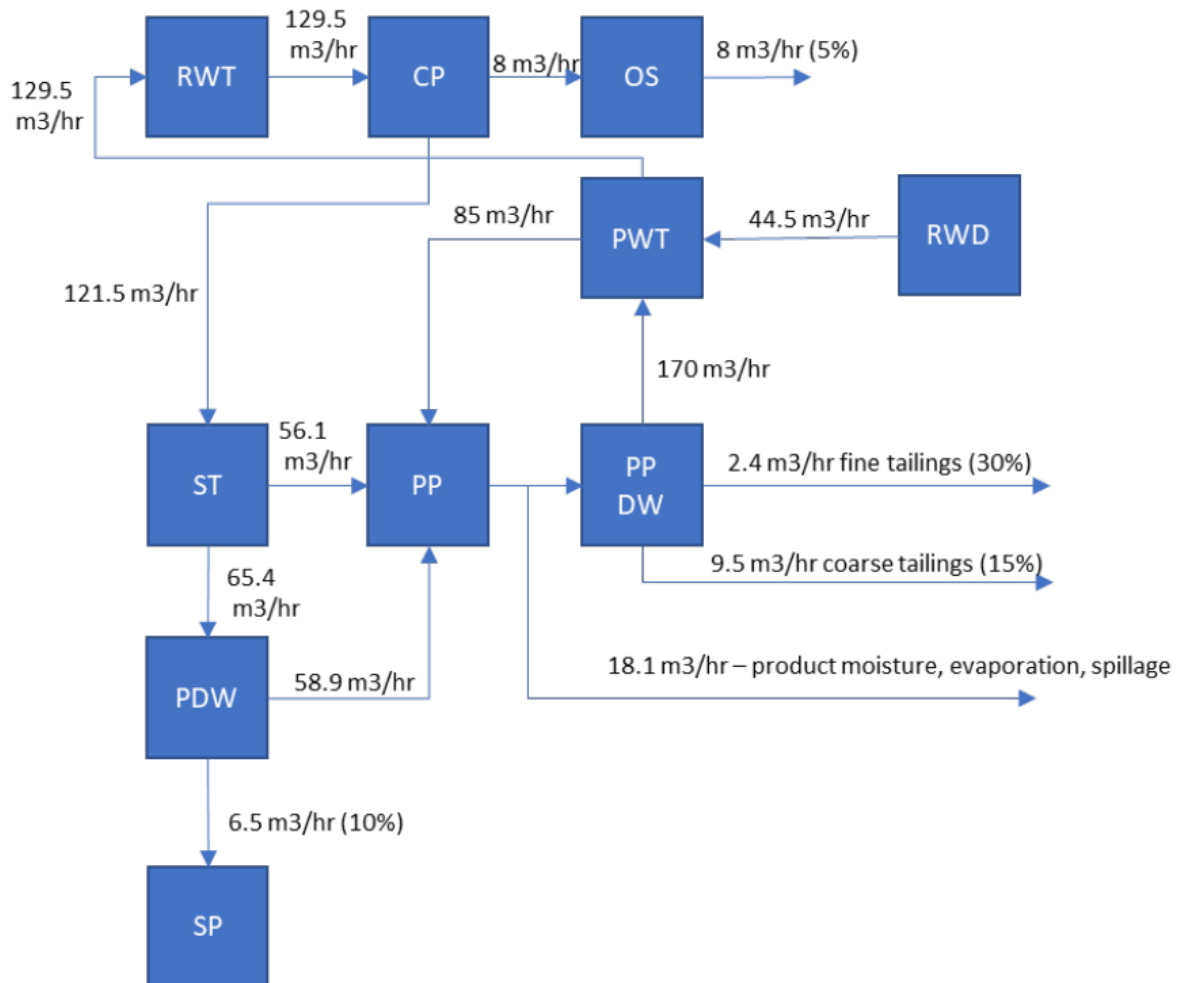
5.2.4 Pumping Regime

As discussed earlier in this section, all clean surface water runoff will be diverted around the site in diversion channels. No clean water is supplied to the site by water main or borehole extraction. All pumping on the site is of mine impacted water for retreatment processes or site movement between storages, as discussed in **Sections 2.6 and 5.2.3**.

Pump routing and expected maximum transfer rates were provided from discussions with site personnel and the memo from Jukes Todd [22]. A copy of the memo is provided in **Appendix D**, the key assumptions are presented in **Section 2.6.2** and the process flow charts are replicated in **DIAGRAM 10** and **DIAGRAM 11**. These site water demands are provided in tabular format in **TABLE 12**.



DIAGRAM 10: PROCESS FLOW DIAGRAM – DAY SHIFT

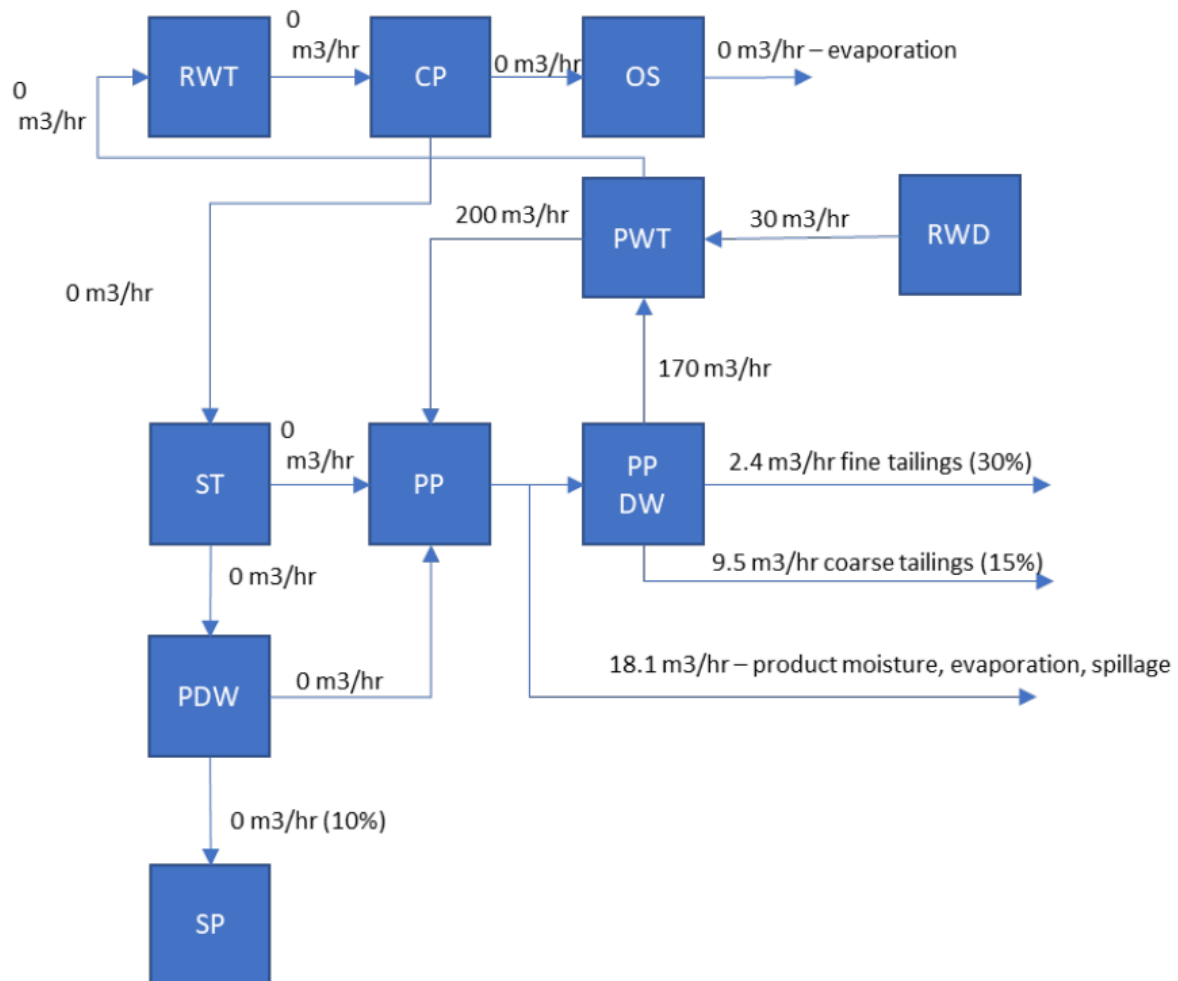


Legend:

RWT – Crushing Plant Raw Water Tank
CP – Crushing Plant
OS – Ore Sorter
PWT – Process Water Tank
RWD – Raw Water Dam
ST – Surge Tank
PP – Process Plant
PP DW – Process Plant Dewatering
PDW – Product Dewatering
SP – Product Stockpile



DIAGRAM 11: PROCESS FLOW DIAGRAM – NIGHT SHIFT



Legend:

RWT – Crushing Plant Raw Water Tank
CP – Crushing Plant
OS – Ore Sorter
PWT – Process Water Tank
RWD – Raw Water Dam
ST – Surge Tank
PP – Process Plant
PP DW – Process Plant Dewatering
PDW – Product Dewatering
SP – Product Stockpile



TABLE 12: SITE WATER BALANCE

Process	Peak hourly water demand			
	Day Shift		Night Shift	
	(m ³ /h)	(L/s)	(m ³ /h)	(L/s)
Supply from TSF4				
Supply from TSF4 to Process Water Tank (PWT)	44.5	12.4	30	8.3
Crushing Plant				
Supply from PWT to Crushing Plant	129.5	36.0	0	0
Recycling from Surge Tank and Product Dewatering Cell to Process Plant	115.0	31.9	0	0
Evaporation and material moisture loss from Product Stockpile (10%)	6.5	1.8	0	0
Evaporation and material moisture loss from Ore Sorter (5%)	8	2.2	0	0
Processing Plant				
Supply from PWT to Processing Plant	85.0	23.6	200	55.6
Processing Plant requirements (product moisture loss, evaporation and spillage)	18.1	5.0	18.1	5.0
Recycling from the Process Plant Dewatering Cell to the PWT	170	47.2	170	47.2
Fine material moisture loss (30%)	2.4	0.7	2.4	0.7
Coarse material moisture loss (15%)	9.5	2.6	9.5	2.6
Other water demands from TSF3				
Dust Suppression and Operational Requirements	20 m ³ /h, 8 hours per day	5.6 L/s, 8 hours per day	0	0
Evaporative Sprayers 21 No. from TSF3, operating 10 hours/day, if rainfall is less than 5 mm/day	588 m ³ /day	163.3 L/day	0	0

Site water transfers between storages, other than for the process water or operational demands listed in **TABLE 12** are shown in **TABLE 13**.



TABLE 13: SITE WATER TRANSFERS BETWEEN STORAGES

Source	Destination	Rate	Activation Condition	Deactivation Condition
Open Cut Pit	TSF4	100 L/s	Occurs when water elevation within TSF4 is below RL 356.2 m.	Ceases when water elevation within TSF4 is above RL 356.2 m.
Open Cut Pit	TSF3	100 L/s	Occurs when water elevation within TSF3 is below RL 374.0 m.	Ceases when water elevation within TSF3 is above RL 374.0 m.
TSF3	TSF4	110 L/s	Occurs when water elevation within TSF4 is less than RL 356.2 m And Water elevation in TSF3 is above RL 374.5 m.	Ceases when water elevation within TSF4 is greater than RL 356.2 m Or Water elevation in TSF3 is below RL 374.5 m..
Low Grade Material Stockpile	TSF3	0.7 ML/d	As required (TBC)	When empty (TBC)

Information regarding the pumps currently in use on site was provided by EQR site personnel. This information is replicated in **TABLE 14**.

TABLE 14: PUMPS IN USE AT THE MINE SITE

Pump Location	Pump Model	Estimated Duty Capacity (l/s)
TSF4 to Process Water Tank	Sykes 150-115	150
Low Grade Stockpile Sump to TSF3	Southern Cross 250x200-315	200
Open Pit to TSF3	Multiflo 360G	100
TSF3 to TSF4	Ajax 125-100	150
Total		600

5.3 Review of Capacity of Clean Water Diversion Channels

5.3.1 Introduction

The capacities of the diversion channels were reviewed in the 2021 water management plan [32] and the review has been retained in this report.

The channel dimensions were extracted from the LiDAR model at the downstream end of the catchments, that is, at the outlet/discharge point of the channels. The clean water diversion channel dimensions were clearly defined by the LiDAR data, so assessments of all four of the channels were made.

A XPStorm model was developed for each of the drainage channel catchments. The rainfall data for the site were obtained from the Bureau of Meteorology website [33] and the temporal pattern ensemble was downloaded from the Australian Rainfall and Runoff (ARR) Data Hub [34]. The design

storm events for the 50%, 20%, 10% and 1% AEP events were simulated and the median results for each of the temporal pattern ensembles were used in this assessment.

Details of the model set up is provided in the following sections.

5.3.2 Catchment Delineation

The catchments for each drainage diversion were delineated and sub-catchments created to clearly represent the routing down the drainage diversions. The catchment and sub-catchment layouts are shown on **Figure 006** at the end of the report. The catchment and sub-catchment areas are presented in **TABLE 15**.

TABLE 15: CLEAN WATER DIVERSION CATCHMENT AREAS

Diversion Channel	Sub-Catchment Reference	Area (ha)
TSF4 East	TSF4_A	8.83
	Total Area	8.83
TSF4 West	TSF4_B1	9.94
	TSF4_B2	9.24
	TSF4_B3	27.44
	TSF4_B4	15.26
	TSF4_B5	17.30
	Total Area	79.18
Low Grade Stockpile West	B1	2.77
	B2	6.60
	B3	3.81
	Total Area	13.18
Low Grade Stockpile East	C1	2.35
	C2	5.03
	C3	5.33
	C4	4.44
	Total Area	17.15

5.3.3 Catchment Parameters

The Manning's 'n' values applied to the drainage channels and catchments were based on the aerial photography of the site. The applied Manning's roughness parameters and initial and continuing losses are presented in **TABLE 16**. The loss parameters applied to the model were obtained from the ARR Data Hub for the site [34].

**TABLE 16: MANNING'S ROUGHNESS PARAMETERS**

Surface	Manning's 'n' Roughness Value	Initial loss / Continuing loss
Overland flow over natural surface, sparse grass, trees and shrubs	0.13	35 mm / 2.8 mm/h
Drainage Channel, clean, straight, no rifts or pools.	0.025	35 mm / 2.8 mm/h

5.3.4 Diversion Channel Dimensions and Capacities

Typical drainage channel dimensions were extracted from the LiDAR data for inclusion in the XPStorm model and for calculation of their capacities. The channel dimensions were extracted at the downstream end of the diversion channels and are presented in **DIAGRAM 12**. The equivalent channel dimensions used in the calculation are provided in **TABLE 17**. The capacities of the channels were calculated using Manning's formula, as set out in **Equation 1**.

EQUATION 1: MANNING'S FORMULA

$$Q = \left(\frac{1}{n}\right) AR^{\frac{2}{3}}\sqrt{S}$$

Where:

Q = Flow Rate (m³/s)

A = Flow Area (m²)

n = Manning's Roughness Coefficient

R = Hydraulic Radius (m)

S = Channel slope (m/m)

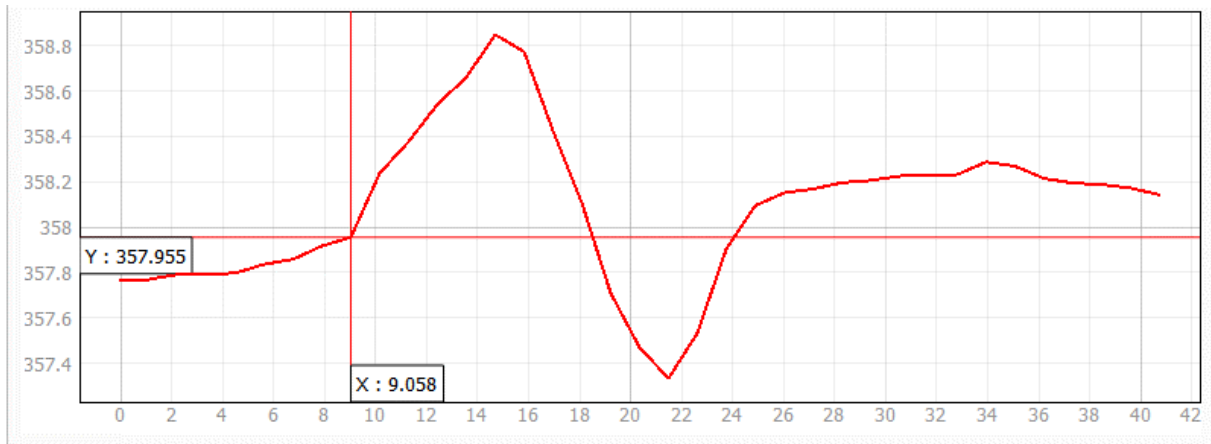
TABLE 17: DRAINAGE CHANNEL DIMENSIONS AND CAPACITIES

Drainage Channel	Base Width (m)	Channel Depth (m)	Side Slopes V:H	Channel Capacity (m ³ /s)
TSF4 East	0 (V-drain)	1	1:5	7.4
TSF4 West	1	1	1:3	6.8
Low Grade Stockpile West	0 (V-drain)	1	1:3	16.9
Low Grade Stockpile East	1.0	1.0	1:3	6.8

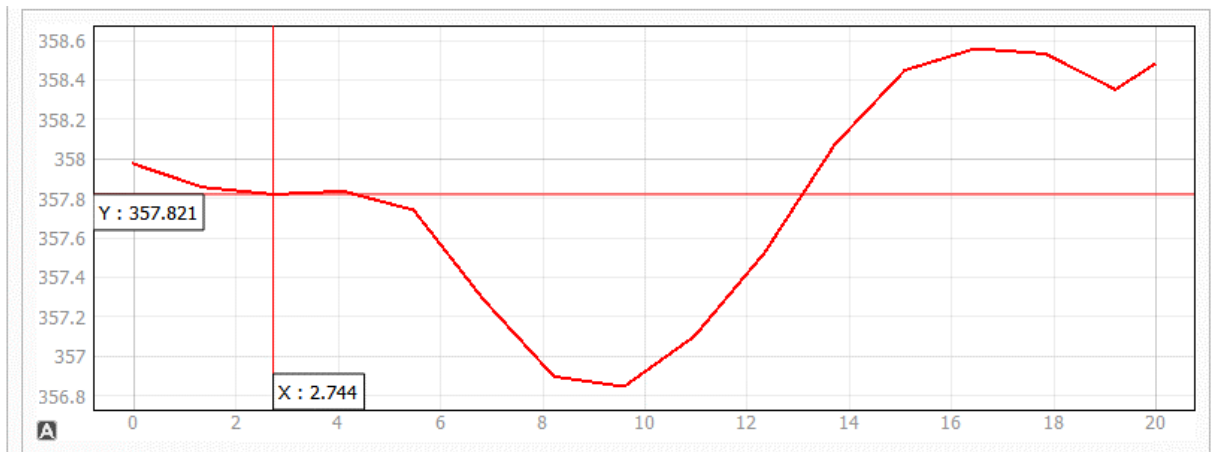


DIAGRAM 12: CROSS SECTIONS OF CLEAN WATER DIVERSION CHANNELS.

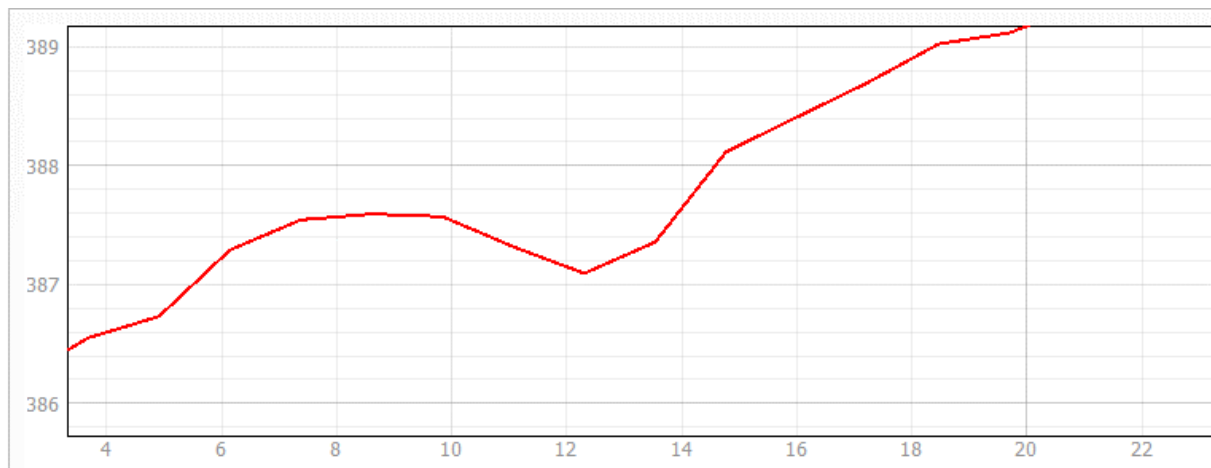
i. TSF4 East



ii. TSF4 West

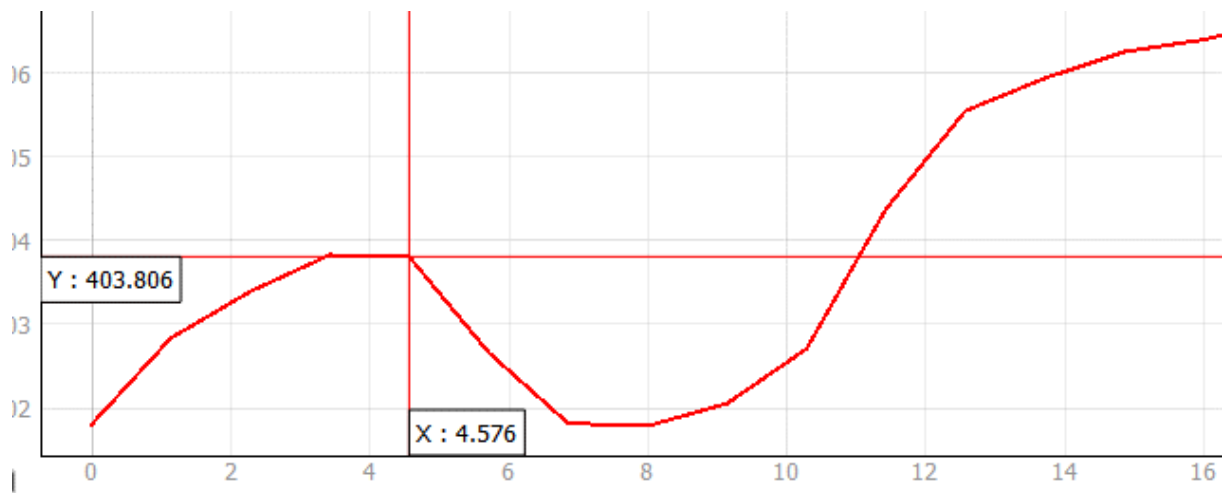


iii. Low Grade Stockpile West





iv. Low Grade Stockpile East



5.3.5 Results and Discussion

The results of the XPStorm modelling produced estimates of the rainfall runoff quantities at the downstream end of the diversion channels. The estimated median discharges for the 50%, 20%, 10% and 1% AEP design storm events and the estimated channel capacity for each diversion channel are presented in **TABLE 18**. Box and whisker plots of the 1% AEP peak discharge results in the four catchments are presented in **DIAGRAM 13**, **DIAGRAM 14**, **DIAGRAM 15** and **DIAGRAM 16**. The plots show the peak discharges of the ten ensemble temporal patterns for each storm duration. The whiskers represent the 10th and 90th percentile values, the boxes the 25th to 75th percentile values and the line in the box the 50th percentile (median) values. The largest median peak discharge values for each storm event were used in the diversion channel capacity assessment.

DIAGRAM 13: 1% AEP PEAK DISCHARGES FOR TSF4 EAST CLEAN WATER DIVERSION CATCHMENT

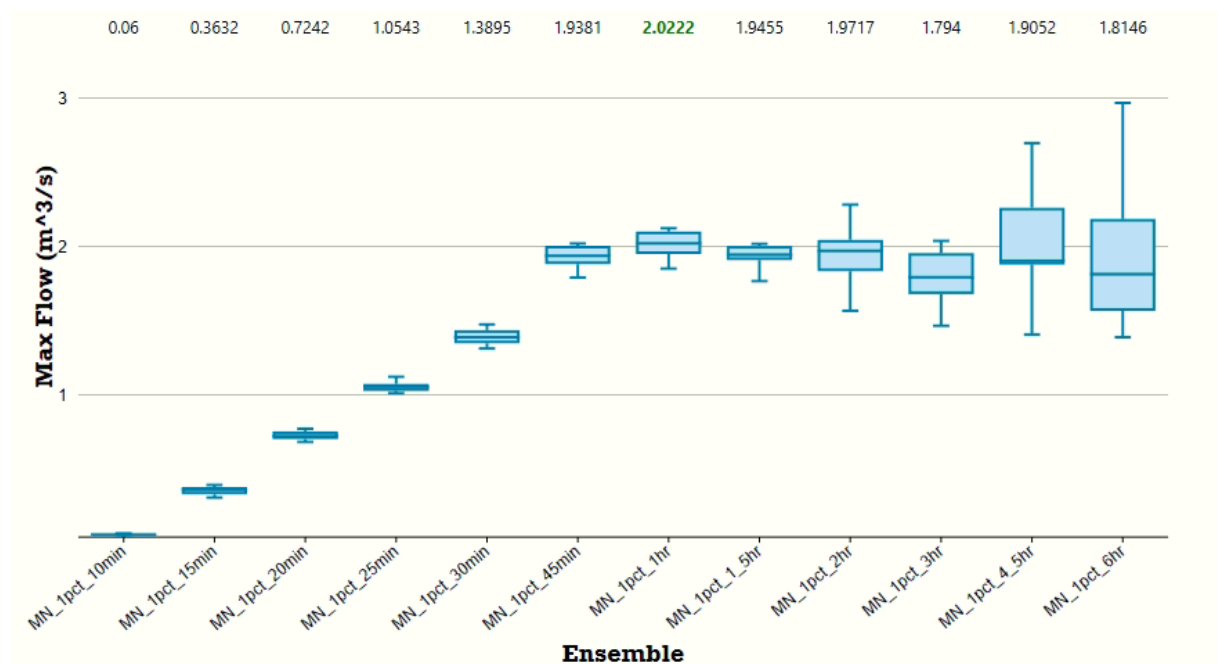




DIAGRAM 14: 1% AEP PEAK DISCHARGES FOR TSF4 WEST CLEAN WATER DIVERSION CATCHMENT

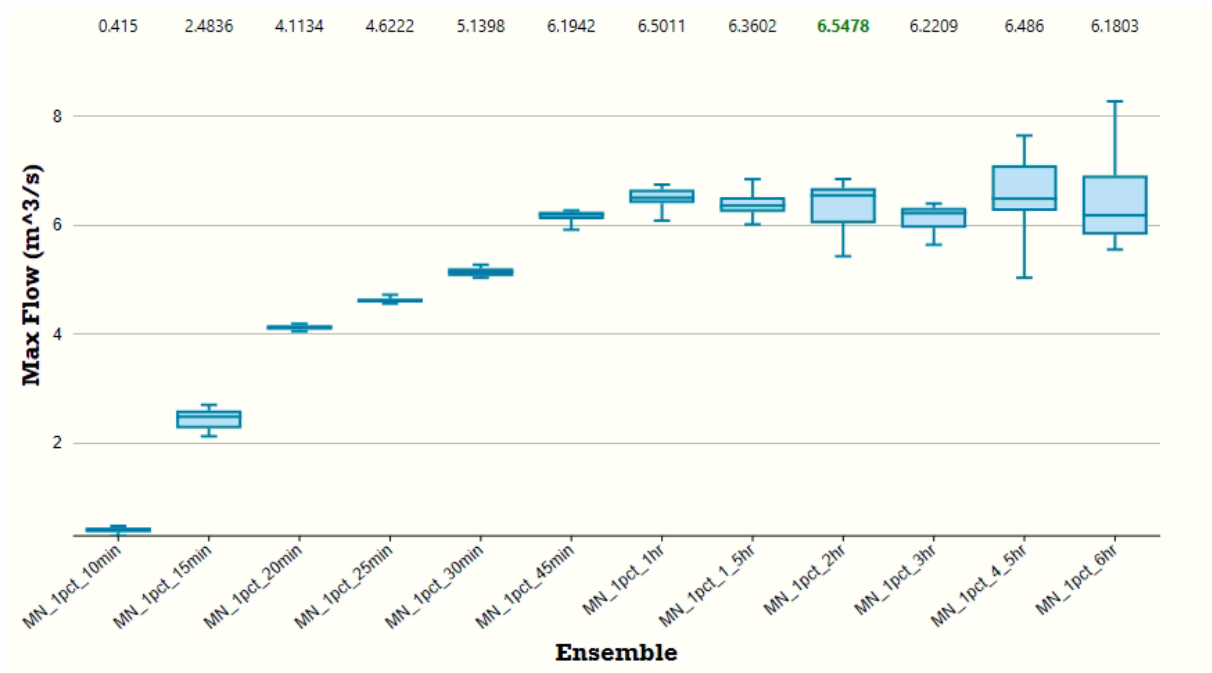


DIAGRAM 15: 1% AEP PEAK DISCHARGES FOR THE LOW GRADE STOCKPILE WEST CLEAN WATER DIVERSION CATCHMENT

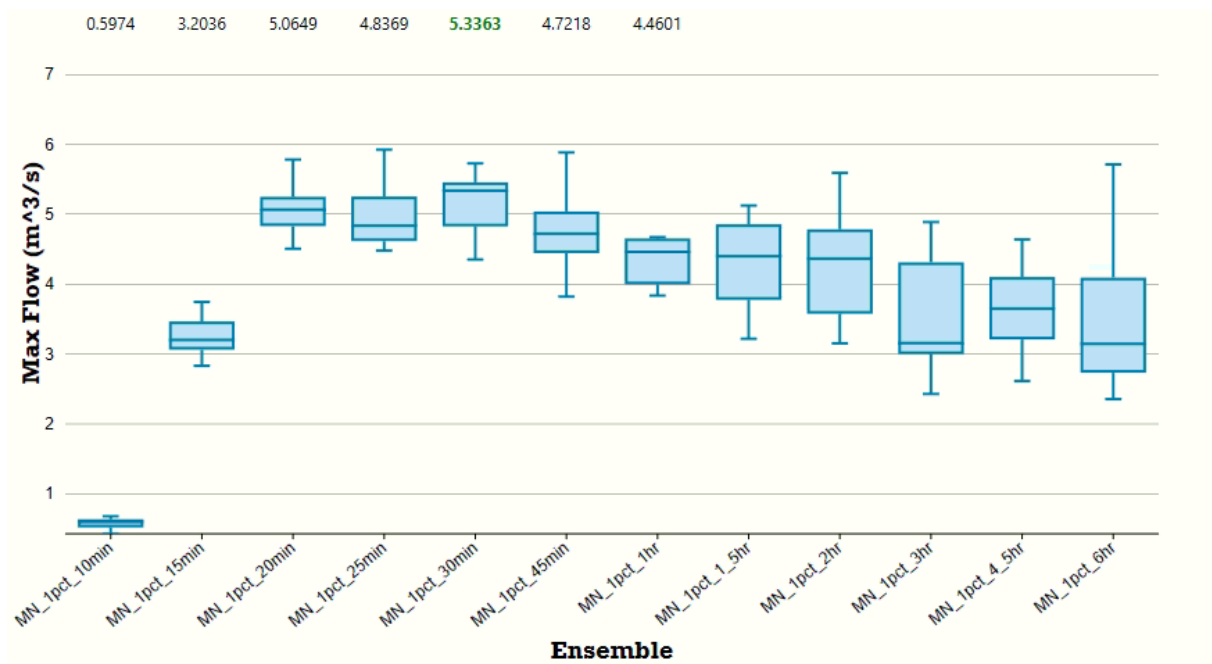
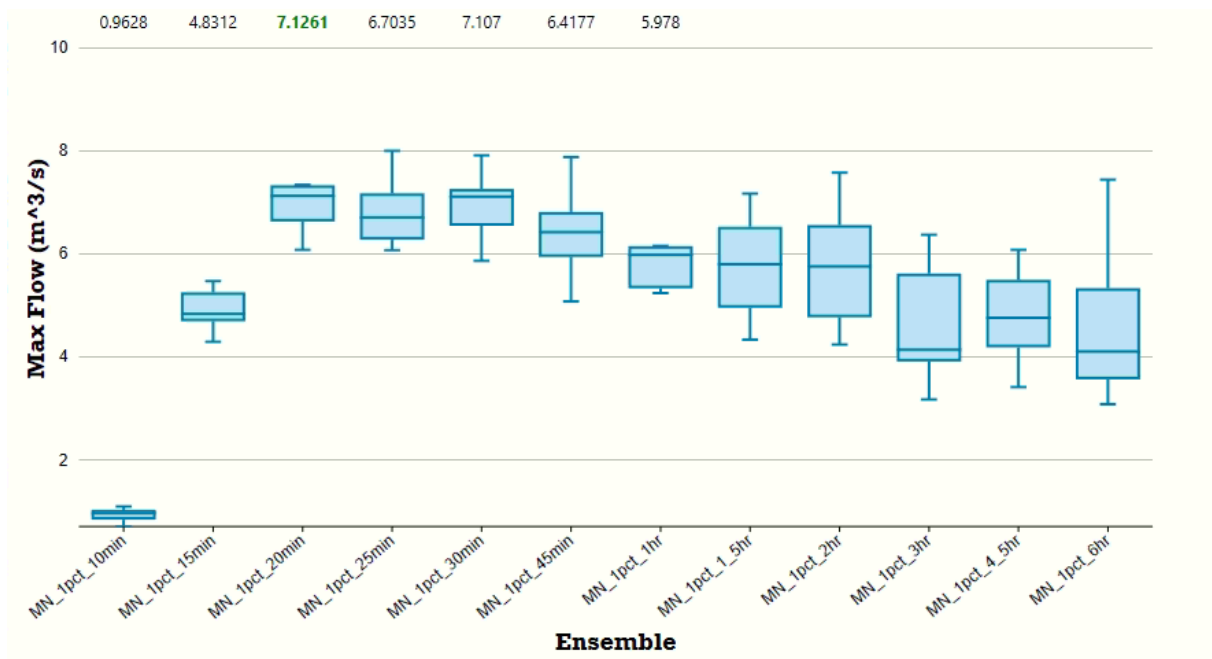




DIAGRAM 16: 1% AEP PEAK DISCHARGES FOR THE LOW GRADE STOCKPILE EAST CLEAN WATER DIVERSION CATCHMENT



From the results, it can be seen that with the exception of the clean water diversion channel on the eastern side of the low grade stockpile, all the diversion channels have sufficient capacity to contain the estimated discharge in the 1% AEP design storm event. For events less than the 1% AEP design storm, all drainage channels had sufficient capacity to convey the estimated surface runoff quantities.

TABLE 18: DIVERSION CHANNEL ESTIMATED DISCHARGE FOR 1% AEP DESIGN STORM EVENT

Drainage Channel	Channel Capacity (m³/s)	Estimated Discharge (m³/s)			
		50% AEP	20% AEP	10% AEP	1% AEP
TSF4 East	7.35	0.67	1.05	1.17	2.02
TSF4 West	6.80	4.20	4.92	5.12	6.58
Low Grade Stockpile West	16.92	1.43	2.54	2.95	5.34
Low Grade Stockpile East	6.81	1.90	3.43	3.98	7.13



6 SITE WATER BALANCE ASSESSMENT

6.1 Preamble

Water balance modelling was conducted to assess the performance of the site water management system under the increased retreatment regime for the Stage 3 operations. The objectives of the water balance model were:

- to assess the performance of the proposed operational site water management system; and
- to identify the quantity of runoff and site water generated from the mining activities and surrounding catchments based on a range of realistic climatic events.

6.2 Water Balance Model Development

A new water balance model was developed for the proposed Stage 3 operations. A dynamic probabilistic simulation modelling approach, using GoldSim Pro Version 14.1, was adopted for this purpose, based on a daily climatic record for the site. An integrated catchment yield analysis for site catchments was also coupled with the water balance model. Using the available Silo Data Drill climatic record, 132 No. Monte Carlo sampling realisations were used to generate probabilistic distribution results.

The model was based on the conditions outlined in this report, with the duration from September 2022 to September 2027, when the mining operations in the Open Cut Pit are planned to cease. The water balance model included the staged emptying of the Open Cut Pit from September 2022 to the projected closure of the open cut mining operation in 2027. The agreed dates for the different water balance operations until completion of the Stage 3 upgrades are presented in **TABLE 19**.

TABLE 19: TIMING OF STAGE 3 CONSTRUCTION

Phase	Date
Commence dewatering Open Cut Pit with evaporative sprayers and pumping to TSF4	01/09/2022
Completion of TSF3 and TSF4 construction	15/12/2022
Pumping from Open Cut Pit to TSF3	15/12/2022
Transfer of half the evaporative sprayers from the Open Cut Pit to TSF3	01/02/2023
Commencement of mining from the Open Cut Pit (Dependent on dewatering of Open Cut Pit)	01/02/2023

The key elements in this site water balance model are described below, with a process flow diagram representing the initial dewatering of the Open Cut Pit prior to construction of TSF3 shown in **DIAGRAM 17** and the post TSF3 and TSF4 upgrade conditions shown in **DIAGRAM 18**.



DIAGRAM 17: PROCESS FLOW DIAGRAM (PRIOR TO CONSTRUCTION OF TSF3)

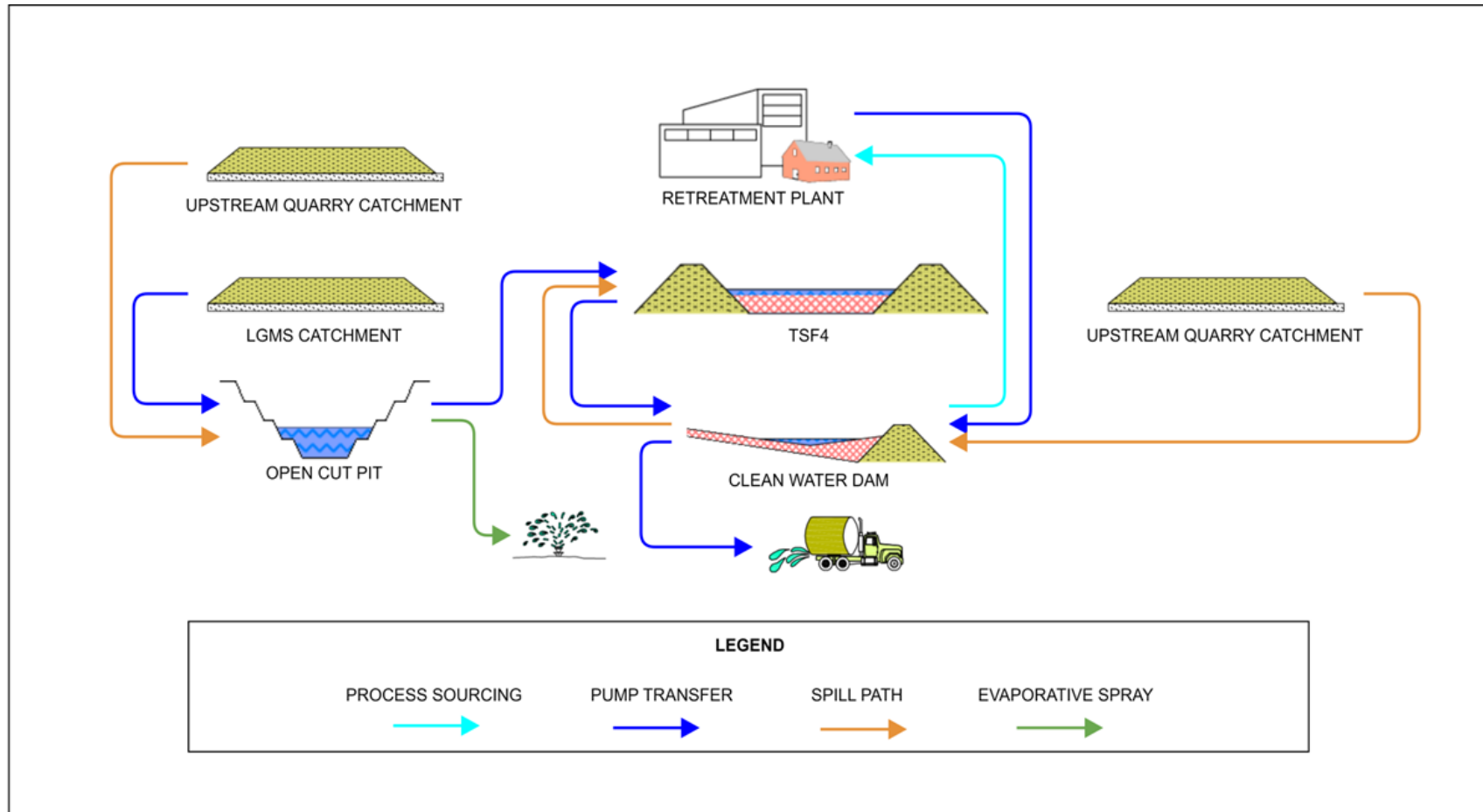
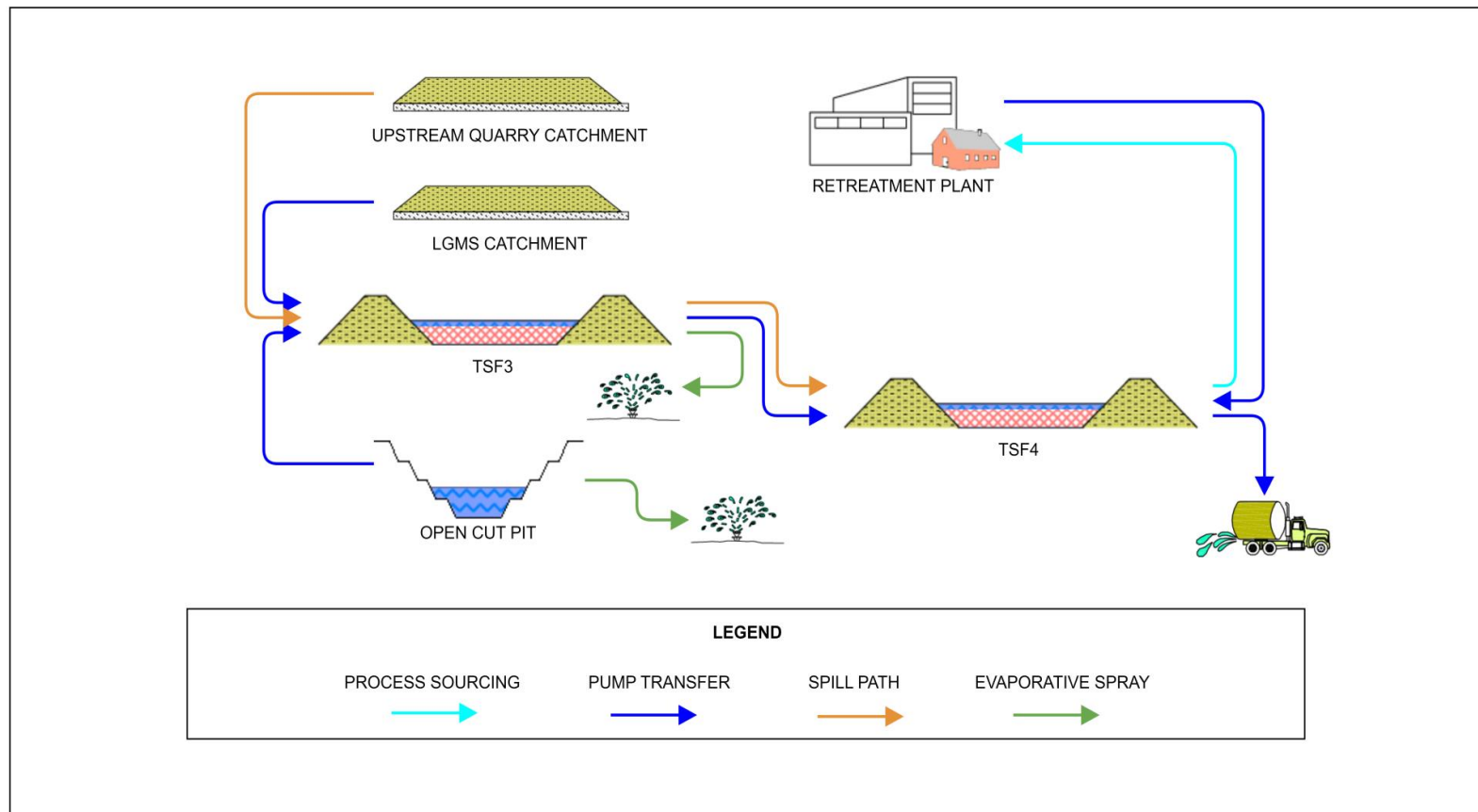




DIAGRAM 18: PROCESS FLOW DIAGRAM POST CONSTRUCTION OF TSF3 AND TSF4 UPGRADE





6.3 Modelling Assumptions and Relevant Data

6.3.1 Assumptions

The following assumptions were made in the development of the water balance model.

- The delineated catchment areas were re-estimated based on the LiDAR survey data provided by MCQ for the Mount Carbine site [35]. Plans of the sub-catchment layouts for the phased mining of the Open Cut Pit are provided in **Figures 001 to 004** at the end of this report.
- All dewatering in the retreatment processes is accounted for in the mass balance of the water, as agreed with MCQ and set out in **TABLE 12**.
- The timing of the changes in the process flows is based on the projected timeframes provided by MCQ.
- The stage storage characteristics of the Open Cut Pit are based on the profiles provided by EQR [20].
- The stage storage characteristics of the upgraded TSF4, TSF3 and the Low Grade Material Stockpile Sump are based on the designs prepared by ATCW.
- The WRD that will be nominally formed to the north of TSF3 between May 2023 and December 2024 has been progressively included in the pit catchment over this period, to reflect capture of runoff from this area for transfer and treatment within the pit, if required.

6.3.2 Base Model Inputs

The water balance model was developed to reflect site conditions within the modelling horizon. Data inputs for the model are summarized below.

6.3.2.1 Storage Conditions

Primary water balance inputs for the site storages are outlined in **TABLE 20**. The initial water levels for available storages were estimated based on the TSF3 and TSF4 designs. The capacities of the staged storages for the Open Cut Pit voids were provided by EQR [20].

TABLE 20: WATER BALANCE MODEL – SITE STORAGE PROPERTIES

Storage	Full Supply Level (FSL)	Storage Capacity (ML)	Initial Storage Level
Open Cut Pit – Pre-dewatering*	RL 380.0 m	3,429	RL 347.78 m
Open Cut Pit – Stage 1	RL 380.0 m	3,429	N/A
Open Cut Pit – Stage 2	RL 380.0 m	8,444	N/A
Open Cut Pit – Stage 3	RL 380.0 m	11,040	N/A
TSF3	RL 375.5 m	326.8	RL 366.2 m
TSF4*	RL 357.5 m	418.0	RL 356.35 m

* Initial water levels for TSF4 and the Open Cut Pit were supplied by EQ Resources as at 5 September 2022.

6.3.2.2 Pumping Schedule

Pump routing and typical transfer rates were based on discussions with site personnel. Site transfers from storages and process water sourcing are as presented in **TABLE 13** and **TABLE 14** respectively.

The efficiency of the evaporative sprayers is dependent on seasonal weather conditions. The assumed seasonal efficiency applied to the evaporative sprayers in the model was as shown in **TABLE 21**.

TABLE 21: SEASONAL EFFICIENCY OF THE EVAPORATIVE SPRAYERS

Season	Efficiency
Summer (December to February)	100%
Spring and Autumn (September to November, March to May)	75%
Winter (June to August)	50%

To allow for the seasonal variation in the seepage from the Low Grade Material Stockpile, the estimated seepage into the sump was applied according to the assumed factors in **TABLE 22**.

TABLE 22: SEASONAL FACTORS APPLIED TO SEEPAGE PRODUCTION

Season	Seepage Production Rate as Percentage of 0.7ML/d
Summer (December to February)	100%
Spring and Autumn (September to November, March to May)	75%
Winter (June to August)	50%

6.3.2.3 Retreatment Water Sourcing

Process water is sourced from TSF4 in a loop circuit within the processing area. Based on discussions with site personnel, it is understood that the plant water demand will be approximately 200 m³/h (55.6 L/s), with a day shift intake of approximately 44.5 m³/h (12.4 L/s) from TSF4 to the Process Water Tank that serves both the Crushing Plant and the Process Plant. The night shift intake will be approximately 30 m³/h. The balance of the water required by the processing area is from recycling and dewatering within the plant. The supply requirements for the Process Plant and Crushing Plant were combined into a single Retreatment Plant demand within the water balance model (WBM).

6.3.2.4 Catchment Runoff Estimation

Rainfall runoff in the WBM is simulated using the Australian Water Balance Model (AWBM) [36]. The AWBM is a nationally recognised catchment scale water balance model that estimates catchment yield as a flow rate from rainfall and evaporation.

AWBM simulation of flow from six different sub-catchment types was undertaken: natural, undisturbed areas, hardstand (roads and infrastructure areas), open cut pit, active waste rock emplacement, rehabilitated waste rock emplacement and tailings. Within the model, areas of open water, such as in storages, have the same characteristics as hardstand. Areas of future sub-catchment types were taken from the plans provided by EQR and the design layouts by ATCW.

AWBM simulation of flow from each sub-catchment type was undertaken. The model AWBM parameters were updated from the previous WBM [32], based on previous model experience at similar project locations. The AWBM parameters in the model are summarised in **TABLE 23**.

The catchment and sub-catchment areas corresponding to the sub-catchment types in **TABLE 23** were calculated using aerial imagery and survey data, as described in **Section 2.7**.



The sub-catchment areas varied slightly over the duration of the water balance model simulation due to the expansion of the Open Cut Pit from mining, construction of TSF3 and the TSF4 embankment raise. The changes in sub-catchment type over the duration of the model are provided in **TABLE 24**.

TABLE 23: MODEL AWBM PARAMETERS BY SUB-CATCHMENT TYPE

Parameter	Sub-Catchment Type					
	Natural	Open Cut	Spoil/Waste	Rehabilitated	Hardstand/ Open Water	Tailings
C1	12	5	35	20	5	5
C2	120	20	200	55	5	5
C3	240	20	240	100	5	25
A1	0.134	0.1	0.2	0.1	0.5	0.2
A2	0.433	0.9	0.8	0.3	0.5	0.2
A3	0.433	0	0	0.6	0	0
k _s	0.8	0.2	0.2	0.2	0.1	0.1
k _b	0.861	0.96	0.9	0.9	0.94	0
BFI	0.2	0	0.9	0.9	0	0



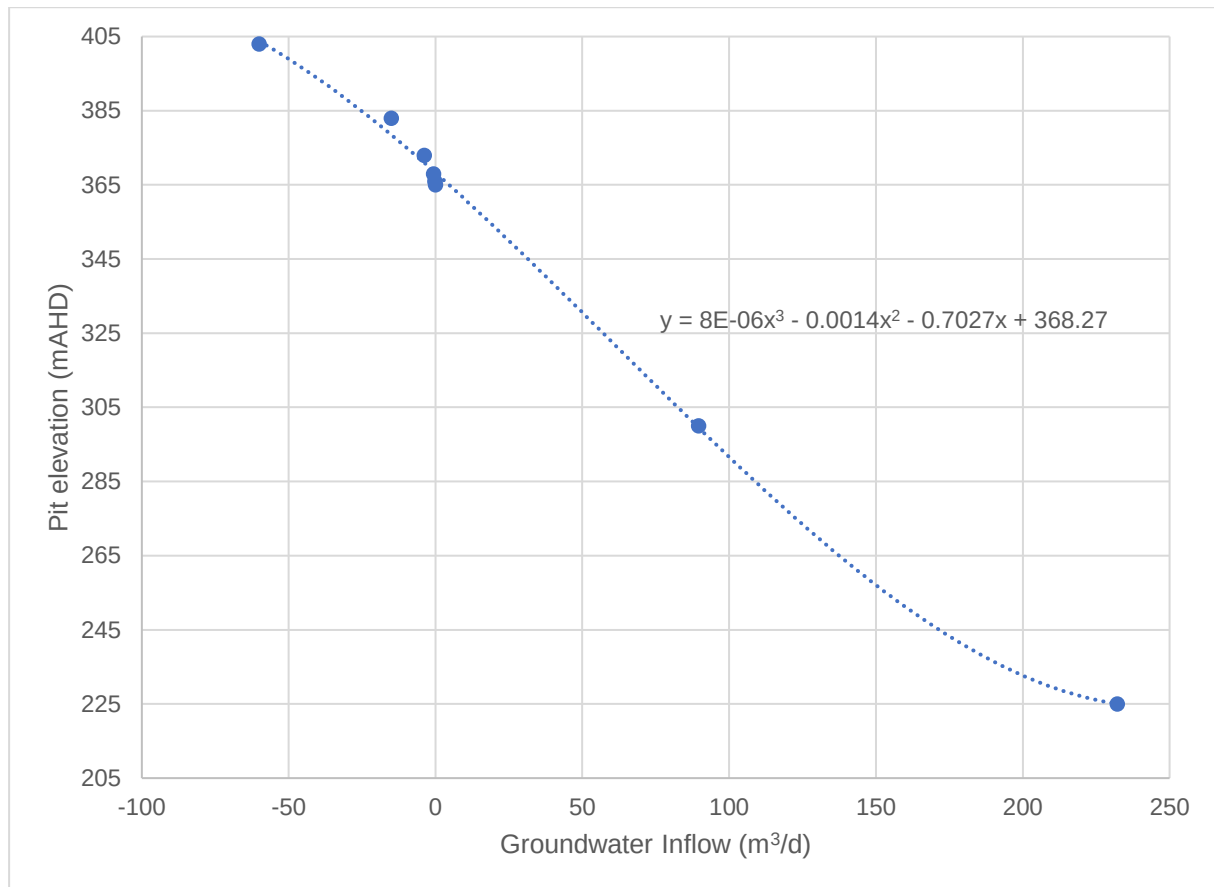
TABLE 24: SURFACE TYPES AND SUB-CATCHMENT AREAS

Storage	Date	Catchment Area by Land Use Type (ha)						
		Natural	Pit	Waste	Rehab	Hardstand	Tailings	Sum
Pit	1/09/2022	0.00	12.59	0.00	0.00	10.48	0.00	23.07
	15/12/2022	0.00	12.59	0.00	0.00	10.48	0.00	23.07
	1/05/2023	0.00	12.59	0.00	0.00	10.48	0.00	23.07
	1/12/2023	0.00	18.71	1.47	0.00	6.96	0.00	27.14
	1/05/2024	0.00	18.71	2.93	0.00	6.96	0.00	28.61
	1/12/2024	0.00	18.71	4.40	0.00	6.96	0.00	30.07
	1/12/2025	0.00	24.71	4.40	0.00	5.03	0.00	34.14
	1/09/2027	0.00	24.71	4.40	0.00	5.03	0.00	34.14
TSF3	1/09/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15/12/2022	5.08	0.00	15.37	0.00	10.41	0.00	30.85
	1/05/2023	5.08	0.00	15.37	0.00	10.41	0.00	30.85
	1/12/2023	5.08	0.00	13.20	0.00	10.41	0.00	28.68
	1/05/2024	5.08	0.00	11.73	0.00	10.41	0.00	27.22
	1/12/2024	5.08	0.00	10.26	0.00	10.41	0.00	25.75
	1/12/2025	2.64	0.00	8.63	0.00	18.81	0.00	30.08
	1/09/2027	2.64	0.00	8.63	0.00	18.81	0.00	30.08
TSF4	1/09/2022	0.00	0.00	0.00	0.00	39.41	24.75	64.16
	15/12/2022	0.00	0.00	0.00	0.00	42.36	24.75	67.12
	1/09/2027	0.00	0.00	0.00	0.00	42.36	24.75	67.12
Clean Water Dam	1/09/2022	16.09	0.00	15.37	0.00	8.62	0.00	40.08
	15/12/2022	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1/09/2027	0.00	0.00	0.00	0.00	0.00	0.00	0.00

6.3.2.5 Groundwater Inflows and Outflows to the Open Cut Pit

A relationship between the groundwater inflow/outflow to the Open Cut Pit void and the elevation of the water stored in the Pit was provided by EQR [37]. The relationship is presented graphically in **DIAGRAM 19**. The raw data provided indicated that there is outflow from the Pit when the water surface elevation is above RL 365 m AHD and increasing inflow as the water surface elevation in the Pit is lowered. It should be noted that the pit will spill when the water surface elevation reaches RL 380 m AHD.

DIAGRAM 19: RELATIONSHIP BETWEEN THE GROUNDWATER INFLOW AND WATER SURFACE ELEVATION IN THE OPEN CUT PIT



In the later stages of mining in the Open Cut Pit, the mine extends into the hill to the northwest, but the spill level will remain at RL 380 m AHD at the southern edge of the open cut.

6.4 Modelled Case

To address the key requirement of the WMP to control and minimise the spill risk of potentially mine affected water from the site, the following scenario was modelled within the WBM.

- Operational model based on the staged development of mining within the Open Cut Pit, from dewatering to full operation.

6.5 Water Balance Results

The water balance model results for the site storages have been presented as probability plots depicting percentile outcomes for water storage volumes in each storage.

The total volume of water on the site, shown in **DIAGRAM 20**, indicates that from September 2022, the total volume of water stored on site is reducing, driven primarily by dewatering of the Open Cut Pit through the use of the evaporative sprayers. As the 2022/23 wet season commences, there is an increase in stored water on the site, although dewatering of the Pit continues. It should be noted that the Pit is also dewatered by pumping to TSF4 where capacity exists and from December 2022 to TSF3, but it is the evaporative sprayers that have the greatest impact on removing water from the total volume on site.

The WBM indicates that the Pit dewatering will be completed in the first half of 2023 and subsequently the total water volume on the site is affected by the seasonal rainfall patterns and the increase in Open Cut Pit mine extents. The mean peak volume stored on site is estimated to be approximately 450 ML from 2026 when the Stage 3 Pit extents are at their greatest. The 50% line on **DIAGRAM 20**



represents the 50th percentile probability value of total water stored on the site from the simulations using the historical data.

DIAGRAM 20: TOTAL WATER VOLUME FOR THE SITE – OPERATIONAL CASE

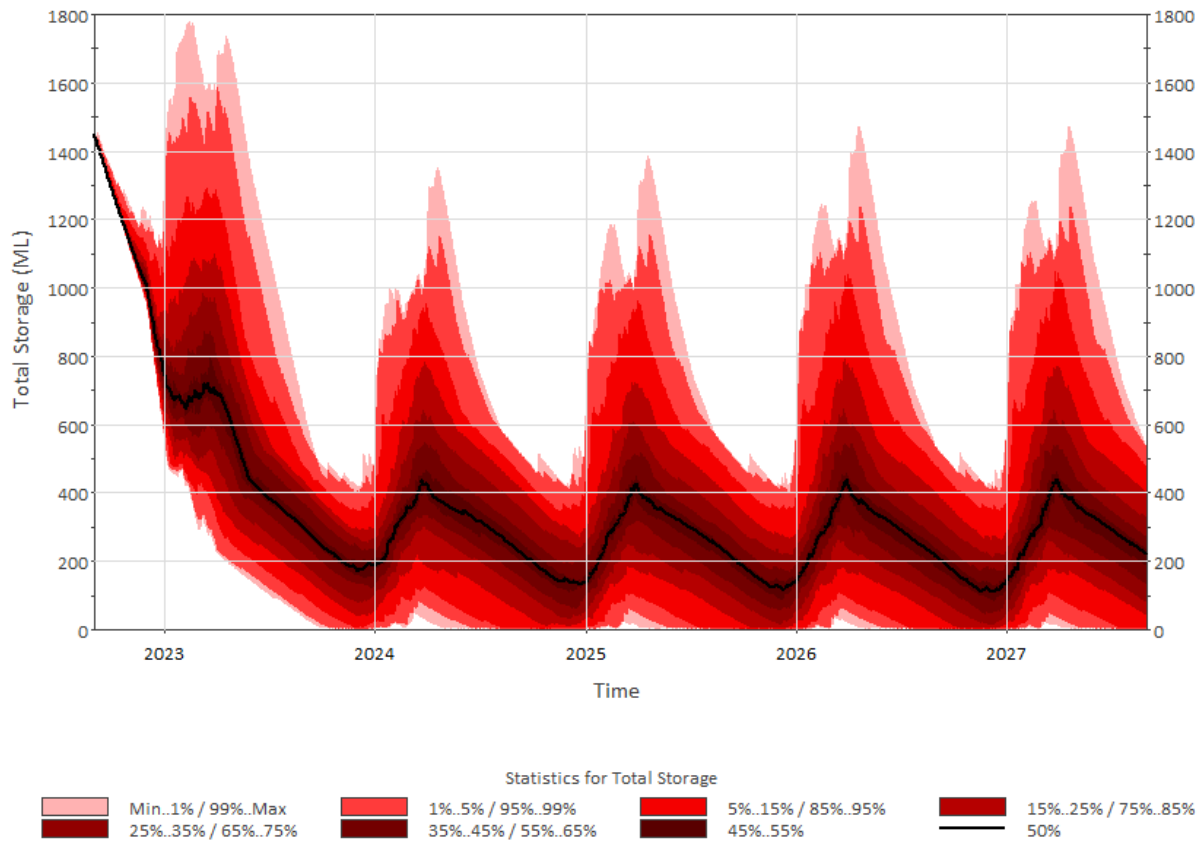




DIAGRAM 21: STORED VOLUME IN OPEN CUT PIT – OPERATIONAL CASE

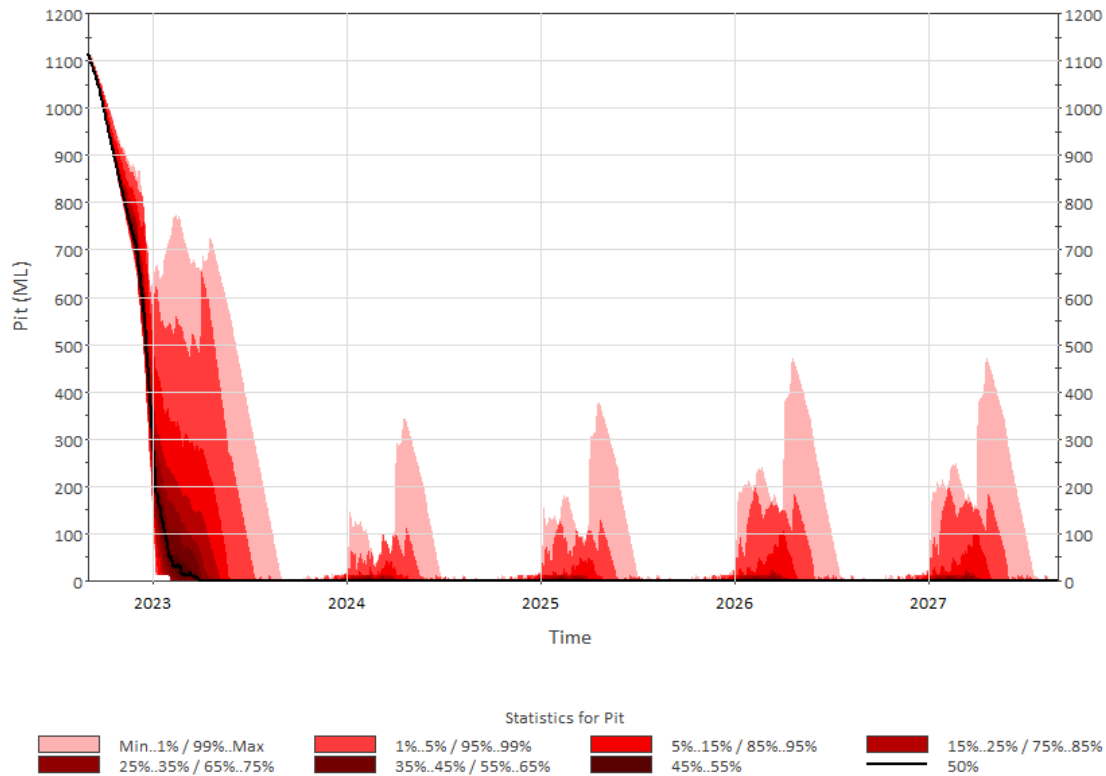
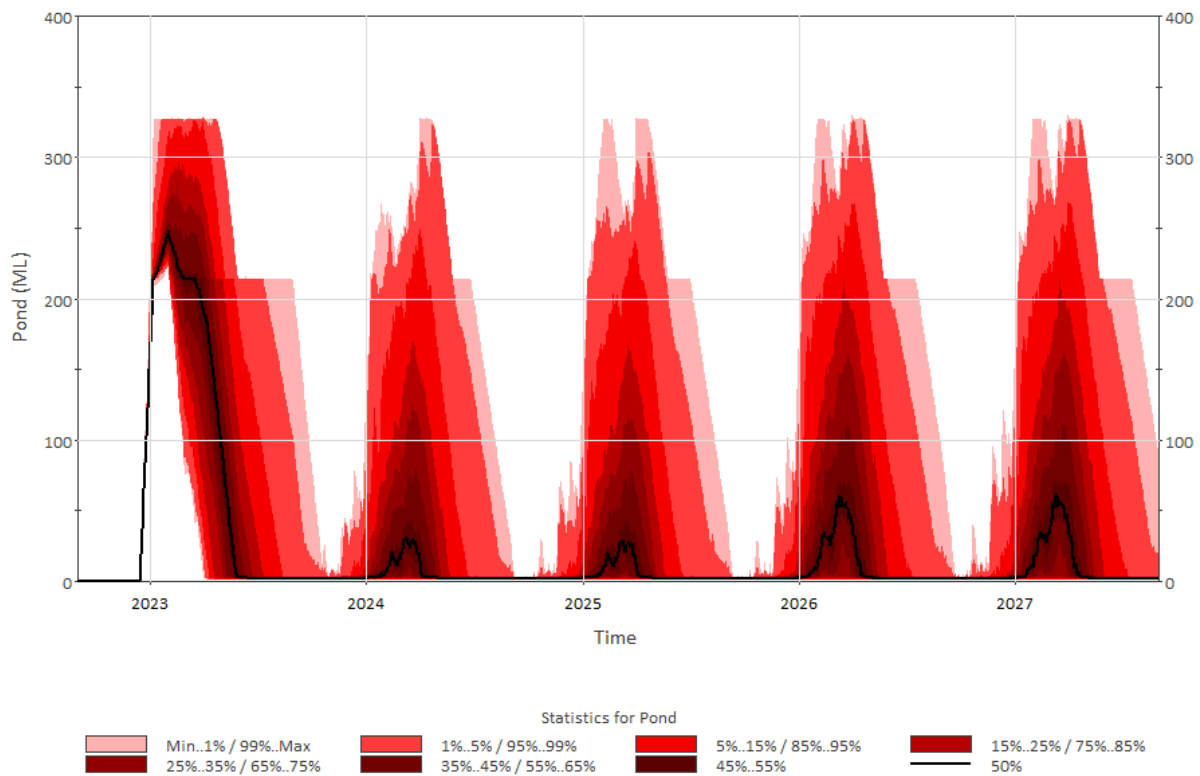


DIAGRAM 21 represents the stored volume within the Open Cut Pit. As expected, the diagram indicates that the Pit is being dewatered from September 2022 but has a potential increase in stored volumes due to the 2022/23 wet season. After the Pit is dewatered, no further runoff from external catchments is received by the Pit (with runoff generally directed to the upgraded TSF3) and only runoff from the Pit sub-catchment is stored. As mentioned previously, the Pit Stage 3 operations increase the area of the void and hence the volume of rainfall and surface runoff collected. This is reflected in the increase in potential stored volume until 2026, although the mean probability (50%) stored volume is close to zero. It should be noted that stored surface runoff in the Pit will be pumped out to TSF3 when constructed (estimated date 15/12/2022).

The results of the modelling indicate that the Pit will not have uncontrolled spills during its operation as an open cut mine.



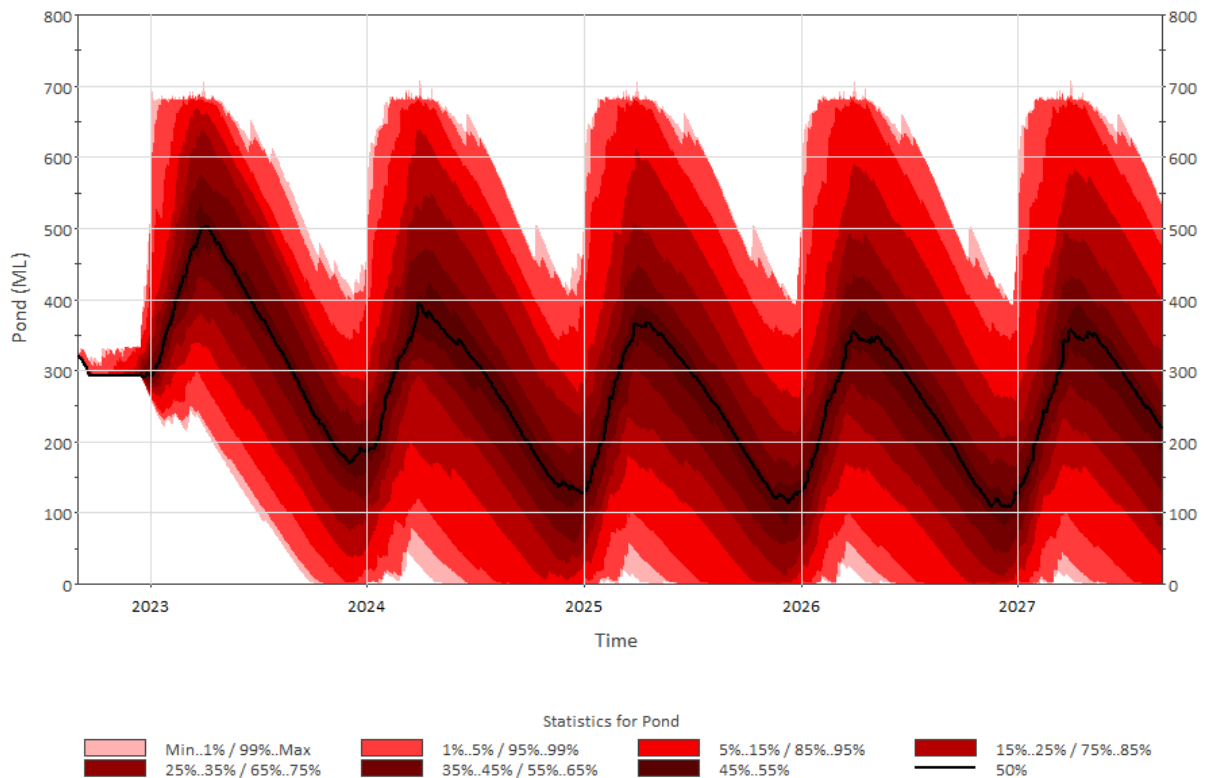
DIAGRAM 22: STORED VOLUME IN TSF3 – OPERATIONAL CASE



The modelled stored water volume in TSF3 is shown in **DIAGRAM 22**. The diagram indicates that TSF3 has a greater probability of spilling over the 2022/23 wet season than in subsequent years. This increased spill risk is because TSF3 will be receiving greater volumes of water from the dewatering of the Open Cut Pit in 2022 to early 2023.

The plot has a level section at the end of the wet season in every year. This level section represents the threshold of pumping to TSF4 to reduce the likelihood of spills from TSF3 (refer to **TABLE 13** in **Section 5.2.4**).

DIAGRAM 23: STORED VOLUME IN TSF4 – OPERATIONAL CASE



The plot of stored water in TSF4 in **DIAGRAM 23** shows that there will be an elevated volume of water stored over the 2022/23 wet season than in subsequent years. This large volume of water will be stored in TSF4 due to the dewatering of the Open Cut Pit to the storage prior to the construction of TSF3. The dewatering of the Pit has also occurred when the existing TSF4 storage is already nearly full.

A summary of the modelling results in the form of spill risks is provided in **TABLE 25**. These values represent the modelled statistical likelihood of a storage experiencing a spill over the modelling horizon of five years.

TABLE 25: WET SEASON SPILL PROBABILITIES – OPERATIONAL CASE

Storage	Modelled Spill Probability – Operational Case		
	2022 (annualised risk for September to December)	2023 (annualised risk from January to December)	2024 to 2027
Open Cut Pit	0	0	0
TSF3	N/A	20%	2%
TSF4	52%	23%	12%

The estimated modelled spill probabilities presented in **TABLE 25** demonstrate that, when completed, the spill risk from the site will be reduced once the Open Cut Pit is dewatered and both TSF3 and TSF4 upgrades have been completed. There will be no spill risk from the Open Cut Pit; spills from TSF3 will report to TSF4; and the spills from TSF4 will be via the permissible release point at the southern point of the site. It is noted that the WBM indicated that all the spills from TSF3 and TSF4 will be contained within their design spillways and are not over-embankment spills.



The existing site layout had a spill risk of 3.9% from TSF4, with a spill risk of 3.1% from the Open Cut Pit. The raising of TSF4 embankment and the construction of TSF3 have mitigated a large amount of the potential impact of the Pit no longer being available for storage of water on the site.

6.6 Summary

The results outlined in **TABLE 25** indicate that there will be no spill risk from the Open Cut Pit whilst it is being dewatered and operated as a mine. Over the 2022/2023 wet season, there is a high spill risk for TSF4 (52%), but this spill risk will reduce after the Pit is dewatered and the water storages have equalised. The WBM estimated that the spill risks in TSF3 and TSF4 will be approximately 2% and 12% respectively, from 2024. It should be noted that the spills from TSF3 will report to TSF4.



7 SITE WATER MONITORING

7.1 Regulatory Context

Under the current Environmental Authorities (EA's), the activities on site are:

- Extraction and screening of not more than 1,000,000 t of material per year [1]; and
- Mineral processing of mineral products greater than 100,000 t per year [2].

The Stage 3 application is to re-commence mining from the Open Cut Pit.

The processing plant will operate 24 hours a day, seven days per week, with an estimated processing time of 511 hours per month, the remaining hours being downtime for maintenance.

7.1.1 Receiving Water

There is one permissible release point of contaminated water from the site, as described in EA EPML00956913 [2]. The release point is from TSF4 spillway to Manganese Creek. The details of the release point are provided in **TABLE 26**. Table D2 of the EA provides release quality objectives for releases from TSF4.

The EA provides details of the receiving water monitoring points. The locations of these monitoring points have been replicated in **TABLE 27**.

A receiving environment monitoring program (REMP) has been developed by NRA Environmental Consultants [38] to monitor, identify and describe any adverse impact to surface water environmental values, quality and flows due to the mining activities. From the EA, the REMP monitoring frequency must be, at a minimum, as set out below.

- *for receiving waters and sediment quality, biannually (once at the end of the wet season and once at the end of the dry season); and*
- *For water quality of receiving waters during a release or flow event, one sample must be taken within 12 hours of the event commencing. Where release or flow events have durations of greater than 24 hours, samples must be taken daily for 1 week and once a week thereafter until the release or flow event ceases. [2]*

TABLE 26: RELEASE POINT LOCATION

Release Point	Description of Release	Receiving Water	Coordinates (GDA94 MGA Zone 55)		Monitoring Frequency
			Easting	Northing	
OW4	TSF4 Spillway	Manganese Creek	299526	8170822	For all parameters, 1 sample must be taken within 12 hours of a release event commencing and for release events with a duration of greater than 24 hours, samples must be taken daily for 1 week and once a week thereafter until the release event ceases.

Table reproduced from Table D1 in EA EPML00956913 [2].



TABLE 27: RECEIVING WATERS COMPLIANCE MONITORING LOCATIONS

Monitoring Point	Description	Coordinates (GDA94 MGA Zone 55)	
		Easting	Northing
Compliance Point			
SW15	TSF4 gully – site release monitoring point at the boundary of the licensed place (approximately 250 m from OW4 release point). Reports to Manganese Creek.	299920	8170844
Manganese Creek			
SW7	Manganese Creek (approximately 40 m upstream of confluence with gully).	300507	8168109
Holmes Creek			
SW17	Unnamed tributary of Holmes Creek (at ML4867 northeast boundary).	299381	8173168
SW4	Holmes Creek (immediately upstream of crossing with Mulligan Highway).	297426	8172386
Reference Points			
Manganese Creek			
SW1	Manganese Creek, upstream of site inputs.	301816	8172340
Holmes Creek			
SW16	Reference site – Holmes Creek upstream of site and historic disturbance.	299715	8174372

Table reproduced from Table D4 in EA EPML00956913 [2].

Surface water monitoring locations are shown on the figure in **Appendix C [7]**. The water and sediment monitoring locations are both upstream and downstream of any potential spills from the mine site.

7.1.1.1 Groundwater

EA EPML00956913 [2] sets out the requirements for groundwater monitoring. In particular, the EA states that MCQ must not release any contaminants to groundwater. The location of groundwater monitoring bores and their monitoring frequency are replicated from the EA in **TABLE 28**.

The groundwater quality objectives for both shallow and deep groundwater are listed in table D6 of the EA.



TABLE 28: COMPLIANCE GROUNDWATER MONITORING LOCATIONS AND FREQUENCY

Monitoring Point	Description	Coordinates (GDA94 MGA Zone 55)		Surface RL (m AHD)	Monitoring Frequency
		Easting	Northing		
Compliance Bores					
Shallow					
MB4A	Downslope of TSF4 water pond	299994	8170776	353.49	1 sample every 3 months
MB5A	Downstream of Holmes Creek	298226	8172597	357.30	
MB6A	Manganese Creek	300597	8171181	357.19	
Deep					
MB4B	Downslope of TSF4 water pond	299994	8170776	353.30	1 sample every 3 months
MB5B	Downstream of Holmes Creek	298226	8172597	357.41	
MB6B	Manganese Creek	300597	8171181	357.28	
RFB	Rural Fire Brigade	301144	8171764	360.87	
Reference Bores					
Shallow					
MB1A	Upslope of TSF4	299177	8171929	36.54	1 sample every 3 months
MB3A	Upslope of pit	301004	8172643	376.50	
Deep					
MB1B	Upslope of TSF4	299177	8171929	364.91	1 sample every 3 months
MB3B	Upslope of pit	301004	8172643	376.89	

Table reproduced from Table D5 in EA EPML00956913 [2].

The locations of the compliance groundwater monitoring points are shown on the figure in **Appendix C [7]**.

A request to revise the groundwater monitoring requirements in the EA is being requested as part of the Stage 3 application for amendment.



8 EMERGENCY AND CONTINGENCY PROCEDURES

To manage the water levels within the site water storages, an emergency contingency plan has been developed by EQ Resources to minimise unplanned spills to the natural environment and to ensure an adequate supply of water for operational purposes.

The planned response to an unplanned rainfall event(s) is as follows.

1. Processing operations are intended to continue as processing is a net consumer of water.
2. Where TSF3 appears likely to overtop, water will be transferred to TSF4.
 - a. The logic is that TSF4 is planned to be operated not at capacity; rather TSF3 is the storage area intended to service makeup water requirements and TSF3 will therefore be run closer to capacity than TSF4.
 - b. TSF4 is the licenced release point.
3. Where TSF3 and TSF4 are likely to overtop,
 - a. Overtopping will be via the designed spillway
 - i. Landholders and DES will be notified if a discharge event appears likely; and
 - ii. if discharge occurs, Landholders and DES will be notified.
 - b. Release monitoring (quantity of water and quality of release and receiving environment) will occur as has occurred for past release events.



9 EROSION AND SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) [9] for the Mt Carbine Project has been prepared by NRA Environmental Consultants in compliance with the requirements of the EA [2]. The ESCP was updated in April 2022 for the existing (Stage 2) site conditions, but the principles in the document should be applied to the future Stage 3 site arrangements.

A copy of the ESCP has been provided in **Appendix G** of this document.



10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

This report presents a water management plan for the Stage 3 development of the Mount Carbine Project. The plan is based on information and data provided by EQ Resources and NRA Environmental Consultants. The key outcomes from the plan are summarised below.

- The proposed water mass balance for the retreatment and mined ore processes may be managed using site water collected in the two storages on site during wet weather. No additional water supply is required.
- After the Open Cut Pit has been dewatered, there is an estimated spill risk of 12% from TSF4 to the Release Point and 2% from TSF3 to TSF4.
- The estimated spill risk from the Open Pit is 0%, due to the pumped dewatering that is scheduled to occur until the pit is empty and available for mining and the continuing use of evaporative sprayers and pumping to TSF3.
- The clean water diversion drains have been estimated to have sufficient capacity to convey all but the 1% AEP surface runoff to the east of the Low Grade Stockpile around the Project.
- An Emergency and Contingency Plan is in place in the event of uncontrolled spills from any water storage.
- The Erosion and Sediment Control Plan was updated in April 2022 for the site conditions at that time. The principles described in the Plan may be applied to the Stage 3 site configuration until the Plan is updated.

10.2 Recommendations

The following recommendations for future water management plans are undertaken.

1. Increased monitoring of the groundwater inflows and outflows to the Open Cut Pit be undertaken in the future. This monitoring will provide additional information for any future updates to the water balance model, which will refine the estimates of probability of spills from TSF3 and TSF4.
2. To account for the changes in the surface runoff across the site due to reforming of the Low Grade Material Stockpile, Quarry Operational Area, Optical Sorter Reject Stockpile Area, Open Cut Pit, and the planned construction of TSF embankment raises and waste rock dump, it is recommended the water balance model be reviewed on an annual basis using newly flown LiDAR data. It is recommended that the capacities of the diversion drains are reviewed at the same time. This will inform any changes required to the Water Management Plan.



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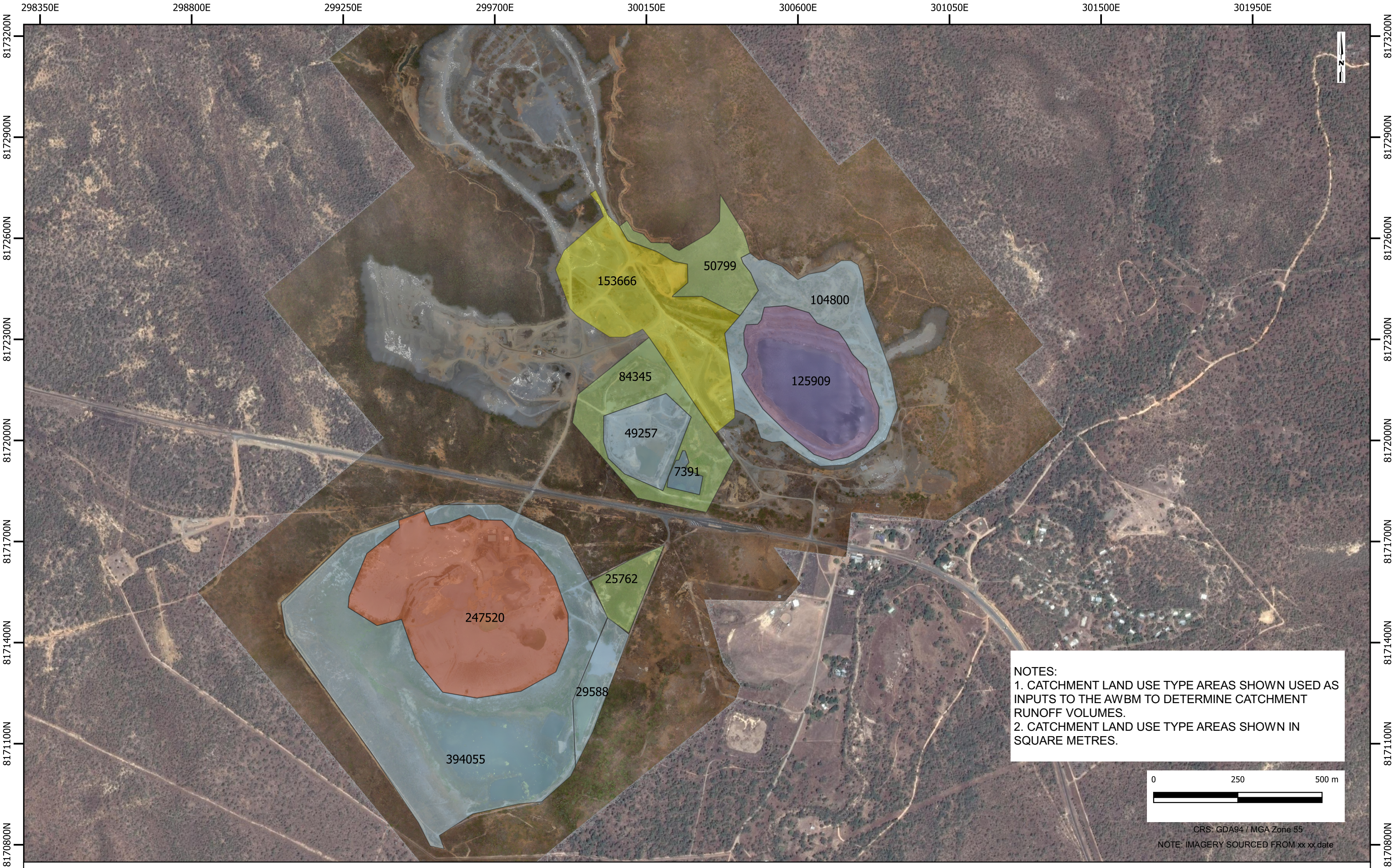


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FIGURES



LEGEND

CATCHMENT LAND USE TYPES

- | | | | |
|---|-------------------------|---|-------------|
|  | NATURAL |  | TAILINGS |
|  | HARDSTANDING/OPEN WATER |  | PIT SURFACE |
|  | WASTE ROCK | | |

EQ RESOURCES

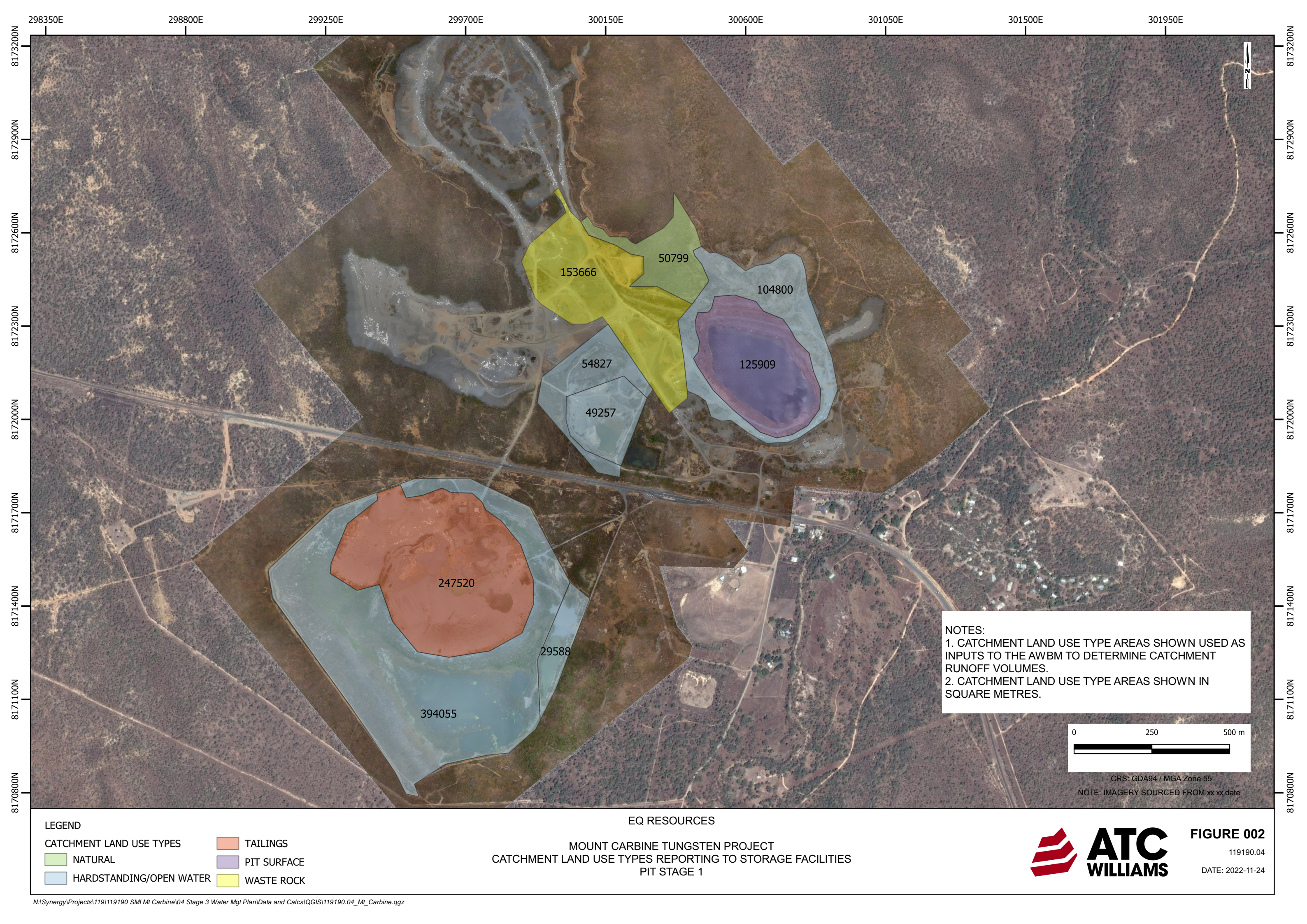
MOUNT CARBINE TUNGSTEN PROJECT
CATCHMENT LAND USE TYPES REPORTING TO STORAGE FACILITIES
EXISTING

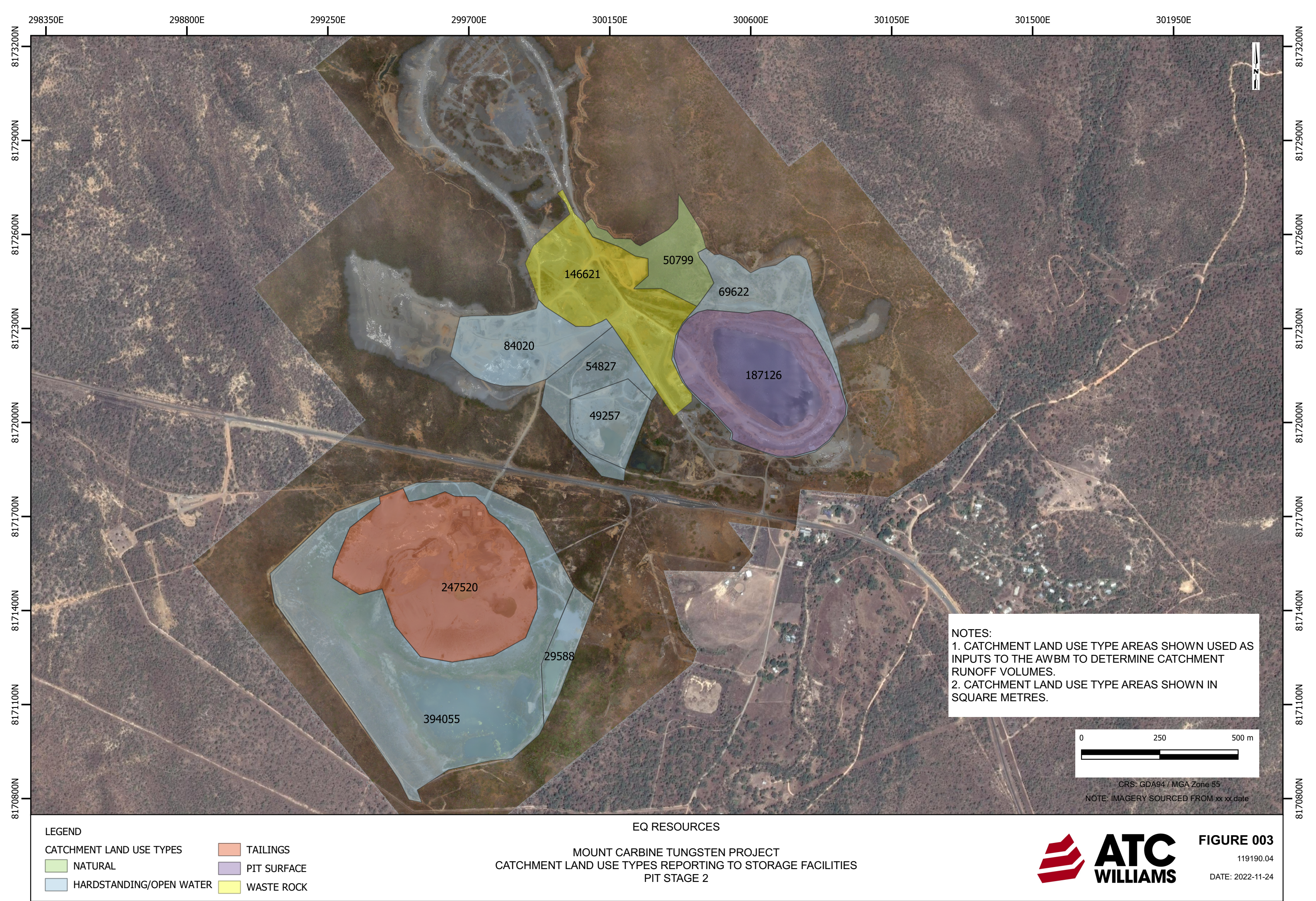


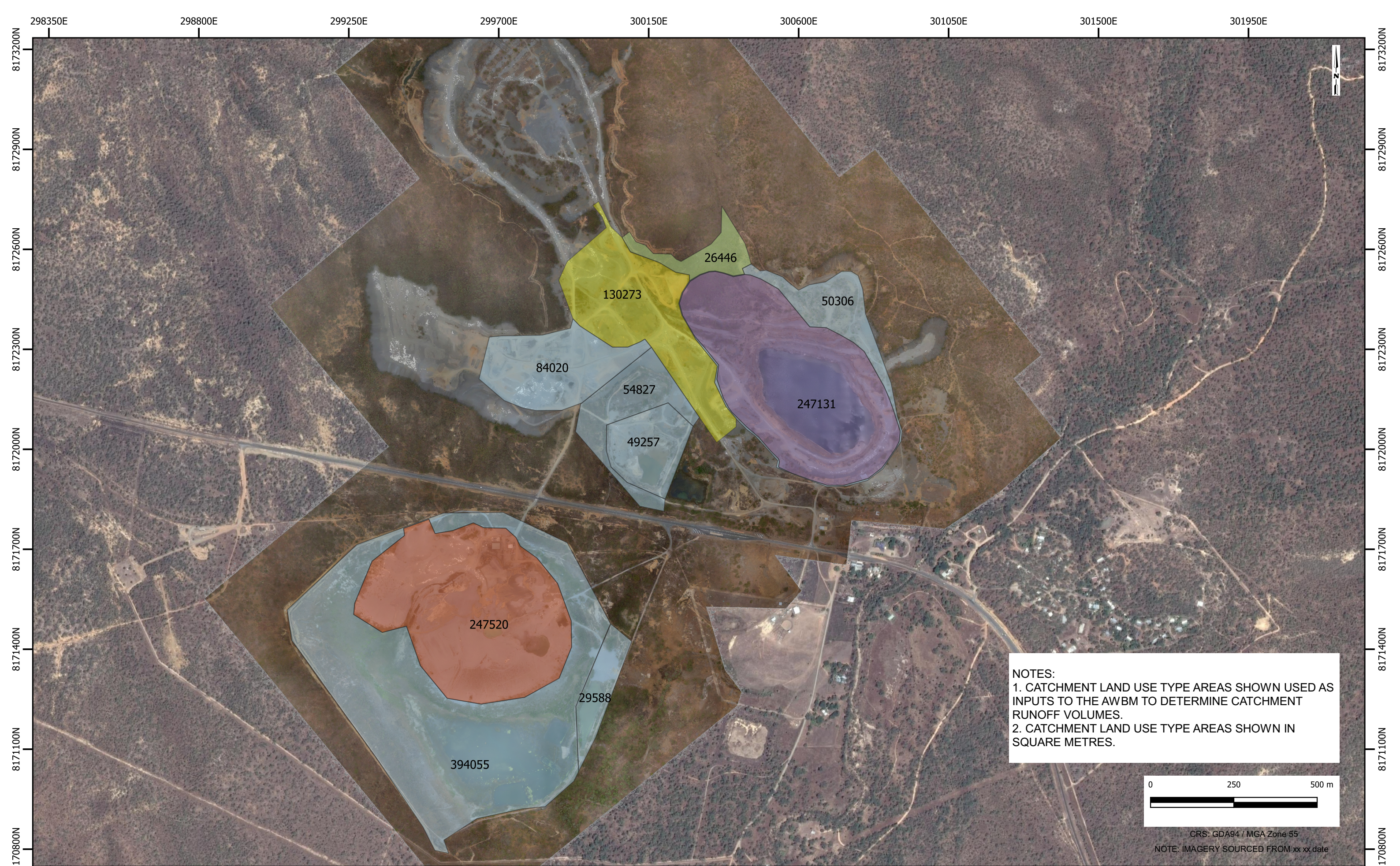
FIGURE 001

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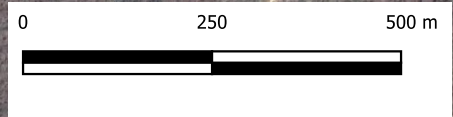
DATE: 2022-11-24







NOTES:
1. CATCHMENT LAND USE TYPE AREAS SHOWN USED AS INPUTS TO THE AWBM TO DETERMINE CATCHMENT RUNOFF VOLUMES.
2. CATCHMENT LAND USE TYPE AREAS SHOWN IN SQUARE METRES.



CRS: GDA94 / MGA Zone 55
NOTE: IMAGERY SOURCED FROM xx xx date

LEGEND

CATCHMENT LAND USE TYPES	TAILINGS
NATURAL	PIT SURFACE
HARDSTANDING/OPEN WATER	WASTE ROCK

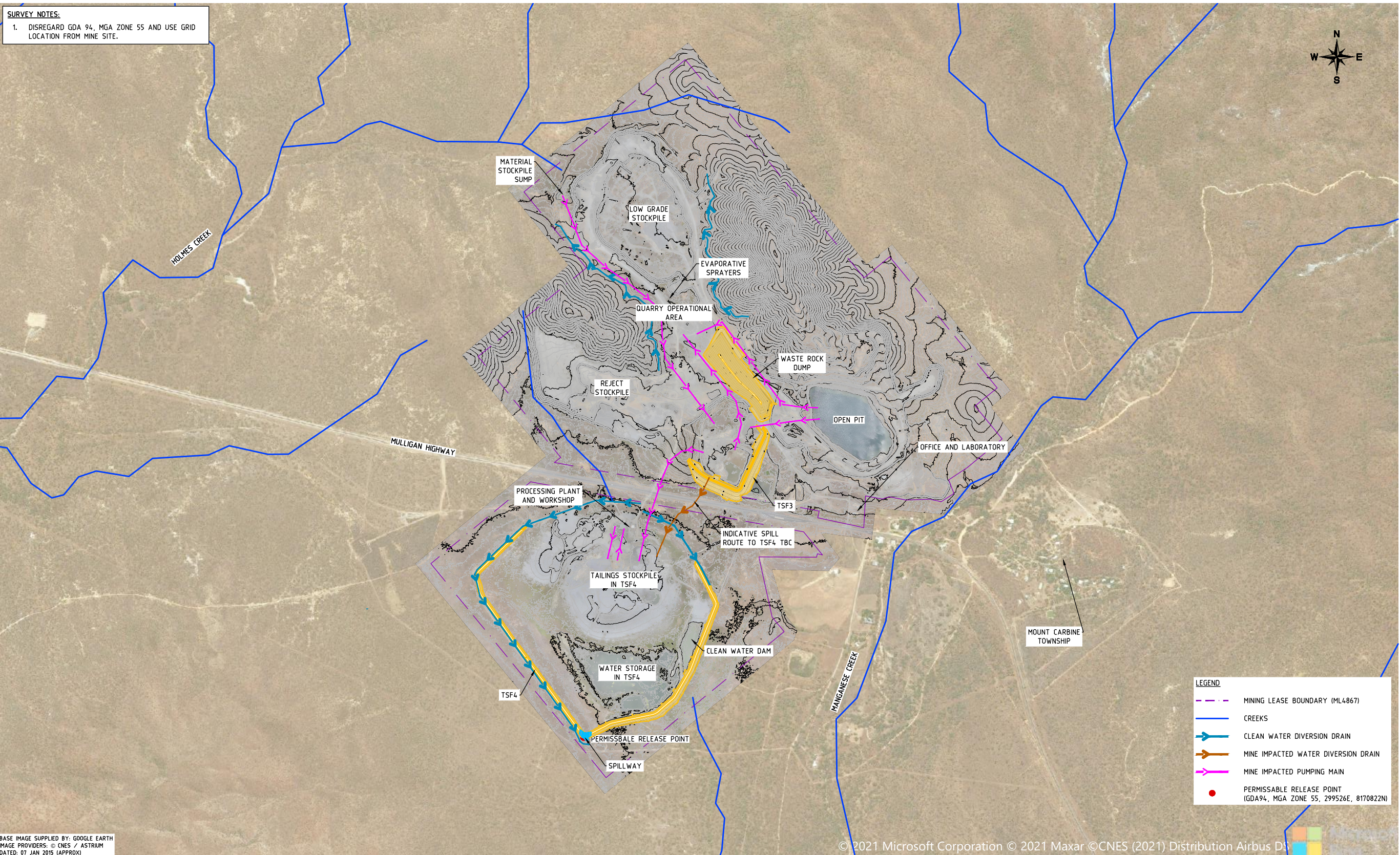
EQ RESOURCES

MOUNT CARBINE TUNGSTEN PROJECT
CATCHMENT LAND USE TYPES REPORTING TO STORAGE FACILITIES
PIT STAGE 3



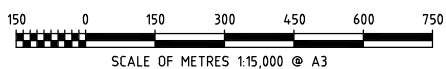
FIGURE 004
119190.04
DATE: 2022-11-24

SURVEY NOTES:
1. DISREGARD GDA 94, MGA ZONE 55 AND USE GRID LOCATION FROM MINE SITE.



BASE IMAGE SUPPLIED BY: GOOGLE EARTH
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DATED: 07 JAN 2015 (APPROX)

ISSUED FOR REPORTING
NOT FOR CONSTRUCTION



CLIENT: SMI MT CARBINE
PROJECT TITLE: STAGE 3 WATER MANGEMENT PLAN
PROJECT NUMBER: 119190-04

DRAWING TITLE: EMBANKMENT
DESIGN STAGE: GENERAL ARRANGEMENT
PLOT TITLE:

FOR INFORMATION ONLY

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LEGEND

-  Clean Water Drainage Diversions
-  Sub-catchment Boundaries

MT. CARBINE PROJECT
DRAINAGE DIVERSION CATCHMENT PLAN



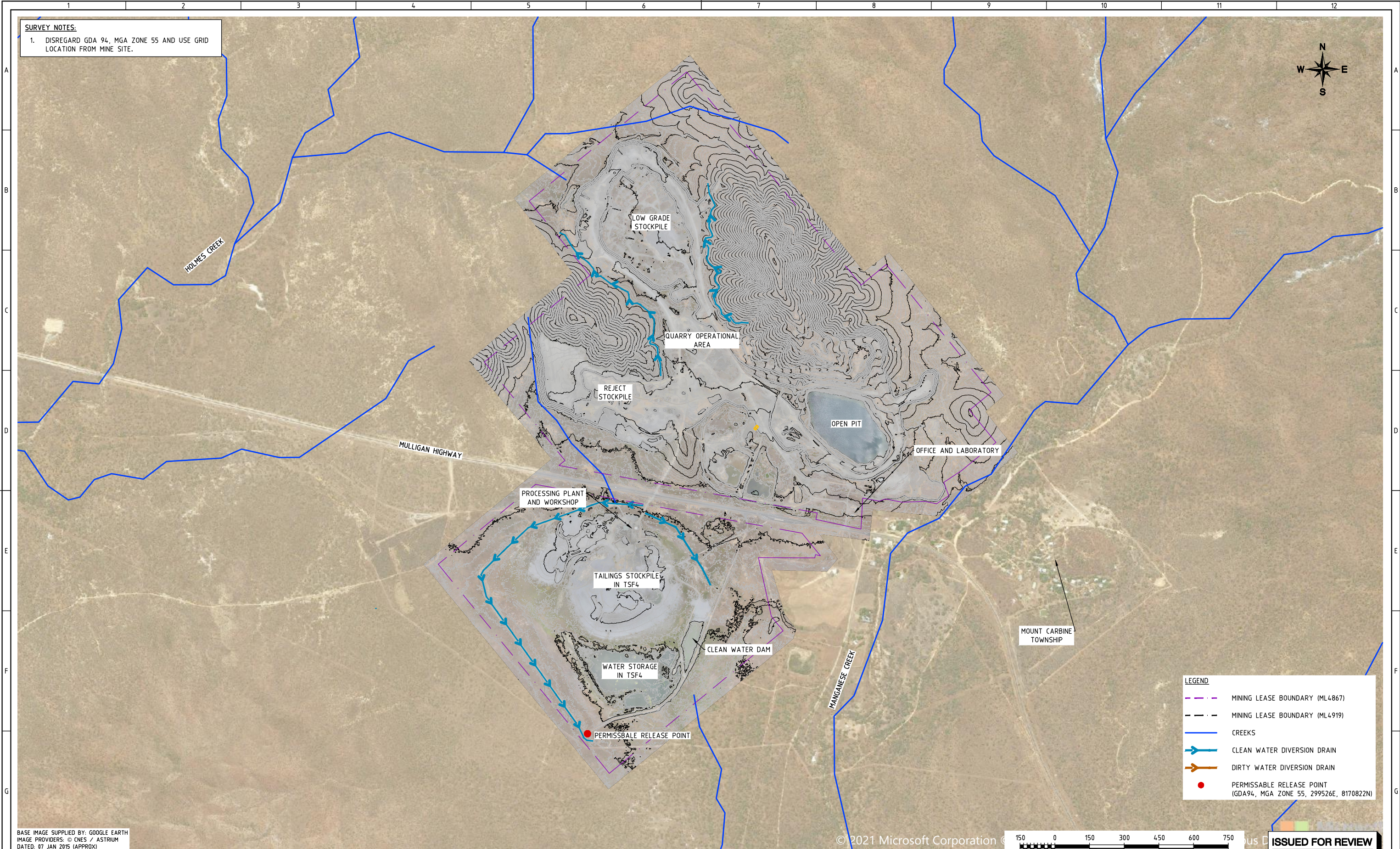
FIGURE 006
119190-03
DATE: 2021-11-19



APPENDICES



APPENDIX A – MOUNT CARBINE EXISTING SITE LAYOUT PLANS



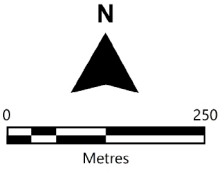
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Mt Carbine Tungsten Project ERC general arrangements
Project: 2022 Estimated Rehabilitation Cost for EA EPML00956913

- Mining lease
- Mt Carbine Quarry EA boundary
- Quarry area

- 2022 ERC disturbance (mining)
- Existing disturbance areas
 - Existing disturbance (roads)
 - Proposed disturbance (pipeline)



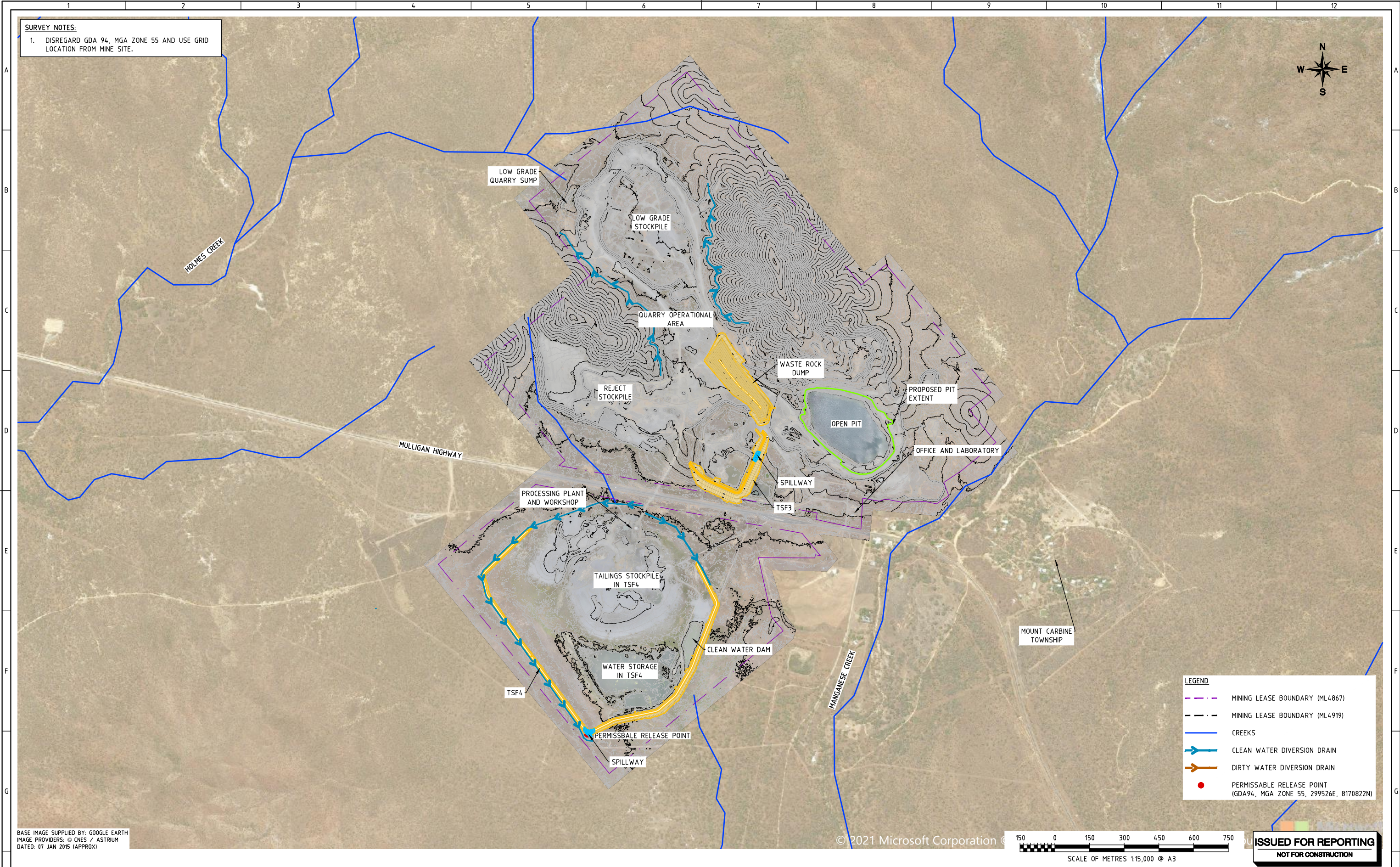
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NRA Ref: 380011.04
Date: March 2022





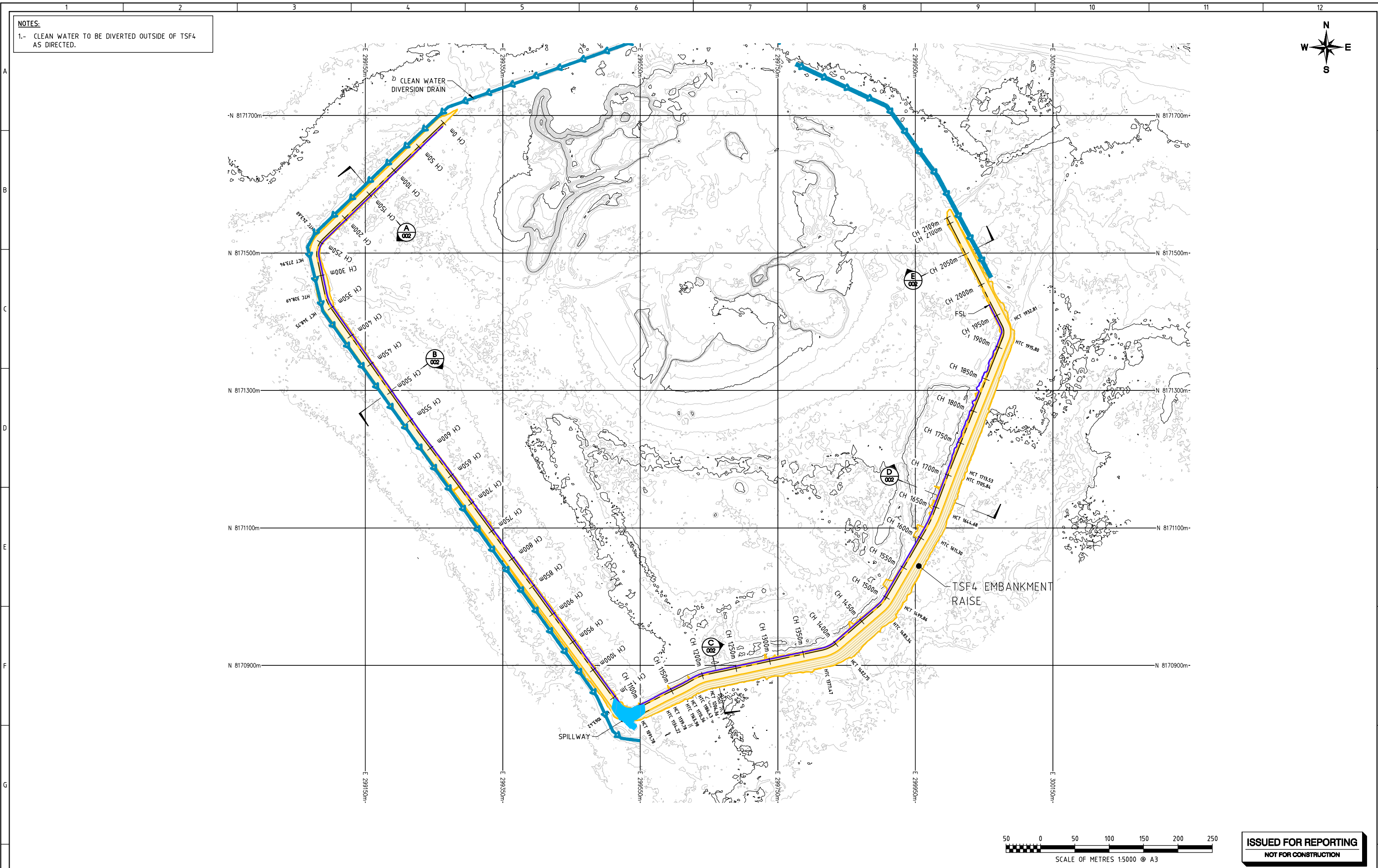
APPENDIX B – MOUNT CARBINE PROPOSED SITE LAYOUT PLANS



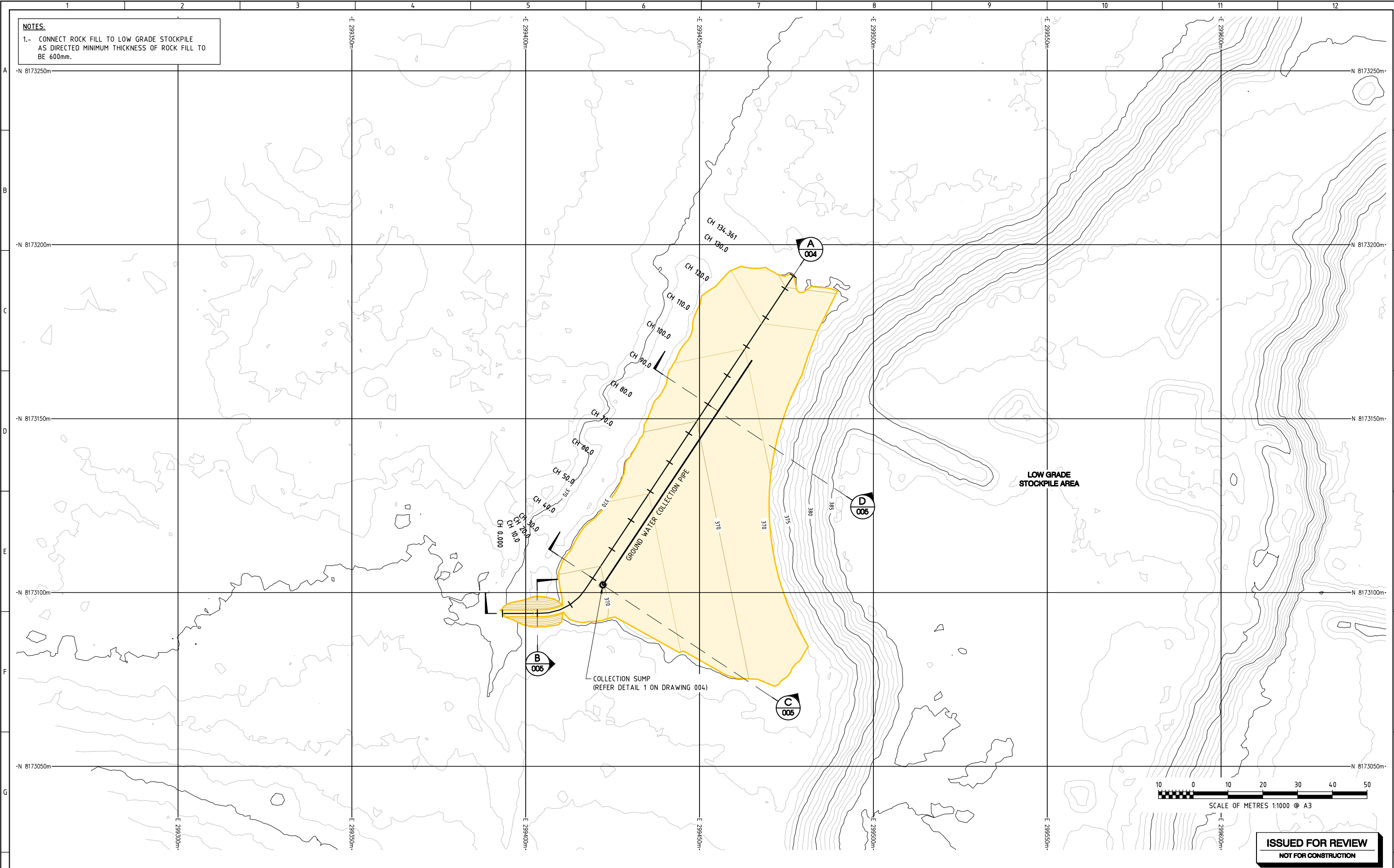
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APPENDIX C – RECEIVING WATER, SEDIMENT AND GROUNDWATER MONITORING LOCATIONS PLAN

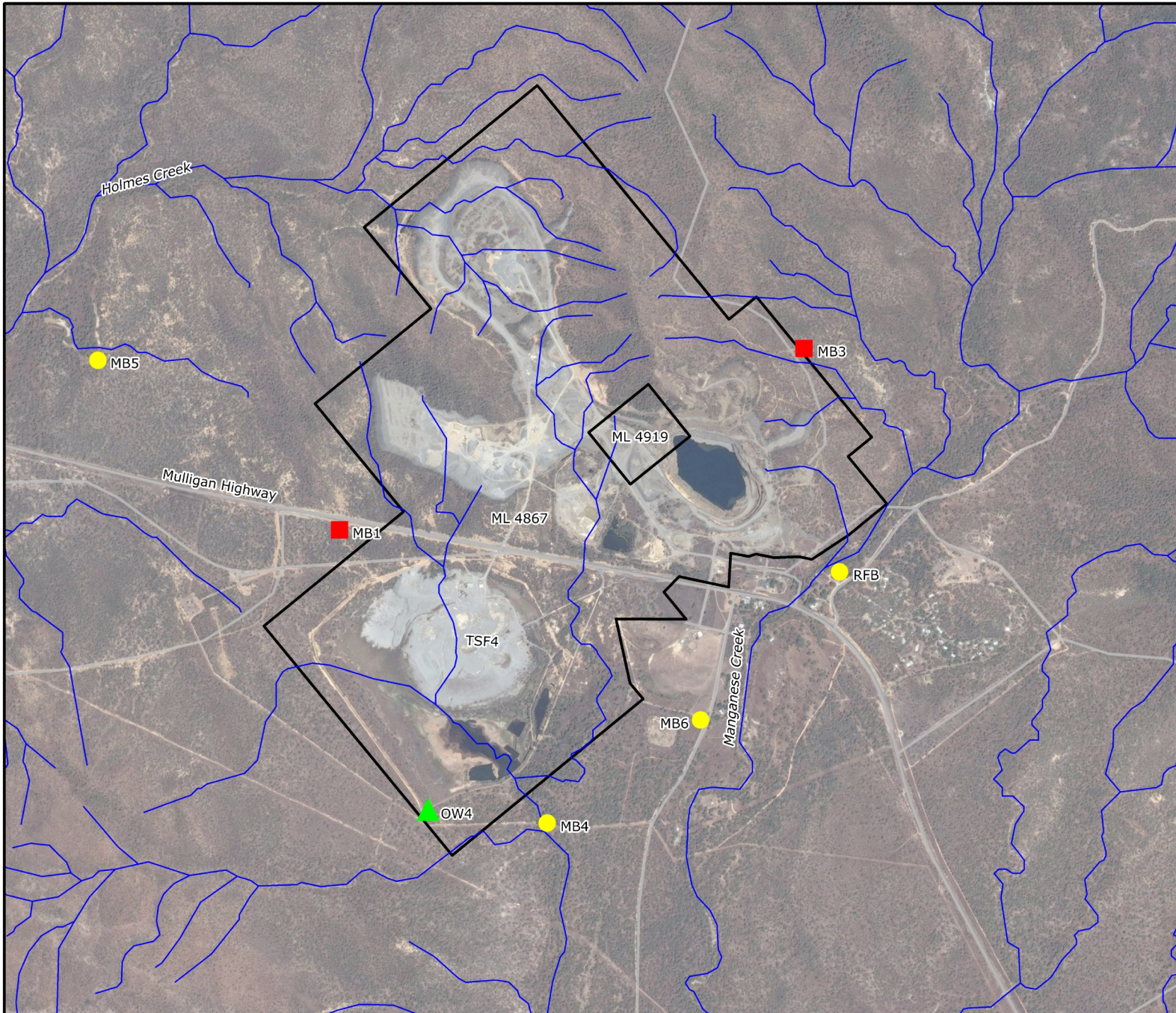


Figure 1: Compliance and reference monitoring bores in the environmental authority

Project: Groundwater Quality Assessment – August 2022 Monitoring

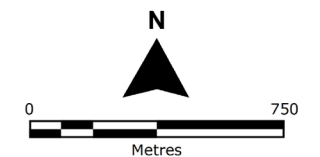
- Mining lease boundary
- Road
- Drainage

Groundwater monitoring bore

- Compliance
- Reference

Note: each bore location (excluding RFB) includes a shallow bore ('A') and deep bore ('B') for EA assessment purposes

- ▲ Surface water monitoring site



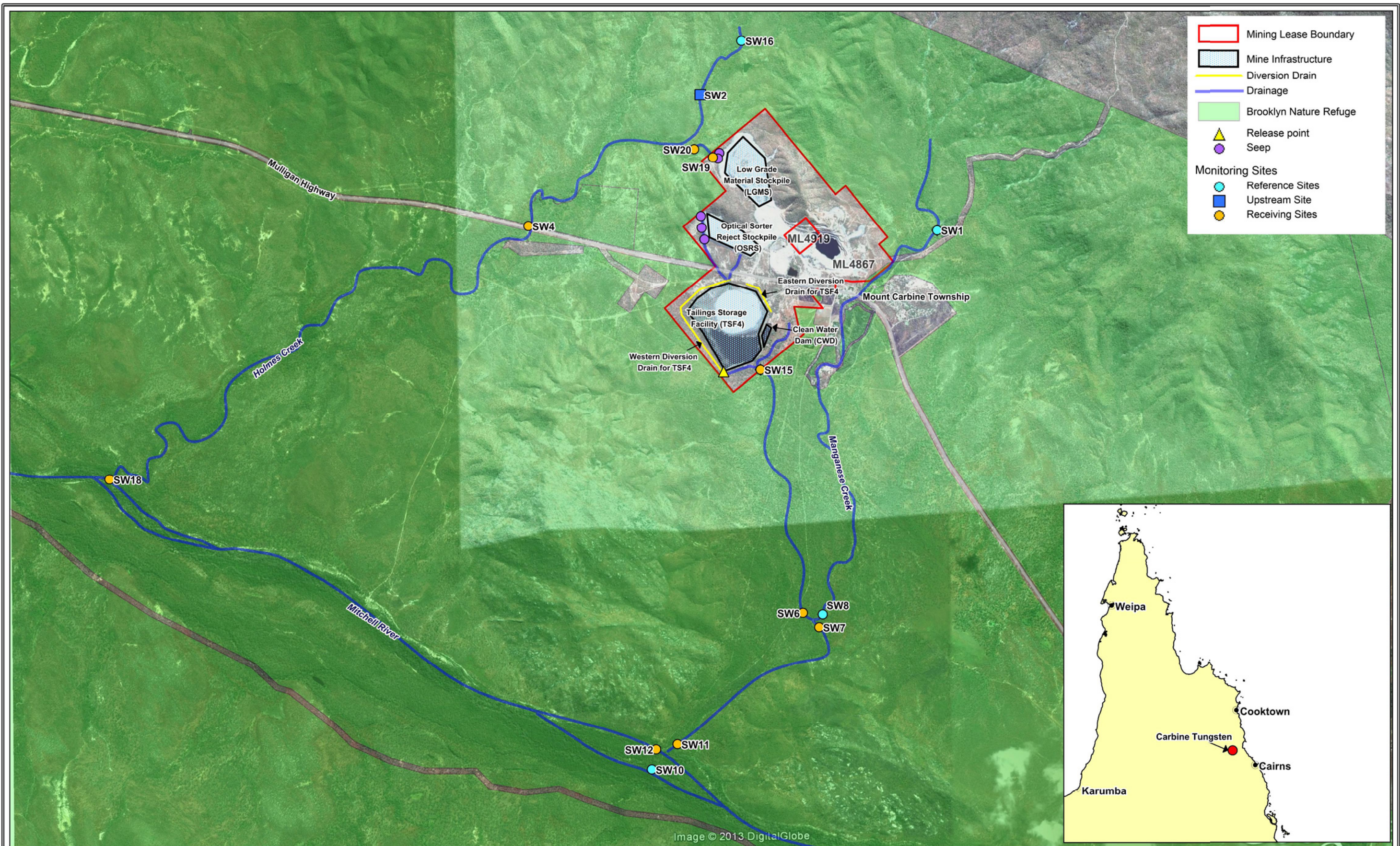
Source:
Queensland Department of Resources 2022, Google Earth 2019

NRA Ref: 380010.03
Date: October 2022



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Recommended print size: A4





APPENDIX D – ‘MT CARBINE WATER BALANCE FOR PHASE 2’, MEMORANDUM

	Total number of pages: 3	Date: 19/05/2022
To:	Tim Anderson	
Cc:	Kevin MacNeill	
From:	Peter Jukes	
Subject:	Mt Carbine Water Balance for Phase 2	

Below summarises the crushing and processing plant water balance for the Phase 2 development of the Mt Carbine Complex, operating under the assumption that the open pit is no longer included in the water circuit for supply or storage.

Key assumptions:

- Crushing plant water requirements – 129.5m³/hr
- Crushing plant moisture loss – 8m³/hr – 5% by weight through +6m, -30mm material reporting to ore sorter (remainder sent to process plant as slurry)
- Process plant water requirements – 200m³/hr
- Moisture loss through process plant – 30m³/hr (0.5m³/t feed assuming 60tph throughput aligned to current plant performance)
- Additional 6.5m³/hr lost from dewatering and stockpiling of process plant ROM material (product dewatering, 10% moisture)
- 2.4m³/hr loss at fine tailings (assumes 70% solids)
- 9.5m³ loss at coarse takings (assumes 85% solids)
- Balance of loss through product moisture, evaporation and spillage

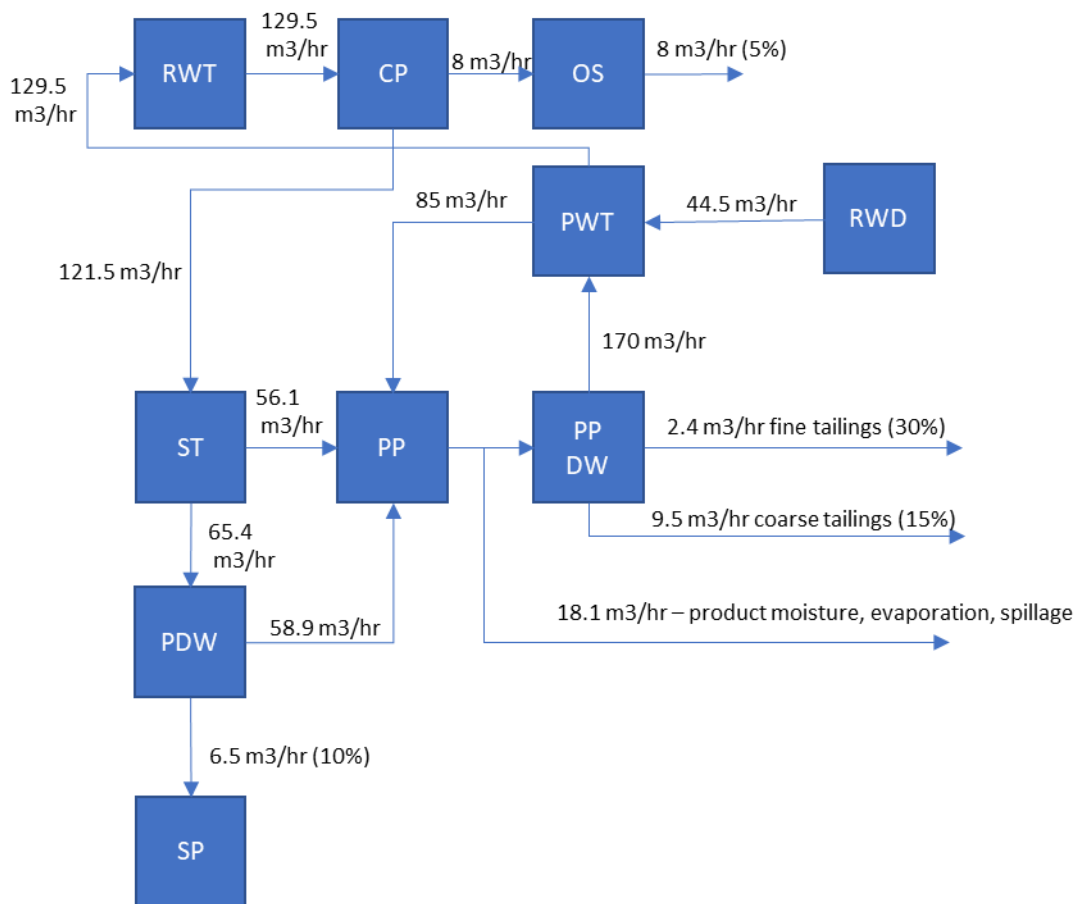
The crushing plant and process plant particle size distributions were based on information supplied by Mincore for the BFS. The water requirements for the crushing plant were supplied by Mincore for the BFS. The process plant water requirements were based on operational averages from the existing plant.

Two block flow scenarios were developed, based on day shift and night shift. During day shift, the crushing and screening plant operates at 350tph and slurry feeds -6mm material directly to the processing plant. Approximately half of the slurry material is dewatered and stockpiled while the other half is fed directly into the processing plant.

During night shift, the crushing and screening plant is not operating and the dewatered material from the crushing plant is dry fed into the processing plant.

In addition to the water usage below, Mt Carbine is currently using approximately 160m³ per day for dust suppression and other operational requirements.

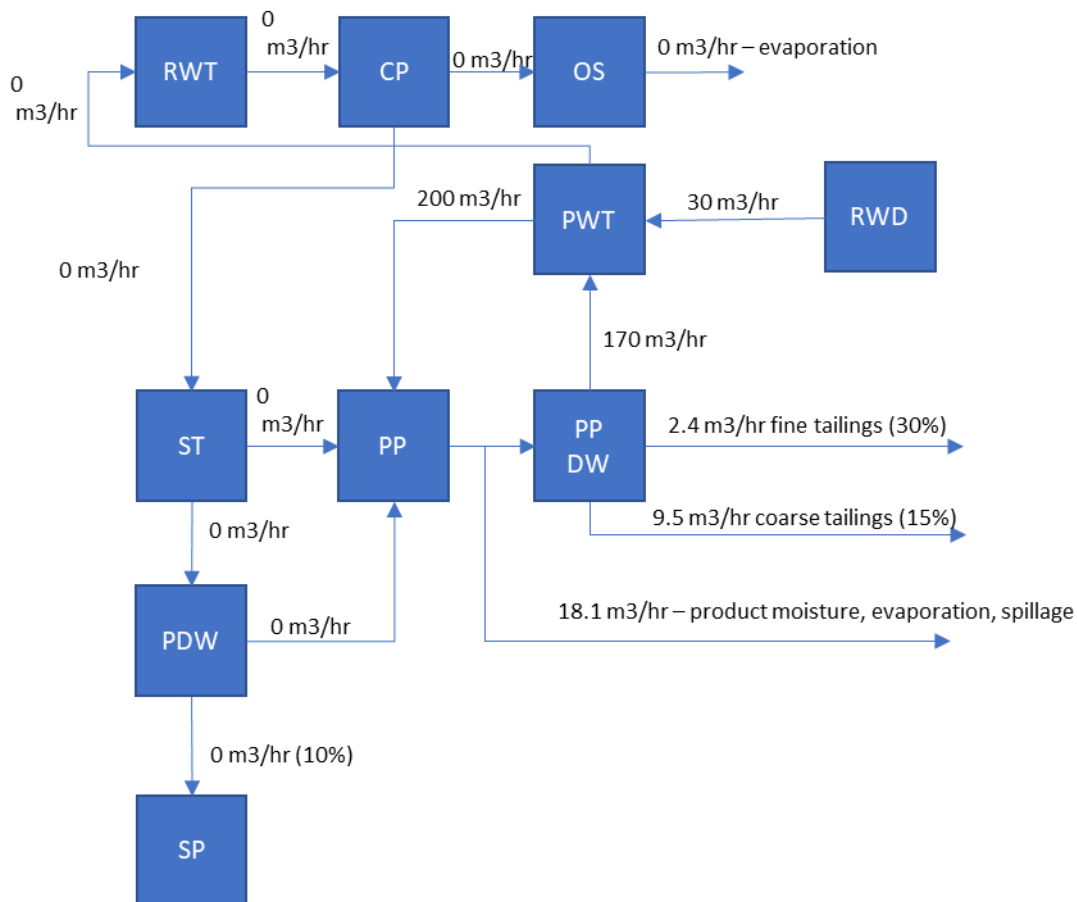
Day Shift:



Legend:

RWT – Crushing Plant Raw Water Tank
 CP – Crushing Plant
 OS – Ore Sorter
 PWT – Process Water Tank
 RWD – Raw Water Dam
 ST – Surge Tank
 PP – Process Plant
 PP DW – Process Plant Dewatering
 PDW – Product Dewatering
 SP – Product Stockpile

Night Shift:





APPENDIX E – QUEENSLAND GOVERNMENT ENVIRONMENTAL REPORTS

State Assessment and Referral Agency

Date: 05/11/2021



Queensland Government

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Disclaimer:
This map has been generated from the information supplied to the Queensland Government for the purposes of the Development Assessment Mapping System. The map generated has been prepared with due care based on the best available information at the time of publication. The State of Queensland holds no responsibility for any errors, inconsistencies or omissions within this document. Any decisions made by other parties based on this document solely the responsibility of those parties. This information is supplied subject to the full terms and conditions available on the department's website.

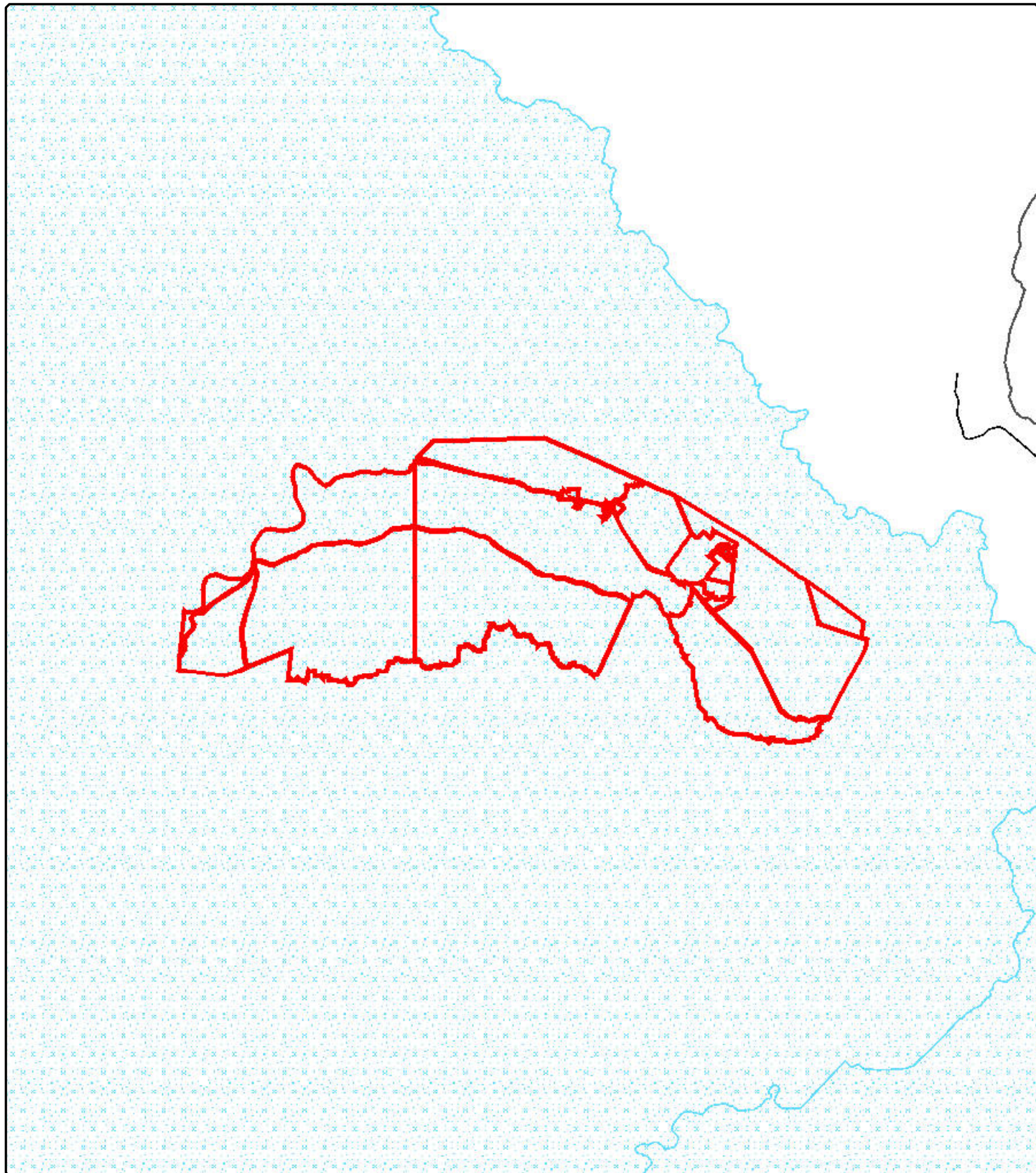


Matters of Interest for all selected Lot Plans

Queensland waterways for waterway barrier works
Water resource planning area boundaries
Regulated vegetation management map (Category A and B extract)
State-controlled road
Area within 25m of a State-controlled road

Matters of Interest by Lot Plan

Lot Plan: 13SP254833 (Area: 590000000 m²)
Queensland waterways for waterway barrier works
Water resource planning area boundaries
Regulated vegetation management map (Category A and B extract)
State-controlled road
Area within 25m of a State-controlled road



State Assessment and Referral Agency

Date: 05/11/2021



Queensland Government

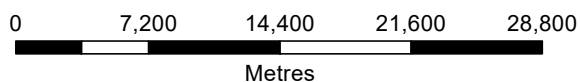
© The State of Queensland 2021.

Legend

Water resource planning area boundaries

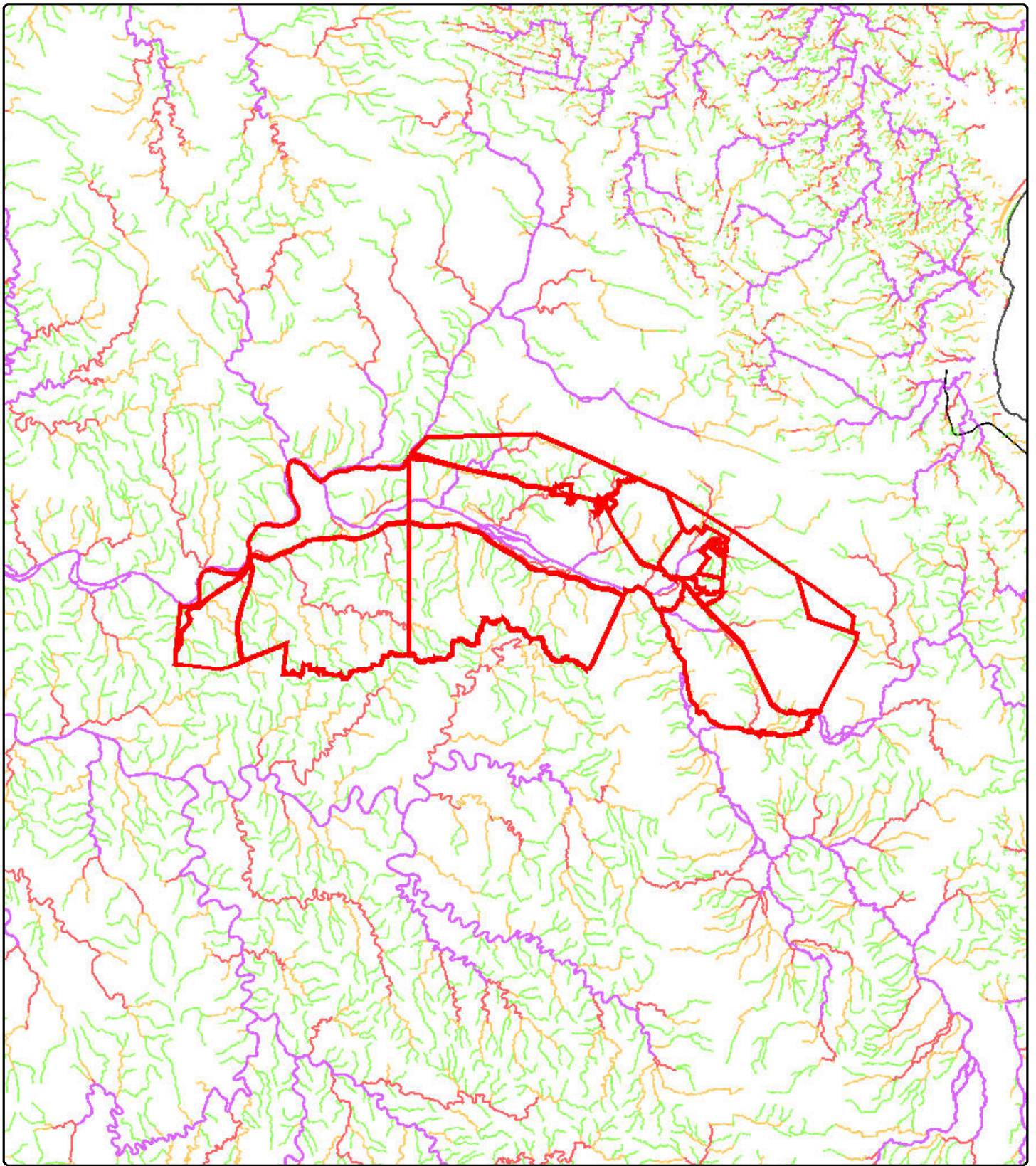


Water resource planning area boundaries



Disclaimer:

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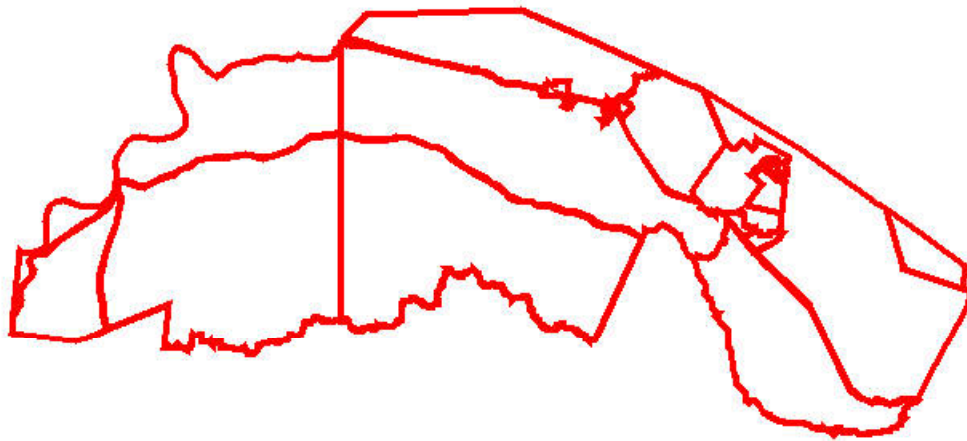
Legend

Queensland waterways for waterway
barrier works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 7,200 14,400 21,600 28,800
Metres

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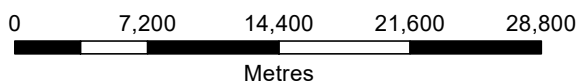
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Legend

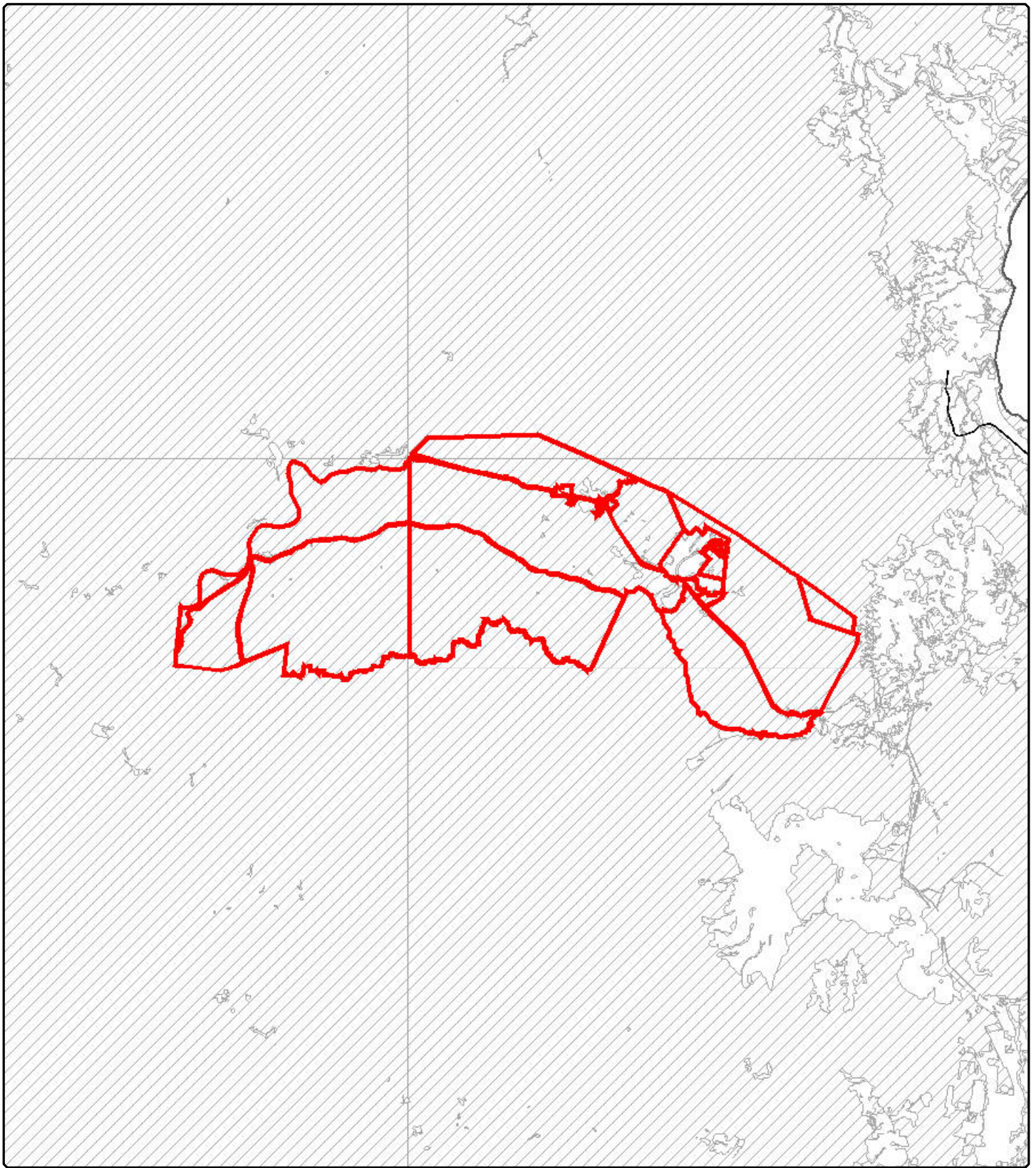
Area within 25m of a State-controlled road

This layer is not displayed at the current map scale



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Legend

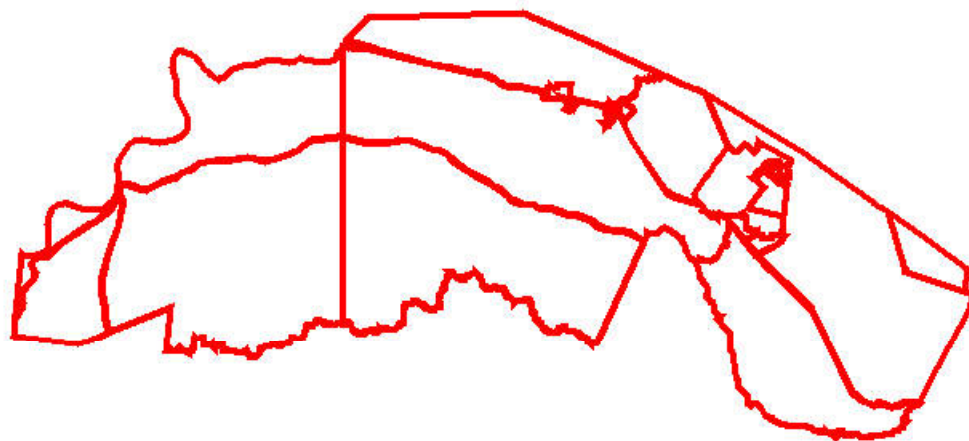
Regulated vegetation management map
(Category A and B extract)

-  Category A on the regulated vegetation management map
-  Category B on the regulated vegetation management map

0 7,200 14,400 21,600 28,800
Metres

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Date: 05/11/2021



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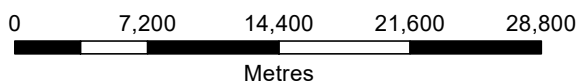
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Legend

State-controlled road

This layer is not displayed at the current map scale



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Queensland Government

Department of Environment and Science

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest
Lot: 13 Plan: SP254833

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government 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 the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Area of interest details: Lot: 13 Plan: SP254833

Size (ha)	58,779.14
Local Government(s)	Mareeba Shire
Bioregion(s)	Einasleigh Uplands, Wet Tropics
Subregion(s)	Hodgkinson Basin, Macalister, Daintree - Bloomfield
Catchment(s)	Mitchell

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Assessment Type	Assessment Area and Version
Biodiversity Planning Assessment(s)	Einasleigh Uplands v1.1, Wet Tropics v1.1
Aquatic Conservation Assessment(s) (riverine)	Eastern Gulf of Carpentaria v1.1
Aquatic Conservation Assessment(s) (non-riverine)	Eastern Gulf of Carpentaria v1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	619.09	1.05
Of concern	4,516.50	7.68
No concern at present	52,370.06	89.1

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of Environment and Science's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	6,072.94	10.33
State	34,190.47	58.17
Regional	8,928.42	15.19
Local or Other Values	7,829.73	13.32

Table 5: Non-riverine wetlands intersecting the AOI

Non-riverine wetland types intersecting the area of interest	#
Number of Palustrine wetlands	15
Number of Lacustrine wetlands	18
Total number of non-riverine wetlands	33

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

Name	Permanency
MARY CREEK	Non-perennial
MCLEOD RIVER	Non-perennial
MITCHELL RIVER	Non-perennial
PENNYWEIGHT CREEK	Non-perennial
RIFLE CREEK	Non-perennial
WOLSTENCROFT CREEK	Non-perennial

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of Environment and Science's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	58,719.59	99.9
High	41.66	0.07
Medium	18.04	0.03
Low	0.0	0.0
Very Low	0.0	0.0

Table 8: Summary table, aquatic conservation significance (non-riverine)

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
Very High	5.07	0.01
High	0.0	0.0
Medium	283.9	0.48
Low	0.0	0.0
Very Low	0.0	0.0

Biodiversity Planning Assessments

Introduction

The Department of Environment and Science (DES) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DES.

Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

<http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/>

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

<http://qspatial.information.qld.gov.au/geoportal/>

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	6,072.94	10.33
State	34,190.47	58.17
Regional	8,928.42	15.19
Local or Other Values	7,829.73	13.32

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the

Environment Protection and Biodiversity Conservation Act 1999. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	13,168.16	22.4
State	Remnant contains at least 1 Endangered or 2 Vulnerable or Near Threatened species (A)	6,072.94	10.33
State	Remnant contains at least 1 Endangered RE (B1)	52.3	0.09
State	Remnant contains at least 1 Endangered RE (B1) & World Heritage Area (B1)	113.54	0.19
State	Remnant contains at least one Of Concern RE (B1) & Is part of moderately large Tract (C) & Contains a RE that is a moderately large RE of its type in the bioregion (D1) & Has high connectivity or buffers an endangered RE or Significant Wetland (G)	11.19	0.02
State	Remnant contains at least one Of Concern RE (B1) & Remnant contains an RE that is one of the largest of its type in the bioregion (D1)	4,053.33	6.9
State	Remnant contains at least one Of Concern RE (B1) & Remnant is part of moderately large Tract (C) & Remnant contains a RE that is a moderately large RE of its type in the bioregion (D1) & Remnant has Ecosystem diversity in the top quartile (F)	18.58	0.03
State	World Heritage Area (B1)	1,090.43	1.86
Regional	Remnant contains an RE that is one of the largest of its type in the subregion (D2)	930.01	1.58
Regional	Remnant contains at least 1 RE with <10 pc extent remaining or rare in subregion (B2)	666.46	1.13
Regional	Remnant contains at least 1 RE with 10-30 percent extent remaining in the subregion (B2) & Remnant is part of moderately large Tract (C) & Remnant has high connectivity or buffers an endangered RE or Significant Wetland (G)	6.77	0.01
Regional	Remnant contains at least 1 Vulnerable or Near Threatened species (A)	384.89	0.65
Regional	Remnant contains at least one Of Concern RE (B1)	7,566.49	12.87
Local or Other Values	Refer to diagnostic data for additional information	21,648.10	36.83

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa	6,073.07	10.3	415.1	0.7	34,562.82	58.8	14,732.33	25.1
B1: Ecosystem Value (Bioregion)	5,458.04	9.3	12,143.28	20.7	37,866.05	64.4	315.95	0.5

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
B2: Ecosystem Value (Subregion)	1,316.39	2.2			48,901.11	83.2	5,565.82	9.5
C: Tract Size			55,713.36	94.8			69.96	0.1
D1: Relative RE Size (Bioregion)	17,648.56	30.0	2,925.07	5.0	7,216.39	12.3	27,993.30	47.6
D2: Relative RE Size (Subregion)	22,436.08	38.2	2,428.78	4.1	5,125.14	8.7	25,793.14	43.9
F: Ecosystem Diversity	19,263.25	32.8	21,099.83	35.9	4,019.88	6.8	11,400.36	19.4
G: Context and Connection	51,048.24	86.8	3,781.68	6.4	936.54	1.6	16.86	

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Refer to Expert Panel data for additional information	189.37	0.32
State	Remnant contains Core Habitat for Priority Taxa (H) & Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	1,795.83	3.06
State	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	10,737.62	18.27
State	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I) & Remnant forms part of a bioregional corridor (J)	11,832.06	20.13
State	Remnant forms part of a bioregional corridor (J)	290.03	0.49
Regional	Refer to Expert Panel data for additional information	1,062.92	1.81
Regional	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	6,573.27	11.18
Regional	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I) & Remnant forms part of a bioregional corridor (J)	44.05	0.07
Regional	Remnant forms part of a bioregional corridor (J)	28.98	0.05
Local	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	0.4	0.0

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al.* 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa	2,881.53	4.9	3,924.65	6.7	1,923.06	3.3		
Ia: Centres of Endemism	5,211.18	8.9	19,308.45	32.8	6.5			
Ib: Wildlife Refugia	21,322.20	36.3	9,660.36	16.4				
Ic: Disjunct Populations	12,212.52	20.8	11,515.56	19.6				
Id: Limits of Geographic Ranges	12,184.79	20.7	27.73					
Ie: High Species Richness	21,965.06	37.4	8,925.41	15.2				
If: Relictual Populations	4,805.83	8.2	17,159.13	29.2				
Ig: Variation in Species Composition	9,402.36	16.0	1,871.01	3.2				
Ih: Artificial Wetland								

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
li: Hollow Bearing Trees	12,184.79	20.7	4,895.69	8.3				
lj: Breeding or Roosting Site	14,925.47	25.4	2,134.50	3.6				
lk: Climate Refugia	2,157.60	3.7	1,891.52	3.2				

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to lj cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

- Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;
- Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;
- Maintaining large scale seasonal/migratory species processes and movement of fauna;
- Maximising connectivity between large tracts/patches of remnant vegetation;
- Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

- Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);
- Follow major watershed/catchment and/or coastal boundaries;
- Incorporate major altitudinal/geological/climatic gradients;
- Include and maximise connectivity between large tracts/patches of remnant vegetation;
- Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

- Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

Biodiversity Significance	Area (Ha)	% of AOI
State	12,029.09	20.46
Regional	166.02	0.28
Local	0.0	0.0

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

Decision Number	Description	Panel Recommended Significance	Criteria Values
eu_fa_10	Upper Mitchell-Brooklyn	State	1b (wildlife refugia): VERY HIGH 1e (high species richness): VERY HIGH
eu_fa_24	Eastern ecotone	State	1a (centre of endemism): HIGH 1b (wildlife refugia): VERY HIGH 1c (disjunct populations): VERY HIGH 1d (taxa at the limits of their ranges): VERY HIGH 1e (high species richness): VERY HIGH 1i (high density of hollow-bearing trees): VERY HIGH 1j (significant breeding or roosting sites): VERY HIGH
eu_fa_27	Areas of Regional significance for invertebrates	Regional	1a (centre of endemism): HIGH 1b (wildlife refugia): HIGH 1c (disjunct populations): HIGH 1e (high species richness): HIGH 1f (relictual populations): HIGH
eu_fa_28	High precision records for priority taxa of State significance are contained within the remnant.	State	Criterion H: VERY HIGH
eu_fa_30	High precision records for priority taxa of Regional significance are contained within the remnant.	Regional	Criterion H: HIGH
eu_fa_31	Low precision records for priority taxa of Regional significance are contained within the remnant.	None	Criterion H: MEDIUM
eu_fl_08	Bakers Blue and nearby granite areas	Regional	1b (wildlife refugia): HIGH 1c (disjunct populations): HIGH 1e (high species richness): VERY HIGH
eu_fl_24	High precision records for priority taxa of State significance are contained within the remnant.	State	Criterion H: VERY HIGH
eu_fl_25	Low precision records for priority taxa of State significance are contained within the remnant.	None	Criterion H: MEDIUM
eu_fl_26	High precision records for priority taxa of Regional significance are contained within the remnant.	Regional	Criterion H: HIGH

Decision Number	Description	Panel Recommended Significance	Criteria Values
eu_fl_27	Low precision records for priority taxa of Regional significance are contained within the remnant.	None	Criterion H: MEDIUM
eu_l_03	Riparian ecosystems and associated areas.	State	lb (wildlife refugia): VERY HIGH le (high species richness): VERY HIGH lg (RE's with distinct variation): VERY HIGH li (high density of hollow-bearing trees): HIGH lj (significant breeding or roosting sites): VERY HIGH
eu_l_06	Wetlands	Regional	lb (wildlife refugia): HIGH le (high species richness): HIGH li (high density of hollow-bearing trees): HIGH lj (significant breeding or roosting sites): HIGH
eu_l_11	Vine Thickets	State	la (centre of endemism): VERY HIGH lb (wildlife refugia): VERY HIGH lc (disjunct populations): VERY HIGH ld (taxa at the limits of their ranges): HIGH le (high species richness): VERY HIGH lf (relictual populations): HIGH
eu_l_15	Ecosystems with a Biodiversity status of Endangered or Of Concern and a current extent of less than 10,000ha	State	lb (wildlife refugia): HIGH lg (RE's with distinct variation): VERY HIGH
eu_l_22	Corridor Special Management Areas	State	J (corridors): State (all remnant, and disturbed Wet Tropics vegetation)
eu_l_32	Bioregional Terrestrial Corridors	State or Regional	J (corridors): State or Regional
eu_l_33	Bioregional Riparian Corridors	State	J (corridors): State
eu_l_34	Corridor Special Management Areas (non-remnant)	Regional	J (corridors): Regional (non remnant, excluding disturbed Wet Tropics vegetation)
wet_fa_21	Instream fauna - Mt Lewis, upper Mitchell creek, Mt Molloy, McLeod River riparian system	Local	la (endemic richness): M li (hollows and habitat): H lk (climate change refugia): H
wet_fa_22	High 'rainforest vertebrate' taxa richness	State	le (species richness): VH
wet_fa_23	High 'rainforest vertebrate' WET endemic taxa richness	State	la) endemics: VH
wet_l_04	Upland climate refugia	State	la (endemic richness): VH lb (refugia): VH lc (disjunct populations): VH ld (range limits): VH le (species richness): VH lf (relictual taxa): VH li (hollows and habitat): VH lj (aggregation site): VH lk (climate change refugia): VH
wet_l_15	Sclerophyll forest west of rainforest - tall open forest	State	la (endemic richness): VH lb (refugia): VH lc (disjunct populations): VH ld (range limits): VH le (species richness): VH lg (ecosystem variation): H li (hollows and habitat): VH lj (aggregation site): H lk (climate change refugia): H
wet_l_16	Wet Tropics endemic BVGs of simple to complex upland mesophyll and notophyll vine forests.	State	la (endemic richness):VH
wet_l_22	Wet Tropics World Heritage Area Outstanding Universal Values - Relictual and important evolutionary Areas	State	lf (relictual taxa): VH

Decision Number	Description	Panel Recommended Significance	Criteria Values
wet_l_23	Wet Tropics World Heritage Area Outstanding Universal Values - Concentrations of endemism	State	1a (endemics): VH
wet_l_24	Wet Tropics World Heritage Area Outstanding Universal Values - Habitats for conserving biodiversity and rare and threatened species of flora and fauna	State	1b (refugia): VH 1e (species richness): VH
wet_l_25	Core areas	Regional	1b (refugia): H
wet_l_28	Carbine uplands including Mount Spurgeon	State	1a (endemic richness): VH 1b (refugia): VH 1c (disjunct populations): VH 1d (range limits): VH 1e (species richness): VH 1f (relictual taxa): VH 1g (ecosystem variation): VH 1i (hollows and habitat): VH 1j (aggregation site): VH 1k (climate change refugia): VH
wet_l_30a	Terrestrial bioregional corridors (landscape connections)	State	Criterion J (terrestrial corridor): STATE
wet_l_31a	Riparian bioregional corridors (landscape connections)	State	Criterion J (riparian corridor): STATE

Expert panel decision descriptions:

eiu_fa_10

Includes upper tributaries of the Mitchell River, downstream to near Hurricane Station. An extensive rain fed system draining the western margin of the Wet Tropics bioregion, including numerous permanent waterholes. Supports high fish diversity, including disjunct populations of the coal grunter (**Hephaestus carbo**) and other fish species, and the sooty grunter (**Hephaestus fuliginosus**). Also supports the Mitchell river prawn (**Macrobrachium rosenberghii**). Rifle creek is the upper most permanent creek in the upper Mitchell. Includes Font Hills, the source of genetic stock of redclaw (**Cherax quadricarinatus**) aquaculture worldwide. Area includes 500m buffer from riparian zone.

eiu_fa_24

The Eastern ecotone of the Einasleigh Uplands is a band of eucalypt forest separating the rainforest of the Wet Tropics from the dry tropical woodlands that characterize the bioregion. These better developed forests support a number of species that are endemic to the ecotone, or are isolated populations of species more widely distributed in the wet sclerophyll forest of south-east Queensland. These species include the northern bettong (**Bettongia tropica**), eastern yellow robin (**Eopsaltria australis**), yellow thornbill (**Acanthiza nana**), greater glider (**Petauroides volans**), Squirrel glider (**Petaurus norfolcensis**), crested shrike-tit (**Falcunculus frontatus**) and the yellow-faced honeyeater (**Lichenostomus chrysops**). Disjunct tree species that have the major part of their North Queensland distribution in the ecotone include **Eucalyptus resinifera**, **E. pellita**, **E. grandis**, **E. moluccana**, **E. reducta**, **E. cloeziana**, **E. citriodora** and **Angophora floribunda**.

eiu_fa_27

Between Carbine and McLeod River: Endemic Buprestidae (**Casturinia** spp.).

Irvinebank/Watsonville Area: Endemic Scarabidae (including **Blackburnium** sp. and **Tesserodon** sp.) and Bolboceratidae.

SW of Mt. Molloy: Endemic population of *Macropenesthie* spp (burrowing cockroach).

Southern Hann Tableland: Endemic Scarabidae, Histeridae spp. This area was incorporated into landscape decision eiu_l_12 and removed from here.

Well wooded country on the Newcastle Range: Rich variety of spp. in the Scarabidae (with at least one endemic Buprestid).

ei_u_fa_28

Remnant contains Core Habitat for Priority taxa with high precision records.

ei_u_fa_30

Remnant contains Core Habitat for Priority taxa with high precision records.

ei_u_fa_31

Remnant contains Core Habitat for Priority taxa with low precision records.

ei_u_fl_08

Biotite granite hills north-west of Mareeba. These hills and ranges are surrounded by low sedimentary hills and plains, forming small biogeographic isolates near the western boundary of the Wet Tropics bioregion. All have skeletal soils and coarse sands and are characterized by species with disjunct populations and unusual species assemblages, as well as some R T species. Ecosystems include Wet Tropics outliers as well as drier vine thickets, woodlands and heaths.

Although poorly known, plants of conservation significance known to occur include **Brachychiton albidus** (R), *Pimelea* sp. (Bakers Blue Mt D.G.Fell DF1588) and *Tephrosia gaudium-solis*.

Note: the Hann Tableland part of this decision was removed and included in Landscape Decision ei_u_I_12.

ei_u_fl_24

Remnant contains Core Habitat for Priority taxa with high precision records.

ei_u_fl_25

Remnant contains Core Habitat for Priority taxa with low precision records.

ei_u_fl_26

Remnant contains Core Habitat for Priority taxa with high precision records.

ei_u_fl_27

Remnant contains Core Habitat for Priority taxa with low precision records.

ei_u_I_03

Most of the Einasleigh Uplands is dominated by open vegetation on shallow or skeletal soils. Riparian RE's associated with the larger river systems function as important refuges for many species of flora and fauna because of the relatively high nutrient levels associated with most of these areas, their better moisture balance and their generally well developed vegetation. These mesic ribbons of habitat provide an important seasonal refuge and resources for a variety of species, in particular arboreal mammals, woodland birds, hollow-roosting species and amphibians. Many raptor species preferentially nest in tall riparian trees.

Riparian areas are also biogeographically significant habitat as they allow inland incursions of many east coast species into drier areas on the edge of their geographic range.

Riparian areas were given a 200m buffer with the same significance rating to ensure that adjacent habitat used opportunistically by species using the riparian areas was also included.

This decision includes Landscape decision 4.

ei_u_I_06

- Wetlands have a range of biodiversity values, both in their own right, and for the role they play in maintaining water quality, protecting downstream aquatic ecosystems, and as part of the wetland ecosystem continuum where they are periodically connected with other aquatic ecosystems. Wetlands act as refugia for many species, and play a vital role in the life cycle of others.
- Wetlands were given a 200m buffer with the same significance rating to ensure that all areas adjacent to them, and the areas most likely to have higher values, were also included.

ei_u_I_11

The bioregion has a wide variety of dry vine thickets across a number of different substrates. Vine thickets have been largely cleared from the Brigalow Belt, and the Einasleigh Uplands is of state significance in the protection of these ecosystems and their values. Vine thickets are refugia for a large number of plants and animals, many of which are disjunct populations, or at the limits of their geographic ranges. Although species combinations vary with substrate, EVR and other priority species are present in many occurrences and endemism of invertebrate species is common.

Mapped vine thickets were buffered by 500m to allow for species that shelter in the vine thicket but use resources in the surrounding woodlands.

Some occurrences are at risk from weed invasions (particularly lantana **Lantana camara**), pig damage and adverse fire regimes.

This decision combines and replaces Flora decision 22 and Fauna decision 23.

ei_u_I_15

Einasleigh Upland regional ecosystems with a remaining extent that is less than 10,000ha have a naturally restricted distribution, and their threatened status is a reflection of this. They are susceptible to what would normally be viewed as local threats or impacts, and are therefore most vulnerable of all ecosystems to rapid and potentially total loss of natural values. In most cases their restricted distribution relates to geomorphic and/or micro-climatic settings that are also restricted and these areas therefore have particular ecological and scientific values. These values relate to the unique combination of ecological characteristics, and to the unusual habitat conditions they provide for particular species or genotypes. Where the status has been upgraded to Endangered due to the impact of threatening processes their susceptibility to further loss of values is extreme.

ei_u_I_22

Corridor Special Management Areas (SMAs) are areas where there are gaps or weaknesses (such as disturbed, cleared or regrowth areas) in habitat continuity in a significant corridor or special biodiversity area, and there is an ecological relationship with the corridor or biodiversity area, or it has similar ecological values to those areas. These areas therefore have significant values in their own right. They also provide a focus for protecting existing vegetation, for consolidating habitat and for increasing habitat connectivity across areas of identified weakness. Focussed planning, management and rehabilitation can play a significant role in enhancing the special ecological values associated with these areas.

The objectives for the corridor SMAs are to limit land use intensification, promote compatible uses, and retain all remaining remnant, disturbed and regrowth vegetation. The restoration of habitat and habitat continuity in cleared parts of the SMAs should be facilitated through detailed planning and negotiation.

Disturbed or regrowth vegetation are not differentiated from cleared areas in the EIU but are in the Wet Tropics. Disturbed Wet Tropics vegetation in SMAs is of State significance, otherwise non-remnant vegetation in SMAs is of Regional Significance (see decision eiu_I_34).

eiu_I_32

This terrestrial corridors decision identifies major themes of habitat connectivity across the bioregion. They identify north/south and east/west links that cover higher altitude areas along watersheds and mountain ranges, and areas characterised by a relative continuity of similar or related habitats, using the methodology outlined in EPA 2008. Identified corridor centrelines are buffered according to the significance of the centreline and the landscape context within which it occurs

Decision eiu_I_22 Corridor Special Management Areas identifies areas where values associated with landscape scale habitat connectivity have been compromised.

eiu_I_33

Riparian corridors in the Einasleigh Uplands are particularly significant for biodiversity, both as a climatic refuge and as a major element of habitat continuity. This decision is based on the bioregional corridor values of major riparian areas. The refugial and other values of riparian areas are covered by decision eiu_I_03.

The watercourse centrelines were buffered by 200m to indicate the general location of this habitat continuity theme, in line with the state-wide approach for riparian corridors in undeveloped bioregions.

eiu_I_34

Corridor Special Management Areas (SMAs) are areas where there are gaps or weaknesses (such as disturbed, cleared or regrowth areas) in habitat continuity in a significant corridor or special biodiversity area, and there is an ecological relationship with the corridor or biodiversity area, or it has similar ecological values to those areas. These areas therefore have significant values in their own right. They also provide a focus for protecting existing vegetation, for consolidating habitat and for increasing habitat connectivity across areas of identified weakness. Focussed planning, management and rehabilitation can play a significant role in enhancing the special ecological values associated with the area.

The objectives for the corridor SMAs are to limit land use intensification, promote compatible uses, and retain all remaining remnant, disturbed and regrowth vegetation. The restoration of habitat and habitat continuity in cleared parts of the SMAs should be facilitated through detailed planning and negotiation.

Disturbed or regrowth vegetation are not differentiated from cleared areas in the EIU but are in the Wet Tropics. Disturbed Wet Tropics vegetation in SMAs is of State significance (see decision eiu_I_22) otherwise non-remnant vegetation in SMAs is of Regional Significance

wet_fa_21

Upper watercourses of the Mitchell River catchment whose sources lies in the Wet Tropics are westward flowing unlike all of the other waterways in the bioregion. This area encompasses Mt Lewis which provides cold water habitat due to its higher elevation. Many of the terrestrial values for the highest part of the mountain are given in wet_fa_12. Other endemics from lower altitudes include: **Uperoleia altissima**, **Carlia rubrigularis**, **Glaphyromorphus mjobergi**, **Xanthotis macleayanus**, **Arses kaupi**, **Ptiloris victoriae**, **Antechinus adustus**, **Uromys hadrourus** and **Cercartetus caudatus**.

Significant stream-dependent fauna include **Litoria lorica**, **Euastacus fleckeri** and **Cherax wasselli**.

This area provides suitable habitat for unique Wet Tropics fish fauna, where these taxa are more typical of the Gulf of Carpentaria, e.g. **Scortum ogilbyi**, **Hephaestus carbo**, **Ambassis macleayi**, **Brachirus selheimi** and **Zenarchopterus novaeguineae**.

wet_fa_22

Areas of WET remnant vegetation modelled as being of either high richness for rainforest dependent/partly dependent amphibian, avian, mammalian, or reptile taxa.

This special area representation is derived from research produced through a collaborative fauna modelling project (Williams 2006). Part of the project resulted in the construction of approximately 170 rainforest vertebrate species distribution models. Additionally, species richness, diversity and endemic richness maps were subsequently produced. Rainforest taxa were defined as those species which were obligate to periodic users of Wet Tropic rainforests.

For the purpose of the current special area representation, the extent shown in the adjoining thumbnail captures remnant vegetation which overlapped areas modelled as being of either high amphibian, avian, mammal, or reptile richness. For each taxonomic group, the area of high rainforest taxa richness was defined as the highest modelled 10% area (limited to areas within remnant vegetation) within the WET. The resultant outputs, were then combined to provide a flattened extent area capturing the four major vertebrate taxonomic faunal groups of modelled high species richness.

wet_fa_23

Areas of WET remnant vegetation modelled as being of either high richness for rainforests dependent/partly dependent amphibian, avian, mammalian, or reptile taxa, which are endemic to the WET.

This special area representation is based upon research produced through a collaborative fauna modelling project (Williams 2006). Distribution models were constructed for approximately 170 rainforest vertebrate species as part of this project. Additionally, species richness, diversity and endemic richness maps were also produced. Rainforest taxa were defined as those species which were obligate to periodic users of Wet Tropic rainforests.

For the purpose of the current special area, the extent depicted in the adjoining thumbnail captures the highest modelled 10% area of remnant vegetation which overlaps areas modelled as being of high endemic taxa richness.

wet_I_04

High elevation areas identified as important refugia areas, both currently and in the future (Reside et al. 2013). A comparison of different modelling techniques reveal a consistent result with respect to the upland areas being significant refugia for a high diversity of flora and fauna species (Reside et al. 2013). These high altitude areas include the Carbine, Windsor and Thornton Uplands in the north; Lamb and Herberton Ranges, and Bartle Frere/Bellenden Ker in the centre of the bioregion; and Mt Spec and Mt Elliot in the south.

All are recognised as being biodiversity hotspots, attributed as containing a plethora of upland rainforest-restricted vertebrates and invertebrates. Of these key areas, the highest priority refugia is possibly the upland intact rainforest of the Atherton Uplands possessing high species endemism and high numbers of unique lineages. A study by Graham et al. (2010) showed models predicted that rainforest persisted south of the Black Mountain corridor and that coastal refugia areas which comprise Bellenden-Ker and Thomson Ranges, and the Thornton and Finnegan Uplands, had high historical stability relative to their current extent. Regions of greatest stability for wet sclerophyll forest were the western edge of the Atherton to Kirrama to Paluma uplands and Mt Elliot (VanDerWal et al. 2009).

It is important to note, that whilst mountainous areas will likely provide a refugia for some species currently present at lower altitude, many species currently restricted to cool high altitude areas with narrow environmental niches, may similarly be at increased risk due either to displacement, or limited retreat options (Reside et al. 2013).

wet_I_15

Predominantly situated at the Western margins of the WET and extending from Mt Windsor south to Mt Zero, the feature also incorporates Einasleigh elements. The transition from dry, moist through to tall wet sclerophyll up to the rainforest margin is a highly dynamic zone influenced by climate and fire regimes (and is one of the few WET landscape systems that can carry a crown fire). The considerable environmental heterogeneity associated with the transition often incorporates the tension zone between lowland and upland species, resulting in a high diversity of vertebrate taxa, including many endemics. The largest

contiguous remaining tracts of wet sclerophyll adjacent to rainforest occur along western margin of Coane, Seaview and Cardwell ranges and in upper Daintree area (Stanton et al. 2014). Reduced fire exposure is considered a significant threat to the wet sclerophyll communities from rainforest incursion (Stanton et al. 2014).

The panel noted that the system has an adaptive capacity to climate change with potential movement of vegetation communities along an elevation gradient. This feature also acts as an important corridor along the western bioregion boundary, and areas with the greatest long-term climatic stability for wet sclerophyll forest have been identified as the sections encompassing the western edge of the Atherton, Kirrama and Paluma uplands (VanDerWal et al. 2009).

A number of threatened fauna inhabit this ecotone including **Delma mitella**, **Dasyurus hallucatus**, **Dasyurus maculatus gracilis**, **Bettongia tropica**, **Petauroides volans** and **Petaurus australis** unnamed subsp. (NQ). Disjunct taxa also occur, e.g. **Cormobates leucophaea minor**, **Falcunculus frontatus**, **Antechinus flavipes** and **Isodon obesulus peninsulae**.

Presence of widespread endemics, e.g. **Bolemoreus frenatus**, **Xanthotis macleayanus** and **Arses kaupi**. The snail **Steorra estherlilleya** is narrowly restricted to this habitat west of Paluma. Other invertebrates associated with wet sclerophyll forest include **Temnoplectron cooki**, **Onthophagus pinaroo**, **Pamborus elegans** and **Anomalomorpha monteithi** (Yeates Monteith 2008). Many WET taxa also reach their western and southern limits in this community. Tall eucalypts provide hollows for gliders, possums and large cockatoos, e.g. **Calyptrorhynchus lathamii**. This habitat is also important for winter feeding by **Pteropus conspicillatus**.

With respect to flora, some of the threatened species present include: **Prostanthera clotteniana**, **Tylophora rupicola**, **Corymbia leptoloma**, **Corymbia rhodops**, **Parsonsia wildensis**, **Plectranthus amoenus**,

Calochlaena villosa, and **Dodonaea uncinata**.

Examples of Wet Tropic endemic flora include: **Actephila flavescens**, **Acrothamnus spathaceus**, **Alpinia arctiflora**, **Argyrodendron peralatum**, **Athertonia diversifolia**, **Brackenridgea australiana**, **Bulbophyllum gadgarrense**, **Comesperma rhyoliticum**, **Corymbia leptoloma**, **Desmos goezeanus**, **Elaeocarpus carolinae**, **Endiandra bessaphila**, **Gmelina fasciculiflora**, **Hibbertia melhanioides** var. *baileyana*, **Lastreopsis tinarooensis**, **Medicosma glandulosa**, **Myrsine smithii**, **Persoonia tropica**, **Sarcochilus borealis**, **Solanum magnifolium** and **Symplocos glabra**. Examples of disjunct flora include: **Acacia ulicifolia**, **Alectryon semicinerus**, **Archidendron hendersonii**, **Boletellus emodensis**, **Cantharellus concinnus**, **Fistulinella mollis**, **Hibiscus diversifolius**, **Knoxia sumatrensis**, **Lomandra laxa**, **Notelaea ovata** and **Platyserium superbum**.

wet_I_16

The special area encompasses the broad vegetation groups 1b and 5c (at the 1:1,000,000 scale). BVG 1b refers to - Complex mesophyll to notophyll vine forests usually on basalt tablelands whilst the BVG 5c refers to - Simple to complex notophyll vine forests, often with **Agathis** spp. on ranges and uplands of the WET.

Both these BVGs are unique and endemic to the Wet Tropics and exhibit a unique combination of vegetation communities that only exist within the bioregion.

wet_I_22

The WET contains one of the most complete and diverse living records of the major stages in the evolutionary history of land plants. This is primarily as a result of the rainforests persisting through time since Gondwana. It also provides one of the most important living records of the history of the world's marsupials and songbirds as they originated in the rainforest ecosystems of the Wet Tropics.

The special feature depicted reflects taxa rich "hot spots" derived from known records, and for taxa considered to be of relictual of evolutionary importance (DES 2018). For the purpose of this implementation, the highest ranked 10% area of remnant vegetation within the bioregion was extracted.

Nb. spatial representation not restricted to the WTWHA.

wet_I_23

The Wet Tropics is regarded as a centre of endemism (second only to New Caledonia in the number of endemic genera per unit area), and provides critical insights into the evolutionary patterns both within and outside the rainforests, including the evolutionary history with the surrounding sclerophyll forests. It also provides outstanding examples of important ongoing ecological processes and biological evolution.

The special feature depicted reflects taxa rich "hot spots" derived from known records, and for taxa considered to be endemic to the bioregion (DES 2018). For the purpose of this implementation, the highest ranked 10% area of remnant vegetation within the bioregion was extracted.

Nb. spatial representation not restricted to the WTWHA.

wet_I_24

The Wet Tropics harbours a significant amount of biological diversity and provides a plethora of habitats for many rare and threatened species of outstanding universal significance. Within Australia, it contains relatively high proportions of fern, cycad, conifer, orchid, butterfly, freshwater fish, mammal, bird and herpetofauna species. In addition, many of these species are endemic to the Wet Tropics and have restricted distributions. As a result of this, many fauna species are subsequently rare and/or threatened (e.g. one third of endemic frog species are endangered across the Wet Tropics).

This world heritage criterion has two important features with regards to the emphasis on 'habitats' conserving populations and the importance of biodiversity in terms of the emphasis on interrelationships between individual populations and their habitats. The attributes of this OUV include habitat and plant diversity, rare and threatened flora (threatened taxa habitats), fauna diversity and, rare and threatened fauna (threatened taxa habitats).

The special feature depicted reflects "hot spots" of areas containing a combination of high ecosystem diversity, areas rich in flora and fauna taxa and areas containing concentrations of threatened taxa (DES 2018). For the purpose of this implementation, the highest ranked 10% area of remnant vegetation within the bioregion was extracted.

Nb. spatial representation not restricted to the WTWHA.

wet_I_25

Tracts are defined as patches of continuous remnant vegetation. The size of any tract is a major indicator of ecological significance and is strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts. These areas can be considered core nodes/refugia in which a large proportion of the bioregions biodiversity is represented.

A modified tract size analysis (Criterion C) (EHP 2014) was used to identify and delineate discrete tracts of remnant vegetation at a bioregion scale. For the purpose of the assessment, a core area was identified as a relatively contiguous area of remnant vegetation (disregarding small perforations, or linear breaks) and which was generally greater than 5km in width (based upon the minimum width of the terrestrial corridor network). Tracts of greater than 2,000ha were included.

wet_I_28

In the northern half of the WET, the Carbine uplands encompasses a substantial area of important high altitude forested habitats for a plethora of species. The uplands contain Notophyll and microphyll rainforest above 900m altitude on granite. Compared to other areas in the bioregion, the area has had less impact from cyclones and historical wood harvesting, and is relatively intact. The high rainfall area, with its eastern margins which incorporate steep slopes, facilitate species movement over relatively small distances across environmental gradients. Similarly, this mosaic of environmental gradients is thought to be a factor in driving significant changes in species turnover within regional ecosystems.

The entire tableland forms a significant upland refugia especially towards the centre of the range. The prevalence of boulders and diversity of micro habitats within the landscape facilitate a high resilience to climate change. The area is considered to house a number of disjunct populations and there is some shared species with the western foothills of Mt Bartle Frere.

Flora: The area exhibits very high species richness, and includes concentrations of endemic and relictual taxa. Examples of endemic taxa include: *Aceratium ferrugineum*, *Acronychia chooreechillum*, *Aglaia brassii*, *Apodytes brachystylis*, *Athertonia diversifolia*, *Bubbia queenslandiana* subsp. *queenslandiana*, *Catalepidia heyana*, *Cryptocarya leucophylla*, *Elaeocarpus carolinae*, *Endiandra jonesii*, *Garcinia brassii*, *Goniothalamus australis*, *Helicia lewisensis*, *Lenbrassia australiana* var. *Australiana*, *Medicosma glandulosa*, *Motherwellia haplosciadea*, *Niemeyera* sp. (Mt Lewis A.K.Irvine 1402), *Paphia meiniana*, *Pilidiostigma sessile*, *Pittosporum trilobum*, *Polyosma rigidiuscula*, *Psychotria* sp. (Mt Lewis V.K.Moriarty 2445), *Rhododendron lochiaie*, *Sarcopteryx montana*, *Sphalmium racemosum*, *Symplocos graniticola*, *Triunia montana*, *Wilkiea angustifolia*. Relictual taxa examples include: *Phlegmariurus filiformis*, *Phlegmariurus lockyeri*, *Tmesipteris truncate*, *Podocarpus smithii* and *Prumnopitys ladei* (Mt Spurgeon black pine). The panel also noted the area as being rich in upland palm species including *Laccospadix australasicus* (Atherton palm), *Archontophoenix purpurea* and *Oraniopsis appendiculata*.

Similar to its eastern face, the Carbine Tableland is globally significant for its lycophytes, epiphyte orchids and ferns and epiphytes in general, however, has the highest diversity of terrestrial ferns in Australia. Fern species include: *Diplopterygium longissimum* (giant scrambling fern), *Gleichenia dicarpa* (pouched coral fern), *Phlegmariurus filiformis*, *Sticherus flabellatus* var. *compactus*. In addition, the area has one of the highest concentration of species with big-seeded fruit relative to elevation (Lauraceae), upon which a number of fauna are dependent, including the iconic southern cassowary.

Fauna: The peaks within this area are high in richness of both total number and number of endemic low vagility invertebrates (Yeates Monteith 2008; Staunton et al. 2014). Examples of invertebrates confined to the high altitude include snails (*Koreelahropa plowmanae*, *Hedleya montlewis*, *Montanopoma carbine* and *Nitor reisi*); crustaceans (*Euastacus fleckeri*); spiders (*Carbinea breviscapa*, *C. longiscapa*, *C. robertsi*, *Centrothele spurgeon*, *Heteropoda spurgeon*, *Megateg spurgeon* and *Maxanapis mossman*); odonates (*Lestoidea lewisiana*, *Eusynthemis barbarae* and *E. netta*), bug (*Grosshygia nigra*) and beetles (*Apterotheca astraphes*, *A. chloros*, *A. pecticrinis*, *A. trichopectoris*, *Philipis laevigata*, *P. spurgeoni* and *P. geoffreyi*). *Chlamydopsis trichonota* is a relictual taxon known to occur in the area.

The area is home to narrow range endemic frogs such as *Mixophyes carbinensis* and *Cophixalus hosmeri*. Other endemic taxa, several of which are threatened, also occur in the area and these including *Cophixalus aenigma*, *Litoria nannotis*, *L. lorica*, *L. rheocola*, *L. serrata*, *L. nyakalensis*, *Taudactylus rheophilus*, *Lampropholis robertsi*, *Saproscincus czechurai*, *Oreoscopus gutturalis*, *Acanthiza katherina*, *Heteromyias cinereifrons*, *Amblyornis newtonianus*, *Scenopoeetes dentirostris*, *Hemibelideus lemuroides*, *Pseudochirops archeri* and *Antechinus adustus*.

Disjunct taxa found in these mesic environs include *Tyto tenebricosa multipunctata*, *Cormobates leucophaea minor*, *Sericornis citreogularis*, *Ailuroedus melanotis* and *Concinnia frerei*. This area is also considered a stronghold for *Dasyurus maculatus gracilis*, particularly in the upland rainforest habitat (i.e. above 900m) around Mt Lewis and Mt Spurgeon. Various records over the past 15 or so years of the threatened *Bettongia tropica* are known from the Mt Spurgeon area.

Threatened species known to occur include *Casuarius Casuarius* and *Erythrura trichroa*. Being relatively rich in specialist and endemic bird species, the area has been identified as part of the Daintree Key Biodiversity Area (Birdlife Australia 2018). The area is also a noted refugium for flightless insects (Yeates et al. 2002).

wet_I_30a

The broad purpose of landscape-scale connections, is to provide for ecological and evolutionary processes at a bioregional scale. Maintaining connectivity across a landscape, either through "continuous linkages" or via "stepping-stones" of remnant vegetation, is important for the long-term conservation of biodiversity.

Corridor triggered remnant vegetation is focused upon areas between core tracts/nodes (as identified under the special area decision wet_I_25) within the bioregion. For further information regarding the broad principles and intent, as well as more specific information relating to the Wet Tropics terrestrial corridor network, refer to Section 3.3.2.1 and Table 14.

wet_I_31a

Riparian corridors encompass some of the most diverse, dynamic and complex habitats incorporating both environmental and topographic gradients. Comparatively, such areas tend to exhibit high species richness with respect to both flora and fauna, provide important resources in terms of water, food, shelter, nesting and nursery sites and act as a refugia during periods of drought, or in response to longer terms impacts associated with climatic change.

At the landscape scale, networks of major and minor riparian linkages are a significant element of habitat continuity and provide important migratory and dispersal pathways for a substantial number of species (especially birds, insects and flora, but also for many arboreal mammals and reptiles). In some areas of fragmented landscapes, watercourses often provide the only remaining habitat connectivity due to the extensive clearing and surrounding modified landscape.

Within the WET, the panel determined that remnant vegetation within 200m and 100m of major and minor waterways should be designated as being of State and Regional significance respectively. The significance of selected riverine systems were also modified in some instances (Table 16). Corridor triggered remnant vegetation focuses upon identifying key connections between remaining core tracts/nodes (as identified under the special area decisions [wet_I_25](#)) within the bioregion. For further information regarding the broad principles and intent, as well as more specific information relating to the Wet Tropics riparian corridor network, refer to Section 3.3.2.2.

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in Queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning processes

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland Info:

<http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca>

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

<http://qspatial.information.qld.gov.au/geoportal/>

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For

flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	58,719.59	99.9

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
High	41.66	0.07
Medium	18.04	0.03
Low	0.0	0.0
Very Low	0.0	0.0

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic			58,779.31	100.0				
2. Naturalness catchment			39,536.64	67.3	19,242.67	32.7		
3. Diversity and richness	58,719.60	99.9	59.71	0.1				
4. Threatened species and ecosystems	58,737.64	99.9	41.67	0.1				
5. Priority species and ecosystems	45,148.06	76.8	13,571.54	23.1	40.37	0.1		
6. Special features	58,719.60	99.9						
7. Connectivity			53,108.18	90.4				
8. Representative-ness								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
ml_r_ec_06	Perennial waterholes in active streams	Mitchell	5.2.1, 6.1.1, 6.2.1, 6.3.1, 6.3.4, 6.4.1, 7.1.2	3, 3, 3, 4, 3, 3, 3
ml_r_ec_16	Wet Tropics rainforests and associated riverine habitats across the upper Mitchell basin	Mitchell	5.2.1, 6.1.1, 6.2.1, 6.3.1, 6.3.3, 6.3.4, 6.4.1	4, 4, 4, 4, 4, 4, 4
ml_r_ec_18	Priority refugia for freshwater fish	Mitchell	6.2.1, 6.3.1, 6.3.3, 6.3.4, 6.4.1	3, 4, 4, 4, 3

4 is the highest rating/value

Expert panel decision descriptions:

ml_r_ec_06

In the seasonally dry tropics of the Eastern Gulf, perennial waterholes in active streams provide critical refugial (6.3.1) dry season habitat for obligate freshwater species including conservation dependent and listed species such as juvenile

freshwater sawfish **Pristis pristis** and snapping turtles and represent a priority aquatic ecosystems (5.2.1). They are also important for migratory fish species (7.1.2) in particular sooty grunter **Hephaestus fuliginosus** and adult phase eel tailed catfish. Permanent waterholes in active streams support a range of ecological processes that are distinct relative to the more extensive seasonal aquatic habitats that characterise the eastern Gulf (6.2.1). Within the seasonally dry climate of the eastern Gulf the presence of permanent freshwater usually owes its existence to a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1). Within the suite of exiting perennial waterholes are subset will also have an increasingly important role as refugia within the increasingly variable rainfall and elevated temperature regimes predicted under climate change (6.4.1).

ml_r_ec_16

The Mitchell is the most bioregionally diverse basin in the eastern Gulf and is unique within all Gulf River basins in having areas of its upper catchment fall within the Wet Tropics Bioregion. Each of the sub basins of the upper Mitchell drain three different Wet Tropics Provinces including the Palmer which drains the Daintree Bloomfield Province, the Upper Mitchell which drains both the Daintree-Bloomfield and the Macalister Provinces and the Walsh which drains the Atherton Province. These areas are fully representative of the Wet Tropics and include extremely high and seasonally distributed rainfall, high cool (6.1.1) altitude mountains and tropical rainforest vegetation. This combination of biophysical features within a Gulf drainage basin generates unique hydrological conditions (6.2.1) and associated riverine (and some unmapped non riverine) wetland habitats, communities and values. High elevation areas receive regular rainfall often via cloud capture, which sustains perennial riverine habitats often via direct rainfall run off (6.4.1) rather than groundwater contributions alone which are associated with perennial streams elsewhere in the eastern Gulf. Cool water temperatures associated with high altitude (>700m) areas support habitats rich in bryophytes and mosses and endemic fauna including a large spiny crayfish **Euastacus fleckeri** restricted within the Mitchell Basin to areas draining Mt Windsor and the Hann Tableland in the adjoining Einasleigh Uplands Bioregion (Ryan et al. 2002). An area also vegetated by Wet Tropics rainforest regional ecosystem. The potential for additional **Euastacus** species to be discovered elsewhere in these upland rainforest catchments is high. Numerous frog species including at least nine that are listed as threatened (6.3.1) also characterise the fauna of the Wet Tropics upper catchments of the Mitchell (Tait et al. 2015). These high altitude areas also include flat tablelands likely to host a number of unmapped non-riverine wetland types including springs and soaks associated with past alluvial deposits. Another restricted crayfish species red tipped yabby **Cherax wassellii** occupies mid altitude uplands ranging from 500m adjoining Black Mountain to 350m in the lower Rifle Creek system adjoining Mt Carbine. This species occurs more widely throughout adjoining eastern drainages and is believed to be a natural translocation (Ryan et al. 2002). Perennial flows from these upland rainforest catchments sustain perennial riverine habitat into lower altitude reaches and contribute to downstream shallow aquifer recharge (6.4.1) beyond the McLeod River - Rifle Creek confluence in the upper Mitchell (Hydrobiology 2005). These perennial habitats act as refugia for aquatic species (6.3.1) including fish and crustaceans more typically associated with lower western reaches. When hosted in Wet Tropics upper catchments unique community types of Gulf basins species juxtaposed within Wet Tropics habitats are formed (Vallance and Hogan 2001, Ryan et al. 2002). Some of these perennial riverine reaches are likely to provide important climate change refugia in future years (6.3.4). Frontage communities associated with these Wet Tropics riverine reaches also include a large number of 'endangered' or 'of concern' regional ecosystems (5.2.1) (e.g. RE 7.3.23, RE 7.3.25, RE 7.3.26, RE 7.3.28, RE 7.3.49, RE 7.11.42). In many cases the threatened status of these regional ecosystems is due to impacts elsewhere within the Wet Tropics and the more limited development pressure within the upper Mitchell has thus far retained good examples of them. Ongoing emerging development pressure in these uplands of the Mitchell basin underpins the need for recognition of the conservation value of these wetland associated priority ecosystems.

ml_r_ec_18

These 'Priority Refugia for Freshwater Fish' (6.3.1) are based on those defined by Hermoso et al. (2013) (6.3.3) for the Mitchell river basin on the basis of water residency (6.4.1) assessed by satellite imagery over multiple years and considerations of fish community distribution across the basin. Fish distribution was used to prioritise candidate refugia by seeking to maximise individual species representation across the set of prioritised refugia. Individual species vagility was also assessed and incorporated in refugia selection by seeking to maximise the length of stream area accessible for colonisation (6.2.1) from refugia following their isolation by extreme droughts including those predicted to occur under future climate change scenarios (6.3.4). Two sets of priority refugia were nominated one using a baseline catchment condition and another using current conditions and projections of ecological pressure that reduce the viability of some candidate refugia. Both sets of prioritised refugia intersected with riverine spatial units have been conservatively used for this decision recognising that not all projected condition pressures have been realised and also that management intervention may have the capacity to mitigate them where they have been realised. Given the use of remote sensing in the identification of potential refugia some caution is needed in the application of identified refugia values recognising that artificial waterbodies including dams may have contributed to satellite based indications of water perenniality in the landscape.

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
Very High	5.07	0.01
High	0.0	0.0
Medium	283.9	0.48
Low	0.0	0.0
Very Low	0.0	0.0

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	159.89	0.3			4.2		124.87	0.2
2. Naturalness catchment			262.47	0.4	26.49			
3. Diversity and richness	88.79	0.2	200.17	0.3				
4. Threatened species and ecosystems	200.17	0.3	88.79	0.2				
5. Priority species and ecosystems	288.96	0.5						
6. Special features	5.07							
7. Connectivity								
8. Representative-ness					125.8	0.2	74.37	0.1

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
ml_nr_ec_22	Clear to turbid or turbid perennial off river waterholes	Mitchell	5.2.1, 6.1.1, 6.2.1, 6.3.1, 6.3.3, 6.3.4, 6.4.1	4, 3, 4, 4, 3, 4, 4

4 is the highest rating/value

Expert panel decision descriptions:

ml_nr_ec_22

Within the seasonally dry climate of the eastern Gulf perennial waterholes are a limited asset and have high values as aquatic refugia (6.3.1) particularly considering the spectre of increasing rainfall variability due to climate change (6.3.4). Perennial off river waterholes owe their existence to a combination of special geomorphic features (6.1.1) and hydrological regimes (6.4.1). These include greater waterhole depth associated with prior channels and/or flood scouring and groundwater supplementation. Groundwater is often supplied from shallow alluvial aquifers associated with interbedded sands in quaternary alluvium. Such aquifers are recharged by a combination of rainfall, overbank flood flows and connectivity to within channel flows in adjoining rivers channels as occurs in mid reaches of the Mitchell River, or via supplementation from fractured rock aquifers as occurs in some upper Gilbert Basin waterholes (Battle-Aguilar et al. 2014; CSIRO 2009; Petheram et al. 2013a). Direct supplementation of waterholes from fractured rock and deeper groundwater aquifers also occurs in upper catchment areas of the Mitchell, Staaten and Gilbert basins (CSIRO 2009; Petheram et al. 2013a). Water clarity regimes within perennial waterholes are a key driver of their ecology and can also be an indicator of their condition. Mitchell, Staaten and Gilbert basin waterhole perenniality and clarity has been assessed by reference to multiple years of satellite TM imagery (Lymburner and Burrows 2008). Such imagery is not capable of detecting smaller sized or heavily vegetated waterholes which may not be included in this value decision. Such smaller perennial wetlands will share equivalent values to larger sites particularly where they occur in aggregations. While clear waterholes are often associated with high values, e.g. instream productivity, aquatic plant and fish diversity, water turbidity is often a natural water quality feature of eastern Gulf drainages. However in some cases it is indicative of land use pressure or other disturbances including cattle access, elevated soil erosion and pig wallowing particularly in the Mitchell, Staaten and Gilbert Basins where good water clarity is associated with baseline conditions in these typically sand bedded and groundwater supplemented systems. Consequently waterholes that don't exhibit sustained clarity have been valued less than their clear counterparts for these basins. Regardless of water clarity priority aquatic ecosystems are commonly associated with non-clear perennial waterholes including RE 2.3.16 lagoons on Quaternary alluvial plain. This RE is recognised as important breeding and feeding sites (6.3.1) for waterbirds and have an 'of concern' biodiversity status (Sattler and Williams 1999). The significant value of non-permanently clear and or turbid perennial waterholes are still recognised in a number (6.3.3) of national and regional assessments (Kennard et al. 2011; Hermoso et al. 2013). They also underpin key refugia and nursery habitat values nominated for several National Directory listed (6.3.2) wetlands including the Mitchell River Fan, Smithburne-Gilbert Fan and Dorunda Lakes aggregations (Blackman et al. 1999).

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, HerbreCs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Back on Track rank	Migratory species*	Wetland species**	Identified flora/fauna
<i>Acacia guymeri</i>		V		Low			FL
<i>Acanthopis antarcticus</i>	common death adder	V		Medium			FA
<i>Aceratium ferrugineum</i>	rusty carabeen	NT		Low			FL
<i>Aglaia brassii</i>		NT		Low			FL
<i>Amyema plicatula</i>		C	E				FL
<i>Austrobuxus megacarpus</i>		NT		Low			FL
<i>Austrocallerya pilipes</i>		NT					FL
<i>Austromuellera valida</i>		V		Low			FL
<i>Boea kinnearii</i>		E		Low			FL
<i>Bubbia queenslandiana</i> <i>subsp. queenslandiana</i>		NT		Low			FL
<i>Bulbophyllum windsorens</i>		V		Data deficient			FL
<i>Calidris ferruginea</i>	curlew sandpiper	CE	CE	Low	Y	I	FA
<i>Calidris tenuirostris</i>	great knot	CE	CE	Low	Y	I	FA
<i>Carex breviscapa</i>		V		Low			FL

Species	Common name	NCA status	EPBC status	Back on Track rank	Migratory species*	Wetland species**	Identified flora/fauna
<i>Casuarius casuarius johnsonii</i> (southern population)	southern cassowary (southern population)	E	E	Critical			FA
<i>Cophixalus aenigma</i>	tapping nurseryfrog	NT	E	Low			FA
<i>Cophixalus hosmeri</i>	rattling nurseryfrog	CE	CE	Low			FA
<i>Cophixalus monticola</i>	mountain nurseryfrog	CE	CE	Low			FA
<i>Corymbia rhodops</i>	red-throated bloodwood	V	V	Low			FL
<i>Crocodylus porosus</i>	estuarine crocodile	V		Low	Y	I	FA
<i>Ctenotus monticola</i>	Atherton ctenotus	V		Low			FA
<i>Cyclopsitta diophthalma macleayana</i>	Macleay's fig-parrot	V		Low			FA
<i>Dasyurus hallucatus</i>	northern quoll	C	E	Medium			FA
<i>Dasyurus maculatus gracilis</i>	spotted-tailed quoll (northern subspecies)	E	E	Critical			FA
<i>Dendrobium bigibbum</i>	Cooktown orchid	V	V	High			FL
<i>Dendrolagus bennettianus</i>	Bennett's tree-kangaroo	NT		Low			FA
<i>Dendrolagus lumholtzi</i>	Lumholtz's tree-kangaroo	NT		Low			FA
<i>Diospyros granitica</i>		NT		Low			FL
<i>Egernia rugosa</i>	yakka skink	V	V	Medium			FA
<i>Ehretia microphylla</i>		V					FL
<i>Elaphoglossum callifolium</i>		NT		Low			FL
<i>Endiandra jonesii</i>		V		Low			FL
<i>Endiandra phaeocarpa</i>		V		Low			FL
<i>Erythrura trichroa</i>	blue-faced parrot-finch	NT		Low			FA
<i>Gastrodia urceolata</i>		V		Low			FL
<i>Glochidion pungens</i>		NT		Low			FL
<i>Grammitis reinwardtii</i>		V	V	Low			FL
<i>Grantiella picta</i>	painted honeyeater	V	V	High			FA
<i>Graptophyllum excelsum</i>		NT		Low			FL
<i>Grevillea glossadenia</i>		V	V	Low			FL
<i>Habenaria chlorosepala</i>		E					FL
<i>Helicia grayi</i>		V		Low			FL
<i>Helicia lewisensis</i>		V		Low			FL
<i>Helicia recurva</i>		NT		Low			FL
<i>Hipposideros diadema reginae</i>	diadem leaf-nosed bat	NT		Low			FA
<i>Hymenophyllum digitatum</i>		V		Low			FL
<i>Hymenophyllum pallidum</i>		NT					FL
<i>Lastreopsis tinaroensis</i>		V		Low			FL
<i>Lindsaea terrae-reginae</i>		E		Low			FL
<i>Linospadix palmerianus</i>		NT		Low			FL

Species	Common name	NCA status	EPBC status	Back on Track rank	Migratory species*	Wetland species**	Identified flora/fauna
<i>Litoria dayi</i>	Australian lacelid	V	V	Low		I	FA
<i>Litoria nannotis</i>	waterfall frog	E		Low		I	FA
<i>Litoria nyakalensis</i>	mountain mistfrog	CE	CE	Low			FA
<i>Litoria rheocola</i>	common mistfrog	E		Low		I	FA
<i>Litoria serrata</i>	tapping green eyed frog	V		Low		I	FA
<i>Litsea granitica</i>		V		Low			FL
<i>Macropteranthes montana</i>		V	V	Low			FL
<i>Medicosma glandulosa</i>		NT		Low			FL
<i>Mesembriomys gouldii</i>	black-footed tree-rat	C	V	Low			FA
<i>Parsonsia bartlensis</i>		V		Low			FL
<i>Petauroides volans</i>	greater glider	V	V	Low			FA
<i>Petauroides volans minor</i>	northern greater glider	V	V				FA
<i>Petaurus australis</i> <i>unnamed subsp.</i>	yellow-bellied glider (northern subspecies)	E	V	Critical			FA
<i>Phaleria biflora</i>		V	V	Low			FL
<i>Phlegmariurus creber</i>	rat-tail tassel-fern	CE					FL
<i>Phlegmariurus delbrueckii</i>		V					FL
<i>Phlegmariurus filiformis</i>		C	E	Critical			FL
<i>Phlegmariurus ledermannii</i>		V					FL
<i>Phlegmariurus lockyeri</i>		V	V	Critical			FL
<i>Phlegmariurus phlegmarioides</i>		V		High			FL
<i>Phlegmariurus squarrosus</i>	water tassel-fern	CE	CE	Critical			FL
<i>Phlegmariurus tetrastichoides</i>		V	V	High			FL
<i>Pristis pristis</i>	freshwater sawfish		V	High	Y	D	FA
<i>Pteridoblechnum acuminatum</i>		NT		Low			FL
<i>Pteropus conspicillatus</i>	spectacled flying-fox	E	E	High			FA
<i>Randia audasii</i>		NT		Low			FL
<i>Rhaphidospora cavernarum</i>		V					FL
<i>Rhinolophus philippinensis</i>	greater large-eared horseshoe bat	E	V	High			FA
<i>Rostratula australis</i>	Australian painted snipe	E	E	Medium		I	FA
<i>Sarcopteryx montana</i>		NT		Low			FL
<i>Sminthopsis archeri</i>	chestnut dunnart	NT		Low			FA
<i>Solanum angustum</i>		CE		Medium			FL
<i>Spathoglottis paulinae</i>		NT		Low			FL
<i>Stegانهthera laxiflora subsp. lewisensis</i>		NT		Low			FL
<i>Stylidium elachophyllum</i>		E				I	FL
<i>Symplocos ampulliformis</i>		NT		Low			FL

Species	Common name	NCA status	EPBC status	Back on Track rank	Migratory species*	Wetland species**	Identified flora/fauna
<i>Symplocos crassiramifera</i>		V		Low			FL
<i>Taudactylus rheophilus</i>	northern tinkerfrog	E	E	Low		I	FA
<i>Toechima pterocarpum</i>	orange tamarind	E	E	Low			FL
<i>Turnix olivii</i>	buff-breasted button-quail	E	E	Data deficient			FA
<i>Tyto novaehollandiae kimberli</i>	masked owl (northern subspecies)	V	V	Low			FA
<i>Waterhousea mulgraveana</i>		V		Low			FL
<i>Xylosma</i> sp. (Mt Lewis G.Sankowsky+ 1108)		V		Low			FL
<i>Zieria alata</i>	Mt Lewis stink bush	CE					FL

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DES internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

*JAMBA - Japan-Australia Migratory Bird Agreement; CAMBA - China-Australia Migratory Bird Agreement; ROKAMBA - Republic of Korea-Australia Migratory Bird Agreement; CMS - Convention on the Conservation of Migratory Species.

**I - wetland indicator species; D - wetland dependent species.

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Acacia whitei</i>	None	L	FL
<i>Acanthiza katherina</i>	Mountain Thornbill	L	FA
<i>Acianthus borealis</i>	None	None	FL
<i>Aepyprymnus rufescens</i>	Rufous Bettong	L	FA
<i>Aidia gyropetala</i>	None	None	FL
<i>Ailuroedus maculosus</i>	Spotted Catbird	L	FA
<i>Amblyornis newtonianus</i>	Golden Bowerbird	L	FA
<i>Bonnaya tenuifolia</i>	None	None	FL
<i>Caladenia catenata</i>	None	None	FL
<i>Calanthe triplicata</i>	christmas orchid	None	FL
<i>Ceratopetalum hylandii</i>	None	None	FL
<i>Chlamydopsis trichonota</i>	beetle	None	FA
<i>Chlamydosaurus kingii</i>	Friilled Lizard	L	FA
<i>Climacteris picumnus</i>	Brown Treecreeper	L	FA
<i>Colluricincla boweri</i>	Bower's Shrike-thrush	L	FA
<i>Corybas barbarae</i>	helmet orchid	None	FL
<i>Crikey steveirvini</i>	Steve Irwin's Treesnail	None	FA
<i>Croton minimus</i>	None	L	FL
<i>Cryptocarya bellendenkerana</i>	None	None	FL

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Cyathea baileyana</i>	wig tree fern	L	FL
<i>Dromaeschna weiskei</i>	Ochre-tipped Darner	None	FA
<i>Elaeocarpus linsmithii</i>	None	None	FL
<i>Euastacus fleckeri</i>	freshwater crayfish	L	FA
<i>Eucalyptus atrata</i>	Herberton ironbark	L	FL
<i>Eucalyptus tardecidens</i>	None	L	FL
<i>Eugenia reinwardtiana</i>	beach cherry	None	FL
<i>Garcinia brassii</i>	None	L	FL
<i>Gossia lewisensis</i>	None	L	FL
<i>Grammitis wurunuran</i>	None	None	FL
<i>Gynochthodes podistra</i>	None	None	FL
<i>Heliotropium collinum</i>	None	L	FL
<i>Heliotropium peninsulare</i>	None	None	FL
<i>Hemibelideus lemuroides</i>	Lemuroid Ringtail Possum	L	FA
<i>Heteromyias cinereifrons</i>	Grey-headed Robin	L	FA
<i>Heteromyias cinereifrons</i>	Grey-headed robin	L	FA
<i>Hibbertia longifolia</i>	None	None	FL
<i>Koreelahropa plowmanae</i>	Plowman's Pinwheel Snail	None	FA
<i>Leptospermum wooroonooran</i>	None	None	FL
<i>Linospadix apetirolatus</i>	None	L	FL
<i>Lomandra longifolia</i>	None	None	FL
<i>Lomandra multiflora</i>	None	None	FL
<i>Lomandra multiflora subsp. multiflora</i>	None	None	FL
<i>Melaleuca dealbata</i>	swamp tea-tree	None	FL
<i>Melaleuca leucadendra</i>	broad-leaved tea-tree	None	FL
<i>Melaleuca monantha</i>	None	L	FL
<i>Melaleuca quinquenervia</i>	swamp paperbark	None	FL
<i>Melaleuca viridiflora</i>	None	None	FL
<i>Melaleuca viridiflora var. viridiflora</i>	None	None	FL
<i>Mixophyes carbinensis</i>	Carbine Barred Frog	L	FA
<i>Mogurnda mogurnda</i>	Northern Purplespotted Gudgeon	L	FA
<i>Monteithium storeyi</i>	beetle	None	FA
<i>Nitor reisi</i>	Mount Lewis Glass-snail	None	FA
<i>Oreokera cumulus</i>	Odhner's Pinwheel Snail	None	FA
<i>Oreoscopus gutturalis</i>	Fernwren	L	FA
<i>Orthonyx spaldingii</i>	Chowchilla	L	FA
<i>Peperomia hunteriana</i>	None	None	FL
<i>Phlegmariurus phlegmaria</i>	None	H	FL
<i>Phyllanthus carpentariae</i>	None	None	FL
<i>Phyllanthus collinus</i>	None	None	FL

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Phyllanthus lamprophyllus</i>	None	None	FL
<i>Phyllanthus maderaspatensis</i>	None	None	FL
<i>Phyllanthus minutiflorus</i>	None	None	FL
<i>Phyllanthus similis</i>	None	None	FL
<i>Phyllanthus simplex</i>	None	None	FL
<i>Phyllanthus virgatus</i>	None	None	FL
<i>Pimelea chlorina</i>	None	None	FL
<i>Podocarpus smithii</i>	None	None	FL
<i>Polyosma reducta</i>	None	L	FL
<i>Polyosma sp. (Mt Lewis B.P.Hyland RFK25241)</i>	None	L	FL
<i>Polyscias willmottii</i>	None	None	FL
<i>Portulaca bicolor</i>	None	None	FL
<i>Pseudochirops archeri</i>	Green Ringtail Possum	L	FA
<i>Pseudochirulus herbertensis</i>	Herbert River Ringtail Possum	L	FA
<i>Psydrax montigena</i>	None	None	FL
<i>Pterostylis depauperata</i>	None	None	FL
<i>Ptiloris victoriae</i>	Victoria's Riflebird	L	FA
<i>Rhodamnia spongiosa</i>	None	None	FL
<i>Rhodomyrtus pervagata</i>	None	None	FL
<i>Santalum lanceolatum</i>	None	L	FL
<i>Scenopoeetes dentiostriis</i>	Tooth-billed Bowerbird	L	FA
<i>Sericornis kerri</i>	Atherton Scrubwren	L	FA
<i>Setoturbinata taylora</i>	Spiny Turban Pinwheel Snail	None	FA
<i>Solanum dimorphispinum</i>	None	L	FL
<i>Stylidium diffusum</i>	None	None	FL
<i>Stylidium rotundifolium</i>	None	None	FL
<i>Stylidium tenerum</i>	None	L	FL
<i>Tephrosia filipes</i>	None	None	FL
<i>Tephrosia filipes subsp. filipes</i>	None	None	FL
<i>Tephrosia filipes var. latifolia</i>	None	None	FL
<i>Tephrosia gaudium-solis</i>	None	None	FL
<i>Tephrosia juncea</i>	None	None	FL
<i>Tephrosia leptoclada</i>	None	None	FL
<i>Tephrosia macrostachya</i>	None	None	FL
<i>Tephrosia varians</i>	None	None	FL
<i>Thelymitra aristata</i>	great sun orchid	None	FL
<i>Uromyrtus metrosideros</i>	None	None	FL
<i>Uromys hadrourus</i>	Pygmy White-tailed Rat	L	FA
<i>Xanthorrhoea johnsonii</i>	None	None	FL
<i>Zieria alata</i>	None	None	FL

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Acrostichum speciosum</i>	mangrove fern	Low	FL
<i>Actitis hypoleucos</i>	Common Sandpiper	None	FA
<i>Austrothelphusa agassizi</i>	None	None	FA
<i>Austrothelphusa wasselli</i>	None	None	FA
<i>Calidris ferruginea</i>	Curlew Sandpiper	None	FA
<i>Cherax wasselli</i>	None	None	FA
<i>Eleocharis philippinensis</i>	None	None	FL
<i>Euastacus fleckeri</i>	freshwater crayfish	None	FA
<i>Eucalyptus camaldulensis</i>	None	None	FL
<i>Eucalyptus tereticornis</i>	None	None	FL
<i>Gallinago hardwickii</i>	Latham's Snipe	None	FA
<i>Gallinago megala</i>	Swinhoe's Snipe	None	FA
<i>Gelochelidon nilotica</i>	Gull-billed Tern	None	FA
<i>Hephaestus fuliginosus</i>	Sooty Grunter	None	FA
<i>Hydroprogne caspia</i>	Caspian Tern	None	FA
<i>Leersia hexandra</i>	swamp rice grass	None	FL
<i>Leiopotherapon unicolor</i>	Spangled Perch	None	FA
<i>Lepidosperma laterale</i>	None	None	FL
<i>Limnophila brownii</i>	None	None	FL
<i>Lomandra longifolia</i>	None	None	FL
<i>Melaleuca bracteata</i>	None	None	FL
<i>Melaleuca fluviatilis</i>	None	None	FL
<i>Melaleuca leucadendra</i>	broad-leaved tea-tree	None	FL
<i>Melaleuca viminalis</i>	None	Low	FL
<i>Nauclea orientalis</i>	Leichhardt tree	None	FL
<i>Neosilurus ater</i>	Black Catfish	None	FA
<i>Neosilurus hyrtlui</i>	Hyrtl's Catfish	None	FA
<i>Nymphaea violacea</i>	None	None	FL
<i>Ornithorhynchus anatinus</i>	Platypus	None	FA
<i>Oryza rufipogon</i>	None	None	FL
<i>Pandanus spiralis</i>	None	None	FL
<i>Pandion cristatus</i>	Eastern Osprey	None	FA
<i>Plegadis falcinellus</i>	Glossy Ibis	None	FA

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Pristis pristis</i>	Freshwater Sawfish	None	FA
<i>Scleria mackaviensis</i>	None	None	FL
<i>Scortum ogilbyi</i>	Gulf Grunter	None	FA
<i>Tringa stagnatilis</i>	Marsh Sandpiper	None	FA

Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

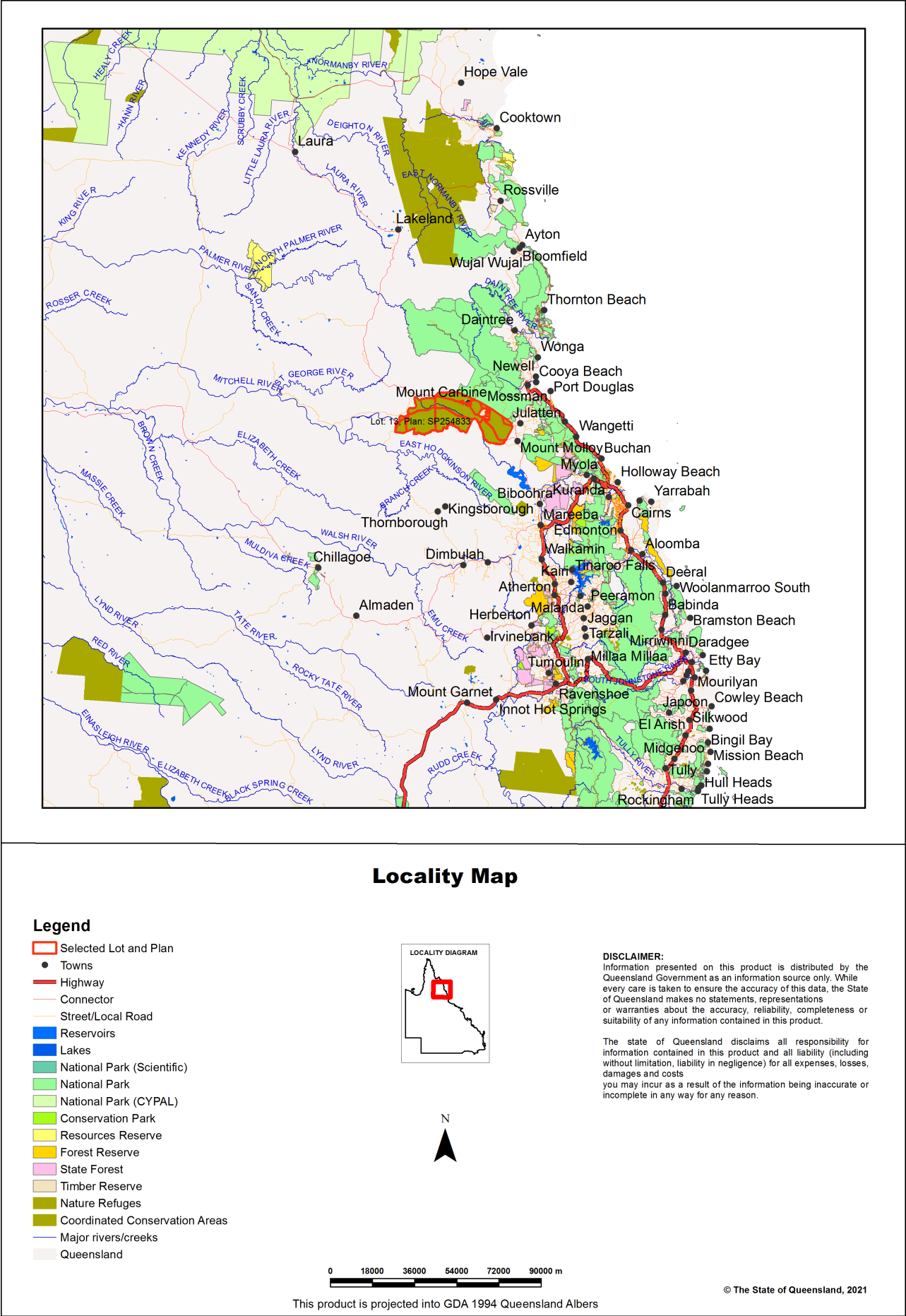
Species	Common name	Back on Track rank	Identified flora/fauna
<i>Acrostichum speciosum</i>	mangrove fern	Low	FL
<i>Baumea rubiginosa</i>	soft twigrush	None	FL
<i>Bonnaya tenuifolia</i>	None	None	FL
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	None	FA
<i>Calidris ferruginea</i>	Curlew Sandpiper	None	FA
<i>Calidris ruficollis</i>	Red-necked Stint	None	FA
<i>Eleocharis atropurpurea</i>	None	None	FL
<i>Eleocharis brassii</i>	None	None	FL
<i>Eleocharis philippinensis</i>	None	None	FL
<i>Eleocharis spiralis</i>	None	None	FL
<i>Eleocharis tetraquetra</i>	None	None	FL
<i>Eucalyptus camaldulensis</i>	None	None	FL
<i>Eucalyptus tereticornis</i>	None	None	FL
<i>Gallinago hardwickii</i>	Latham's Snipe	None	FA
<i>Gallinago megala</i>	Swinhoe's Snipe	None	FA
<i>Gelochelidon nilotica</i>	Gull-billed Tern	None	FA
<i>Hephaestus fuliginosus</i>	Sooty Grunter	None	FA
<i>Hydroprogne caspia</i>	Caspian Tern	None	FA
<i>Leersia hexandra</i>	swamp rice grass	None	FL
<i>Leiopotherapon unicolor</i>	Spangled Perch	None	FA
<i>Lepidosperma laterale</i>	None	None	FL
<i>Limnophila brownii</i>	None	None	FL
<i>Marsilea crenata</i>	None	None	FL
<i>Melaleuca bracteata</i>	None	None	FL
<i>Melaleuca leucadendra</i>	broad-leaved tea-tree	None	FL
<i>Melaleuca viminalis</i>	None	Low	FL
<i>Monochoria cyanea</i>	None	None	FL
<i>Neosilurus ater</i>	Black Catfish	None	FA
<i>Neosilurus hyrtlai</i>	Hyrtl's Catfish	None	FA
<i>Nymphaea violacea</i>	None	None	FL
<i>Ornithorhynchus anatinus</i>	Platypus	None	FA
<i>Oryza australiensis</i>	None	None	FL
<i>Oryza rufipogon</i>	None	None	FL
<i>Pandanus spiralis</i>	None	None	FL

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Pandion cristatus</i>	Eastern Osprey	None	FA
<i>Plegadis falcinellus</i>	Glossy Ibis	None	FA
<i>Pluvialis fulva</i>	Pacific Golden Plover	None	FA
<i>Pristis pristis</i>	Freshwater Sawfish	None	FA
<i>Pseudoraphis spinescens</i>	spiny mudgrass	None	FL
<i>Scleria mackaviensis</i>	None	None	FL
<i>Scortum ogilbyi</i>	Gulf Grunter	None	FA
<i>Tringa stagnatilis</i>	Marsh Sandpiper	None	FA

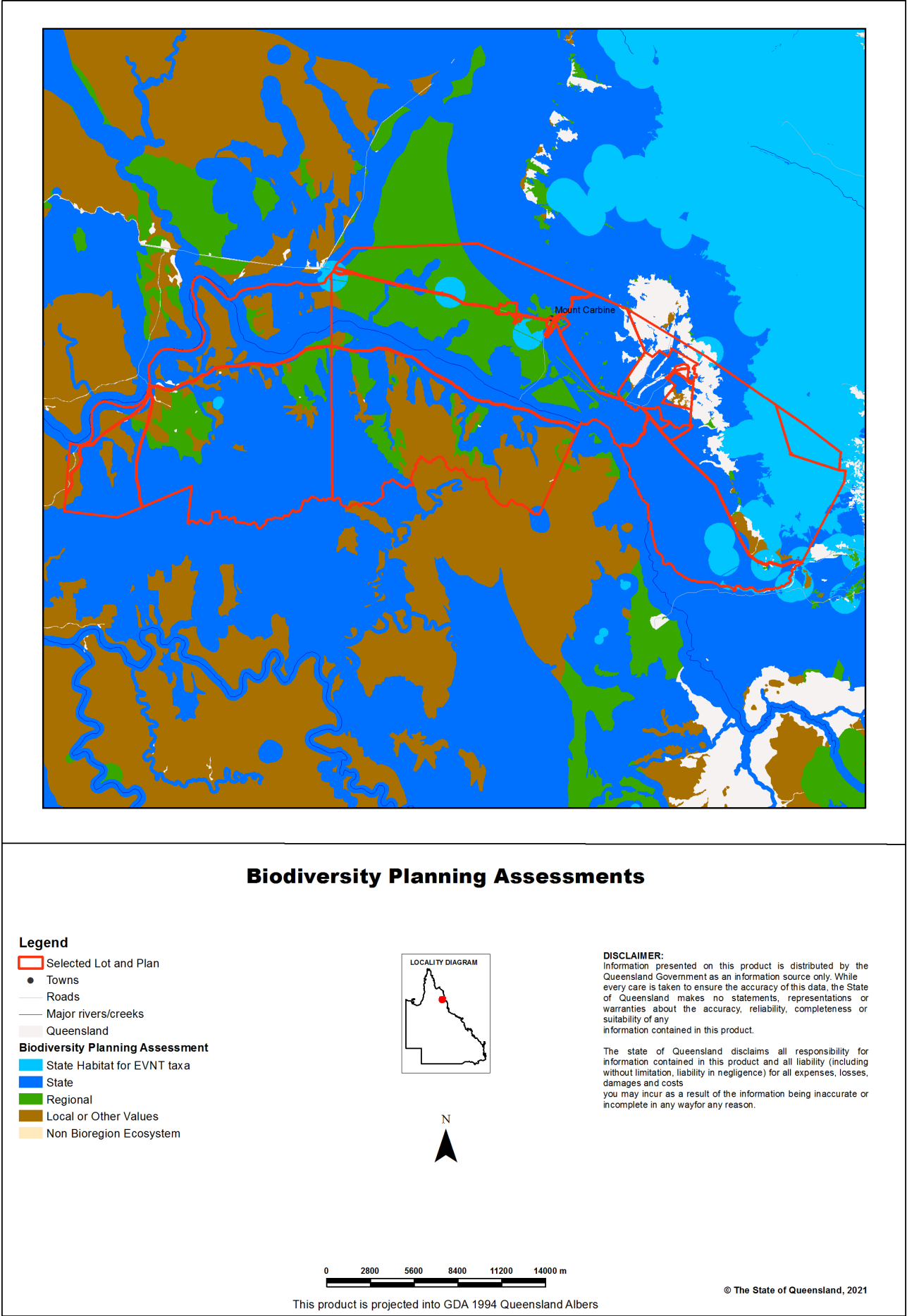
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

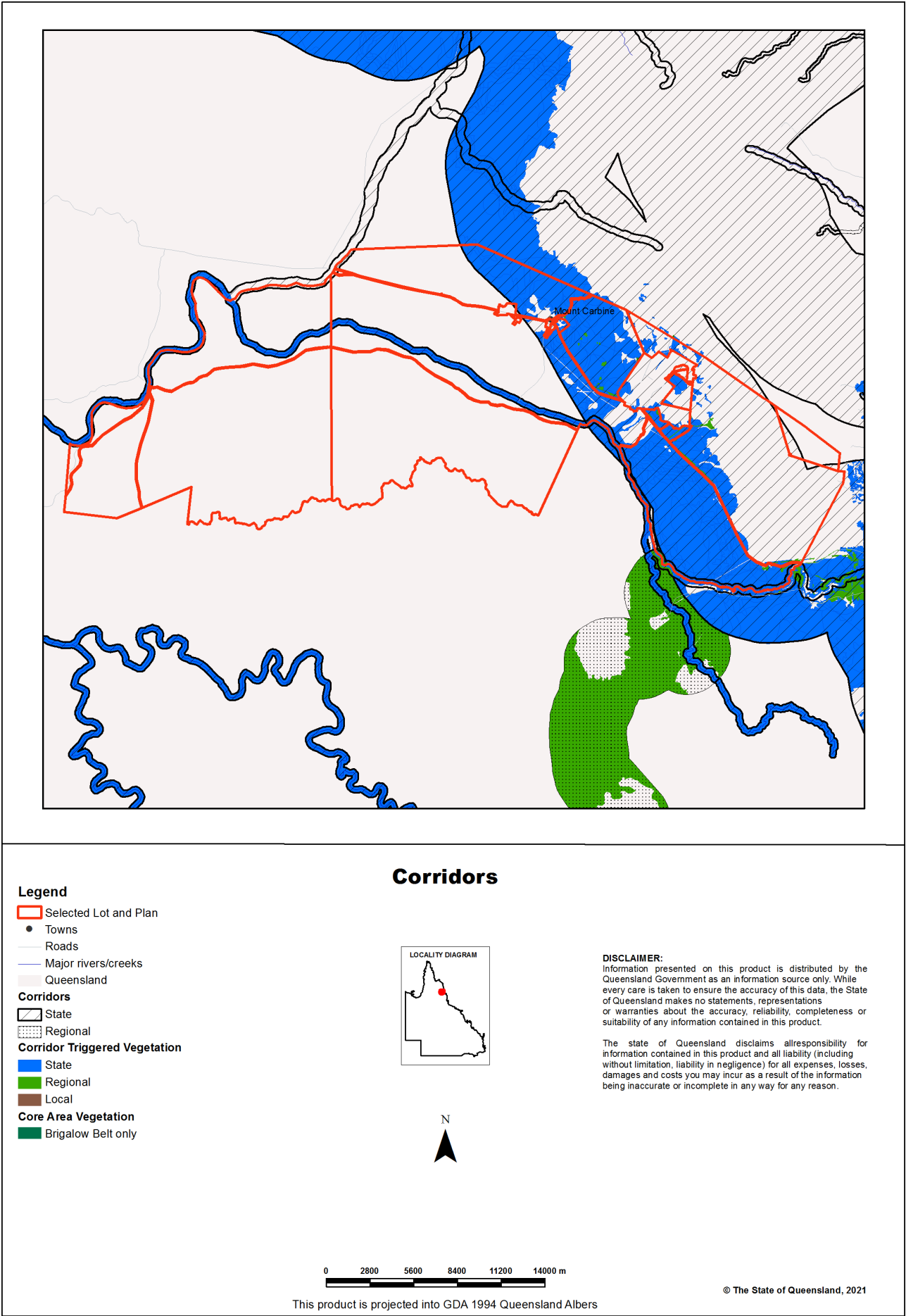
Map 1 - Locality Map



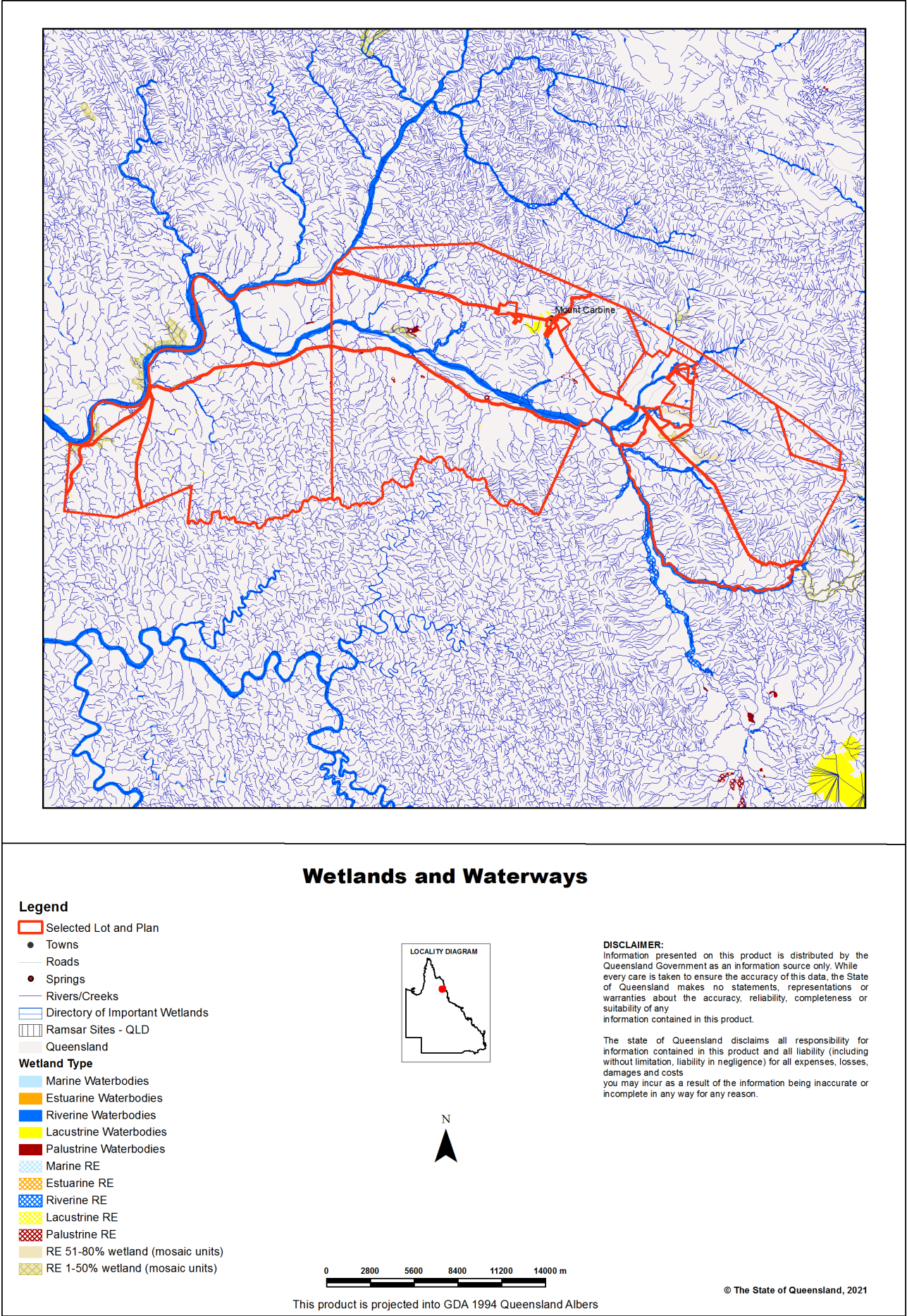
Map 2 - Biodiversity Planning Assessment (BPA)



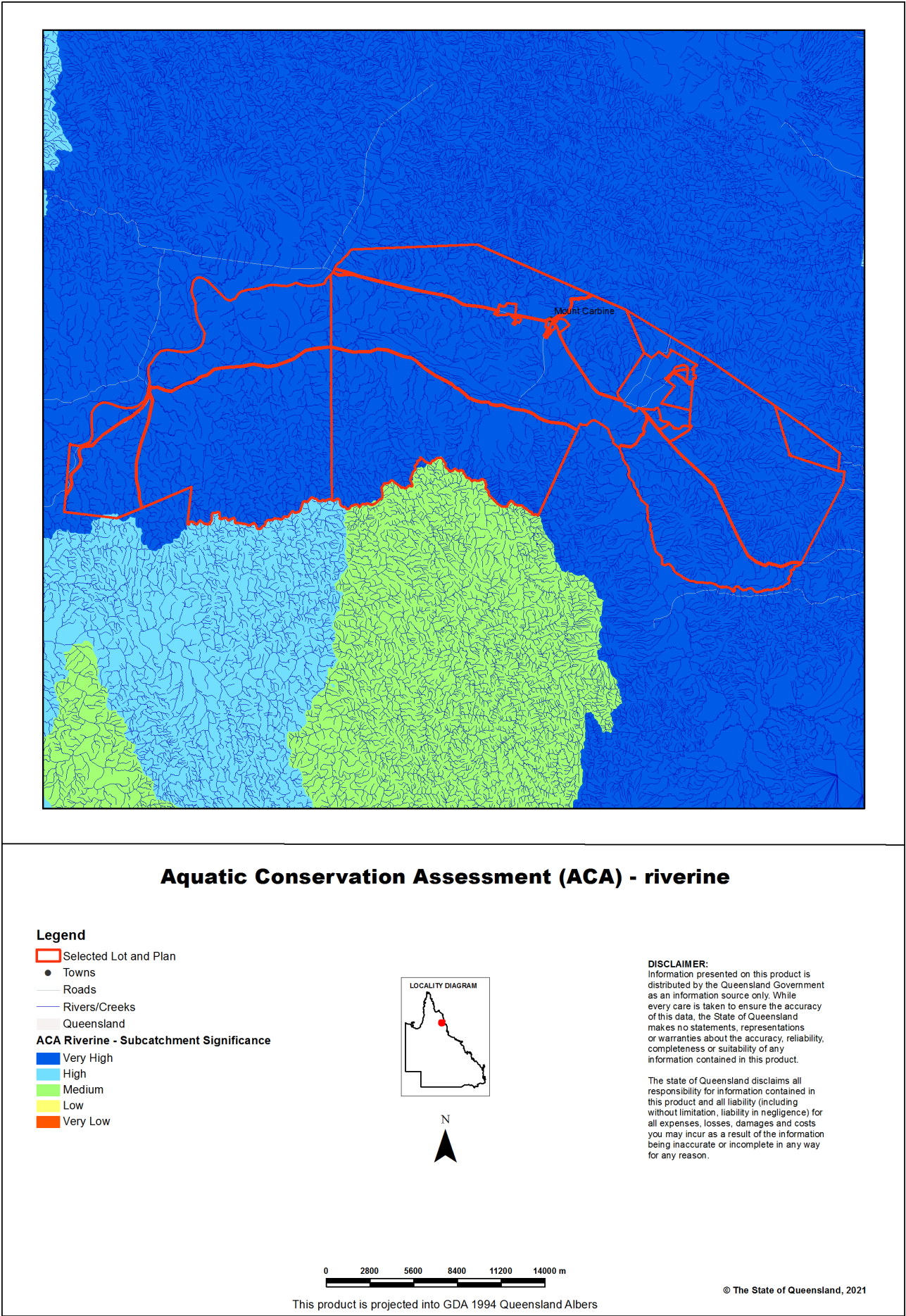
Map 3 - Corridors



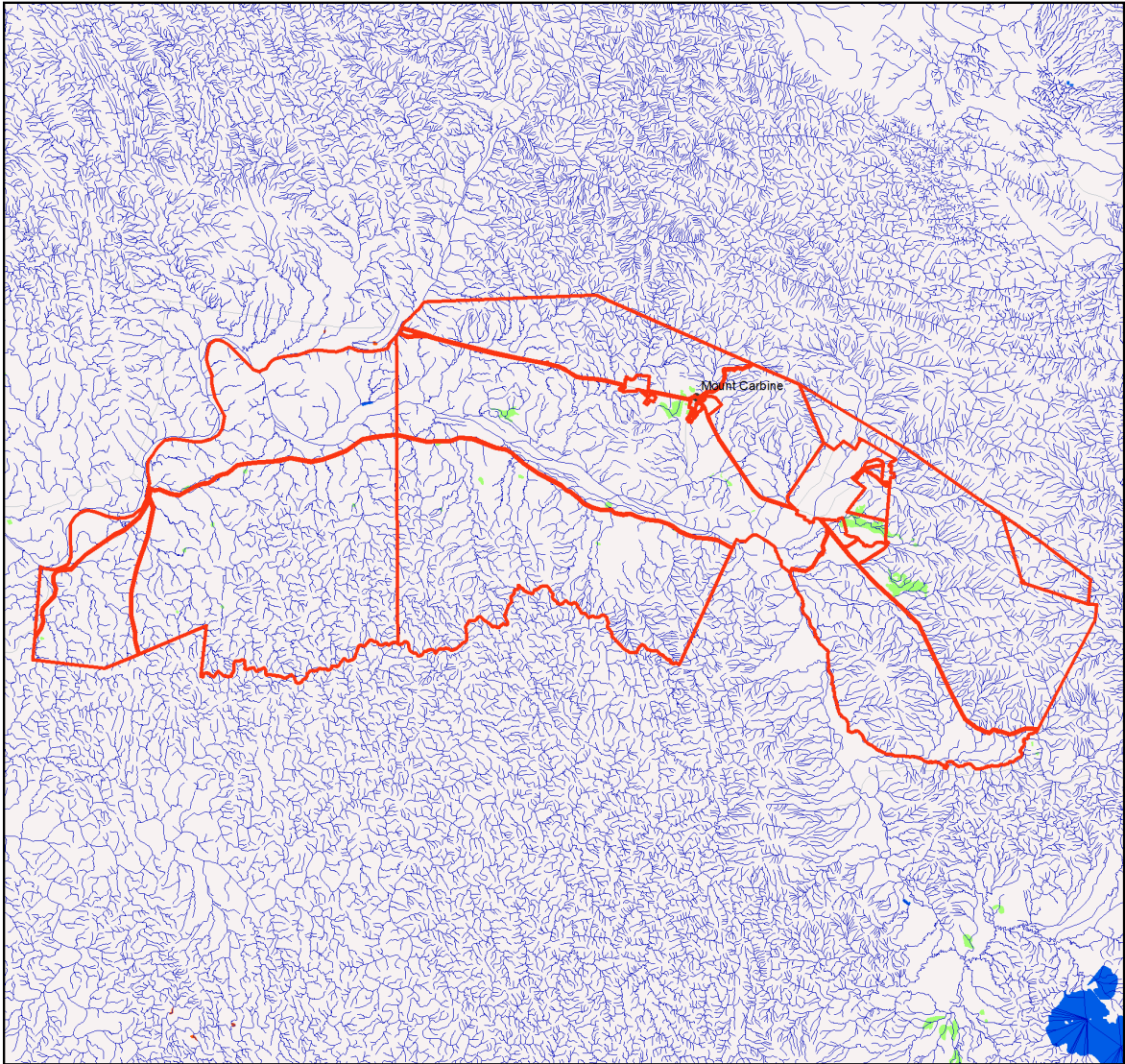
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



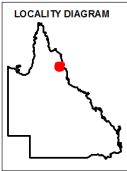
Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



Aquatic Conservation Assessment (ACA) - nonriverine

Legend

- Selected Lot and Plan
- Towns
- Roads
- Rivers/Creeks
- Queensland
- ACA Non-riverine
 - Very High
 - High
 - Medium
 - Low
 - Very Low



This product is projected into GDA 1994 Queensland Albers

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Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDB Non-riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDB Riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v2.3 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.6
Threatened Species	An internal DES database compiled from Wildnet, Herbrecks, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DES database compiled from Wildnet, Herbrecks, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DES database compiled from Wildnet, Herbrecks, Corveg, the QLD Museum, as well as other incidental sources.

*These datasets are available at:

<http://dds.information.qld.gov.au/DDS>

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DES	- Department of Environment and Science
EPBC	- <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EVNT	- Endangered, Vulnerable, Near Threatened
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- <i>Nature Conservation Act 1992</i>
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement



Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
Lot: 13 Plan: SP254833

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

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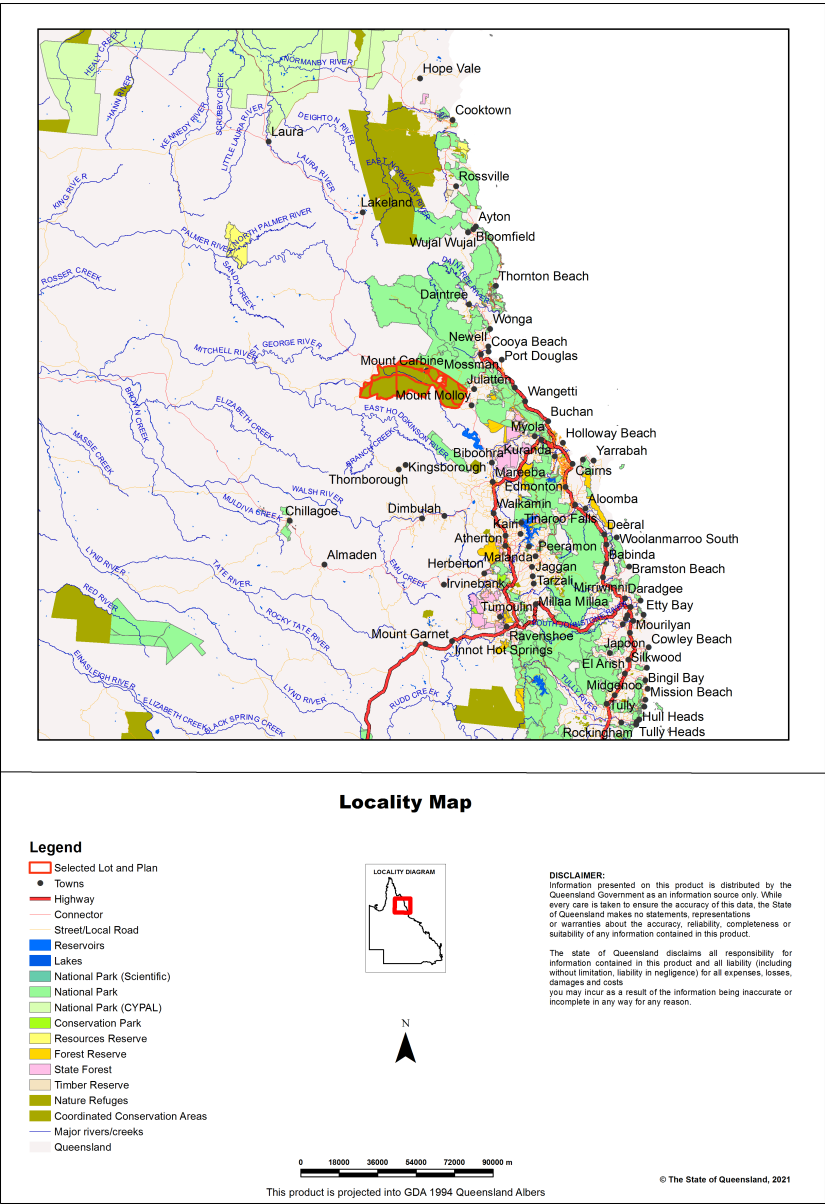
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI Lot: 13 Plan: SP254833

Size (ha)	58,779.14
Local Government(s)	Mareeba Shire
Bioregion(s)	Einasleigh Uplands, Wet Tropics
Subregion(s)	Hodgkinson Basin, Macalister, Daintree - Bloomfield
Catchment(s)	Mitchell



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;
- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;
- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;
- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;
- Regulated vegetation under the *Vegetation Management Act 1999* that is:
 - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
 - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
 - Category R areas on the regulated vegetation management map;
 - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
 - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;
- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;
- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;
- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	58412.12 ha	99.4%
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	155.0 ha	0.3%
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways **	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	10293.25 ha	17.5%
7b Special least concern animals	1491.14 ha	2.5%
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	2187.24 ha	3.7%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	6.23 ha	0.0%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0.0 ha	0.0 %
8d Regulated Vegetation - Essential habitat	10794.17 ha	18.4%
8e Regulated Vegetation - intersecting a watercourse **	1435.4 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	465.15 ha	0.8%
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

Name
Brooklyn Nature Refuge

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

Natural wetlands that are 'High Ecological Significance' (HES) on the Map of Queensland Wetland Environmental Values are present.

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Values are present

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
<i>Boronia keysii</i>		V	None
<i>Calyptorhynchus lathamii</i>	Glossy black cockatoo	V	None
<i>Casuarus casuarus johnsonii</i>	Sthn population cassowary	E	Core
<i>Crinia tinnula</i>	Wallum froglet	V	None
<i>Denisonia maculata</i>	Ornamental snake	V	None
<i>Litoria freycineti</i>	Wallum rocketfrog	V	None
<i>Litoria olongburensis</i>	Wallum sedgefrog	V	None
<i>Melaleuca irbyana</i>		E	None
<i>Petaurus gracilis</i>	Mahogany Glider	E	None
<i>Petrogale persephone</i>	Proserpine rock-wallaby	E	None
<i>Phascogale cinereus</i>	Koala - outside SEQ*	V	None
<i>Pezoporus wallicus wallicus</i>	Eastern ground parrot	V	None
<i>Taudactylus pleione</i>	Kroombit tinkertoad	E	None
<i>Xeromys myoides</i>	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

Scientific name	Common name	NCA status	EPBC status	Migratory status
<i>Heliccia grayi</i>		V		
<i>Egernia rugosa</i>	yakka skink	V	V	
<i>Phlegmariurus squarrosus</i>		E	CE	
<i>Cophixalus monticola</i>	mountain nurseryfrog	V	CE	
<i>Acanthophasis antarcticus</i>	common death adder	V		
<i>Corymbia rhodops</i>	red-throated bloodwood	V	V	
<i>Rhaphidospora cavernarum</i>		V		
<i>Acacia guymeri</i>		V		
<i>Litoria nannotis</i>	waterfall frog	E	E	

Scientific name	Common name	NCA status	EPBC status	Migratory status
<i>Solanum angustum</i>		E		
<i>Toechima pterocarpum</i>	orange tamarind	E	E	
<i>Rostratula australis</i>	Australian painted snipe	E	E	
<i>Lindsaea terrae-reginae</i>		V		
<i>Turnix olivii</i>	buff-breasted button-quail	E	E	
<i>Tyto novaehollandiae kimberli</i>	masked owl (northern subspecies)	V	V	
<i>Phlegmariurus phlegmarioides</i>		V		
<i>Helicia lewisensis</i>		V		
<i>Gastrodia urceolata</i>		V		
<i>Crocodylus porosus</i>	estuarine crocodile	V		M-B/E
<i>Litoria serrata</i>	tapping green eyed frog	V		
<i>Ehretia microphylla</i>		V		
<i>Symplocos crassiramifera</i>		V		
<i>Macropteranthes montana</i>		V	V	
<i>Calidris ferruginea</i>	curlew sandpiper	E	CE	M-C/J/R/B/E
<i>Parsonsia bartensis</i>		V		
<i>Litoria rheocola</i>	common mistfrog	E	E	
<i>Dasyurus maculatus gracilis</i>	spotted-tailed quoll (northern subspecies)	E	E	
<i>Petauroides volans</i>	greater glider	V	V	
<i>Xylosma</i> sp. (Mt Lewis G.Sankowsky+ 1108)		V		
<i>Phlegmariurus tetrastichoides</i>		V	V	
<i>Grantiella picta</i>	painted honeyeater	V	V	PM
<i>Macroderma gigas</i>	ghost bat	E	V	
<i>Taudactylus rheophilus</i>	northern tinkerfrog	E	E	
<i>Lastreopsis tinaroensis</i>		V		
<i>Bulbophyllum windsorensense</i>		V		
<i>Litoria nyakalensis</i>	mountain mistfrog	E	CE	
<i>Litoria dayi</i>	Australian lacelid	E	V	
<i>Grammitis reinwardtii</i>		V	V	

Special least concern animal species records

Scientific name	Common name	Migratory status
<i>Tachyglossus aculeatus</i>	short-beaked echidna	
<i>Ornithorhynchus anatinus</i>	platypus	
<i>Rhipidura rufifrons</i>	rufous fantail	M-B/E
<i>Gallinago megala</i>	Swinhoe's snipe	M-C/J/R/B/E
<i>Tringa nebularia</i>	common greenshank	M-C/J/R/B/E
<i>Gallinago hardwickii</i>	Latham's snipe	M-J/R/B/E

Scientific name	Common name	Migratory status
<i>Actitis hypoleucos</i>	common sandpiper	M-C/J/R/B/E
<i>Calidris acuminata</i>	sharp-tailed sandpiper	M-C/J/R/B/E
<i>Calidris ruficollis</i>	red-necked stint	M-C/J/R/B/E
<i>Pluvialis fulva</i>	Pacific golden plover	M-C/J/R/B/E
<i>Tringa stagnatilis</i>	marsh sandpiper	M-C/J/R/B/E

*Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL).
Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

<https://www.qld.gov.au/environment/plants-animals/species-list/>

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

<https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

<https://environment.ehp.qld.gov.au/regional-ecosystems/>

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Regional ecosystem	Vegetation management polygon	Vegetation management status
7.3.49a	O-dom	rem_oc
7.12.57a	O-dom	rem_oc
9.3.2/9.3.4/9.3.3c	O-subdom	rem_oc
7.12.66a	O-dom	rem_oc
7.12.58	O-dom	rem_oc
7.12.9	O-dom	rem_oc
7.12.57	O-dom	rem_oc
7.11.44	O-dom	rem_oc
7.3.28d	O-dom	rem_oc
7.12.62c	O-dom	rem_oc
7.12.69b	O-dom	rem_oc
7.12.5c	O-dom	rem_oc
9.3.4	O-dom	rem_oc
7.12.48	O-dom	rem_oc
7.12.37i	O-dom	rem_oc
7.12.66b	O-dom	rem_oc

Regional ecosystem	Vegetation management polygon	Vegetation management status
9.3.4/9.5.9c	O-dom	rem_oc
9.12.43b/9.12.43a	O-dom	rem_oc
9.12.2/9.12.43b/9.12.43a	O-subdom	rem_oc
7.3.14a	O-dom	rem_oc
9.12.17/7.12.34/9.12.43a	O-subdom	rem_oc

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Regional ecosystem	Vegetation management polygon	Vegetation management status
9.3.4	O-dom	hvr_oc
9.3.2/9.3.4/9.3.3c	O-subdom	hvr_oc

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Regulated vegetation map category	Map number
B	7964
C	7964
B	7864

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

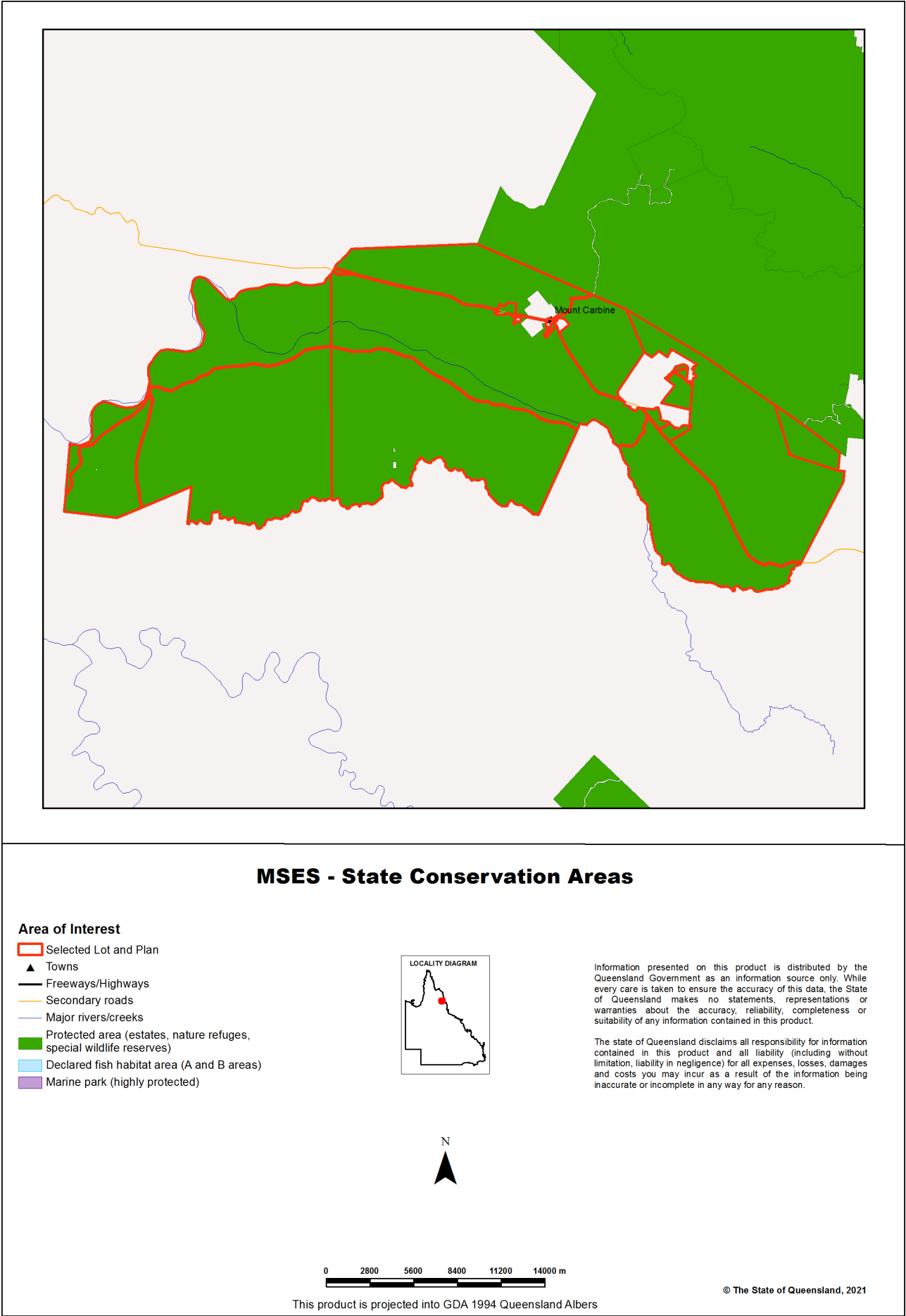
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

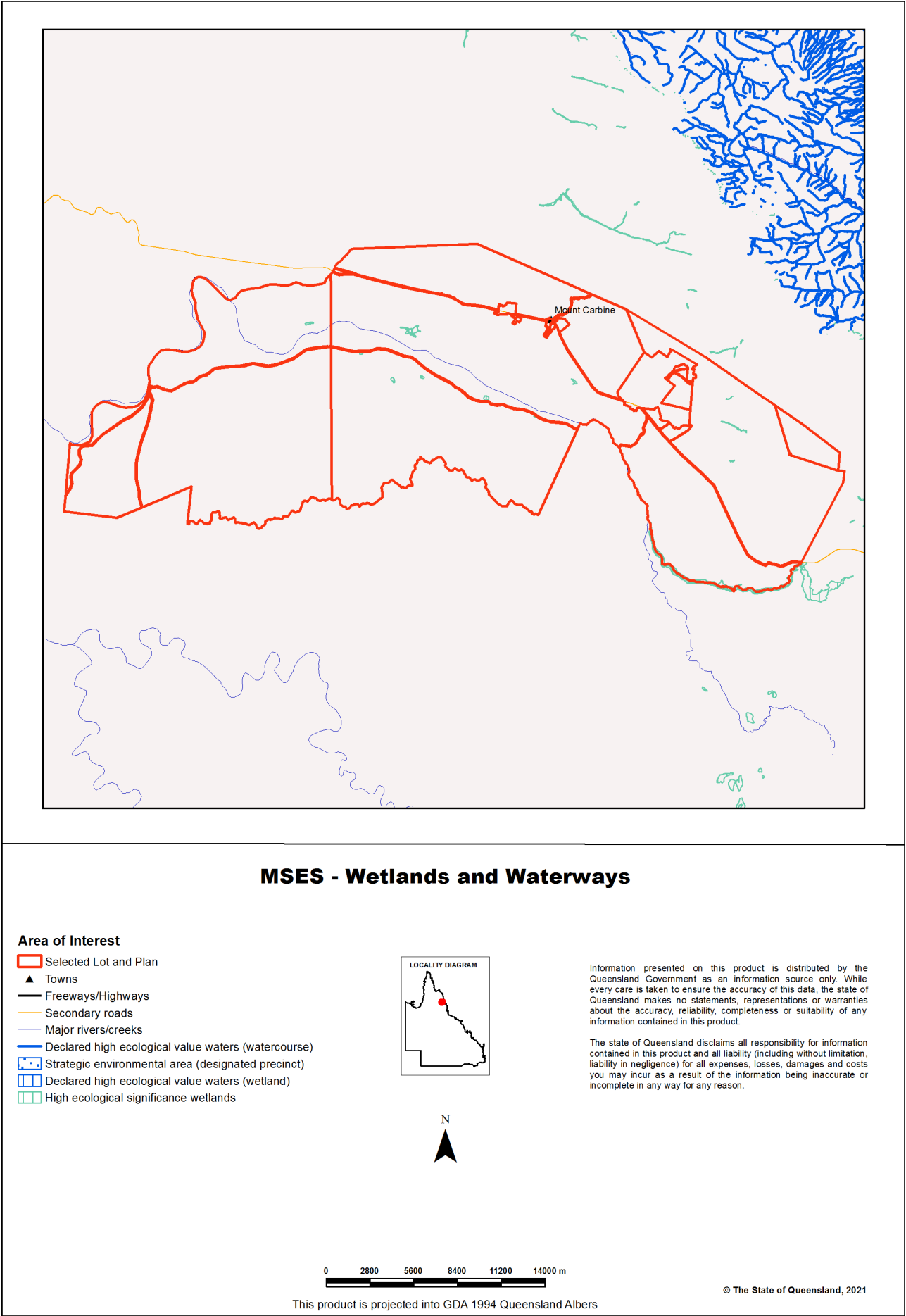
(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

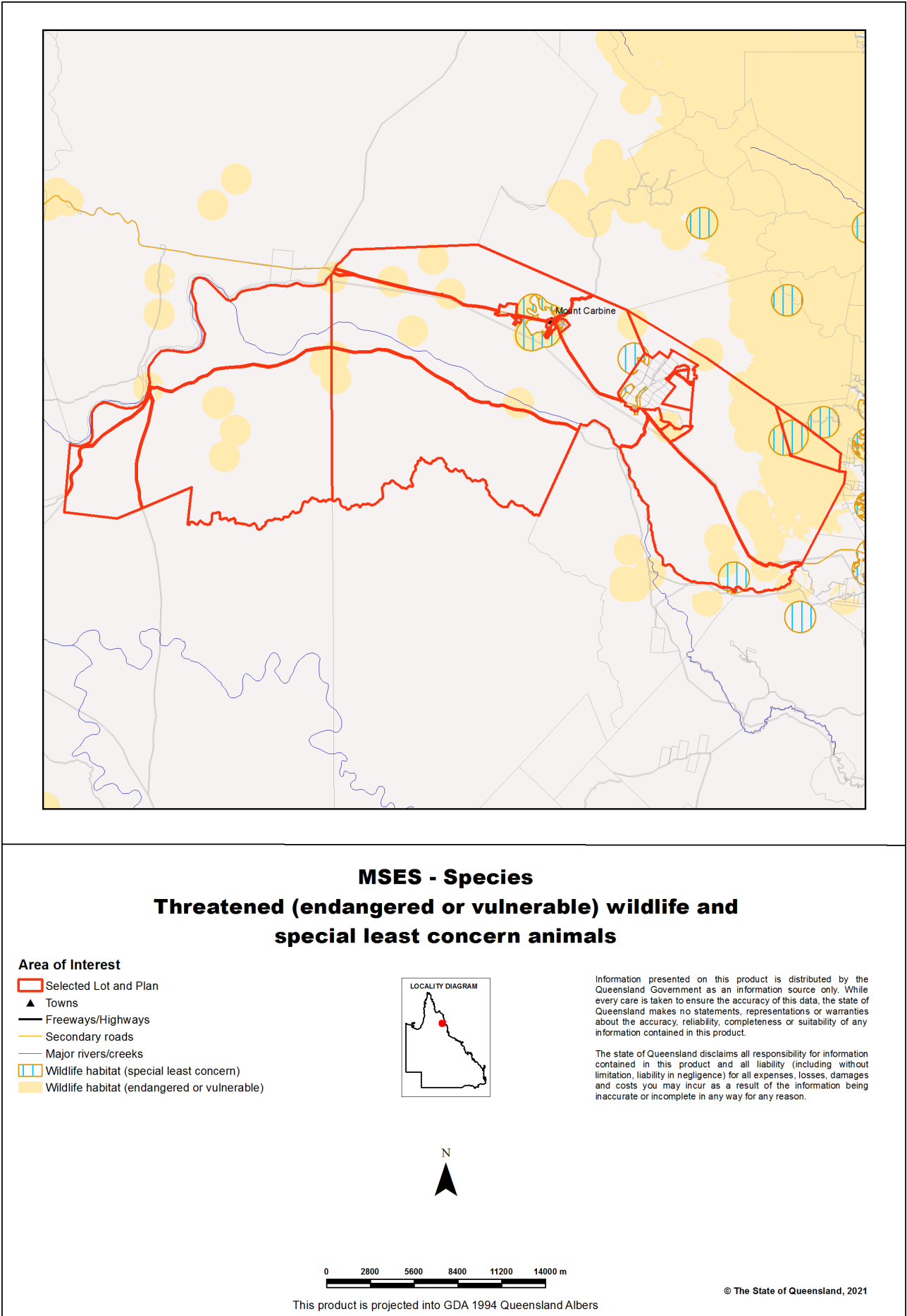
Map 1 - MSES - State Conservation Areas



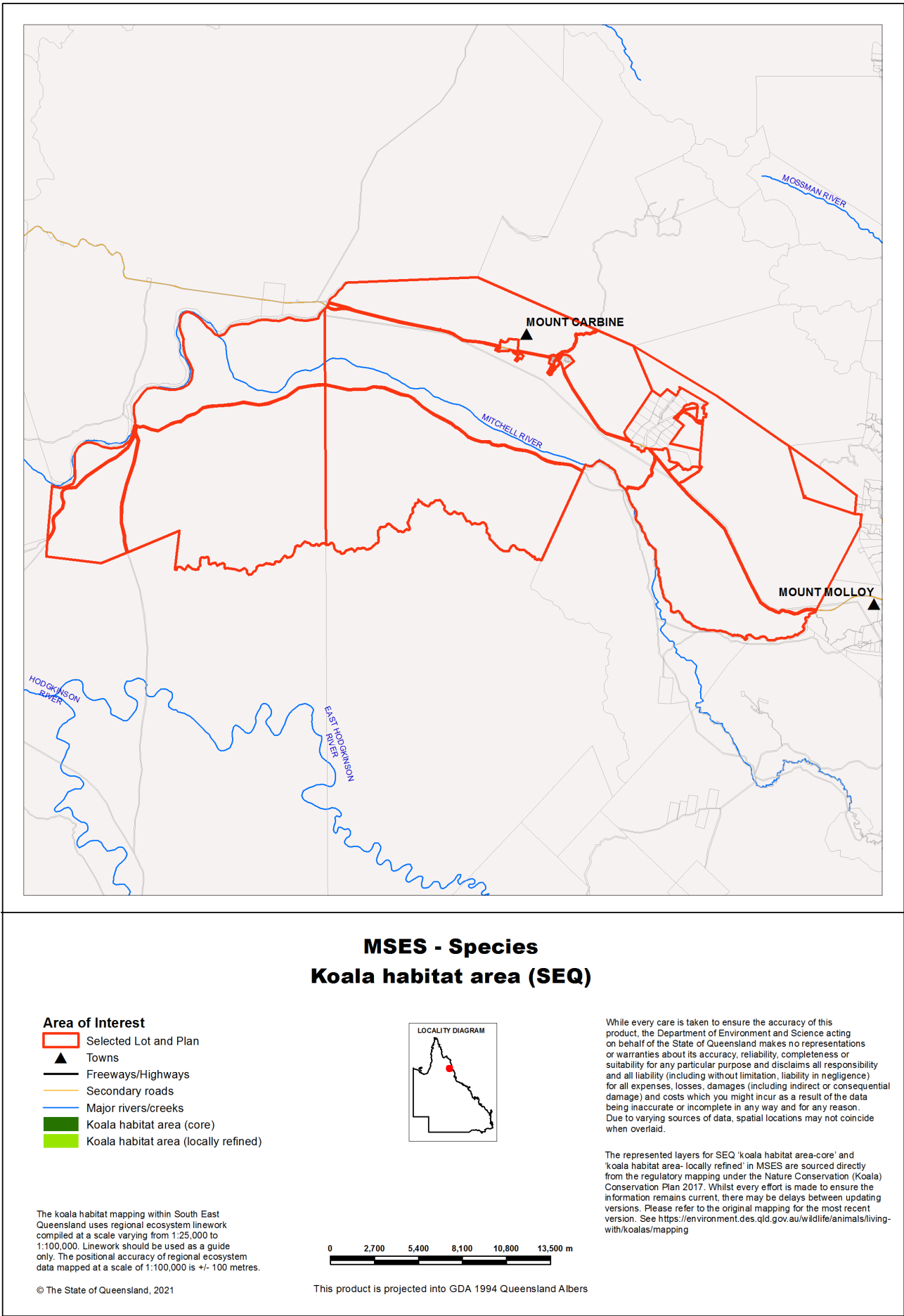
Map 2 - MSES - Wetlands and Waterways



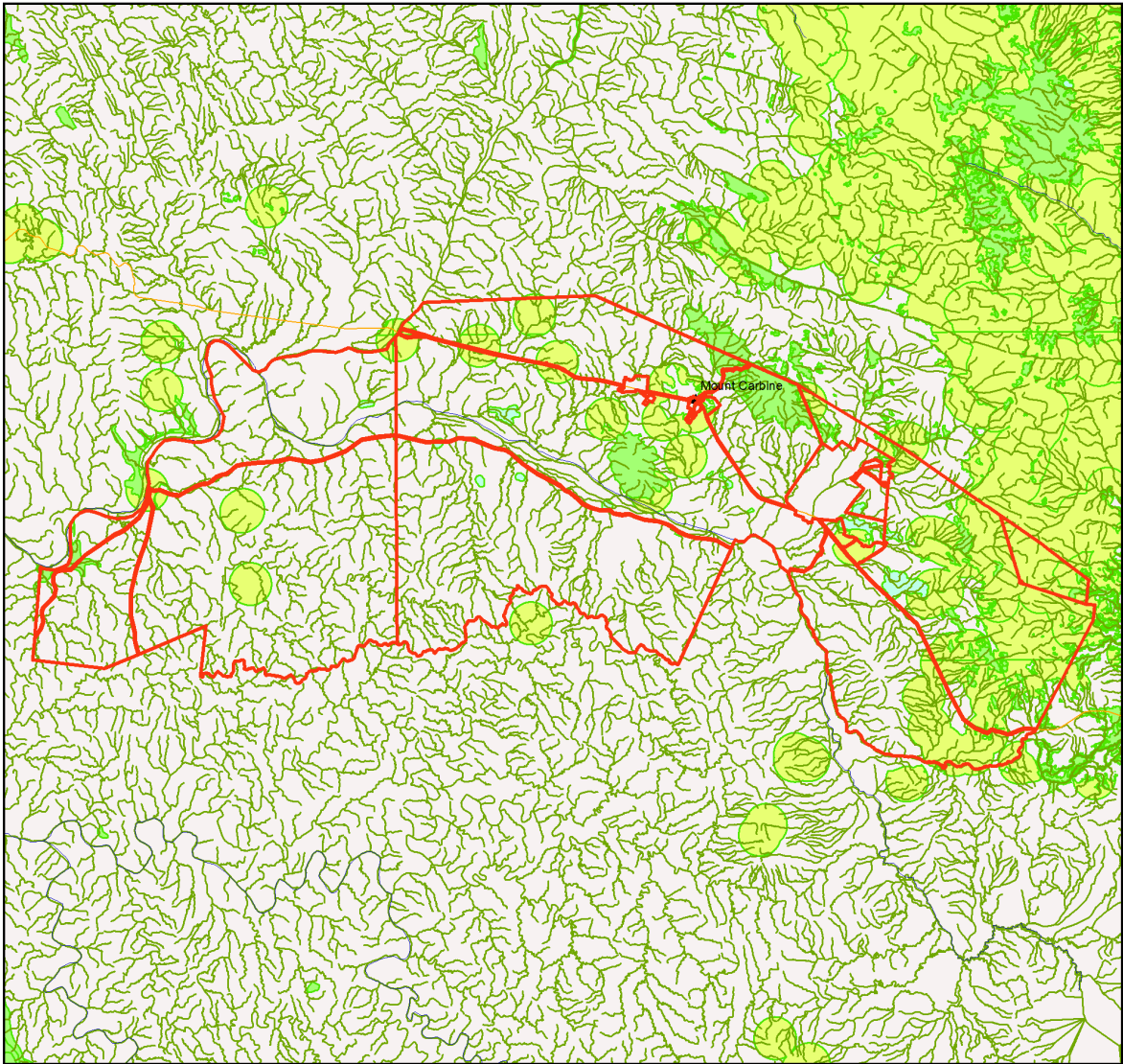
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



Map 3b - MSES - Species - Koala habitat area (SEQ)



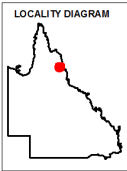
Map 4 - MSES - Regulated Vegetation



MSES - Regulated Vegetation

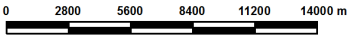
Area of Interest

- Selected Lot and Plan
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)



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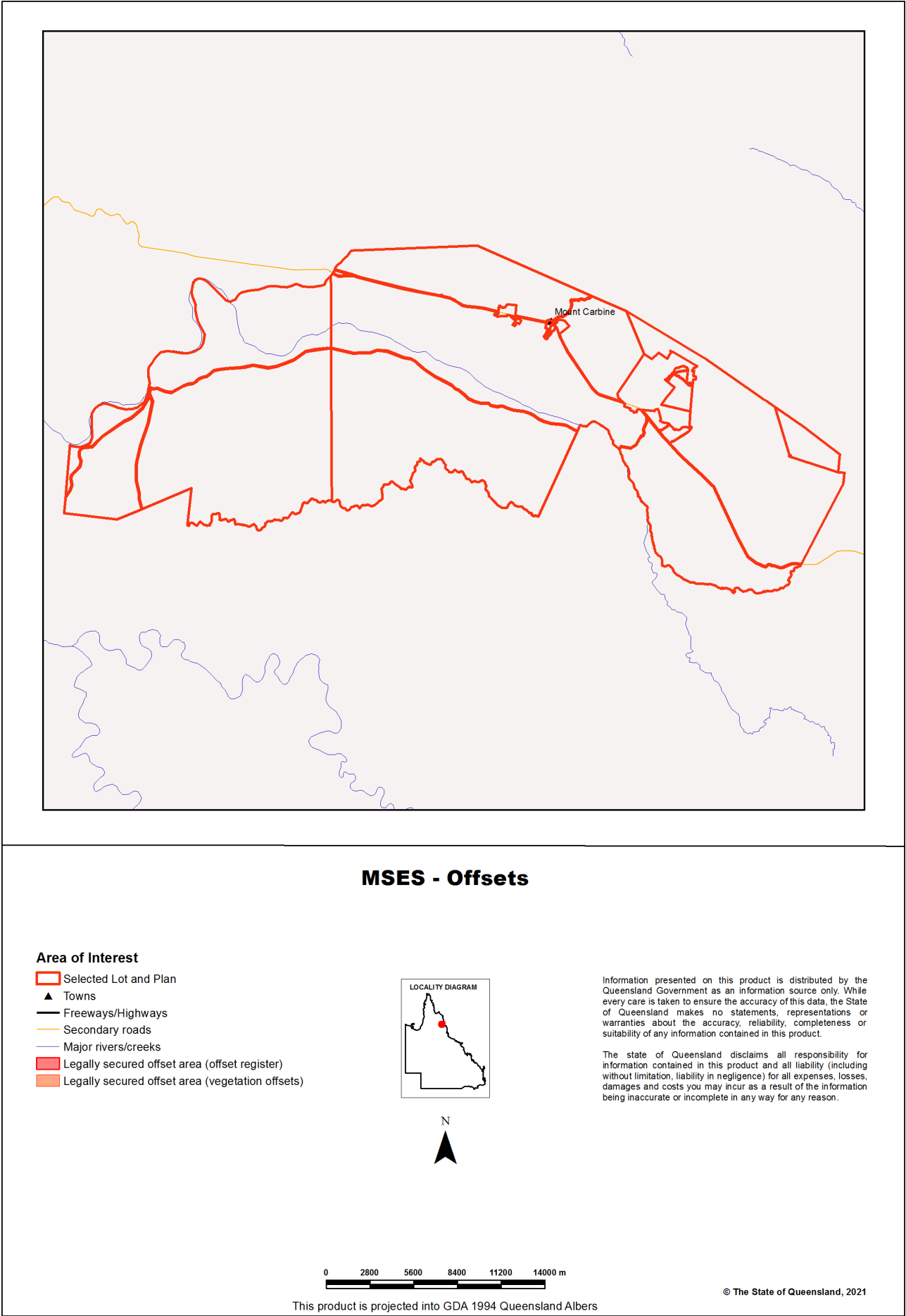
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Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

<http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html> .

Appendix 2 - Source Data

The datasets listed below are available on request from:

<http://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	current QSpatial data (http://qspatial.information.qld.gov.au)
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- <i>Environmental Protection Act 1994</i>
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- <i>Nature Conservation Act 1992</i>
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- <i>Vegetation Management Act 1999</i>



Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Lot: 13 Plan: SP254833

Environmental Reports - General Information

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The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website <https://www.dnrme.qld.gov.au/>

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government 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 the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: Lot: 13 Plan: SP254833

Size (ha)	58,779.14
Local Government(s)	Mareeba Shire
Bioregion(s)	Einasleigh Uplands, Wet Tropics
Subregion(s)	Hodgkinson Basin, Macalister, Daintree - Bloomfield
Catchment(s)	Mitchell

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	619.09	1.05
Of concern	4,516.50	7.68
No concern at present	52,370.06	89.1
Total remnant vegetation	57,505.66	97.83

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2020) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

<https://www.dnrme.qld.gov.au/>

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
7.11.1a	Simple to complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics (excluding amphibolites) of moderate fertility of the moist and wet lowlands, foothills and uplands	No concern at present	0.21	less than 0.01
7.11.44	Eucalyptus tereticornis open forest to woodland on coastal metamorphic foothills	Of concern	2.5	less than 0.01
7.11.51a	Corymbia clarksoniana and/or Eucalyptus drepanophylla open forest to woodland on metamorphics	Of concern	0.75	less than 0.01
7.12.16a	Simple to complex notophyll vine forest, including small areas of Araucaria bidwillii, of cloudy wet and moist uplands and highlands on granites and rhyolites	No concern at present	1,782.68	3.03
7.12.16b	Simple to complex notophyll vine forest, including small areas of Araucaria bidwillii, of cloudy wet and moist uplands and highlands on granites and rhyolites	No concern at present	1.79	less than 0.01
7.12.16c	Simple to complex notophyll vine forest, including small areas of Araucaria bidwillii, of cloudy wet and moist uplands and highlands on granites and rhyolites	No concern at present	8.14	0.01
7.12.19a	Simple microphyll vine-fern forest with Balanops australiana, Elaeocarpus spp. +/- Trochocarpa bellendenkerensis +/- Uromyrtus spp. +/- Agathis atropurpurea of cloudy wet highlands on granites and rhyolites	No concern at present	248.58	0.42
7.12.1a	Simple to complex mesophyll to notophyll vine forest of moderately to poorly-drained granites and rhyolites of moderate fertility of the moist and wet lowlands, foothills and uplands	No concern at present	626.28	1.07
7.12.1b	Simple to complex mesophyll to notophyll vine forest of moderately to poorly-drained granites and rhyolites of moderate fertility of the moist and wet lowlands, foothills and uplands	No concern at present	1.14	less than 0.01
7.12.21a	Eucalyptus grandis open forest to woodland, or Corymbia intermedia, E. pellita and E. grandis open forest to woodland, (or vine forest with these species as emergents) on granites and rhyolites	Endangered	44.68	0.08

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
7.12.21b	<i>Eucalyptus grandis</i> open forest to woodland, or <i>Corymbia intermedia</i> , <i>E. pellita</i> and <i>E. grandis</i> open forest to woodland, (or vine forest with these species as emergents) on granites and rhyolites	Endangered	19.71	0.03
7.12.22a	<i>Eucalyptus resinifera</i> +/- <i>E. portuensis</i> +/- <i>Syncarpia glomulifera</i> tall open forest to tall woodland (or vine forest with these species as emergents) of granite and rhyolite uplands and highlands	Endangered	403.22	0.69
7.12.22b	<i>Eucalyptus resinifera</i> +/- <i>E. portuensis</i> +/- <i>Syncarpia glomulifera</i> tall open forest to tall woodland (or vine forest with these species as emergents) of granite and rhyolite uplands and highlands	Endangered	76.13	0.13
7.12.24a	<i>Eucalyptus portuensis</i> and <i>Corymbia intermedia</i> open forest to woodland (or vine forest with <i>E. portuensis</i> and <i>C. intermedia</i> emergents) on foothills and uplands on granites and rhyolites	No concern at present	189.93	0.32
7.12.30a	<i>Corymbia citriodora</i> +/- <i>Eucalyptus portuensis</i> woodland to open forest on granite and rhyolite	No concern at present	1,030.42	1.75
7.12.30b	<i>Corymbia citriodora</i> +/- <i>Eucalyptus portuensis</i> woodland to open forest on granite and rhyolite	No concern at present	413.85	0.7
7.12.34	<i>Eucalyptus portuensis</i> and/or <i>E. drepanophylla</i> +/- <i>C. intermedia</i> +/- <i>C. citriodora</i> , +/- <i>E. granitica</i> open woodland to open forest on uplands on granite	No concern at present	723.12	1.23
7.12.37i	Rock pavements and seepage areas of wet lowlands, uplands and highlands of the eastern escarpment and central range (excluding Hinchinbrook Island and Bishop Peak) on granite and rhyolite, with <i>Allocasuarina</i> spp. Low woodland and/or sedgelands	Of concern	0.73	less than 0.01
7.12.48	Wind-sheared notophyll vine forest on exposed granite and rhyolite ridge crests and steep slopes	Of concern	43.73	0.07
7.12.57	Shrubland and low woodland mosaic with <i>Syncarpia glomulifera</i> , <i>Corymbia abergiana</i> , <i>Eucalyptus portuensis</i> , <i>Allocasuarina littoralis</i> and <i>Xanthorrhoea johnsonii</i> on uplands and highlands on granite	Of concern	31.34	0.05
7.12.57a	Shrubland and low woodland mosaic with <i>Syncarpia glomulifera</i> , <i>Corymbia abergiana</i> , <i>Eucalyptus portuensis</i> , <i>Allocasuarina littoralis</i> and <i>Xanthorrhoea johnsonii</i> on uplands and highlands on granite	Of concern	78.85	0.13
7.12.58	<i>Eucalyptus reducta</i> +/- <i>E. granitica</i> +/- <i>Corymbia dimorpha</i> +/- <i>C. citriodora</i> woodland to open forest on granite and rhyolite	Of concern	71.58	0.12
7.12.5c	<i>Eucalyptus pellita</i> +/- <i>Corymbia intermedia</i> open forest, or <i>Acacia mangium</i> and <i>Lophostemon suaveolens</i> open forest (or vine forest with these species as emergents), on granites and rhyolites	Endangered	74.57	0.13
7.12.61a	<i>Eucalyptus tereticornis</i> +/- <i>E. granitica</i> woodland to open forest of foothills and uplands on granite and rhyolite	Of concern	193.69	0.33
7.12.62c	<i>Eucalyptus</i> sp. and/or <i>Corymbia stockeri</i> +/- <i>C. hylandii</i> +/- <i>Syncarpia glomulifera</i> +/- <i>E. portuensis</i> woodland on dry granite hill slopes in the north-west of the bioregion	Of concern	13.6	0.02

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
7.12.65e	Rock pavement or areas of skeletal soil on granite and rhyolite of dry western or southern areas +/- shrublands to closed forests of <i>Acacia</i> spp. And/or <i>Lophostemon suaveolens</i> and/or <i>Allocasuarina littoralis</i> and/or <i>Eucalyptus lockyeri</i> subsp. <i>Exuta</i>	Of concern	33.0	0.06
7.12.65f	Rock pavement or areas of skeletal soil on granite and rhyolite of dry western or southern areas +/- shrublands to closed forests of <i>Acacia</i> spp. And/or <i>Lophostemon suaveolens</i> and/or <i>Allocasuarina littoralis</i> and/or <i>Eucalyptus lockyeri</i> subsp. <i>Exuta</i>	Of concern	0.2	less than 0.01
7.12.65k	Rock pavement or areas of skeletal soil on granite and rhyolite of dry western or southern areas +/- shrublands to closed forests of <i>Acacia</i> spp. And/or <i>Lophostemon suaveolens</i> and/or <i>Allocasuarina littoralis</i> and/or <i>Eucalyptus lockyeri</i> subsp. <i>Exuta</i>	Of concern	2.12	less than 0.01
7.12.66a	<i>Lophostemon confertus</i> low shrubland or low closed forest on exposed rocky slopes on granite and rhyolite	Of concern	6.6	0.01
7.12.66b	<i>Lophostemon confertus</i> low shrubland or low closed forest on exposed rocky slopes on granite and rhyolite	Of concern	54.84	0.09
7.12.69b	<i>Eucalyptus drepanophylla</i> and/or <i>E. granitica</i> +/- <i>Corymbia clarksoniana</i> +/- <i>C. erythrophloia</i> woodland on uplands on granite and rhyolite	Of concern	22.3	0.04
7.12.7a	Simple to complex microphyll to notophyll vine forest, often with <i>Agathis robusta</i> or <i>A. microstachya</i> , on granites and rhyolites of moist foothills and uplands	No concern at present	18.99	0.03
7.12.9	<i>Acacia celsa</i> open forest to closed forest on granites and rhyolites	Of concern	72.51	0.12
7.3.14a	<i>Eucalyptus leptophleba</i> +/- <i>Corymbia clarksoniana</i> +/- <i>Melaleuca dealbata</i> woodland to open forest on alluvium in low rainfall areas of the west and north	Of concern	0.21	less than 0.01
7.3.28d	Rivers and streams including riparian herbfield and shrubland on river and stream bed alluvium and rock within stream beds	Endangered	0.77	less than 0.01
7.3.49a	Notophyll vine forest on rubble terraces of streams	Of concern	11.01	0.02
9.11.25	<i>Eucalyptus tardecidens</i> or <i>E. chlorophylla</i> +/- <i>Corymbia</i> spp. +/- <i>E. cullenii</i> low woodland on steep to rolling metamorphic hills and rises	No concern at present	2,543.97	4.33
9.11.26a	<i>Eucalyptus leptophleba</i> and/or <i>E. cullenii</i> and/or <i>Corymbia clarksoniana</i> +/- <i>E. platyphylla</i> woodland on undulating terrain to rolling hills	No concern at present	3,337.66	5.68
9.11.3a	<i>Eucalyptus cullenii</i> or <i>E. staigeriana</i> +/- <i>Corymbia clarksoniana</i> woodland on skeletal soils on metamorphic hills	No concern at present	2,573.99	4.38
9.11.3b	<i>Eucalyptus cullenii</i> or <i>E. staigeriana</i> +/- <i>Corymbia clarksoniana</i> woodland on skeletal soils on metamorphic hills	No concern at present	15,814.95	26.91
9.11.3d	<i>Eucalyptus cullenii</i> or <i>E. staigeriana</i> +/- <i>Corymbia clarksoniana</i> woodland on skeletal soils on metamorphic hills	No concern at present	92.69	0.16

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
9.11.7a	Eucalyptus platyphylla and/or E. cullenii +/- Corymbia clarksoniana woodland on texture contrast soils on metamorphic hills	No concern at present	99.68	0.17
9.11.7b	Eucalyptus platyphylla and/or E. cullenii +/- Corymbia clarksoniana woodland on texture contrast soils on metamorphic hills	No concern at present	118.9	0.2
9.12.17	Eucalyptus atrata +/- Corymbia citriodora subsp. citriodora +/- E. portuensis woodland on mountains and hills on igneous rocks	No concern at present	580.56	0.99
9.12.2	Eucalyptus portuensis, Corymbia citriodora subsp. citriodora, E. granitica or E. crebra, C. intermedia or C. clarksoniana mixed woodland on steep hills and ranges on igneous hills close to Wet Tropics boundary	No concern at present	435.24	0.74
9.12.31a	Eucalyptus leptophleba, Corymbia clarksoniana and E. crebra +/- C. dallachiana woodland on igneous rocks	Of concern	20.04	0.03
9.12.43a	Granite and rhyolite boulders and pavements edged with patches of Callitris intratropica +/- vine thicket species	Of concern	157.83	0.27
9.12.43b	Granite and rhyolite boulders and pavements edged with patches of Callitris intratropica +/- vine thicket species	Of concern	85.13	0.14
9.12.7a	Eucalyptus cullenii +/- Corymbia leichhardtii +/- C. erythrophloia woodland on igneous rocks	No concern at present	339.88	0.58
9.12.7c	Eucalyptus cullenii +/- Corymbia leichhardtii +/- C. erythrophloia woodland on igneous rocks	No concern at present	679.23	1.16
9.12.8a	Semi-evergreen vine thicket on rocky outcrops and shallow soils of igneous rocks	No concern at present	0.08	less than 0.01
9.3.12a	River beds and associated waterholes on major rivers and channels	Of concern	3.56	0.01
9.3.12b	River beds and associated waterholes on major rivers and channels	Of concern	79.64	0.14
9.3.13	Melaleuca spp., Eucalyptus camaldulensis and Casuarina cunninghamiana fringing open forest on streams and channels	Of concern	227.52	0.39
9.3.14a	Melaleuca spp. +/- Acacia spp. +/- Syzygium spp. +/- Leptospermum spp. fringing woodland on channels and levees	Of concern	1,120.88	1.91
9.3.16	Eucalyptus tereticornis and/or E. platyphylla and/or Corymbia clarksoniana woodland on alluvial flats, levees and plains	Of concern	112.09	0.19
9.3.2	Eucalyptus leptophleba and/or E. chlorophylla +/- Corymbia dallachiana woodland on river levees and terraces	No concern at present	7,309.38	12.44
9.3.3c	Corymbia spp. and Eucalyptus spp. dominated mixed woodland on alluvial flats, levees and plains	Of concern	1,939.28	3.3
9.3.4	Permanent or seasonal wetlands frequently fringed by narrow bands of trees and shrubs including Eucalyptus spp. on alluvial plains	Of concern	130.98	0.22
9.3.6a	Eucalyptus platyphylla +/- Eucalyptus spp. +/- Corymbia spp. woodland on alluvial plains	No concern at present	127.18	0.22

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
9.5.12	Eucalyptus chlorophylla and/or E. tardecidens woodland on Tertiary plains	No concern at present	5,284.08	8.99
9.5.13a	Melaleuca citrolens and/or Macropteranthes montana low woodland with Eucalyptus spp. emergents on Tertiary sand sheets	No concern at present	1,056.23	1.8
9.5.15a	Melaleuca monantha +/- M. viridiflora +/- Callitris intratropica mixed low woodland on valley infill	No concern at present	1,394.07	2.37
9.5.9b	Corymbia clarksoniana and/or Eucalyptus leptophleba and/or E. platyphylla woodland on plains	No concern at present	2,322.64	3.95
9.5.9c	Corymbia clarksoniana and/or Eucalyptus leptophleba and/or E. platyphylla woodland on plains	No concern at present	3,214.51	5.47
non-remnant	None	None	1,231.73	2.1
water	None	None	42.27	0.07

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
7.11.1a	Pre-clearing 146000 ha; Remnant 2019 130000 ha	2a	None	High
7.11.44	Pre-clearing 10000 ha; Remnant 2019 9000 ha	9c	None	High
7.11.51a	Pre-clearing 19000 ha; Remnant 2019 16000 ha	9c	None	High
7.12.16a	Pre-clearing 242000 ha; Remnant 2019 230000 ha	6b	None	High
7.12.16b	Pre-clearing 242000 ha; Remnant 2019 230000 ha	5d	None	High
7.12.16c	Pre-clearing 242000 ha; Remnant 2019 230000 ha	5c	None	High
7.12.19a	Pre-clearing 14000 ha; Remnant 2019 14000 ha	6b	None	High
7.12.1a	Pre-clearing 124000 ha; Remnant 2019 120000 ha	2a	None	High
7.12.1b	Pre-clearing 124000 ha; Remnant 2019 120000 ha	5d	None	High
7.12.21a	Pre-clearing 16000 ha; Remnant 2019 16000 ha	8a	None	High
7.12.21b	Pre-clearing 16000 ha; Remnant 2019 16000 ha	8a	None	High

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
7.12.22a	Pre-clearing 40000 ha; Remnant 2019 39000 ha	8a	None	High
7.12.22b	Pre-clearing 40000 ha; Remnant 2019 39000 ha	8a	None	High
7.12.24a	Pre-clearing 33000 ha; Remnant 2019 32000 ha	9d	None	High
7.12.30a	Pre-clearing 44000 ha; Remnant 2019 43000 ha	10b	None	High
7.12.30b	Pre-clearing 44000 ha; Remnant 2019 43000 ha	10b	None	High
7.12.34	Pre-clearing 53000 ha; Remnant 2019 51000 ha	9d	None	High
7.12.37i	Pre-clearing 5000 ha; Remnant 2019 5000 ha	29b	None	High
7.12.48	Pre-clearing 7000 ha; Remnant 2019 7000 ha	6b	None	High
7.12.57	Pre-clearing 4000 ha; Remnant 2019 4000 ha	9d	None	Medium
7.12.57a	Pre-clearing 4000 ha; Remnant 2019 4000 ha	9d	None	Medium
7.12.58	Pre-clearing 1000 ha; Remnant 2019 1000 ha	9d	None	High
7.12.5c	Pre-clearing 12000 ha; Remnant 2019 9000 ha	9c	None	High
7.12.61a	Pre-clearing 26000 ha; Remnant 2019 25000 ha	9c	None	High
7.12.62c	Pre-clearing 600 ha; Remnant 2019 600 ha	7b	None	High
7.12.65e	Pre-clearing 16000 ha; Remnant 2019 16000 ha	28e	None	High
7.12.65f	Pre-clearing 16000 ha; Remnant 2019 16000 ha	29b	None	High
7.12.65k	Pre-clearing 16000 ha; Remnant 2019 16000 ha	29b	None	High
7.12.66a	Pre-clearing 5000 ha; Remnant 2019 5000 ha	28e	None	High
7.12.66b	Pre-clearing 5000 ha; Remnant 2019 5000 ha	28e	None	High
7.12.69b	Pre-clearing 700 ha; Remnant 2019 700 ha	13c	None	High
7.12.7a	Pre-clearing 15000 ha; Remnant 2019 14000 ha	5c	None	High
7.12.9	Pre-clearing 5000 ha; Remnant 2019 5000 ha	5d	None	High
7.3.14a	Pre-clearing 3000 ha; Remnant 2019 2000 ha	9b	None	Medium
7.3.28d	Pre-clearing 8000 ha; Remnant 2019 8000 ha	16d	Riverine wetland or fringing riverine wetland.	High

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
7.3.49a	Pre-clearing 800 ha; Remnant 2019 800 ha	22c	Riverine wetland or fringing riverine wetland.	High
9.11.25	Pre-clearing 195000 ha; Remnant 2019 193000 ha	19d	None	Low
9.11.26a	Pre-clearing 67000 ha; Remnant 2019 66000 ha	13a	None	Low
9.11.3a	Pre-clearing 924000 ha; Remnant 2019 917000 ha	13a	None	Low
9.11.3b	Pre-clearing 924000 ha; Remnant 2019 917000 ha	13a	None	Low
9.11.3d	Pre-clearing 924000 ha; Remnant 2019 917000 ha	21b	None	Low
9.11.7a	Pre-clearing 41000 ha; Remnant 2019 39000 ha	9b	None	Low
9.11.7b	Pre-clearing 41000 ha; Remnant 2019 39000 ha	21a	None	Low
9.12.17	Pre-clearing 19000 ha; Remnant 2019 19000 ha	13c	None	Low
9.12.2	Pre-clearing 117000 ha; Remnant 2019 116000 ha	9d	None	High
9.12.31a	Pre-clearing 11000 ha; Remnant 2019 10000 ha	9b	None	No representation
9.12.43a	Pre-clearing 7000 ha; Remnant 2019 7000 ha	29b	None	Low
9.12.43b	Pre-clearing 7000 ha; Remnant 2019 7000 ha	29b	None	Low
9.12.7a	Pre-clearing 610000 ha; Remnant 2019 606000 ha	13a	None	Low
9.12.7c	Pre-clearing 610000 ha; Remnant 2019 606000 ha	13a	None	Low
9.12.8a	Pre-clearing 11000 ha; Remnant 2019 11000 ha	7a	None	High
9.3.12a	Pre-clearing 64000 ha; Remnant 2019 63000 ha	16d	Riverine wetland or fringing riverine wetland.	Low
9.3.12b	Pre-clearing 64000 ha; Remnant 2019 63000 ha	16d	Riverine wetland or fringing riverine wetland.	Low
9.3.13	Pre-clearing 95000 ha; Remnant 2019 93000 ha	22c	Riverine wetland or fringing riverine wetland.	Low
9.3.14a	Pre-clearing 18000 ha; Remnant 2019 18000 ha	22c	Riverine wetland or fringing riverine wetland.	Low
9.3.16	Pre-clearing 33000 ha; Remnant 2019 29000 ha	16c	Floodplain (other than floodplain wetlands).	Low
9.3.2	Pre-clearing 19000 ha; Remnant 2019 18000 ha	16b	None	Low
9.3.3c	Pre-clearing 150000 ha; Remnant 2019 130000 ha	16b	Floodplain (other than floodplain wetlands).	Low
9.3.4	Pre-clearing 6000 ha; Remnant 2019 5000 ha	34d	Palustrine wetland (e.g. vegetated swamp).	Medium

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
9.3.6a	Pre-clearing 20000 ha; Remnant 2019 19000 ha	16c	Contains palustrine wetland (e.g. in swales).	Medium
9.5.12	Pre-clearing 30000 ha; Remnant 2019 27000 ha	18c	None	Low
9.5.13a	Pre-clearing 31000 ha; Remnant 2019 31000 ha	21b	None	High
9.5.15a	Pre-clearing 16000 ha; Remnant 2019 12000 ha	21a	None	Low
9.5.9b	Pre-clearing 92000 ha; Remnant 2019 55000 ha	18c	None	Low
9.5.9c	Pre-clearing 92000 ha; Remnant 2019 55000 ha	9e	None	Low
non-remnant	None	None	None	None
water	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
7.11.1a	Habitat for threatened plant species of 7.11.1a include: Archidendron kanisii, Archidendropsis xanthoxylon, Asplenium wildii, Austromuellera trinervia, Beilschmiedia castrisinensis, Cyclophyllum costatum, Dioclea hexandra, Endiandra grayi, Endiandra microneura, Euodia hylandii, Euodia pubifolia, Freycinetia marginata, Gardenia actinocarpa, Phlegmariurus spp., Lepiderema hirsuta, Megahertzia amplexicaulis, Microsorium membranifolium, Mitrantia bilocularis, Neostrearia fleckeri, Noahdendron nicholasii, Peripentadenia phelpsi, Samadera baileyana, Randia audasii, Ryparosa kurrangii, Sankowskyia stipularis, Symplocos crassiramifera, Vrydagzynea grayi, Whyanbeelia terrae-reginae and Xanthophyllum fragrans. Also there are many locally restricted regional endemics and unusual species such as: Austrocallerya australis, Coelospermum dasylobum, Cupaniopsis diploglottoides, Mischarytera megaphylla, Storckia australiensis, Tainia trinervis and Idiospermum australiense. Other species of local significance are Argirodendron sp. (Whyanbeel B.P.Hyland RFK1106), Monoon patinatum and Rhodomyrtus effusa.
7.11.44	Potential habitat for NCA listed species: Randia audasii
7.11.51a	Potential habitat for NCA listed species: Grevillea glossadenia, Coleus gratus

Regional Ecosystem	Special Values
7.12.16a	Habitat of threatened plant species including: <i>Albizia</i> sp. (Windsor Tableland B.Gray 2181), <i>Argophyllum cryptophlebium</i>, <i>Ctenopteris walleri</i>, <i>Eidothea zoexylocarya</i>, <i>Elaeocarpus thelmae</i>, <i>Endiandra jonesii</i>, <i>Endiandra phaeocarpa</i>, <i>Helicia grayi</i>, <i>Helicia lewisensis</i>, <i>Phlegmariurus</i> spp., <i>Diteilis simmondsii</i>, <i>Litsea granitica</i>, <i>Phaleria biflora</i>, <i>Stenocarpus davallioides</i>, , <i>Symplocos granitica</i> and <i>Xylosma</i> sp. (Mt Lewis G.Sankowsky+ 1108). Habitat for near threatened plant species <i>Aceratium ferrugineum</i>, <i>Aglaia brassii</i>, <i>Austrobuxus megacarpus</i>, <i>Bubbia queenslandiana</i> subsp. <i>queenslandiana</i>, <i>Glochidion pungens</i>, <i>Goodyera viridiflora</i>, <i>Diospyros granitica</i>, <i>Polyalthia submontana</i> subsp. <i>submontana</i>, <i>Helicia recurva</i>, <i>Medicosma glandulosa</i>, <i>Pectinopitys ladei</i>, <i>Pteridoblechnum acuminatum</i>, <i>Sarcopteryx montana</i>, <i>Symplocos ampulliformis</i> and <i>Wendlandia connata</i>. Habitat of many endemic species of fauna and flora. Other species of local significance include <i>Diospyros hemicycloides</i>, <i>Elaeocarpus johnsonii</i>, <i>Solanum dimorphispinum</i> and <i>Steganthra cooperorum</i>.
7.12.16b	Habitat of threatened plant species including: <i>Albizia</i> sp. (Windsor Tableland B.Gray 2181), <i>Argophyllum cryptophlebium</i>, <i>Ctenopteris walleri</i>, <i>Eidothea zoexylocarya</i>, <i>Elaeocarpus thelmae</i>, <i>Endiandra jonesii</i>, <i>Endiandra phaeocarpa</i>, <i>Helicia grayi</i>, <i>Helicia lewisensis</i>, <i>Phlegmariurus</i> spp., <i>Diteilis simmondsii</i>, <i>Litsea granitica</i>, <i>Phaleria biflora</i>, <i>Stenocarpus davallioides</i>, , <i>Symplocos granitica</i> and <i>Xylosma</i> sp. (Mt Lewis G.Sankowsky+ 1108). Habitat for near threatened plant species <i>Aceratium ferrugineum</i>, <i>Aglaia brassii</i>, <i>Austrobuxus megacarpus</i>, <i>Bubbia queenslandiana</i> subsp. <i>queenslandiana</i>, <i>Glochidion pungens</i>, <i>Goodyera viridiflora</i>, <i>Diospyros granitica</i>, <i>Polyalthia submontana</i> subsp. <i>submontana</i>, <i>Helicia recurva</i>, <i>Medicosma glandulosa</i>, <i>Pectinopitys ladei</i>, <i>Pteridoblechnum acuminatum</i>, <i>Sarcopteryx montana</i>, <i>Symplocos ampulliformis</i> and <i>Wendlandia connata</i>. Habitat of many endemic species of fauna and flora. Other species of local significance include <i>Diospyros hemicycloides</i>, <i>Elaeocarpus johnsonii</i>, <i>Solanum dimorphispinum</i> and <i>Steganthra cooperorum</i>.
7.12.16c	Habitat of threatened plant species including: <i>Albizia</i> sp. (Windsor Tableland B.Gray 2181), <i>Argophyllum cryptophlebium</i>, <i>Ctenopteris walleri</i>, <i>Eidothea zoexylocarya</i>, <i>Elaeocarpus thelmae</i>, <i>Endiandra jonesii</i>, <i>Endiandra phaeocarpa</i>, <i>Helicia grayi</i>, <i>Helicia lewisensis</i>, <i>Phlegmariurus</i> spp., <i>Diteilis simmondsii</i>, <i>Litsea granitica</i>, <i>Phaleria biflora</i>, <i>Stenocarpus davallioides</i>, , <i>Symplocos granitica</i> and <i>Xylosma</i> sp. (Mt Lewis G.Sankowsky+ 1108). Habitat for near threatened plant species <i>Aceratium ferrugineum</i>, <i>Aglaia brassii</i>, <i>Austrobuxus megacarpus</i>, <i>Bubbia queenslandiana</i> subsp. <i>queenslandiana</i>, <i>Glochidion pungens</i>, <i>Goodyera viridiflora</i>, <i>Diospyros granitica</i>, <i>Polyalthia submontana</i> subsp. <i>submontana</i>, <i>Helicia recurva</i>, <i>Medicosma glandulosa</i>, <i>Pectinopitys ladei</i>, <i>Pteridoblechnum acuminatum</i>, <i>Sarcopteryx montana</i>, <i>Symplocos ampulliformis</i> and <i>Wendlandia connata</i>. Habitat of many endemic species of fauna and flora. Other species of local significance include <i>Diospyros hemicycloides</i>, <i>Elaeocarpus johnsonii</i>, <i>Solanum dimorphispinum</i> and <i>Steganthra cooperorum</i>.

Regional Ecosystem	Special Values
7.12.19a	Threatened species include: <i>Acrotriche baileyana</i> , <i>Aglaia brassii</i> , <i>Albizia</i> sp. (Windsor Tableland B.Gray 2181), <i>Austromuellera valida</i> , <i>Bubbia whiteana</i> , <i>Ceratopetalum corymbosum</i> , <i>Ctenopteris walleri</i> , <i>Eidothea zoexylocarya</i> , <i>Endiandra jonesii</i> , <i>Flindersia oppositifolia</i> , <i>Grammitis alboetosa</i> , <i>Helicia grayi</i> , <i>Helicia lewisensis</i> , <i>Phlegmariurus</i> spp., <i>Leionema ellipticum</i> , <i>Litsea granitica</i> , <i>Phaleria biflora</i> , <i>Stenocarpus davallioides</i> , <i>Symplocos granitcola</i> , and <i>Wendlandia connata</i> . Habitat for near threatened plant species <i>Austobuxus megacarpus</i> , <i>Bubbia queenslandiana</i> subsp. <i>queenslandiana</i> , <i>Chiloglottis longiclavata</i> , <i>Diospyros granitica</i> , <i>Glochidion pungens</i> , <i>Goodyera viridiflora</i> , <i>Helicia recurva</i> , <i>Medicosma glandulosa</i> , <i>Pectinopitys ladei</i> , <i>Sarcopteryx montana</i> , <i>Symplocos ampulliformis</i> and <i>Symplocos oresbia</i> . Habitat of many endemic species of fauna and flora. Other species of local significance include <i>Diospyros hemicycloides</i> , <i>Elaeocarpus johnsonii</i> and <i>Steghanthera cooperorum</i> .
7.12.1a	Habitat for threatened plant species including: <i>Actephila foetida</i> , <i>Arytera dictyoneura</i> , <i>Citrus inodora</i> , <i>Cladopus queenslandicus</i> , <i>Cheilocostus potierae</i> , <i>Croton densivestitus</i> , <i>Dansiea elliptica</i> , <i>Diploglottis pedleyi</i> , <i>Drosera adelae</i> , <i>Endiandra anthropophagorum</i> , <i>Phlegmariurus</i> spp., <i>Lepiderema largiflorens</i> , <i>Neostrearia fleckeri</i> and <i>Piper mestonii</i> . Habitat for many plant species endemic to the bioregion. The vegetation community 7.12.1c (G166) harbours many regionally endemic species such as <i>Choriceras majus</i> , <i>Beilschmiedia castrisinensis</i> , <i>Mesua larnachiana</i> , <i>Dissiliaria tuckeri</i> and <i>Buckinghamia ferruginiflora</i> . Endemicity levels and species number decline south of the Tully River. The unusual grass <i>Lophatherum gracile</i> occurs along creeks particularly in the Tully area. It is the only known habitat of <i>Passiflora aurantioides</i> which in Australia is confined to the Babinda-Bellenden Ker area.
7.12.1b	Habitat for threatened plant species including: <i>Actephila foetida</i> , <i>Arytera dictyoneura</i> , <i>Citrus inodora</i> , <i>Cladopus queenslandicus</i> , <i>Cheilocostus potierae</i> , <i>Croton densivestitus</i> , <i>Dansiea elliptica</i> , <i>Diploglottis pedleyi</i> , <i>Drosera adelae</i> , <i>Endiandra anthropophagorum</i> , <i>Phlegmariurus</i> spp., <i>Lepiderema largiflorens</i> , <i>Neostrearia fleckeri</i> and <i>Piper mestonii</i> . Habitat for many plant species endemic to the bioregion. The vegetation community 7.12.1c (G166) harbours many regionally endemic species such as <i>Choriceras majus</i> , <i>Beilschmiedia castrisinensis</i> , <i>Mesua larnachiana</i> , <i>Dissiliaria tuckeri</i> and <i>Buckinghamia ferruginiflora</i> . Endemicity levels and species number decline south of the Tully River. The unusual grass <i>Lophatherum gracile</i> occurs along creeks particularly in the Tully area. It is the only known habitat of <i>Passiflora aurantioides</i> which in Australia is confined to the Babinda-Bellenden Ker area.
7.12.21a	Habitat for arboreal mammals. Habitat for plant species of limited distribution including <i>Bertya polystigma</i> , <i>Pityrodia salviifolia</i> , <i>Pomaderris argyrophylla</i> , <i>Dodonaea uncinata</i> , <i>Phebalium longifolium</i> and <i>Persoonia tropica</i> .
7.12.21b	Habitat for arboreal mammals. Habitat for plant species of limited distribution including <i>Bertya polystigma</i> , <i>Pityrodia salviifolia</i> , <i>Pomaderris argyrophylla</i> , <i>Dodonaea uncinata</i> , <i>Phebalium longifolium</i> and <i>Persoonia tropica</i> .
7.12.22a	Important arboreal mammal habitat for species including the yellow-bellied glider (<i>Petaurus australis</i>). Habitat for the tropical bettong (<i>Bettongia tropica</i>). Habitat for plant species with restricted distribution including <i>Bertya polystigma</i> , <i>Pityrodia salviifolia</i> , <i>Pomaderris argyrophylla</i> , <i>Dodonaea uncinata</i> , <i>Phebalium longifolium</i> , and <i>Persoonia tropica</i> .

Regional Ecosystem	Special Values
7.12.22b	Important arboreal mammal habitat for species including the yellow-bellied glider (<i>Petaurus australis</i>). Habitat for the tropical bettong (<i>Bettongia tropica</i>). Habitat for plant species with restricted distribution including <i>Bertya polystigma</i> , <i>Pityrodia salviifolia</i> , <i>Pomaderris argyrophylla</i> , <i>Dodonaea uncinata</i> , <i>Phebalium longifolium</i> , and <i>Persoonia tropica</i> .
7.12.24a	Potential habitat for NCA listed species: <i>Arytera dictyoneura</i> , <i>Corymbia leptoloma</i> , <i>Marsdenia rara</i> , <i>Coleus gratus</i>
7.12.30a	Potential habitat for NCA listed species: <i>Acacia longipedunculata</i> , <i>Acacia purpureopetala</i> , <i>Acacia tingoorensis</i> , <i>Corymbia rhodops</i> , <i>Diuris oporina</i> , <i>Dodonaea uncinata</i> , <i>Grevillea glossadenia</i> , <i>Homoranthus porteri</i> , <i>Melaleuca sylvana</i> , <i>Micromyrtus delicata</i> , <i>Coleus amoenus</i> , <i>Prostanthera clotteniana</i> , <i>Triplarina nitchaga</i> , <i>Zieria obovata</i> 7.12.30d: Habitat for several locally restricted and disjunct species. Threatened plant species include <i>Micromyrtus delicata</i> , <i>Melaleuca sylvana</i> , <i>Diuris oporina</i> , <i>Homoranthus porteri</i> , <i>Grevillea glossadenia</i> , <i>Acacia purpureopetala</i> , <i>Corymbia rhodops</i> and <i>Prostanthera clotteniana</i> . Other species of local significance are <i>Eucalyptus lockyeri</i> .
7.12.30b	Potential habitat for NCA listed species: <i>Acacia longipedunculata</i> , <i>Acacia purpureopetala</i> , <i>Acacia tingoorensis</i> , <i>Corymbia rhodops</i> , <i>Diuris oporina</i> , <i>Dodonaea uncinata</i> , <i>Grevillea glossadenia</i> , <i>Homoranthus porteri</i> , <i>Melaleuca sylvana</i> , <i>Micromyrtus delicata</i> , <i>Coleus amoenus</i> , <i>Prostanthera clotteniana</i> , <i>Triplarina nitchaga</i> , <i>Zieria obovata</i> 7.12.30d: Habitat for several locally restricted and disjunct species. Threatened plant species include <i>Micromyrtus delicata</i> , <i>Melaleuca sylvana</i> , <i>Diuris oporina</i> , <i>Homoranthus porteri</i> , <i>Grevillea glossadenia</i> , <i>Acacia purpureopetala</i> , <i>Corymbia rhodops</i> and <i>Prostanthera clotteniana</i> . Other species of local significance are <i>Eucalyptus lockyeri</i> .
7.12.34	Potential habitat for NCA listed species: <i>Acacia longipedunculata</i> , <i>Calochlaena villosa</i> , <i>Croton densivestitus</i> , <i>Grevillea glossadenia</i> , <i>Homoranthus porteri</i> , <i>Coleus amoenus</i> , <i>Solanum angustum</i> , <i>Zieria obovata</i>
7.12.37i	Potential habitat for NCA listed species: <i>Austrobuxus megacarpus</i> , <i>Coleus gratus</i> , <i>Polyalthia submontana</i> subsp. <i>submontana</i> , <i>Prostanthera albobirta</i> , <i>Prostanthera clotteniana</i> , <i>Vincetoxicum rupicola</i>
7.12.48	Potential habitat for NCA listed species: <i>Argophyllum cryptophlebium</i> , <i>Helicia grayi</i> , <i>Lepiderema hirsuta</i> , <i>Symplocos ampulliformis</i>
7.12.57	Threatened species include <i>Diuris oporina</i> (NT), <i>Homoranthus porteri</i> (V), <i>Melaleuca uxorum</i> (E) and <i>Prostanthera clotteniana</i> (E). Other species of local significance are <i>Eucalyptus lockyeri</i> . 7.12.57a: Threatened species include <i>Corymbia leptoloma</i> (V), <i>Homoranthus porteri</i> (V), <i>Marsdenia brevifolia</i> (V), <i>Acacia longipedunculata</i> (NT), <i>Dodonaea uncinata</i> and <i>Diuris oporina</i> (NT). Other species of local significance are <i>Eucalyptus lockyeri</i> . 7.12.57c: Habitat for several locally restricted and disjunct species. Threatened species include <i>Micromyrtus delicata</i> (E), <i>Melaleuca sylvana</i> (E), <i>Melaleuca uxorum</i> (E), <i>Diuris oporina</i> (NT), <i>Homoranthus porteri</i> (V), <i>Grevillea glossadenia</i> (V), <i>Acacia purpureopetala</i> (V), <i>Corymbia rhodops</i> (V) and <i>Prostanthera clotteniana</i> (E). Other species of local significance are <i>Eucalyptus lockyeri</i> .

Regional Ecosystem	Special Values
7.12.57a	Threatened species include <i>Diuris oporina</i> (NT), <i>Homoranthus porteri</i> (V), <i>Melaleuca uxor</i> (E) and <i>Prostanthera clotteniana</i> (E). Other species of local significance are <i>Eucalyptus lockyeri</i> . 7.12.57a: Threatened species include <i>Corymbia leptoloma</i> (V), <i>Homoranthus porteri</i> (V), <i>Marsdenia brevifolia</i> (V), <i>Acacia longipedunculata</i> (NT), <i>Dodonaea uncinata</i> and <i>Diuris oporina</i> (NT). Other species of local significance are <i>Eucalyptus lockyeri</i> . 7.12.57c: Habitat for several locally restricted and disjunct species. Threatened species include <i>Micromyrtus delicata</i> (E), <i>Melaleuca sylvana</i> (E), <i>Melaleuca uxor</i> (E), <i>Diuris oporina</i> (NT), <i>Homoranthus porteri</i> (V), <i>Grevillea glossadenia</i> (V), <i>Acacia purpureopetala</i> (V), <i>Corymbia rhodops</i> (V) and <i>Prostanthera clotteniana</i> (E). Other species of local significance are <i>Eucalyptus lockyeri</i> .
7.12.58	Potential habitat for NCA listed species: <i>Homoranthus porteri</i>
7.12.5c	Potential habitat for NCA listed species: <i>Acianthus subleustus</i> , <i>Marsdenia rara</i>
7.12.61a	Potential habitat for NCA listed species: <i>Arthraxon hispidus</i> , <i>Cucumis costatus</i> , <i>Dendrobium bigibbum</i> , <i>Dendrobium johannis</i> , <i>Dodonaea uncinata</i> , <i>Coleus gratus</i>
7.12.62c	None
7.12.65e	Potential habitat for NCA listed species: <i>Acacia purpureopetala</i> , <i>Buckinghamia ferruginiflora</i> , <i>Corymbia leptoloma</i> , <i>Corymbia rhodops</i> , <i>Diuris oporina</i> , <i>Dodonaea uncinata</i> , <i>Grevillea glossadenia</i> , <i>Homoranthus porteri</i> , <i>Melaleuca sylvana</i> , <i>Melaleuca uxor</i> , <i>Micromyrtus delicata</i> , <i>Coleus amoenus</i> , <i>Prostanthera clotteniana</i> , <i>Pterostylis caligna</i> , <i>Zieria obovata</i> 7.12.65k: Habitat for several locally restricted and disjunct species. Threatened species include <i>Micromyrtus delicata</i> , <i>Melaleuca sylvana</i> , <i>Melaleuca uxor</i> , <i>Diuris oporina</i> , <i>Homoranthus porteri</i> , <i>Grevillea glossadenia</i> , <i>Acacia purpureopetala</i> , <i>Corymbia rhodops</i> and <i>Prostanthera clotteniana</i> . Other species of local significance are <i>Eucalyptus lockyeri</i> .
7.12.65f	Potential habitat for NCA listed species: <i>Acacia purpureopetala</i> , <i>Buckinghamia ferruginiflora</i> , <i>Corymbia leptoloma</i> , <i>Corymbia rhodops</i> , <i>Diuris oporina</i> , <i>Dodonaea uncinata</i> , <i>Grevillea glossadenia</i> , <i>Homoranthus porteri</i> , <i>Melaleuca sylvana</i> , <i>Melaleuca uxor</i> , <i>Micromyrtus delicata</i> , <i>Coleus amoenus</i> , <i>Prostanthera clotteniana</i> , <i>Pterostylis caligna</i> , <i>Zieria obovata</i> 7.12.65k: Habitat for several locally restricted and disjunct species. Threatened species include <i>Micromyrtus delicata</i> , <i>Melaleuca sylvana</i> , <i>Melaleuca uxor</i> , <i>Diuris oporina</i> , <i>Homoranthus porteri</i> , <i>Grevillea glossadenia</i> , <i>Acacia purpureopetala</i> , <i>Corymbia rhodops</i> and <i>Prostanthera clotteniana</i> . Other species of local significance are <i>Eucalyptus lockyeri</i> .
7.12.65k	Potential habitat for NCA listed species: <i>Acacia purpureopetala</i> , <i>Buckinghamia ferruginiflora</i> , <i>Corymbia leptoloma</i> , <i>Corymbia rhodops</i> , <i>Diuris oporina</i> , <i>Dodonaea uncinata</i> , <i>Grevillea glossadenia</i> , <i>Homoranthus porteri</i> , <i>Melaleuca sylvana</i> , <i>Melaleuca uxor</i> , <i>Micromyrtus delicata</i> , <i>Coleus amoenus</i> , <i>Prostanthera clotteniana</i> , <i>Pterostylis caligna</i> , <i>Zieria obovata</i> 7.12.65k: Habitat for several locally restricted and disjunct species. Threatened species include <i>Micromyrtus delicata</i> , <i>Melaleuca sylvana</i> , <i>Melaleuca uxor</i> , <i>Diuris oporina</i> , <i>Homoranthus porteri</i> , <i>Grevillea glossadenia</i> , <i>Acacia purpureopetala</i> , <i>Corymbia rhodops</i> and <i>Prostanthera clotteniana</i> . Other species of local significance are <i>Eucalyptus lockyeri</i> .
7.12.66a	None
7.12.66b	None
7.12.69b	Potential habitat for NCA listed species: <i>Dendrobium bigibbum</i>

Regional Ecosystem	Special Values
7.12.7a	Habitat for threatened plant species including: <i>Alectryon semicinerus</i> , <i>Alpinia hylandii</i> , <i>Elaeocarpus coorangooloo</i> , <i>Arytera dictyoneura</i> . <i>Rhodamnia longisepala</i> is endemic and confined to this RE on the Windsor Tableland.
7.12.9	None
7.3.14a	None
7.3.28d	An important component of stream ecology and structure influencing substrate types, depth gradients, flow characteristics and flooding characteristics.
7.3.49a	Potential habitat for NCA listed species: <i>Buckinghamia ferruginiflora</i> , <i>Gymnostoma australium</i> , <i>Hollandaea riparia</i> , <i>Sphaerantia chartacea</i>
9.11.25	Potential habitat for NCA listed species: <i>Acacia guyeri</i> , <i>Acacia purpureopetala</i> , <i>Cucumis costatus</i>
9.11.26a	None
9.11.3a	Potential habitat for NCA listed species: <i>Acacia guyeri</i> , <i>Acacia purpureopetala</i> , <i>Cucumis costatus</i> , <i>Dianella incollata</i> , <i>Ehretia microphylla</i> , <i>Euphorbia carissoides</i> , <i>Macropteranthus montana</i> , <i>Panicum chillagoanum</i> , <i>Stenanthemum argenteum</i>
9.11.3b	Potential habitat for NCA listed species: <i>Acacia guyeri</i> , <i>Acacia purpureopetala</i> , <i>Cucumis costatus</i> , <i>Dianella incollata</i> , <i>Ehretia microphylla</i> , <i>Euphorbia carissoides</i> , <i>Macropteranthus montana</i> , <i>Panicum chillagoanum</i> , <i>Stenanthemum argenteum</i>
9.11.3d	Potential habitat for NCA listed species: <i>Acacia guyeri</i> , <i>Acacia purpureopetala</i> , <i>Cucumis costatus</i> , <i>Dianella incollata</i> , <i>Ehretia microphylla</i> , <i>Euphorbia carissoides</i> , <i>Macropteranthus montana</i> , <i>Panicum chillagoanum</i> , <i>Stenanthemum argenteum</i>
9.11.7a	None
9.11.7b	None
9.12.17	Potential habitat for NCA listed species: <i>Goodenia stirlingii</i> , <i>Coleus amoenus</i>
9.12.2	Old growth of this ecosystem is significant for a number of species including arboreal mammals. Habitat for vulnerable flora species including <i>Corymbia rhodops</i>
9.12.31a	Potential habitat for NCA listed species: <i>Peristylus banfieldii</i> , <i>Spathoglottis paulinae</i>
9.12.43a	None
9.12.43b	None
9.12.7a	Habitat for near threatened and threatened flora species. 9.12.7a: Potential habitat for the vulnerable plant species <i>Cycas platyphylla</i> .
9.12.7c	Habitat for near threatened and threatened flora species. 9.12.7a: Potential habitat for the vulnerable plant species <i>Cycas platyphylla</i> .
9.12.8a	Potential habitat for NCA listed species: <i>Dubouzetia saxatilis</i> , <i>Graptophyllum excelsum</i> , <i>Ipomoea saintroanensis</i> , <i>Panicum chillagoanum</i>
9.3.12a	Significant habitat as drought refuge, wildlife corridors and for arboreal animals.
9.3.12b	Significant habitat as drought refuge, wildlife corridors and for arboreal animals.

Regional Ecosystem	Special Values
9.3.13	Significant habitat as drought refuge, wildlife corridors and for arboreal animals.
9.3.14a	Significant habitat as drought refuge, wildlife corridors and for arboreal animals.
9.3.16	Significant habitat as drought refuge, wildlife corridors and for arboreal animals.
9.3.2	Significant habitat particularly for herbivores such as macropods and arboreal mammals
9.3.3c	Significant habitat as drought refuge, wildlife corridors and for arboreal animals.
9.3.4	Seasonal and permanent fresh water habitats significant for water bird feeding, breeding and drought refuge
9.3.6a	Includes seasonal wetlands important for water bird feeding. 9.3.6a: Includes seasonal wetlands important for water bird feeding.
9.5.12	Potential habitat for NCA listed species: <i>Habenaria rumphii</i>
9.5.13a	Habitat for the vulnerable plant species <i>Macropteranthes montana</i> .
9.5.15a	None
9.5.9b	Potential habitat for NCA listed species: <i>Habenaria rumphii</i>
9.5.9c	Potential habitat for NCA listed species: <i>Habenaria rumphii</i>
non-remnant	None
water	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

<https://publications.qld.gov.au/dataset/redd/resource/>

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	1,273.99	2.17
10b	Moist open forests to woodlands dominated by <i>Corymbia citriodora</i> (spotted gum). (land zones 12, 11, 9, 5, 8) (SEQ, CQC, EIU, WET)	1,444.27	2.46
13a	Woodlands and open woodlands dominated by ironbarks such <i>Eucalyptus cullenii</i> (Cullen's ironbark), <i>E. staigeriana</i> (lemon-scented ironbark) or <i>E. melanophloia</i> (silver-leaved ironbark) and bloodwoods such as <i>Corymbia stockeri</i> subsp. <i>peninsularis</i> , <i>C. clarksoniana</i> (grey bloodwood) or <i>C. leichhardtii</i> (rustyjack). (land zones 11, 12, 7, 5) (EIU, CYP, GUP)	22,745.70	38.7

BVG (1 Million)	Description	Area (Ha)	% of AOI
13c	Woodlands of <i>Eucalyptus crebra</i> (sens. lat.) (narrow-leaved red ironbark), <i>E. drepanophylla</i> (grey ironbark), <i>E. fibrosa</i> (dusky-leaved ironbark), <i>E. shirleyi</i> (shirley's silver-leaved ironbark) on granitic and metamorphic ranges (land zones 12, 11, 9, [5]) (BRB, EIU, SEQ, NET, CQC)	602.86	1.03
16b	Woodlands dominated by <i>Eucalyptus leptophleba</i> (Molloy red box), with <i>Corymbia tessellaris</i> (carbeen) or <i>C. clarksoniana</i> (grey bloodwood) or <i>C. dallachiana</i> . On sandy levees. (land zones 3, 5) (GUP, EIU, CYP)	9,248.66	15.73
16c	Woodlands and open woodlands dominated by <i>Eucalyptus coolabah</i> (coolabah) or <i>E. microtheca</i> (coolabah) or <i>E. largiflorens</i> (black box) or <i>E. tereticornis</i> (blue gum) or <i>E. chlorophylla</i> on floodplains. Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded. (land zone 3) (All bioregions except WET, principally GUP, BRB, MUL).	239.27	0.41
16d	River beds, open water or sand, or rock, frequently unvegetated. (land zone 3) (GUP, EIU, BRB, CYP, DEU, [CQC, MUL])	83.97	0.14
18c	Woodlands and open woodlands dominated by <i>Eucalyptus chlorophylla</i> (<i>E. microtheca</i> or <i>E. leptophleba</i> on heavy soils) frequently with <i>Corymbia</i> spp. (land zones 9, 5, 3, 12, [4]) (CYP, GUP, EIU, MGD, [NWH])	7,606.72	12.94
19d	Low open woodlands dominated by <i>Eucalyptus persistens</i> (or <i>E. normantonensis</i> (Normanton box), <i>E. tardecidens</i> , <i>E. protracta</i>) with <i>Triodia</i> spp. dominated ground layer, mainly on hills and ranges. (land zones 7, 11, 12, 5, [4, 10]) (EIU, MGD, CHC, BRB, GUP, DEU)	2,543.97	4.33
21a	Low woodlands and low open woodlands dominated by <i>Melaleuca viridiflora</i> (coarse-leaved paperbark) on depositional plains. (land zones 3, 5, 11, [10]) (GUP, CYP, BRB, CQC, EIU, WET, SEQ)	1,512.97	2.57
21b	Low open woodlands and tall shrublands of <i>Melaleuca citrolens</i> or <i>M. stenostachya</i> or other <i>Melaleuca</i> spp. (land zones 5, 3, 7, 10, 11, 12) (GUP, CYP, EIU, DEU, BRB, [SEQ])	1,148.93	1.95
22c	Open forests dominated by <i>Melaleuca</i> spp. (<i>M. argentea</i> (silver tea-tree), <i>M. leucadendra</i> (broad-leaved tea-tree), <i>M. dealbata</i> (swamp tea-tree) or <i>M. fluviatilis</i>), fringing major streams with <i>Melaleuca saligna</i> or <i>M. bracteata</i> (black tea-tree) in minor streams. (land zone 3) (CYP, GUP, EIU, BRB, CQC, DEU, NWH, WET, [SEQ])	1,359.40	2.31
28e	Low open forest to woodlands dominated by <i>Lophostemon suaveolens</i> (swamp box) (or <i>L. confertus</i> (brush box)) or <i>Syncarpia glomulifera</i> (turpentine) frequently with <i>Allocasuarina</i> spp. on rocky hill slopes. (land zones 12, 9, 3, 11, [10, 8]) (CQC, WET, SEQ, BRB, [CYP])	94.44	0.16
29b	Open shrublands to open heaths in montane frequently rocky locations. (land zones 7, 12, 11, 5, 8, 10) (BRB, NWH, WET, CYP, EIU, SEQ, DEU, [NET, CQC])	246.01	0.42
2a	Complex evergreen notophyll vine forest frequently with <i>Araucaria cunninghamii</i> (hoop pine) from foothills to ranges. (land zones 11, 12, 8) (WET, SEQ, CQC) (Tracey 1982 5a, 5b)	626.49	1.07
34d	Palustrine wetlands. Freshwater swamps/springs/billabongs on floodplains ranging from permanent and semi-permanent to ephemeral. (land zone 3) (GUP, EIU, BRB, CYP, CHC, [MGD])	130.98	0.22

BVG (1 Million)	Description	Area (Ha)	% of AOI
5c	Simple to complex notophyll vine forests, often with <i>Agathis</i> spp. on ranges and uplands of the Wet Tropics bioregion. (land zones 12, 11, 8, [3]) (WET) (Tracey 1982 6)	27.13	0.05
5d	<i>Acacia celsa</i> / <i>A. mangium</i> (brown salwood) / <i>A. polystachya</i> closed forests to open forests with mixed rainforest species understorey, includes areas regenerating after disturbance (upland and lowland areas). (land zones 12, 11, 3, 8) (CYP, WET)	75.44	0.13
6b	Simple evergreen notophyll vine forest to simple microphyll vine fern thicket on high peaks and plateaus of northern Queensland. (land zones 12, 11) (WET, CQC) (Tracey 1982 8, 9, 10)	2,074.99	3.53
7a	Semi-evergreen vine thickets on wide range of substrates. (land zones 8, 9, 11, 12, 5, 4, 3, 10, [7]) (BRB, EIU, SEQ, CQC, [WET, GUP]) (Tracey 1982 11)	0.08	less than 0.01
7b	Deciduous microphyll vine thicket on ranges and heavy clay alluvia in northern bioregions. (land zones 3, 12, 11, 10, 7) (CYP, WET)	13.6	0.02
8a	Wet tall open forest dominated by species such as <i>Eucalyptus grandis</i> (flooded gum) or <i>E. saligna</i> , <i>E. resinifera</i> (red mahogany), <i>Lophostemon confertus</i> (brush box), <i>Syncarpia glomulifera</i> (turpentine), <i>E. laevopinea</i> (silvertop stringybark). Contains a well developed understorey of rainforest components, including ferns and palms, or the understorey may be dominated by sclerophyll shrubs. (land zones 12, 8, 10, 11, 3, 5, 9) (SEQ, WET, BRB, CQC, [NET])	543.75	0.93
9b	Moist to dry woodlands dominated by <i>Eucalyptus platyphylla</i> (poplar gum) and/or <i>E. leptophleba</i> (Molloy red box). Other frequent tree species include <i>Corymbia clarksoniana</i> (grey bloodwood), <i>E. drepanophylla</i> (grey ironbark) and occasionally <i>E. chlorophylla</i> . (land zones 12, 11, 3, 10, 5). (CYP, CQC, BRB, WET, EIU)	119.93	0.2
9c	Open forests of <i>Corymbia clarksoniana</i> (grey bloodwood) (or <i>C. intermedia</i> (pink bloodwood) or <i>C. novoguineensis</i>), <i>C. tessellaris</i> (carbeen) +/- <i>Eucalyptus tereticornis</i> (blue gum) predominantly on coastal ranges. Other frequent tree species include <i>Eucalyptus drepanophylla</i> (grey ironbark), <i>E. pellita</i> (large-fruited red mahogany), <i>E. brassiana</i> (Cape York red gum) and <i>Lophostemon suaveolens</i> (swamp box). (land zones 12, 11, 8, 5). (WET, CQC, CYP, BRB)	271.51	0.46
9d	Moist to dry open forest to woodland dominated by <i>Eucalyptus portuensis</i> , <i>Corymbia intermedia</i> (pink bloodwood), <i>E. drepanophylla</i> , <i>E. resinifera</i> or <i>E. reducta</i> +/- <i>Syncarpia glomulifera</i> (turpentine) or <i>E. cloeziana</i> (Gympie messmate) on ranges. Also includes mixed forests with <i>Eucalyptus pellita</i> or <i>Corymbia torelliana</i> emergents and rainforest understories (land zones 12, 11, 3, 9, 5, 8). (CQC, WET, EIU)	1,530.08	2.6
9e	Open forests, woodlands and open woodlands dominated by <i>Corymbia clarksoniana</i> (grey bloodwood) (or <i>C. novoguineensis</i> or <i>C. intermedia</i> (pink bloodwood) or <i>C. polycarpa</i> (long-fruited bloodwood)) frequently with <i>Erythrophleum chlorostachys</i> (red ironwood) or <i>Eucalyptus platyphylla</i> (poplar gum) predominantly on coastal sandplains and alluvia. (land zones 3, 5, 2) (CYP, BRB, CQC, WET, EIU)	3,214.51	5.47

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/>

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2020 (PDF)* section 3.3 of:

<https://publications.qld.gov.au/dataset/redd/resource/>

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

<http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/>

Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

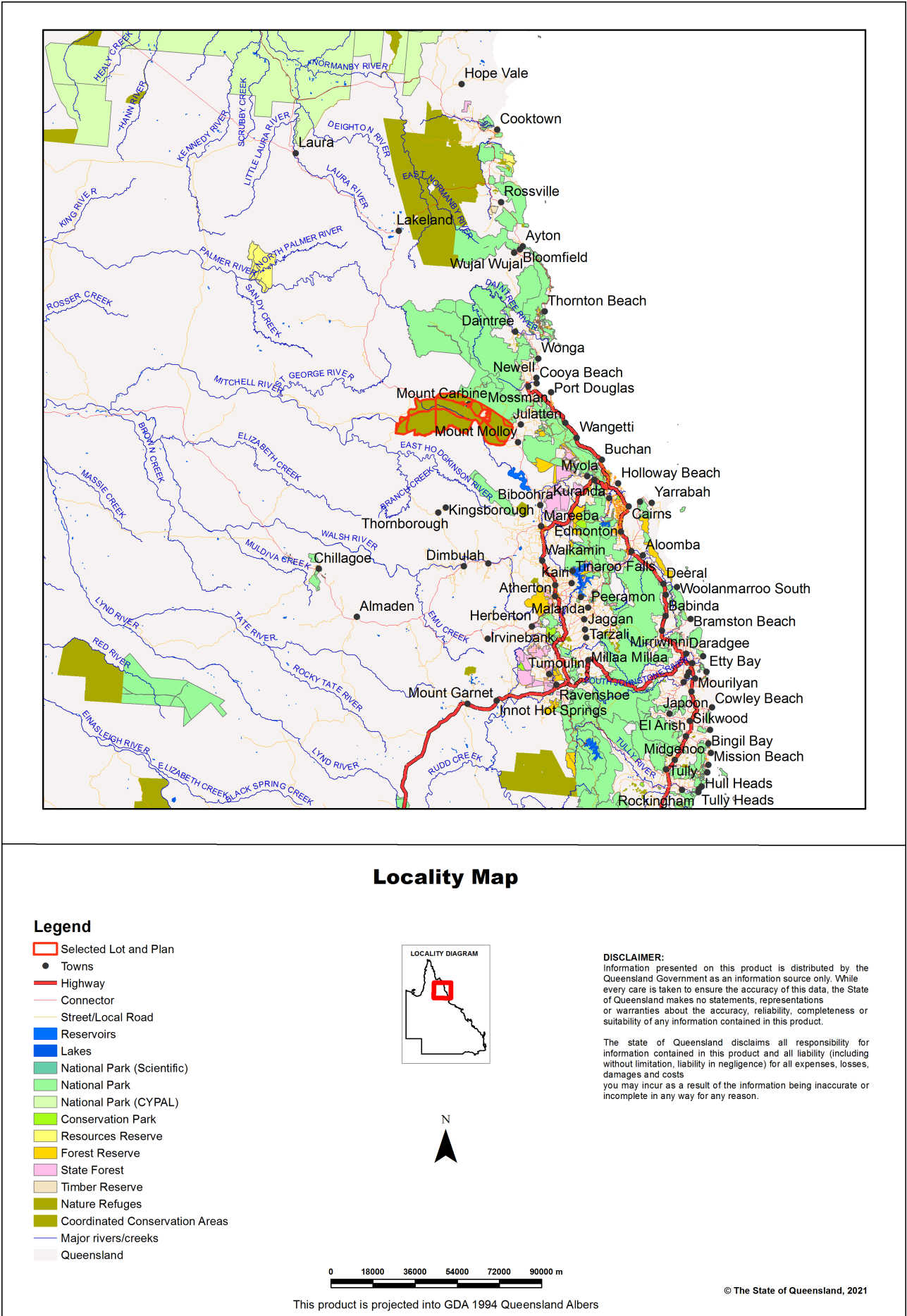
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
7.11.1a	Not currently available	Not currently available
7.11.44	Not currently available	Not currently available
7.11.51a	Not currently available	Not currently available
7.12.16a	Not currently available	Not currently available
7.12.16b	Not currently available	Not currently available
7.12.16c	Not currently available	Not currently available
7.12.19a	Not currently available	Not currently available
7.12.1a	Not currently available	Not currently available
7.12.1b	Not currently available	Not currently available
7.12.21a	Not currently available	Not currently available
7.12.21b	Not currently available	Not currently available
7.12.22a	Not currently available	Not currently available
7.12.22b	Not currently available	Not currently available
7.12.24a	Not currently available	Not currently available
7.12.30a	Not currently available	Not currently available
7.12.30b	Not currently available	Not currently available
7.12.34	Not currently available	Not currently available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
7.12.37i	Not currently available	Not currently available
7.12.48	Not currently available	Not currently available
7.12.57	Not currently available	Not currently available
7.12.57a	Not currently available	Not currently available
7.12.58	Not currently available	Not currently available
7.12.5c	Not currently available	Not currently available
7.12.61a	Not currently available	Not currently available
7.12.62c	Not currently available	Not currently available
7.12.65e	Not currently available	Not currently available
7.12.65f	Not currently available	Not currently available
7.12.65k	Not currently available	Not currently available
7.12.66a	Not currently available	Not currently available
7.12.66b	Not currently available	Not currently available
7.12.69b	Not currently available	Not currently available
7.12.7a	Not currently available	Not currently available
7.12.9	Not currently available	Not currently available
7.3.14a	Not currently available	Not currently available
7.3.28d	Not currently available	Not currently available
7.3.49a	Not currently available	Not currently available
9.11.25	Available	Available
9.11.26a	Available	Not currently available
9.11.3a	Available	Available
9.11.3b	Available	Not currently available
9.11.3d	Available	Not currently available
9.11.7a	Available	Not currently available
9.11.7b	Available	Not currently available
9.12.17	Available	Not currently available
9.12.2	Available	Not currently available
9.12.31a	Available	Not currently available
9.12.43a	Not currently available	Not currently available
9.12.43b	Not currently available	Not currently available
9.12.7a	Available	Not currently available
9.12.7c	Available	Not currently available
9.12.8a	Not currently available	Not currently available
9.3.12a	Available	Not currently available
9.3.12b	Not currently available	Not currently available
9.3.13	Available	Not currently available
9.3.14a	Available	Not currently available
9.3.16	Available	Not currently available
9.3.2	Available	Not currently available
9.3.3c	Available	Not currently available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
9.3.4	Available	Not currently available
9.3.6a	Available	Not currently available
9.5.12	Available	Not currently available
9.5.13a	Available	Not currently available
9.5.15a	Available	Not currently available
9.5.9b	Available	Not currently available
9.5.9c	Available	Not currently available
non-remnant	Not currently available	Not currently available
water	Not currently available	Not currently available

Maps

Map 1 - Location

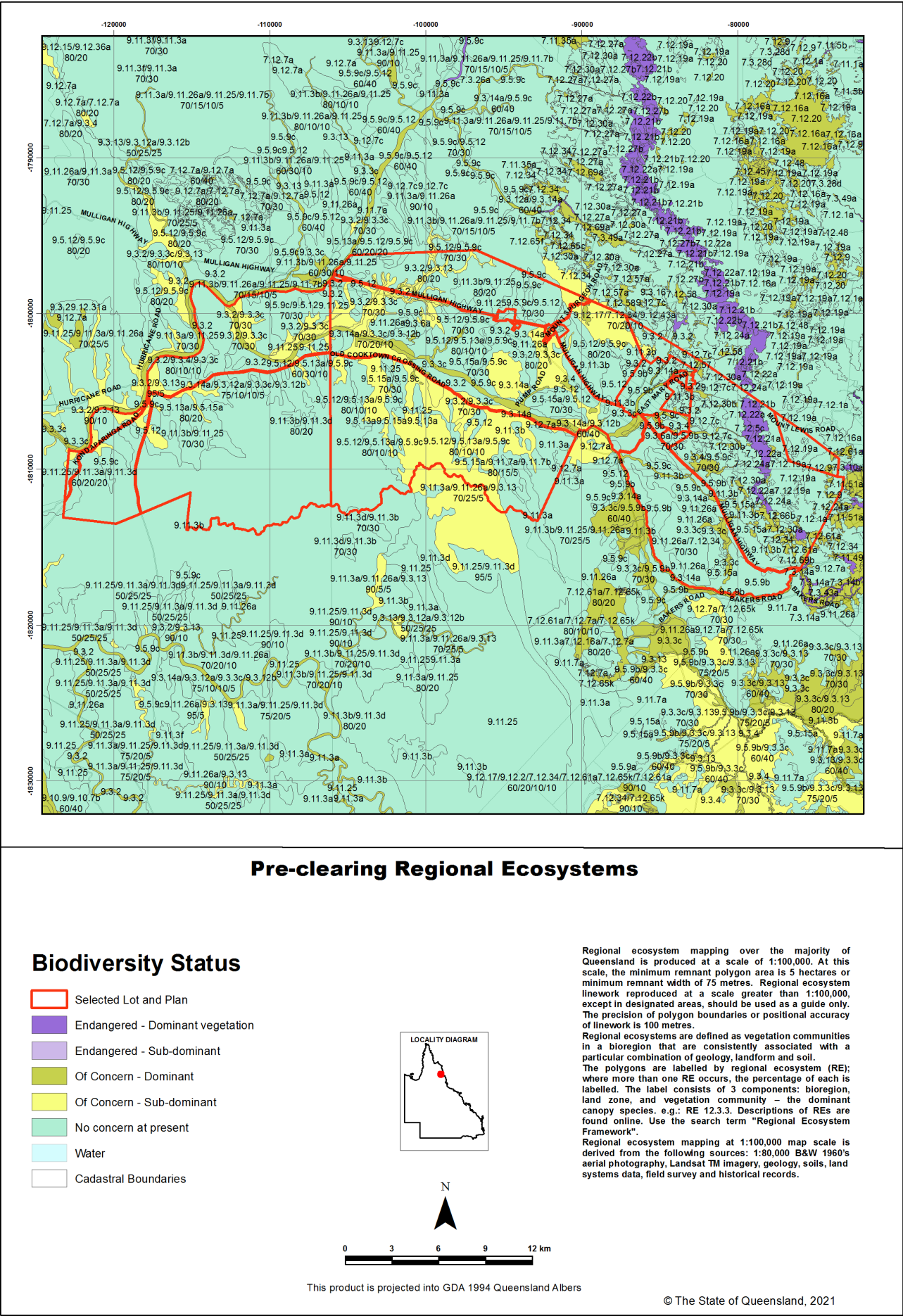


This topographic map displays the Gulf Coast region, characterized by a mix of low-lying coastal areas and higher inland terrain. Key features include:

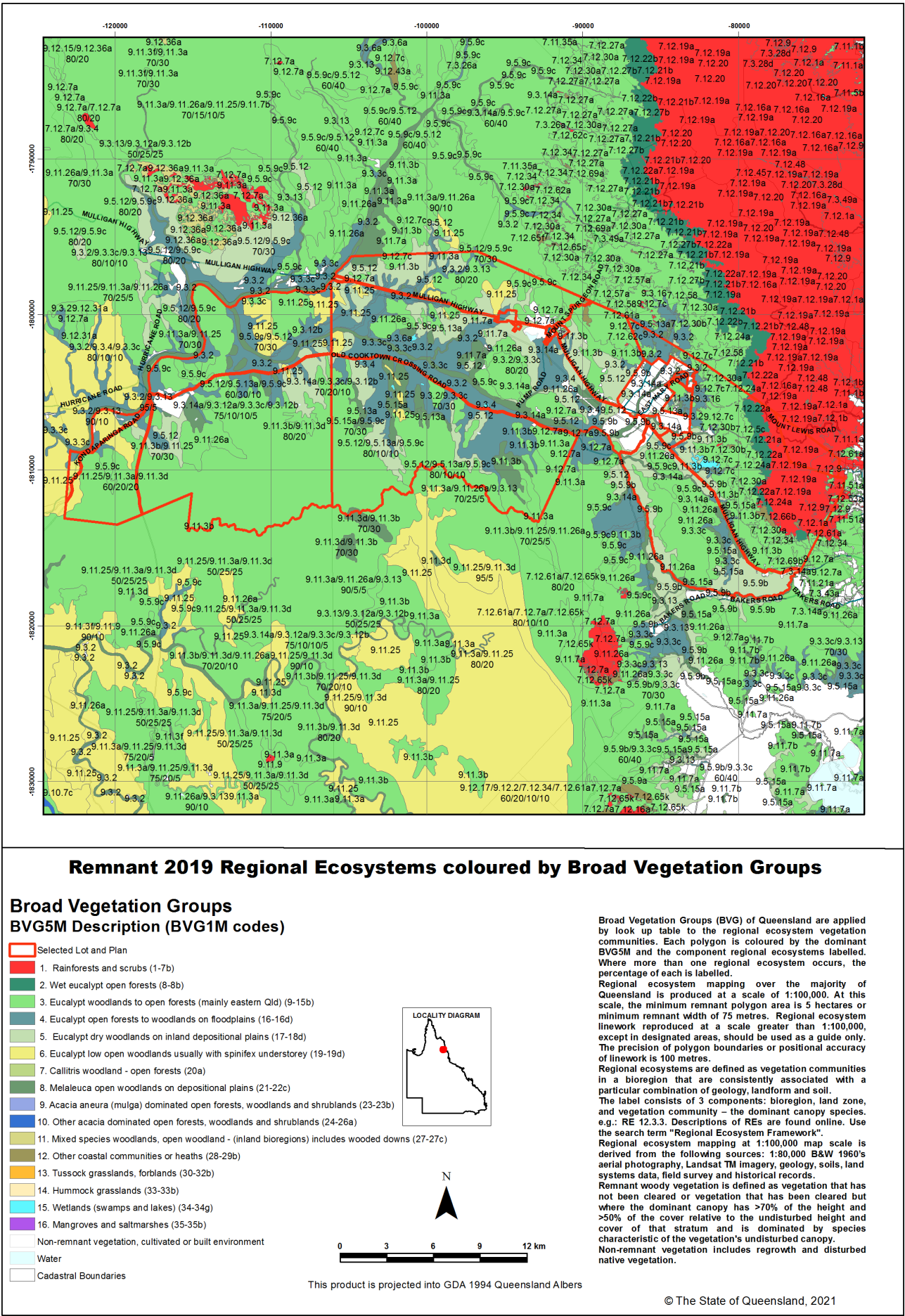
- Major Roads:** Labeled roads include Hurricane Road, Mulligan Highway, Cooktown Crossing Road, and Bakers Road.
- Elevation Contours:** The map shows various contour lines indicating different elevations across the landscape.
- Elevation Points:** Numerous numerical values are scattered across the map, representing specific elevation measurements at various locations.
- Geographic Labels:** Place names such as Mulligan Highway, Cooktown Crossing Road, and Bakers Road are clearly marked.

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Map 3 - Pre-clearing regional ecosystems



Map 4 - Remnant 2019 regional ecosystems by BVG (5M)



Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

Selected Lot and Plan

1. Rainforests and scrubs (1-7b)
2. Wet eucalypt open forests (8-8b)
3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
4. Eucalypt open forests to woodlands on floodplains (16-16d)
5. Eucalypt dry woodlands on inland depositional plains (17-18d)
6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
7. Callitris woodland - open forests (20a)
8. Melaleuca open woodlands on depositional plains (21-22c)
9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
12. Other coastal communities or heaths (28-29b)
13. Tussock grasslands, forblands (30-32b)
14. Hummock grasslands (33-33b)
15. Wetlands (swamps and lakes) (34-34g)
16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

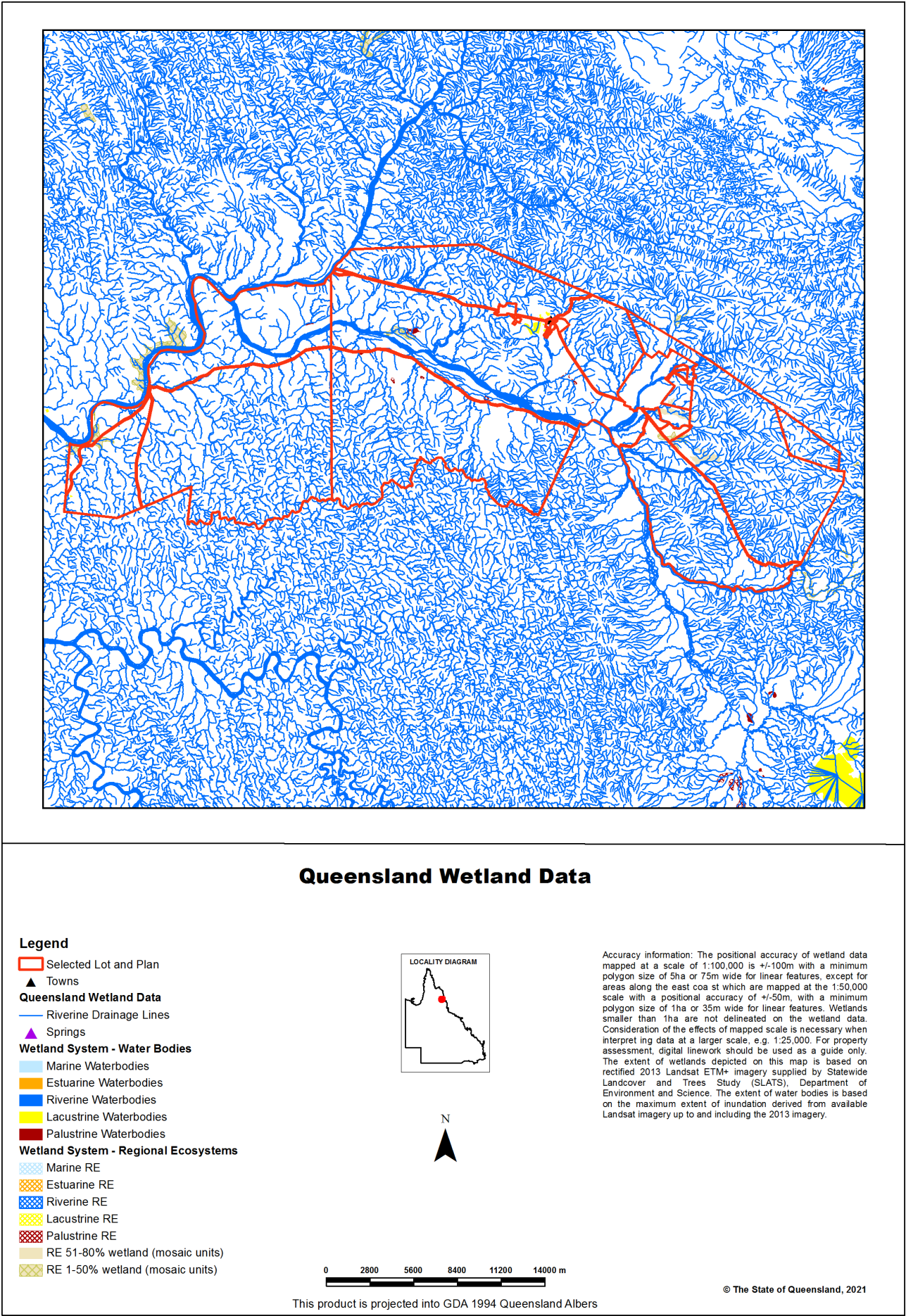
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community - the dominant canopy species. e.g.: RE 12.33. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

This product is projected into GDA 1994 Queensland Albers

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Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of Environment and Science's Website -

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

<https://publications.qld.gov.au/dataset/redd/resource/>

The methodology for mapping regional ecosystems can be downloaded from:

<https://publications.qld.gov.au/dataset/redd/resource/>

Technical descriptions for regional ecosystems can be obtained from:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/>

Benchmarks can be obtained from:

<http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/>

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

<http://dds.information.qld.gov.au/dds/>

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

<http://www.dnrm.qld.gov.au/mapping-data/queensland-globe>

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2019). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 4.0. Queensland Herbarium, Department of Environment and Science.

<https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086>

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F., Addicott, E.P. and Appelman, C.N. (2020). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

<https://publications.qld.gov.au/dataset/redd/resource/6dee78ab-c12c-4692-9842-b7257c2511e4>

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/>

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

<http://dds.information.qld.gov.au/dds/>

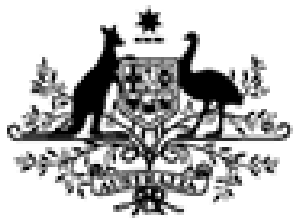
- Biodiversity status of pre-clearing and 2019 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- <i>Vegetation Management Act 1999</i>



APPENDIX F – EPBC ACT PROTECTED MATTERS REPORT



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

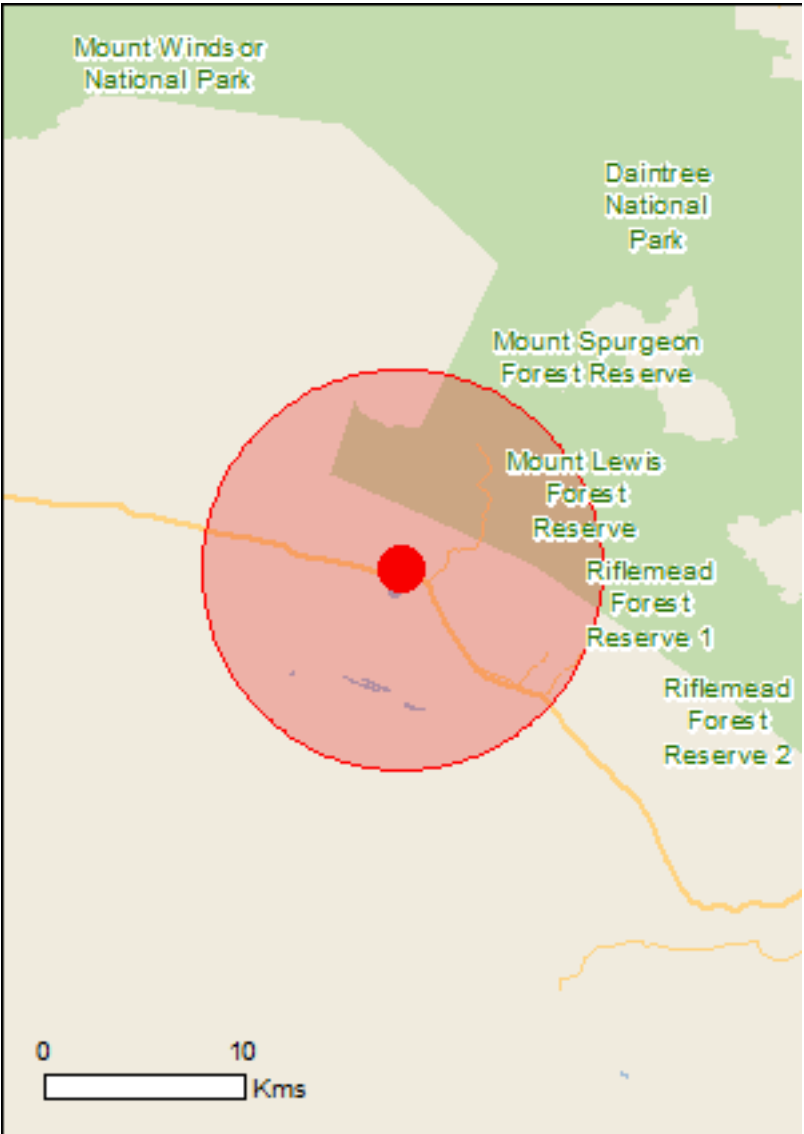
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 04/11/21 12:41:09

- [Summary](#)
- [Details](#)

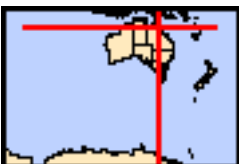
[Matters of NES](#)[Other Matters Protected by the EPBC Act](#)[Extra Information](#)
- [Caveat](#)
- [Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	1
National Heritage Places:	2
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	42
Listed Migratory Species:	20

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	26
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	26
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties		[Resource Information]
Name	State	Status
Wet Tropics of Queensland	QLD	Declared property
National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Wet Tropics of Queensland	QLD	Listed place
Indigenous		
Wet Tropics World Heritage Area (Indigenous Values)	QLD	Within listed place

Listed Threatened Ecological Communities	[Resource Information]
--	--------------------------

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Broad leaf tea-tree (Melaleuca viridiflora) woodlands in high rainfall coastal north Queensland	Endangered	Community may occur within area

Listed Threatened Species	[Resource Information]
---------------------------	--------------------------

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Casuarius casuarius johnsonii Southern Cassowary, Australian Cassowary, Double-wattled Cassowary [25986]	Endangered	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Turnix olivii Buff-breasted Button-quail [59293]	Endangered	Species or species

Name	Status	Type of Presence
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	habitat likely to occur within area Species or species habitat likely to occur within area
Frogs		
Cophixalus aenigma Tapping Nursery-frog [79086]	Endangered	Species or species habitat known to occur within area
Litoria dayi Australian Lace-lid, Lace-eyed Tree Frog, Day's Big-eyed Treefrog [86707]	Vulnerable	Species or species habitat likely to occur within area
Litoria lorica Armoured Mistfrog [1841]	Critically Endangered	Species or species habitat known to occur within area
Litoria nyakalensis Mountain Mistfrog, Nyakala Frog [1820]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Bettongia tropica Northern Bettong [214]	Endangered	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Hipposideros semoni Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat [180]	Vulnerable	Species or species habitat may occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Mesembriomys gouldii rattoides Black-footed Tree-rat (north Queensland), Shaggy Rabbit-rat [87620]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat likely to occur within area
Petaurus australis Wet Tropics subspecies Yellow-bellied Glider (Wet Tropics), Fluffy Glider [88022]	Endangered	Foraging, feeding or related behaviour known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pteropus conspicillatus Spectacled Flying-fox [185]	Endangered	Species or species habitat known to occur within area
Rhinolophus robertsi Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	Vulnerable	Species or species habitat likely to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acriopsis emarginata Pale Chandelier Orchid [83928]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Cepobaculum carronii an orchid [78700]	Vulnerable	Species or species habitat likely to occur within area
Cycas platyphylla a cycad [55796]	Vulnerable	Species or species habitat may occur within area
Cyclophyllum costatum a shrub [82770]	Vulnerable	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Macropteranthes montana [9003]	Vulnerable	Species or species habitat likely to occur within area
Oreogrammitis reinwardtii [83552]	Vulnerable	Species or species habitat may occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Phaleria biflora [82049]	Vulnerable	Species or species habitat likely to occur within area
Prostanthera albohirta [82052]	Critically Endangered	Species or species habitat may occur within area
Tomophyllum walleri [83507]	Vulnerable	Species or species habitat likely to occur within area
Tropilis callitrophilis Thin Feather Orchid [82771]	Vulnerable	Species or species habitat may occur within area
Vappodes lithocola Dwarf Butterfly Orchid, Cooktown Orchid [78893]	Endangered	Species or species habitat known to occur within area
Vappodes phalaenopsis Cooktown Orchid [78894]	Vulnerable	Species or species habitat may occur within area
Zeuxine polygonoides Velvet Jewel Orchid [46794]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]	Vulnerable	Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Monarcha frater Black-winged Monarch [607]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]	Critically Endangered	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species

Name	Threatened	Type of Presence
Tringa nebularia		habitat known to occur within area
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]	
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha frater Black-winged Monarch [607]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves		[Resource Information]
Name		State
Brooklyn		QLD
Brooklyn		QLD
Mount Lewis		QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311] Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913] Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large- leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat may occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-16.52333 145.12559

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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APPENDIX G – EROSION AND SEDIMENT CONTROL PLAN



Environmental Approval & Compliance Solutions

Mt Carbine Project Erosion and Sediment Control Plan Update

Mt Carbine Quarries Pty Ltd

Document Control Summary

NRA Environmental Consultants

NRA Filepath:	F:\AAA\380_EQ Resources\380008_ESCP\380008.02 EQR ESCP update 2021\Rpt\EQR ESCP_R02.docx		
Status:	R02	Date of Issue:	27 April 2022
Project Manager:	Darcy Simpson		
Title:	Mt Carbine Project Erosion and Sediment Control Plan Update		
Client:	Mt Carbine Quarries Pty Ltd		
Client Contact:	Natasha Troughton, Administration Manager		
Copies Dispatched:	1 PDF via email		
Other Info or Requirements:	This R02 supersedes and replaces all previous documentation prepared.		

Report Summary	
Key Words	Mount Carbine, Mt Carbine Quarries Pty Ltd, MCQ, EQ Resources, EQR, Erosion and Sediment Control Plan, ESCP.
Abstract	This ESCP details the erosion and sediment control measures applicable to current operations at the Mt Carbine Project. It has been prepared based on Best Practice Erosion and Sediment Control guidelines (IECA 2008). The ESCP should be considered a live document and will require periodic review and update.

Citation
This report should be cited as: NRA 2022, <i>Mt Carbine Project Erosion and Sediment Control Plan Update</i> , R02, prepared by NRA Environmental Consultants for Mt Carbine Quarries Pty Ltd, 27 April 2022.

Quality Assurance					
Author	Technical Review	Editor	Document Version	Approved for Issue by QA Manager	
				Date	Signature
Darcy Simpson BSc-BEng(Env), RPEQ (#27080) CPESC-IT (#9664)	Tim Anderson MAgrSc, BAgrSc(Hons), CEnvP (#002), CPESC (#2723)	Nadine Hunt BA	R01	8/4/2022	<i>N. Hunt</i>
	-		R02	27/4/2022	<i>N. Hunt</i>

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Certified Integrated
Management System



Limitations of this Report

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Appendix C: Rock Size Determination for a Perimeter Drain at Mt Carbine Mines

1. Introduction

NRA Environmental Consultants (NRA) was commissioned by Mt Carbine Quarries Pty Ltd (MCQ) to update the Erosion and Sediment Control Plan (ESCP) for the Mt Carbine Project (the site). The ESCP is a requirement of Environmental Authority (EA) EPML00956913, dated 14 April 2022. EA Condition D13 states:

An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented before 1 November 2013, to minimise erosion, contamination of stormwater and the release of sediment to receiving waters.

This ESCP has been prepared cognisant of the Department of Environment and Science guidance¹ and updates the previous Erosion and Sediment Control Plan (NRA 2013a), which is included in **Appendix A**.

1.1 Qualifications

The International Erosion Control Association (IECA) Best Practice Guidelines (IECA 2008) have been referred to for technical guidance on the erosion and sediment control (ESC) measures adopted.

This ESCP has been prepared by appropriately qualified persons who are Certified Professionals in Erosion and Sediment Control (CPESC):

- Darcy Simpson - CPESC-IT (#9664)
- Tim Anderson - CPESC (#2723).

1.2 Site description

The site is on mining leases 4867 and 4919 at Mount Carbine, approximately 80 km north-west of Cairns, in north Queensland (**Figure 1**). The site is within the existing disturbance area of an open cut and underground tungsten mine which operated in the 1970s and 1980s. In addition to mining activities, quarrying occurs on-site under EA EPPR00438313 (dated 16 March 2021), with the surrounding land use a mixture of residential (the township of Mount Carbine), conservation (Brooklyn Wildlife Sanctuary) and low intensity cattle grazing (NRA 2013b).

The site has a history of land degradation (QT 1993, NRA 2013a, 2013b.).

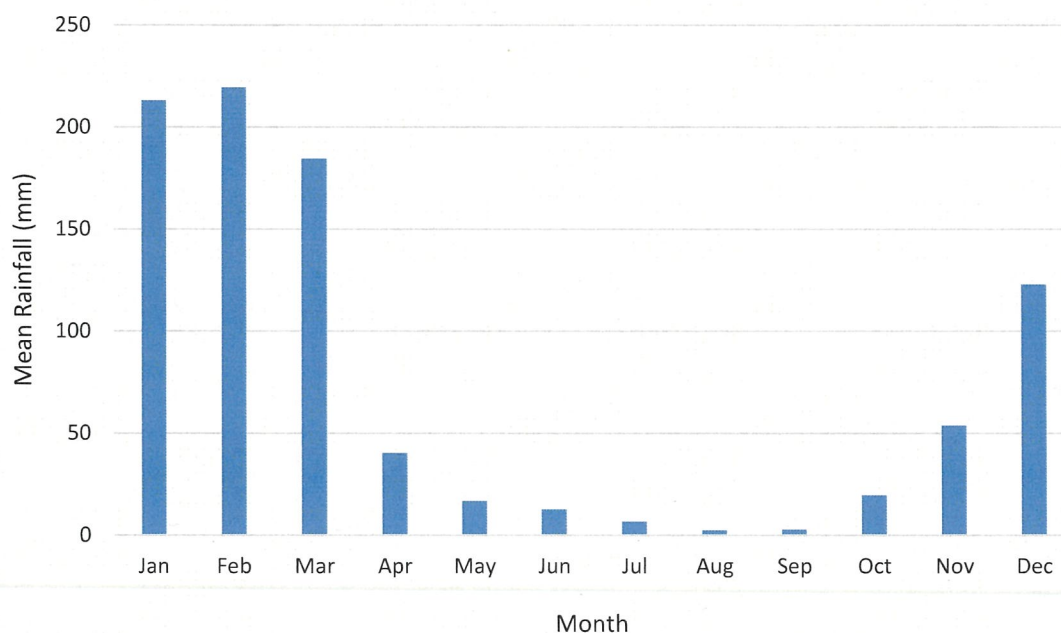
Current mining activities consist of reprocessing existing stockpiles from historical mining operations. Parts of the site have been, and are currently being, used for extractive industry purposes (quarrying/crushing of existing stockpiles) that are administered under separate statutory approvals by MCQ.

¹ DES 2021, *Stormwater Guideline: Environmentally Relevant Activities*, Queensland Department of Environment and Science, Brisbane, ESR/2015/1653 Version 1.04.

1.3 Climate

Mt Carbine is located in an area dominated by low rainfall ‘dry’ seasons and tropical monsoon ‘wet’ seasons. The meteorological station at the Mount Carbine Township (Bureau of Meteorology (BoM) Station 31180) was used to provide the information in **Graph 1**.

The majority of rain falls from December to March (*ie* the wet season), while the lowest rainfall typically occurs from April to November (*ie* the dry season). Mean annual rainfall is 952.1 mm (BoM 2022).



Source: BoM (2022).

Graph 1: Mean monthly rainfall for Mount Carbine Township weather station

1.4 Topography

The topography of the site is described as varying between level alluvial plains, rising to short, gently sloping pediments and foot-slopes, to high hilly, to mountainous lands with very steep slopes (Northcote *et al.* 1960–1968). All waterways in the site drain to the Mitchell River, approximately 5 km south of the leases, via the catchments of Manganese and Holmes creeks (**Figure 1**). The topography south of the Mulligan Highway is generally flat in comparison to north of the highway (**Figure 2**).

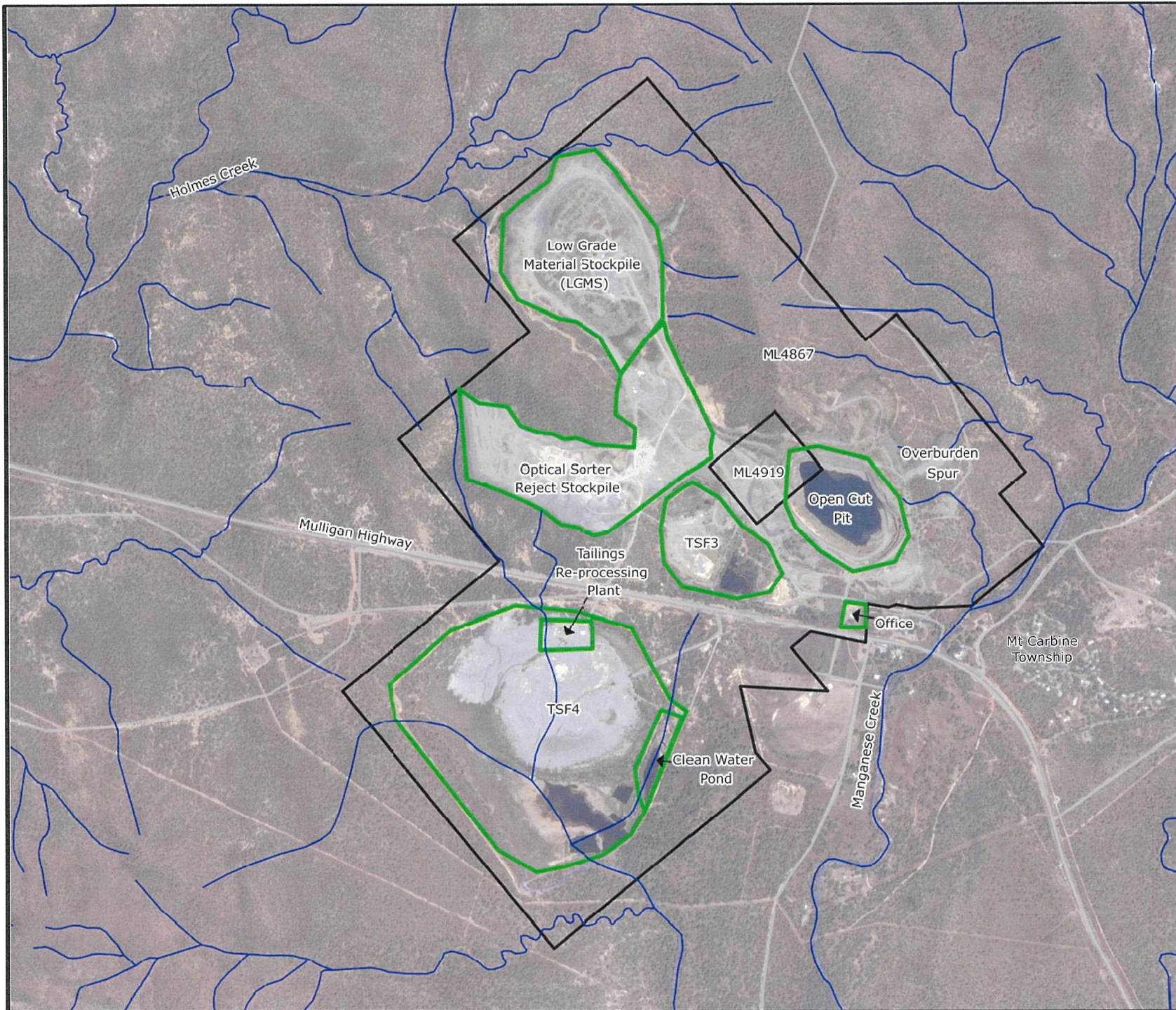
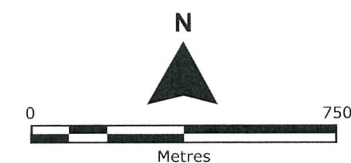


Figure 1: Site features and layout

Project: Mount Carbine Project
Erosion and Sediment Control Plan
Update

- Mining lease boundaries
- Site features
- Roads
- Drainage



Source:
Queensland Department of Resources 2022, Queensland
Department of Resources 2021, Google Earth

NRA Ref: 380008.02
Date: April 2022



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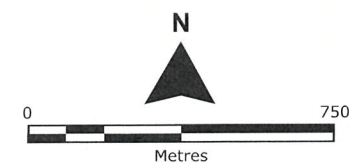
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Figure 2: Site topography

Project: Mount Carbine Project
Erosion and Sediment Control Plan
Update

-  Mining lease boundaries
-  Site features
-  5 m interval contours



Source:
Queensland Department of Resources 2022

NRA Ref: 380008.02
Date: April 2022



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1.5 Soils

The ESCP prepared in 2013 (**Appendix A**) presents information on soil. There is limited site-specific information available on pre-disturbance soil condition (land disturbances occurred circa 1970 and soil material was not salvaged for reuse). Results of previous soil testing indicate that surface materials are generally infertile having chemical and physical limitations (inherently low levels of soil nutrients and low organic matter).

Recent investigations (NRA 2021) have further confirmed that soils are shallow on-site (*eg* rock outcrops at surface and soil limited to 0.3 m depth). Additionally, areas previously disturbed (*eg* drains excavated at the time of NRA (2013a)), now exhibit signs of active erosion demonstrative of inherent dispersive characteristics in the exposed subsoils (**Plates 1 and 2**). Soils on-site are considered vulnerable and should be managed with care *ie*:

1. existing vegetated areas should not be disturbed wherever practicable
2. disturbance of subsoils should be avoided
3. stabilisation of areas where vegetation has been removed is essential, and will require resource inputs, given the characteristic infertility of the growing media (*in situ* surface soil and old mine wastes) and the limitations likely in subsoil materials.



Plate 1: TSF4 diversion drain invert erosion with vegetated banks



Plate 2: Erosion along TSF4 diversion drain banks, sediment deposition in drain invert

2. Erosion and Sediment Control Plan

By a combination of historical land uses (*eg* waste rock stockpiling) and ongoing land uses (*eg* rock quarrying) much of the disturbances at the site are covered by crushed rock (particularly north of the Mulligan Highway). For the purposes of ESC, this may be considered a form of large-scale rock mulching. Operations south of the Mulligan Highway (*ie* tailings re-processing) are undertaken within the TSF4 catchment, a closed catchment not intended to discharge. As such, many of the remaining ESC measures to be implemented or maintained are focused on clean water diversion away from site operations, and minimising erosion where practicable. Relevant standard drawings from IECA guidance material are provided in Appendix B.

2.1 Drainage controls (clean water diversions)

Diversion of clean water away from site activities is a key element of ESC. By minimising the amount of water on-site, the erosive potential of water that moves through the site is reduced and, accordingly, the amount of material (sediment) transported. Clean water diversions around major site infrastructure consist of the following and are indicated in **Figures 3 and 4**:

- TSF4 East
- TSF4 West
- LGMS East
- LGMS West.

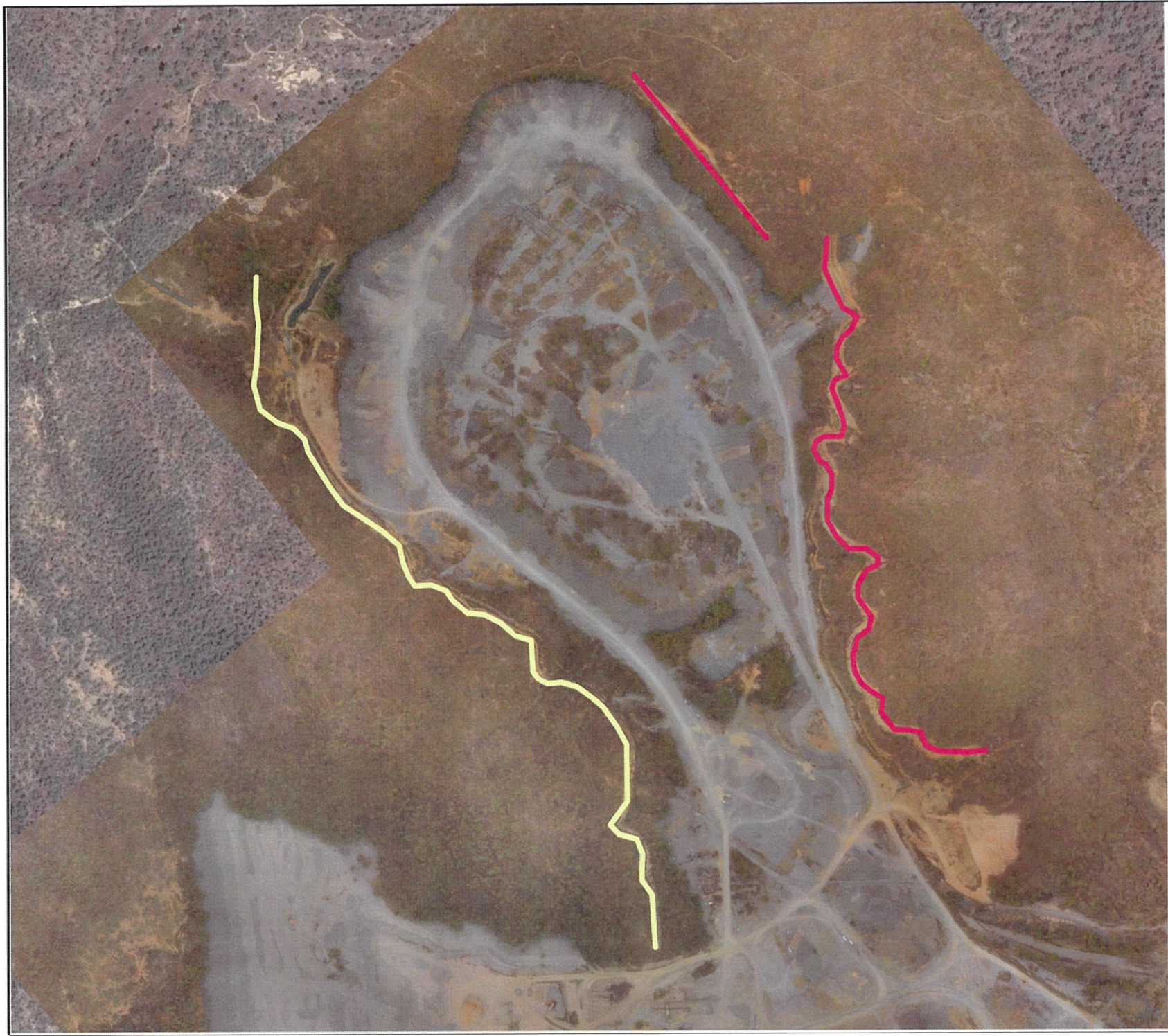
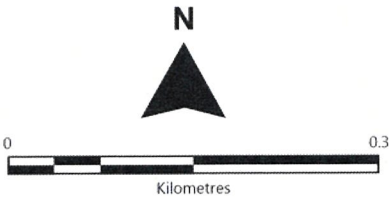


Figure 3: LGMS diversion drainage

Project: Mount Carbine Project Erosion and Sediment Control Plan Update

- LGMS diversion drainage east
- LGMS diversion drainage west



Source: Google Earth 2022

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Date: April 2022



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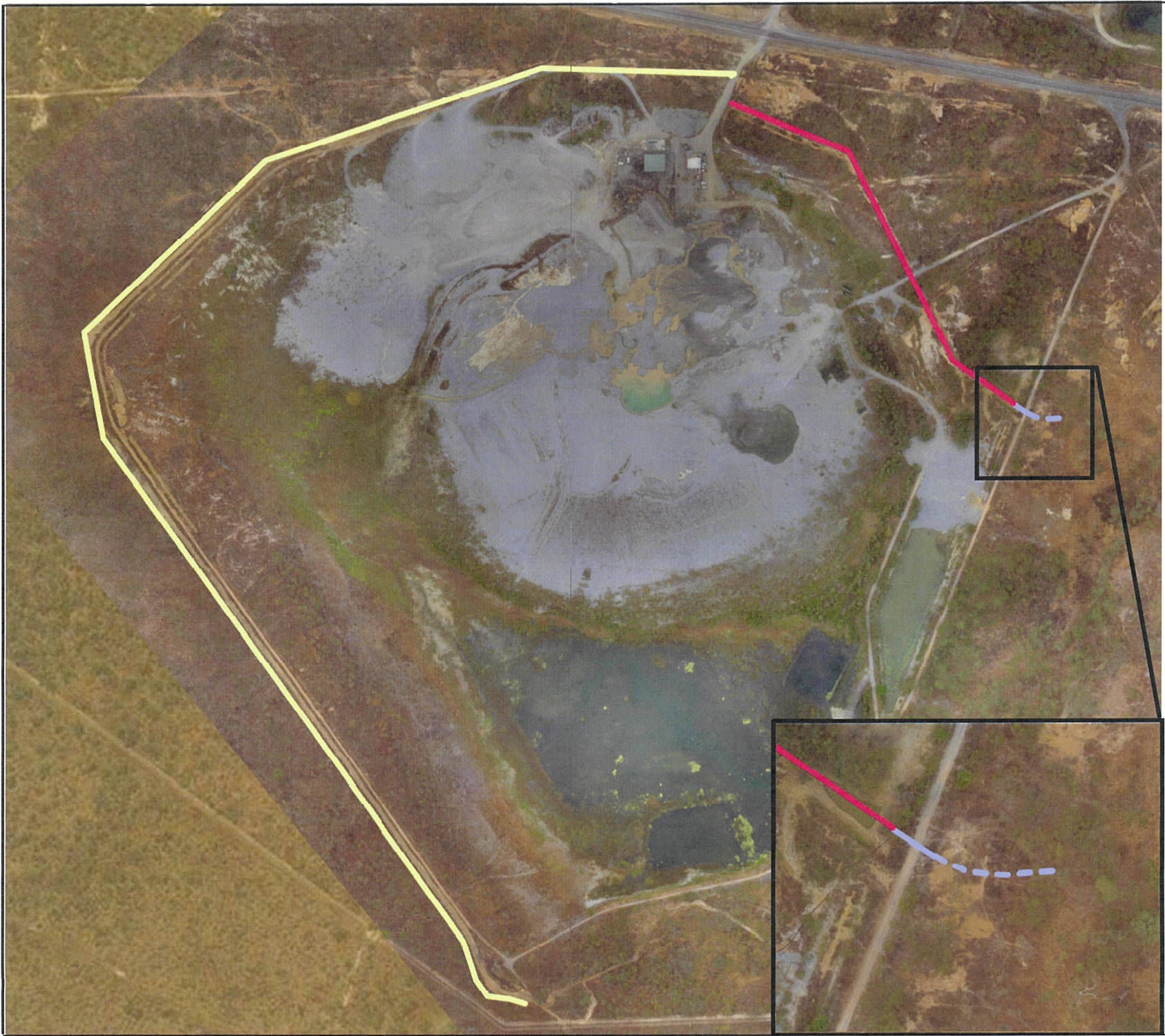


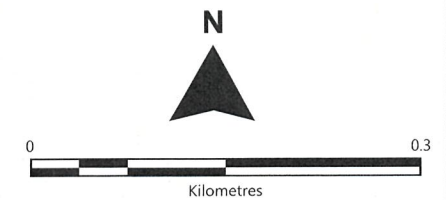
Figure 4: TSF4 diversion drainage

Project: Mount Carbine Project Erosion and Sediment Control Plan Update

- TSF4 diversion drainage east
- TSF4 diversion drainage west
- Extended drain¹
- Level spreader²

¹Under perimeter road.

²Outlet side must be level. End of level spreader must be higher than outlet side.



Source: EQ Resources, Bing Aerial

NRA Ref: 380008.02
Date: April 2022



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2.1.1 Capacity assessment

These diversions were assessed for suitability, with all diversions deemed capable of discharging a 10% annual exceedance probability (AEP) storm for their relevant catchment, and all except the LGMS East diversion able to discharge a 1% AEP storm (ATCW 2021).

2.1.2 TSF4 East outfall

There is no apparent outfall for diversion TSF4 East (the channel appears to end in a topographical low north of the clean water pond). This diversion should be extended east to drain via a level spreader (**Figure 4** and **Appendix B**) towards the Manganese Creek tributary system south of TSF4 (as per TSF4 West). IECA (2008) recommends stabilised earth be used for the level spreader; however, IECA (2018) recommends wood and/or V-notch plate (aluminium or steel) set in concrete. Preliminary works should use stabilised earth, and be reviewed for suitability. The level spreader must be constructed and maintained level (*ie* 0% grade) across its length to avoid concentrating water flow.

2.2 Erosion controls

Following drainage controls, controlling erosion should be the next priority. Associated controls are detailed below.

2.2.1 Rock mulching

The majority of the site is covered by crushed rock. This is considered a form of rock mulching and good ESC practice. Following recent site visits by NRA (*eg* 23 November 2021) minor improvements are suggested, as follows.

- Consider laying rock over all access tracks, including infrequently used tracks.
- Avoid the use of fine (*ie* <5 mm) gravels where practicable.

2.2.2 Diversion lining

Channelised flow in diversion drains may require erosion controls, depending on the material from which the drain is formed.

LGMS

Diversions around LGMS are generally formed by cutting into the weathered rock outcropping of Mt Carbine. This provides a stable (non-eroding) channel base for the diversion. No lining of this drain is required at this time.

TSF4

Diversions around TSF4 are generally formed in the alluvial floodplains of the Mitchell River valley and are less stable (**Plates 1 and 2**). Placement of suitable rock fill in the base of this channel to reduce flow velocity and provide a less erosive surface for water to flow over may reduce the observed erosion occurring. Previous rock lining (*eg* as recommended in NRA (2013a)) covered only the most high-risk areas and has degraded over time.

Rock lining must be recessed into the diversion channel with Geofabric underlay where rock lining is deployed, with specific attention to the stabilisation of the interfaces between natural surface and formed channel. Soils affected should be further assessed for sodicity and

ameliorated as required². Inadequate or incorrect lining of the drain may increase erosion and reduce drain capacity (**Appendix B**).

Preliminary design work (**Appendix C**)³ has identified a minimum material size ($d_{50}=0.2$ m) for rock lining all TSF4 drains.

Potential alternatives to rock lining include grass lining, erosion control mats and cellular confinement systems. These are not considered as practicable as rock lining, given the cost of materials and the proximity of the Mt Carbine Quarry.

2.2.3 Clearing and rehabilitation

Clearing should be progressive and only as required. Clearing is expected to be limited to access tracks, which will be surfaced with rock where practicable. Rehabilitation trials, a requirement of the EA, were undertaken at Mt Carbine (NRA 1994) and are due to continue (*pers. comm.* Natasha Troughton, Administration Manager, EQ Resources, to NRA, email dated 1 December 2021).

2.3 Sediment controls

Large scale sediment control structures (*eg* sediment basins) are problematic in monsoonal climates (given the volume of water). Modified approaches that incorporate the use of chemicals to promote settlement of suspended solids (and reduce the size of basins) can be applied, though present challenges as well (*eg* chemical suitability and operational challenges). Further, the basin(s) need to be constructed, and for this site, it is advisable to avoid additional disturbance and to avoid exposing subsoil materials. The area's natural watercourses, which may have naturally elevated turbidity during rainfall events, should also be considered (**Plate 3**).

² Typical gypsum application rates are 10–25 t/ha. The actual application rate should be determined by soil testing (IECA 2008).

³ This design has conservatively used enlarged catchments (*cf* ATCW 2021), which are applicable only to sizing rock lining and should not be used for any other purpose.



Plate 3: Manganese Creek upstream of site impacts (February 2022); water is visibly turbid following rainfall

Sediment controls should be implemented where practicable, for example:

- long-term stockpiles of fine material (*eg* <2 mm or ‘crusher dust’) should have a sediment fence or other bunding to capture mobilised sediments down gradient
- releases from site-affected water storages (*eg* TSF4) should be avoided.

2.4 Dust controls

Dust suppression should be undertaken where required, based on visual inspection. This may be performed via sprinklers and/or a water cart. Water used in dust suppression may briefly pond, but should not run off-site.

3. Monitoring and Maintenance

Review of ESC measures should be undertaken prior to the onset of the wet season, and monitoring and maintenance should continue throughout the wet season. Careful attention should be given to the TSF4 diversion drainage as this feature requires maintenance now and into the future to prevent further degradation.

3.1 Responsible Person

The nominated Responsible Person for the monitoring and maintenance of the ESCP is the Site Senior Executive (or their delegate). Maintaining records of review and the maintenance of ESCP measures is their responsibility.

3.2 Performance standards

3.2.1 Water quality

Water quality performance criteria exist for the site and should be maintained for this ESCP (*ie* Receiving Environment Monitoring Program and EA water quality criteria). No additional water quality criteria are required.

3.2.2 Rehabilitation

Rehabilitation success criteria should be informed by rehabilitation trials. IECA (2008) recommends 70% cover outside of the wet season⁴.

3.3 ESCP review

The ESCP should be reviewed and updated as required, or every 3 years as a minimum (in line with site-based management planning and third-party compliance reporting).

⁴ Based on average monthly dry season rainfall and Tables 4.4.2 and 4.4.7 of IECA (2008).

4. References

ATCW 2021, *Mount Carbine Mining Water Management Plan (Revision 2)*, produced for Mt Carbine Quarries Pty Ltd by ATC Williams Ltd, 29 November 2021.

BoM 2022, *Monthly Rainfall, Mount Carbine Township, Station Number 31180*, Australian Bureau of Meteorology, viewed 28 January 2022, <www.bom.gov.au>.

IECA 2008, *Best Practice Erosion and Sediment Control*, International Erosion and Sediment Control Association (Australasian Chapter), Picton, NSW, Australia, November 2008.

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Northcote, KH, Beckmann, GG, Bettenay, E, Churchward, HM, Van Dijk, DC, Dimmock, GM, Hubble, GD, Isbell, RF, McArthur, WM, Murtha, GG, Nicolls, KD, Paton, TR, Thompson, CH, Webb, AA & Wright, MJ 1960–1968, *Atlas of Australian Soils, Sheets 1 to 10 with explanatory data*, CSIRO and Melbourne University Press: Melbourne. (Viewed via the Queensland Government IRTM v4.2 viewer, webgis.dme.qld.gov.au/webgis/webqmin/viewer.htm).

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NRA 2013a, *Mount Carbine Tungsten Project (Stage 1) Erosion and Sediment Control Plan, R01 (Final)*, prepared by NRA Environmental Consultants for Carbine Tungsten Limited, 1 November 2013.

NRA 2013b, *Mount Carbine Tungsten Project Stage 1 Environmental Management Plan June 2013, R03 (Final)*, prepared by NRA Environmental Consultants for Carbine Tungsten Limited, 28 June 2013.

NRA 2021, *Surficial bore logs from 6-9 December 2021*, letter prepared by NRA Environmental Consultants for EQ Resources Limited, 21 December 2021.

QT 1993, *Mount Carbine Mine Decommissioning and Rehabilitation Programme*, prepared by Queensland Tungsten, a subsidiary of Normandy Poseidon Ltd, 17 September 1993.

Appendix A:
2013 Erosion and Sediment
Control Plan



Environmental Approval & Compliance Solutions

Mount Carbine Tungsten Project (Stage 1) Erosion and Sediment Control Plan

Carbine Tungsten Limited



Environmental Approval & Compliance Solutions

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1 November 2013

Carbine Tungsten Ltd
PO Box 1040
BUNGALOW QLD 4870

Attention: Jim Morgan, CEO and Managing Director, Carbine Tungsten Limited

Dear Jim

RE: Mount Carbine Tungsten Project (Stage 1) – Erosion and Sediment Control Plan

Please find enclosed the Mount Carbine Tungsten Project (Stage 1) – Erosion and Sediment Control Plan.

If you have any questions about the enclosed document please do not hesitate to contact me on 4034 5300 or tim@natres.com.au.

Yours sincerely

NRA Environmental Consultants

Tim Anderson

Principal Environmental Scientist

Our Ref: CT ESCP Coverletter L01.docx

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NRA Environmental Consultants

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Title:	Mount Carbine Tungsten Project (Stage 1) Erosion and Sediment Control Plan
Author/s:	Tim Anderson
Client:	Carbine Tungsten Limited
Client Contact:	Jim Morgan, CEO & Managing Director, Carbine Tungsten Limited
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Report Summary	
Key Words	Mount Carbine, Carbine Tungsten, Mount Carbine Tungsten Project Stage 1, ESCP, Erosion.
Abstract	This ESCP details the measures applicable to current operations at the Mount Carbine Tungsten Project. The current Environmental Authority requires that an ESCP be prepared. The ESCP will require review and update in response to field conditions and routine monitoring observations as well as to modifications to the nature and scale of activities.

Quality Assurance					
Author	Technical Review	Editor	Document Version	Approved for Issue by QA Manager	
				Date	Signature
Tim Anderson MAgrSc, BAgrSc (Hons) CPESC #2723	Shannon Wetherall BAppSc (Hons) David Campbell BSc	Kate Steyn BAgrSc	R01	1/11/2013	

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Appendices

Appendix A: Soils and Tailings Characterisation Data

Appendix B: Erosion and Sediment Control Plan for TSF4 Catchments Diversion Works

Appendix C: Technical Notes (IECA 2008)

Appendix D: Inspection Test Plans (ITPs)

Appendix E: ESC Monitoring Checklist

1. Introduction

NRA Environmental Consultants (NRA) was commissioned by Carbine Tungsten Limited to prepare an Erosion and Sediment Control Plan (ESCP) for the Mount Carbine Tungsten Project, North Queensland.

The ESCP is a requirement of Environmental Authority (EA) EPML00956913, dated 15 August 2013, and is limited to the mining activities of Carbine Tungsten Limited.

EA Condition D13 states:

An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented before 1 November 2013, to minimise erosion, contamination of stormwater and the release of sediment to receiving waters.

The International Erosion Control Association (IECA) Best Practice Guidelines (IECA 2008) have been referred to for technical guidance on the erosion and sediment control (ESC) measures adopted.

No site surveys specific to the preparation of this ESCP have been conducted; rather existing data (including that gathered during recent site visits by NRA scientists) and personal knowledge of the site gained by the author from the late 1980s has been used.

The ESCP will be subject to periodic revisions and updates. Triggers for revisions include:

- results of performance monitoring of the ESC measures during and following wet seasons
- changes to activities that warrant amendments to either the Plan of Operations (PoO) and/or the EA
- annual review.

The process for managing these future alterations is detailed in **Section 3.4**.

1.1 Site description

The Mount Carbine Tungsten Project is on granted mining leases 4867 and 4919 at Mount Carbine, approximately 80 km north-west of Cairns, in north Queensland (**Figure 1**). The project is within the existing disturbance area of an open cut and underground tungsten mine which operated in the 1970s and 1980s. In addition to mining activities, land use on the site is quarrying, with the surrounding land use a mixture of residential (the township of Mount Carbine), conservation (Brooklyn Wildlife Sanctuary) and low intensity beef cattle grazing (NRA 2013a).

The land capability of the area in 1992 was described as ‘*not of high quality and supports a variety of Braham at a density of about one head per 20 hectares outside of small area of improved pastures.*’ (QT 1992); with EMOS (1995) reporting that the ‘*agricultural capability of the general area in and around the project is assessed as CVII and VIII*’ – noting that this assessment was based on the pre-mining land use including areas of ‘*decommissioned waste rock dump and decommissioned tailings dam*’. Following a visit to the project area QDPI (1993) reported ‘*Whatever pasture exists is subject to heavy overgrazing because of the proximity of water. This applies to everywhere around Mt Carbine, not just the mine site. It has probably been the normal condition for a hundred*

years. As a consequence, the whole area is degraded, and the vegetation is of little value from aesthetic, botanical or pastoral points of view. It has, however, a useful function to perform in the stabilisation of some of the disturbed surfaces of the mine area. --- The disturbed areas as a whole cannot be restored and revegetated in the modern manner, since the operation was begun before such demands were made and top soil was not stockpiled. They are too extensive to contemplate retrospective action. They are, moreover, in an area where evidence of mining activity has long been accepted as part of the scenery. They are not unduly obtrusive, and the surfaces are not notably mobile. The process of revegetation of the deposits of fine material could be hastened by deliberate action if this were required, but there seems to be little point, and ground cover is likely to return naturally, if slowly. ”. NRA concluded that based on field observations, pre-disturbance land suitability for beef cattle grazing is assumed to be Class 4 on flatter areas, and Class 5 on steeper areas (NRA 2013a).

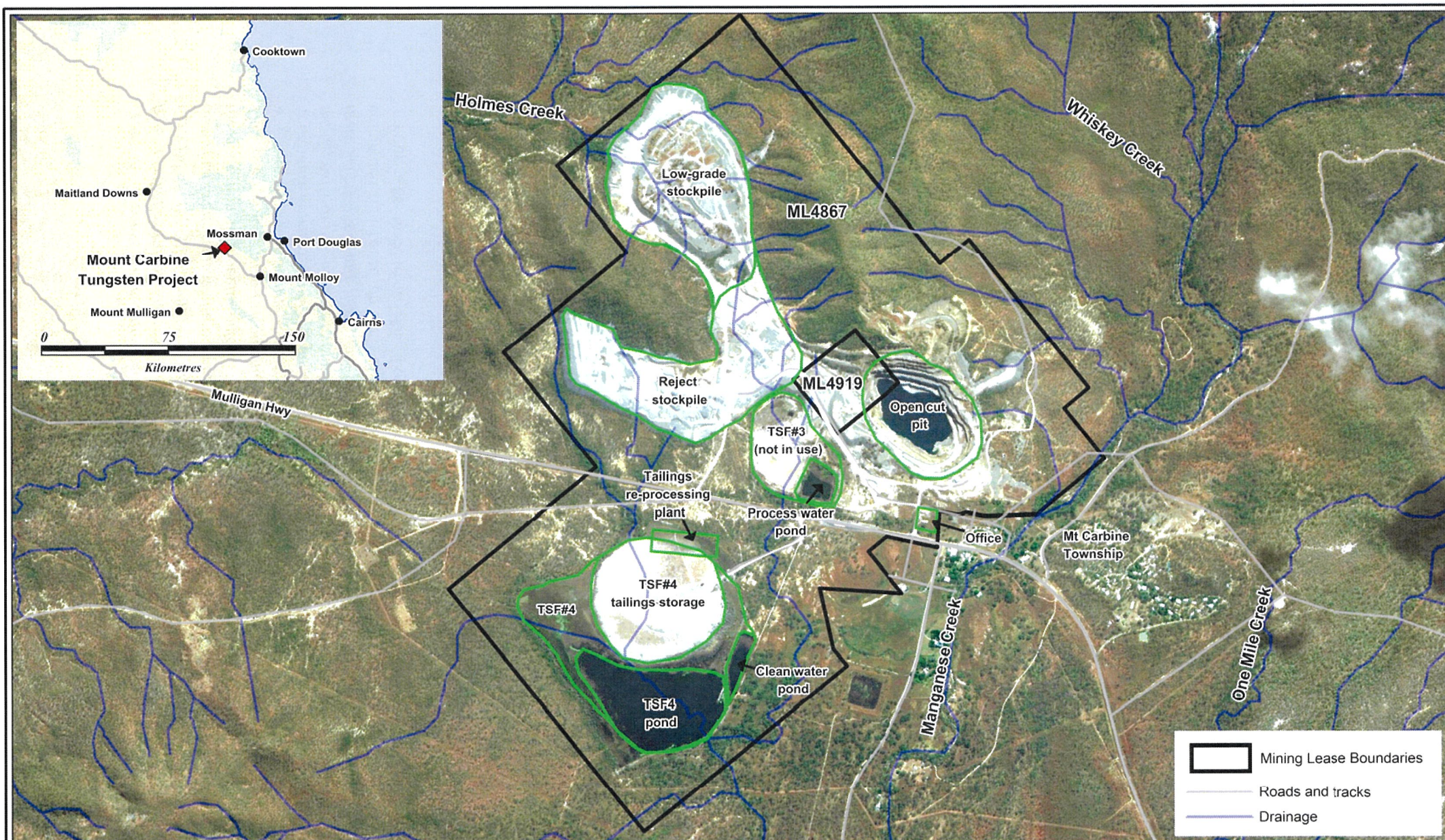
The mine site is within the Mitchell River Catchment. The site drains to two creeks. Manganese Creek collects water from the south and east, and Holmes Creek from the north-west. The environmental values for waterways in the Mount Carbine Project Area that are to be protected and enhanced are:

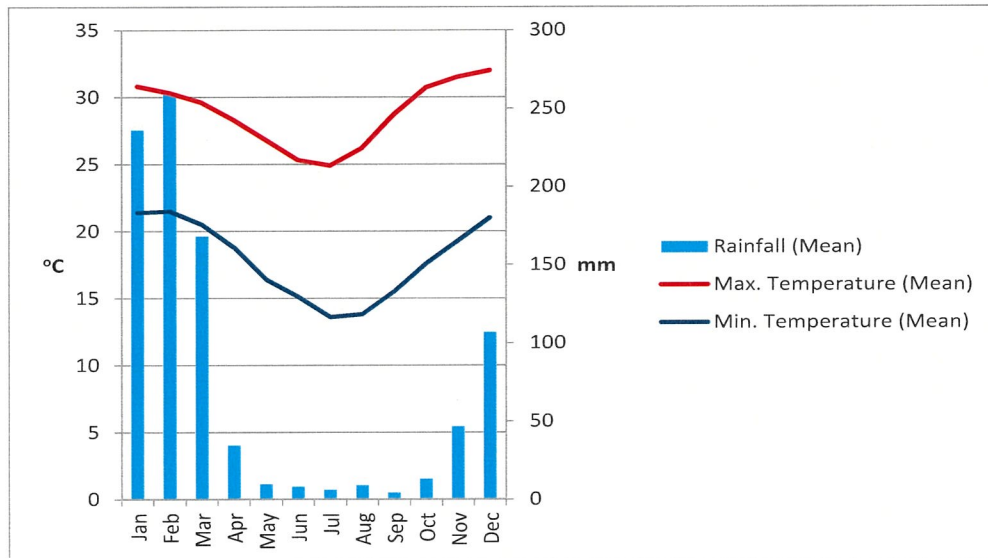
- aquatic ecosystems (slightly to moderately disturbed)
- livestock drinking water
- industrial use
- cultural heritage (NRA 2013a).

The current mining activities consist of reprocessing tailings and low-grade stockpiles from previous mining operations. Further detail is provided in the Plan of Operations (PoO) (NRA 2013b). Parts of the project area have been, and are currently being, used for extractive industry purposes (quarrying/crushing of waste rock and tailings) that are administered under separate statutory approvals by Mount Carbine Quarries Proprietary Limited.

1.2 Climate

The following information is from the Mount Carbine Tungsten Project Stage 1 Environmental Management Plan (EM Plan) (NRA 2013a). The nearest meteorological station likely to be representative of site conditions is at the Mareeba Airport (Bureau of Meteorology (BoM) Station 031210), 80 km from the site. **Graph 1** shows the average minimum and maximum temperature at Mareeba. Temperatures in the area range from 13.6°C in winter to 32.0°C during summer (BoM 2012). **Graph 1** shows that the majority of rain falls during February (mean 259.4 mm) in Mareeba, while the lowest rainfall typically occurs in September (mean 4.4 mm) (*ie* the highest risk of high intensity storms occurs in the distinct wet season between November and April inclusive). Average total rainfall is 829 mm (BoM 2012).





Source: BoM 2012.

Graph 1: Average monthly minimum and maximum temperatures and rainfall (Mareeba Airport)

1.3 Topography

The area is relatively rugged¹ with the topography described as varying between level alluvial plains rising to short gently sloping pediments and foot-slopes to high hilly to mountainous lands with very steep slopes (Northcote *et al.* 1960–1968). All waterways in the project area drain to the Mitchell River, approximately 5 km downstream of the leases, via the catchments of Manganese and Holmes creeks (**Figure 2a** and **2b**). Manganese Creek, which collects run-off from the majority of the leases, is an intermittent creek. The low-grade stockpile areas of the lease drain northwards to Holmes Creek, which is also an intermittent waterway.

1.4 Soils

Geology of the mine site is dominated by the Hodgkinson Formation, recent alluvium, and old mine workings (Bultitude *et al.* 1999). Soils are either shallow bleached loams or hard pedal mottled-yellow duplex soils (Northcote *et al.* 1960–1968). There is limited information available on soil (land disturbances occurred in a different era and soil material was not salvaged for reuse). The decommissioning plan for the project (QT 1993) presents limited data that was used to inform rehabilitation trials that NRA undertook in 1993/94 (NRA 1993a, b; NRA 1994)². The soil data supports the assertion that the soils are generally low in chemical fertility though do not present significant challenges in regard to physical stability (such as highly dispersive)³. In 2013 NRA collected four surface soil samples, associated with planned water diversion works, for slaking and dispersion assessment using a

¹ A description of physiography presented in the Plan of Operations (QT 1992) was extracted from *The Wolfram Mines of Mt Carbine-North Queensland* by Lionel C. Ball. Geological Survey of Queensland, 1915.

² The soil analysis data (QT 1993) and the tailings analysis data for the NRA trial work is presented in **Appendix A** for future reference.

³ From NRA (1993a) – “The soil analysis of tailings material (Table 1) indicates the general absence of toxic quantities of metals or excessive salts and deficiencies in nitrogen, phosphorus and potassium. The pH of the material was slightly-moderately alkaline, but not considered to directly inhibit plant growth. A virtual absence of organic matter was noted.”.

screening test based on the Modified Emerson Dispersion Test (MEDT) described by Loveday and Pyle (1973). The samples were collected by NRA Environmental Scientist John Broughton on 1 October 2013 from the southern end of the TSF4 diversion drain (in the vicinity of the spillway). The drain was under construction at the time of sampling. Sample descriptions are given in **Table 1**. Results of the MEDT are given in **Table 2**.

Table 1: Details of Samples Screened by the Modified Emerson Dispersion Test

Sample ID	Description	Type
TSF4 Drain #1	Dark yellowish brown (2.5Y 7/4), no roots, no mottles, weak consistency. Collected from pile of disturbed surface material excavated to form drain.	Topsoil
TSF4 Drain #2	Dark yellowish brown (10YR 4/4), fine roots, no mottles, very weak consistency. Collected from disturbed surface material excavated to form drain.	Topsoil
TSF4 Drain #3	Pale yellow (2.5Y 7/4), no roots, faint orange mottles, very firm consistency. Collected from material excavated to form drain.	Subsoil
TSF4 Drain #4	Light yellowish brown (10YR 6/4), no roots, no mottles, firm consistency. Collected from material excavated to form drain.	Subsoil

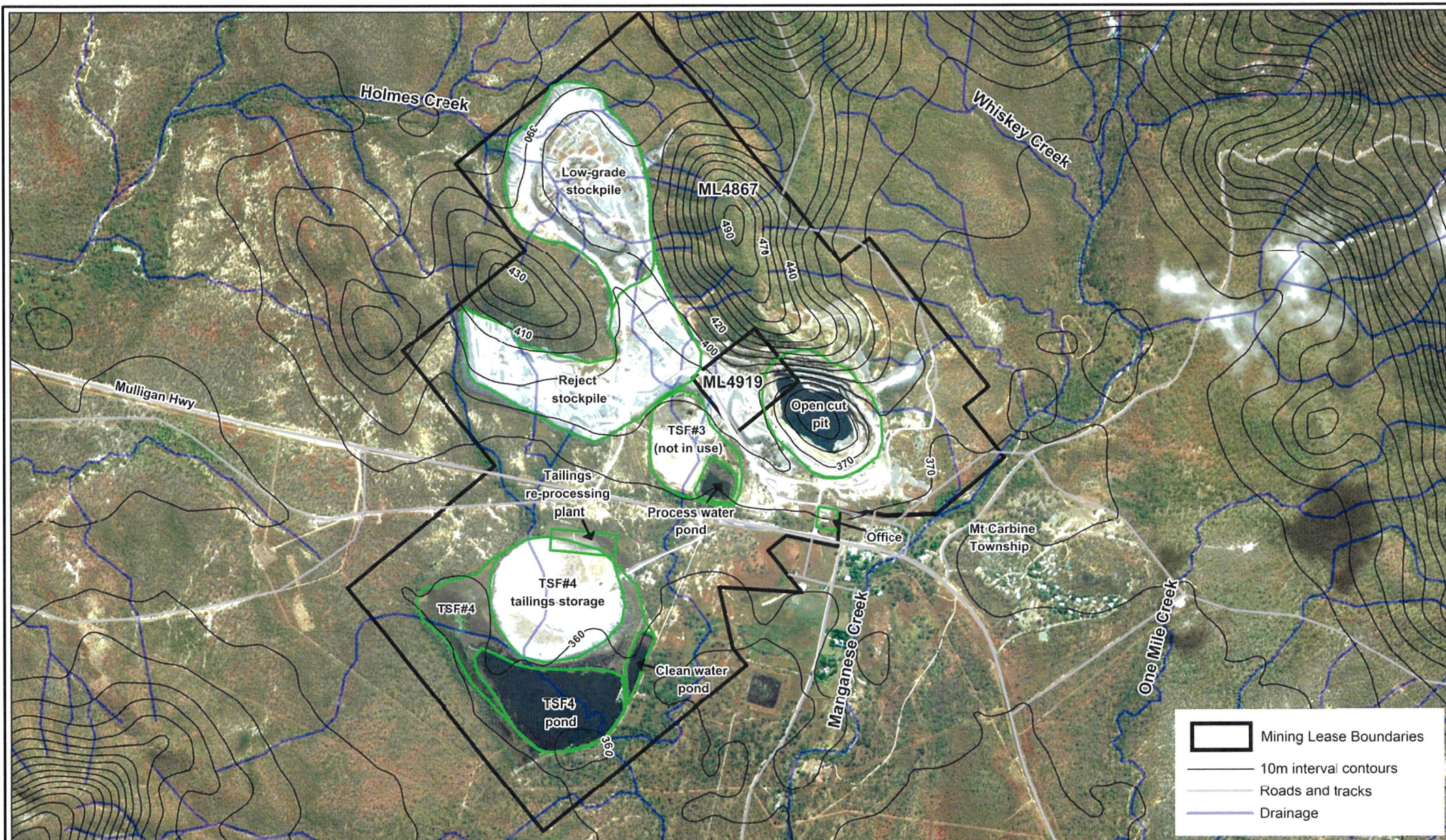
Table 2: Results of the Modified Emerson Dispersion Test

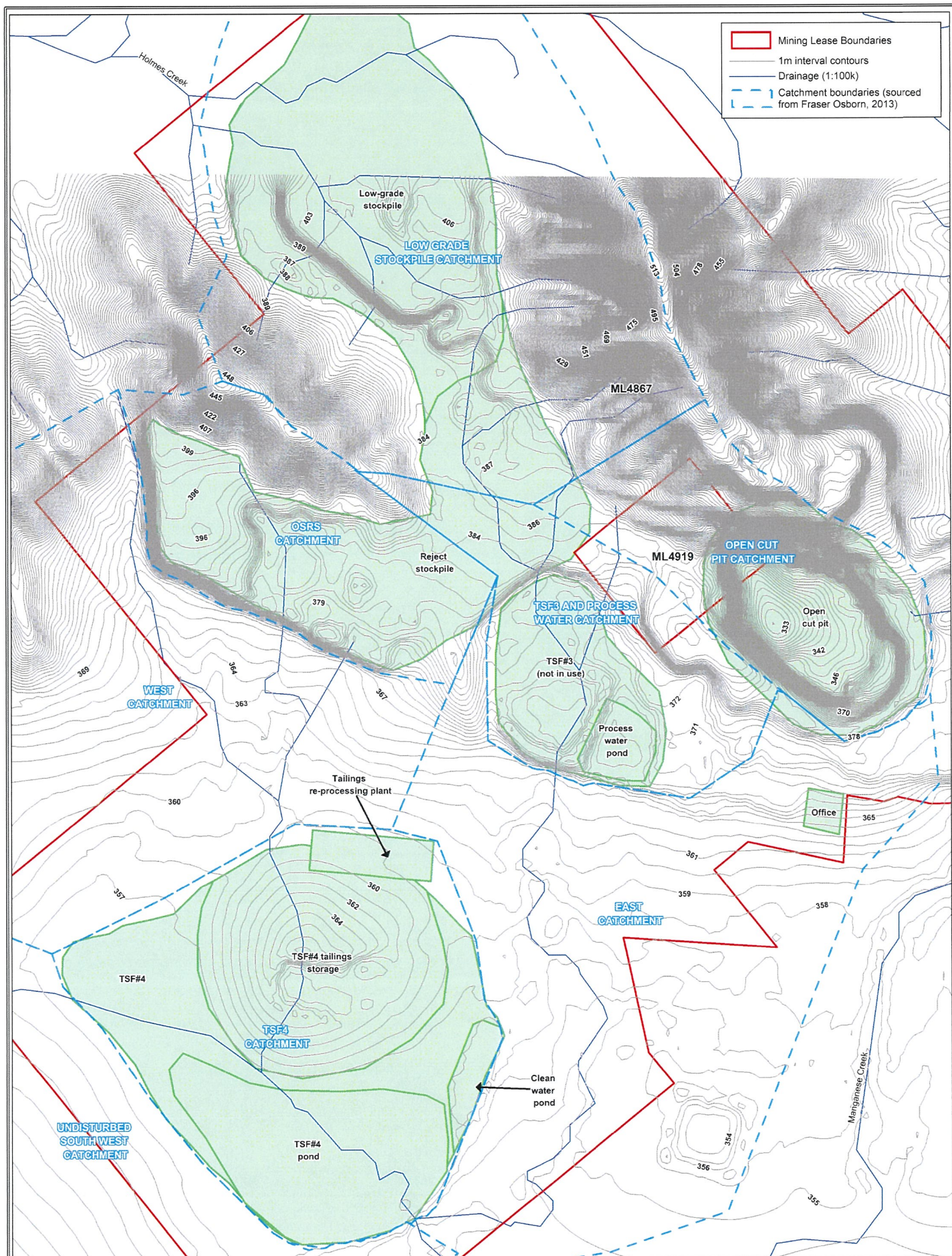
Sample	Slaking	Dispersion	
		After 2 hours	After 20 hours
TSF4 Drain #1	Immediate complete slumping	No dispersion	No dispersion
TSF4 Drain #2	No significant slumping	No dispersion	No dispersion
TSF4 Drain #3	Immediate minor slumping	No dispersion	Slight dispersion
TSF4 Drain #4	Immediate complete slumping	No dispersion	No dispersion

Based on the observations and results, the soils of the project area appear to be not of high quality and typical of arid regions of northern Queensland. Nevertheless most soils, especially those near the surface, are worthy of salvage ahead of being disturbed on account of their improved agronomic value relative to waste rock/tailings material. Given the previous practice of not salvaging soil material, it is very important that the salvage of soil material happens for any future land disturbances. Wherever possible, soil should be placed directly onto areas to be rehabilitated. Where storage is unavoidable, stockpiles should be placed away from drainage lines, steep slopes where they may be exposed to erosive sheet or concentrated flows, and areas of future disturbance. They should be built no more than 2 m in height, and sown with a species mix proposed for use in the rehabilitation program or in the absence of specification sown with a 20–40 kg/ha of cover crop (commercially available sterile hybrid pasture species). In addition to the benefits of maintaining some degree of biological activity, combating weed invasion and generating a useful seed bank, the rapid establishment of a vegetative cover (at least 60% cover) will negate the need for construction of silt fences around the toe of soil stockpiles.

It is concluded that surface soil materials are unlikely to present unusually difficult erosion and sediment control issues (though fertiliser addition will be required for the establishment of cover crops in any revegetation program where this material is used). While soils are likely to be generally stable in their undisturbed state (noting that a significant area of land disturbance has occurred in the past and soil salvage was not enacted), the lack of cohesion is likely to result in an increased erosion risk in the following cases:

- loose windrowed or stockpiled material from local excavations
- on slopes
- in areas of concentrated flow.





2. Erosion and Sediment Control Plan

Water management and erosion and sediment control are interlinked and are controlled under a Water Management Plan (NRA 2013c *in prep.*) which addresses clean water and mine water management. The objectives of the Water Management Plan are to divert run-off from undisturbed catchments, where possible, and manage run-off from disturbed areas⁴. ESC measures that are applicable to activities proposed in the PoO (NRA 2013b) are relatively straight forward on account of:

1. the limited nature and scale of proposed activities
2. the proposed activities are restricted to areas of past disturbance
3. the relatively stable condition of existing disturbed areas over an extended period of time (>25 years) and the apparent sustained containment of sedimentation in the area of the project.

The ESCP will require revision and updating if there are changes to the nature and scale of activities.

Deviation from the recommendations provided herein may be necessary due to site-specific conditions encountered. Any alternative practices should be documented to facilitate future monitoring. A change management mechanism is detailed in **Section 3.4**.

It will be necessary to monitor performance of structures (refer to **Section 3.2**). Routine monitoring should be in the form of site inspections following rainfall events that cause run-off to determine if repair/replacement is necessary. Detailed monitoring should be carried out prior to and following the wet season and necessary reparation and/or corrective actions taken.

Structures defined as high or significant hazard dams according to the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (DERM 2012) are to be managed and operated according to conditions outlined in Schedule E of the EA and as such the EA conditions take precedence over any requirements of this ESCP. These storage facilities are not considered further in this ESCP.

2.1 Clean water diversions

A clean water diversion has been constructed to reduce the catchment of TSF4. Permanent ESC measures were not considered necessary due to the low fall of the diversion drain (0.5%) (*pers comm.* Matthew Boschen, Senior Civil Engineer, Fraser Osborn, email dated 3 October 2013). A post construction inspection was undertaken by Fraser Osborn civil engineer on 28 October 2013. Rock armouring is required on the diversion drain where two gullies intercept the drain on the south-western side, and rock armouring is required at the outlets of the diversion drain on the western and eastern sides (*pers. comm.* Matthew Boschen, Senior Civil Engineer, Fraser Osborn). The base and sides of the diversion drain would benefit from cover (*eg* established vegetative cover (*eg* sterile grass)). No further diversions are anticipated given the activities proposed; however, the following information is relevant to

⁴ A clean water diversion has been installed to reduce the catchment reporting to the TSF4 and these ESC measures have been reported separately (included as **Appendix B**).

the construction and operation of clean water diversions around infrastructure sites (refer also to **Appendix C**).

- Prior to commencement of any clearing, the extent of proposed work areas should be delineated in the field.
- Diversion banks should be installed at the limits of the disturbance area to divert clean flows around the earthworks area.
- Run-off from disturbed areas should be controlled by temporary structures to limit the velocity and concentration of flows (*eg* diversion banks and sediment fencing).
- Run-off from disturbed areas should be treated prior to leaving site (*eg* rock filter dams).
- Any discharge of run-off should be via controlled discharge points with energy dissipaters as required (*eg* placed rock).
- The area of disturbance should be minimised and temporary/permanent surface stabilisation provided as soon as practicable following completion of earthworks.
- Batter slopes should be between 1:4 and 1:6 on fill slopes and a maximum of 1:3 on cut slopes to allow surface stabilisation and maintenance (DMR 2000).

2.1.1 Performance standards

Performance standards applying to erosion and sediment control works associated with clean water diversions are described in **Table 3**.

Table 3: Performance Standards

Key Measure	Development Phase	Performance Standard	Method	Timing
Water Quality	Operational	Investigation threshold - turbidity in receiving water greater than 10% above background (up stream of development site) or total suspended solids in receiving water greater than 50 mg/L ¹ whichever is higher.	Samples taken upstream and downstream of the site	During run-off event.
Stabilisation	Post-construction (or maintenance)	60% groundcover (vegetation and/or rock mulch) in areas identified for surface stabilisation.	Groundcover estimate	Removal of temporary ESC measures.
Erosion control structures functional	Operational	Structures correctly placed and serviceable. Weeds and sediment removed from drains.	Inspection	November (prior to the wet season ²). During the wet season after run-off events. Following the wet season (April).

¹ DERM 2009. Queensland Water Quality Guidelines. Version 3. September 2009 (Table 8.2.1).

² Wet season: 1 November – 30 April.

2.2 Access corridors

The following approach will apply to erosion and sediment control on access corridors.

- Maintain a single access point to the work area (*ie* avoid multiple entry and exit tracks).
- If excavation is not required (*eg* exploration tracks) limit clearing to removal of above ground woody material.
- Run-off from disturbed areas should be controlled by temporary structures to limit the velocity and concentration of flows (for example diversion banks and sediment fencing).

- The area of disturbance should be minimised and temporary/permanent surface stabilisation provided as soon as practicable following completion of earthworks.
- Batter slopes should be between 1:4 and 1:6 on fill slopes and a maximum of 1:3 on cut slopes to allow surface stabilisation and maintenance (DMR 2000).
- Road/access track drainage should be:
 - crowned to ensure cross-fall and run-off is to the road side and not along the road.
 - length of slope minimised by cross-fall, cross-drains or whoa boys. Maximum spacings between structures should be as follows:

Slope	Max spacing of drainage control (m)
<8%	30
8-25%	20
>25%	10

- Road maintenance should avoid windrowing along road edges which prevent discharge of surface drainage.

Suitable ESC structures for use in access corridors and exploration areas are described in Table 4.

Table 4: Access Corridors and Exploration ESC Structures

Type of Structure	Purpose	Design Criteria	Design/Construction Notes	As Built Confirmation
Roll Over Bank	To direct run-off from sloping tracks (not suitable for haul roads).	<u>Minimum Specification:</u> - 500 mm high - 1:6 approaches - Cross fall of <2% <u>Relevant Guideline:</u> NA.	- Compact material to prolong serviceability.	Inspection Test Procedure (ITP) documentation. Field inspection records.
Roadside Table Drains	To collect and control road and track run-off.	<u>Design Criteria:</u> - 1 in 2 year critical event. <u>Minimum Specification:</u> - Trapezoidal profile - Base width – 0.8 m - Depth – 0.5 m <u>Relevant Guideline:</u> NA.	- Compact side slopes - Ensure all loose material removed from shoulder and surrounds following construction. - Where slopes exceed 5% use Check Dams to control velocity. - Turnout provided at regular intervals (if scour or gullying occurs - install additional turnouts). - Turnouts discharge to placed rock (1m x 1 m) and grass (if necessary seed the area downslope).	Inspection Test Procedure (ITP) documentation. Field inspection records.
Check Dams	To control velocity of concentrated flows in roadside drains.	<u>Minimum Specification:</u> - Height to 0.3 m - Provide central invert <u>Relevant Guideline¹:</u> Appendix C.	- On slopes install at spacing so that crest of lower check dam is level with toe of upstream check dam. - Construct of rock min 200 mm diameter.	Inspection Test Procedure (ITP) documentation. Field inspection records.

¹ Note these are guidelines not specifications

Performance standards applying to erosion and sediment control works associated with access corridors and exploration are described in **Table 5**.

Table 5: Performance Standards

Key Measure	Development Phase	Performance Standard	Method	Timing
Installation of ESC measures.	Establishment or maintenance of access track or exploration facility (eg drill pad).	ESC structures in place and serviceable.	Inspection by Senior Environmental Advisor.	Completion and duration of construction.
Stability	Operations	Turnout drain outlets discharge to stable grassed or rock-lined areas.	Inspection	Completion of construction and maintenance.
Stability	Operations	No scour or gullyng of road surface.	Inspection	Completion of construction and maintenance.
Stability	Operations	No scour or gullyng of table drains.	Inspection	Completion of construction and maintenance.
Erosion control structures functional	Operations	Structures correctly placed and serviceable.	Inspection	November (prior to the wet season ¹). During the wet season after run-off events. Following the wet season (April).

¹ Wet season: 1 November – 30 April.

3. Implementation

This section describes the process to be followed in implementing erosion and sediment control on-site.

3.1 Inspection Test Plan

Installation is controlled by use of an Inspection Test Plan (ITP) as described below.

- Each structure is given a unique number (or other identifier).
- Structures are numbered/identified in the field.
- ITPs are completed as structures are installed.

An example of an ITP is provided in **Appendix D**.

3.2 Monitoring and reporting

Routine monitoring should be undertaken in the form of site inspections. These inspections should follow rainfall events that cause run-off to determine if repair/replacement is necessary.

Detailed monitoring should be carried out prior to and following the wet season and necessary repair and/or corrective actions taken.

The ESC Monitoring Checklist (**Appendix E**) should be used as a record of monitoring.

Reporting will be via the ITP (signifying status of structure installation) and the ESC Monitoring Checklist (running record of any maintenance requirements).

3.3 Responsible Person

The nominated Responsible Person for the implementation of the ESCP is the Site Senior Executive. Final sign-off on ITPs and ESC Monitoring Checklist will be provided by the Site Senior Executive.

3.4 Modifications

ESCP reviews

Changes to the ESCP will be necessary as the result of monitoring of performance of erosion and sediment control measures and site developments that warrant amendment to either the PoO and/or the EA. Irrespective of this, the ESCP should be reviewed annually.

Change management

It is expected that modifications to the measures described in the ESCP will be needed in response to site circumstances. The modifications may be considered minor, moderate or significant. It is expected that significant modifications will be the exception, whereas moderate and certainly minor changes will occur.

To accommodate these circumstances a change management decision matrix is presented in **Table 6**.

Table 6: Change Management Decision Matrix

Authority Required/Item	Minor	Moderate		Significant
	Maintenance of all structures	Removal or relocation of minor structures	Permanent measure relocation	Permanent measure removal revisions to ESCP
Site ESC Representative	✓	✗	✗	✗
Responsible Person Site Senior Executive	✓	✓	✓	✗
Qualified Erosion Control Professional or Senior Environmental Advisor	✓	✓	✓	✓

✓ Authorised to undertake.

✗ Not authorised to undertake.

3.5 Training

Should project expansion occur, as anticipated, it is recommended that at least one member of the site team have formal training in erosion and sediment control.

4. References

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- Northcote, K. H., Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., Hubble, G. D., Isbell, R. F., McArthur, W. M., Murtha, G. G., Nicolls, K. D., Paton, T. R., Thompson, C. H., Webb, A. A. & Wright, M. J. 1960–1968. Atlas of Australian Soils, Sheets 1 to 10 with explanatory data. CSIRO and Melbourne University Press: Melbourne. (Viewed via the Queensland Government IRTM v4.2 viewer, webgis.dme.qld.gov.au/webgis/webqmin/viewer.htm).
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- NRA 2013b. Mount Carbine Tungsten Project, Plan of Operations October, 2013 – October 2014. Prepared by NRA Environmental Consultants for Carbine Tungsten Limited.
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QT 1992. Mount Carbine Mine, Mt Carbine-North Queensland. Plan of Operations (June 1992-June 1997). Prepared by Queensland Tungsten Inc. (a subsidiary of Normandy Poseidon Ltd).

QT 1993. Mount Carbine Mine, Mt Carbine-North Queensland. Decommissioning and Rehabilitation Programme (July 1993-December 1993). Prepared by Queensland Tungsten Inc. (a subsidiary of Normandy Poseidon Ltd).

Appendix A: Soils and Tailings Characterisation Data

Soil Sample Analysis Summary

	SITE 3	SITE 6	SITE 5	SITE 4
Soil Colour (Munsell)	Brown	Brown	Brown	Brown
Soil Texture	Gravelly Sandy Clay Loam	Gravelly Sandy Clay Loam	Gravelly Sandy Clay Loam	Gravelly Sandy Clay Loam
pH (1:5 Water)	5.2	5.3	5.7	5.7
Buffer pH	6.1	5.9	6.1	6.2
Organic Carbon %C	1.0	1.3	1.2	0.6
Nitrate Nitrogen mg/kg	3.4	2.3	0.5	0.4
Sulfur mg/kg	65	194	16	4
Phosphorus (BSES) mg/kg	41	9	7	7
Phosphorus (Colwell) mg/kg	7	3	3	4
Potassium meq/100g	0.25	0.15	0.21	0.25
Calcium meq/100g	1.55	2.83	3.92	1.78
Magnesium meq/100g	1.31	2.91	2.40	0.53
Aluminium meq/100g	0.17	0.03	-	-
Sodium meq/100g	0.36	0.70	0.23	0.07
Chloride mg/kg	60	85	40	20
Copper mg/kg	2.9	0.9	1.0	0.5
Zinc mg/kg	3.4	0.3	0.7	0.4
Manganese mg/kg	19	8	6	28
Iron mg/kg	82	137	44	9
Boron mg/kg	0.07	0.10	0.04	0.06
Liming Requirement 5.5	0.1	0.3	-	-
Liming Requirement 6.5	0.7	1.3	0.7	0.5
Cation Exch. Capacity meq/100g	3.64	6.62	6.77	2.64
Calcium/Magnesium Ratio	1.18	0.97	1.63	3.36
Aluminium Saturation %	4.7	0.5	-	-
Sodium% of cations (ESP)	9.89	10.57	3.40	2.65
Elec. Conductivity (s.e.) ds/m	1.2	2.3	0.5	0.3

SITE 3 - *Adjacent highway*

SITE 4 - *Pipeline easement*

SITE 5 - *Adjacent creeks behind large size rock pile*

SITE 6 - *Adjacent highway*

A copy of Analysis Systems test reports is included as appendix 1.

SOIL ANALYSIS REPORT

**Analysis
Systems**

From Incitec People with answers.

Incitec Ltd
Australian Company Number 010 767 263
Paringa Road, Gibson Island, Murarrie
P.O. Box 140, Morningside, Qld 4170
Tel: (07) 867 9300

QLD Tungsten
Mt Carbine
Mt Carbine
QLD 4871

Phone 070 943157 Fax
Nearest Town Postcode
Distance to Town Direction to Town
Australian Map Grid Ref Average Annual Rainfall mm

SOIL SAMPLE AND SITE INFORMATION:

Sampling depth(cm) 0-15 Surface Months of Fallow
Sampling depth(cm) - Deep Age of cultivation yrs
Drainage
Paddock area ha Stubble/Trash
Soil type Tillage
Slope Irrigation
Soil profile depth m
Reasons for sampling 1. Determine fertilizer needs
2. Concern with major nutrients

PRODUCTION INFORMATION:

Main species to be fertilized Aluvium Age established yrs mths
Variety Root stock(Hort)
Previous best yield Plant population ha
Yield last year Canopy radius(Hort) m
Vigour of growth Grain protein
Row/tree spacing(Hort) m X m Legume content
Row spacing(Grain/Cotton) Stock type
Interrow treatment Stock number
Stage in Crop Cycle(Sugar Cane)
Method of fertilizer placement:
1. 2. 3.

FERTILIZER HISTORY:

Fertilizers	Application Rate	Units	Date Applied Year Month
Most Recent Crop	=====	=====	=====

Previous Crop

Previous Crop

Other Relevant Comments

Results of Analysis

Paddock Name No5
Order Number 129648
Product Hort and Full Range Soil
Sample Bag Number Surface 03126
Corresponding Deep Soil Bag No
Date of Sampling 24/05/93
Date Received 26/05/93
Date of Report 02/06/93

Soil colour (Munsell) Brown
Soil texture Gravelly Sandy Clay Loam
pH(1:5 Water) 5.2
Buffer pH 6.1
Organic Carbon %C 1.0
Nitrate Nitrogen mg/kg 3.4
Sulfur mg/kg 65
Phosphorus(BSES) mg/kg 41
Phosphorus(Colwell) mg/kg 7
Potassium meq/100g 0.25
Calcium meq/100g 1.55
Magnesium meq/100g 1.31
Aluminium meq./100g 0.17
Sodium meq/100g 0.36
Chloride mg/kg 60
Copper mg/kg 2.9
Zinc mg/kg 3.4
Manganese mg/kg 19
Iron mg/kg 82
Boron mg/kg 0.07

Calculations

Liming Requirement 5.5 0.1
Liming Requirement 6.5 0.7
Cation Exch. Capacity meq/100g 3.64
Calcium/Magnesium Ratio 1.18
Aluminium Saturation % 4.7
Sodium% of cations(ESP) 9.89
Elec. Conductivity (s.e.) dS/m 1.2

Methods, Calculations outlined overpage.

FOR INTERPRETATION OF THESE RESULTS,
PLEASE CONTACT YOUR DEALER: 070 922444

TOBACCO GRWRS MAREEBA
PO BOX 171
MAREEBA QLD 4880

OR YOUR INCITEC AREA MANAGER
J STEPHENSON PH: 070 922524/018 774452

Registered Signatory

Samples are analysed as received

Report # 23788

SOIL ANALYSIS REPORT

Incitec Ltd
Australian Company Number 010 767 263
Paringa Road, Gibson Island, Murarrie
P.O. Box 140, Morningside, Qld 4170
Tel: (07) 867 9300



From Incitec People with answers.

QLD Tungsten
Mt Carbine
Mt Carbine
QLD 4871

Phone 070 943157 Fax
Nearest Town Postcode
Distance to Town Direction to Town
Australian Map Grid Ref Average Annual Rainfall mm

SOIL SAMPLE AND SITE INFORMATION:

Sampling depth(cm) 0-15 Surface Months of Fallow
Sampling depth(cm) - Deep Age of cultivation yrs
Drainage
Paddock area ha Stubble/Trash
Soil type Tillage
Slope Irrigation
Soil profile depth m
Reasons for sampling 1. Determine fertilizer needs
2. Concern with major nutrients

PRODUCTION INFORMATION:

Main species to be fertilized Wooded Stockpile Age established yrs mths
Variety Root stock(Hort)
Previous best yield Plant population ha
Yield last year Canopy radius(Hort) m
Vigour of growth Grain protein
Row/tree spacing(Hort) m X m Legume content
Row spacing(Grain/Cotton) Stock type
Interrow treatment Stock number
Stage in Crop Cycle(Sugar Cane)
Method of fertilizer placement:
1. 2. 3.

FERTILIZER HISTORY: Fertilizers Application Units Date Applied
Rate Year Month

Most Recent Crop =====

Previous Crop

Previous Crop

Other Relevant Comments

Results of Analysis

PADDOCK NAME No 8
ORDER NUMBER 131051
PRODUCT Hort and Full Range Soil
SAMPLE BAG NUMBER SURFACE 04592
CORRESPONDING DEEP SOIL BAG No
DATE OF SAMPLING 24/05/93
DATE RECEIVED 26/05/93
DATE OF REPORT 02/06/93

Soil colour (Munsell) Brown
Soil texture Gravelly Sandy Clay Loam
pH(1:5 Water) 5.3
Buffer pH 5.9
Organic Carbon % 1.3
Nitrate Nitrogen mg/kg 2.3
Sulfur mg/kg 194
Phosphorus(BSES) mg/kg 9
Phosphorus(Colwell) mg/kg 3
Potassium meq/100g 0.15
Calcium meq/100g 2.83
Magnesium meq/100g 2.91
Aluminium meq./100g 0.03
Sodium meq/100g 0.70
Chloride mg/kg 85
Copper mg/kg 0.9
Zinc mg/kg 0.3
Manganese mg/kg 8
Iron mg/kg 137
Boron mg/kg 0.10

Calculations

Liming Requirement 5.5 0.3
Liming Requirement 6.5 1.3
Cation Exch. Capacity meq/100g 6.62
Calcium/Magnesium Ratio 0.97
Aluminium Saturation % 0.5
Sodium% of cations(ESP) 10.57
Elec. Conductivity (s.e.) dS/m 2.3

Methods, Calculations outlined overpage.

FOR INTERPRETATION OF THESE RESULTS,
PLEASE CONTACT YOUR DEALER: 070 922444

TOBACCO GRWRS MAREEBA
PO BOX 171
MAREEBA QLD 4880

OR YOUR INCITEC AREA MANAGER
J STEPHENSON PH: 070 922524/018 774452

Registered Signatory

Samples are analysed as received
Report # 23791

SOIL ANALYSIS REPORT

**Analysis
Systems**

From **Incitec** People with answers.

Incitec Ltd
Australian Company Number 010 767 263
Paringa Road, Gibson Island, Murarrie
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QLD Tungsten
Mt Carbine
Mt Carbine
QLD 4871

Phone 070 943157 Fax
Nearest Town Postcode
Distance to Town Direction to Town
Australian Map Grid Ref Average Annual Rainfall mm

SOIL SAMPLE AND SITE INFORMATION:

Sampling depth(cm) - Surface Months of Fallow
Sampling depth(cm) - Deep Age of cultivation yrs
Drainage
Paddock area ha Stubble/Trash
Soil type Tillage
Slope Irrigation
Soil profile depth m
Reasons for sampling
1. Determine fertilizer needs
2. Concern with major nutrients

PRODUCTION INFORMATION:

Main species to be fertilized Wooded near dam Age established yrs mths
Variety Root stock(Hort)
Previous best yield Plant population ha
Yield last year Canopy radius(Hort) m
Vigour of growth Grain protein
Row/tree spacing(Hort) m X m Legume content
Row spacing(Grain/Cotton) Stock type
Interrow treatment Stock number
Stage in Crop Cycle(Sugar Cane)
Method of fertilizer placement:
1. 2. 3.

FERTILIZER HISTORY:

Fertilizers	Application Rate	Units	Date Applied Year Month
Most Recent Crop	=====	=====	=====
Previous Crop			
Previous Crop			
Other Relevant Comments			

Results of Analysis

PADDOCK NAME No6
ORDER NUMBER 129649
PRODUCT Hort and Full Range Soil
SAMPLE BAG NUMBER SURFACE 06922
CORRESPONDING DEEP SOIL BAG No
DATE OF SAMPLING 24/05/93
DATE RECEIVED 26/05/93
DATE OF REPORT 02/06/93

Soil colour (Munsell) Brown
Soil texture Gravelly Sandy Clay Loam
pH(1:5 Water) 5.7
Buffer pH 6.2
Organic Carbon %C 0.6
Nitrate Nitrogen mg/kg 0.4
Sulfur mg/kg 4
Phosphorus(BSES) mg/kg 7
Phosphorus(Colwell) mg/kg 4
Potassium meq/100g 0.25
Calcium meq/100g 1.78
Magnesium meq/100g 0.53
Sodium meq/100g 0.07
Chloride mg/kg 20
Copper mg/kg 0.5
Zinc mg/kg 0.4
Manganese mg/kg 28
Iron mg/kg 9
Boron mg/kg 0.06

Calculations

Liming Requirement 6.5 0.5
Cation Exch. Capacity meq/100g 2.64
Calcium/Magnesium Ratio 3.36
Sodium% of cations(ESP) 2.65
Elec. Conductivity (s.e.) dS/m 0.3

Methods, Calculations outlined overpage.

FOR INTERPRETATION OF THESE RESULTS,
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Registered Signatory

Samples are analysed as received
Report # 23789

METHODS OF SOIL ANALYSIS

Soil Colour	- visual assessment of moist soil against Munsell colour chart.
Soil Texture	- field texture techniques of Northcole.
pH (1:5 water)	- 1 to 5, soil to water dilution, stirred, stand 1 hour and read while stirring, using combination electrode.
Buffer pH	- Mehlich buffer - 1:1 soil water for 1/2 hour, add buffer to 1:2 soil solution, stand 1 hour, read while stirring.
Organic Carbon	- Walkley and Black, using H_2SO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ in 1:100 dilution, colourimetric, finished with Brinkman Probe colourimeter.
Nitrate Nitrogen	- 1:5 soil:water, intermittent stirring over 1 hour, centrifuged and nitrate measured colourimetrically in segmented flow analyser.
Sulfur	- 1:5 soil: solution of 0.01 M Ca (H_2PO_4) ₂ , end-over-end shake for 16 hours, centrifuge, measured on ICP AES as phosphate extractable sulfur (sulfate).
Phosphorus (Colwell)	- 1:100 soil:solution of 0.5 M NaHCO_3 , end-over-end 16 hour shake, centrifuge, measured colourimetrically in segmented flow analyser.
Phosphorus (BSES)	- 1:200 soil:solution of 0.01 N H_2SO_4 , end-over-end, 16 hour shake, centrifuge, measured colourimetrically in segmented flow analyser.
Potassium, calcium magnesium, sodium	- 1:10 neutral, normal ammonium acetate, 1/2 hour vigorous shake, centrifuged, measured on ICP AES.
Aluminium	- 1:10 soil:solution of 1M KCl, 1 hour vigorous shake, centrifuged, measured on Atomic Absorption spectrophotometer.
Chloride	- 1:5 soil:water, intermittent stirring over 1 hour, centrifuged and chloride measured colourimetrically in segmented flow analyser.
Electrical conductivity	- 1:5 soil:water, stirred, stand 1 hour and read by conductivity meter.
Copper, zinc, manganese, iron	- 1:10 soil:solution of DTPA, triethanolamine and CaCl_2 1/2 hour vigorous shake, centrifuged, measured on ICP AES.
Boron	- 1:2 soil:solution of hot 0.01M CaCl_2 , end-over-end, 1 hour shake, centrifuged, measured on ICP AES.

CALCULATIONS

Cation exchange capacity = sum of K, Ca, Mg, Na and Al (if present).

Calcium/Magnesium ratio = $\text{Ca} \div \text{Mg}$

Aluminium saturation = $\frac{\text{Al} \times 100}{\text{Cation exchange capacity}}$

Sodium % (ESP) = $\frac{\text{Na} \times 100}{\text{Cation exchange capacity}}$

Elec. conductivity of saturated extract (equiv) is based on conversions of EC (1:5) and soil texture class, to give more accurate assessment of soil salinity hazard (R.J. Shaw et al. QDPI)

CONDITIONS OF SALE OF SOIL, PLANT TISSUE, WATER AND POTTING MIX ANALYSES

1. DEFINITIONS:

"Company" hereinafter stated is Incitec Ltd.

2. WARRANTIES/LIMITATION OF LIABILITY:

The Company warrants that the services supplied hereto shall comply with the description and specification as set out in Company brochures or other product documentation published by the Company. All services are supplied subject to this warranty only and all other warranties, whether express or implied, are hereby excluded (subject however to any over-riding provisions of the Trade Practices Act 1974 or other Statute). Any other liability arising out of the supply of the services or the rendering of the services, however arising and whether for consequential loss or otherwise and including any liability whatsoever the Company may otherwise have by virtue of any representation, warranty, conditions or term whether expressed or implied by law is hereby excluded. Any liability which may be implied by over-riding provisions of the Trade Practices Act 1974 or other Statute hereinafter enacted, shall be limited to the extent that it is lawful to do so at the option of the Company, to the rendering again of the services provided and in particular shall not extend to consequential loss or damage and shall be conditional upon the purchaser within thirty (30) days of delivery making a written claim to the Company setting out the full particulars of such claim and where possible returning to the Company sufficient information regarding the rendering of the services to enable a proper investigation of the matter.

3. RECOMMENDATIONS:

It is a condition of any recommendations given pursuant to the results of any analysis supplied by the Company that the samples upon which the analyses were conducted are representative of the area from which the samples came and hence are indicative of soil type and soil structure for which the recommendations are made. As agronomic circumstances and practices vary substantially from place to place and from time to time and as such circumstances and practices are outside the controls of the Company, any recommendations which may be made by the Company are based on general and reasonably anticipated conditions and circumstances and the Company cannot and does not warrant or otherwise guarantee the results of any agronomic recommendations given as a result of the analysis carried out and therefore, subject to any statutory rights, any advice, recommendations, information, assistance or services provided by the Company in relation to the analytical services hereby rendered is given in good faith and is believed by the Company to be appropriate and reliable, however, any liability arising out of or in respect of any such advice, recommendations, information, assistance or services provided by the Company in rendering the analytical services is hereby expressly excluded.

4. DELAY:

All orders for soil, plant tissue, water and potting mix analysis shall be accepted by the Company without responsibility for loss or damage to samples or delays in performance or failure to carry out analyses for any reason whatsoever. The Company will make all reasonable efforts to have the analytical services rendered to the purchaser on or before the date agreed between the parties as the delivery date, but the Company shall be under no responsibility or liability whatsoever should delivery not be made on or before that date.

5. INTELLECTUAL PROPERTY:

No right or licence is granted to the purchaser of these analytical services for any patent, copyright, registered design or other industrial or intellectual property whatsoever and the user acknowledges that all such intellectual property and confidential information shall remain the property of the Company and shall not be used or disclosed by any party unless expressly authorised so to do by the Company.

6. NOTICES:

Any notice required to be given herein shall be in writing and shall be deemed to be properly served if delivered personally, sent by ordinary prepaid mail or sent by telex or facsimile machine to the other party at its last known address. The date of the service of the notice sent by mail shall be deemed to be duly served at the time when in due course the postage would have been delivered.

SOIL ANALYSIS REPORT

Incitec Ltd
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Analysis Systems
From Incitec People with answers.

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Mt Carbine
QLD 4871

Phone 070 943157 Fax
Nearest Town Postcode
Distance to Town Direction to Town
Australian Map Grid Ref Average Annual Rainfall mm

SOIL SAMPLE AND SITE INFORMATION:

Sampling depth(cm) 0-15 Surface Months of Fallow
Sampling depth(cm) - Deep Age of cultivation yrs
Drainage
Paddock area ha Stubble/Trash
Soil type Tillage
Slope Irrigation
Soil profile depth m
Reasons for sampling
1. Concern with major nutrients
2. Concern with micronutrients

PRODUCTION INFORMATION:

Main species to be fertilized Lower 4 Dam Age established yrs mths
Variety Root stock(Hort)
Previous best yield Plant population ha
Yield last year Canopy radius(Hort) m
Vigour of growth Grain protein
Row/tree spacing(Hort) m X m Legume content
Row spacing(Grain/Cotton) Stock type
Interrow treatment Stock number
Stage in Crop Cycle(Sugar Cane)
Method of fertilizer placement:
1. 2. 3.

FERTILIZER HISTORY:

Fertilizers	Application Rate	Units	Date Applied Year Month
Most Recent Crop	=====	=====	=====

Previous Crop

Previous Crop

Other Relevant Comments

Results of Analysis

PADDOCK NAME No2
ORDER NUMBER 129645
PRODUCT Hort and Full Range Soil
SAMPLE BAG NUMBER SURFACE 06948
CORRESPONDING DEEP SOIL BAG No
DATE OF SAMPLING 19/05/93
DATE RECEIVED 20/05/93
DATE OF REPORT 26/05/93

Soil colour (Munsell) Grey Brown
Soil texture Gritty Sandy Loam
pH(1:5 Water) 8.6
Organic Carbon %C 0.1
Nitrate Nitrogen mg/kg 0.2
Sulfur mg/kg 293
Phosphorus(BSES) mg/kg 200+
Phosphorus(Colwell) mg/kg 5
Potassium meq/100g 0.09
Calcium meq/100g 5.80
Magnesium meq/100g 0.26
Sodium meq/100g 0.19
Chloride mg/kg 55
Copper mg/kg 1.7
Zinc mg/kg 2.3
Manganese mg/kg 8
Iron mg/kg 10
Boron mg/kg 0.13

Calculations

Cation Exch. Capacity meq/100g 6.35
Calcium/Magnesium Ratio 22.31
Sodium% of cations(ESP) 2.99
Elec. Conductivity (s.e.) dS/m 3.4

Methods, Calculations outlined overpage.

FOR INTERPRETATION OF THESE RESULTS,
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Registered Signatory

Samples are analysed as received
Report # 23465

SOIL ANALYSIS REPORT



From **Incitec** People with answers.

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Mt Carbine
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QLD 4871

Phone 070 943157 Fax
Nearest Town Postcode
Distance to Town Direction to Town
Australian Map Grid Ref Average Annual Rainfall mm

SOIL SAMPLE AND SITE INFORMATION:

Sampling depth(cm) 0-15 Surface Months of Fallow
Sampling depth(cm) - Deep Age of cultivation yrs
Drainage
Paddock area ha Stubble/Trash
Soil type Tillage
Slope Irrigation
Soil profile depth m
Reasons for sampling 1. Concern with major nutrients
2. Concern with micronutrients

PRODUCTION INFORMATION:

Main species to be fertilized 4 Tailings Dam Mid Age established yrs mths
Variety Root stock(Hort)
Previous best yield Plant population ha
Yield last year Canopy radius(Hort) m
Vigour of growth Grain protein
Row/tree spacing(Hort) m X m Legume content
Row spacing(Grain/Cotton) Stock type
Interrow treatment Stock number
Stage in Crop Cycle(Sugar Cane)
Method of fertilizer placement:
1. 2. 3.

FERTILIZER HISTORY: Fertilizers Application Units Date Applied
Rate Year Month
Most Recent Crop

Previous Crop

Previous Crop

Other Relevant Comments

Results of Analysis

Paddock NAME No3
ORDER NUMBER 129646
PRODUCT Hort and Full Range Soil
SAMPLE BAG NUMBER SURFACE 04589
CORRESPONDING DEEP SOIL BAG No
DATE OF SAMPLING 19/05/93
DATE RECEIVED 20/05/93
DATE OF REPORT 26/05/93

Soil colour (Munsell) Grey Brown
Soil texture Gritty Sandy Loam
pH(1:5 Water) 8.9
Organic Carbon %C 0.1
Nitrate Nitrogen mg/kg 0.2
Sulfur mg/kg 87
Phosphorus(BSES) mg/kg 200 +
Phosphorus(Colwell) mg/kg 5
Potassium meq/100g 0.06
Calcium meq/100g 5.70
Magnesium meq/100g 0.15
Sodium meq/100g 0.09
Chloride mg/kg 30
Copper mg/kg 1.7
Zinc mg/kg 2.1
Manganese mg/kg 4
Iron mg/kg 10
Boron mg/kg 0.14

Calculations

Cation Exch. Capacity meq/100g 6.01
Calcium/Magnesium Ratio 38.00
Sodium% of cations(ESP) 1.50
Elec. Conductivity (s.e.) dS/m 1.3

Methods, Calculations outlined overpage.

FOR INTERPRETATION OF THESE RESULTS,
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Registered Signatory

Samples are analysed as received
Report # 23466

SOIL ANALYSIS REPORT

Incitec Ltd

Australian Company Number 010 767 263

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P.O. Box 140, Morningside, Qld 4170
Tel: (07) 867 9300



From Incitec People with answers.

QLD Tungsten
Mt Carbine
Mt Carbine
QLD

4871

Phone 070 943157

Fax

Nearest Town

Postcode

Distance to Town

Direction to Town

Australian Map Grid Ref

Average Annual Rainfall mm

SOIL SAMPLE AND SITE INFORMATION:

Sampling depth(cm) 0- Surface Months of fallow
Sampling depth(cm) - Deep Age of cultivation yrs
Drainage
Paddock area ha Stubble/Trash
Soil type Tillage
Slope Irrigation
Soil profile depth m
Reasons for sampling 1. Concern with major nutrients
2. Concern with micronutrients

PRODUCTION INFORMATION:

Main species to be fertilized Top 4 Dam Age established yrs mths
Variety Root stock(Hort)
Previous best yield Plant population ha
Yield last year Canopy radius(Hort) m
Vigour of growth Grain protein
Row/tree spacing(Hort) m X m : Legume content
Row spacing(Grain/Cotton) Stock type
Interrow treatment Stock number
Stage in Crop Cycle(Sugar Cane)
Method of fertilizer placement:
1. 2. 3.

FERTILIZER HISTORY: Fertilizers Application Units Date Applied
Rate Year Month
Most Recent Crop =====

Previous Crop

Previous Crop

Other Relevant Comments

Results of Analysis

Paddock NAME No4
ORDER NUMBER 129647
PRODUCT Hort and Full Range Soil
SAMPLE BAG NUMBER SURFACE 06949
CORRESPONDING DEEP SOIL BAG No
DATE OF SAMPLING 19/05/93
DATE RECEIVED 20/05/93
DATE OF REPORT 26/05/93

Soil colour (Munsell) Grey Brown
Soil texture Gritty Sandy Loam
pH(1:5 Water) 9.2
Organic Carbon %C 0.1
Nitrate Nitrogen mg/kg 0.2
Sulfur mg/kg 8
Phosphorus(BSES) mg/kg 200 +
Phosphorus(Colwell) mg/kg 4
Potassium meq/100g 0.04
Calcium meq/100g 6.67
Magnesium meq/100g 0.10
Sodium meq/100g 0.11
Chloride mg/kg 25
Copper mg/kg 1.0
Zinc mg/kg 1.9
Manganese mg/kg 2
Iron mg/kg 6
Boron mg/kg 0.07

Calculations

Cation Exch. Capacity meq/100g 6.93
Calcium/Magnesium Ratio 66.70
Sodium% of cations(ESP) 1.59
Elec. Conductivity (s.e.) dS/m 0.7

Methods, Calculations outlined overpage.

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Report # 23480

Table 1
Soil Analysis – No. 4 Tailings Dam

Parameters	Site 1	Site 2	Site 3	Guideline Levels **
Soil colour (Munsell)	Grey Brown	Grey Brown	Grey Brown	–
Soil texture	Gritty Sandy Loam	Gritty Sandy Loam	Gritty Sandy Loam	–
pH (1:5 water)	8.6	8.9	9.2	5.5 – 8.5
Organic carbon %C	0.1	0.1	0.1	–
Nitrate Nitrogen mg/kg	0.2	0.2	0.2	–
Sulphur mg/kg	293	87	8	15
Phosphorus (BSES) mg/kg	200+	200+	200+	–
Phosphorus (Colwell) mg/kg	5	5	4	30
Potassium meq/100g	0.09	0.06	0.04	0.3
Calcium meq/100g	5.80	5.70	6.67	1.2
Magnesium meq/100g	0.26	0.15	0.10	0.8
Sodium meq/100g	0.19	0.09	0.11	–
Chloride mg/kg	55	30	25	<200–600
Copper mg/kg	1.7	1.7	1.0	0.2
Zinc mg/kg	2.3	2.1	1.9	0.5–1
Manganese mg/kg	8	4	2	2.0
Iron mg/kg	10	10	6	4.5
Boron mg/kg	0.13	0.14	0.07	–
Cation Exch. Capacity meq/100g	6.35	6.01	6.93	–
Calcium/Magnesium ratio	22.31	38.00	66.70	–
Sodium % of cations (ESP)	2.99	1.50	1.59	<6++
Elec. Conductivity (s.e.) dS/m	3.4	1.3	0.7	<2+

** Cited in Bell, L.C. and Bell, M.A. (1988) AMIC 1988 Papers; and ASSSI Refresher Course in Soil Science (1985). For nutrients, this is the level below which a plant response to application of the nutrient is expected (Aitken et al, 1984); for Cl, E.C. and ESP, the critical level is the value above which growth retardation may occur.

+ An E.C. <2 dS/m is considered to have negligible affects on plant growth with many plants affected in soils having an EC in the range of 4–8 dS/m. Beyond 16 dS/m only a few very salt tolerant plants grow.

++ An ESP $>15\%$ is classed strongly sodic.

Table 3
'Soil' Analysis – No 4 Tailings Dam

Parameters	Block 1A	Block 1B	Block 2A	Block 2B	Block 3A	Block 3B	Guideline Levels *
Soil colour (Munsell)	Grey	Grey	Grey	Grey	Grey	Grey	–
Soil texture	Sandy Tails	Sandy Tails	Sandy Tails	Sandy Tails	Sandy Tails	Sandy Tails	–
pH (1:5 Water)	8.7	7.2	8.4	8.8	8.8	9.2	5.5–8.5
Organic Carbon %C	0.1	0.1	0.1	0.1	0.1	0.1	–
Nitrate Nitrogen mg/kg	1.5	0.5	1.2	1	0.8	0.9	–
Sulfur mg/kg	8	5	8	6	10	12	15
Phosphorus (BSES) mg/kg	200+	200+	200+	200+	200+	200+	–
Phosphorus (Colwell) mg/kg	3	2	2	2	5	2	30
Potassium meq/100g	0.03	0.02	0.02	0.01	0.02	0.01	0.3
Calcium meq/100g	1.76	1.01	1.24	1.76	1.55	3.72	1.2
Magnesium meq/100g	0.06	0.06	0.06	0.06	0.06	0.1	0.8
Sodium meq/100g	0.01	0.01	0.01	0.01	0.01	0.01	–
Chloride mg/kg	10	5	10	10	10	5	<200–600
Copper mg/kg	0.7	0.6	0.8	0.6	0.5	0.6	0.2
Zinc mg/kg	1.3	1.2	1.2	1.2	1.3	1.4	0.5–1
Manganese mg/kg	1	1	1	1	1	1	2
Iron mg/kg	7	8	5	5	5	6	4.5
Boron mg/kg	0.04	0.03	0.04	0.02	0.05	0.06	–
ESP (%)	0.53	0.9	0.75	0.54	0.61	0.26	<6**
EC _(e) d S/m	0.4	0.2	0.4	0.3	0.3	0.4	<2***
CEC meq/100g	1.87	1.11	1.34	1.85	1.65	3.85	–
Ca/Mg ratio	29.33	16.83	20.67	29.33	25.83	37.2	–

* Cited in Bell, L C and Bell M A (1988) and ASSSI Refresher course in Soil Science (1985). For nutrients, this is the level below which a plant response to application of the nutrient is expected (Aitken et al, 1984); for Cl, EC and ESP, the critical level is the value above which growth retardation may occur.

** An ESP >15% is classed strongly sodic.

*** An EC_{4e2} dS/m is considered to have negligible effects on plant growth with many plants affected in soils having an EC in the range of 4–8 dS/m. Beyond 16 dS/m only a few very salt tolerant plants grow.

Appendix B:
Erosion and Sediment Control Plan
for TSF4 Catchments Diversion
Works

Erosion and Sediment Control Plan for TSF4 Catchment Diversion Works

The following erosion and sediment control plan (ESCP) has been developed for the isolation/diversion drain works required (in part) to make TSF4 on the Mount Carbine mine site conform to hazardous dam guidelines (DERM 2012¹).

Erosion and sedimentation risk – construction

Earthworks associated with installing the isolation/diversion drains for TSF4 pose the primary risk for erosion issues during the construction activities. These works are planned to occur during September and October 2013, during the nominal dry season for the area. It is not likely that significant rainfall will occur at site during the construction. Should heavy rainfall occur, erosion may occur when soils are disturbed.

Due to the timing of the construction works (*ie* north Queensland dry season) there is a low risk of sediment-laden water leaving the construction site during or following rainfall events. Windblown dirt in the dry season may be an issue if excavations or stockpiles are exposed for extended periods and dry out.

Erosion and sediment control measures – construction

The following controls should be implemented during the proposed construction works.

- Works shall be staged so that disturbance of one drain will not occur until the previous drain has been stabilised.
- Use existing tracks where possible.
- Mark limits of disturbance.
- Minimise handling of material.
- Spread seed on disturbed areas to establish ground cover on drains at the onset of the wet season.
- Cover soil stockpiles, if they are to remain on-site for more than 4 weeks or if dust is mobilised during dry conditions. Note that it is expected that there will be minimal stockpiles as material excavated will be used to create banks on the diversion drains.
- Install sediment fences around stockpiles if rainfall is expected to occur.
- Install sediment traps at drainage outlet (*eg* sandbags) if rainfall is expected to occur prior to drains having an established ground cover.
- Remove all temporary erosion and sediment controls after disturbed areas are stabilised.

Site-specific plans for construction are not provided here due to the low risk and simple erosion and sediment control measures. Information on the correct installation and maintenance of relevant erosion and sediment control measures are provided in **Attachment 1**.

Erosion and sediment control – operation

Water captured in the proposed diversion drains will be diverted to stable areas prior to release to the receiving environment. The V-Drain to the north of the TSF4 will drain to a stable area to the east of the TSF4. The Table Drain along the north-west part of the TSF4 will flow into the Catchbank, which will enter the receiving environment via a stabilised (rock armoured) drainage line adjacent to the existing TSF4 spillway.

¹ DERM 2012. *Manual for assessing hazard categories and hydraulic performance of dams*. EM635, Version 1. February 2012

Construction plans will consider permanent erosion and sediment control requirements.

Monitoring – construction phase

Prior to rainfall events, sediment traps (*eg* using sand bags) should be installed at drainage outlets, and sediment fences should be installed around stockpile areas (if present). The check dams and sediment fences should be inspected following any heavy rainfall events. Clean out or repair as required. Re-position if required.

Monitoring – operation phase

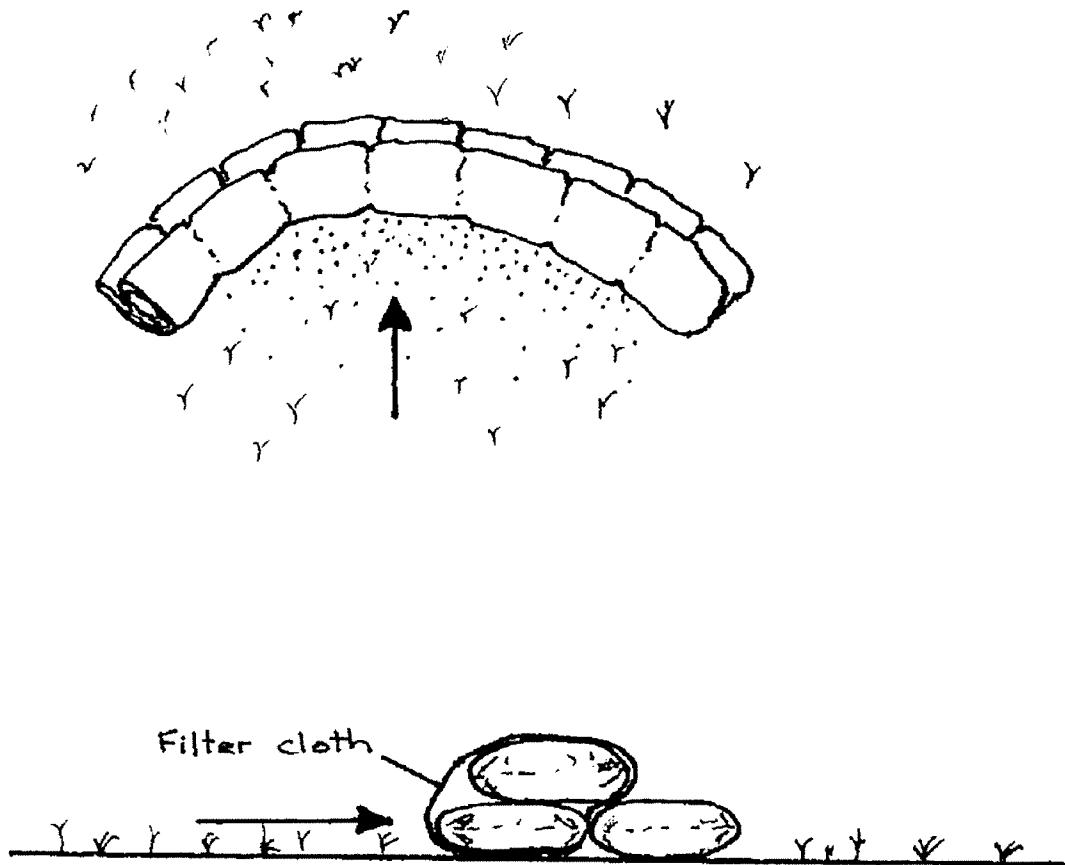
The integrity of the diversion drains and outlets will be inspected after major rainfall events during the wet season for evidence of erosion. Any occurrences of erosion will be remediated and stabilised (*eg* grass cover or rock mulch) as soon as possible. The receiving environment will be inspected during the wet season for evidence of sedimentation. If sedimentation is found, the source of the erosion will be investigated and remediated.

Attachment 1

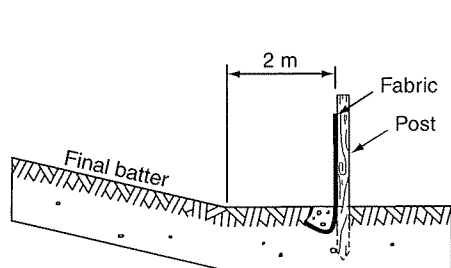
Sediment Trap

Rationale: Capture eroded sediment by slowing the velocity of water so that the soil particles settle out.

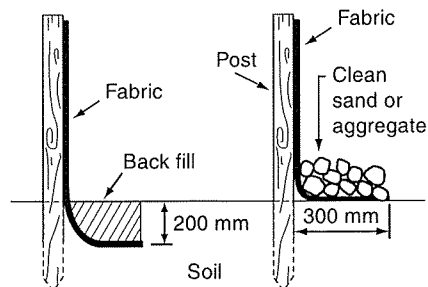
Installation: Wall of sandbags covered with a filter fabric to create a structure that will form a pond.



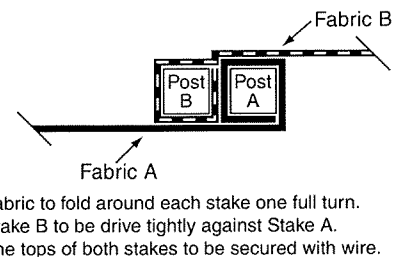
Monitoring and Maintenance: Sediment traps should be inspected after each runoff event (after rainfall). Sediment collected behind the sandbag wall should be removed if the sediment is within 200 mm of the top of the structure. Spread the collected sediment over areas being worked (provided no contamination is present) or on stable grassed areas. Any damaged sections of the sediment traps (eg undercutting, flows around trap) are to be repaired or replaced. The source of any excessive sedimentation should be identified and treated.



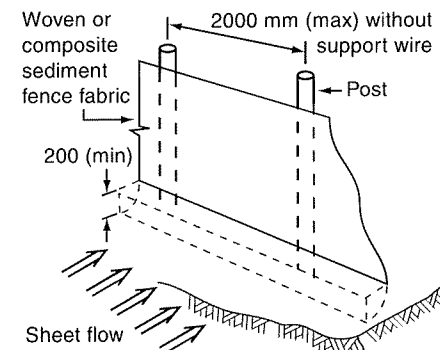
(a) Location of fence relative to base of slope



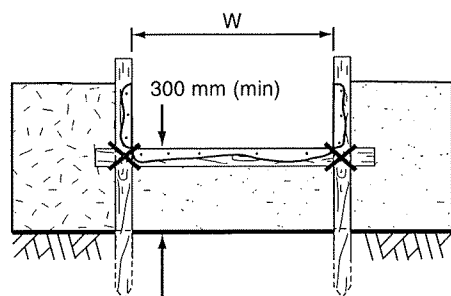
(b) Anchoring base of fabric



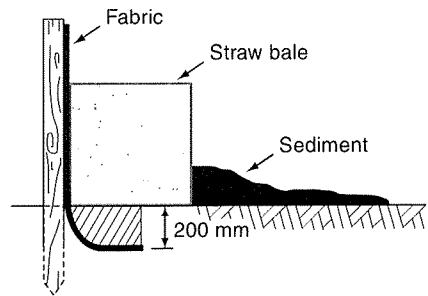
(c) Joining fabric - Method 1



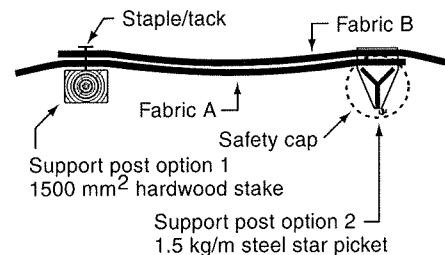
(d) Installation without backing support



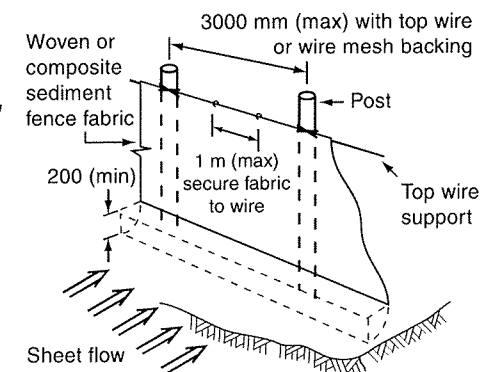
(e) Spill-through weir



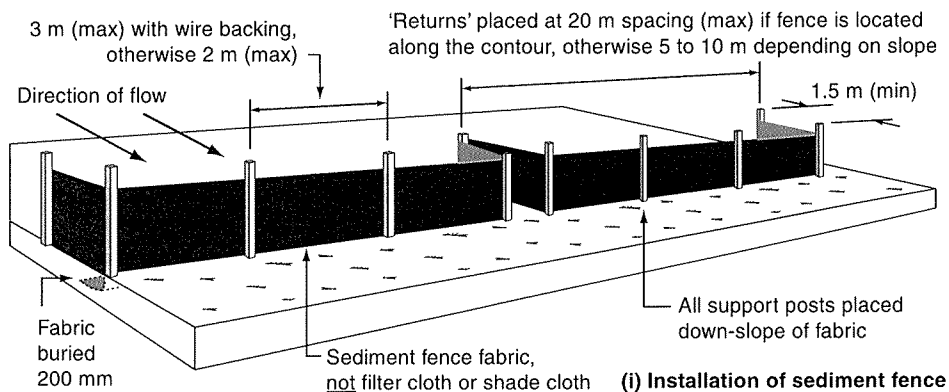
(f) Placement of up-slope straw bale



(g) Joining fabric - Method 2



(h) Installation with top wire support



(i) Installation of sediment fence

Notes:

1. Sediment fence to be installed along a line of constant ground elevation wherever practical.
2. Both end of the sediment fence to extend up the slope at least 1m.
3. Support post to be spaced a maximum 2m unless the fence is supported by a top wire or wire mesh backing, in which case 3m maximum spacing.
4. Fence 'returns' shall be installed at maximum 20m spacing if fence is installed along the contour, otherwise 5 to 10m maximum spacing.
5. Minimum 4 staples or tie wires per stake.

Drawn:	Date:		
GMW	Dec-09	Sediment Fence	SF-01

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140GSM. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm² (MIN) HARDWOOD, 2500mm² (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. TO THE MAXIMUM DEGREE PRACTICAL, AND WHERE THE PLANS ALLOW, ENSURE THE FENCE IS LOCATED:

- (i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;
- (ii) ALONG A LINE OF CONSTANT ELEVATION WHEREVER PRACTICAL;
- (iii) AT LEAST 2m FROM THE TOE OF ANY FILLING OPERATIONS THAT MAY RESULT IN SHIFTING SOIL/FILL DAMAGING THE FENCE.

3. INSTALL RETURNS WITHIN THE FENCE AT MAXIMUM 20m INTERVALS IF THE FENCE IS INSTALLED ALONG THE CONTOUR, OR 5 TO 10m MAXIMUM SPACING (DEPENDING ON SLOPE) IF THE FENCE IS INSTALLED AT AN ANGLE TO THE CONTOUR. THE 'RETURNS' SHALL CONSIST OF EITHER:

- (i) V-SHAPED SECTION EXTENDING AT LEAST 1.5m UP THE SLOPE; OR
- (ii) SANDBAG OR ROCK/AGGREGATE CHECK

DAM A MINIMUM 1/3 AND MAXIMUM 1/2 FENCE HEIGHT, AND EXTENDING AT LEAST 1.5m UP THE SLOPE.

4. ENSURE THE EXTREME ENDS OF THE FENCE ARE TURNED UP THE SLOPE AT LEAST 1.5m, OR AS NECESSARY, TO MINIMISE WATER BYPASSING AROUND THE FENCE.

5. ENSURE THE SEDIMENT FENCE IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE FENCE, AND THE UNDESIRABLE DISCHARGE OF WATER AROUND THE ENDS OF THE FENCE.

6. IF THE SEDIMENT FENCE IS TO BE INSTALLED ALONG THE EDGE OF EXISTING TREES, ENSURE CARE IS TAKEN TO PROTECT THE TREES AND THEIR ROOT SYSTEMS DURING INSTALLATION OF THE FENCE. DO NOT ATTACH THE FABRIC TO THE TREES.

7. UNLESS DIRECTED BY THE SITE SUPERVISOR OR THE APPROVED PLANS, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE PROPOSED FENCE LINE, PLACING THE EXCAVATED MATERIAL ON THE UP-SLOPE SIDE OF THE TRENCH.

8. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 3m IF SUPPORTED BY A TOP SUPPORT WIRE OR WEIR MESH BACKING, OTHERWISE NO GREATER THAN 2m.

9. IF SPECIFIED, SECURELY ATTACH THE SUPPORT WIRE OR MESH TO THE UP-SLOPE SIDE OF THE STAKES WITH THE MESH EXTENDING AT LEAST 200mm INTO THE EXCAVATED TRENCH. ENSURE THE MESH AND FABRIC IS ATTACHED TO THE UP-SLOPE SIDE OF THE STAKES EVEN WHEN DIRECTING A FENCE AROUND A CORNER OR SHARP CHANGE OF DIRECTION.

10. WHEREVER POSSIBLE, CONSTRUCT THE SEDIMENT FENCE FROM A CONTINUOUS ROLL OF FABRIC. TO JOIN FABRIC EITHER:

- (i) ATTACH EACH END TO TWO OVERLAPPING STAKES WITH THE FABRIC FOLDING AROUND THE ASSOCIATED STAKE ONE TURN, AND WITH

THE TWO STAKES TIED TOGETHER WITH WIRE; OR
(ii) OVERLAP THE FABRIC TO THE NEXT ADJACENT SUPPORT POST.

11. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS USING 25 X 12.5mm STAPLES, OR TIE WIRE AT MAXIMUM 150mm SPACING.

12. SECURELY ATTACH THE FABRIC TO THE SUPPORT WIRE/MESH (IF ANY) AT A MAXIMUM SPACING OF 1m.

13. ENSURE THE COMPLETED SEDIMENT FENCE IS AT LEAST 450mm, BUT NOT MORE THAN 700mm HIGH. IF A SPILL-THROUGH WEIR IS INSTALLED, ENSURE THE CREST OF THE WEIR IS AT LEAST 300mm ABOVE GROUND LEVEL.

14. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

ADDITIONAL REQUIREMENTS FOR THE INSTALLATION OF A SPILL-THROUGH WEIR

1. LOCATE THE SPILL-THROUGH WEIR SUCH THAT THE WEIR CREST WILL BE LOWER THAN THE GROUND LEVEL AT EACH END OF THE FENCE.

2. ENSURE THE CREST OF THE SPILL-THROUGH WEIR IS AT LEAST 300mm THE GROUND ELEVATION.

3. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE SUPPORT POSTS/ STAKES EACH SIDE OF THE WEIR. CUT THE FABRIC DOWN THE SIDE OF EACH POST AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

4. INSTALL A SUITABLE SPLASH PAD AND/OR CHUTE IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION AND APPROPRIATELY DISCHARGE THE CONCENTRATED FLOW PASSING OVER THE WEIR.

MAINTENANCE

1. INSPECT THE SEDIMENT FENCE AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. IF THE FENCE IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 1/3 THE HEIGHT OF THE FENCE.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS 6-MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT FENCE ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE FENCE MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Sediment Fence	SF-02

Appendix C:
Technical Notes
(IECA 2008)

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, DIMENSIONS AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, DIMENSIONS, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. WHEREVER PRACTICAL, LOCATE THE LEVEL SPREADER ON UNDISTURBED, STABLE SOIL.

3. ENSURE FLOW DISCHARGING FROM THE LEVEL SPREADER WILL DISPERSE ACROSS A PROPERLY STABILISED SLOPE NOT EXCEEDING 10:1 (H:V) AND SUFFICIENTLY EVEN IN GRADE ACROSS THE SLOPE TO AVOID CONCENTRATING THE OUTFLOW.

4. THE OUTLET SILL OF THE SPREADER SHOULD BE PROTECTED WITH EROSION CONTROL MATTING TO PREVENT EROSION DURING THE ESTABLISHMENT OF VEGETATION. THE MATTING SHOULD BE A MINIMUM OF 1200mm WIDE EXTENDING AT LEAST 300mm UPSTREAM OF THE EDGE OF THE OUTLET CREST AND BURIED AT LEAST 150mm IN A VERTICAL TRENCH. THE DOWNSTREAM EDGE SHOULD BE SECURELY HELD IN PLACE WITH CLOSELY SPACED HEAVY-DUTY WIRE STAPLES AT LEAST 150mm LONG.

5. ENSURE THAT THE OUTLET SILL (CREST) IS LEVEL FOR THE SPECIFIED LENGTH.

6. IMMEDIATELY AFTER CONSTRUCTION, TURF, OR SEED AND MULCH WHERE APPROPRIATE, THE LEVEL SPREADER.

MAINTENANCE

1. INSPECT THE LEVEL SPREADER AFTER EVERY RAINFALL EVENT UNTIL VEGETATION IS ESTABLISHED.

2. AFTER ESTABLISHMENT OF VEGETATION OVER THE LEVEL SPREADER, INSPECTIONS SHOULD BE MADE ON A REGULAR BASIS AND AFTER RUNOFF-PRODUCING RAINFALL.

3. ENSURE THAT THERE IS NO SOIL EROSION AND THAT SEDIMENT DEPOSITION IS NOT CAUSING THE CONCENTRATION OF FLOW.

4. ENSURE THAT THERE IS NO SOIL EROSION OR CHANNEL DAMAGE UPSTREAM OF THE LEVEL SPREADER, OR SOIL EROSION OR VEGETATION DAMAGE DOWNSTREAM OF THE LEVEL SPREADER.

5. INVESTIGATE THE SOURCE OF ANY EXCESSIVE SEDIMENTATION.

6. MAINTAIN GRASS IN A HEALTHY CONDITION WITH NO LESS THAN 90% COVER UNLESS CURRENT WEATHER CONDITIONS REQUIRE OTHERWISE.

7. GRASS HEIGHT SHOULD BE MAINTAINED AT A MINIMUM 50mm BLADE LENGTH WITHIN THE LEVEL SPREADER AND DOWNSTREAM DISCHARGE AREA, AND A MAXIMUM BLADE LENGTH NO GREATER THAN ADJACENT GRASSES.

REMOVAL

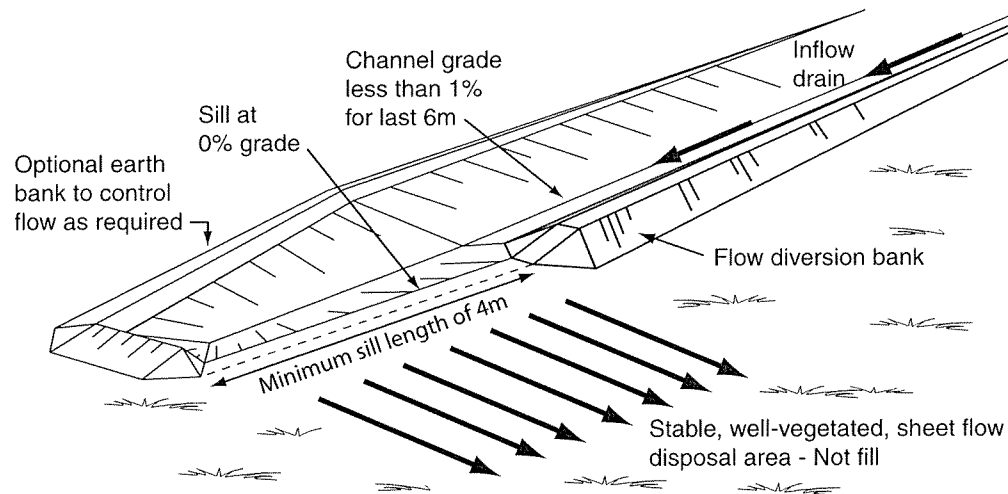
1. TEMPORARY LEVEL SPREADERS SHOULD BE DECOMMISSIONED ONLY AFTER AN ALTERNATIVE STABLE OUTLET IS OPERATIONAL, OR WHEN THE INFLOW CHANNEL IS DECOMMISSIONED.

2. REMOVE COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

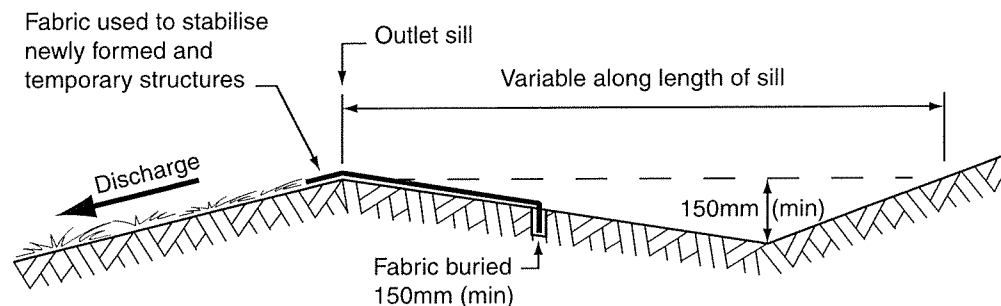
3. REMOVE AND APPROPRIATELY DISPOSE OF ANY EXPOSED GEOTEXTILE.

4. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.

5. STABILISE THE AREA AS SPECIFIED ON THE APPROVED PLAN.



(a) Typical layout of level spreader



(b) Typical profile of the the outlet weir

Drawn:	Date:		
GMW	Dec-09	Level Spreaders	LS-01

Appendix B:

IECA Standard Drawings

Monitoring Checklist– Erosion/Sediment Control Measures

Area:

Date:

Inspection Participants:

Page: of

ESC Structure	Identification Code	Complies (✓/ x)	Corrective Action / Notes

Authorisation/Acceptance of Corrective Actions

Relevant Department Manager:

name

signature

date

Senior Environmental Advisor:

name

signature

date

Appendix E: ESC Monitoring Checklist

Inspection Test Plan – Erosion/Sediment Control Measures

Note: Structures are to be identified and individually numbered (or otherwise identified) in the field as part of the implementation of the ESCP. The ITP will then be updated.

[illegible]

Authorisation/Acceptance of Corrective Actions

Relevant Department Manager:
name
signature
date

Senior Environmental Advisor:

name
signature
date

Appendix D: Inspection Test Plans (ITPs)

MATERIALS

ROCK: 150 TO 300mm EQUIVALENT DIAMETER, HARD, EROSION RESISTANT ROCK.

SANDBAGS: GEOTEXTILE BAGS (WOVEN SYNTHETIC, OR NON-WOVEN BIODEGRADABLE) FILLED WITH CLEAN COARSE SAND, CLEAN AGGREGATE, OR COMPOST.

INSTALLATION (ROCK CHECK DAM)

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT OF THE SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.

3. LOCATE EACH CHECK DAM SEDIMENT TRAP AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES.

4. IF THE CHECK DAMS ARE ALSO BEING USED TO CONTROL EROSION WITHIN THE DRAINAGE CHANNEL, THEN LOCATE EACH SUCCESSIVE CHECK DAM SUCH THAT THE CREST OF THE IMMEDIATE DOWNSTREAM DAM IS LEVEL WITH THE CHANNEL INVERT AT THE IMMEDIATE UPSTREAM CHECK DAM.

5. CONSTRUCT EACH CHECK DAM TO THE DIMENSIONS AND PROFILE SHOWN WITHIN THE APPROVED PLAN.

6. WHERE SPECIFIED, THE CHECK DAMS MUST BE CONSTRUCTED ON A SHEET OF GEOTEXTILE FABRIC USED AS A DOWNSTREAM SPLASH PAD.

7. EACH CHECK DAM MUST BE EXTENDED UP THE CHANNEL BANK (WHERE PRACTICABLE) TO AN ELEVATION AT LEAST 150mm ABOVE THE CREST LEVEL OF THE DAM.

INSTALLATION (COMPOST-FILLED SOCKS)

1. REFER TO APPROVED PLANS FOR LOCATION AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. PRIOR TO PLACEMENT OF THE SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.

3. LOCATE EACH SOCK AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES.

4. PLACE EACH SOCK TO THE LINES AND PROFILE SHOWN IN THE APPROVED PLAN OR AS DIRECTED BY THE SITE SUPERVISOR.

5. ENSURE EACH SOCK EXTENDS UP THE CHANNEL BANKS (WHERE PRACTICAL) TO A LEVEL AT LEAST 100mm ABOVE THE CREST LEVEL OF THE CHECK DAM.

MAINTENANCE

1. INSPECT EACH CHECK DAM AND THE DRAINAGE CHANNEL AT LEAST WEEKLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CORRECT ALL DAMAGE IMMEDIATELY. IF SIGNIFICANT EROSION OCCURS BETWEEN ANY OF THE CHECK DAMS, THEN CHECK THE SPACING OF THE DAMS AND WHERE NECESSARY INSTALL INTERMEDIATE CHECK DAMS OR A SUITABLE CHANNEL LINER.

3. CHECK FOR DISPLACEMENT OF THE CHECK DAMS.

4. CHECK FOR SOIL SCOUR AROUND THE ENDS OF EACH CHECK DAM. IF SUCH EROSION IS OCCURRING, CONSIDER EXTENDING THE WIDTH OF THE CHECK DAM TO AVOID SUCH PROBLEMS.

5. IF SEVERE SOIL EROSION OCCURS EITHER UNDER OR AROUND THE CHECK DAMS, THEN SEEK EXPERT ADVICE ON AN ALTERNATIVE TREATMENT MEASURE.

6. DE-SILT SEDIMENT TRAP IF THE SEDIMENT LEVEL EXCEEDS 1/3 THE CREST HEIGHT.

7. DISPOSE OF COLLECTED SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN CONSTRUCTION WORK WITHIN THE DRAINAGE AREA ABOVE THE CHECK DAMS HAS BEEN COMPLETED AND DISTURBED AREAS SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE DAMS MUST BE REMOVED, UNLESS THE SEDIMENT TRAPS ARE TO REMAIN AS A PERMANENT FEATURE.

2. REMOVE COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REMOVE AND APPROPRIATELY DISPOSE OF ALL MATERIALS INCLUDING ANY GEOTEXTILE FABRIC.

4. STABILISE THE DISTURBED CHANNEL WITH A LINING OF FABRIC AND ROCK, OR ESTABLISH VEGETATION AS APPROPRIATE.

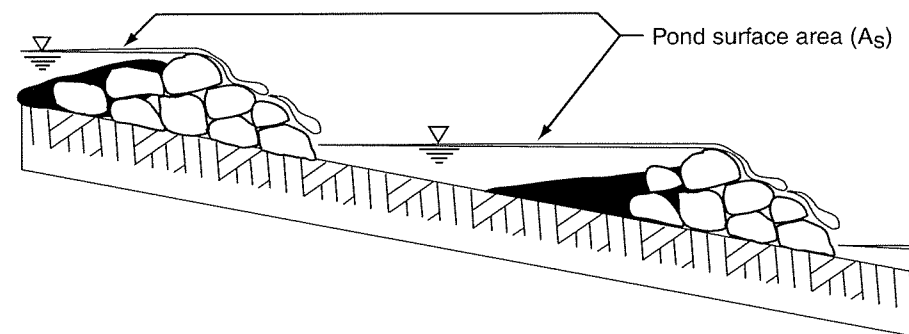


Figure 1 - Placement of check dam sediment traps

Drawn:	Date:	Check Dam Sediment Trap	
GMW	Apr-10	CDT-01	

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.
2. ENSURE ALL NECESSARY SOIL TESTING (e.g. SOIL pH, NUTRIENT LEVELS) AND ANALYSIS HAS BEEN COMPLETED, AND REQUIRED SOIL ADJUSTMENTS PERFORMED PRIOR TO PLANTING.
3. CLEAR THE LOCATION FOR THE CHANNEL, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND CONSTRUCTION EQUIPMENT.
4. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD ANY ASSOCIATED EMBANKMENTS.
5. EXCAVATE THE DIVERSION CHANNEL TO THE SPECIFIED SHAPE, ELEVATION AND GRADIENT. THE SIDES OF THE CHANNEL SHOULD BE NO STEEPER THAN A 2:1 (H:V) IF CONSTRUCTED IN EARTH, UNLESS SPECIFICALLY DIRECTED WITHIN THE APPROVED PLANS.
6. STABILISE THE CHANNEL AND BANKS IMMEDIATELY UNLESS IT WILL OPERATE FOR LESS THAN 30 DAYS. IN EITHER CASE, TEMPORARY EROSION PROTECTION (MATTING, ROCK, ETC.) WILL BE REQUIRED AS SPECIFIED WITHIN THE APPROVED PLANS OR AS DIRECTED.
7. ENSURE THE CHANNEL DISCHARGES TO A STABLE AREA.

ADDITIONAL REQUIREMENTS FOR TURF PLACEMENT:

1. TURF SHOULD BE USED WITHIN 12 HOURS OF DELIVERY, OTHERWISE ENSURE THE TURF IS STORED IN CONDITIONS APPROPRIATE FOR THE WEATHER CONDITIONS (e.g. A SHADED AREA).
2. MOISTENING THE TURF AFTER IT IS UNROLLED WILL HELP MAINTAIN ITS VIABILITY.
3. TURF SHOULD BE LAID ON A MINIMUM 75mm BED OF ADEQUATELY FERTILISED TOPSOIL. RAKE THE SOIL SURFACE TO BREAK THE CRUST JUST BEFORE LAYING THE TURF.
4. DURING THE WARMER MONTHS, LIGHTLY IRRIGATE THE SOIL IMMEDIATELY BEFORE LAYING THE TURF.
5. ENSURE THE TURF IS NOT LAID ON GRAVEL, HEAVILY COMPACTED SOILS, OR SOILS THAT HAVE BEEN RECENTLY TREATED WITH HERBICIDES.
6. ENSURE THE TURF EXTENDS UP THE SIDES OF THE DRAIN AT LEAST 100mm ABOVE THE ELEVATION OF THE CHANNEL INVERT, OR AT LEAST TO A SUFFICIENT ELEVATION TO FULLY CONTAIN EXPECTED CHANNEL FLOW.
7. ON CHANNEL GRADIENTS OF 3:1 (H:V) OR STEEPER, OR IN SITUATIONS WHERE HIGH FLOW VELOCITIES (i.e. VELOCITY >1.5m/s) ARE LIKELY WITHIN THE FIRST TWO WEEK FOLLOWING PLACEMENT, SECURE THE INDIVIDUAL TURF STRIPS WITH WOODEN OR PLASTIC PEGS.
8. ENSURE THAT INTIMATE CONTACT IS ACHIEVED AND MAINTAINED BETWEEN

THE TURF AND THE SOIL SUCH THAT SEEPAGE FLOW BENEATH THE TURF IS AVOIDED.

9. WATER UNTIL THE SOIL IS WET 100mm BELOW THE TURF. THEREAFTER, WATERING SHOULD BE SUFFICIENT TO MAINTAIN AND PROMOTE HEALTHY GROWTH

MAINTENANCE

1. DURING THE SITE'S CONSTRUCTION PERIOD, INSPECT THE DIVERSION CHANNEL WEEKLY AND AFTER ANY INCREASE IN FLOWS WITHIN THE CHANNEL. REPAIR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD.
2. ENSURE FILL MATERIAL OR SEDIMENT IS NOT PARTIALLY BLOCKING THE CHANNEL. WHERE NECESSARY, REMOVE ANY DEPOSITED MATERIAL TO ALLOW FREE DRAINAGE.

3. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.

REMOVAL

1. WHEN THE CONSTRUCTION WORK ABOVE A TEMPORARY DIVERSION CHANNEL IS FINISHED AND THE AREA IS STABILISED, THE AREA SHOULD BE APPROPRIATELY REHABILITATED.
2. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A MANNER THAT WILL NOT CREATE AN EROSION OR POLLUTION HAZARD.
3. GRADE THE AREA AND SMOOTH IT OUT IN PREPARATION FOR STABILISATION.
4. STABILISE THE AREA AS SPECIFIED IN THE APPROVED PLAN.

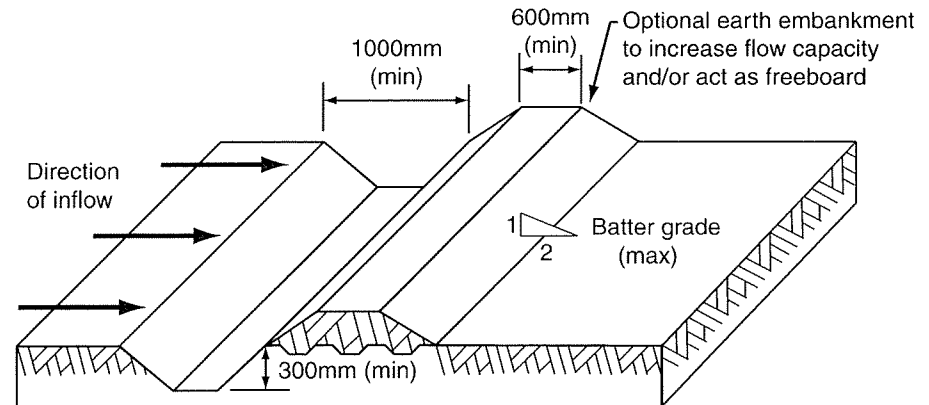


Figure 1 - Typical profile of diversion channel with bank

Drawn:	Date:		
GMW	Dec-09	Diversion Channels	DC-01

MATERIAL

ROCK MULCH: 25–75mm DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE (IF SPECIFIED).

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND APPLICATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF APPLICATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. SPREAD ENOUGH ROCK TO COMPLETELY COVER THE SURFACE OF THE SOIL AT THE DENSITY OR THICKNESS SPECIFIED IN THE APPROVED PLANS. IF THE APPLICATION DENSITY IS NOT SUPPLIED, THEN APPLY AT A THICKNESS OF AT LEAST 50mm OR TWICE THE NOMINAL ROCK SIZE (WHICHEVER IS GREATER).

3. IF THE EXPOSED SOILS ARE DISPERSIVE, THEN ENSURE THESE SOILS ARE COVERED WITH A LAYER OF NON-DISPERSIVE SOIL (MINIMUM 200mm) BEFORE PLACEMENT OF ROCK.

4. MAKE ALL NECESSARY ADJUSTMENTS TO ENSURE ANY SURFACE FLOW IS ALLOWED TO PASS FREELY ACROSS THE TREATED AREA FOLLOWING ITS NATURAL DRAINAGE PATH.

MAINTENANCE

1. INSPECT ALL TREATED SURFACES FORTNIGHTLY AND AFTER RUNOFF-PRODUCING RAINFALL.

2. CHECK FOR RILL EROSION, OR DISLODGMET OF THE ROCKS.

3. REPLACE ANY DISPLACED ROCKS TO MAINTAIN THE REQUIRED COVERAGE.

4. IF WASH-OUTS OCCUR, REPAIR THE SLOPE AND REINSTALL ROCK COVER.

5. IF THE ROCK MULCHING IS NOT EFFECTIVE IN CONTAINING THE SOIL EROSION IT SHOULD BE REPLACED, OR AN ALTERNATIVE EROSION CONTROL PROCEDURE ADOPTED.

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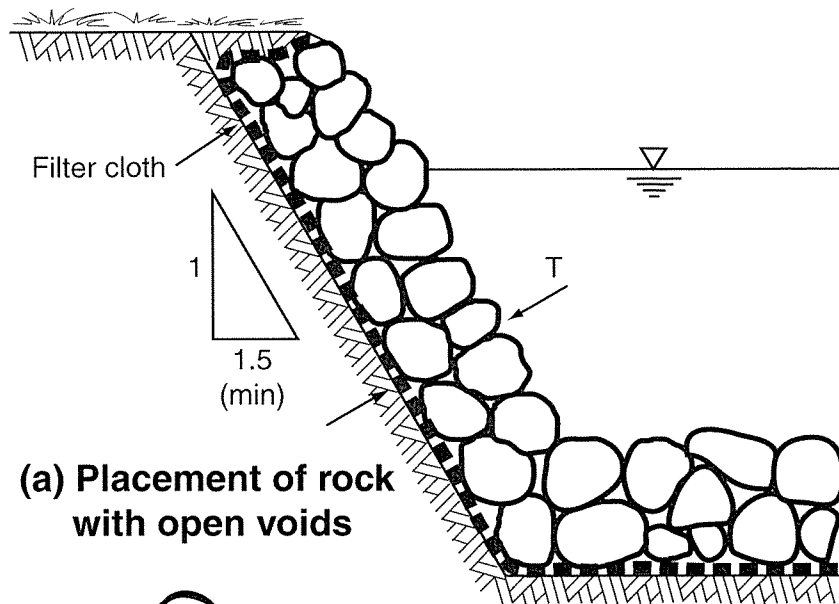
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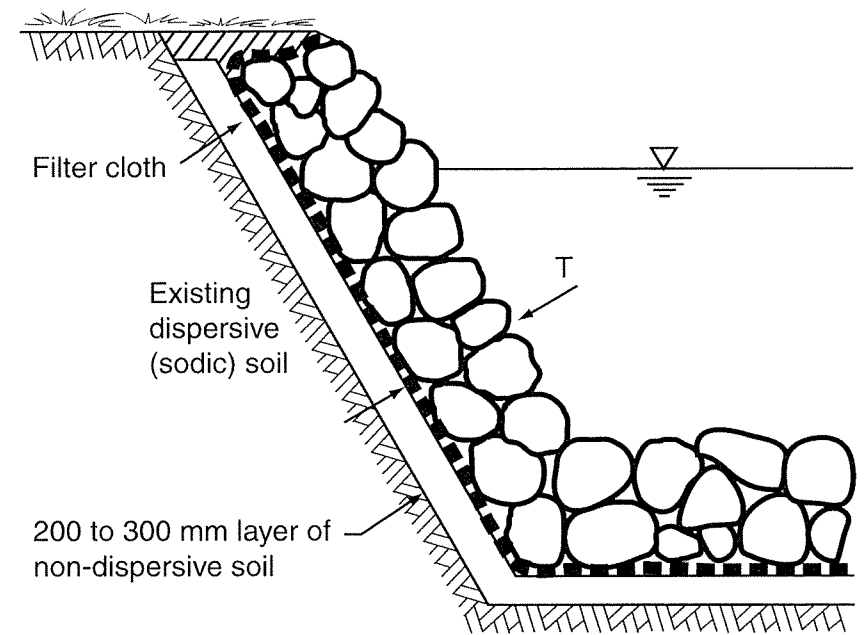
Dec-09

Rock Mulching

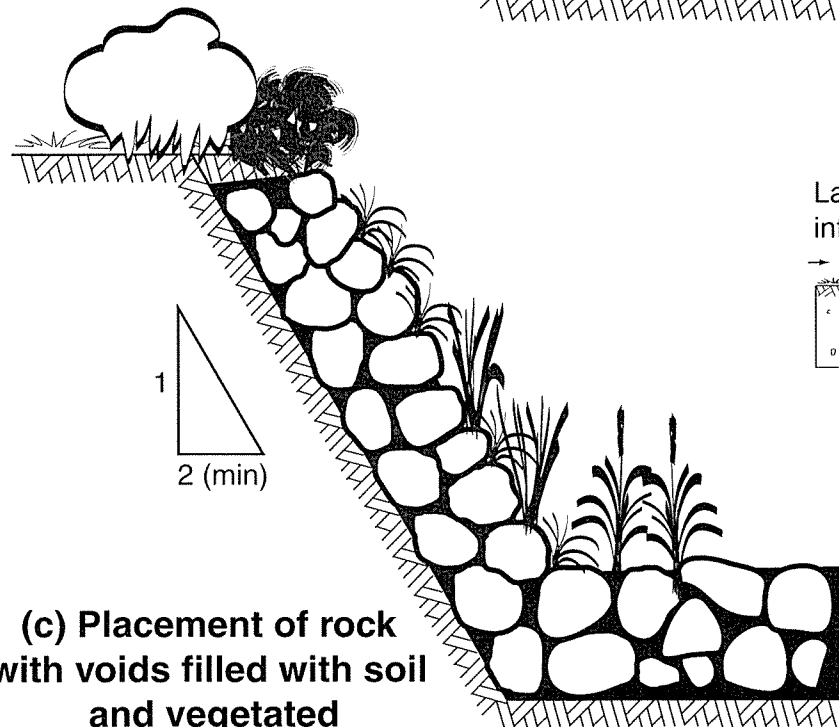
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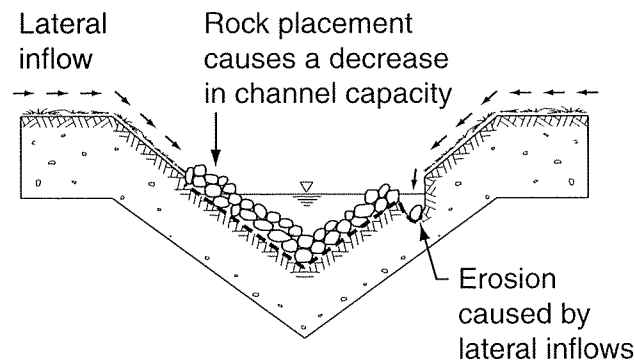
(a) Placement of rock with open voids



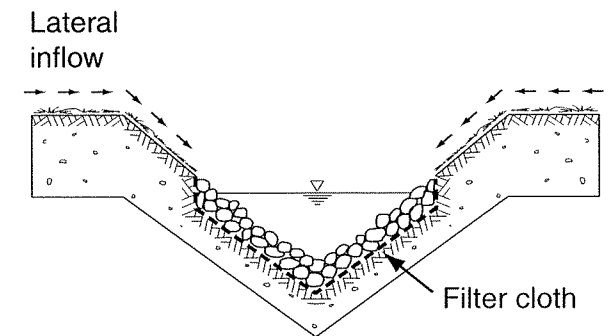
(b) Placement of rock within a channel cut into dispersive soils



(c) Placement of rock with voids filled with soil and vegetated



(d) Poor placement of rock along channel invert



(e) Good placement of rock along channel invert

Drawn:	Date:		
GMW	Dec-09	Rock Linings	RR-01

MATERIALS

ROCK: HARD, ANGULAR, DURABLE, WEATHER RESISTANT AND EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. SPECIFIC GRAVITY TO BE AT LEAST 2.5.

GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM BIDIM A24 OR EQUIVALENT.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT AND INSTALLATION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.
2. CLEAR THE PROPOSED CHANNEL AREA OF TREES, STUMPS, ROOTS, LOOSE ROCK, AND OTHER OBJECTIONABLE MATERIALS.
3. EXCAVATE THE CHANNEL TO THE LINES AND GRADES AS SHOWN ON THE PLANS. OVER-CUT THE CHANNEL TO A DEPTH EQUAL TO THE SPECIFIED DEPTH OF ROCK PLACEMENT SUCH THAT THE FINISHED ROCK SURFACE WILL BE AT THE ELEVATION OF THE SURROUNDING LAND.
4. ROCK MUST BE PLACED WITHIN THE CHANNEL AS SPECIFIED WITHIN THE APPROVED PLANS, INCLUDING THE PLACEMENT OF ANY SPECIFIED FILTER LAYER.

5. IF DETAILS ARE NOT PROVIDED ON THE ROCK PLACEMENT, THEN THE PRIMARY ARMOUR ROCK MUST BE EITHER PLACED ON:

- (i) A FILTER BED FORMED FROM A LAYER OF SPECIFIED SMALLER ROCK (ROCK FILTER LAYER);
- (ii) AN EARTH BED LINED WITH FILTER CLOTH;
- (iii) AN EARTH BED NOT LINED IN FILTER CLOTH, BUT ONLY IF ALL VOIDS BETWEEN THE ARMOUR ROCK ARE TO BE FILLED WITH SOIL AND POCKET PLANTED IMMEDIATELY AFTER PLACEMENT OF THE ROCK.

6. IF A ROCK/AGGREGATE FILTER LAYER IS SPECIFIED, THEN PLACE THE FILTER LAYER IMMEDIATELY AFTER THE FOUNDATIONS ARE PREPARED. SPREAD THE FILTER ROCK IN A UNIFORM LAYER TO THE SPECIFIED DEPTH BUT A MINIMUM OF 150mm. WHERE MORE THAN ONE LAYER OF FILTER MATERIAL HAS BEEN SPECIFIED, SPREAD EACH LAYER SUCH THAT MINIMAL MIXING OCCURS BETWEEN EACH LAYER OF ROCK.

7. IF A GEOTEXTILE (FILTER CLOTH) UNDERLAY IS SPECIFIED, PLACE THE FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FABRIC IS REQUIRED TO COVER THE AREA, OVERLAP THE EDGE OF EACH SHEET AT LEAST 300mm AND PLACE ANCHOR PINS AT MINIMUM 1m SPACING ALONG THE OVERLAP.

8. ENSURE THE GEOTEXTILE FABRIC IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE FABRIC AND THE ROCK. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND PLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA

OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.

9. WHERE NECESSARY, A MINIMUM 100mm LAYER OF FINE GRAVEL, AGGREGATE OR SAND SHOULD BE PLACED OVER THE FABRIC TO PROTECT IT FROM DAMAGE.

10. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER LAYER. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS.

11. PLACE ROCK TO ITS FULL THICKNESS IN ONE OPERATION. DO NOT PLACE ROCK BY DUMPING THROUGH CHUTES OR OTHER METHODS THAT CAUSE SEGREGATION OF ROCK SIZES.

12. THE FINISHED SURFACE SHOULD BE FREE OF POCKETS OF SMALL ROCK OR CLUSTERS OF LARGE ROCKS. HAND PLACING MAY BE NECESSARY TO ACHIEVE THE PROPER DISTRIBUTION OF ROCK SIZES TO PRODUCE A RELATIVELY SMOOTH, UNIFORM SURFACE. THE FINISHED GRADE OF THE ROCK SHOULD BLEND WITH THE SURROUNDING AREA. NO OVERFALL OR PROTRUSION OF ROCK SHOULD BE APPARENT.

13. IMMEDIATELY UPON COMPLETION OF THE CHANNEL, VEGETATE ALL DISTURBED AREAS OR OTHERWISE PROTECT THEM AGAINST SOIL EROSION.

14. WHERE SPECIFIED, FILL ALL VOIDS WITH SOIL AND VEGETATE THE ROCK SURFACE IN ACCORDANCE WITH THE APPROVED PLAN.

MAINTENANCE

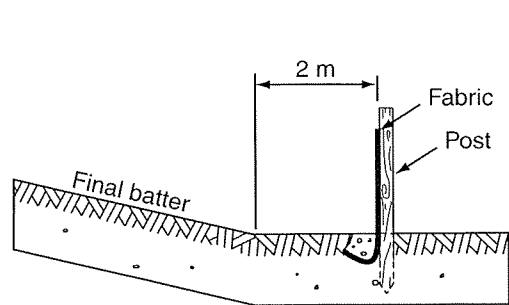
1. ROCK-LINED CHANNELS SHOULD BE INSPECTED PERIODICALLY AND AFTER SIGNIFICANT STORM EVENTS. CHECK FOR SCOUR OR DISLODGED ROCK. REPAIR DAMAGED AREAS IMMEDIATELY.

2. CLOSELY INSPECT THE OUTER EDGES OF THE ROCK PROTECTION. ENSURE WATER ENTRY INTO THE CHANNEL OR CHUTE IS NOT CAUSING EROSION ALONG THE EDGE OF THE ROCK PROTECTION.

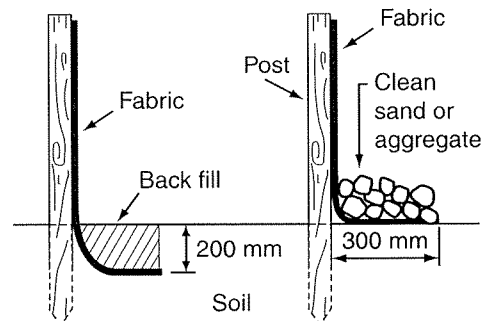
3. CAREFULLY CHECK THE STABILITY OF THE ROCK LOOKING FOR INDICATIONS OF PIPING, SCOUR HOLES, OR BANK FAILURES.

4. REPLACE ANY DISPLACED ROCK WITH ROCK OF A SIGNIFICANTLY (MINIMUM 110%) LARGER SIZE THAN THE DISPLACED ROCK.

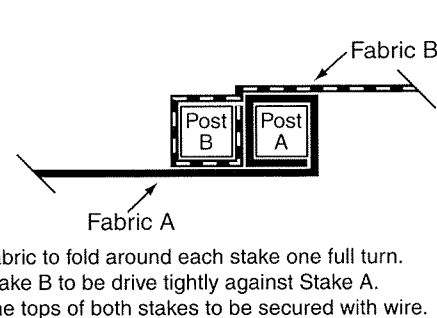
Drawn:	Date:		
GMW	May-10	Rock Linings	RR-02



(a) Location of fence relative to base of slope

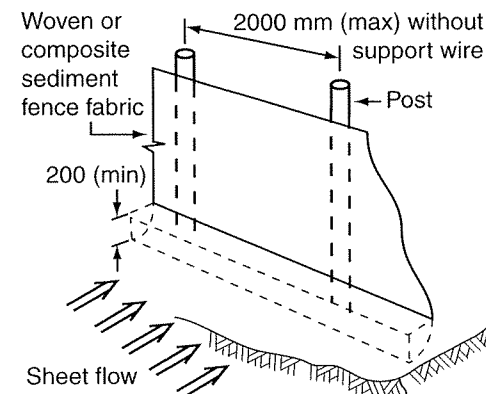


(b) Anchoring base of fabric

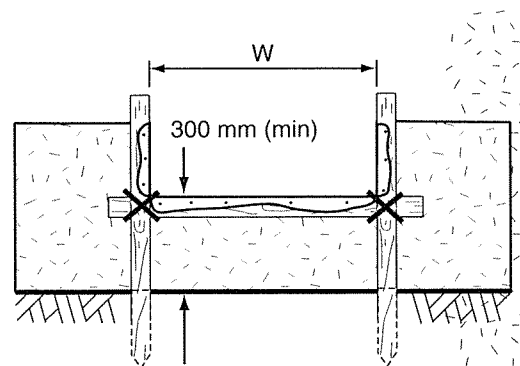


Fabric to fold around each stake one full turn.
Stake B to be driven tightly against Stake A.
The tops of both stakes to be secured with wire.

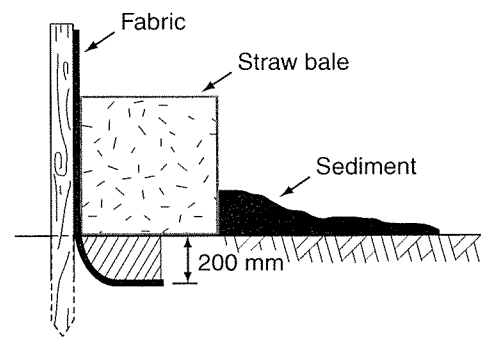
(c) Joining fabric - Method 1



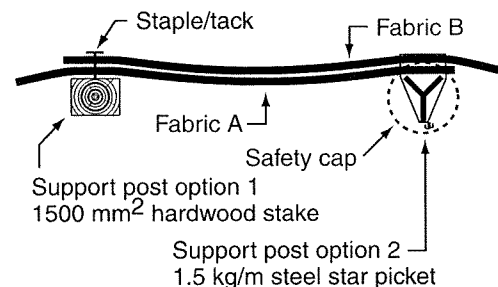
(d) Installation without backing support



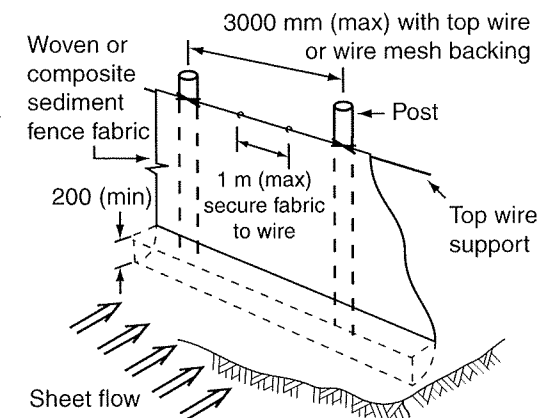
(e) Spill-through weir



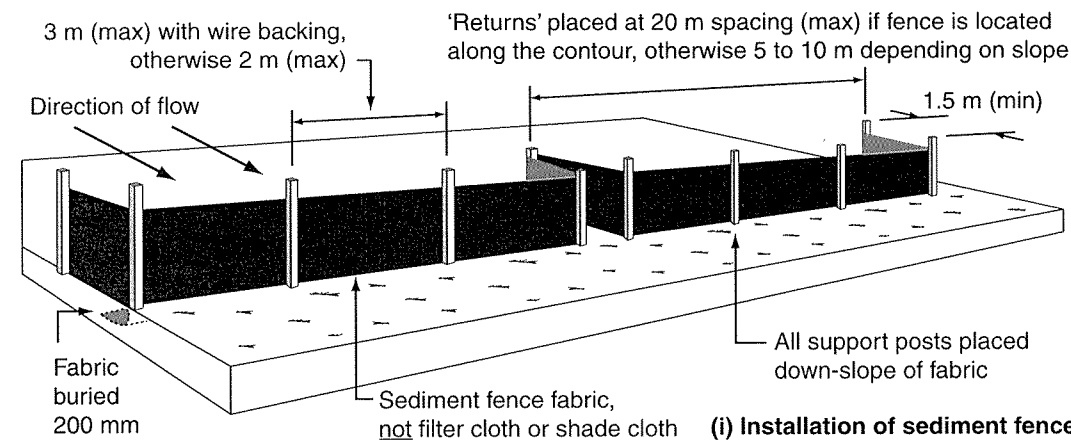
(f) Placement of up-slope straw bale



(g) Joining fabric - Method 2



(h) Installation with top wire support



(i) Installation of sediment fence

Notes:

1. Sediment fence to be installed along a line of constant ground elevation wherever practical.
2. Both end of the sediment fence to extend up the slope at least 1m.
3. Support post to be spaced a maximum 2m unless the fence is supported by a top wire or wire mesh backing, in which case 3m maximum spacing.
4. Fence 'returns' shall be installed at maximum 20m spacing if fence is installed along the contour, otherwise 5 to 10m maximum spacing.
5. Minimum 4 staples or tie wires per stake.

Drawn:	Date:		
GMW	Dec-09	Sediment Fence	SF-01

MATERIALS

FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140GSM. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).

FABRIC REINFORCEMENT: WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.

SUPPORT POSTS/STAKES: 1500mm² (MIN) HARDWOOD, 2500mm² (MIN) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION

1. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND REQUIRED TYPE OF FABRIC (IF SPECIFIED). IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, FABRIC TYPE, OR METHOD OF INSTALLATION CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.

2. TO THE MAXIMUM DEGREE PRACTICAL, AND WHERE THE PLANS ALLOW, ENSURE THE FENCE IS LOCATED:

- (i) TOTALLY WITHIN THE PROPERTY BOUNDARIES;
- (ii) ALONG A LINE OF CONSTANT ELEVATION WHEREVER PRACTICAL;
- (iii) AT LEAST 2m FROM THE TOE OF ANY FILLING OPERATIONS THAT MAY RESULT IN SHIFTING SOIL/FILL DAMAGING THE FENCE.

3. INSTALL RETURNS WITHIN THE FENCE AT MAXIMUM 20m INTERVALS IF THE FENCE IS INSTALLED ALONG THE CONTOUR, OR 5 TO 10m MAXIMUM SPACING (DEPENDENT ON SLOPE) IF THE FENCE IS INSTALLED AT AN ANGLE TO THE CONTOUR. THE 'RETURNS' SHALL CONSIST OF EITHER:

- (i) V-SHAPED SECTION EXTENDING AT LEAST 1.5m UP THE SLOPE; OR
- (ii) SANDBAG OR ROCK/AGGREGATE CHECK

DAM A MINIMUM 1/3 AND MAXIMUM 1/2 FENCE HEIGHT, AND EXTENDING AT LEAST 1.5m UP THE SLOPE.

4. ENSURE THE EXTREME ENDS OF THE FENCE ARE TURNED UP THE SLOPE AT LEAST 1.5m, OR AS NECESSARY, TO MINIMISE WATER BYPASSING AROUND THE FENCE.

5. ENSURE THE SEDIMENT FENCE IS INSTALLED IN A MANNER THAT AVOIDS THE CONCENTRATION OF FLOW ALONG THE FENCE, AND THE UNDESIRABLE DISCHARGE OF WATER AROUND THE ENDS OF THE FENCE.

6. IF THE SEDIMENT FENCE IS TO BE INSTALLED ALONG THE EDGE OF EXISTING TREES, ENSURE CARE IS TAKEN TO PROTECT THE TREES AND THEIR ROOT SYSTEMS DURING INSTALLATION OF THE FENCE. DO NOT ATTACH THE FABRIC TO THE TREES.

7. UNLESS DIRECTED BY THE SITE SUPERVISOR OR THE APPROVED PLANS, EXCAVATE A 200mm WIDE BY 200mm DEEP TRENCH ALONG THE PROPOSED FENCE LINE, PLACING THE EXCAVATED MATERIAL ON THE UP-SLOPE SIDE OF THE TRENCH.

8. ALONG THE LOWER SIDE OF THE TRENCH, APPROPRIATELY SECURE THE STAKES INTO THE GROUND SPACED NO GREATER THAN 3m IF SUPPORTED BY A TOP SUPPORT WIRE OR WEIR MESH BACKING, OTHERWISE NO GREATER THAN 2m.

9. IF SPECIFIED, SECURELY ATTACH THE SUPPORT WIRE OR MESH TO THE UP-SLOPE SIDE OF THE STAKES WITH THE MESH EXTENDING AT LEAST 200mm INTO THE EXCAVATED TRENCH. ENSURE THE MESH AND FABRIC IS ATTACHED TO THE UP-SLOPE SIDE OF THE STAKES EVEN WHEN DIRECTING A FENCE AROUND A CORNER OR SHARP CHANGE OF DIRECTION.

10. WHEREVER POSSIBLE, CONSTRUCT THE SEDIMENT FENCE FROM A CONTINUOUS ROLL OF FABRIC. TO JOIN FABRIC EITHER:

- (i) ATTACH EACH END TO TWO OVERLAPPING STAKES WITH THE FABRIC FOLDING AROUND THE ASSOCIATED STAKE ONE TURN, AND WITH

THE TWO STAKES TIED TOGETHER WITH WIRE; OR

- (ii) OVERLAP THE FABRIC TO THE NEXT ADJACENT SUPPORT POST.

11. SECURELY ATTACH THE FABRIC TO THE SUPPORT POSTS USING 25 X 12.5mm STAPLES, OR TIE WIRE AT MAXIMUM 150mm SPACING.

12. SECURELY ATTACH THE FABRIC TO THE SUPPORT WIRE/MESH (IF ANY) AT A MAXIMUM SPACING OF 1m.

13. ENSURE THE COMPLETED SEDIMENT FENCE IS AT LEAST 450mm, BUT NOT MORE THAN 700mm HIGH. IF A SPILL-THROUGH WEIR IS INSTALLED, ENSURE THE CREST OF THE WEIR IS AT LEAST 300mm ABOVE GROUND LEVEL.

14. BACKFILL THE TRENCH AND TAMP THE FILL TO FIRMLY ANCHOR THE BOTTOM OF THE FABRIC AND MESH TO PREVENT WATER FROM FLOWING UNDER THE FENCE.

ADDITIONAL REQUIREMENTS FOR THE INSTALLATION OF A SPILL-THROUGH WEIR

1. LOCATE THE SPILL-THROUGH WEIR SUCH THAT THE WEIR CREST WILL BE LOWER THAN THE GROUND LEVEL AT EACH END OF THE FENCE.

2. ENSURE THE CREST OF THE SPILL-THROUGH WEIR IS AT LEAST 300mm THE GROUND ELEVATION.

3. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE SUPPORT POSTS/ STAKES EACH SIDE OF THE WEIR. CUT THE FABRIC DOWN THE SIDE OF EACH POST AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.

4. INSTALL A SUITABLE SPLASH PAD AND/OR CHUTE IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION AND APPROPRIATELY DISCHARGE THE CONCENTRATED FLOW PASSING OVER THE WEIR.

MAINTENANCE

1. INSPECT THE SEDIMENT FENCE AT LEAST WEEKLY AND AFTER ANY SIGNIFICANT RAIN. MAKE NECESSARY REPAIRS IMMEDIATELY.

2. REPAIR ANY TORN SECTIONS WITH A CONTINUOUS PIECE OF FABRIC FROM POST TO POST.

3. WHEN MAKING REPAIRS, ALWAYS RESTORE THE SYSTEM TO ITS ORIGINAL CONFIGURATION UNLESS AN AMENDED LAYOUT IS REQUIRED OR SPECIFIED.

4. IF THE FENCE IS SAGGING BETWEEN STAKES, INSTALL ADDITIONAL SUPPORT POSTS.

5. REMOVE ACCUMULATED SEDIMENT IF THE SEDIMENT DEPOSIT EXCEEDS A DEPTH OF 1/3 THE HEIGHT OF THE FENCE.

6. DISPOSE OF SEDIMENT IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

7. REPLACE THE FABRIC IF THE SERVICE LIFE OF THE EXISTING FABRIC EXCEEDS 6-MONTHS.

REMOVAL

1. WHEN DISTURBED AREAS UP-SLOPE OF THE SEDIMENT FENCE ARE SUFFICIENTLY STABILISED TO RESTRAIN EROSION, THE FENCE MUST BE REMOVED.

2. REMOVE MATERIALS AND COLLECTED SEDIMENT AND DISPOSE OF IN A SUITABLE MANNER THAT WILL NOT CAUSE AN EROSION OR POLLUTION HAZARD.

3. REHABILITATE/REVEGETATE THE DISTURBED GROUND AS NECESSARY TO MINIMISE THE EROSION HAZARD.

Drawn:	Date:		
GMW	Apr-10	Sediment Fence	SF-02

Appendix C:
Rock Size Determination for a
Perimeter Drain at Mt Carbine
Mines



Rock Size Determination for a Perimeter Drain at Mt Carbine Mines

April 2022



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The logo for ERSCON CONSULTING ENGINEERS features a green gear icon with a white circle in the center, overlaid by a green swoosh. Below the icon, the word "ERSCON" is written in large, bold, grey capital letters, and "CONSULTING ENGINEERS" is written in smaller, green capital letters below it.[illegible]

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APPENDIX A – Site Hydraulic Calculations

APPENDIX B – ERSCON Super Drain Templates

APPENDIX C – NRA Supplied Images

APPENDIX D – Form 15 Certification

1 INTRODUCTION

1.1 APPLICANT DETAILS

Instructions from Client	Prepare a report that recommends the type and sizing of rock required to include in an existing perimeter drain at the EQ Resources Mine at Mt Carbine.
Type of approval sought:	RPEQ approved report
Site address:	EQ Resources - Mt Carbine Mines
Real property description:	Lot 13 on SP254833, Mt Carbine
Catchment area:	92.36Ha
Assessment manager:	NA
Owner details:	EQ Resources - Mt Carbine Mines
Applicant details:	NRA Natural Resource Assessment Pty Ltd

1.2 ASSESSMENT INSTRUMENT DETAILS

Planning scheme:	NA
Zone:	Mining – Extractive Industry
Local plan:	Mareeba Shire Council Planning Scheme
Level of assessment:	NA
Applicable codes:	Catchments and Creeks QUDM Queensland Urban Drainage Manual

1.3 PROPOSED WORKS

Determine the rock specification required to line an existing trapezoidal drain. Images received from the client indicates that the soil is highly dispersive. The client has requested for ERSCON to use the publication *Rock Linings – Drainage Control Technique* by Catchment and Creeks Pty Ltd (Version 2 – May 2010) (see Attachment A) to be used as the primary guide. The report is to be signed by an RPEQ.

Table 1: Summary of Deliverables

Report Type	Prepare a RPEQ signed report specifying the type of rock required to line an existing trapezoidal drain which has highly erodible soils.
-------------	--

2 SITE DETAILS

2.1 SITE DESCRIPTION

Access to the site is located on the southern side of the Mulligan Hwy, 1km to the west of Pump Road, Mt Carbine. Two diversion drains are located around the site and are called TSF4 Diversion Drain East (0.49km) and TSF4 Diversion Drain West (1.64km) (see image 1).

The drains are installed to capture external surface water and divert them away from the site.

Photos supplied by NRA indicate that the embankment of the existing trapezoidal drain exhibits highly dispersive material (see Appendix C). From the images, it appears that the proximity of the perimeter access track in relation to the drain, indicates that the surface flow into the diversion drain has created extensive rutting.

From the photos supplied, it was observed that the existing trapezoidal drain have the following dimensions:

- 4m wide base;
- 1.5m deep;
- 1 on 1 grade (internal wall to 10m wide mound next to access road);
- Vertical (external wall) – highly eroded and rutted.

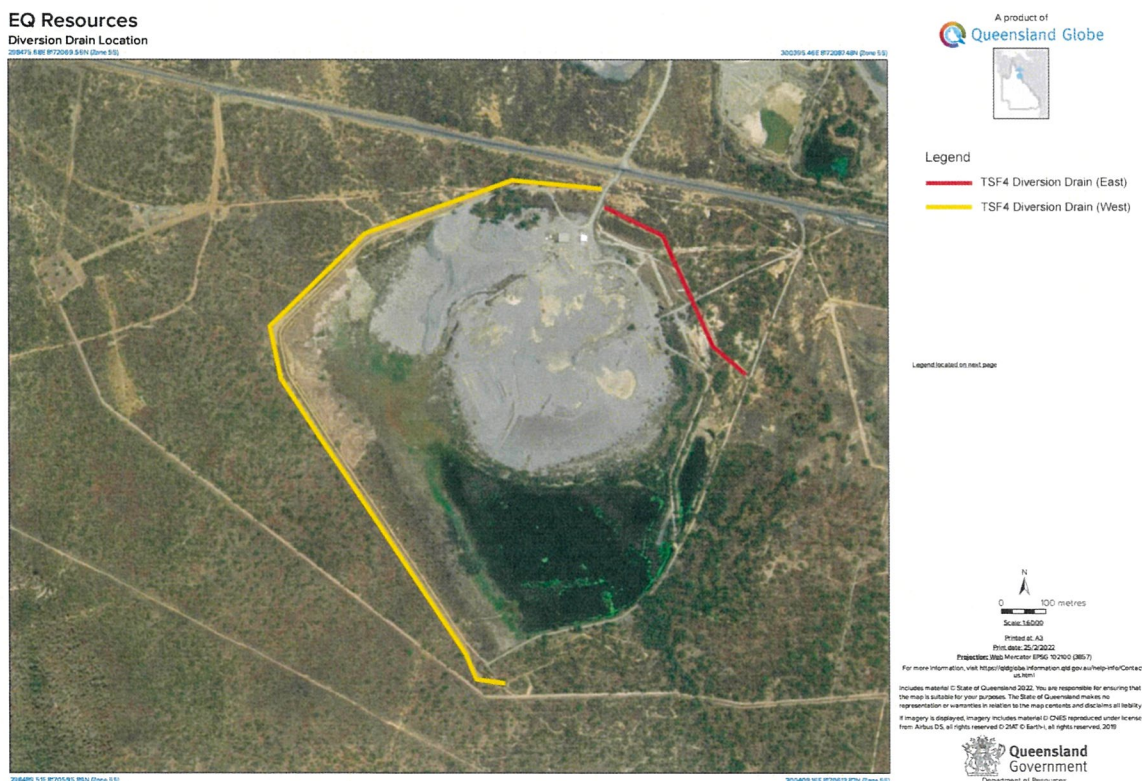


Figure 1: Diversion Drain Location
Source: Queensland Globe

Site characteristic	Description
Existing land use	The site is predominantly utilised for the extraction and processing of minerals
Existing structures	Site sheds, processing areas and storage facilities.
Frontage and access	The existing land fronts the Mulligan Highway, 1km west of Pump Road, Mt Carbine.
Topography	The site is located on the southern side of Mulligan Highway. It lies at the foothills of Mt Alto (755m) to it's south-west and Carbine Hill (515m) to the north-west. The site is generally flat and grades at 1-2% towards the foothills of Mt Alto and 2-5% towards Carbine Hill.
Existing vegetation	The land is lightly wooded and grassed.
Existing waterways	Tributaries around the area appear to all flow towards the Mitchell River located about 1km to the south.

3 ROCK LINING OF DIVERSION DRAIN

3.1 DESIGN METHOD

The stormwater assessment and design has been carried out using the Rational Method, in accordance with the *Queensland Urban Drainage Manual* (QUDM) and the Far North Queensland Regional Organisation of Councils (FNQROC). Reference has been made to the Bureau of Meteorology and FNQROC D4 Stormwater Drainage (see Appendix A).

The rock lining has been designed based on *Rock Linings – Damage Control Technique* by Catchments and Creeks Pty Ltd – May 2010.

The Hydrological Analysis undertaken includes overland flow paths and catchments and are documented in Appendix A.

To determine the rock size required to line the drain, it was required to determine the flow and velocity in different events. A check of the catchments indicated that the information supplied by NRA for the flows may have been based on smaller catchments.

3.2 HYDROLOGICAL ANALYSIS

3.2.1 Catchment Area

Catchment areas were determined from Lidar for three distinct sections of the drain. Catchment A1 and A2 which flow into the western drain and Catchment B that flows into the Eastern drain.

Surface flow occurred across the Mulligan Highway via culverts.

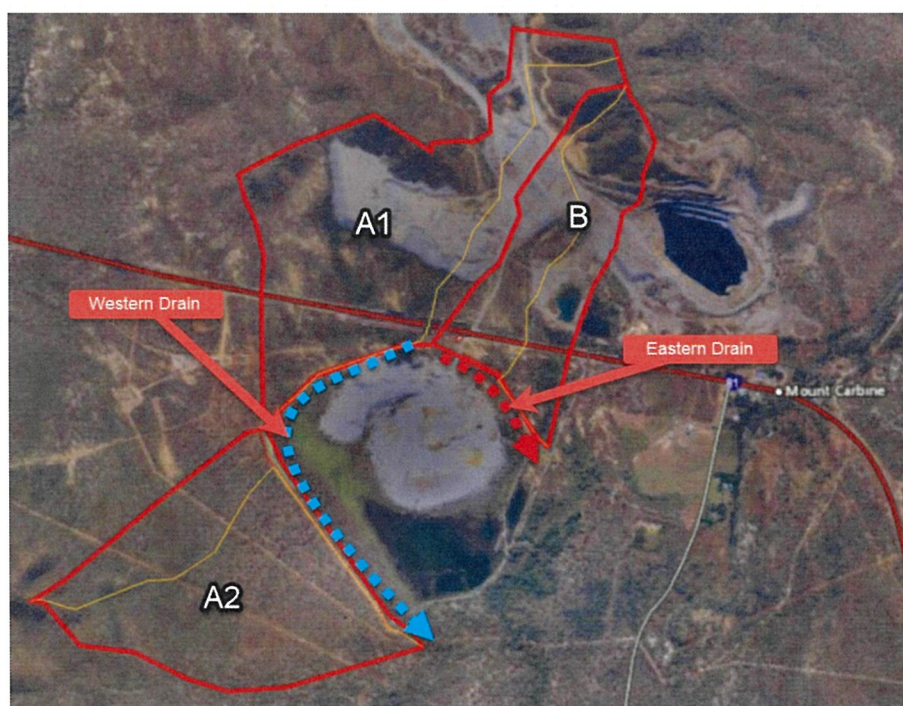


Figure 2: Catchment Areas
Source: Queensland Globe

3.2.2 Time of Concentration

Flow paths and average surface profiles were determined for the three catchments. This was achieved by utilising current Lidar information available from the Government website Elvis - Elevation and Depth – Foundation Spatial Data [Elvis \(fsdf.org.au\)](http://Elvis.fsdf.org.au) and converting the information into contours using the 12D software. Longest flow paths were chosen and draped across the terrain model.

Utilising the Bransby-Williams Equation, Times of Concentrations were calculated. (refer Table 1 – Catchment Area Summary and Appendix A for calculations).

Table 1: Catchment Area Summary

Catchment Label	Area (Ha)	Length (km)	Average Slope %	Time of Concentration (min)	Adopted Time of Concentration (min)
A1	82	2.062	2.4	64.6	65
A2	68	1.93	1.3	69.5	70
B	42	1.572	3.6	48.6	50

3.2.3 Determining Flow Rates

Rainfall intensities were calculated from the IFD charts accessed through the BOM site and were based on the adopted time of concentration for each catchment. A coefficient of discharge (C_{10}) of 0.7 was adopted based on medium to low soil permeability and referring to QUDM Table 4.5.4 based on an AEP of 10% (approximate occurrence every 10 years). Frequency factors were based on the relevant AEP and taken from Table 4.5.2. (Refer to Appendix A for Calculations).

Flow Calculation for Upstream Catchment

Catchment A1

Fraction Impervious =
1 hour @ 10 year ARI =

$f_i = 0$
 $I_{10} = 68.5$
 $C_{10} = 0.7$

Table Below (QUDM Table 4.5.3)
mm/hr (IFD CHARTS)
(QUDM Table 4.5.3)

AEP	63%	39%	18%	10%	5%	2%	1%	
Design ARI	1	2	5	10	20	50	100	
Frequency Factor F_y	0.8	0.85	0.95	1	1.05	1.15	1.2	(QUDM Table 4.5.2)
Coefficient of Discharge C_y	0.56	0.595	0.665	0.7	0.735	0.805	0.84	(QUDM Equation 4.3)
Time of Concentration T_c	65	65	65	65	65	65	65	min
Rainfall Intensity i_{10}^{65min}	42	47	61	71	79	90	97	mm/hr (IFD CHARTS)
Area A	82	82	82	82	82	82	82.00	Ha
Flow A1	5.33	6.34	9.29	11.26	13.25	16.41	18.56	m ³ /s
Velocity	0.96	1.01	1.14	1.21	1.29	1.39	1.45	m/s
Height	1.10	1.21	1.45	1.65	1.79	2.01	2.14	m

Taken from ERSCON
Super Drain Table

Flow Calculation for Upstream Catchment

Catchment A1+A2

Fraction Impervious = $f_i = 0$ Table Drain (QUDM Table 4.5.3)
 1 hour @ 10 year ARI = $I_{10} = 68.5$ mm/hr (IFD CHARTS)
 $C_{10} = 0.7$ (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		1	2	5	10	20	50	100		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.56	0.595	0.665	0.7	0.735	0.805	0.84		(QUDM Equation 4.3)
Time of Concentration	T_C	70.0	70	70	70	70	70	70.0	min	
Rainfall Intensity	$^{70mm}I_{10}$	43	48	63	73	82	92	100	mm/hr	(IFD CHARTS)
Area	A	68	68	68	68	68	68	68	Ha	
Flow A2		4.55	5.41	7.93	9.61	11.31	14.02	15.87	m ³ /s	
Cumulative Flow A1 + A2		9.88	11.74	17.22	20.87	24.57	30.43	34.43	m ³ /s	
Velocity		0.95	1.02	1.17	1.26	1.34	1.45	1.53	m/s	Taken from ERSCON Super Drain Table
Height		1.80	1.97	2.42	2.69	2.94	3.31	3.55	m	

Flow Calculation for Upstream Catchment

Catchment B

Fraction Impervious = $f_i = 0$ Table Drain (QUDM Table 4.5.3)
 1 hour @ 10 year ARI = $I_{10} = 68.5$ mm/hr (IFD CHARTS)
 $C_{10} = 0.7$ (QUDM Table 4.5.3)

AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		1	2	5	10	20	50	100		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.56	0.595	0.665	0.7	0.735	0.805	0.84		(QUDM Equation 4.3)
Time of Concentration	T_C	50.0	50	50	50	50	50	50	min	
Rainfall Intensity	$^{50mm}I_{10}$	37	42	55	63	71	80	87	mm/hr	(IFD CHARTS)
Area	A	42	42	42	42	42	42	42	Ha	
Flow B		2.44	2.90	4.24	5.14	6.05	7.50	8.49	m ³ /s	
Velocity		0.89	0.95	1.08	1.15	1.22	1.30	1.36	m/s	Taken from ERSCON Super Drain Table
Height		0.59	0.66	0.82	0.91	1.00	1.12	1.20	m	

3.2.4 Existing Trapezoidal Drains

Cross sections of drains taken from the Lidar information (supplied by NRA) and also from the Government website indicates that the extrapolated cross sections are shaped as a V-Drain. However, the photos supplied by NRA indicate that the majority of the drains are trapezoidal in shape with measurements of approximately 4m across the base and 1.5m high with a nominal 1 on 1 batter slope.

The calculations to determine depth of flow and velocity were based on the trapezoidal shape (refer to Appendix B for ERSCON Super Drain Table).

3.3 ROCK SIZE DETERMINATION

The equation to determine rock sizing was taken from Table 1 – Equation (1) the Preferred Equation for bed slopes $S_o < 50\%$ of Rock Linings – Catchments & Creeks (version 2 – 2010).

$$D_{50} = \frac{1.27 \times SF \times K_1 \times K_2 \times S_o^{0.5} \times q^{0.5} \times y^{0.25}}{(s_r - 1)}$$

Where:

SF = 1.5 [Safety Factor = 1.5 (see Table 2)]

K_1 = 1.0 (Angular Rock)

K_2 = 1.0 (unknown rock grading)

S_o =	Bed Slope (m/m)		
	A1	A2	B
	0.4%	0.2%	0.7%

q =	Flow/unit width for 1% AEP ($m^3/s/m$)		
	A1	A1+A2	B
Q (m^3/s)	18.56	34.43	8.49
q ($m^3/s/m$)	3.71	6.89	1.70

y =	Depth of Flow (m)		
	A1	A1+A2	B
	2.14	3.55	1.20

s_r = 2.5 (Specific Gravity of Rock)

Therefore:

	d_{50}		
	A1	A1+A2	B
Calculated d_{50} (m)	0.187	0.205	0.145
Nominal Rock Size d_{50} (m)	0.20	0.20	0.15

4 CONCLUSION

After reviewing the supplied information and further discussions with our client, it was decided to prepare updated catchment areas and flow paths based on the most current available data. This would result in new flow rates and velocities for application when calculating rock sizing.

Existing drain sizes were referenced against cross sections taken from Lidar and compared against supplied images of the drain. The images indicated a consistent trapezoidal shape with a length approximately 100m long, 4m wide base and a 1 on 1 batter to a depth of 1.5m. The images also showed the outside batter to be highly dispersive.

The profile adopted was visually taken from the supplied images (see Appendix C).

The client asked that we prepare rock sizing based on Rock Lining - Catchments & Creeks.

Our calculations indicate that if the profile of the drain was shaped as mentioned above, inundation of the bank would occur in a AEP 39% event in the lower length of the Western Drain.

Due to the potential of dispersive soils, all precautions and constructability should follow the instructions mentioned in Rock Linings – Catchments and Creeks Version 2 – 2010.

As a result of our review of the catchment areas, flows to the drains (in multiple normal rainfall events) and consideration of the site characteristics, we have determined the rock sizing to be provided to the drains is as follows:

- **Western drain - Catchment A1** $d_{50} = 0.20\text{m}$
- **Western drain - Catchment A1+A2** $d_{50} = 0.20\text{m}$
- **Eastern drain - Catchment B** $d_{50} = 0.20\text{m}$

The rock type should be resistant to weathering and shaped so that its length is a maximum of 3 times it's width. It should also be angular (fractured) for interlocking purposes and to reduce movement under high stream flow. The minimum thickness of rock (T) should be 0.34m

It is suggested that the drain be constructed in accordance with *Figure 2 of Rock Linings – Damage Control Techniques Version 2 – May 2010* by Catchment and Creeks Pty Ltd

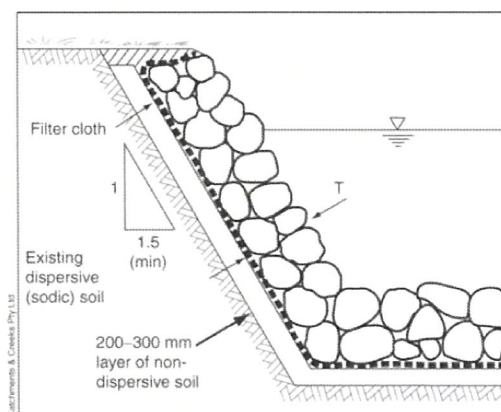


Figure 2 – Rock placement (without vegetation) on dispersive soil

APPENDIX A

*Site Hydrological
Calculations*

Label: Mt Carbine
 Mt Carbine
 Easting: 299026
 Northing: 8171529
 Zone: 55

Table

Annual Exceedance Probability (AEP)							
Duration	63.20%	50%#	20%*	10%	5%	2%	1%
1 min	2.41	2.7	3.55	4.09	4.59	5.21	5.66
2 min	4.31	4.81	6.27	7.18	8.01	8.94	9.57
3 min	6.04	6.74	8.81	10.1	11.3	12.6	13.6
4 min	7.61	8.51	11.2	12.8	14.3	16.1	17.4
5 min	9.07	10.1	13.3	15.3	17.2	19.4	21
10 min	15.1	16.9	22.2	25.6	28.8	32.8	35.7
15 min	19.6	22	29	33.4	37.5	42.7	46.5
20 min	23.4	26.2	34.4	39.7	44.5	50.7	55.1
25 min	26.5	29.7	39	44.9	50.4	57.3	62.3
30 min	29.3	32.7	42.9	49.4	55.4	62.9	68.4
45 min	35.7	39.9	52.3	60.2	67.5	76.4	82.9
50 min	37.3	41.7	54.7	63.0	70.6	79.9	86.6
1 hour	40.6	45.4	59.5	68.5	76.8	86.8	94
65 min	41.8	46.8	61.3	70.6	79.2	89.5	97.0
70 min	43.0	48.1	63.1	72.7	81.5	92.2	100.0
1.5 hour	47.8	53.5	70.4	81.1	90.9	103	112
2 hour	53.2	59.6	78.7	90.8	102	116	126
3 hour	61.2	68.8	91.5	106	120	137	149
4.5 hour	69.8	78.8	106	124	140	162	178
6 hour	76.5	86.7	118	138	158	184	203
9 hour	87.1	99.3	137	163	187	221	247
12 hour	95.8	110	153	183	212	253	285
18 hour	110	127	180	218	256	309	351
24 hour	122	141	203	247	293	356	407
30 hour	133	154	223	273	325	397	457
36 hour	143	165	240	296	354	434	500
48 hour	160	185	271	335	403	496	573
72 hour	187	217	319	396	478	587	677
96 hour	209	242	354	439	530	648	745
120 hour	226	261	381	471	566	688	788
144 hour	239	276	401	493	589	713	814
168 hour	249	288	415	508	603	727	827

Note:

- # The 50% AEP IFD does not correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rath
- * The 20% AEP IFD does not correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rath

JOB NO: 900-047
 JOB: Mt Carbine Mines
 TITLE: Catchment A1
 DATE: 8/03/2022



Time of concentration Calculation
 (Using Bransby-Williams' Equation)

Proportionality Factor P = 58 (for Ha)

Length of Flow Path L = 2.062 km
 Top of Catchment (RL) RL = 513 m
 Area of Catchment A = 82.00 Ha

Catchment Profile 358.3 [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	358.3	0	-----
520	360	1.7	442
878	366.7	8.4	1810
954	380	21.7	1144
1495	387	28.7	13633
1764	400	41.7	9469
1897	419	60.7	6810
2062	513	154.7	17771
2062	513	154.7	0
2062	513	154.7	0

Average Slope Calculation	
Outlet Chainage	0
Catchment length	2062
Outlet RL	0
Top RL (Av Slope)	49.5

$$T_c = \frac{P \times L}{(A^{0.1}) \times (S^{0.2})}$$

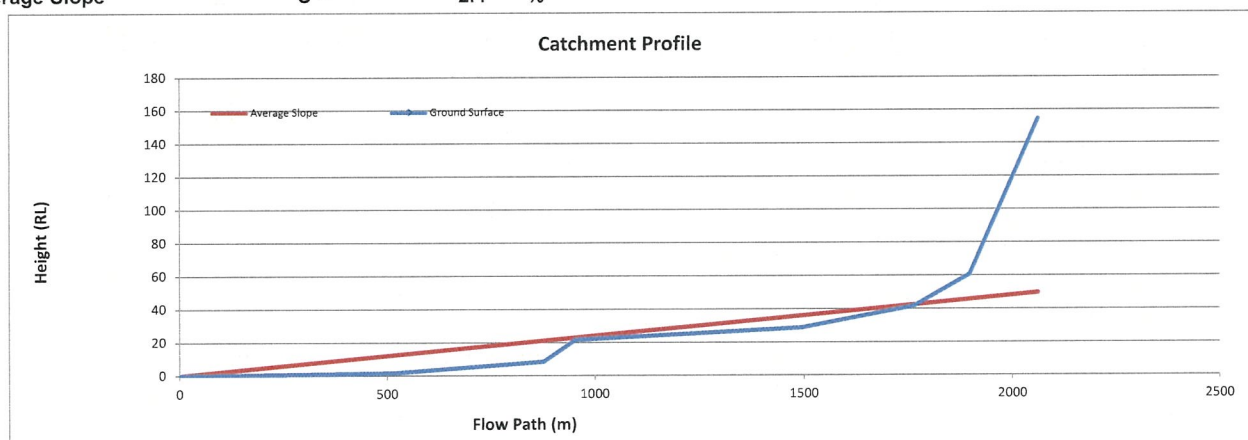
Tc = 64.6 min

Adpoted Tc 65.0 min

Total area under graph 51078 m²
 Area below outlet level 0 m²
 Area above outlet 51078 m²

Height for average slope 49.54 m

Average Slope S = 2.4 %



Flow Calculation for Upstream Catchment
Catchment A1

Fraction Impervious = $f_i = 0$ Table Below (QUDM Table 4.5.3)
 1 hour @ 10 year ARI = $I_{10} = 68.5$ mm/hr (IFD CHARTS)
 $C_{10} = 0.7$ (QUDM Table 4.5.3)

		63%	39%	18%	10%	5%	2%	1%		
Design ARI		1	2	5	10	20	50	100		
Frequency Factor	F_Y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_Y	0.56	0.595	0.665	0.7	0.735	0.805	0.84		(QUDM Equation 4.3)
Time of Concentration	T_C	65	65	65	65	65	65	65	min	
Rainfall Intensity	I_{10}	42	47	61	71	79	90	97	mm/hr	(IFD CHARTS)
Area	A	82	82	82	82	82	82	82.00	Ha	
Flow A1		5.33	6.34	9.29	11.26	13.25	16.41	18.56	m³/s	
Velocity		0.96	1.01	1.14	1.21	1.29	1.39	1.45	m/s	Taken from ERSCON Super Drain Table
Height		1.10	1.21	1.45	1.65	1.79	2.01	2.14	m	

JOB NO: 900-047
 JOB: Mt Carbine Mines
 TITLE : Catchment A2
 DATE: 4/03/2022



Time of concentration Calculation
 (Using Bransby-Williams' Equation)

Proportionality Factor P = 58 (for Ha)

Length of Flow Path L = 1.93 km
 Top of Catchment (RL) RL = 429.4 m
 Area of Catchment A = 68.00 Ha

Catchment Profile 355.7 [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m ²)
0	355.7	0	-----
850	357.1	1.4	595
1372	369	13.3	3837
1456	376	20.3	1411
1647	383	27.3	4546
1778	400	44.3	4690
1856	420.5	64.8	4255
1927	429.4	73.7	4917
1927	429.4	73.7	0
1927	429	73.7	0

Average Slope Calculation	
Outlet Chainage	0
Catchment length	1927
Outlet RL	0
Top RL (Av Slope)	25.2

$$T_c = \frac{P \times L}{(A^{0.1}) \times (S^{0.2})}$$

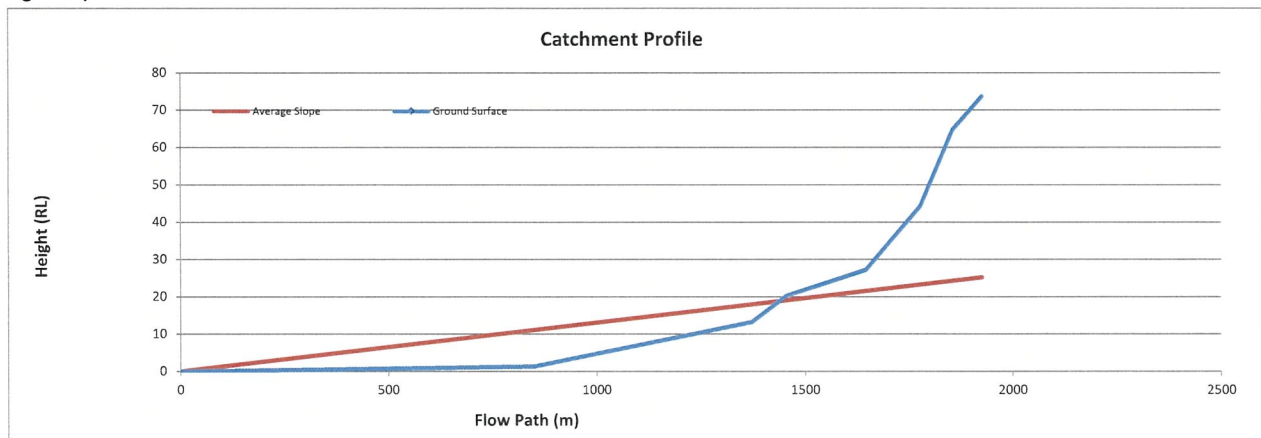
T_c = 69.5 min

Adpoted T_c 70.0 min

Total area under graph 24250 m²
 Area below outlet level 0 m²
 Area above outlet 24250 m²

Height for average slope 25.17 m

Average Slope S = 1.3 %



Flow Calculation for Upstream Catchment
Catchment A1+A2

Fraction Impervious = f_i = 0 Table Drain (QUDM Table 4.5.3)
 1 hour @ 10 year ARI = ¹I₁₀ = 68.5 mm/hr (IFD CHARTS)
 C₁₀ = 0.7 (QUDM Table 4.5.3)

AEP	63%	39%	18%	10%	5%	2%	1%		
Design ARI	1	2	5	10	20	50	100		
Frequency Factor	F _Y	0.8	0.85	0.95	1	1.05	1.15	1.2	(QUDM Table 4.5.2)
Coefficient of Discharge	C _V	0.56	0.595	0.665	0.7	0.735	0.805	0.84	(QUDM Equation 4.3)
Time of Concentration	T _C	70.0	70	70	70	70	70	70.0	min
Rainfall Intensity	^{70min} I ₁₀	43	48	63	73	82	92	100	mm/hr (IFD CHARTS)
Area	A	68	68	68	68	68	68	68	Ha
Flow A2	4.55	5.41	7.93	9.61	11.31	14.02	15.87	m³/s	
Cumulative Flow A1 + A2	9.88	11.74	17.22	20.87	24.57	30.43	34.43	m³/s	
Velocity	0.95	1.02	1.17	1.26	1.34	1.45	1.53	m/s	Taken from ERSCON Super Drain Table
Height	1.80	1.97	2.42	2.69	2.94	3.31	3.55	m	

JOB NO: 900-047
 JOB: Mt Carbine Mines
 TITLE: Catchment B
 DATE: 8/03/2022



Time of concentration Calculation
 (Using Bransby-Williams' Equation)

Proportionality Factor P = 58 (for Ha)

Length of Flow Path L = 1.572 km
 Top of Catchment (RL) RL = 504 m
 Area of Catchment A = 42.00 Ha

Catchment Profile 355.5 [to utilise graph area better]

Chainage	RL	RL	Area under Graph (m²)
0	355.5	0	----
68	358.1	2.6	88
450	362	6.5	1738
620	370	14.5	1785
936	374	18.5	5214
1011	385	29.5	1800
1290	392	36.5	9207
1401	423	67.5	5772
1561	503	147.5	17200
1572	504	148.5	1628

Average Slope Calculation	
Outlet Chainage	0
Catchment length	1572
Outlet RL	0
Top RL (Av Slope)	56.5

$$T_c = \frac{P \times L}{(A^{0.1}) \times (S^{0.2})}$$

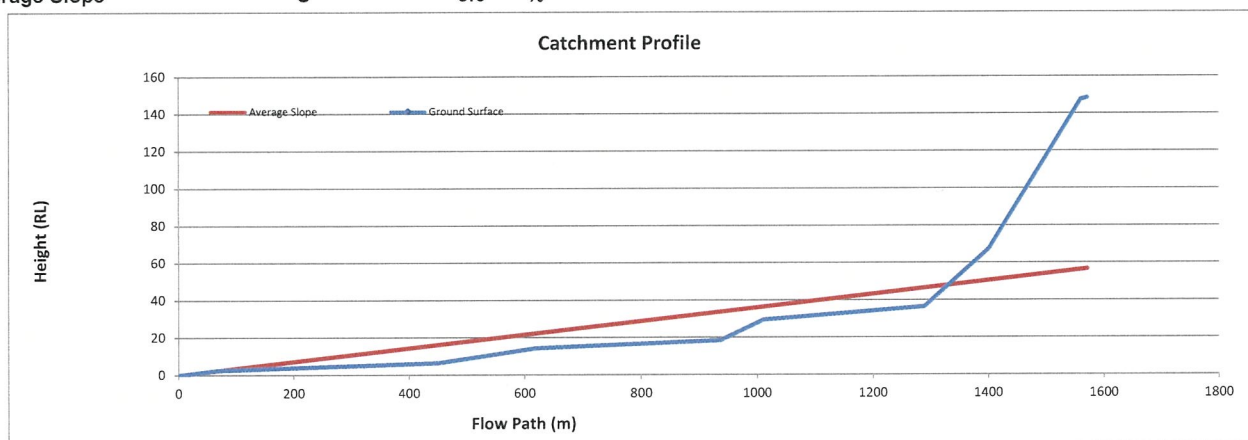
Tc = 48.6 min

Adopted Tc = 50.0 min

Total area under graph 44433 m²
 Area below outlet level 0 m²
 Area above outlet 44433 m²

Height for average slope 56.53 m

Average Slope S = 3.6 %



Flow Calculation for Upstream Catchment
Catchment B

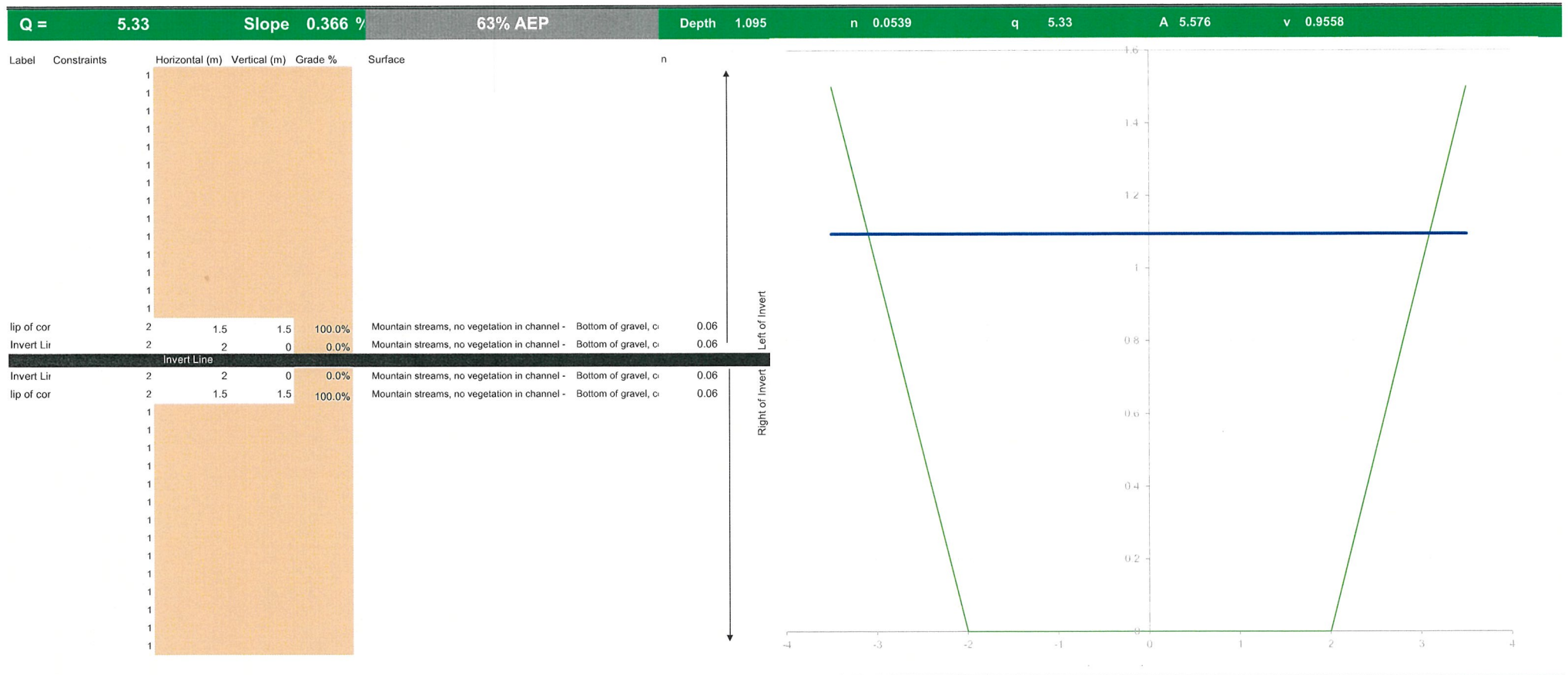
Fraction Impervious = $f_i = 0$ Table Drain (QUDM Table 4.5.3)
 1 hour @ 10 year ARI = ${}^1I_{10} = 68.5$ mm/hr (IFD CHARTS)
 $C_{10} = 0.7$ (QUDM Table 4.5.3)

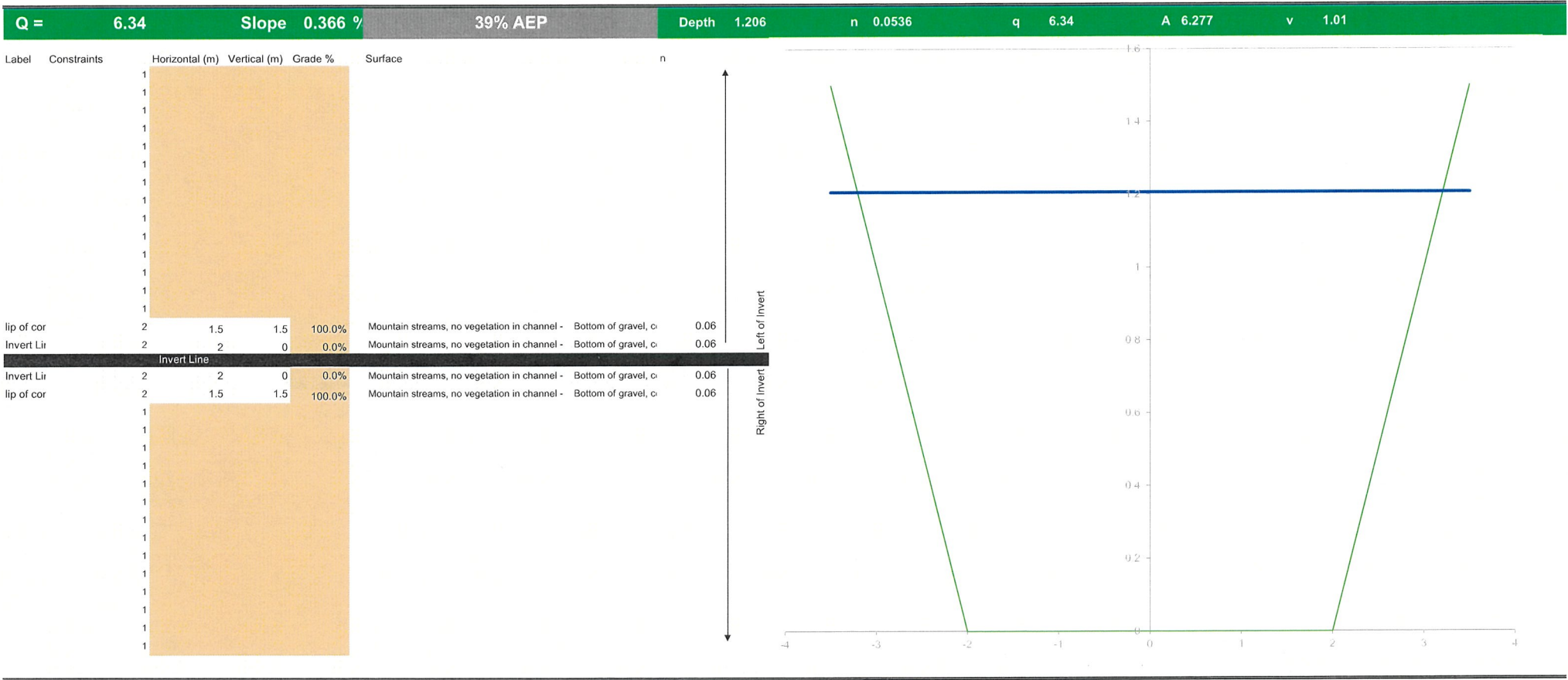
AEP		63%	39%	18%	10%	5%	2%	1%		
Design ARI		1	2	5	10	20	50	100		
Frequency Factor	F_y	0.8	0.85	0.95	1	1.05	1.15	1.2		(QUDM Table 4.5.2)
Coefficient of Discharge	C_y	0.56	0.595	0.665	0.7	0.735	0.805	0.84		(QUDM Equation 4.3)
Time of Concentration	T_c	50.0	50	50	50	50	50	50	min	
Rainfall Intensity	${}^{50min}I_{10}$	37	42	55	63	71	80	87	mm/hr	(IFD CHARTS)
Area	A	42	42	42	42	42	42	42	Ha	
Flow B		2.44	2.90	4.24	5.14	6.05	7.50	8.49	m³/s	
Velocity		0.89	0.95	1.08	1.15	1.22	1.30	1.36	m/s	Taken from ERSCON Super Drain Table
Height		0.59	0.66	0.82	0.91	1.00	1.12	1.20	m	

APPENDIX B

ERSCON Super Drain Templates

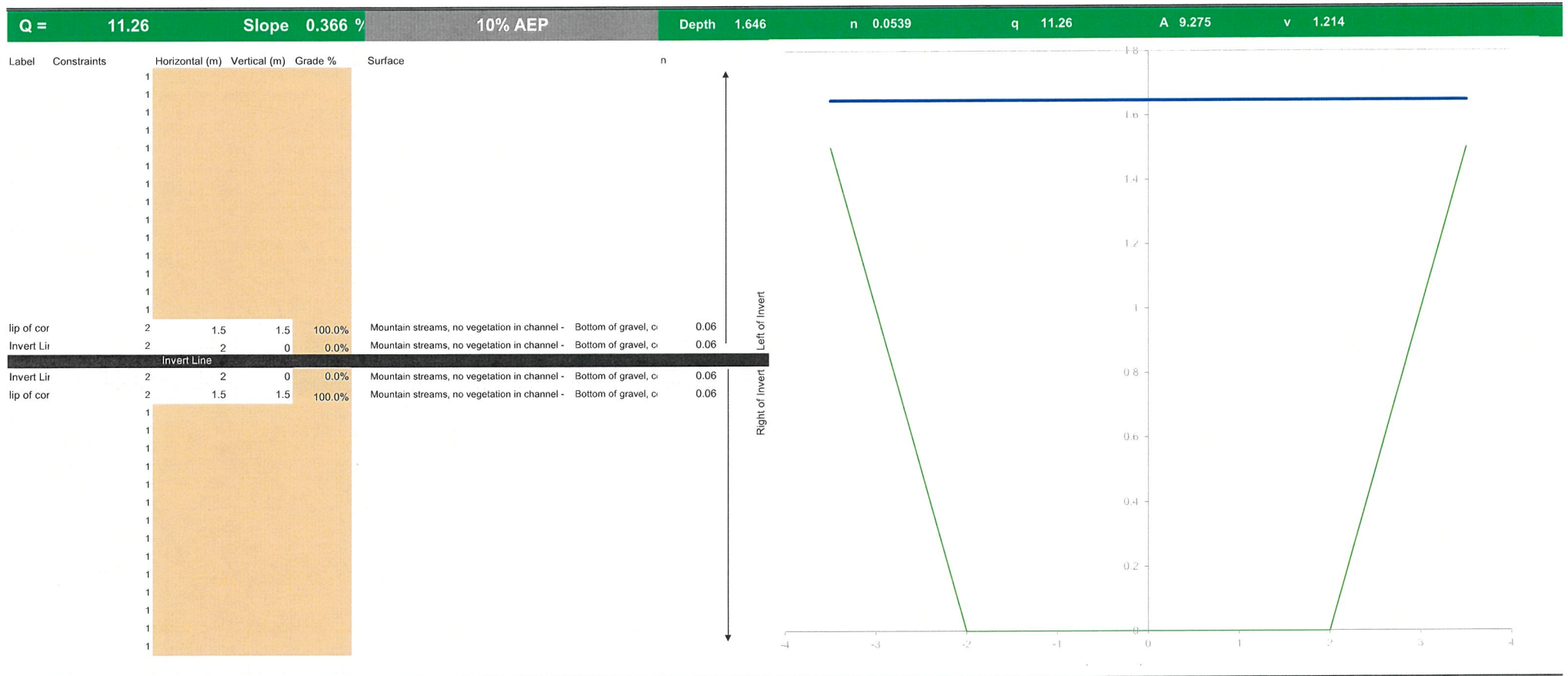
PROJECT
DRAIN A1
63% AEP



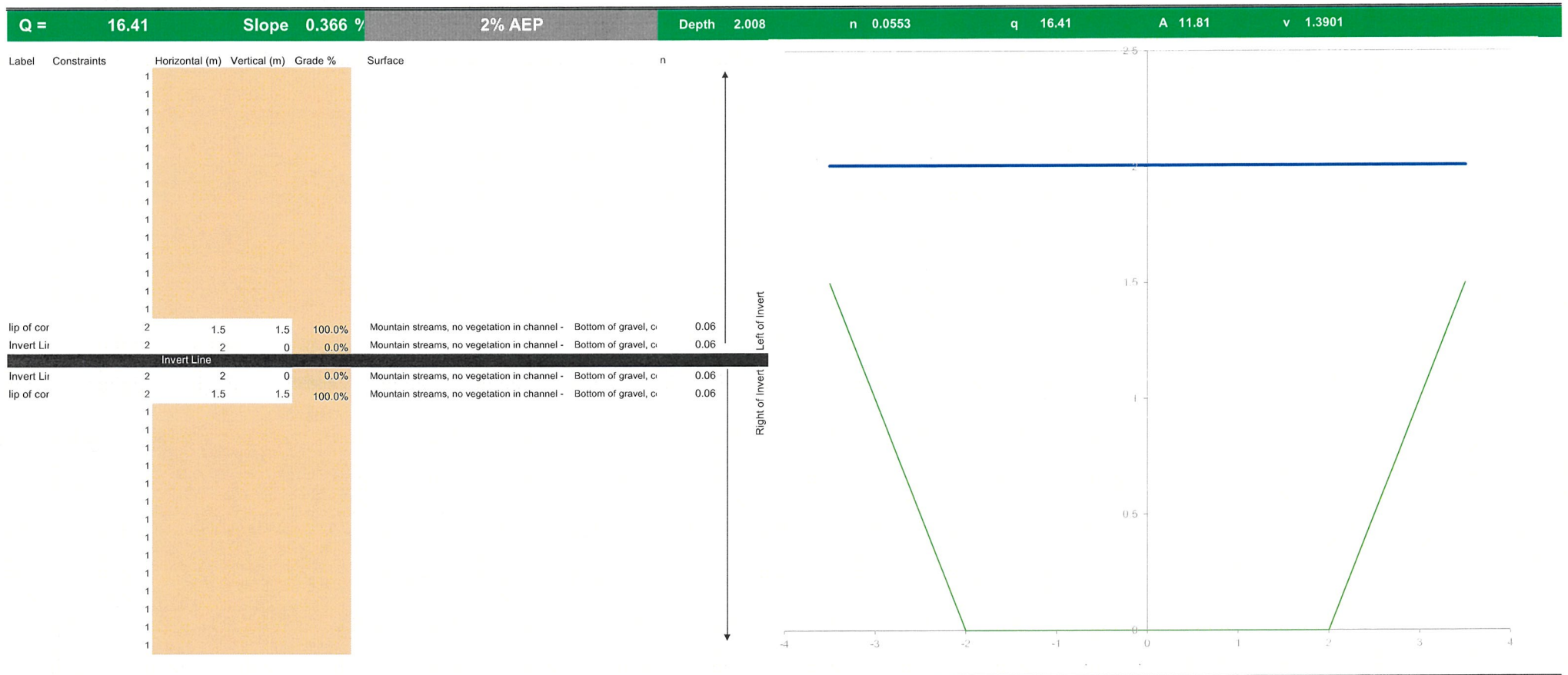


X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment A1 AEP values.xls

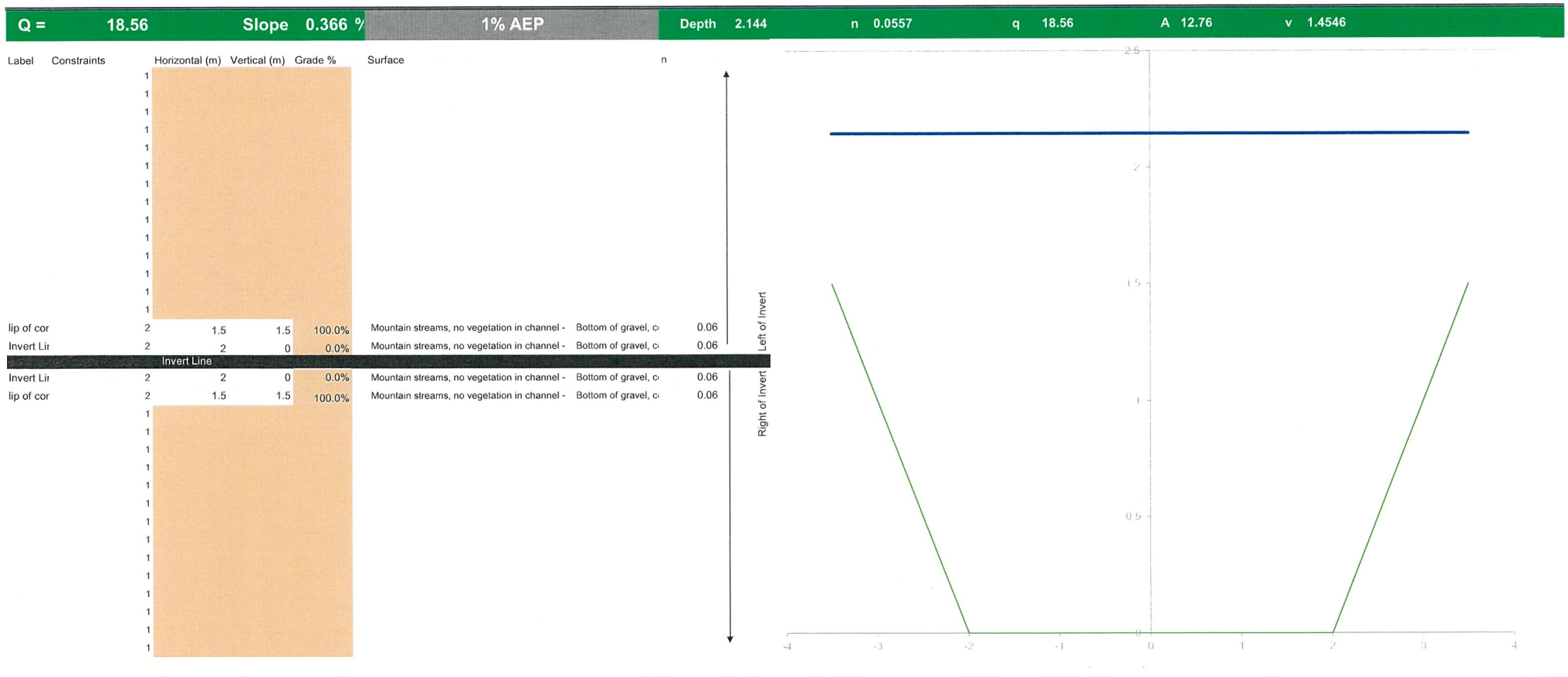
PROJECT
DRAIN A1
10% AEP



PROJECT
DRAIN A1
2% AEP



PROJECT
DRAIN A1
1% AEP



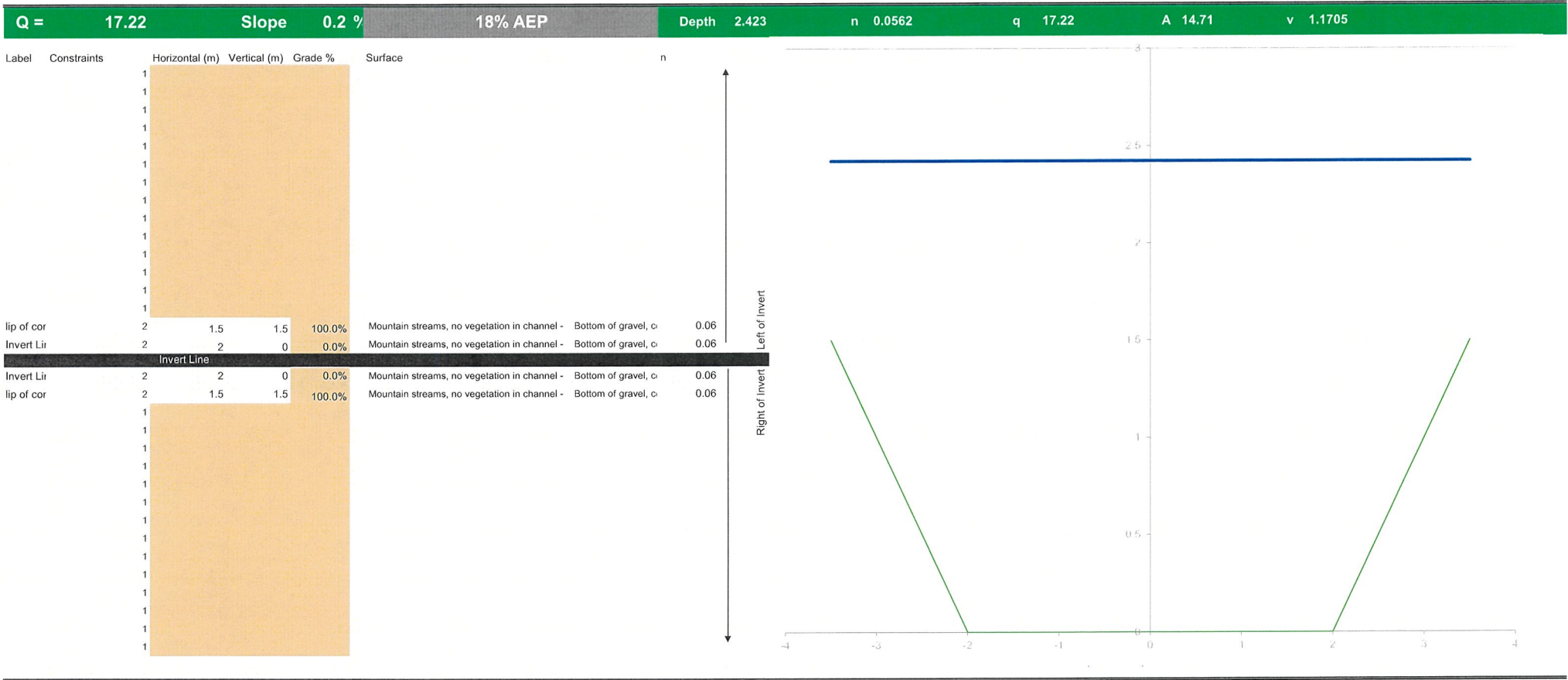
X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment TOTAL A AEP values.xls

PROJECT
DRAIN A1 + A2
39% AEP



Q =		11.74		Slope		0.2 %		39% AEP		Depth		1.973		n		0.0552		q		11.74		A		11.56		v		1.0153	
Label	Constraints	Horizontal (m)	Vertical (m)	Grade %	Surface	n																							
		1																											

PROJECT
DRAIN A1 + A2
18% AEP



X:\1900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment TOTAL A AEP values.xls

X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment TOTAL A AEP values.xls

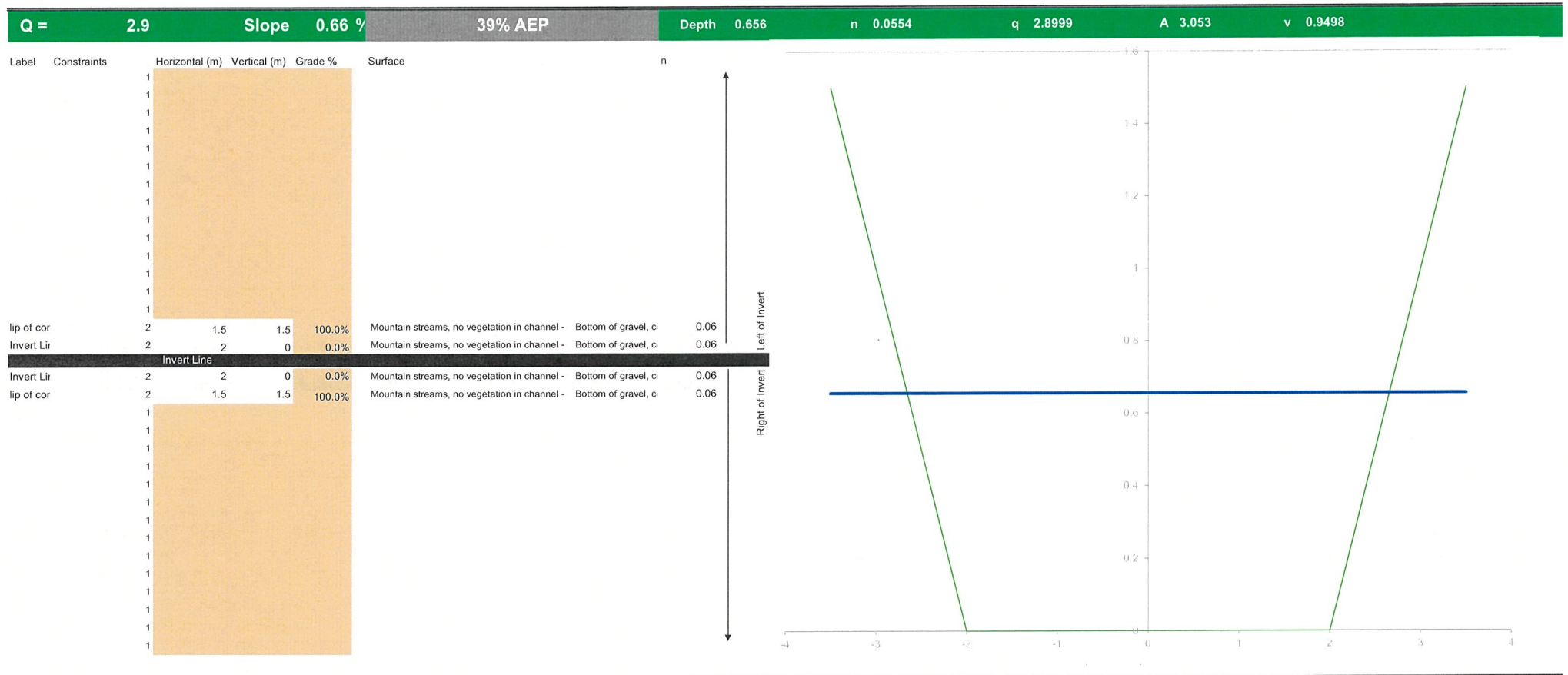
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X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment TOTAL A AEP values.xls

ERSCON
CONSULTING ENGINEERS

X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment B AEP values.xls

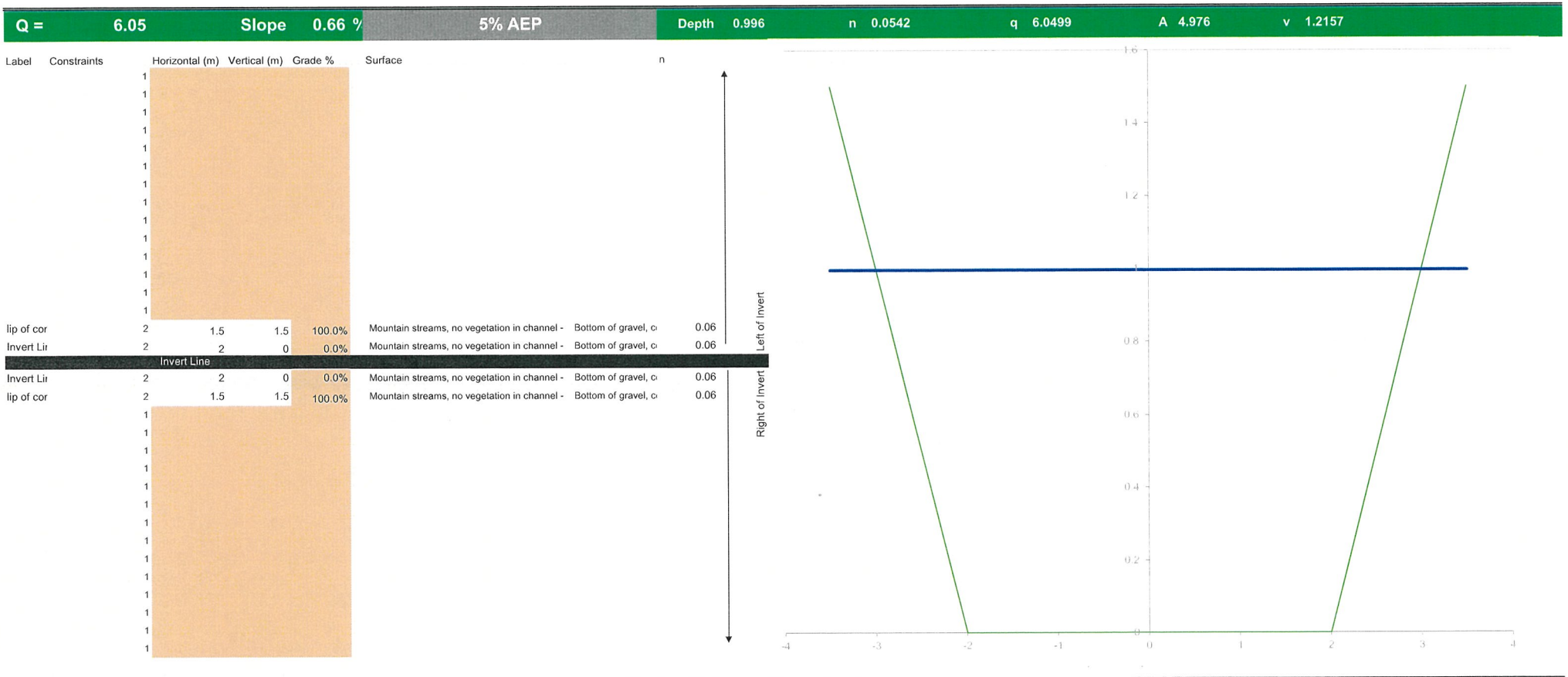
PROJECT
DRAIN B
39% AEP



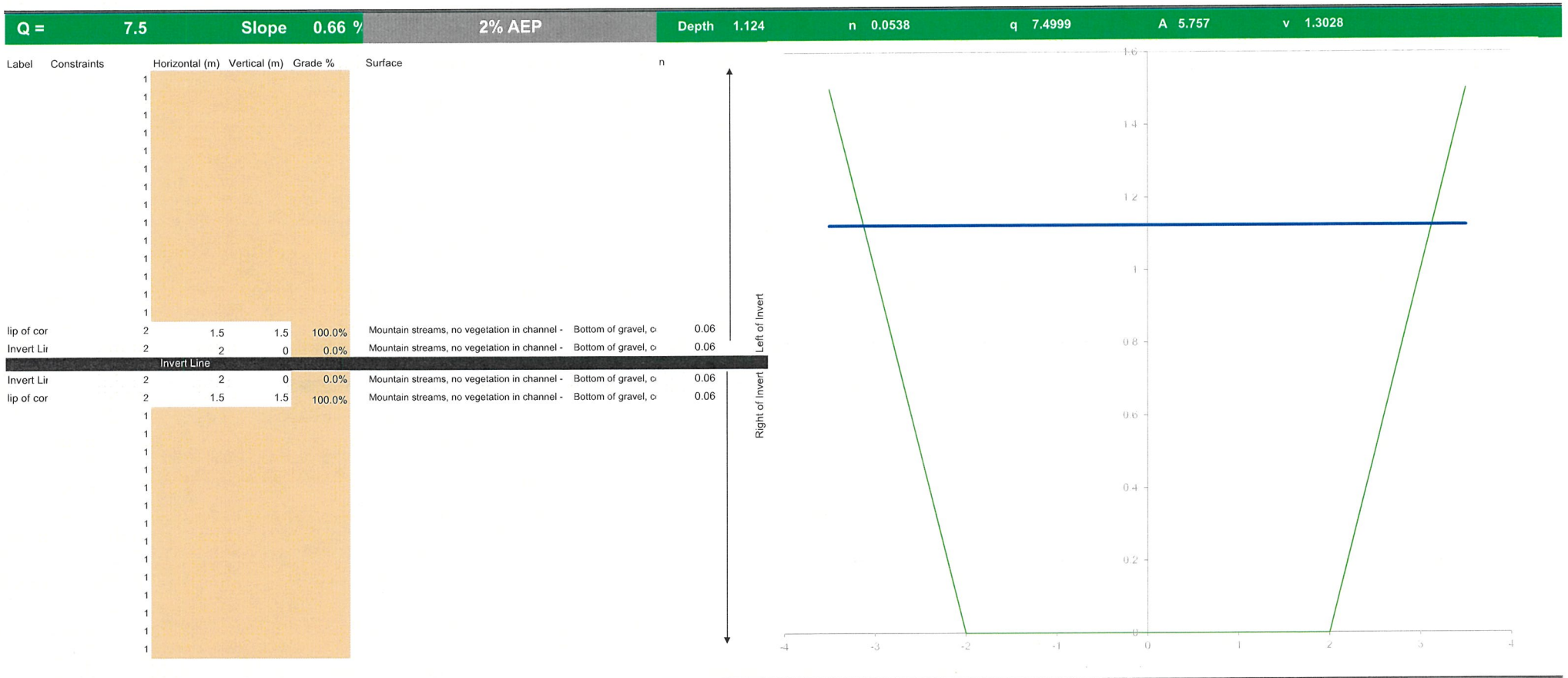
X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment B AEP values.xls

X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment B AEP values.xls

PROJECT
DRAIN B
5% AEP



PROJECT
DRAIN B
2% AEP



X:\900 Minor Jobs\047 Mt Carbine Drain\Engineering\Stormwater\Super Drain Template - Trapezoidal - Catchment B AEP values.xls

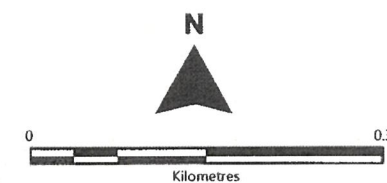
APPENDIX C

NRA supplied Images

Figure 3b: Diversion drainage

Project: EQ Resources Erosion and
Sediment Control Plan

— TSF4 diversion drainage east
— TSF4 diversion drainage west



Source: Bing Aerial 2022

NRA Ref: 380008.02
Date: February 2022

T:\Temp Mapping 2022\3801380008.02
1380008.02_DrainageDiversion_b.220216.vor



Recommended print size: A4





APPENDIX D

Form 15 Certification

This form is to be used by an appointed competent person for the purposes of section 10 of the *Building Act 1975* and sections 73 and 77 of the *Building Regulation 2021* (Design-specification certificate) stating that an aspect of building work or specification will, if installed or carried out as stated in this form, comply with the building assessment provisions.

Additional explanatory information is included in the Appendix at the end of this form.

1. Property description This section need only be completed if details of street address and property description are applicable. E.g. in the case of (standard/generic) pool design/shell manufacture and/or patio and carport systems this section may not be applicable. The description must identify all land the subject of the application. The lot and plan details (e.g. SP/RP) are shown on title documents or a rates notice. If the plan is not registered by title, provide previous lot and plan details.	Street address <i>(include number, street, suburb/locality and postcode)</i> State Postcode Lot and plan details <i>(attach list if necessary)</i> Lot 14 on SP254833 Local government area the land is situated in Mt Carbine
2. Description of aspect/s certified Clearly describe the extent of work covered by this certificate, e.g. all structural aspects of the steel roof beams.	This certificate specifically covers the size and shape of rock required to line an existing perimeter drain at the mine site, located on the southern side of the Mulligan Highway, Mt Carbine.
3. Basis of certification Detail the basis for giving the certificate and the extent to which tests, specifications, rules, standards, codes of practice and other publications were relied upon.	The rock sizing was determined from an in-house assessment of catchment areas, LIDAR information and a report extraction supplied from NRA. The standards used to base calculations were from QUDM and Catchment and Creeks publication "Rock Lining" - May 2010. Calculations were prepared using ERSCON in-house spreadsheets "External Catchments" and "Super Drain". The results were cross checked with manual calculations.

4. Reference documentation Clearly identify any relevant documentation, e.g. numbered structural engineering plans.	All information relating to the determination of rock sizing is contained in the report 900-047 "Rock Size Determination for a Perimeter Drain at Mt Carbine Mines" - April 2022.
5. Building certifier reference number and building development application number	Building certifier reference number 05085 Building development application number (if available)
6. Appointed competent person details Under Part 6 of the Building Regulation a person must be assessed as a competent for the type of work (design-specification) by the relevant building certifier.	Name (in full) John Dale Martin Company name (if applicable) ERSCON Consulting Engineers Business phone number 0742 428479 Email address johnmartin@erscon.com.au Postal address Suite 11, 320 Sheridan Street Cairns Licence class or registration type (if applicable) RPEQ No 5085 Licence or registration number (if applicable) Contact person Mark Freeman Mobile number 0410 724 331 State QLD Postcode 4870
7. Signature of appointed competent person This certificate must be signed by the individual assessed and appointed by the building certifier as competent to give design-specification help.	Signature  Date 4/04/22

LOCAL GOVERNMENT USE ONLY

Date received		Reference number/s	
----------------------	--	---------------------------	--

Appendix – explanatory information

IMPORTANT NOTE: it is an offence for a competent person to give a building certifier a document, including this form, that the person knows or reasonably suspects, is false or misleading.

Who can complete this certificate? (sections 10 of the *Building Act 1975* (Building Act) and 73 of Building Regulation 2021 (BR 2021))
A building certifier can accept from a competent person (design – specifications) a certificate stating that the competent person has assessed the building design or specification for the aspect of building work, and it will, if installed or carried out under the certificate, comply with the building assessment provisions, including any relevant standards and codes.

Schedule 10 of the BR 2021 defines *building design or specification* as any material, system, method of building or other thing related to the design of or specifications for building work.

For a competent person to meet the regulation requirements (section 77 of the BR 2021) they must substantially complete all sections of this form, including information, such as the design of a particular material, system, method of building or that a building element complies with the Building Code of Australia or a provision of the Queensland Development Code. It is also important that the details of the relevant reference documents are included, for example, the applicable Australian Standards or other technical provisions that may be applicable to the subject work.

What is the purpose of this form? (section 10 of the *Building Act 1975*)

The information in this form informs the building certifier's decision making when they are assessing a building development application and issuing the building development approval for the building work the subject of the certificate (form).

When is this form not required?

The assessment of some building applications will be entirely within the expertise of the relevant building certifier and therefore they may not seek the help of a competent person. In these instances, this form is not required.

Is a manufacturer or supplier required under the BR 2021 to complete and sign this Form 15, if requested?

No. A manufacturer or supplier of building materials is not required to complete and give this form or any aspect and inspection certificates if requested by a construction contractor, builder, appointed competent person, or a building certifier.

However, a manufacturer or supplier may give the construction contractor, builder, competent person or the building certifier evidence of suitability such as a manufacturers statement for an aspect or material that it is compliant with the relevant reference documents in the BCA i.e. the applicable Australian Standard/s.

What if there is not enough space for all the supporting material/documents?

Items 2, 3 and 4 requires the competent person to clearly identify the extent of the assessment that was undertaken for aspect/s of work identified in this form.

For instance, there is provision for material such as specifications, standards, codes or other relevant publications to be referenced in the form. However, if the space in the form is not sufficient to accommodate all of this material, you can create and refer to additional material in an addendum or attachment to the form.

The form is also available in a Microsoft Word version, that you can download and edit to include additional material in the relevant parts of the form. Note that editing the form in the Microsoft Word version may cause the relevant boxes to expand and increase the length of the document. This is acceptable and does not change the approved form, provided the section text (description on the left-hand side of the page) is not altered.

Appointed competent person (design or specification) – (sections 34 and 36 of the BR 2021)

A building certifier must assess and decide to appoint an individual as a competent person before they can, as a competent person, give design-specification help. The building certifier is required to keep detailed records about what was considered when appointing a competent person.

A building certifier must be satisfied that an individual is competent to give the type of inspection help having regard to the individual's experience, qualifications and skills and if required by law to hold a licence or registration, that the individual is appropriately registered or licensed.

An individual is appointed as competent to give design-specification help on or from a particular day. The building certifier can also decide an individual is a competent person (design-specification) and a competent person (inspection) at the same time or for the same systems or components of the work.

For further information about assessment of someone as a competent person refer to the **Guideline for the assessment of competent persons**.

PRIVACY NOTICE

The Department of Energy and Public Works is collecting personal information as required under the *Building Act 1975*. This information may be stored by the Department, and will be used for administration, compliance, statistical research and evaluation of building laws. Your personal information will be disclosed to other government agencies, local government authorities and third parties for purposes relating to administering and monitoring compliance with the *Building Act 1975*. Personal information will otherwise only be disclosed to third parties with your consent or unless authorised or required by law.