Proponent Joyful View Garden Real Estate Development Resort Co Pty Ltd

Cherrabah Granite Mine

Surface Water Impact Assessment

April 2019
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# 1. Introduction

## 1.1 Project overview

The proposed Cherrabah Granite Mine is located approximately 25km south of Warwick on Lot 1000 SP268215 which is within the Southern Downs Regional Council area and is part of the New England Tablelands. The mining lease covers an area of 17.42 hectares, which is a very small portion of the 1,988 hectare property (<1% of total land area). The site is accessed from Keogh Road via O’deas Road and Cullendore Road. The existing access to the site is via the northeast corner of the property and Keogh Road through the Cherrabah Resort facility.

The proposed development will operate as a granite mine for the extraction and processing of 8,000 tonnes of dimensioned stone product annually. The development will require a mobile fleet of equipment which includes:

- Front end loader
- Excavator and Rockbreaker
- Stitch Drill
- Diamond Wire Saw
- Blade Saw
- Water Truck
- 4WD Light Vehicles
- Forklift
- Generators

The mine operation requires a number of fixed and semi-mobile buildings that include:

- A basic workshop for machinery maintenance comprised of two sea containers and an ‘igloo’ type shelter;
- A self-bunded fuel storage facility (Approx 30000L);
- Site office; and
- Staff amenity block (lunch room/first aid) including ablutions with septic tank.

## 1.2 Stages of Development

The site will be developed in three discrete stages;

- Site establishment and Construction
- Mine development and Operation
- Rehabilitation and decommissioning of the site once operations have concluded

### 1.2.1 Site Establishment and Construction

Site establishment and construction of the mine requires several construction/earthworks elements including:

- Construction of an internal access road from the Mining Lease to the property entrance: this is to be constructed to rural road standard with a 6m wide gravel pavement on an 8m formation or other suitable design
• Earthworks to level an appropriate processing and stockpiling area to the north of the resource area: including appropriate stormwater drainage infrastructure

• Establishment of the site infrastructure (including office, amenities, power and communications)

• Establishment of access to the extraction area by several access roads graded to suit vehicle access

• Once production exceeds 5,000t/a, upgrade of Keogh Road to an 8m sealed pavement

1.2.2 Mine Development

The granite mine will be developed from the base of the resources and progress upslope to the south in a benched fashion. Benches will be determine by block height but a maximum bench height of 10m is proposed. Extraction will be facilitated by sawing (rock saws and/or wire saws). Once the upper layer of weathered stone is removed the mine will be developed in a square benched manner governed by the natural fracture location and spacing. A haul road will be developed on the eastern side of the resource to access the upper benches and an existing 4WD access track will be maintained on the western side of the resource. The vegetation surrounding the resource will be maintained where feasible.

1.2.3 Rehabilitation and Decommissioning

Rehabilitation of the mine operation will be carried out in stages, as some areas will be operational for more than 10 years. Separate rehabilitation methodologies are will be used for the extraction areas and the processing and stockpiling areas. The final slope profile for the extraction areas is currently designed with a 90° face angle, 10m bench height and 10m bench width. This design is based on assumed geotechnical specifications; however ongoing analysis is required of the face stability as the mine progresses. At various places around the pit secondary may be placed as a ‘bridge’ between the benches to allow wildlife passage however each bench will be integrated into the surrounding topography at the edge of the pit. A sediment basin will be constructed within the floor of the extraction pit which will remain as a water storage to manage sediment runoff from the extraction pit post mining operations.

The processing and stockpiling areas will be contoured to suit the final rehabilitation profile (with appropriate drainage) and compacted areas will be deep ripped followed by topsoil placement.
1.3 **Purpose of this report**

The purpose of this report is to assess the potential impacts of proposed releases from the project on surface water resources as well as to identify required mitigation measures.

1.4 **Scope of work**

The following works have been completed as part of the Surface Water Impact Assessment:

- The environmental values and water quality objectives for the receiving environment have been described.
- The contaminants of concern which are likely to be present in the release water have been described based on a review of available geological information.
- An assessment of the potential impacts of stormwater releases from the receiving environment has been undertaken (including consideration of impacts to wetlands) and required mitigation measures identified.
- Water quality objectives for releases from the stormwater detention basins have been developed in accordance with Technical Guideline Wastewater release to Queensland waters (ESR/2015/1654);
- A water quality monitoring program has been developed which provides details of the proposed monitoring of release events and the receiving environment, including monitoring locations, frequency and parameters.
- Spatially accurate detailed diagrams have been prepared showing the locations of:
  - All proposed stormwater management structures;
  - Receiving environment features;
  - All monitoring locations;
  - Any proposed releases points; and
  - The water storage dimensions post closure.

1.5 **Scope and limitations**

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The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

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2. Receiving Environment

2.1 Catchment Context

The proposed Cherrabah Mine Site is located at the top of the Lord John Creek, which forms part of the headwaters of the Upper Condamine River. The Lord John Creek catchment area is approximately 108 km². Oaky Creek flows into the lower section of Lord John Creek approximately 3km from its junction with the Condamine River. The location of the project site in the context of the local watercourses is presented in Error! Reference source not found.
2.1 Catchment Land use

The current land use on the mining lease site is grazing from relatively natural vegetation as shown in Figure 2. A resort, including a reservoir, is located approximately 3 km east of the site, however is not a part of the receiving environment from the Site. Similarly a quarry located approximately 7 km east of the Site is not within the receiving environment.

Agriculture is a dominant land use downstream from the Site within the headwaters region of the catchment. Dryland agriculture, plantation and irrigated cropping are features located along the Condamine River that are downstream from the Site.

A number of small private reservoirs are also located downstream of the project site, most notably one adjacent to Lord John Creek approximately 8.5 km downstream from the site and two near the junction of Lord John Creek and Condamine River, approximately 21.5 km downstream from the Site. Further downstream is the township of Warwick, where land use transitions from the predominately agricultural uses to residential and intensive uses.
**Wetlands**

A Wetland considered of High Ecological Significance (HEV) is located 2 km west of the Site, and is approximately 12 km upstream from the Connolly Dam on the Rosenthal Creek. The wetland is not within the receiving environment of the proposed granite mine.

A small wetland area is located more than 30 km downstream of the Site and approximately 450 km west of the Condamine River.

No other wetlands are located within the vicinity of the site or the receiving environment.
3. **Environmental Values**

### 3.1 Environmental Protection Policy (Water)

The Environmental Protection Policy (Water) (EPP Water) is a Queensland State policy that protects the quality of water, including rivers, streams, wetlands, lakes, groundwater aquifers, estuaries and coastal areas, while supporting ecologically sustainable development (DES, 2019). The EPP (Water) is a policy for achieving objectives set out in the Environmental Protection Act 1994 (EP Act).

### 3.2 Existing Environmental Values

Environmental values (EVs) are ascribed to regions with the purpose of protecting Queensland’s water environment while also allowing ecologically sustainable development to occur. The Site is situated in the Condamine headwaters region, which has been designated ten of the twelve EVs by the Healthy Water Management Plan. The Condamine headwater’s assigned EVs are noted in Table 1. Table 2 outlines the ten EVs and their relevance to the Site and receiving environment, and therefore their applicability in the context of the local area. Human consumer and drinking water are environmental values applicable to the region, however, not to the local area for reasons described in Table 2.

**Table 1 Environmental values – Condamine headwaters**

<table>
<thead>
<tr>
<th>Environmental Values</th>
<th>Headwaters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic ecosystems</td>
<td>✓</td>
</tr>
<tr>
<td>Irrigation</td>
<td>✓</td>
</tr>
<tr>
<td>Farm supply use</td>
<td>✓</td>
</tr>
<tr>
<td>Stock water</td>
<td></td>
</tr>
<tr>
<td>Aquaculture</td>
<td></td>
</tr>
<tr>
<td>Human consumer</td>
<td>✓</td>
</tr>
<tr>
<td>Primary recreation</td>
<td>✓</td>
</tr>
<tr>
<td>Secondary recreation</td>
<td>✓</td>
</tr>
<tr>
<td>Visual recreation</td>
<td>✓</td>
</tr>
<tr>
<td>Drinking water</td>
<td>✓</td>
</tr>
<tr>
<td>Industrial use</td>
<td></td>
</tr>
<tr>
<td>Cultural, spiritual and ceremonial values</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Table 2 EVs and their applicability to the Site**

<table>
<thead>
<tr>
<th>Environmental Value</th>
<th>Relevance to Site and Receiving Environment</th>
<th>Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic Ecosystems</td>
<td>The aquatic ecosystem value is applicable to all regions. The aquatic ecosystem at the Site and surrounding areas, including the receiving environment for the Site, is considered Moderately Disturbed (MD)</td>
<td>Yes</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Farming, including irrigated farming, is a current land use feature along the banks of the Condamine River and Lord John Creek.</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Irrigated agriculture occurs along Lord John Creek, beginning approximately 17.5 km downstream from the Site.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple irrigated cropping sites are located along the Condamine River, downstream from the Site. These properties are more than 25 km downstream from the Site.</td>
<td></td>
</tr>
</tbody>
</table>
Irrigation is considered applicable due to the irrigated agriculture and farming sites surrounding the waterways

| Farm Use Supply | A number of farms, including irrigation farms and dryland agriculture areas, exist along Lord John Creek. Grazing from relatively natural vegetation is the primary land use surrounding the site. A private reservoir along Lord John Creek is located approximately 8.5 km downstream from site. Two reservoirs exist at the junction of the Condamine River and Lord John Creek, approximately 21.5 km downstream for the Site. Farm use supply is considered applicable environmental value due to the current land uses surrounding the waterways | Yes |

| Stock Water | Grazing from relatively natural vegetation is the primary land use surrounding the waterway in the receiving environment. Stock water is considered an applicable environmental value. | Yes |

| Human Consumer | The immediate receiving waterway is an ephemeral system, and there is no aquaculture production in the receiving waterway (at Lord John Creek). There is no aquaculture production directly downstream from the Condamine River and Lord John Creek junction. The human consumption environmental value is considered inapplicable to the Site and the surrounding environment because it is a feature of the local environment | No |

| Secondary Recreation | Lord John Creek is an ephemeral creek system adjacent to natural vegetation and agricultural land. There is a potential for indirect contact to humans through wading, boating or other similar recreational activities. There is a potential, but low probability, of water being swallowed. Secondary recreation is considered an applicable EV to the local area | Yes |

| Visual Recreation | Lord John Creek and the Condamine River are natural waterways and are visible features for residents and visitors in the region. Visual recreation is considered an applicable EV to the local area | Yes |

| Drinking Water | There are no public water supply offtakes from Lord John Creek to a water treatment plant. Lord John Creek is an ephemeral system, and therefore it would not be a reliable supply waterway for future water supply. | No |
Drinking water is supplied to Warwick from Leslie Dam and Connolly Dam, which are not receiving bodies from the Site. The Condamine River in the headwaters region reports steady but relatively low flows. Drinking water is considered as inapplicable to the local area and the Site receiving environment.

| Industrial use | Industrial users include power generation and manufacturing and mining and minerals processing. The proposed project is a mine site which is consistent with this environmental value. Industrial use environmental value is considered applicable to local region. | Yes |
| Cultural, Spiritual and Ceremonial Values | Lord John Creek and Condamine River are natural waterways within the local region. Cultural, spiritual and ceremonial values considered applicable environmental values. | Yes |
4. **Water Supply**

4.1 **Water Act 2000**

The Water Act 2000 provides the framework for the allocation and sustainable management of water resources in Queensland, including:

- Sustainable and secure water supply and demand management
- Management of impacts on underground water
- Effective operation of water authorities

Under the act, water usage for activities including industry activities, must make allowances to support the ecological health of watercourses. Watercourses impacted by the works of Cherrabah mine will be subject to protection under the Act.

4.2 **Water Plan (Condamine and Balonne) 2004**

Water resource plans are developed under the Water Supply Act in order to provide context for the sustainable management of water with considerations of the social, economic and environmental needs of a catchment.

The Water Plan (Condamine and Balonne) is a resource plan developed in 2004, which regulates the extraction and use of all water resources in the catchment, including overland flows, stored water and groundwater. A draft plan (2019) for the catchment has been developed and will supersede the 2004 plan once ratified.

4.3 **Condamine Water Resource Operations Plan**

The Condamine Water Resource Operations Plan details the implementation of the Water Plan (Condamine and Balonne) at an operational level. The operational plan supports the water security and ecological objectives of the Water Resource plan through a number of defined strategies. The plan sets the foundation of rules for trading of water allocations, allows allocations of unallocated water and provides operational rules for weirs and dams within the catchment. Permits are issued to users for water supply, impoundment or irrigation use authorisation.

There are a number of licenced private storages for agricultural, irrigation and stock watering purposes between the Site and Warwick, as detailed in Table 4. It is unlikely that the project will impact these permit holders.

**Table 3 Water permit holders between the Site and Warwick**

<table>
<thead>
<tr>
<th>Reference Number</th>
<th>Permit Type</th>
<th>Authorised Purpose</th>
<th>Lot &amp; Plan</th>
<th>Watercourse</th>
</tr>
</thead>
<tbody>
<tr>
<td>54818T</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>1/PER200774</td>
<td>Condamine River</td>
</tr>
<tr>
<td>39890T</td>
<td>Licence to interfere by impounding-Embarkment or Wall</td>
<td>Impound Water</td>
<td>1/SP167953</td>
<td>Condamine River</td>
</tr>
<tr>
<td>54899T</td>
<td>Licence to interfere by impounding-Embarkment or Wall</td>
<td>Impound Water</td>
<td>1/SP192372</td>
<td>Condamine River</td>
</tr>
<tr>
<td>Licence ID</td>
<td>Licence Type</td>
<td>Use</td>
<td>Licence Number</td>
<td>Water Course</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>-----</td>
<td>----------------</td>
<td>--------------</td>
</tr>
<tr>
<td>50744T</td>
<td>Licence to interfere by impounding-Embankment or Wall</td>
<td>Impound Water</td>
<td>1/SP260978</td>
<td>Condamine River</td>
</tr>
<tr>
<td>59535T</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>17/RP15538</td>
<td>Condamine River</td>
</tr>
<tr>
<td>27294T</td>
<td>Licence to take water</td>
<td>Domestic Supply</td>
<td>2/RP113831</td>
<td>Condamine River</td>
</tr>
<tr>
<td>405016</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>311/M3432</td>
<td>Condamine River</td>
</tr>
<tr>
<td>54873T</td>
<td>Licence to interfere by impounding-Embankment or Wall</td>
<td>Impound Water</td>
<td>36/RP15550</td>
<td>Condamine River</td>
</tr>
<tr>
<td>54825T</td>
<td>Licence to interfere by impounding-Embankment or Wall</td>
<td>Impound Water</td>
<td>555/ML1529</td>
<td>Condamine River</td>
</tr>
<tr>
<td>606450</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>6/SP238010</td>
<td>Condamine River</td>
</tr>
<tr>
<td>66873T</td>
<td>Licence to take water</td>
<td>Irrigation</td>
<td>700/M34317</td>
<td>Lord John Swamp Alluvium</td>
</tr>
<tr>
<td>50743T</td>
<td>Licence to interfere by impounding-Embankment or Wall</td>
<td>Impound Water</td>
<td>97/M3420; 98/ML1190</td>
<td>Condamine River</td>
</tr>
<tr>
<td>617733</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>A on SP276974</td>
<td>Condamine River</td>
</tr>
<tr>
<td>54790T</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>A/AP22540</td>
<td>Condamine River</td>
</tr>
<tr>
<td>618036</td>
<td>Licence to take water</td>
<td>Domestic Supply; Stock</td>
<td>A/SP235100</td>
<td>Condamine River</td>
</tr>
</tbody>
</table>
5. **Hydrology**

5.1 **Overview**

The Site is located in the Lord John Creek catchment, which forms part of the Upper Condamine River. Lord John Creek is an ephemeral system and is the main drainage line from the Site. Lord John Creek flows into the Condamine River approximately 21.5 km downstream from the Site which flows directly to the Condamine River. The Condamine River is also considered an ephemeral system in the Upper Condamine River region.

The Condamine River in the region between the Site and Warwick is an important source of water for domestic water supply, irrigation, and stock supply purposes. A lacustrine waterbody is located approximately 3 km east of the Site, and High Ecological Value wetlands are located approximately 2 km to the west, as shown in Figure 3. Both the wetlands and lacustrine waterbody are located outside of the Site’s receiving environment.
Turner Creek
Fitz Creek
Farm Creek
Rocky Creek
Condamine River
Mountain Creek
Glen Creek
Oaky Creek
Emu Creek

FIGURE 3

Proposed Haul Road
Mining Lease Area

Wetland and waterbodies within vicinity of site

Based on or contains data provided by the State of Queensland (Department of Natural Resources, Mines and Energy, 2019).

In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.
5.2 Climate

The climate conditions in the Condamine-Balonne catchment are sub-humid and sub-tropical. The Site is located in the south-eastern part of the catchment, which falls more within the sub-tropical climate region than the sub-humid region. The closest weather gauge to the Site is located approximately 11.5 km north-east at Elbow Valley. The gauge reports data consistent with a sub-humid climate, with the highest rainfall amounts falling in late-spring and summer, and the lowest amounts falling in the cooler months of the year, as shown in Figure 4.

![Figure 4: Average monthly rainfall (Elbow Valley)](image)

5.3 Stream Flows

5.3.1 Gauge location

The closest streamflow station to the Site is located on the Condamine River at Elbow Valley (Station number: 422394A), approximately 14.5 km upstream from the junction of the Condamine River and Lord John Creek, as shown in Error! Reference source not found. Error! Reference source not found.. This gauge is considered to experience conditions most consistent with those in the receiving environment of the Site.

The nearest gauge downstream of the Site is located further downstream along the Condamine at Warwick. The details of this gauge and the Elbow Valley station are outlined in Table 4.

<table>
<thead>
<tr>
<th>Gauge Number</th>
<th>Location</th>
<th>Period of Record</th>
<th>Catchment Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>422394A</td>
<td>Elbow Valley</td>
<td>02/12/1972 - Current</td>
<td>325 km²</td>
</tr>
<tr>
<td>422310C</td>
<td>Condamine River at</td>
<td>01/10/1960 - Current</td>
<td>1360 km²</td>
</tr>
<tr>
<td></td>
<td>Warwick</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3.2 Flows

Flow rates from Elbow Valley gauge show that the highest average flow rates in the region are in the summer and autumn months, while the lowest rates are in winter and spring, as shown in Figure 5. This suggests that the Condamine River at Elbow Valley is highly responsive to rainfall events that occur in the late spring and summer, which is indicative of the expected behaviour of other waterways in the region. The prolonged flow rates into the autumn months are likely due to the reduction in infiltration in the wetted soil.

Flow records for the Elbow Valley gauge show that watercourses in the region are highly ephemeral and do not sustain flow. Flow periods in the watercourses downstream of the project site are expected to be sporadic and limited to direct response to rainfall.

Figure 5 Average monthly flow rates at Elbow Valley (Condamine River) station
6. **Existing Water Quality**

6.1 **Guidelines**

The Australian and New Zealand Environment and Conservation Council Guidelines 2000 (ANZECC 2000) provide guideline values or descriptive statements for environmental values to protect aquatic ecosystems and human uses of waters (e.g. primary recreation, human drinking water, agriculture, stock watering). The ANZECC Guidelines are a broad scale assessment and it is recommended that, where applicable, locally relevant guidelines are adopted.

The Queensland Environmental Protection Authority’s (EPA) Queensland Water Quality Guidelines 2009 (QWQG) are intended to address the need identified in the ANZECC Guidelines by:

- Providing guideline values that are specific to Queensland regions and water types; and
- Providing a process/framework for deriving and applying local guidelines for waters in Queensland (i.e. more specific guidelines than those in the ANZECC).

Relevant WQOs for the Site were identified from QWQG (2009) to support and protect different environmental values for water in the Condamine catchment. Lord John Creek is identified as part of the ‘Upper Condamine’. The aquatic ecosystem at the Site and surrounding areas, including the receiving environment for the Site, is considered Moderately Disturbed (MD). The water quality objectives which are applicable to moderately disturbed waters within the Upper Condamine are shown in Table 5.

**Table 5 Water quality objectives for aquatic ecosystem protection for moderately disturbed areas in the Upper Condamine catchment waters**

<table>
<thead>
<tr>
<th>Water quality parameter</th>
<th>Low Flow Objective (Median)</th>
<th>High Flow Objective (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium N (µg/L)</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Oxidised N (µg/L)</td>
<td>18</td>
<td>145</td>
</tr>
<tr>
<td>Total N (µg/L)</td>
<td>400</td>
<td>1050</td>
</tr>
<tr>
<td>Filterable Reactive P (µg/L)</td>
<td>35</td>
<td>80</td>
</tr>
<tr>
<td>Total P (µg/L)</td>
<td>75</td>
<td>210</td>
</tr>
<tr>
<td>Chlorophyll-a (µg/L)</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Dissolved Oxygen (% Saturation) (mg/L)</td>
<td>60-110%</td>
<td>60-110%</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>7</td>
<td>50</td>
</tr>
<tr>
<td>Suspended Solids (mg/L)</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>pH</td>
<td>7.5 - 8.0</td>
<td>7.1-7.7</td>
</tr>
<tr>
<td>Conductivity</td>
<td>275</td>
<td>170</td>
</tr>
<tr>
<td>Sulfate (mg/L)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Alkalinity (mg/L CaCO3)</td>
<td>75</td>
<td>50</td>
</tr>
</tbody>
</table>

6.2 **Existing water quality assessment**

Due to the location of the site at the top of the Lord John Creek being a highly ephemeral watercourse there in an absence of local site-specific water quality data. The expected water quality characteristics for the receiving environment were determined from historical data available for Elbow Valley (DNRME stream gauge and water quality monitoring station 422394A).
The water quality of Elbow Valley is expected to be comparable to the water quality of the receiving environment of the project site, as both are ephemeral and have similar stream and catchment characteristics like proximity to one another and catchment size.

Water quality measurements have been collected for Elbow Valley from 02/12/1972 – Current. A summary of the water quality data for Elbow Valley for the parameters listed in Table 5 is provided in Table 6.

**Table 6** Water Quality Summary for Elbow Valley

<table>
<thead>
<tr>
<th></th>
<th>Turbidity (NTU)</th>
<th>Total Phosphorus (µg/L)</th>
<th>Total Nitrogen (µg/L)</th>
<th>Dissolved Oxygen (% sat)</th>
<th>pH</th>
<th>Total Suspended Solids (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Flow Conditions (&lt;1.7 m³/s)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Flow Criteria</td>
<td>7</td>
<td>75</td>
<td>400</td>
<td>60-110</td>
<td>7.5 - 8.0</td>
<td>10</td>
</tr>
<tr>
<td>Low Flow (Elbow Valley)</td>
<td>16.5</td>
<td>110</td>
<td>492</td>
<td>90%</td>
<td>7.7</td>
<td>12</td>
</tr>
<tr>
<td><strong>High Flow Conditions (&gt;1.7 m³/s)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Flow Criteria</td>
<td>50</td>
<td>210</td>
<td>1050</td>
<td>60-110</td>
<td>7.1-7.7</td>
<td>50</td>
</tr>
<tr>
<td>High Flow (Elbow Valley)</td>
<td>64</td>
<td>152</td>
<td>540</td>
<td>94%</td>
<td>7.36</td>
<td>84</td>
</tr>
</tbody>
</table>

The available water quality data compared against relevant trigger values for the EV identified the following existing water quality conditions:

- **Turbidity**
  - The median turbidity result during low flow conditions at Elbow Valley is significantly higher than the water quality objective. The high turbidity is typical of ephemeral streams which are characterised by short periods of flow and for catchments exhibiting natural erosion and impacting land use that can increase erosion.
  - The median turbidity result for high flow conditions complies with the water quality objective.

- **Total Phosphorus**
  - The median total phosphorus concentration at Elbow Valley exceeds the water quality objective for low flow conditions. However, as for turbidity the median total phosphorus concentration during high flow conditions complies with the water quality objective.

- **Total Nitrogen**
  - Median total nitrogen concentrations are within the objective range for both low and high flow conditions.

- **Dissolved Oxygen**
  - Dissolved oxygen saturation levels were calculated based on the concentration of dissolved oxygen (mg/L), median water temperature and elevation of Elbow Valley.
  - Both low and high flow results were within the objective range.

- **pH**
  - pH levels for both low and high flow conditions fall within the objective range.

- **Total Suspended Solids (TSS)**

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GHD | Report for Joyful View Garden Real Estate Co Pty Ltd - Cherrabah Granite Mine Environmental Assessment, 4132137 | 11
- Median total suspended solids concentrations exceed both the low and high flow water quality objective
7. **Impact assessment and management Measures**

The potential impacts of the construction, operations and decommissioning phases of the Project on surface water resources are considered in this section. The activities, potential impacts and mitigation measures are discussed for each phase of the Project under Sections 7.1 - 7.3.

### 7.1 Construction Phase impacts

Commencement of construction activities at the Site are subject to particular approvals and permits. Once gained, the construction phase of the Project will involve several construction and earthwork elements, all of which could impact surface waters in and around the Site to varying degrees. These construction and earthwork elements include:

- **Construction of infrastructure**
  - Stockpile facilities
  - Storage facilities
  - Access and haul roads
  - Upgrading Keogh Road (once production exceeds 5,000 tonnes/year)
  - Amenities (lunch room, first aid room, and ablutions with a septic tank)
  - Sediment basins
  - Stormwater diversion drain

- **Earth moving activities**
  - Vegetation removal
  - Topsoil removal and stockpiling
  - Earthworks & excavation

The potential impacts of these elements, as well as methods to mitigate and manage the impacts, are discussed in the subsequent sections below.

#### 7.1.1 Erosion and sediment mobilisation

##### 7.1.1.1 Activities

All of the activities listed in Section 7.1 have the potential to mobilise sediment and cause erosion by exposing and disturbing soil to varying degrees.

##### 7.1.1.2 Potential Impacts

The potential impacts of mobilised sediments during construction activities include:

- Sediments entering surface waters via runoff during rainfall events
- Sediments carried into surface waters via wind
- Reduction to quality of surface waters due to increased sediment loads
- Reduction to quality of surface waters due to elevated metals, potentially present in disturbed topsoil or secondary material, entering waterways

##### 7.1.1.3 Management and mitigation measures

Sediment mobilisation and erosion of disturbed or exposed soil should be managed by:
- Minimising the disturbance from heavy earth moving equipment
- Using bunds to restrict velocity of flow
- Minimising the number of water crossings
- Protecting topsoil from erosion by ensuring stripping and stockpiling is away from drainage lines
- Ensuring that vegetation clearing is not undertaken during heavy rainfall
- Adopting a dust suppression plan, such as water spraying and covering stockpiles
- Implementing a vehicle wash bay (away from drainage lines)
- Preparing and implementing a sediment and erosion plan
- Constructing two sedimentation basins to capture water from the extraction pit and from the processing stockpiles
- Ensuring vehicle crossings of waterways are designed to include under road drainage and for a range of flow conditions
- Ensuring all dewatering activities from site to be treated or managed appropriately before discharge

A risk assessment was undertaken for the potential impacts of the construction works on the surface water environment and is detailed in Appendix A. The risk assessment concluded that implementation of the mitigation measures for activities that cause sediment mobilisation and erosion reduce the inherent risk from significant to low (unlikely with moderate consequences).

7.1.2 Works within proximity of drainage lines

7.1.2.1 Activities

Construction of facilities and infrastructure including the access and haul roads, and the stormwater diversion drain will be undertaken in or around drainage lines.

7.1.2.2 Potential impacts

Construction works in and around drainage lines significantly risk impacting the watercourse. The potential impacts of the construction activities to be undertaken include alteration of flow characteristics by channel bed level modification or by sediment mobilisation.

7.1.2.3 Management and mitigation measures

The potential impacts to drainage lines may be managed through:

- Undertaking construction in months with the lowest average rainfall amounts
- Constructing appropriate stormwater management infrastructure prior to undertaking works in drainage lines
- Minimising disturbance from heavy earth moving equipment, particularly in riparian zones
- Diverting runoff from road shoulders into sedimentation ponds through mitre drains and table drains
- Using slope protection on road batters to reduce sediment mobilisation
- Using groundcovers on disturbed areas (for rehabilitation)
- Designing all vehicle crossings and under road drainage for a range of flow conditions

A risk assessment was undertaken for the potential impacts of the construction works on the surface water environment and is detailed in Appendix A. The risk assessment concluded that
implementation of the mitigation measures for works within proximity of drainage lines reduce the inherent risk from significant to low (unlikely with moderate consequences).

7.1.3 Contaminant mobilisation

7.1.3.1 Activities
Contamination of watercourses may occur through the following activities:

- Construction of a self-bunded fuel storage facility (Approximately 30 ML)
- Construction of chemical storage facilities
- Construction of a staff amenity block (lunch room/first aid) including ablutions with septic tank.
- Refuelling of earth moving equipment and vehicles
- Vehicle wash downs

7.1.3.2 Potential impacts
The potential impacts of contamination generated through the activities discussed above include:

- Drainage of contaminants into nearby watercourses
  - Reduction in water quality in watercourses from chemical contamination, such as oils, fuels or waste water treatment chemicals
- Contamination of surface waters through contact with litter and construction waste
  - Waste may be washed into surface watercourses during rainfall events

7.1.3.3 Management and mitigation measures
The potential impacts of contaminant mobilisation during the construction phase may be managed through:

- Construction of temporary and permanent areas for chemical and fuel storage as per AS 1940
- Construction of controlled re-fuelling areas within bunded region
- Regular treatment and drainage of bunds, particularly after rainfall events
- Ensuring the availability of spill kits (as per Australian Standards AS1940 and AS3780) in areas containing chemicals or fuels, including on vehicles and machinery
- Containing and controlling all spills
- Collection of any spillages to be undertaken by licenced collector contractors
- Appropriate site selection for refuelling and chemical storage areas to minimising likelihood of contaminating stormwater runoff
- Treatment of wash down waste water with oil and grease separators, then directed to construction ponds for reuse

A risk assessment was undertaken for the potential impacts of the construction works on the surface water environment and is detailed in Appendix A. The risk assessment concluded that implementation of the mitigation measures for activities that cause contaminant mobilisation reduce the inherent risk from significant to low (unlikely with moderate consequences).
7.1.4 Water supply

7.1.4.1 Potential impacts
Inadequate water supply during the construction phase may impact the water quality within nearby watercourses due to a lack of dust suppression, vehicle washdown and soil compaction.

7.1.4.2 Management and mitigation measures
The potential impacts of during the construction phase may be managed through:

- Development and implementation of a water supply strategy
- Development of an emergency plan
- Collection of water in sedimentation dams for water supply during construction phase
- Implementation of management measures outlined in Section 7.1.1.3, erosion and sedimentation, to reduce requirement of water for dust suppression and soil compaction

A risk assessment was undertaken for the potential impacts of the construction works on the surface water environment and is detailed in Appendix A. The risk assessment concluded that implementation of mitigation measures for water supply reduces the inherent risk from significant to low (unlikely with moderate consequences).
7.2 Operations phase impacts

The operational phase of the granite mine will involve the following activities and elements:

- Development of granite mine from the base of the resources and progress upslope to the south in a benched fashion, with a maximum bench height of 10 metres
- Excavation and stockpiling of topsoil and secondary materials
- Extraction of granite by sawing (rock saws and/or wire saws)
- Hauling of materials via the developed and upgraded roads

7.2.1 Contaminants of concern from releases

7.2.1.1 Activities

Extraction of topsoil and granite during the operations at the Site will increase the quantity of mobilised sediment and contaminants. These sediments and contaminants are to be captured in sediment basins for treatment prior to release of stormwater to the environment.

7.2.1.2 Geochemistry of granite

Granite is a coarsely grained material, comprised primarily of three minerals, quartz, alkali feldspar and plagioclase feldspar, which are primarily made up of the following compounds:

- **Quartz**
  - Silicon dioxide compound
  - Commonly occurs in minerals
  - Practically insoluble in water at room temperature
- **Alkali feldspar**
  - Feldspar is determined by the alumina and silica in their chemistry
  - Alkali feldspar is rich in sodium and potassium
  - Practically insoluble in the environment
- **Plagioclase feldspar**
  - Rich in sodium and calcium
  - Practically insoluble in water

Based on the geochemistry of granite, and the practical insolubility in water, total suspended solids (TSS) is the only contaminant of concern of the proposed mining activities.

7.2.1.3 Potential impacts

Granite material will be extracted from the Site via rock and/or wire saws. Granite and the compounds that make-up granite will be exposed to the environment due to the mining activities. The geochemistry of granite is such that the contaminant of concern from release water is limited to TSS, as discussed above. Releasing high amounts of TSS into the environment has the potential to reduce the water quality and interrupt flow regimes in receiving watercourses.

7.2.1.4 Management and mitigation measures

The potential impacts of the release of contaminants may be mitigated by:

- Capturing water in a sedimentation basin before releasing it to the environment. Details of the proposed sediment basins and associated stormwater infrastructure are provided in Appendix B.
- Implementation of a stormwater management plan
• Monitoring water quality of release water
• Monitoring downstream water quality during release events
• Releasing water within 120 hours of the event which filled the basin however, after the peak of the event (to mimic natural flow regimes but not exacerbate peak flow)
• Releasing water with a TSS concentration of less than 50 mg/L

A risk assessment was undertaken for the potential impacts of the operational phase on the surface water environment and is detailed in Appendix A. The risk assessment concluded that implementation of the mitigation measures for activities that cause contaminants of concern from releases reduce the inherent risk from moderate to low (unlikely with moderate consequences).

7.2.2 Water management system failures

7.2.2.1 Activities
Failure of water management system may lead to the discharge of MAW into the receiving watercourses. These potential failures include:
• Inadequate storage availability within sedimentation pond
• Embankment failure of the sedimentation pond due to poor design or construction
• Extreme rainfall or storm events
• Inadequate diversion of clean stormwater away from Site

7.2.2.2 Potential impacts
The potential impacts of water management system failures include:
• Changes to the flow regimes of the watercourses in the area
  – Destruction or alteration of riparian vegetation due to flow regime changes
  – Destruction or alteration of aquatic species due to flow regime changes
• Discharging poor quality water into nearby watercourses
• Increasing erosion and sedimentation mobilisation

7.2.2.3 Management measures
The potential impacts of the water management failures may be mitigated through:
• Designing sedimentation basins and spillway in accordance with Stormwater and environmentally relevant activities guideline
• Designing of sedimentation basins to be undertaken by a Registered Professional Engineer of Queensland (RPEQ)
• Overseeing of sedimentation basin construction to be done by an RPEQ
• Regular inspections to diversion drains, drainage channels and sedimentation basins

A risk assessment was undertaken for the potential impacts of the operational phase on the surface water environment and is detailed in Appendix A. The risk assessment concluded that implementation of the mitigation measures for activities that cause water management system failures reduce the inherent risk from low to insignificant (unlikely with minor consequences).
7.2.3  Erosion and sediment mobilisation

7.2.3.1  Activities
The operational activities that have the potential to cause erosion and sediment mobilisation include:

- Removal of topsoil via earthmoving equipment
- Extraction of granite via wire and/or rock saws
- Inadequate erosion protection along drains and road shoulders

7.2.3.2  Potential Impacts
The potential impacts of erosion and sediment mobilisation during the operational phase of the Project include harmful effects to nearby watercourses, riparian vegetation and aquatic species.

7.2.3.3  Mitigation and Management Measures
The potential impacts of the erosion and sedimentation mobilisation may be mitigated through:

- Appropriate design of erosion protection along road shoulders and drains
- Implementation of a water management plan for the Site operations
- Plantation of swales or buffers to provide filtration
- Appropriate stockpiling of topsoil and secondary materials
- Rehabilitation of topsoil

A risk assessment was undertaken for the potential impacts of the operational phase on the surface water environment and is detailed in Appendix A. The risk assessment concluded that implementation of the mitigation measures for activities that cause sediment mobilisation and erosion reduce the inherent risk from significant to low (unlikely with moderate consequences).

7.2.4  Flooding

7.2.4.1  Activities
The sedimentation basin established to capture mine runoff may increase the peak flood level and flow rate during a flood event.

7.2.4.2  Potential impacts
The potential impacts of a flood event during the operations at Site include:

- Overtopping of sediment dam and unregulated release to the receiving watercourses
  - Increase to peak flood level or flow rate
  - Destruction of aquatic and riparian habitat

7.2.4.3  Mitigation and Management Measures
The potential impacts detailed above in Section 7.2.4.2 may be mitigated or avoided through:

- Design and construction of drainage diversions of stormwater away from site
- Design and construction of levees surrounding site
- Inspect drainage structures after storm events
- Implementation of emergency response plan and warning system

A risk assessment was undertaken for the potential impacts of the operational phase on the surface water environment and is detailed in Appendix A. The risk assessment concluded that
implementation of the mitigation measures for flooding reduce the inherent risk from moderate to low (very unlikely with moderate consequences).
7.3 **Decommissioning impacts**

Impacts that may occur in the decommissioning phase of the Project are similar to the impacts identified for the construction phase. These activities include:

- Rehabilitation of mine site, including stockpile area, mine pit and sedimentation basin
- Removal of mine site infrastructure and equipment

Similarly, the mitigation measures that were discussed for the construction phase apply to the decommissioning phase of the Project.

7.3.1 **Sediment mobilisation**

The impacts and mitigation measures of sediment mobilisation for the decommissioning phase are detailed in Section 7.1.1.

The risk assessment, detailed in Appendix A, concluded that implementation of the mitigation measures for activities that cause sediment mobilisation and erosion reduce the inherent risk from significant to low (unlikely with moderate consequences).

7.3.2 **Works within proximity of drainage lines**

The impacts and mitigation measures of drainage works for the decommissioning phase are detailed in Section 7.1.2.

The risk assessment, detailed in Appendix A, concluded that implementation of the mitigation measures for works within proximity of drainage lines reduce the inherent risk from significant to low (unlikely with moderate consequences).

7.3.3 **Contaminant Mobilisation**

The impacts and mitigation measures of contaminant mobilisation for the decommissioning phase are detailed in Section 7.1.3.

The risk assessment, detailed in Appendix A, concluded that implementation of the mitigation measures for activities that cause contaminant mobilisation reduce the inherent risk from significant to low (unlikely with moderate consequences).
8. Monitoring program

A program for monitoring water quality should be undertaken on an on-going basis to assess impacts of the Site on the receiving environment. The on-going monitoring program is to be undertaken in accordance with the Monitoring and Sampling Manual (DERM, 2009) and is described in the subsequent section.

8.1 On-going monitoring program

8.1.1 Objectives

The objectives of the on-going monitoring program are to measure the impacts to surface water from construction, operations and decommissioning at the Site, and to highlight the performance of mitigation measures. The predominant motivation behind the monitoring program is to maintain the water quality of the receiving environment within the water quality objectives outlined or developed for the local area, as discussed in section Error! Reference source not found..

8.1.2 Monitoring locations

Water quality monitoring assesses the performance of the control measures implemented in a stormwater management plan. Generally, appropriate monitoring locations are positioned upstream, downstream as well as at the location of interest. This allows for appropriate analysis of the impacts due to activities at a location of interest.

The proposed Cherrabah Mine site is located in the far-upper headwaters of the Condamine catchment. No defined waterways exist upstream of the proposed site location. For this reason, it is impractical to monitor an upstream location.

The downstream locations were chosen to allow for the most accurate and practical assessment of the impacts due to the Site activities. Release Points 1 and 2 provide the concentration of TSS directly released. Elbow Valley Station is an existing gauge, which provides a baseline dataset. Lord John Creek at O’Deas Road provides a downstream location for monitoring environmental impacts. The details of each monitoring location are outlined in Table 7.
<table>
<thead>
<tr>
<th>Location</th>
<th>Location details</th>
</tr>
</thead>
</table>
| Release Point 1 | • Located at the northern end of Sedimentation basin 1  
• Releases directly to the spillway channel, which flows to Lord John Creek  
• To ensure less than 50 mg/L of TSS is released to the environment  
• To monitor actual amount of TSS released to the environment  
• To be monitored during a release event |
| Release Point 2 | • Located at the northern end of Sedimentation basin 2  
• Releases directly to the spillway channel, which flows to Lord John Creek  
• To ensure less than 50 mg/L of TSS is released to the environment  
• To monitor actual amount of TSS released to the environment  
• To be monitored during a release event |
| Elbow Valley Station | • Located on the Condamine River, approximately 14.5 km upstream of the Condamine River and Lord John Creek junction  
• Provides a baseline TSS reading for comparison with downstream monitoring locations  
• Ensures that increased TSS loads from sources along the Condamine River are not associated with releases from the Site  
• Water quality data, including TSS, is accessible from the Water Monitoring Information Portal, however it is not recorded daily. Monitoring to be undertaken within 5 days of a release event. |
| Lord John Creek at Odeas Road | • Closest downstream monitoring location, approximately 10 km downstream from the Site  
• Monitors TSS concentrations in the water for comparison with baseline values  
• Allows for the assessment of the performance of the Site’s control measures and compliance with water quality objective for TSS  
• To be monitored within five days of a release event |

### 8.1.3 Parameters for monitoring

Parameters for monitoring were determined based on protecting the environmental values detailed in Section 3.2 and the mitigating the potential impacts identified in Section 7. The parameters for monitoring are detailed in Table 8.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Analyte Group</th>
<th>Monitoring rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspended solids</td>
<td></td>
<td>General condition and site water management performance indicators</td>
</tr>
<tr>
<td>Turbidity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.1.4 Monitoring frequency

Monitoring is to be undertaken as soon as practical after a release event from either of the two sediment basins. Table 9 details the monitoring schedule as well as summarises the location of each monitoring point.

Table 9 Summary of monitoring locations and parameters

<table>
<thead>
<tr>
<th>Location relative to the Site</th>
<th>RP 1</th>
<th>RP 2</th>
<th>Elbow Valley Station</th>
<th>Lord John Creek at Odeas Rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedimentation basin 1</td>
<td></td>
<td></td>
<td>Condamine River, upstream of Condamine River and Lord John Creek junction</td>
<td>Downstream from site</td>
</tr>
<tr>
<td>Sedimentation basin 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring frequency</td>
<td>Release event</td>
<td>Release event</td>
<td>Release event</td>
<td>Release event</td>
</tr>
<tr>
<td>Parameters tested</td>
<td>See Table 8</td>
<td>See Table 8</td>
<td>See Table 8</td>
<td>See Table 8</td>
</tr>
</tbody>
</table>
9. Conclusion

The proposed Cherrabah Granite Mine Site is located in Lord John Creek catchment, approximately 46 km upstream of Warwick. The Lord John Creek catchment forms part of the upper Condamine, flowing directly to the Condamine River approximately 22 km downstream from the Site.

The surface water impact assessment undertaken for this report assessed the existing conditions of the receiving environment, as well as the potential impacts the activities at the Site may have on the receiving environment. The assessment also detailed management measures to mitigate these impacts on surface waters.

The Site is located within the Condamine headwaters region, which is considered to have moderately disturbed waterways (DES, 2018). The environmental values applicable to the Condamine headwaters region are indicated in Table 11.

Table 10 Environmental values summary

<table>
<thead>
<tr>
<th>Headwaters</th>
<th>Aquatic ecosystems</th>
<th>Irrigation</th>
<th>Farm supply use</th>
<th>Stock water</th>
<th>Aquaculture</th>
<th>Human consumer</th>
<th>Primary recreation</th>
<th>Secondary recreation</th>
<th>Visual recreation</th>
<th>Drinking water</th>
<th>Industrial use</th>
<th>Cultural, spiritual and ceremonial values</th>
</tr>
</thead>
</table>

The environmental values considered applicable to the Condamine headwaters region were however, considered different to the EV’s applicable for the Site and its receiving environment. Human consumer and Drinking water were not considered applicable for the local region for reasons including:

- Lord John Creek is an ephemeral system, and therefore it would not be a reliable supply waterway for future water supply or yield suitable fishing conditions.
- There are no public water supply offtakes from Lord John Creek to a water treatment plant.
- Drinking water is supplied to Warwick from Leslie Dam and Connolly Dam, which are not receiving bodies from the Site.
- There is no aquaculture production in the receiving waterway (at Lord John Creek). There is no aquaculture production directly downstream from the Condamine River and Lord John Creek junction.

Historical water quality data for the local environment was sourced from the nearest gauge location, Elbow Valley (DRNME, 2018). The Elbow Valley station was considered applicable to the Site due to the proximity and relatively similar conditions. Available data dating from 1973 to 2018 was used to determine the existing water quality conditions for the Site.

An assessment of the surface water resources around the Site concluded that the existing water quality is below the water quality objectives for the region in Turbidity during low flow conditions, as well as Total Phosphorus and TSS in all flow conditions. Localised water quality objectives for these parameters should be developed in accordance with Queensland Water Quality Guidelines (2009) to reflect the environment in this region.
Potential impacts to the local environment from the project were identified for each of the construction, operational and decommissioning phases of the Project. The potential impacts identified included erosion and sediment mobilisation, works within drainage lines, contaminant mobilisation, flooding, water supply and water management system failures.

Mitigation and management measures for each potential impact were identified to reduce the inherent risk level to the receiving environment. Measures including dust suppression, sediment and erosion, water supply, water release and emergency plans are expected to reduce the inherent risk of impacts to local surface waters to negligible.

On-going monitoring is proposed to be undertaken directly after a triggering storm event at five locations including two release points, Lord John Creek at Odeas Road, Lord John Creek at Cullendore Road and Condamine River at Warwick-Killarney Road. The water quality results from these locations are to be compared with data sourced from the Elbow Valley gauge (which will not be impacted by activities at the Site) to assess the impacts of the Site and performance of the mitigation measures. Impacts of from the activities at the Site are expected to be negligible if the mitigation measures, discussed in section 7, are implemented.
## Appendix A – Risk assessment

### Table 11 Cherrabah Mine Environmental risk assessment – Surface Water

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Potential impact</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Inherent Risk rating</th>
<th>Mitigation Strategy</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Residual Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Erosion and sediment mobilisation</td>
<td>Sediments entering surface waters via runoff during rainfall events</td>
<td>4 - Likely</td>
<td>3 - Moderate</td>
<td>Significant</td>
<td>Minimising the disturbance from heavy earth moving equipment Using bunds to restrict velocity of flow</td>
<td>2 - Unlikely</td>
<td>3 - Moderate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Sediments carried into surface waters via wind</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Reduction to quality of surface waters due to increased sediment loads</td>
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<td></td>
<td>Reduction to quality of surface waters due to elevated metals, potentially present in disturbed topsoil or secondary material, entering waterways</td>
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<td></td>
<td>Sediments entering surface waters via runoff during rainfall events</td>
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<td></td>
<td>Sediments carried into surface waters via wind</td>
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<td>Reduction to quality of surface waters due to increased sediment loads</td>
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<tr>
<td></td>
<td>Reduction to quality of surface waters due to elevated metals, potentially present in disturbed topsoil or secondary, entering waterways</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Works within proximity of drainage lines</td>
<td>Construction works in and around drainage lines significantly risk impacting the watercourse. The potential impacts of the construction activities to be undertaken include alteration of flow characteristics by channel bed level modification or by sediment mobilisation.</td>
<td>4 - Likely</td>
<td>3 - Moderate</td>
<td>Significant</td>
<td>Undertaking construction in months with the lowest average rainfall amounts Constructing appropriate stormwater management infrastructure prior to undertaking works in drainage lines Minimising disturbance from heavy earth moving equipment, particularly in riparian zones Diverting runoff from road shoulders into sedimentation ponds through mitre drains and table drains Using slope protection on road batters to reduce sediment mobilisation Using groundcovers on disturbed areas (for rehabilitation) Designing all vehicle crossings and under road drainage for a range of flow conditions</td>
<td>2 - Unlikely</td>
<td>3 - Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Contaminant mobilisation</td>
<td>Drainage of contaminants into nearby watercourses</td>
<td>4 - Likely</td>
<td>3 - Moderate</td>
<td>Significant</td>
<td>Construction of temporary and permanent areas for chemical and fuel storage as per AS 1940</td>
<td>2 - Unlikely</td>
<td>3 - Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Water supply</td>
<td>Reduction in water quality in watercourses from chemical contamination, such as oils, fuels or waste water treatment chemicals</td>
<td>Contamination of surface waters through contact with groundwater (caused by excavation)</td>
<td>Heavy metals may be present in groundwater, impacting the ecological sustainability of the watercourse as well as posing a risk to human health</td>
<td>Contamination of surface waters through contact with litter and construction waste</td>
<td>Waste may be washed into surface watercourses during rainfall events</td>
<td>Construction of controlled re-fuelling areas within bunded region</td>
<td>Regular treatment and drainage of bunds, particularly after rainfall events</td>
<td>Ensuring the availability of spill kits (as per Australian Standards AS1940 and AS3780) in areas containing chemicals or fuels, including on vehicles and machinery</td>
</tr>
</tbody>
</table>

| 3 - Possible | 3 - Moderate | Significant |

| Contaminant of concern from releases | Releasing high amounts of TSS into the environment has the potential to reduce the water quality and interrupt flow regimes in receiving watercourses. | Capturing treating water in a sedimentation basin before releasing it to the environment | Implementation of a stormwater management plan | Monitoring water quality of release water | Monitoring downstream water quality during release events | Releasing water within 120 hours of the event which filled the basin however, after the peak of the event (to mimic natural flow regimes but not exacerbate peak flow) | Releasing water with a TSS concentration of less than 50 mg/L | 2 - Unlikely | 3 - Moderate | Low |

| 4 - Likely | 3 - Moderate | Moderate |

| Water management system failures | Changes to the flow regimes of the watercourses in the area | Destruction or alteration of riparian vegetation due to flow regime changes | Destruction or alteration of aquatic species due to flow regime changes | Discharging poor quality water into nearby watercourses Increasing erosion and sedimentation mobilisation | Designing sedimentation basins and spillway in accordance with Stormwater and environmentally relevant activities guideline | Designing of sedimentation basin to be undertaken by a Registered Professional Engineer of Queensland (RPEQ) | Overseeing of sedimentation basin construction to be done by an RPEQ | Regular inspections to diversion drains, sedimentation basin and sedimentation embankment | 2 - Unlikely | 2 - Minor |

| 4 - Likely | 2 - Minor | Low |

| 2 - Unlikely | 2 - Minor | Insignificant |
### Erosion and Sediment Mobilisation

The potential impacts of erosion and sediment mobilisation during the operational phase of the Project include harmful effects to nearby watercourses, riparian vegetation and aquatic species.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Likelihood</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - Likely</td>
<td>Moderate</td>
<td>Appropriate design of erosion protection along road shoulders and drains.</td>
</tr>
<tr>
<td>3 - Possible</td>
<td>Moderate</td>
<td>Implementation of a water management plan for the Site operations.</td>
</tr>
<tr>
<td>3 - Moderate</td>
<td>Moderate</td>
<td>Plantation of swales or buffers to provide filtration.</td>
</tr>
<tr>
<td>2 - Unlikely</td>
<td>Moderate</td>
<td>Appropriate stockpiling of topsoil and secondary materials.</td>
</tr>
<tr>
<td>1 - Very Unlikely</td>
<td>Moderate</td>
<td>Rehabilitation of topsoil.</td>
</tr>
<tr>
<td>1 - Very Unlikely</td>
<td>Moderate</td>
<td>Design and construction of drainage diversions of stormwater away from site.</td>
</tr>
<tr>
<td>1 - Very Unlikely</td>
<td>Moderate</td>
<td>Design and construction of levees surrounding site.</td>
</tr>
<tr>
<td>1 - Very Unlikely</td>
<td>Moderate</td>
<td>Inspections of levees and drainage structures after storm events.</td>
</tr>
<tr>
<td>1 - Very Unlikely</td>
<td>Moderate</td>
<td>Implementation of emergency response plan and warning system.</td>
</tr>
</tbody>
</table>

### Flooding

Overtopping of sediment dam and unregulated release to the receiving watercourses.

Increase to peak flood level or flow rate.

Destruction of aquatic and riparian habitat.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Likelihood</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - Moderate</td>
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</table>

### Decommissioning Phase

The impacts of sediment mobilisation for the decommissioning phase are the same as the impacts detailed in the commissioning phase, discussed above.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Likelihood</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - Likely</td>
<td>Significant</td>
<td>The mitigation measures of sediment mobilisation for the decommissioning phase are the same as the impacts detailed in the commissioning phase, discussed above.</td>
</tr>
<tr>
<td>3 - Moderate</td>
<td>Significant</td>
<td>The mitigation measures of works within proximity of drainage lines for the decommissioning phase are the same as the impacts detailed in the commissioning phase, discussed above.</td>
</tr>
<tr>
<td>2 - Unlikely</td>
<td>Significant</td>
<td>The mitigation measures of works within proximity of drainage lines for the decommissioning phase are the same as the impacts detailed in the commissioning phase, discussed above.</td>
</tr>
</tbody>
</table>

### Contaminant Mobilisation

The impacts of contaminant mobilisation for the decommissioning phase are the same as the impacts detailed in the commissioning phase, discussed above.

<table>
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</tr>
</tbody>
</table>
Appendix B – Stormwater Infrastructure Details
GHD
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Document Status

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<th>Reviewer</th>
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<td>S Wilson</td>
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