

Big Rocks Weir

Initial Advice Statement

Charters Towers Regional Council
January 2021



 CHARTERS TOWERS
REGIONAL COUNCIL

Executive summary

Purpose and scope of the Initial Advice Statement

The purpose of the Big Rocks Weir (BRW) Initial Advice Statement (IAS) is to:

- Support an application to the Coordinator-General (CG) for determination of the BRW project as a coordinated project under Part 4, Section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act).
- Provide necessary information to assist the CG in determining an appropriate impact assessment process for evaluating the project under the SDPWO Act.

The scope of this IAS is for all aspects of the proposed BRW project (inclusive of the weir, storage area, fishway, saddle dam and access tracks) on the Burdekin River adjacent to Lot 16 on Plan BKN116 and Lot 4 on Plan DV450 in accordance with the CG's *Application requirements for a 'coordinated project' declaration* dated August 2015.

The documents provided in support of the application for a coordinated project (i.e. the Capability Statement, Pre-feasibility Assessment and this IAS) have been prepared in accordance with the requirements under Section 27AB of the SDPWO Act. These documents are considered to demonstrate suitability that the project is strategically significant to the locality and involves government supported capital investment in infrastructure which will result in long term economic and social benefits for the region. These being matters under Section 27 (2) (b) of the SDPWO Act which the CG must be satisfied to have been met prior to considering an application for a declaration under Section 26 (1) of the SDPWO Act.

The proponent

The project proponent, owner, operator and developer of BRW will be Charters Towers Regional Council (CTRC).

CTRC are considered to be a suitably skilled and experienced proponent. CTRC are the current owner and operator of the existing Charters Towers Weir, and given the relative proximity of BRW to the existing Charters Towers Weir, there are expected to be benefits from having both BRW and Charter Towers Weir owned and operated by the same entity.

CTRC have engaged a suitably qualified and experienced consultant in the way of GHD for the Detailed Design, Environmental Assessment and Approvals processes, Project Management and Tender Administration. Other suitably qualified and experienced consultants will be engaged as necessary for completion of technical investigations and/or assessments.

The project

BRW involves the construction and operation of a weir at Big Rocks, located on the Burdekin River approximately 26 km north of Charters Towers, Queensland and 23.9 km upstream of the existing Charters Towers Weir.

The BRW Business Case was undertaken via a tripartite agreement (Grant Deed) between the Australian Government North Queensland Water Infrastructure Authority (NQWIA), Queensland Government Department of Natural Resources, Mines and Energy (DNRM) and Townsville Enterprise Limited (TEL). TEL completed the BRW Business Case on 21 August 2020

TEL is also responsible for delivering the Hells Gates Dam (HGD) Business Case under the same Grant Deed for BRW. However, BRW is not considered to form part of a larger 'action' for the proposed HGD. As such, separate applications and referrals for the HGD and BRW projects will be lodged on the basis that the actions will be taken by different proponents, both projects

are being developed with stand-alone Business Cases, neither project is reliant or co-dependant on the other, economic and community objectives differ, timeframes and financing for both projects are very different/independent and impacts to MNES and MSES for both projects will be significantly different.

The general concept for BRW is for the construction of a new weir on the Burdekin River with a storage capacity of 10,000 ML and a maximum yield of up to 20,000 ML to achieve the desired water reliability targets for existing and future water users and to meet environmental flow objectives (EFOs). The objectives of BRW is to establish a new water source that provides additional supply security for the township of Charters Towers and supports the further development of existing irrigated agriculture already occurring along the Burdekin River. Other uses include the potential to support future growth of industry and further development of open space recreational opportunities. Industrial opportunities being investigated by CTRC include large scale residential/accommodation development, a new meat processing facility and a new hemp production and processing facility.

The project comprises four main components:

- Weir and storage area (including outlet works)
- Fishway
- Saddle dam
- Vehicle access tracks and land management requirements.

Road works required as part of the project (for construction and operation) include a new concrete floodway to maintain access to Big Bend Recreation Reserve, upgrades to the existing access track and bed level crossing at Lolworth Creek within Fletcherview Research Station and intersection upgrades for access onto Gregory Developmental Road (a State-controlled road).

Supporting infrastructure associated with the construction phase will also include:

- Diversion works
- Borrow areas for the supply of construction resource material
- Site laydowns, stockpiles and processing areas to facilitate construction works
- Construction of site amenities.

The location, extent and design details of supporting infrastructure may change based on inputs from the design team and construction contractor as part of the Detailed Design phase and final detailed construction program.

Although the BRW Business Case has identified that the project will support further development of recreation and irrigated agriculture already occurring in the region. The addition of new recreational facilities, water supply infrastructure and an irrigated agriculture scheme do not form part of the project nor is the project seeking to obtain development approvals to establish a designated recreation or irrigation area. Consultation undertaken with landholders proximal to BRW during development of the Business Case, has confirmed that the scale of likely facilitated irrigated agriculture can be established without additional land clearing or the need for a coordinated scheme to change existing land tenure and ownership, based on the current demand and potential volume of water supplied by the project.

A copy of the BRW Business Case can be viewed online by visiting:

<https://www.nqwia.gov.au/projects>.

Social impact considerations

A Social Impact Evaluation (SIE) was prepared by GHD in August 2020 to inform the BRW Business Case through consideration of social benefits (positive impacts) and negative impacts, in accordance with the Building Queensland SIE Guide (Building Queensland, 2020). The SIE assisted in developing a social baseline for the study area and involved stakeholder analysis and consultation in order to be able to identify and evaluate the social benefits and impacts.

Targeted consultation was undertaken by the SIE team during April 2020, through telephone interviews with CTRC officers and a sample of affected landholders located adjacent to the project footprint including adjacent to the storage area and downstream of the weir, to inform preparation of the SIE. Inputs from Native Title Holders in the project area, the Gudjala and Gugu Badhun Peoples were received through the North Queensland Land Council (NQLC) in the form of a report. Key findings from the SIE are summarised below.

The land surrounding BRW is predominantly used for cattle grazing using existing or native vegetation. There is a comparatively a small proportion of land used for cropping. Challenges of the Charters Towers community include high unemployment, high levels of unskilled and low skilled employment and difficulty attracting and retaining skilled workers.

The Gudjala People have strong cultural and historical connections to recreational areas in and surrounding the project area, including Big Bend, Fletcher Creek, and the Burdekin River. A number of spiritually and culturally significant sites are also thought to be located within the BRW footprint (NQLC, 2020). Accordingly, BRW will be required to undertake cultural heritage surveys and establish both a Cultural Heritage Management Agreement (CHMA) for investigative works and a separate Cultural Heritage Management Plan (CHMP) for the construction and operation of BRW.

The construction of the weir is expected to have a positive social impact on the local and regional study area, through direct employment opportunities during construction and increased local business opportunities. Negative impacts from construction may include the introduction and spread of weeds, short term interruption to property use for Fletcherview Research Station temporary increase in traffic with works expected to generate between 50 to 100 additional vehicle trips along the Gregory Developmental Road per day and intermittent changes to the quiet rural amenity of the immediate area from construction related noise, vibration and dust.

The implementation of appropriate management plans was identified as a way to help mitigate and reduce any negative impacts arising from construction works resulting in low level risks. The social benefits of the project from the operation of BRW include increased regional water availability and security; increase in agricultural production leading to high value crops and further employment opportunities; improved access to Big Bend Recreation Reserve and an increase in recreational opportunities along the Burdekin River.

Negative impacts from the operation of BRW might include a decrease in amenity and privacy for adjoining landholders due to an increase in the number of visitors to recreational areas like Big Bend Recreation Reserve; a decrease in informal access options for landholders with properties located on the northern bank of the Burdekin River resulting in additional travel time (due to not being able to drive across the Burdekin River and Keelbottom Creek during drier periods of the year); and an increase in permanent water retention which may cause some minor inundation to several adjoining landholdings where property boundaries extend below the high banks of the Burdekin River or include the flow of water into tributaries from the Burdekin River. However, the majority of these impacts are expected to be medium to low risk for the project.

If a Social Impact Assessment (SIA) is required to be undertaken as part of the impact assessment process should the CG decide to declare the project as a coordinated project, it would be undertaken in line with the SIA Guideline (DSDMIP, 2018) developed by the CG, and commensurate with the nature and scale of the project and its social risk profile.

A copy of the SIE and NQLC report are attached to the BRW Business Case and can be viewed online by visiting: <https://www.nqwia.gov.au/projects>.

Environmental impact considerations

A preliminary environmental impact assessment has been undertaken to inform the BRW Business Case. This was informed by desktop investigations and field assessments of the existing environment and included preparation of a Regulatory Approvals Plan, Baseline Ecological Assessment (Pre-wet and Post-wet Reports), Water Entitlement Options Report and environmental chapters within the Business Case. The baseline ecological assessment of terrestrial and aquatic ecological values included seasonal field surveys that were undertaken from 9 to 14 December 2019 for the Pre-wet surveys and from 26 April to 22 May 2020 for the Post-wet surveys. The Pre-wet and Post-wet Ecological Assessment Reports were finalised in June 2020 and August 2020, respectively. Key findings from the baseline ecological assessment reports are summarised below.

The baseline terrestrial ecological assessment revealed that the study area supports least concern regional ecosystems (REs) dominated by open woodlands and existing cleared grazing lands. The total extent of category B Least Concern REs mapped within the project footprint which could be impacted by the project during construction and operational phases is 332.87 ha. However, no conservation significant flora species or Threatened Ecological Communities (TECs) are considered likely to occur within these areas.

Terrestrial habitat types confirmed present during the field survey included:

- Open eucalypt woodland on sandy levees
- Open eucalypt woodland on rocky low hills and rises
- Open grassland on alluvial plains
- River bed
- Rocky outcrops
- Ephemeral waterways dominated by *Eucalyptus spp.* and/or *Melaleuca spp.*

These habitats are highly seasonal, responding to changes in rainfall and river flow. Ephemeral waterways represent sensitive terrestrial fauna habitats within the study area. Such habitats provide resources for a wide array of common fauna species, including amphibians (breeding and foraging), reptiles (foraging), ground-dwelling mammals (foraging), microchiropteran bats (foraging) and birds (foraging and nesting amongst dense riparian vegetation). The study area has the potential to support a small number of conservation significant species based on field survey records, previous records and the availability of suitable habitat within the study area.

The aquatic habitat of the proposed BRW is composed of pool-run-riffle flow types which provides habitat for a number of common fish and turtle species. Species diversity is influenced by the restriction of aquatic fauna movement past existing water infrastructure downstream.

A likelihood of occurrence assessment undertaken for each conservation significant species identified in a desktop assessment found that:

- Two conservation significant fauna species, the greater glider (northern) (*Petauroides volans minor*) and squatter pigeon (southern) (*Geophaps scripta scripta*) were **confirmed present** within the study area.

- One conservation significant species, the koala (*Phascolarctos cinereus*) is considered **likely to occur**.
- One migratory species, the glossy ibis (*Plegadis falcinellus*) was confirmed present within the study area.
- Six migratory species were considered **likely to occur**.
- No conservation significant aquatic species are considered **likely to occur**.

Construction activities have the potential to cause localised impact through vehicle and plant movement, clearing of native vegetation (approx. 9.57 ha associated with construction of the weir wall, fishway, saddle dam, access tracks, floodway and temporary laydown areas), construction within the waterway, spillage of hazardous materials, and acquisition of materials for use in construction. The project is expected to be relatively benign in terms of operational phase impacts. However, the initial filling of the impoundment and operational phase of the weir have the potential to cause localised fauna injury and mortality, disruption to behaviour and restriction of movement of wildlife assemblages, loss, alteration and degradation of terrestrial and aquatic habitats, increase in feral animals and weed species, and changes to downstream flow regimes.

Impacts associated with construction of the project will be avoided as far as practicable and minimised by locating the ancillary infrastructure, such as laydown and borrow areas in open areas that have been previously cleared or degraded. Impacts associated with the initial filling of the impoundment have been minimised through the design of the weir, with inundation to be kept within the bed and banks, as well as frequent drownout of the weir with no changes to flood profiles/overland flows. Impacts associated with the operational phase of the project such as aquatic fauna movement, injury and mortality will be investigated during subsequent design phases of the project to ensure that these impacts are minimised. These potential construction and operational impacts can be effectively mitigated through routine mitigation measures, and are summarised in Section 7.

Following detailed field assessments and habitat mapping and completion of formal significance of impact assessment for each conservation significant species, the project was considered unlikely to have a significant impact on the squatter pigeon (southern), greater glider (northern) and koala. The project, however, will result in a local loss of potential habitat for these species.

BRW is also located 320 km upstream of the Great Barrier Reef World Heritage Area (GBRWHA). The Burdekin River is a significant tributary flowing into the GBRWHA, subsequently the project may have the potential to indirectly impact on GBRWHA values via changes to water quality and flow regimes. However, due to the relatively small size of the project and the likely facilitated development within the catchment, the very large distance upstream from the GBRWHA and the presence of the Burdekin Falls Dam (BFD) between the BRW and GBRWHA, no notable changes are expected to occur to the hydrological regime or water quality at the mouth of the Burdekin River.

Baseline water quality conditions will be monitored during the construction and operation phases of the project and associated factors such as, erosion, sedimentation and runoff will be managed using site specific controls. Best practice industry land care guidelines and mitigation measures are expected to be implemented on facilitated irrigated agricultural or supported industry development as per the Australian and Queensland Reef 2050 Long-Term Sustainability Plan (Reef Plan) to reduce pressures on end of catchment loads. Overall, the values of the GBRWHA are not expected to be notably altered, modified, observed or diminished and no significant impact to the GBRWHA is expected to occur.

Regulatory approval considerations

Approvals intended to be coordinated during the impact assessment process under Part 4 of the SDPWO Act and associated conditions that would be sought as an outcome of the CG's evaluation report include:

- Operational work for taking or interfering with water in a watercourse
- Operational work for constructing waterway barrier works
- Operational work impacting on and for access to a State Controlled Road (SCR)
- Operational work for clearing native vegetation
- MCU assessable under the local government planning scheme. Noting that this is only applicable if part of the water storage area is considered to require Code assessment under the Charters Towers Regional Town Plan for a 'utility installation' in the Environmental Management and Conservation zone
- Environmental offsets for any aspects of development relating to the above approvals.

All other approvals identified in Section 8, Table 8-1 will be applied for and dealt with outside of the Part 4 process of the SDPWO Act.

Key reasons for seeking coordinated project declaration

The coordinated project process is well understood and recognised as a transparent process and is generally accepted by the public in relation to infrastructure projects of this nature. It provides clearly defined statutory requirements for environmental assessment and a process through which key stakeholders can have their say.

In accordance with Section 27(2)(b) of the SDPWO Act the project is characterised by:

- Various approval requirements imposed by Commonwealth, State and local governments (some of which are considered to be complex)
- Strategic significance to the Charters Towers region, including aspects that relate to water security, economic and social benefits, capital investment and employment opportunities. Findings from the BRW Business Case identified that the project is anticipated to provide:
 - A net economic benefit to the State and National economy of \$26.46 million and a Benefit Cost Ratio (BCR) of 1.38 (based on 10,000 ML of water)
 - A major economic boost to the Charters Towers region, with an estimated \$35 million each year in additional agricultural revenues
 - Additional employment opportunities for the Charters Towers region, with an estimated 172 full-time equivalent (FTE) employees to be supported during construction of BRW and an estimated 117 FTEs to be supported as a direct result of expansion in agricultural activity
 - Commonwealth and State government funding and economic development initiatives such that further government grant contributions will be approved to facilitate construction of BRW with the capital cost estimate predicted to be \$59.82 million. The Australian Government and Queensland Government have each committed \$30 million towards the construction of BRW
 - Additional water security to the Charters Towers residents during extended dry periods
 - New irrigated cropping opportunities and supported industries
 - Additional lifestyle, recreation and tourism opportunities for the region.
- The potential for environmental effects on Matters of National Environmental Significance (MNES), including the GBRWHA, threatened species and migratory species.

- The potential for environmental effects on Matters of State Environmental Significance (MSES), including regulated vegetation, connectivity, watercourses, protected wildlife habitat for fauna, essential habitat, protected areas and waterways providing for fish passage.

In terms of approval requirements, BRW will need to be declared a coordinated project under the SDPWO Act or a project of regional significance in order for DNRME to be able to release unallocated water from the strategic reserve under the *Water Plan (Burdekin Basin) 2007* (Burdekin Water Plan). Regional significance status can only be given by the Chief Executive's delegate from DNRME after a request is made and includes responses to social and economic criteria (including being able to demonstrate how a project will have a positive impact on accommodation and housing, community services and facilities and improving community wellbeing and quality of life). Regional significance status allows proponents to request and negotiate access to water from a strategic reserve without competition. If regional significance status is given, DNRME's Chief Executive's delegate must then decide whether to make the unallocated water available and provide a Terms of Release/Sale to the proponent. This requires key consideration of objectives, measures and outcomes described in both the Burdekin Water Plan and the Resource Operations Plan. Given the array of approval requirements, it is thought that the coordinated project process would be more appropriate to advance the relevant project approvals and to achieve project timelines.

Clearing of native vegetation, unless determined to be exempted or accepted development, is generally assessable development requiring Code assessment for operational work. Vegetation management laws allow development applications to be made only for a relevant purpose as defined under Section 22A of the *Vegetation Management Act 1999* (VM Act). Though clearing of Category B Least Concern REs for BRW (consisting of approx.. 9.57 ha of mapped REs for construction of the weir wall, fishway, saddle dam, access tracks, floodway and temporary laydown areas and 323.30 ha associated with inundation of the storage area at FSL) may be able to meet the relevant purpose definition of development that is for establishing and maintaining a necessary road or vehicular track and for constructing and maintaining necessary built infrastructure, the determination is ultimately made by DNRME. Whereas a project declared to be a coordinated project under the SDPWO Act is more readily defined as development for a relevant purpose. Should BRW be declared a coordinated project under the SDPWO Act, a greater level of certainty in being able to secure the relevant purpose determination from DNRME under Section 22A of the VM Act would be possible.

In obtaining a coordinated project declaration from the CG, CTRC as the project proponent hope to be able to secure the required water allocation from the general and strategic reserves under the Burdekin Water Plan, streamline project approvals for BRW and receive coordinated and targeted whole of government advice with respect to likely conditions for subsequent development approvals and any technical investigations and/or assessments necessary to facilitate project approvals prior to commencement of construction.

On the basis of preliminary assessments and investigations undertaken as part of the Business Case phase and preparation of the *Environment Protection and Biodiversity Conservation Act 1999* Referral and this IAS, the Impact Assessment Report (IAR) process is considered appropriate for the CG to assess the project in the instance that a coordinated project determination is made. As outlined within this IAS, the potential environmental impacts of the project are not considered to be significant, are well defined and classify as low-medium risk which can be suitably managed by applying routine mitigation measures, therefore not warranting an Environmental Impact Statement (EIS). Furthermore, CTRC as the project proponent, owner, operator and developer of BRW will resolve to implement best practice measures to minimise the magnitude of any potential environmental impacts associated with the project.

Table of contents

1.	Introduction	1
1.1	Project background	1
1.2	Purpose and scope of the IAS	3
2.	The proponent.....	7
3.	Nature of the proposal.....	8
3.1	Scope of the project	8
3.2	Land use	11
3.3	Project need, justification and alternatives considered.....	11
3.4	Components, developments, activities and infrastructure that constitute the project to be declared a coordinated project	13
3.5	External infrastructure requirements.....	23
3.6	Construction and operational processes	25
3.7	Workforce requirements during construction and operation.....	26
3.8	Timeframes for the project.....	26
3.9	Economic indicators.....	28
3.10	Financing requirements and implications	28
4.	Location of key project elements	30
4.1	Location	30
4.2	Tenure.....	30
5.	Description of the existing environment.....	34
5.1	Natural environment.....	34
5.2	Social and economic environment.....	76
5.3	Built environment	85
5.4	Traffic and transport.....	88
5.5	Land use and tenures	88
5.6	Planning instruments and government policies	89
6.	Potential project impacts.....	95
6.1	Natural environment.....	95
6.2	Amenity	104
6.3	Social environment	106
6.4	Economic effects.....	114
6.5	Built environment	114
6.6	MNES under the EPBC Act	114
6.7	Associated and cumulative impacts.....	115
7.	Environmental management and mitigation measures.....	117
7.1	Natural environment.....	117
7.2	Amenity	123
7.3	Social environment	124

7.4	Built environment	124
7.5	Cultural heritage management plan (Indigenous)	124
7.6	Non-Indigenous cultural heritage management.....	125
7.7	Greenhouse gas management plan	125
7.8	Waste management.....	125
7.9	Hazard and risk, and health and safety	126
7.10	Environmental management.....	126
8.	Approvals required for the project.....	128
8.1	Legal and regulatory considerations.....	128
8.2	Summary of key project approvals	132
8.3	Approvals to be assessed as part of the impact assessment process.....	140
8.4	Justification for assessment via the IAR process	140
9.	Costs and benefits	142
9.1	Cost estimate	142
9.2	Local, state and national economies	142
9.3	Natural environment.....	142
9.4	Social environment	143
10.	Community and stakeholder consultation	144
11.	References and data sources	146
12.	Glossary, acronyms and abbreviations.....	150

Table index

Table 3-1	BRW alternatives	13
Table 3-2	Weir design summary	14
Table 4-1	Properties impacted by BRW.....	31
Table 5-1	BoM (2020) Charters Towers climate statistics – month averages (station. 034084).....	40
Table 5-2	Regional ecosystem descriptions	44
Table 5-3	Regional ecosystems considered present within the project footprint.....	46
Table 5-4	Conservation significant flora species predicted to occur within the study area	49
Table 5-5	Threatened fauna species predicted to occur within the study area	50
Table 5-6	Migratory species predicted to occur within the study area.....	51
Table 5-7	Habitat types observed within the study area.....	56
Table 5-8	Weed species and general distribution.....	61
Table 5-9	Pest animal fauna species recorded within the study area	63
Table 5-10	Habitat scores for the pre-wet aquatic assessment.....	68
Table 5-11	Habitat scores for the post-wet aquatic assessment.....	69

Table 5-12	In-situ water quality during the pre-wet survey	70
Table 5-13	In-situ water quality during the post-wet field survey	71
Table 5-14	Abundance of fish species caught during the field survey.....	73
Table 5-15	Abundance of turtle species caught during the field survey	73
Table 5-16	Key population indicators for Charters Towers LGA and UCL	78
Table 5-17	Identity, values, opportunities and challenges.....	80
Table 5-18	Main recreational opportunities.....	83
Table 6-1	Proposed extent of vegetation clearing	96
Table 6-2	Social impact evaluation – construction phase.....	108
Table 6-3	Social impact evaluation – operation phase	112
Table 7-1	Sub management plans.....	127
Table 8-1	Project approvals register	133
Table 9-1	P50 and P90 cost estimates	142

Figure index

Figure 3-1	Digital visualisation from upstream of the weir looking downstream	9
Figure 3-2	Digital visualisation from downstream of the weir looking upstream	9
Figure 3-3	Site locality figure.....	10
Figure 3-4	General arrangement.....	16
Figure 3-5	Glenore fishway at low (a) and high flows with low turbulence resting areas (b) (extract from Stuart and Marsden 2019).....	18
Figure 3-6	Fishway layout plan	18
Figure 3-7	3D representation of weir and fishway (apron and stilling basin not shown).....	19
Figure 3-8	Cone style weir – repeating section.....	20
Figure 3-9	Cone style weir baffle types – Isometric view.....	20
Figure 3-10	Existing crossing to Big Bend	21
Figure 3-11	BRW inundation extents and proposed access to Big Bend	22
Figure 3-12	Access road options.....	23
Figure 3-13	Typical condition of existing access track (left) and Lolworth Creek crossing (right).....	23
Figure 3-14	Preliminary construction program	27
Figure 4-1	Adjacent properties and land tenures.....	32
Figure 4-2	Native title determinations	33
Figure 5-1	Typical site topography	34
Figure 5-2	Locally deep incised channel.....	35

Figure 5-3	Topography and soils	36
Figure 5-4	Surface water features.....	38
Figure 5-5	BoM (2019a) Charters Towers rose of 9 am May wind direction versus wind speed in km/h (station. 034084)	41
Figure 5-6	BoM (2019b) Charters Towers rose of 3 pm May wind direction versus wind speed in km/h (station. 034084)	41
Figure 5-7	BoM (2019c) Charters Towers rose of 9 am October wind direction versus wind speed in km/h (station. 034084)	42
Figure 5-8	BoM (2019d) Charters Towers rose of 3 pm October wind direction versus wind speed in km/h (station. 034084)	42
Figure 5-9	DNRME regional ecosystem mapping.....	45
Figure 5-10	Essential habitat and significant bioregional wildlife corridors.....	55
Figure 5-11	Habitat types identified within the study area	60
Figure 5-12	Land uses surrounding BRW	77
Figure 5-13	Charters Towers LGA four economic pillars.....	80
Figure 5-14	Top industries of employment in 2016.....	81
Figure 5-15	Surrounding land uses.....	87
Figure 6-1	Impact risk assessment	107

Appendices

Appendix A – Selected Reference Design Drawings

Appendix B – Desktop Searches and Mapping

Appendix C – Baseline Terrestrial and Aquatic Ecology Assessment – Pre-wet Assessment

Appendix D – Baseline Terrestrial and Aquatic Ecology Assessment – Post-wet Assessment

Appendix E – GBRWHA Assessment

Appendix F – Regulatory Approvals Plan

1. Introduction

1.1 Project background

1.1.1 Business Case development

Townsville Enterprise Limited (TEL) was the recipient of a Grant Deed for two core deliverables:

- Hells Gates Dam (HGD) – Business Case and Draft Environmental Impact Statement (EIS)
- Big Rocks Weir (BRW) – Business Case and Environmental Assessment.

The purpose of the Grant Deed and two Business Cases is to evaluate the financial and economic viability of potential new or augmented water infrastructure and to inform investment decisions. TEL is the lead project manager responsible for the delivery of both the HGD and BRW Business Cases. TEL engaged the services of SMEC and KPMG to help deliver the HGD Business Case and GHD and KPMG to deliver the BRW Business Case. The HGD Business Case is still ongoing whereas the BRW Business Case was completed on 21 August 2020.

Charters Towers Regional Council (CTRC) were recommended to be the project proponent, owner, operator and developer of BRW. CTRC are considered to be a suitably skilled and experienced proponent. CTRC are also the current owner and operator of the existing Charters Towers Weir, and given the relative proximity of BRW to the existing Charters Towers Weir, there are expected to be benefits from having both BRW and Charter Towers Weir owned and operated by the same entity.

Regarding the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) assessment of the BRW project and confirming whether BRW is a component of a larger ‘action’ for HGD, the following has been carefully considered:

- BRW will have a different proponent (person taking the action) to manage construction, own and operate the weir compared to HGD. The proposed designated proponent for BRW is CTRC. HGD is a much larger water supply scheme and will likely require significant investment and operation by an organisation experienced in owning and managing supplemented water supply schemes of a similar size.
- While both HGD and BRW Business Cases are being developed by TEL, BRW is a weir development seeking 10,000-20,000 ML of annual unallocated water from the general and strategic reserves which can be developed under Section 33 of the *Water Plan (Burdekin Basin) 2007* (Burdekin Water Plan), while HGD is a major Dam project with a proposed water storage in the order of 2,100 GL which will require changes to the Burdekin Water Plan prior to approval. The viability of BRW has been assessed as part of a separate Business Case in its own right as a stand-alone project without any co-dependency on HGD. The BRW Business Case was completed on 21 August 2020 and is available to download online: <https://www.nqwia.gov.au/projects>.
- BRW has very tight milestones for design and construction as well as very different requirements for funding than those associated with HGD. The scope and potential for environmental impacts is also significantly different from HGD with the 10,000 ML storage area for BRW contained within the banks of existing watercourses and no irrigation areas currently proposed as part of the project. Whereas HGD will include a 2,100 GL dam, 50,000 ha irrigation scheme, run-of-river hydropower station, solar farm, three additional downstream weirs, and associated supply infrastructure (water pipelines and pump stations).

- Though the two projects have the ability to be perceived to have overlapping geographical footprints with the three additional weirs located upstream of BRW and the southern irrigation district/zone for HGD proposed to the west of BRW; the construction and installation of any facilities for HGD will not be related or dependent on BRW and vice versa.
- The Business Case and Draft EIS for HGD are scheduled for delivery by 30 April 2022. HGD will likely require significant investment/finance from different funding sources before any further design or construction works could proceed and more complex development approvals. HGD will require more land use and tenure changes to achieve the desired benefits and will trigger more large scale field assessments/investigations across a broader catchment area in comparison to BRW.

Noting the above points, separate referrals for the HGD and BRW projects will be required given that the actions will be taken by different proponents, both projects are being developed on the basis of stand-alone Business Cases, neither project is reliant or co-dependant on the other, economic and community objectives differ, timeframes and financing for both projects are very different and independent, impacts to matters of national environmental significance (MNES) and matters of state environmental significance (MSES) for both projects are significantly different. Therefore, BRW is not considered to form part of a larger 'action' for HGD.

1.1.2 Overview of the BRW project

Big Rocks is located on the Burdekin River approximately 26 km north of Charters Towers, Queensland and 23.9 km upstream of the existing Charters Towers Weir. The construction of a weir at Big Rocks has been considered previously, as part of separate studies such as the Hells Gates Feasibility Study (SMEC 2018), Big Rocks Weir Concept Plan (GHD 2015) and Big Rocks Weir Preliminary Design Report (McIntyre & Associates 1994).

The general concept for BRW is for the construction of a new weir on the Burdekin River with a storage capacity of 10,000 ML and total yield of up to 20,000 ML to achieve the desired water reliability targets for existing and future raw water users and meet environmental flow objectives (EFOs).

The objectives of BRW is to establish a new water source that provides additional supply security for the township of Charters Towers and supports the further development of existing irrigated agriculture occurring in the region. Other opportunities include the potential to support future growth of industry and further development of recreation.

The BRW project comprises four main components:

- Weir and storage area (including outlet works)
- Fishway
- Saddle dam
- Vehicle access tracks and land management requirements.

Road works required as part of the project (for construction and operation) include a new concrete floodway to maintain access to Big Bend Recreation Reserve, upgrades to the existing access track and bed level crossing at Lolworth Creek within Fletcherview Research Station and intersection upgrades for access onto Gregory Developmental Road (a State-controlled road).

Supporting infrastructure associated with the construction phase will also include:

- Diversion works
- Borrow areas for the supply of construction resource material
- Site laydowns, stockpiles and processing areas to facilitate construction works
- Construction of site amenities.

The location, extent and design details of supporting infrastructure may change based on inputs from the design team and construction contractor as part of the Detailed Design phase and final detailed construction program.

Although the BRW Business Case has identified that the project will support further development of recreation and irrigated agriculture already occurring in the region, the addition of new recreational facilities, water supply infrastructure and an irrigated agriculture scheme do not form part of the project nor is the project seeking to obtain development approvals to establish a designated recreation or irrigation area. Consultation undertaken with landholders proximal to BRW during development of the Business Case, has confirmed that the scale of likely facilitated irrigated agriculture can be established without additional land clearing or the need for a coordinated scheme to change existing land tenure and ownership arrangements, based on the current demand and potential volume of water supplied by the project.

1.2 Purpose and scope of the IAS

1.2.1 Purpose of the IAS

The purpose of the Initial Advice Statement (IAS) is to:

- Support an application to the Coordinator-General (CG) for determination of the BRW project as a coordinated project under Section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act).
- Provide necessary information to assist the CG in determining the appropriate impact assessment process for evaluating the project under the SDPWO Act.

1.2.2 Scope of the IAS

The scope of this IAS is for all aspects of the proposed BRW project (inclusive of the weir, storage area, fishway, saddle dam and access tracks) on the Burdekin River adjacent to Lot 16 BKN116 and Lot 4 DV450 in accordance with the CG's *Application requirements for a 'coordinated project' declaration* dated August 2015.

The documents provided in support of the application for a coordinated project (i.e. the Capability Statement, Pre-feasibility Assessment and this IAS) have been prepared in accordance with the requirements under Section 27AB of the SDPWO Act. They are considered to demonstrate suitability that the project is strategically significant to the locality and involves government supported capital investment in infrastructure which will result in long term economic and social benefits for the region. These being matters under Section 27 (2)(b) of the SDPWO Act which the CG must be satisfied to have been met prior to considering an application for a declaration under Section 26(1) of the SDPWO Act.

1.2.3 Reason for seeking coordinated project declaration

The coordinated project process is well understood and recognised as a transparent process and is generally accepted by the public in relation to infrastructure projects of this nature. It provides clearly defined statutory requirements for environmental assessment and a process through which key stakeholders can have their say.

In accordance with Section 27(2)(b) of the SDPWO Act the project is characterised by:

- Various approval requirements imposed by Commonwealth, State and local governments (some of which are considered to be complex)
- Strategic significance to the Charters Towers region, including aspects that relate to water security, economic and social benefits, capital investment and employment opportunities. Findings from the BRW Business Case identified that the project is anticipated to provide:
 - A net economic benefit to the State and National economy of \$26.46 million and a Benefit Cost Ratio (BCR) of 1.38 (based on 10,000 ML of water)
 - A major economic boost to the Charters Towers region, with an estimated \$35 million each year in additional agricultural revenues
 - Additional employment opportunities for the Charters Towers region, with an estimated 172 full-time equivalent (FTE) employees to be supported during construction of BRW and an estimated 117 FTEs to be supported as a direct result of expansion in agricultural activity
 - Commonwealth and State government funding and economic development initiatives such that further government grant contributions will be approved to facilitate construction of BRW with the capital cost estimate predicted to be \$59.82 million. The Australian Government and Queensland Government have each committed \$30 million towards the construction of BRW
 - Additional water security to the Charters Towers residents during extended dry periods
 - New irrigated cropping opportunities and supported industries
 - Additional lifestyle, recreation and tourism opportunities for the region.
- The potential for environmental effects on MNES, including the Great Barrier Reef World Heritage Area (GBRWhA), threatened species and migratory species
- The potential for environmental effects on Matters of State Environmental Significance (MSES), including regulated vegetation, connectivity, watercourses, protected wildlife habitat for fauna, essential habitat, protected areas and waterways providing for fish passage.

In terms of approval requirements, BRW will need to be declared a coordinated project under the SDPWO Act or a project of regional significance in order for the Department of Natural Resources, Mines and Energy (DNRME) to be able to release unallocated water from the strategic reserve under the Burdekin Water Plan. Regional significance status can only be given by the Chief Executive's delegate from DNRME after a request is made and includes responses to social and economic criteria (including being able to demonstrate how a project will have a positive impact on accommodation and housing, community services and facilities and improving community wellbeing and quality of life). Regional significance status allows proponents to request and negotiate access to strategic reserve without competition. If regional significance status is given, the DNRME Chief Executive's delegate must then decide whether to make unallocated water available and provide a Terms of Release to the proponent. This requires key consideration of objectives, measures and outcomes described in both the Burdekin Water Plan and the Resource Operations Plan. It was considered that the coordinated project process would be more appropriate to advance the relevant project approvals and to achieve project timelines.

Clearing of native vegetation, unless exempted or accepted development, is assessable development that will require a development permit for operational work that is the clearing of native vegetation. Vegetation management laws allow development applications to be made only for a relevant purpose as defined under Section 22A of the *Vegetation Management Act*

1999 (VM Act). Although clearing for the weir wall, fishway, saddle dam and access tracks may be able to meet the relevant purpose definition of development that is for establishing and maintaining a necessary road or vehicular track and for constructing and maintaining necessary built infrastructure, the determination is ultimately made by DNRME. Whereas a project declared to be a coordinated project under the SDPWO Act is clearly defined as development for a relevant purpose. Should BRW be declared a coordinated project under the SDPWO Act, a greater level of certainty in being able to secure the relevant purpose determination from DNRME under Section 22A of the VM Act would be possible.

Although the size of the project is not significant in comparison to other proposed water resource projects across Queensland, the project seeks to improve water reliability for the local community and landholders in the Charters Towers region, requires approvals via multiple jurisdictions, incorporates a range of regionally significant stakeholders and has Commonwealth funding support. It is considered that BRW and its economic credentials would benefit if declared as a coordinated project by the CG under the SDPWO Act. This is also consistent with advice from DNRME regarding the appropriate and equitable regulatory pathway to achieve access to the water resource, specifically unallocated water from the strategic reserve as described above.

In obtaining a coordinated project declaration from the CG, CTRC as the project proponent hope to be able to secure the required water allocation from the general and strategic reserves under the Burdekin Water Plan, streamline project approvals for BRW and receive coordinated and targeted whole of government advice with respect to likely conditions for subsequent development approvals and any technical investigations and/or assessments necessary to facilitate project approvals prior to commencement of construction.

1.2.4 Assumptions

The following assumptions were made in the development of this IAS:

- Environmental values established through Queensland Government supplied mapping and data reviewed in desktop assessments reflect actual site conditions.
- The proposed yield and water allocation of between 10,000 to 20,000 ML for BRW is based on the available storage capacity for the Reference Design and initial estimates to achieve the desired water reliability targets for existing and future water users while also trying to meet EFOs.
- Workforce demands for construction of BRW are based on findings in the BRW Business Case and numbers provided by a third party as part of the P50 and P90 cost estimates for the Reference Design.
- Projected traffic numbers for construction of BRW are based on the Concept and Reference Design options/estimates for sourcing of construction materials and assumed construction methodologies. This will be subject to further review at the Detailed Design phase of the project and will also be investigated further as part of subsequent technical studies (i.e. Traffic Impact Assessment).
- On the basis that the BRW project does not include the development of irrigated land areas or water distribution infrastructure, this IAS along with the BRW Business Case has not included land suitability investigations in determining the appropriateness or extent of land that could be used for small to medium scale agriculture in the district. Consultation undertaken by KPMG with existing landholders has been relied on to identify user demand and suitability of existing land for agricultural purposes.

1.2.5 Statement of limitations

This IAS has been prepared by GHD on behalf of CTRC for submission to the CG and may only be used and relied on by CTRC and the CG for the purpose set out in Section 1.2.1 of this report. GHD otherwise disclaims responsibility to any person other than CTRC arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in this IAS and are subject to the scope and assumptions set out in Sections 1.2.2 and 1.2.4.

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 and are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect. 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.

GHD has prepared this report on the basis of information provided by CTRC and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. The proponent

The project proponent, owner, operator and developer of BRW will be CTRC.

CTRC are considered to be a suitably skilled and experienced proponent. CTRC are the current owner and operator of the existing Charters Towers Weir, and given the relative proximity of BRW to the existing Charters Towers Weir, there are expected to be benefits from having both BRW and Charter Towers Weir owned and operated by the same entity.

CTRC have engaged a suitably qualified and experienced consultant in the way of GHD for the next phase of the project. This includes the Detailed Design, Environmental Assessment and Approvals processes, Project Management and Tender Administration. Other suitably qualified and experienced consultants will be engaged as necessary for completion of technical investigations and/or assessments.

Further information with respect to CTRC's financial and technical capabilities (Capability Statement) and the projects technical and commercial feasibility (Pre-feasibility Assessment) are provided to the CG separately with our formal submission of the IAS.

Contact details for the proponent are as follows:

Charters Towers Regional Council

Mr Aaron Johansson

Chief Executive Officer

PO Box 189 Charters Towers Qld 4820

Phone: (07) 4761 5352

Email: ajohansson@charterstowers.qld.gov.au

3. Nature of the proposal

3.1 Scope of the project

The project will consist of the construction of a new weir at Big Rocks, capable of storing up to 10,000 ML of water. The proposed purpose of the weir is for water supply for irrigation, industrial development and urban water supply.

Consultation with CTRC as part of the BRW Business Case has indicated that Council are actively pursuing opportunities to attract investment within the region by engaging with a number of potential investors. These discussions are in various stages of planning and agreement between CTRC and the proponents, which are subject to commercial-in-confidence conditions. However, it is understood that the opportunities include:

- Large scale residential/accommodation development
- New meat processing facility
- New hemp production and processing facility.

The project includes construction of a mass concrete gravity weir and associated infrastructure including outlet works, a fishway, saddle dam, and access tracks.

Road works required as part of the project (for construction and operation) include a new concrete floodway to maintain access to Big Bend Recreation Reserve, upgrades to the existing access track and bed level crossing at Lolworth Creek within Fletcherview Research Station and intersection upgrades for access onto Gregory Developmental Road (a State-controlled road).

Supporting infrastructure associated with the construction phase will also include:

- Diversion works
- Borrow areas for the supply of construction resource material
- Site laydowns, stockpiles and processing areas to facilitate construction works
- Construction of site amenities.

The location, extent and design details of supporting infrastructure may change based on inputs from the design team and construction contractor as part of the Detailed Design phase and final detailed construction program.

Following construction, it is intended that BRW will be maintained and operated by CTRC, including maintenance of the weir, associated infrastructure and management of water allocations.

BRW is designed to fill during flood events and be slowly drawn down primarily via the outlet works in order to meet EFOs and Water Allocation Security Objectives (WASOs), provide a source of water which may be harvested by downstream users and to maintain the level in the existing Charters Towers Weir located 23.9 km downstream of BRW.

The general operating philosophy for the scheme is that whilst the weir is overtopping irrigators or other users may extract water either directly from the storage, from downstream of the weir or from the Charters Towers Weir storage. Once flows in the river have ceased, and the storage within the existing Charters Towers Weir starts to be depleted, water would be released downstream from BRW from a low-level outlet in the main weir to supplement supply to the Charters Towers weir downstream and meet EFOs. The Reference Design has sought to minimise complexity in both construction and operation and reduce ongoing and operating costs as much as practicable.

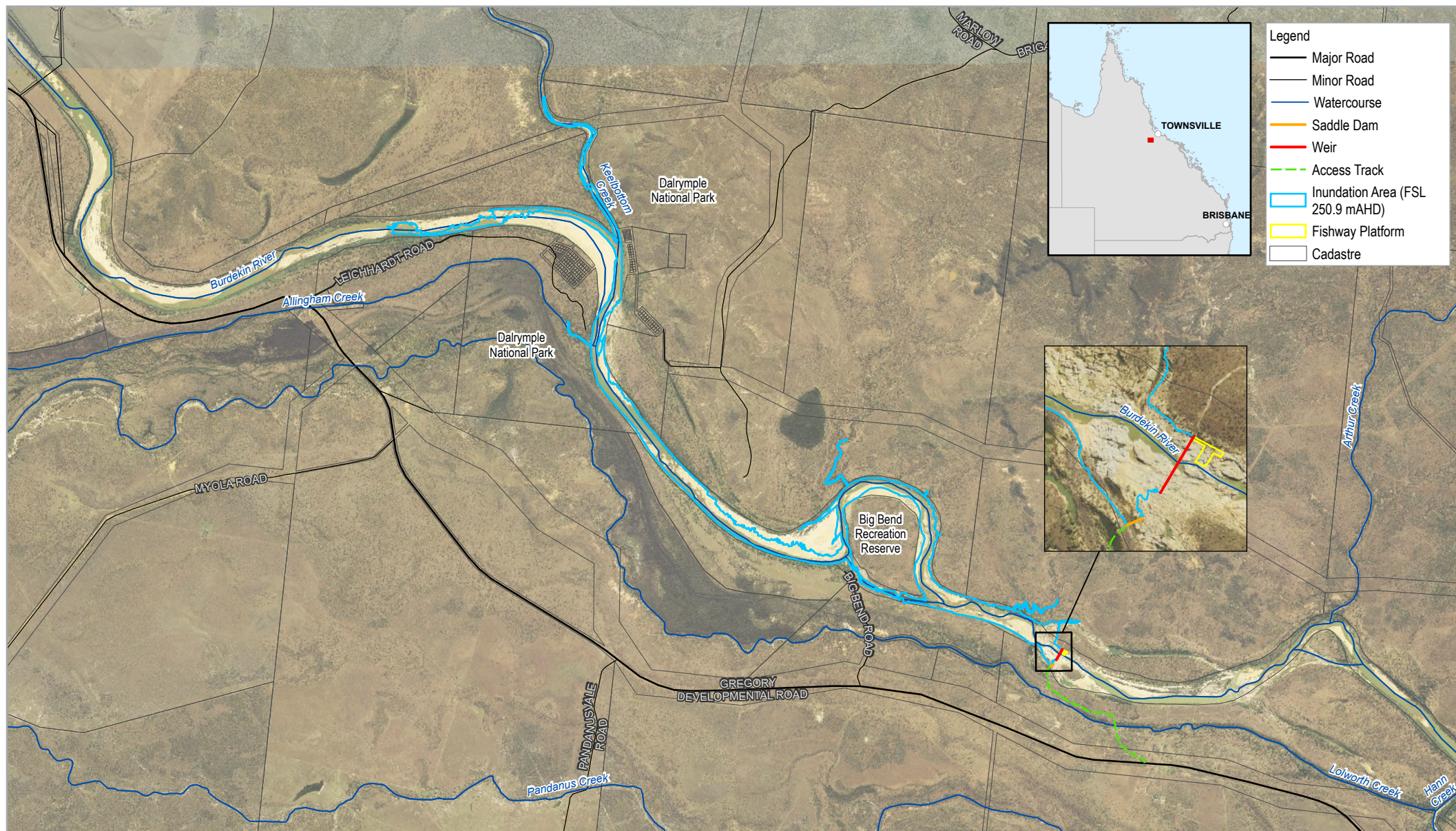
Either farmers or other users would develop their own delivery systems from either the weir storage area or downstream of the weir with flows released through the low-level outlet, depending on the location of the user. Therefore, the scope of BRW is limited to the weir and directly associated infrastructure and does not include the development of irrigated land areas or water distribution infrastructure. Figure 3-1 and Figure 3-2 include a digital visualisation of what the weir is expected to look like. Figure 3-3 shows the proposed locality, general arrangement and inundation extent for BRW.



Figure 3-1 Digital visualisation from upstream of the weir looking downstream

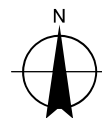


Figure 3-2 Digital visualisation from downstream of the weir looking upstream



Data Disclaimer
 ©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4
 0 1 2 3
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Charters Towers Regional Council
Big Rocks Weir

**Locality of the project
 footprint and study area**

Project No. **12512214**
 Revision No. **0**
 Date **28/09/2020**

FIGURE 3-3

3.2 Land use

The Burdekin River where the weir infrastructure and storage area are proposed is defined as a watercourse under State government mapping databases. Following construction of BRW it is intended that the Burdekin River will still continue to function as a watercourse albeit with an additional waterway barrier and in stream water storage located within the bed and banks.

The Burdekin River is also identified as a waterway in the Charters Towers Regional Town Plan and the majority of surrounding land to the north and south of the project is zoned Rural, with the exception of Dalrymple National Park which is zoned for Environmental Management and Conservation.

For the purposes of development, the Burdekin River is considered to take on the zoning of the adjoining land, which in the case of the weir wall, fishway and saddle dam would be Rural. No changes to the existing land use zoning is proposed as a result of the project.

3.3 Project need, justification and alternatives considered

3.3.1 Project need

The Charters Towers Region is a Local Government Area (LGA) located between Townsville (130 km east) and Mt Isa (770 km west). The construction of BRW could provide the Charters Towers community with a higher level of water security. The weir will have the ability to serve multiple purposes, including a permanent weir pool and release flows where adjoining landholders and downstream farmers are able to draw reliable water for irrigation, augmentation of Charters Towers' urban water needs, industrial development and recreational benefits.

With regards to irrigated agriculture, previous studies have shown that BRW may provide the ability to support small to medium scale agriculture in the district, supporting up to 3,000 ha of high value perennial crops. Consultation undertaken as part of this Business Case with potential users of water from BRW identified 1,324 ha of known, existing cleared agricultural land suitable for high value irrigated agriculture, of which 683 ha is currently under irrigation. In addition to this, other landholders have identified further areas of land that may be suitable for high value agriculture (TEL 2020).

The following service need and opportunities were identified as part of the BRW Business Case (TEL 2020):

- Within the Charters Towers LGA, the Agriculture, Forestry and Fishing industry is a major employing industry, accounting for 12.3 percent of the region's total employment as at the 2016 census. Across Queensland, employment in the Agriculture, Forestry and Fishing industry represents 2.8 percent of total employment, demonstrating a significant reliance on the agriculture industry within Charters Towers LGA as a driver of employment and economic activity. For the 2015-16 year, the value of agricultural production for the Charters Towers LGA was \$242 million (TEL 2020).
- The proposed location of BRW falls within the Upper Burdekin (G) subcatchment area, Upper Burdekin water management area (WMA) and Upper Burdekin C water allocation zone. The take of water for 73 percent of nominal volume water allocations within the water allocation zone is subject to flow conditions, limiting access to water for irrigation when stream flow in the Burdekin River is low. Stakeholder consultations with landholders within the immediate proximity of the proposed BRW (members of the Big Rocks Agricultural Group – BRAG) confirmed that these limitations on access to water during low stream flow periods and the low level of reliability of access to water limits the crop types able to be produced within the region, and creates a risk in relation to being able to 'finish' seasonal crops (TEL 2020).

- Feedback obtained indicated it also does not provide irrigators with the confidence to invest in high value perennial or permanent horticulture, which rely on sufficient access to water throughout the year, particularly during the driest months (TEL 2020).
- In 2016, a Regional Water Supply Security Assessment (RWSSA) was undertaken for the township of Charters Towers, which draws its water from the 5,227 ML capacity Charters Towers Weir. Following the findings of the RWSSA, CTRC supported the investigation and development of solutions to manage demand and ensure water supply security for Charters Towers. Increasing the storage capabilities in the region through a new upstream weir to provide extra water for agriculture and increased security for residential demand was identified as a key area for investigation (TEL 2020)
- The reliance on the Charters Towers Weir for the Charters Towers township poses a water availability risk in the face of growing climate variability, with the Weir reliant on the seasonal inflows of water to maintain water supply for urban and industrial users.

The Burdekin Haughton Water Supply Scheme and the Broken Bowen Water Supply Scheme currently service the drinking and irrigation water needs in the Burdekin region. Both water supply schemes are operated by Sunwater. As BRW will only support an area of irrigated agriculture directly adjacent to or downstream of the weir, there is no significant water pipelines, channels or pump infrastructure proposed to be constructed and there will be no interference with the existing water schemes in the region, including the Charters Towers Weir and Burdekin Falls Dam (BFD). The project is also not dependent on HGD. Further hydraulic modelling is to be undertaken during the Detailed Design phase to meet EFOs and WASOs.

3.3.2 Alternatives

A number of potential options were considered as part of the BRW Business Case which could potentially address the service need as identified above. The options considered included a range of potential solutions which can be categorised according to the Queensland Government's options prioritisation tier, as specified in the 2015 Queensland Government State Infrastructure Plan (SIP), which notes a preference from government for low cost solutions that achieve similar outcomes to costly new or improved infrastructure. Both capital and non-capital alternatives to BRW have been evaluated as part of the Business Case. (TEL 2020).

The assessment of alternatives also included input and information from the following groups:

- The BRW Business Case project management team (KPMG, GHD and TEL)
- BRAG
- CTRC
- DNRME
- NQWIA

The options considered are outlined in Table 3-1.

BRW was assessed as the preferred solution due to:

- Relatively low capital cost compared to the Charters Towers Weir Raise option
- Relatively higher economic benefit
- High reliability of supply for a minimum of 10,000 ML to 20,000 ML to support high value agriculture, and other economic development opportunities (e.g. industrial)
- Relatively low construction cost and risk compared to the Charters Towers Weir Raise option.

Table 3-1 BRW alternatives

Number	Option	Description
1	Trading existing allocations	Encourage greater trading of existing underutilised water allocations from within the water allocation area
2	Invest in on-farm storage	Target greater private investment in on-farm storage solutions to provide farm specific water storage for irrigation
3	Raising of existing Charters Towers Weir	Raise the height of the existing Charters Towers Weir to provide additional water storage on the Burdekin River
4	Deliver new water infrastructure in the form of BRW	Build new water storage infrastructure with approximately 10,000 ML of additional water storage capacity for the region
5	Do nothing	Continue with current practises

3.4 Components, developments, activities and infrastructure that constitute the project to be declared a coordinated project

The project components that are sought to be declared include:

- Weir and storage area (including outlet works)
- Fishway
- Saddle dam
- Vehicle access tracks and land management requirements.

Road works required as part of the project (for construction and operation) include a new concrete floodway to maintain access to Big Bend Recreation Reserve, upgrades to the existing access track and bed level crossing at Lolworth Creek within Fletcherview Research Station and intersection upgrades for access onto Gregory Developmental Road (a State-controlled road).

Supporting infrastructure associated with the construction phase will also include:

- Diversion works
- Borrow areas for the supply of construction resource material
- Site laydowns, stockpiles and processing areas to facilitate construction works
- Construction of site amenities.

The location, extent and design details of supporting infrastructure may change based on inputs from the design team and construction contractor as part of the Detailed Design phase and final detailed construction program.

Although the BRW Business Case has identified that the project will support further development of recreation and irrigated agriculture already occurring in the region, the addition of new recreational facilities, water supply infrastructure and an irrigated agriculture scheme do not form part of the project nor is the project seeking to obtain development approvals to establish a designated recreation or irrigation area. Consultation undertaken with landholders proximal to BRW during development of the Business Case, has confirmed that the scale of likely facilitated irrigated agriculture can be established without additional land clearing or the need for a coordinated scheme to change existing land tenure and ownership, based on the current demand and potential volume of water supplied by the project.

The project components for BRW will be further refined in the Detailed Design phase subject to further investigative works and consultation with administering agencies, and will also be subject to further environmental, social and cultural heritage assessments as part of the impact assessment process.

Table 3-2 provides an overview of the key design characteristics of BRW.

Table 3-2 Weir design summary

Characteristic	Project
General	
Weir type	An uncontrolled gravity broad crested weir constructed using conventional concrete and one saddle dam on the right bank high flow channel
Purpose	Irrigated agriculture and water supply
Design life	100 years
Associated infrastructure	Upgrade to the existing access at Big Bend by construction of a concrete floodway and culverts to provide ongoing public access following construction of the weir. Construction of access track to the weir.
Location	19°51'50 S, 146°9'51 E
Storage characteristics	
Catchment area	36,205 km ²
Full supply level (FSL)	250.87 m AHD
Storage at FSL	10,000 ML
Minimum operating level	243.36 m AHD
Dead storage volume	444 ML
Commandable storage at FSL	9556 ML
Surface area at FSL	319 ha
Yield	Minimum of 10,000 ML per annum
Impoundment length (main channel) at full supply level)	16.6 km
Weir characteristics	
Crest type	Broad crested weir
Crest level	250.87 m AHD
Weir height (above lowest foundation)	Approx. 13.3 m
Weir length	188 m
Weir crest width	6 m
Erosion protection	5 m wide reinforced concrete apron along the toe of the weir and rock stabilisation on the abutments
Saddle dam	
Type	An uncontrolled gravity broad crested weir constructed using conventional concrete
Location	Right abutment
Crest type	An uncontrolled gravity broad crested saddle dam
Crest level	251.17 m AHD
Height (above lowest toe)	4.4 m
Length	56 m approx.
Crest width	6 m
Erosion protection	Rock stabilisation on the abutments
Outlet works	
Low level outlet	0.9 m x 0.9 m rectangular conduit with upstream guard gate, inlet debris screens and downstream hydraulically actuated sluice gate

Characteristic	Project
Length of outlet	14 m approx.
Outlet stilling basin type	USBR Type 1
Aquatic fauna passage	
Type	Primary cone style fishway
Cone style fishway	
Hydraulic grade	1V:20H
Fishway exit	
Cone weir invert level	249.87 m AHD
Low flow invert level	249.37 m AHD
Fishway entry	
Cone weir invert level	237.62 m AHD
Low flow invert level	237.12 m AHD

3.4.1 Weir and storage area

The general concept of BRW is for the construction of a new weir on the Burdekin River with a storage capacity of 10,000 ML. BRW is proposed as an uncontrolled gravity broad crested weir constructed using conventional concrete to around reduced level (RL) 250.87 m Australian Height Datum (AHD), approximately 13.3 m above the height of the river bed. The weir will extend 188 m across the river and at full supply level (FSL) will inundate 16.6 km of the Burdekin River and lower tributary of Keelbottom Creek. The general arrangement of the weir infrastructure (inclusive of the fishway and saddle dam) is shown in Appendix A and Figure 3-4.

Construction of the weir is expected to occur using a Lift Form / Formwork Panel system. Concrete will be poured into the monoliths via truck mounted concrete pump at a rate of 200 m³ per day. Conventional formwork will be used to construct the stilling basin and saddle dam.

Outlet works and stilling basin

The outlet is positioned in the low flow channel on the right hand side of the fishway. The outlet arrangement developed consists of a 900 mm x 900 mm concrete culvert through the weir at an invert level of RL 241.37 m AHD. This culvert size has been adopted based upon the minimum size required hydraulically and readily available pre-cast culvert sizes. The low level outlet will be operated when the weir stops overtopping to augment flows released through the fishway from RL 250.87 m AHD to the minimum operating level RL 244.37 m AHD.

A stilling basin is incorporated into the design to reduce turbulent flow and erosion effects as a result of concentrated discharge from the outlet. The stilling basin is designed in accordance with USBR Type 1 stilling basin (USBR, 1984), with the tailwater level in the basin controlled by a weir adjacent to the fishway to RL 238.63 m AHD.

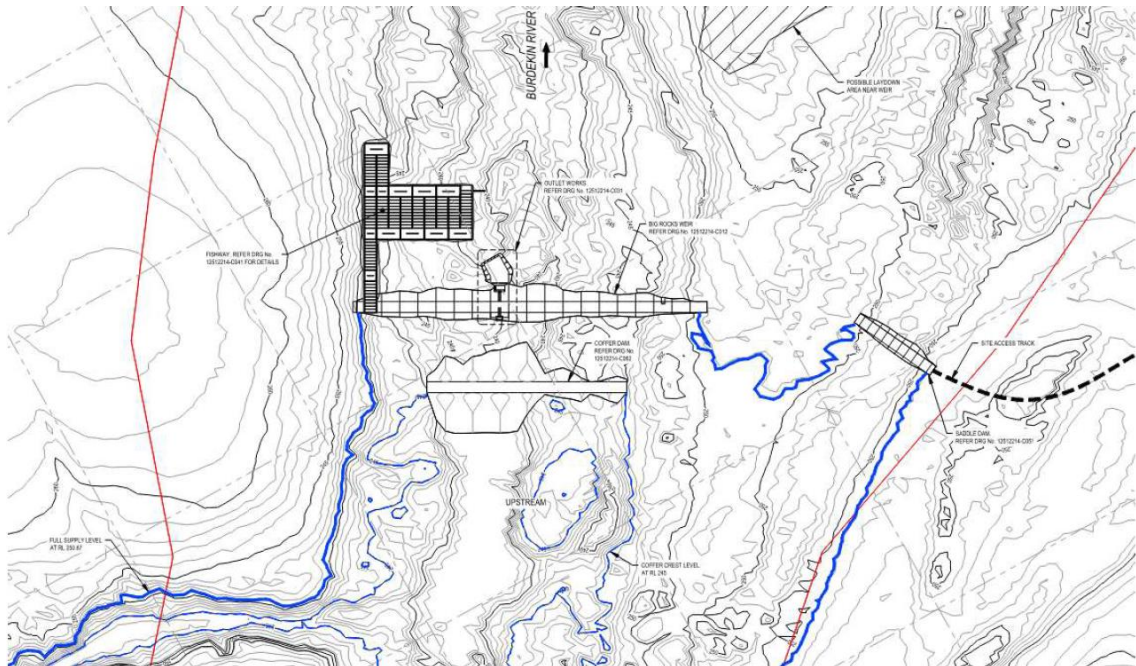


Figure 3-4 General arrangement

3.4.2 Fishway

In-stream water infrastructure (i.e. waterway barriers) such as dams, weirs and barrages can adversely impact the ability of native aquatic species to successfully undertake their natural migration cycles, causing poor ecological health outcomes within waterways. The Burdekin River is classified as a purple waterway under the Queensland Waterways for Waterway Barrier Works data layer, indicating a High risk of impacts upon fish passage from waterway barriers.

The construction and raising of a waterway barrier is classed as operational works under the *Planning Act 2016*, thereby requiring development approval. Included in the development approval process is an assessment under the *Fisheries Act 1994* and State code 18: Constructing or raising waterway barrier works in fish habitats. The purpose of the code is to ensure development in fish habitat:

1. Maintains fish movement and connectivity throughout waterways and within and between fish habitats.
2. Maintains the health and productivity of fisheries resources and fish habitat.
3. Maintains the community and fishing sectors' use of the area and access to fisheries resources.
4. Only occurs where there is a need for the development and no other reasonable alternative exists.
5. Provides adequate fish passage including a fish way, if necessary.
6. Avoids impacts on marine plants, waterways that provide for fish passage and declared fish habitat areas that are matters of state environmental significance, and where avoidance is not reasonably possible, minimises and mitigates impacts, and provides an offset for significant residual impacts where appropriate.

Site characteristics

A list of key site characteristics considered in the fishway design are based on site inspections undertaken by GHD in December 2019 and preliminary assessments, including the Baseline Terrestrial and Aquatic Ecology Assessment (GHD 2020a; GHD 2020b) and the Geotechnical Interpretative Report (GHD 2020c). Key site characteristics considered include:

- Site geology at the weir comprises of predominately high to very high strength rhyolite.
- The fish in the local community are small to medium sized potamodromous (migrates within freshwater only) species. Based on the species sizes, the maximum burst swimming velocities of these species are expected to be low and within the range of 0.8 – 1.2 m/s.
- Preliminary assessment of the Gainsford gauge located approximately 19 km upstream of the proposed weir location, indicates the stream is flowing regularly.
- Differential head between the weir crest level to fishway entrance location on the downstream side of 12.25 m.
- The design criteria for the fishway are outlined below, primarily based on the site characteristics.
- Provide adequate fish passage for the range of fish species, sizes, life-stages and swimming abilities present within the upper Burdekin River (i.e. small to medium size fish species with burst swimming velocities of 0.8 – 1.2 m/s).
- Provide safe fish passage through all pathways of potential fish movement.
- For the life of the waterway barrier works, the hydrology of the development and operation of the fishway maximises fish movement.
- The fishway is to be located on the left bank due to the close proximity to the plunge pool and more favourable topography for construction of the fishway compared to the right bank.
- The design will limit excavation due to the potential difficulty excavating the rhyolite foundation.
- The structure will maintain a grade of 1H in 20V to provide suitable fish passage conditions for the range of fish species, sizes, life-stages and swimming abilities present within the upper Burdekin River.
- Operational and maintenance issues are minimised.

Selection of fishway type

A high-level options assessment of fishway design types was undertaken to identify a preferred Reference Design for the purposes of the Business Case. The high level options assessment indicated a passive system with minimal operational and maintenance requirements is preferred due to the semi-remote site location and difficulty of access. As such, a cone style fishway was selected for the reference design. The cone fishway design has been proven effective at providing fish passage for small and medium size fish in other Queensland river systems (Stuart and Marsden 2019). While the effectiveness of the proposed cone fishway design to provide fish passage for large bodied fish sizes has not yet been confirmed in published literature, a lowered section in each cone weir is provided in the design to facilitate passage of large bodied fish species when submerged

An example of an operational cone style fishway in Queensland is shown in Figure 3-5



Figure 3-5 Glenore fishway at low (a) and high flows with low turbulence resting areas (b) (extract from Stuart and Marsden 2019)

Fishway operational range

The BRW cone fishway will operate during all flow releases from 1.5 m below FSL up to initial spilling at FSL + 100 mm. Above FSL + 100 mm, water velocities within the main river channel downstream of the weir are in excess of the burst swimming capabilities of the existing fish community (i.e. >2 m/s) resulting in non-viable fishway approach hydraulics. Internal fishway hydraulics are favourable and the fishway will continue to operate up until down out of the fishway between FSL +300 mm and FSL + 880 mm. Downstream fish passage will occur over the spillway during all spilling events.

At flow events greater than FSL + 300 mm, fish passage will occur past BRW via the southern and northern auxiliary channels. The provision of fish passage at BRW reflects existing conditions where the rocky outcrop in the main channel is a natural barrier to fish passage during flow events. During post-weir conditions, fish passage via the southern and northern auxiliary channels will occur at smaller flow events than existing conditions and therefore the provision of fish passage past the weir is enhanced during these flow events (GHD 2020d).

Proposed fishway layout

The cone fishway is located on the downstream left bank of the weir. It is approximately 250 m long with a 1H in 20V grade. The fishway layout plan is presented in Figure 3-6 and a 3D representation is shown in Figure 3-7. Drawings of the fishway are also included in Appendix A.

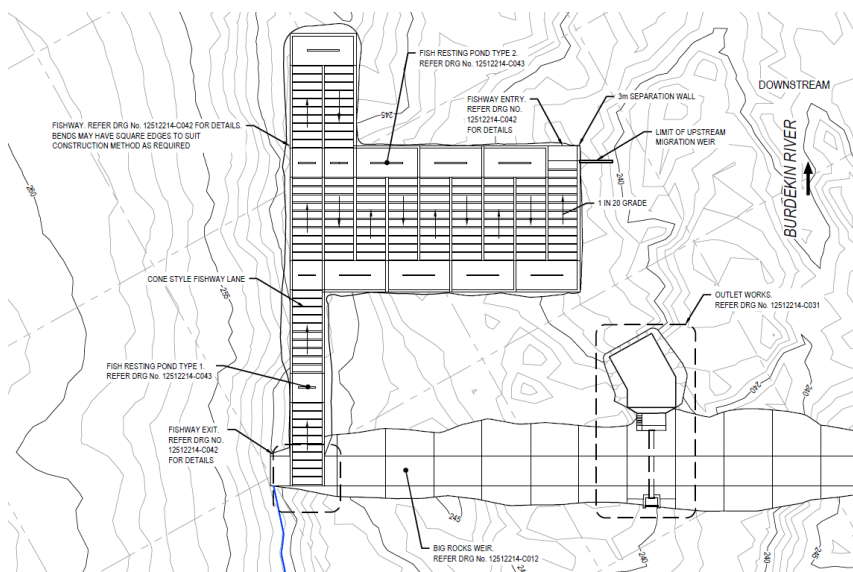


Figure 3-6 Fishway layout plan

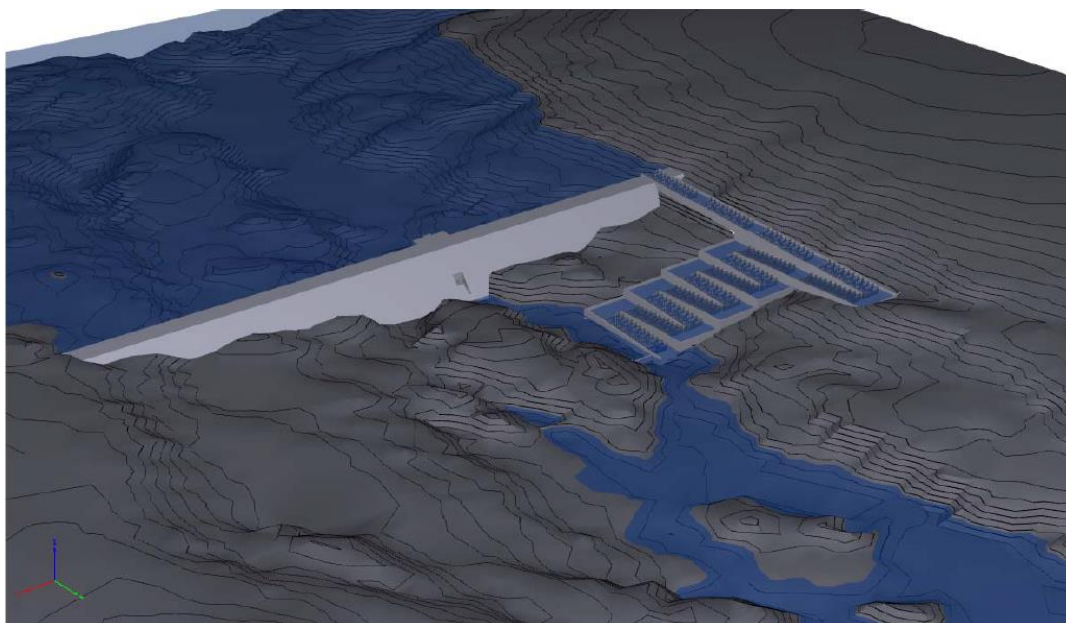


Figure 3-7 3D representation of weir and fishway (apron and stilling basin not shown)

The proposed fishway is specified to be similar in concept to the cone style fishway specified in *Evaluation of Cone Fishways to Facilitate Passage of Small-bodied Fish* (Stuart and Marsden 2019), with the arrangement modified to suit the conditions at the BRW site.

The proposed fishway features the key design elements as specified below.

- Hydraulic grade is 1H:20V (i.e. from one cone weir baffle crest to the next)
- 144 cone weir baffles in total
 - 11 cone weir baffles per typical lane
 - 13 lanes, separated by 11 resting pools. The nominal dimensions of the resting pools are 6 m x 12 m.
- Cones, low flow slots and wing wall protrusions on each baffle are staggered laterally to break up continuous stream flows.
- Three cone weir baffle types are utilised throughout the fishway:
 - Exit weir: 2 high, 3 low, 2 high cone configuration
 - Type A weir: 2 high, 2 low, 3 high cone configuration
 - Type B weir: 3 high, 2 low, 2 high cone configuration.

The upstream most cell of each lane features the exit weir configuration, and then a cycle of Type A and B weirs is specified for the remaining cells moving downstream.

The two different cone heights allows for fish migration of a larger size range of species. Smaller fish species are accommodated in the low height cone section at small flows, and as the spill depth rises the flow in the channel increases drowning out the small cones. This allows larger fish to climb the fishway in the area above the small cones, while maintaining passage for smaller fish in the high cone section of the fishway. A low flow slot is also incorporated into each of the cone weir baffles to facilitate the passage of smaller bodied fish.

Each panel of cones is slightly offset to minimise velocity connection between pools which might result in higher than acceptable velocities. This is similar to the approach for vertical slot fishways where the pools allow fish to rest between burst swimming episodes between the cone baffles.

A graphical representation of a typical repeating section of the proposed fishway (featuring two lanes separated by a resting pool) is provided in Figure 3-8 and an isometric view of each of three different cone weir baffle types is provided in Figure 3-9.

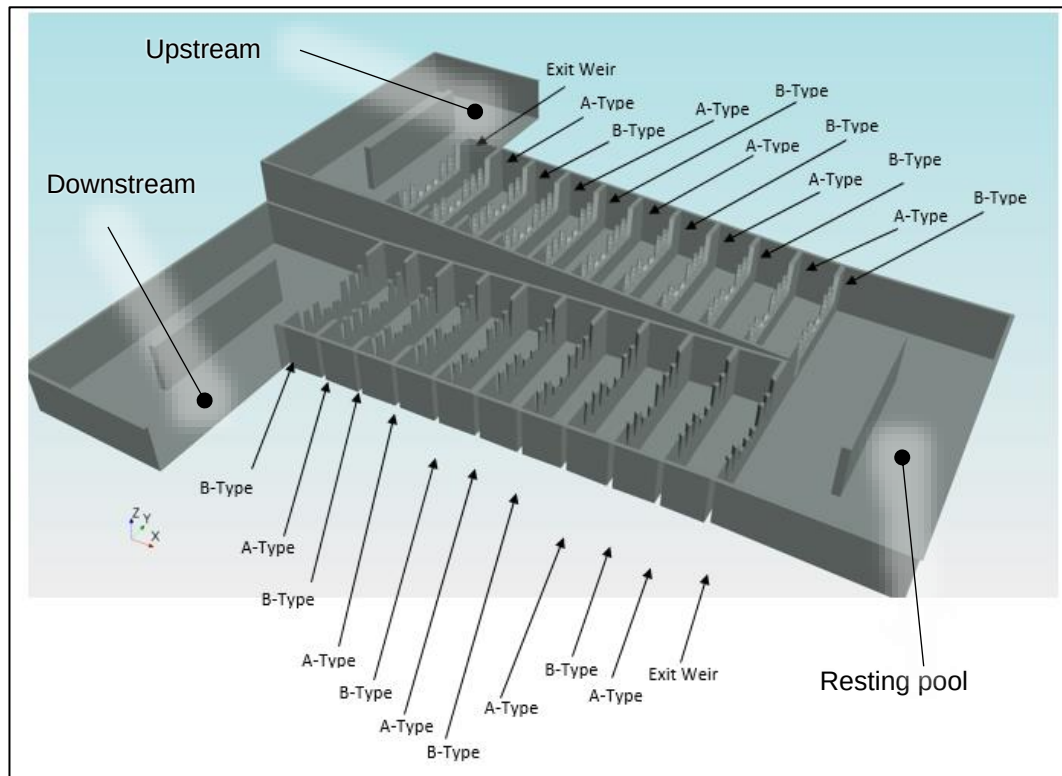


Figure 3-8 Cone style weir – repeating section

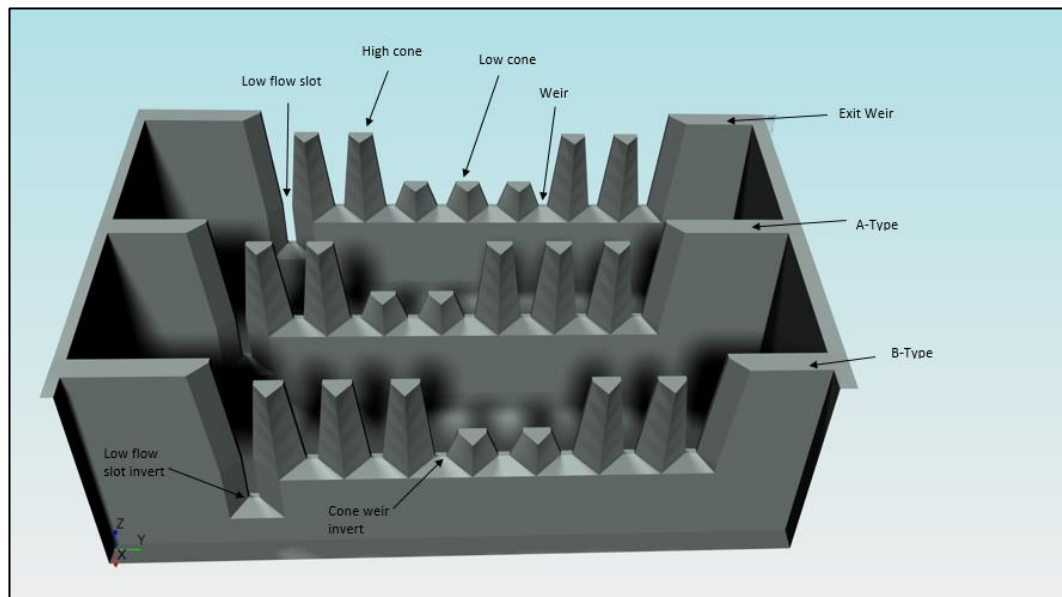


Figure 3-9 Cone style weir baffle types – Isometric view

3.4.3 Saddle dam

A saddle dam is proposed to be constructed along the high flow channel of the right abutment approximately 100 m south of BRW. The saddle dam is proposed to be constructed from mass concrete as an uncontrolled gravity broad crested saddle dam. The specific weir geometry includes a crest level of 251.17 m AHD with a maximum weir height (above lowest toe) of approximately 4.4 m and weir length of approximately 56 m. The saddle dam is proposed to be

constructed nominally 0.3 m higher than BRW to RL 251.17 m AHD such that flow preferentially overtops BRW, improving the function of the cone fishway.

The design of the saddle dam has been refined through the Reference Design process for the Business Case including hydraulic modelling with particular consideration to erodibility, afflux and stability considerations. The saddle dam will be founded predominantly on Rhyolite, however the right abutment will likely be founded in contact with the Toomba Basalt Flow.

The location of the saddle dam relative to the main weir is shown in the drawings. Selected drawings are located within Appendix A.

3.4.4 Access tracks

Access to Big Bend Recreation Reserve

Big Bend is an established recreational site located directly upstream of BRW. Currently, no formal crossing exists to Big Bend and visitors access the area via 4WD across a sandy overflow area as shown in Figure 3-10.



Figure 3-10 Existing crossing to Big Bend

The FSL of the weir will inundate the existing access to Big Bend Recreation Reserve. As such, it is proposed to construct a concrete floodway, consisting of a series of box culvert cells, to maintain access to the recreational area after construction of BRW. The lowest section of the access has a depth of up to 1.9 m from existing surface to FSL of BRW. The extent to which the construction of BRW will prevent access to Big Bend is shown in Figure 3-11.

The overall length of the floodway required is approximately 75 m in length and has a total width of approximately 20 m. The traffic across the floodway is recommended to be one way as this matches the existing site conditions. Limited clearing is expected to be required to allow the construction of the floodway. No upgrades are proposed to Big Bend Road as part of this project, other than construction of the floodway to restore access following construction of BRW. The proposed floodway design is shown in the selected drawings within Appendix A.

The crossing will generally comprise a series box culvert cells in order to reduce the potential impact on flow through this section of the river. The culverts will be overlaid by a reinforced concrete slab for access and the embankments on each of the abutments will be protected with a reinforced concrete overlay to provide resistance to erosion. The base of the culverts will need to be roughened and baffles installed at 600 centres on the outside edge of the outer culverts to help facilitate fish passage and meet *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF 2019). The proposed location of the crossing is at the end of Big Bend Road.

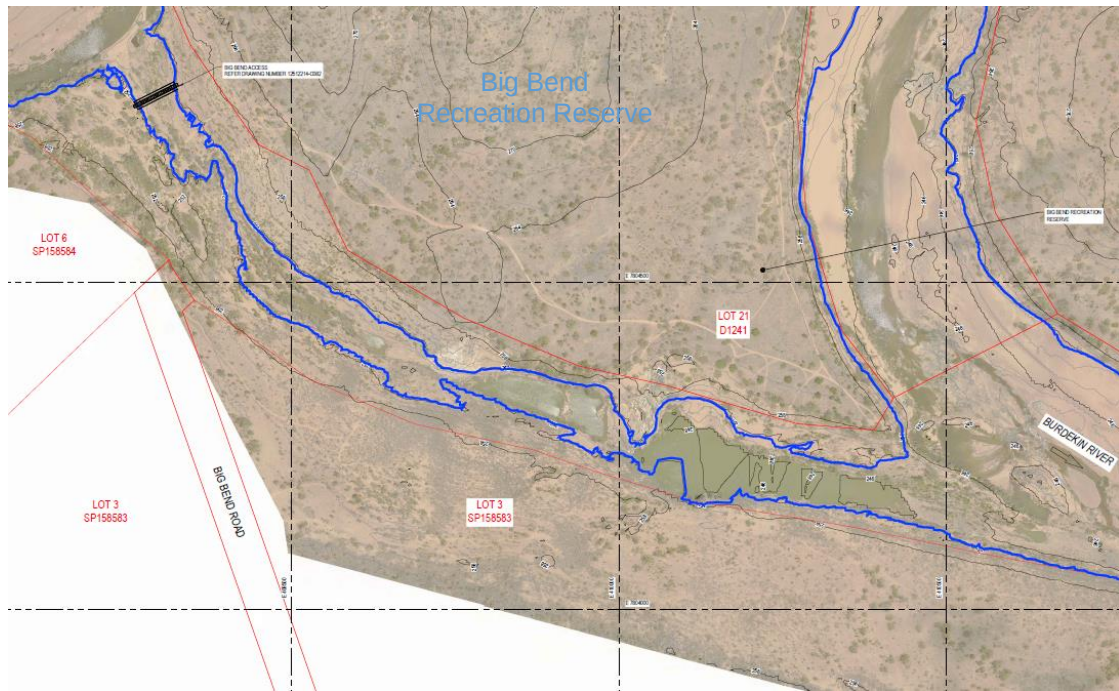


Figure 3-11 BRW inundation extents and proposed access to Big Bend

Access to BRW

An access route to the weir has been developed based on initial consultation with landholders adjacent to the weir, and to make use of the existing access track and Lolworth Creek crossing, limiting land disturbance where practical. An alternative access was considered on the western extents of the property boundary (4 DV450, adjoining AAP23190 and 20 DV558), however the topography was not favourable and the landholders preferred to upgrade the existing access track (refer Figure 3-12).

The proposed weir site will be accessed from the Gregory Developmental Road (which is a State controlled road (SCR) running north of Charters Towers), then along the western extent of Fletcherview Research Station, across Lolworth creek, and then to the weir site by following the high bank of the river. It is preferred to access the weir site from the Gregory Developmental Road due to the better road (a sealed road) and shorter travel distance from Charters Towers.

The construction access roads will be a minimum of 6 m wide along existing routes where possible to minimise clearing and will be locked at all times to prevent public access to the weir. Access to the weir will be possible for water levels less than 0.3 m above the weir crest, however operation of the outlet structure will only be able to be undertaken manually when the weir stops overtopping. A suitable area will be provided for helicopter landing adjacent to the right abutment for emergency access.

Access to the weir site after construction, is proposed to be limited to operations personnel, nominally up to once per week during periods of the year when the environmental flow outlet is required to be operated or for maintenance purposes. Therefore, considering no public access is proposed, the construction access is proposed to be retained following completion of the works, which will be adequate for the intended access frequency with regular maintenance.

Due to high flow channels on the right bank of the river it won't be cost effective to construct a permanent access to the weir site itself. As such, access will be to the bank of the anabranch, after which the construction access is proposed to be used for access by foot or potentially an all-terrain vehicle (ATV) for manual operation of the valve and inspection. Inspection and operation requirements will be kept to a minimum which may involve weekly inspection and operation of the outlet valve when the weir is not overtopping and occasional access to the weir

crest to allow installation of the baulk when upstream isolation is required or the screens are required to be cleaned. Basic mooring facilities can be provided at the weir to allow boat access if required.

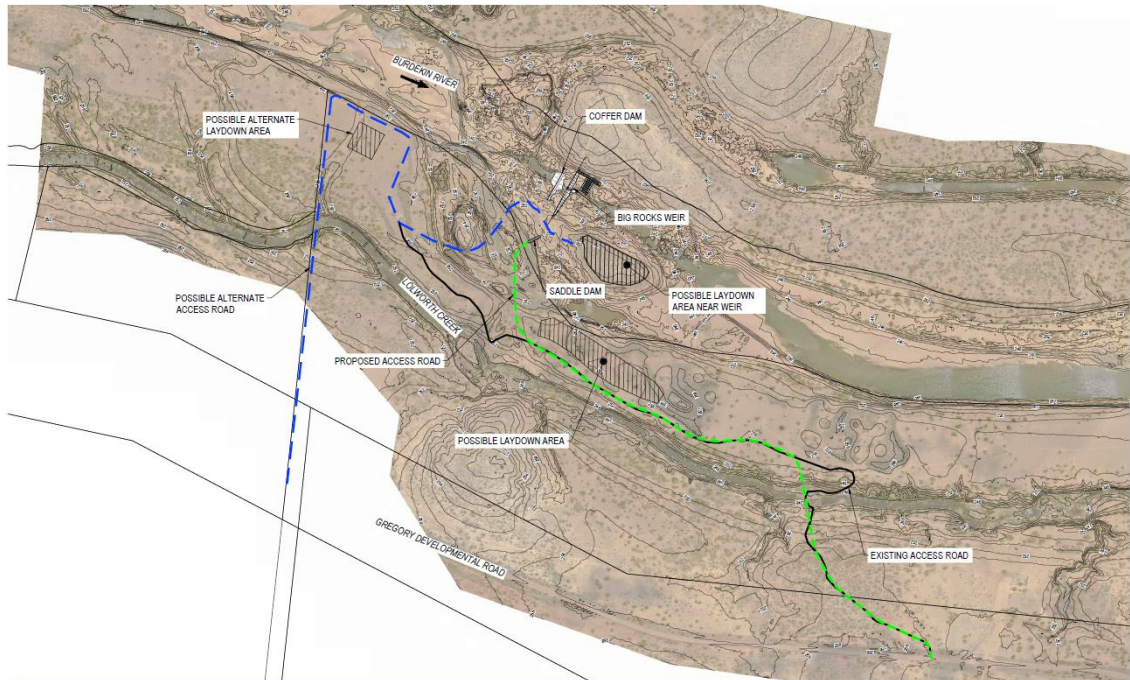


Figure 3-12 Access road options

Figure 3-13 shows the condition of the existing access track and Lolworth Creek crossing.



Figure 3-13 Typical condition of existing access track (left) and Lolworth Creek crossing (right)

3.5 External infrastructure requirements

Diversion works

Diversion of water will be required during construction of the weir. A number of diversion strategies were considered for construction, including diversion channels, coffer dams and siphon solutions. A relatively low height coffer dam to RL 245 m AHD together with three siphons to provide sufficient capacity to pass the average daily six month dry season flow was adopted as the preferred option. This option was assessed to be most practical and cost effective to construct considering the relatively short construction program and relatively high cost of alternative diversion works strategies.

Early tenderer involvement will form an important part of the final stages of design and procurement to confirm the final diversion strategy and risk profile adopted for construction.

Construction materials

Geotechnical investigations have not covered assessment of site materials for suitability as concrete aggregate however, it is expected that either concrete or aggregate could be delivered from existing quarries and batch plants in Charters Towers. River sands and gravels may be suitable for fine aggregate and blending with coarser aggregate for production of concrete on site using a small scale pug mill or similar considering the relatively minor volume of concrete required (approximately 15,000 m³).

Rock from site may also be required for crushing to produce gravel for the fishway resting pools.

Clayey soil is required for construction of the coffer dam for diversion of water during construction. Recent river alluvial material identified on the right bank, to the south of the basalt flow, from geological mapping and previous geotechnical investigations (e.g. BH09) suggest that suitable materials are available in close proximity to the site.

Temporary laydown areas

Two areas within proximity to the proposed weir site and access road alignment were identified as possible temporary construction laydown areas (to be removed and rehabilitated following completion of construction works).

The northern laydown area closest to the weir has a relatively flat land area of around 2 ha. This area is generally above the 5% AEP (Annual Exceedance Probability) flood event (RL 256.79 m AHD (Australian Height Datum)) based on the preliminary flood frequency analysis and tailwater curve. The elevation of the land varies from around 257 m AHD to 258 m AHD and some minor reshaping will be required to achieve a suitable laydown area. This laydown area may be suitable for setting up batching plant for concrete and storage of frequently needed construction materials such as formwork and scaffolding.

The southern laydown area is located further from the weir site above the high bank of the Burdekin River. The ground is flatter and can be extended as required by the construction activities. This area may be established as the main site compound, storage for construction aggregates and temporary parking for site vehicles.

On-site facilities

During construction establishment of temporary site facilities are required and are likely to comprise: construction offices; storage areas and hardstands; amenities; power generation infrastructure; hydraulic infrastructure; chemical stores; batching, screening and crushing facilities; and minor vehicle washdown and maintenance areas.

Power and water supply

During construction power supply will be via generators and potable water supply for site offices will be by tanks if required. The weir is not proposed to require power to operate and there are no permanent site facilities or offices proposed that would require potable water post-construction.

Restoration of temporary construction areas

Following completion of construction works, the temporary construction areas will be remediated in accordance with approved management plans, which will include general site tidy up, rehabilitation of temporary laydown and borrow areas, decommissioning and removal of temporary diversion works and removal of temporary creek crossings. The construction access is proposed to be retained for future weir access by CTRC for operation of BRW.

3.6 Construction and operational processes

3.6.1 Construction

Construction of the project will typically involve the following activities:

- Acquisition or land agreements across various tenures, including exploration and mining tenure as discussed further in Section 4.2
- Development of the weir access road through Fletcherview Research Station (4 DV450) and a separate floodway to Big Bend Recreation Reserve
- Land clearing associated with establishing the access tracks, constructing the weir infrastructure and for temporary construction areas (i.e. laydown areas, site amenities, etc.)
- Potential for the establishment of batching plants, vehicle service areas and quarry or borrow areas for construction materials. The requirement for these activities will likely be determined in the Detailed Design phase or by the contractor during the tender phase
- Earthworks associated with establishing construction areas, weir infrastructure and the temporary diversion works
- Construction of the weir wall, fishway, saddle dam and access tracks
- Inundation of approximately 10.35 ha of land (within the high banks of the river and associated tributaries) and 323.85 ha of the Burdekin River for the water storage area
- Revegetation of cleared areas (where applicable).

The weir will be a mass concrete weir. Geotechnical investigations have not covered assessment of site materials for suitability as concrete aggregate however, it is expected that either concrete or aggregate could be delivered from existing quarries and batch plants in Charters Towers. River sands and gravels may be suitable for fine aggregate and blending with coarser aggregate for production of concrete on site using a small scale pug mill or similar considering the relatively minor volume of concrete required (approximately 15,000 m³).

Rock from site may also be required for crushing to produce gravel for the fishway resting pools. Clayey soil is required for construction of the coffer dam for diversion of water during construction. Recent river alluvial material identified on the right bank, to the south of the basalt flow, from geological mapping and previous geotechnical investigations suggest that suitable materials are available in close proximity to the site.

Further geotechnical investigation and laboratory testing is required to confirm the suitability of site materials for use in batching concrete on site.

3.6.2 Operation

Inspection and operation requirements will be kept to a minimum which may involve weekly inspection and operation of the outlet valve when the weir is not overtopping and occasional access to the weir crest to allow installation of the baulk when upstream isolation is required or the screens are required to be cleaned. Basic mooring facilities can be provided at the weir to allow boat access if required. Access may also be required to carry out regular land management activities and to ensure any operational monitoring is conducted in accordance with approval conditions.

3.7 Workforce requirements during construction and operation

Based on the P50 risk-adjusted capital costs (real), and the guidance from Queensland Treasury regarding estimates of the number of direct full-time equivalent (FTE) positions supported by capital works (Queensland Treasury, 2019), it is anticipated that the project will support up to 172 direct FTE positions during the construction period for the 2022 calendar year. This will include:

- In house works for labour, plant operation, engineer, supervisor, and administration
- Subcontractors for mobile concrete batch plant and truck operations.

It is anticipated that the majority of the construction workforce will be sourced from the surrounding region in addition to drive-in drive-out (DIDO) or fly-in fly-out (FIFO) workers (where required). As the project is located a short distance from Charters Towers, approximately 26 km north of the town, it is proposed that local workforces can remain within their own homes, with regional and DIDO or FIFO worker accommodation supplied through local accommodation within the town (hotels, motels etc.). As such, no temporary workforce camps are proposed or considered to be required.

Direct operational employment will be one to two maintenance workers that will monitor the weir once or twice a week, administer distribution of water allocations, schedule and undertake periodic maintenance and operate valve releases and flows. It is also estimated that the additional agricultural output associated with BRW at full levels of production could directly support up to 117 FTEs each year in the Agriculture, Forestry and Fishing industry within the Charters Towers region¹.

The operational workforce is proposed to be sourced locally. As such, workers are anticipated to remain within their own homes within Charters Towers and the surrounding region.

3.8 Timeframes for the project

As the project has received a \$30 million capital funding commitment from the Australian Government and a further \$30 million commitment from the Queensland Government construction is likely to commence in 2022, subject to being able to obtain all required project approvals. It is expected that the project will be completed within the dry season of one year.

Construction activities in the way of mobilisation and site preparation are proposed to commence in February 2022 (weather and site conditions permitting) with practical completion to be achieved by December 2022. A preliminary program for construction is provided in Figure 3-14 for reference.

¹This estimate is based on an analysis undertaken regarding the relationship of total output for the Agriculture, Forestry and Fishing industry as reported in the 2017-18 Australian National Accounts (ABS, 5209.0.55.001 Australian National Accounts: Input Output Tables, 2017-18, 2020) and the corresponding total employment in the industry in the ABS Labour Force statistics. A simplifying assumption has been made that the relationship between the number of FTEs employed per \$1m of output for the industry will hold.

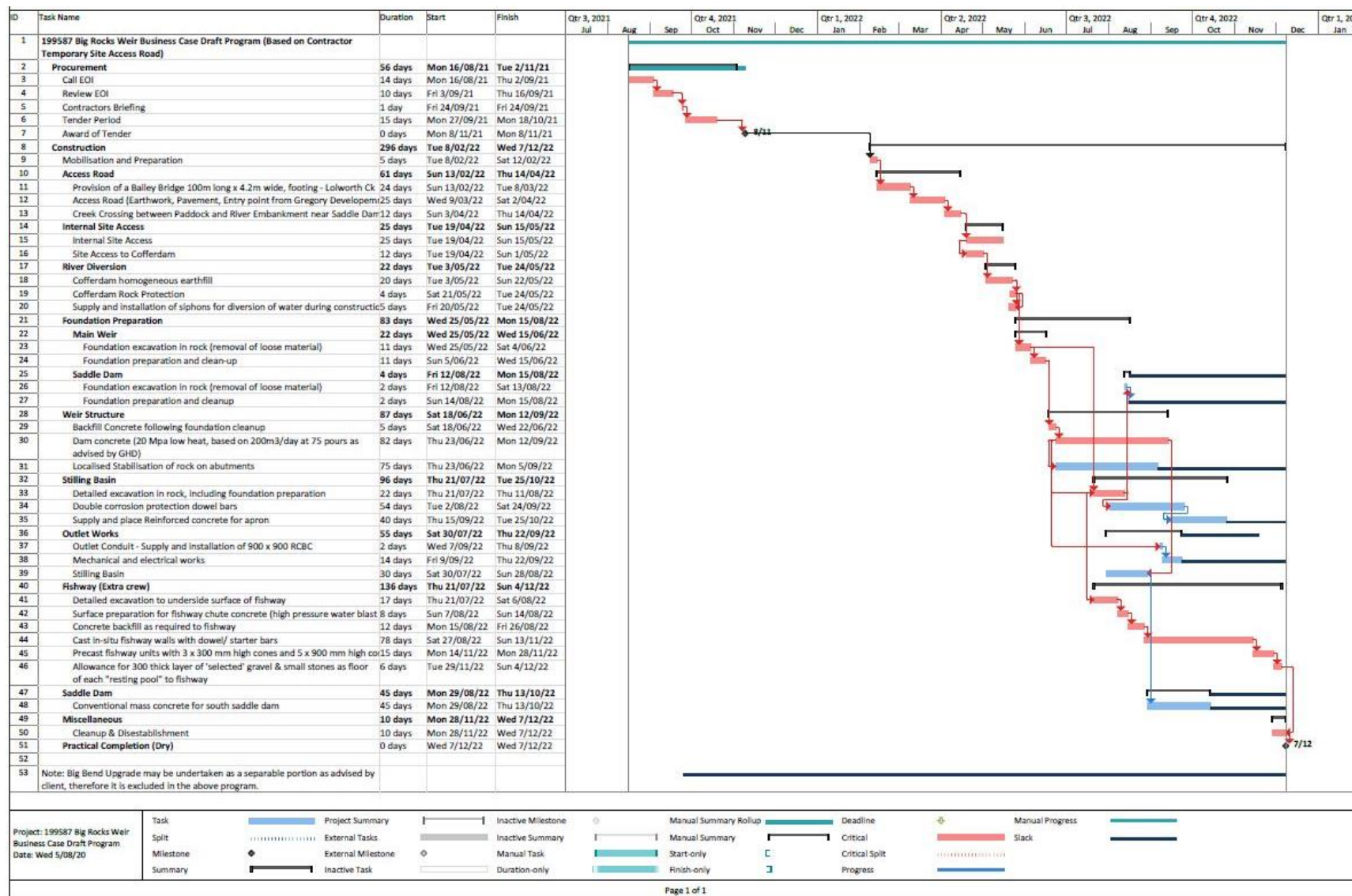


Figure 3-14 Preliminary construction program

3.9 Economic indicators

Within the Charters Towers LGA, the Agriculture, Forestry and Fishing industry accounts for around 12.3 percent of the regions total employment and 11 percent of the region's economic output (the second largest contributor behind the mining industry). The project is anticipated to result in greater accessibility to higher reliability water allocations, which will support a transition towards high-value agriculture crops, delivering high value add agricultural production for the Charters Towers region and will contribute significantly to the Charters Towers economy. Given the degree of reliance on agriculture as a key economic driver, opportunities to better use the natural resources through improved water storage and reliable water will further contribute to economic growth for Charters Towers and encourage diversification of agricultural crops currently grown within the region.

The current low level of reliability of water for irrigation purposes within the region limits the crop types that can be grown, and as a result, irrigation is currently limited to low value add annual crops such as cattle fodder and some annual crops. By enhancing the reliability of the water allocations resulting from the project, this provides irrigators with the opportunity to grow longer lived, higher-value perennial crops such as tree crops which require reliable access to water during dry periods.

By expanding the types of crops able to be grown in the region, as well as an increase in volume of production, it provides additional economic and employment opportunities within the region to support this additional economic activity. This is expected to take the form of more direct employment associated with the operation of irrigation activities on-farm, as well as associated indirect employment opportunities for the region that result from the additional economic activity required to support these direct activities, such as new packing/processing facilities, agricultural support services, transport services and fertiliser production.

3.10 Financing requirements and implications

A \$30 million funding commitment was originally made by the Australian Government toward the construction of BRW. Based on the estimated, risk-adjusted P90 capital cost of \$59.82 million (nominal) as part of the BRW Business Case, this left a funding gap of \$29.91 million for the construction of the weir. The Queensland Government has since announced that they will also commit a further \$30 million toward construction of the project.

The project is expected to be constructed in one stage over a single dry season in 2022.

It is anticipated that the operational costs of the weir will be met through cost recovery of these components through water charges to end users through a renewals annuity.

3.10.1 Implications of project not proceeding

A best practice risk management process has been adopted for project delivery and development of risk mitigation strategies. Should additional funding from the Commonwealth or State Government not be secured or if CTRC decide not to proceed with the project, there is opportunity for a private entity to come forward to take over the project based on strong economic findings of the Business Case, including:

- For 10,000 ML of water the project has a BCR of 1.38 and economic return of \$26.46 million
- For 15,000 ML of water the project has a BCR of 1.80
- For 20,000 ML of water the project has a BCR of 2.14

If BRW were not to proceed, there is limited opportunity to support the reliable supply of high reliability water to support agricultural, industrial and urban growth for the Charters Towers region. In particular, the alternative options discussed in Section 3.3.2 do not satisfy the short or long-term demands for high reliability water in the region, particularly to support permanent plantings and high value irrigation development in the region. The 'no development' option will limit the growth of high value agriculture in the region and would fail to deliver the project objectives. It also has the potential to inhibit growth locally in the Charters Towers LGA and impact upon the local economy.

4. Location of key project elements

4.1 Location

The BRW is proposed along the Burdekin River, approximately 26 km north of Charters Towers, Queensland, and 23.9 km upstream from the existing Charters Towers Weir. The site is located within the CTRC LGA.

The proposed weir is located within the Burdekin River, between lots 16 BKN116 and 4 DV450 and will be accessed via the Gregory Developmental Road which is a State highway running north of Charters Towers. The weir access road will be through Fletcherview Research Station between the Burdekin River and Gregory Developmental Road. The location of key project components and real property descriptions for the project are shown on Figure 4-1.

4.2 Tenure

4.2.1 Land tenure

Land tenure within the study area consists of a combination of private freehold land and non-freehold land otherwise referred to as State land. Surrounding properties are represented by a variety of State land tenures including but not limited to National Park (Dalrymple National Park), reserve land (for recreation), perpetual leases, term leases, watercourses and both State and local road reserve as shown in Figure 4-1.

The Burdekin River is defined as a watercourse and will contain the weir infrastructure and storage area. Land directly adjoining the weir to the north is held as freehold land (Burdekin Downs) and may be subject to some minor inundation from the storage area due to the left high flow channel of the Burdekin River and another small watercourse/tributary being located within the cadastral boundary of the property. Fletcherview Research Station is located to the south of the weir and is State leasehold land under a 30 year term lease to James Cook University (JCU). Fletcherview Research Station will contain the weir access track as well as some temporary laydown areas.

JCU have been supportive of the project, providing access for site inspections and field surveys and consulting with the BRW Business Case team in order to inform the SIE and demand assessment. The presence of laydown areas and access routes during construction has the potential to temporarily impact on the day to day operations at Fletcherview Research Station as construction areas would not be available for use by cattle, the station manager, JCU students or any visitors.

As part of the pre-construction works, it is anticipated that an access and haulage plan will be developed in conjunction with landholder discussions and agreements, which will ensure all parties agree to any proposed access movements through the site during construction. Public utility and access agreements will also be established between CTRC and JCU over Lot 4 DV450 for the long term operational requirements of the weir site.

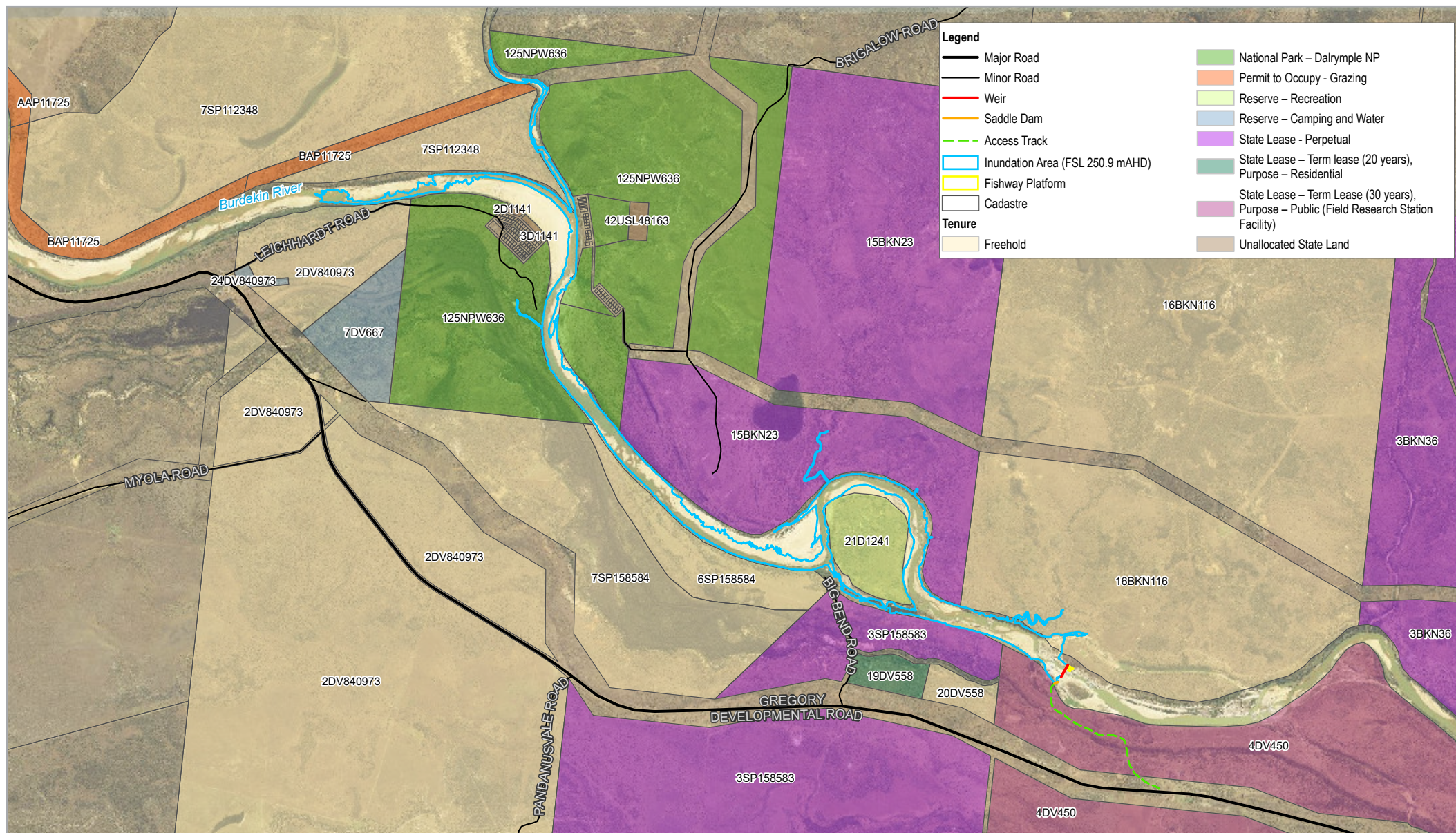
Based on the proposed weir design and full supply level in Section 3.4, construction of BRW is expected to impact a total of six properties as identified in Table 4-1.

Table 4-1 Properties impacted by BRW

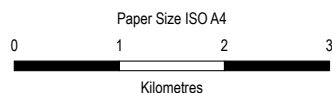
Property description	Project components	Description of area impacted	Approx. area of land impacted at FSL (ha)
Burdekin River	Weir wall, storage area, fishway, saddle dam and access culvert to Big Bend	Permanent water body within the banks of the Burdekin River.	323.854
4DV450 (Fletcherview Research Station)	Access track and temporary laydown areas	Use of the existing access track, minor realignment of the access track and temporary occupancy of laydown areas for one dry season.	0.643
16BKN116 (Burdekin Downs)	Storage area	Backflow of water into a small tributary and inundation along the left high flow channel of the Burdekin River.	5.85
15BKN23	Storage area	Backflow of water into two small tributaries off the Burdekin River.	2.02
125NP2636 (Dalrymple National Park)	Storage area	Backflow of water into a small tributary in the southern part of the park and inundation of a small low lying area along the bank of the Burdekin River affecting the northern part of the park.	1.04
7SP112348	Storage area	Inundation of a small low lying area located along the bank of Keelbottom Creek.	0.8

4.2.2 Native title

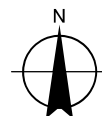
BRW is located within the external boundaries of the *Elizabeth Dodd & Ors on behalf of the Gudjala People Core Country Claim #1 v State of Queensland & Ors* native title determination (Federal Court Number: QUD80/2005 and NNTT Number: QCD2014/006). The weir infrastructure and storage area will cover lands and water where non-exclusive native title rights and interests are determined to exist as shown in Figure 4-2.



Data Disclaimer
 ©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55

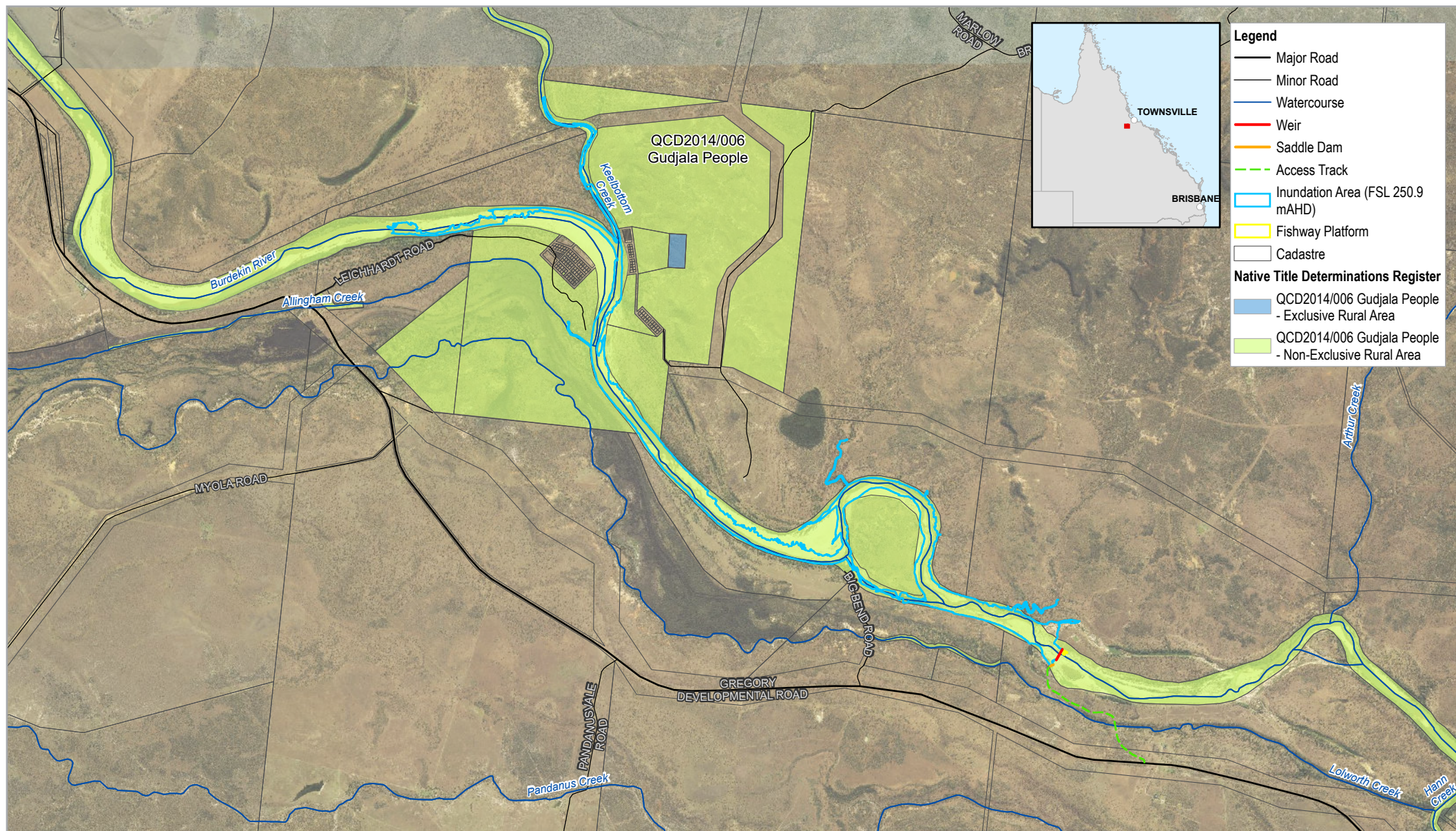


Charters Towers Regional Council
Big Rocks Weir

Project No. **12512214**
 Revision No. **0**
 Date **29/09/2020**

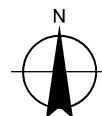
Adjacent properties and land tenures

FIGURE 4-1



Data Disclaimer
 ©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4
 0 1 2 3
 Kilometres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Charters Towers Regional Council
Big Rocks Weir

Project No. **12512214**
 Revision No. **0**
 Date **28/09/2020**

Native Title Determinations

FIGURE 4-2

5. Description of the existing environment

5.1 Natural environment

5.1.1 Land

5.1.1.1 Topography

BRW is situated on a greenfield site approximately 26 km north of Charters Towers.

In the selected site area, the Burdekin River divides a rock outcrop over a distance of approximately one kilometre. This main divide has auxiliary channels running on the north and south, with additional two smaller overflow channels directing water into Lolworth Creek. These auxiliary channels re-join the Burdekin River downstream of the rock divide and outside of the site area.

Access to the site provides a challenge due to the rocky topography and bodies of water surrounding the proposed location. Access to the right (south) bank of the site area is via an unsealed track off the Gregory Developmental Road. The left (north) bank is accessed from Sellheim and through local properties.

Access to the south bank of the general site area will be via the Gregory Developmental Road. Access to the actual weir site from the right bank is difficult due to the rock outcrops and high flow channels described below. Access to the left bank of the general site would not be required frequently and could be via agreement with the property owner to the north of the site, establishment of an easement, boat or across the crest of the weir when it isn't overtopping.

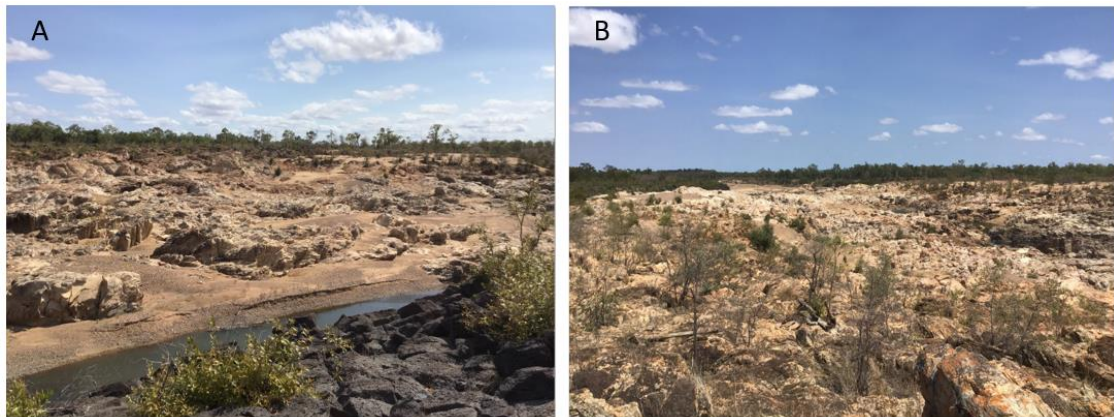


Figure 5-1 Typical site topography

5.1.1.2 Visual amenity and light

The landscape within the Upper Burdekin includes grazing and agricultural land, native forests, mining and industry with limited urban centres.

The site is predominately surrounded by grazing land and there are no existing light sources. The Gregory Developmental Road runs to the south of the Burdekin River and the project site, however the river is not visible from the highway.

The Big Bend Recreation Reserve is surrounded by and has open views of the Burdekin River.

5.1.1.3 Geology

At Big Rocks the Burdekin River cuts through a major rock outcrop over a distance of some 1000 m. The prominent feature in this area is the Toomba Basalt Flow which runs along the south bank of the river.

The river has cut its way around the lava flow forming a main channel that runs approximately parallel to the lava flow in times of low and moderate flow. Rhyolite forms the bed of the main channel. During large floods a complex array of high flow channels have formed primarily over the basalt wall on the south bank but also through the north bank.

The main channel of the Burdekin River at the proposed weir site is locally sharply incised into high strength rhyolitic rock

The Queensland Government's online mapping tool (GeoResGlobe accessed 8 January 2020) indicates that the proposed weir site is predominantly underlain by late Carboniferous to Early Permian age Kennedy Province rhyolite with more recent Toomba Basalt Flow basalt of Pleistocene to Holocene age toward the right (southern) abutment.

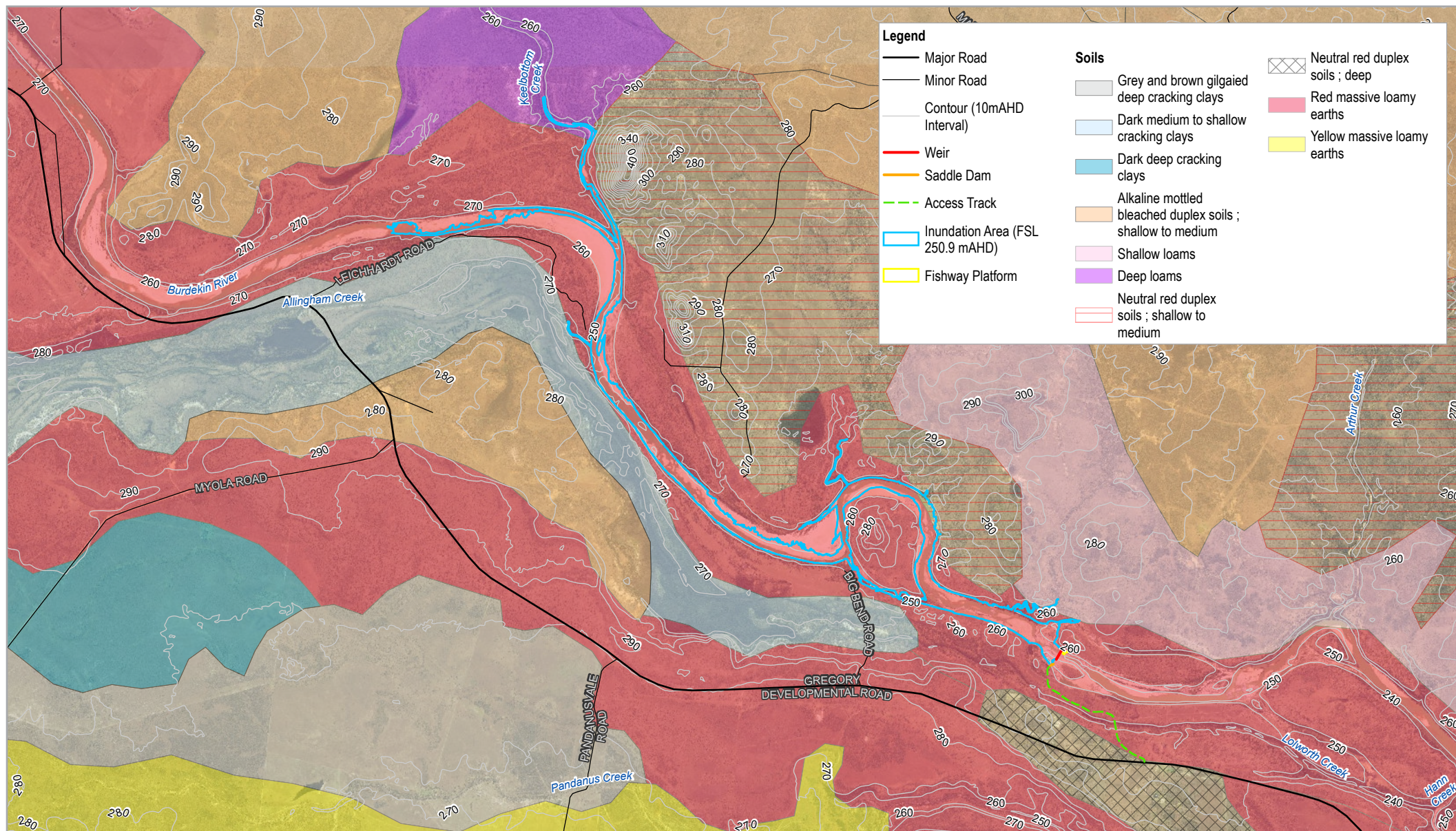


Figure 5-2 Locally deep incised channel

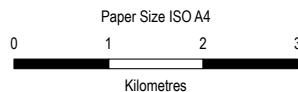
5.1.1.4 Soils

The Australian Soil Resource Information System maps the BRW study area as primarily occurring on Tenosol Soils. Sections of the study area also occur on Sodosols, Kandosols and Chromosols (refer to Figure 5-3).

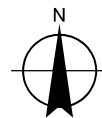
Tenosols are known to contain weak soil profile development and are often shallow in nature. These soils tend to develop on rocky areas in the uplands, or on alluvial or Aeolian deposits (VRO 2020). This soil type is found along the Burdekin River and consistent with the rocky nature of the watercourse. Kandosols lack strong texture between the surface and subsoil horizons and are characterised by weak subsoils. The soils are usually well drained and often have low fertility. These soils are located upstream of the weir location. Chromosols are characterised by a strong texture contrast between surface and upper subsoil horizons. Chromosols are mapped in limited areas directly adjacent to the Burdekin River however are mapped over large expanses in the surrounding environment.



Data Disclaimer
 ©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Charters Towers Regional Council
Big Rocks Weir

Project No. 12512214
 Revision No. 0
 Date 28/09/2020

Topography and soils

FIGURE 5-3

5.1.2 Water

5.1.2.1 Surface water features

The Burdekin River is a major river (stream order 8) within the Upper Burdekin River sub-catchment. Lolworth Creek (stream order 6) and Keelbottom Creek (stream order 5) which connect with the Burdekin River downstream and upstream of the proposed BRW, respectively are also classified as major waterways (Figure 5-4). A waterway crossing is to be installed on Lolworth Creek to allow access during construction and operation of the BRW.

Wetlands

A small area of palustrine regional ecosystem (RE) (arid/semi-arid floodplain tree swamp) is mapped approximately 2 km south of the proposed weir. Upstream, eight small areas of palustrine RE (arid/semi-arid floodplain tree swamp) are mapped within approximately 10 km, upstream of the proposed weir.

One area of 01-50_RE (arid-semi-arid non-floodplain tree swamp) is mapped upstream and within 10 km of the proposed weir.

The Burdekin River is mapped as riverine wetland, with banks and tributaries mapped similarly and with riverine vegetation.

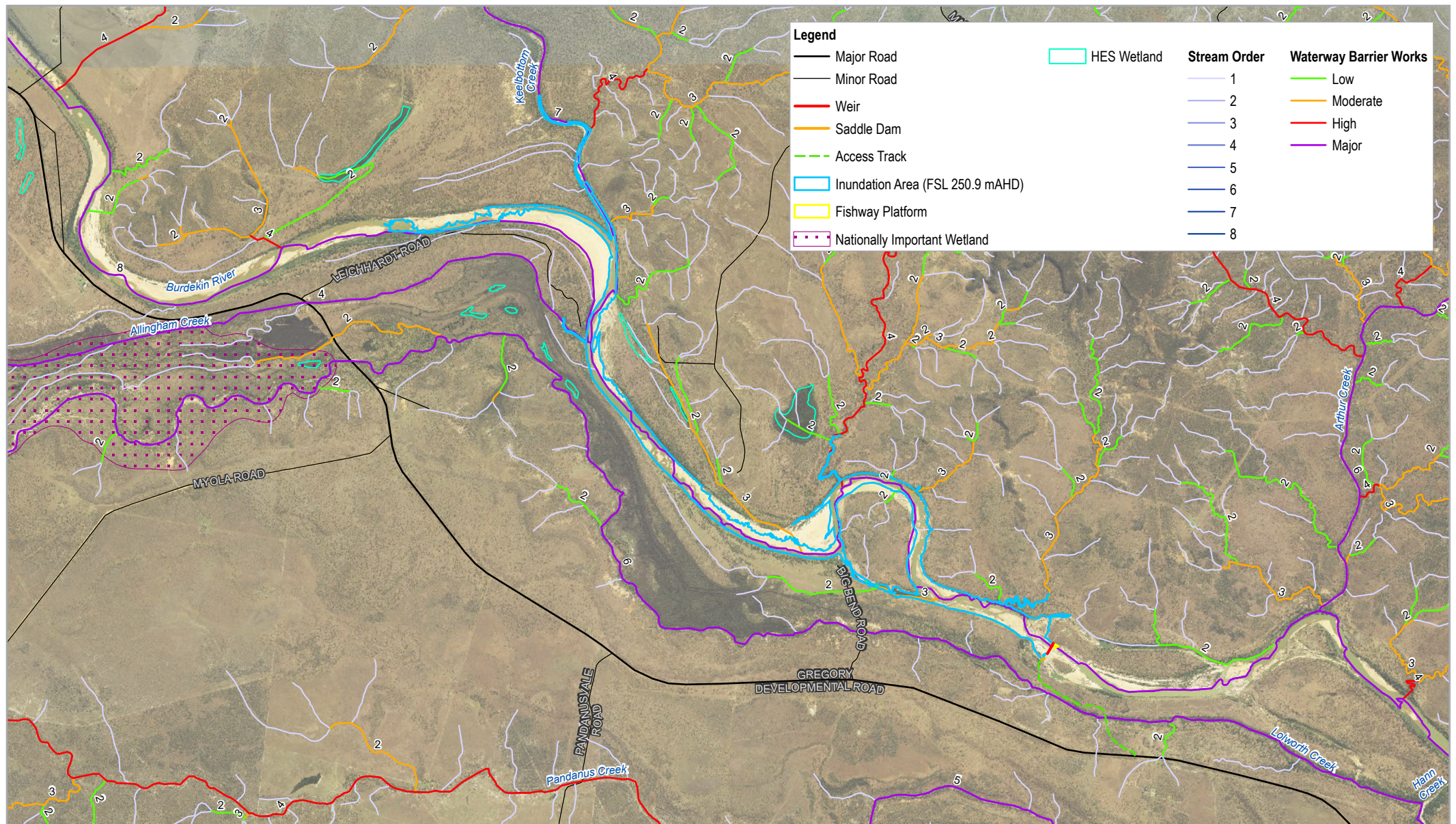
Additionally, Spring Lake and Eumara Lake are mapped as palustrine wetland buffer (WB) and RE approximately 22 km upstream, to the north-east.

Isolated areas of lacustrine wetland not listed as ecologically significant are mapped in the wider region, however these are artificial wetlands such as stock water dams and located far from the Burdekin River.

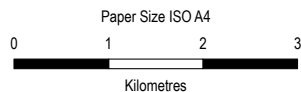
Wetlands of high ecological significance

The study area does not occur within a nationally important wetland. The nearest nationally important wetland, namely the Great Basalt Wall Directory of Important Wetlands in Australia (DIWA), is located approximately 12 km north-east of the study area.

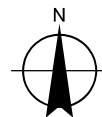
High Ecological Significance (HES) wetlands areas are mapped within the study area, ten of these are mapped within 1 km from the Burdekin River. Two areas of HES wetlands are mapped downstream of the proposed development, approximately 21 km and 23 km downstream. Upstream, eight small pockets of HES wetlands are mapped within approximately 10 km of the proposed weir and within approximately 1 km of the Burdekin River, with larger HES wetlands forming part of the Nationally Important Great Basalt DIWA, mapped approximately 20 km upstream of the proposed weir and within 2 km of the Burdekin River (Figure 5-4).



Data Disclaimer
 ©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Charters Towers Regional Council
Big Rocks Weir

Project No. 12512214
 Revision No. 0
 Date 28/09/2020

Wetlands and watercourses

FIGURE 5-4

N:\AU\Brisbane\Projects\4212512214\GIS\Maps\APRX\12512214_IAS_Figures.aprx
 Print date: 28 Sep 2020 - 16:08

Data source: DAF: Waterway Barrier Works (2019); DNRME: Imagery (2015); Wetlands, Roads, Watercourse (2019); GHD: Inundation Area, Proposed Infrastructure (2020). Created by: xlee

5.1.2.2 Flooding

BRW is proposed to be situated across the Burdekin River in the north-west portion of the Burdekin Basin, which receives contributions from the Clarke, Star and Basalt Rivers.

The existing Upper Burdekin River floods are rapid and extensive. Major flood events cause inundation of properties and closure of main roads, including the Flinders Highway. The river has large flood volumes, as well as a large flood peak flow rate.

The river has cut its way around the lava flow forming a main channel that runs approximately parallel to the lava flow in times of low and moderate flow. Rhyolite forms the bed of the main channel. During large floods a complex array of high flow channels have formed primarily over the basalt wall on the south bank but also through the north bank. All flows that exit the main channel into the high flow channels re-enter the main channel immediately downstream of weir site.

5.1.2.3 Groundwater

There is currently limited information about groundwater in the region. DNRME are currently undertaking a groundwater study in the Upper Burdekin region. There are two bores located 4.5 km north of the weir site (RN 102830 and RN96320) and one 6.5 km south-west (DN125948). There is no groundwater data publicly available for these bores.

5.1.3 Air

5.1.3.1 Climate and meteorology

The project area is located within the Einasleigh Uplands bioregion. This bioregion has a tropical climate with moderate to high-rainfall summers. The Einasleigh Uplands bioregion consists of a series of rugged hills and ranges, dissected plateaus and alluvial and sand plains. The bioregion is dominated by eucalypt woodlands, with land used extensively for grazing with some mining, cropping and horticulture.

The climate data, as shown in Table 5-1, was sourced from the Bureau of Meteorology (BoM) Charters Towers Airport weather station (Station ID: 034084) for the years 1942 to present. The station is located approximately 24 km south of the project area.

The climate of the project area is typical of tropical areas with two distinct seasons; the wet season (spanning from October to March) and the dry season (spanning from April to September). The wet season is characterised by high temperatures, averaging 33.4 °C, and high rainfall, averaging 88.4 mm. The dry season is has more mild conditions, with lower average temperatures and rainfall, 27.4 °C and 18.8 mm respectively.

The predominant wind direction in May is from east to southeast during mornings (9 am) with a mean speed of 6.5 km/h and from the east in the afternoon (3 pm) with a mean speed of 7 km/h. During October, the wind direction is from the east in the mornings (9 am) with a mean speed of 9.1 km/h and from the east in the afternoon (3 pm) with a mean speed of 9.5 km/h (BoM, 2019a, 2019b).

Table 5-1 BoM (2020) Charters Towers climate statistics – month averages (station. 034084)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean rainfall (mm)	152.0	145.8	75.8	26.2	22.8	20.1	20.1	15.0	9.1	17.7	61.5	77.7	643.2
Mean maximum temperature (°C)	33.9	33.0	32.0	30.2	27.4	25.0	25.0	26.8	30.3	32.9	34.1	34.7	30.4
Mean minimum temperature (°C)	22.4	22.3	21.0	18.3	15.3	12.7	11.6	12.3	15.2	18.1	20.4	22.0	17.6
Mean 9 am wind speed (km/h)	6.7	6.5	7.1	7.1	6.5	7.5	6.7	8.3	8.7	9.1	8.2	7.3	7.5
Mean 3 pm wind speed (km/h)	8.0	7.7	8.0	8.0	7.0	7.3	7.8	9.2	9.3	9.5	8.7	8.0	8.2

9 am May
834 Total Observations

Calm 5%

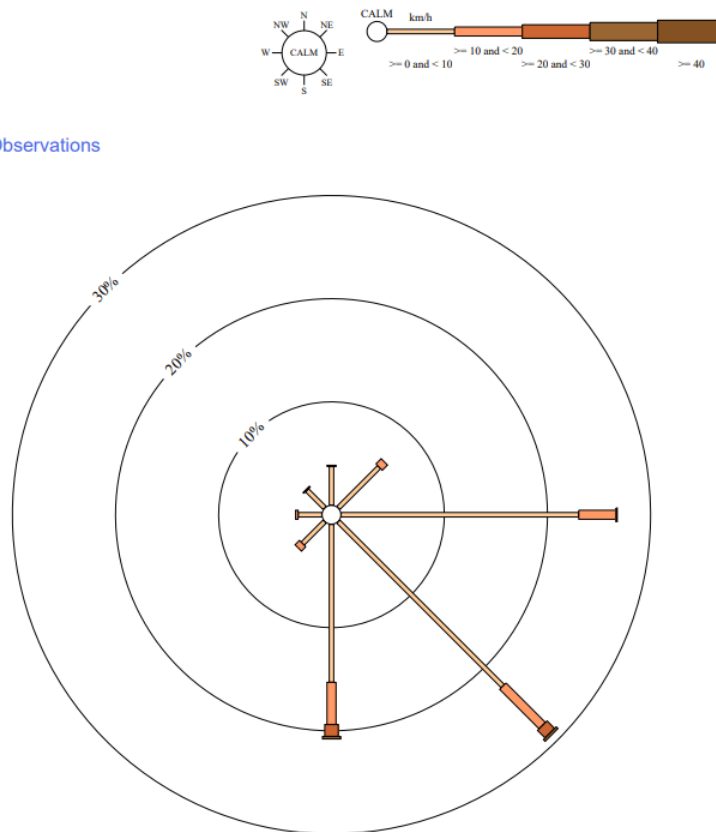


Figure 5-5 BoM (2019a) Charters Towers rose of 9 am May wind direction versus wind speed in km/h (station. 034084)

3 pm May
813 Total Observations

Calm 6%

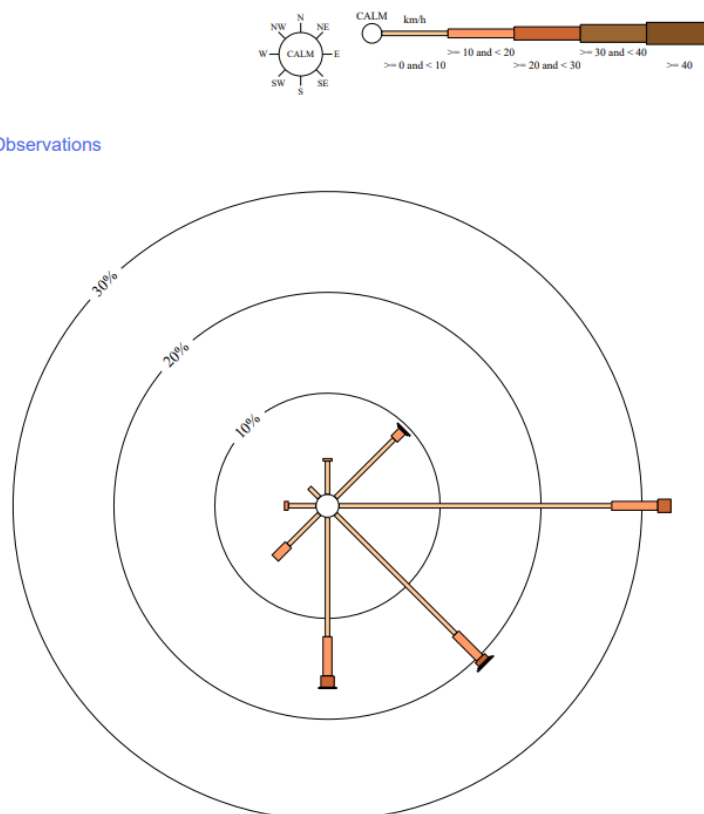


Figure 5-6 BoM (2019b) Charters Towers rose of 3 pm May wind direction versus wind speed in km/h (station. 034084)

9 am Oct
801 Total Observations

Calm 2%

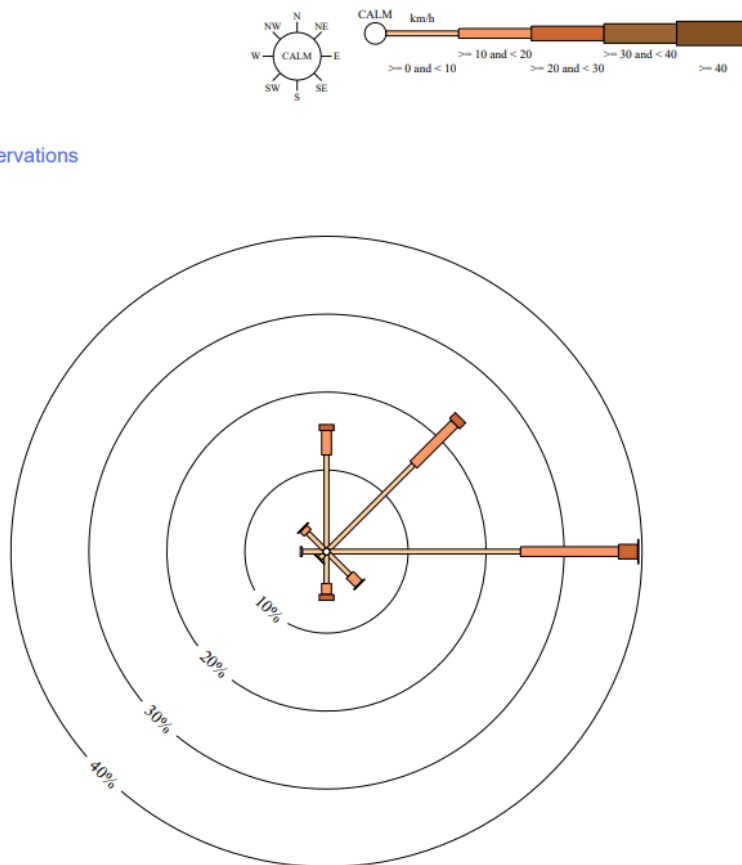


Figure 5-7 BoM (2019c) Charters Towers rose of 9 am October wind direction versus wind speed in km/h (station. 034084)

3 pm Oct
787 Total Observations

Calm 2%

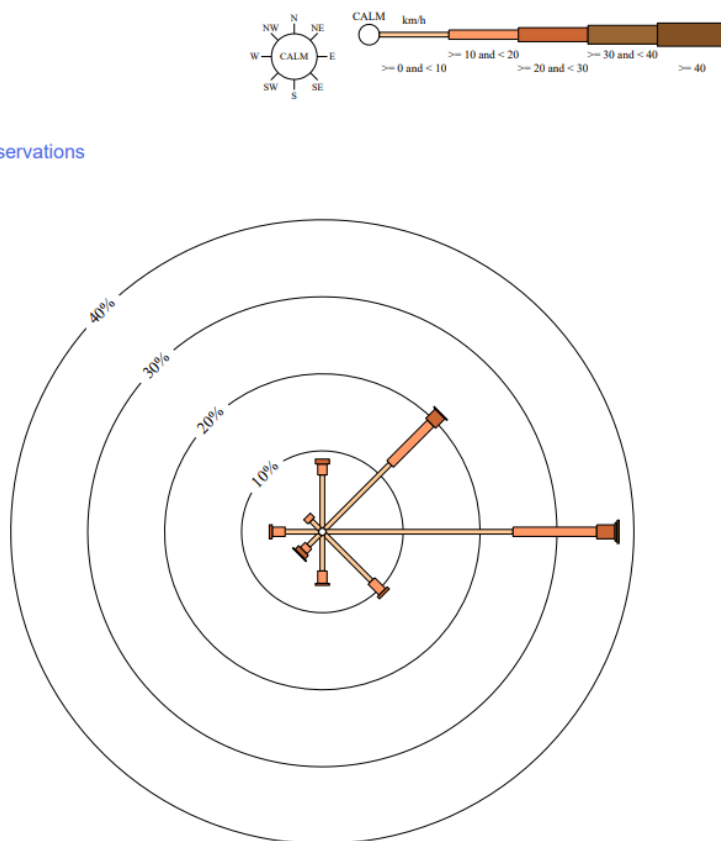


Figure 5-8 BoM (2019d) Charters Towers rose of 3 pm October wind direction versus wind speed in km/h (station. 034084)

5.1.3.2 Noise / vibration and air quality

The study area is predominately characterised by cattle grazing, therefore the existing noise and air environment would be typical of rural areas, with most noise and air emissions associated with insects, birds and other local wildlife or the use of farm vehicles, machinery and bikes or side by side ATVs. The Gregory Developmental Road is located 1.3 km from the weir site which would be the most pronounced noise source in the project area. Other nearby uses include recreational areas that are used by people camping, 4WD enthusiasts, bush walkers and recreational fishers resulting in additional vehicle movements.

5.1.4 Ecosystem

5.1.4.1 Protected areas

The Dalrymple National Park is located upstream of the proposed weir site (Figure 4-1). The park is known for ancient lava flows, fossilised limestone and the Burdekin River. It is also the site of the former Dalrymple township which was one of the first inland settlements in northern Australia.

5.1.4.2 Wetlands

A small area of palustrine RE (arid/semi-arid floodplain tree swamp) is mapped approximately 2 km south of the proposed weir. Upstream, eight small areas of palustrine RE (arid/semi-arid floodplain tree swamp) are mapped within approximately 10 km, upstream of the proposed weir.

One area of 01-50_RE (arid-semi-arid non-floodplain tree swamp) is mapped upstream and within 10 km of the proposed weir. The Burdekin River is mapped as riverine wetland, with banks and tributaries mapped similarly and with riverine vegetation. Additionally, Spring Lake and Eumara Lake are mapped as palustrine WB and RE approximately 22 km upstream, to the north-east.

Isolated areas of lacustrine wetland not listed as ecologically significant are mapped in the wider region, however these are artificial wetlands such as stock water dams and located far from the Burdekin River.

Wetlands of high ecological significance

The study area does not occur within a nationally important wetland. The nearest nationally important wetland, namely the Great Basalt Wall DIWA, is located approximately 12 km north-east of the study area.

A total of ten High Ecological Significance (HES) wetland areas are mapped approximately 1 km from the Burdekin River. Two areas of HES wetlands are mapped downstream of the proposed weir, approximately 21 km and 23 km downstream. Upstream, eight small pockets of HES wetland are mapped within approximately 10 km of the proposed weir and within approximately 1 km of the Burdekin River, with larger HES wetlands forming part of the Nationally Important Great Basalt DIWA, mapped approximately 20 km upstream of the proposed weir and within 2 km of the Burdekin River (Figure 5-4).

5.1.5 Flora and fauna

5.1.5.1 Ecological communities

Threatened ecological communities

No TECs were identified by the PMST (Protected Matters Search Tool) as potentially occurring within the study area. This database is based on maps derived from recovery plans, State vegetation maps, remote sensing imagery and other sources.

Identification of REs listed in existing Version 11 RE mapping and REs identified in the field were assessed for their potential to meet the requirements to constitute Commonwealth EPBC Act listed TECs. No vegetation communities that could be confirmed as potential TEC were identified within the project footprint during the pre-wet field survey.

Mapped regional ecosystem communities

Descriptions of REs mapped within the project footprint are provided in Table 5-2 and mapped in Figure 5-9. REs listed occurred either as homogenous or heterogeneous units.

Table 5-2 Regional ecosystem descriptions

RE	VMA status	BD status	RE description
9.3.1	LC	OC	<i>Eucalyptus camaldulensis</i> and/or <i>E. tereticornis</i> +/- <i>Melaleuca</i> spp. +/- <i>Casuarina cunninghamiana</i> fringing woodland on channels and levees
9.3.3b	LC	OC	<i>Corymbia</i> spp. and <i>Eucalyptus</i> spp. dominated mixed woodland on alluvial flats, levees and plains
9.3.12a	LC	OC	River beds and associated waterholes on major rivers and channels
9.3.22a	LC	OC	Open woodland to woodland of <i>Eucalyptus crebra</i> , <i>Corymbia clarksoniana</i> and/or <i>C. dallachiana</i> +/- <i>Eucalyptus</i> spp. on levees, terraces and banks of larger rivers.
9.8.1a	LC	NC	Open woodland to woodland of <i>Eucalyptus crebra</i> , <i>Corymbia erythrophloia</i> +/- <i>C. dallachiana</i> , <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. on basalt plains and rocky plains.
9.8.13	LC	NC	<i>Iseilema</i> spp. and/or <i>Dichanthium</i> spp. tussock grassland on basalt plains
9.11.31	LC	NC	<i>Corymbia terminalis</i> and/or <i>Eucalyptus crebra</i> and/or <i>C. erythrophloia</i> woodland on aprons surrounding limestone outcrops
9.12.1a	LC	NC	<i>Eucalyptus crebra</i> and/or <i>E. xanthoclada</i> and/or <i>E. drepanophylla</i> low open woodland on igneous rocks
9.12.4b	LC	NC	<i>Eucalyptus shirleyi</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia peltata</i> and/or <i>Callitris intratropica</i> low open woodland on igneous rocks

Key to table: RE – regional ecosystem; VMA – *Vegetation Management Act 1999*; BD – Biodiversity; OC – of concern; LC – least concern; NC – no concern at present.

All of the REs identified within the project footprint are remnant (Category B) with a VM status of Least Concern. The total extent of Category B Least Concern REs mapped within the project footprint is 332.87 ha. Overall of the RE types and boundaries appeared to be accurately mapped within the project footprint (Figure 5-9), with only minor discrepancies observed due to the scale of the RE mapping. A description of all RE communities observed and the extent of the areas mapped within the project footprint is provided in Table 5-3.

Table 5-3 Regional ecosystems considered present within the project footprint

RE (VM Status)	Area in project footprint (ha)	GHD field description	Photo
9.3.1 / 9.3.12a (LC)	283.20	Vegetation: Open woodland with a sparse canopy of <i>Eucalyptus camaldulensis</i>, <i>E. tereticornis</i> and <i>Corymbia tessellaris</i> over a mid-dense sub-canopy of juvenile canopy species, <i>Melaleuca</i> spp., <i>Pleiogynium timorense</i>, <i>Casuarina cunninghamiana</i> and <i>Lophostemon grandiflorus</i>. Sparse shrub layer including <i>Ficus opposita</i>, <i>Lophostemon grandiflorus</i>, <i>Parkinsonia aculeata</i>* and <i>Melaleuca</i> spp. Ground cover was dominated by <i>Parthenium hysterophorus</i>*, <i>Cynodon dactylon</i>, <i>Stylosanthes scabra</i>* and <i>Argemone ochroleuca</i>.* Landform: Undulating alluvial plain Geology/soils: Sandy and rocky river beds	
9.3.1	1.52	Vegetation: Open woodland with a sparse to mid-dense canopy cover of <i>Eucalyptus coolabah</i>, over a sub-canopy of <i>Lysiphyllum carronii</i> and <i>Pleiogynium timorense</i>. Sparse shrub layer including <i>Atalaya hemiglauc</i>a and <i>Trema tomentosa</i>. Grassy ground cover absent. Juvenile <i>Parthenium hysterophorus</i>* was moderately dense. Landform: Alluvial plains Geology/soils: Dark clay soils	
9.3.3b (LC)	18.63	Vegetation: Open woodland with a sparse to mid-dense canopy cover of <i>Eucalyptus crebra</i>, <i>Corymbia tessellaris</i> and <i>C. clarksoniana</i> over a sub-canopy of canopy species, <i>Pleiogynium timorense</i> and <i>Owenia acidula</i>. Very sparse shrub layer including <i>Carissa lanceolata</i>* and <i>Opuntia tomentosa</i>*. Common species in the ground layer included <i>Heteropogon contortus</i>, <i>Cenchrus ciliaris</i>*, <i>Sida</i> sp.* and <i>Crotalaria</i> sp.*. Landform: Alluvial plain Geology/soils: Brown sandy loam	

RE (VM Status)	Area in project footprint (ha)	GHD field description	Photo
9.3.22a# (LC)	2.76	-	No photo available
9.8.1a (LC)	0.16	Vegetation: Open woodland with a sparse canopy of <i>Corymbia erythrophloia</i>, <i>Eucalyptus crebra</i>, <i>C. dallachiana</i> and <i>E. melanophloia</i> over a very sparse sub-canopy of <i>Erythrina vespertilio</i>. Ground cover was dominated by <i>Cenchrus ciliaris</i>*. Landform: Rocky plain Geology/soils: Brown / red clay loam	
9.8.13 (LC)	8.43	Vegetation: Open grassland with <i>Cenchrus ciliaris</i>*, <i>Crotalaria</i> sp.* and <i>Stylosanthes scabra</i>*. Very sparse canopy of <i>Eucalyptus crebra</i>, <i>Corymbia erythrophloia</i> and <i>C. dallachiana</i> and <i>Pleiogynium timorense</i> over very sparse shrub layer including <i>Acacia farnesiana</i>* and <i>Opuntia tomentosa</i>*. Landform: Undulating alluvial plain Geology/soils: Brown / red sandy loam	
9.11.31 (LC)	15.70	Vegetation: Open woodland with a sparse canopy of <i>Eucalyptus crebra</i>, <i>Corymbia erythrophloia</i> and <i>C. dallachiana</i> with a sub-canopy of canopy species and <i>Atalaya hemiglauca</i>. Sparse shrub layer included juvenile canopy species and <i>Carissa lanceolata</i>* over a dense grassy ground layer dominated by <i>Heteropogon contortus</i> and <i>Cenchrus ciliaris</i>*. Landform: Undulating plain Geology/soils: Brown / red sandy loam	

RE (VM Status)	Area in project footprint (ha)	GHD field description	Photo
9.12.1a (LC)	2.29	Vegetation: Open woodland to low open woodland with a sparse canopy of <i>Eucalyptus crebra</i>, <i>Corymbia erythrophloia</i> and <i>C. dallachiana</i> over a sub-canopy of <i>Geijera salicifolia</i>, <i>Grevillia striata</i>, <i>Petalostigma pubescens</i> and <i>Acacia bidwilli</i>. Sparse shrub layer included juvenile canopy species and <i>Carissa lanceolata</i>*. Ground cover was dominated by <i>Heteropogon contortus</i> and <i>Cenchrus ciliaris</i>*. Landform: Undulating plain Geology/soils: Igneous rock	
9.12.4b# (LC)	0.18	Vegetation: Open woodland with a mid-dense canopy of <i>Eucalyptus shirleyi</i>.	No photo available

Key to table: RE – regional ecosystem; (*) – introduced flora species, (#) access was limited and additional survey is required to confirm RE verification, VM Status – *Vegetation Management Act 1999* Status.

5.1.5.2 Flora

Conservation significant flora species

The EPBC Act Protected Matters Search predicted six conservation significant flora species that have the potential to occur within the study area. According to State-based searches (i.e. Wildlife Online, Species Profile Search and Biomaps), four conservation significant flora species have been historically recorded within the study area.

The conservation status of species predicted or recorded from desktop searches are provided in Table 5-4. No conservation significant flora species were recorded during the field survey within the study area.

Table 5-4 Conservation significant flora species predicted to occur within the study area

Species	Common name	Status		Source
		EPBC Act	NC Act	
<i>Bulbophyllum globuliforme</i>	Miniature moss-orchid	V	NT	PMST
<i>Croton magneticus</i>	-	NL	V	WO
<i>Dichanthium queenslandicum</i>	King blue-grass	E	V	PMST; WO
<i>Dichanthium setosum</i>	Bluegrass	V	LC	PMST
<i>Eucalyptus raveretiana</i>	Black ironbox	V	LC	PMST
<i>Graptophyllum excelsum</i>	-	NL	NT	WO
<i>Marsdenia brevifolia</i>	-	V	V	PMST
<i>Solanum sporadotrichum</i>	-	NL	NT	WO
<i>Tephrosia leveillei</i>	-	V	V	PMST

Key to table: E – endangered; V – vulnerable; NT – near threatened; NL – not listed; LC – least concern; PMST – Protected Matters Search Tool; WO – Wildlife Online.

5.1.5.3 Fauna

Conservation significant fauna species

Threatened species

A total of 22 threatened fauna species were predicted or recorded in desktop searches. This comprised of seven mammals, eight birds and six reptiles. Of these species, 16 threatened fauna species listed under the EPBC Act were predicted to occur within the desktop search area by the PMST. Desktop search results are provided in Appendix B.

Species predicted or recorded in the desktop searches are summarised in Table 5-5.

Three conservation significant fauna species, namely the greater glider (northern) (*Petauroides volans minor*) (listed as vulnerable under the EPBC Act and NC Act), squatter pigeon (southern) (listed as vulnerable under the EPBC Act and NC Act) and short-beaked echidna (*Tachyglossus aculeatus*) (listed as special least concern under the NC Act) were confirmed present within the study area during the field surveys. Conservation significant species likely to occur within the study area include the koala (*Phascolarctos cinereus*) (listed as vulnerable under the EPBC Act and NC Act).

Table 5-5 Threatened fauna species predicted to occur within the study area

Species	Common name	Status		Source
		EPBC Act	NC Act	
Mammals				
<i>Dasyurus hallucatus</i>	Northern quoll	E	LC	PMST
<i>Macroderma gigas</i>	Ghost bat	V	E	PMST
<i>Petauroides volans minor</i>	Northern greater glider	V	V	WO
<i>Phascolarctos cinereus</i>	Koala	V	V	PMST; WO
<i>Pteropus conspicillatus</i>	Spectacled flying-fox	E	V	PSMT
<i>Rhinolophus robertsi</i>	Large-eared horseshoe bat	V	E	PMST
<i>Saccolaimus saccolaimus nudicluniatus</i>	Bare-rumped sheath-tailed bat	V	E	PMST
<i>Ornithorhynchus anatinus</i>	Platypus	–	SL	WO
Birds				
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	E	PMST
<i>Erythroriorchis radiatus</i>	Red goshawk	V	E	PMST
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	WO
<i>Neochmia ruficauda</i>	Star finch (eastern)	E	E	PMST
<i>Numenius madagascariensis</i>	Eastern curlew	CE	E	PMST
<i>Poephila cincta cincta</i>	Southern black-throated finch	E	E	PMST
<i>Rostratula australis</i>	Australian painted-snipe	E	V	PMST; WO
<i>Tyto novaehollandiae kimberli</i>	Masked owl (northern)	V	V	PSMT
Reptiles				
<i>Acanthophis antarcticus</i>	Common death adder	NL	V	WO
<i>Denisonia maculata</i>	Ornamental snake	V	V	PMST; WO
<i>Egernia rugosa</i>	Yakka skink	V	V	PMST
<i>Lerista cinerea</i>	Vine-thicket fine-lined slider	NL	V	WO
<i>Lerista vittata</i>	Mount Cooper striped skink	V	V	PMST
<i>Crocodylus porosus</i>	Salt-water crocodile	Mig	V	PMST

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NL – not listed; LC – least concern; Special Least Concern – SL; PMST – Protected Matters Search Tool; WO – Wildlife Online.

Migratory species

A total of 22 migratory bird species and one migratory reptile species were predicted or recorded in the desktop search extent.

The PMST database predicted 16 migratory species listed under the EPBC Act to have the potential to occur within the desktop search extent. The Wildlife Online search identified 12 migratory species that have been historically recorded within the desktop search extent.

Migratory species and the source of the records identified in the desktop searches are provided in Table 5-6. Desktop search results are provided in Appendix B.

One migratory bird species, namely the glossy ibis (*Plegadis falcinellus*) (listed as migratory under the EPBC Act), was confirmed present within the study area. Conservation significant species likely to occur within the study area include the common sandpiper (*Actitis hypoleucos*), Latham's snipe (*Gallinago hardwickii*), Caspian tern (*Hydroprogne caspia*), osprey (*Pandion haliaetus*), wood sandpiper (*Tringa glareola*) and common greenshank (*Tringa nebularia*).

Table 5-6 Migratory species predicted to occur within the study area

Species	Common name	Status		Source
		EPBC Act	NC Act	
Birds				
<i>Actitis hypoleucos</i>	Common sandpiper	Mig	LC	PMST; WO
<i>Apus pacificus</i>	Fork-tailed swift	Mig	LC	PMST
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	Mig	LC	PMST
<i>Calidris ferruginea</i>	Curlew sandpiper	CE, Mig	E	PMST
<i>Calidris melanotos</i>	Pectoral sandpiper	Mig	LC	PMST
<i>Cuculus optatus</i>	Oriental cuckoo	Mig	LC	PMST
<i>Gallinago hardwickii</i>	Latham’s snipe	Mig	LC	PMST; WO
<i>Gelochelidon nilotica</i>	Gull-billed tern	Mig	LC	WO
<i>Hydroprogne caspia</i>	Caspian tern	Mig	LC	WO
<i>Monarcha melanopsis</i>	Black-faced monarch	Mig	LC	PMST
<i>Motacilla cinerea</i>	Grey wagtail	Mig	LC	PMST
<i>Motacilla flava</i>	Yellow wagtail	Mig	LC	PMST
<i>Myiagra cyanoleuca</i>	Satin flycatcher	Mig	LC	PMST
<i>Numenius madagascariensis</i>	Eastern curlew	CE, Mig	E	PMST
<i>Pandion haliaetus</i>	Osprey	Mig	LC	PMST; WO
<i>Plegadis falinellus</i>	Glossy ibis	Mig	LC	WO
<i>Rhipidura rufifrons</i>	Rufous fantail	Mig	LC	PMST; WO
<i>Symposiachrus trivirgatus</i>	Spectacled monarch	Mig	LC	WO
<i>Tringa brevipes</i>	Grey-tailed tattler	Mig	LC	WO
<i>Tringa glareola</i>	Wood sandpiper	Mig	LC	WO
<i>Tringa nebularia</i>	Common greenshank	Mig	LC	PMST; WO
<i>Tringa stagnatilis</i>	Marsh sandpiper	Mig	LC	WO
Reptiles				
<i>Crocodylus porosus</i>	Salt-water crocodile	Mig	V	PMST

Key to table: CE – critically endangered; E – endangered; V – vulnerable; LC – least concern; Mig – migratory; PMST – Protected Matters Search Tool; WO – Wildlife Online.

Terrestrial fauna species

A total of 120 fauna species were recorded during the field survey within the study area. This comprised of 22 species of mammals, 86 species of birds, eight species of reptiles and four species of amphibians.

Mammals

Two conservation significant mammal species, namely the greater glider (northern) and short-beaked echidna were recorded within the study area during nocturnal spotlighting. The greater glider (northern) was recorded in the higher parts of a river red gum (*Eucalyptus camaldulensis*) within the study area, and the short-beaked echidna was recorded within open eucalypt woodland within the study area.

Mammal species recorded during the field survey included the eastern grey kangaroo (*Macropus giganteus*), common wallaroo (*Macropus robustus*) and agile wallaby (*Macropus agilis*), black-striped wallaby (*Macropus dorsalis*) and swamp wallaby (*Wallabia bicolor*). Nocturnal spotlighting confirmed the presence of the common brushtail possum (*Trichosurus vulpecula*). No small ground mammals were encountered during the field survey.

The anabat detector positively identified 13 microbat species, including the hoary wattled bat (*Chalinolobus nigrogriseus*), large-footed myotis (*Myotis macropus*) and eastern cave bat (*Vespadelus troughtoni*).

Birds

Two conservation significant bird species, namely the squatter pigeon (southern) and glossy ibis were recorded within the study area. The squatter pigeon (southern) was recorded along maintained access tracks in northern area of Dalrymple National Park within the study area. The species were identified during the flushing/driving surveys. The glossy ibis was recorded foraging within the riparian zone of the Burdekin River.

A total of 86 bird species were recorded during the field survey within the study area. Bird species that were most abundant and widespread were species naturally adapted to open landscapes, such as the torresian crow (*Corvus orru*), pied butcherbird (*Cracticus nigrogularis*), Australian magpie (*Cracticus tibicen*) and apostlebird (*Struthidea cinerea*).

Grassland bird specialists, including Australasian pipit (*Anthus novaeseelandiae*), Australian bustard (*Ardeotis australis*), brown quail (*Coturnix ypsilophora*) and emu (*Dromaius novaehollandiae*) were observed within the open grassland areas. Raptors including the wedge-tailed eagle (*Aquila audax*), nankeen kestrel (*Falco cenchroides*) and whistling kite (*Haliastur sphenurus*) were recorded foraging in open pasture areas within the study area.

Birds encountered in regrowth and open woodland areas included the pheasant coucal (*Centropus phasianinus*), red-browed pardalote (*Pardalotus rubricatus*) and double-barred finch (*Taeniopygia bichenovii*). Remnant eucalypt woodland within the study area provides nesting and foraging habitat for woodland-dependent birds, including the red-winged parrot (*Aprosmictus erythropterus*), red-tailed black-cockatoo (*Calyptorhynchus banksii*), white-bellied cuckoo-shrike (*Coracina papuensis*), blue-winged kookaburra (*Dacelo leachii*), and pale-headed rosella (*Platycercus adscitus*).

Bird species encountered along the Burdekin River and other waterways within the study area included the grey teal (*Anas gracilis*), Australasian darter (*Anhinga novaehollandiae*), eastern great egret (*Ardea modesta*), black-fronted dotterel (*Euseyonis melanops*), brolga (*Grus rubicunda*), white-bellied sea-eagle (*Haliaeetus leucogaster*) and forest kingfisher (*Todiramphus macleayii*).

Reptiles

Eight reptile species, including the wall skink (*Cryptoblepharus virgatus*), copper-tailed skink (*Ctenotus taeniolatus*), tree skink (*Egernia striolata*), Bynoe's gecko (*Heteronotia binoei*), common tree snake (*Dendrelaphis punctulatus*) and carpet python (*Morelia spilota*) were recorded within the study area during the field survey. The common tree snake and carpet python were encountered along the Burdekin River within dense riparian vegetation. The wall skink, copper-tailed skink and bynoe's gecko were located within open eucalypt woodland under woody debris and rock piles, and the tree skink was observed within dense vegetation under large granite rocks.

Least concern reptile species that are likely to occur within the study area due to their regional abundance include the, tommy roundhead (*Diporiphora australis*), dubious dtella (*Gehyra dubia*), northern velvet gecko (*Oedura castelnaui*) and fire-tailed skink (*Morethia taeniopleura*).

Amphibians

Three amphibian species were recorded during the field survey, including the green tree frog (*Litoria caerulea*), desert tree frog (*Litoria rubella*) and ornate burrowing frog (*Platyplectrum ornatum*). These amphibian species were recorded within riparian vegetation along the Burdekin River and Lolworth Creek within the study area.

Least concern amphibian species that are common within the region and considered likely to occur included the northern laughing treefrog (*Litoria rothii*), bumpy rocketfrog (*Litoria inermis*), greenstripe frog (*Cyclorana alboguttata*) and eastern snapping frog (*Cyclorana novaehollandiae*).

5.1.5.4 Essential habitat

Essential habitat for the squatter pigeon (southern) (*Geophaps scripta scripta*) is mapped within the study area, and essential habitat for the koala (*Phascolarctos cinereus*) is mapped approximately 1 km south east of the study area (Figure 5-10). Both species are listed as vulnerable under the EPBC Act and NC Act.

The project footprint is located within a State-significant bioregional wildlife corridor. The wildlife corridor follows Burdekin River, Keelbottom Creek, Lolworth Creek and Allingham Creek (Figure 5-10).

Habitat assessments

A total of seven habitat types were identified within the study area during the field survey, and are listed below. The ecological values associated with each habitat type are summarised in Table 5-7. Habitat types identified within the study area included:

- Open eucalypt woodland on alluvial plains (Plate 5-1)
- Open eucalypt woodland on rocky low hills and rises (Plate 5-1)
- Open grassland on alluvial plains
- Deep cracking clays
- River bed (Plate 5-1)
- Rocky outcrops
- Ephemeral waterways dominated by Eucalyptus spp. and/or Melaleuca spp. (Plate 5-1).

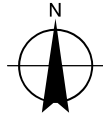
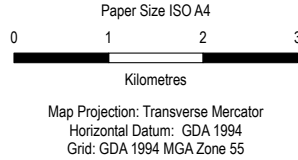
Mapping of habitat types within the study area were updated following the post-wet field survey based on RE descriptions and field observations during the pre and post-wet field surveys. Habitat types are mapped in Figure 5-11.



Plate 5-1 Left to right, top to bottom; open eucalypt woodland on alluvial plains; open eucalypt woodland on rocky low hills and rises; river bed; Ephemeral waterways dominated by *Eucalyptus* spp. and/or *Melaleuca* spp.



Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.



Charters Towers Regional Council
Big Rocks Weir

**Essential habitat and significant
bioregional wildlife corridors**

Project No. **12512214**
Revision No. **0**
Date **28/09/2020**

FIGURE 5-10

Table 5-7 Habitat types observed within the study area

Habitat type	General characteristics and ecological values
Open eucalypt woodland on sandy levees 	• Mature canopy vegetation provides blossoms and nesting opportunities for honeyeaters, flower peckers and parrots, and foraging habitat for flying-foxes. • Variety of koala food trees present, including <i>Eucalyptus crebra</i>, <i>E. coolabah</i>, <i>Corymbia tessellaris</i>, <i>C. clarksoniana</i>, <i>C. erythrophloia</i> and <i>C. dallachiana</i>. • Hollow-bearing trees were moderately prevalent in <i>Eucalyptus crebra</i>, providing dens for possums, gliders, microbats, owls, parrots, monitors, snakes and tree frogs. • Shrub layer was either absent or sparse, consisting of various shrub species and juvenile canopy species. The shrub layer that does exist provides some nesting and foraging resources for shrub-nesting birds, including finches and fairy-wrens. • Ground-level microhabitats include large fallen woody debris and some leaf litter. These microhabitats provide shelter and foraging microhabitat for ground-dwelling mammals and reptiles. • Ground cover was moderately dense, dominated by introduced grasses. Provides food resources for granivorous birds and herbivorous mammals.
Open eucalypt woodland on rocky low hills and rises 	• Mature eucalypts provide blossoms and nesting opportunities for honeyeaters and parrots, and foraging habitat for flying foxes. • Hollow-bearing trees are moderately prevalent with small hollows. Small hollows provide habitat for small mammals, such as gliders and arboreal reptiles. • Shrub layer was either absent or sparse, consisting of various shrub species and juvenile canopy species. The shrub layer that does exist provides some nesting and foraging resources for shrub-nesting birds, including finches and fairy-wrens. • Relatively complex ground-level microhabitats, with an abundance of fallen woody debris, large logs, small rocks and dense ground cover. Decorticating bark from dead ironbark trees were present, providing refuge for microbats and arboreal reptiles.

Habitat type	General characteristics and ecological values
Open grassland on alluvial plains 	• Characterised by the absence or low abundance of canopy and shrub vegetation, and is dominated by introduced grass species. • Low abundance of hollow-bearing trees resulting in limited roosting sites for microbat species, and nesting sites for hollow-nesting bird species. • Sparse fallen woody debris resulting in limited shelter and foraging microhabitats for ground-dwelling reptiles and rodents. • Native and introduced grass species provide food resources for granivorous birds, such as the Australasian pipit, and herbivorous mammals such as kangaroos and wallabies. • The open landscape provides foraging habitat for raptors and snakes. • In most areas, the ground-layer has been heavily altered by cattle grazing and trampling, and intensive cultivation. These alterations have reduced the presence of suitable microhabitats for a range of fauna species.
Deep cracking clays 	• Large depressions with deep soil cracks, providing foraging and breeding habitat for a variety of reptiles and amphibians. • Wetlands are formed after seasonal rainfall, providing foraging and breeding habitat for a wide range of fauna, such as water birds.

Habitat type	General characteristics and ecological values
River bed 	• Burdekin River forms part of a state-significant bioregional wildlife corridor, and is an important foraging routes and flyways for microbats. • Sandy creek beds can retain an important source of drinking water that is utilised by a variety of fauna species for months after the wet season has ended. • Sandy creek banks allow bird species, such as the rainbow bee-eater and red-browed pardalote to excavate long horizontal nesting tunnels.
Rocky outcrops 	• Rocky outcrops are present along the Burdekin River, with small patches of <i>Melaleuca sp.</i> and <i>Lophostemon sp.</i> • Retain long vertical crevices and medium-sized tunnels, providing potential habitat for rock wallabies, microbats, reptiles and amphibians. • Rocky formations provide basking areas for thermoregulating reptiles. • Sparse growth of <i>Melaleuca sp.</i> and <i>Lophostemon sp.</i>

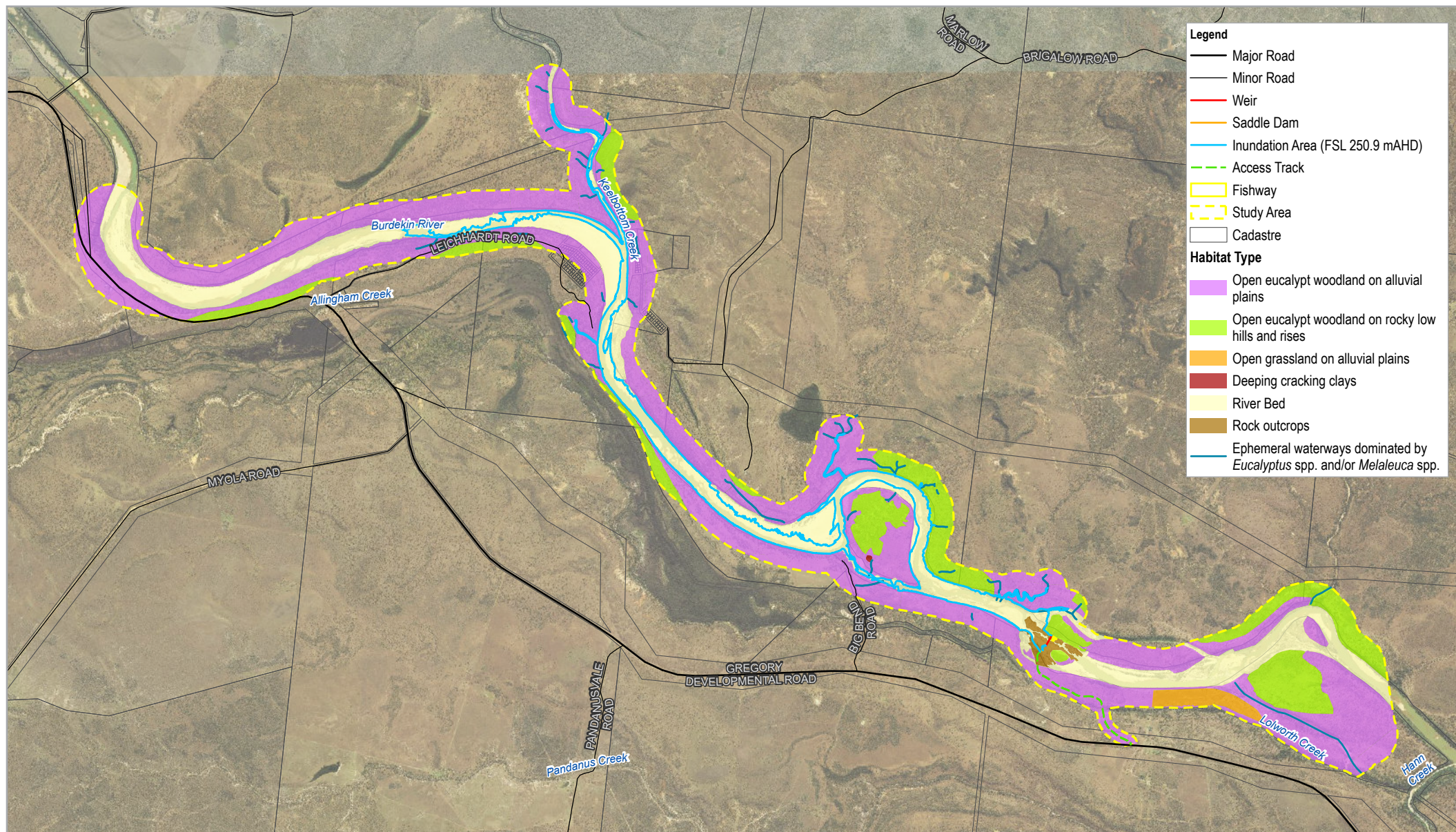
Habitat type

Ephemeral waterways dominated by *Eucalyptus* sp. and / or *Melaleuca* sp.

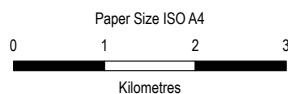


General characteristics and ecological values

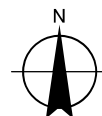
- Ephemeral waterways are an important movement corridor for native mammals, birds, reptiles and amphibians, and are important foraging routes and flyways for microbats.
- Sandy creek beds can retain an important source of drinking water that is utilised by a variety of fauna species for months after the wet season has ended.
- Mature Eucalyptus and Melaleuca species provide blossoms and nesting opportunities for honeyeaters and parrots, and foraging habitat for flying-foxes. Hollow-bearing trees provide dens for possums, gliders, microbats, owls, parrots, snakes and tree frogs.
- In some areas, mid-storey vegetation is moderately dense providing shelter and nesting habitat for finches, fairy-wrens and other shrub-dwelling birds.
- Ground-level microhabitats, including coarse woody debris, scattered rock and sandy soils provide shelter and foraging habitat for a variety of reptile and frog species.
- In-stream complexity, including undercut banks, root balls, trailing vegetation and rocks were present.



Data Disclaimer
 ©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 55



Charters Towers Regional Council
Big Rocks Weir

Project No. **12512214**
 Revision No. **0**
 Date **28/09/2020**

Identified habitat types

FIGURE 5-11

5.1.5.5 Biosecurity species

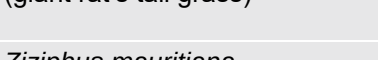
Introduced flora species

The EPBC Act Protected Matters Search predicted nine introduced flora species as potentially present in the region that have potential to pose significant threat to biodiversity values. Eight of the species listed are classified as restricted invasive plants under the *Biosecurity Act 2014* (Bio Act) and are listed as Weeds of National Significance (WoNS).

Weed species were observed throughout much of the study area, with higher abundances recorded in more heavily utilised areas, particularly within the vicinity of tracks and waterways. The predominant weed species, and their general distribution and classification as WoNS or those declared under the Bio Act are listed in Table 5-8.

Table 5-8 Weed species and general distribution

Weed species	WoNS	State declaration / Bio Act Category	General distribution
<i>Cryptostegia grandiflora</i> (rubber vine)* 	✓	Category 3	Abundance varies throughout the landscape. Scattered patches of moderately dense growth along the upper and lower banks of the Burdekin River.
<i>Harissa martini</i> (moonlight cactus)* 		Category 3	Few individuals recorded from one location south of the proposed weir.
<i>Lantana camara</i> (lantana)* 	✓	Category 3	Small patch of lantana recorded south of the proposed weir along lower banks of the Burdekin River.

Weed species	WoNS	State declaration / Bio Act Category	General distribution
<i>Opuntia tomentosa</i> (velvet tree pear)* 	✓	Category 3	Individual recorded north of the proposed weir. Sparsely located in open paddocks and remnant areas south of the proposed weir. Mature trees (~4 m high) were recorded in remnant vegetation within the southern extent of the study area.
<i>Parkinsonia aculeata</i> (parkinsonia)* 	✓	Category 3	The species is widely dispersed throughout the study area, with scattered patches of moderately dense growth along the Burdekin River and creek lines.
<i>Parthenium hysterophorus</i> (parthenium weed)* 	✓	Category 3	The species is widely dispersed throughout the study area, with scattered patches of moderately dense juvenile growth along the Burdekin River and creek lines.
<i>Sporobolus pyramidalis</i> (giant rat's tail grass) 		Category 3	Located along mid-bank of cut through channel of Big Bend floodway.
<i>Ziziphus mauritiana</i> (chinee apple)* 		Category 3	Sparsely located throughout most grazing paddocks in close proximity to the Burdekin River.

Introduced fauna species

The EPBC Act Protected Matters Search predicted 15 introduced fauna species as potentially occurring present in the region, including six bird species, one amphibian species, and eight mammal species. Of these, six are declared as restricted invasive animals under the Bio Act (DAF 2019a).

Pest animal species

Four pest animal species were identified within the study area during the field survey. Of these, three are declared as restricted invasive animals under the BioAct (DAF 2019a). The identities, status and distribution of the species observed within the study area is provided in Table 5-9.

Table 5-9 Pest animal fauna species recorded within the study area

Species	Bio Act Category	Area of occurrence
Chital deer (<i>Axis axis</i>)	Category 3, 4 and 6	Four individuals were recorded foraging along the banks of the Burdekin River within the study area
Wild dog (<i>Canis lupus</i>)	Category 3, 4 and 6	Two individuals were identified along an access track within the study area, adjacent to the Burdekin River
European rabbit (<i>Oryctolagus cuniculus</i>)	Category 3, 4 and 6	Two individuals were observed in an open area along the Burdekin River within the study area
Cane toad (<i>Rhinella marina</i>)		Several cane toads were recorded under woody debris along the water's edge of the Burdekin River and other tributaries
Feral pig (<i>Sus scrofa</i>)	Category 3, 4 and 6	Species tracks, diggings and rootings were observed along the Burdekin River and other tributaries within the study area

5.1.6 Aquatic environment

Aquatic habitat

Aquatic habitats identified within the study area were isolated and connected pools, riffle, and run habitat (Plate 5-1). Key habitat features included overhanging vegetation, large woody debris and in-stream macrophytes (Plate 5-2).

The Burdekin River is a major river (stream order 8) within the Upper Burdekin River sub-catchment. Lolworth Creek (stream order 6) and Keelbottom Creek (stream order 5) which connect with the Burdekin River downstream and upstream of the proposed BRW, respectively are also classified as major waterways. Numerous MSES regulated vegetation (defined watercourses) are present within the study area and surrounding region, both upstream and downstream.

The study area does not occur within a nationally important wetland; however, the Great Basalt Wall DIWA is located immediately adjacent to the western extent of the study area. The wetland is located outside the proposed inundation area of the weir. High Ecological Significance (HES) wetlands areas are mapped within the study area, approximately 1 km from the Burdekin River, with ten mapped 1 km from the Burdekin River. Downstream two HES wetlands are approximately 22 km from BRW. While upstream, eight small pockets of HES wetlands are mapped within 10 km of the BRW.

Aquatic habitat descriptions of Keelbottom Creek, Burdekin River and Lolworth Creek recorded during the pre-wet and post-wet field surveys are presented below.



Plate 5-2 Left to right, top to bottom; isolated pool (SDS); connected pool (W3); riffle (LC); run (W1)



Plate 5-3 Left to right, top to bottom; overhanging vegetation (US3); large woody debris (LC); submerged macrophytes (DS3); emergent macrophytes (LC)

Keelbottom Creek

Keelbottom Creek at site US3 consisted of a wide channel with a large sand bank adjacent to the right bank. Water was connected through the channel but was not flowing at the time of the survey. The wetted width at this location was approximately 15 m and had a variable depth of 1 m – 2 m. A dry tributary connected with the main channel on the left bank. Land use adjacent to the survey area was native forest and cattle grazing.

Bed substrate was primarily sand with some bedrock and a small proportion of cobbles, pebbles, gravel and silt/clay. The left bank was composed almost entirely of bedrock whereas, the right bank was predominantly sand. Both banks were steep, whereas the right bank also had areas of moderate to low slope.

Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and either grasses or bedrock in the understorey. The riparian vegetation was semi-continuous and provided some overhanging and trailing bank vegetation for cover.

In-stream habitat consisted of deep pools, small bedrock bars, large woody debris, tree roots, terrestrial leaves and twigs, and aquatic macrophytes. *Potamogeton octandrus*, water lily sp. and filamentous algae were scattered along the water's edge. The macrophytes would support small bodied fish species such as the firetail gudgeon and flyspecked hardyhead.

Overall, site US3 within Keelbottom Creek was in 'good' condition during the pre-wet survey, with a habitat assessment score of 85 (Table 5-10). During the post-wet survey, the habitat assessment score also decreased from 'good' (85) to 'fair' (59) (Table 5-11). The left bank of Keelbottom Creek primarily consisted of bedrock during the pre-wet field survey; however, during the post-wet, many areas of the bedrock were covered in silt/clay and there were signs of cattle movement along the left bank and through the tributary. The instream habitat also changed with few macrophytes or large woody debris, which were present during the pre-wet field survey.

Burdekin River

The Burdekin River consisted of a wide, irregularly meandering channel (approximately 230 m to 500 m). Water was connected throughout the channel and snaked from the left bank to the right bank. Small isolated pools were present at site SDS. Water flow was only very slow at the time of the survey. The wetted width varied from approximately 4 m to 50 m and had a variable depth of 0.2 m – >2 m. Land use adjacent to the survey area was native forest, national park and cattle grazing.

Bed substrate was variable throughout the channel with areas that were predominantly sandy (DS1 and DS3); cobbley, gravelly sand (W1 and W3) and bedrock with sand (BRW and SDS). The banks were typically composed of sand (DS1, DS3, W1 and W3) or bedrock (BRW and SDS) and were often high (approximately up to 10 m) and steep.

Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and either grasses or bedrock in the understorey. The riparian vegetation was semi-continuous and provided some overhanging and trailing bank vegetation for cover (DS1, DS3, W1 and W3). The bedrock substrate of the channel and banks at sites BRW and SDS limited the available cover for the river.

In-stream habitat throughout the Burdekin River consisted of deep pools, shallow fast moving riffles and runs, large woody debris and aquatic macrophytes. *Hydrilla verticillata*, *Myriophyllum* sp. and *Ottelia alismoides* were present in scattered beds. *Cyperus difformis*, *Cyperus* sp. and filamentous algae were also scattered but isolated along the water's edge. Isolated parthenium (a declared noxious plant species) was present on the banks of the Burdekin River.

Overall, sites W1, W3, BRW, SDS, DS1 and DS3 within the Burdekin River were in 'fair' to 'good' condition during the pre-wet field survey, with a habitat assessment scores ranging from 65 to 114 (Table 5-10). During the post-wet field survey, the habitat score category decreased for two sites, W1 decreased from an 'excellent' (114) to 'good' (85) score and BRW from 'good' (86) to 'fair' (70) (Table 5-11). The main reason for the decreases in habitat assessment scores for both sites was an increase in bottom scouring or deposition, also increase in fine sediments (W1) and lack of stable bottom substrate habitat (BRW).

Lolworth Creek

Lolworth Creek at site LC consisted of a moderately wide channel with clear flowing water. Water flow alternated between areas of faster runs and riffles and slower pools. The wetted width at this location was approximately 10 m and had a variable depth of 0.2 – 1 m. A concrete bed level crossing intersected the site. Land use adjacent to the survey area was predominantly cattle grazing.

Bed substrate was stable and was primarily composed of bedrock, boulders with some cobbles and sand. Exposed bed substrate created in-stream bars which covered approximately 15% of the site. The banks consisted of material similar to the bed substrate but also had sections of terrestrial soils. The left bank had a moderate slope, whereas the right bank was steep to vertical.

Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and either grasses or bedrock/large material in the understorey. The riparian vegetation was semi-continuous and provided some overhanging and trailing bank vegetation for cover.

In-stream habitat consisted of deep pools, bedrock/boulder bars, large woody debris terrestrial leaves and twigs, and aquatic macrophytes. *Ludwigia peploides*, *Marsilea* sp., *Ottelia alismoides* and filamentous algae were scattered along the water's edge with *Myriophyllum* sp. in beds.

Overall, site LC within Lolworth Creek was in 'excellent' condition with a habitat assessment score of 113 (Table 5-10). Lolworth Creek had minimal changes to the habitat between the pre and post-wet field surveys. Generally, changes included wider wetted widths in many sections of the Burdekin River, decreases in sand bars and increases in silt/clay content on the banks.

Big Bend Recreation Reserve

The Big Bend (BB) site consisted of a high flow channel that was dry at the time of the survey. The high flow channel is within the Big Bend Recreation Reserve and during flooding events, Big Bend Recreation Reserve becomes an island. The BB site is used as a vehicle crossing point to gain access to the Big Bend Recreation Reserve (Plate 5-4).

Bed substrate was predominantly sand with silt/clay and gravel. The banks consisted of similar substrate and were steep to moderately sloped between 6 m – 10 m high.

The riparian vegetation was moderately to highly disturbed with a width of approximately 120 m. The canopy primarily consisted of *Eucalyptus* spp. and/or *Melaleuca* spp. and grasses in the understory. The riparian vegetation is semi-continuous and would provide shading over the channel when flowing.

Overall, site BB within Big Bend Recreation Reserve was in 'fair' condition with a habitat assessment score of 57 (Table 5-11).



Plate 5-4 Big Bend Recreation Reserve (site BB); downstream and right bank vehicle crossing

Table 5-10 Habitat scores for the pre-wet aquatic assessment

Habitat variable	Scale ⁺	US3	W1	W3	BRW	SDS	DS1	DS3	LC
Bottom substrate	0-20	14	16	16	11	13	6	16	18
Embeddedness	0-20	12	20	16	14	14	6	13	19
Velocity and depth category	0-20	5	18	17	5	5	5	15	15
Channel alteration	0-15	10	11	11	13	14	10	12	12
Bottom scouring and deposition	0-15	11	12	10	12	11	8	10	13
Pool/riffle, run/bend ratio	0-15	8	13	12	11	9	10	11	11
Bank stability	0-10	7	6	7	9	9	5	6	8
Bank vegetation and stability	0-10	8	8	9	9	2	6	6	8
Streamside cover	0-10	10	10	9	2	2	9	9	9
Totals	0-135	85	114	107	86	79	65	98	113
Habitat score category*		Good	Excellent	Good	Good	Good	Fair	Good	Excellent

⁺ Scale as per AusRivAS habitat assessment method

^{*} Excellent = 111-135, good = 75-110, fair = 39-74, poor = 0-38

Colour categories: excellent = blue, good = green, fair = orange, poor = red

Table 5-11 Habitat scores for the post-wet aquatic assessment

Habitat variable	Scale ⁺	US1	US3	W1	W2	W3	BB	SSD	BRW	DS1	DS3	LC
Bottom substrate	0-20	6	5	15	13	17	9	11	3	5	15	17
Embeddedness	0-20	3	3	10	9	15	5	15	16	4	14	18
Velocity and depth category	0-20	7	5	16	13	18	0	5	5	5	19	15
Channel alteration	0-15	7	7	6	5	10	5	13	12	8	13	10
Bottom scouring and deposition	0-15	4	7	4	3	11	6	13	5	8	10	13
Pool/riffle, run/bend ratio	0-15	4	5	9	5	13	6	10	8	3	13	11
Bank stability	0-10	6	9	7	7	8	7	10	10	7	7	9
Bank vegetation and stability	0-10	8	9	9	9	8	9	9	9	7	7	9
Streamside cover	0-10	9	9	9	9	9	10	2	2	9	6	9
Totals	0-135	54	59	85	73	109	57	88	70	56	104	111
Habitat score category*		Fair	Fair	Good	Fair	Good	Fair	Good	Fair	Fair	Good	Excellent

⁺ Scale as per AusRivAS habitat assessment method

* Excellent = 111-135, good = 75-110, fair = 39-74, poor = 0-38

Colour categories: excellent = blue, good = green, fair = orange, poor = red

5.1.7 Water quality

In-situ water quality was measured at eight sites during the pre-wet survey, and 10 sites during the post-wet survey. Site BB was dry at the time of the post-wet survey. The results are presented in Table 5-12 and Table 5-13.

Pre-wet water quality results

Water temperature ranged between 28.9°C at the proposed weir site (BRW) and 34.2°C within the weir storage area (W3).

The pH exceeded the Queensland Water Quality Guidelines (QWQG) values at all sites with the exception of sites US3 and LC. pH was highest at site SDS (8.53 pH units) and lowest at site US3 (7.90 pH units).

Electrical conductivity exceeded the guideline value at all sites and ranged from 422 µS/cm to 590 µS/cm.

Dissolved oxygen was higher than the guideline value at three sites upstream of the proposed weir (US3, W1 and W3). The highest dissolved oxygen concentration was recorded at site W3 (127% saturation).

Turbidity complied with the water quality guideline at all sites. All sites recorded turbidity below 3.4 NTU with the exception of site DS3 which was notably higher at 28.9 NTU.

Table 5-12 In-situ water quality during the pre-wet survey

Site	Temperature	pH	Electrical conductivity	Dissolved oxygen	Turbidity
Units	°C	pH units	µS/cm	% saturation	NTU
QWQG	–	6.5 – 8.0	120 – 310 ¹	85 – 110	50
US3	33.8	7.90	485	125.8	1.9
W1	33.3	8.07	590	123.8	0.1
W3	34.2	8.20	495	127.0	3.4
BRW	28.9	8.27	446	96.3	1.2
SDS	29.2	8.53	483	102.7	0.5
DS1	30.3	8.22	452	103.5	2.2
DS3	30.1	8.07	458	101.7	28.9
LC	31.3	7.91	422	102.4	1.5

¹ 20th and 80th percentiles from the DEHP (2009) Queensland water quality guideline (2009)

Queensland water quality guideline (2009) Central Coast lowland streams

Post-wet water quality results

Water temperature ranged from 21.7°C at site US3 to 23.7°C at site US1. These temperatures are between 7°C – 10°C cooler than the maximum and minimum temperatures recorded in the pre-wet field survey.

The pH exceeded the the *Queensland Water Quality Guidelines 2009* (QWQG) (DEHP 2009) values at all sites with the exception of US3 and W1. pH was highest at site SSD (8.52) and lowest at site US3 (7.47). These sites also had the highest and lowest pH readings in the pre-wet field survey.

Electrical conductivity exceeded the QWQG at all sites with the exception of sites US3 and SSD. Electrical conductivity was lowest at site SSD (215 µS/cm) and highest at site LC (389 µS/cm). The range of electrical conductivity was lower in the post-wet field survey than the pre-wet field survey.

Dissolved oxygen was lower than the guideline value at sites US3 and LC. Dissolved oxygen concentration was lowest at US3 (71.3%) and highest at SSD (100.2%).

Turbidity complied with the QWQG at all sites with the exception of site US3, which was marginally higher than the guideline value. US3 recorded the highest turbidity of 51.5 NTU while all other sites recorded turbidity below 16.7 NTU. The lowest turbidity reading was at site LC (4.6 NTU). Overall, the turbidity in the post-wet field survey was higher than the pre-wet field survey.

Table 5-13 In-situ water quality during the post-wet field survey

Site	Temperature	pH	Electrical conductivity	Dissolved oxygen	Turbidity
Units	°C	pH units	µS/cm	% saturation	NTU
QWQG	–	6.5 – 8.0	120 – 310 ¹	85 – 110	50
US1	23.7	8.17	360	100.1	10.6
US3	21.7	7.47	224	71.3	51.5
W1	22.1	7.89	345	87.8	13.7
W2	22.2	8.21	355	94.1	13.1
W3	21.9	8.10	356	89.5	12.2
SSD	23.0	8.52	215	100.2	9.9
BRW	22.7	8.30	356	100.0	11.5
DS1	22.8	8.27	354	95.1	12.4
DS3	22.1	8.30	351	94.9	16.7
LC	22.1	8.17	389	80.7	4.6

¹ 20th and 80th percentiles from the Queensland water quality guideline for coastal lowland streams (DEHP 2009)

Queensland water quality guideline (2009) Central Coast lowland streams

5.1.8 Aquatic fauna species

No conservation significant aquatic species were recorded within the study area during the field survey.

Of the 25 species of fish known to occur in the Upper Burdekin catchment (Pusey *et al.* 2004), 15 species were captured (Table 5-14). Of these, the eastern rainbowfish (*Melanotaenia splendida splendida*) was the most common with 480 individuals caught across six sites. The barred grunter (*Amniataba percooides*) was also found across six sites and was also relatively abundant with 217 individuals captured during the field survey. The Aggassiz's glassfish (*Ambassis agassizii*), firetail gudgeon (*Hypseleotris galii*), southern purple-spotted gudgeon (*Mogurnda adspersa*), black catfish (*Neosilurus ater*), Hyrtl's tandan (*Neosilurus hyrtlii*), and sevenspot archerfish (*Toxotes chatareus*), were the least abundant species captured across all sites. Site W3 recorded the highest abundance of individuals and was dominated by eastern rainbowfish (*Melanotaenia splendida splendida*), barred grunter (*Amniataba percooides*) and bony bream (*Nematalosa erebi*). Native species richness was highest at site LC (13 species) with site W3 (11 species) also recording relatively high native species richness.

Two noxious fish species were found during the post-wet field survey. These included tilapia (*Oreochromis mossambicus*) and eastern gambusia (*Gambusia holbrooki*). Tilapia was found at five sites including upstream, downstream and within the weir inundation area (US3, W1, W3, DS3 and LC). Eastern gambusia was less common and occurred at two sites (W3 and LC).

Red claw (*Cherax quadricarinatus*) was widespread with individuals captured throughout the Burdekin River (W1, W3, DS3), Keelbottom Creek (US3) and Lolworth Creek (LC).

Of the five freshwater turtle species known to occur in the Upper Burdekin catchment (Cann 1998), the Krefft's river turtle (*Emydura macquarii krefftii*) and saw-shelled turtle (*Wollumbinia latisternum*) were confirmed present within the study area (Table 5-15). The Krefft's river turtle occurred at all six detailed sites, recording between 1 – 14 individuals. Sites W1 and LC had the highest abundance of Krefft's river turtle between eight and 14 individuals, respectively. A single adult, female saw-shell turtle was captured at W3. The majority of turtles were adults with a smaller number of juveniles. The sex ratio of the Krefft's turtle caught was relatively equal between males and females.

There were no platypus captured or observed during the field survey. However, there is potential platypus habitat present on Lolworth Creek, Keelbottom Creek and the Burdekin River within consolidated sandy silty/clay banks or under rock ledges, roots and woody debris.

Photos of aquatic fauna are presented in Plate 5-5 and Plate 5-6.

Table 5-14 Abundance of fish species caught during the field survey

Common name	Scientific name	US3	W1	W3	BRW	SDS	DS1	DS3	LC
Native species									
Aggassiz's glassfish	<i>Ambassis agassizii</i>								7
Barred grunter	<i>Amniataba percooides</i>	1	9	84		7		27	89
Flyspecked hardyhead	<i>Craterocephalus stercusmuscarum</i>		40	1				4	2
Sooty grunter	<i>Hephaestus fuliginosus</i>		3	19			13	27	35
Firetail gudgeon	<i>Hypseleotris galii</i>		1				1		9
Gudgeon	<i>Hypseleotris</i> sp.			1					21
Spangled perch	<i>Leiopotherapon unicolor</i>		13	14				11	25
Eastern rainbowfish	<i>Melanotaenia splendida splendida</i>		9	252		12	26	24	157
Rainbowfish sp.	<i>Melanotaenia</i> sp.					15			50
Southern purple-spotted gudgeon	<i>Mogurnda adspersa</i>			1					11
Bony bream	<i>Nematalosa erebi</i>	11	1	96		4		17	25
Black catfish	<i>Neosilurus ater</i>			3					
Hyrtl's tandan	<i>Neosilurus hyrtlii</i>			3					
Sleepy cod	<i>Oxyeleotris lineolata</i>	3	21	2				11	6
Sevenspot archerfish	<i>Toxotes chatareus</i>	1			3	5	1		2
Total native species abundance		16	97	476	3	43	41	121	439
Native species richness		4	8	11	1	5	4	7	13
Exotic species									
Tilapia	<i>Oreochromis mossambicus</i>	1	12	15				13	6
Eastern gambusia	<i>Gambusia holbrooki</i>			1					2
Total exotic species abundance		1	12	16				13	8
Exotic species richness		1	1	2				1	2
All species									
Total abundance		17	109	492	3	43	41	134	447
Species richness		5	9	13	1	5	4	8	15

Table 5-15 Abundance of turtle species caught during the field survey

Common name	Scientific name	US3	W1	W3	DS1	DS3	LC
Krefftt's river turtle	<i>Emydura macquarii krefftii</i>	13	14	1	8	11	14
Saw-shelled turtle	<i>Wollumbinia latisternum</i>			1			



Plate 5-5 Left to right, top to bottom; Eastern rainbowfish (*Melanotaenia splendida splendida*); rainbowfish sp. (*Melanotaenia sp.*); sleepy cod (*Oxyeleotris lineolata*); barred grunter (*Amniataba percoides*); sooty grunter (*Hephaestus fuliginosus*); flyspecked hardyhead (*Craterocephalus stercusmuscarum*)



Plate 5-6 Bony bream (*Nematalosa erebi*) (left); Krefft's river turtle (*Emydura macquarii krefftii*) (right)

5.2 Social and economic environment

A Social Impact Evaluation (SIE) was prepared by GHD in August 2020 to inform the BRW Business Case through consideration of social benefits (positive impacts) and negative impacts, in accordance with the *Building Queensland Social Impact Evaluation Guide* (Building Queensland, 2020).

The purpose of the SIE was to:

- Determine and describe the social study area, inclusive of the local and regional study area.
- Identify and describe the project's potential social impacts, their materiality and whether the impacts can be monetised.
- Identify the significance of social impacts from the project through an impact risk assessment.
- Recommend management and mitigation measures.

Targeted consultation was undertaken by the SIE team during April 2020 through telephone interviews with CTCRC officers and a sample of affected landholders located adjacent to the project footprint including adjacent to the storage area and downstream of the weir was to inform preparation of the SIE. Inputs from the Native Title Holders of the project area, the Gudjala and Gugu Badhun Peoples were received through the North Queensland Land Council (NQLC) in the form of a report *Consultation with Indigenous parties Report for inclusion in the Big Rocks Weir Social Impact Evaluation and Business Case* (NQLC, 2020). Overall SIE Consultation was limited based on the availability and willingness of stakeholders to participate in the discussions during preparation of the SIE.

A copy of the SIE and NQLC report is attached to the BRW Business Case and can be viewed online by visiting: <https://www.nqwia.gov.au/projects>.

A summary of the social baseline from the SIE, including existing social characteristics and community dynamics is provided below.

5.2.1 Social baseline

Local study area

The land surrounding the project is predominantly used for cattle grazing using existing or native vegetation, as shown in Figure 5-12. There is a comparatively a small proportion of land used for cropping and irrigated cropping (Figure 5-12). Landholders consulted for the SIE who undertake cropping noted that they predominantly farm fodder crops, such as hay and grain. Some properties surrounding the project footprint feature homesteads.

The nearest sensitive receptors to the proposed weir site are three existing homesteads located to the south west and south east of the site. The closest residential dwellings are located approximately 1 km south west of the site on Lot 20DV558 and approximately 2 km in the same direction on Lot 19DV558. To the south east of the weir site and across the other side of the Gregory Developmental Road is the homestead for Fletcherview Research Station (4 DV450) being almost 2.5 km from the site.

Fletcherview Research Station is located directly adjacent to the proposed weir site and is an operational cattle station that supports student research activities for JCU. From consultation undertaken as part of the SIE, it is understood that the focus of research is predominantly agricultural, including a range of cattle reproduction and fertility trials, in addition to pasture trials (JCU, 2020). Geological research has also been undertaken adjacent to Lolworth Creek, approximately 1.5 km from the proposed weir site (SIE Consultation, 2020).

The Dalrymple National Park is located upstream of the proposed weir site and is shown in Figure 5-12. The park was established to protect the geological formations, which include ancient and recent lava flows, sandy deposits, and limestone that features marine fossils (DES, 2011). The National Park is also the site of the former Dalrymple township, which was one of the first inland settlements in northern Australia.

The Big Bend Recreation Reserve is located approximately 2 km upstream of the proposed weir location. The recreational use of the Big Bend Recreation Reserve is discussed further in Table 5-18.

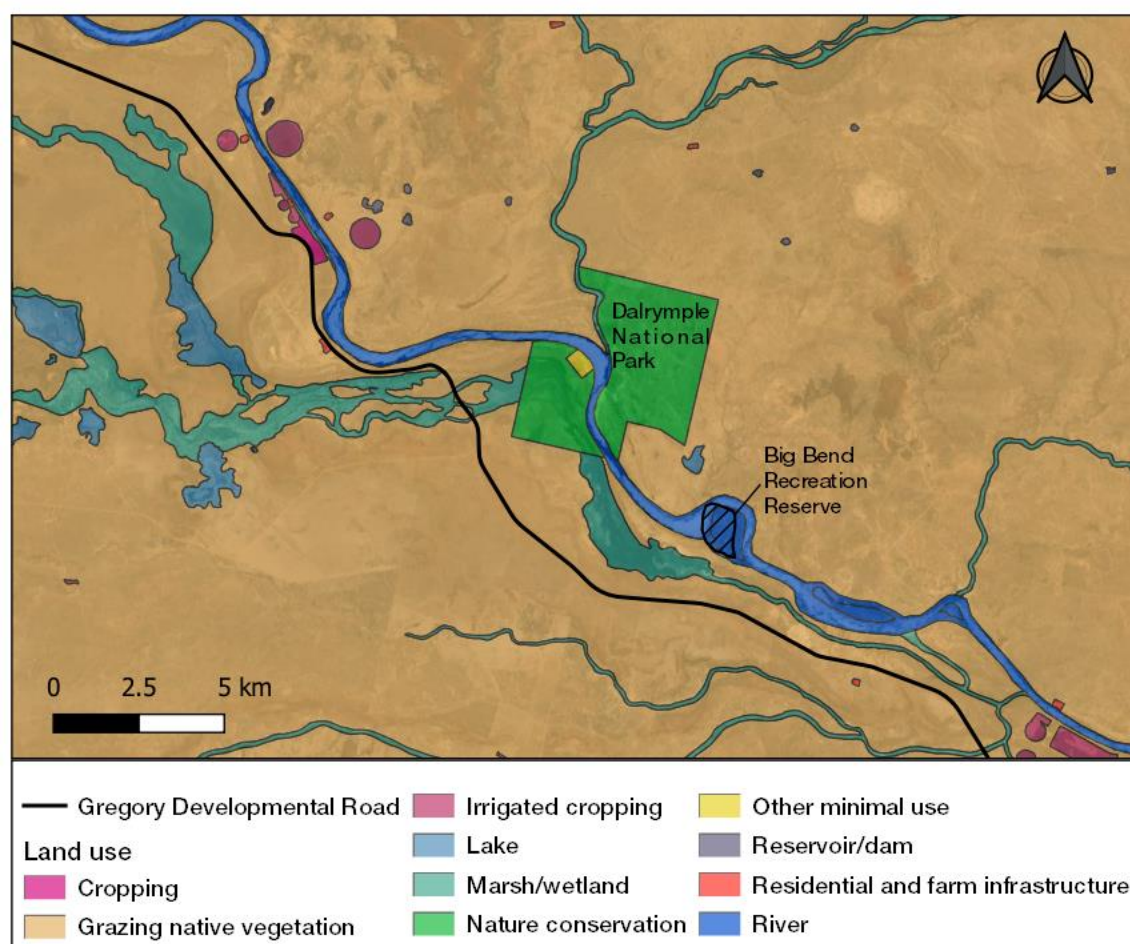


Figure 5-12 Land uses surrounding BRW

Source: Queensland Government (2017) Queensland Land Use Mapping Program 2016 – Burdekin Natural Resource Management Region. Google Earth.

Regional study area

Community overview

The CTRC is an inland regional council that covers an area of almost 70,000 km². The Charters Towers region is located south-west of the regional centre of Townsville. The CTRC LGA incorporates the urban centre of Charters Towers, a number of smaller localities and a large area of rural homesteads. The closest urban centre to BRW is Charters Towers.

The Gudjala people are the traditional owners of the area. Charters Towers was founded in the 1870s following the discovery of gold, which resulted in a gold rush and significant population boom. Charters Towers population declined following the decrease in the value of gold and World War I.

Demographic profile

A high-level demographic profile of Charters Towers is provided in Table 5-16. This information is based on the ABS 2016 Census data unless otherwise specified.

Table 5-16 Key population indicators for Charters Towers LGA and UCL

Data type	Charters Towers LGA	Charters Towers UCL
Population	The total population was 11,876 persons in 2016, representing a slight (2%) decrease since 2011. Based on a 'medium' population projection scenario, the Charters Towers LGA population is expected to increase by 329 persons between 2016 and 2041. This represents a 3% population growth based on Queensland Government projections (QGSO, 2018).	The total population was 8,120 persons in 2016 (68% of the LGA population), representing a slight (1%) decrease since 2011.
Age and gender	The median age in the LGA is of 40 years, three years more than the State of Queensland average (State) median of 37 years. Compared to the State, the LGA had a higher proportion of residents aged 5 to 17 years (21.4% in the LGA and 16.9% in the state) and 65 to 84 years (16.8% in the LGA and 13.4% in the state). The overall LGA gender ratio was generally balanced (ratio of 1:1).	The median age in the UCL is 39 years, one year less than the LGA. The proportion of UCL residents aged 12 to 17 years (12.8%) was higher than in the LGA (11.1%). The proportion of residents aged 75 years and over was also high in the UCL compared to the LGA (8.5% and 7.5% respectively). With an overall gender ratio of 0.9, there was a slightly higher proportion of females living in the UCL. The UCL gender ratio are generally balanced.
Unemployment	The LGA unemployment rate in September 2019 was of 8.9% (Australian Department of Education, Skills and Employment, 2020). This is higher than the state unemployment rate of 5.5%. Despite unemployment rates being higher than the Queensland unemployment rate, consultation identified that many regional employers struggle to attract and retain skilled and unskilled workers. These consultation findings reflect the broader literature on skills shortages in regional Australia (Sharma, Oczkowski, and Hicks 2016), and in regional and remote Queensland (Mangan and Trendle 2017). Indigenous unemployment was also noted to be higher than the state average as per 2016 Census 32.8% in the LGA verses 20.1% in the State. It is recognised that Indigenous people face other social barriers to employment, including poorer health, low levels of work retention and high levels of	In September 2019, the unemployment rate in the UCL was 11.9%. The unemployment rate in the Charters Towers urban area (SA2) has consistently been higher than that of the LGA over the last 10 years (Australian Department of Education, Skills and Employment, 2020).

Data type	Charters Towers LGA	Charters Towers UCL
	interaction with the criminal justice system (AIHW 2012). This means that engaging regional and regional Indigenous workforce may be challenging for the Project.	
Indigenous population	A relatively high proportion of LGA residents identify as Indigenous (8.7%) compared to the State (4.0%) as at the 2016 Census.	A relatively high proportion of UCL residents identified as Indigenous (10.9%) at the 2016 Census compared to the LGA and State.
Average household size and family composition	In 2016, the average household size was 2.4 persons. This is slightly lower than the State average household size of 2.6 persons. The main family type was couples without children (42.1%), followed by couples with children (38.3%) and one-parent families (18.1%).	At 2.4 persons per household, the UCL average household size was consistent with the LGA. The main family types in the UCL are generally similar to the LGA. However, there was a higher proportion of one-parent families in the UCL (21.6%) compared to the LGA (18.1%) and the state (16.5%).
Need for assistance	There is a higher proportion of LGA residents reported needing assistance (6.4%) compared to the State (5.2%). It is worth noting that 10.6% of the population did not state whether they needed assistance or not. The proportion of residents needing assistance could therefore be higher than 6.4% of the population.	A higher proportion of UCL residents reported needing assistance (7.4%) than the State (5.2%). As for the LGA, a high proportion of the UCL population (10.1%) did not state whether they needed assistance or not. The proportion of residents needing assistance could therefore be higher than 7.4% of the population.
Income (weekly)	In 2016, the median weekly personal income was \$522. The median weekly household income was of \$1,047. Income was relatively low compared to the State, which had a median weekly personal income of \$660 and household income of \$1,402.	The median income was slightly lower for the UCL compared to the LGA: the median weekly personal income was of \$509 and household income was of \$1,040.
Socio-economic Index of Disadvantage	The Socio-economic Indexes for Disadvantage (SEIDA) is a summary measure of the social and economic conditions of a region. SEIDA is generated by the ABS and compiles a range of indicators, including low-income, relatively lower education attainment, high unemployment and dwellings without motor vehicles. SEIDA is not available at the UCL level. The index distributes areas within the state in terms of deciles. 'Decile 1' represents the most disadvantaged group, while 'Decile 10' represents the least disadvantaged group. In 2016, Charters Towers LGA was ranked within Decile 4 within the State, indicating moderately high levels of disadvantage (ABS, 2018).	

Community identity, values, opportunities and challenges

The community identity, values, opportunities and challenges of the Charters Towers community are summarised in Table 5-17.

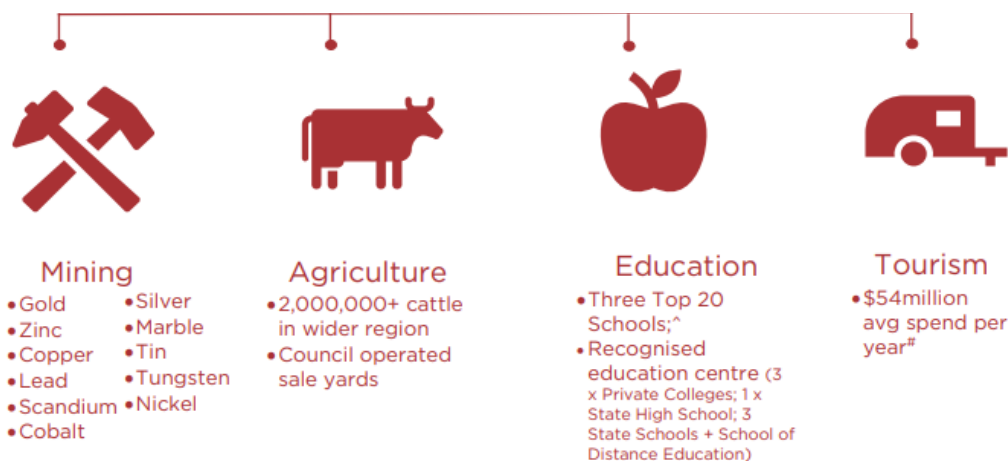
Table 5-17 Identity, values, opportunities and challenges

Identity, values and opportunities	Challenges
Charters Towers is a regional centre and the primary hub for agriculture in the region. The community are proud of their town's history which they embrace and highly value (Charters Towers Regional Council, 2019).	Council recognises the following challenges: • Economic reliance on agriculture and challenges associated with drought • Flying fox management • Youth out-migration • Upgrading and management of Flinders Highway and Gregory Developmental Road to provide for community connectivity and economic development opportunities • Service provision gaps in the health service, with no dialysis, birthing, or radiology available in the LGA (Charters Towers Regional Council, 2019). During consultation Council identified the following key challenges for the community: • High unemployment • High levels of unskilled and low skilled employment • Difficult to attract and retain skilled workers.

Industry and economy

Industries of employment

The Charters Towers LGA's four economic pillars are mining, agriculture, education, and tourism as shown in Figure 5-13. Of these four industries, the specific contribution of agriculture and tourism to the economy is described below, as it is relevant to the impacts from the project.



Source: Charters Towers Regional Council, 2019

Figure 5-13 Charters Towers LGA four economic pillars

Based on the 2016 ABS Census, the main industry of employment in both Charters Towers LGA and UCL in 2016 was education and training (13.6% and 16.2% respectively) (Figure 5-14). A high proportion of LGA residents were also employed by the agriculture, forestry and fishing industry (12.4%). As the main township in Charters Towers LGA, the proportion of residents employed in the agriculture, forestry and fishing industry was low for the UCL (3.1%) compared to the LGA. UCL residents were more likely to be employed by the healthcare and social assistance industry (14.2%) or retail trade (12.0%).

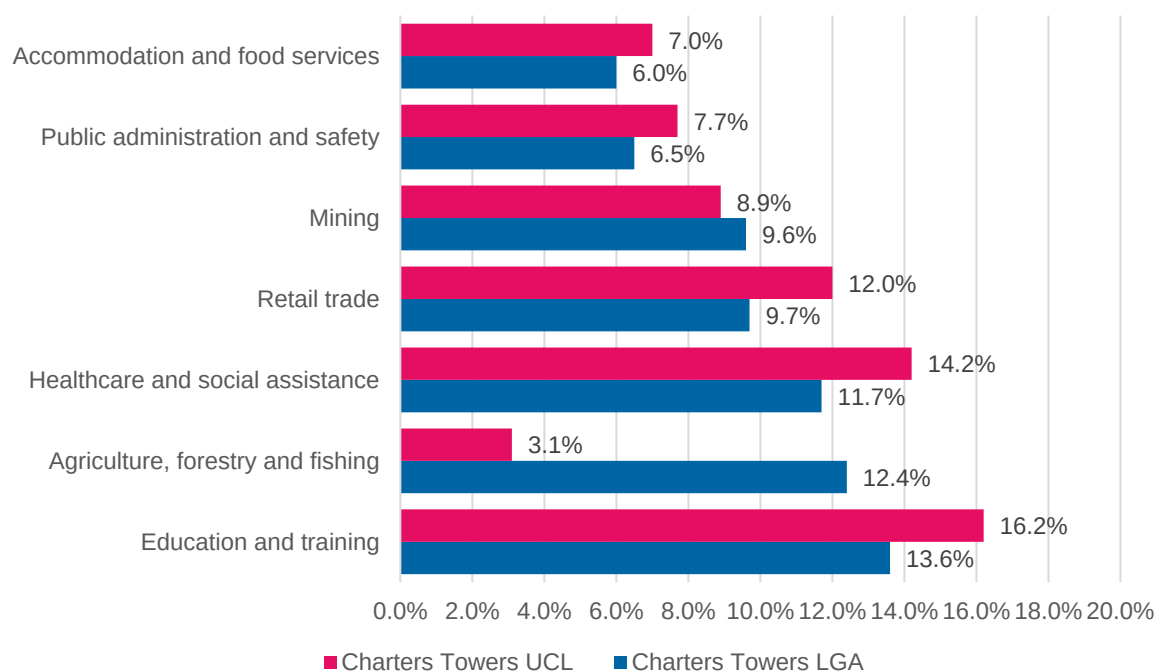


Figure 5-14 Top industries of employment in 2016

Source: ABS, 2016

Local and regional economy

Agriculture

Agriculture is a significant economic driver for the North Queensland economy (KPMG, 2019). According to KPMG's 2019 *North Queensland Agricultural Market and Supply Chain Study*, the Gross Regional Product (GRP) of the agricultural, forestry and fishing industry was worth \$1 billion in 2016-17. In June 2019, the LGAs GRP was estimated at \$0.84 billion and in 2015-16 the total value of agricultural output was estimated at \$242 million (.id, 2019).

There are approximately 1,130 local businesses operating in Charters Towers LGA (.id, 2019). Representing 41.5% of all registered businesses in the LGA in 2018, agricultural, forestry and fishing businesses dominate the local Charters Towers industry (.id, 2019). Livestock slaughtering accounted for 98.3% of the LGAs total agricultural output in 2015-16 (.id, 2019). This was followed by vegetables (0.8%) and crops for hay (0.5%).

Irrigation and water availability is a key infrastructure requirement to develop a state supply chain for the beef opportunities in particular (KPMG, 2019).

Tourism and hospitality

According to the CTCRC corporate plan, tourism is one of Council's priority areas for development to 2023 (Charters Towers Regional Council, n.d).

In 2018-19, tourism and hospitality sales (both direct and indirect) in Charters Towers LGA was \$25.9 million (.id, 2019). Visitors to the LGA were mainly domestic overnight visitors or domestic day-trippers.

"To be a destination of choice for new and repeat regional, intrastate, interstate and international visitors known for our unique and authentic experiences derived from our natural and historical assets."

Social infrastructure

Road networks and river crossings

The proposed weir is located on the Burdekin River and would be accessed via the Gregory Developmental Road, which is a state highway running north of Charters Towers and from south-east to north-west of the site.

Access to the south bank of the site is currently via an unsealed track off Gregory Developmental Road and through Fletcherview Research Station. Access to the north bank of the site is currently via Sellheim through local grazing properties.

There is a stock route 2.5 km to the north (341CHAR) and another 1.5 km to the south (123CHAR) of the Burdekin River.

The Big Bend Road is an access track west of the proposed weir. The road connects the Big Bend Recreation Reserve to Gregory Developmental Road. Visitors to Big Bend access the site via 4WD across a sandy overflow area of the river.

Several other secondary roads and small tracks pass through the local study area. These include:

- Leichhardt Road north-west of the site
- Brigalow Road north-west of the site
- Lolworth Creek Crossing south of the site
- Pandanus Vale Road south-west of the site
- Myola Road west of the site.

Health and emergency services

Health and emergency services for the local and regional study area are mainly available in Charters Towers UCL. This includes police, fire and ambulance services, and the Charters Towers Health Service, which comprises the Charters Towers Health Centre and the Charters Towers Rehabilitation Unit. Charters Towers Health Service includes 23 beds and offers a range of services, such as accident and emergency care, general in-patient medical, surgical and paediatric services (Townsville Hospital and Health Service, 2020).

Recreation

The study area is popular for its nature-based recreation offerings (Visit Charters Towers, 2019; Charters Towers Regional Council, n.d.). More specifically, the Burdekin River where the BRW is proposed is a favourite spot for locals and visitors to go fishing, camping and enjoy other recreational activities (Visit Charters Towers, 2019). The camping grounds are highly utilised during holidays and long weekend. During consultation, it was noted that use of these areas peaks during the 'tourist season', which is typically during the dry and cooler periods in and around winter.

Table 5-18 describes the main recreational opportunities in and around the project area.

Table 5-18 Main recreational opportunities

Item	Description	Location in relation to BRW (approx. distance)	Within project study area
Dalrymple National Park	The Dalrymple National Park is a protected area for recreation. Facilities and activities in the national park include the Burdekin River Campground described below, walking trails and cycle/mountain bike/4WD trails (Queensland Department of Environment and Science, 2020).	8 km north-west upstream	Yes
Burdekin River Campground	The campground is located in the Dalrymple National Park. The campsite is accessible via an unsealed road that can become boggy and impassable with minor rainfall (Queensland Department of Environment and Science, 2020). Tents and vehicle-based bush camping is permitted in the campsite. There are no facilities. Permits and fees apply.	Located in the Dalrymple National Park, 9 km north-west upstream	Yes
Big Bend and Echo Point (Big Bend Recreation Reserve)	Big Bend Recreation Reserve is State land leased to Council for a public purpose and is commonly used by locals and the public as a free bush campground (DES, 2011). The campground is only accessible with high-clearance vehicles from Gregory Developmental Road, although some people walk from the road to the site (DES, 2011; Daly, Dehne, Leffman, & Scott, 2003). There are no designated camp spots or facilities here (Warneke, 2016). The area is popular for fishing and for its cycle/mountain bike/4WD trails. Despite there being the potential for crocodiles in the Burdekin River, locals frequently swim at Big Bend Recreation Reserve (Warneke, 2016). Echo Hole is located on the south-east side of Big Bend and, like Big Bend, is known for its basalt formation and lava flow. A swimming spot is located here (Visit Charters Towers, 2020c; Warneke, 2016).	2 km north-west upstream	Yes
Fletcher Creek Camping Reserve	Fletcher Creek Camping Reserve is located near the entrance to the Dalrymple National Park and can be accessed via Gregory Developmental Road. The campsite includes facilities such as flushing toilets, cold showers, sheltered picnic tables and wood barbecues. It is suitable for tents, caravans and camper trailers.	12 km north-west upstream	Yes
Anabranh	Anabranh is a 3 km-long waterhole adjacent to the Burdekin River (Visit Charters Towers, 2020b). The waterhole is normally dry in summer. However, after consistent rain it floods with fresh water from the river. Anabranh is popular for water sports such as canoeing, paddle-boarding and fishing (Visit Charters Towers, 2020b).	1 km south-east downstream	No

5.2.2 Native title determinations

As previously described in Section 4.2.2, BRW is located within the external boundaries of *the Elizabeth Dodd & Ors on behalf of the Gudjala People Core Country Claim #1 v State of Queensland & Ors* Native Title determination (Federal Court Number: QUD80/2005 and NNTT Number: QCD2014/006).

Under the Native Title determination, the Gudjala People do not have exclusive use rights to the Burdekin River watercourse, Keelbottom Creek watercourse, Dalrymple National Park (other than Lot 42 USL48163) and Big Bend Recreational Reserve, with the public able to access and enjoy these areas. The Gudjala People do however have the right to exclusive possession for Lot 42 USL48163.

The weir infrastructure and storage area will cover lands and water where non-exclusive native title rights and interests are determined to exist. BRW is not expected to impact on Lot 42 USL48163.

5.2.3 Cultural heritage

5.2.3.1 Indigenous cultural heritage

A search of the Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) cultural heritage database identified seven recorded Aboriginal cultural heritage sites or registered places within the project area (10 km radius). While no other registered places or Indigenous cultural heritage sites have been identified, high risk landscape features such as ephemeral water sources are commonly identified as places of importance to Aboriginal people and may include the Burdekin River and tributaries. Subsequently, there is a high chance of additional, unrecorded Indigenous cultural heritage being present. The full cultural heritage search report is provided in Appendix B.

The Gudjala People have identified that they have strong cultural and historical connections to recreational areas in and surrounding the project area. The Gudjala People continue to utilise the area and in particular Big Bend, Fletcher Creek, and the Burdekin River for recreational activities such as swimming, fishing, hunting, traditional barbecue, collecting food from plants and intergenerational teaching, where older people teach young people about relevant creation / dreaming stories, special sites, fishing and hunting, and the use of traditional resources and medicine (NQLC, 2020).

The NQLC (2020) report notes that while Gudjala People may visit Anabranh and Echo Hole, they do not 'camp, fish, or swim there and do not drink water at Anabranh.' The NQLC, 2020 report also notes that Gudjala People have told NQLC of a number of spiritually and culturally significant sites that may be located within the BRW footprint, including:

- Artefact scatters
- Graves, a grinding stone, handprint in lava, hunting grounds
- A fishtrap
- Lava flows
- A knapping site, a spear making site, massacre sites, a men's site and a women's site
- A rock circle, a trading route and sacred trees
- Particular topographic features and waterholes.

In view of the cultural significance of the project area, BRW will be required to undertake cultural heritage surveys and establish both a Cultural Heritage Management Agreement (CHMA) for investigative works and a separate Cultural Heritage Management Plan (CHMP) for the construction and operation of BRW.

5.2.3.2 Non-indigenous cultural heritage

According to the National Heritage Register and PMST, no National or Commonwealth heritage places are identified within 10 km of the project area. Additionally, no State or local heritage is identified within 10 km of the project area, as mapped by the Queensland Heritage Register and the Charters Towers Regional Town Plan Version 2.

5.3 Built environment

5.3.1 Local and regional infrastructure

There is an existing transmission line that runs from the National energy market (NEM) into Charters Towers. The Mount Isa rail line runs south of Charters Towers from Townsville to Mount Isa. The Flinders Highway is the major arterial route which runs from Townsville to Cloncurry. Existing built infrastructure within close proximity to BRW is shown in Figure 5-15.

5.3.2 Urban areas

The main urban area located within the project surrounds is Charters Towers, approximately 26 km west of the project area. Regional goals for the area, as outlined in the Charters Towers Regional Town Plan, include supporting economic development, protecting natural resources and building resilience against natural hazards.

5.3.3 Declared coordinated projects in the region

The CopperString project is a coordinated project 45 km south west of the proposed BRW. The project proposes to construct a 1,100 km alternating current 275 kV transmission line to transfer electricity to and from the North West Queensland electricity supply system and the National Electricity Market (NEM).

The CopperString project is located on the southern side of the Flinders highway and is not likely to create a potential conflict capacity constraint.

5.3.4 Major proposed infrastructure or development projects

Additional, independent infrastructure projects including the BFD (raising), HGD and Urannah Dam are planned for construction within the Burdekin Catchment.

BFD (raising)

The BFD (raising) project involves raising of the existing BFD by at least 2 metres and possibly up to 6 metres. The final decision as to the level of raising will be made through the Business Case process which will be undertaken concurrent with the EIS. Some ancillary infrastructure will also require upgrade. The additional yield will be available for purchase to a range of clients including urban, mining and agricultural. As is now the case, the dam will be maintained to meet dam safety standards and Sunwater will operate the dam to comply with the Burdekin Water Plan, Operations Manual, Water Management Protocol, Resource Operations Licence and other relevant legislation.

Given the geographical distance between BRW and BFD, it is not anticipated that there would be a direct overlapping client base between the two projects.

HGD

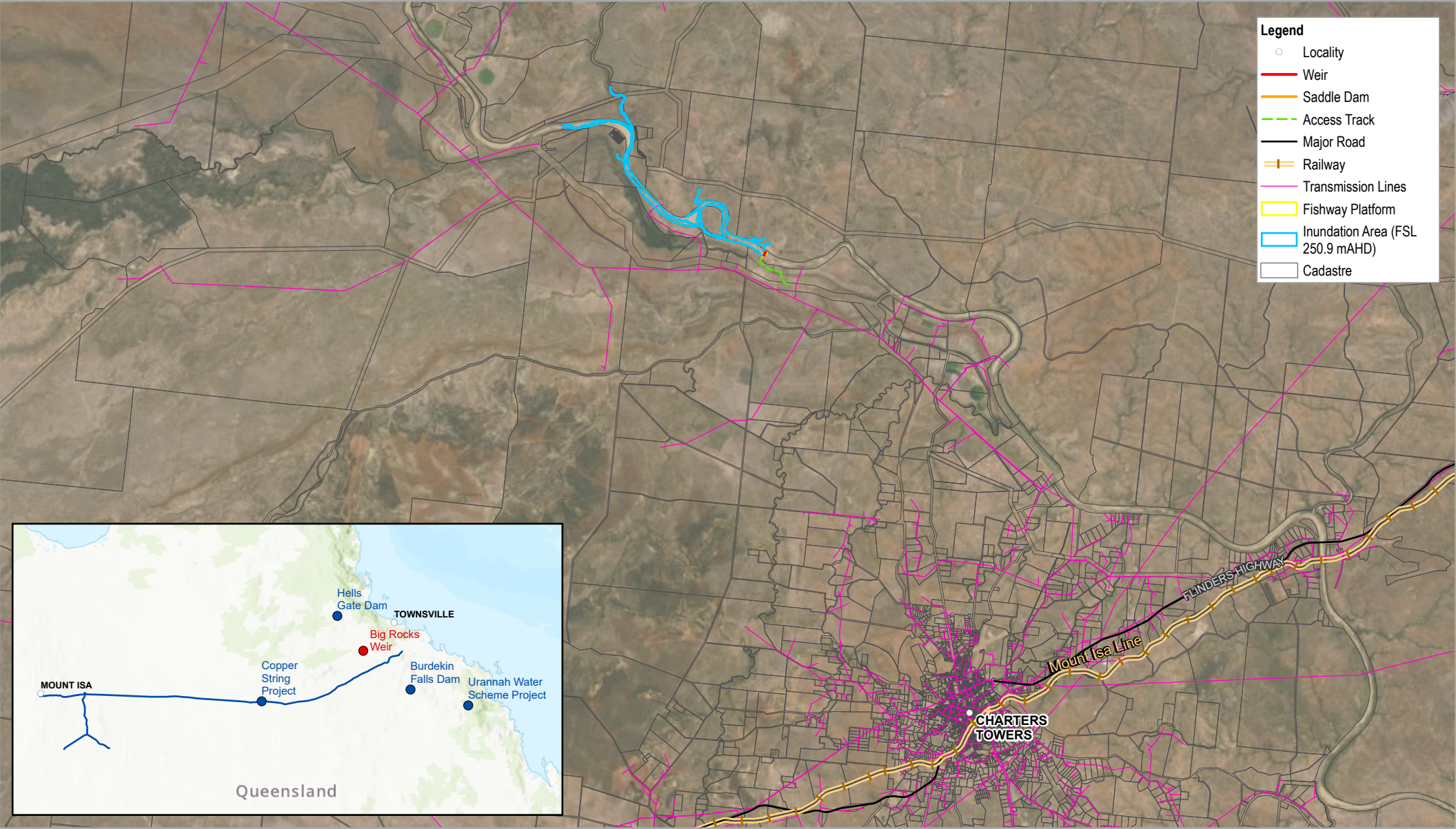
The Australian Government has committed \$54 million to the HGD project, with \$24 million for a detailed business case, including detailed geotechnical and cultural heritage assessments, environmental impact report and engineering analysis. The business case will test findings from the 2018 HGD Feasibility Study that up to 50,000 ha of irrigation could be supported through a 2,100 GL Dam, bolstered by 3 downstream irrigation weirs. The HGD Scheme is a potentially nation-building undertaking, involving over \$5 billion in enabling infrastructure and over \$1 billion of on-farm investment during construction. The 2018 Feasibility Study also suggested the HGD project could result in the creation of more than 4,000 long-term regional jobs and deliver up to \$1.3 billion of GRP annually into the North Queensland economy. The Business Case and Draft EIS for HGD are scheduled for delivery by 30 April 2022.

As discussed in Section 1.1.1, although the BRW and HGD projects have the ability to be perceived to have overlapping geographical footprints with the three additional weirs located upstream of BRW and the southern irrigation district/zone for HGD proposed to the west of BRW; the construction and installation of any facilities for HGD will not be related or dependent on BRW and vice versa. Therefore, it is not anticipated that there would be a direct overlapping client base between the two projects.

Urannah Dam

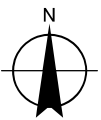
The Urannah Project comprises the proposed construction and operation of a new 80 m high dam on the Broken River at Urannah in Central Queensland, a water distribution network including connecting water pipelines and instream distribution and storage of water, an irrigation precinct (25,000 ha) and a pumped hydroelectric scheme (PHES), together with supporting ancillary infrastructure and associated works. The project has the potential to supplement existing water supplies in the Mackay, Isaac, and Whitsunday regions, stimulating irrigated agricultural development and strengthening regional water security. The addition of the PHES to the project offers the potential for reliable dispatchable power supply during the transition of Queensland's economy from fossil fuelled powered generation to renewables.

Given the geographical distance between BRW and Urannah Dam, it is not anticipated that there would be a direct overlapping client base between the two projects.



Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4
0 2.5 5 7.5 10
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Charters Towers Regional Council
Big Rocks Weir

Project No. **12512214**
Revision No. **0**
Date **29/09/2020**

Land use

FIGURE 5-15

5.4 Traffic and transport

The proposed weir site will be accessed via the Gregory Developmental Road which is a State highway running north of Charters Towers. The proposed access route is via Fletcherview Research Station (4 DV450) on the river side of the Gregory Developmental Road. It is preferred to access the weir site from the Gregory Developmental Road due to the quality of the State-controlled road and shorter travel distance from Charters Towers.

An access route to the weir has been developed based on initial consultation with landholders adjacent to the weir, and to make use of the existing access track and Lolworth Creek crossing, limiting land disturbance where practical. An alternative access was considered on the western extents of the property boundary (4 DV450, adjoining AAP23190 and 20 DV558), however the topography was not favourable and the landholders preferred to upgrade the existing access track.

Access to the weir site after construction, is proposed to be limited to operations personnel, nominally up to once per week during periods of the year when the environmental flow outlet is required to be operated or for maintenance purposes. Therefore, considering no public access is proposed, the construction access is proposed to be retained following completion of the works, which will be adequate for the intended access frequency with regular maintenance by the owner.

Gregory Developmental Road is a State-controlled road and is managed by the Department of Transport and Main Roads (DTMR). As access is via DTMR's road asset, it will be necessary to upgrade the intersection and comply with DTMR's requirements, with the increase in traffic volume. The proposed intersection design has been determined from minimum DTMR requirements and involves providing a Basic Left Turn Treatment (BAL) and Basic Right Turn Treatment (BAR). This will improve the overall safety and performance of the intersection. Further liaison with DTMR will be required to obtain final design approval.

A detailed traffic and transport study will be undertaken during Detailed Design and appropriate mitigation measures implemented.

5.5 Land use and tenures

5.5.1 Key local and regional land uses

The surrounding land is primarily used for cattle grazing and cultivation. Dalrymple National Park is located towards the upstream reach of the proposed storage area and is best known for ancient lava flows, fossilised limestone and the Burdekin River. It is also the site of the former Dalrymple township which was one of the first inland settlements in northern Australia.

Big Bend Recreation Reserve is a recreational area utilised by the local community and tourists visiting the region to go camping, fishing and bush walking.

The selected site is located in the Burdekin River which is identified as a waterway in the Charters Towers Regional Town Plan. The majority of surrounding land is zoned Rural, with the exception of Dalrymple National Park which is zoned Environmental Management and Conservation. The project is considered to take on the zoning of the adjoining land, which in the case of the weir infrastructure, access tracks and laydown areas would be rural.

Gregory Developmental Road is a State controlled road located to the south of the project. It extends from Charters Towers northwest to Greenvale. There is a stock route located 2.5 km to the north and 1.5 km to the south of the Burdekin River (refer Figure 4-1).

5.5.2 Key local and regional land tenures

As previously described in Section 4.2.1, land tenure within the BRW study area consists of a mixture of private freehold land (Burdekin Downs) and State land. The State land includes watercourses (Burdekin River, Keelbottom Creek and other small tributaries), National Park (Dalrymple National Park), reserve land (Big Bend Recreation Reserve), perpetual leases (several adjoining landholders), term leases (Fletcherview Research Station) and both State and local road reserve (Gregory Developmental Road and Big Bend Road).

For land tenure mapping and a description of land parcels likely to be impacted by the project see Section 4.2.1.

There is also an Environmental Authority held by Access Australia Mining Pty Ltd which covers the site, it is for a resource activity, non-scheduled mining activity, exploration permit mineral – EPM (EA0001271).

5.6 Planning instruments and government policies

There are a number of instruments and government policies applicable to the project, including:

- Queensland's State Planning Policy (SPP)
- North Queensland Regional Plan
- Charters Towers Regional Town Plan
- Relevant state codes under the State Development Assessment Provisions (SDAP)
- Australian and Queensland Reef 2050 Long-Term Sustainability Plan (Reef Plan)
- Burdekin Region Water Quality Improvement Plan 2016 (WQIP)
- Northern Australia Infrastructure Facility
- Our North, Our Future: White Paper
- Australian Infrastructure Plan
- State Infrastructure Plan
- Queensland Bulk Water Opportunities Statement
- Queensland's Agricultural Strategy.

The project is considered to be generally consistent with the outcomes, strategies and policies of the above mentioned planning instruments and further detailed assessments will be undertaken as part of the impact assessment process.

5.6.1 State Planning Policy

The SPP commenced on 3 July 2017 and contains 17 state interests that must be considered in every planning scheme across Queensland.

The state interests are arranged under five themes:

- Liveable communities and housing
- Economic growth
- Environment and heritage
- Safety and resilience to hazards
- Infrastructure.

The state interests that are likely to be of most relevance to the project include:

- Agriculture
- Biodiversity
- Water quality
- Energy and water supply.

A detailed assessment of how the project seeks to achieve the assessment benchmarks for each relevant state interest of the SPP will be undertaken as part of the impact assessment process.

5.6.2 North Queensland Regional Plan

The first North Queensland Regional Plan was given effect on 6 March 2020. The plan provides a 25-year framework to guide growth and support future jobs in North Queensland. The regional plan enables the Burdekin, Charters Towers, Hinchinbrook, Palm Island and Townsville councils to work together to drive a leading economy in regional Australia. It also highlights opportunities for prosperity and liveability.

BRW is referenced in the North Queensland Regional Plan as a recognised water supply and distribution initiative with the ability to have a significant influence on Charters Towers future by providing potable water security and future economic opportunities linked to agriculture, energy and tourism. This will in turn support economic growth in the region and aligns with the vision of *Goal 4 - infrastructure networks support a safe, connected and efficient North Queensland*. With regards to the vision of *Goal 2 – a rich and healthy environment*, approximately 13 km of the water storage area for BRW is located within the Strategic Environmental Area (SEA). In addition to this, all of the BRW project area is located within the regional biodiversity corridor and regional biodiversity value area.

Under Section 17 (1)(b) of the *Regional Planning Interests Act 2014* (RPI Act) and Section 11 of the *Regional Planning Interests Regulation 2014*, a regulated activity for a SEA includes broadacre cropping and water storage (dam). As per the RPI Act Statutory Guideline 05/14 ‘*a water storage dam includes any barrier that may impound water, plus the water storage area created by the barrier, plus any embankment or other structure that is associated with the barrier and controls the flow of water*’.

On this basis, an assessment application for a regional interests development approval (RIDA) will be required for BRW as a large portion of the storage area is located within a SEA, constitutes a regulated activity and may be considered to have a widespread or irreversible impact.

It is understood that regulated activities that have the potential for widespread or irreversible impacts on the environmental attributes of the SEA are considered to be incompatible development. The environmental attributes for the Highland reach and Great Basalt Wall relate to riparian vegetation and wildlife habitat, changes to water quality, changes to surface or groundwater hydrology and changes to erosion and depositing of sediments along river systems. Any unavoidable impacts to the attributes will need to demonstrate that an effort has been made to minimise impacts through location, design, operation and management requirements. The prescribed solution in Part 5, Section 15 (1) of the RPI Reg for development in an SEA states that:

(1) *The application demonstrates either -*

(a) the activity will not, and is not likely to, have a direct or indirect impact on an environmental attribute of the strategic environmental area; or

(b) all of the following -

(i) if the activity is being carried out in a designated precinct in the strategic environmental area—the activity is not an unacceptable use for the precinct;

(ii) the construction and operation footprint of the activity on the environmental attribute is minimised to the greatest extent possible;

(iii) the activity does not compromise the preservation of the environmental attribute within the strategic environmental area;

(iv) if the activity is to be carried out in a strategic environmental area identified in a regional plan—the activity will contribute to the regional outcomes, and be consistent with the regional policies, stated in the regional plan.

The BRW footprint is not located within a designated precinct in the SEA.

A detailed assessment and supporting information describing how the project intends to comply with Prescribed Solution 1(b) as well as the regional outcomes and policies under the North Queensland Regional Plan will be undertaken as part of the impact assessment process.

5.6.3 Charters Towers Regional Town Plan

BRW is located entirely within the Charters Towers Regional LGA. The Charters Towers Regional Town Plan Version 2 was adopted in February 2020. The project is considered to be generally consistent with the strategic intent of the Charters Towers Regional Town Plan, specifically the following strategic intent statements:

- Agricultural and grazing activities are influenced by access to water and climatic conditions resulting in innovative primary production activities and associated industries. The Burdekin River and its tributaries is vital 'natural infrastructure' supporting existing and future agriculture and associated activities.
- Economic development outcomes maximise the strategic locational and physical attributes of the region to service regional, national and global markets and supply chains associated with mining, agriculture, rural enterprises, logistics and distribution. The strategic local and physical attributes include a reliable water supply from the Burdekin River and its catchment.
- Rural places consume the largest area throughout the region and are used primarily for agriculture, grazing and complementary tourism, agribusiness and rural activities.
- Rural land is abundant throughout the Charters Towers region, and various forms of rural production and associated activities are a major source of economic activity and employment.
- The function, connectivity and pasture productivity of the stock route network, including reserves associated with the network (i.e. for camping and watering purposes) and existing pasturage rights are protected from development that comprise the use of the network and adjoining pasturage rights.

The Burdekin River is mapped as a waterway in the Charters Towers Regional Town Plan and the adjacent land to the north and south of the BRW site (specifically in the location of the weir wall, fishway, saddle dam) is zoned Rural. Whereas Dalrymple National Park is mapped in the Environmental Management and Conservation zone. When defining the applicable land use zoning for development assessment purposes, waterways like the Burdekin River are considered to take on the zoning of the adjoining land, which in the case of the proposed weir wall, fishway and saddle dam would be the Rural zone. For the top extent of the BRW storage area this may be required to assume the Environmental Management and Conservation zoning.

As per Section 5.3.2(4) of the Charters Towers Regional Town Plan, where an aspect of development is proposed on premises included in more than one zone or overlay, the category of development or assessment for that aspect is the highest category under each of the applicable zones or overlays. Using the material change of use (MCU) definition for a 'utility installation' (i.e. the use of premises for supplying or treating water) and if undertaken by a public sector entity (such as a local government) in the Rural zone, BRW is accepted development with no assessment benchmarks. In the event that the proponent of BRW does not end up being a public sector entity, an impact assessable development application would be required in the Rural zone. A MCU for a utility installation in the Environmental Management and Conservation zone requires Code assessment.

A detailed assessment of the project against the relevant provisions of the Charters Towers Regional Town Plan can be undertaken as part of the impact assessment process should Code assessment for part of the BRW storage area be required.

5.6.4 SDAP

The SDAP provide assessment benchmarks for the assessment of development applications where the Chief Executive is the assessment manager of a referral agency. The SDAP is structured in a performance-based code format, whereby applicants address criteria to demonstrate that a development appropriately manages any impacts on a matter of state interest and/or protects a development from impacts of matters of state interest. In making a development application to the SARA, applicants should respond to each of the relevant provisions of the applicable state codes in the SDAP.

The SDAP outlines a purpose statement for each state code, as well as performance outcomes and acceptable outcomes. It includes locational and use-based state codes.

The relevant state codes for the project may include:

- State Code 10: Taking or Interfering with Water
- State Code 15: Removal of Quarry Material from a Watercourse or Lake
- State Code 16: Native Vegetation Clearing
- State Code 18: Constructing or Raising Waterway Barrier Works in Fish Habitats
- State Code 22: Environmentally Relevant Activities.

A detailed assessment of the project against the relevant state codes will be undertaken as part of the impact assessment process and subsequent applications for development approval.

5.6.5 Reef Plan

The Reef Plan provides an overarching strategy for managing the GBR. The Reef Plan sets out an outcomes framework with seven overarching themes, including ecosystem health, biodiversity, heritage, water quality, community benefits, economic benefits and governance. These themes reflect the priority areas for action identified by governments and other stakeholders.

The Reef Plan considers risks from current and future threats to the reef's ecological and heritage values. These risks are grouped into the following four major influencing factors:

- Climate change
- Land-based run-off
- Coastal land use change
- Direct use.

These four themes represent the highest risks to the reef identified in the Outlook Report 2014.

As the project is located within the Burdekin Basin, identified as the largest contributor of fine sediment to the GBR according to the WQIP, and has potential to alter water quality and the hydrological regimes of the area an assessment of the project against the frameworks and strategies in the Reef Plan will be undertaken as part of the impact assessment process.

Implementation of minimum practice standards for facilitated irrigated agriculture and supported industry development as per the Reef Plan and best practice industry guidelines for agriculture will ensure project compliance with broader catchment initiatives and long term protection of downstream environmental values. Furthermore, the Charters Towers Regional Town Plan specifies the requirement for an Erosion and Sediment Control Plan (ESCP) or Stormwater Management Plan for construction activities in the region to minimise land-based runoff.

5.6.6 WQIP

The WQIP is a strategy developed in a partnership between NQ Dry Tropics, and the Australian and Queensland Governments. The WQIP aims to improve the water quality in the Burdekin region (and ultimately the GBR) by reducing the loss of sediment, nutrients and pesticides from the Burdekin catchments. It recognises that for agricultural lands, sediment run-off, nutrients, and pesticides affect productivity and contribute to environmental degradation.

Suspended sediments and associated particulate nutrients are a major contributor to water quality issues in regions dominated by grazing.

An assessments of how the project meets the outcomes and strategies outlined in the WQIP will be provided as part of the impact assessment process.

5.6.7 Key government policy

The project will contribute to the strategic objectives of the following government plans and policies:

Northern Australia Infrastructure Facility

At a strategic level the project supports the vision of the Federal Government's Northern Australia Infrastructure Facility (NAIF) to accelerate development in northern Australia on the foundations of land, labour, water and infrastructure. The project aligns with the vision of the NAIF by delivering additional water security to Northern Australia.

Our North, Our Future: White Paper

The Australian Government has a strong preference to invest in water resources with the potential to diversify regional economies and increase exports. Development of the right water infrastructure in the right area is considered key to realising the vision set out in Our North, Our Future: White Paper on Developing Northern Australia (2015).

The project aligns with the priority area of water security.

Australian Infrastructure Plan

The Australian Infrastructure Plan (2016) states that infrastructure investment in Northern Australia should enhance the nation's regional productive capacity to take advantage of growing demand for Australian produce in places such as Southeast Asia and China. It also notes that successful irrigated agriculture depends on reliable and secure water resources. The Northern Australia Audit: Infrastructure for a Developing North (2015) highlighted the potential for new dams to support prospective agriculture.

The project aligns in that it will enhance regional productive capacity to take advantage of growing demand for Australian produce in South-East Asia and China.

State Infrastructure Plan

In the State Infrastructure Plan (2016), the Queensland Government indicates that water supply infrastructure should be in place where there is a sound Business Case and water resources are available. Solutions should be evaluated and determined after water needs are assessed.

The project supports the key outcome, such as:

- Water supply infrastructure where there is a need and water resources are available
- Supporting the water needs of local governments
- Capturing a valuable finite resource (water) and increasing its availability to Queenslanders.

Queensland Bulk Water Opportunities Statement

The framework by which new proposals for water storage are considered is outlined in the Queensland Bulk Water Opportunities Statement (2018). For new water storage projects to proceed, the proponent currently needs to have commitment from foundation customers to take the water that will be made available. This allows long-term contracts to be put in place ensuring that construction costs will be recouped and revenue will be ongoing. The objectives of the Queensland Bulk Water Opportunities Statement include:

- Safety & reliability of urban water supplies
- Use existing water resources more efficiently
- Support infrastructure projects that provide a commercial return to bulk water providers
- Consider projects that will provide regional economic benefits.

Consultation with the broader community, State agencies, irrigation groups and landholders seeking available and reliable water supply has been undertaken. Interested parties have confirmed a long-term commitment to the water allocation should the project proceed. Therefore, the project aligns with these objectives and furthers water security for Charters Towers and economic growth within the region.

Queensland's Agricultural Strategy

Queensland's Agricultural Strategy (2013) highlights the importance of agricultural industries to the state economy and the social fabric of rural and regional communities. Most jobs in agriculture and half of all jobs in food processing are regionally based. One of the four key pathways to grow Queensland's agricultural production – securing and increasing resource availability – focuses on enabling agricultural growth through optimal use of critical resources including land and water. The strategy outlines the government's intention to improve access to, and reliability of, water supplies for agricultural producers. Delivering secure and defined water entitlements for agriculture was identified as a key initiative to achieve this aim.

The project aligns with the strategy of improving access to reliable water for agriculture.

6. Potential project impacts

Key environmental, social and economic impacts have been identified through a desktop review of the existing environment and baseline ecological survey.

6.1 Natural environment

6.1.1 Land

Soil profiles will likely be disrupted during the construction phase of the project. Topsoil will be removed as a result of earthworks associated with trenching and grading. Access routes and work areas will be compacted through use of areas by heavy machinery and earthmoving equipment. There is the potential for erosion once vegetation has been cleared and soil is exposed to the effects of wind or rain. Sediment laden runoff has the potential to degrade water quality within the project area and at sites downstream.

Hydrologic and hydraulic modelling was undertaken for the Reference Design by conducting a Flood Frequency Analysis and TufLOW HPC to determine the design flood characteristics for the site and surrounding area. From this modelling it was determined that the incremental flood impacts due to construction of the weir are likely to be negligible, with little to no change observed in the inundation mapping following development of the weir when the Burdekin River is flowing above bank full conditions. The potential for the project to result in increased flooding was also raised as a concern by several stakeholders (including surrounding landholders and traditional owners) as part of the SIE consultation. Whilst initial modelling undertaken for the Reference Design suggests that the project would not result in significant increased flooding or other hydrogeological impacts, further detailed hydrologic and hydraulic modelling will be undertaken as part of the Detailed Design phase to confirm that EFOs can be achieved and that any potential flooding is avoided or appropriately mitigated and managed.

6.1.2 Water

Surface water

Construction activities may result in temporary, localised impacts on surface water through:

- Increased turbidity through terrestrial sediment laden runoff as a result of ground disturbance (excavation, earthworks, road construction, vegetation removal or on-site cleaning activities)
- Increased turbidity and sedimentation as a result of in-stream works
- Disruption of downstream flows as a result of weir construction within the bed and banks of the river
- Pollution of waterways through contaminant spillage, release of untreated water from storages or through dewatering.

Disturbance of the ground cover and vegetation clearing are required for construction and has the potential to expose surfaces to runoff and erosion. Material, whether it is sediment or other contaminants (including nutrients and metals), has the potential to mobilise directly into the waterways via runoff.

Machinery, equipment and materials used in the construction of the access track and weir will contain oil and fuel which could potentially result in the introduction of contaminants to the aquatic environment in the event of a spill or leak.

Operational impacts to surface water will include impacts to water and fish movement through the waterway, as well as an increase in sediment load at the weir as a result of impediment of water flow.

Groundwater

Construction activities will not directly impact groundwater infrastructure as there are no registered bores within the construction footprint. The proposed works are considered unlikely to affect groundwater systems in the surrounding area.

6.1.3 Ecosystem

Loss and degradation of vegetation and terrestrial habitat

Construction

Impacts associated with construction of the project have been avoided as far as practicable and will be minimised by locating the ancillary infrastructure, such as laydown and borrow areas, soil stockpiles, and machinery/equipment storage in open areas that have been previously cleared or degraded. Despite this, construction of the project will involve clearing of riparian and mixed woodland vegetation within the construction footprint of the weir, fishway, saddle dam, access tracks, temporary laydown areas and Big Bend floodway as shown in Table 6-1.

The extent of Least Concern RE (as mapped by DNRME) within the proposed storage area is also included Table 6-1. While this vegetation will not be subjected to any mechanical clearing during the construction phase, the immediate loss of habitat (vegetation on rocky outcrops and sandy levees) and gradual dieback of larger trees located below the high banks of the Burdekin River is expected to occur as the weir fills and is drawn down regularly through operation.

Table 6-1 Proposed extent of vegetation clearing

Component of the project	Extent of Least Concern RE to be disturbed/cleared (ha)
Weir	0.27
Fishway	0.23
Saddle dam	0.05
Widening of existing access track (to approx. 10m wide)	1.80
Extension of new access track (approx. 10m wide)	0.57
Temporary laydown areas	6.51
Concrete floodway (at Big Bend Recreation Reserve)	0.14
Storage area at FSL (inundation of mapped REs within the Burdekin River)	323.30
Total	323.87

The above extent of vegetation disturbance/clearing has been calculated using DNRME's regulated vegetation mapping. The actual on ground extent of vegetation disturbance/clearing is anticipated to be much less (approx. 41.81 ha) based on a review of aerial imagery for the project area and removing non-vegetated areas within the bed and banks of the Burdekin River that appear to be predominately characterised by sand and water (approx. 291.06 ha). Therefore, the extent of actual vegetation disturbance/clearing is calculated as 332.87 ha - 291.06 ha = 41.81 ha.

No conservation significant REs or TECs are known to occur within the proposed areas of impact. The vegetation communities present are common and well represented within the local landscape.

The loss and degradation of vegetation as a result of project construction activities will decrease the diversity and availability of resources for terrestrial fauna species within the immediate local area. While impacting upon smaller, less mobile animals (i.e. small reptiles, rodents, frogs), the selective clearing of a limited amount of vegetation is considered unlikely to constitute a substantial impact on local faunal assemblages which are adapted to a fragmented landscape. The existing vegetation at the site of the proposed weir is fragmented and degraded by cattle, and as such, does not represent important fauna habitat for conservation significant species that were confirmed present or are likely to occur. A fauna spotter catcher will be present on site during all vegetation clearing to relocate fauna, and therefore, minimise injury and mortality on less mobile species.

Based on field observations, the largest contributors to habitat degradation within the study area is historic land clearing associated with agriculture, livestock (within the riparian zone and in shallow water areas), feral animals and weeds. Construction activities have the potential to introduce and / or spread weeds, which can increase the edge effects associated with vegetation clearing. Generally, the landscape surrounding the inundation area is partially fragmented, and as such, isolated patches of vegetation are presently exposed to these processes. Earthworks and increased vehicle movements associated with construction activities at the weir site have the potential to exacerbate local levels of weed infestation.

Construction activities may also foster greater utilisation of the area by introduced fauna. The incorrect disposal of rubbish and other refuse may encourage competitive introduced species including pigs, dogs, foxes and cats to the area, which in turn may increase predation pressure on local native wildlife. These species may also out-compete resident native predators. The potential risks from weeds and pest species will be mitigated by the implementation of a site specific construction environmental management plan (CEMP) and operational phase environmental management plan (EMP) governing construction and operation of the project.

Operation

The construction of BRW will result in the inundation of vegetation within the riparian zone along the Burdekin River. This inundation zone will not exceed the Burdekin River banks which routinely flood naturally. This inundation will result in the loss and alteration of vegetation communities and fauna habitat.

Vegetation will not be cleared prior to impoundment and consequently total habitat loss within the expected inundation area will occur over a prolonged period as the weir fills and is drawn down regularly through operation. On first filling, it is anticipated that an immediate loss of ground cover vegetation within the impoundment will occur. Larger and woody vegetation such as trees will remain for a period of time before dieback occurs. Given that water levels in the impoundment will rise and fall with filling and drawdown, habitat loss at the limits of the impoundment will occur more gradually, in response to intermittent inundation.

The riparian zone within the expected area of inundation is already disturbed through clearing, weed infestation and cattle grazing and no conservation significant REs, TECs or flora species are known to occur. The area of inundation does provide suitable habitat for terrestrial fauna with desktop reviews and field surveys identifying that species present are primarily generalist species that are widespread and relatively abundant in the study area and the wider North Queensland region. Potential impacts on flora and fauna associated with habitat loss and / or alteration within the inundation area may include:

- Loss of mature trees, particularly *Melaleuca spp.*, *Eucalyptus spp.* and *Corymbia spp.*, over time (months to years) in the riparian zone that provide foraging (leaves, nectar, pollen, fruit, sap and invertebrates), breeding and sheltering/roosting/nesting resources (e.g. tree

hollows and shedding bark) for a range of woodland and forest birds, arboreal mammals and bats.

- Short-term reduction in dense, low growing riparian vegetation along the main river channels and creeks that provide habitat for small woodland and forest birds and ground-dwelling mammals.
- A reduction in availability of habitats supporting a structurally complex ground layer that is inundation of riparian habitats supporting fallen timber, log piles, leaf litter and burrowing / cracking soils that provide habitat for reptiles.
- Short-term loss of overhanging vegetation that provides perching habitat for kingfishers, cormorants, raptors and the eastern water dragon (*Physignathus lesueurii*). The loss of this overhanging vegetation also reduces suitable nesting habitat for birds including cormorants and egrets.
- Short-term loss of existing marginal and emergent vegetation in shallow water aquatic habitats utilised by waterbirds such as ducks, egrets, herons and storks as well as small fish, macroinvertebrates and turtles.
- Inundation of sand banks and rocky outcrops which may support waterbirds, mammals and reptiles.
- Creation of habitat for waterbirds such as ducks and pelicans through the increase in permanency of water within the impoundment.

The inundation of riparian vegetation and the disruption to terrestrial habitats bordering the new full supply level of the impoundment may also foster habitat degradation. This degradation may result from:

- Edge effects occurring in newly fragmented riparian habitat.
- Isolation of remnant vegetation patches, allowing for domination by generalist and invasive plants and animals.
- Increased competition for resources in riparian vegetation habitats due to a reduction in the overall extent of this habitat.
- Adverse impacts associated with edge effects include:
 - Increased penetration of light and wind into habitat patch, potentially altering vegetation communities
 - Alteration to microclimate.
 - Increased invasion of exotic plants and animals.
 - Increased sensitivity to fire.

For the most part, impacts of habitat loss and degradation are considered to be short-term with fauna having the ability to move between areas of suitable habitat returning once vegetation has re-established above the impoundment.

Conservation significant fauna confirmed present or considered likely to occur within the study area include the squatter pigeon (southern), greater glider (northern), short-beaked echidna, koala, and seven migratory bird species. Some loss of habitat and habitat resources for these species is expected to occur as a result of the inundation of riparian vegetation within the BRW impoundment. Due to the small area of vegetation that is expected to be lost or altered, impacts to these species are not expected to be significant; however, assessment against significant impact guidelines will be undertaken following wet season surveys and finalisation of project impact areas.

Loss and degradation of aquatic habitat

Construction

Excavation of the bed and banks as part of construction activities for BRW, saddle dam and Big Bend floodway will result in the direct loss of aquatic habitat for aquatic fauna. Aquatic habitat within the BRW construction area includes shallow and deep isolated pools, slow flowing channels and undercut banks. The area of habitat to be lost as a result of construction activities is however, relatively small in size compared to the availability of similar habitat upstream and downstream of the sites and no habitat for conservation significant species occurs. Additional loss of aquatic habitat has the potential to occur within Lolworth Creek associated with construction of the access track crossing. Construction footprints should be kept to the minimum amount necessary in order to minimise impacts to aquatic flora and fauna.

Construction works located within and adjacent to the river channel, have the potential to degrade the quality of habitat through increased erosion and run-off and introduction and spread of invasive weed. These activities have the potential to affect water quality resulting in altered water chemistry (including increased turbidity, decreased oxygen levels, reduced light penetration), changes in channel morphology (including filling of pools), alteration of substrate composition and smothering of habitat resources (Wood and Armitage 1997; Wheeler *et al.* 2005). Unmitigated these impacts may have a localised effect on fauna by reducing habitat value (e.g. amount of refuges, microhabitats and food availability) within the immediate and downstream areas. The potential ecological consequences to the species may include a temporary and localised decrease in fauna abundance and decrease in breeding success. Use of construction machinery in and around aquatic habitats also has the potential to result in the spillage of contaminants, such as fuels and lubricants. In severe cases, chemical pollution of the aquatic environment could result in mortality of aquatic fauna and long-term degradation of aquatic habitat. Strict environmental controls and management actions will be implemented to avoid and/or minimise the potential for proposed actions to degrade terrestrial and aquatic habitat. These management actions will be embedded within a CEMP.

Operation

Aquatic habitat within the Burdekin River will be altered as result of BRW through the conversion of flowing pool-riffle-run sequences to a more homogenous lentic impounded pool. Habitat alteration will occur on commissioning and persist through operations as the weir fills and is drawn down regularly. The lower reaches of the Keelbottom Creek are also likely to experience varying degrees of alteration resulting from changes in connectivity and hydrology. Habitat alteration is expected to include the inundation of periodically dry creek bed and banks. The extent of this alteration will be more notable in and adjacent to the lower reaches of the weir impoundment.

Operation of the proposed BRW can be expected to result in impacts on water quality at the site. Potential water quality impacts arising from the proposed weir operation may include:

- Decomposition of plant material and subsequent release of nutrients in areas of inundation within the impoundment.
- A reduction in dissolved oxygen and temperature stratification within the water column as a result of the riverine system changing to deep, slow flowing pools.
- Mobilisation of contaminants in areas of contaminated land (if present).
- An increase in the presence of blue-green algae.

Changes in water quality will primarily occur within the impoundment, however, downstream habitats may also be affected should waters of lower quality be released.

No palustrine or lacustrine wetland areas will be directly impacted by the proposed weir. Water levels within the impoundment will remain within the high banks of the existing river with the weir wall drowning out completely during flows above this level. As such, flow events that naturally breakout of the river banks and form overland flows will not be impacted by BRW. No impact to seasonality, duration, frequency and volume of water entering and leaving the off-stream water bodies is expected to occur. Consequently, it is not expected that the proposed weir will impact the specific habitat characteristic of the off-stream water bodies (including the Great Basalt Wall DIWA, Wetland Protection Areas and HES wetlands) and their value for aquatic flora and fauna.

Aquatic fauna in the Burdekin Basin are adapted to the highly dynamic and variable nature of the system. These adaptations are represented by the specific foraging, breeding and sheltering preferences of the species that occur within the system. A review of the ecology of fish species known to occur within the Burdekin Basin catchment revealed that most species prefer (or are tolerant of) the still or slow flowing conditions that are present in pool habitats (Pusey *et al.* 2004; Allen *et al.* 2003). The conversion of pool-riffle-run sequences to a weir impoundment will most adversely impact species that prefer flowing water and high levels of instream habitat.

The impounded habitat created as a result of the weir will be generally characterised by a deep, wide river channel, slow to zero flow, poorer quality clay/silt substrate, lower density of in-stream debris and lower density of overhanging riparian vegetation. The deep water benthic areas (5 to 10 m deep) that will dominate the weir pool habitat directly behind the weir wall are expected to be sub-optimal to most aquatic fauna species due to low oxygen levels, little or no light penetration and relatively colder temperatures. The upper water column within the more open inundation area is likely to provide suitable habitat for species such as large bodied fish – sooty grunter, barred grunter, bony bream and the Krefft's river turtle. Many other species are likely use the inundated habitat intermittently with low abundance of micro-habitats and food resources generally limiting permanent occupancy of more open water habitats.

In general, suitable habitat for aquatic fauna will occur within the shallow littoral habitats along the perimeter of the inundated area and within the upper extent of inundation. These areas will contain a higher diversity of in-stream microhabitats such as fallen logs and root mats and food resources. Macrophyte communities are also likely to re-establish in the upper reaches with the frequency of water level fluctuations expected to impact macrophytes growth within the main impoundment.

Overall, the alteration of natural riverine habitats within the BRW footprint will reduce the heterogeneity of the river system and therefore the diversity of habitats available to aquatic fauna. Ecological consequences are expected to include variation in relative abundance of fish and turtle species. An upsurge in macroinvertebrate diversity and abundance within the proposed BRW, is predicted to occur immediately following inundation due to the release of nutrients from newly inundated soil and vegetation (Baumgartner 2005). However, following this initial productivity, nutrient depletion and habitat homogeneity is expected to result in a decline in macroinvertebrate diversity and fewer pollution sensitive taxa when compared with riverine sites (Duivenvoorden *et al.* 2000; Baumgartner 2005).

Fragmentation of riparian habitat

Construction and operation

Most of the landscape surrounding the inundation area has been partially cleared, predominantly for agriculture. This is particularly the case on lowland alluvial floodplains, where cattle grazing on cleared pasture is the dominant land use. Vegetation in these otherwise cleared or fragmented landscapes tends to be concentrated along the riparian fringe of the Burdekin River and adjoining creeks.

Extensive open woodland communities on low rocky hills and rises, and less disturbed open woodland on sandy levees represent important habitat nodes within the disturbed landscape matrix. These habitats are likely to act as a source for fauna dispersal across the landscape. Fauna dispersal across the fragmented landscape is likely to be facilitated, at least in part, by vegetation corridors adjacent to the Burdekin River and adjoining creeks.

The impoundment of riparian vegetation resultant from the project has the potential to disrupt connectivity between habitats, thereby further fragmenting habitats within the inundation area (and the wider study area). This reduction in connectivity along the riparian zone is likely to be most notable where only a thin strip of fringing riparian vegetation, abutted by cleared agricultural land, occurs. The inundation and drowning of this vegetation will disrupt the corridor along which fauna can move between more extensively vegetated habitats. This is likely to be of particular consequence to more mobile species that undertake occasional to frequent foraging, reproductive and / or dispersal movements, and / or species that may become more exposed to predation due to reduced habitat connectivity.

The increased width of permanent pools within the river channel, and the reduced occurrence of shallow water and seasonally dry riverine habitats will also reduce the ability of terrestrial fauna (namely mammals and reptiles) to move back and forth across the river.

The potential impacts of reduced connectivity and subsequent habitat fragmentation on common terrestrial fauna (namely reptiles, small ground-dwelling and arboreal mammals and birds) and species of conservation significance (such as the greater glider (northern) and koala) may include:

- Greater competition (intraspecific and interspecific) for resources in increasingly isolated habitat patches in an already fragmented landscape
- Increased habitat degradation due to concentration of animals in isolated patches.
- Dominance of isolated habitat patches by competitive, generalist species (plants and animals).
- Increased exposure to predation for animals that are forced to move across disturbed, open landscapes.
- Greater magnitude of impact of environmental changes (fire, drought, disease etc.) when animals are unable to move between habitat patches due to hostile surrounding land use (unsuitable resources, greater risk of predation).

While the impoundment has the potential to disrupt terrestrial fauna movement corridors, bioregional corridors will still prevail directly adjacent to the high water level of the impoundment.

6.1.4 Flora and fauna

Individual fauna injury and mortality

Construction

Construction activities associated with the project will involve a temporary increase in vehicular traffic and plant movement to, from and at the site, including traffic on existing and new access roads. This has the potential to increase the incidence of wildlife and livestock mortality from vehicle strike. Fauna at particular risk of vehicle strike include ground-dwelling bird species and reptile species that commonly occur on tracks throughout the region.

Clearing to facilitate construction (including along access tracks) may also result in direct mortality to individual animals residing in trees and other vegetation, and within ground cover,

litter or debris to be cleared. Similarly, aquatic fauna may experience direct injury and/or mortality if individuals are present within the areas of disturbance at the time of works.

Key mitigations for the protection of terrestrial and aquatic fauna are listed below and include the requirement for a fauna spotter/catcher to be present on site during vegetation clearing, during initial site works and works within the bed and banks where aquatic fauna risk injury.

Operation

Injury and mortality of terrestrial fauna may result during rapid filling of the impoundment when less mobile animals are caught within the inundation area. Native fauna in the Burdekin River exist within a system in which flooding (often rapid and extensive) is a regular event and most animals are able to seek refuge above rising flood water and similarly it is expected that animals will move away from rising water within the impoundment. The inundation of terrestrial habitats above typical high flow mark at the proposed BRW is likely to result in the death of less-mobile animals that are unable to retreat from the rising water. Small terrestrial animals within the impoundments such as skinks, geckos, rodents and juvenile animals in nests or borrows, may be trapped by rising water and be injured or drowned.

Beyond the initial filling of the construction of BRW, regular draw-down and filling of the storage during operation is considered unlikely to result in significant fauna mortalities. Vegetation is expected to re-establish on riverbanks at the FSL and loss of vegetation from within the impoundment will deter use of the impoundment for foraging and breeding by terrestrial fauna species. Water levels within the Burdekin River fluctuate annually in their natural state (high flows and flood to no or very low flow) and it is considered unlikely that the operation of the weir will have a notable long-term impact on upstream terrestrial fauna. During operations, as draw-down occurs, livestock and kangaroos have the potential to become bogged directly behind the impoundment where fines may build up creating soft sediments.

During operation, injury and mortality can occur when aquatic fauna (in particular freshwater turtles and fish species) are swept over the spillway during periods of high flow. Fish species are particularly susceptible to shearing and abrasion injuries from contact with hard structures in the downstream pool and contact with the spillway during flooding events. Fish are also vulnerable to gill, eye and internal organ damage from the sudden changes in velocity and pressure that occur as the fish are swept over the spillway or through undershot gates (Larinier 2000m, Baumgartner *et al.* 2006). Freshwater turtle injury and mortality is commonly associated with entrapment on trash screens, contact with hard surfaces and aggregations of turtles within areas of intermittent flow velocity.

Disruption to behaviour of localised terrestrial and aquatic fauna

Construction

Construction activities will cause a temporary localised and intermittent increase in light, noise and vibration adjacent to construction sites. This has the potential to cause short-term disruption to the behaviour and activities of nearby wildlife. There are no noteworthy fauna communal nesting, breeding, roosting or foraging resources directly adjacent to the construction footprints. Nevertheless, construction activities have the potential to deter terrestrial wildlife from foraging, drinking, seeking shelter or nesting within the vicinity of construction activities. Construction activities may require works to be undertaken at night. In the event that lighting is required to facilitate night works (for example concrete pour operations), there is potential for light pollution to disrupt nocturnal fauna behaviour.

Increased levels of disturbance (e.g. from noise, vibration, light, vehicles, machinery, personnel) also have the potential to disrupt the behaviour and dynamics (i.e. foraging, movement) of aquatic fauna inhabiting the river channel within and adjacent to the construction footprints.

Behavioural changes expected to occur include avoidance and evasive (startled) movement leading to displacement from habitat and loss of resources within the direct areas of impact.

Water flow within the Burdekin River will be impacted as a result of construction activities and therefore upstream and downstream movement of aquatic fauna is likely to be restricted through the construction period. Weir construction and upgrade of Big Bend floodway within the river channel is expected to primarily be undertaken during the dry season when flows are reduced and the river is more likely to exist as a series of isolated pools. Movement of aquatic fauna during this period is likely to be low. An in-stream flow diversion strategy will be developed to maintain flows during construction and provide safe aquatic fauna passage during the construction phase flow events.

Restriction of fauna movement

Construction and operation

The Burdekin River and Lolworth Creek are both categorised as major (purple) waterways which indicates that there is a high risk of impact from waterway barrier works. During operation, in-stream structures such as the weir wall, saddle dam and Big Bend floodway will represent an impediment to the movement of aquatic fauna. This disruption to connectivity along the continuum of the river not only has the potential to fragment populations and habitats, but also potentially impedes the life-history behaviour of aquatic fauna occurring within the system.

Tropical freshwater fish regularly move among spawning, feeding and refuge habitats (Lowe-McConnell 1987; Lucas and Baras 2001) and free movement of fish within the river system is thought to be crucial in order to maintain viable populations (Marsden and Power 2007). The diversity of fish within the upper reaches of the Burdekin River has been influenced by existing waterway barriers including Charters Towers Weir and the BFD, located approximately 23.9 km and 180 km downstream of BRW, respectively. Burdekin Falls is a natural barrier to fish movement and as such the fish community upstream is naturally comprised of potamodromous (species that move wholly within the freshwater environment) species only. Some diadromous species (species that move between freshwater and marine environments), have been artificially stocked within BFD but do not naturally occur (Pusey *et al.* 2004).

No conservation significant fish species occur at BRW, however, a number of fish species are likely to be negatively impacted by the restriction of movement in the absence of mitigation measures proposed below. These species include, long-finned eels, leathery grunter, spangled perch, Hyrtl's tandan, Rendahl's catfish, eastern rainbowfish and empire gudgeon, all of which undertake spawning migrations during flow events (Reynolds 1983; Stuart 1997; Stuart 1999; Pusey *et al.* 2004). The potential ecological consequence of the restriction of fish movement can include declines in abundance, species distribution truncation, localised extinction events and a reduction in species diversity (Marsden and Power 2007).

Other aquatic fauna, including turtles and macroinvertebrates, are also likely to be impacted by the restriction of movement past the weir wall. The home range size of freshwater turtles is generally relatively small, however, long-distance (>10 km) migrations can occur for the purpose of dispersal, repositioning following flood displacement and reproduction (Tucker *et al.*, 2001; Hamann *et al.* 2007). BRW is likely to restrict these migrations which may lead to fragmentation of populations, disruption of breeding and aggregation of some species (particular the Krefft's River turtle) within the stilling basin below the weir wall. A reduction in diversity of macroinvertebrates downstream of BRW is also likely to occur as a result of the impediment of downstream drift (Marchant and Hehir 2002).

Minor impacts to the downstream flow regime

Operation

The operation of BRW is predicted to result in a change to the downstream flow regime between the weir and upper inundation limit of the existing Charters Towers Weir. The timing and quantity of releases downstream is likely to vary between seasons with the dry winter period expected to trigger the highest demand for water resources downstream. As a result, water flows downstream will increase during the dry season and the frequency and duration of no flow periods will decrease. The increase in flows during the dry season has the potential to improve the quality of aquatic habitat downstream by reducing the duration and severity of pool isolation and prolonging the presence of flowing riffles zones and runs. The increase in habitat availability during the dry season will provide additional resources for aquatic fauna during times when conditions would be limiting under pre-development conditions. The diversity and abundance of macrophytes and macroinvertebrates, is likely to change with a potential increase in species that prefer flowing conditions and a reduction in species that prefer slow flowing and ephemeral habitats.

The operation of the proposed weir is also likely to result in a reduction in the frequency and magnitude of small to medium downstream flood flows. Flood flows entering the impoundment are likely to be captured and stored until the weir reaches its FSL. This will result in the reduction of flows downstream (or at least a lag in the flow downstream) and is most likely to occur at the start of summer when the storage is predicted to be at a minimum in most years. It is noted that this lag is expected to be of short duration. Once the weir reaches its FSL, downstream flows will increase however the magnitude of the events will be reduced compared to existing conditions. Large flood flows, i.e. weir drown-out will, however, not be affected by the proposed infrastructure.

Releases of water from the proposed BRW will be made in accordance with the *Water Act 2000* and EFOs outlined in the Burdekin Water Plan and Resource Operations Plan. These EFOs have been specifically nominated to maintain base flows and other ecologically important flow characteristics, for the protection of environmental values throughout the Burdekin River Basin. Compliance within these objectives will minimise adverse impacts of BRW on ecological values both upstream and downstream.

Further detailed assessment in the form of yield modelling will be undertaken within the Detailed Design phase to optimise systems and accurately identify potential project impacts on upstream and downstream EFOs and flood flows. Further engagement with DNRME will also be undertaken to establish a set of operational rules for BRW which ensure any potential impacts on EFOs are able to be managed under the Burdekin Water Plan.

6.2 Amenity

6.2.1 Noise and vibration

The nearest sensitive receptors to the proposed weir site are three existing homesteads located to the south-west and south-east of the site. The closest residential dwellings located to the south west of the site are on Lot 20 DV558 at a distance of approximately 1 km and Lot 19 DV558 at just under 2 km. To the south-west of the weir site and across the other side of Gregory Developmental Road is the homestead for Fletcherview Research Station (4 DV450) at a distance of almost 2.5 km.

Given the remote and rural nature of the project area, existing noise levels are likely to be low, and dominated by typical rural activity, road usage and environmental contributors. The project involves the construction of a weir and associated access road. These activities have the potential to generate additional noise and vibration, with construction activities likely to contribute to noise emissions including:

- Earthworks
- Drilling
- Rock stabilisation
- Concrete batching
- Increased vehicle movements
- Other general construction activities.

Operational equipment that may contribute to noise and vibration include:

- Increased recreational opportunities that may lead to noise increases
- Minor increase in traffic to and from the weir for maintenance activities.

The limited predicted increases in noise is therefore not expected to be a significant impact to surrounding receptors during construction and operation.

6.2.2 Air quality

Sources of emissions that have the potential to impact on ambient air quality during the construction phase of the project include:

- Dust emissions from mechanical ground disturbance, excavation and vegetation clearing
- Dust emissions from construction vehicles travelling over unsealed roads
- Dust emissions from exposed disturbed soil surfaces
- Emissions from machinery and equipment used.

It is expected that these impacts will be temporary and minor in nature as a result of the location and environment in which the construction activities are occurring. The area is largely rocky and contains sparse vegetation, with the main urban area located within the project surrounds being Charters Towers, approximately 26 km south of the project area.

The operational phase of the weir is considered unlikely to impact on air quality.

6.2.3 Lighting, urban design and visual aesthetics

While not anticipated or encouraged night time works have the potential to occur and therefore lighting may cause some impacts on visual amenity to the surrounding environment. Night time lighting may result in disruptions to the use of the area by fauna species.

The BRW is proposed along the Burdekin River, approximately 26 km north of Charters Towers, Queensland, and 23.9 km upstream from the existing Charters Towers Weir. It is therefore considered unlikely that urban design and visual aesthetics will be impacted by the proposed works.

6.3 Social environment

The definition of social impacts in the SIE is based on the *SIE Guide* (Building Queensland, 2020), where a social impact refers to the net effect of the proposed project on stakeholders. Impacts can be positive and negative and can include impacts on a community, individuals, families, organisations, and agencies, or society as a whole.

As part of the SIE, an initial list of the project's potential social benefits and issues was developed. The scoping of issues was informed by the project description and study team's understanding of the study area. Preliminary scoping was then augmented as other issues and benefits were identified through desktop research and stakeholder consultation.

The initial list of potential benefits and impacts included:

- Landholder impacts – disruption to daily life and business due to project planning activities
- Landholder impacts – loss of amenity during construction
- Landholder impacts – increased water security
- Landholder impacts – increased productivity due to improved water access
- Increased water security at a regional level
- Raised expectations of potential benefits
- Increased employment and business opportunities
- Impacts on social infrastructure (emergency and health services) during construction
- Traffic safety and transport impacts
- Increased recreational opportunities.
- The predicted impacts were identified using a data triangulation process, where possible. This included three sources of data:
 - The social conditions (including trends and forecasts) in the social study area
 - Review of technical assessments or specialist inputs to assessing other impacts as part of the Business Case
 - Inputs from consultation with key stakeholders.

It is anticipated that predicted social impacts and their evaluation may change with any alterations to the socio-economic and political context, or as stakeholder perceptions change.

Significance of the social impacts was assessed through the risk assessment process established in the *SIE Guide* (Building Queensland, 2020), using a likelihood and consequence risk rating provided in Figure 6-1.

The consequence criteria adopted was as follows:

- **Insignificant:** Local and small-scale social impacts. These social impacts provide limited value or costs to society. These social impacts may require future consideration if, for example, there is change to the option reference design.
- **Minor:** Short-term and mostly local social impacts. Positive social impacts provide some value to society. Negative social impacts can be easily adapted to by society.
- **Moderate:** Medium-term social impacts. Positive social impacts can be enhanced to provide substantial value to society. Society has the capacity to adapt and cope with the negative social impacts.

- **Major:** Long-term and potentially far reaching social impacts. Positive social impacts will provide substantial value to society. Society has limited capacity to adapt and cope with the negative social impacts.
- **Significant:** Long-term, high magnitude and far reaching social impacts. Positive social impacts will provide enormous value both locally and regionally. Society has no capacity to cope with potentially catastrophic negative social impacts.

The likelihood criteria adopted was as follows:

- **Rare:** <5% probability. The impact may occur only in exception circumstances.
- **Unlikely:** 5% to 35% probability. The impact could occur at some time but is improbable.
- **Possible:** 35% to 65% probability. This event might occur at some time.
- **Likely:** 65% to 95% probability. The event is likely to occur.
- **Almost certain:** 95% to 100%. The event is expect to occur.

In accordance with the *SIE Guide* (Building Queensland, 2016):

- High risk impacts (red boxes) should meet the materiality criteria of 'significant and relevant' and could influence option design/filtering or reference design
- Medium risk (yellow boxes) social impacts might be considered material but will require further investigation
- Low risk (green boxes) social impacts are not material and require no further investigation.

		Consequence				
		Insignificant	Minor	Moderate	Major	Significant
Likelihood	Almost certain			High		
	Likely					
	Possible			Medium		
	Unlikely					
	Rare	Low				

Figure 6-1 Impact risk assessment

Following completion of the stakeholder consultation, a more refined list and assessment of the social impacts and benefits that could arise from the construction (Table 6-2) and operation (Table 6-3) of the project were identified. Suggested mitigation measures have been provided to mitigate impacts and enhance benefits and impacts that can be monetised are identified.

The SIE was prepared on the understanding that the water storage area was going to be limited to within the banks of the Burdekin River and immediate tributaries. Should the storage area boundaries change, impacts on properties and land use will need to be assessed further in subsequent design phases.

Table 6-2 Social impact evaluation – construction phase

Theme	Impact statement	Nature of impact	Likelihood	Consequence	Risk	Monetised	Mitigation measures	Likelihood	Consequence	Residual risk
Employment opportunities	Construction of the project would generate local and regional employment opportunities through its workforce requirements of approximately 50 workers². This would include works for labour, plant operation, engineering, supervisory roles, administration and management. It is expected that the project would be completed within the dry season of one year. Depending on the availability of suitable workforce, these opportunities will be available for both Indigenous and non-Indigenous labour force. Local employment for both Indigenous and non-Indigenous people in the study area may be challenged due to skills shortage and other challenges such as lack of job readiness and other barriers.	Positive	Possible	Minor	Med.	Yes	Local employment opportunities could be enhanced through the inclusion of local and Indigenous employment and training in the tender evaluation criteria for the project's major contracts. Early engagement with Indigenous representatives, and local training and employment organisations should be undertaken to inform them about employment and business opportunities from the project.	Likely	Minor	Med.

² The 50 person workforce outlined for the construction phase works is based on information provided by WTP from the P50 Business Case Cost Estimate in April 2020. This initial labour estimate was provided to assist with stakeholder consultation and SIE discussions in identifying the social impacts and benefits that could arise from the project. Further analysis and refinement of employment opportunities were subsequently undertaken as part of the Business Case which was completed on 21 August 2020. KPMG used the P50 and P90 Business Case Cost Estimate (assuming \$53.8m of capital expenditure) and then applied the Queensland Treasury 2019 'Guidelines FTE jobs supported by capital works' to arrive at 172 FTE positions as being required during the construction period of 2022. The 172 FTE's was based on an estimated 3.2 FTE's per \$1m of capital expenditure (calculated as \$53.8m x 3.2 jobs/\$m = 172 jobs).

Theme	Impact statement	Nature of impact	Likelihood	Consequence	Risk	Monetised	Mitigation measures	Likelihood	Consequence	Residual risk
Business opportunities	Local and regional businesses, including Indigenous businesses would have the opportunity to provide goods and services to the project.	Positive	Possible	Minor	Med.	Yes	Local procurement opportunities could be enhanced through the inclusion of local procurement planning in tender evaluation criteria for the project's major contracts. Early engagement with Indigenous representatives, and local chamber of commerce should be undertaken to inform them about employment and business opportunities from the project.	Likely	Minor	Med.
Spread of weeds	Earthworks and increased vehicle movements associated with the construction of the project have the potential to introduce and spread weeds. The proposed weir site will be accessed via Fletcherview Research Station off of the Gregory Developmental Road. The property is a working cattle station and research centre. The introduction or spread of weeds has the potential to impact on the productivity of the property and increase property management requirements, alongside reducing the amenity of the area for traditional owners.	Negative	Possible	Minor	Med.	Yes	The potential for the spread of weeds can be reduced through the development of a weed and pest management plan that outlines practices to prevent the introduction of new weeds and minimise the spread of existing weeds. Engage with traditional owners to inform the development of measures to reduce the impacts that may occur from vegetation removal.	Unlikely	Minor	Low

Theme	Impact statement	Nature of impact	Likelihood	Consequence	Risk	Monetised	Mitigation measures	Likelihood	Consequence	Residual risk
Temporary change to property use	The project's construction will involve upgrading the current access track on Fletcherview Research Station. Two areas within the same property have also been identified as possible laydown areas. The presence of laydown areas and access routes would result in a temporary change of use on Fletcherview Research Station. The areas used by the project during construction would not be available for use by other users at Fletcherview Research Station, including visiting students. This would be temporary, and within the construction period (dry season of one year).	Negative	Likely	Minor	Med.	No	To reduce the project's impact on the operation of Fletcherview Research Station, the project should engage with JCU and the station manager to establish property access procedures and identify areas for laydowns that will have minimal impact on property operation. The CEMP should include measures to reduce and manage interaction between construction activities and visitors, including haul vehicles, and other users of Fletcherview Research Station.	Unlikely	Minor	Low
Temporary increase in traffic	The project's construction is estimated to generate between 50 to 100 vehicle trips per day. The haul route would include Gregory Developmental Road and an improved access track within Fletcherview Research Station. Residents may notice additional heavy vehicles on Gregory Developmental Road. A traffic and transport study will be undertaken during approval phases to confirm and manage the project's impacts to the road network and road safety.	Negative	Almost certain	Minor	Low	No	The traffic and transport study to be undertaken during project approvals will identify mitigation measures for any traffic and transport related impacts.	Almost certain	Insignificant	Low

Theme	Impact statement	Nature of impact	Likelihood	Consequence	Risk	Monetised	Mitigation measures	Likelihood	Consequence	Residual risk
Changes to amenity	Construction activities are likely to increase traffic and construction related noise and dust in the immediate surroundings, potentially reducing the quiet rural amenity of the surrounding permanent resident landholders. However, it is understood that homes are located at a fair distance from the construction and haul route site and that the construction would be temporary and would occur during day time working hours.	Negative	Possible	Minor	Med.	No	Noise and air quality studies and management plans will be developed as part of the project approval process and implemented during construction.	Unlikely	Insignificant	Low
Changes to amenity	The Gudjala People use the project area for recreational purposes and hunting and food collection. The Gudjala People have expressed concerns in regards to vegetation removal during the project's construction. Vegetation removal may decrease the amenity of the area and in turn, the enjoyment and use of the area for traditional purposes.	Negative	Possible	Minor	Med.	No	Engage with traditional owners to inform the development of measures to reduce the impacts that may occur from vegetation removal. Undertake cultural heritage assessment and CHMP in consultation with the Gudjala People and NQLC.	Unlikely	Minor	Low

Table 6-3 Social impact evaluation – operation phase

Theme	Impact statement	Nature of impact	Likelihood	Consequence	Risk	Monetised	Mitigation measures	Likelihood	Consequence	Residual risk
Increased water security	The construction of the BRW could provide the Charters Towers community with a higher level of water security. An increase in water storage capacity has the potential to support increased population in the urban area and may support other future industrial uses.	Positive	Almost certain	Moderate	High	Yes	Not applicable. The impact is positive and apart of project design.	Almost certain	Moderate	High
Increased agricultural productivity	The project is estimated to support development of up to 3,000 ha of annual crops with potential for additional perennial cropping (such as table grapes, avocado and mango). It is understood that a transition to annual and perennial cropping would potentially result in increased agricultural productivity leading to further employment opportunities and business development activities.	Positive	Almost certain	Moderate	High	Yes	Not applicable. The impact is positive and a part of project design.	Almost certain	Moderate	High
Improved access to Big Bend Recreation Reserve	Currently, no formal crossing exists to Big Bend Camping Ground and visitors to Big Bend use a 4WD access track across the Burdekin River. The project will establish a concrete culvert crossing to the reserve, which will maintain safe access to the Big Bend Camping Ground during the dry season and at full supply level for the weir.	Positive	Almost certain	Minor	Med.	No.	Not applicable. The impact is positive and a part of project design.	Almost certain	Minor	Med.
Increased recreational opportunities	The project will create a water storage area within the banks of the Burdekin River. This has the potential to create opportunities for increased water based recreational activities in the area.	Positive	Almost certain	Minor	Med.	Yes	Not applicable. The impact is positive and a part of project design.	Almost certain	Minor	Med.
Decreased amenity and privacy for landholders	The increased recreational opportunities and improved access to Big Bend Recreation Reserve may increase the number of visitors to the area. The use of motorised boats may be possible in the storage area. The increase in visitation and activities (such as motorbikes and powered boats) may decrease privacy for adjacent landholders, and reduce noise amenity for	Negative	Likely	Minor	Med.	No	To reduce amenity impacts and the potential for anti-social behaviour, CTRC may need to consider establishing water traffic and recreational management / restrictions for users of Big Bend	Possible	Minor	Med.

Theme	Impact statement	Nature of impact	Likelihood	Consequence	Risk	Monetised	Mitigation measures	Likelihood	Consequence	Residual risk
	permanent residents on adjacent properties. There is also the potential for an increase in anti-social behaviour in recreational areas, which may impact on amenity and values of the adjacent landholders. Similarly, the Gudjala People have expressed concern about the current use of the area by recreational visitors and the potential for an increase in anti-social behaviour. The increase in visitation and activities may decrease amenity for traditional owners.						Recreation Reserve and the storage area. The project should engage with traditional owners to inform the development of measures to reduce the amenity and enjoyment of the area that may occur from an increase in recreational use of the area (i.e. cultural heritage assessment and CHMP with the Gudjala People).			
Decreased informal access	Informal access tracks located within the proposed storage area cross the Burdekin River and offer some landholders in the area more direct access to Charters Towers during dry season than using the formal road network. The project's storage area would result in these tracks no longer being accessible. This would result in the loss of a convenient crossing for some landholders.	Negative	Almost certain	Insignificant	Low	No	None. As the impact is low, no mitigation measures suggested or developed at the Business Case phase.	Almost certain	Insignificant	Low
Increased area of permanent water retention	Based on the extent of the storage area and full supply level, the project would result in water being retained on a permanent basis on some adjacent properties, from where it would have otherwise seasonally retreated. The potential for the project area to result in insufficient water downstream and flooding upstream was raised as a stakeholder concern, including Indigenous stakeholders. However, hydrology modelling indicates that the project design would not result in increased flooding or other hydrogeological impacts.	Negative	Almost certain	Insignificant	Low	No	None. As the impact is low, no mitigation measures suggested or developed at Business Case phase.	Almost certain	Insignificant	Low

6.4 Economic effects

The identified social benefits and impacts (Section 6.3) associated with the project are also economic in nature.

The initial construction of the weir and associated infrastructure will require capital expenditure, which will provide economic benefits to businesses in the region through procurement of goods and services. Employment opportunities for residents of the region will also be created, particularly during the construction phase of the project but also on a long term basis in the agricultural industry. Direct and indirect employment opportunities will generate both temporary and permanent population growth in the region thus having a flow on effect on the broader economy of the region.

6.5 Built environment

The project has the potential to impact on some aspects of the existing built environment. This includes impacts to the existing access crossing over to the Big Bend Recreation Reserve. Currently, no formal crossing exists to Big Bend and visitors to Big Bend access via 4WD across the sandy overflow area, however, this area is expected to become part of the weir inundation area and will become inaccessible. To maintain access to Big Bend, a crossing will be required, such as a concrete floodway with culverts.

The project will result in an increase in the number of vehicles on Gregory Development Road, and other proximal arterial roads. The increase will be short term and expected to be within the capacity of the road. During construction it is estimated that there will be in the order of 50 to 100 vehicle trips per day and that these vehicles will be within the approved heavy vehicle size limits for the road corridor. It is expected that regular use of the road would be continued. If there were to be any specific impacts, stakeholders would be consulted.

Access to the weir will be via a private access track and will be limited to construction and operations personnel. During operations, it is anticipated that the weir will be monitored up to once a week during periods of the year when the environmental flow outlet is required to be operated or for maintenance purposes. No public access is proposed for the access track and therefore the dirt track is expected to be retained, with no allowance for construction of a permanent bitumen or gravel road.

6.6 MNES under the EPBC Act

The project will be referred for impacts to:

- World Heritage properties and National Heritage places including the GBRWHA and GBR
- Ramsar wetland including the Bowling Green Bay.
- Listed species including the squatter pigeon (southern), greater glider (northern), koala) and seven migratory species.

A significant impact assessment has been undertaken for each MNES species and no significant impact is predicted. Therefore, it is anticipated that the project will be “not a controlled action”.

6.7 Associated and cumulative impacts

In addition to the potential impacts discussed above, there is potential for the project to have associated and cumulative impacts on the surrounding environment, water reserves within the Burdekin Catchment and downstream water quality entering the GBRWHA. These impacts are primarily associated with the expansion of irrigated agriculture in the region as a land use and the construction and operational impacts from multiple water storage infrastructure proposals in the same catchment.

6.7.1 Irrigated agricultural expansion

The increased facilitation of irrigated agriculture through the use of additional water made available by the project has the potential to impact the existing environment. This is related to the potential for additional land clearing and the increase of sedimentation, pesticide and nutrient loads into the Burdekin River catchment associated with agricultural uses.

A consultation process was undertaken as part of the BRW Business Case with potential users of water from BRW. Through this process, landholders identified 1,324 ha of known, existing cleared agricultural land suitable for high value irrigated agriculture, of which 683 ha is currently under irrigation. Additionally, other landholders have identified further areas of land that may be suitable for high value agriculture. Based on this feedback, no additional land clearing beyond what already exists or has been approved is anticipated to be required to support the proposed demand and potential volume of water supplied by the project (TEL 2020).

A range of crop types were considered to inform the development of demand scenarios for the BRW Business Case. Crops types were selected on the basis of regional suitability and stakeholder consultation and validation, and included:

- Type A – Hay: Rhodes Grass
- Type B – Annual Horticulture: Rockmelon, Watermelon, Capsicum, Pumpkin
- Type C – Perennial Horticulture: Avocado, Oranges, Lemon, Table Grapes.

Through consultation with existing landholders, it was indicated that there is strong support and demand for high reliability water in order to produce a mix of all crop types. Local irrigators also indicated a strong preference to move toward the irrigation of high-value agriculture crops such as perennial crops, which are currently unable to be supported given the low degree of water reliability during key periods across the year. It is therefore considered that there would be sufficient demand and uptake of production for all crop types.

Determination of the nature and scale of facilitated impacts associated with a potential increase of sedimentation, pesticide and nutrient loads associated with agricultural uses will be subject to the outcomes of further detailed land suitability assessments, landholder negotiations, cropping types and the identification of appropriate land use and management practices, including erosion and soil protection management. It is considered that this should be investigated separately from the impact assessment process for BRW as details will largely be market driven and dependent on decisions made by individual landholders which are unlikely to be able to be investigated and finalised within the tight timeframes required to secure project approvals for construction of BRW in 2022.

An assessment has also been undertaken in accordance with the Significant Impact Guidelines 1.1 (DoE 2013) for a World Heritage property to determine the potential for project related impacts to the GBRWHA and subsequent GBR National Heritage place. The assessment concluded that with adoption of the proposed mitigation and management measures, no World Heritage values will be lost, degraded, damaged, notably altered, modified, obscured or

diminished as a result of BRW and therefore no significant impact on a World Heritage property is anticipated to occur as a result of the proposed development.

6.7.2 Impacts associated with other proposed water storage infrastructure

Currently, there are a number of other potential water storage infrastructure projects proposed within the Burdekin Catchment. These include the BFD (raising), HGD and Urannah Dam.

The BFD (raising) is located on the Burdekin River with a current capacity of up to 1,860,000 megalitres. The project is proposed to raise the existing dam full supply level by at least 2 m and possibly up to 6 m. HGD has the potential to support up to 50,000 ha of irrigation through a 2,100,000 megalitres Dam, bolstered by 3 downstream irrigation weirs. Urannah Dam is proposed on the Broken River with a capacity of up to 940,000 megalitres supporting an irrigation precinct in the order of 25,000 ha and an associated water distribution network including water supply pipelines and instream distribution north to Peter Faust Dam and south towards Moranbah.

BRW with a capacity of 10,000 megalitres and supporting approximately 3,000 ha of irrigation is comparatively small to the other proposed developments. However, all of these water infrastructure developments are located within the same catchment. Hence there is potential for these projects to result in cumulative impacts on the catchment water reserves, operational interrelationships of the proposed associated storage and the ability to maintain current water quality objectives and availability for existing licenced water uses.

Initial development options and yield modelling undertaken as part of a water resource assessment for the Reference Design identified the potential for small impacts to the Charters Towers water supply, existing unsupplemented irrigation demands and one of the EFO metrics in the immediate subcatchment area. Potential mitigation strategies to be explored in the Detailed Design phase include further refinement of the final combination of demands (i.e. direct demand volume, supplementary irrigation demand volume and water harvesting volume) and operating rules for BRW and the existing Charters Towers Weir to ensure sufficient flow to downstream water entitlement holders and the environment can be met to achieve compliance with the Burdekin Water Plan.

Notwithstanding, BRW is of a vastly different scale compared to the other potential water storage projects in the Burdekin Catchment. BRW is of a relatively localised scale and is only seeking to access unallocated water that is already provided for and currently available within the general reserve and strategic reserve of the Burdekin Water Plan. Hydraulic conditions and potential impacts of large dams also vary significantly to weirs (where the impoundment is contained within the streambed). The construction of BRW will occur over a short timeframe and might only partially overlap with the construction of other water infrastructure projects in the Burdekin Catchment, if at all. Each independent infrastructure project will be responsible for managing relevant environmental values and applying mitigation measures to eliminate or reduce project-related impacts. This includes the development and implementation of site-specific environmental management plans (such as but not limited to a CEMP, operational phase EMP and an ESCP).

7. Environmental management and mitigation measures

7.1 Natural environment

This Section outlines the key environmental management and mitigation measures during:

- Construction/commissioning
- Operation.

Measures to avoid or mitigate potential negative impacts will be documented in a project specific CEMP and operational EMP with various sub management plans, which will utilise a well-established framework to implement the desired environmental outcomes and employ routine and reliable environmental practices to avoid or minimise impacts.

7.1.1 Land

Direct and indirect impacts will be managed through a CEMP and operational phase EMP for the project.

7.1.2 Water

Surface water

Downstream flows will be maintained throughout the construction period and it is not expected that flows will be adversely impacted as a result of the construction of the weir. However, weir construction should be undertaken, where possible, during the dry season to minimise impacts to water flow and water quality. Water quality impacts will be managed through the CEMP.

The alteration of surface flows and increase in inundation areas will impact on the access road to the Big Bend Recreation Reserve. To maintain access to Big Bend, a crossing will be required, such as a concrete floodway with culverts.

For operation the low-level outlet and environmental flow requirements have been determined based on the requirements defined by the Burdekin Water Plan. It has also been determined that the required outlet valve capacity is 200 ML/day to meet environmental flow requirements. The low level outlet will be operated when the weir stops overtopping to augment flows released through the fishway from RL 250.87 m AHD to the minimum operating level RL 244.37 m AHD. Below this level, the outlet may still be operated at a release rate lower than 200 ML/day.

Groundwater

No groundwater mitigation measures are proposed.

7.1.3 Ecosystem

Loss and degradation of vegetation and terrestrial habitat

Design and construction

The loss and degradation of vegetation and terrestrial habitat will be mitigated by:

- Minimising the loss of RE and terrestrial habitat during the design phase by locating the ancillary infrastructure such as laydown and borrow areas in areas that have been previously cleared or degraded.

- Clearly marking vegetation clearing areas on construction plans and in the field. Areas that must not be cleared or damaged must also be identified.
- Locating any additional construction areas or construction sites, such as soil stockpiles, machinery/equipment storage within existing cleared areas.
- Clearly identifying all fauna breeding habitat (e.g. hollow bearing trees) within the project construction footprint and managing in accordance with conditions of an approved Species Management Plan (SMP) for animal breeding places under the NC Act.
- Retaining important habitat features (hollow bearing trees, timber) that will become in-stream snag and perch material.
- Where practicable, commencing revegetation activities in and adjacent to construction areas as soon as possible after the completion of construction.
- Developing and implementing a stringent and site specific CEMP to detail actions and procedures for the protection of the terrestrial environments. The CEMP will include the following actions and sub management plans below to avoid and minimise risks of habitat degradation.
- Developing a Weed Management Plan as part of the CEMP that outlines practices to prevent the introduction of new weeds and minimise the spread of declared weeds. Actions to include:
 - Removing existing weeds within the construction footprint prior to construction activities.
 - Training key personnel on site to be capable of identifying weed species and preventing their spread and translocation.
 - Undertaking daily inspections to monitor control and implementation of appropriate preventative measures for weed and pest species. The construction contractor must control and treat all prohibited and restricted matters in accordance with the Bio Act.
 - Requiring all plant and equipment to be washed down prior to arriving on site, with a declaration stipulating that the plant and equipment is clean, in accordance with DAF 'Ways to Prevent Weed Seed Spread' and the 'Weed Hygiene Declaration' forms.
 - Performing a wash-down of all vehicles, plant and equipment used on site prior to the final departure from site and providing a declaration stipulating that vehicles, plant and equipment is clean.
- Managing pest species in coordination with adjacent landholders and catchment management groups. Identification and management of pest species will be undertaken in accordance with the plans and strategies set out by Biosecurity Queensland in the Bio Act. Likewise, management of declared local pests will be undertaken in accordance with relevant local government strategies and plans, including the Charters Towers Biosecurity Plan 2019 – 2024. Actions to include:
 - Disposing of all rubbish and other refuse that may potentially attract introduced animals (food scraps) in sturdy waste disposal receptacles that are frequently emptied.
 - Preventing access of domestic animals on the construction site.
- Developing and implementing a Dust Management Plan as part of the CEMP to minimise the generation of dust through restriction of speed limits and watering of exposed ground surfaces.
- Developing and implementing Waste and Hazardous Materials Management Plan as part of the CEMP including fuel and chemical storage protocols and spill responses.

- Where practicable, avoid clearing vegetation for the Big Bend floodway. Preferentially locate the floodway in disturbed and/or existing cleared areas to minimise the removal of native vegetation and habitat.

Operation

As a function of operations of the proposed weir, loss and degradation of vegetation and terrestrial habitat will occur. To minimise and alleviate the potential impacts on flora and fauna, the following mitigation measures should be considered:

- Preventing clearing of vegetation prior to filling of the impoundment to retain habitat above and below FSL.
- Reinstating important habitat features (hollow bearing trees, timber) retained during the construction phase.
- Developing and implementing a stringent and site-specific operational phase EMP. Management actions prior to operation of the project to include the preparation of a Weed and Pest Management Plan and ESCP.
- Where relevant, providing vegetation offset to ensure no-net-loss of potential habitat for conservation significant species (in regional context).
- Designing the operational strategy of the proposed weir to consider ecological processes occurring within and adjacent to the impoundment. Rapid drawdowns of the storage should be avoided and water levels should be controlled to allow changes to existing habitat about the margins of the storage to proceed more slowly.

Loss and degradation of aquatic habitat

Design and construction

The loss and degradation of aquatic habitat will be mitigated by:

- Minimising the loss of aquatic habitat during the design phase by locating access tracks and ancillary infrastructure outside waterways.
- Locating any additional construction areas or construction sites, such as soil stockpiles, machinery/equipment storage within existing cleared areas and away from the waterway bed and banks.
- Retaining large woody debris from vegetation clearing for addition to the Burdekin River and Lolworth Creek to provide instream habitat post-construction.
- Using high quality fill for abutments and the saddle dam to minimise the introduction of contaminants into the Burdekin River.
- Restoring bed and banks to pre-existing profiles following completion of works.
- Preparing and implementing a stringent and site specific CEMP to detail actions and procedures for the protection of the aquatic environments.
- Preparing and implementing a project specific ESCP in accordance with practices described in the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline and/or Queensland Division of the Australian Institute of Engineers' Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites. The ESCP will be prepared by a highly experienced certified professional in erosion and sediment control (CPESC) and will include the following methods to minimise degradation of aquatic habitats:

- Installing erosion protection measures in the form of sediment fences where required to minimise the transport of sediment into the Burdekin River, Lolworth Creek and adjacent terrestrial habitats.
- Installing sediment curtains to minimise downstream transport of sediments released during vegetation clearing and earthworks.
- Minimising erosion potential through scour protection treatments at abutments.
- Minimising vegetation clearing and the area of bare ground required for construction to only that which is necessary.
- Appropriately managing and protecting stockpiles.
- Monitoring of water quality conditions (visual and in situ recordings) to identify the potential for water quality degradation within Burdekin River and allow for adaptive management if required.
- Connectivity of the aquatic habitat will be maintained through the installation of a fishway which is appropriate for the passage of aquatic fauna. The fishway consists of a series of prefabricated cone shaped concrete baffles, with the upstream opening positioned in an area of lower velocity. This cone fishway design has been proven effective at providing fish passage for small and medium size fish in other Queensland river systems (Stuart and Marsden 2019).

Operation

The following management measures are proposed to avoid/minimise the potential impact of habitat alteration on aquatic ecological values:

- Preventing clearing of riparian vegetation prior to inundation to create instream and overhanging habitat at full supply level.
- Reinstating important habitat features (e.g. large woody debris) retained during the construction phase.
- Encouraging re-establishment of aquatic habitat within the impoundment through the following actions:
 - Avoiding rapid drawdowns of the storage area to allow for the stabilisation of aquatic habitat around the margins of the impoundment.
 - Promoting the natural regeneration of trees and shrubs.
 - Controlling introduced weeds and feral animals in accordance with an operational phase EMP which will be prepared prior to operation of the project.
- Developing and implementing an operations Water Quality Management Plan in accordance with the operational phase EMP which will be prepared prior to operation of the project.

Fragmentation of riparian habitat

Design, construction and operation

As a function of operations of the proposed weir, fragmentation of terrestrial habitat will occur. To minimise and alleviate the potential impacts on fauna, the following mitigation measures should be considered:

- Maintenance and enhancement of movement conduits for terrestrial fauna through implementation of the operational phase EMP which will be prepared prior to operation of the project and rehabilitation of habitat in key movement areas.

7.1.4 Flora and fauna

Individual fauna injury and mortality

Design and construction

The risk of fauna injury and mortality will be mitigated by:

- Conducting a pre-construction survey for breeding habitat within disturbance footprints to determine the requirement for SMP under the NC Act.
- Enforcing on-site speed limits to restrict the incidence of vehicle strike.
- Minimise the need to travel near dawn or dusk by adhering to standard daytime work hours, limit haulage and delivery of materials to the day time and/or where possible, minimise the number of vehicles travelling during this period through the use of carpooling to transport construction personnel.
- Educating employees regarding the presence of conservation significant species and other fauna and livestock on access roads.
- Erecting temporary construction fencing to exclude mobile animals such as macropods and livestock from the construction areas.
- Checking of trenches, excavations and machinery daily for the presence of reptiles.
- Fauna spotter catchers present prior to and during clearing activities associated with construction to relocate or assist wildlife to disperse into adjacent habitat.
- Fauna spotter catchers present to relocate aquatic fauna where there is risk of injury to fauna prior to and during any works within the river.
- If injuries occur, the fauna spotter catcher will capture and transport the injured animal to a qualified veterinarian for treatment or euthanasia (unless suitably-qualified). Prior to clearing for construction, formalise arrangements with local veterinary services to treat and care for injured animals.
- Clearly demarcating no-go areas of sensitive vegetation and habitat, including all vegetation and habitat not to be cleared.
- Sequential clearing of vegetation to allow resident fauna the opportunity to disperse away from the immediate construction area.
- Further hydrology modelling in the Detailed Design phase to improve the design of the weir to mitigate against mortality or injury to aquatic species during periods of high flows. For example, during a 1 in 1.5 year event, the plunge height (from the top of the spillway to the surface of the water below) decreases from 9.25 m to 5.92 m. Injuries to fish are known to occur when fall velocities over spillways exceed 16m/s, which occurs at heights >13 m. Injuries can be avoided by limiting the free fall of fish to < 13 m. Water depth below the spillway (in the tailwater) increases from 4.85 m to 10.10 m during a flood event. This results in a tailwater buffer depth of 171% of the plunge height.

Operation

The following management measures are proposed to avoid/minimise the potential for fauna injury and mortality:

- Avoiding key design features responsible for high levels of fauna injury and mortality (stepped spillway, dissipater teeth, high turbulence, insufficient pool length and depth, high velocity trash screens) thereby substantially reducing the risk of injury and mortality to fish and turtles.
- Designing the operational strategy of the proposed weir to avoid/minimise risk of fauna injury and mortality. Specific operational actions will include:
 - Controlling the flow of water through release valves to provide gradual increments in water release volume.
 - Depending on design, during planned releases, increase water release during dawn and dusk periods when turtles are more likely to be away from weir infrastructure.

Disruption to behaviour of localised terrestrial and aquatic fauna

Design and construction

Proposed mitigation during the design and construction phases to minimise the impacts of noise, light and vibration disturbance include:

- Minimise the duration of the construction period to the minimum necessary.
- Use noise dampening devices on machinery wherever practical and requiring that all equipment is maintained and serviced in accordance with manufacturer's instructions to reduce noise levels.
- Require soft starts and broadcast of a warning noise so that individuals have a chance to move away from the area before more intense noise and vibrations start.
- Restrict night works as far as is possible during the construction phase.
- Install directional lighting and shields to minimise light spill outside of the immediate work areas having consideration for health and safety requirements.
- Maintain river flow and aquatic fauna movement within its natural course for as long as possible. A flow diversion strategy will be developed to limit river diversion to a single dry season.
- Design temporary river crossings/working platforms in accordance with DAF's '*Accepted development requirements for operational work that is constructing or raising waterway barrier works*'.

Restriction of fauna movement

Construction and operation

The following management measures are proposed to avoid/minimise the restriction of aquatic fauna movement:

- Providing adequate upstream and downstream fish passage for the entire fish community in accordance with State Code 18: Constructing or raising waterway barrier works in fish habitats. A fishway design process should be undertaken in accordance with DAF's Fishway Design Process criteria. This process involves the selection and refinement of fishway design specifications and success criteria and the development of fishway designs. Fish biologists and technical specialists (suitably qualified and experienced in fish passage

biology and fishway design) should participate in the fishway design process to provide key technical input and review. The fishway design options should be assessed against an agreed design specification and success criteria to demonstrate that the fishway design provides adequate fish passage.

- Investigating design options for providing adequate upstream and downstream passage for freshwater turtles during key movement periods.
- Designing and implementing a monitoring program to monitor the effectiveness of aquatic fauna passage infrastructure.
- Submission of a waterway barrier works development application and provision of acceptable fish passage for any waterway crossing or auxiliary access.

Alteration to downstream flow regime

Operation

The following mitigation measures are proposed to avoid and/or minimise potential impacts associated within the alteration to downstream flows:

- Designing the operation strategy of the weir in accordance with EFOs. Where required, yield adjustments and operating rules will be amended to comply with the objectives.
- Developing and implementing an operations water quality management plan in accordance with the operational phase EMP which will be prepared prior to operation of the project. Specific management actions should include:
 - Considering opportunities for multi-level off-takes in weir design.
 - Using selective withdrawal outlets to select water of most appropriate quality for downstream release.
 - Manipulating flows to prevent the build-up of blue-green algae or to disperse blooms.

7.2 Amenity

7.2.1 Noise and vibration

The following mitigation measures in regards to noise and vibration are to be implemented during the construction phase of the project:

- Development and implementation of a noise and vibration management plan.
- In-stream earthworks will be undertaken during the dry period when fish movement is natural inhibited, thereby minimising the potential to disrupt up and downstream movement.
- Fauna spotter catchers will be present prior to and during clearing activities associated with construction, including assisting wildlife to disperse into adjacent habitat.

7.2.2 Air quality

Design and construction

The following mitigation measures in regards to air quality are to be implemented during the construction phase of the project:

- Development and implementation of an air quality (dust) management plan.
- Consideration is to be given to climatic conditions during construction (for example, high dust generating activities should avoid being undertaken during windy conditions).
- Areas of exposed soils are to be stabilised and rehabilitated as soon as possible.

- Traffic on unsealed roads is to be minimised to manage dust potential.
- Enforcement of low speed limits during construction.
- Employ a water truck or similar on site and along access roads (where practical) to control dust.
- A complaint based hotline will be established, along with a complaints handling procedure. If complaints are received, they will be investigated and air quality monitoring undertaken as appropriate.

Operation

The following mitigation measures in regards to air quality are to be implemented during the operation phase of the project:

- Enforcement of low speed limits along the access track to limit the potential for dust emissions.

7.2.3 Lighting, urban design and visual aesthetics

Construction activities will as far as practicably possible be restricted to daylight hours. In the event that lighting is required to facilitate night works (for example concrete pour operations), directional lighting restricted to the immediate work area will be utilised. Residential buildings are not expected to be impacted as a result of light pollution during night works given the proximity of the site to the sensitive receptors.

As far as practicable, maintenance works will be undertaken during daylight hours.

7.3 Social environment

To manage social impacts, the following mitigation and management measures are proposed:

- Inclusion of a local workforce management plan.
- Inclusion of a local procurement management plan.
- Developing and implementing a site specific CEMP and EMP, which will need to include a land access protocol, workplace health and safety management plan, weed and pest management plan, and traffic management plan.
- Recreational management plan for Big Bend Recreation Reserve and the storage area.

7.4 Built environment

A Traffic Impact Assessment will be undertaken for all roads associated with access for construction and operation to identify any changes to the traffic and usage of these roads. Based on the outcomes of this assessment, a traffic management plan will be developed.

7.5 Cultural heritage management plan (Indigenous)

Database records show that seven recorded sites of indigenous cultural heritage significance are located within a 10 km radius of the project. While no specific sites are recorded within the storage area or at the weir site itself, ephemeral water sources are commonly identified as places of importance to Aboriginal people and may include the Burdekin River and tributaries. Subsequently, there is a high chance of additional, unrecorded Indigenous cultural heritage being present.

The NQLC (2020) report notes that Gudjala People have told NQLC of a number of spiritually and culturally significant sites in the BRW study area. Therefore, the project has the potential to

impact on sites or items of indigenous cultural heritage significance that lie within undisturbed areas where the weir infrastructure is to be constructed and will be inundated.

Consultation with NQLC and the Gudjala People about BRW commenced in April 2020 and following ongoing correspondence during preparation of the Business Case GHD were able to establish and execute a CHMP with Gudjala's representative (Ngrragoonda Aboriginal Corporation (NAC)) in order to allow investigative works requiring ground disturbance (such as geotechnical investigations) to occur in the Detailed Design phase of the project.

However, it is also acknowledged that the establishment of a CHMP will need to be progressed in close consultation with NQLC and NAC to determine mitigation and management measures for the project to be able to proceed to construction and operational phases. The CHMP will be developed in accordance with the provisions of the ACH Act and will be for the life of the project.

Early engagement with Indigenous representatives, traditional owners and local chamber of commerce was also identified as part of the SIE as a recommended measure to inform the Gudjala People about employment and business opportunities and to better understand any impacts from vegetation clearing and an increase in recreational use of the area.

7.6 Non-Indigenous cultural heritage management

Non-Indigenous cultural heritage sites, as relevant, will be investigated further as part of the impact assessment process to determine any potential or unidentified areas of importance within the project area. Where non-indigenous cultural heritage sites are discovered, a non-indigenous cultural heritage management plan will be developed and implemented during construction as part of the CEMP.

7.7 Greenhouse gas management plan

A greenhouse gas management plan will be developed for the project as part of the CEMP or it may form part of the proponent's overall greenhouse gas management strategy.

7.8 Waste management

A waste management plan will be developed as part of the CEMP for the project prior to the commencement of construction.

The main objective of the plan would be to minimise the direct and indirect potential impacts to human health and the environmental, social and economic values of the project area. The plan will address:

- Identification of waste streams.
- Appropriate transport, storage and disposal of waste streams.
- Training of site personnel on procedures developed concerning transport, storage and disposal of waste streams.
- Monitoring and auditing of waste streams against the waste management plan to ensure the objectives are being met.

The general management of site waste will be in accordance with the waste reduction hierarchy. The following general management measures will be implemented:

- Waste will not be stored on land outside of the construction areas.
- Non-regulated waste will be separated into recycling, industrial and general receptacles.
- All waste receptacles will be covered to prevent water infiltration and wind from causing litter.

- All rubbish that may potentially attract vermin, insects and pests should be appropriately disposed of in sturdy waste disposal receptacles that are frequently emptied.
- Supply, storage and transport of hazardous substances will be regulated with appropriate forms and comply with relevant guidelines and Australian Standards to prevent release of hazardous substances.
- Regulated waste will be collected and removed by a specialised licensed waste contractor and tracking of this waste will take place using a Waste Tracking Register.
- Spill clean-up material and contaminated soil to be stored and disposed of appropriately.
- Removal of all construction waste streams will be undertaken once works have been completed.

7.9 Hazard and risk, and health and safety

To manage hazard and risk and health and safety impacts, the following management plans will be developed:

- Emergency spill response plan
- Fire management plan
- Bushfire hazard mitigation and management plan
- Hazard reduction plan
- Flood management plan
- Emergency response plan.

7.10 Environmental management

The BRW project has been designed to minimise environmental impacts, wherever possible. The proposed weir and inundation area is within the high banks of the Burdekin River which is prone to routine flooding. Additional disturbance will be associated with the fishway, saddle dam and access tracks, along with ancillary construction works (diversion of water, sourcing construction materials, laydown areas, on-site facilities), however impact areas have been limited, wherever possible.

Additional environmental management and mitigation measures required for the project will be determined during the impact assessment process and will be developed based on consultation with relevant authorities and in accordance with legislative, policy and industry guidelines. It is likely that the matters are routine and can be managed with standard mitigation measures. The sub management plans likely to be required within the overarching CEMP and/or operational phase EMP to support environmental management of potential project impacts are summarised in Table 7-1.

Table 7-1 Sub management plans

Aspect	Management plan
Natural environment	Flora and fauna management plan Weed and pest management plan ESCP Stormwater management plan Water quality management plan Vegetation management plan (including revegetation and rehabilitation requirements) Soils management plan Greenhouse gas management plan
Built environment	Transport and traffic management plan
Amenity	Air quality (dust) management plan Noise and vibration management plan
Social /economic environment	Land access protocol Workforce management plan Procurement management plan Recreational management plan
Indigenous Cultural Heritage	Indigenous CHMP
Non-indigenous Cultural Heritage	Non-indigenous CHMP
Hazard and risk, and health and safety	Emergency spill response plan Fire management plan Bushfire hazard mitigation and management plan Hazard reduction plan Flood management plan Emergency response plan
Waste management	Waste and hazardous materials management plan Waste management plan

8. Approvals required for the project

8.1 Legal and regulatory considerations

8.1.1 EPBC Referral

Actions that have, or are likely to have, a significant impact on MNES require referral to the Australian Government Minister for the Environment, otherwise known as DAWE, who will decide whether assessment and approval is required under the EPBC Act.

The nine matters of national environmental significance protected under the EPBC Act are:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

Based on desktop investigations and findings from the pre-wet and post-wet baseline ecological assessments, risks associated with BRW have been assessed to have the potential for low to moderate direct and/or indirect impacts on the following protected species and their habitat:

- Listed threatened species including the Greater glider (northern) (*Petauroides volans minor*), Squatter pigeon (southern) (*Geophaps scripta scripta*) and Koala (*Phascolarctos cinereus*)
- Migratory species including the Glossy ibis (*Plegadis falcinellus*), Caspian tern (*Hydroprogne caspia*), Common greenshank (*Tringa nebularia*), Common sandpiper (*Actitis hypoleucos*), Latham's snipe (*Gallinago hardwickii*), Osprey (*Pandion haliaetus*) and Wood sandpiper (*Tringa glareola*).

Other provisions include the potential for indirect impacts to the GBR given that the Burdekin River is located within the reef catchment. Therefore, additional MNES include:

- World Heritage properties for the GBRWHA
- National Heritage places for the GBR
- Ramsar wetland for Bowling Green Bay.

A pre-referral meeting has been held with DAWE to discuss the potential impacts the project may have on MNES and amendments have been made to the referral documentation in response to several items raised by DAWE in the meeting. Significant impact assessments conducted as part of the baseline ecological assessments and EPBC referral have identified that the project is unlikely to have a significant impact on any MNES and that the action should be determined 'a not controlled action'.

In the event that the Minister determines that significant impacts to MNES are considered likely, and the action is deemed to be 'a controlled action', the referral will proceed to the next stages of the assessment.

The EPBC Act provides for five different levels of assessment:

- Accredited assessment (e.g. bilateral agreement)
- Assessment on referral information (assessment undertaken solely on the information provided in the referral form)
- Assessment on preliminary documentation (referral form and any other relevant material identified by the Minister as being necessary to adequately assess a proposed action)
- Assessment by EIS or Public Environment Report
- Assessment by public inquiry.

Depending on the outcomes of the determination by DAWE and in conjunction with the determination by the CG for a coordinated project declaration, the bilateral agreement process between the Queensland and Commonwealth Government may be applicable for the project.

8.1.2 Water entitlement

In reviewing Queensland's water planning framework (consisting of the *Water Act 2000*, *Water Regulation 2016*, *Water (Burdekin Basin) Plan 2007*, *Water Amendment Plan (Burdekin Basin) 2019*, *Burdekin Basin Water Management Protocol 2016 (Amended June 2019)* and the *Water Supply (Safety and Reliability) Act 2008*) it is evident that there has been a recent State reform towards establishing a water market for tradeable water allocations within the majority of the Burdekin Basin subcatchments for both supplemented and unsupplemented water.

Water trading is intended to provide greater flexibility for water users to be able to subdivide, amalgamate and transfer existing water allocations or even apply for seasonal assignments so to manage water more sustainably. It is also common practice for the State to now set a price for unallocated water in order to encourage the recognition of water as a valuable resource and promote its highest value and efficient use.

To secure the necessary water entitlement for BRW, the project would be seeking to access unallocated water from both the general reserve (10,000 ML available) and strategic reserve (10,000 ML available) as well as potentially acquiring existing water allocations from existing water users.

The process for DNRME to be able to release unallocated water is by:

- Public auction; or
- Tender; or
- Fixed price sale; or
- Grant for a particular purpose.

Unallocated water from the strategic reserve can only be released by DNRME for a State purpose such as a 'coordinated project', project of regional significance or for town water supply. While unallocated water from the general reserve can be released for any purpose. Although the *Water Plan (Burdekin Basin) Plan 2007* does not specifically contemplate the grant of unallocated water held in the general and strategic reserves for BRW, in obtaining a coordinated project declaration under the SDPWO Act, the project would be able to qualify under the definition of a State purpose and CTRC could request and negotiate access to the water from DNRME without competition (through a Terms of Release/Sale).

Under Queensland's water planning framework and the *Planning Act 2016*, a development permit for the interference and take of water from a watercourse is required from the State Assessment and Referral Agency (SARA) and DNRME. An application to DNRME to enter into a Terms of Release/Sale will need to be made and progressed prior to the lodgement of the development application for the water entitlement (likely to be granted as a water allocation and/or Resource Operations Licence) and necessary permits under the *Water Act 2000* and *Planning Act 2016*.

The applications to DNRME will need to address the following matters which are required to be considered in deciding whether to grant a water allocation or licence:

- The purpose for which the water is required
- The efficiency of existing and proposed water use practices
- The extent to which water is being taken under existing authorisations in the plan area
- The availability of an alternative water supply for the purpose for which the water is required
- The impact the proposed taking of, or interfering with, the water may have on existing water users in the plan area
- Whether the proposed taking or interfering is likely to have a direct adverse effect on groundwater flows
- The environmental management rules and provisions including but not limited to maintaining streamflows, protecting terrestrial and aquatic habitats, connectivity of pools and rivers in allowing movement of instream biota, water quality, movement of sediment recreational and aesthetic values and cultural values.

8.1.3 Land tenure

The Burdekin River is defined as a watercourse and will contain the weir infrastructure and storage area. Land directly adjoining the weir to the north is held as freehold land (Burdekin Downs) which will be subject to some minor inundation from the storage area due to the left high flow channel of the Burdekin River and another small watercourse/tributary being located within the cadastral boundary of the property. Fletcherview Research Station is located to the south of the weir and is State leasehold land under a 30 year term lease to James Cook University. Fletcherview Research Station will contain the weir access track as well as some temporary construction areas (i.e. laydown areas, site amenities, etc.).

State land is managed under the *Land Act 1994* (Land Act) whereas freehold land is administered by the *Land Title Act 1994*. The six properties identified in Section 4.2.1, Table 4-1 are likely to experience more permanent inundation from the BRW water storage area at FSL.

Tenure options discussed with DNRME in pre-lodgement meetings, include the requirement for:

- A right of way public utility easement under section 369 of the Land Act for the weir access track on State lease land (being Lot 4 DV450)
- A public utility easement for water storage under section 362(5) of the Land Act for a portion of Grazing Homestead Perpetual Lease land (Lot 15BKN23) which will likely experience inundation from the water storage area at FSL
- An easement for a specific purpose such as water storage (granted to a public utility provider) under section 82 of the Land Titles Act 1994 for parts of freehold land (Lot 16BKN116 and Lot 7SP112348) which will likely experience inundation from the water storage area at FSL.

To the extent that the weir infrastructure and storage area is located within the watercourse there is no requirement under the Land Act to acquire an interest in the land. However, under section 972D of the Water Act, a development permit, for taking or interfering with water, is taken to include a right to use and occupy the part of the watercourse or lake that (a) forms all or part of the boundary of the land to which the development permit attaches; and (b) on which the works are situated. Therefore, the Water Act provides the relevant permit and licencing requirements for the occupation of the watercourse for a weir.

For inundation within the National Park (Lot 125NP2636), this will need to be authorised by the Department of Environment and Science (DES) through Queensland Parks and Wildlife Services (QPWS) separate to the Land Act. Authorisation for infrastructure in protected areas can either be granted under sections 34, 35 and 35a of the NC Act or a revocation of an area of National Park may be required instead, requiring compensation to QPWS for the revocation actions. And finally, the proposed concrete floodway (located approximately 3.5 km upstream of the proposed weir infrastructure) required to provide permanent access to Big Bend Recreation Reserve following the construction of BRW will need to be dedicated as a local government road under section 59 of the *Local Government Act 2009*, resulting in an extension to the Big Bend road reserve.

CTRC will also need to enter into access agreements with landholders and the State or lessee for State lease land to enable cultural heritage surveys to be undertaken and for contractors to temporarily occupy and use the land for investigative works or during construction if the appropriate easement arrangements are still to be formalised or work is to be carried outside the defined easement areas. The proponent may be subject to compensation claims for any physical damage caused by the entry, occupation or use of the land during investigative works, construction and/or operation of the project under an access agreement. As such, the relevant access agreements will need to be prepared and/or reviewed by a legal professional.

8.1.4 Native Title

The *Native Title Act 1993* (Cth) (NTA) recognises the traditional rights and interests of Aboriginal and Torres Strait Islander people in Australia. The NTA prohibits the undertaking of acts that affect Native Title, being acts that are wholly or partly inconsistent with the continued existence, enjoyment or exercise of Native Title, other than in accordance with the provisions of the NTA. Acts that affect Native Title are called 'future acts'. The NTA sets out the processes that apply to enable the carrying out of 'valid future acts' which are informed by the type, or category, of a future act.

BRW is considered to constitute 'valid future acts' and will be subject to compliance with the requirements of section 24KA under the NTA, including claims for compensation for the effect the BRW Future Acts will have on the Gudjala People's Native Title rights and interests. The non-extinguishment principle will apply to the BRW Future Acts on the basis that freehold tenure will not be required for any component of the project. As such, an Indigenous Land Use Agreement (ILUA) is unlikely to be required for BRW unless agreed to by CTRC in consultation with the NQLC and the Gudjala People (represented by NAC).

In relation to the Burdekin River watercourse and Keelbottom Creek watercourse, members of the public currently enjoy rights of public access and recreation. This is also the case for Dalrymple National Park (other than Lot 42 USL 48163) and Big Bend Recreational Reserve, where the Gudjala People do not have the right to possession, occupation, use or enjoyment to the exclusion of all others. In relation to Lot 42 USL 48163, the Gudjala People do have the right to exclusive possession. Access to or any works within this lot without first obtaining permission would be inconsistent with the Gudjala People's right to exclude others and may therefore be an act that affects Native Title. The project is not expected to impact on Lot 42 USL 48163.

8.1.5 Aboriginal cultural heritage

The *Aboriginal Cultural Heritage Act 2003* (ACH Act) recognises, protects, and conserves Aboriginal cultural heritage. In part, it achieves this protection by providing that any person who undertakes an activity has a 'Duty of Care' to take all reasonable and practicable measures to ensure that the activity does not harm Aboriginal cultural heritage (Duty of Care).

Under the ACH Act, the Duty of Care can be discharged in a number of ways, including:

- At a minimum, adhering to the Duty of Care Guidelines
- Entering into a voluntary CHMA with an 'Aboriginal party' for the given area or
- Entering into a CHMP under Part 7 of the ACH Act.

To ensure compliance with the Duty of Care requirements, consultation with NQLC and the Gudjala People about BRW commenced in April 2020. Following ongoing correspondence during preparation of the BRW Business Case, GHD was able to establish and execute a CHMP with Gudjala's representative NAC. The CHMA allows for investigative works requiring ground disturbance (such as geotechnical investigations) to occur in the Detailed Design phase of the project, subject to cultural heritage surveys and the required clearances being granted.

A separate CHMP will also need to be progressed by CTRC in consultation with NQLC and NAC following completion of the investigative works or at the same time as the impact assessment process in order to identify and agree on appropriate mitigation and management measures for the project to be able to proceed to construction and operation. The CHMP will be applicable for the life of the project.

Other relevant legislation includes the Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth) (ATSIHP Act). The ATSIHP Act preserves and protects areas and objects that are of particular significance to Aboriginal people. The ATSIHP Act allows the Federal Minister for the Environment, on an application by an Aboriginal person or group, to make a declaration to protect such areas or objects from specific threats of injury or desecration for defined periods of time. In this instance, a declaration is unlikely to be made if the project is compliant with the provisions of the ACH Act (including the establishment, negotiation and implementation of a CHMA and CHMP).

8.2 Summary of key project approvals

Table 8-1 provides a summary of approvals applicable to the project in accordance with regulatory requirements. This will continuously be reviewed as the project is developed and in consultation with relevant State agencies.

For clarity, Section 37 of the SDPWO Act provides that the CG's report for a coordinated project is taken to be the concurrence agency response for a material change of use (MCU) of premises under the *Planning Act 2016* until such time that a development approval for the application has effect. Furthermore, it is understood that an impact assessable development application made under the *Planning Act 2016* will not require public notification when the development application is lodged with the assessment manager as any submissions received during the Impact Assessment Report (IAR) or EIS process are taken to be a properly made submission for an application under the *Planning Act 2016*.

Operational Works approvals are not included under Section 37 of SDPWO Act and as such the CG's report is not taken to be the concurrence agency response for these aspects of BRW. Accordingly separate applications will need to be submitted to the relevant State agencies for Operational Works development approval.

Table 8-1 Project approvals register

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
Commonwealth approvals				
EPBC Referral EPBC Act	DAWE	Weir wall, saddle dam, storage area and access track.	A referral is required when a project has the potential to significantly impact on a MNES protected under the EPBC Act. Although impacts are not expected to be significant, baseline ecological assessments have indicated that the project has the potential to impact on several MNES, including: • Listed threatened and species and communities • Listed migratory species • World Heritage properties • National Heritage places • Ramsar wetlands. Therefore, a referral will be submitted to DAWE for a determination on whether the project constitutes a controlled action or not. The referral prepared for BRW is recommending that the action be 'a not controlled action'.	No
Valid future acts and suppression of native title NTA <i>Native Title (Queensland) Act 2003</i>	National Native Title Tribunal (NNTT) Attorney-General's Department – Registered Native Title Party	Weir wall, saddle dam, storage area and access track.	A future act is an act in relation to land or waters which must 'affect' native title. BRW will constitute valid future acts and will require development to be carried out in accordance with the requirements set out in section 24KA of the NTA. The Gudjala People will be entitled to compensation for the effect that BRW future acts will have on their Native Title rights and interests. Where the extinguishment of Native Title is proposed by way of any land acquisitions within the determination areas, an ILUA will be required.	No
State – SDPWO Act, RPI Act approvals and infrastructure designation				
Application for 'coordinated project' declaration- requiring an IAR or EIS <i>SDPWO Act</i>	CG - Department of State Development, Tourism and Innovation (DSDTI)	Weir wall, saddle dam, storage area and access track.	A coordinated project declaration is given to projects with complex approval requirements, significant environmental effects, strategic significance or significant infrastructure requirements. The declaration will also assist with the release of unallocated water from the strategic reserve as described in section 33B of the Burdekin Water Plan. In obtaining a coordinated project declaration under the SDPWO Act, BRW would be able to qualify under the definition of a State purpose and CTIRC could request and negotiate access to the water from DNRME without competition (through a Terms of Release/Sale). This IAS recommends that BRW be declared a coordinated project requiring assessment by the IAR process.	Yes
Application for approval as a Private Infrastructure Facility (PIF) Section 153AA of the SDPWO Act	CG - DSDTI	Weir wall, saddle dam, storage area and access track.	The proponent of a proposed infrastructure facility can make an application to the CG for approval of a project as a PIF. The definition of a PIF in the Act includes a water storage facility. Approval as a PIF enables the CG to take land under section 153AA of the SDPWO Act if agreement cannot be reached between the proponent and registered owners of the land and/or native title parties. This is unlikely to be required for BRW. Land tenure advice from DNRME has indicated that the relevant permits under the Water Act 2000 will authorise the occupation of the water course for the weir infrastructure and storage area. And application for public utility easement can be sought to accommodate the weir access track and any minor inundation impacts on state lease land and freehold land.	No
Regulated activity in a SEA RPI Act RPI Reg	DSDTI	Storage area	In Queensland, the majority of land use planning activities and development proposals are assessed under the <i>Planning Act 2016</i>. The <i>Planning Act 2016</i> is complemented by the RPI Act which extends the consideration of land use policies contained in regional plans to include resource activities (e.g. mining and petroleum) and other regulated activities (e.g. broadacre cropping and water storage dams) that generally occur outside the jurisdiction of the <i>Planning Act 2016</i> and local planning schemes. Approximately 13 km of the water storage area for BRW is located within an SEA. Regulated activities under the RPI Act that have the potential for widespread or irreversible impacts on the environmental attributes of the SEA are considered to be incompatible development. An activity is likely to have a widespread or irreversible impact if it permanently modifies any habitat or ecosystem components, results in a change in water quality, permanently changes surface or groundwater hydrology for a watercourse and impedes the natural transport of sediments along a river system.	No

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
			Therefore, a RIDA will be required for part of the BRW storage area as it overlaps with a SEA, constitutes a regulated activity for water storage and may be considered to have a widespread or irreversible impact.	
Designation of premises for development of infrastructure (17 - water cycle management infrastructure) <i>Planning Act 2016</i> <i>Planning Regulation 2017</i>	DSDTI	Weir wall, saddle dam, storage area and access track.	An infrastructure designation (ID) is a decision of the Minister, or a local government, that identifies premises for the development of one or more types of infrastructure that are prescribed by regulation. In the case of BRW, it may include establishment of an ID area for the weir infrastructure and any subsequent development of water cycle management or supply infrastructure. An ID is only considered to be necessary or beneficial for BRW if the project proponent is not a public sector entity.	No
State – DA rules approvals				
Owner's Consent <i>Planning Act 2016</i> <i>Land Act 1994</i>	SLAM - DNRME	MCU activities undertaken on land not owned by the project proponent.	Where the proponent is not the landholder, owner's consent is required to be obtained and provided to support an MCU development application. For unallocated State land, State lease land and road reserves, consent must be obtained from SLAM (State Land and Asset Management Unit).	No
Development permit for operational works for taking or interfering with water in a watercourse. <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Water Act 2000</i> <i>Burdekin Water Plan</i> <i>Water Amendment Plan (Burdekin Basin) 2019</i> <i>Burdekin Basin Water Management Protocol 2016 (Amended June 2019)</i>	DNRME	Weir wall, saddle dam, storage area and any construction related activities.	This will apply to operational works associated with construction of the BRW infrastructure within the Burdekin River and for the take of unallocated water. The proposed water storage is 10,000 ML with the potential for BRW to yield up to a maximum of 20,000 ML per annum. Unallocated water will need to be sourced from both the general and strategic reserve for the Upper Burdekin sub catchment area G to meet the proposed demand. Options for water trading with existing water allocation holders in the same sub catchment and/or water allocation zone will also be critical where each of the whole reserves is not able to be released by DNRME. A Terms of Release/Sale is required to be negotiated with DNRME for the release and purchase of the unallocated water. A resource operations licence will also be required by CTRC in order to trade and sell water under water supply agreements to other users.	Yes
Development permit for operational works for constructing waterway barrier works & Compliance with DAF's accepted development requirements for WWBWs <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Fisheries Act 1994</i>	SARA and DAF as a technical agency.	Weir wall, saddle dam, access track and concrete floodway to Big Bend Recreation Reserve. Construction activities resulting in temporary waterway barrier works (e.g. erosion and sediment control structures).	This will apply to permanent and temporary waterway barrier works located within the bed and banks of the Burdekin River and Lolworth Creek. Both watercourses are identified as major waterways (purple).	Yes
Development Permit for a MCU involving Environmentally	SARA and DES as a technical agency.	Weir wall, saddle dam, storage area and laydown areas.	BRW has the potential to trigger the requirement for a number of ERA's including: • 8 Chemical storage • 16 Extractive and screening activities • 41 Cement manufacturing	No

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
Relevant Activities (ERAs) <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Environmental Protection Act 1994</i> (EP Act) <i>Environmental Protection Regulation 2019</i>			Given that these activities are likely to be dependent of the construction methodology adopted by the construction contractor, details are unlikely to be known prior to or during the 'coordinated project' process. However, if ERAs are applied for by the project proponent as part of the IAR or EIS, section 37 of the SDPWO Act provides that the CG's report can be taken to be the concurrence agency response for the application until a development approval under the <i>Planning Act 2016</i> has effect. As such, the CG's report on the IAR or EIS may be taken as the State response on ERAs until such time that a subsequent development application or environmental authority application is made.	
Referable dam <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Water Supply (Safety and Reliability) Act 2008</i>	DNRME	Weir wall	Only applicable if BRW will have a variable flow control structure on the crest of the weir, as it may constitute a referable dam and require a failure impact assessment (FIA). A dam is referable if a FIA determines the dam will have a category 1 or category 2 failure impact rating. BRW is not considered to constitute a referable dam.	No
Development permit for operational work impacting on and for access to a State Controlled Road (SCR) <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Transport Infrastructure Act 1994</i>	DTMR	Weir wall, saddle dam and access track	BRW is likely to require operational work within 25 m of a State transport corridor and the work will relate to access to a State transport corridor.	Yes
Development permit for operational work triggers for vegetation clearing. <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Vegetation Management Act 1999</i> (VM Act)	SARA and DNRME as a technical agency.	Weir storage area and access track. Additional vegetation clearing associated with construction laydown areas. Any other ground clearing associated with construction works.	This will apply to the loss of any remnant vegetation from construction of BRW and filling of the water storage / impoundment area (including long term die back of vegetation located below the high banks of the Burdekin River). The baseline terrestrial ecological assessments revealed that the BRW study area supports least concern regional ecosystems dominated by open woodlands and existing cleared grazing lands. No conservation significant flora species or TECs were considered likely to occur within these area. For a MCU, section 37 of the SDPWO Act provides that the CG's report can be taken to be the concurrence agency response for the application until a development approval under the <i>Planning Act 2016</i> has effect. As such, the CG's report on the IAR or EIS may be taken as the State response on vegetation clearing matters for a MCU until such time that a subsequent development application is made. For operational work, clearing of native vegetation is prohibited development unless it is for a relevant purpose under section 22A of the VM Act. A relevant purpose includes a project declared to be a coordinated project under the SDPWO Act. Exemptions for clearing native vegetation also exist under Schedule 21 of the <i>Planning Regulation 2017</i>. Clearing vegetation for the construction or maintenance of infrastructure if the clearing is on designated premises is exempt development.	Yes
Development permit for operational work in a wetland protection area. <i>Planning Act 2016</i>	SARA and DES as a technical agency.	Weir storage area and construction activities.	This applies to operational work that involves high impact earthworks in a wetland protection area. Examples of activities that involve high impact earthworks include: • Filling or levelling of land, including raising the level of land by the placing of fill material • Excavation of land, including excavation to create a canal, channel or water storage • Construction of a new drain • Overland flow storage and sediment erosion ponds	No

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
<i>Planning Regulation 2017</i> EP Act			- Construction of a levee, farm dam, weir or other barrier across a waterway - Construction of a road, culvert or causeway. BRW is not expected to require earthworks to be undertaken in a wetland nor is the project expect to impact on any nearby wetlands.	
Local – DA rules approvals				
Development permit for MCU assessable development under the local government planning scheme <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> Charters Towers Regional Town Plan	CTRC	Weir wall, saddle dam and lay down areas	Under the Charters Towers Regional Town Plan, a MCU application for a utility installation (for the weir wall, storage area, fishway, saddle dam and access tracks) in the Rural zone is defined as accepted development with no assessment benchmarks as long as the project is undertaken by a public sector entity (such as CTRC). In the event that the proponent of BRW does not end up being a public sector entity, an impact assessable development application would be required in the Rural zone. A MCU application for a utility installation in the Environmental Management and Conservation zone requires Code assessment, regardless of who the project proponent is. The definition of 'utility installation' includes the use of premises for supplying or treating water and a maintenance or storage depot for supplying water. If the ID process was to be successfully undertaken, subsequent MCU development applications under the local planning scheme would not be required. However, given that the highest level of assessment is likely to be Code assessment for a small portion of the water storage area adjoining Dalrymple National Park, an ID is not really considered to be necessary or beneficial for BRW. If the project proponent was not a public sector entity, then an ID may help to avoid having to submit an Impact assessable application to CTRC as the assessment manager under the local planning scheme.	Yes
Development permit for operational works (earthworks) assessable under the local government planning scheme <i>Planning Act 2016</i> <i>Schedule 6, Part 3, Item 8 of the Planning Regulation 2017</i> Charters Towers Regional Town Plan	CTRC	Bulk earthworks associated with weir wall, saddle dam, access track and laydown areas.	Bulk earthworks are identified as accepted development subject to complying with the development works codes for any excavation or filling that is (a) less than 1 metre above or below ground level and involving less than 100 m³ of material; or (b) 1 metre or more above or below ground level and involving less than 50 m³ of material. Any operational work undertaken by a private sector entity involving excavation or filling above these thresholds will require code assessment. Exemptions exist under Schedule 6, Part 3 of the <i>Planning Regulation 2017</i> for operational work undertaken by a public sector entity which cannot be made assessable under a local planning scheme. If the project proponent was not a public sector entity then an ID may help to avoid having to apply for subsequent operational works development approvals under the local planning scheme.	No
Plumbing and Drainage Work <i>Planning Act 2016</i> <i>Schedule 6, Part 3, Item 8 of the Planning Regulation 2017</i> <i>Plumbing and Drainage Act 2018</i> <i>Plumbing and Drainage Regulation 2019</i>	CTRC	Plumbing and drainage works associated with any buildings or structures (should the need for these be identified at a later date).	Only applicable if carrying out plumbing and drainage works. Plumbing and drainage work undertaken by a private sector entity may require an application to be submitted to CTRC under local law requirements. Exemptions exist under Schedule 6, Part 3 of the <i>Planning Regulation 2017</i> for plumbing and drainage work undertaken by a public sector entity which states that the work cannot be made assessable under a local planning scheme.	No
Building Work <i>Planning Act 2016</i>	CTRC / Private building certifier	Building works associated with any pump stations,	Only applicable if carrying out building work.	No

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
<i>Planning Regulation 2017</i> <i>Building Act 1975</i>		construction camps or maintenance or storage depots (should the need for these be identified at a later date).	There is no building work regulated by the Charters Towers Regional Town Plan other than where identified in an overlay in section 5.8 of the Town Plan. However, under the <i>Building Act 1975</i> a development permit may be required for building work associated with any new buildings, pump stations, or other construction related activities (i.e. site offices, concrete batching plants, etc.).	
State – Non DA rules approvals				
CHMA and CHMP Duty of Care ACH Act	Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP)	Invasive ground disturbance works (such as geotechnical investigations) during detailed design and/or pre-construction. Construction, operation and maintenance of the weir wall, saddle dam, storage area and access track.	This will apply to BRW in order to avoid impacting on any significant Aboriginal cultural heritage sites or places and to minimise the potential for harm to Aboriginal cultural heritage. A CHMA is required to meet the Duty of Care requirements prior to any invasive ground disturbance works occurring for BRW. The CHMA for BRW was executed by NAC and GHD on 27 August 2020 in order to allow investigative works (such as geotechnical investigations) to be undertaken for the Detailed Design phase. CTRC will also need to develop a CHMP in consultation with NQLC and NAC for execution prior to the commencement of construction works. In addition to the construction works, the CHMP will also need to capture operational and maintenance requirements for the life of BRW.	No
General Environmental Duty EP Act	DES	Construction activities including access tracks, material transport, mobilisation and demobilisation activities and temporary laydown areas.	This applies to BRW. The general environmental duty outlines the duty of care responsibilities of all those undertaking work on the project and the obligation to take all necessary measures to prevent environmental harm.	No
General Biosecurity Obligation <i>Biosecurity Act 2014</i> <i>Commonwealth pest and weed management strategies</i>	Biosecurity Queensland DAF	Construction activities including access tracks, material transport, mobilisation and demobilisation activities.	This will apply to BRW where undertaking activities which may contribute to the spread of invasive plant or animal species.	No
Disposal permit EP Act	DES	Removal of contaminated soils during construction.	This applies where soils are removed from land listed on the Environmental Management Register (EMR) or Contaminated Land Register (CLR) which exceed investigation thresholds. Contaminated soils may occur in locations of former cattle dips or other agricultural activities. A search of the EMR and CLR Register for Lot 4 DV450 (Fletcherview Research Station) indicates that the site it is not listed on either register. This is likely to be the primary lot for access and construction work. It is unlikely that a disposal permit will be required for BRW unless contamination of land occurs as a result of an incident/spill during the construction phase. This will be the responsibility of the contractor to manage during construction.	No
Protected plant clearing permit or exempt clearing notification NC Act	DES	Weir wall, saddle dam, storage area, access track and laydown areas. Ground clearing for construction.	This applies when clearing areas identified as being within the high risk flora survey trigger areas for protected plants or where protected plants have been detected, a flora survey must be undertaken in accordance with the guideline and a clearing permit or exemption notice obtained. A search of the Protected Plants Flora Survey Trigger Map identifies that the BRW study area does not contain any high risk areas. Baseline ecological assessments involving pre and post wet field surveys have also been undertaken and the presence of protected plants in key areas was not identified. However, further footprint specific surveys are recommended prior to any clearing for the access track, laydown areas and construction of the weir infrastructure within the watercourse.	No

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
Species management plan (SMP) NC Act <i>Nature Conservation (Wildlife Management) Regulation 2006</i>	DES	Weir wall, saddle dam, storage area, access track and laydown areas. Ground clearing for construction.	This applies when undertaking activities which impact on species listed under the NC Act. The BRW study area has the potential to support a small number of conservation significant species based on field survey records, previous records and the availability of suitable habitat within the study area. A likelihood of occurrence assessment and field surveys undertaken as part of the Baseline Ecological Assessment Reports (pre-wet and post-wet assessments) found that: • Three conservation significant fauna species, namely the greater glider (northern) (<i>Petauroides Volans minor</i>), squatter pigeon (southern) and short-beaked echidna (<i>Tachyglossus aculeatus</i>) were confirmed present within the study area • The koala (<i>Phascolarctos cinereus</i>) was considered likely to occur in the study area • One migratory species, the glossy ibis (<i>Plegadis falinellus</i>) was confirmed present within the study area • Six migratory species were considered likely to occur in the study area No conservation significant aquatic species were considered likely to occur within the study area.	No
Environmental offsets <i>Environment Offsets Act 2014 (EO Act)</i>	SARA, DES and/or DNRME	Residual impacts resulting from clearing activities.	Environmental offsets are required where there are residual impacts following the removal of fauna, flora and habitat that cannot be avoided after applying mitigation and management measures. An assessment of significant residual impacts in accordance with Queensland Environmental Offsets Policy Significant Residual Impact Guideline will be undertaken as part of the 'coordinated project' process through the IAR or EIS.	Yes
Permit to take quarry material from a watercourse <i>Forestry Act 1959</i> <i>Water Act 2000</i>	DNRME DAF	Removing material from a watercourse for use in construction or other commercial purposes.	This will apply if material is proposed to be extracted from within the watercourse for use in the construction of access tracks or other construction activities. The requirement for material is to be determined by the construction contractor.	No
Riverine Protection Permit (RPP) <i>Water Act 2000</i> <i>Water Regulation 2016</i>	DNRME	Clearing, excavation or filling within watercourses for the weir, saddle dam and the access track.	A RPP is required to excavate, place fill or destroy vegetation in a watercourse, lake or spring unless such works are otherwise authorised or exempt. It is assumed that the project proponent undertaking the works will be an approved entity under Schedule 2 of the RPP exemption guideline. If not, a RPP will be required. The purpose of the RPP exemption requirements are to outline when it is permitted to excavate, place fill or destroy vegetation in a watercourse, lake or spring without the need for a RPP under the <i>Water Act 2000</i> . For the exemption to apply vegetation clearing must be: • Carried out under an accepted development vegetation clearing code (other than category A), or • Of an area that is less than 0.5 ha of a least concern RE in a category B area, or • Of an area that is less than 0.5 ha in a category C, R or X area.	No
Take of water without a water entitlement <i>Water Act 2000</i> <i>Water Regulation 2016</i>	DNRME	Using water from a watercourse for use in construction activities.	This applies to the take of water by a constructing authority without a permit or licence for the purpose of constructing or maintaining infrastructure. It is assumed that the project proponent undertaking the works will be a constructing authority as defined in Schedule 2 of the <i>Acquisition of Land Act 1967</i> . If not, a permit or licence may be required if not captured as part of the development permit for the take of water from a watercourse.	No
Work in a State Road Corridor <i>Transport Infrastructure Act 1994</i>	DTMR	Construction transport and logistics as well as construction activities.	A Road Corridor Permit will be required for undertaking an activity, conducting works or erecting a structure within the State-controlled road corridor during construction. A Traffic Control Permit will be required for any required lane closures and traffic controls. These permits are likely to be applied for by the construction contractor prior to or during construction as details are unlikely to be known during the 'coordinated project' process or initial approvals phase.	No

Approval & legislation	Authority	Project aspects	Approval trigger & relevance to the project	Assessment under Part 4 of the SDPWO Act
Public utility easement <i>Land Act 1994</i> <i>Land Title Act 1994</i>	SLAM - DNRME	Weir storage area and access track	This applies to development on State lease land and freehold land. An application to DNRME will be required to apply for a right of way public utility easement for the weir access track on State lease land under section 369 of the <i>Land Act 1994</i>. A public utility easement will also be required for parts of the water storage area that inundate State lease land and freehold land. This can be applied for under section 362(5) of the <i>Land Act 1994</i> and section 82 of the <i>Land Title Act 1994</i>. To be able to be granted a public utility easement, the grantee needs to be a public utility provider. It is assumed that the project proponent will be a public utility provider as defined under Schedule 6 of the <i>Land Act 1994</i>. If the project proponent is not a recognised public utility provider, an application can be made to DNRME to seek approval to be considered as a public utility provider for a particular public utility service.	No
Authorisations for the development of infrastructure in a protected area. NC Act	DES	Weir storage area	This applies to development (including the building of infrastructure and structures) in protected areas. An application to DES under sections 34, 35 and 35a of the NC Act may be required for the potential inundation of a small area of low lying land and a tributary (at FSL) within the boundaries of Dalrymple National Park. Any infrastructure and development on protected areas must generally be consistent with the management principles for the protected area and any management plan or statement for the area.	No
Applying to dedicate State land as local road reserve. <i>Land Government Act 2009</i>	CTRC and DNRME	Concrete floodway to Big Bend Recreation Reserve	This applies to the proposed concrete floodway (located approximately 3.5 km upstream of the proposed weir infrastructure). A dedicated road reserve is required where road related infrastructure is to be located on State land and public use and access is proposed. It is assumed that the proposed floodway would become an extension of Big Bend Road.	No
Local – Non-DA rules approvals				
Work in a local road corridor <i>Local Law No. 1 (Administration) 2011</i> <i>Subordinate Local Law No. 1.15 (Carrying out Works on a Road or Interfering with a Road or its Operation) 2011</i>	CTRC	Construction transport and logistics; construction activities	This will apply to the use of local governmental roads during construction. A Road Opening Permit and /or Application for Road Excavation / Road Closure Permit / Carrying out works or interfering with a road approval may be required for construction related activities. These permits are likely to be applied for by the construction contractor prior to or during construction as details are unlikely to be known during the 'coordinated project' process or initial approvals phase.	No

8.3 Approvals to be assessed as part of the impact assessment process

Approvals intended to be coordinated during the impact assessment process under Part 4 of the SDPWO Act and associated conditions that would be sought as an outcome of the CG's evaluation report include:

- Operational work for taking or interfering with water in a watercourse
- Operational work for constructing waterway barrier works
- Operational work impacting on and for access to a State Controlled Road (SCR)
- Operational work for clearing native vegetation
- MCU assessable under the local government planning scheme. Noting that this is only applicable if part of the water storage area is considered to require Code assessment under the Charters Towers Regional Town Plan for a 'utility installation' in the Environmental Management and Conservation zone
- Environmental offsets for any aspects of development relating to the above approvals.

All other approvals identified in Table 8-1 will be applied for and dealt with outside of the Part 4 process of the SDPWO Act.

8.4 Justification for assessment via the IAR process

Under Section 26(b) of the SDPWO Act, the CG may declare the project to be a coordinated project for which an IAR is required. The requirements for a declaration under Section 26(b) (for a project that requires an IAR) are set out in Section 26(2) of the SDPWO Act which identifies that the CG must be satisfied that the environmental effects of the project do not, having regard to their scale and extent, require assessment through the EIS process.

The requirements for the CG to be able to declare a project that requires an IAR are also expanded on in further detail in the CG's *Application requirements for 'coordinated project' declaration* dated August 2015 as follows:

- The expected magnitude and scale of the project and impacts are less than those of a coordinated project requiring an EIS.
- The risk of environmental harm arising from the potential impacts of the project is considered to be significantly less than a coordinated project requiring an EIS, given the nature or extent of those impacts.
- The impacts and measures to avoid or mitigate any potential adverse impacts of the project are generally well understood, widely practiced, easily applicable and/or adequately managed by application of standard conditions or codes.

An IAR process is considered an acceptable approvals pathway given that the BRW project is of a small scale and is expected to have limited environmental impacts (based on baseline ecological surveys undertaken to date), all of which are considered to be routine matters for this type of water infrastructure and can be managed through implementation of proven and recognised environmental mitigation and adaptive management measures.

The construction and environmental management for working within watercourses and building new, upgrading or managing weirs, dams or other structures are a normal part of business for most Regional Councils. All of which require site-specific investigations and planning, to ensure environmental management of bulk earthworks, truck movements and haulage, spoil

disposal/reuse, construction in waterways, community and recreation impacts, and indigenous cultural heritage are well managed.

The main environmental impacts from development of the weir are generally from loss of habitat (pool –riffle run) for aquatic species; however, at the BRW site and based on desktop studies to date, conservation significant aquatic species are considered unlikely to occur. The loss of riparian vegetation will be gradual and terrestrial fauna species will have an opportunity to relocate. As with other weirs and water storages along the Burdekin River, a dense buffer of vegetation and newly formed habitat is also expected to re-establish along the banks of the river above the full supply level. There is also a low risk for negative impacts of any magnitude or scale to amenity (noise, air quality, vibration, lightning and visual aesthetics), and mostly positive outcomes for the economic and recreational environment of the region are anticipated as a result of the project.

Measures to avoid or mitigate potential negative impacts will be documented in a project specific CEMP and operational phase EMP with various sub management plans, which will utilise a well-established framework to implement the desired environmental outcomes and employ routine and reliable environmental practices to avoid or minimise impacts. Therefore, the impacts and measures to avoid or mitigate any potential adverse impacts of BRW are considered to be well understood, widely practised, easily applicable and can be adequately managed by application of standard conditions or codes.

Non-routine matters include the requirement to apply for a RIDA under the North Queensland Regional Plan as a large portion of the proposed BRW storage area is located within a SEA and constitutes a regulated activity (water storage) under Section 17(1)(b) of the RPI Act. The application will need to demonstrate that BRW will not, and is not likely to, have a direct or indirect impact on the environmental attributes for the SEA or where it may, be able to adequately justify the impacts and benefits against the overall goals and intent of the North Queensland Regional Plan.

9. Costs and benefits

9.1 Cost estimate

A 50% (P50) and 90% (P90) confidence factor estimate for the project has been calculated through quantitative analysis in accordance with ISO 31000-2009. The total out-turn costs in 2022 including escalation, the P50 and P90 cost estimates are summarised below in Table 9-1.

Table 9-1 P50 and P90 cost estimates

Description	P50 Cost (\$ ex GST)	P90 Cost (\$ ex GST)
Base Cost	40,815,341	40,815,341
Risk Contingency (planned and unplanned)	9,218,584	15,461,549
Project Estimate (in 2020 dollars)	50,033,925	56,276,890
Escalation	3,149,735	3,542,742
TOTAL OUT-TURN COSTS (in 2022, incl. contingency)	53,183,660	59,819,632

9.2 Local, state and national economies

BRW will have a direct economic impact on the agriculture industry within the Charters Towers region, increasing the volume of agricultural products produced and the underlying value of the products produced, contributing to growth of a key industry where the region holds a competitive advantage. In addition, in 2018-19, mining was the largest contributor to the region's economic output, accounting for around 45% of the LGA's Gross Value Added (GVA). By providing additional water storage for the region, this has the potential to increase the volume of total available water for the region and provide sufficient water to ensure future economic opportunities to expand industrial development are not constrained by availability of water, by ensuring an appropriate mix of availability of water for future industrial purposes as well as ensuring the security of the Charters Towers urban water supply.

Should the project result in additional supporting economic activity within Charters Towers, and provide additional employment opportunities for the region, this may contribute toward attracting additional workers (and their families) to the region. This in turn may result in additional demand for education services.

Employment opportunities provided by temporary workforce requirements (e.g. fruit picking) associated with additional irrigation activity may result in additional tourism activity for the region, attracting temporary domestic and international workers to the region during peak picking seasons.

9.3 Natural environment

Key environmental costs and benefits have been identified through a desktop review of the existing environment and baseline ecological survey.

Key environmental costs include:

- Loss of vegetation cover within the storage area
- Impacts to surface water including increased turbidity and disruption of downstream flows
- Loss of existing fish passage within the low flow channel of the Burdekin River (which is often reduced depending on seasonality and where not impeded by natural barriers)

- Loss and degradation of terrestrial and aquatic habitat (where covered by the water storage area, weir infrastructure or temporally disturbed during construction works for access and laydown areas)

Key environmental benefits include:

- Creation of a permanent water source and aquatic habitats associated with water storages
- Provision of fish passage through auxiliary channels that will be connected more frequently
- Re-establishment of vegetation and terrestrial habitat towards the top of the high banks of the river (above the full supply level).

9.4 Social environment

Initial construction workforce estimates identified in April 2020 for the purposes of the SIE consultation suggested that BRW may have the potential for between 50-53 personnel to be employed on-site for construction of the project. This preliminary estimate consisted of 20 labour and plant operators; 8 engineers, supervisors, administrators and managers; 5 mobile concrete batch plant subcontractors; 10 concrete subcontractors; 5 gravel subcontractors and 5 other subcontractors.

In August 2020 and subsequent to completion of the SIE, further analysis of employment opportunities as part of the Business Case using the P50 risk-adjusted capital costs (real) and guidance from Queensland Treasury regarding estimates of the number of direct FTE positions supported by capital works (Queensland Treasury, 2019), identified that BRW could potentially support up to 172 direct FTE positions during the construction period for the 2022 calendar year. At full production levels during the operations phase, the additional agricultural output associated with BRW is anticipated to deliver \$35 million per annum in additional revenue and directly support up to 117 FTE positions in the agriculture industry each year within the local economy.

Therefore, the construction of BRW is expected to have a positive social and economic impact on the local and regional study area, through direct employment opportunities during construction, operation and increased local business opportunities.

Additional social benefits from the operation of BRW include an:

- Increase in regional water availability and security
- Increase in procurement of goods and services from local businesses
- Improved access to Big Bend Recreation Reserve
- Increase in recreational opportunities within and along the Burdekin River.

10. Community and stakeholder consultation

The following community consultation and stakeholder engagement activities have been undertaken or are planned to be undertaken for the BRW project:

- A public information meeting was hosted by CTRC on 12 February 2020 which included presentations by TEL, GHD and KPMG on BRW. More than 80 members of the public attended the information session and were given the opportunity to ask questions at the end of the presentation as well as talk with key project team members following the meeting. The majority of people hang around after the meeting for refreshments and discussions about the project. A locally manned office is also propped to be established in Charters Towers CBD in the near future to provide the local community and public with further information on both the BRW and HGD projects.
- Approximately four meetings have taken place between CTRC and the project team (TEL, KPMG and GHD) since the award of the Business Case study in November 2019. The purpose of these meetings has been to provide the CEO and Mayor with updates on the project, progress of Business Case analysis and to request specific information/inputs for technical studies such as the SIE.
- Approximately three meetings have been held with the Big Rocks Agricultural Group (BRAG) to discuss the project, understand what demand currently exists and will likely exist from both existing and future water users, farmers in the area surrounding BRW and the ability of the region to expand into irrigated agriculture and high value cropping. TEL have been issuing newsletters to update BRAG and other key stakeholders on any upcoming meetings and the actions/outcomes in relation to any items raised at past meetings.
- GHD have been in contact with landholders directly adjoining the Burdekin River and BRW study area to request access for site walk-overs, seasonal ecology surveys and other field investigations. The majority of adjoining landholders have been supportive of the project and willing to allow access when requested.
- KPMG has undertaken separate targeted stakeholder consultation for the purposes of the Business Case and their economic modelling. This consisted of meetings with CTRC, BRAG and landholders in the vicinity of BRW between February 2020 and May 2020 and involved more detailed questions around their onsite farm practices and plans for future expenditure should more reliable water become available.
- A commencement meeting was held with NQLC on 1 April 2020 to provide an overview of BRW and to discuss GHD's intention for establishing a CHMP and requesting participation of the relevant Aboriginal parties for input into the SIE and overall Business Case. Following the commencement meeting and due to COVID 19 restrictions, ongoing correspondence with NQLC has been via email and phone conversations to ensure relevant information can be shared with their clients and inputs sought for the Business Case. A CHMA was subsequently drafted and executed by NAC and GHD on 27 August 2020 in order to allow investigative works (such as geotechnical investigations) to be undertaken for the Detailed Design phase. A CHMP is still required for construction and operation of BRW.
- SIE discussions with selected stakeholders including CTRC and impacted landholders took place in April 2020. NQLC also provided the SIE team with a report that identified project related concerns and possible mitigation measures raised by the Gudjala People and the Gugu Badhun People for inclusion in the SIE and the BRW Business Case.

- A pre-referral meeting was held with DAWE on 8 July 2020 to discuss the EPBC referral and its timing, the project scope, environmental assessments undertaken to date as well as potential direct, indirect, cumulative and facilitated impacts on MNES.
- Two pre-lodgment meetings have been held with the CG (20 January 2020 and 15 May 2020) to discuss the BRW project and preparation of the IAS prior to lodgment of an application for declaration. A preliminary draft IAS was submitted to the CG on 25 June 2020 with comments and feedback received on 11 August 2020. GHD are currently in the process of responding to the CG's comments on the preliminary draft IAS and are preparing the Final IAS for formal submission/lodgement.
- Separate to the meetings with the CG, GHD have also consulted with the following State government agencies:
 - Project briefing with DNRME's Acting Regional Manager –Water Services on 19 January 2020 and 25 March 2020 followed by a discussion on the requirements and the legislative process for applying for a water entitlement under the Burdekin Water Plan. Key items of discussion included water reliability, EFOs, IQQM (Integrated water quantity and quality simulation model) model, water trading, pricing and economic modelling for water supply schemes and criteria for a project to be considered "Regionally Significant".
 - Project briefing with DAF's Impact Assessment team on 20 July 2020 followed by a discussion around the waterway barrier works for BRW and the proposed fishway in order to determine if the preferred design will provide safe and effective fish passage.
 - Project briefing with DNRME's planning services team on 23 August 2020 with respect to tenure options for the Burdekin River and state lease land.
 - Project briefing with members of the Great Barrier Reef Marine Park Authority (GBRMPA) on 31 August 2020 to discuss the EPBC referral and its timing, the environmental assessment undertaken to date as well as potential direct, indirect, cumulative and facilitated impacts on the Burdekin catchment and potential pressure on end of catchment loads with the potential to effect the reef.
 - Project briefing with members of the Queensland Parks and Wildlife Service and Partnerships (QPWSP) on 8 September 2020 to discuss operational aspects and ongoing management considerations relating to Dalrymple National Park.
 - Email correspondence with DSDTI's Development Assessment Division to discuss potential conflicts with the North Queensland Regional Plan and requirements for development in a SEA.

Further stakeholder engagement activities and agency meetings are proposed to be ongoing and will continue as part of the Detailed Design phase and approvals process.

11. References and data sources

- ABS, 2016a. 2016 Census. Accessed 13 March 2020, <https://quickstats.censusdata.abs.gov.au/>
- ABS, 2016b. 2016 Census QuickStats – Charters Towers, Accessed 13 March 2020, https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA32310.
- ABS, 2018. *Socio-Economic Indexes for Areas (SEIFA), Australia, 2016*. Accessed 16 March 2020, <https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/2033.0.55.001Main+Features12016?OpenDocument>.
- Allen, GR, Midgley, SH and Allen, M 2003. '*Field Guide to the Freshwater Fishes of Australia*', Perth, Western Australian Museum.
- Australian Department of Education, Skills and Employment, 2020b. *Small Area Labour Markets publication*. Accessed 17 March 2020, <https://www.employment.gov.au/small-area-labour-markets-publication-0>.
- Baumgartner, LJ 2005. '*Effects of weirs on fish movements in the Murray-Darling Basin*', PhD thesis, University of Canberra.
- Baumgartner, LJ, Reynoldson, N and Gilligan, DM 2006. 'Mortality of larval Murray cod (*Maccullochella peelii peilii*) and golden perch (*Macquaria ambigua*) associated with passage through two types of low-head weirs', *Marine and Freshwater Research*, vol 57, pp 187-191.
- Building Queensland, 2016. Social impact evaluation: supplementary guidance.
- Building Queensland, 2020. Social impact evaluation guide. Release 3. <https://buildingqueensland.qld.gov.au/wp-content/uploads/2020/04/Social-Impact-Evaluation-Guide.pdf>
- Bureau of Meteorology, 2019a. '*Rose of Wind direction versus Wind speed in km/h, Charters Towers Airport*,' Accessed 29 April 2020, http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.034084.9amMay.pdf
- Bureau of Meteorology, 2019b. '*Rose of Wind direction versus Wind speed in km/h, Charters Towers Airport*,' Accessed 29 April 2020, http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.034084.3pmMay.pdf
- Bureau of Meteorology, 2019b. '*Rose of Wind direction versus Wind speed in km/h, Charters Towers Airport*,' Accessed 29 April 2020, http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.034084.3pmMay.pdf
- Bureau of Meteorology, 2019c. '*Rose of Wind direction versus Wind speed in km/h, Charters Towers Airport*,' Accessed 29 April 2020, http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.034084.9amOct.pdf
- Bureau of Meteorology, 2019d. '*Rose of Wind direction versus Wind speed in km/h, Charters Towers Airport*,' Accessed 29 April 2020, http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.034084.3pmOct.pdf
- Bureau of Meteorology, 2020. '*Climate Statistics for Australian Locations*,' Accessed 29 April 2020, http://www.bom.gov.au/climate/averages/tables/cw_034084.shtml
- Charters Towers Regional Council, n.d. *Corporate Plan 2018-2023*. Accessed 17 March 2020, <http://www.charterstowers.qld.gov.au/documents/41682213/0109dac7-3cca-4970-ac22-77fc02b8420b>

Charters Towers Regional Council, 2019. *Advocacy Plan*.
<http://www.charterstowers.qld.gov.au/documents/41682213/41768443/Advocacy Plan June 2019>.

Daly, M., Dehne, A., Leffman, D., & Scott, C., 2003. *The rough guide to Australia* (6th Ed.) New York, USA. :Rough Guides.

Department of Agriculture and Fisheries (DAF), 2019a. Restricted invasive animals of Queensland. Available from:
https://www.daf.qld.gov.au/_data/assets/pdf_file/0011/403868/IPA-Restricted-animals-of-Queensland.pdf. Accessed 4 February 2020.

Department of Agriculture and Fisheries (DAF), 2019b. *Water barrier works – State Code 18*, April 2019

Department of Environment and Energy (DEE), 2020. Species Profiles and Threats Database. Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>. Accessed 20 January 2020.

Department of Environment and Heritage Protection (DEHP), 2009. Queensland Water Quality Guidelines, Version 3, ISBN 978-0-9806986-0-2.

Department of Environment and Science (DES), 2011. *Dalrymple National Park Management Plan*. Accessed 24 March 2020, <https://parks.des.qld.gov.au/managing/plans-strategies/pdf/mp008-dalrymple-national-park-mgtplan-ginc-approved-2011.pdf>

Department of Environment and Science (DES), 2020. WetlandInfo – Queensland Wetlands Information. Available from: <https://wetlandinfo.ehp.qld.gov.au/wetlands/>. Accessed 20 January 2020.

Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP), 2018. Social Impact Assessment Guideline, March 2018.
<https://www.statedevelopment.qld.gov.au/resources/cg/social-impact-assessment-guideline.pdf>

Duivenvoorden, LJ, Hamilton, DR, Price, MD and Attard, TB 2000. 'Temporal Variation of Macroinvertebrate Communities of impounded and riverine sites in Central Queensland', in Noble, RM (ed.), *River Health in the Fitzroy Catchment: Community Ownership*, Rockhampton, Department of Natural Resources.

GeoResGlobe, 2020. *Regional Geology Mapping*, Accessed 8 January 2020.

GHD, 2015. Big Rocks Weir Concept Plan, Revision 0, 4219018, 11 September 2015, Townsville.

GHD, 2020a. *Big Rocks Weir Business Case Baseline Terrestrial and Aquatic Ecology Assessment, Pre-wet Assessment*, 12512214, Revision 0, June 2020.

GHD, 2020b. *Big Rocks Weir Business Case Baseline Terrestrial and Aquatic Ecology Assessment, Post-wet Assessment*, 12512214, Revision 0, August 2020.

GHD, 2020c. Big Rocks Weir Geotechnical Interpretative Report, 12512214, Revision 0, 12512214, Revision 0, August 2020.

GHD, 2020d. *Big Rocks Weir Business Case Reference Design Report*, 12512214, Revision 0, August 2020

Hamann, M, Schauble, CS, Limpus, DJ, Emerick, SP and Limpus, CJ 2007. '*Management plan for the conservation of Elseya sp. (Burnett River) in the Burnett River Catchment*', Queensland, Environmental Protection Agency.

- .id, 2019. *Charters Towers Regional Council economic profile*. Accessed 16 March 2020, <https://economy.id.com.au/charters-towers>.
- James Cook University (JCU), 2020. Fletcherview - Research. JCU. <https://www.jcu.edu.au/fletcherview/research>
- KPMG, 2019. *North Queensland Agricultural Market and Supply Chain Study*. Accessed 16 March 2020, <https://www.burdekin.qld.gov.au/downloads/file/236/north-queensland-market-and-agricultural-supply-chain-study>
- Larinier, M 2000. '*Dams and fish migration*', contributing paper to the World Commission of Dams Thematic Review II.1 Ecosystems.
- Lowe-McConnell, RH 1987. '*Ecological studies in tropical fish communities*', New York, Cambridge University Press.
- Lucas, MC and Baras, E 2001. '*Migrations of freshwater fishes*', Oxford, Blackwell Science.
- Marchant, R and Hehir, G 2002. '*The use of AUSRIVAS predictive models to assess the response of lotic macroinvertebrates to dams in south-east Australia*', *Freshwater Biology*, vol 47, pp 1033-1050.
- Marsden, T & Power, T 2007. 'Proposal for raising Eden Bann Weir and construction of Rookwood Weir – An assessment of the potential requirements for fish passage', Commercial-in-confidence report prepared for the Department of Natural Resources and Water, Queensland.
- McIntyre & Associates, 1994b. Charters Towers water supply Big Rocks Weir, Preliminary design report, Job No. 6133.
- Pusey, B, Kennard, M and Arthington, A 2004. '*Freshwater Fishes of North-Eastern Australia*', Collingwood, CSIRO Publishing.
- Queensland Treasury, 2019, Guidelines FTE jobs supported by capital works.
- Reynolds, LM 1983. 'Migration patterns of five fish species in the Murray-Darling River system'. *Australian Journal of Marine and Freshwater Research*. vol 34, pp. 857- 871.
- State Assessment and Referral Agency (SARA), 2020. *Database*, Accessed 13 April 2020.
- Stuart, IG 1997. 'Assessment of a Modified Vertical-Slot Fishway, Fitzroy River, Queensland', Department of Primary Industries, Queensland. Project report QO97023.
- Stuart, IG and Mallen-Cooper, M 1999. 'An assessment of the effectiveness of a vertical-slot fishway for non-salmonid fish at a tidal barrier on a large tropical/subtropical river', *Regulated Rivers Research and Management*, vol 15, pp 575-590.
- QGSO, 2018. *Queensland Government population projections, 2018 edition: Local government areas snapshot*. Accessed 16 March 2020, <https://www.qgso.qld.gov.au/issues/5281/qld-population-projections-regions-tables-local-government-areas-qld-low-med-high-series-2016-2041.xlsx>.
- SMEC Australia Pty Ltd, 2018. Hells Feasibility Study Final Feasibility Report. Available from: https://s3-ap-southeast-2.amazonaws.com/os-data-2/townsvilleenterprise-com-au/documents/hells_gates_dam_-_executive_summary.pdf
- Stuart, I. and Marsden, T., 2019. Evaluation of cone fishways to facilitate passage of small-bodied fish, *Aquaculture and Fisheries*, <https://doi.org/10.1017/j.aaf.2019.02.003>.
- Townsville Enterprise Limited (TEL), 2020, *Big Rocks Business Case*, Document No: 0019-43-TEL, Rev B, August 2020, <https://www.nqwia.gov.au/projects>

Townsville Hospital and Health Service, 2020. *Charters Towers Health Service*. Accessed 18 March 2020, <https://www.townsville.health.qld.gov.au/facilities/charters-towers/charters-towers-health-service/>.

Tucker, A.D, Limpus, C.J, 2001. *Home ranges of Fitzroy River turtles (Rheodytes leukops) overlap riffle zones: Potential concerns related to river regulation*, Biological Conservation, Queensland, Australia,

United States Department of the Interior, Bureau of Reclamation (USBR), 1984. *Engineering Monograph No.25, Hydraulic Design of Stilling Basins and Energy Dissipaters*, USBR, Denver, CO.

Victorian Resources Online, 2020. *Tenosols*. Agriculture Victoria, Accessed 3 March 2020, http://vro.agriculture.vic.gov.au/dpi/vro/neregn.nsf/pages/ne_soil_ten

Visit Charters Towers, 2019. *Charters Towers North Queensland: 2019/2020 Regional Holiday Guide*. Accessed 17 March 2020, <https://charterstowers.partica.online/charters-towers-holiday-guide/regional-holiday-guide-2019-2020/flipbook/1/>.

Visit Charters Towers, 2020a. *Anabranh*. Accessed 19 March 2020, <https://www.visitcharterstowers.com.au/anabranh>.

Visit Charters Towers, 2020b. *Big Bend & Echo Hole*. Accessed 24 March 2020, <https://www.visitcharterstowers.com.au/big-bend-echo-hole>.

Visit Charters Towers, 2020c. *Fletcher Creek*. Accessed 19 March 2020, <https://www.visitcharterstowers.com.au/fletcher-creek>.

Warneke, L., 2016. Exploring Big Bend and Echo Hole, Burdekin River. *Wandestories*. Accessed 19 March 2020, <https://wanderstories.space/big-bend-charters-towers/>

12. Glossary, acronyms and abbreviations

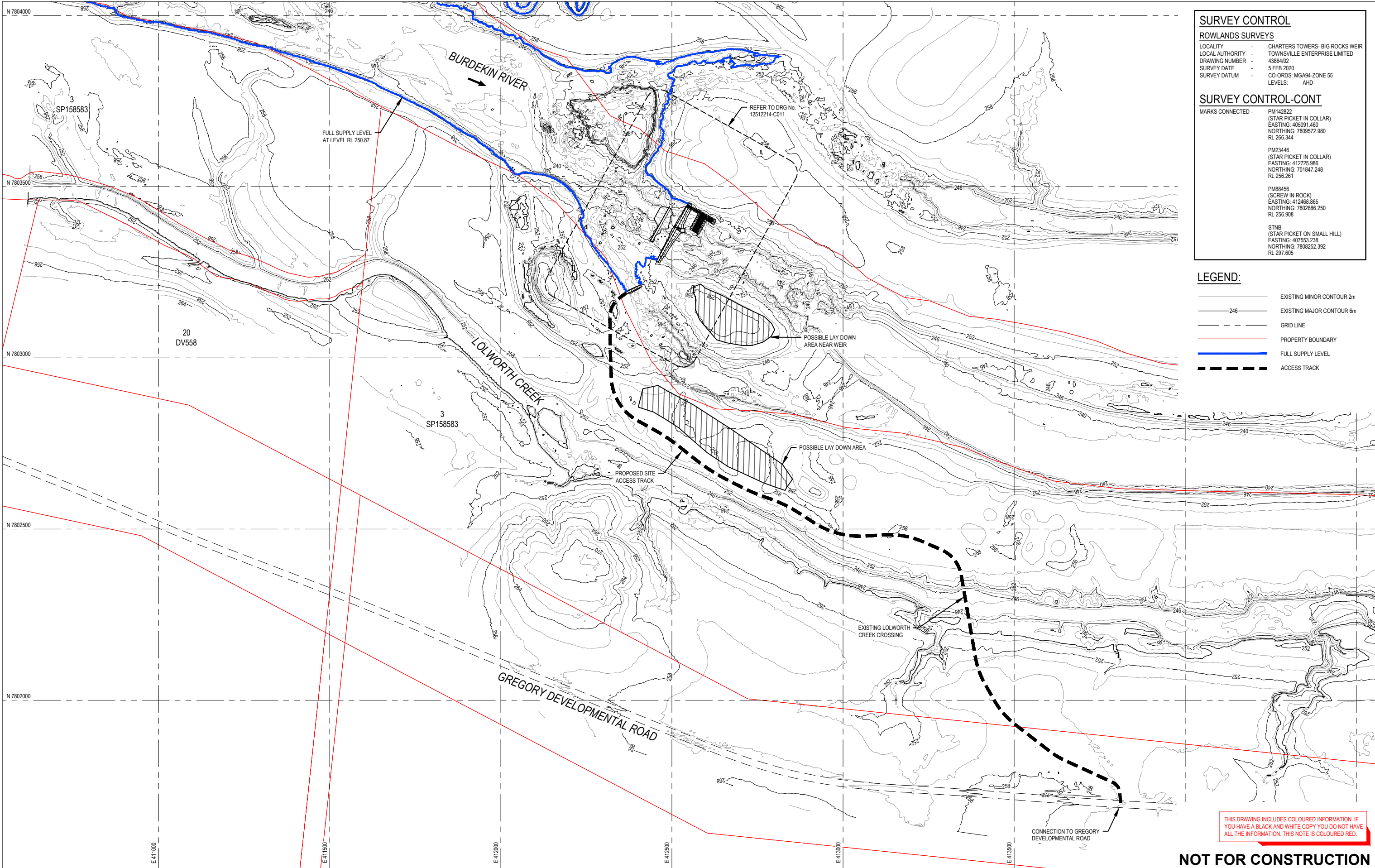
Abbreviation	Definition
4WD	4 wheel drive
ABS	Australian Bureau of Statistics
ACH Act	<i>Aboriginal Cultural Heritage Act 2003</i>
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ATV	All terrain vehicle
BAL	Basic left turn treatment
BAR	Basic right turn treatment
BB	Big Bend
Bio Act	<i>Biosecurity Act 2014</i>
BCR	Benefit Cost Ratio
BoM	Bureau of Meteorology
BRAG	Big Rocks Agricultural Group
BRW	Big Rocks Weir
CEMP	Construction Environmental Management Plan
CG	Coordinator-General
CHMP	Cultural Heritage Management Plan
CPESC	certified professional in erosion and sediment control
CTRC	Charters Towers Regional Council
DA	Development Application
DAF	Department of Agriculture and Fisheries
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships
DAWE	Department of Agriculture, Water and the Environment
DEE	Department of Environment and Energy
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
DIDO	Drive-in Drive-out
DIWA	Directory of Important Wetlands in Australia
DNRME	Department of Natural Resources, Mines and Energy
DSDMIP	Department of State Development, Manufacturing, Infrastructure and Planning
DTMR	Department of Transport and Main Roads
EA	Environmental Authority
EFOs	Environmental flow objectives
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EO Act	<i>Environmental Offsets Act 2014</i>
EP Act	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPM	Exploration permit mineral
ESCP	Erosion and Sediment Control Plan
FIA	Failure Impact Assessment
FIFO	Fly-in Fly-out
FSL	Full Supply Level
FTE	Full-time equivalent
GBR	Great Barrier Reef
GBRWHA	Great Barrier Reef World Heritage Area
GRP	Gross Regional Product

Abbreviation	Definition
GST	Goods and services tax
GVA	Gross Value Added
ha	Hectares
HES	High Ecological Significance
HGD	Hells Gates Dam
IAR	Impact Assessment Report
IAS	Initial Advice Statement
ID	Infrastructure Designation
IQQM	Integrated water quantity and quality simulation model
JCU	James Cook University
km	Kilometres
kV	Kilovolts
LGA	Local Government Area
MCU	Material Change of Use
ML	Megalitres
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NAC	Ngrragoonda Aboriginal Corporation
NAIF	Northern Australia Infrastructure Facility
NC Act	<i>Nature Conservation Act 1992</i>
NEM	National energy market
NNTT	National Native Title Tribunal
NQLC	North Queensland Land Council
NQWIA	North Queensland Water Infrastructure Authority
NTU	Nephelometric Turbidity Units
PHES	Pumped hydroelectric scheme
PIF	Private Infrastructure Facility
PMST	Protected Matters Search Tool
QGSO	Queensland Government Statistician's Office
QWQG	Queensland Water Quality Guidelines
RE	Regional Ecosystem
RIDA	Regional interests development approval
RL	Reduced level
RPI Act	<i>Regional Planning Interests Act 2014</i>
RPI Reg	<i>Regional Planning Interests Regulation 2014</i>
RPP	Riverine Protection Permit
SARA	State Assessment and Referral Agency
SEIDA	Socio-economic Indexes for Disadvantage
SCR	State Controlled Road
SDAP	State Development Assessment Provisions
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i>
SEA	Strategic environmental area
SIE	Social Impact Evaluation
SIP	State Infrastructure Plan
SLAM	State Land and Asset Management Unit
SMP	Species Management Plan
SPP	State Planning Policy
TEC	Threatened Ecological Community
TEL	Townsville Enterprise Limited
UCL	Urban Centre Locality
USBR	United States Department of the Interior Bureau of Reclamation

Abbreviation	Definition
WASO	Water Allocation Security Objectives
WB	Wetland buffer
WoNS	Weeds of National Significance
WQIP	<i>Burdekin Region Water Quality Improvement Plan 2016</i>
VM Act	<i>Vegetation Management Act 1999</i>

Appendices

Appendix A – Selected Reference Design Drawings



SURVEY CONTROL

ROWLANDS SURVEYS

LOCALITY - CHARTERS TOWERS- BIG ROCKS WEIR
LOCAL AUTHORITY - TOWNSVILLE ENTERPRISE LIMITED
DRAWING NUMBER - 43864/02
SURVEY DATE - 5 FEB 2020
SURVEY DATUM - CO-ORDS: MGA94-ZONE 55
LEVELS: AHD

SURVEY CONTROL-CONT

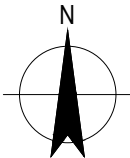
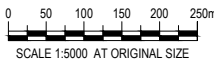
MARKS CONNECTED - PM142822
(STAR PICKET IN COLLAR)
EASTING: 405091.460
NORTHING: 7809572.980
RL 266.344
PM23446
(STAR PICKET IN COLLAR)
EASTING: 412725.986
NORTHING: 701847.248
RL 256.261
PM88456
(SCREW IN ROCK)
EASTING: 412468.865
NORTHING: 7802886.250
RL 256.908
STNB
(STAR PICKET ON SMALL HILL)
EASTING: 407553.238
NORTHING: 7808252.392
RL 297.605

LEGEND:

- EXISTING MINOR CONTOUR 2m
- EXISTING MAJOR CONTOUR 6m
- GRID LINE
- PROPERTY BOUNDARY
- FULL SUPPLY LEVEL
- ACCESS TRACK

NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director
					Date



townsville
enterprise



71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E ts@mail@ghd.com W www.ghd.com

DO NOT SCALE

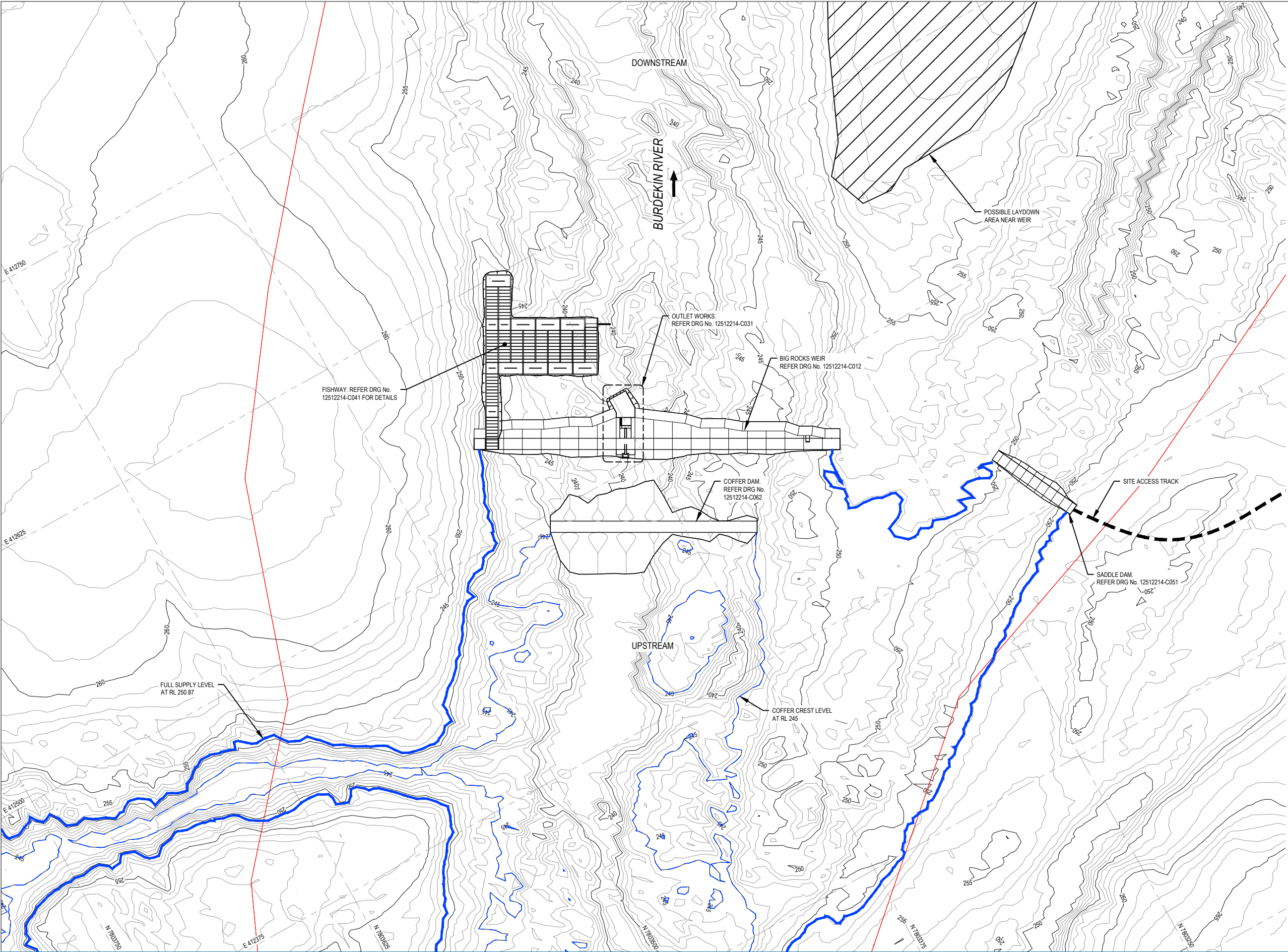
Conditions of Use.
This document may only be used by
GHD's client (and any other person who
GHD has agreed can use this document)
for the purpose for which it was prepared
and must not be used by any other
person or for any other purpose.

Drawn J. EDWARDS	Designer N.T. KINSELLA
Drafting Check	Design Check
Approved (Project Director)	Date
Scale 1:5000	This Drawing must not be used for Construction unless signed as Approved

Client **TOWNSVILLE ENTERPRISE LIMITED**
Project **BIG ROCKS WEIR BUSINESS CASE**
Title **SITE LAYOUT PLAN**

Original Size **A1** Drawing No: **12512214-C003**

Rev: **B**



LEGEND:

- EXISTING MINOR CONTOUR 1m
- EXISTING MAJOR CONTOUR 5m
- GRID LINE
- PROPERTY BOUNDARY
- FULL SUPPLY LEVEL
- COFFER DAM CREST LEVEL
- ACCESS TRACK

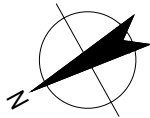
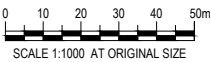
NOTES:

- REFER DRAWING 12512214-C003 FOR SURVEY CONTROL.
- ALL MEASUREMENTS IN mm AND ALL LEVELS IN m AHD UNLESS NOTED OTHERWISE.

THIS DRAWING INCLUDES COLOURED INFORMATION. IF YOU HAVE A BLACK AND WHITE COPY YOU DO NOT HAVE ALL THE INFORMATION. THIS NOTE IS COLOURED RED.

NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20
No	Revision	Note:	Drawn	Job Manager	Project Director
					Date



townsville
enterprise



71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E tsvalmail@ghd.com W www.ghd.com

DO NOT SCALE

Conditions of Use.
This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

Drawn J. EDWARDS

Designer N.T. KINSELLA

Drafting Check

Design Check

Approved (Project Director)

Date

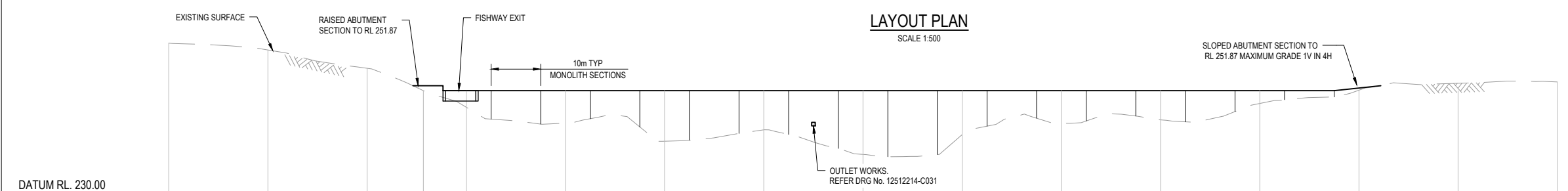
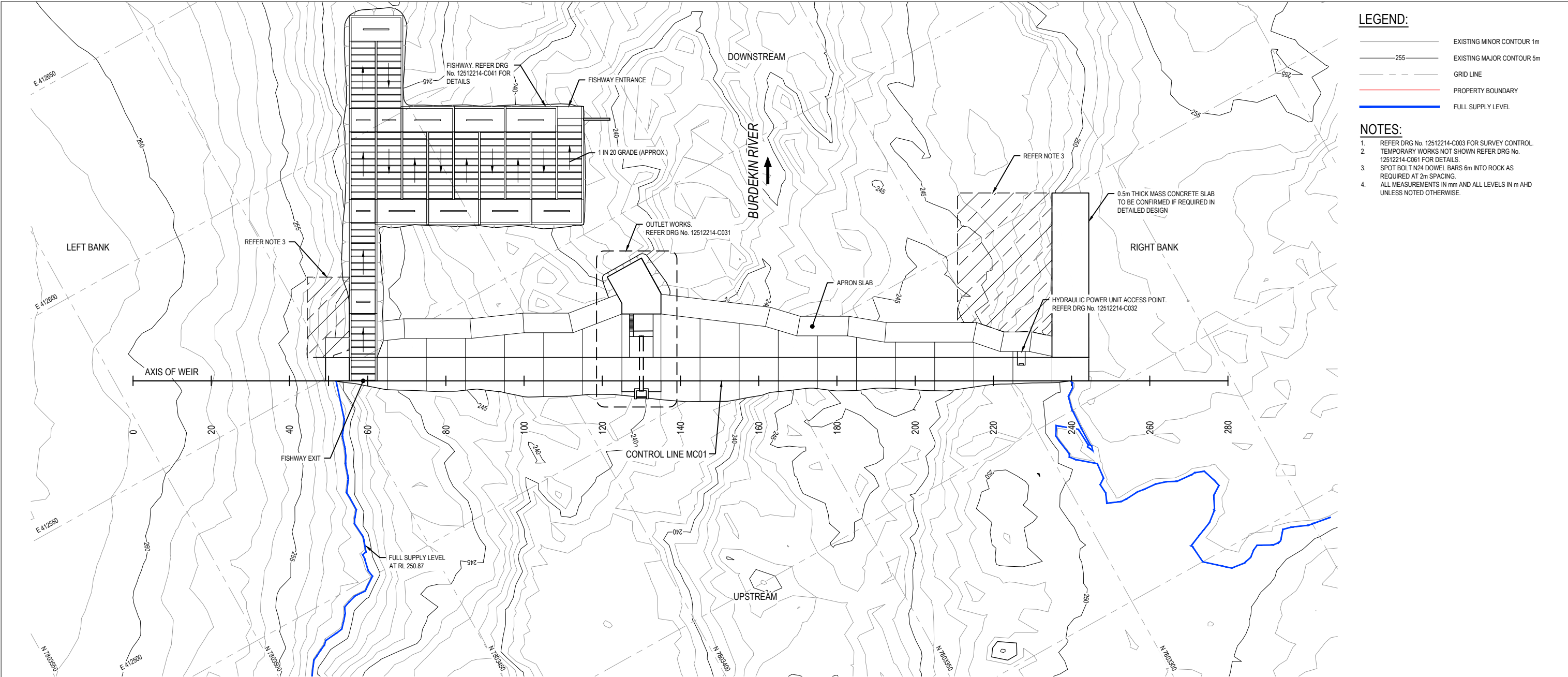
Scale 1:1000

This Drawing must not be used for Construction unless signed as Approved

Client **TOWNSVILLE ENTERPRISE LIMITED**
Project **BIG ROCKS WEIR BUSINESS CASE**
Title **GENERAL ARRANGEMENT WEIR AND OUTLET STRUCTURES**

Original Size **A1** Drawing No: **12512214-C011**

Rev: B



DATUM RL. 230.00																
LEVEL DIFFERENCE CUT - / FILL +	-9.56	-8.19	-4.51	0.00	3.35	6.59	10.19	7.88	12.85	8.85	6.58	5.88	2.58	-0.09	-1.48	-1.76
DESIGN SURFACE LEVEL	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87	250.87
EXISTING SURFACE LEVEL	260.43	259.06	255.38	250.87	247.52	244.28	240.68	242.99	238.02	242.02	244.29	244.99	246.29	250.96	252.35	252.63
CHAINAGE	0.00	20.00	40.00	51.35	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00

LONGITUDINAL SECTION - CONTROL LINE MC01
HORZ 1:500 VERT 1:500

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20	
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20	
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E ts@mail@ghd.com W www.ghd.com

DO NOT SCALE

Conditions of Use.
This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

Drawn	J. EDWARDS	Designer	N.T. KINSELLA
Drafting Check		Design Check	
Approved (Project Director)		Date	
Scale	1:500	This Drawing must not be used for Construction unless signed as Approved	

Client **TOWNSVILLE ENTERPRISE LIMITED**

Project **BIG ROCKS WEIR BUSINESS CASE**

Title **WEIR PLAN AND LONGITUDINAL SECTION**

Original Size **A1** Drawing No: **12512214-C012** Rev: **B**

NOTE:

1. ALL MEASUREMENTS IN mm AND ALL LEVELS IN m AHD UNLESS NOTED OTHERWISE.

LEGEND:

40 MPa CONCRETE

20 MPa CONCRETE

DENTAL CONCRETE

UPSTREAM

DOWNSTREAM

AXIS OF WEIR

6000

CREST RL 250.87

FSL 250.87

PVC CENTREBULB WATERSTOP. REFER 'TYPICAL MONOLITH JOINT DETAIL' ADJACENT

CONCRETE MONOLITH (20MPa)

VARIES TO 13.3m APPROX.

0.4

1

0.8

1

EXISTING SURFACE

FOUNDED ON SLIGHTLY WEATHERED (SW) RHYOLITE OR BETTER

DENTAL CONCRETE INDICATIVE

UPSTREAM

DOWNSTREAM

MONOLITH

CONSTRUCTION JOINT

300

WATERSTOP SHALL BE FIXED USING PVC CENTRE BULB WATERSTOP

TYPICAL MONOLITH JOINT DETAIL

SCALE 1:20

PVC CENTRE BULB WATERSTOP

EXCAVATED SURFACE

5000

1000

APRON SLAB

DOUBLE CORROSION PROTECTION N28 DOWELS ON 1200 X 1200 GRID 3m INTO ROCK

DENTAL CONCRETE INDICATIVE

TYPICAL MONOLITH SECTION (AT JOINT)

SCALE 1:50

NOT FOR CONSTRUCTION

						0 0.2 0.4 0.6 0.8 1.0m SCALE 1:20 AT ORIGINAL SIZE		townsville enterprise 71 Stanley Street, Townsville QLD 4810 Australia PO Box 930 Townsville QLD 4810 T 61 7 4720 0400 F 61 7 4772 6514 E tsvmail@ghd.com W www.ghd.com	DO NOT SCALE Conditions of Use. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.	Drawn J. EDWARDS	Designer N.T. KINSELLA	Client TOWNSVILLE ENTERPRISE LIMITED		
						0 0.5 1.0 1.5 2.0 2.5m SCALE 1:50 AT ORIGINAL SIZE				Drafting Check	Design Check	Project BIG ROCKS WEIR BUSINESS CASE		
B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20					Approved (Project Director)	Date	Title WEIR - MONOLITH		
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20					This Drawing must not be used for Construction unless signed as Approved		Original Size A1		
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date			Scale AS SHOWN		Drawing No: 12512214-C021		Rev: B	

Plot Date: 14 August 2020 - 12:50 PM Plotted by: James Edwards Cad File No: C:\12d\SW\data\VP-00-12D-00\142-12512214 - Big Rocks Weir_639\CADD\Drawings\12512214-C021.dwg

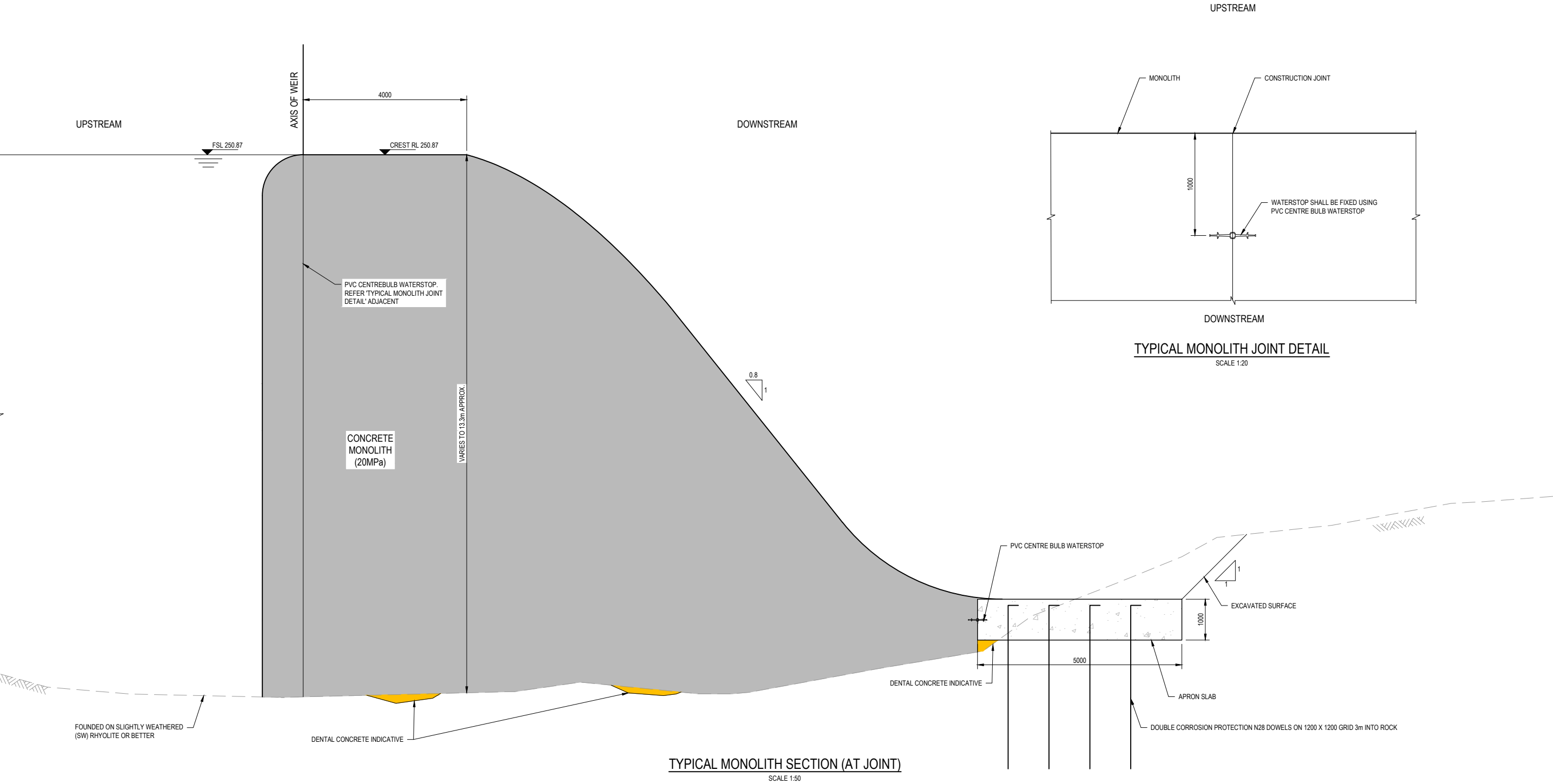
NOTE:
1. ALL MEASUREMENTS IN mm AND ALL LEVELS IN m AHD UNLESS NOTED OTHERWISE.

LEGEND:

40 MPa CONCRETE

20 MPa CONCRETE

DENTAL CONCRETE

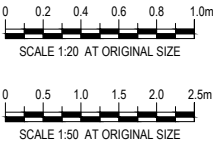


TYPICAL MONOLITH JOINT DETAIL
SCALE 1:20

TYPICAL MONOLITH SECTION (AT JOINT)
SCALE 1:50

NOT FOR CONSTRUCTION

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	FINAL BUSINESS CASE ISSUE		JE	NTK*	SO*	14.08.20

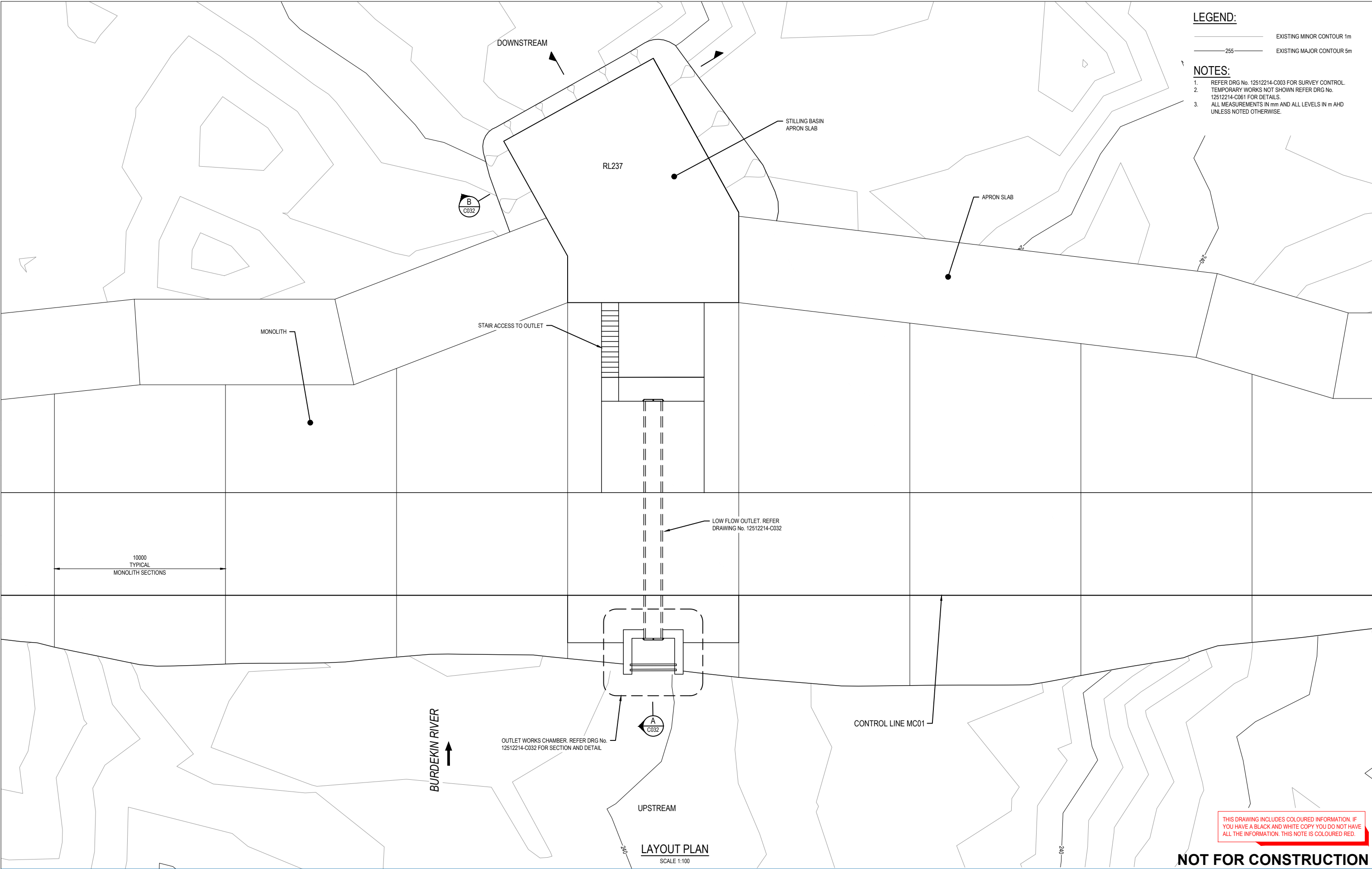


GHD

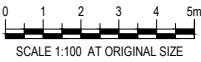
71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E tsvmail@ghd.com W www.ghd.com

DO NOT SCALE	Drawn J. EDWARDS	Designer N.T. KINSELLA
Conditions of Use. This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.	Drafting Check	Design Check
	Approved (Project Director) Date	
	Scale AS SHOWN	This Drawing must not be used for Construction unless signed as Approved

Client	TOWNSVILLE ENTERPRISE LIMITED
Project	BIG ROCKS WEIR BUSINESS CASE
Title	WEIR - MONOLITH (ALTERNATE SECTION)
	TYPICAL SECTIONS AND DETAILS
Original Size	A1
Drawing No:	12512214-C022
Rev:	A



B	FINAL BUSINESS CASE ISSUE			JE	NTK* SO* 14.08.20
A	PRELIMINARY ISSUE			JE	NTK* SO* 28.04.20
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing			Drawn Job Manager Project Director Date



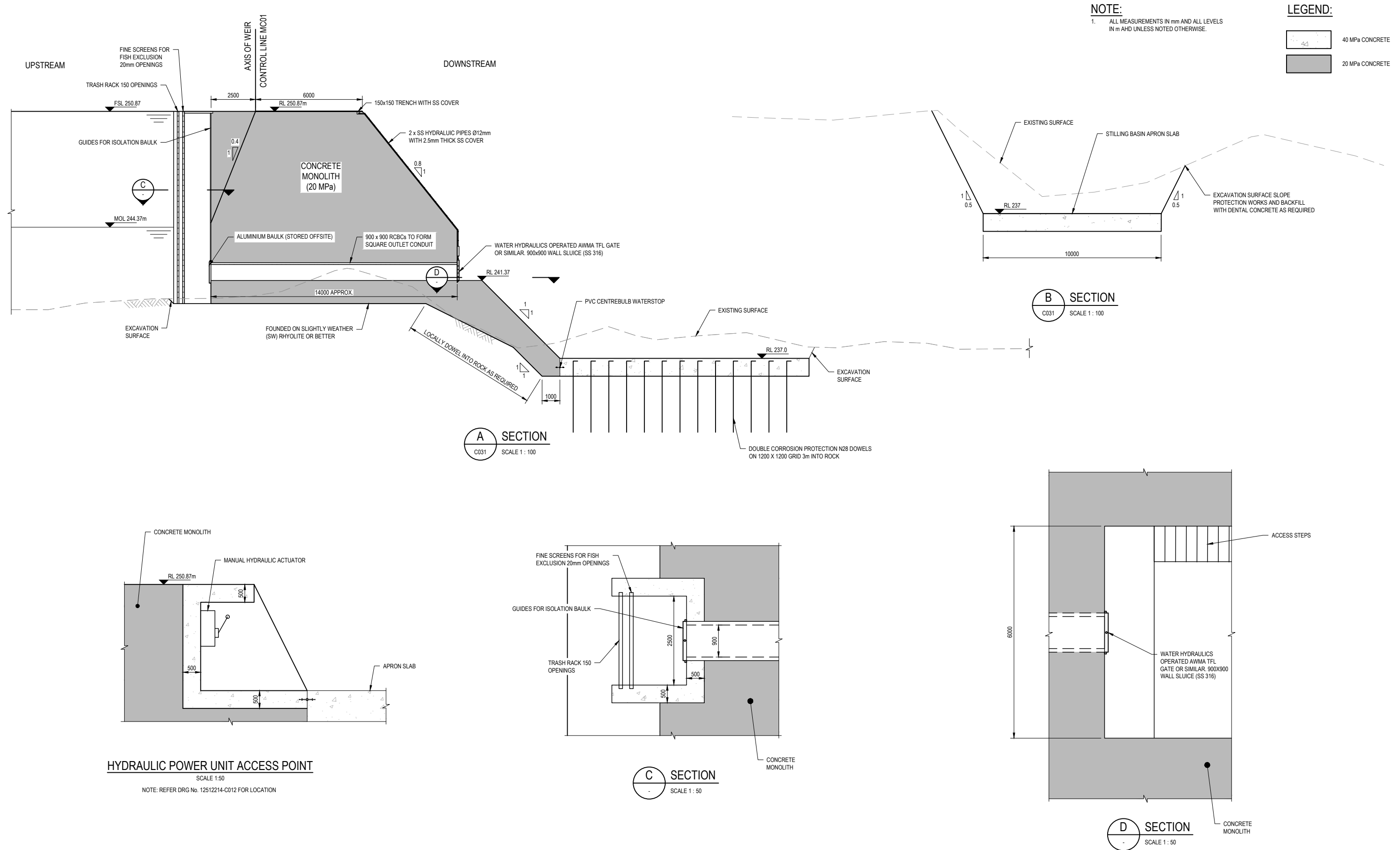
GHD
71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E tsvmail@ghd.com W www.ghd.com

DO NOT SCALE

Conditions of Use.
This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

Drawn	J. EDWARDS	Designer	N.T. KINSELLA
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client	TOWNSVILLE ENTERPRISE LIMITED		
Project	BIG ROCKS WEIR BUSINESS CASE		
Title	OUTLET WORKS LAYOUT PLAN		
Original Size	A1		
Drawing No:	12512214-C031		Rev: B



NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE		JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE		JE	NTK	SO	28.04.20
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date



DO NOT SCALE

Conditions of Use.
This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

Drawn J. EDWARDS

Designer N.T. KINSELLA

Drafting Check

Design Check

Approved (Project Director)

Date

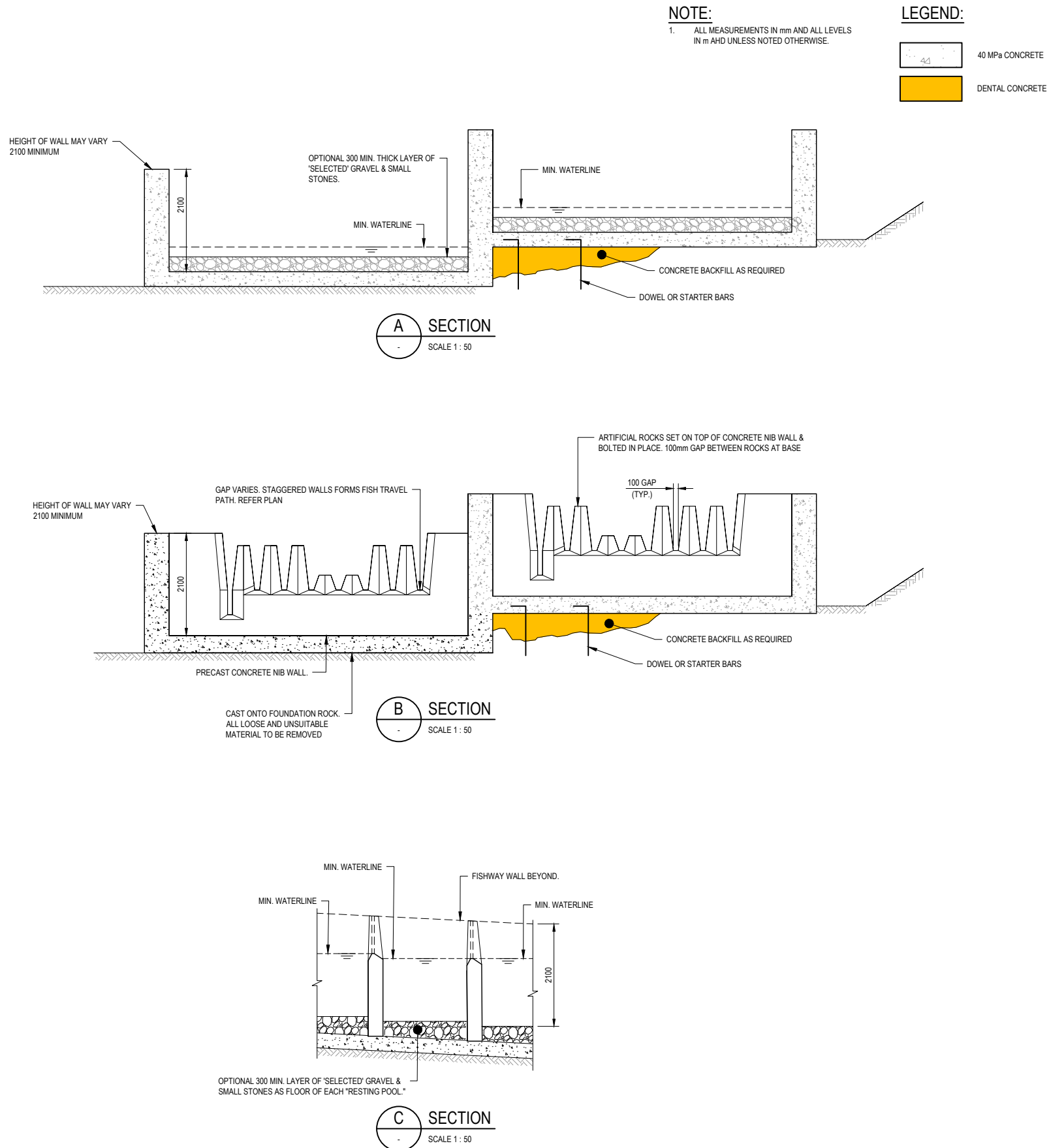
Scale AS SHOWN

This Drawing must not be used for Construction unless signed as Approved

Client TOWNSVILLE ENTERPRISE LIMITED
Project BIG ROCKS WEIR BUSINESS CASE
Title OUTLET WORKS
TYPICAL SECTIONS AND DETAILS

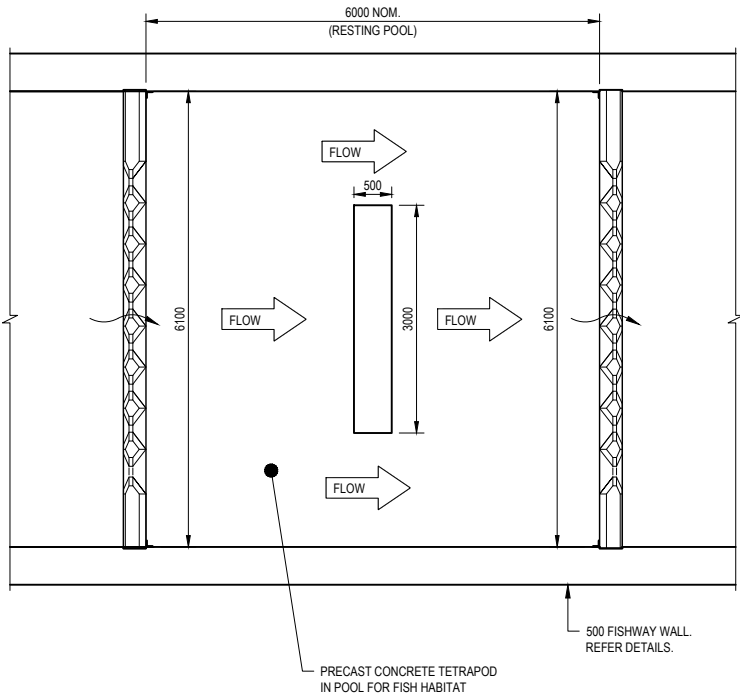
Original Size A1 Drawing No: 12512214-C032

Rev: B

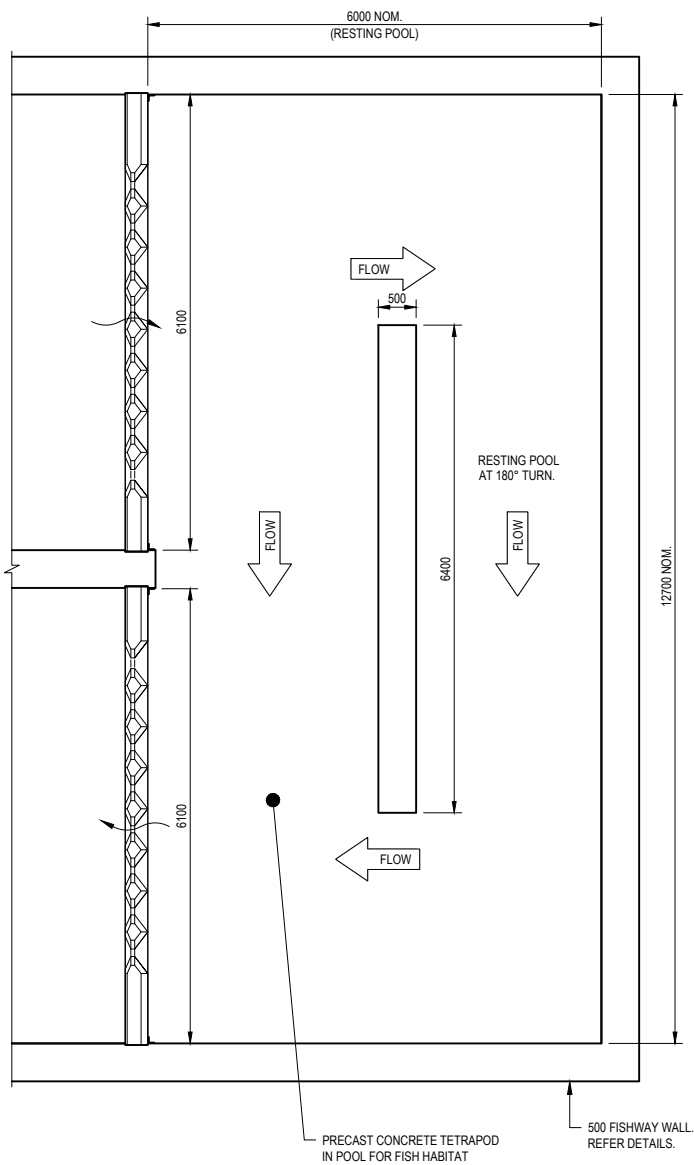


Client	TOWNSVILLE ENTERPRISE LIMITED		
Project	BIG ROCKS WEIR BUSINESS CASE		
Title	FISH PASSAGE TYPICAL SECTIONS AND DETAILS SHEET 1		
Original Size	A1		Rev: B

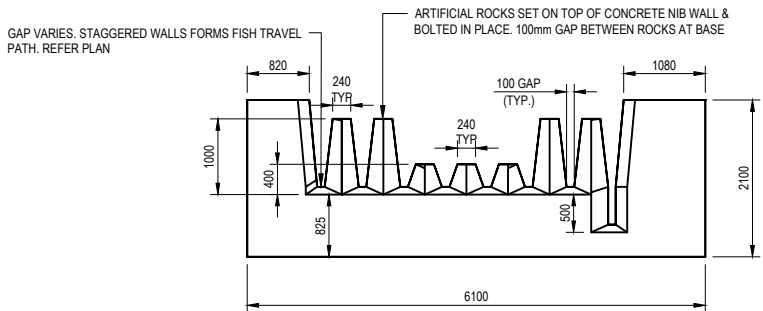
NOTE:
1. ALL MEASUREMENTS IN mm AND ALL LEVELS
IN m AHD UNLESS NOTED OTHERWISE.



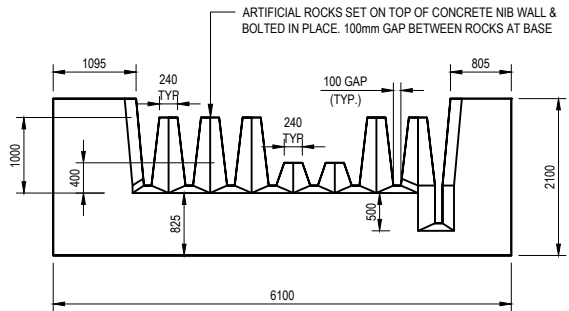
FISHWAY RESTING POOL TYPE 1
SCALE 1:50
REFER DRG No. 12512214-C041 FOR LOCATION



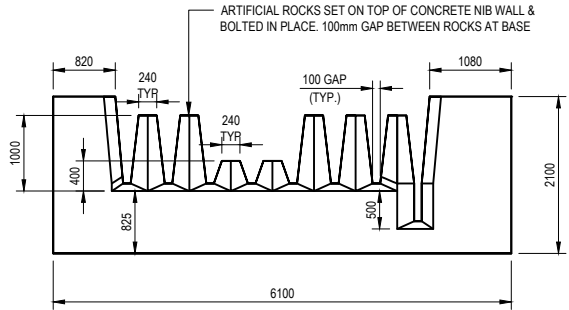
FISHWAY RESTING POOL TYPE 2
SCALE 1:50
REFER DRG No. 12512214-C041 FOR LOCATION



CONE EXIT/ENTRY WEIR
SCALE 1:50
REFER DRG No. 12512214-C042 FOR LOCATION



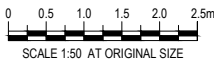
CONE WEIR TYPE A
SCALE 1:50
REFER DRG No. 12512214-C042 FOR LOCATION



CONE WEIR TYPE B
SCALE 1:50
REFER DRG No. 12512214-C042 FOR LOCATION

NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director



DO NOT SCALE

Conditions of Use.
This document may only be used by
GHD's client (and any other person who
GHD has agreed can use this document)
for the purpose for which it was prepared
and must not be used by any other
person or for any other purpose.

Drawn J. EDWARDS

Designer N.T. KINSELLA

Drafting Check

Design Check

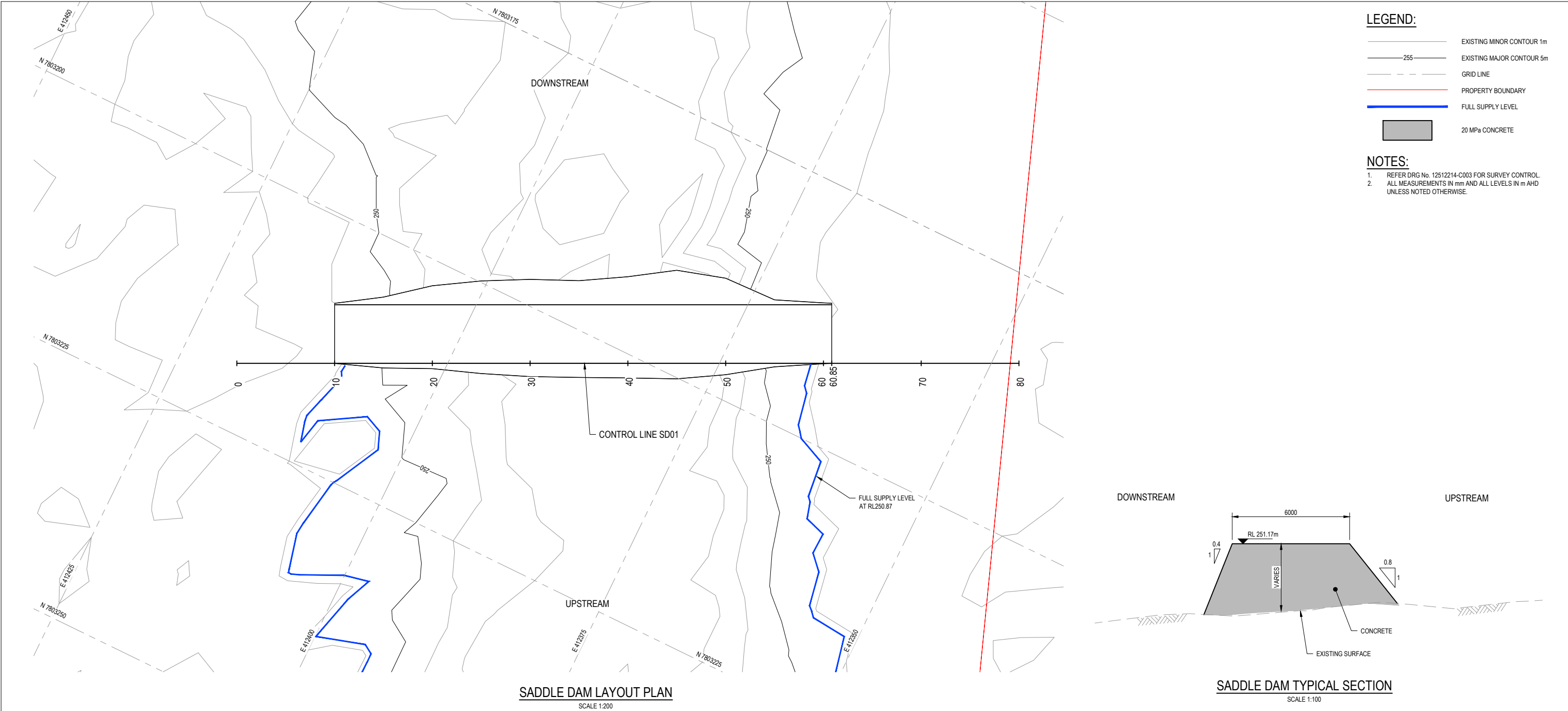
Approved (Project Director)

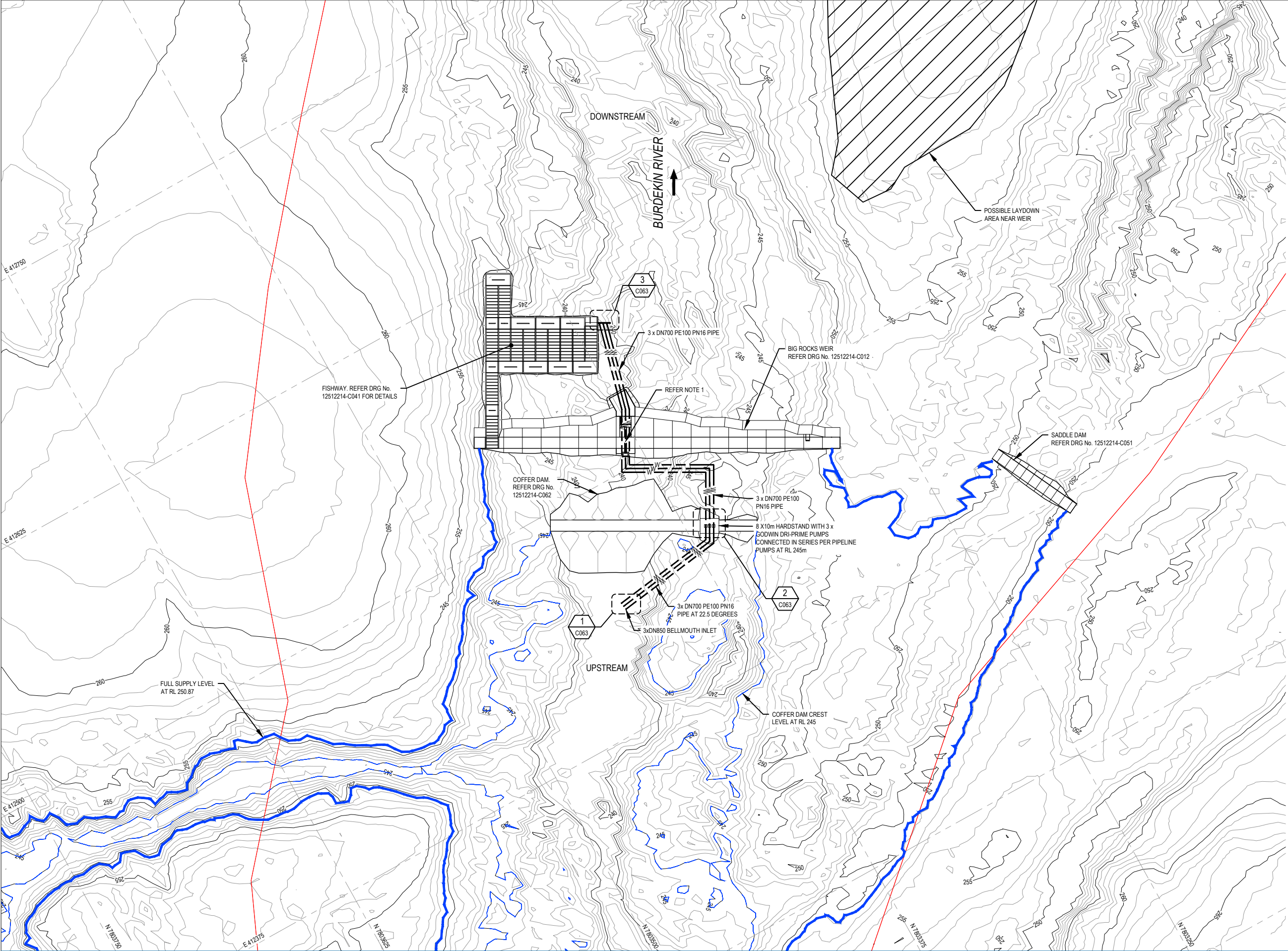
Date

Scale 1:50

This Drawing must not be
used for Construction unless
signed as Approved

Client	TOWNSVILLE ENTERPRISE LIMITED
Project	BIG ROCKS WEIR BUSINESS CASE
Title	FISH PASSAGE TYPICAL SECTIONS AND DETAILS SHEET 2
Original Size	A1
Drawing No:	12512214-C043
Rev:	B





LEGEND:

- EXISTING MINOR CONTOUR 1m
- EXISTING MAJOR CONTOUR 5m
- GRID LINE
- PROPERTY BOUNDARY
- FULL SUPPLY LEVEL
- COFFER DAM CREST LEVEL
- PIPEWORK

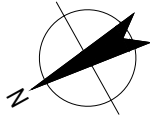
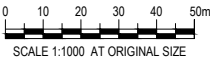
NOTES:

- REFER DRG No. 12512214-C003 FOR SURVEY CONTROL.
- DIVERSION PIPES TO BE RELOCATED AND CONSTRUCTION STAGED AS REQUIRED.
- ALL MEASUREMENTS IN mm AND ALL LEVELS IN m AHD UNLESS NOTED OTHERWISE.

THIS DRAWING INCLUDES COLOURED INFORMATION. IF YOU HAVE A BLACK AND WHITE COPY YOU DO NOT HAVE ALL THE INFORMATION. THIS NOTE IS COLOURED RED.

NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20
No	Revision	Note:	* Indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager
				Project Director	Date



townsville
enterprise



71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E tsvalm@ghd.com W www.ghd.com

DO NOT SCALE

Conditions of Use.
This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

Drawn J. EDWARDS

Designer N.T. KINSELLA

Drafting Check

Design Check

Approved (Project Director)

Date

Scale 1:1000

This Drawing must not be used for Construction unless signed as Approved

Client

Project

Title

Original Size

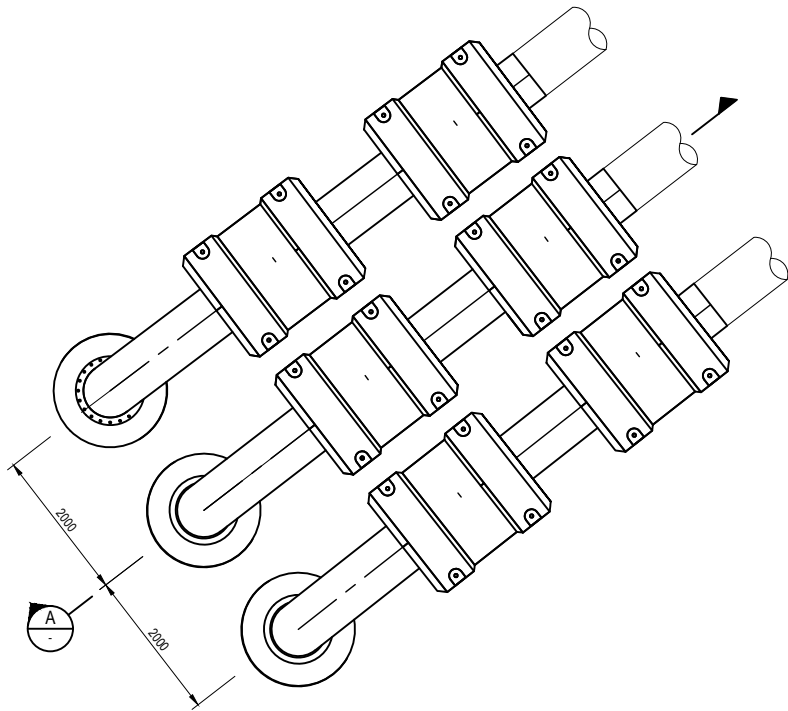
A1

TOWNSVILLE ENTERPRISE LIMITED
BIG ROCKS WEIR BUSINESS CASE
TEMPORARY DIVERSION WORKS
LAYOUT PLAN

Drawing No: 12512214-C061

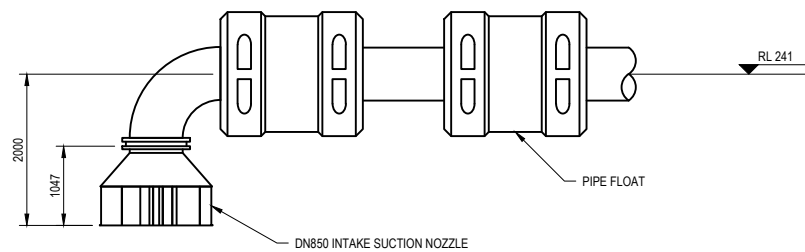
Rev: B

NOTE:
1. ALL MEASUREMENTS IN mm AND ALL LEVELS
IN m AHD UNLESS NOTED OTHERWISE.



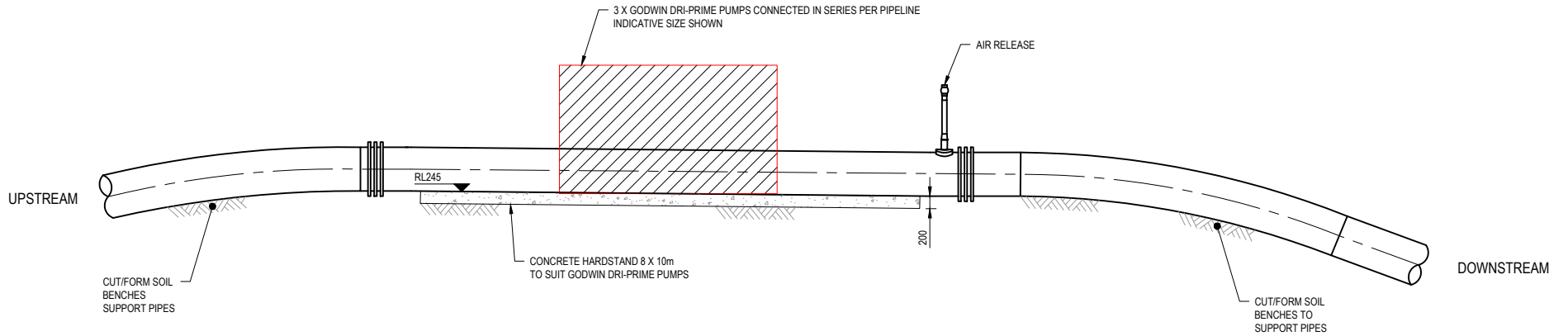
1 DETAIL
C061 SCALE 1 : 50

INLET CONFIGURATION



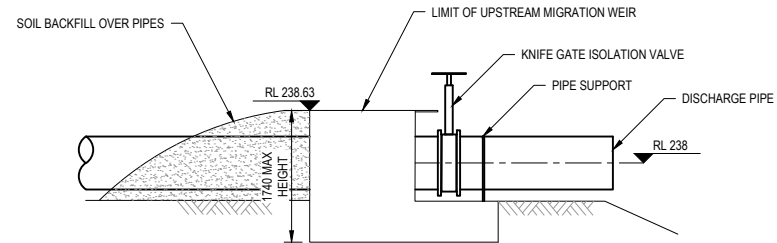
A SECTION
SCALE 1 : 50

INLET CONFIGURATION



2 DETAIL
C061 SCALE 1 : 50

PUMP HARDSTAND CONFIGURATION

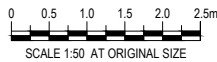


3 DETAIL
C061 SCALE 1 : 50

OUTLET CONFIGURATION

NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE	JE	NTK	SO	28.04.20
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director



DO NOT SCALE

Conditions of Use.
This document may only be used by
GHD's client (and any other person who
GHD has agreed can use this document)
for the purpose for which it was prepared
and must not be used by any other
person or for any other purpose.

Drawn J. EDWARDS

Drafting Check

Approved (Project Director)

Date

Scale 1:50

Designer N.T. KINSELLA

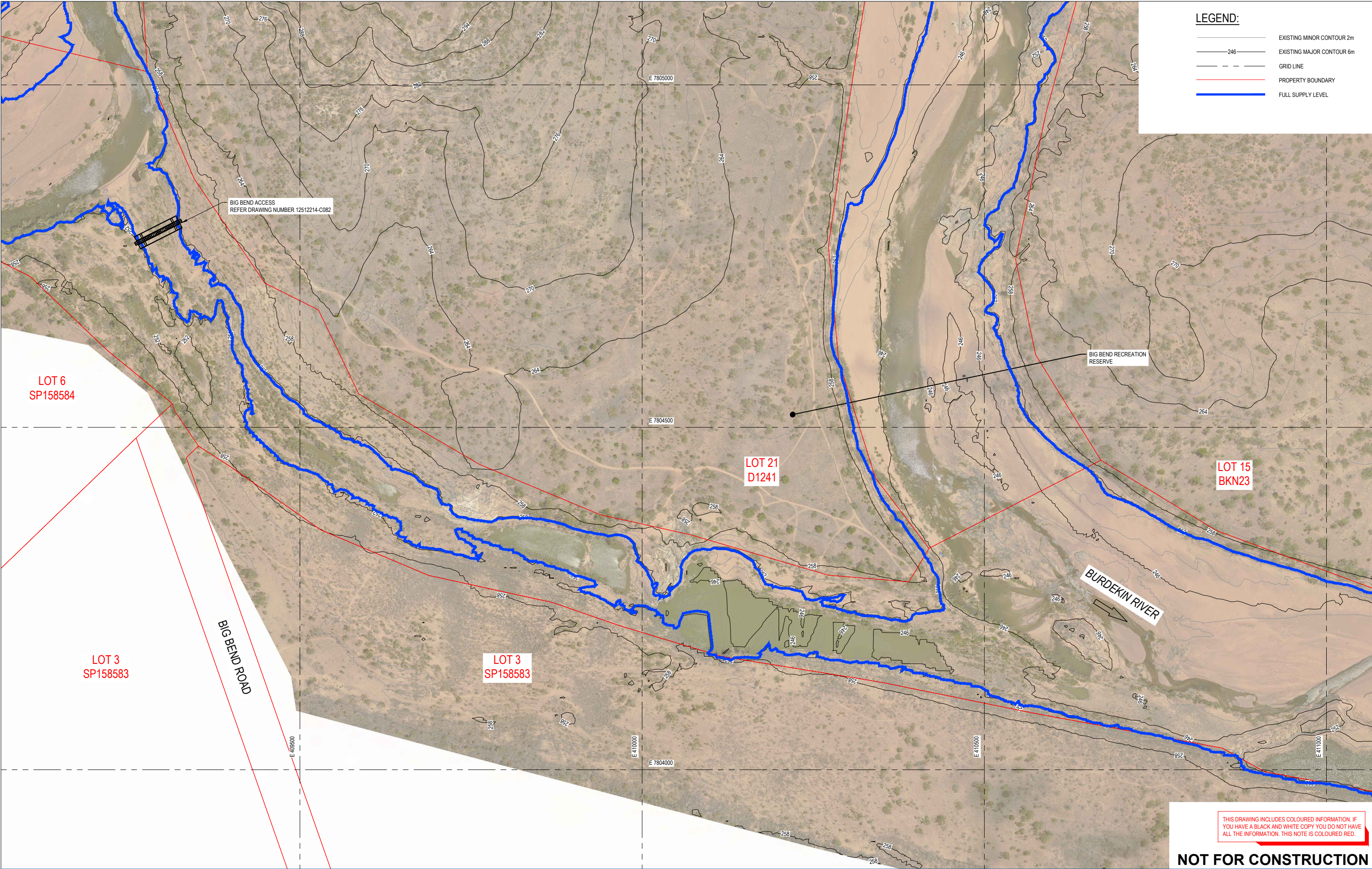
Design Check

This Drawing must not be
used for Construction unless
signed as Approved

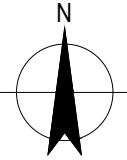
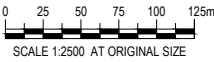
Client TOWNSVILLE ENTERPRISE LIMITED
Project BIG ROCKS WEIR BUSINESS CASE
Title TEMPORARY DIVERSION WORKS
SIPHON ARRANGEMENT

Original Size A1 Drawing No: 12512214-C063

Rev: B



B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20
A	PRELIMINARY ISSUE	JE	NTK*	SO*	03.04.20
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director



71 Stanley Street, Townsville QLD 4810 Australia
PO Box 930 Townsville QLD 4810
T 61 7 4720 0400 F 61 7 4772 6514
E ts@mail@ghd.com W www.ghd.com

DO NOT SCALE

Conditions of Use.
This document may only be used by
GHD's client (and any other person who
GHD has agreed can use this document)
for the purpose for which it was prepared
and must not be used by any other
person or for any other purpose.

Drawn J. EDWARDS

Drafting

Check

Approved

(Project Director)

Date

Designer J. PETHER

Design

Check

Client

Project

Title

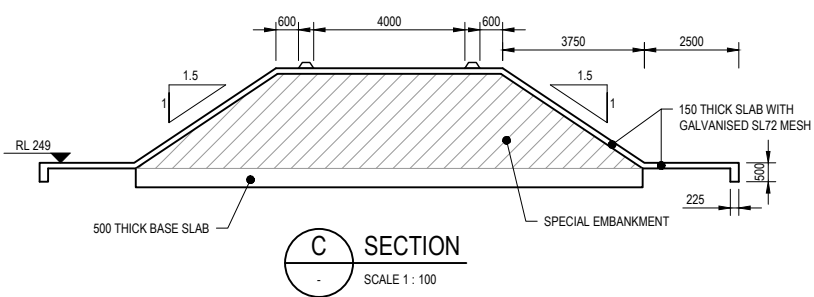
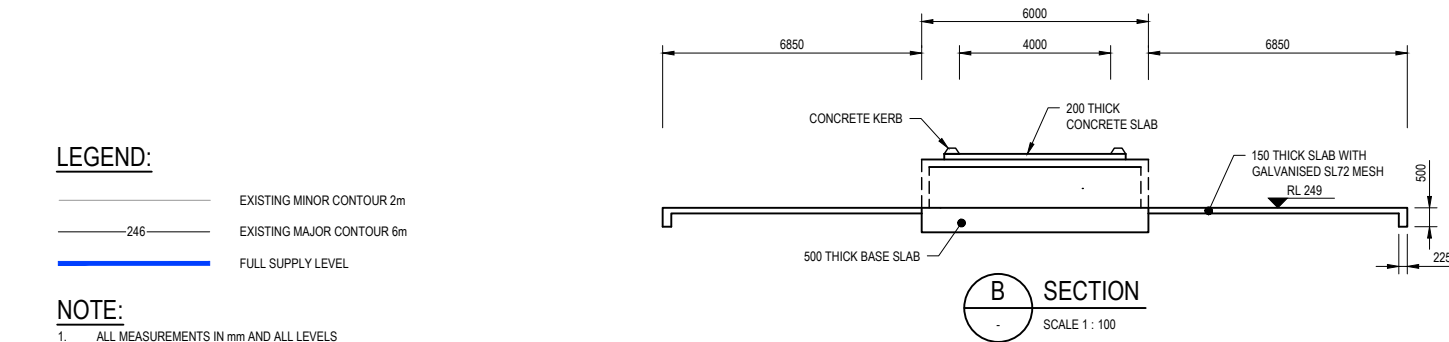
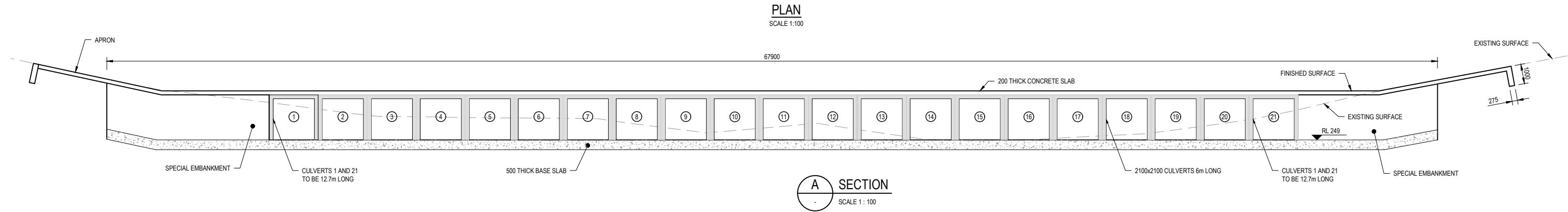
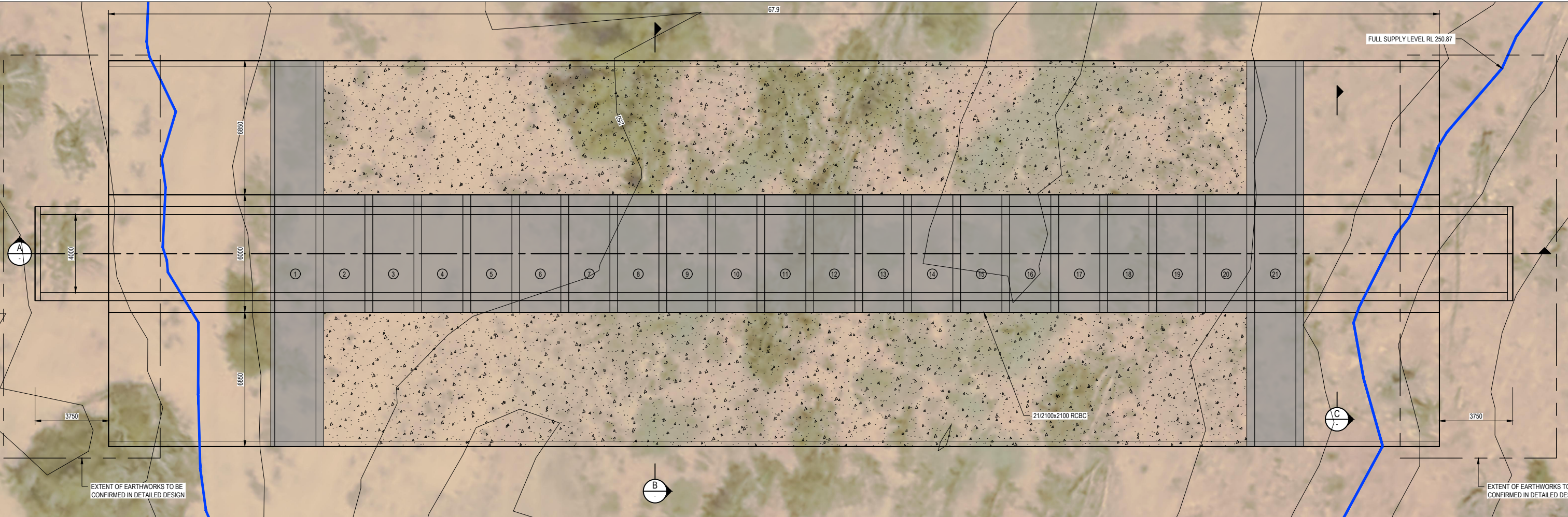
Original Size

A1

TOWNSVILLE ENTERPRISE LIMITED
BIG ROCKS WEIR BUSINESS CASE
ACCESS TO BIG BEND
GENERAL ARRANGEMENT

Drawing No: 12512214-C081

Rev: B



LEGEND:

- EXISTING MINOR CONTOUR 2m
- EXISTING MAJOR CONTOUR 6m
- FULL SUPPLY LEVEL

NOTE:

1. ALL MEASUREMENTS IN mm AND ALL LEVELS IN m AHD UNLESS NOTED OTHERWISE.

THIS DRAWING INCLUDES COLOURED INFORMATION. IF YOU HAVE A BLACK AND WHITE COPY YOU DO NOT HAVE ALL THE INFORMATION. THIS NOTE IS COLOURED RED.

NOT FOR CONSTRUCTION

B	FINAL BUSINESS CASE ISSUE	JE	NTK*	SO*	14.08.20		
A	PRELIMINARY ISSUE	JE	NTK*	SO*	03.04.20		
No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing		Drawn	Job Manager	Project Director	Date



DO NOT SCALE

Conditions of Use.
This document may only be used by GHD's client (and any other person who GHD has agreed can use this document) for the purpose for which it was prepared and must not be used by any other person or for any other purpose.

Drawn J. EDWARDS

Drafting Check

Approved (Project Director)

Date

Designer J. PETHER

Design Check

This Drawing must not be used for Construction unless signed as Approved

Client TOWNSVILLE ENTERPRISE LIMITED
Project BIG ROCKS WEIR BUSINESS CASE
Title ACCESS TO BIG BEND SECTIONS AND DETAILS

Original Size A1 Drawing No: 12512214-C082

Rev: B

Appendix B – Desktop Searches and Mapping



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.

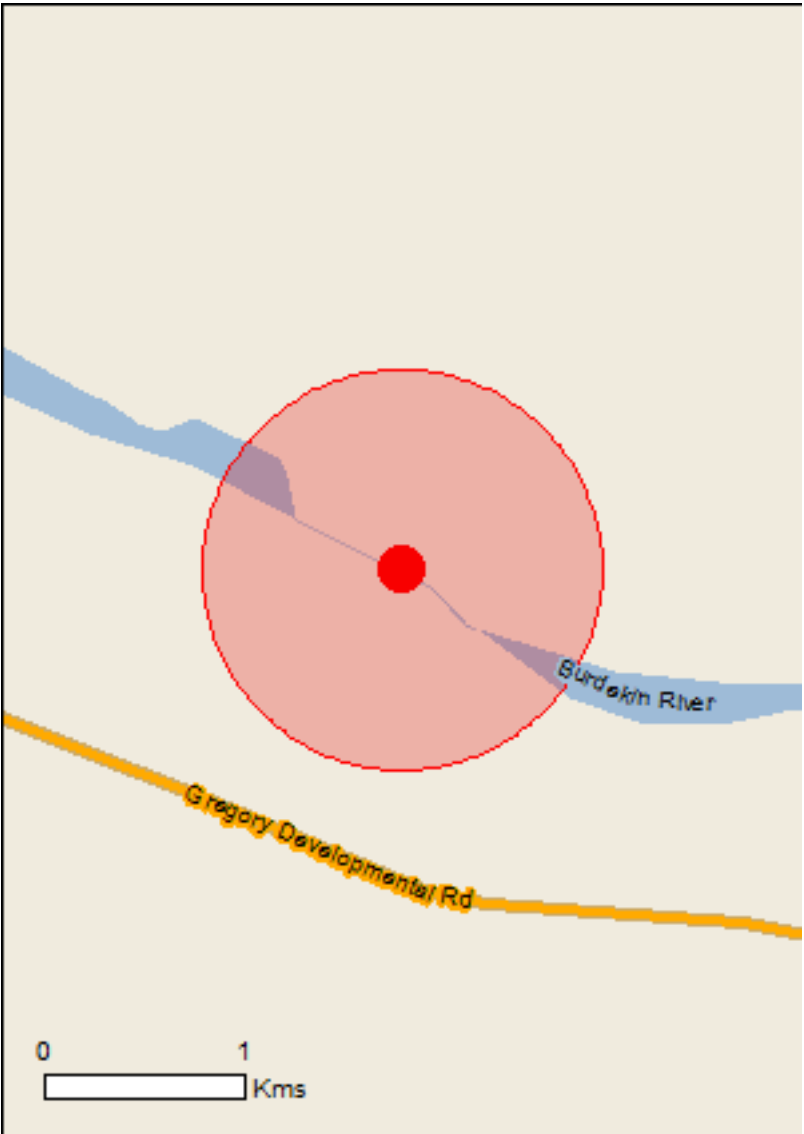
Report created: 23/10/19 17:07:22

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

[Matters of NES](#)

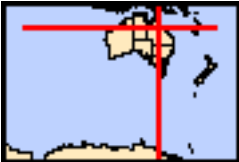
[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)
- [Caveat](#)
- [Acknowledgements](#)



This map may contain data which are
©Commonwealth of Australia
(Geoscience Australia), ©PSMA 2010

[Coordinates](#)
Buffer: 1.0Km



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:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	12

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:	18
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:	None
Regional Forest Agreements:	None
Invasive Species:	18
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely 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 may occur within area
Rhinolophus robertsi Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	Vulnerable	Species or species habitat may occur within area
Plants		
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Marsdenia brevifolia [64585]	Vulnerable	Species or species habitat may occur within area
Tephrosia leveillei [16946]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat may occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area
Lerista vittata Mount Cooper Striped Skink, Mount Cooper Striped Lerista [1308]	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 within area
Migratory Marine Species		
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely 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 may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may 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 may occur within

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		area 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 may 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 alba Great Egret, White Egret [59541]		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 may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may 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 may occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely 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 may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Reptiles

Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
--	--	--

Extra Information

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
Anas platyrhynchos Mallard [974]		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

Name	Status	Type of Presence
Frogs		
Rhinella marina		Species or species habitat known to occur within area
Cane Toad [83218]		
Mammals		
Canis lupus familiaris		Species or species habitat likely to occur within area
Domestic Dog [82654]		
Felis catus		Species or species habitat likely to occur within area
Cat, House Cat, Domestic Cat [19]		
Oryctolagus cuniculus		Species or species habitat likely to occur within area
Rabbit, European Rabbit [128]		
Rattus rattus		Species or species habitat likely to occur within area
Black Rat, Ship Rat [84]		
Sus scrofa		Species or species habitat likely to occur within area
Pig [6]		
Vulpes vulpes		Species or species habitat likely to occur within area
Red Fox, Fox [18]		
Plants		
Acacia nilotica subsp. indica		Species or species habitat may occur within area
Prickly Acacia [6196]		
Cryptostegia grandiflora		Species or species habitat likely to occur within area
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		
Jatropha gossypifolia		Species or species habitat likely to occur within area
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		
Parkinsonia aculeata		Species or species habitat likely to occur within area
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		
Parthenium hysterophorus		Species or species habitat likely to occur within area
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		

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

-19.86435 146.16541

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.



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: 01/11/19 13:05:43

[Summary](#)

[Details](#)

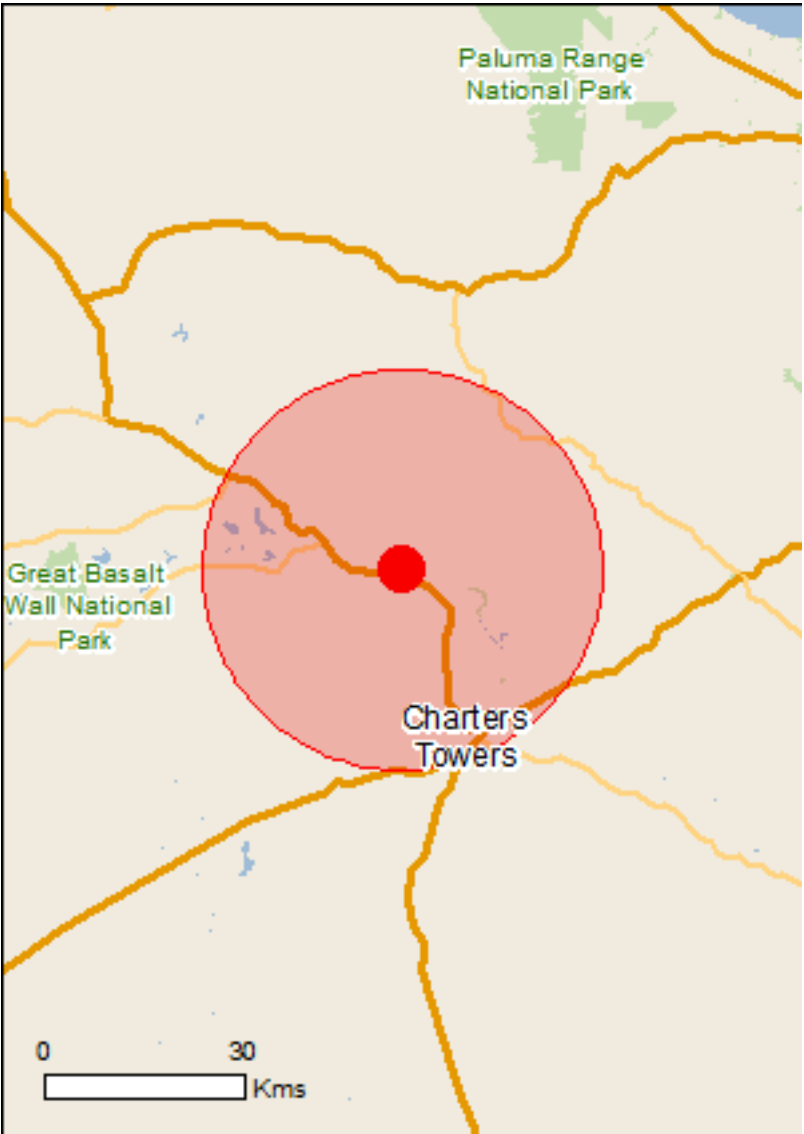
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

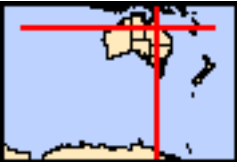
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 30.0Km](#)



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:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	22
Listed Migratory Species:	16

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:	2
Commonwealth Heritage Places:	1
Listed Marine Species:	22
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:	1
Regional Forest Agreements:	None
Invasive Species:	24
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	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
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding likely 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 may occur within area
Pteropus conspicillatus Spectacled Flying-fox [185]	Endangered	Species or species habitat may 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	Vulnerable	Species or species

Name	Status	Type of Presence
Sheathtail Bat [66889]		habitat may occur within area
Plants		
Bulbophyllum globuliforme Miniature Moss-orchid, Hoop Pine Orchid [6649]	Vulnerable	Species or species habitat may occur within area
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat likely to occur within area
Marsdenia brevifolia [64585]	Vulnerable	Species or species habitat likely to occur within area
Tephrosia leveillei [16946]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area
Lerista vittata Mount Cooper Striped Skink, Mount Cooper Striped Lerista [1308]	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 within area
Migratory Marine Species		
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may 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]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may 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 may 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
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - CHARTERS TOWERS DEPOT
Defence - TOWNSVILLE FIELD TRAINING AREA

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Historic		
Charters Towers Post Office	QLD	Listed place

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 likely to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known 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 may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may 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 may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may 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 may 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

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

Reptiles		
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves		[Resource Information]
Name		State
Dalrymple		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
Anas platyrhynchos Mallard [974]		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

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

Name	Status	Type of Presence
Feral deer Feral deer species in Australia [85733]		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
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913] Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507] 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
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		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
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Great Basalt Wall		QLD

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

-19.866 146.1726

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.

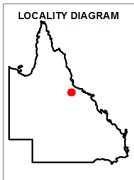
Please feel free to provide feedback via the [Contact Us](#) page.



Protected Plants Flora Survey Trigger Map

Legend

-  Lot and Plan
-  High risk area
-  Cadastral line
-  Property boundaries shown are provided as a locational aid only
-  Freeways / motorways / highways
-  Secondary roads / streets



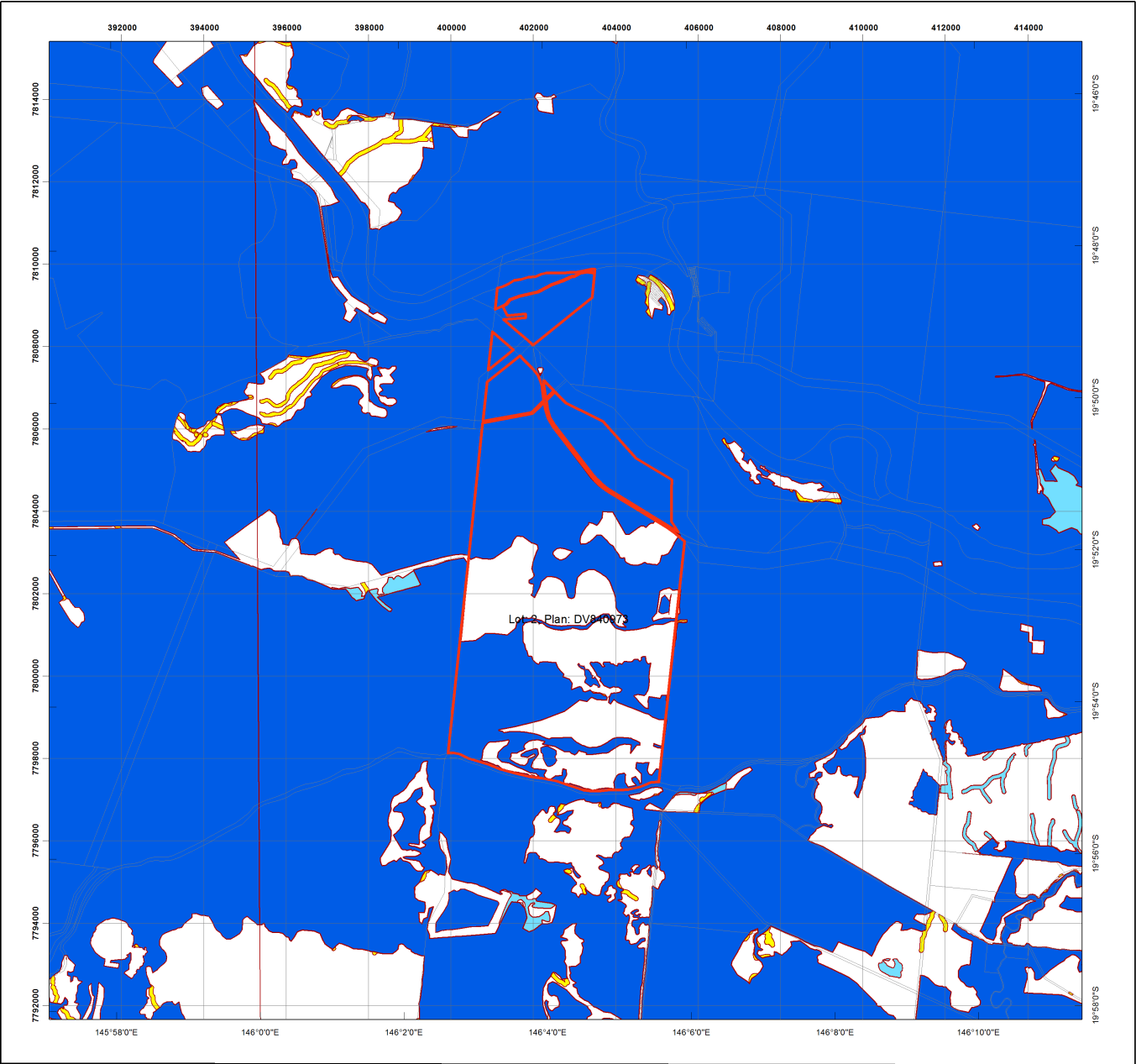
This product is projected into:
GDA 1994 Queensland Albers

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Science at palm@ehp.qld.gov.au

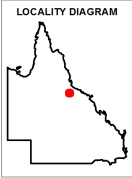
Disclaimer:
While every care is taken to ensure the accuracy of the data used to generate this product, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damages) and costs which might be incurred as a consequence of reliance on the data, or as a result of the data being inaccurate or incomplete in any way and for any reason.



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Area not categorised
- Cadastral line
- Property boundaries shown are provided as a locational aid only



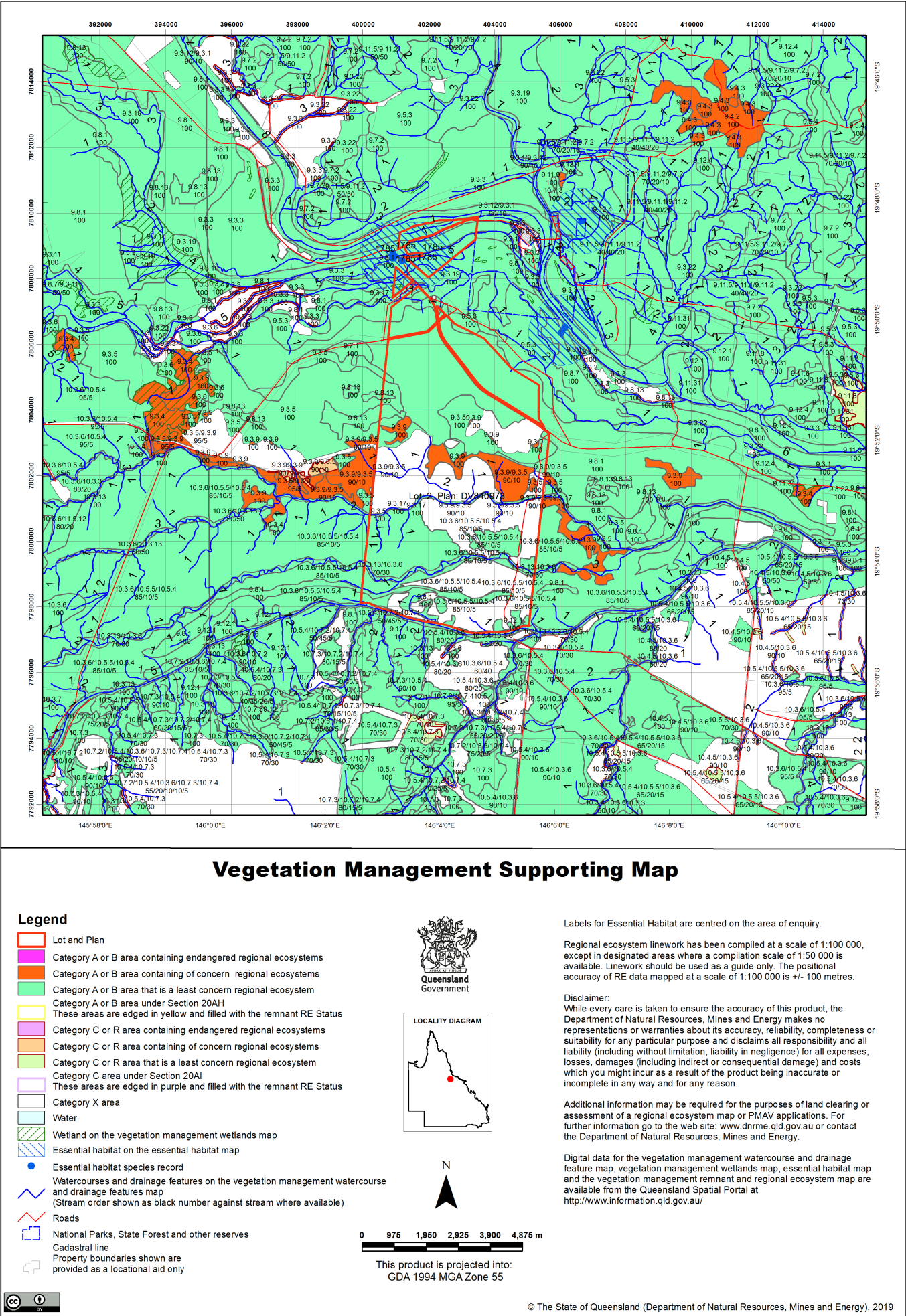
Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources, Mines and Energy makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability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

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources, Mines and Energy.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at <http://www.information.qld.gov.au/>

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.





Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Natural Resources, Mines and Energy website (<http://www.dnrme.qld.gov.au>) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
1785	Geophaps scripta scripta	squatter pigeon (southern subsp.)	V	Dry eucalypt woodland (including poplar box, spotted gum, yellow box, acacia and callitris), with sparse short grass, often on sandy areas near to permanent water; grassy eucalypt woodlands. Nest on ground near or under grass tussock, log or low bush.	None	None	Gravelly ridges, traprock and river flats.

Label	Regional Ecosystem (mandatory unless otherwise specified)
1785	8.2.1, 8.2.7, 8.2.8, 8.2.12, 8.3.2, 8.3.3, 8.3.5, 8.3.6, 8.3.13, 8.5.2, 8.5.3, 8.5.5, 8.5.6, 8.9.1, 8.11.1, 8.11.3, 8.11.4, 8.11.5, 8.11.6, 8.11.8, 8.12.6, 8.12.7, 8.12.9, 8.12.12, 8.12.14, 8.12.20, 8.12.22, 8.12.23, 8.12.25, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.18, 9.3.19, 9.3.20, 9.3.21, 9.3.22, 9.3.23, 9.4.1, 9.4.2, 9.4.3, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.16, 9.7.1, 9.7.2, 9.7.3, 9.7.5, 9.7.6, 9.8.1, 9.8.2, 9.8.4, 9.8.5, 9.8.6, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.6, 9.10.7, 9.10.8, 9.11.1, 9.11.2, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.11, 9.11.12, 9.11.13, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.23, 9.11.26, 9.11.28, 9.11.29, 9.11.31, 9.11.32, 9.12.1, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.26, 9.12.28, 9.12.30, 9.12.31, 9.12.33, 9.12.35, 9.12.37, 9.12.39, 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.19, 10.3.20, 10.3.27, 10.3.28, 10.3.30, 10.3.31, 10.4.3, 10.5.1, 10.5.2, 10.5.4, 10.5.5, 10.5.7, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.2, 10.7.3, 10.7.5, 10.7.11, 10.7.12, 10.9.1, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7, 11.2.1, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.6, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.7, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.15, 11.11.16, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 12.2.5, 12.2.6, 12.2.7, 12.2.10, 12.2.11, 12.3.3, 12.3.6, 12.3.10, 12.3.12, 12.3.14, 12.3.18, 12.3.19, 12.5.1, 12.5.2, 12.5.4, 12.5.5, 12.5.7, 12.5.8, 12.5.11, 12.5.12, 12.7.1, 12.7.2, 12.8.14, 12.8.16, 12.8.17, 12.8.19, 12.9-10.5, 12.9-10.7, 12.9-10.8, 12.9-10.12, 12.9-10.13, 12.9-10.25, 12.9-10.26, 12.9-10.28, 12.11.5, 12.11.7, 12.11.8, 12.11.14, 12.11.15, 12.11.20, 12.11.21, 12.11.22, 12.11.24, 12.11.25, 12.11.26, 12.11.27, 12.11.28, 12.12.7, 12.12.8, 12.12.9, 12.12.12, 12.12.14, 12.12.21, 12.12.22, 12.12.23, 12.12.24, 12.12.25, 12.12.27, 13.3.1, 13.3.4, 13.3.7, 13.11.1, 13.11.3, 13.11.4, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10

Protected plants flora survey trigger map

The protected plants flora survey trigger map identifies 'high risk areas' where endangered, vulnerable or near threatened plants are known to exist or are likely to exist. Under the *Nature Conservation Act 1992* (the Act) it is an offence to clear protected plants that are 'in the wild' unless you are authorised or the clearing is exempt, for more information see [section 89](#) of the Act.

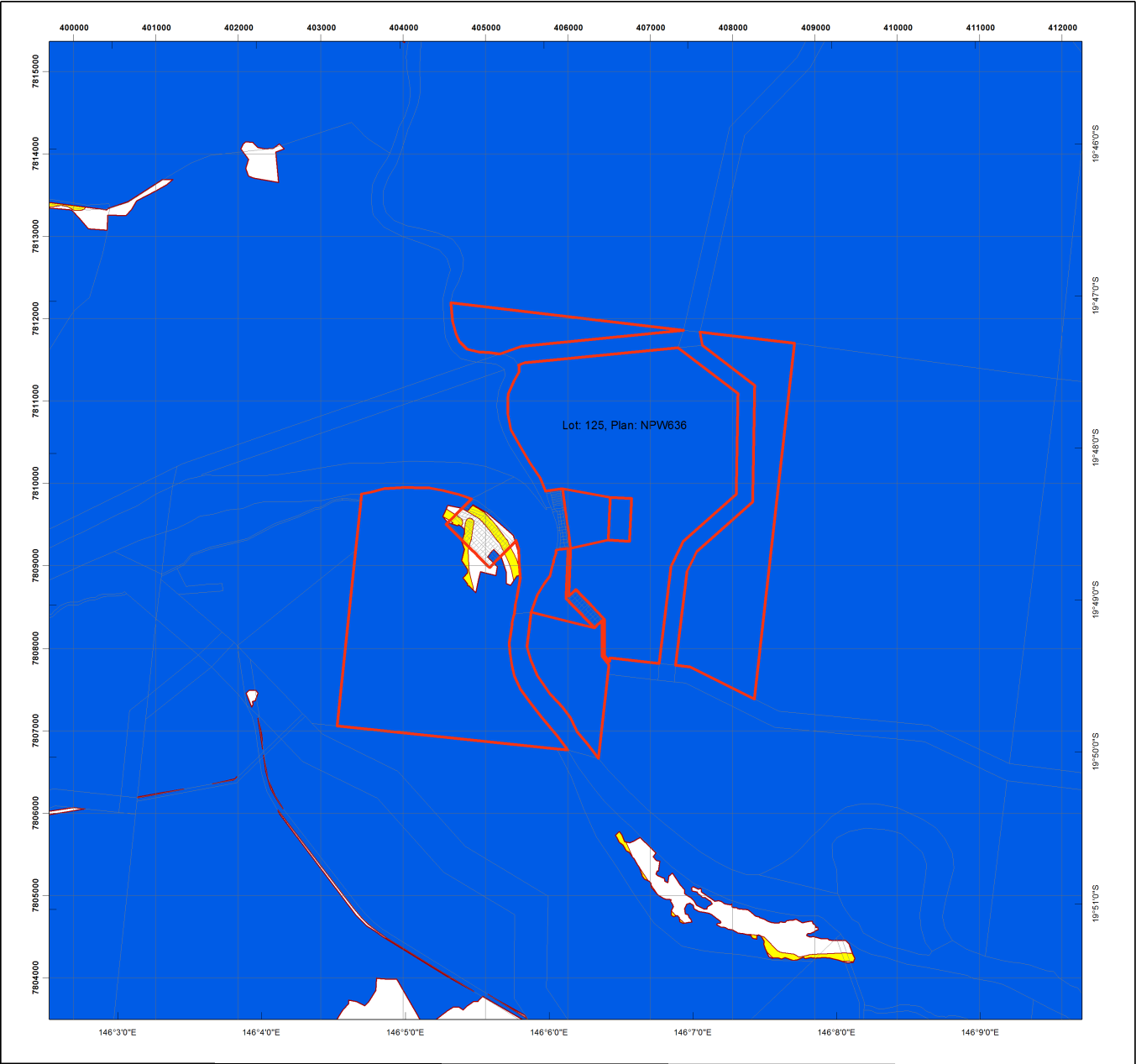
Please see the Department of Environment and Science webpage on the [clearing of protected plants](#) for information on what exemptions may apply in your circumstances, whether you may need to undertake a flora survey, and whether you may need a protected plants clearing permit.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

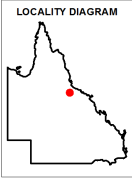
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the [Queensland Spatial Catalogue](#), the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the [clearing of protected plants](#) for more information.



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Area not categorised
- Cadastral line
- Property boundaries shown are provided as a locational aid only



0 675 1,350 2,025 2,700 3,375 m

This product is projected into:
GDA 1994 MGA Zone 55

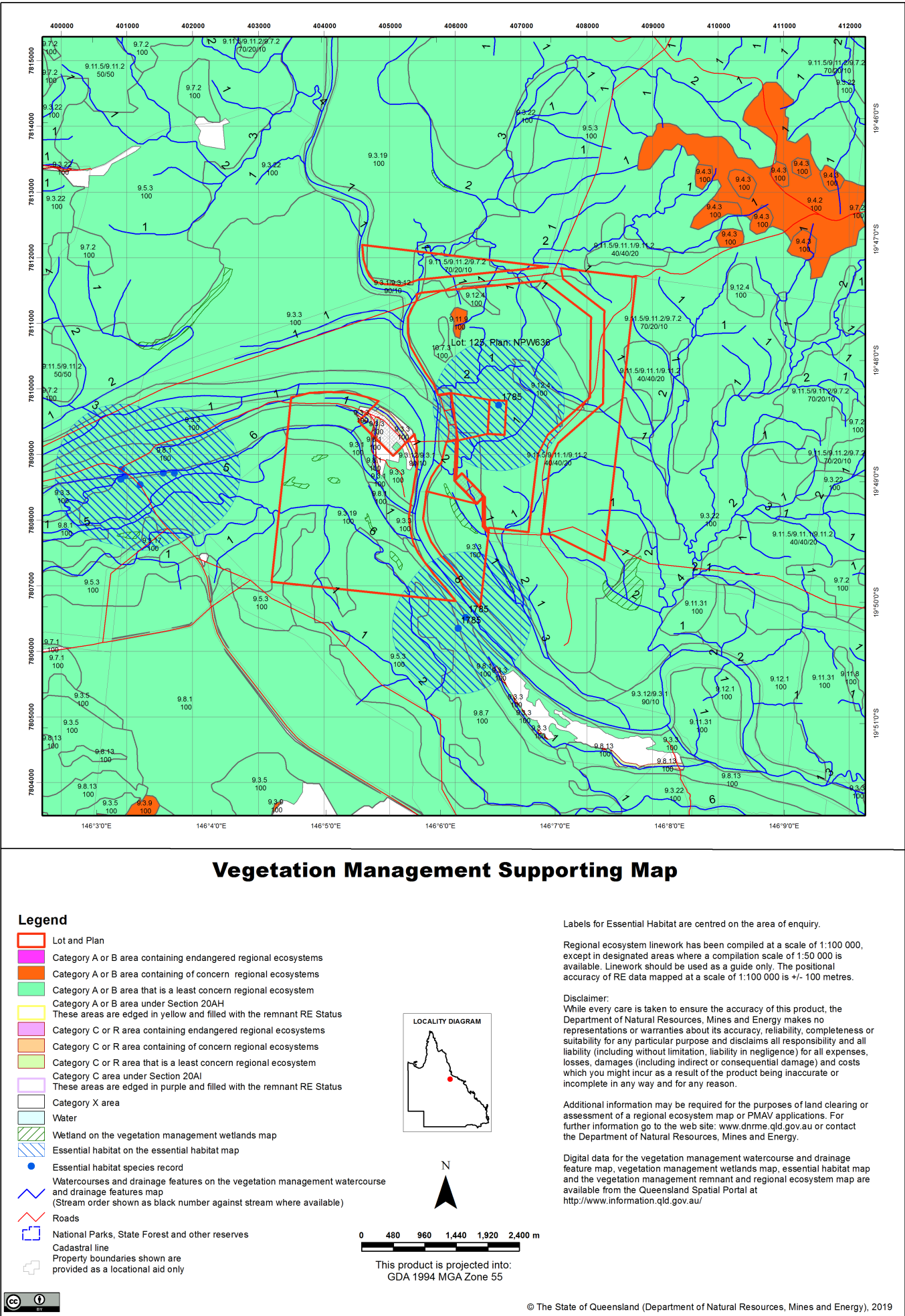
© The State of Queensland (Department of Natural Resources, Mines and Energy), 2019

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

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources, Mines and Energy.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at <http://www.information.qld.gov.au/>

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.



Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Natural Resources, Mines and Energy website (<http://www.dnrme.qld.gov.au>) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

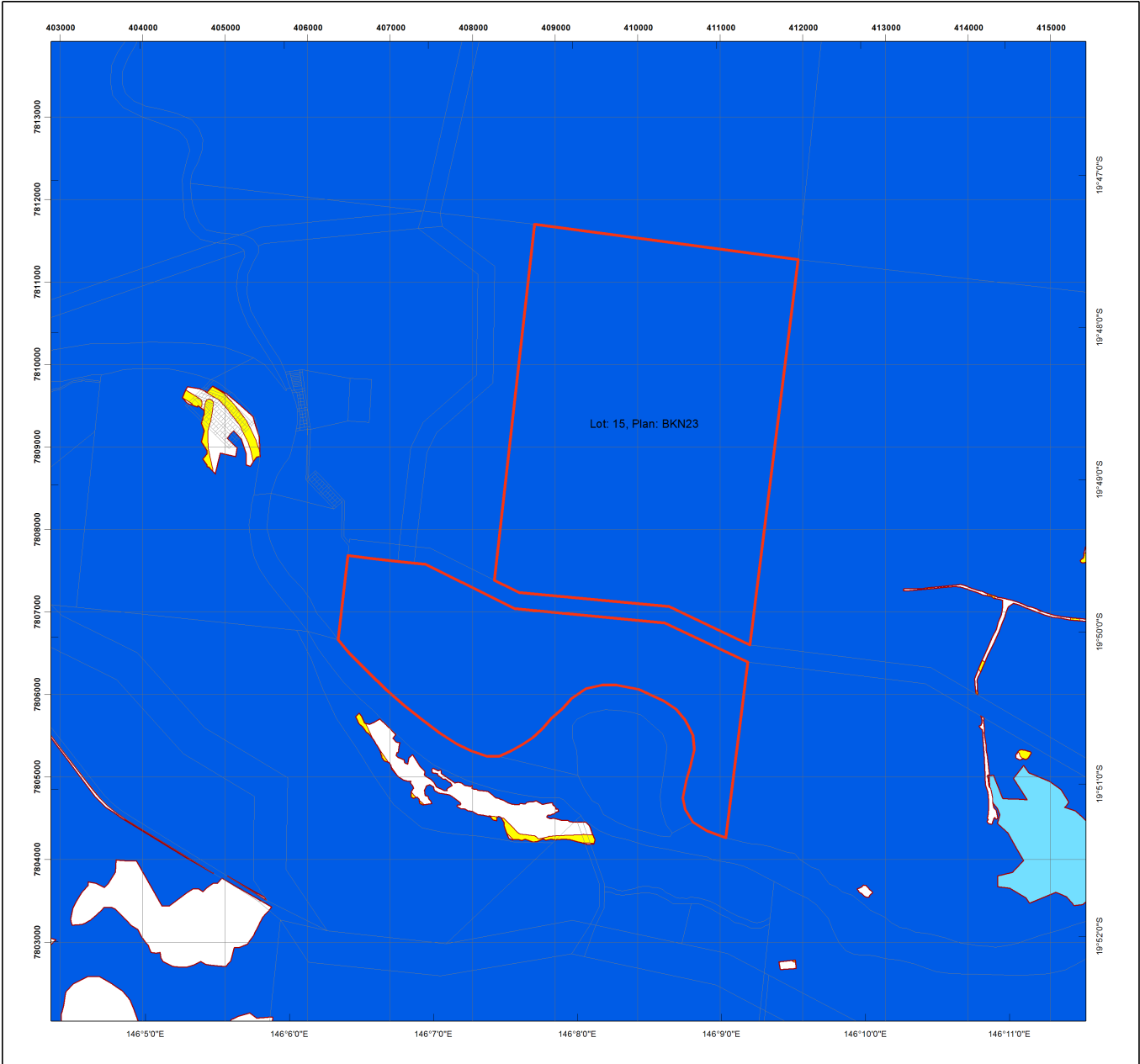
- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
1785	Geophaps scripta scripta	squatter pigeon (southern subsp.)	V	Dry eucalypt woodland (including poplar box, spotted gum, yellow box, acacia and callitris), with sparse short grass, often on sandy areas near to permanent water; grassy eucalypt woodlands. Nest on ground near or under grass tussock, log or low bush.	None	None	Gravelly ridges, traprock and river flats.

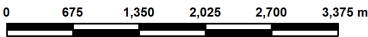
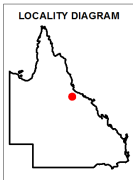
Label	Regional Ecosystem (mandatory unless otherwise specified)
1785	8.2.1, 8.2.7, 8.2.8, 8.2.12, 8.3.2, 8.3.3, 8.3.5, 8.3.6, 8.3.13, 8.5.2, 8.5.3, 8.5.5, 8.5.6, 8.9.1, 8.11.1, 8.11.3, 8.11.4, 8.11.5, 8.11.6, 8.11.8, 8.12.6, 8.12.7, 8.12.9, 8.12.12, 8.12.14, 8.12.20, 8.12.22, 8.12.23, 8.12.25, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.18, 9.3.19, 9.3.20, 9.3.21, 9.3.22, 9.3.23, 9.4.1, 9.4.2, 9.4.3, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.16, 9.7.1, 9.7.2, 9.7.3, 9.7.5, 9.7.6, 9.8.1, 9.8.2, 9.8.4, 9.8.5, 9.8.6, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.6, 9.10.7, 9.10.8, 9.11.1, 9.11.2, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.11, 9.11.12, 9.11.13, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.23, 9.11.26, 9.11.28, 9.11.29, 9.11.31, 9.11.32, 9.12.1, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.26, 9.12.28, 9.12.30, 9.12.31, 9.12.33, 9.12.35, 9.12.37, 9.12.39, 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.19, 10.3.20, 10.3.27, 10.3.28, 10.3.30, 10.3.31, 10.4.3, 10.5.1, 10.5.2, 10.5.4, 10.5.5, 10.5.7, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.2, 10.7.3, 10.7.5, 10.7.11, 10.7.12, 10.9.1, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7, 11.2.1, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.6, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.7, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.15, 11.11.16, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 12.2.5, 12.2.6, 12.2.7, 12.2.10, 12.2.11, 12.3.3, 12.3.6, 12.3.10, 12.3.12, 12.3.14, 12.3.18, 12.3.19, 12.5.1, 12.5.2, 12.5.4, 12.5.5, 12.5.7, 12.5.8, 12.5.11, 12.5.12, 12.7.1, 12.7.2, 12.8.14, 12.8.16, 12.8.17, 12.8.19, 12.9-10.5, 12.9-10.7, 12.9-10.8, 12.9-10.12, 12.9-10.13, 12.9-10.25, 12.9-10.26, 12.9-10.28, 12.11.5, 12.11.7, 12.11.8, 12.11.14, 12.11.15, 12.11.20, 12.11.21, 12.11.22, 12.11.24, 12.11.25, 12.11.26, 12.11.27, 12.11.28, 12.12.7, 12.12.8, 12.12.9, 12.12.12, 12.12.14, 12.12.21, 12.12.22, 12.12.23, 12.12.24, 12.12.25, 12.12.27, 13.3.1, 13.3.4, 13.3.7, 13.11.1, 13.11.3, 13.11.4, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Area not categorised
- Cadastral line
- Property boundaries shown are provided as a locational aid only



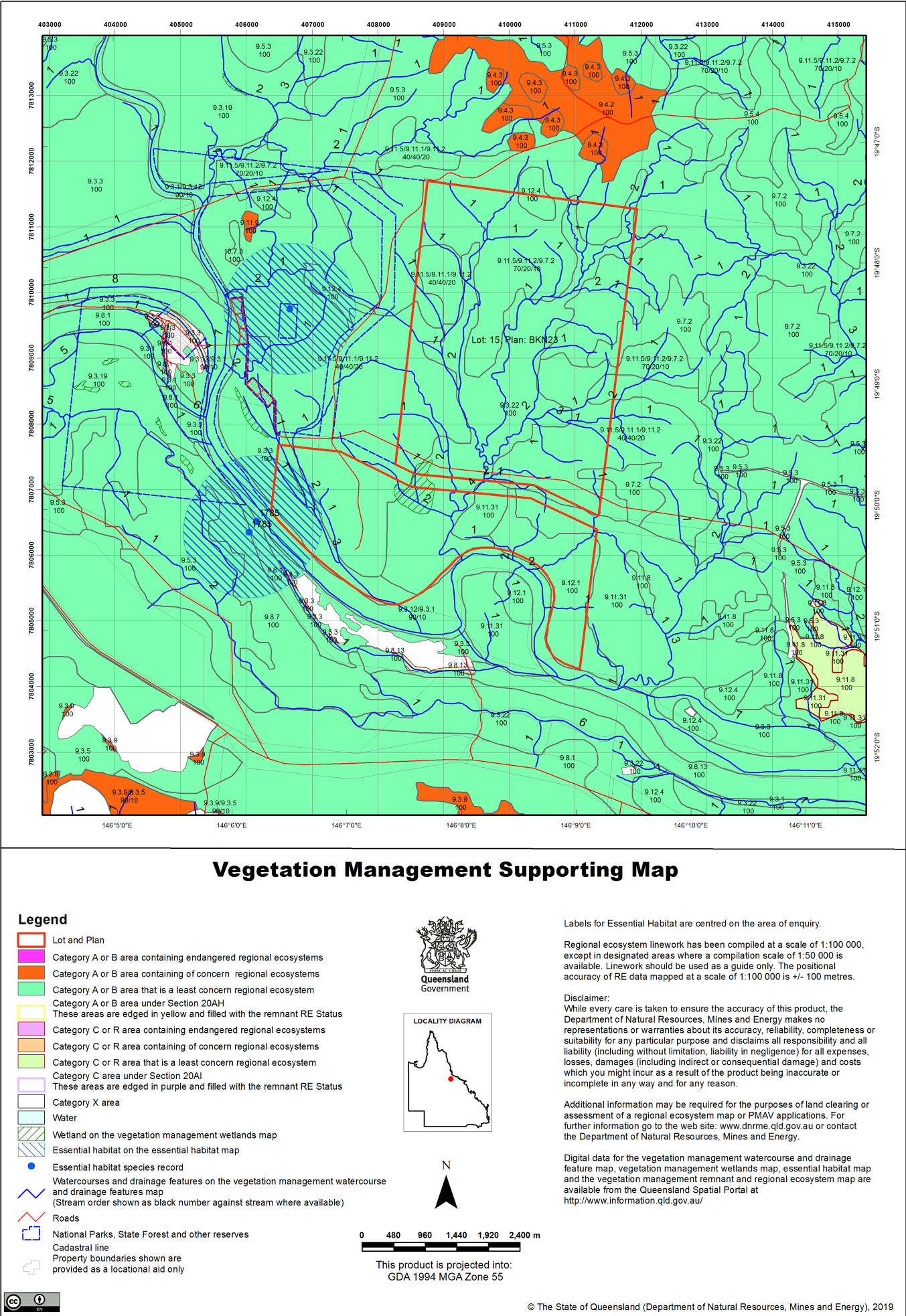
Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources, Mines and Energy makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability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

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources, Mines and Energy.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at <http://www.information.qld.gov.au/>

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.





Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Natural Resources, Mines and Energy website (<http://www.dnrme.qld.gov.au>) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

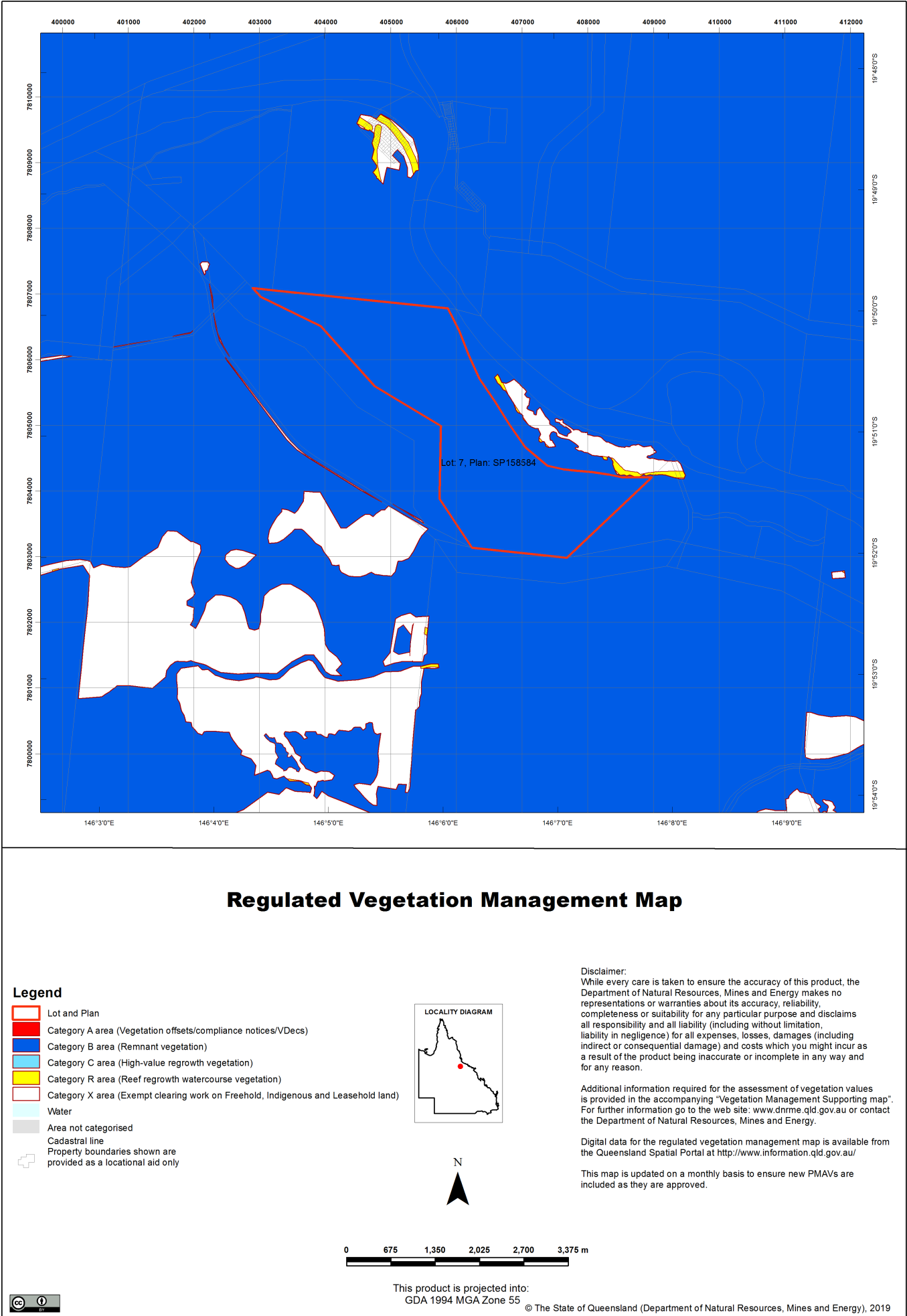
- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

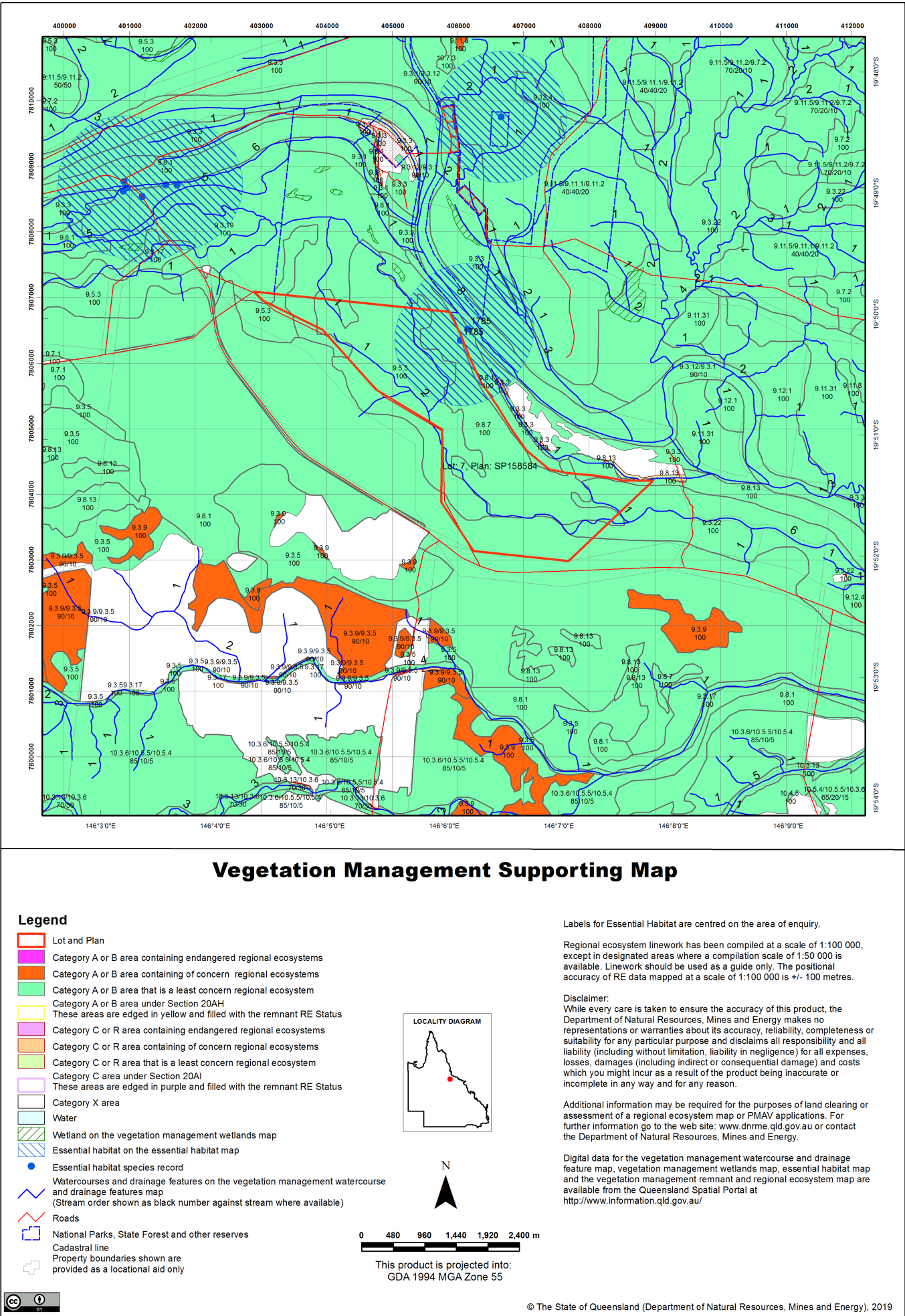
Protected wildlife includes endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
1785	Geophaps scripta scripta	squatter pigeon (southern subsp.)	V	Dry eucalypt woodland (including poplar box, spotted gum, yellow box, acacia and callitris), with sparse short grass, often on sandy areas near to permanent water; grassy eucalypt woodlands. Nest on ground near or under grass tussock, log or low bush.	None	None	Gravelly ridges, traprock and river flats.

Label	Regional Ecosystem (mandatory unless otherwise specified)
1785	8.2.1, 8.2.7, 8.2.8, 8.2.12, 8.3.2, 8.3.3, 8.3.5, 8.3.6, 8.3.13, 8.5.2, 8.5.3, 8.5.5, 8.5.6, 8.9.1, 8.11.1, 8.11.3, 8.11.4, 8.11.5, 8.11.6, 8.11.8, 8.12.6, 8.12.7, 8.12.9, 8.12.12, 8.12.14, 8.12.20, 8.12.22, 8.12.23, 8.12.25, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.18, 9.3.19, 9.3.20, 9.3.21, 9.3.22, 9.3.23, 9.4.1, 9.4.2, 9.4.3, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.16, 9.7.1, 9.7.2, 9.7.3, 9.7.5, 9.7.6, 9.8.1, 9.8.2, 9.8.4, 9.8.5, 9.8.6, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.6, 9.10.7, 9.10.8, 9.11.1, 9.11.2, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.11, 9.11.12, 9.11.13, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.23, 9.11.26, 9.11.28, 9.11.29, 9.11.31, 9.11.32, 9.12.1, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.26, 9.12.28, 9.12.30, 9.12.31, 9.12.33, 9.12.35, 9.12.37, 9.12.39, 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.19, 10.3.20, 10.3.27, 10.3.28, 10.3.30, 10.3.31, 10.4.3, 10.5.1, 10.5.2, 10.5.4, 10.5.5, 10.5.7, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.2, 10.7.3, 10.7.5, 10.7.11, 10.7.12, 10.9.1, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7, 11.2.1, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.6, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.7, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.15, 11.11.16, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 12.2.5, 12.2.6, 12.2.7, 12.2.10, 12.2.11, 12.3.3, 12.3.6, 12.3.10, 12.3.12, 12.3.14, 12.3.18, 12.3.19, 12.5.1, 12.5.2, 12.5.4, 12.5.5, 12.5.7, 12.5.8, 12.5.11, 12.5.12, 12.7.1, 12.7.2, 12.8.14, 12.8.16, 12.8.17, 12.8.19, 12.9-10.5, 12.9-10.7, 12.9-10.8, 12.9-10.12, 12.9-10.13, 12.9-10.25, 12.9-10.26, 12.9-10.28, 12.11.5, 12.11.7, 12.11.8, 12.11.14, 12.11.15, 12.11.20, 12.11.21, 12.11.22, 12.11.24, 12.11.25, 12.11.26, 12.11.27, 12.11.28, 12.12.7, 12.12.8, 12.12.9, 12.12.12, 12.12.14, 12.12.21, 12.12.22, 12.12.23, 12.12.24, 12.12.25, 12.12.27, 13.3.1, 13.3.4, 13.3.7, 13.11.1, 13.11.3, 13.11.4, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10





Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Natural Resources, Mines and Energy website (<http://www.dnrme.qld.gov.au>) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

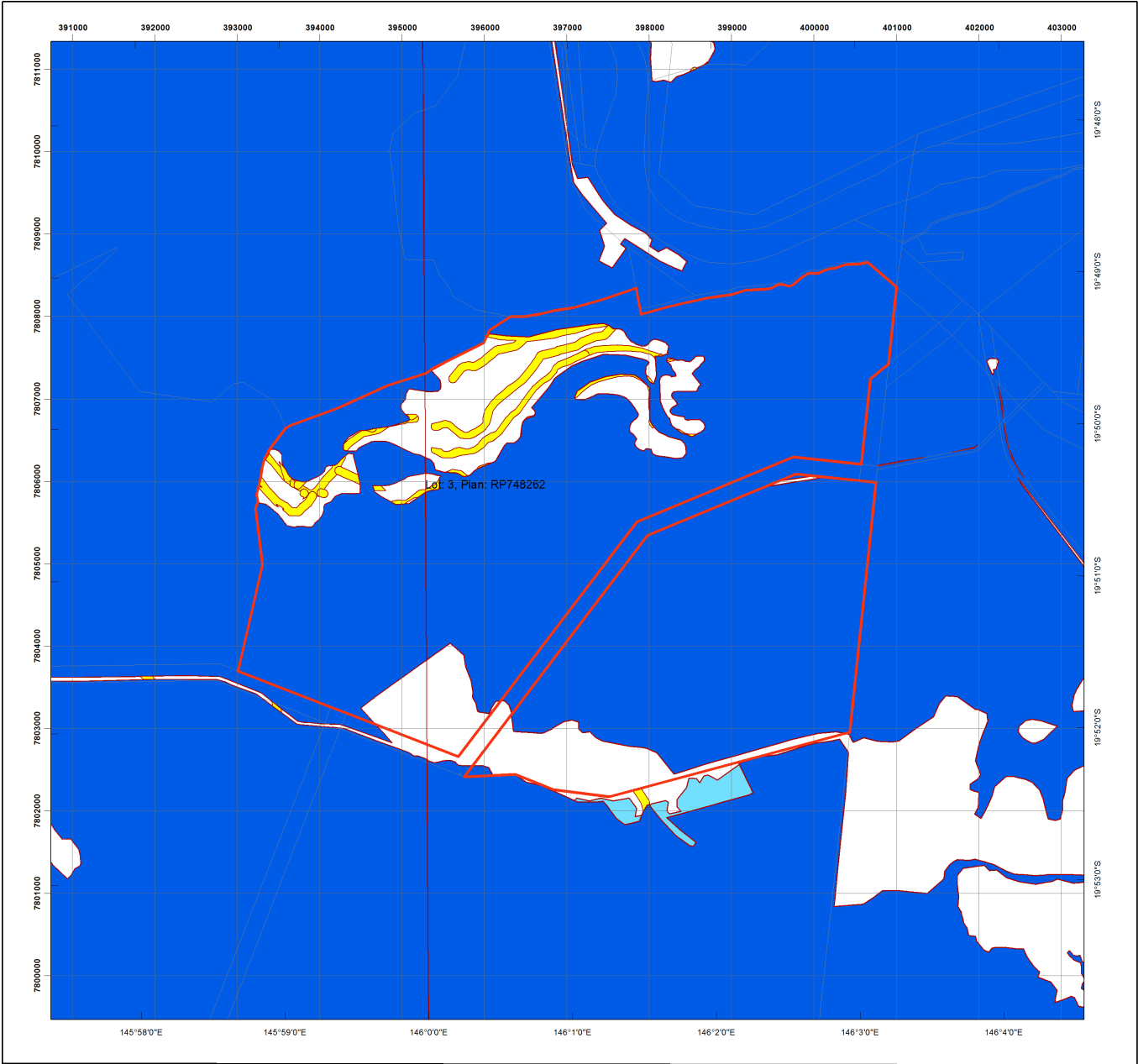
- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
1785	Geophaps scripta scripta	squatter pigeon (southern subsp.)	V	Dry eucalypt woodland (including poplar box, spotted gum, yellow box, acacia and callitris), with sparse short grass, often on sandy areas near to permanent water; grassy eucalypt woodlands. Nest on ground near or under grass tussock, log or low bush.	None	None	Gravelly ridges, traprock and river flats.

Label	Regional Ecosystem (mandatory unless otherwise specified)
1785	8.2.1, 8.2.7, 8.2.8, 8.2.12, 8.3.2, 8.3.3, 8.3.5, 8.3.6, 8.3.13, 8.5.2, 8.5.3, 8.5.5, 8.5.6, 8.9.1, 8.11.1, 8.11.3, 8.11.4, 8.11.5, 8.11.6, 8.11.8, 8.12.6, 8.12.7, 8.12.9, 8.12.12, 8.12.14, 8.12.20, 8.12.22, 8.12.23, 8.12.25, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.18, 9.3.19, 9.3.20, 9.3.21, 9.3.22, 9.3.23, 9.4.1, 9.4.2, 9.4.3, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.16, 9.7.1, 9.7.2, 9.7.3, 9.7.5, 9.7.6, 9.8.1, 9.8.2, 9.8.4, 9.8.5, 9.8.6, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.6, 9.10.7, 9.10.8, 9.11.1, 9.11.2, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.11, 9.11.12, 9.11.13, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.23, 9.11.26, 9.11.28, 9.11.29, 9.11.31, 9.11.32, 9.12.1, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.26, 9.12.28, 9.12.30, 9.12.31, 9.12.33, 9.12.35, 9.12.37, 9.12.39, 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.19, 10.3.20, 10.3.27, 10.3.28, 10.3.30, 10.3.31, 10.4.3, 10.5.1, 10.5.2, 10.5.4, 10.5.5, 10.5.7, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.2, 10.7.3, 10.7.5, 10.7.11, 10.7.12, 10.9.1, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7, 11.2.1, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.6, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.7, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.15, 11.11.16, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 12.2.5, 12.2.6, 12.2.7, 12.2.10, 12.2.11, 12.3.3, 12.3.6, 12.3.10, 12.3.12, 12.3.14, 12.3.18, 12.3.19, 12.5.1, 12.5.2, 12.5.4, 12.5.5, 12.5.7, 12.5.8, 12.5.11, 12.5.12, 12.7.1, 12.7.2, 12.8.14, 12.8.16, 12.8.17, 12.8.19, 12.9-10.5, 12.9-10.7, 12.9-10.8, 12.9-10.12, 12.9-10.13, 12.9-10.25, 12.9-10.26, 12.9-10.28, 12.11.5, 12.11.7, 12.11.8, 12.11.14, 12.11.15, 12.11.20, 12.11.21, 12.11.22, 12.11.24, 12.11.25, 12.11.26, 12.11.27, 12.11.28, 12.12.7, 12.12.8, 12.12.9, 12.12.12, 12.12.14, 12.12.21, 12.12.22, 12.12.23, 12.12.24, 12.12.25, 12.12.27, 13.3.1, 13.3.4, 13.3.7, 13.11.1, 13.11.3, 13.11.4, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Area not categorised
- Cadastral line
- Property boundaries shown are provided as a locational aid only



0 675 1,350 2,025 2,700 3,375 m

This product is projected into:
GDA 1994 MGA Zone 55

© The State of Queensland (Department of Natural Resources, Mines and Energy), 2019

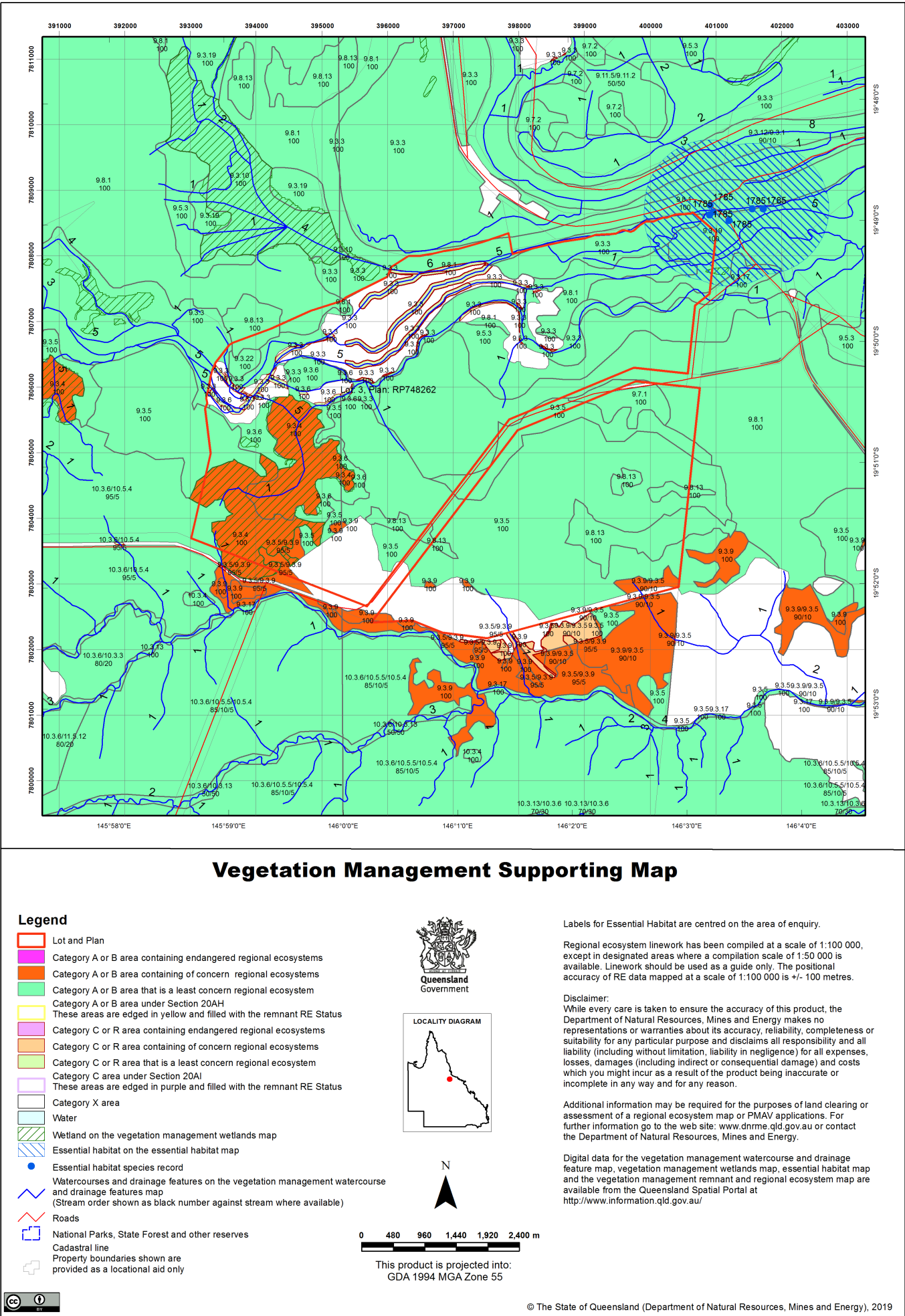
Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources, Mines and Energy makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability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

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources, Mines and Energy.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at <http://www.information.qld.gov.au/>

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.





Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Natural Resources, Mines and Energy website (<http://www.dnrme.qld.gov.au>) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

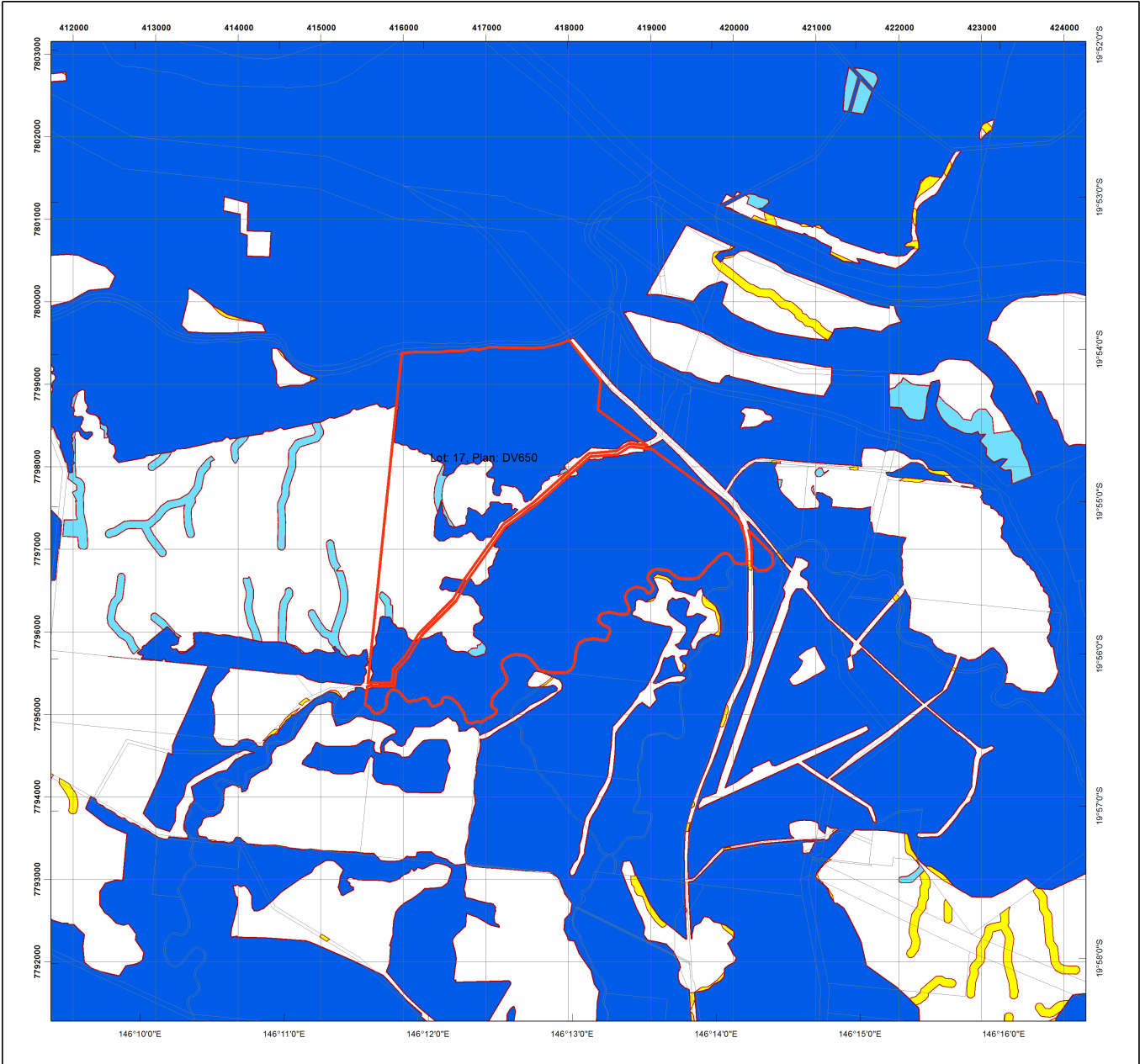
- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
1785	Geophaps scripta scripta	squatter pigeon (southern subsp.)	V	Dry eucalypt woodland (including poplar box, spotted gum, yellow box, acacia and callitris), with sparse short grass, often on sandy areas near to permanent water; grassy eucalypt woodlands. Nest on ground near or under grass tussock, log or low bush.	None	None	Gravelly ridges, traprock and river flats.

Label	Regional Ecosystem (mandatory unless otherwise specified)
1785	8.2.1, 8.2.7, 8.2.8, 8.2.12, 8.3.2, 8.3.3, 8.3.5, 8.3.6, 8.3.13, 8.5.2, 8.5.3, 8.5.5, 8.5.6, 8.9.1, 8.11.1, 8.11.3, 8.11.4, 8.11.5, 8.11.6, 8.11.8, 8.12.6, 8.12.7, 8.12.9, 8.12.12, 8.12.14, 8.12.20, 8.12.22, 8.12.23, 8.12.25, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.18, 9.3.19, 9.3.20, 9.3.21, 9.3.22, 9.3.23, 9.4.1, 9.4.2, 9.4.3, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.16, 9.7.1, 9.7.2, 9.7.3, 9.7.5, 9.7.6, 9.8.1, 9.8.2, 9.8.4, 9.8.5, 9.8.6, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.6, 9.10.7, 9.10.8, 9.11.1, 9.11.2, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.11, 9.11.12, 9.11.13, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.23, 9.11.26, 9.11.28, 9.11.29, 9.11.31, 9.11.32, 9.12.1, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.26, 9.12.28, 9.12.30, 9.12.31, 9.12.33, 9.12.35, 9.12.37, 9.12.39, 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.19, 10.3.20, 10.3.27, 10.3.28, 10.3.30, 10.3.31, 10.4.3, 10.5.1, 10.5.2, 10.5.4, 10.5.5, 10.5.7, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.2, 10.7.3, 10.7.5, 10.7.11, 10.7.12, 10.9.1, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7, 11.2.1, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.4, 11.7.6, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.7, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.15, 11.11.16, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 12.2.5, 12.2.6, 12.2.7, 12.2.10, 12.2.11, 12.3.3, 12.3.6, 12.3.10, 12.3.12, 12.3.14, 12.3.18, 12.3.19, 12.5.1, 12.5.2, 12.5.4, 12.5.5, 12.5.7, 12.5.8, 12.5.11, 12.5.12, 12.7.1, 12.7.2, 12.8.14, 12.8.16, 12.8.17, 12.8.19, 12.9-10.5, 12.9-10.7, 12.9-10.8, 12.9-10.12, 12.9-10.13, 12.9-10.25, 12.9-10.26, 12.9-10.28, 12.11.5, 12.11.7, 12.11.8, 12.11.14, 12.11.15, 12.11.20, 12.11.21, 12.11.22, 12.11.24, 12.11.25, 12.11.26, 12.11.27, 12.11.28, 12.12.7, 12.12.8, 12.12.9, 12.12.12, 12.12.14, 12.12.21, 12.12.22, 12.12.23, 12.12.24, 12.12.25, 12.12.27, 13.3.1, 13.3.4, 13.3.7, 13.11.1, 13.11.3, 13.11.4, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10



Regulated Vegetation Management Map

Legend

- Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Area not categorised
- Cadastral line
- Property boundaries shown are provided as a locational aid only



0 675 1,350 2,025 2,700 3,375 m

This product is projected into:
GDA 1994 MGA Zone 55 © The State of Queensland (Department of Natural Resources, Mines and Energy), 2019

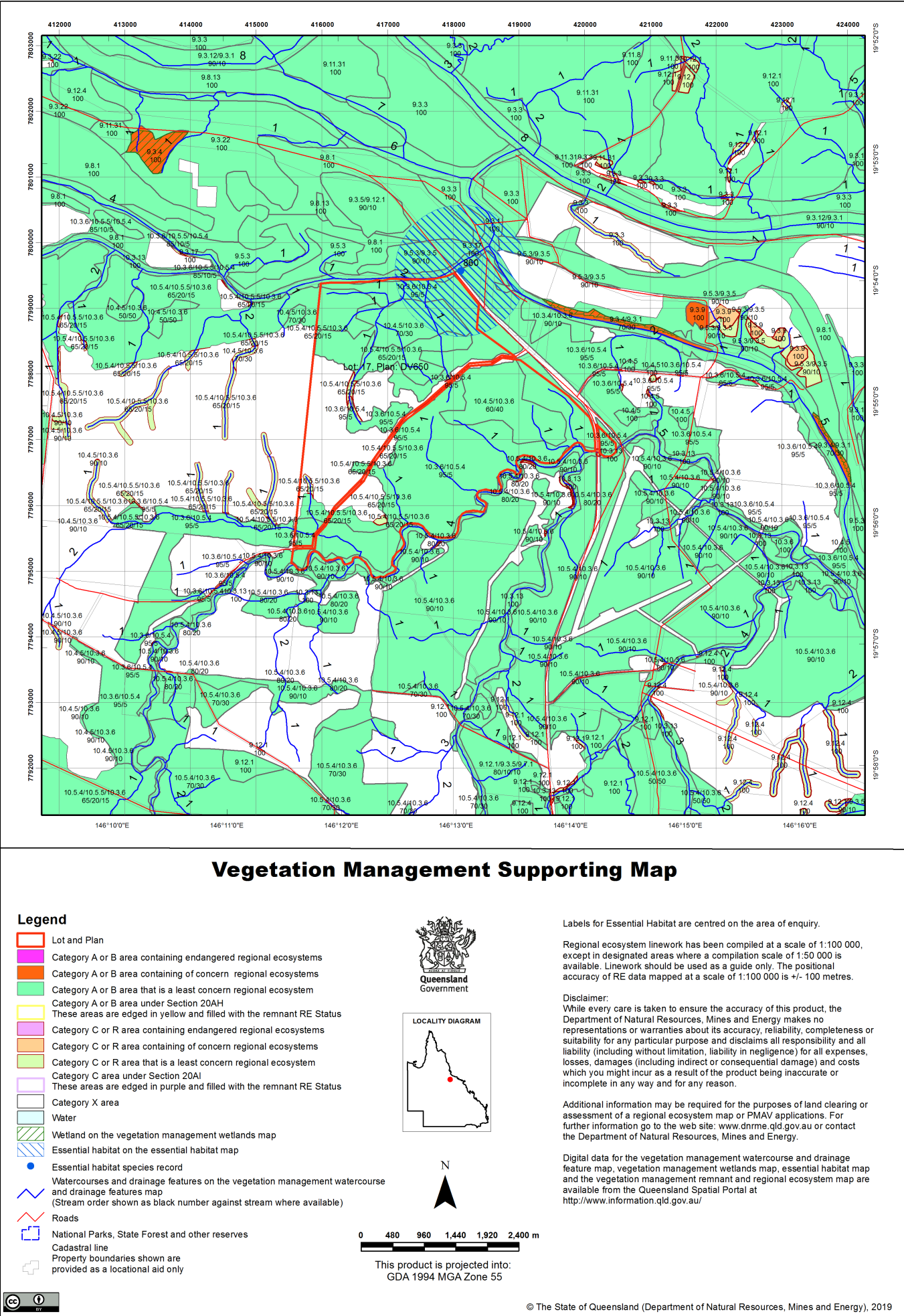
Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources, Mines and Energy makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability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

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.dnrm.qld.gov.au or contact the Department of Natural Resources, Mines and Energy.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at <http://www.information.qld.gov.au/>

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.





Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Natural Resources, Mines and Energy website (<http://www.dnrme.qld.gov.au>) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
860	Phascolarctos cinereus	koala	V	SEQ: Open eucalypt forest and woodland that has: a) multiple strata layers containing Eucalyptus, Corymbia, Angophora, Lophostemon or Melaleuca trees that-at 1.3 metres above the ground-have a diameter both greater and less than 30 centimetres; and b) at least 1 of the following species: Eucalyptus tereticornis, E. fibrosa, E. propinqua, E. umbra, E. grandis, E. microcorys, E. tindaliae, E. resinifera, E. populnea, E. robusta, E. nigra, E. racemosa, E. crebra, E. exserta, E. seeana, Lophostemon confertus, L. suaveolens, Melaleuca quinquenervia. Outside SEQ: Open eucalypt forest and woodland that contains Eucalyptus &/or Corymbia spp. Tree species used for food varies across State and can include Eucalyptus tereticornis, E. camaldulensis, E. colabah, E. dropanophylla, E. platyphylla, E. ordagophilla, E. thozetiana, E. melanophloia, E. populnea, E. melliodora, E. dealbata, E. microthea, E. crebra, E. exserta, E. blakelyi, E. papuana, Corymbia tessellaris, C. citriodora, Melaleuca quinquenervia, M. leucadendra.	Sea level to 1000m.	None	Riparian areas, plains and hill/escarpment slopes.

Label	Regional Ecosystem (mandatory unless otherwise specified)
860	SEQ: 11.3.2, 11.3.4, 11.3.25, 11.3.26, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.9.9, 12.2.5, 12.2.6, 12.2.7, 12.2.8, 12.2.10, 12.3.2, 12.3.3, 12.3.4, 12.3.5, 12.3.6, 12.3.7, 12.3.9, 12.3.10, 12.3.11, 12.3.14, 12.3.18, 12.3.19, 12.3.20, 12.5.1, 12.5.2, 12.5.3, 12.5.4, 12.5.6, 12.5.7, 12.5.10, 12.5.12, 12.8.1, 12.8.8, 12.8.9, 12.8.11, 12.8.12, 12.8.14, 12.8.16, 12.8.17, 12.8.20, 12.8.24, 12.8.25, 12.9-10.1, 12.9-10.2, 12.9-10.3, 12.9-10.4, 12.9-10.5, 12.9-10.7, 12.9-10.8, 12.9-10.11, 12.9-10.12, 12.9-10.14, 12.9-10.17, 12.9-10.18, 12.9-10.19, 12.9-10.21, 12.9-10.25, 12.9-10.26, 12.9-10.27, 12.9-10.28, 12.9-10.29, 12.11.2, 12.11.3, 12.11.5, 12.11.6, 12.11.7, 12.11.8, 12.11.9, 12.11.14, 12.11.15, 12.11.16, 12.11.17, 12.11.18, 12.11.22, 12.11.23, 12.11.24, 12.11.25, 12.11.26, 12.11.27, 12.11.28, 12.12.2, 12.12.3, 12.12.5, 12.12.6, 12.12.7, 12.12.8, 12.12.9, 12.12.11, 12.12.12, 12.12.14, 12.12.15, 12.12.23, 12.12.24, 12.12.25, 12.12.28. Outside SEQ: 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5, 4.3.6, 4.3.8, 4.3.10, 4.3.11, 4.4.1, 4.5.3, 4.5.5, 4.5.6, 4.5.8, 4.5.9, 4.7.1, 4.7.7, 4.7.8, 4.9.6, 4.9.10, 4.9.12, 4.9.17, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.7, 6.3.8, 6.3.9, 6.3.11, 6.3.12, 6.3.17, 6.3.18, 6.3.22, 6.3.24, 6.3.25, 6.4.1, 6.4.2, 6.4.3, 6.4.4, 6.5.1, 6.5.2, 6.5.3, 6.5.5, 6.5.6, 6.5.7, 6.5.8, 6.5.9, 6.5.10, 6.5.11, 6.5.13, 6.5.14, 6.5.15, 6.5.16, 6.5.17, 6.5.18, 6.5.19, 6.6.2, 6.7.1, 6.7.2, 6.7.5, 6.7.6, 6.7.7, 6.7.9, 6.7.11, 6.7.12, 6.7.13, 6.7.14, 6.7.17, 6.9.3, 7.2.3, 7.2.4, 7.2.7, 7.2.11, 7.3.7, 7.3.8, 7.3.9, 7.3.12, 7.3.13, 7.3.14, 7.3.16, 7.3.19, 7.3.20, 7.3.21, 7.3.25, 7.3.26, 7.3.39, 7.3.40, 7.3.42, 7.3.43, 7.3.44, 7.3.45, 7.3.47, 7.3.48, 7.3.50, 7.5.1, 7.5.2, 7.5.3, 7.5.4, 7.8.7, 7.8.8, 7.8.10, 7.8.15, 7.8.16, 7.8.17, 7.8.18, 7.8.19, 7.11.5, 7.11.6, 7.11.13, 7.11.14, 7.11.16, 7.11.18, 7.11.19, 7.11.20, 7.11.21, 7.11.31, 7.11.32, 7.11.33, 7.11.34, 7.11.35, 7.11.37, 7.11.41, 7.11.42, 7.11.43, 7.11.44, 7.11.45, 7.11.46, 7.11.47, 7.11.48, 7.11.49, 7.11.50, 7.11.51, 7.12.4, 7.12.5, 7.12.17, 7.12.21, 7.12.22, 7.12.23, 7.12.24, 7.12.25, 7.12.26, 7.12.27, 7.12.28, 8.2.12, 8.2.13, 8.2.14, 8.3.1, 8.3.2, 8.3.3, 8.3.5, 8.3.6, 8.3.8, 8.3.10, 8.3.11, 8.3.13, 8.5.1, 8.5.2, 8.5.3, 8.5.5, 8.5.6, 8.5.7, 8.9.1, 8.10.1, 8.11.1, 8.11.3, 8.11.4, 8.11.5, 8.11.6, 8.11.8, 8.11.10, 8.11.12, 8.12.4, 8.12.5, 8.12.6, 8.12.7, 8.12.8, 8.12.9, 8.12.12, 8.12.14, 8.12.20, 8.12.22, 8.12.23, 8.12.25, 8.12.26, 8.12.27, 8.12.29, 8.12.31, 8.12.32, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.10, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.19, 9.3.20, 9.3.21, 9.3.22, 9.3.27, 9.4.1, 9.4.2, 9.4.3, 9.5.1, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.15, 9.5.16, 9.5.17, 9.7.1, 9.7.2, 9.7.3, 9.7.4, 9.7.5, 9.7.6, 9.8.1, 9.8.2, 9.8.3, 9.8.4, 9.8.5, 9.8.9, 9.8.10, 9.8.11, 9.8.13, 9.10.1, 9.10.3, 9.10.4, 9.10.5, 9.10.7, 9.10.8, 9.11.1, 9.11.2, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.12, 9.11.13, 9.11.14, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.21, 9.11.22, 9.11.23, 9.11.24, 9.11.25, 9.11.26, 9.11.28, 9.11.29, 9.11.30, 9.11.31, 9.11.32, 9.12.1, 9.12.2, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.14, 9.12.15, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.25, 9.12.26, 9.12.27, 9.12.28, 9.12.29, 9.12.30, 9.12.31, 9.12.32, 9.12.33, 9.12.35, 9.12.36, 9.12.37, 9.12.38, 9.12.39, 9.12.44, 10.3.2, 10.3.3, 10.3.5, 10.3.6, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.17, 10.3.20, 10.3.27, 10.3.28, 10.4.3, 10.4.9, 10.5.1, 10.5.2, 10.5.4, 10.5.5, 10.5.7, 10.5.8, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.1, 10.7.2, 10.7.3, 10.7.4, 10.7.5, 10.7.9, 10.7.10, 10.7.11, 10.7.12, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7, 11.2.1, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.6, 11.3.7, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.21, 11.3.23, 11.3.25, 11.3.26, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.32, 11.3.33, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.7, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.17, 11.5.18, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.3, 11.7.4, 11.7.6, 11.7.7, 11.8.1, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.1, 11.9.2, 11.9.3, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.9.11, 11.9.13, 11.9.14, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.5, 11.10.6, 11.10.7, 11.10.9, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.2, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.12, 11.11.13, 11.11.14, 11.11.15, 11.11.16, 11.11.17, 11.11.19, 11.12.0, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.13, 11.12.14, 11.12.15, 11.12.16, 11.12.17, 11.12.19, 11.12.20, 13.3.1, 13.3.2, 13.3.3, 13.3.4, 13.3.5, 13.3.7, 13.9.2, 13.11.1, 13.11.2, 13.11.3, 13.11.4, 13.11.5, 13.11.6, 13.11.8, 13.11.9, 13.12.1, 13.12.2, 13.12.3, 13.12.4, 13.12.5, 13.12.6, 13.12.8, 13.12.9, 13.12.10.



Vegetation management report

For Lot: 3 Plan: SP158583

Current as at 23/10/2019

This publication has been compiled by Operations Support, Department of Natural Resources, Mines and Energy.

© State of Queensland, (2019)

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons - Attribution 4.0 International (CC BY) licence.

Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms.



You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication.

Note: Some content in this publication may have different licence terms as indicated.

For more information on this licence, visit <http://creativecommons.org/licenses/by/3.0/au/deed.en>

The information contained herein is subject to change without notice. The Queensland Government shall not be liable for technical or other errors or omissions contained herein. The reader/user accepts all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using this information.

Recent changes

Updated mapping

The Regulated Vegetation Management Map and Supporting Map was updated in June 2019 to reflect the most up to date information available in relation to regional ecosystems, essential habitat and wetland mapping (Version 11).

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:

- *Vegetation management framework* - an explanation of the application of the framework.
- *Property details* - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s), catchment(s), coastal or non coastal status, and any applicable area management plans associated with your property.
- *Vegetation management details for the specified Lot on Plan* - specific information about your property including vegetation categories, regional ecosystems, watercourses, wetlands, essential habitat, and protected plants.
- *Contact information*.
- *Maps* - a series of colour maps to assist in identifying regulated vegetation on your property.
- *Other legislation contact information*.

This information will assist you to determine your options for managing vegetation under the vegetation management framework, which may include:

- exempt clearing work
- accepted development vegetation clearing code
- an area management plan
- a development approval.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as Queensland's Protected Plants framework or the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 6 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

Table of Contents

1. Vegetation management framework	5
1.1 Exempt clearing work	5
1.2 Accepted development vegetation clearing codes	5
1.3 Area management plans	6
1.4 Development approvals	6
2. Property details	6
2.1 Tenure	6
2.2 Property location	6
3. Vegetation management details for Lot: 3 Plan: SP158583	8
3.1 Vegetation categories	8
3.2 Regional ecosystems	9
3.3 Watercourses	10
3.4 Wetlands	10
3.5 Essential habitat	10
3.6 Protected plants (administered by the Department of Environment and Science (DES))	11
3.7 Emissions Reduction Fund (ERF)	11
4. Contact information for DNRME	12
5. Maps	13
5.1 Regulated vegetation management map	14
5.2 Vegetation management supporting map	15
5.3 Pre-clear map	16
5.4 Coastal/non coastal map	17
5.5 Agricultural Land Class A or B map	18
5.6 Protected plants map administered by DES	19
6. Other relevant legislation contacts list	21

1. Vegetation management framework

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2012, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem prescribed under Schedule 5 of the Vegetation Management Regulation 2012; and
- a mangrove.

1.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify DNRME or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 5.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact DNRME before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

<https://www.qld.gov.au/environment/land/vegetation/exemptions/>.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact DNRME prior to clearing in any of these areas.

1.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

<https://www.qld.gov.au/environment/land/vegetation/codes/>

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify DNRME before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at

<https://apps.dnrm.qld.gov.au/vegetation/>

1.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

AMPs for fodder harvesting, managing thickened vegetation and managing encroachment will continue until March 2020. New notifications cannot be made for these AMPs.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an area management plan applies to your property for which you can make a new notification, it will be listed in Section 2.2 of this report. Before clearing under one of these AMPs, you must first notify the DNRME and then follow the conditions and requirements listed in the AMP.

<https://www.qld.gov.au/environment/land/vegetation/area-plans/>

1.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

<https://www.qld.gov.au/environment/land/management/vegetation/development>

2. Property details

2.1 Tenure

All of the lot, plan and tenure information associated with property Lot: 3 Plan: SP158583, including links to relevant Smart Maps, are listed in Table 1. The tenure of the property (whether it is freehold, leasehold, or other) may be viewed by clicking on the Smart Map link(s) provided.

Table 1: Lot, plan and tenure information for the property

Lot	Plan	Tenure	Link to property on SmartMap
3	SP158583	Lands Lease	https://apps.information.qld.gov.au/data/cadastre/GenerateSmartMap?q=3\SP158583

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

2.2 Property location

Table 2 provides a summary of the locations for property Lot: 3 Plan: SP158583, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)
Charters Towers Regional

Bioregion(s)	Subregion(s)
Einasleigh Uplands	Undara - Toomba Basalts
Einasleigh Uplands	Broken River
Desert Uplands	Cape - Campaspe Plains

Catchment(s)
Burdekin

Area Management Plan(s)

Area Management Plan for the control of pest plants in the Dry Tropics region

For the purposes of the accepted development vegetation clearing codes and the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 5.4

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?

Class A: 193.79ha

Class B: 186.93ha

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See section 5 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 3 Plan: SP158583.

3. Vegetation management details for Lot: 3 Plan: SP158583

3.1 Vegetation categories

Vegetation categories are shown on the regulated vegetation management map in section 5.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property. Total area: 2897.0ha

Vegetation category	Area (ha)
Category B	2883.1
Category R	4.1
Category X	9.8

Table 4

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact DNRME to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact DNRME to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

This report does not confirm if a Property Map of Assessable Vegetation (PMAV) exists on a lot. To confirm whether or not a PMAV exists on a lot, please check the PMAV layer on the Queensland Globe2, or contact DNRME on 135VEG (135 834).

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 5.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at

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

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
10.3.13	Least concern	B	28.82	Melaleuca fluviatilis and/or Eucalyptus camaldulensis woodland along watercourses	Sparse
10.3.6	Least concern	B	863.73	Eucalyptus brownii woodland to open woodland on alluvial plains	Very sparse
10.5.4	Least concern	B	50.45	Eucalyptus crebra or E. drepanophylla woodland on sand plains	Sparse
10.5.5	Least concern	B	100.91	Eucalyptus melanophloia woodland to open woodland on sand plains	Very sparse
9.11.31	Least concern	B	0.02	Corymbia terminalis and/or Eucalyptus crebra and/or C. erythrophloia woodland on aprons surrounding limestone outcrops	Sparse
9.3.1	Least concern	B	0.01	Eucalyptus camaldulensis and/or E. tereticornis +/- Melaleuca spp. +/- Casuarina cunninghamiana fringing woodland on channels and levees	Sparse
9.3.12	Least concern	B	0.05	River beds and associated waterholes on major rivers and channels	Other
9.3.17	Least concern	B	59.34	Casuarina cunninghamiana and/or Eucalyptus camaldulensis or E. tereticornis fringing open forest on channels and levees on basalt flows	Mid-dense
9.3.17	Least concern	R	0.04	Casuarina cunninghamiana and/or Eucalyptus camaldulensis or E. tereticornis fringing open forest on channels and levees on basalt flows	Mid-dense
9.3.22	Least concern	B	145.26	Eucalyptus crebra or E. cullenii +/- Corymbia spp. open woodland on alluvial levees and terraces	Very sparse
9.3.3	Least concern	B	0.32	Corymbia spp. and Eucalyptus spp. dominated mixed woodland on alluvial flats, levees and plains	Sparse
9.3.5	Least concern	B	228.28	Eucalyptus brownii +/- Eucalyptus spp. +/- Corymbia spp. open woodland on alluvial plains	Very sparse
9.3.5	Least concern	R	0.15	Eucalyptus brownii +/- Eucalyptus spp. +/- Corymbia spp. open woodland on alluvial plains	Very sparse
9.3.9	Of concern	B	224.62	Acacia cambagei +/- A. harpophylla woodland on cracking clay soils	Sparse
9.3.9	Of concern	R	1.31	Acacia cambagei +/- A. harpophylla woodland on cracking clay soils	Sparse
9.8.1	Least concern	B	1,045.74	Eucalyptus crebra +/- Corymbia dallachiana +/- E. leptophleba open woodland on plains and rocky rises of basalt geologies	Very sparse

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
9.8.13	Least concern	B	116.65	Iseilema spp. and/or Dichanthium spp. tussock grassland on basalt plains	Grassland
9.8.13	Least concern	R	2.65	Iseilema spp. and/or Dichanthium spp. tussock grassland on basalt plains	Grassland
9.8.7	Least concern	B	18.92	Semi-evergreen vine thicket on cones, craters and rocky basalt flows with little soil development	Dense
non-rem	None	X	9.76	None	None

Please note:

1. All area and area derived figures included in this table 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.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work
- accepted development vegetation clearing codes
- performance outcomes in State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 5.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA), and includes endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 5.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map as assessable vegetation -

- 1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
- 2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C

No records

3.6 Protected plants (administered by the Department of Environment and Science (DES))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA), with clearing of protected plants in the wild regulated by the [Nature Conservation \(Wildlife Management\) Regulation 2006](#). These requirements apply irrespective of the classification of the vegetation under the *Vegetation Management Act 1999*.

Prior to clearing, if the plants proposed to be cleared are in the wild (see [Operational policy: When a protected plant in Queensland is considered to be 'in the wild'](#)) and the exemptions under the [Nature Conservation \(Wildlife Management\) Regulation 2006](#) are not applicable to the proposed clearing, you must check the flora survey trigger map to determine if any part of the area to be cleared is within a high risk area. The trigger map for this property is provided in section 5.6. The exemptions relate to:

- imminent risk of death or serious injury (refer s261A)
- imminent risk of serious damage to a building or other structure on land, or to personal property (refer s261B)
- *Fire and Emergency Service Act 1990* (refer 261C)
- previously cleared areas (refer s261ZB)
- maintenance activities (refer s261ZC)
- firebreak or fire management line (refer s261ZD)
- accepted development vegetation clearing code (refer s261ZE)
- conservation purposes (refer s261ZG)
- authorised in particular circumstances (refer s385).

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) from the *Vegetation Management Act 1999* (i.e. listed in the Planning Regulations 2017) while some are different.

If the proposed area to be cleared is shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken in accordance with the flora survey guidelines. The main objective of a flora survey is to locate any endangered, vulnerable or near threatened plants (EVNT plants) that may be present in the clearing impact area.

If a flora survey identifies that EVNT plants are not present within the clearing impact area or clearing within 100m of EVNT plants can be avoided, the clearing activity is exempt from a permit. An [exempt clearing notification form](#) must be submitted to the Department of Environment and Science, with a copy of the flora survey report, at least one week prior to clearing. The clearing must be conducted within two years after the flora survey report was submitted.

If a flora survey identifies that EVNT plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the [application form clearing permit](#).

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that EVNT plants are present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

Further information on protected plants is available at

<http://www.ehp.qld.gov.au/licences-permits/plants-animals/protected-plants/>

For assistance on the protected plants flora survey trigger map for this property, please contact the Department of Environment and Science at palm@des.qld.gov.au.

3.7 Emissions Reduction Fund (ERF)

The ERF is an Australian Government scheme which offers incentives for businesses and communities across the economy to reduce emissions.

Under the ERF, landholders can earn money from activities such as planting (and keeping) trees, managing regrowth vegetation and adopting more sustainable agricultural practices.

The purpose of a project is to remove greenhouse gases from the atmosphere. Each project will provide new economic opportunities for farmers, forest growers and land managers.

Further information on ERF is available at <https://www.qld.gov.au/environment/land/state/use/carbon-rights/>.

4. Contact information for DNRME

For further information on vegetation management:

Phone 135VEG (135 834)

Email vegetation@dnrme.qld.gov.au

Visit <https://www.dnrme.qld.gov.au/?contact=vegetation> to submit an online enquiry.

For contact details for other State and Commonwealth agencies, please see Section 6.

5. Maps

Maps included in this report may also be requested individually at:

<https://www.dnrme.qld.gov.au/qld/environment/land/vegetation/vegetation-map-request-form>

and

<http://www.ehp.qld.gov.au/licences-permits/plants-animals/protected-plants/map-request.php>

Regulated vegetation management map

The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new [property maps of assessable vegetation \(PMAV\)](#).

Vegetation management supporting map

The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Pre-clear map

The vegetation management pre-clear regional ecosystem mapping shows the regional ecosystem, location and extent which is likely to have occurred at that location prior to clearing. This map can be used for identifying exchange areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code. It may also be used for identifying offsets under the vegetation management framework.

Coastal/non coastal map

The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and the State Development Assessment Provisions (SDAP).

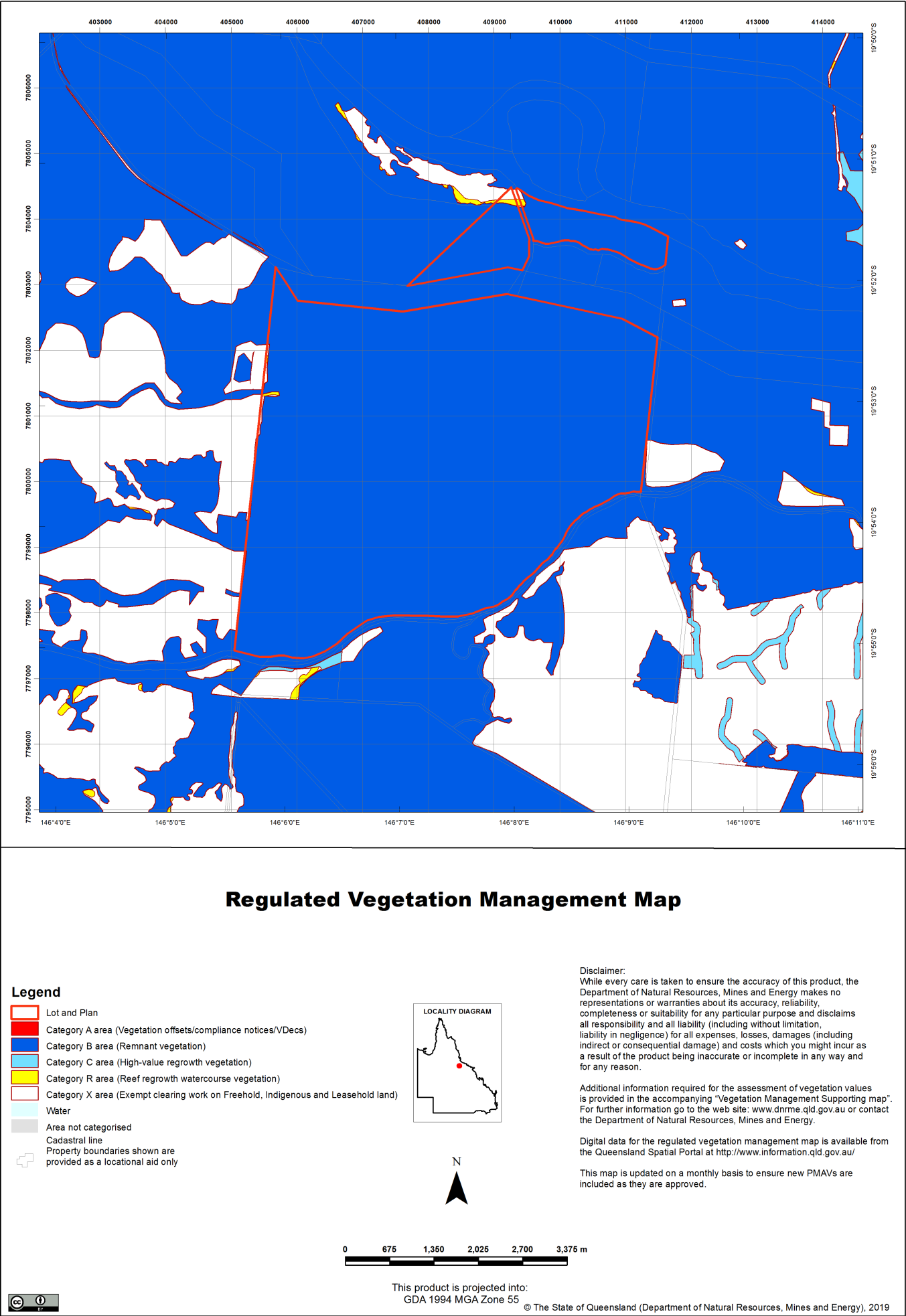
Agricultural Land Class A or B

The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

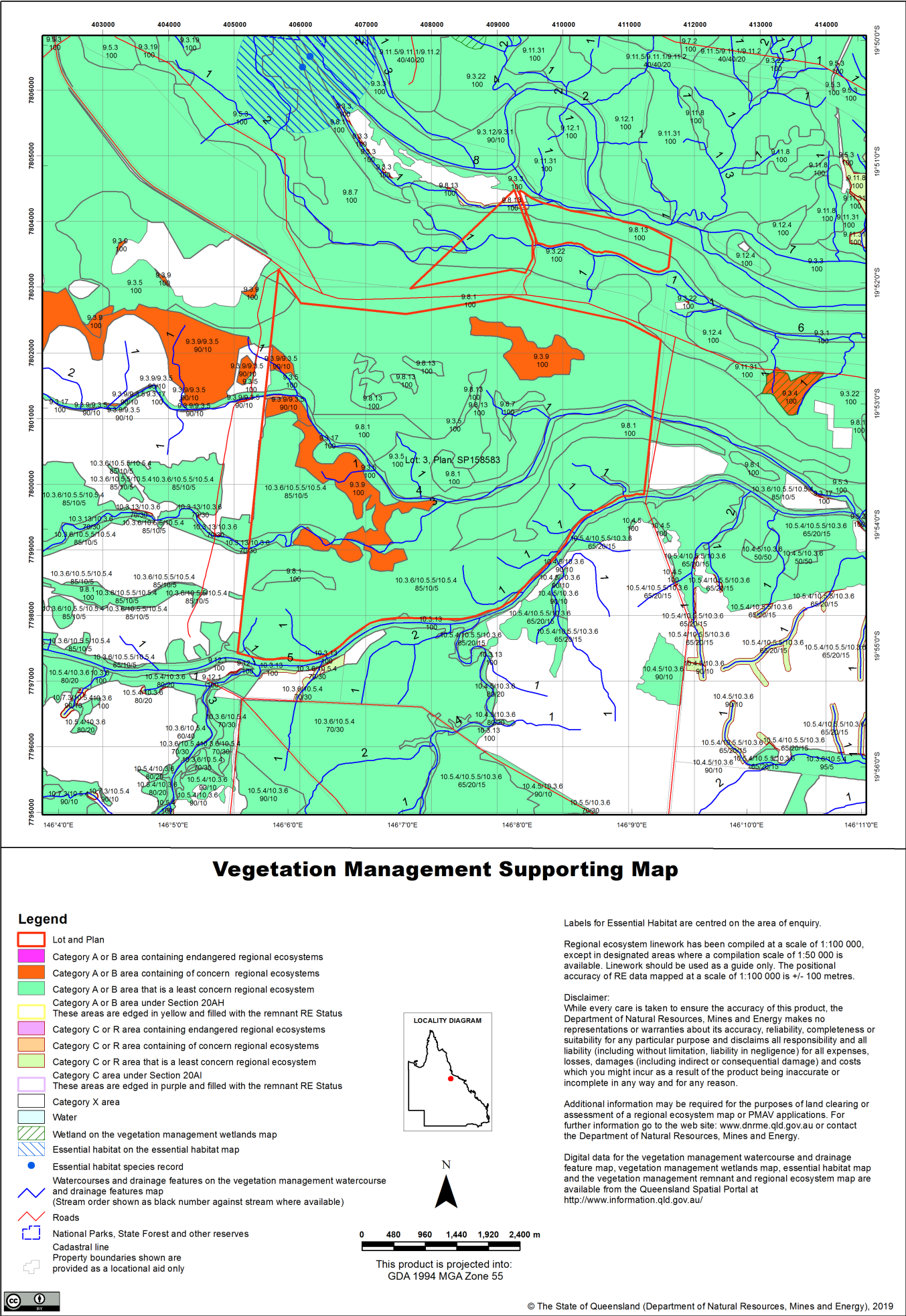
Protected plants map

The protected plants map shows areas where particular provisions of the *Nature Conservation Act 1992* apply to the clearing of protected plants.

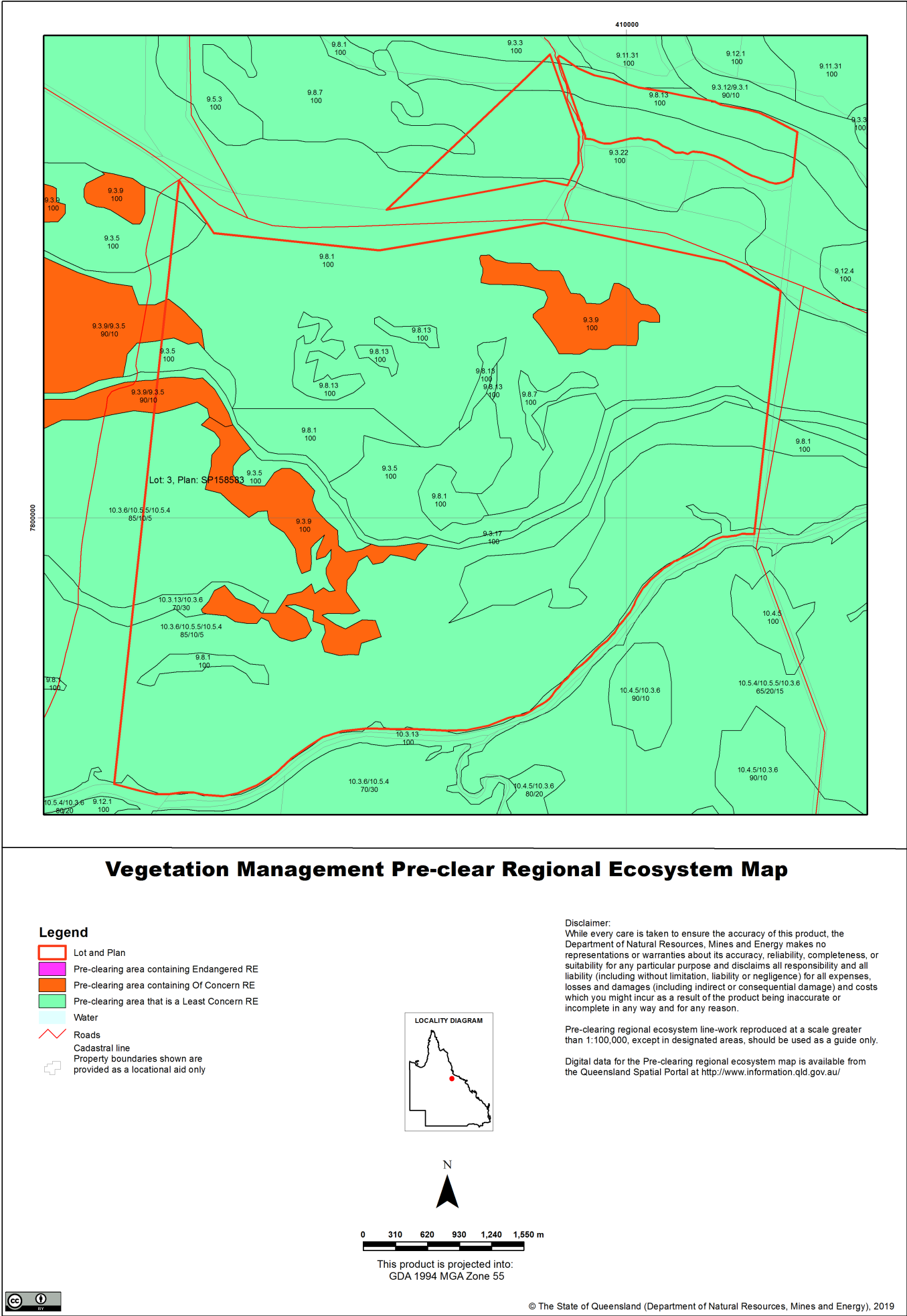
5.1 Regulated vegetation management map



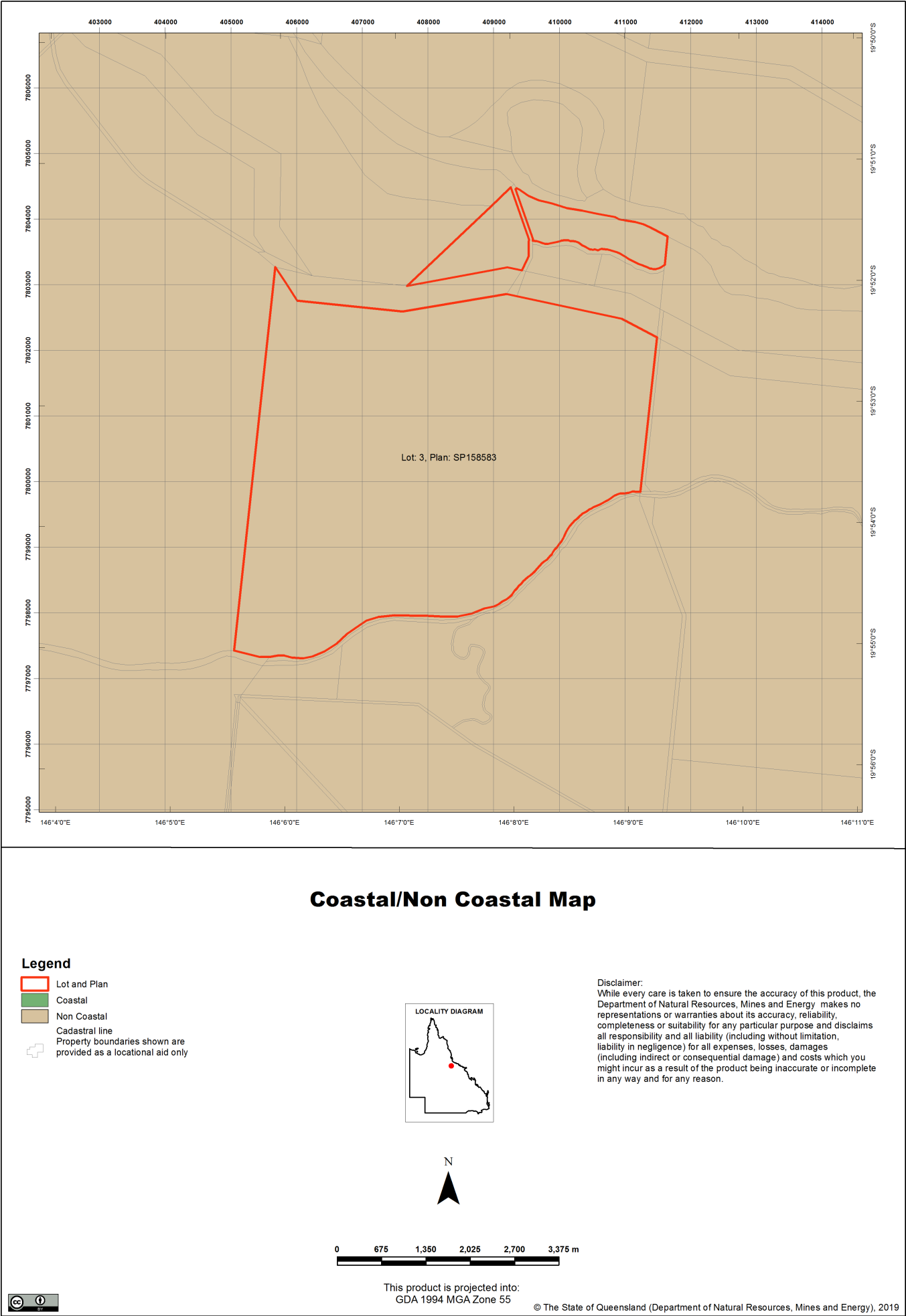
5.2 Vegetation management supporting map



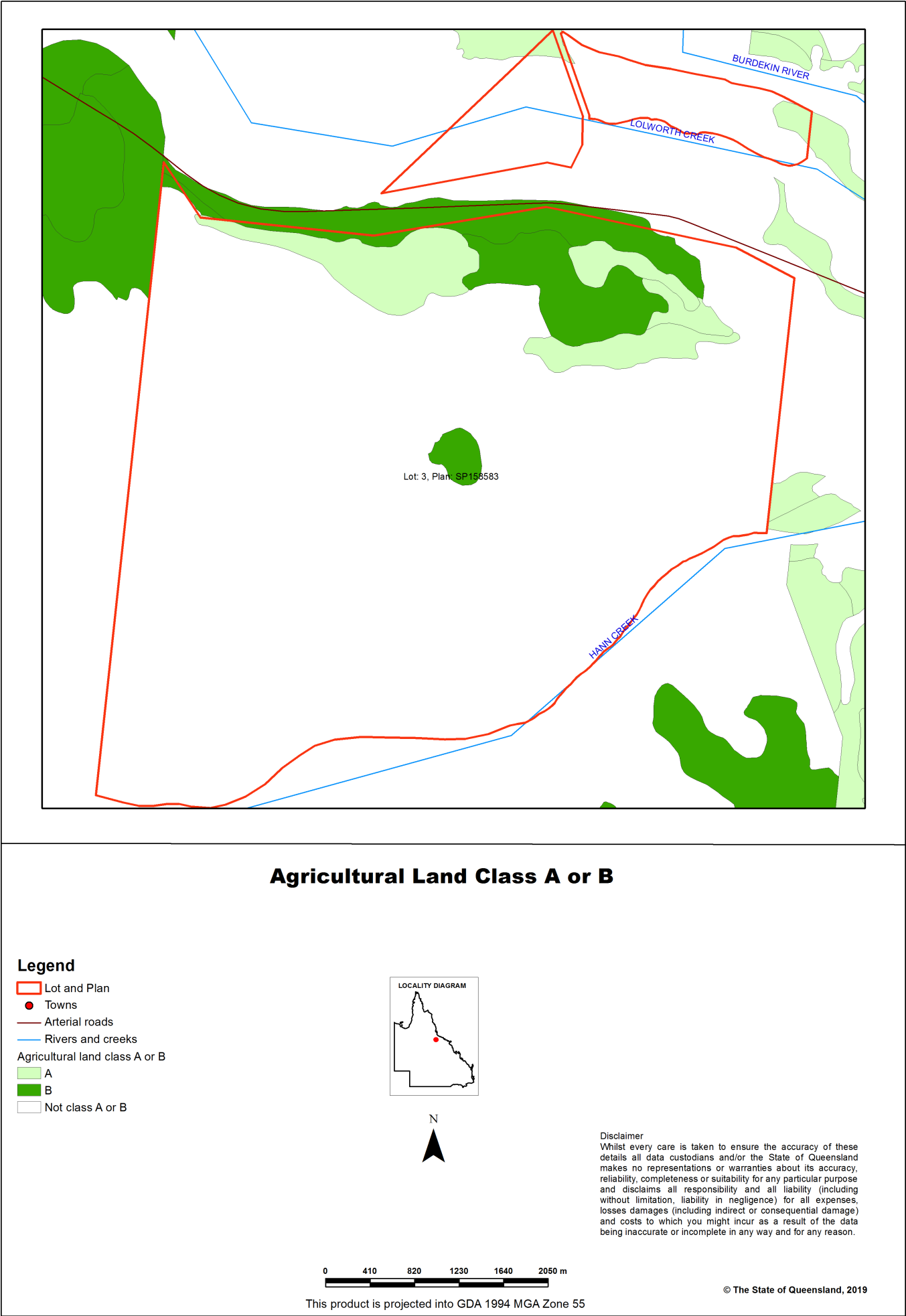
5.3 Pre-clear map



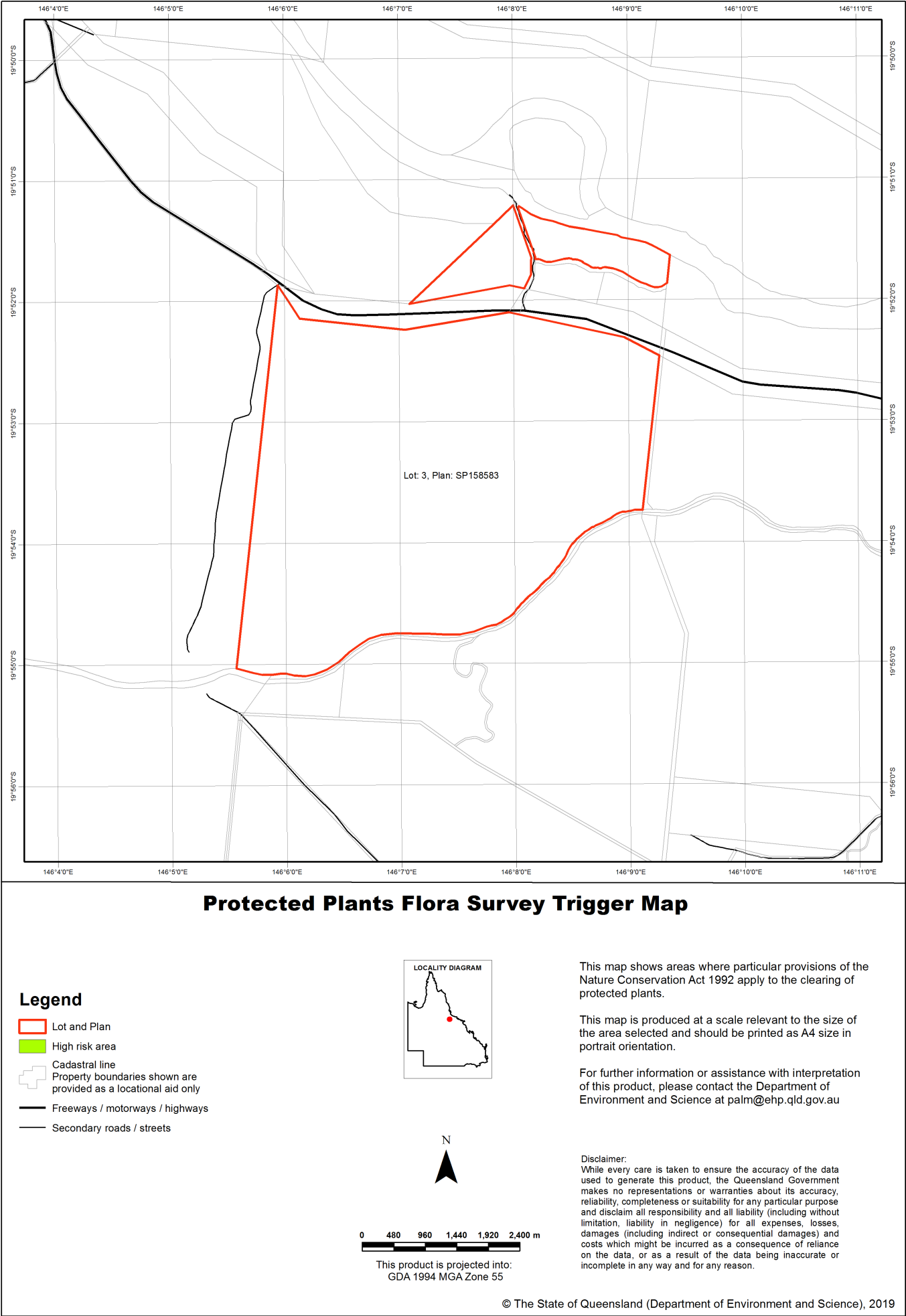
5.4 Coastal/non coastal map



5.5 Agricultural Land Class A or B map



5.6 Protected plants map administered by DES



Protected plants flora survey trigger map

The protected plants flora survey trigger map identifies 'high risk areas' where endangered, vulnerable or near threatened plants are known to exist or are likely to exist. Under the *Nature Conservation Act 1992* (the Act) it is an offence to clear protected plants that are 'in the wild' unless you are authorised or the clearing is exempt, for more information see [section 89](#) of the Act.

Please see the Department of Environment and Science webpage on the [clearing of protected plants](#) for information on what exemptions may apply in your circumstances, whether you may need to undertake a flora survey, and whether you may need a protected plants clearing permit.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the [Queensland Spatial Catalogue](#), the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the [clearing of protected plants](#) for more information.

6. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
• Interference with overland flow • Earthworks, significant disturbance	<i>Water Act 2000</i> <i>Soil Conservation Act 1986</i>	Department of Natural Resources, Mines and Energy (Queensland Government)	Ph: 13 QGOV (13 74 68) www.dnrme.qld.gov.au
• Indigenous Cultural Heritage	<i>Aboriginal Cultural Heritage Act 2003</i> <i>Torres Strait Islander Cultural Heritage Act 2003</i>	Department of Aboriginal and Torres Strait Islander Partnerships (Queensland Government)	Ph: 13 QGOV (13 74 68) www.datsip.qld.gov.au
• Mining and environmentally relevant activities • Infrastructure development (coastal) • Heritage issues • Protected plants and protected areas¹	<i>Environmental Protection Act 1994</i> <i>Coastal Protection and Management Act 1995</i> <i>Queensland Heritage Act 1992</i> <i>Nature Conservation Act 1992</i>	Department of Environment and Science (Queensland Government)	Ph: 13 QGOV (13 74 68) www.des.qld.gov.au
• Interference with fish passage in a watercourse, mangroves • Forestry activities²	<i>Fisheries Act 1994</i> <i>Forestry Act 1959</i>	Department of Agriculture and Fisheries (Queensland Government)	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
• Matters of National Environmental Significance including listed threatened species and ecological communities	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Department of the Environment (Australian Government)	Ph: 1800 803 772 www.environment.gov.au
• Development and planning processes	<i>Planning Act 2016</i> <i>State Development and Public Works Organisation Act 1971</i>	Department of State Development, Manufacturing, Infrastructure and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) www.dsdmip.qld.gov.au
• Local government requirements	<i>Local Government Act 2009</i> <i>Planning Act 2016</i>	Department of Local Government, Racing and Multicultural Affairs (Queensland Government)	Ph: 13 QGOV (13 74 68) Your relevant local government office

1. In Queensland, all plants that are native to Australia are protected plants under the [Nature Conservation Act 1992](http://www.des.qld.gov.au), which endeavours to ensure that protected plants (whether whole plants or protected plants parts) are not illegally removed from the wild, or illegally traded. Prior to clearing, you should check the flora survey trigger map to determine if the clearing is within a high-risk area by visiting www.des.qld.gov.au. For further information or assistance on the protected plants flora survey trigger map for your property, please contact the Department of Environment and Science on 13QGOV (13 74 68) or email palm@des.qld.gov.au.

2. Contact the Department of Agriculture and Fisheries before clearing:

- Any sandalwood on state-owned land (including leasehold land)
- On freehold land in a 'forest consent area' or a 'forest entitlement area'
- More than five hectares on state-owned land (including leasehold land) containing commercial timber species listed in parts 2 or 3 of Schedule 6 of the Vegetation Management Regulation 2012 and located within any of the following local government management areas-Banana, Bundaberg Regional, Fraser Coast Regional, Gladstone Regional, Isaac Regional, North Burnett Regional, Somerset Regional, South Burnett Regional, Southern Downs Regional, Tablelands Regional, Toowoomba Regional, Western Downs Regional.



Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point

Species: All

Type: All

Status: All

Records: All

Date: All

Latitude: -19.8660

Longitude: 146.1726

Distance: 30

Email: shannon.blatchford@ghd.com

Date submitted: Friday 01 Nov 2019 12:04:27

Date extracted: Friday 01 Nov 2019 12:10:19

The number of records retrieved = 928

Disclaimer

As the DSITIA is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	<i>Rhinella marina</i>	cane toad	Y			8
animals	amphibians	Hylidae	<i>Litoria rothii</i>	northern laughing treefrog		C		4
animals	amphibians	Hylidae	<i>Litoria bicolor</i>	northern sedgefrog		C		2
animals	amphibians	Hylidae	<i>Litoria inermis</i>	bumpy rocketfrog		C		5
animals	amphibians	Hylidae	<i>Litoria rubella</i>	ruddy treefrog		C		5/1
animals	amphibians	Hylidae	<i>Cyclorana brevipes</i>	superb collared frog		C		2
animals	amphibians	Hylidae	<i>Cyclorana alboguttata</i>	greenstripe frog		C		3
animals	amphibians	Hylidae	<i>Cyclorana novaehollandiae</i>	eastern snapping frog		C		3
animals	amphibians	Hylidae	<i>Litoria nasuta</i>	striped rocketfrog		C		2
animals	amphibians	Hylidae	<i>Litoria caerulea</i>	common green treefrog		C		6/4
animals	amphibians	Limnodynastidae	<i>Platyplectrum ornatum</i>	ornate burrowing frog		C		8/4
animals	birds	Acanthizidae	<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill		C		4
animals	birds	Acanthizidae	<i>Gerygone magnirostris</i>	large-billed gerygone		C		1
animals	birds	Acanthizidae	<i>Acanthiza nana</i>	yellow thornbill		C		2
animals	birds	Acanthizidae	<i>Smicronis brevirostris</i>	weebill		C		16
animals	birds	Acanthizidae	<i>Acanthiza reguloides</i>	buff-rumped thornbill		C		1
animals	birds	Acanthizidae	<i>Gerygone mouki</i>	brown gerygone		C		1
animals	birds	Acanthizidae	<i>Gerygone olivacea</i>	white-throated gerygone		C		35
animals	birds	Acanthizidae	<i>Gerygone palpebrosa</i>	fairy gerygone		C		3
animals	birds	Acanthizidae	<i>Gerygone fusca</i>	western gerygone		C		4
animals	birds	Accipitridae	<i>Pandion cristatus</i>	eastern osprey		SL		3
animals	birds	Accipitridae	<i>Circus approximans</i>	swamp harrier		C		1
animals	birds	Accipitridae	<i>Lophoictinia isura</i>	square-tailed kite		C		1
animals	birds	Accipitridae	<i>Aviceda subcristata</i>	Pacific baza		C		6
animals	birds	Accipitridae	<i>Elanus axillaris</i>	black-shouldered kite		C		13
animals	birds	Accipitridae	<i>Circus assimilis</i>	spotted harrier		C		1
animals	birds	Accipitridae	<i>Milvus migrans</i>	black kite		C		57
animals	birds	Accipitridae	<i>Haliastur sphenurus</i>	whistling kite		C		59
animals	birds	Accipitridae	<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		C		15
animals	birds	Accipitridae	<i>Hieraaetus morphnoides</i>	little eagle		C		4
animals	birds	Accipitridae	<i>Accipiter fasciatus</i>	brown goshawk		C		5
animals	birds	Accipitridae	<i>Aquila audax</i>	wedge-tailed eagle		C		20
animals	birds	Accipitridae	<i>Accipiter cirrocephalus</i>	collared sparrowhawk		C		2
animals	birds	Acrocephalidae	<i>Acrocephalus australis</i>	Australian reed-warbler		C		12
animals	birds	Aegothelidae	<i>Aegotheles cristatus</i>	Australian owl-nightjar		C		3
animals	birds	Alaudidae	<i>Mirafra javanica</i>	Horsfield's bushlark		C		2
animals	birds	Alcedinidae	<i>Ceyx azureus</i>	azure kingfisher		C		13
animals	birds	Alcedinidae	<i>Ceyx pusillus</i>	little kingfisher		C		1
animals	birds	Anatidae	<i>Dendrocygna arcuata</i>	wandering whistling-duck		C		3
animals	birds	Anatidae	<i>Stictonetta naevosa</i>	freckled duck		C		1
animals	birds	Anatidae	<i>Dendrocygna eytoni</i>	plumed whistling-duck		C		4
animals	birds	Anatidae	<i>Chenonetta jubata</i>	Australian wood duck		C		15
animals	birds	Anatidae	<i>Anas superciliosa</i>	Pacific black duck		C		55
animals	birds	Anatidae	<i>Aythya australis</i>	hardhead		C		8
animals	birds	Anatidae	<i>Cygnus atratus</i>	black swan		C		5
animals	birds	Anatidae	<i>Anas gracilis</i>	grey teal		C		23

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Anatidae	<i>Anas castanea</i>	chestnut teal		C		1
animals	birds	Anatidae	<i>Nettapus coromandelianus</i>	cotton pygmy-goose		C		4
animals	birds	Anatidae	<i>Spatula rhynchotis</i>	Australasian shoveler		C		1
animals	birds	Anatidae	<i>Nettapus pulchellus</i>	green pygmy-goose		C		1
animals	birds	Anhingidae	<i>Anhinga novaehollandiae</i>	Australasian darter		C		30
animals	birds	Anseranatidae	<i>Anseranas semipalmata</i>	maggie goose		C		3
animals	birds	Apodidae	<i>Aerodramus terraereginae</i>	Australian swiftlet		C		1
animals	birds	Ardeidae	<i>Egretta novaehollandiae</i>	white-faced heron		C		34
animals	birds	Ardeidae	<i>Nycticorax caledonicus</i>	nankeen night-heron		C		6
animals	birds	Ardeidae	<i>Ixobrychus flavicollis</i>	black bittern		C		2
animals	birds	Ardeidae	<i>Butorides striata</i>	striated heron		C		3
animals	birds	Ardeidae	<i>Egretta garzetta</i>	little egret		C		18
animals	birds	Ardeidae	<i>Ardea intermedia</i>	intermediate egret		C		24
animals	birds	Ardeidae	<i>Ardea pacifica</i>	white-necked heron		C		18
animals	birds	Ardeidae	<i>Bubulcus ibis</i>	cattle egret		C		4
animals	birds	Ardeidae	<i>Ardea alba modesta</i>	eastern great egret		C		40
animals	birds	Artamidae	<i>Artamus superciliosus</i>	white-browed woodswallow		C		2
animals	birds	Artamidae	<i>Artamus leucorhynchus</i>	white-breasted woodswallow		C		16
animals	birds	Artamidae	<i>Cracticus torquatus</i>	grey butcherbird		C		33
animals	birds	Artamidae	<i>Strepera graculina</i>	pieb currawong		C		13
animals	birds	Artamidae	<i>Gymnorhina tibicen</i>	Australian magpie		C		112
animals	birds	Artamidae	<i>Artamus cinereus</i>	black-faced woodswallow		C		19
animals	birds	Artamidae	<i>Artamus minor</i>	little woodswallow		C		5
animals	birds	Artamidae	<i>Cracticus nigrogularis</i>	pieb butcherbird		C		94
animals	birds	Burhinidae	<i>Burhinus grallarius</i>	bush stone-curlew		C		9
animals	birds	Cacatuidae	<i>Calyptorhynchus banksii</i>	red-tailed black-cockatoo		C		54/1
animals	birds	Cacatuidae	<i>Nymphicus hollandicus</i>	cockatiel		C		7
animals	birds	Cacatuidae	<i>Eolophus roseicapilla</i>	galah		C		33
animals	birds	Cacatuidae	<i>Cacatua sanguinea</i>	little corella		C		2
animals	birds	Cacatuidae	<i>Cacatua galerita</i>	sulphur-crested cockatoo		C		54
animals	birds	Campephagidae	<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		C		83
animals	birds	Campephagidae	<i>Coracina tenuirostris</i>	cicadabird		C		3
animals	birds	Campephagidae	<i>Coracina papuensis</i>	white-bellied cuckoo-shrike		C		27
animals	birds	Campephagidae	<i>Lalage leucomela</i>	varied triller		C		6
animals	birds	Campephagidae	<i>Lalage tricolor</i>	white-winged triller		C		12
animals	birds	Caprimulgidae	<i>Caprimulgus macrurus</i>	large-tailed nightjar		C		2
animals	birds	Casuariidae	<i>Dromaius novaehollandiae</i>	emu		C		9
animals	birds	Charadriidae	<i>Elseyornis melanops</i>	black-fronted dotterel		C		22
animals	birds	Charadriidae	<i>Vanellus miles</i>	masked lapwing		C		45
animals	birds	Charadriidae	<i>Vanellus tricolor</i>	banded lapwing		C		1
animals	birds	Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	black-necked stork		C		6
animals	birds	Cisticolidae	<i>Cisticola exilis</i>	golden-headed cisticola		C		6
animals	birds	Columbidae	<i>Phaps chalcoptera</i>	common bronzewing		C		3
animals	birds	Columbidae	<i>Ocyphaps lophotes</i>	crested pigeon		C		78
animals	birds	Columbidae	<i>Geopelia humeralis</i>	bar-shouldered dove		C		13
animals	birds	Columbidae	<i>Chalcophaps indica</i>	emerald dove		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Columbidae	<i>Geophaps scripta</i>	squatter pigeon		C		9
animals	birds	Columbidae	<i>Geopelia striata</i>	peaceful dove		C		103
animals	birds	Columbidae	<i>Geophaps scripta scripta</i>	squatter pigeon (southern subspecies)		V	V	4
animals	birds	Columbidae	<i>Streptopelia chinensis</i>	spotted dove	Y			1
animals	birds	Columbidae	<i>Macropygia amboinensis</i>	brown cuckoo-dove		C		1
animals	birds	Columbidae	<i>Ptilinopus superbus</i>	superb fruit-dove		C		1
animals	birds	Columbidae	<i>Columba livia</i>	rock dove	Y			3
animals	birds	Columbidae	<i>Geopelia cuneata</i>	diamond dove		C		3
animals	birds	Coraciidae	<i>Eurystomus orientalis</i>	dollarbird		C		13
animals	birds	Corcoracidae	<i>Struthidea cinerea</i>	apostlebird		C		55
animals	birds	Corcoracidae	<i>Corcorax melanorhamphos</i>	white-winged chough		C		7
animals	birds	Corvidae	<i>Corvus coronoides</i>	Australian raven		C		32
animals	birds	Corvidae	<i>Corvus bennetti</i>	little crow		C		3
animals	birds	Corvidae	<i>Corvus orru</i>	Torresian crow		C		59
animals	birds	Corvidae	<i>Corvus sp.</i>					4
animals	birds	Cuculidae	<i>Chalcites lucidus</i>	shining bronze-cuckoo		C		2
animals	birds	Cuculidae	<i>Cacomantis pallidus</i>	pallid cuckoo		C		4
animals	birds	Cuculidae	<i>Chalcites minutillus</i>	little bronze-cuckoo		C		5
animals	birds	Cuculidae	<i>Eudynamys orientalis</i>	eastern koel		C		18/1
animals	birds	Cuculidae	<i>Chalcites basal</i>	Horsfield's bronze-cuckoo		C		3
animals	birds	Cuculidae	<i>Chalcites minutillus russatus</i>	Gould's bronze-cuckoo		C		1
animals	birds	Cuculidae	<i>Scythrops novaehollandiae</i>	channel-billed cuckoo		C		19
animals	birds	Cuculidae	<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		C		4
animals	birds	Cuculidae	<i>Centropus phasianinus</i>	pheasant coucal		C		27
animals	birds	Cuculidae	<i>Cacomantis variolosus</i>	brush cuckoo		C		11
animals	birds	Dicruridae	<i>Dicrurus bracteatus</i>	spangled drongo		C		12
animals	birds	Estrildidae	<i>Poephila cincta</i>	black-throated finch		C		1
animals	birds	Estrildidae	<i>Neochmia modesta</i>	plum-headed finch		C		269
animals	birds	Estrildidae	<i>Lonchura punctulata</i>	nutmeg mannikin	Y			18
animals	birds	Estrildidae	<i>Neochmia temporalis</i>	red-browed finch		C		4
animals	birds	Estrildidae	<i>Taeniopygia guttata</i>	zebra finch		C		33
animals	birds	Estrildidae	<i>Taeniopygia bichenovii</i>	double-barred finch		C		84
animals	birds	Estrildidae	<i>Lonchura castaneothorax</i>	chestnut-breasted mannikin		C		3
animals	birds	Eurostopodidae	<i>Eurostopodus argus</i>	spotted nightjar		C		1
animals	birds	Falconidae	<i>Falco berigora</i>	brown falcon		C		9
animals	birds	Falconidae	<i>Falco subniger</i>	black falcon		C		1
animals	birds	Falconidae	<i>Falco longipennis</i>	Australian hobby		C		4
animals	birds	Falconidae	<i>Falco cenchroides</i>	nankeen kestrel		C		26
animals	birds	Falconidae	<i>Falco peregrinus</i>	peregrine falcon		C		2
animals	birds	Gruidae	<i>Antigone rubicunda</i>	broilga		C		16
animals	birds	Gruidae	<i>Antigone antigone</i>	sarus crane		C		1
animals	birds	Halcyonidae	<i>Dacelo leachii</i>	blue-winged kookaburra		C		36
animals	birds	Halcyonidae	<i>Dacelo novaeguineae</i>	laughing kookaburra		C		46
animals	birds	Halcyonidae	<i>Todiramphus sanctus</i>	sacred kingfisher		C		29
animals	birds	Halcyonidae	<i>Todiramphus macleayi</i>	forest kingfisher		C		29
animals	birds	Halcyonidae	<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher		C		7

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Hirundinidae	<i>Hirundo neoxena</i>	welcome swallow		C		6
animals	birds	Hirundinidae	<i>Petrochelidon ariel</i>	fairy martin		C		15
animals	birds	Hirundinidae	<i>Petrochelidon nigricans</i>	tree martin		C		7
animals	birds	Jacanidae	<i>Irediparra gallinacea</i>	comb-crested jacana		C		4
animals	birds	Laridae	<i>Chlidonias hybrida</i>	whiskered tern		C		1
animals	birds	Laridae	<i>Chroicocephalus novaehollandiae</i>	silver gull		C		1
animals	birds	Laridae	<i>Gelochelidon nilotica</i>	gull-billed tern		SL		2
animals	birds	Laridae	<i>Hydroprogne caspia</i>	Caspian tern		SL		7
animals	birds	Maluridae	<i>Malurus leucopterus</i>	white-winged fairy-wren		C		1
animals	birds	Maluridae	<i>Malurus melanocephalus</i>	red-backed fairy-wren		C		41
animals	birds	Megaluridae	<i>Megalurus timoriensis</i>	tawny grassbird		C		2
animals	birds	Megaluridae	<i>Cincloramphus mathewsi</i>	rufous songlark		C		5
animals	birds	Megapodiidae	<i>Alectura lathamii</i>	Australian brush-turkey		C		26
animals	birds	Meliphagidae	<i>Bolemoreus frenatus</i>	bridled honeyeater		C		1
animals	birds	Meliphagidae	<i>Meliphaga notata</i>	yellow-spotted honeyeater		C		3
animals	birds	Meliphagidae	<i>Myzomela obscura</i>	dusky honeyeater		C		2
animals	birds	Meliphagidae	<i>Stomiopera flava</i>	yellow honeyeater		C		34
animals	birds	Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's honeyeater		C		12
animals	birds	Meliphagidae	<i>Ptilotula plumula</i>	grey-fronted honeyeater		C		1
animals	birds	Meliphagidae	<i>Caligavis chrysops</i>	yellow-faced honeyeater		C		1
animals	birds	Meliphagidae	<i>Entomyzon cyanotis</i>	blue-faced honeyeater		C		82
animals	birds	Meliphagidae	<i>Manorina flavigula</i>	yellow-throated miner		C		45/1
animals	birds	Meliphagidae	<i>Meliphaga gracilis</i>	graceful honeyeater		C		3
animals	birds	Meliphagidae	<i>Plectorhyncha lanceolata</i>	striped honeyeater		C		4
animals	birds	Meliphagidae	<i>Gavicalis virescens</i>	singing honeyeater		C		8
animals	birds	Meliphagidae	<i>Philemon buceroides</i>	helmeted friarbird		C		1
animals	birds	Meliphagidae	<i>Lichmera indistincta</i>	brown honeyeater		C		75
animals	birds	Meliphagidae	<i>Melithreptus lunatus</i>	white-naped honeyeater		C		2
animals	birds	Meliphagidae	<i>Philemon argenticeps</i>	silver-crowned friarbird		C		1
animals	birds	Meliphagidae	<i>Ramsayornis modestus</i>	brown-backed honeyeater		C		2
animals	birds	Meliphagidae	<i>Philemon corniculatus</i>	noisy friarbird		C		27
animals	birds	Meliphagidae	<i>Ptilotula penicillata</i>	white-plumed honeyeater		C		1
animals	birds	Meliphagidae	<i>Manorina melanocephala</i>	noisy miner		C		5
animals	birds	Meliphagidae	<i>Myzomela sanguinolenta</i>	scarlet honeyeater		C		5
animals	birds	Meliphagidae	<i>Philemon citreogularis</i>	little friarbird		C		46
animals	birds	Meliphagidae	<i>Conopophila rufogularis</i>	rufous-throated honeyeater		C		8
animals	birds	Meliphagidae	<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater		C		2
animals	birds	Meliphagidae	<i>Melithreptus albogularis</i>	white-throated honeyeater		C		40
animals	birds	Meropidae	<i>Merops ornatus</i>	rainbow bee-eater		C		62
animals	birds	Monarchidae	<i>Arses kaupii</i>	piebald monarch		C		1
animals	birds	Monarchidae	<i>Myiagra alecto</i>	shining flycatcher		C		1
animals	birds	Monarchidae	<i>Myiagra inquieta</i>	restless flycatcher		C		9
animals	birds	Monarchidae	<i>Myiagra rubecula</i>	leaden flycatcher		C		15
animals	birds	Monarchidae	<i>Grallina cyanoleuca</i>	magpie-lark		C		127
animals	birds	Monarchidae	<i>Symposiachrus trivirgatus</i>	spectacled monarch		SL		3
animals	birds	Monarchidae	<i>Machaerirhynchus flaviventer</i>	yellow-breasted boatbill		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian pipit		C		9
animals	birds	Nectariniidae	<i>Dicaeum hirundinaceum</i>	mistletoebird		C		20
animals	birds	Nectariniidae	<i>Cinnyris jugularis</i>	olive-backed sunbird		C		1
animals	birds	Neosittidae	<i>Daphoenositta chrysoptera</i>	varied sittella		C		4
animals	birds	Oriolidae	<i>Oriolus sagittatus</i>	olive-backed oriole		C		27
animals	birds	Oriolidae	<i>Sphecotheres vieilloti</i>	Australasian figbird		C		33
animals	birds	Otididae	<i>Ardeotis australis</i>	Australian bustard		C		12
animals	birds	Pachycephalidae	<i>Pachycephala rufiventris</i>	rufous whistler		C		55
animals	birds	Pachycephalidae	<i>Colluricincla harmonica</i>	grey shrike-thrush		C		7
animals	birds	Pachycephalidae	<i>Colluricincla megarrhyncha</i>	little shrike-thrush		C		3
animals	birds	Pardalotidae	<i>Pardalotus striatus</i>	striated pardalote		C		65
animals	birds	Pardalotidae	<i>Pardalotus rubricatus</i>	red-browed pardalote		C		1
animals	birds	Passeridae	<i>Passer domesticus</i>	house sparrow	Y			26
animals	birds	Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian pelican		C		21
animals	birds	Petroicidae	<i>Microeca fascians</i>	jacky winter		C		2
animals	birds	Petroicidae	<i>Microeca flavigaster</i>	lemon-bellied flycatcher		C		3
animals	birds	Petroicidae	<i>Petroica goodenovii</i>	red-capped robin		C		6
animals	birds	Petroicidae	<i>Poecilodryas superciliosa</i>	white-browed robin		C		2
animals	birds	Petroicidae	<i>Tregellasia capito</i>	pale-yellow robin		C		1
animals	birds	Phalacrocoracidae	<i>Phalacrocorax carbo</i>	great cormorant		C		13
animals	birds	Phalacrocoracidae	<i>Phalacrocorax varius</i>	pied cormorant		C		6
animals	birds	Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	little pied cormorant		C		32
animals	birds	Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	little black cormorant		C		26
animals	birds	Phasianidae	<i>Coturnix ypsilophora</i>	brown quail		C		7
animals	birds	Pittidae	<i>Pitta versicolor</i>	noisy pitta		C		1
animals	birds	Podargidae	<i>Podargus strigoides</i>	tawny frogmouth		C		21
animals	birds	Podicipedidae	<i>Podiceps cristatus</i>	great crested grebe		C		6
animals	birds	Podicipedidae	<i>Poliocephalus poliocephalus</i>	hoary-headed grebe		C		1
animals	birds	Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian grebe		C		23
animals	birds	Pomatostomidae	<i>Pomatostomus temporalis</i>	grey-crowned babbler		C		16
animals	birds	Psittacidae	<i>Trichoglossus chlorolepidotus</i>	scaly-breasted lorikeet		C		3
animals	birds	Psittacidae	<i>Trichoglossus haematodus moluccanus</i>	rainbow lorikeet		C		84
animals	birds	Psittacidae	<i>Platycercus adscitus adscitus</i>	pale-headed rosella (northern form)		C		1
animals	birds	Psittacidae	<i>Aprosmictus erythropterus</i>	red-winged parrot		C		42
animals	birds	Psittacidae	<i>Melopsittacus undulatus</i>	budgerigar		C		1
animals	birds	Psittacidae	<i>Platycercus adscitus</i>	pale-headed rosella		C		73
animals	birds	Ptilonorhynchidae	<i>Ptilonorhynchus nuchalis</i>	great bowerbird		C		59
animals	birds	Ptilonorhynchidae	<i>Ptilonorhynchus maculatus</i>	spotted bowerbird		C		4
animals	birds	Rallidae	<i>Porphyrio melanotus</i>	purple swamphen		C		16
animals	birds	Rallidae	<i>Fulica atra</i>	Eurasian coot		C		4
animals	birds	Rallidae	<i>Porzana pusilla</i>	Baillon's crane		C		1
animals	birds	Rallidae	<i>Gallinula tenebrosa</i>	dusky moorhen		C		23
animals	birds	Recurvirostridae	<i>Recurvirostra novaehollandiae</i>	red-necked avocet		C		2
animals	birds	Recurvirostridae	<i>Himantopus himantopus</i>	black-winged stilt		C		10
animals	birds	Rhipiduridae	<i>Rhipidura rufifrons</i>	rufous fantail		SL		3
animals	birds	Rhipiduridae	<i>Rhipidura leucophrys</i>	willie wagtail		C		112

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Rhipiduridae	<i>Rhipidura rufiventris</i>	northern fantail		C		3
animals	birds	Rhipiduridae	<i>Rhipidura albiscapa</i>	grey fantail		C		50
animals	birds	Rostratulidae	<i>Rostratula australis</i>	Australian painted snipe		E	E	1
animals	birds	Scolopacidae	<i>Tringa brevipes</i>	grey-tailed tattler		SL		1
animals	birds	Scolopacidae	<i>Tringa glareola</i>	wood sandpiper		SL		1
animals	birds	Scolopacidae	<i>Tringa nebularia</i>	common greenshank		SL		2
animals	birds	Scolopacidae	<i>Actitis hypoleucos</i>	common sandpiper		SL		2
animals	birds	Scolopacidae	<i>Tringa stagnatilis</i>	marsh sandpiper		SL		1
animals	birds	Scolopacidae	<i>Gallinago hardwickii</i>	Latham's snipe		SL		2
animals	birds	Strigidae	<i>Ninox connivens</i>	barking owl		C		2
animals	birds	Strigidae	<i>Ninox boobook</i>	southern boobook		C		14
animals	birds	Sturnidae	<i>Acridotheres tristis</i>	common myna	Y			1
animals	birds	Threskiornithidae	<i>Threskiornis molucca</i>	Australian white ibis		C		16
animals	birds	Threskiornithidae	<i>Threskiornis spinicollis</i>	straw-necked ibis		C		53
animals	birds	Threskiornithidae	<i>Platalea regia</i>	royal spoonbill		C		5
animals	birds	Threskiornithidae	<i>Plegadis falcinellus</i>	glossy ibis		SL		1
animals	birds	Threskiornithidae	<i>Platalea flavipes</i>	yellow-billed spoonbill		C		5
animals	birds	Timaliidae	<i>Zosterops lateralis</i>	silveryeye		C		18
animals	birds	Turnicidae	<i>Turnix maculosus</i>	red-backed button-quail		C		1
animals	birds	Turnicidae	<i>Turnix velox</i>	little button-quail		C		1
animals	birds	Tytonidae	<i>Tyto delicatula</i>	eastern barn owl		C		3
animals	malacostracans	Parastacidae	<i>Cherax quadricarinatus</i>	redclaw				1
animals	mammals	Canidae	<i>Canis lupus dingo</i>	dingo				5
animals	mammals	Dasyuridae	<i>Sminthopsis macroura</i>	stripe-faced dunnart		C		1/1
animals	mammals	Emballonuridae	<i>Taphozous troughtoni</i>	Troughton's sheath-tail bat		C		3/1
animals	mammals	Emballonuridae	<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tail bat		C		2/1
animals	mammals	Felidae	<i>Felis catus</i>	cat	Y			8/1
animals	mammals	Leporidae	<i>Oryctolagus cuniculus</i>	rabbit	Y			9
animals	mammals	Macropodidae	<i>Lagorchestes conspicillatus</i>	spectacled hare-wallaby		C		3
animals	mammals	Macropodidae	<i>Petrogale assimilis</i>	allied rock-wallaby		C		6/1
animals	mammals	Macropodidae	<i>Macropus giganteus</i>	eastern grey kangaroo		C		10
animals	mammals	Macropodidae	<i>Macropus robustus</i>	common wallaroo		C		8
animals	mammals	Macropodidae	<i>Macropus dorsalis</i>	black-striped wallaby		C		8
animals	mammals	Macropodidae	<i>Wallabia bicolor</i>	swamp wallaby		C		15
animals	mammals	Macropodidae	<i>Macropus agilis</i>	agile wallaby		C		8
animals	mammals	Macropodidae	<i>Macropus parryi</i>	whiptail wallaby		C		1
animals	mammals	Macropodidae	<i>Macropus rufus</i>	red kangaroo		C		1
animals	mammals	Miniopteridae	<i>Miniopterus schreibersii oceanensis</i>	eastern bent-wing bat		C		2
animals	mammals	Miniopteridae	<i>Miniopterus sp.</i>					1
animals	mammals	Molossidae	<i>Mormopterus ridei</i>	eastern free-tailed bat		C		1
animals	mammals	Molossidae	<i>Chaerephon jobensis</i>	northern freetail bat		C		5/3
animals	mammals	Muridae	<i>Mus musculus</i>	house mouse	Y			4/3
animals	mammals	Muridae	<i>Pseudomys gracilicaudatus</i>	eastern chestnut mouse		C		2
animals	mammals	Muridae	<i>Hydromys chrysogaster</i>	water rat		C		3
animals	mammals	Muridae	<i>Rattus rattus</i>	black rat	Y			1
animals	mammals	Petauridae	<i>Petaurus breviceps</i>	sugar glider		C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Petauridae	<i>Petaurus norfolcensis</i>	squirrel glider		C		2/2
animals	mammals	Phalangeridae	<i>Trichosurus vulpecula</i>	common brushtail possum		C		14
animals	mammals	Phascolarctidae	<i>Phascolarctos cinereus</i>	koala		V	V	4
animals	mammals	Potoroidae	<i>Aepyprymnus rufescens</i>	rufous bettong		C		8
animals	mammals	Pseudocheiridae	<i>Petauroides volans minor</i>	northern greater glider		V	V	5
animals	mammals	Pteropodidae	<i>Nyctimene robinsoni</i>	eastern tube-nosed bat		C		1
animals	mammals	Pteropodidae	<i>Pteropus scapulatus</i>	little red flying-fox		C		5
animals	mammals	Pteropodidae	<i>Pteropus alecto</i>	black flying-fox		C		4
animals	mammals	Suidae	<i>Sus scrofa</i>	pig	Y			4
animals	mammals	Tachyglossidae	<i>Tachyglossus aculeatus</i>	short-beaked echidna		SL		6
animals	mammals	Vespertilionidae	<i>Chalinolobus morio</i>	chocolate wattled bat		C		1
animals	mammals	Vespertilionidae	<i>Nyctophilus bifax</i>	northern long-eared bat		C		1
animals	mammals	Vespertilionidae	<i>Myotis macropus</i>	large-footed myotis		C		1
animals	mammals	Vespertilionidae	<i>Vespadelus sp.</i>					4/3
animals	mammals	Vespertilionidae	<i>Scotorepens greyii</i>	little broad-nosed bat		C		3/2
animals	mammals	Vespertilionidae	<i>Vespadelus pumilus</i>	eastern forest bat		C		1
animals	mammals	Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's wattled bat		C		7/4
animals	mammals	Vespertilionidae	<i>Scoteanax rueppellii</i>	greater broad-nosed bat		C		1
animals	mammals	Vespertilionidae	<i>Chalinolobus nigrogriseus</i>	hoary wattled bat		C		10/5
animals	mammals	Vespertilionidae	<i>Scotorepens balstoni</i>	inland broad-nosed bat		C		6/3
animals	mammals	Vespertilionidae	<i>Scotorepens sanborni</i>	northern broad-nosed bat		C		1
animals	mammals	Vespertilionidae	<i>Vespadelus troughtoni</i>	eastern cave bat		C		1
animals	ray-finned fishes	Ambassidae	<i>Ambassis species</i>	northwest glassfish				3
animals	ray-finned fishes	Ambassidae	<i>Ambassis agrammus</i>	sailfin glassfish				1
animals	ray-finned fishes	Ambassidae	<i>Ambassis sp.</i>					1
animals	ray-finned fishes	Atherinidae	<i>Craterocephalus stercusmuscarum</i>	flyspecked hardyhead				4
animals	ray-finned fishes	Centropomidae	<i>Lates calcarifer</i>	barramundi				88
animals	ray-finned fishes	Cichlidae	<i>Oreochromis mossambica</i>	Mozambique mouthbrooder	Y			49
animals	ray-finned fishes	Clupeidae	<i>Nematalosa erebi</i>	bony bream				187
animals	ray-finned fishes	Eleotridae	<i>Oxyeleotris lineolata</i>	sleepy cod				130
animals	ray-finned fishes	Eleotridae	<i>Hypseleotris compressa</i>	empire gudgeon				1
animals	ray-finned fishes	Eleotridae	<i>Mogurnda mogurnda</i>	northern purplespotted gudgeon				1
animals	ray-finned fishes	Eleotridae	<i>Mogurnda adspersa</i>	southern purplespotted gudgeon				2
animals	ray-finned fishes	Melanotaeniidae	<i>Melanotaenia splendida splendida</i>	eastern rainbowfish				135
animals	ray-finned fishes	Plotosidae	<i>Neosilurus ater</i>	black catfish				9/4
animals	ray-finned fishes	Plotosidae	<i>Tandanus tandanus</i>	freshwater catfish				1
animals	ray-finned fishes	Plotosidae	<i>Neosilurus hyrtlai</i>	Hyrtl's catfish				12/7
animals	ray-finned fishes	Plotosidae	<i>Neosilurus mollespiculum</i>	softspine catfish				2/2
animals	ray-finned fishes	Plotosidae	<i>Porochilus rendahli</i>	Rendahli's catfish				4/4
animals	ray-finned fishes	Terapontidae	<i>Hephaestus fuliginosus</i>	sooty grunter				27
animals	ray-finned fishes	Terapontidae	<i>Leiopotherapon unicolor</i>	spangled perch				21
animals	ray-finned fishes	Terapontidae	<i>Amniataba percoides</i>	barred grunter				9
animals	ray-finned fishes	Terapontidae	<i>Scortum parviceps</i>	smallhead grunter				10/1
animals	ray-finned fishes	Terapontidae	<i>Scortum hillii</i>	leathery grunter				1
animals	ray-finned fishes	Toxotidae	<i>Toxotes chatareus</i>	sevenspot archerfish				6
animals	reptiles	Agamidae	<i>Chlamydosaurus kingii</i>	frilled lizard		C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	reptiles	Agamidae	<i>Diporiphora australis</i>	tommy roundhead		C		10/10
animals	reptiles	Agamidae	<i>Diporiphora nobbi</i>	nobbi		C		1/1
animals	reptiles	Agamidae	<i>Diporiphora sp.</i>					1/1
animals	reptiles	Boidae	<i>Aspidites melanocephalus</i>	black-headed python		C		2/1
animals	reptiles	Boidae	<i>Antaresia maculosa</i>	spotted python		C		6/2
animals	reptiles	Carphodactylidae	<i>Nephrurus asper</i>	spiny knob-tailed gecko		C		5/5
animals	reptiles	Chelidae	<i>Chelodina canni</i>	Cann's longneck turtle		C		1/1
animals	reptiles	Chelidae	<i>Emydura macquarii krefftii</i>	Krefft's river turtle		C		2
animals	reptiles	Colubridae	<i>Tropidonophis mairii</i>	freshwater snake		C		1/1
animals	reptiles	Colubridae	<i>Dendrelaphis punctulatus</i>	green tree snake		C		4/2
animals	reptiles	Diplodactylidae	<i>Lucasium steindachneri</i>	Steindachner's gecko		C		5/3
animals	reptiles	Diplodactylidae	<i>Strophurus williamsi</i>	soft-spined gecko		C		1/1
animals	reptiles	Diplodactylidae	<i>Oedura castelnaui</i>	northern velvet gecko		C		7/7
animals	reptiles	Diplodactylidae	<i>Diplodactylus platyurus</i>	eastern fat-tailed gecko		C		1/1
animals	reptiles	Elapidae	<i>Pseudonaja nuchalis sensu lato</i>	western brown snake		C		1/1
animals	reptiles	Elapidae	<i>Acanthophis antarcticus</i>	common death adder		V		1/1
animals	reptiles	Elapidae	<i>Vermicella annulata</i>	bandy-bandy		C		1/1
animals	reptiles	Elapidae	<i>Pseudonaja textilis</i>	eastern brown snake		C		3
animals	reptiles	Elapidae	<i>Suta suta</i>	myall snake		C		1/1
animals	reptiles	Elapidae	<i>Furina ornata</i>	orange-naped snake		C		3/1
animals	reptiles	Elapidae	<i>Denisonia maculata</i>	ornamental snake		V	V	1/1
animals	reptiles	Gekkonidae	<i>Gehyra dubia</i>	dubious dtella		C		10/8
animals	reptiles	Gekkonidae	<i>Heteronotia binoei</i>	Bynoe's gecko		C		9/5
animals	reptiles	Gekkonidae	<i>Hemidactylus frenatus</i>	house gecko	Y			1
animals	reptiles	Pygopodidae	<i>Lialis burtonis</i>	Burton's legless lizard		C		2/2
animals	reptiles	Scincidae	<i>Liburnascincus mundivensis</i>	outcrop rainbow-skink		C		1
animals	reptiles	Scincidae	<i>Carlia pectoralis sensu lato</i>			C		12/10
animals	reptiles	Scincidae	<i>Cryptoblepharus virgatus sensu lato</i>			C		2/1
animals	reptiles	Scincidae	<i>Carlia sp.</i>					1/1
animals	reptiles	Scincidae	<i>Carlia munda</i>	shaded-litter rainbow-skink		C		1/1
animals	reptiles	Scincidae	<i>Carlia rubigo</i>	orange-flanked rainbow skink		C		2/2
animals	reptiles	Scincidae	<i>Menetia greyii</i>	common dwarf skink		C		7/5
animals	reptiles	Scincidae	<i>Lerista cinerea</i>	vine-thicket fine-lined slider		V		1
animals	reptiles	Scincidae	<i>Egernia striolata</i>	tree skink		C		1/1
animals	reptiles	Scincidae	<i>Ctenotus eutaenius</i>	black-backed yellow-lined ctenotus		C		2/2
animals	reptiles	Scincidae	<i>Ctenotus strauchii</i>	eastern barred wedgesnout ctenotus		C		2/2
animals	reptiles	Scincidae	<i>Tiliqua scincoides</i>	eastern blue-tongued lizard		C		1
animals	reptiles	Scincidae	<i>Glaphyromorphus sp.</i>					1/1
animals	reptiles	Scincidae	<i>Notoscincus ornatus</i>	ornate soil-crevice skink		C		3/2
animals	reptiles	Scincidae	<i>Ctenotus taeniolatus</i>	copper-tailed skink		C		1/1
animals	reptiles	Scincidae	<i>Morethia taeniopleura</i>	fire-tailed skink		C		11/8
animals	reptiles	Scincidae	<i>Cryptoblepharus metallicus</i>	metallic snake-eyed skink		C		7/7
animals	reptiles	Varanidae	<i>Varanus storri</i>	Storr's monitor		C		6/4
animals	reptiles	Varanidae	<i>Varanus scalaris</i>	spotted tree monitor		C		1
animals	reptiles	Varanidae	<i>Varanus tristis</i>	black-tailed monitor		C		1/1
animals	uncertain	Indeterminate	<i>Indeterminate</i>	Unknown or Code Pending		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
bacteria	blue-green algae	Aphanizomenonaceae	<i>Nodularia spumigena</i>			C		1/1
bacteria	blue-green algae	Aphanothecaceae	<i>Aphanothece stagnina</i>			C		1/1
bacteria	blue-green algae	Entophysalidaceae	<i>Entophysalis lemaniae</i>			C		1/1
bacteria	blue-green algae	Microcystaceae	<i>Anacystis montana</i>			C		1/1
bacteria	blue-green algae	Microcystaceae	<i>Anacystis thermalis</i>			C		1/1
bacteria	blue-green algae	Nostocaceae	<i>Anabaena licheniformis</i>			C		2/2
bacteria	blue-green algae	Nostocaceae	<i>Nostoc commune</i>			C		5/5
bacteria	blue-green algae	Oscillatoriaceae	<i>Oscillatoria princeps</i>			C		1/1
bacteria	blue-green algae	Rivulariaceae	<i>Calothrix parietina</i>			C		2/2
fungi	Agaricomycetes	Ganodermataceae	<i>Ganoderma</i>					1/1
fungi	Agaricomycetes	Ganodermataceae	<i>Ganoderma steyaertanum</i>			C		1/1
fungi	lecanoromycetes	Acarosporaceae	<i>Acarospora novae-hollandiae</i>			C		1/1
fungi	lecanoromycetes	Caliciaceae	<i>Dirinaria minuta</i>			C		1/1
fungi	lecanoromycetes	Caliciaceae	<i>Buellia</i>					1/1
fungi	lecanoromycetes	Lecanoraceae	<i>Lecanora</i>					1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Xanthoparmelia amplexula</i>			C		2/2
fungi	lecanoromycetes	Parmeliaceae	<i>Xanthoparmelia furcata</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Xanthoparmelia scabrosa</i>			C		1/1
fungi	lecanoromycetes	Physciaceae	<i>Rinodina moziana</i> var. <i>moziana</i>			C		1/1
plants	Charophyceae	Characeae	<i>Nitella pseudoflabellata</i>			C		1/1
plants	Charophyceae	Characeae	<i>Chara</i>					1/1
plants	Charophyceae	Characeae	<i>Chara fibrosa</i>			C		2/2
plants	Conjugatophyceae	Zygnemataceae	<i>Mougeotia laetevirens</i>			C		1/1
plants	Ulvophyceae	Cladophoraceae	<i>Rhizoclonium hieroglyphicum</i>			C		2/2
plants	green algae	Chaetophoraceae	<i>Stigeoclonium subuligerum</i>			C		1/1
plants	green algae	Chaetophoraceae	<i>Stigeoclonium</i>					1/1
plants	green algae	Hydrodictyaceae	<i>Pediastrum tetras</i>			C		1/1
plants	green algae	Oedogoniaceae	<i>Oedogonium punctatum</i>			C		1/1
plants	green algae	Oedogoniaceae	<i>Oedogonium crassum</i>			C		1/1
plants	green algae	Oedogoniaceae	<i>Bulbochaete monile</i>			C		1/1
plants	land plants	Acanthaceae	<i>Ruellia tuberosa</i>		Y			4/3
plants	land plants	Acanthaceae	<i>Nelsonia campestris</i>			C		3/3
plants	land plants	Acanthaceae	<i>Thunbergia fragrans</i>		Y			1/1
plants	land plants	Acanthaceae	<i>Graptophyllum excelsum</i>			NT		1/1
plants	land plants	Acanthaceae	<i>Hygrophila angustifolia</i>			C		1/1
plants	land plants	Acanthaceae	<i>Pseuderanthemum variabile</i>	pastel flower		C		2/2
plants	land plants	Acanthaceae	<i>Brunoniella acaulis</i> subsp. <i>ciliata</i>			C		1/1
plants	land plants	Acanthaceae	<i>Rostellularia adscendens</i> var. <i>clementii</i>			C		1/1
plants	land plants	Acanthaceae	<i>Rostellularia adscendens</i> var. <i>latifolia</i>			C		3/3
plants	land plants	Agavaceae	<i>Agave vivipara</i> var. <i>vivipara</i>		Y			1/1
plants	land plants	Aizoaceae	<i>Trianthema triquetra</i>	red spinach		C		1/1
plants	land plants	Alismataceae	<i>Caldesia oligococca</i>			C		1/1
plants	land plants	Amaranthaceae	<i>Gomphrena lanata</i>			C		2/2
plants	land plants	Amaranthaceae	<i>Amaranthus hybridus</i>	redshank	Y			1/1
plants	land plants	Amaranthaceae	<i>Amaranthus spinosus</i>	needle burr	Y			1/1
plants	land plants	Amaranthaceae	<i>Gomphrena celosioides</i>	gomphrena weed	Y			2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Amaranthaceae	<i>Deeringia amaranthoides</i>	redberry		C		1/1
plants	land plants	Amaranthaceae	<i>Amaranthus interruptus</i>			C		1/1
plants	land plants	Amaranthaceae	<i>Alternanthera denticulata</i> var. <i>micrantha</i>			C		2/2
plants	land plants	Amaranthaceae	<i>Alternanthera angustifolia</i>			C		3/3
plants	land plants	Amaranthaceae	<i>Amaranthus cochleitepalus</i>			C		1/1
plants	land plants	Amaranthaceae	<i>Alternanthera denticulata</i>	lesser joyweed		C		1
plants	land plants	Anacardiaceae	<i>Pleiogynium timorense</i>	Burdekin plum		C		2/2
plants	land plants	Anacardiaceae	<i>Schinus terebinthifolius</i>		Y			1/1
plants	land plants	Apocynaceae	<i>Parsonsia plaesiophylla</i>			C		1/1
plants	land plants	Apocynaceae	<i>Cryptostegia grandiflora</i>	rubber vine	Y			16/2
plants	land plants	Apocynaceae	<i>Tylophora williamsii</i>	Williams' tylophora		C		1/1
plants	land plants	Apocynaceae	<i>Parsonsia lanceolata</i>	northern silkpod		C		4/4
plants	land plants	Apocynaceae	<i>Marsdenia pleiadenia</i>			C		1/1
plants	land plants	Apocynaceae	<i>Marsdenia microlepis</i>			C		2/2
plants	land plants	Apocynaceae	<i>Wrightia versicolor</i>			C		1/1
plants	land plants	Apocynaceae	<i>Gymnanthera oblonga</i>			C		1/1
plants	land plants	Apocynaceae	<i>Catharanthus roseus</i>	pink periwinkle	Y			2/2
plants	land plants	Apocynaceae	<i>Calotropis gigantea</i>		Y			2/2
plants	land plants	Apocynaceae	<i>Secamone elliptica</i>			C		2/2
plants	land plants	Apocynaceae	<i>Carissa lanceolata</i>			C		1/1
plants	land plants	Apocynaceae	<i>Calotropis procera</i>		Y			3/2
plants	land plants	Apocynaceae	<i>Alyxia ruscifolia</i>			C		3/3
plants	land plants	Apocynaceae	<i>Wrightia saligna</i>			C		1/1
plants	land plants	Apocynaceae	<i>Tylophora erecta</i>			C		1/1
plants	land plants	Apocynaceae	<i>Carissa ovata</i>	currantbush		C		2/2
plants	land plants	Apocynaceae	<i>Cynanchum viminalis</i> subsp. <i>brunonianum</i>			C		1/1
plants	land plants	Asphodelaceae	<i>Aloe vera</i> var. <i>officinalis</i>		Y			1/1
plants	land plants	Asteraceae	<i>Cyanthillium cinereum</i>			C		1/1
plants	land plants	Asteraceae	<i>Streptoglossa adscendens</i>	desert daisy		C		1/1
plants	land plants	Asteraceae	<i>Chrysocephalum apiculatum</i>	yellow buttons		C		1/1
plants	land plants	Asteraceae	<i>Sphaeromorphaea subintegra</i>			C		2/2
plants	land plants	Asteraceae	<i>Apowollastonia spilanthis</i>			C		1/1
plants	land plants	Asteraceae	<i>Thymophylla tenuiloba</i> var. <i>tenuiloba</i>		Y			1/1
plants	land plants	Asteraceae	<i>Acmella grandiflora</i> var. <i>brachyglossa</i>			C		2/2
plants	land plants	Asteraceae	<i>Pterocaulon serrulatum</i> var. <i>serrulatum</i>			C		1/1
plants	land plants	Asteraceae	<i>Chromolaena odorata</i>	Siam weed	Y			1/1
plants	land plants	Asteraceae	<i>Praxelis clematidea</i>		Y			1/1
plants	land plants	Asteraceae	<i>Streptoglossa odora</i>			C		3/3
plants	land plants	Asteraceae	<i>Erigeron bonariensis</i>		Y			1/1
plants	land plants	Asteraceae	<i>Pterocaulon ciliosum</i>			C		1/1
plants	land plants	Asteraceae	<i>Sphaeranthus indicus</i>			C		1/1
plants	land plants	Asteraceae	<i>Xanthium occidentale</i>		Y			1/1
plants	land plants	Asteraceae	<i>Peripleura sericea</i>			C		1/1
plants	land plants	Asteraceae	<i>Blumea tenella</i>			C		1/1
plants	land plants	Asteraceae	<i>Pluchea dentex</i>	bowl daisy		C		1/1
plants	land plants	Asteraceae	<i>Calotis cuneata</i>			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Asteraceae	<i>Pluchea dunlopia</i>			C		1/1
plants	land plants	Asteraceae	<i>Camptacra barbata</i>			C		1/1
plants	land plants	Asteraceae	<i>Eclipta prostrata</i>	white eclipta	Y			1
plants	land plants	Asteraceae	<i>Tridax procumbens</i>	tridax daisy	Y			2/2
plants	land plants	Asteraceae	<i>Calotis cuneifolia</i>	burr daisy		C		1/1
plants	land plants	Asteraceae	<i>Centipeda borealis</i>			C		1/1
plants	land plants	Asteraceae	<i>Verbesina encelioides</i>	crownbeard	Y			1/1
plants	land plants	Asteraceae	<i>Gamochaeta pensylvanica</i>		Y			1/1
plants	land plants	Bignoniaceae	<i>Tecoma stans</i> var. <i>stans</i>		Y			1/1
plants	land plants	Bignoniaceae	<i>Pandorea pandorana</i>	wonga vine		C		1/1
plants	land plants	Bignoniaceae	<i>Tecoma stans</i>	tecoma	Y			1/1
plants	land plants	Bombacaceae	<i>Lagunaria queenslandica</i>			C		6/6
plants	land plants	Boraginaceae	<i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>			C		1/1
plants	land plants	Boraginaceae	<i>Heliotropium ovalifolium</i>			C		4/4
plants	land plants	Boraginaceae	<i>Heliotropium peninsulare</i>			C		2/2
plants	land plants	Boraginaceae	<i>Heliotropium indicum</i>		Y			2/2
plants	land plants	Brassicaceae	<i>Lepidium didymum</i>		Y			1/1
plants	land plants	Brassicaceae	<i>Rorippa eustylis</i>			C		2/2
plants	land plants	Byttneriaceae	<i>Seringia hookeriana</i>			C		1/1
plants	land plants	Byttneriaceae	<i>Melochia pyramidata</i>		Y			1/1
plants	land plants	Cactaceae	<i>Opuntia stricta</i>		Y			1/1
plants	land plants	Cactaceae	<i>Harrisia martinii</i>		Y			1/1
plants	land plants	Cactaceae	<i>Opuntia tomentosa</i>	velvety tree pear	Y			1/1
plants	land plants	Cactaceae	<i>Opuntia monacantha</i>		Y			3/2
plants	land plants	Cactaceae	<i>Opuntia ficus-indica</i>	Indian fig	Y			1
plants	land plants	Caesalpiniaceae	<i>Senna gaudichaudii</i>			C		2/2
plants	land plants	Caesalpiniaceae	<i>Chamaecrista longipes</i>			C		1/1
plants	land plants	Caesalpiniaceae	<i>Parkinsonia aculeata</i>	parkinsonia	Y			3
plants	land plants	Caesalpiniaceae	<i>Lysiphyllum hookeri</i>	Queensland ebony		C		1/1
plants	land plants	Caesalpiniaceae	<i>Senna occidentalis</i>	coffee senna	Y			2/2
plants	land plants	Caesalpiniaceae	<i>Tamarindus indica</i>		Y			1
plants	land plants	Caesalpiniaceae	<i>Senna barclayana</i>			C		1/1
plants	land plants	Caesalpiniaceae	<i>Cassia brewsteri</i>			C		1/1
plants	land plants	Campanulaceae	<i>Wahlenbergia gracilis</i>	sprawling bluebell		C		2/2
plants	land plants	Campanulaceae	<i>Lobelia leucotos</i>			C		1/1
plants	land plants	Campanulaceae	<i>Wahlenbergia graniticola</i>	granite bluebell		C		1/1
plants	land plants	Campanulaceae	<i>Wahlenbergia caryophylloides</i>			C		1/1
plants	land plants	Capparaceae	<i>Capparis shanesiana</i>			C		1/1
plants	land plants	Capparaceae	<i>Capparis lasiantha</i>	nipan		C		5/5
plants	land plants	Capparaceae	<i>Capparis ornans</i>			C		1/1
plants	land plants	Capparaceae	<i>Capparis sepiaria</i>			C		1/1
plants	land plants	Capparaceae	<i>Capparis umbonata</i>			C		1/1
plants	land plants	Celastraceae	<i>Denhamia oleaster</i>			C		1/1
plants	land plants	Celastraceae	<i>Denhamia pittosporoides</i> subsp. <i>angustifolia</i>			C		3/3
plants	land plants	Ceratophyllaceae	<i>Ceratophyllum demersum</i>	hornwort		C		1/1
plants	land plants	Chenopodiaceae	<i>Sclerolaena ramulosa</i>			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Chenopodiaceae	<i>Dysphania pumilio</i>			C		1/1
plants	land plants	Chenopodiaceae	<i>Dysphania ambrosioides</i>		Y			1/1
plants	land plants	Cleomaceae	<i>Cleome gynandra</i>		Y			1/1
plants	land plants	Cleomaceae	<i>Cleome viscosa</i>	tick-weed		C		1/1
plants	land plants	Colchicaceae	<i>Iphigenia indica</i>			C		1/1
plants	land plants	Combretaceae	<i>Terminalia porphyrocarpa</i>			C		1/1
plants	land plants	Commelinaceae	<i>Cyanotis axillaris</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Jacquemontia paniculata</i>			C		2/2
plants	land plants	Convolvulaceae	<i>Ipomoea polymorpha</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Polymeria pusilla</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Distimake quinquefolius</i>		Y			1/1
plants	land plants	Convolvulaceae	<i>Operculina aequisejala</i>			C		2/2
plants	land plants	Convolvulaceae	<i>Polymeria</i> sp. (Greenvale A.R.Bean 18928)			C		1/1
plants	land plants	Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Polymeria</i>					1/1
plants	land plants	Convolvulaceae	<i>Ipomoea nil</i>		Y			1/1
plants	land plants	Convolvulaceae	<i>Ipomoea abrupta</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Ipomoea eriocarpa</i>			C		2/2
plants	land plants	Convolvulaceae	<i>Ipomoea gracilis</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Ipomoea aquatica</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Argyrea nervosa</i>		Y			1/1
plants	land plants	Convolvulaceae	<i>Ipomoea triloba</i>		Y			1/1
plants	land plants	Cucurbitaceae	<i>Diplocyclos palmatus</i> subsp. <i>palmatus</i>			C		2/2
plants	land plants	Cucurbitaceae	<i>Cucumis metuliferus</i>	prickly cucumber	Y			1/1
plants	land plants	Cucurbitaceae	<i>Cucumis althaeoides</i>			C		1/1
plants	land plants	Cucurbitaceae	<i>Sicyos australis</i>	star cucumber		C		1/1
plants	land plants	Cucurbitaceae	<i>Luffa aegyptiaca</i>			C		2/1
plants	land plants	Cucurbitaceae	<i>Cucumis melo</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus exaltatus</i>	tall flatsedge		C		1/1
plants	land plants	Cyperaceae	<i>Cyperus nervulosus</i>			C		3/3
plants	land plants	Cyperaceae	<i>Cyperus squarrosus</i>	bearded flatsedge		C		1/1
plants	land plants	Cyperaceae	<i>Cyperus tenuispica</i>			C		1/1
plants	land plants	Cyperaceae	<i>Eleocharis pallens</i>	pale spikerush		C		1/1
plants	land plants	Cyperaceae	<i>Fuirena incrassata</i>			C		1/1
plants	land plants	Cyperaceae	<i>Bulbostylis barbata</i>			C		3/3
plants	land plants	Cyperaceae	<i>Cyperus brevifolius</i>	Mullumbimby couch	Y			1/1
plants	land plants	Cyperaceae	<i>Cyperus perangustus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Scleria mackaviensis</i>			C		3/3
plants	land plants	Cyperaceae	<i>Cyperus alopecuroides</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-rush		C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis aestivalis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis littoralis</i>			C		2/2
plants	land plants	Cyperaceae	<i>Fimbristylis microcarya</i>			C		4/4
plants	land plants	Cyperaceae	<i>Fimbristylis sieberiana</i>			C		1/1
plants	land plants	Cyperaceae	<i>Lipocarpa microcephala</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis depauperata</i>			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Cyperaceae	<i>Fimbristylis bisumbellata</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus haspan subsp. haspan</i>			C		1/1
plants	land plants	Cyperaceae	<i>Schoenoplectiella praelongata</i>			C		1/1
plants	land plants	Cyperaceae	<i>Schoenoplectiella dissachantha</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus polystachyos var. polystachyos</i>			C		2/1
plants	land plants	Cyperaceae	<i>Cyperus dietrichiae var. brevibracteatus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus microcephalus subsp. microcephalus</i>			C		2/2
plants	land plants	Cyperaceae	<i>Schoenoplectiella lateriflora var. lateriflora</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus iria</i>			C		2/2
plants	land plants	Cyperaceae	<i>Gahnia aspera</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus fulvus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus betchei</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus distans</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus gilesii</i>			C		3/3
plants	land plants	Cyperaceae	<i>Cyperus flavidus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus gracilis</i>			C		4/4
plants	land plants	Cyperaceae	<i>Cyperus pygmaeus</i>	dwarf sedge		C		1
plants	land plants	Cyperaceae	<i>Eleocharis plana</i>	ribbed spikerush		C		2/2
plants	land plants	Cyperaceae	<i>Cyperus aquatilis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus castaneus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus concinnus</i>			C		2/2
plants	land plants	Cyperaceae	<i>Cyperus difformis</i>	rice sedge		C		2/2
plants	land plants	Cyperaceae	<i>Cyperus digitatus</i>			C		2/2
plants	land plants	Dioscoreaceae	<i>Dioscorea transversa</i>	native yam		C		1/1
plants	land plants	Droseraceae	<i>Drosera spatulata var. gympiensis</i>			C		1/1
plants	land plants	Ebenaceae	<i>Diospyros humilis</i>	small-leaved ebony		C		1/1
plants	land plants	Ebenaceae	<i>Diospyros geminata</i>	scaly ebony		C		1/1
plants	land plants	Elatinaceae	<i>Elatine gratioloides</i>	waterwort		C		1/1
plants	land plants	Erythroxylaceae	<i>Erythroxylum australe</i>	cocaine tree		C		2/2
plants	land plants	Euphorbiaceae	<i>Euphorbia hyssopifolia</i>		Y			3/3
plants	land plants	Euphorbiaceae	<i>Jatropha gossypifolia</i>	bellyache bush	Y			7/4
plants	land plants	Euphorbiaceae	<i>Euphorbia papillata var. papillata</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia papillata var. laevicaulis</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia mitchelliana var. mitchelliana</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia papillifolia var. papillifolia</i>			C		2/2
plants	land plants	Euphorbiaceae	<i>Claoxylon tenerifolium subsp. tenerifolium</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia coghlanii</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Croton phebaloides</i>	narrow-leaved croton		C		2/2
plants	land plants	Euphorbiaceae	<i>Croton magneticus</i>			V		2/2
plants	land plants	Euphorbiaceae	<i>Ricinus communis</i>	castor oil bush	Y			7/3
plants	land plants	Euphorbiaceae	<i>Beyeria viscosa</i>			C		1/1
plants	land plants	Fabaceae	<i>Cajanus scarabaeoides var. scarabaeoides</i>			C		1/1
plants	land plants	Fabaceae	<i>Erythrina vespertilio subsp. vespertilio</i>			C		1/1
plants	land plants	Fabaceae	<i>Crotalaria novae-hollandiae subsp. novae-hollandiae</i>			C		6/6
plants	land plants	Fabaceae	<i>Tephrosia astragaloides var. (Belyando Crossing E.J.Thompson+ 139)</i>			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Fabaceae	<i>Vigna</i>					1/1
plants	land plants	Fabaceae	<i>Glycine</i>					4/4
plants	land plants	Fabaceae	<i>Hovea longipes</i>	brush hovea			C	1/1
plants	land plants	Fabaceae	<i>Canavalia rosea</i>	coastal jack bean			C	1/1
plants	land plants	Fabaceae	<i>Cullen cinereum</i>				C	1/1
plants	land plants	Fabaceae	<i>Vigna lanceolata</i>				C	1/1
plants	land plants	Fabaceae	<i>Clitoria ternatea</i>	butterfly pea	Y			2/2
plants	land plants	Fabaceae	<i>Crotalaria juncea</i>	sunhemp	Y			1/1
plants	land plants	Fabaceae	<i>Rhynchosia minima</i>				C	2/2
plants	land plants	Fabaceae	<i>Glycine tomentella</i>	woolly glycine			C	1/1
plants	land plants	Fabaceae	<i>Indigofera colutea</i>	sticky indigo			C	2/2
plants	land plants	Fabaceae	<i>Indigofera linnaei</i>	Birdsville indigo			C	2/2
plants	land plants	Fabaceae	<i>Zornia muelleriana</i>				C	1/1
plants	land plants	Fabaceae	<i>Desmodium tortuosum</i>	Florida beggar-weed	Y			1/1
plants	land plants	Fabaceae	<i>Galactia tenuiflora</i>				C	1/1
plants	land plants	Fabaceae	<i>Tephrosia barbatala</i>				C	2/2
plants	land plants	Fabaceae	<i>Crotalaria goreensis</i>	gambia pea	Y			1/1
plants	land plants	Fabaceae	<i>Crotalaria verrucosa</i>				C	3/3
plants	land plants	Fabaceae	<i>Indigofera linifolia</i>				C	1/1
plants	land plants	Fabaceae	<i>Indigofera tinctoria</i>		Y			2/2
plants	land plants	Fabaceae	<i>Tephrosia leptoclada</i>				C	1/1
plants	land plants	Fabaceae	<i>Tephrosia delestangii</i>				C	1/1
plants	land plants	Fabaceae	<i>Crotalaria laburnifolia</i>		Y			1/1
plants	land plants	Fabaceae	<i>Desmodium campylocaulon</i>				C	1/1
plants	land plants	Fabaceae	<i>Tephrosia astragaloides</i>				C	2/2
plants	land plants	Fabaceae	<i>Alysicarpus bupleurifolius</i>	sweet alys	Y			1/1
plants	land plants	Fabaceae	<i>Macroptilium atropurpureum</i>	siratro	Y			2/2
plants	land plants	Fabaceae	<i>Crotalaria incana</i> subsp. <i>incana</i>		Y			2/2
plants	land plants	Fabaceae	<i>Crotalaria pallida</i> var. <i>obovata</i>		Y			2/2
plants	land plants	Fabaceae	<i>Galactia tenuiflora</i> var. <i>lucida</i>				C	1/1
plants	land plants	Fabaceae	<i>Tephrosia purpurea</i> var. <i>sericea</i>				C	3/3
plants	land plants	Fabaceae	<i>Vigna lanceolata</i> var. <i>lanceolata</i>				C	1/1
plants	land plants	Fabaceae	<i>Galactia tenuiflora</i> forma <i>sericea</i>				C	1/1
plants	land plants	Fabaceae	<i>Zornia muriculata</i> subsp. <i>angustata</i>				C	3/3
plants	land plants	Fabaceae	<i>Zornia muriculata</i> subsp. <i>muriculata</i>				C	1/1
plants	land plants	Fabaceae	<i>Abrus precatorius</i> subsp. <i>precatorius</i>				C	1/1
plants	land plants	Fabaceae	<i>Cajanus reticulatus</i> var. <i>reticulatus</i>				C	1/1
plants	land plants	Fabaceae	<i>Crotalaria medicaginea</i> var. <i>linearis</i>				C	1/1
plants	land plants	Fabaceae	<i>Tephrosia brachyodon</i> var. <i>brachyodon</i>				C	1/1
plants	land plants	Goodeniaceae	<i>Goodenia armitiana</i>				C	1/1
plants	land plants	Goodeniaceae	<i>Goodenia hirsuta</i>				C	1/1
plants	land plants	Haloragaceae	<i>Haloragis heterophylla</i>	rough raspweed			C	1/1
plants	land plants	Hemerocallidaceae	<i>Dianella longifolia</i> var. <i>longifolia</i>				C	1/1
plants	land plants	Hernandiaceae	<i>Gyrocarpus americanus</i> subsp. <i>americanus</i>				C	1/1
plants	land plants	Hernandiaceae	<i>Gyrocarpus americanus</i> subsp. <i>sphenopteris</i>				C	3/3
plants	land plants	Hydrocharitaceae	<i>Vallisneria nana</i>				C	2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Hydrocharitaceae	<i>Hydrocharis dubia</i>	frogbit	Y			2/2
plants	land plants	Lamiaceae	<i>Vitex trifolia</i> var. <i>subtrisetia</i>			C		1/1
plants	land plants	Lamiaceae	<i>Clerodendrum floribundum</i>			C		1/1
plants	land plants	Lamiaceae	<i>Clerodendrum tomentosum</i>			C		1/1
plants	land plants	Lamiaceae	<i>Basilicum polystachyon</i>			C		2/2
plants	land plants	Lamiaceae	<i>Ocimum caryophyllinum</i>			C		1/1
plants	land plants	Lamiaceae	<i>Leucas lavandulifolia</i>		Y			3/3
plants	land plants	Lamiaceae	<i>Glossocarya hemiderma</i>			C		1/1
plants	land plants	Lamiaceae	<i>Ocimum americanum</i>		Y			2/2
plants	land plants	Lamiaceae	<i>Ocimum x africanum</i>		Y			6/6
plants	land plants	Lamiaceae	<i>Teucrium puberulum</i>			C		1/1
plants	land plants	Lamiaceae	<i>Anisomeles moschata</i>			C		1/1
plants	land plants	Lamiaceae	<i>Glossocarya calcicola</i>			C		2/2
plants	land plants	Lamiaceae	<i>Salvia plebeia</i>	common sage		C		1/1
plants	land plants	Laxmanniaceae	<i>Lomandra confertifolia</i> subsp. <i>pallida</i>			C		1/1
plants	land plants	Linderniaceae	<i>Lindernia hyssopoides</i>			C		1/1
plants	land plants	Linderniaceae	<i>Lindernia crustacea</i>			C		1/1
plants	land plants	Lindsaeaceae	<i>Lindsaea obtusa</i>			C		1/1
plants	land plants	Loganiaceae	<i>Mitrasacme prolifera</i>			C		1/1
plants	land plants	Loganiaceae	<i>Strychnos psilosperma</i>	strychnine tree		C		2/2
plants	land plants	Lythraceae	<i>Ammannia multiflora</i>	jerry-jerry		C		4/4
plants	land plants	Lythraceae	<i>Rotala mexicana</i>			C		2/2
plants	land plants	Lythraceae	<i>Ammannia auriculata</i>		Y			1/1
plants	land plants	Malpighiaceae	<i>Stigmaphyllon australiense</i>			C		2/2
plants	land plants	Malvaceae	<i>Sida</i> sp. (Aramac E.J.Thompson+ JER192)			C		1/1
plants	land plants	Malvaceae	<i>Malvastrum americanum</i> var. <i>americanum</i>		Y			3/3
plants	land plants	Malvaceae	<i>Abutilon oxycarpum</i> var. <i>incanum</i>			C		1/1
plants	land plants	Malvaceae	<i>Malvastrum chillagoense</i>			C		3/3
plants	land plants	Malvaceae	<i>Abutilon hannii</i>			C		1/1
plants	land plants	Malvaceae	<i>Sida trichopoda</i>			C		1/1
plants	land plants	Malvaceae	<i>Hibiscus krichauffianus</i>			C		1/1
plants	land plants	Malvaceae	<i>Sida atherophora</i>			C		1/1
plants	land plants	Malvaceae	<i>Abutilon otocarpum</i>			C		2/2
plants	land plants	Malvaceae	<i>Gossypium australe</i>			C		2/2
plants	land plants	Malvaceae	<i>Hibiscus meraukensis</i>	Merauke hibiscus		C		1/1
plants	land plants	Malvaceae	<i>Hibiscus verdcourtii</i>			C		1/1
plants	land plants	Malvaceae	<i>Abelmoschus ficulneus</i>	native rosella		C		1/1
plants	land plants	Malvaceae	<i>Abutilon micropetalum</i>			C		1/1
plants	land plants	Malvaceae	<i>Hibiscus panduriformis</i>			C		1/1
plants	land plants	Malvaceae	<i>Sida</i> sp. (Charters Towers E.J.Thompson+ CHA456)			C		1/1
plants	land plants	Malvaceae	<i>Abutilon auritum</i>	Chinese lantern		C		1/1
plants	land plants	Meliaceae	<i>Owenia acidula</i>	emu apple		C		2/2
plants	land plants	Meliaceae	<i>Turraea pubescens</i>	native honeysuckle		C		3/3
plants	land plants	Menispermaceae	<i>Pleogyne australis</i>	wiry grape		C		3/3
plants	land plants	Mimosaceae	<i>Acacia shirleyi</i>	lancewood		C		3/3
plants	land plants	Mimosaceae	<i>Albizia lebbek</i>	Indian siris		C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Mimosaceae	<i>Acacia lazaridis</i>			C		2/2
plants	land plants	Mimosaceae	<i>Acacia elachantha</i>			C		1/1
plants	land plants	Mimosaceae	<i>Vachellia nilotica</i>	prickly acacia	Y			1
plants	land plants	Mimosaceae	<i>Acacia leptostachya</i>	Townsville wattle		C		1/1
plants	land plants	Mimosaceae	<i>Acacia longispicata</i>			C		1/1
plants	land plants	Mimosaceae	<i>Acacia fasciculifera</i>	scaly bark		C		1/1
plants	land plants	Mimosaceae	<i>Vachellia farnesiana</i>		Y			16
plants	land plants	Mimosaceae	<i>Leucaena leucocephala</i>		Y			1
plants	land plants	Mimosaceae	<i>Desmanthus pernambucanus</i>		Y			1/1
plants	land plants	Mimosaceae	<i>Mimosa pudica</i> var. <i>unijuga</i>		Y			1/1
plants	land plants	Mimosaceae	<i>Acacia excelsa</i> subsp. <i>excelsa</i>			C		1/1
plants	land plants	Mimosaceae	<i>Acacia julifera</i> subsp. <i>julifera</i>			C		1/1
plants	land plants	Mimosaceae	<i>Acacia victoriae</i> subsp. <i>fasciaria</i>			C		1/1
plants	land plants	Mimosaceae	<i>Acacia julifera</i> subsp. <i>gilbertensis</i>			C		1/1
plants	land plants	Mimosaceae	<i>Acacia burrana</i>			C		1/1
plants	land plants	Mimosaceae	<i>Acacia salicina</i>	doolan		C		1/1
plants	land plants	Mimosaceae	<i>Acacia decora</i>	pretty wattle		C		1/1
plants	land plants	Molluginaceae	<i>Mollugo verticillata</i>		Y			2/2
plants	land plants	Molluginaceae	<i>Glinus lotoides</i>	hairy carpet weed		C		2/1
plants	land plants	Molluginaceae	<i>Glinus oppositifolius</i>			C		1/1
plants	land plants	Moraceae	<i>Ficus obliqua</i>			C		1/1
plants	land plants	Moraceae	<i>Ficus henneana</i>			C		1/1
plants	land plants	Moraceae	<i>Ficus rubiginosa</i> forma <i>rubiginosa</i>			C		2/2
plants	land plants	Moraceae	<i>Ficus racemosa</i> var. <i>racemosa</i>			C		1/1
plants	land plants	Moraceae	<i>Ficus virens</i> var. <i>virens</i>			C		2/2
plants	land plants	Myrsinaceae	<i>Myrsine variabilis</i>			C		1/1
plants	land plants	Myrtaceae	<i>Melaleuca trichostachya</i>			C		1/1
plants	land plants	Myrtaceae	<i>Corymbia setosa</i> subsp. <i>pedicellaris</i>			C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus melanophloia</i> subsp. <i>melanophloia</i>			C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus tereticornis</i> subsp. <i>tereticornis</i>			C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved red ironbark		C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus similis</i>	Queensland yellowjacket		C		1/1
plants	land plants	Myrtaceae	<i>Corymbia terminalis</i>			C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus coolabah</i>	coolabah		C		2/2
plants	land plants	Myrtaceae	<i>Eucalyptus shirleyi</i>			C		1/1
plants	land plants	Myrtaceae	<i>Melaleuca viminalis</i>			C		1
plants	land plants	Myrtaceae	<i>Corymbia dallachiana</i>			C		1/1
plants	land plants	Myrtaceae	<i>Corymbia clarksoniana</i>			C		5/5
plants	land plants	Myrtaceae	<i>Eucalyptus persistens</i>			C		5/5
plants	land plants	Myrtaceae	<i>Melaleuca fluviatilis</i>			C		1/1
plants	land plants	Myrtaceae	<i>Melaleuca leucadendra</i>	broad-leaved tea-tree		C		1
plants	land plants	Myrtaceae	<i>Corymbia erythrophloia</i>	variable-barked bloodwood		C		5/5
plants	land plants	Myrtaceae	<i>Eucalyptus platyphylla</i>	poplar gum		C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus raveretiana</i>	black ironbox		C	V	2/2
plants	land plants	Myrtaceae	<i>Eucalyptus xanthoclada</i>	yellow-branched ironbark		C		7/7
plants	land plants	Nyctaginaceae	<i>Boerhavia dominii</i>			C		4/4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Nyctaginaceae	<i>Boerhavia pubescens</i>			C		2/2
plants	land plants	Nymphaeaceae	<i>Nymphaea violacea</i>			C		2/2
plants	land plants	Nymphaeaceae	<i>Nymphaea</i>					1/1
plants	land plants	Nymphaeaceae	<i>Nymphaea macrosperma</i>			C		1/1
plants	land plants	Oleaceae	<i>Notelaea microcarpa</i>			C		2/2
plants	land plants	Oleaceae	<i>Jasminum didymum subsp. racemosum</i>			C		1/1
plants	land plants	Onagraceae	<i>Oenothera speciosa</i>		Y			1/1
plants	land plants	Onagraceae	<i>Ludwigia octovalvis</i>	willow primrose		C		1/1
plants	land plants	Oxalidaceae	<i>Oxalis radicata</i>			C		1/1
plants	land plants	Oxalidaceae	<i>Oxalis debilis var. corymbosa</i>	pink shamrock	Y			1/1
plants	land plants	Papaveraceae	<i>Argemone ochroleuca subsp. ochroleuca</i>	Mexican poppy	Y			1/1
plants	land plants	Passifloraceae	<i>Passiflora foetida</i>		Y			1/1
plants	land plants	Passifloraceae	<i>Passiflora pallida</i>		Y			1/1
plants	land plants	Pentapetaceae	<i>Melhania oblongifolia</i>			C		2/2
plants	land plants	Phyllanthaceae	<i>Phyllanthus collinus</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Bridelia leichhardtii</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Phyllanthus carpentariae</i>			C		4/4
plants	land plants	Phyllanthaceae	<i>Phyllanthus lamprophyllus</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Phyllanthus debilis</i>		Y			1/1
plants	land plants	Phyllanthaceae	<i>Flueggea virosa subsp. melanthesoides</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Breynia oblongifolia</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Phyllanthus novae-hollandiae</i>			C		1/1
plants	land plants	Plantaginaceae	<i>Scoparia dulcis</i>	scoparia	Y			1/1
plants	land plants	Plantaginaceae	<i>Mecardonia procumbens</i>		Y			1/1
plants	land plants	Plumbaginaceae	<i>Plumbago zeylanica</i>	native plumbago		C		1/1
plants	land plants	Poaceae	<i>Enneapogon lindleyanus</i>			C		2/2
plants	land plants	Poaceae	<i>Enneapogon polyphyllus</i>	leafy nineawn		C		2/2
plants	land plants	Poaceae	<i>Eragrostis trichophora</i>		Y			1/1
plants	land plants	Poaceae	<i>Sporobolus pyramidalis</i>		Y			1/1
plants	land plants	Poaceae	<i>Pseudoraphis spinescens</i>	spiny mudgrass		C		1/1
plants	land plants	Poaceae	<i>Sporobolus actinocladus</i>	katoora grass		C		2/2
plants	land plants	Poaceae	<i>Echinochloa telmatophila</i>	swamp barnyard grass		C		1/1
plants	land plants	Poaceae	<i>Paspalidium albobillosum</i>			C		1/1
plants	land plants	Poaceae	<i>Sporobolus australasicus</i>			C		5/5
plants	land plants	Poaceae	<i>Diplachne fusca var. fusca</i>			C		1/1
plants	land plants	Poaceae	<i>Arthrargrostis aristispicula</i>			C		1/1
plants	land plants	Poaceae	<i>Calyptochloa cylindrosperma</i>			C		2/2
plants	land plants	Poaceae	<i>Hyparrhenia rufa subsp. rufa</i>		Y			1/1
plants	land plants	Poaceae	<i>Urochloa gilesii var. gilesii</i>			C		1/1
plants	land plants	Poaceae	<i>Cynodon dactylon var. dactylon</i>		Y			1/1
plants	land plants	Poaceae	<i>Aristida calycina var. calycina</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida calycina var. praealta</i>			C		2/2
plants	land plants	Poaceae	<i>Dinebra decipiens var. asthenes</i>			C		2/2
plants	land plants	Poaceae	<i>Dinebra decipiens var. decipiens</i>			C		1/1
plants	land plants	Poaceae	<i>Hymenachne amplexicaulis 'Olive'</i>		Y			3/3
plants	land plants	Poaceae	<i>Megathyrsus maximus var. maximus</i>		Y			1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	<i>Panicum decompositum</i> var. <i>tenuius</i>			C		1/1
plants	land plants	Poaceae	<i>Chloris divaricata</i> var. <i>divaricata</i>	slender chloris		C		1/1
plants	land plants	Poaceae	<i>Megathyrsus maximus</i> var. <i>pubiglumis</i>		Y			2/2
plants	land plants	Poaceae	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>			C		2/2
plants	land plants	Poaceae	<i>Aristida jerichoensis</i> var. <i>jerichoensis</i>			C		1/1
plants	land plants	Poaceae	<i>Dichanthium sericeum</i> subsp. <i>polystachyum</i>			C		1/1
plants	land plants	Poaceae	<i>Bothriochloa decipiens</i> var. <i>cloncurrrens</i>			C		1/1
plants	land plants	Poaceae	<i>Dimorphochloa</i> sp. (Charters Towers E.J.Thompson+ CHA554)			C		4/4
plants	land plants	Poaceae	<i>Thyridolepis xerophila</i>			C		2/2
plants	land plants	Poaceae	<i>Urochloa mosambicensis</i>	sabi grass	Y			3/3
plants	land plants	Poaceae	<i>Urochloa subquadripara</i>		Y			2/2
plants	land plants	Poaceae	<i>Ancistrachne uncinulata</i>	hooky grass		C		2/2
plants	land plants	Poaceae	<i>Dactyloctenium radulans</i>	button grass		C		1/1
plants	land plants	Poaceae	<i>Eragrostis spartinoides</i>			C		1/1
plants	land plants	Poaceae	<i>Triodia</i>					1/1
plants	land plants	Poaceae	<i>Perotis rara</i>	comet grass		C		1/1
plants	land plants	Poaceae	<i>Melinis repens</i>	red natal grass	Y			2/2
plants	land plants	Poaceae	<i>Chloris inflata</i>	purpletop chloris	Y			3/3
plants	land plants	Poaceae	<i>Eriachne obtusa</i>			C		1/1
plants	land plants	Poaceae	<i>Panicum effusum</i>			C		1/1
plants	land plants	Poaceae	<i>Sehima nervosum</i>			C		1/1
plants	land plants	Poaceae	<i>Cynodon dactylon</i>		Y			1
plants	land plants	Poaceae	<i>Panicum robustum</i>			C		1/1
plants	land plants	Poaceae	<i>Themeda avenacea</i>			C		1/1
plants	land plants	Poaceae	<i>Urochloa reptans</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida muricata</i>			C		1/1
plants	land plants	Poaceae	<i>Astrebula lappacea</i>	curly mitchell grass		C		1/1
plants	land plants	Poaceae	<i>Cenchrus ciliaris</i>		Y			4/4
plants	land plants	Poaceae	<i>Cenchrus setaceus</i>		Y			5/5
plants	land plants	Poaceae	<i>Dichanthium tenue</i>	small bluegrass		C		3/3
plants	land plants	Poaceae	<i>Enneapogon virens</i>			C		3/3
plants	land plants	Poaceae	<i>Paspalidium rarum</i>			C		1/1
plants	land plants	Poaceae	<i>Urochloa pubigera</i>			C		2/2
plants	land plants	Poaceae	<i>Aristida latifolia</i>	feathertop wiregrass		C		2/2
plants	land plants	Poaceae	<i>Aristida lazardis</i>			C		1/1
plants	land plants	Poaceae	<i>Astrebula squarrosa</i>	bull mitchell grass		C		1/1
plants	land plants	Poaceae	<i>Chrysopogon fallax</i>			C		3/3
plants	land plants	Poaceae	<i>Digitaria diminuta</i>			C		1/1
plants	land plants	Poaceae	<i>Echinochloa colona</i>	awnless barnyard grass	Y			2/2
plants	land plants	Poaceae	<i>Eragrostis brownii</i>	Brown's lovegrass		C		1/1
plants	land plants	Poaceae	<i>Aristida burraensis</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida gracilipes</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida perniciososa</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida sciuroides</i>			C		1/1
plants	land plants	Poaceae	<i>Brachyachne tenella</i>			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	<i>Cymbopogon obtectus</i>			C		1/1
plants	land plants	Poaceae	<i>Enneapogon gracilis</i>	slender nineawn		C		2/2
plants	land plants	Poaceae	<i>Eragrostis cumingii</i>			C		1/1
plants	land plants	Poaceae	<i>Eragrostis elongata</i>			C		2/2
plants	land plants	Poaceae	<i>Eragrostis speciosa</i>			C		1/1
plants	land plants	Poaceae	<i>Oxychloris scariosa</i>	winged chloris		C		2/2
plants	land plants	Poaceae	<i>Panicum larcomianum</i>			C		2/1
plants	land plants	Poaceae	<i>Paspalidium gracile</i>	slender panic		C		3/3
plants	land plants	Poaceae	<i>Sporobolus sessilis</i>			C		1/1
plants	land plants	Poaceae	<i>Bothriochloa pertusa</i>		Y			1/1
plants	land plants	Poaceae	<i>Eragrostis lacunaria</i>	purple lovegrass		C		1/1
plants	land plants	Poaceae	<i>Eragrostis schultzei</i>			C		1/1
plants	land plants	Poaceae	<i>Eragrostis tenellula</i>	delicate lovegrass		C		4/4
plants	land plants	Poaceae	<i>Tripogon loliiformis</i>	five minute grass		C		1/1
plants	land plants	Poaceae	<i>Alloteropsis cimicina</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida hygrometrica</i>			C		1/1
plants	land plants	Poaceae	<i>Chionachne cyathopoda</i>	river grass		C		2/2
plants	land plants	Poaceae	<i>Dichanthium aristatum</i>	angleton grass	Y			1/1
plants	land plants	Poaceae	<i>Digitaria breviglumis</i>			C		1/1
plants	land plants	Poaceae	<i>Iseilema vaginiflorum</i>	red flinders grass		C		1/1
plants	land plants	Poaceae	<i>Setaria australiensis</i>	scrub pigeon grass		C		3/3
plants	land plants	Poaceae	<i>Setaria oplismenoides</i>			C		1/1
plants	land plants	Poaceae	<i>Sporobolus natalensis</i>		Y			1/1
plants	land plants	Poaceae	<i>Arundinella nepalensis</i>	reedgrass		C		1/1
plants	land plants	Poaceae	<i>Bothriochloa ewartiana</i>	desert bluegrass		C		3/3
plants	land plants	Poaceae	<i>Brachyachne convergens</i>	common native couch		C		1/1
plants	land plants	Poaceae	<i>Cleistochloa subjuncea</i>			C		2/2
plants	land plants	Polygalaceae	<i>Polygala difficilis</i>			C		1/1
plants	land plants	Polygonaceae	<i>Persicaria lapathifolia</i>	pale knotweed		C		1/1
plants	land plants	Polygonaceae	<i>Persicaria attenuata</i>			C		1
plants	land plants	Polygonaceae	<i>Polygonum plebeium</i>	small knotweed		C		1/1
plants	land plants	Polygonaceae	<i>Duma florulenta</i>			C		2/2
plants	land plants	Pontederiaceae	<i>Monochoria cyanea</i>			C		1/1
plants	land plants	Portulacaceae	<i>Portulaca pilosa</i>		Y			1/1
plants	land plants	Portulacaceae	<i>Portulaca filifolia</i>			C		2/2
plants	land plants	Potamogetonaceae	<i>Potamogeton tepperi</i>			C		1/1
plants	land plants	Potamogetonaceae	<i>Potamogeton octandrus</i>			C		1/1
plants	land plants	Potamogetonaceae	<i>Potamogeton tricarinatus</i>	floating pondweed		C		1/1
plants	land plants	Proteaceae	<i>Grevillea glauca</i>	bushy's clothes peg		C		1/1
plants	land plants	Proteaceae	<i>Grevillea parallela</i>			C		2/2
plants	land plants	Proteaceae	<i>Stenocarpus angustifolius</i>			C		2/2
plants	land plants	Pteridaceae	<i>Cheilanthes sieberi subsp. sieberi</i>			C		1/1
plants	land plants	Pteridaceae	<i>Cheilanthes nudiuscula</i>			C		1/1
plants	land plants	Pteridaceae	<i>Cheilanthes distans</i>	bristly cloak fern		C		2/2
plants	land plants	Pteridaceae	<i>Paraceterach muelleri</i>			C		2/2
plants	land plants	Putranjivaceae	<i>Drypetes deplanchei</i>	grey boxwood		C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Rhamnaceae	<i>Ziziphus mauritiana</i>	Indian jujube	Y			4
plants	land plants	Rubiaceae	<i>Larsenaikia ochreatea</i>			C		1/1
plants	land plants	Rubiaceae	<i>Synaptantha tillaeacea</i> var. <i>tillaeacea</i>			C		1/1
plants	land plants	Rubiaceae	<i>Psydrax forsteri</i>			C		1/1
plants	land plants	Rubiaceae	<i>Psydrax johnsonii</i>			C		2/2
plants	land plants	Rubiaceae	<i>Oldenlandia mitrasacmoides</i> subsp. <i>trachymenoides</i>			C		1/1
plants	land plants	Rubiaceae	<i>Oldenlandia galioides</i>			C		1
plants	land plants	Rubiaceae	<i>Spermacoce brachystema</i>			C		3/3
plants	land plants	Rubiaceae	<i>Everistia vacciniifolia</i> forma <i>crassa</i>			C		1/1
plants	land plants	Rubiaceae	<i>Oldenlandia corymbosa</i> var. <i>corymbosa</i>		Y			1/1
plants	land plants	Rutaceae	<i>Flindersia dissosperma</i>			C		4/4
plants	land plants	Rutaceae	<i>Geijera salicifolia</i>	brush wilga		C		2/2
plants	land plants	Salicaceae	<i>Homalium alnifolium</i>	homalium		C		3/3
plants	land plants	Salviniaceae	<i>Azolla pinnata</i>	ferny azolla		C		1/1
plants	land plants	Santalaceae	<i>Santalum lanceolatum</i>			C		2/2
plants	land plants	Sapindaceae	<i>Alectryon reticulatus</i>	wild quince		C		2/2
plants	land plants	Sapindaceae	<i>Atalaya hemiglaucula</i>			C		1/1
plants	land plants	Sapindaceae	<i>Alectryon oleifolius</i> subsp. <i>elongatus</i>			C		2/2
plants	land plants	Sapindaceae	<i>Atalaya calcicola</i>			C		1/1
plants	land plants	Sapindaceae	<i>Alectryon connatus</i>	grey birds-eye		C		1/1
plants	land plants	Sapindaceae	<i>Alectryon tropicus</i>			C		1/1
plants	land plants	Sapotaceae	<i>Planchonella cotinifolia</i> var. <i>pubescens</i>			C		2/2
plants	land plants	Scrophulariaceae	<i>Eremophila longifolia</i>	berrigan		C		1/1
plants	land plants	Scrophulariaceae	<i>Eremophila maculata</i> subsp. <i>maculata</i>			C		3/3
plants	land plants	Scrophulariaceae	<i>Eremophila mitchellii</i>			C		1/1
plants	land plants	Solanaceae	<i>Solanum ellipticum</i>	potato bush		C		1/1
plants	land plants	Solanaceae	<i>Solanum ferocissimum</i>			C		1/1
plants	land plants	Solanaceae	<i>Physalis lanceifolia</i>		Y			1/1
plants	land plants	Solanaceae	<i>Solanum stelligerum</i>	devil's needles		C		2/2
plants	land plants	Solanaceae	<i>Solanum sporadotrichum</i>			NT		1/1
plants	land plants	Solanaceae	<i>Solanum americanum</i>			C		1/1
plants	land plants	Solanaceae	<i>Solanum galbinum</i>			C		1/1
plants	land plants	Solanaceae	<i>Solanum esuriale</i>	quena		C		1/1
plants	land plants	Solanaceae	<i>Nicotiana glauca</i>	tree tobacco	Y			3/3
plants	land plants	Sparrmanniaceae	<i>Grewia papuana</i>			C		1/1
plants	land plants	Sparrmanniaceae	<i>Grewia latifolia</i>	dysentery plant		C		2/2
plants	land plants	Sparrmanniaceae	<i>Grewia scabrella</i>			C		1/1
plants	land plants	Sparrmanniaceae	<i>Corchorus tridens</i>			C		1/1
plants	land plants	Sparrmanniaceae	<i>Corchorus olitorius</i>	jute		C		1/1
plants	land plants	Sterculiaceae	<i>Sterculia quadrifida</i>	peanut tree		C		1/1
plants	land plants	Tamaricaceae	<i>Tamarix aphylla</i>	athel pine	Y			1/1
plants	land plants	Thymelaeaceae	<i>Pimelea sericostachya</i>			C		4/4
plants	land plants	Urticaceae	<i>Pipturus argenteus</i>	white nettle		C		1/1
plants	land plants	Verbenaceae	<i>Lantana camara</i>	lantana	Y			1/1
plants	land plants	Violaceae	<i>Hybanthus monopetalus</i>			C		1/1
plants	land plants	Vitaceae	<i>Clematicissus opaca</i>			C		4/4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Vitaceae	<i>Cissus cardiophylla</i>			C		2/2
plants	land plants	Vitaceae	<i>Cissus oblonga</i>			C		2/2
plants	land plants	Vitaceae	<i>Cissus reniformis</i>			C		1/1
plants	land plants	Zygophyllaceae	<i>Tribulus</i>					2/2
plants	land plants	Zygophyllaceae	<i>Tribulus micrococcus</i>	yellow vine		C		1/1
plants	land plants	Zygophyllaceae	<i>Tribulopsis pentandra</i>			C		1/1
plants	land plants	Zygophyllaceae	<i>Tribulus terrestris</i>	caltrop		C		1/1
plants	uncertain	Incertae sedis Plantae	<i>Schizothrix mexicana</i>			C		1/1
plants	uncertain	Incertae sedis Plantae	<i>Schizothrix calcicola</i>			C		1/1
plants	uncertain	Indet.	<i>Indet.</i>			C		1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ().

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*. The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

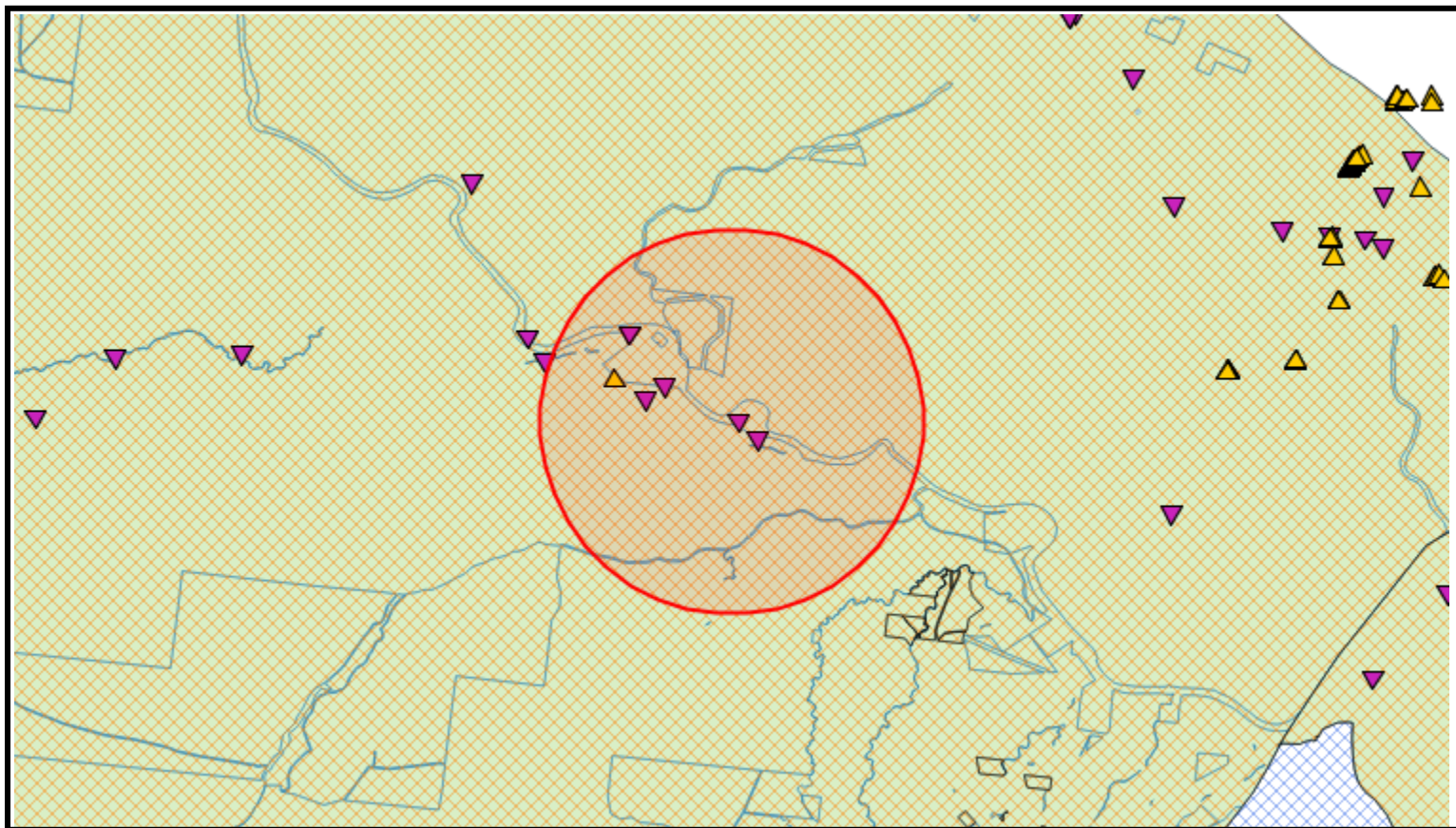
Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).

This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.

This number is output as 999 if it equals or exceeds this value.

Latitude/Longitude Search

Reference Number:	65445
Latitude:	-19.84955
Longitude:	146.12834
Buffer Distance:	10000 metres



Cultural heritage site points for the area are:

Site ID	Latitude	Longitude	Record Date	Attribute	Party
FK:A64	-19.851847	146.132009	Nov 9, 1975	Artefact Scatter	Gudjala People
FK:B02	-19.860929	146.141319	Jul 14, 1990	Artefact Scatter	Gudjala People
FK:B28	-19.841317	146.085589	Nov 29, 1993	Artefact Scatter	Gudjala People
FK:B29	-19.834589	146.095052	Nov 30, 1993	Stone Arrangement(s)	Gudjala People
FK:B30	-19.808746	146.077536	Dec 22, 1993	Stone Arrangement(s)	Gudjala People
FK:B31	-19.808746	146.077536	Dec 22, 1993	Stone Arrangement(s)	Gudjala People

Latitude/Longitude Search

Cultural heritage site points for the area are:

Site ID	Latitude	Longitude	Record Date	Attribute	Party
FK-0070-1	-19.826389	146.07	May 27, 2016	Scarred Tree	Gudjala People

There are no Aboriginal or Torres Strait Islander cultural heritage site polygons recorded in your specific search area.

Cultural heritage party for the area is:

QC Ref Number	QUD Ref Number	Party Name	Contact Details
QCD2014/006 DET	QUD80/2005	Gudjala People	Ngrragoonda Aboriginal Corporation RNTBC Secretary Ms Karleen Kerr PO Box 1545 CHARTERS TOWERS QLD 4820 Phone: (07) 4764 5511 Fax: (07) 4787 9671 Email: ngrragoondaabocorprntbc@outlook.com

Cultural heritage body for the area is:

Name	Contact Details
Ngrragoonda Aboriginal Corporation RNTBC	Ngrragoonda Aboriginal Corporation RNTBC Secretary Ms Karleen Kerr PO Box 1545 CHARTERS TOWERS QLD 4820 Phone: (07) 4764 5511 Fax: (07) 4787 9671 Email: ngrragoondaabocorprntbc@outlook.com
Gudjal Traditional Owners Aboriginal Corporation	Mr Laurie Flinders Kerr Director PO Box 1244 Charters Towers QLD 4820 Phone: (07) 4787 3882 Email: bushl87@yahoo.com

Latitude/Longitude Search

There are no cultural heritage management plans recorded in your specific search area.

There are no Designated Landscape Areas (DLA) recorded in your specific search area.

There are no Registered Cultural Heritage Study Areas in your specific search area.

Regional Coordinator:

Name	Position	Phone	Mobile	Email
Leigh Preston	Cultural Heritage Coordinator North Region	07 4796 7862	0427 142 782	Leigh.Preston@atsip.qld.gov.au

Disclaimer: Department of Aboriginal and Torres Strait Islander Partnerships is the custodian of spatial data provided by various third parties for inclusion in the Aboriginal and Torres Strait Islander cultural heritage online portal. This includes spatial data provided by the National Native Title Tribunal and Aboriginal and Torres Strait Islander parties. Department of Aboriginal and Torres Strait Islander Partnerships is not responsible for the accuracy of information provided by third parties or any errors in this search report arising from such information.

Latitude/Longitude Search

I refer to your submission in which you requested advice regarding Aboriginal or Torres Strait Islander cultural heritage recorded at your nominated location.

The Cultural Heritage Database and Register have been searched in accordance with the location description provided, and the results are set out in the above report.

Aboriginal or Torres Strait Islander cultural heritage which may exist within the search area is protected under the terms of the *Aboriginal Cultural Heritage Act 2003* and the *Torres Strait Islander Cultural Heritage Act 2003*, even if the Department of Aboriginal and Torres Strait Islander Partnerships has no records relating to it.

Under the legislation a person carrying out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal or Torres Strait Islander cultural heritage. This applies whether or not such places are recorded in an official register and whether or not they are located on private land.

Please refer to our website <https://www.datsip.qld.gov.au/people-communities/aboriginal-torres-strait-islander-cultural-heritage> for a copy of the gazetted Cultural Heritage Duty of Care Guidelines, which set out reasonable and practicable measure for meeting the cultural heritage duty of care.

In order to meet your duty of care, any land-use activity within the vicinity of recorded cultural heritage should not proceed without the agreement of the Aboriginal or Torres Strait Islander Party for the area, or by developing a Cultural Heritage Management Plan under Part 7 of the legislation.

If your proposed activity is deemed a Category 5 activity pursuant to the Duty of Care Guidelines, there is generally a high risk that it may harm cultural heritage. In these circumstances, the activity should not proceed without cultural heritage assessment.

Where a category 5 activity is proposed, it is necessary to notify the Aboriginal or Torres Strait Islander Party and seek:

- a. Advice as to whether the area is culturally significant;
- b. If it is, agreement on how best the activity may be managed to avoid or minimise harm to any cultural heritage values.

The extent to which the person has complied with Cultural Heritage Duty of Care Guidelines and the extent the person consulted Aboriginal or Torres Strait Islander Parties about carrying out the activity – and the results of the consultation – are factors a court may consider when determining if a land user has complied with the cultural heritage duty of care.



Latitude/Longitude Search

Should you have any further queries, please do not hesitate to contact the Search Approval Officer on 1300 378 401.

Kind regards

The Director

Cultural Heritage | Community Participation | Department of Aboriginal and Torres Strait Islander Partnerships

Appendix C – Baseline Terrestrial and Aquatic Ecology Assessment – Pre-wet Assessment



Townsville Enterprise Limited

Big Rocks Weir Business Case

Baseline Terrestrial and Aquatic Ecology Assessment

Pre-wet Assessment



June 2020

Abbreviations

Acronym	Abbreviation of
BRW	Big Rocks Weir
Bio Act	<i>Biosecurity Act 2014</i>
CE	Critically Endangered
CEMP	Construction Environmental Management Plan
DAF	Department of Agriculture and Fisheries
DAWE	Department of Agriculture, Water and the Environment
DES	Department of Environment and Science
DIWA	Directory of Important Wetlands in Australia
DNRME	Department of Natural Resources, Mines and Energy
DSITI	Department of Science, Information Technology and Innovation
E	Endangered
EIA	Environmental Impact Assessment
EMP	Operational phase Environmental Management Plan
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FSL	Full supply level
GHD	GHD Pty Ltd
HES	High Ecological Significance
LC	Least Concern
Mig	Migratory
ML	Megalitres
MSES	Matters of State Environmental Significance
NC Act	<i>Nature Conservation Act 1992</i>
NL	Not Listed
NT	Near Threatened
NSD	Northern saddle dam
PMST	Protected Matters Search Tool
QWQG	Queensland Water Quality Guide
RE	Regional Ecosystems
SAT	Spot Assessment Technique
SSD	Southern saddle dam
SIE	Social Impact Evaluation
SMP	Species Management Plan
SPP	State Planning Policy
TECs	Threatened Ecological Communities
TEL	Townsville Enterprise Limited
V	Vulnerable
VMA	<i>Vegetation Management Act 1999</i>
WO	Wildlife Online
WoNS	Weeds of National Significance

Table of contents

1.	Introduction	1
1.1	Overview	1
1.2	Purpose of this report.....	2
1.3	Scope and limitations.....	2
1.4	Assumptions and limitations	3
1.5	Definitions	3
2.	Methodology.....	5
2.1	Approach.....	5
2.2	Desktop assessment.....	5
2.3	Field assessment.....	6
2.4	Likelihood of occurrence	13
3.	Desktop assessment results	14
3.1	Ecological communities	14
3.2	Flora	16
3.3	Fauna.....	16
3.4	Essential habitat.....	18
3.5	State-significant bioregional wildlife corridor	18
3.6	Biosecurity species	19
3.7	Wetlands and watercourses	21
4.	Field survey results	23
4.1	Terrestrial flora	23
4.2	Terrestrial fauna.....	30
4.3	Aquatic environment	38
5.	Likelihood of occurrence	47
5.1	Threatened flora and fauna species	47
5.2	Migratory species.....	48
6.	Conservation significant species.....	49
6.1	Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>).....	49
6.2	Greater glider (northern) (<i>Petauroides volans minor</i>).....	49
6.3	Koala (<i>Phascolarctos cinereus</i>)	50
6.4	Glossy ibis (<i>Plegadis falcinellus</i>) – confirmed present	50
7.	Potential impacts and mitigation measures	52
7.1	Overview	52
7.2	Construction phase.....	52
7.3	Operational phase.....	57
8.	Significance of impacts assessment	66
8.1	Overview	66
8.2	Significance of impact on conservation significant species.....	66

9.	Summary	77
10.	References	79

Table index

Table 2-1	Location of sites sampled as part of the pre-wet aquatic survey	9
Table 2-2	River bioassessment program: habitat assessment score criteria	10
Table 2-3	Likelihood of occurrence criteria	13
Table 3-1	Regional ecosystem descriptions	14
Table 3-2	Conservation significant flora species predicted to occur within the study area	16
Table 3-3	Threatened fauna species predicted to occur within the study area	17
Table 3-4	Migratory species predicted to occur within the study area	18
Table 4-1	Regional ecosystems considered present within the study area	24
Table 4-2	Weed species and general distribution	28
Table 4-3	Habitat types observed within the study area	31
Table 4-4	Pest animal species recorded within the study area	37
Table 4-5	Habitat scores for the pre-wet aquatic survey	41
Table 4-6	In-situ water quality during the pre-wet survey	42
Table 4-7	Abundance of fish species caught during the pre-wet survey	44
Table 4-8	Abundance of turtle species caught during the pre-wet survey	44
Table 5-1	Threatened flora and fauna species likelihood of occurrence	47
Table 5-2	Migratory species likelihood of occurrence	48
Table 8-1	Significance of impact on the squatter pigeon (southern)	67
Table 8-2	Significance of impact on the greater glider (northern)	69
Table 8-3	Assessment of koala habitat using the habitat assessment tool	71
Table 8-4	Assessment of additional factors	72
Table 8-5	Potential impacts on the recovery of the koala	73
Table 8-6	Significance of impact on the koala	74
Table 8-7	Significance impact on migratory species	75

Figure index

Figure 1-1	Locality of the project footprint and study area	4
Figure 2-1	Distribution of survey effort	12
Figure 3-1	DNRME regional ecosystem mapping	15
Figure 3-2	Essential habitat and significant bioregional wildlife corridors	20

Figure 3-3 Wetlands and watercourses22

Figure 4-1 Habitat types identified within the study area35

Appendices

Appendix A – Terrestrial fauna survey results

Appendix B – Likelihood of occurrence

1. Introduction

1.1 Overview

Townsville Enterprise Limited (TEL) is preparing a business case for Big Rocks Weir (BRW). The business case is being undertaken via a tripartite agreement between the Australian Government (North Queensland Water Infrastructure Authority), Queensland Government (Department of Natural Resources, Mines and Energy (DNRME)) and TEL. The business case is supported by funding from the Australian Government National Water Infrastructure Development Fund, an initiative of the Northern Australia and Agricultural Competitiveness White Papers.

The business case is being prepared by KPMG for TEL and will assess the viability of BRW considering a range of information including but not limited to:

- Engineering reference design
- Design quantities and cost estimates
- Asset operation and maintenance schedules
- Land acquisition
- Economic demand modelling
- Cost benefit analysis
- Regulatory approval requirements
- Environmental impact assessment (EIA) outcomes
- Social impact evaluation (SIE) outcomes
- Liaison with project stakeholders.

GHD Pty Ltd (GHD) will be providing technical inputs into the business case with regards to the engineering design, capital cost estimates, regulatory approvals pathway, EIA and SIE.

1.1.1 Big Rocks Weir

“Big Rocks” is located on the Burdekin River approximately 26 km north of Charters Towers and 23 km upstream of the existing Charters Towers Weir. The construction of a weir at Big Rocks has been considered previously, as part of separate studies such as the Hells Gates Feasibility Study (SMEC 2018), BRW Concept Plan (GHD 2015) and BRW Preliminary Design Report (McIntyre and Associates 1994). The general concept for BRW is for the construction of a new weir on the Burdekin River with a storage capacity of around 10,000 megalitres (ML).

The objectives of BRW are to provide a new water source that provides additional supply security for the township of Charters Towers and supports the further development of existing irrigated agriculture occurring in the region. The extent and reliability of the water supply provided by BRW is to be determined as part of the business case and will be subject to a range of regulatory, economic and environmental factors.

There will also be an upgrade to the existing 4WD access track to Big Bend recreational reserve through the construction of a concrete floodway and culverts. This will provide ongoing public access following construction of the weir.

1.2 Purpose of this report

This report details the methods and results of the baseline ecological survey undertaken in December 2019, to document the existing terrestrial and aquatic environment that has the potential to be impacted by construction and/or operation of BRW. The scope of this work included:

- A desktop review of the ecological values of the study area, including Protected Matters searches, Wildlife Online and other historical databases, and review of Regional Ecosystem mapping, essential habitat mapping and other government spatial data layers.
- Terrestrial and aquatic field surveys within the study area to provide baseline information on the existing environment, including characterisation of vegetation communities, terrestrial habitats, aquatic habitats, and existing flora and fauna communities. Surveys included targeted methods for conservation significant species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Queensland *Nature Conservation Act 1992* (NC Act).
- Assessment of the likelihood of occurrence of Matters of National, State and Local Environmental Significance, including threatened ecological communities, protected areas and conservation significant species.
- Assessment of potential impacts and recommendations for potential mitigation measures to avoid or minimise the magnitude, duration, severity and significance of the projects construction and operation phase.

For the purposes of this report, the project footprint refers to areas of potential impact from the project including construction footprint for the weir, proposed inundation area upstream of the weir and the downstream environment that may be impacted by changes in flow regime. Assessment of the Big Bend floodway will occur during the post-wet survey.

The study area, as mapped in Figure 1-1, refers to the area over which the ecological values of the area were investigated.

1.3 Scope and limitations

This report has been prepared by GHD for TEL and may only be used and relied on by TEL for the purpose agreed between GHD and the TEL as set out in this report. GHD otherwise disclaims responsibility to any person other than TEL arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by TEL and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific survey sites. Survey conditions at other parts of the site may be different from the site conditions found at the specific survey sites.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as land access, geographical constraints and vegetation. As a result, not all relevant site features and conditions may have been identified in this report. Site conditions (including the presence of flora and fauna populations) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to site conditions. GHD is also not responsible for updating this report if site conditions change.

1.4 Assumptions and limitations

This report should be read with respect to the following:

- Access was not available to all areas within the study area during the field survey. The ecological values of areas that were unable to be accessed has been based on desktop assessments results and ground-truthing of environmental conditions within the broader study area.
- The assessment presents results from one seasonal survey, undertaken in the dry season conditions in December 2019. The presence and detectability of terrestrial and aquatic flora and fauna species during field assessments is strongly influenced by seasonality and therefore survey results have been interpreted with consideration of this potential variability.
- The impact assessment presented in this report is based on the draft BRW reference design and potential operating scenarios.

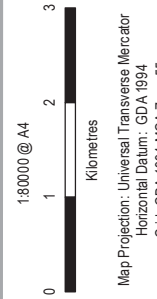
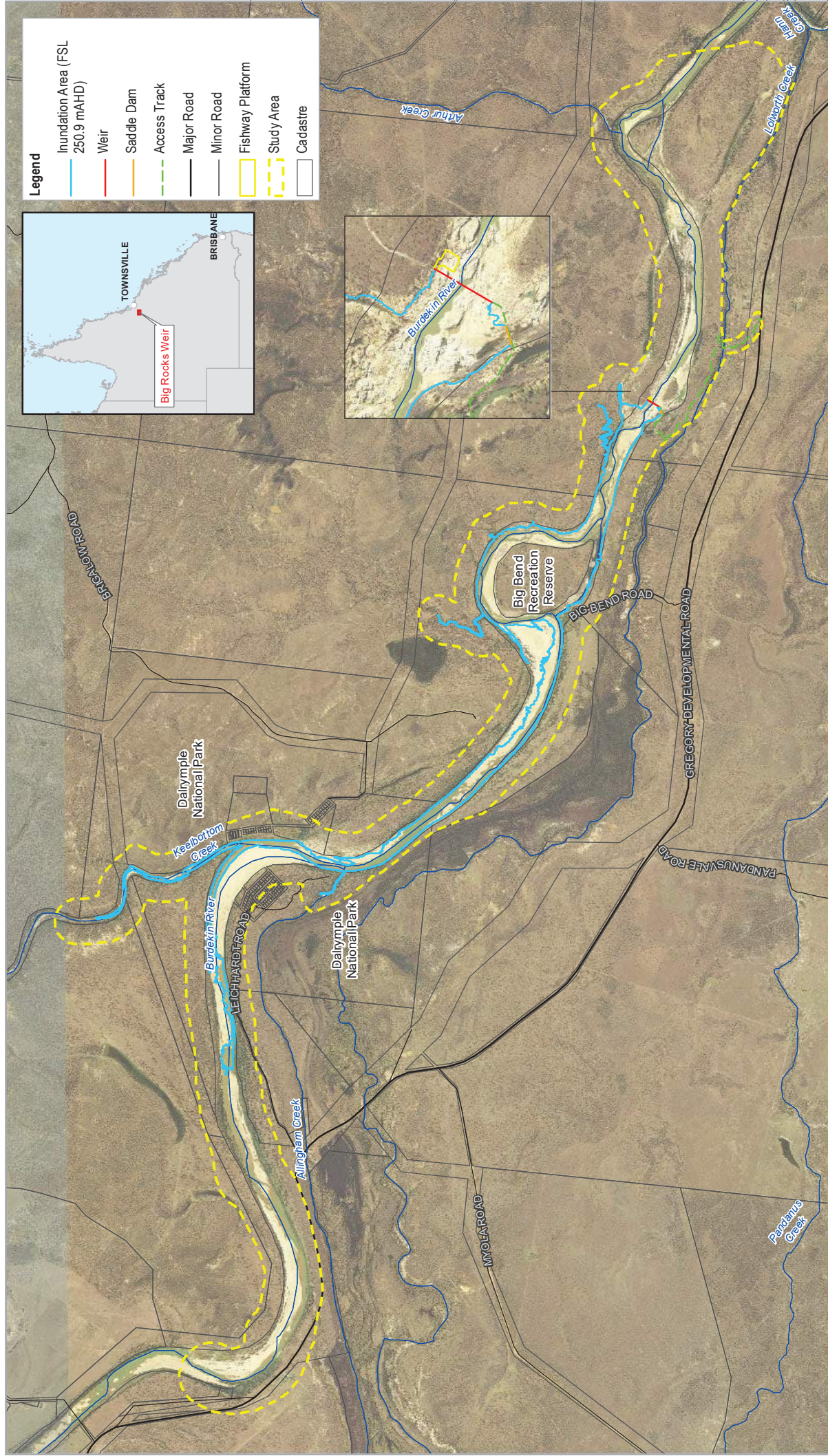
Due to these limitations the assessment of ecological values within the study area and associated assessment of potential impacts from the project has adopted a precautionary approach. It is recommended that additional field surveys are conducted following the wet season to further inform likelihood of occurrence assessments (refer to Section 9).

Reassessment of potential impacts will also be required following results of the wet season field surveys and further development of the project reference design.

1.5 Definitions

The following are key descriptors used throughout this report:

- Desktop search extent – This refers to the environment within and adjacent to the inundation area that was subject to desktop ecological assessment. This included areas within a 30 km radius of the approximate centre of the inundation area.
- Project footprint – This represents areas subject to direct impact, including the proposed inundation area, weir structures (Big Rocks weir, northern saddle dam (NSD) and southern saddle dam (SSD)).
- Study area – This refers to the area that has been subject to field survey as indicated in Figure 1-1. The extent of the study area was selected to assess environmental values of the areas within the vicinity of the project footprint.
- Conservation significant species – This term refers to species listed as critically endangered, endangered, vulnerable, or migratory under the EPBC Act as well as species listed as endangered, vulnerable or near threatened under the NC Act.



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 24/06/2020

Locality of the project footprint and study area

FIGURE 1-1

2. Methodology

2.1 Approach

The baseline assessment of terrestrial and aquatic ecological values within the study area employed a combination of desktop review of environmental databases and relevant mapping layers, and an ecological field assessment combining survey of terrestrial flora, fauna, and aquatic ecological values.

2.2 Desktop assessment

A desktop review was undertaken to identify and collate existing information on the ecological values of the environment within the study area and surrounding landscape. For most sources, the desktop search extent encompassed areas within a 30 km radius of the approximate centre of the study area on 1 November 2019. This was undertaken to provide context about potential presence of mobile species or cryptic species that are known to occur in similar habitat within the region. Details of database searches are included below.

Protected Matters Search Tool

The Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) was used to identify conservation significant flora and fauna species and threatened ecological communities (TECs) listed under the EPBC Act that have the potential to occur within the vicinity of the study area.

Wildlife Online database

The Department of Environment and Science (DES) Wildlife Online database was searched to retrieve historical records of flora and fauna species previously recorded within the vicinity of the study area.

Species Profile Search database

The DES Species Profile Search was undertaken to obtain spatial data records for conservation significant flora and fauna species including those responsible for generating high risk trigger areas and essential habitat intersecting the study area. The search was also undertaken to gain an understanding of the location and collection date of any conservation significant flora and fauna records in proximity to the study area.

Atlas of Living Australia database

The Atlas of Living Australia database was searched to retrieve historical records of flora and fauna species previously observed within the vicinity of the study area.

Biomaps

The Department of Science, Information Technology and Innovation (DSITI) Biomaps mapping tool was used to review specific locations, collection date and details of records of species of conservation significance within the study area.

Regulated Vegetation Mapping

The DNRME Vegetation Management Regional Ecosystem (RE) and Remnant Map spatial layer (version 11) was viewed to determine the extent and type of REs mapped within the study area.

Essential Habitat Mapping

The DES Essential Habitat Map spatial layer (version 6.13) was viewed to determine if vegetation within the study area has been identified as essential habitat for any conservation significant species listed under provisions of the NC Act.

Protected Plants Flora Survey Trigger Map

The DES Protected Plants Flora Trigger Map spatial layer (version 7.1) was viewed to identify whether the vegetation within the study area was in proximity to a record of a conservation significant flora species.

State Planning Policy Mapping

State Planning Policy (SPP) mapping was reviewed to identify Matters of State Environmental Significance (MSES) that occur within or adjacent to the study area. This mapping assists with the understanding of key areas of value to State matters.

Waterway Barriers

Queensland Waterways for Barrier Works spatial layer was used to determine the risk to aquatic environmental values from the construction of waterway barriers including weirs and dams. This layer also informs the need for a development application.

Stream Order

A spatial layer which identifies the stream order of a waterway. The higher the stream order the more major the waterway is as this indicates the level of water input from the catchment at that point.

Wetland Info

The DES website for water management resources which provides information on aquatic environments including but not limited to flora and fauna species, wetlands and catchments.

2.3 Field assessment

2.3.1 Overview

Terrestrial flora and fauna surveys were undertaken by terrestrial ecologist Shannon Blatchford. Shannon has a Bachelor of Science in Ecology and Conservation Biology with 12 years' experience in environmental management and ecological assessments. Aquatic surveys were undertaken by senior aquatic ecologist Lauren Pratt. Lauren has a Bachelor of Marine Studies in Marine Biology and Ecology with Honours, and has 11 years' experience in aquatic ecosystem monitoring.

Field surveys were undertaken in summer over six days from 9 to 14 December 2019. Weather conditions during the field survey were dry and warm. During the field survey, the minimum daily temperatures ranged from 19.3 to 24 °C, with maximum ranging from 36.1 to 40.9 °C (BoM 2019). September, October and November were dry, with a total of 13.2 mm of rain during this period (BoM 2019).

The survey involved assessments undertaken at representative locations throughout the study area. The methods used are detailed in Sections 2.3.2, 2.3.3 and 2.3.4. The assessments were designed to ground truth results of the desktop assessment and identify key areas and/or ecological values for detailed assessment during the post-wet season surveys. Where access restricted field surveys within the direct project footprint, representative sites were selected in the broader study area.

2.3.2 Vegetation and flora assessments

Vegetation and flora assessments were undertaken at 46 sites within the study area. The methodology adopted for the respective components of the assessments is described in the below sections.

Threatened Ecological Communities

The structural and composition characteristics of vegetation communities across the study area were compared with DAWEs approved conservation advice of TECs to assess whether any vegetation communities present met the requirements necessary to constitute a TEC.

Regional Ecosystems

Verification of REs accessed during the surveys was undertaken using a combination of Quaternary level assessments and informal observations (as described in Neldner *et al.* 2019). Data and observations were collected on the structural and floristic composition of vegetation communities to determine the RE type, some discrepancies in RE boundaries were also noted.

Conservation significant flora species

Targeted searches for conservation significant flora species were undertaken within areas of suitable habitat identified within the study area.

Weeds

Opportunistic observations of introduced flora species listed under the *Biosecurity Act 2014* (Bio Act) were also undertaken. Throughout this report, an asterisk (*) is used to identify species that are listed as introduced (i.e. exotic) pursuant to the Queensland *Nature Conservation (Wildlife Regulation) 2006*.

2.3.3 Terrestrial fauna assessments

Fauna surveys involved a combination of habitat assessments and rapid survey techniques for fauna species. Assessments were undertaken at 27 sites across the study area. At each site, the survey methods described in the below sections were undertaken.

Habitat assessments

At each site shown in Figure 2-1, habitat assessments were undertaken to document the value of habitats for birds, mammals, reptiles and amphibians. This was based on the presence of key resources and microhabitats as determined by the structural complexity of vegetation and the presence of features such as tree hollows, burrows, rocky outcrops, caves, leaf litter and woody debris. Key habitat features important for conservation significant species were recorded.

Targeted searches for traces of threatened species

Within suitable habitat, targeted searches were undertaken to detect characteristic traces of threatened wildlife including communal burrowing sites of the yakka skink (*Egernia rugosa*), latrine sites of the northern quoll (*Dasyurus hallucatus*), and nest sites of the red goshawk (*Erythrotriorchis radiatus*) and southern black-throated finch (*Poephila cincta cincta*).

Bird census

Area-based bird surveys were undertaken in accordance with the Birds Australia census technique (i.e. recording all birds seen or heard in a 2 ha area within a 20-minute period). This survey technique targeted a number of conservation significant bird species that have the potential to occur in the study area, including the squatter pigeon (southern) (*Geophaps scripta*

scripta), Australian painted snipe (*Rostratula australis*), red goshawk, star finch (eastern) (*Neochmia ruficauda*) and southern black-throated finch.

Active searches for reptiles and frogs

A 20-minute active search was undertaken to detect reptile and amphibian species by actively searching beneath rocks, logs, bark, leaf litter and other suitable microhabitats. Species targeted included the yakka skink, ornamental snake (*Denisonia maculata*), common death adder (*Acanthophis antarcticus*) and vine-thicket fine-lined slider (*Lerista cinerea*).

Nocturnal active searches and spotlighting

Nocturnal active searches were undertaken in key habitats where there was reason to suspect threatened mammal or reptile species may occur. Species targeted included the greater glider (northern) (*Petauroides volans minor*), koala (*Phascolarctos cinereus*), northern quoll, masked owl (northern) (*Tyto novaehollandiae kimberli*) and ornamental snake. One night of spotlighting was undertaken.

Spot Assessment Technique

The Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) was used to survey for koala faecal pellets in any areas of potentially suitable habitat. Based on the results, assessments of habitat quality were undertaken using the koala habitat assessment toolkit detailed in the EPBC Act Referral guidelines for the vulnerable koala.

Driving / flushing surveys

Driving / flushing surveys were undertaken to detect the squatter pigeon (southern) and other small ground-dwelling birds.

Opportunistic searches for wildlife and traces

All incidental records of fauna observed during surveys were recorded. Bones, feathers, skulls, sloughed skins, faecal pellets, tracks, burrows, scratchings and other indirect wildlife traces were also recorded.

Deployment of remote surveillance cameras

Remote surveillance cameras (refer to Plate 2-1) were baited and set at three locations, shown in Figure 2-1. The remote cameras were deployed in representative habitat types to target conservation significant species, such as the northern quoll, yakka skink and southern black-throated finch.

Deployment of anabat detector

An anabat detector (refer to Plate 2-1) was used to record the echolocations of microbat species. The anabats was deployed at two locations as shown in Figure 2-1, and was left overnight in suitable flyways. Recorded calls were sent to specialist sub-consultant Greg Ford for analysis.



Plate 2-1 Anabat detector (left) and remote surveillance camera (right) deployed within the study area

2.3.4 Aquatic assessment

There were eight pre-wet aquatic assessment survey locations (Table 2-1), these included:

- One site upstream of the proposed weir storage area (US3)
- Two sites within the proposed weir storage area (W1 and W3)
- Two sites at the proposed weir site (BRW – weir wall and SSD)
- Two sites downstream of the proposed weir (DS1 and DS3)
- One site on Lolworth Creek (LC) which may require modification to enable access during weir construction.

Five sites (two upstream - US1, US2; one within the proposed weir storage area W2; one at the NSD; and one downstream of the proposed weir DS2) could not be accessed during the pre-wet survey due to landholder permissions. Fauna surveys at sites BRW, SSD and US3 were by observation only due to limited access for equipment.

Table 2-1 Location of sites sampled as part of the pre-wet aquatic survey

Site	Location	Latitude #	Longitude #
US3	Keelbottom Creek; approximately 14.2 km upstream of the proposed weir wall	-19.79149	146.09656
W1	Burdekin River; approximately 11.5 km upstream of the proposed weir wall	-19.81406	146.09916
W3	Burdekin River; approximately 2.4 km upstream of the proposed weir wall	-19.85520	146.14478
BRW	Burdekin River; at the proposed weir wall	-19.86435	146.16541
SSD	Burdekin River; SSD	-19.86510	146.16378
DS1	Burdekin River; approximately 1.7 km downstream of the proposed weir wall	-19.86993	146.18078
DS3 ^	Burdekin River; approximately 2.7 km downstream of the proposed weir wall	-19.86946	146.19095
LC	Lolworth Creek; approximately 6.1 km upstream of the confluence with the Burdekin River and proposed creek crossing location during construction	-19.87383	146.17241

Datum: GDA94

^ fish and turtle surveys for this site was conducted at latitude -19.86760, longitude 146.20972

Habitat assessments

Habitat assessments were undertaken at eight sites to describe the presence and condition of key aquatic habitat features and overall condition of each site. The assessments were conducted in accordance with the Queensland AusRivAS Sampling and Processing Manual (DNRM 2001) and the Department of Environment and Science's Monitoring and Sampling Manual 2009. Photographs of each site were taken as an additional record of habitat conditions at the time of the monitoring event. An overall condition score was calculated using the data collected for each site (Table 2-2). These scores were then compared between sites to identify patterns within the data and provide an ecologically relevant interpretation of the results.

Table 2-2 River bioassessment program: habitat assessment score criteria

Habitat variable	Poor	Fair	Good	Excellent
Bottom substrate	0 - 5	6 - 10	11 - 15	16 - 20
Embeddedness	0 - 5	6 - 10	11 - 15	16 - 20
Velocity and depth category	0 - 5	6 - 10	11 - 15	16 - 20
Channel alteration	0 - 3	4 - 7	8 - 11	12 - 15
Bottom scouring and deposition	0 - 3	4 - 7	8 - 11	12 - 15
Pool/riffle, run/bend ratio	0 - 3	4 - 7	8 - 11	12 - 15
Bank stability	0 - 2	3 - 5	6 - 8	9 - 10
Bank vegetation and stability	0 - 2	3 - 5	6 - 8	9 - 10
Streamside cover	0 - 2	3 - 5	6 - 8	9 - 10
Total	0 - 38	39 - 74	75 - 110	111 - 135

Source: Department of Natural Resources and Mines (2001)

In-situ water quality

In-situ water quality data was collected at eight sites. *In-situ* water quality measurements were recorded at the surface (0.3 m depth) using a calibrated water quality meter, and measurements included:

- Water temperature (°C)
- pH (pH units)
- Electrical conductivity (µS/cm)
- Dissolved oxygen (mg/L and % saturation)
- Turbidity (NTU).

Water quality results were compared against the *Queensland Water Quality Guidelines 2009* (DEHP 2006) for coastal lowland streams.

Fish survey

Fish community assessments were conducted at five sites, with opportunistic observations recorded at three sites. Community-based ecological assessments ideally require that the capture probability of each species is proportional to its absolute abundance at each site (Royle and Nichols 2003). In support of collecting as representative a sample as possible, a variety of trapping methods were used during the survey. Methods selected supported ability to target a variety of habitats, fish sizes and site conditions.

The selected methods included fyke nets, seine nets and bait trapping. The fish community data was assessed to determine the abundance and diversity of species collected at each site, and population structure (community composition and size classes).

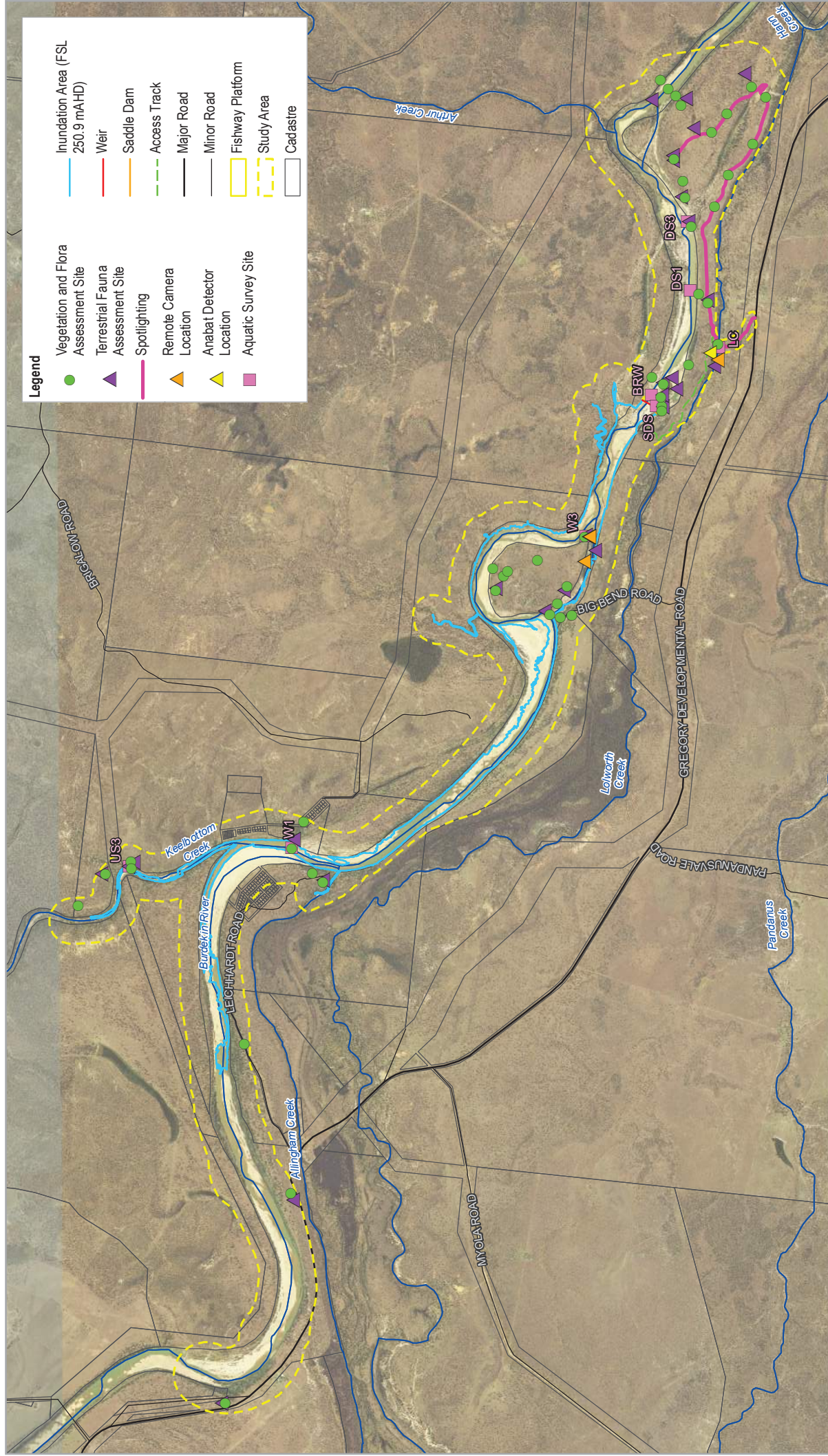
Turtle survey

Turtle surveys involved cathedral trapping and seine netting in pool habitat areas, and were in accordance with the standard methodology of the DES (Limpus *et al.* 2002; Hamann *et al.* 2007; Limpus *et al.* 2011). Survey for potential nesting habitat involved opportunistically searching accessible bank margins for evidence of nesting along strip transects parallel to the water's edge. Transects were in accordance with standard DES methodology (e.g. Hamann *et al.* 2007). Potential suitability of habitat for turtle nesting were assessed based on results of the systematic surveys and an assessment of habitat characteristics.

2.3.5 Scientific permits

The ecological field surveys were conducted in accordance with the following permits and approvals:

- Department of Employment, Economic Development and Innovation Scientific Users Registration Certificate (Registration Number 132)
- Queensland Government Scientific Purposes Permit (permit number WISP15723315)
- General Fisheries Permit (permit number 192406)
- Animal Research Authority issued by the accredited GHD Animal Ethics Committee.



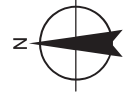
Legend

- Vegetation and Flora Assessment Site
- Terrestrial Fauna Assessment Site
- Spotlighting
- Remote Camera Location
- Anabat Detector Location
- Aquatic Survey Site
- Inundation Area (FSL 250.9 mAHd)
- Weir
- Saddle Dam
- Access Track
- Major Road
- Minor Road
- Fishway Platform
- Study Area
- Cadastre

Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including direct or consequential damages) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

N:\AUBrisbane\Projects\4212512214\GIS\Map\WAD\12512214_006_Ecol_Survey\Effort_Rev0.mxd
Print date: 19 Jun 2020 - 15:55

1:80,000 @ A4
0 1 2 3
Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 19/06/2020

Distribution of survey effort

FIGURE 2-1

Data source: DNRME Imagery (2016); Roads, Cadastre, Watercourse (2019); GHD: Inundation Area, Study Area, Survey Sites (2020). Created by: ecob

2.4 Likelihood of occurrence

An assessment was conducted to attribute a 'likelihood of occurrence' rating to conservation significant species (i.e. species listed under the EPBC Act and/or NC Act) that have been previously recorded or were predicted to occur from the desktop searches. The assessment is provided in Appendix B.

The likelihood of occurrence assessment was based on a review of species distributions and habitat requirements, historical records for the region, and the results of habitat assessments and field surveys conducted within the study area. The likelihood of occurrence ranking was based on the framework detailed in Table 2-3.

Table 2-3 Likelihood of occurrence criteria

Likelihood	Criteria
Confirmed present	Species recorded during the field survey.
Likely to occur	Species has been recorded in the desktop search extent and suitable habitat is present in the study area. Comprehensive field surveys have not been undertaken or were undertaken in sub-optimal conditions or the species is highly cryptic and/or very short-lived.
May occur	Species distribution incorporates the study area but only marginal habitat is present or the species has not been recorded in the desktop extent.
Unlikely to occur	Species has not been previously recorded in the desktop search extent and/or current known distribution does not encompass the study area and/or suitable habitat is generally lacking from the study area.

3. Desktop assessment results

3.1 Ecological communities

3.1.1 Threatened ecological communities

No TECs were identified by the PMST as potentially occurring within the study area. This database is based on maps derived from recovery plans, State vegetation maps, remote sensing imagery and other sources.

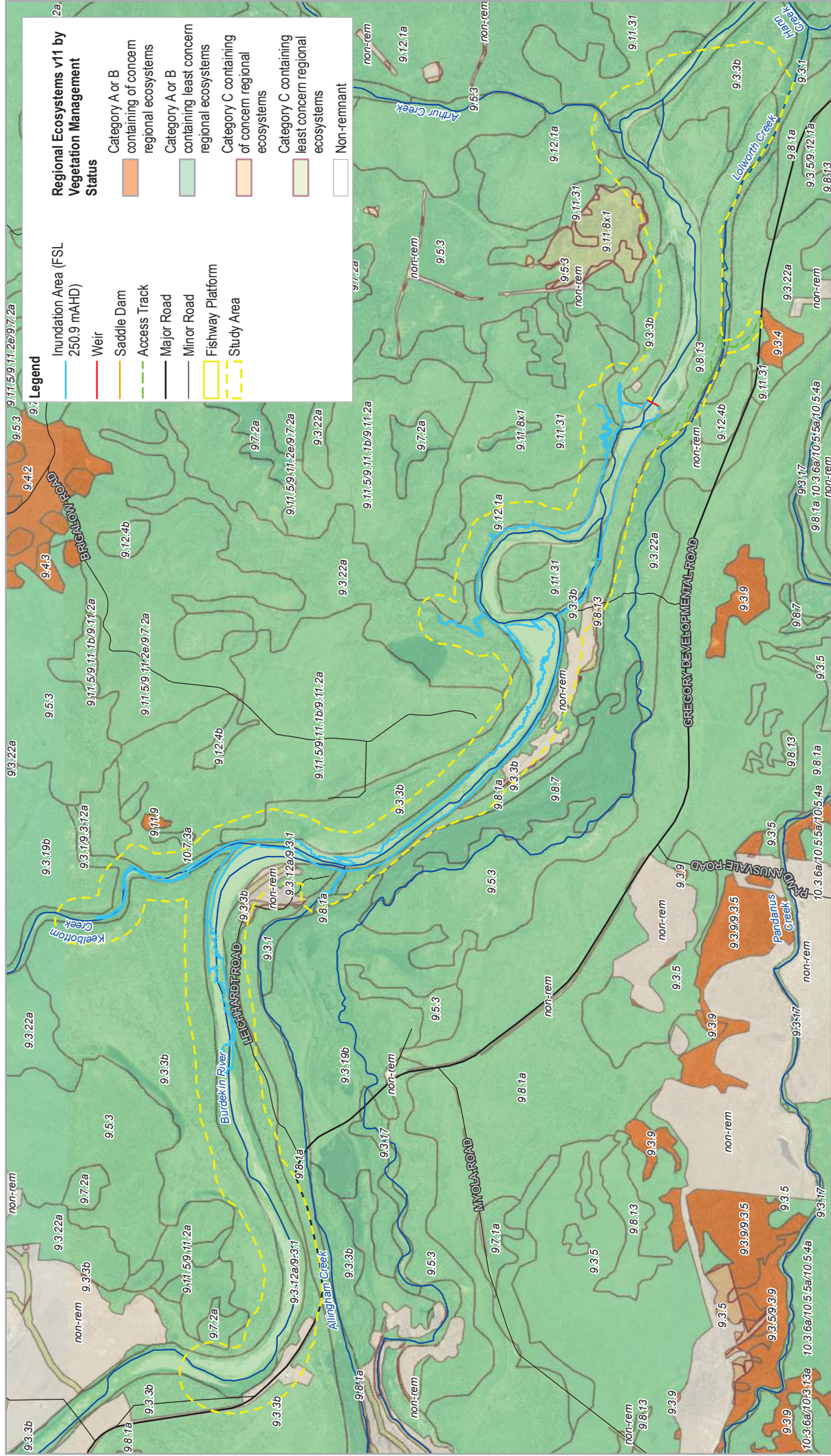
3.1.2 Mapped regional ecosystem communities

Descriptions of REs mapped within the project footprint are provided in Table 3-1 and mapped in Figure 3-1. REs listed occurred either as homogenous or heterogeneous units.

Table 3-1 Regional ecosystem descriptions

RE	VMA status	BD status	RE description
9.3.1	LC	OC	<i>Eucalyptus camaldulensis</i> and/or <i>E. tereticornis</i> +/- <i>Melaleuca</i> spp. +/- <i>Casuarina cunninghamiana</i> fringing woodland on channels and levees
9.3.3b	LC	OC	<i>Corymbia</i> spp. and <i>Eucalyptus</i> spp. dominated mixed woodland on alluvial flats, levees and plains
9.3.12a	LC	OC	River beds and associated waterholes on major rivers and channels
9.3.19b	LC	OC	Open woodland to woodland of <i>Eucalyptus coolabah</i> on alluvial plains adjacent to major watercourses
9.3.22a	LC	OC	Open woodland to woodland of <i>Eucalyptus crebra</i> , <i>Corymbia clarksoniana</i> and/or <i>C. dallachiana</i> +/- <i>Eucalyptus</i> spp. on levees, terraces and banks of larger rivers.
9.8.1a	LC	NC	Open woodland to woodland of <i>Eucalyptus crebra</i> , <i>Corymbia erythrophloia</i> +/- <i>C. dallachiana</i> , <i>Corymbia</i> spp. +/- <i>Eucalyptus</i> spp. on basalt plains and rocky plains.
9.8.13	LC	NC	<i>Iseilema</i> spp. and/or <i>Dichanthium</i> spp. tussock grassland on basalt plains
9.11.1b	LC	NC	Low open woodland to woodland of <i>Eucalyptus melanophloia</i> or <i>E. shirleyi</i> +/- <i>Corymbia dallachiana</i> +/- <i>E. persistens</i> +/- <i>C. peltata</i> +/- <i>E. crebra</i> on skeletal soils of slopes and crests of undulating rises and low hills of folded metasediments and other metamorphic rocks
9.11.2a	LC	NC	Woodland to open woodland of <i>Eucalyptus crebra</i> +/- <i>Corymbia dallachiana</i> +/- <i>C. erythrophloia</i> +/- <i>C. clarksoniana</i> +/- <i>Eucalyptus</i> spp. +/- <i>Corymbia</i> spp. on metamorphic hills and rises
9.11.5	LC	NC	<i>Eucalyptus persistens</i> +/- <i>E. crebra</i> woodland on low metamorphic hills
9.11.31	LC	NC	<i>Corymbia terminalis</i> and/or <i>Eucalyptus crebra</i> and/or <i>C. erythrophloia</i> woodland on aprons surrounding limestone outcrops
9.12.1a	LC	NC	<i>Eucalyptus crebra</i> and/or <i>E. xanthoclada</i> and/or <i>E. drepanophylla</i> low open woodland on igneous rocks
9.12.4b	LC	NC	<i>Eucalyptus shirleyi</i> and/or <i>E. melanophloia</i> and/or <i>Corymbia peltata</i> and/or <i>Callitris intratropica</i> low open woodland on igneous rocks

Key to table: RE – regional ecosystem; VMA – *Vegetation Management Act 1999*; BD – Biodiversity; OC – of concern; LC – least concern; NC – no concern at present.



Project No. 12512214
Revision No. 0
Date 19/06/2020

Townsville Enterprise Ltd
Big Rocks Weir



1:80,000 @ A4
0 1 2 3
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

DNRME regional ecosystem mapping

FIGURE 3-1

3.2 Flora

3.2.1 Conservation significant flora species

The EPBC Act Protected Matters Search predicted six conservation significant flora species that have the potential to occur within the study area. According to State-based searches (i.e. Wildlife Online, Species Profile Search and Biomaps), four conservation significant flora species have been historically recorded within the study area.

The conservation status of species predicted or recorded from desktop searches are provided in Table 3-2.

Table 3-2 Conservation significant flora species predicted to occur within the study area

Species	Common name	Status		Source
		EPBC Act	NC Act	
<i>Bulbophyllum globuliforme</i>	Miniature moss-orchid	V	NT	PMST
<i>Croton magneticus</i>	-	NL	V	WO
<i>Dichanthium queenslandicum</i>	King blue-grass	E	V	PMST; WO
<i>Dichanthium setosum</i>	Bluegrass	V	LC	PMST
<i>Eucalyptus raveretiana</i>	Black ironbox	V	LC	PMST
<i>Graptophyllum excelsum</i>	-	NL	NT	WO
<i>Marsdenia brevifolia</i>	-	V	V	PMST
<i>Solanum sporadotrichum</i>	-	NL	NT	WO
<i>Tephrosia leveillei</i>	-	V	V	PMST

Key to table: E – endangered; V – vulnerable; NT – near threatened; NL – not listed; LC – least concern; PMST – Protected Matters Search Tool; WO – Wildlife Online.

3.3 Fauna

3.3.1 Conservation significant fauna species

Threatened species

A total of 22 threatened fauna species were predicted or recorded in desktop searches. This comprised of seven mammals, eight birds and six reptiles. Of these species, 16 threatened fauna species listed under the EPBC Act were predicted to occur within the desktop search area by the PMST.

Database searches (i.e. Wildlife Online, Species Profile Search and Biomaps) provided records of seven threatened fauna species that have been historically recorded within the desktop search extent.

Species predicted or recorded in the desktop searches are summarised in Table 3-3.

Table 3-3 Threatened fauna species predicted to occur within the study area

Species	Common name	Status		Source
		EPBC Act	NC Act	
Mammals				
<i>Dasyurus hallucatus</i>	Northern quoll	E	LC	PMST
<i>Macroderma gigas</i>	Ghost bat	V	E	PMST
<i>Petauroides volans minor</i>	Greater glider (northern)	V	V	WO
<i>Phascolarctos cinereus</i>	Koala	V	V	PMST; WO
<i>Pteropus conspicillatus</i>	Spectacled flying-fox	E	V	PSMT
<i>Rhinolophus robertsi</i>	Large-eared horseshoe bat	V	E	PMST
<i>Saccolaimus saccolaimus nudicluniatus</i>	Bare-rumped sheath-tailed bat	V	E	PMST
<i>Ornithorhynchus anatinus</i>	Platypus	—	SL	Wetland info
Birds				
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	E	PMST
<i>Erythroriorchis radiatus</i>	Red goshawk	V	E	PMST
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	WO
<i>Neochmia ruficauda</i>	Star finch (eastern)	E	E	PMST
<i>Numenius madagascariensis</i>	Eastern curlew	CE	E	PMST
<i>Poephila cincta cincta</i>	Southern black-throated finch	E	E	PMST
<i>Rostratula australis</i>	Australian painted-snipe	E	V	PMST; WO
<i>Tyto novaehollandiae kimberli</i>	Masked owl (northern)	V	V	PSMT
Reptiles				
<i>Acanthophis antarcticus</i>	Common death adder	NL	V	WO
<i>Denisonia maculata</i>	Ornamental snake	V	V	PMST; WO
<i>Egernia rugosa</i>	Yakka skink	V	V	PMST
<i>Lerista cinerea</i>	Vine-thicket fine-lined slider	NL	V	WO
<i>Lerista vittata</i>	Mount Cooper striped skink	V	V	PMST
<i>Crocodylus porosus</i>	Salt-water crocodile	Mig	V	PMST

Key to table: CE – critically endangered; E – endangered; V – vulnerable; NL – not listed; LC – least concern; SL – special least concern; PMST – Protected Matters Search Tool; WO – Wildlife Online.

Migratory species

A total of 22 migratory bird species and one migratory reptile species were predicted or recorded in the desktop search extent.

The PMST database predicted 16 migratory species listed under the EPBC Act to have the potential to occur within the desktop search extent. The Wildlife Online search identified 12 migratory species that have been historically recorded within the desktop search extent.

Migratory species and the source of the records identified in the desktop searches are provided in Table 3-4.

Table 3-4 Migratory species predicted to occur within the study area

Species	Common name	Status		Source
		EPBC Act	NC Act	
Birds				
<i>Actitis hypoleucos</i>	Common sandpiper	Mig	LC	PMST; WO
<i>Apus pacificus</i>	Fork-tailed swift	Mig	LC	PMST
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	Mig	LC	PMST
<i>Calidris ferruginea</i>	Curlew sandpiper	CE, Mig	E	PMST
<i>Calidris melanotos</i>	Pectoral sandpiper	Mig	LC	PMST
<i>Cuculus optatus</i>	Oriental cuckoo	Mig	LC	PMST
<i>Gallinago hardwickii</i>	Latham's snipe	Mig	LC	PMST; WO
<i>Gelochelidon nilotica</i>	Gull-billed tern	Mig	LC	WO
<i>Hydroprogne caspia</i>	Caspian tern	Mig	LC	WO
<i>Monarcha melanopsis</i>	Black-faced monarch	Mig	LC	PMST
<i>Motacilla cinerea</i>	Grey wagtail	Mig	LC	PMST
<i>Motacilla flava</i>	Yellow wagtail	Mig	LC	PMST
<i>Myiagra cyanoleuca</i>	Satin flycatcher	Mig	LC	PMST
<i>Numenius madagascariensis</i>	Eastern curlew	CE, Mig	E	PMST
<i>Pandion haliaetus</i>	Osprey	Mig	LC	PMST; WO
<i>Plegadis falinellus</i>	Glossy ibis	Mig	LC	WO
<i>Rhipidura rufifrons</i>	Rufous fantail	Mig	LC	PMST; WO
<i>Symposiachrus trivirgatus</i>	Spectacled monarch	Mig	LC	WO
<i>Tringa brevipes</i>	Grey-tailed tattler	Mig	LC	WO
<i>Tringa glareola</i>	Wood sandpiper	Mig	LC	WO
<i>Tringa nebularia</i>	Common greenshank	Mig	LC	PMST; WO
<i>Tringa stagnatilis</i>	Marsh sandpiper	Mig	LC	WO
Reptiles				
<i>Crocodylus porosus</i>	Salt-water crocodile	Mig	V	PMST

Key to table: CE – critically endangered; E – endangered; V – vulnerable; LC – least concern; Mig – migratory; PMST – Protected Matters Search Tool; WO – Wildlife Online.

3.4 Essential habitat

Essential habitat for the squatter pigeon (southern) (*Geophaps scripta scripta*) is mapped within the project footprint and study area, and essential habitat for the koala (*Phascolarctos cinereus*) is mapped approximately 1 km south-east of the study area (Figure 3-2). Both species are listed as vulnerable under the EPBC Act and NC Act.

3.5 State-significant bioregional wildlife corridor

The project footprint is located within a State-significant bioregional wildlife corridor. The wildlife corridor follows Burdekin River, Keelbottom Creek, Lolworth Creek and Allingham Creek.

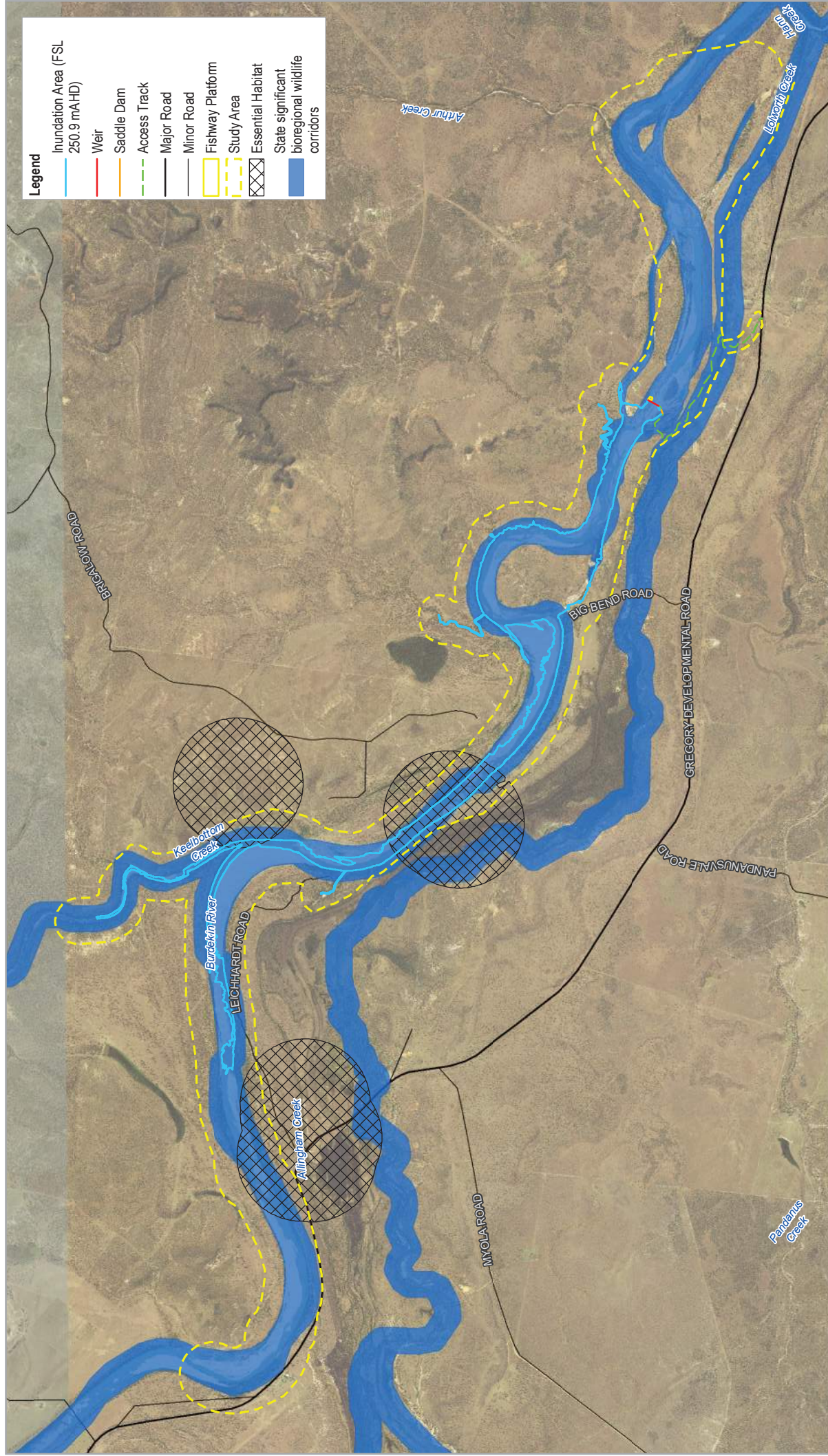
3.6 Biosecurity species

3.6.1 Introduced flora species

The EPBC Act Protected Matters Search predicted nine introduced flora species as potentially present in the region that have potential to pose significant threat to biodiversity values. Eight of the species listed are classified as restricted invasive plants under the Bio Act and are listed as Weeds of National Significance (WoNS).

3.6.2 Introduced fauna species

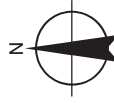
The EPBC Act Protected Matters Search predicted 15 introduced fauna species as potentially occurring present in the region, including six bird species, one amphibian species, and eight mammal species. Of these, six are declared as restricted invasive animals under the Bio Act (DAF 2019).



Project No. 12512214
Revision No. 0
Date 19/06/2020

Townsville Enterprise Ltd
Big Rocks Weir

Essential habitat and significant bioregional wildlife corridors



1: 80,000 @ A4
0 1 2 3
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

FIGURE 3-2

Data source: DNRME Imagery (2016); State significant bioregional wildlife corridors (2018); Essential Habitat, Roads, Watercourse (2019); Inundation Area, Study Area (2020).
Created by: knoble

3.7 Wetlands and watercourses

3.7.1 Watercourses

The Burdekin River is a major river (stream order 8) within the Upper Burdekin River sub-catchment. Lolworth Creek (stream order 6) and Keelbottom Creek (stream order 5) which connect with the Burdekin River downstream and upstream of the proposed BRW, respectively are also classified as major waterways. An existing waterway crossing is to be upgraded on Lolworth Creek to allow access during construction and operation of the BRW.

Numerous MSES regulated vegetation (defined watercourses) are present within the study area and surrounding region, both upstream and downstream. A number of major, high, moderate and low waterways for waterway barrier works are also present both upstream and downstream of the proposed project footprint with the Burdekin River itself being a major waterway.

3.7.2 Wetland systems

Wetlands

A small area of palustrine RE (arid/semi-arid floodplain tree swamp) is mapped approximately 2 km south of the proposed weir. Upstream, eight small areas of palustrine RE (arid/semi-arid floodplain tree swamp) are mapped within approximately 10 km, upstream of the proposed weir.

One area of 01-50_RE (arid/semi-arid non-floodplain tree swamp) is mapped upstream and within 10 km of the proposed weir.

The Burdekin River is mapped as riverine wetland, with banks and tributaries mapped similarly and with riverine vegetation.

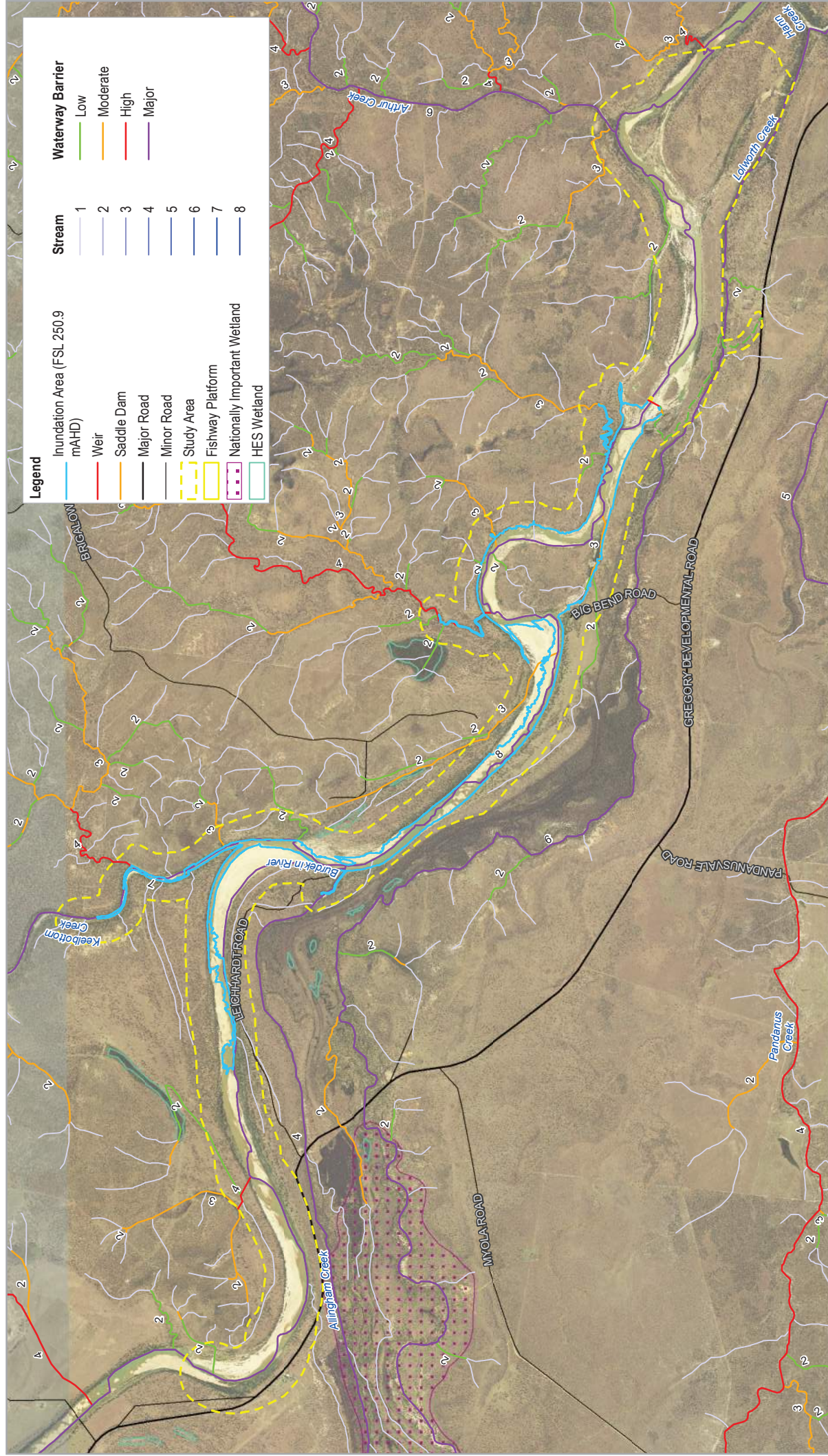
Additionally, Spring Lake and Eumara Lake are mapped as palustrine WB and RE approximately 22 km upstream, to the north-east.

Isolated areas of lacustrine wetland not listed as ecologically significant are mapped in the wider region, however these are artificial wetlands such as stock water dams and located far from the Burdekin River.

Wetlands of high ecological significance

The study area does not occur within a nationally important wetland; however, the Great Basalt Wall DIWA (Directory of Important Wetlands in Australia) is located immediately adjacent to the western extent of the study area. The wetland is located outside the proposed inundation area of the weir.

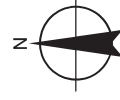
High Ecological Significance (HES) wetlands areas are mapped within the study area, approximately 1 km from the Burdekin River. Ten are mapped 1 km from the Burdekin River. Two areas of HES wetlands are mapped downstream of the proposed development, approximately 21 km and 23 km downstream. Upstream, eight small pockets of HES wetland are mapped within approximately 10 km of the proposed weir and within approximately 1 km of the Burdekin River, with larger HES wetland forming part of the Nationally Important Great Basalt DIWA, mapped approximately 20 km upstream of the proposed weir and within 2 km of the Burdekin River (Figure 3-3).



1:80,000 @ A4



Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 19/06/2020

Wetlands and watercourses

FIGURE 3-3

4. Field survey results

4.1 Terrestrial flora

4.1.1 Threatened ecological communities

Identification of REs listed in existing Version 11 RE mapping and REs identified in the field were assessed for their potential to meet the requirements to constitute Commonwealth EPBC Act listed TECs. No vegetation communities that could be confirmed as potential TEC were identified within the project footprint during the field survey.

4.1.2 Vegetation communities

All of the REs identified within the project footprint are remnant (Category B) with a VM status of least concern. Majority of the RE types and boundaries appeared to be accurately mapped within the project footprint (Figure 3-1), with only minor discrepancies observed due to the scale of the RE mapping. Access was not available to all areas within the study area during the field survey, and therefore, RE 9.3.19b, 9.3.22a, 9.11.5/9.11.1b/9.11.2a and 9.12.4b were not verified. Additional survey is required to confirm RE verification.

A description of all RE communities observed within the project footprint is provided in Table 4-1.

Table 4-1 Regional ecosystems considered present within the study area

RE (VM Status)	GHD field description	Photo
9.3.1 / 9.3.12a (LC)	Vegetation: Woodland to open forest of <i>Eucalyptus camaldulensis</i>, <i>E. tereticornis</i> and <i>Corymbia tessellaris</i> over a sparse sub-canopy of juvenile canopy species, <i>Melaleuca</i> spp., <i>Pleiogynium timorens</i>, <i>Casuarina cunninghamiana</i> and <i>Lophostemon grandiflorus</i>. Very sparse shrub layer including <i>Ficus opposita</i>, <i>Lophostemon grandiflorus</i>, <i>Parkinsonia aculeata</i>* and <i>Melaleuca</i> spp. Ground cover was dominated by <i>Parthenium hysterophorus</i>*, <i>Cynodon dactylon</i>, <i>Stylosanthes scabra</i>* and <i>Argemone ochroleuca</i>*. Landform: Stream bed, banks and lower terraces. Geology/soils: Alluvium (sand and gravels) with exposed rhyolite and basalt rock on lower terraces and stream bed.	
9.3.1	Vegetation: Fringing woodland of <i>E. tessellaris</i>, <i>Ficus racemosa</i>, <i>M. fluviatilis</i>, <i>F. opposita</i>, <i>C. cunninghamiana</i> and <i>P. timorens</i> over <i>Grewia retusifolia</i>, <i>Abutilon auritum</i>, <i>Ricinus communis</i>*, <i>C. grandiflora</i>*, <i>N. glauca</i>*, <i>Verbesina encelioides</i>*, <i>Asclepias curassavica</i>* and <i>P. hysterophorus</i>*. Landform: Stream banks. Geology/soils: Brown sands.	

RE (VM Status)	GHD field description	Photo
9.3.3b (LC)	Vegetation: Open woodland with a sparse to mid-dense canopy cover of <i>Eucalyptus crebra</i>, <i>Corymbia tessellaris</i> and <i>C. clarksoniana</i> over a sub-canopy of canopy species, <i>Pleiogynium timorense</i> and <i>Owenia acidula</i>. Very sparse shrub layer including <i>Carissa lanceolata</i>* and <i>Opuntia tomentosa</i>*. Common species in the ground layer included <i>Heteropogon contortus</i>, <i>Cenchrus ciliaris</i>*, <i>Sida</i> sp.* and <i>Crotalaria</i> sp.*. Landform: Alluvial plain Geology/soils: Brown sandy loam	
9.8.1a (LC)	Vegetation: Open woodland with a sparse canopy of <i>Corymbia erythrophloia</i>, <i>Eucalyptus crebra</i>, <i>C. dallachiana</i> and <i>E. melanophloia</i> over a very sparse sub-canopy of <i>Erythrina vespertilio</i>. Ground cover was dominated by <i>Cenchrus ciliaris</i>*. Landform: Rocky plain Geology/soils: Brown / red clay loam	

RE (VM Status)	GHD field description	Photo
9.8.13 (LC)	Vegetation: Open grassland with <i>Cenchrus ciliaris</i>*, <i>Crotalaria</i> sp.* and <i>Stylosanthes scabra</i>*. Very sparse canopy of <i>Eucalyptus crebra</i>, <i>Corymbia erythrophloia</i> and <i>C. dallachiana</i> and <i>Pleiogynium timorensense</i> over very sparse shrub layer including <i>Acacia farnesiana</i>* and <i>Opuntia tomentosa</i>*. Landform: Undulating alluvial plain Geology/soils: Brown / red sandy loam	
9.11.31 (LC)	Vegetation: Open woodland with a sparse canopy of <i>Eucalyptus crebra</i>, <i>Corymbia erythrophloia</i> and <i>C. dallachiana</i> with a sub-canopy of canopy species and <i>Atalaya hemiglauc</i>a. Sparse shrub layer included juvenile canopy species and <i>Carissa lanceolata</i>* over a dense grassy ground layer dominated by <i>Heteropogon contortus</i> and <i>Cenchrus ciliaris</i>*. Landform: Undulating plain Geology/soils: Brown / red sandy loam	

RE (VM Status)	GHD field description	Photo
9.12.1a (LC)	Vegetation: Open woodland to low open woodland with a sparse canopy of <i>Eucalyptus crebra</i>, <i>Corymbia erythrophloia</i> and <i>C. dallachiana</i> over a sub-canopy of <i>Geijera salicifolia</i>, <i>Grevillia striata</i>, <i>Petalostigma pubescens</i> and <i>Acacia bidwilli</i>. Sparse shrub layer included juvenile canopy species and <i>Carissa lanceolata</i>*. Ground cover was dominated by <i>Heteropogon contortus</i> and <i>Cenchrus ciliaris</i>*. Landform: Undulating plain Geology/soils: Igneous rock	

Key to table: RE – regional ecosystem; (*) – introduced flora species; VM Status – *Vegetation Management Act 1999* Status.

4.1.3 Conservation significant flora species

No conservation significant flora species were recorded during the field survey within the study area. The likelihood of occurrence of species predicted to occur through the desktop assessment is discussed in Section 5.

4.1.4 Weed species

Weed species were observed throughout much of the study area, with higher abundances recorded in more heavily utilised areas, particularly within the vicinity of tracks and waterways. The predominant weed species, and their general distribution and classification as WoNS or those declared under the Bio Act are listed in Table 4-2.

Table 4-2 Weed species and general distribution

Weed species	WoNS	State declaration Bio Act	General distribution
<i>Cryptostegia grandiflora</i> (rubber vine)* 	✓	Category 3	Abundance varies throughout the landscape. Scattered patches of moderately dense growth along the upper and lower banks of the Burdekin River.
<i>Harissa martini</i> (moonlight cactus)* 		Category 3	Few individuals recorded from one location south of the proposed weir.
<i>Lantana camara</i> (lantana)* 	✓	Category 3	Small patch of lantana recorded south of the proposed weir along lower banks of the Burdekin River.

Weed species	WoNS	State declaration Bio Act	General distribution
<i>Opuntia tomentosa</i> (velvet tree pear)* 	✓	Category 3	Individual recorded north of the proposed weir. Sparsely located in open paddocks and remnant areas south of the proposed weir. Mature trees (~ 4 m high) were recorded in remnant vegetation within the southern extent of the study area.
<i>Parkinsonia aculeata</i> (parkinsonia)* 	✓	Category 3	The species is widely dispersed throughout the study area, with scattered patches of moderately dense growth along the Burdekin River and creek lines.
<i>Parthenium hysterophorus</i> (parthenium weed)* 	✓	Category 3	The species is widely dispersed throughout the study area, with scattered patches of moderately dense juvenile growth along the Burdekin River and creek lines.
<i>Ziziphus mauritiana</i> (chinee apple)* 		Category 3	Sparsely located throughout most grazing paddocks in close proximity to the Burdekin River.

4.2 Terrestrial fauna

4.2.1 Habitat assessments

A total of seven habitat types were identified within the study area during the field survey, and are identified below. The ecological values associated with each habitat type are summarised in Table 4-3. Broad habitat types were defined and broadly mapped throughout the study area based on habitat assessments, REs and aerial imagery. Habitat types identified within the study area are mapped in Figure 4-1.

- Open eucalypt woodland on sandy levees
- Open eucalypt woodland on rocky low hills and rises
- Open grassland on alluvial plains
- Deep cracking clays
- River bed
- Rocky outcrops
- Ephemeral waterways dominated by *Eucalyptus* spp. and/or *Melaleuca* spp.

Habitat types were based on RE descriptions and were validated during the field survey where accessed.

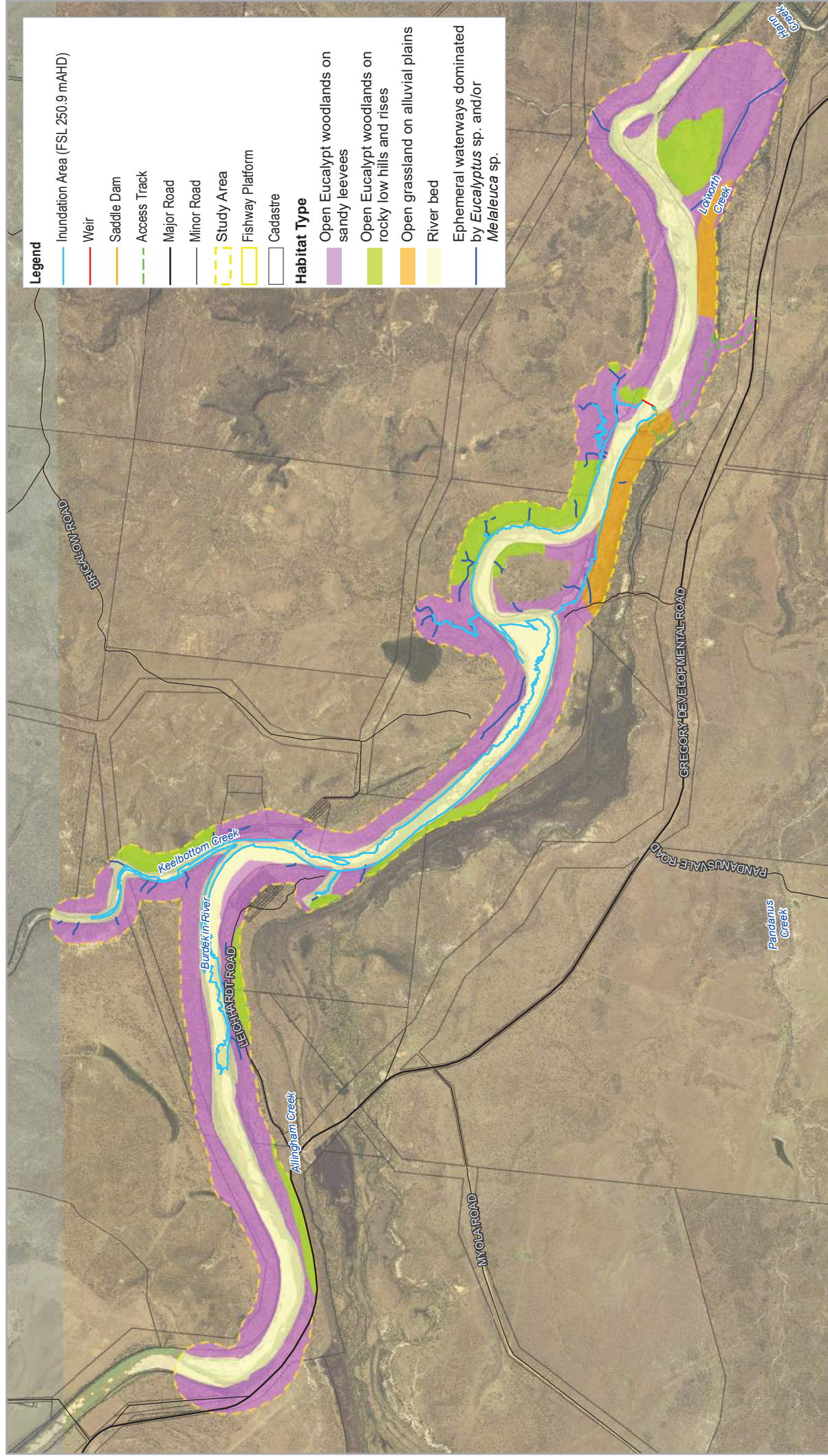
Table 4-3 Habitat types observed within the study area

Habitat type	General characteristics and ecological values
Open eucalypt woodland on sandy levees 	• Mature canopy vegetation provides blossoms and nesting opportunities for honeyeaters, flower peckers and parrots, and foraging habitat for flying-foxes. • Variety of koala food trees present, including <i>Eucalyptus crebra</i>, <i>E. coolabah</i>, <i>Corymbia tessellaris</i>, <i>C. clarksoniana</i>, <i>C. erythrophloia</i> and <i>C. dallachiana</i>. • Hollow-bearing trees were moderately prevalent in <i>Eucalyptus crebra</i>, providing dens for possums, gliders, microbats, owls, parrots, monitors, snakes and tree frogs. • Shrub layer was either absent or sparse, consisting of various shrub species and juvenile canopy species. The shrub layer that does exist provides some nesting and foraging resources for shrub-nesting birds, including finches and fairy-wrens. • Ground-level microhabitats include large fallen woody debris and some leaf litter. These microhabitats provide shelter and foraging microhabitat for ground-dwelling mammals and reptiles. • Ground cover was moderately dense, dominated by introduced grasses. Provides food resources for granivorous birds and herbivorous mammals.
Open eucalypt woodland on rocky low hills and rises 	• Mature eucalypts provide blossoms and nesting opportunities for honeyeaters and parrots, and foraging habitat for flying foxes. • Hollow-bearing trees are moderately prevalent with small hollows. Small hollows provide habitat for small mammals, such as gliders and arboreal reptiles. • Shrub layer was either absent or sparse, consisting of various shrub species and juvenile canopy species. The shrub layer that does exist provides some nesting and foraging resources for shrub-nesting birds, including finches and fairy-wrens. • Relatively complex ground-level microhabitats, with an abundance of fallen woody debris, large logs, small rocks and dense ground cover. Decorticating bark from dead ironbark trees were present, providing refuge for microbats and arboreal reptiles.

Habitat type	General characteristics and ecological values
Open grassland on alluvial plains 	• Characterised by the absence or low abundance of canopy and shrub vegetation, and is dominated by introduced grass species. • Low abundance of hollow-bearing trees resulting in limited roosting sites for microbat species, and nesting sites for hollow-nesting bird species. • Sparse fallen woody debris resulting in limited shelter and foraging microhabitats for ground-dwelling reptiles and rodents. • Native and introduced grass species provide food resources for granivorous birds, such as the Australasian pipit, and herbivorous mammals such as kangaroos and wallabies. • The open landscape provides foraging habitat for raptors and snakes. • In most areas, the ground-layer has been heavily altered by cattle grazing and trampling, and intensive cultivation. These alterations have reduced the presence of suitable microhabitats for a range of fauna species.
Deep cracking clays 	• Large depressions with deep soil cracks, providing foraging and breeding habitat for a variety of reptiles and amphibians. • Wetlands are formed after seasonal rainfall, providing foraging and breeding habitat for a wide range of fauna, such as water birds.

Habitat type	General characteristics and ecological values
River bed 	- Burdekin River forms part of a state-significant bioregional wildlife corridor, and is an important for native mammals, birds, reptiles and amphibians, and an important foraging routes and flyways for microbats. - Sandy creek beds can retain an important source of drinking water that is utilised by a variety of fauna species for months after the wet season has ended. - Sandy creek banks allow bird species, such as the rainbow bee-eater and red-browed pardalote to excavate long horizontal nesting tunnels.
Rocky outcrops 	- Rocky outcrops are present along the Burdekin River, with small patches of <i>Melaleuca</i> sp. and <i>Lophostemon</i> sp. - Retain long vertical crevices and medium-sized tunnels, providing potential habitat for rock wallabies, microbats, reptiles and amphibians. - Rocky formations provide basking areas for thermoregulating reptiles. - Sparse growth of <i>Melaleuca</i> sp. and <i>Lophostemon</i> sp.

Habitat type	General characteristics and ecological values
Ephemeral waterways dominated by <i>Eucalyptus</i> sp. and / or <i>Melaleuca</i> sp. 	• Ephemeral waterways are an important movement corridor for native mammals, birds, reptiles and amphibians, and are important foraging routes and flyways for microbats. • Sandy creek beds can retain an important source of drinking water that is utilised by a variety of fauna species for months after the wet season has ended. • Mature <i>Eucalyptus</i> and <i>Melaleuca</i> species provide blossoms and nesting opportunities for honeyeaters and parrots, and foraging habitat for flying-foxes. Hollow-bearing trees provide dens for possums, gliders, microbats, owls, parrots, snakes and tree frogs. • In some areas, mid-storey vegetation is moderately dense providing shelter and nesting habitat for finches, fairy-wrens and other shrub-dwelling birds. • Ground-level microhabitats, including coarse woody debris, scattered rock and sandy soils provide shelter and foraging habitat for a variety of reptile and frog species. • In-stream complexity, including undercut banks, root balls, trailing vegetation and rocks were present.



Project No. 12512214
Revision No. 0
Date 22/06/2020

Townsville Enterprise Ltd
Big Rocks Weir

Habitat types within the study area



1:80,000 @ A4
0 1 2 3
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

FIGURE 4-1

4.2.2 Conservation significant fauna species

One EPBC migratory bird species, the glossy ibis (*Plegadis falcinellus*) was recorded within the study area during the field surveys. Conservation significant species likely to occur within the study area include the squatter pigeon (southern) (*Geophaps scripta scripta*), koala (*Phascolarctos cinereus*) and greater glider (northern) (*Petauroides volans minor*) (listed as vulnerable under the EPBC Act and NC Act). More information on these conservation significant species is provided in Section 6. The likelihood of occurrence of conservation significant species is provided in Appendix B.

4.2.3 Terrestrial fauna species

A total of 97 fauna species were recorded during the field survey within the study area. This comprised of 18 species of mammals, 74 species of birds, two species of reptiles and three species of amphibians. A description of each of the fauna groups is provided below. A list of fauna species encountered in the field survey is provided in Appendix A.

Mammals

Species recorded during the field survey included the eastern grey kangaroo (*Macropus giganteus*), common wallaroo (*Macropus robustus*) and agile wallaby (*Macropus agilis*). No arboreal mammals or small ground mammals were encountered during the field survey. The anabat detector positively identified 11 microbat species, including the hoary wattled bat (*Chalinolobus nigrogriseus*), large-footed myotis (*Myotis macropus*) and eastern cave bat (*Vespadelus troughtoni*). Mammal species that are likely to occur within the study area due to their regional abundance include the common brushtail possum (*Trichosurus vulpecula*), short-beaked echidna (*Tachyglossus aculeatus*) and squirrel glider (*Petaurus norfolcensis*).

Birds

A total of 74 bird species were recorded during the field survey within the study area. Bird species that were most abundant and widespread were species naturally adapted to open landscapes, such as the torresian crow (*Corvus orru*), pied butcherbird (*Cracticus nigrogularis*), Australian magpie (*Cracticus tibicen*) and apostlebird (*Struthidea cinerea*).

Grassland bird specialists, including Australasian pipit (*Anthus novaeseelandiae*), Australian bustard (*Ardeotis australis*), brown quail (*Coturnix ypsilophora*) and emu (*Dromaius novaehollandiae*) were observed within the open grassland areas. Raptors including the wedge-tailed eagle (*Aquila audax*), nankeen kestrel (*Falco cenchroides*) and whistling kite (*Haliastur sphenurus*) were recorded foraging in open pasture areas within the study area.

Birds encountered in regrowth and open woodland areas included the pheasant coucal (*Centropus phasianinus*), red-browed pardalote (*Pardalotus rubricatus*) and double-barred finch (*Taeniopygia bichenovii*). Remnant eucalypt woodland within the study area provides nesting and foraging habitat for woodland-dependent birds, including the red-winged parrot (*Aprosmictus erythropterus*), red-tailed black-cockatoo (*Calyptorhynchus banksii*), white-bellied cuckoo-shrike (*Coracina papuensis*), blue-winged kookaburra (*Dacelo leachii*) and pale-headed rosella (*Platycercus adscitus*).

Bird species encountered along the Burdekin River and other waterways within the study area included the grey teal (*Anas gracilis*), Australasian darter (*Anhinga novaehollandiae*), eastern great egret (*Ardea modesta*), black-fronted dotterel (*Elsayornis melanops*), brolga (*Grus rubicunda*), white-bellied sea-eagle (*Haliaeetus leucogaster*) and forest kingfisher (*Todiramphus macleayii*).

Reptiles

Three reptile species, including the common tree snake (*Dendrelaphis punctulatus*), bynoe's gecko (*Heteronotia binoei*) and eastern water dragon (*Intellagama lesueurii*) were recorded within the study area during the field survey. The common tree snake and eastern water dragon were encountered along the Burdekin River within dense riparian vegetation. The bynoe's gecko was located within open eucalypt woodland under woody debris.

Least concern reptile species that are likely to occur within the study area due to their regional abundance include the tommy roundhead (*Diporiphora australis*), dubious dtella (*Gehyra dubia*), northern velvet gecko (*Oedura castelnaui*) and fire-tailed skink (*Morethia taeniopleura*).

Amphibians

Three amphibian species were recorded during the field survey, including the green tree frog (*Litoria caerulea*), desert tree frog (*Litoria rubella*) and ornate burrowing frog (*Platyplectrum ornatum*). These amphibian species were recorded within riparian vegetation along the Burdekin River and Lolworth Creek within the study area.

Least concern amphibian species that are common within the region and considered likely to occur included the northern laughing treefrog (*Litoria rothii*), bumpy rocketfrog (*Litoria inermis*), greenstripe frog (*Cyclorana alboguttata*) and eastern snapping frog (*Cyclorana novaehollandiae*).

4.2.4 Pest animal species

Four pest animal species were identified within the study area during the field survey. Of these, three are declared as restricted invasive animals under the Bio Act (DAF 2019). The identities, status and distribution of the species observed within the study area is provided in Table 4-4.

Table 4-4 Pest animal species recorded within the study area

Species	Bio Act Category	Area of occurrence
Chital deer (<i>Axis axis</i>)	Category 3, 4 and 6	Four individuals were recorded foraging along the banks of the Burdekin River within the study area
Wild dog (<i>Canis lupus</i>)	Category 3, 4 and 6	Two individuals were identified along an access track within the study area, adjacent to the Burdekin River
European rabbit (<i>Oryctolagus cuniculus</i>)	Category 3, 4 and 6	Two individuals were observed in an open area along the Burdekin River within the study area
Cane toad (<i>Rhinella marina</i>)		Several cane toads were recorded under woody debris along the water's edge of the Burdekin River and other tributaries

4.3 Aquatic environment

4.3.1 Aquatic habitat

Aquatic habitats identified within the project footprint and study area were isolated and connected pools, riffle, and run habitat (Plate 4-1). Overhanging vegetation, large woody debris and in-stream macrophytes also provided habitat for aquatic fauna (Plate 4-2). Aquatic habitat descriptions of Keelbottom Creek, Burdekin River and Lolworth Creek are presented below.



Plate 4-1 Left to right, top to bottom; isolated pool (SSD); connected pool (W3); riffle (LC); run (W1)



Plate 4-2 Left to right, top to bottom; overhanging vegetation (US3); large woody debris (LC); submerged macrophytes (DS3); emergent macrophytes (LC)

Keelbottom Creek

Keelbottom Creek at site US3 consisted of a wide channel with a large sand bank adjacent to the right bank. Water was connected through the channel but was not flowing at the time of the survey. The wetted width at this location was approximately 15 m and had a variable depth of 1 m – 2 m. A dry tributary connected with the main channel on the left bank. Land use adjacent to the survey area was native forest and cattle grazing.

Bed substrate was primarily sand with some bedrock and a small proportion of cobbles, pebbles, gravel and silt/clay. The left bank was composed almost entirely of bedrock whereas, the right bank was predominantly sand. Both banks were steep, whereas the right bank also had areas of moderate to low slope.

Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and either grasses or bedrock in the understorey. The riparian vegetation was semi-continuous and provided some overhanging and trailing bank vegetation for cover.

In-stream habitat consisted of deep pools, small bedrock bars, large woody debris, tree roots, terrestrial leaves and twigs, and aquatic macrophytes. *Potamogeton octandrus*, water lily sp. and filamentous algae were scattered along the water's edge. The macrophytes would support small bodied fish species such as the firetail gudgeon and flyspecked hardyhead.

Overall, site US3 within Keelbottom Creek was in 'good' condition with a habitat assessment score of 85 (Table 4-5).

Burdekin River

The Burdekin River consisted of a wide, irregularly meandering channel (approximately 230 m to 500 m). Water was connected throughout the channel and snaked from the left bank to the right bank. Small isolated pools were present at site SSD. Water flow was only very slow at the time of the survey. The wetted width varied from approximately 4 m to 50 m and had a variable depth of 0.2 m – >2 m. Land use adjacent to the survey area was native forest, national park and cattle grazing.

Bed substrate was variable throughout the channel with areas that were predominantly sandy (DS1 and DS3); cobbley, gravelly sand (W1 and W3) and bedrock with sand (BRW and SSD). The banks were typically composed of sand (DS1, DS3, W1 and W3) or bedrock (BRW and SSD) and were often high (approximately up to 10 m) and steep.

Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and either grasses or bedrock in the understorey. The riparian vegetation was semi-continuous and provided some overhanging and trailing bank vegetation for cover (DS1, DS3, W1 and W3). The bedrock substrate of the channel and banks at sites BRW and SDS limited the available cover for the river.

In-stream habitat throughout the Burdekin River consisted of deep pools, shallow fast moving riffles and runs, large woody debris and aquatic macrophytes. *Hydrilla verticillata*, *Myriophyllum* sp. and *Ottelia alismoides* were present in scattered beds. *Cyperus difformis*, *Cyperus* sp. and filamentous algae were also scattered but isolated along the water's edge. Isolated parthenium (a declared noxious plant species) was present on the banks of the Burdekin River.

Overall, sites W1, W3, BRW, SSD, DS1 and DS3 within the Burdekin River were in 'fair' to 'good' condition with a habitat assessment scores ranging from 65 to 114 (Table 4-5).

Lolworth Creek

Lolworth Creek at site LC consisted of a moderately wide channel with clear flowing water. Water flow alternated between areas of faster runs and riffles and slower pools. The wetted width at this location was approximately 10 m and had a variable depth of 0.2 – 1 m. A concrete bed level crossing intersected the site. Land use adjacent to the survey area was predominantly cattle grazing.

Bed substrate was stable and was primarily composed of bedrock, boulders with some cobbles and sand. Exposed bed substrate created in-stream bars which covered approximately 15% of the site. The banks consisted of material similar to the bed substrate but also had sections of terrestrial soils. The left bank had a moderate slope, whereas the right bank was steep to vertical.

Riparian vegetation was moderately disturbed and consisted of a eucalypt and melaleuca canopy and either grasses or bedrock/large material in the understorey. The riparian vegetation was semi-continuous and provided some overhanging and trailing bank vegetation for cover.

In-stream habitat consisted of deep pools, bedrock/boulder bars, large woody debris terrestrial leaves and twigs, and aquatic macrophytes. *Ludwigia peploides*, *Marsilea* sp., *Ottelia alismoides* and filamentous algae were scattered along the water's edge with *Myriophyllum* sp. in beds.

Overall, site LC within Lolworth Creek was in 'excellent' condition with a habitat assessment score of 113 (Table 4-5).

Table 4-5 Habitat scores for the pre-wet aquatic survey

Habitat variable	Scale ⁺	US3	W1	W3	BRW	SSD	DS1	DS3	LC
Bottom substrate	0-20	14	16	16	11	13	6	16	18
Embeddedness	0-20	12	20	16	14	14	6	13	19
Velocity and depth category	0-20	5	18	17	5	5	5	15	15
Channel alteration	0-15	10	11	11	13	14	10	12	12
Bottom scouring and deposition	0-15	11	12	10	12	11	8	10	13
Pool/riffle, run/bend ratio	0-15	8	13	12	11	9	10	11	11
Bank stability	0-10	7	6	7	9	9	5	6	8
Bank vegetation and stability	0-10	8	8	9	9	2	6	6	8
Streamside cover	0-10	10	10	9	2	2	9	9	9
Totals	0-135	85	114	107	86	79	65	98	113
Habitat score category*		Good	Excellent	Good	Good	Good	Fair	Good	Excellent

⁺ Scale as per AusRivAS habitat assessment method

* Excellent = 111-135, good = 75-110, fair = 39-74, poor = 0-38

Colour categories: excellent = blue, good = green, fair = orange, poor = red

4.3.2 Water quality

In-situ water quality was measured at eight sites and the results presented in Table 4-6.

Water temperature ranged between 28.9°C at the proposed weir site (BRW) and 34.2°C within the weir storage area (W3).

The pH exceeded the QWQG values at all sites with the exception of sites US3 and LC. pH was highest at site SSD (8.53 pH units) and lowest at site US3 (7.90 pH units).

Electrical conductivity exceeded the guideline value at all sites and ranged from 422 µS/cm to 590 µS/cm.

Dissolved oxygen was higher than the guideline value at three sites upstream of the proposed weir (US3, W1 and W3). The highest dissolved oxygen concentration was recorded at site W3 (127% saturation).

Turbidity complied with the water quality guideline at all sites. All sites recorded turbidity below 3.4 NTU with the exception of site DS3 which was notably higher at 28.9 NTU.

Table 4-6 In-situ water quality during the pre-wet survey

Site	Temperature	pH	Electrical conductivity	Dissolved oxygen	Turbidity
Units	°C	pH units	µS/cm	% saturation	NTU
QWQG	–	6.5 – 8.0	120 – 310 ¹	85 – 110	50
US3	33.8	7.90	485	125.8	1.9
W1	33.3	8.07	590	123.8	0.1
W3	34.2	8.20	495	127.0	3.4
BRW	28.9	8.27	446	96.3	1.2
SSD	29.2	8.53	483	102.7	0.5
DS1	30.3	8.22	452	103.5	2.2
DS3	30.1	8.07	458	101.7	28.9
LC	31.3	7.91	422	102.4	1.5

¹ 20th and 80th percentiles from the DEHP (2009) Queensland water quality guideline (2009)

Queensland water quality guideline (2009) Central Coast lowland streams

4.3.3 Aquatic fauna species

No conservation significant aquatic species were recorded within the study area during the field survey.

Of the 25 species of fish known to occur in the Upper Burdekin catchment, nine species were captured (Table 4-7). Of these, the eastern rainbowfish (*Melanotaenia splendida splendida*) was the most common with 227 individuals caught. The sleepy cod (*Oxyeleotris lineolata*) and sevenspot archerfish (*Toxotes chatareus*) were the least abundant with only six or less individuals captured or observed. Site W3 recorded the highest abundance of individuals and was dominated by eastern rainbowfish (*Melanotaenia splendida splendida*), barred grunter (*Amniataba percooides*) and bony bream (*Nematalosa erebi*). Species richness was highest at site W1 (6 species) with sites W3 and LC also recording relatively high species richness.

Of the five freshwater turtle species known to occur in the Upper Burdekin catchment, only one species was caught (Krefft's river turtle, *Emydura macquarii krefftii*) (Table 4-8). The Krefft's river turtle was present at the five sites which were surveyed. This species was abundant with most sites recording between 8 – 13 individuals. The Krefft's river turtle was most abundant at site W1 and least abundant at site DS1. The majority of turtles were intermediate in age (abundance (N) = 21) with some adults (N = 9) and very few juveniles (N = 2).

There were no platypus captured or observed during the pre-wet survey. There is potential platypus habitat on Lolworth Creek, Keelbotton Creek and the Burdekin River under rock ledges, roots and woody debris.

Photos of aquatic fauna are presented in Plate 4-3 and Plate 4-4.

Table 4-7 Abundance of fish species caught during the pre-wet survey

Common name	Scientific name	US3	W1	W3	BRW	SSD	DS1	DS3	LC
Eastern rainbowfish	<i>Melanotaenia splendida splendida</i>		7	220					
Rainbowfish sp.	<i>Melanotaenia</i> sp.					15			50
Firetail gudgeon	<i>Hypseleotris galii</i>		1				1		9
Sleepy cod	<i>Oxyeleotris lineolata</i>			1				4	
Barred grunter	<i>Amniataba percoides</i>		6	75		5			5
Sooty grunter	<i>Hephaestus fuliginosus</i>		1				3	5	
Flyspecked hardyhead	<i>Craterocephalus stercusmuscarum</i>		40	1					2
Bony bream	<i>Nematalosa erebi</i>		1	70					
Sevenspot archerfish	<i>Toxotes chatareus</i>	1			1	2			2
Total abundance		1	56	367	1	22	4	9	68
Species richness		1	6	5	1	3	2	2	5

Table 4-8 Abundance of turtle species caught during the pre-wet survey

Common name	Scientific name	US3	W1	DS1	DS3	LC
Krefftt's river turtle	<i>Emydura macquarii krefftii</i>	12	13	1	10	8



Plate 4-3 Left to right, top to bottom; Eastern rainbowfish (*Melanotaenia splendida splendida*); rainbowfish sp. (*Melanotaenia sp.*); sleepy cod (*Oxyeleotris lineolata*); barred grunter (*Amniataba percoides*); sooty grunter (*Hephaestus fuliginosus*); flyspecked hardyhead (*Craterocephalus stercusmuscarum*)



Plate 4-4 Bony bream (*Nematalosa erebi*) (left); Krefft's river turtle (*Emydura macquarii krefftii*) (right)

5. Likelihood of occurrence

A likelihood of occurrence assessment was undertaken as detailed in Section 2.4. The results of the assessment are provided in Appendix B. A summary of the likelihood of occurrence assessment is provided in Table 5-1 and Table 5-2. This considers the likelihood of occurrence of conservation significant species predicted to occur within the study area.

5.1 Threatened flora and fauna species

No threatened flora and fauna species were recorded during the field surveys within the study area. Based upon the desktop assessment and assessments of habitats during the field survey, three threatened fauna species, namely the squatter pigeon (southern), greater glider (northern) and koala are considered **likely to occur** and eight threatened flora and fauna species **may occur** within the study area (Table 5-1).

Table 5-1 Threatened flora and fauna species likelihood of occurrence

Species	Common name	Status	
		EPBC Act	NC Act
Likely to occur			
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V
<i>Petauroides volans minor</i>	Greater glider (northern)	V	V
<i>Phascolarctos cinereus</i>	Koala	V	V
May occur			
<i>Acanthophis antarcticus</i>	Common death adder	NL	V
<i>Crocodylus porosus</i>	Estuarine crocodile	Mig	V
<i>Denisonia maculata</i>	Ornamental snake	V	V
<i>Dichanthium queenslandicum</i>	King bluegrass	E	V
<i>Eucalyptus raveretiana</i>	Black ironbox	V	LC
<i>Neochmia ruficauda</i>	Star finch (eastern)	E	E
<i>Poephila cincta cincta</i>	Southern black-throated finch	E	E
<i>Rostratula australis</i>	Australian painted-snipe	E	V

Key to table: E – endangered; V – vulnerable; NL – not listed; LC – least concern.

5.2 Migratory species

One migratory species, namely the glossy ibis was recorded during the field survey within the study area. Based upon the desktop assessment and assessments of habitats during the field survey, six migratory species are considered **likely to occur** and four migratory species **may occur** within the study area (Table 5-2).

Table 5-2 Migratory species likelihood of occurrence

Species	Common name	Status	
		EPBC Act	NC Act
Confirmed present			
<i>Plegadis falinellus</i>	Glossy ibis	Mig	LC
Likely to occur			
<i>Actitis hypoleucos</i>	Common sandpiper	Mig	LC
<i>Gallinago hardwickii</i>	Latham’s snipe	Mig	LC
<i>Hydroprogne caspia</i>	Caspian tern	Mig	LC
<i>Pandion haliaetus</i>	Osprey	Mig	LC
<i>Tringa glareola</i>	Wood sandpiper	Mig	LC
<i>Tringa nebularia</i>	Common greenshank	Mig	LC
May occur			
<i>Apus pacificus</i>	Fork-tailed swift	Mig	LC
<i>Calidris melanotos</i>	Pectoral sandpiper	Mig	LC
<i>Gelochelidon nilotica</i>	Gull-billed tern	Mig	LC
<i>Tringa stagnatilis</i>	Marsh sandpiper	Mig	LC

Key to table: Mig – migratory; LC – least concern.

6. Conservation significant species

Outlined through Section 6 are the conservation significant species that were confirmed present or considered likely to occur within the study area. Species ecology and distribution within the study area are detailed for each of the species below.

6.1 Squatter pigeon (southern) (*Geophaps scripta scripta*)

6.1.1 Species ecology

The squatter pigeon (southern) occurs in remnant and regrowth open forest and woodland dominated by *Eucalyptus*, *Corymbia*, *Acacia* and *Callitris* species with tussock grassy understorey within 3 km of water sources (DAWE 2020). Soils are generally a good predictor of their foraging and breeding habitat (Squatter Pigeon Workshop 2011). Breeding and foraging habitat is generally restricted to well-draining, gravelly, sandy or loamy soils with a tussock-grassy understorey (Squatter Pigeon Workshop 2011). These typically have a patchy ground layer composed of native perennial tussock grasses or a mix of native perennial tussock grasses and low shrubs or forbs (Squatter Pigeon Workshop 2011). Breeding habitats are typically on stony rises within 1 km of permanent (Squatter Pigeon Workshop 2011). Key threats to the squatter pigeon (southern) are predominately loss and fragmentation of habitat, overgrazing by stock, degradation of habitat by weeds and exotic pasture (e.g. *Cenchrus ciliaris*) and feral herbivores, and predation by feral cats and foxes (DAWE 2020).

6.1.2 Distribution within the study area

The species was not recorded during the field survey; however, potentially suitable squatter pigeon (southern) habitat was recorded within the project footprint and study area during the field surveys. Areas of suitable habitat included open eucalypt woodland on alluvial plains, and on rocky low hills and rises in close proximity to the Burdekin River and other tributaries. The squatter pigeon (southern) has been considered likely to occur as the species has been historically recorded within the desktop search extent and essential habitat is mapped within the project footprint and study area.

6.2 Greater glider (northern) (*Petauroides volans minor*)

6.2.1 Species ecology

The greater glider is restricted to mature eucalypt forests and woodlands with an abundance of mature, hollow-bearing trees (Andrews *et al.* 1994; Kavanagh 2000; Eyre 2004; Van der Ree *et al.* 2004; Vanderduys *et al.* 2012). The species has a specialist folivorous diet, and displays seasonal food preferences (Kehl and Borsboom 1984; Kavanagh and Lambert 1990). As a result, the species requires access to forests with a diversity of tree species to provide a consistent food source throughout the year (Kavanagh 1984). The species dens in large hollows in mature trees (Henry 1984; Lindenmayer *et al.* The species has been found to be absent from forests with fewer than six hollow-bearing trees per hectare (ha) (ARCS 1999). The species has a relatively small home range, typically 1 – 4 ha (Henry 1984; Comport *et al.* 1996; Gibbons and Lindenmayer 2002). Given the species' limited capacity for dispersal, and reluctance to cross vegetation gaps, it is sensitive to habitat fragmentation (McCarthy and Lindenmayer 1999).

6.2.2 Distribution within the study area

The species was not observed during spotlighting and no faecal pellets were recorded during the active searches. However, potentially suitable foraging habitat was recorded within the project footprint (i.e. riparian vegetation along the Burdekin River) and within the study area (i.e. *Eucalyptus crebra* dominated woodland on undulating plains). Suitable denning habitat was limited within the project footprint; however, hollow-bearing trees were moderately prevalent within areas that retained mature *Eucalyptus camaldulensis* along the Burdekin River. Given the species has been historically recorded approximately 15 km south-east of the project footprint, and suitable habitat occurs within and adjacent to the project footprint, a precautionary approach has been taken and the species has been considered likely to occur.

6.3 Koala (*Phascolarctos cinereus*)

6.3.1 Species ecology

Koalas are a herbivorous, arboreal marsupial known to utilise a range of open woodland habitats throughout temperate, tropical, sub-tropical and semi-arid Australia. The species feeds on the leaves of various *Eucalyptus*, *Corymbia*, *Lophostomen*, *Angophora* and *Melaleuca* species (Martin and Handasyde 1999) and is highly dependent on the distribution and availability of the feeding resource. The koala is regarded as a specialist feeder and exhibits foraging preference towards the tree species with the highly nutritional content, favouring only 30 of the 600 species of Eucalypts available across Australia (Martin, 2001). On average, the species consumes 500 g of leaves per day and can obtain approximately 50% of their water requirements from their food. Key threats include habitat loss and fragmentation, dog attacks, vehicle strikes, disease and drought (DAWE 2020).

6.3.2 Distribution within the study area

Essential habitat for the koala is mapped approximately 1 km south-east of the study area. The species was not observed during the field survey and no faecal pellets were recorded during the SAT searches. However, potentially suitable koala habitat was recorded within the project footprint and study area during the field surveys. Areas of suitable habitat included *Eucalyptus*-dominated woodlands along and in the vicinity of the Burdekin River and other tributaries. The koala has been considered likely to occur as the species has been historically recorded approximately 7 km south-east of the project footprint and a wide range of koala food trees occur within and adjacent to the study area. Migratory bird species

6.4 Glossy ibis (*Plegadis falcinellus*) – confirmed present

The glossy ibis is the smallest ibis species in Australia, with an average length of 55 – 65 cm, a wingspan of 80 – 95 cm and an approximate weight of 500 – 800 grams (Hancock *et al.* 1992; Marchant and Higgins 1990). This species has a bronze-black body with a metallic iridescent sheen on the wings, a reddish brown neck and a long, distinctive, downward facing bill that is used for foraging. The species is gregarious and known to occur in flocks of up to 30 individuals.

The glossy ibis is the most widespread ibis species with breeding sites scattered throughout Europe, Asia, Africa, America and Australia (Santoro *et al.* 2019). On a global scale, the species is estimated to occupy an area of approximately 19,400,000 km² (BirdLife International, 2010). In Australia, the species is widely distributed though most commonly encountered in the north where it inhabits well-vegetated swamps, wetlands, shallow water mudflats, mangroves and lakes.

The glossy ibis was the only migratory bird confirmed present within the study area where it was encountered within the riparian zone of the Burdekin River.

6.4.1 Migratory bird species considered ‘likely to occur’

Six additional migratory bird species were considered likely to occur, namely the common sandpiper (*Actitis hypoleucos*), latham’s snipe (*Gallinago hardwickii*), caspian tern (*Hydroprogne caspia*), osprey (*Pandion haliaetus*), wood sandpiper (*Tringa glareola*) and common greenshank (*Tringa nebularia*). These species frequent inland and coastal wetlands, swamps and estuarine systems throughout northern and coastal Australia and often undertake annual migrations to the northern hemisphere to breed. The common greenshank, common sandpiper and Caspian tern are known to breed in the Palaearctic regions of Europe, northern Africa and northern Asia, Latham’s snipe often migrates to Japan and Russia, while the wood sandpiper migrates to Scandinavia and areas of western Russia. Although the osprey is often regarded as sedentary, this species has a global distribution and can be found in temperate and tropical regions of all continents except Antarctica.

These species were considered likely to occur due to a combination of past sightings, known distributions and the identification of suitable habitat within the study area.

7. Potential impacts and mitigation measures

7.1 Overview

This impact assessment is based on assessment of current ecological values determined by desktop assessment and results of the dry season survey, concept design and potential operation. Reassessment will be required following the wet season and progression of the project design. Quantification of impacts will occur during this processing, facilitating the assessment of impact significance in accordance with guidelines.

Activities associated with constructing BRW have the potential to cause a number of direct and indirect impacts to local terrestrial and aquatic flora and fauna.

Construction activities that pose a potential risk of impact to flora and fauna include:

- Vehicle and plant movement to, from and around the construction site and during the operational phase
- Removal of vegetation within and immediate construction footprint, storage /stockpiling areas, access tracks and within the river bed and banks
- Construction (excavation, dewatering, establishment of coffer dams) within the waterway
- Inadvertent spillage of potentially hazardous materials
- Acquisition of materials (aggregate) for the use in construction

Potential impacts to flora and fauna resulting from initial filling of the impoundment and operational phase of the weir include:

- Individual fauna injury and mortality
- Disruption to behaviour and restriction of movement of localised wildlife assemblages
- Loss, alteration and degradation of terrestrial and aquatic habitats
- Encroachment of feral animal, pest and weed species increasing predation and competition
- Water capture and storage (impoundment) resulting in changes to downstream flow regimes

7.2 Construction phase

7.2.1 Loss and degradation of vegetation and terrestrial habitat

Potential impacts

Construction of the project will involve clearing of riparian and mixed woodland vegetation within the construction footprint of the weir, saddle dam, access tracks, laydown areas and Big Bend floodway. No conservation significant REs or TECs are known to occur within the proposed areas of impact. The vegetation communities present are common and well represented within the local landscape.

The loss and degradation of vegetation as a result of project construction activities will decrease the diversity and availability of resources for terrestrial fauna species within the immediate local area. While impacting upon smaller, less mobile animals (i.e. small reptiles, rodents, frogs), the selective clearing of a limited amount of vegetation is unlikely to constitute a substantial impact on local faunal assemblages which are adapted to a fragmented landscape. The existing

vegetation at the site of the proposed weir is fragmented and degraded by cattle, and as such, is unlikely to represent important fauna habitat, particularly for conservation significant species.

Based on field observations, the largest contributors to habitat degradation within the study area is historic land clearing associated with agriculture, livestock (within the riparian zone and in shallow water areas), feral animals and weeds. Construction activities have the potential to introduce and / or spread weeds, which can increase the edge effects associated with vegetation clearing. Generally, the landscape surrounding the inundation area is partially fragmented, and as such, isolated patches of vegetation are presently exposed to these processes. Earthworks and increased vehicle movements associated with construction activities at the weir site have the potential to exacerbate local levels of weed infestation.

Construction activities may also foster greater utilisation of the area by introduced fauna. The incorrect disposal of rubbish and other refuse may encourage competitive introduced species including pigs, dogs, foxes and cats to the area, which in turn may increase predation pressure on local native wildlife. These species may also out-compete resident native predators.

Mitigation measures

The loss and degradation of vegetation and terrestrial habitat will be mitigated by:

- Minimising the loss of regional ecosystems and terrestrial habitat during the design phase by locating the ancillary infrastructure such as laydown and borrow areas in areas that have been previously cleared or degraded
- Clearly marking vegetation clearing areas on construction plans and in the field. Areas that must not be cleared or damaged must also be identified
- Locating any additional construction areas or construction sites, such as soil stockpiles, machinery/equipment storage within existing cleared areas
- Clearly identifying all fauna breeding habitat (e.g. hollow bearing trees) within the project construction footprint and managing in accordance with conditions of an approved Species Management Plan for animal breeding places under the Queensland NC Act
- Retaining important habitat features (hollow bearing trees, timber) that will become in-stream snag and perch material
- Where practicable, commencing revegetation activities in and adjacent to construction areas as soon as possible after the completion of construction
- Developing and implementing a stringent and site specific Construction Environmental Management Plan (CEMP) to detail actions and procedures for the protection of the terrestrial environments. The CEMP will include the following actions below to avoid and minimise risks of habitat degradation
- Developing a Weed Management Plan as part of the CEMP that outlines practices to prevent the introduction of new weeds and minimise the spread of declared weeds. Actions to include:
 - Removing existing weeds within the construction footprint prior to construction activities
 - Training key personnel on site to be capable of identifying weed species and preventing their spread and translocation
 - Undertaking daily inspections to monitor control and implementation of appropriate preventative measures for weed and pest species. The construction contractor must control and treat all prohibited and restricted matters in accordance with the Bio Act

- Requiring all plant and equipment to be washed down prior to arriving on site, with a declaration stipulating that the plant and equipment is clean, in accordance with DAF ‘Ways to Prevent Weed Seed Spread’ and the ‘Weed Hygiene Declaration’ forms
- Performing a wash-down of all vehicles, plant and equipment used on site prior to the final departure from site and providing a declaration stipulating that vehicles, plant and equipment is clean
- Managing pest species in coordination with adjacent landholders and catchment management groups. Identification and management of pest species will be undertaken in accordance with the plans and strategies set out by Biosecurity Queensland in the Bio Act. Likewise, management of declared local pests will be undertaken in accordance with relevant local government strategies and plans, including the Charters Towers Biosecurity Plan 2019 – 2024. Actions to include:
 - Disposing of all rubbish and other refuse that may potentially attract introduced animals (food scraps) in sturdy waste disposal receptacles that are frequently emptied
 - Preventing access of domestic animals on the construction site
- Developing and implementing a Dust Management Plan as part of the CEMP to minimise the generation of dust through restriction of speed limits and watering of exposed ground surfaces
- Developing and implementing a Waste and Hazardous Materials Management Plan as part of the CEMP, including fuel and chemical storage protocols and spill responses
- Where practicable, avoid clearing vegetation for the Big Bend floodway. Preferentially locate the floodway in disturbed and/or existing cleared areas to minimise the removal of native vegetation and habitat.

7.2.2 Loss and degradation of aquatic habitat

Potential impacts

Excavation of the bed and banks as part of construction activities for BRW, saddle dam and Big Bend floodway will result in the direct loss of aquatic habitat for aquatic fauna. Aquatic habitat within the BRW construction area includes shallow and deep isolated pools, slow flowing channels and undercut banks. The area of habitat to be lost as a result of construction activities is, however, relatively small in size compared to the availability of similar habitat upstream and downstream of the sites and no habitat for conservation significant species occurs. Additional loss of aquatic habitat has the potential to occur within Lolworth Creek associated with construction of the access track crossing. Construction footprints should be kept to the minimum amount necessary to in order to minimise impacts to aquatic flora and fauna.

Construction works located within and adjacent to the river channel, have the potential to degrade the quality of habitat through increased erosion and run-off and introduction and spread of invasive weed. These activities have the potential to affect water quality resulting in altered water chemistry (including increased turbidity, decreased oxygen levels, reduced light penetration), changes in channel morphology (including filling of pools), alteration of substrate composition and smothering of habitat resources (Wood and Armitage 1997; Wheeler et al. 2005). Unmitigated these impacts may have a localised effect on fauna by reducing habitat value (e.g. amount of refuges, microhabitats and food availability) within the immediate and downstream areas. The potential ecological consequences to the species may include a temporary and localised decrease in fauna abundance and decrease in breeding success. Use of construction machinery in and around aquatic habitats also has the potential to result in the spillage of contaminants, such as fuels and lubricants. In severe cases, chemical pollution of the aquatic environment could result in mortality of aquatic fauna and long-term degradation of

aquatic habitat. Strict environmental controls and management actions will be implemented to avoid and/or minimise the potential for proposed actions to degrade terrestrial and aquatic habitat. These management actions will be embedded within a CEMP.

Mitigation measures

The loss and degradation of aquatic habitat will be mitigated by:

- Minimising the loss of aquatic habitat during the design phase by locating access tracks and ancillary infrastructure outside waterways
- Locating any additional construction areas or construction sites, such as soil stockpiles, machinery/equipment storage within existing cleared areas and away from the waterway bed and banks
- Retaining large woody debris from vegetation clearing for addition to the Burdekin River and Lolworth Creek to provide instream habitat post-construction
- Using high quality fill for abutments and the saddle dam to minimise the introduction of contaminants into Burdekin River
- Restoring bed and banks to pre-existing profiles following completion of works
- Preparing and implementing a stringent and site specific CEMP to detail actions and procedures for the protection of the aquatic environments as described in Section 7.3.1
- Preparing and implementing a project specific Erosion and Sediment Control Plan (ESCP) in accordance with practices described in the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline and/or Queensland Division of the Australian Institute of Engineers' Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites. The ESCP will be prepared by a highly experienced certified professional in erosion and sediment control (CPESC) and will include the following methods to minimise degradation of aquatic habitats:
 - Installing erosion protection measures in the form of sediment fences where required to minimise the transport of sediment into the Burdekin River, Lolworth Creek and adjacent terrestrial habitats
 - Installing sediment curtains to minimise downstream transport of sediments released during vegetation clearing and earthworks
 - Minimising erosion potential through scour protection treatments at abutments
 - Minimising vegetation clearing and the area of bare ground required for construction to only that which is necessary
 - Appropriately managing and protecting stockpiles
- Monitoring of water quality conditions (visual and in situ recordings) to identify the potential for water quality degradation within Burdekin River and allow for adaptive management if required

7.2.3 Individual fauna injury and mortality

Potential impacts

Construction activities associated with the project will involve a temporary increase in vehicular traffic and plant movement to, from and at the site, including traffic on existing and new access roads. This has the potential to increase the incidence of wildlife and livestock mortality from vehicle strike. Fauna at particular risk of vehicle strike include ground-dwelling bird species and reptile species that commonly occur on tracks throughout the region.

Clearing to facilitate construction (including along access tracks) may also result in direct mortality to individual animals residing in trees and other vegetation, and within ground cover, litter or debris to be cleared. Similarly, aquatic fauna may experience direct injury and/or mortality if individuals are present within the areas of disturbance at the time of works. Key mitigations for the protection of terrestrial and aquatic fauna are listed below and include the requirement for a fauna spotter catcher to be present on site during vegetation clearing, during initial site works and works within the bed and banks where aquatic fauna risk injury.

Mitigation measures

The risk of fauna injury and mortality will be mitigated by:

- Conducting a pre-construction survey for breeding habitat within disturbance footprints to determine the requirement for Species Management Plans under the NC Act
- Enforcing on-site speed limits to restrict the incidence of vehicle strike
- Minimise the need to travel near dawn or dusk by adhering to standard daytime work hours, limit haulage and delivery of materials to the day time and/or where possible, minimise the number of vehicles travelling during this period through the use of car pooling to transport construction personnel
- Educating employees regarding the presence of conservation significant species and other fauna and livestock on access roads
- Erecting temporary construction fencing to exclude mobile animals such as macropods and livestock from the construction areas
- Checking of trenches, excavations and machinery daily for the presence of reptiles
- Fauna spotter catchers present prior to and during clearing activities associated with construction to relocate or assist wildlife to disperse into adjacent habitat
- Fauna spotter catchers present to relocate aquatic fauna where there is risk of injury to fauna prior to and during any works within the river
- If injuries occur, the fauna spotter catcher will capture and transport the injured animal to a qualified veterinarian for treatment or euthanasia (unless suitably-qualified). Prior to clearing for construction, formalise arrangements with local veterinary services to treat and care for injured animals
- Clearly demarcating no-go areas of sensitive vegetation and habitat, including all vegetation and habitat not to be cleared
- Sequential clearing of vegetation to allow resident fauna the opportunity to disperse away from the immediate construction area

7.2.4 Disruption to behaviour of localised terrestrial and aquatic fauna

Construction activities will cause a temporary localised and intermittent increase in light, noise and vibration adjacent to construction sites. This has the potential to cause short-term disruption to the behaviour and activities of nearby wildlife. There are no noteworthy fauna communal nesting, breeding, roosting or foraging resources directly adjacent to the construction footprints. Nevertheless, construction activities have the potential to deter terrestrial wildlife from foraging, drinking, seeking shelter or nesting within the vicinity of construction activities. Construction activities may require works to be undertaken at night. In the event that lighting is required to facilitate night works (for example concrete pour operations), there is potential for light pollution to disrupt nocturnal fauna behaviour.

Increased levels of disturbance (e.g. from noise, vibration, light, vehicles, machinery, personnel) also have the potential to disrupt the behaviour and dynamics (i.e. foraging, movement) of aquatic fauna inhabiting the river channel within and adjacent to the construction footprints. Behavioural changes expected to occur include avoidance and evasive (startled) movement leading to displacement from habitat and loss of resources within the direct areas of impact.

Water flow within the Burdekin River will be impacted as a result of construction activities and therefore upstream and downstream movement of aquatic fauna is likely to be restricted through the construction period. Weir construction and upgrade of Big Bend floodway within the river channel is expected to primarily be undertaken during the dry season when flows are reduced and the river is more likely to exist as a series of isolated pools. Movement of aquatic fauna during this period is likely to be low. An in-stream flow diversion strategy will be developed to maintain flows during construction and provide safe aquatic fauna passage during the construction phase flow events.

Mitigation measures

Proposed mitigation during the construction phase to minimise the impacts of noise, light and vibration disturbance include:

- Minimise the duration of the construction period to the minimum necessary
- Use noise dampening devices on machinery wherever practical and requiring that all equipment is maintained and serviced in accordance with manufacturer's instructions to reduce noise levels
- Require soft starts and broadcast of a warning noise so that individuals have a chance to move away from the area before more intense noise and vibrations start
- Restrict night works as far as is possible during the construction phase
- Install directional lighting and shields to minimise light spill outside of the immediate work areas having consideration for health and safety requirements
- Maintain river flow and aquatic fauna movement within its natural course for as long as possible. A flow diversion strategy will be developed to limit river diversion to a single dry season
- Design temporary river crossings/working platforms in accordance with DAFs '*Accepted development requirements for operational work that is constructing or raising waterway barrier works*'

7.3 Operational phase

7.3.1 Loss and degradation of vegetation and terrestrial fauna habitat

Potential impacts

The construction of BRW will result in the inundation of vegetation within the riparian zone along the Burdekin River. This inundation will result in the loss and alteration of vegetation communities and fauna habitat.

Vegetation will not be cleared prior to impoundment and consequently total habitat loss within the expected inundation area will occur over a prolonged period as the weir fills and is drawn down regularly through operation. On first filling, it is anticipated that an immediate loss of ground cover vegetation within the impoundment will occur. Larger and woody vegetation such as trees will remain for a period of time before dieback occurs. Given that water levels in the impoundment will rise and fall with filling and drawdown, habitat loss at the limits of the impoundment will occur more gradually, in response to intermittent inundation.

The riparian zone within the expected area of inundation is already disturbed through clearing, weed infestation and cattle grazing and no conservation significant REs, TECs or flora species are known to occur. The area of inundation does provide suitable habitat for terrestrial fauna with desktop reviews and field surveys identifying that species present are primarily generalist species that are widespread and relatively abundant in the study area and the wider North Queensland region. Potential impacts on flora and fauna associated with habitat loss and / or alteration within the inundation area may include:

- Loss of mature trees, particularly *Melaleuca* spp., *Eucalyptus* spp. and *Corymbia* spp., over time (months to years) in the riparian zone that provide foraging (leaves, nectar, pollen, fruit, sap and invertebrates), breeding and sheltering/roosting/nesting resources (e.g. tree hollows and shedding bark) for a range of woodland and forest birds, arboreal mammals and bats
- Short-term reduction in dense, low growing riparian vegetation along the main river channels and creeks that provide habitat for small woodland and forest birds and ground-dwelling mammals
- A reduction in availability of habitats supporting a structurally complex ground layer, that is inundation of riparian habitats supporting fallen timber, log piles, leaf litter and burrowing / cracking soils that provide habitat for reptiles
- Short-term loss of overhanging vegetation that provides perching habitat for kingfishers, cormorants, raptors and the eastern water dragon (*Physignathus lesueurii*). The loss of this overhanging vegetation also reduces suitable nesting habitat for birds including cormorants and egrets
- Short-term loss of existing marginal and emergent vegetation in shallow water aquatic habitats utilised by waterbirds such as ducks, egrets, herons and storks as well as small fish, macroinvertebrates and turtles
- Inundation of sand banks and rocky outcrops which may support waterbirds, mammals and reptiles
- Creation of habitat for waterbirds such as ducks and pelicans through the increase in permanency of water within the impoundment

The inundation of riparian vegetation and the disruption to terrestrial habitats bordering the new full supply level (FSL) of the impoundment may also foster habitat degradation. This degradation may result from:

- Edge effects occurring in newly fragmented riparian habitat
- Isolation of remnant vegetation patches, allowing for domination by generalist and invasive plants and animals
- Increased competition for resources in riparian vegetation habitats due to a reduction in the overall extent of this habitat

Adverse impacts associated with edge effects include:

- Increased penetration of light and wind into habitat patch, potentially altering vegetation communities
- Alteration to microclimate
- Increased invasion of exotic plants and animals
- Increased sensitivity to fire

For the most part, impacts of habitat loss and degradation are considered to be short-term with fauna having the ability to move between areas of suitable habitat returning once vegetation has re-established above the impoundment.

Conservation significance fauna considered likely to occur within the study area include the greater glider and koala. Some loss of habitat and habitat resources for these species is expected to occur as a result of the inundation of riparian vegetation within the BRW impoundment. Due to the small area of vegetation that is expected to be lost or altered, impacts to these species are not expected to be significant, however, assessment against significant impact guidelines will be undertaken following wet season surveys and finalisation of project impact areas.

Mitigation measures

As a function of operations of the proposed weir, loss and degradation of vegetation and terrestrial habitat will occur. To minimise and alleviate the potential impacts on flora and fauna, the following mitigation measures should be considered:

- Preventing clearing of vegetation prior to filling of the impoundment to retain habitat above and below FSL
- Reinstating important habitat features (hollow bearing trees, timber) retained during the construction phase
- Developing and implementing a stringent and site-specific operational phase EMP. Management actions prior to operation of the project to include the preparation of a Weed and Pest Management Plan and ESCP
- Where relevant, providing vegetation offset to ensure no-net-loss of potential habitat for conservation significant species (in regional context)
- Designing the operational strategy of the proposed weir to consider ecological processes occurring within and adjacent to the impoundment. Rapid drawdowns of the storage should be avoided and water levels should be controlled to allow changes to existing habitat about the margins of the storage to proceed more slowly

7.3.2 Fragmentation of riparian habitat

Potential impacts

Most of the landscape surrounding the inundation area has been partially cleared, predominantly for agriculture. This is particularly the case on lowland alluvial floodplains, where cattle grazing on cleared pasture is the dominant land use. Vegetation in these otherwise cleared or fragmented landscapes tends to be concentrated along the riparian fringe of the Burdekin River and adjoining creeks. Extensive open woodland communities on low rocky hills and rises, and less disturbed open woodland on sandy levees represent important habitat nodes within the disturbed landscape matrix. These habitats are likely to act as a source for fauna dispersal across the landscape. Fauna dispersal across the fragmented landscape is likely to be facilitated, at least in part, by vegetation corridors adjacent to the Burdekin River and adjoining creeks.

The impoundment of riparian vegetation resultant from the project has the potential to disrupt connectivity between habitats, thereby further fragmenting habitats within the inundation area (and the wider study area). This reduction in connectivity along the riparian zone is likely to be most notable where only a thin strip of fringing riparian vegetation, abutted by cleared agricultural land, occurs. The inundation and drowning of this vegetation will disrupt the corridor along which fauna can move between more extensively vegetated habitats. This is likely to be of

particular consequence to more mobile species that undertake occasional to frequent foraging, reproductive and / or dispersal movements, and / or species that may become more exposed to predation due to reduced habitat connectivity.

The increased width of permanent pools within the river channel, and the reduced occurrence of shallow water and seasonally dry riverine habitats will also reduce the ability of terrestrial fauna (namely mammals and reptiles) to move back and forth across the river.

The potential impacts of reduced connectivity and subsequent habitat fragmentation on common terrestrial fauna (namely reptiles, small ground-dwelling and arboreal mammals and birds) and species of conservation significance (such as the greater glider (northern) and koala) may include:

- Greater competition (intraspecific and interspecific) for resources in increasingly isolated habitat patches in an already fragmented landscape
- Increased habitat degradation due to concentration of animals in isolated patches
- Dominance of isolated habitat patches by competitive, generalist species (plants and animals)
- Increased exposure to predation for animals that are forced to move across disturbed, open landscapes
- Greater magnitude of impact of environmental changes (fire, drought, disease etc.) when animals are unable to move between habitat patches due to hostile surrounding landuse (unsuitable resources, greater risk of predation)

While the impoundment has the potential to disrupt terrestrial fauna movement corridors, bioregional corridors will still prevail directly adjacent to the high water level of the impoundment.

Mitigation measures

As a function of operations of the proposed weir, fragmentation of terrestrial habitat will occur. To minimise and alleviate the potential impacts on fauna, the following mitigation measures should be considered:

- Maintenance and enhancement of movement conduits for terrestrial fauna through implementation of the operational phase Environmental Management Plan (EMP) which will be prepared prior to operation of the project and rehabilitation of habitat in key movement areas

7.3.3 Loss and degradation of aquatic habitat

Potential impacts

Aquatic habitat within the Burdekin River will be altered as result of BRW through the conversion of flowing pool-riffle-run sequences to a more homogenous lentic impounded pool. Habitat alteration will occur on commissioning and persist through operations as the weir fills and is drawn down regularly. The lower reaches of the Keelbottom Creek are also likely to experience varying degrees of alteration resulting from changes in connectivity and hydrology. Habitat alteration is expected to include the inundation of periodically dry creek bed and banks. The extent of this alteration will be more notable in and adjacent to the lower reaches of the weir impoundment.

Operation of the proposed BRW can be expected to result in impacts on water quality at the site. Potential water quality impacts arising from the proposed weir operation may include:

- Decomposition of plant material and subsequent release of nutrients in areas of inundation within the impoundment
- A reduction in dissolved oxygen and temperature stratification within the water column as a result of the riverine system changing to deep, slow flowing pools
- Mobilisation of contaminants in areas of contaminated land (if present)
- An increase in the presence of blue-green algae

Changes in water quality will primarily occur within the impoundment, however, downstream habitats may also be affected should waters of lower quality be released.

No palustrine or lacustrine wetland areas will be directly impacted by the proposed weir. Water levels within the impoundment will remain within the high banks of the existing river with the weir wall drowning out completely during flows above this level. As such, flow events that naturally breakout of the river banks and form overland flows will not be impacted by BRW. No impact to seasonality, duration, frequency and volume of water entering and leaving the off-stream water bodies is expected to occur. Consequently, it is not expected that the proposed weir will impact the specific habitat characteristic of the off-stream water bodies (including the Great Basalt Wall DIWA, Wetland Protection Areas and HES wetlands) and their value for aquatic flora and fauna.

Aquatic fauna in the Burdekin Basin are adapted to the highly dynamic and variable nature of the system. These adaptations are represented by the specific foraging, breeding and sheltering preferences of the species that occur within the system. A review of the ecology of fish species known to occur within the Burdekin Basin catchment revealed that most species prefer (or are tolerant of) the still or slow flowing conditions that are present in pool habitats (Pusey et al. 2004; Allen et al. 2003). The conversion of pool-riffle-run sequences to a weir impoundment will most adversely impact species that prefer flowing water and high levels of instream habitat.

The impounded habitat created as a result of the weir will be generally characterised by a deep, wide river channel, slow to zero flow, poorer quality clay/silt substrate, lower density of in-stream debris and lower density of overhanging riparian vegetation. The deep water benthic areas (5 to 10 m deep) that will dominate the weir pool habitat directly behind the weir wall are expected to be sub-optimal to most aquatic fauna species due to low oxygen levels, little or no light penetration and relatively colder temperatures. The upper water column within the more open inundation area is likely to provide suitable habitat for species such as large bodied fish – sooty grunter, barred grunter, bony bream and the Krefft's river turtle. Many other species are likely use the inundated habitat intermittently with low abundance of micro-habitats and food resources generally limiting permanent occupancy of more open water habitats.

In general, suitable habitat for aquatic fauna will occur within the shallow littoral habitats along the perimeter of the inundated area and within the upper extent of inundation. These areas will contain a higher diversity of in-stream microhabitats such as fallen logs and root mats and food resources. Macrophyte communities are also likely to re-establish in the upper reaches with the frequency of water level fluctuations expected to impact macrophytes growth within the main impoundment.

Overall, the alteration of natural riverine habitats within the BRW footprint will reduce the heterogeneity of the river system and therefore the diversity of habitats available to aquatic fauna. Ecological consequences are expected to include variation in relative abundance of fish and turtle species. An upsurge in macroinvertebrate diversity and abundance within the proposed BRW, is predicted to occur immediately following inundation due to the release of nutrients from newly inundated soil and vegetation (Baumgartner 2005). However, following this initial productivity, nutrient depletion and habitat homogeneity is expected to result in a decline in macroinvertebrate diversity and fewer pollution sensitive taxa when compared with riverine sites (Duivenvoorden et al. 2000; Baumgartner 2005).

Mitigation measures

The following management measures are proposed to avoid/minimise the potential impact of habitat alteration on aquatic ecological values:

- Preventing clearing of riparian vegetation prior to inundation to create instream and overhanging habitat at FSL
- Reinstating important habitat features (e.g. large woody debris) retained during the construction phase
- Encouraging re-establishment of aquatic habitat within the impoundment through the following actions:
 - Avoiding rapid drawdowns of the storage area to allow for the stabilisation of aquatic habitat around the margins of the impoundment
 - Promoting the natural regeneration of trees and shrubs
 - Controlling introduced weeds and feral animals in accordance with an operational phase EMP which will be prepared prior to operation of the project
- Developing and implementing an operations Water Quality Management Plan in accordance with the operational phase EMP which will be prepared prior to operation of the project

7.3.4 Restriction of fauna movement

Potential impacts

The Burdekin River and Lolworth Creek are both categorised as major (purple) waterways which indicates that there is a high risk of impact from waterway barrier works. During operation, in-stream structures such as the weir wall, saddle dam and Big Bend floodway will represent an impediment to the movement of aquatic fauna. This disruption to connectivity along the continuum of the river not only has the potential to fragment populations and habitats, but also potentially impedes the life-history behaviour of aquatic fauna occurring within the system.

Tropical freshwater fish regularly move among spawning, feeding and refuge habitats (Lowe-McConnell 1987; Lucas and Baras 2001) and free movement of fish within the river system is thought to be crucial in order to maintain viable populations (Marsden and Power 2007). The diversity of fish within the upper reaches of the Burdekin River has been influenced by existing waterway barriers including Charters Towers Weir and the Burdekin Falls Dam, located approximately 23 km and 180 km downstream of BRW, respectively. Burdekin Falls is a natural barrier to fish movement and as such the fish community upstream is naturally comprised of potamodromous (species that move wholly within the freshwater environment) species only. Some diadromous species (species that move between freshwater and marine environments), have been artificially stocked within Burdekin Falls Dam but do not naturally occur (Pusey et al. 2004).

No conservation significant fish species occur at BRW, however, a number of fish species are likely to be negatively impacted by the restriction of movement in the absence of mitigation measures proposed below. These species include, long-finned eels, leathery grunter, spangled perch, Hyrtl's tandan, Rendahl's catfish, eastern rainbowfish and empire gudgeon, all of which undertake spawning migrations during flow events (Reynolds 1983; Stuart 1997; Stuart 1999; Pusey et al. 2004). The potential ecological consequence of the restriction of fish movement can include declines in abundance, species distribution truncation, localised extinction events and a reduction in species diversity (Marsden and Power 2007).

Other aquatic fauna, including turtles and macroinvertebrates, are also likely to be impacted by the restriction of movement past the weir wall. The home range size of freshwater turtles is generally relatively small, however, long-distance (>10 km) migrations can occur for the purpose of dispersal, repositioning following flood displacement and reproduction (Tucker et al., 2001; Hamann et al., 2007). BRW is likely to restrict these migrations which may lead to fragmentation of populations, disruption of breeding and aggregation of some species (particular the Krefft's River turtle) within the stilling basin below the weir wall. A reduction in diversity of macroinvertebrates downstream of BRW is also likely to occur as a result of the impediment of downstream drift (Marchant and Hehir 2002).

Mitigation measures

The following management measures are proposed to avoid/minimise the restriction of aquatic fauna movement:

- Providing adequate upstream and downstream fish passage for the entire fish community in accordance with State Code 18: Constructing or raising waterway barrier works in fish habitats. A fishway design process should be undertaken in accordance with DAF's Fishway Design Process criteria. This process involves the selection and refinement of fishway design specifications and success criteria and the development of fishway designs. Fish biologists and technical specialists (suitably qualified and experienced in fish passage biology and fishway design) should participate in the fishway design process to provide key technical input and review. The fishway design options should be assessed against an agreed design specification and success criteria to demonstrate that the fishway design provides adequate fish passage
- Investigating design options for providing adequate upstream and downstream passage for freshwater turtles during key movement periods
- Designing and implementing a monitoring program to monitor the effectiveness of aquatic fauna passage infrastructure
- Submission of a waterway barrier works development application and provision of acceptable fish passage for any waterway crossing or auxiliary access

7.3.5 Fauna injury and mortality

Potential impacts

Injury and mortality of terrestrial fauna may result during rapid filling of the impoundment when less mobile animals are caught within the inundation area. Native fauna in the Burdekin River exist within a system in which flooding (often rapid and extensive) is a regular event and most animals are able to seek refuge above rising flood water and similarly it is expected that animals will move away from rising water within the impoundment. The inundation of terrestrial habitats above typical high flow mark at the proposed BRW is likely to result in the death of less-mobile animals that are unable to retreat from the rising water. Small terrestrial animals within the impoundments such as skinks, geckos, rodents and juvenile animals in nests or borrows, may be trapped by rising water and be injured or drowned.

Beyond the initial filling of the construction of BRW, regular draw-down and filling of the storage during operation is considered unlikely to result in significant fauna mortalities. Vegetation is expected to re-establish on riverbanks at the FSL and loss of vegetation from within the impoundment will deter use of the impoundment for foraging and breeding by terrestrial fauna species. Water levels within the Burdekin River fluctuate annually in their natural state (high flows and flood to no or very low flow) and it is unlikely that the operation of the weir will have a notable long-term impact on upstream terrestrial fauna. During operations, as draw-down

occurs, livestock and kangaroos have the potential to become bogged directly behind the impoundment where fines may build up creating soft sediments.

During operation, injury and mortality can occur when aquatic fauna (in particular freshwater turtles and fish species) are swept over the spillway during periods of high flow. Fish species are particularly susceptible to shearing and abrasion injuries from contact with hard structures in the downstream pool and contact with the spillway during flooding events. Fish are also vulnerable to gill, eye and internal organ damage from the sudden changes in velocity and pressure that occur as the fish are swept over the spillway or through undershot gates (Larinier 2000) (Baumgartner et al. 2006). Freshwater turtle injury and mortality is commonly associated with entrapment on trash screens, contact with hard surfaces and aggregations of turtles within areas of intermittent flow velocity.

Mitigation measures

The following management measures are proposed to avoid/minimise the potential for fauna injury and mortality:

- Avoiding key design features responsible for high levels of fauna injury and mortality (stepped spillway, dissipater teeth, high turbulence, insufficient pool length and depth, high velocity trash screens) thereby substantially reducing the risk of injury and mortality to fish and turtles
- Designing the operational strategy of the proposed weir to avoid/minimise risk of fauna injury and mortality. Specific operational actions will include:
 - Controlling the flow of water through release valves to provide gradual increments in water release volume
 - Depending on design, during planned releases, increase water release during dawn and dusk periods when turtles are more likely to be away from weir infrastructure

7.3.6 Alteration to downstream flow regimes

Potential impacts

The operation of BRW is predicted to result in a change to the downstream flow regime between the weir and upper inundation limit of the existing Charters Towers Weir. The timing and quantity of releases downstream is likely to vary between seasons with the dry winter period expected to trigger the highest demand for water resources downstream. As a result, water flows downstream will increase during the dry season and the frequency and duration of no flow periods will decrease. The increase in flows during the dry season has the potential to improve the quality of aquatic habitat downstream by reducing the duration and severity of pool isolation and prolonging the presence of flowing riffles zones and runs. The increase in habitat availability during the dry season will provide additional resources for aquatic fauna during times when conditions would be limiting under pre-development conditions. The diversity and abundance of macrophytes and macroinvertebrates, is likely to change with a potential increase in species that prefer flowing conditions and a reduction in species that prefer slow flowing and ephemeral habitats.

The operation of the proposed weir is also likely to result in a reduction in the frequency and magnitude of small to medium downstream flood flows. Flood flows entering the impoundment are likely to be captured and stored until the weir reaches its FSL. This will result in the reduction of flows downstream (or at least a lag in the flow downstream) and is most likely to occur at the start of summer when the storage is predicted to be at a minimum in most years. It is noted that this lag is expected to be of short duration. Once the weir reaches its FSL, downstream flows will increase however the magnitude of the events will be reduced compared

to existing conditions. Large flood flows, i.e. weir drown-out will, however, not be affected by the proposed infrastructure.

Releases of water from the proposed BRW will be made in accordance with environmental flow objectives outlined in the *Water Plan (Burdekin Basin) 2007* and Resource Operations Plan. These environmental flow objectives have been specifically nominated to maintain base flows and other ecologically important flow characteristics, for the protection of environmental values throughout the Burdekin River Basin. Compliance within these objectives will minimise adverse impacts of BRW on ecological values downstream.

Mitigation measures

The following mitigation measures are proposed to avoid and/or minimise potential impacts associated within the alteration to downstream flows:

- Designing the operation strategy of the weir in accordance with environmental flow objectives. Where required, yield adjustments and operating rules will be amended to comply with the objectives
- Developing and implementing an operations Water Quality Management Plan in accordance with the operational phase EMP which will be prepared prior to operation of the project. Specific management actions should include:
 - Considering opportunities for multi-level off-takes in weir design
 - Using selective withdrawal outlets to select water of most appropriate quality for downstream release
 - Manipulating flows to prevent the build-up of blue-green algae or to disperse blooms

8. Significance of impacts assessment

8.1 Overview

This section assesses the significance of the projects' impacts on conservation significant species that have been confirmed present or considered likely to occur within the study area. For species listed under the EPBC Act, an assessment has been made against the Significant Impact Guidelines 1.1 (DoE 2013). Assessments of the significance of impact have been made for the following conservation significant species that have been confirmed present or considered likely to occur within the study area:

- Squatter pigeon (southern) (*Geophaps scripta scripta*)
- Greater glider (northern) (*Petauroides volans minor*)
- Koala (*Phascolarctos cinereus*)
- Migratory species
 - Glossy ibis (*Plegadis falcinellus*)
 - Common sandpiper (*Actitis hypoleucos*)
 - Latham's snipe (*Gallinago hardwickii*)
 - Caspian tern (*Hydroprogne caspia*)
 - Osprey (*Pandion haliaetus*)
 - Wood sandpiper (*Tringa glareola*)
 - Common greenshank (*Tringa nebularia*)

8.2 Significance of impact on conservation significant species

8.2.1 Squatter pigeon (southern)

The project is unlikely to result in a significant impact on the local squatter pigeon population. The project footprint has been sited outside core breeding and foraging habitat. The project will result in the clearance of 40.99 ha of habitat present within the project footprint, representing 12.52 percent of habitat within the project footprint and 0.24 percent of habitat within the regional area (i.e. available within a 5 km radius of the project footprint). Access to water is an important determinant of habitat utilisation for this species (DAWE 2020) and so, the increase of permanent water resulting from the impoundment of water behind the weirs may provide long-term benefit to the species. As such, it is unlikely that small, localised losses of habitat along the largely disturbed riparian fringe will adversely impact the regional viability of this species. Construction activities within the project footprint will involve a temporary increase in vehicular traffic and plant movement to, from and at the site. This has the potential to increase the incidence of fauna injury and/or mortality due to vehicle strike. The clearing of a limited amount of vegetation to facilitate construction (including access and laydown areas) may also result in injury or direct mortality of the squatter pigeon (southern), residing in areas to be cleared. The project is expected to be relatively benign during the operational phase, with potential for enhanced habitat values through increased levels of land management. A Weed Management Plan will be developed and implemented during the construction and operation phase, providing a greater level of control over weeds than is currently provided. The project is therefore considered unlikely to cause a significant impact given the scale of the loss and context in the context of the surrounding landscape. The justification for this is detailed in Table 8-1, based on the responses to Significant Impact Guidelines 1.1 (DoE 2013).

Table 8-1 Significance of impact on the squatter pigeon (southern)

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of an important population of the species	Unlikely Important populations of the squatter pigeon (southern) are listed as those small, isolated and sparsely distributed sub-populations at the southern extent of the sub-species current range. This includes areas south of the Carnarvon Range (Squatter Pigeon Workshop 2011). The local sub-population occurs approximately 300 km north-east of Carnarvon Range and is well beyond the range of those listed as important populations. The loss of 40.99 ha of habitat (representing 12.52 percent of habitat within the project footprint and 0.24 percent of habitat within the regional area – within a 5 km radius of the project footprint) will not lead to a decline in an important population and is considered unlikely to lead to a significant decline in the general population. Increased vehicular movements during construction will increase the risk of mortality and injury of squatter pigeons; however, this will be managed through implementing speed limits and signage in areas that may support the subspecies. The project is expected to be relatively benign in terms of operational impacts with negligible noise, vibration, land disturbance and vehicular movements. Permanent speed limits and signage on internal roads and education of staff during inductions will minimise the risk of direct mortality by operational vehicles. As such, the project is therefore unlikely to lead to a long-term decrease in the size of the local population of a species.
Reduce the area of occupancy of an important population	Unlikely While the project will result in a loss of 40.99 ha of potential habitat (representing 12.52 percent of habitat within the project footprint and 0.24 percent of habitat within the regional area – within a 5 km radius of the project footprint), the squatter pigeon (southern) present within the area are not known to form part of an important population of the subspecies. The increase of permanent water resulting from the impoundment of water behind the weirs is considered to provide long-term benefit to the subspecies. Given the relatively benign nature of the project in its operation phase, and the continued presence of suitable habitat within the local area, the project is unlikely to reduce the area of occupancy of the local squatter pigeon (southern) population.
Fragment an existing important population into two or more populations	Unlikely Fragmentation of the existing squatter pigeon (southern) population is not expected, as the loss of connectivity between habitats will be maintained above the FSL of the impoundment to facilitate species movement between populations. Accordingly, the project is unlikely to fragment the important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Unlikely While the project will result in a loss (40.99 ha) of potential habitat for the squatter pigeon (southern), this is not considered to constitute habitat critical to the survival of the subspecies. The increase of permanent water resulting from the impoundment of water behind the weirs is considered to provide long-term benefit to the species.
Disrupt the breeding cycle of an important population	Unlikely Breeding habitat for the squatter pigeon (southern) (i.e. hills and rises with rocky, loamy and sandy soils) occurs within the study area. The inundation will not result in the loss of potential breeding habitat for the species; however, clearing of vegetation within the construction footprint of the weir, saddle dam, access tracks and

Impact criteria	Potential to occur
	laydown areas will result in a loss of potential breeding habitat. The project is unlikely to have significant indirect impacts on adjacent breeding habitat. As such, the project is unlikely to disrupt the breeding cycle of the local squatter pigeon (southern) population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The loss of open woodland habitat as a result of the project, is not sufficient to threaten the broader availability or quality of habitat for the subspecies such that this could cause a decline in the population of the subspecies. The increase of permanent water is considered to benefit the population in the long-term.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Unlikely The project footprint is currently impacted by weed and pest species that could be harmful to the squatter pigeon (southern). The presence of these invasive species will not be exacerbated by the project, and any risks of their establishment will be managed via a site specific CEMP.
Introduce disease that may cause the species to decline	Unlikely Recognised threats to the squatter pigeon (southern) do not include diseases. However, it is not expected that the project would result in the introduction of disease.
Interfere substantially with the recovery of the species	Unlikely The project is considered unlikely to adversely affect the potential recovery of the species. The loss of habitat is unlikely to be significant at a local or regional scale, representing only 12.52 percent of local habitat present within the project footprint and 0.24 percent of regional habitat present within a 5 km radius. Implementation of a CEMP for the project has the potential to increase the value of local habitats. Local noise disturbance and mortality threats associated with the project are also expected to be low.

8.2.2 Greater glider (northern)

The project is unlikely to result in a significant impact on the local greater glider (northern) population. No suitable denning habitat occurs within the project footprint, and the project will result in the loss of 40.99 ha of sub-optimal foraging habitat. This represents 12.52 percent of the foraging habitat present within the project footprint and 0.24 percent of regional habitat (i.e. available within a 5 km radius of the project footprint). Areas impacted are considered to be sub-optimal given the low density of hollow-bearing trees. The greater glider (northern) is dependent on the presence of mature hollow-bearing trees to provide den sites (Henry 1984; Kehl and Borsboom 1984; Lindenmayer *et al.* 1991; Goldingay 2012) and typically forages within a 1 – 4 ha area, in proximity to denning habitat (Henry 1984; Kehl and Borsboom 1984; Comport *et al.* 1996; Gibbons and Lindenmayer 2002). Construction related mortality and injury risks are considered low and can be effectively mitigated through the use of experienced spotter-catchers during clearing of potential foraging habitat. During the operation phase, the inundation of vegetation within the riparian zone along the Burdekin River will result in the loss and alteration of habitat. Justification for this assessment has been detailed in Table 8-2, based on the responses to Significant Impact Guidelines 1.1 (DoE 2013).

Table 8-2 Significance of impact on the greater glider (northern)

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of an important population of the species	Unlikely The concept of important populations has not yet been defined for the greater glider (northern). This assessment has been made on the assumption that the local greater glider (northern) population is important. No potential denning habitat for the greater glider (northern) is expected to be directly impacted by the project. Suitable denning habitat occurs on upland slopes, adjacent to the project footprint. The project will result in the loss of 40.99 ha of potential foraging habitat. This represents 12.52 percent of the local habitat present within the project footprint and 0.24 percent of regional habitat present within a 5 km radius. Given the low density of hollow-bearing trees adjacent to the project footprint, the value of foraging habitat is considered low. The project will have low background levels of noise and vibration, and is therefore expected to have negligible indirect impacts on the species through the operational phase. Given the relative low value habitat within the project footprint and the relatively benign nature of the project, no long-term decrease in the size of the local greater glider (northern) population is expected.
Reduce the area of occupancy of an important population	Unlikely At most, the project will result in a localised loss (40.99 ha) of sub-optimal habitat for the greater glider (northern). Likely habitats for the species are located in hilly, forested habitat adjacent to the project footprint. Given the low level of noise and vibration disturbance associated with the project, it is unlikely to have any significant indirect impact on the local population. The local population is therefore not expected to be impacted by the project. Accordingly, the project is unlikely to reduce the area of occupancy of the local greater glider (northern) population.
Fragment an existing important population into two or more populations	Unlikely Fragmentation of existing greater glider (northern) population is not expected as the loss of connectivity between habitats will be maintained above the FSI level of the impoundment to facilitate species movement between populations.
Adversely affect habitat critical to the survival of a species	Unlikely No habitats observed within the project footprint could be described as habitat critical to the survival of the species, or to the survival of the local population. Habitats subject to direct impact are sub-optimal, hollow-deficient woodland areas that will have only limited value as foraging habitat for the greater glider (northern). Areas of suitable denning habitat occur on the slopes uphill of the project. Given the project is expected to have limited noise, light, vibration and other source of potential disturbance, the level of indirect impact is expected to be negligible, and unlikely to adversely affect habitat critical to the survival of the local population.
Disrupt the breeding cycle of an important population	Unlikely No breeding or denning habitat is expected to occur within the project footprint. The project is unlikely to have significant indirect impacts on adjacent breeding habitat. As such, the project is unlikely to disrupt the breeding cycle of the local greater glider (northern) population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that	Unlikely The project will remove up to 40.99 ha of potential foraging habitat for the species. The habitat to be impacted is not considered primary habitat, as it lacks an abundance of large hollows. The

Impact criteria	Potential to occur
the species is likely to decline	loss of 40.99 ha foraging habitat represents 12.52 percent of foraging habitat present within the project footprint and 0.24 percent of regional habitat present within a 5 km radius of the project footprint. The small, localised loss of potential foraging habitat is not likely to impact the species' survival in the region. As such, it is unlikely the project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Unlikely The project is unlikely to result in the introduction or spread of invasive species beyond current levels. The implementation of a site specific CEMP will further reduce potential impacts of invasive species. As such, the project is not expected to result in invasive species that are harmful to the greater glider (northern) becoming established in the species habitat.
Introduce disease that may cause the species to decline	Unlikely Disease is not a known threat to the greater glider (northern). The project is unlikely to introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely Although loss of habitat is described as a major threat to the species, the habitat within the project footprint subject to inundation and clearing, is not considered habitat critical to the species nor is the local population considered an important population. Isolation of a population is not expected as result of habitat loss. As such the project is considered unlikely to interfere with the recovery of the species.

8.2.3 Koala

The significance of the project's impacts on the koala has been assessed using the *EPBC Act referral guidelines for the vulnerable koala* (DoE 2014) and presented in Table 8-6. This employs a two-step process to determine the significance of impact, based on:

- An assessment of the potential to impact habitat critical to the survival of the koala; and
- An assessment of the potential to interfere with the recovery of the species.

The significance of impacts are then summarised using the framework detailed in the *Significance Impact Guidelines 1.1* (DoE 2013) to provide consistency of approach with other conservation significant species list under the EPBC Act.

Assessment of habitat value under the EPBC Act

An assessment of koala habitat value was undertaken using the koala habitat assessment toolkit in the *EPBC Act referral guidelines for the vulnerable koala* (DoE 2014). This utilised the scoring guidelines for inland koala populations, as detailed in Section 6 of the *EPBC Act referral guidelines for the vulnerable koala* (DoE 2014). This found that koala habitats within the study area represent habitat critical to the survival of the species, attaining a score of +6, where any score equal to or greater than 5 constitutes habitat critical to the survival of the koala. Scoring of this is detailed in Table 8-3.

Table 8-3 Assessment of koala habitat using the habitat assessment tool

Attribute	Score	Project habitat appraisal
Koala occurrence	0	Criteria: No koala records within 2 km of the impact area in the last 10 years. Wildlife Online revealed four koala records within 30 km of the project footprint. Of these, two are recorded within 7 km of the project footprint and were both recorded in the 1980's. During the field survey, no faecal pellets were detected.
Vegetation composition	+2	Criteria: Forest, woodland or shrubland with two or more koala food trees present. During the field survey, <i>Eucalyptus</i> -dominated woodlands were confirmed present within the project footprint. Two or more koala food tree species were recorded.
Habitat connectivity	+2	Criteria: Part of a contiguous landscape ≥1000 ha. Review of aerial imagery and RE mapping shows that the study area is part of a contiguous landscape ≥ 1000 ha.
Key existing threats	+1	Criteria: Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present. Compared with urban koala populations, local threats are likely to be relatively low. Threats from roadkill are expected to be infrequent, although dog attacks may be reasonably frequent due to recent dog sightings within the study area.
Recovery value	+1	Criteria: Uncertain whether the habitat is important for achieving the interim recovery objectives for the species. Review of Biodiversity Planning Assessment mapping shows that the project footprint is within a state significant buffer. The habitat in the project footprint is potentially important for contributing to interim recovery objectives by maintaining corridors and connective habitat between areas of suitable koala habitat.
Total score	6	Habitat critical to the survival of the koala

Significance of impact due to loss of habitat critical to the survival of the koala

Broad scale habitat mapping for the koala indicates that the project will result in the direct loss of 46.39 ha of koala habitat with a score of 6. The potential impact is neither above nor below the threshold limits provided in Figure 2 of the *EPBC Act Referral Guidelines for the vulnerable koala* (DoE 2014) and falls within the 'area of uncertainty'. In this circumstance, the referral guidelines suggest that additional characteristics be considered when deciding if an action should be referred to the DAWE. An assessment of additional factors is provided in Table 8-4.

Table 8-4 Assessment of additional factors

Factor	Project appraisal	Risk profile within range of uncertainty
Habitat score	The project will impact habitat critical to the survival of the koala (habitat score of 6). The high value of the habitat affected would mean a significant impact is likely.	High
Impact area	The project will result in the direct loss of 46.39 ha of koala habitat. This large size of the area affected would mean a significant impact is more likely. The <i>EPBC Act referral guidelines for the vulnerable koala</i> (DoE 2014) suggest by example, that a loss of more than 25 ha of habitat scoring 6 or 7 would represent a significant impact. The project is therefore likely to have a significant impact on the koala due to magnitude of loss of habitat critical to the survival of the species.	High
Clearing method	Minimal vegetation clearing is proposed along new access tracks within the project footprint. The majority of habitat loss within the project footprint will be due to inundation within the Burdekin River channel. As the inundation is not permanent and will vary over time with changing water levels, the intensity of impact is not as extreme as would be experienced in the clear-felling of habitat. Some food trees at the upper fringes of the inundation area are likely to persist. Nevertheless, those at the lower extent of the inundation footprint will be permanently impacted and hold no value as koala foraging habitat. Given the magnitude of vegetation permanently inundated, a significant impact is likely.	Moderate-High
Density or abundance	Wildlife Online revealed four koala records within 30 km of the project footprint. Of these, two are recorded within 7 km of the project footprint and were both recorded in the 1980's. This is considered to be a relatively low density of koalas, and would mean a significant impact is less likely.	Low
Level of fragmentation	The proposed footprint is surrounded by large areas of remnant vegetation. Some areas within and adjacent to the project footprint are highly fragmented due to flooding events and vegetation clearing of the understorey. Minimal vegetation clearing will occur along new access tracks, the rest of the impact area is expected to be inundated only within the existing Burdekin River channel. As the project footprint is surrounded by large areas of remnant vegetation and the impact is to occur within the channel, the fragmentation caused by project within the project footprint is more likely not to require referral.	Low
Overall	Likely to be a significant impact on the koala	High

As indicated in Table 8-4, the assessment of additional factors indicates that the project falls within the higher limits of the area of uncertainty for three of the five factors assessed. Accordingly, the project is anticipated to have a significant impact on the koala due to magnitude loss of habitat critical to the survival of the species.

Significance of impact due to interference with the recovery of the species

As detailed in the *EPBC Act referral guidelines for the vulnerable koala* (DoE 2014), for all areas of koala habitat scoring ≥ 5 on the koala habitat assessment toolkit, an assessment of the potential interference with the recovery of the species must be undertaken considering the following factors detailed in Table 8-5. Based on this assessment, the project is unlikely to significantly interfere with the recovery of the koala.

Table 8-5 Potential impacts on the recovery of the koala

Impacts	Project appraisal	Likelihood
Will the project increase fatalities due to dog attacks to a level that is likely to result in multiple, ongoing fatalities?	The project is not expected to result in any change in the abundance of wild dogs. While the project will result in the creation of new access tracks that will facilitate local movement of wild dogs, a large number of farm tracks exist in the landscape and are already utilised by wild dogs for movement. Accordingly, the introduction of additional access tracks is not expected to have a measurable impact on local dog numbers or subsequent frequency of dog attacks on koalas.	Unlikely
Will the project increase koala fatalities due to vehicle strikes to a level that is likely to result in multiple ongoing fatalities?	The project will result in a large increase in vehicle movements during the construction period. This carries a risk of increased vehicle strike but will be mitigated through standard controls such as speed limits. The risks of ongoing mortality from vehicle strikes is low, given the project will only result in occasional movements of maintenance vehicles during the projects' operational phase.	Unlikely
Will the project facilitate the introduction or spread of pathogens such as Chlamydia or Phytophthora cinnamomi that are likely to significantly reduce the reproduction output or the carrying capacity of the habitat?	The use of standard hygiene protocols in vehicle movements during construction means that the potential for introduction of Phytophthora is relatively limited. The project is relatively benign during the operational phase and is unlikely to have any impact on levels of Chlamydia in the local koala population.	Unlikely
Will the project create a barrier to movement between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala?	The project will result in minor localised fragmentation of habitat. However, this will pose no barrier to the movement of koala.	Unlikely
Will the project change hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term?	The project will result in the inundation of vegetation within the riparian zone along the Burdekin River. This inundation will result in the loss and alteration of vegetation communities and koala habitat. Given that relatively large areas of koala habitat remain within the surrounding landscape, local koalas are not expected to experience a significant reduction in foraging and breeding success due to any increase in competition for resources.	Unlikely

A general significance of impact assessment is detailed for the koala in Table 8-6, using the criteria detailed in the *Significance Impact Guidelines 1.1* (DoE 2013). Overall, the project is likely to have a significant impact on the koala due to the loss of 46.39 ha of habitat critical to the survival of the species. This result is based on broad scale mapping of koala habitat within the project footprint. It is recommended that future field surveys undertake detailed habitat mapping for this species to confirm the extent and significance of impact.

Table 8-6 Significance of impact on the koala

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of an important population of the species	Unlikely The project is not expected to result in a decrease in the size of the local koala population. Based on field surveys and species ecology, koalas are predicted to occur at low densities within the project footprint. Given that relatively large areas of habitat remain within the surrounding landscape, local koalas are not expected to experience a significant reduction in foraging and breeding success due to any increase in competition for resources.
Reduce the area of occupancy of an important population	Unlikely Large areas of suitable koala habitat will persist within the local area. The project will not disrupt connectivity to the extent that movement between remnant patches will be disrupted. As such, there will be no change in the extent of occurrence of the species.
Fragment an existing important population into two or more populations	Unlikely Fragmentation of existing koala population is not expected as the loss of connectivity between habitats will not be of sufficient magnitude to disrupt koala movement between populations.
Adversely affect habitat critical to the survival of a species	Likely The project will result in the loss of 46.39 ha of habitat critical to the survival of the koala. Based on the <i>EPBC Act referral guidelines for the vulnerable koala</i> (DoE 2014), this exceeds the threshold level and constitutes a significant impact due to loss of habitat.
Disrupt the breeding cycle of an important population	Unlikely The koala breeding season is generally between September and March, with females giving birth to a single young between October and May. It is unlikely that the construction and operation of the project will disrupt the breeding cycle of the local koala population. During the breeding season, males actively seek female koalas and koala movement is more extensive. Without mitigation, the project could lead to an increase risk of vehicle strike. Traffic volume, speed and visibility influence the koala collision rate. Potential impacts will be mitigated through implementation of on-site speed limits.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The project will directly impact 46.39 ha of koala habitat. This accounts for only a small proportion of suitable habitat in the broader landscape (i.e. 14.17 percent of habitat within the project footprint and 0.27 percent of habitat within the regional area – within a 5 km radius of the project footprint). Although the project will reduce the area of available habitat, the extent of habitat disturbance is not likely to decrease the availability or quality of habitat available to the local population to the extent that the species will decline.
Result in invasive species that are harmful to a vulnerable species becoming established in	Unlikely The study area already supports wild dogs that are a key threat to koalas as a species. While the project will result in the creation of new access tracks that will facilitate local movement of wild dogs,

Impact criteria	Potential to occur
the vulnerable species habitat	a large number of farm tracks exist in the landscape and are already utilised by wild dogs for movement. Accordingly, the introduction of additional access tracks is not expected to have a measurable impact on local dog numbers or subsequent frequency of dog attacks on koalas. The project also has the potential to introduce or spread weeds that could pose a barrier to local koala movement. This potential will be mitigated by the implantation of a Weed Management Plan governing construction and operation of the project. The project therefore poses low risks to the local koala population via introduction and spread of invasive species.
Introduce disease that may cause the species to decline	Unlikely The project is not anticipated to introduce new diseases that may cause the species to decline. Stress may lead to an increase in the expression of Chlamydia in koalas, however the implementation of mitigation measure such as sequential clearing will reduce disturbance-related stress and risk of disease.
Interfere substantially with the recovery of the species	Unlikely As detailed above, the project is unlikely to substantially interfere with the recovery of the species. The project is expected to be relatively benign with no substantial long-term increase in mortality or any substantial barrier effects due to loss of habitat connectivity. All impacts are expected to be localised. Accordingly, the project is unlikely to substantially interfere with the recovery of the species.

8.2.4 Migratory species

The project is unlikely to result in a significant impact on migratory bird species. No breeding habitat occurs within the project footprint. Species confirmed present or predicted to occur migrate to the northern hemisphere during breeding season or suitable breeding habitat does not occur for species that breed in Australia (i.e. glossy ibis and eastern osprey). The project will result in the inundation of sub-optimal foraging habitat for migratory species. Construction related mortality and injury risks are considered low. During the operation phase, the inundation of vegetation within the riparian zone along the Burdekin River will result in the loss and alteration of habitat. Justification for this assessment has been detailed in Table 8-7, based on the responses to Significant Impact Guidelines 1.1 (DoE 2013).

Table 8-7 Significance impact on migratory species

Impact criteria	Potential to occur
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species; or	Unlikely The initial filling of the impoundment will result in changes to the hydrological regime within the project footprint along the Burdekin River. Migratory birds such as ibis and waders depend on the wetting and drying cycles for foraging habitat, whereas other species, such as fish-eating species prefer permanently inundated areas (Scott 1997). Since changes to the hydrological cycle can alter foraging habitat, this can in turn modify the abundance and diversity of migratory birds (Scott 1997). However, the migratory species confirmed present or predicted to occur within the project footprint are transient visitors and as such, the area within the project footprint does not contain habitats of unique ecological value to these species. Accordingly, no impacts on migratory birds are predicted. Construction works located within and adjacent to the river channel, have the potential to degrade the quality of habitat through increased erosion and run-off, and spillage of contaminants. These

Impact criteria	Potential to occur
	activities have the potential to affect water quality resulting in altered water chemistry (Wood and Armitage 1997; Wheeler <i>et al.</i> 2005). Implementation of an Erosion and Sediment Control Plan will reduce potential impacts to water quality. There is unlikely to be any substantial fragmentation or modification of fire regimes that could adversely impact local habitat for these migratory species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Unlikely The project is unlikely to result in the introduction or spread of invasive species beyond current levels. The implementation of a site specific CEMP will further reduce potential impacts of invasive species. The project is therefore unlikely to have any adverse impact on migratory birds to invasive species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Unlikely The woodland and aquatic habitats within the project footprint are not considered critical breeding, foraging, roosting or shelter habitat for the migratory species known to occur within or near the project footprint.

9. Summary

This report presents the results of desktop and field surveys undertaken to assess the ecological values of the proposed BRW in the Charters Towers Region, in North Queensland.

The terrestrial ecological assessment revealed that the study area supports least concern regional ecosystems dominated by open woodlands and existing cleared grazing lands. No conservation significant flora species or TECs are considered likely to occur within these areas. Terrestrial habitat types confirmed present during the field survey included:

- Open eucalypt woodland on sandy levees
- Open eucalypt woodland on rocky low hills and rises
- Open grassland on alluvial plains
- River bed
- Rocky outcrops
- Ephemeral waterways dominated by *Eucalyptus* spp. and/or *Melaleuca* spp.

These habitats are highly seasonal, responding to changes in rainfall and river flow. Ephemeral waterways represent sensitive terrestrial fauna habitats within the study area. Such habitats provide resources for a wide array of common fauna species, including amphibians (breeding and foraging), reptiles (foraging), ground-dwelling mammals (foraging), microchiropteran bats (foraging) and birds (foraging and nesting amongst dense riparian vegetation). The study area has the potential to support a small number of conservation significant species based on field surveys, previous records and the availability of suitable habitat within the study area.

The aquatic habitat of the proposed BRW is composed of pool-run-riffle flow types which provides habitat for a number of common fish and turtle species. Species diversity is influenced by the restriction of aquatic fauna movement past existing water infrastructure downstream.

A likelihood of occurrence assessment undertaken for each conservation significant species identified in the desktop assessment found that:

- Three conservation significant fauna species, the squatter pigeon (southern), (*Geophaps scripta scripta*), greater glider (northern) (*Petauroides volans minor*) and koala (*Phascolarctos cinereus*) were considered **likely to occur**
- One migratory species, the glossy ibis (*Plegadis falcinellus*) was **confirmed present** within the study area
- Six migratory species were considered **likely to occur**
- No conservation significant aquatic species are likely to occur within the study area.

Construction activities have the potential to cause localised impact through vehicle and plant movement, removal of vegetation, construction within the waterway, spillage of hazardous materials, and acquisition of materials for the use in construction. The project is expected to be relatively benign in terms of operational phase impacts. However, the initial filling of the impoundment and operational phase of the weir have the potential to cause localised fauna injury and mortality, disruption to behaviour and restriction of movement of wildlife assemblages, loss, alteration and degradation of terrestrial and aquatic habitats, increase in feral animals and weed species, and changes to downstream flow regimes. These potential construction and operational impacts can be effectively mitigated through routine mitigation measures, and are summarised in Section 7.

A formal significance of impact assessment was undertaken for each conservation significant species, as detailed in Section 8. The project will result in a local loss of potential habitat for the squatter pigeon (southern) and greater glider (northern), and the proposed impacts on the koala are expected to constitute a significant impact under the EPBC Act.

Predicted habitat for each conservation significant species were broadly mapped throughout the study area based on habitat assessments, REs and aerial imagery. To better define and quantify the level of impact on conservation significant species considered likely to occur within the study area, detailed mapping is recommended to be undertaken following the post-wet season survey.

Access limitations restricted field survey effort in many areas of the study area and as such, a precautionary approach was applied to the assessment of ecological values and the potential impacts of the project. It is recommended that a post-wet survey is conducted to assess the seasonal variability of the terrestrial and aquatic ecological values within the study area and to access areas previously restricted during the pre-wet survey. Targeted surveys for conservation significant species considered likely to occur within the study area (i.e. the squatter pigeon (southern), greater glider (northern) and koala), will be undertaken during the post-wet survey to ground-truth broad habitat mapping and verify the significance of potential impacts on the species.

Following the post-wet season survey, and finalisation of the project reference design and operational strategies, the impact assessment will be revised to further quantify risks and a significant impact assessment completed in accordance with guidelines.

10. References

- Allen, GR, Midgley, SH and Allen, M 2003, '*Field Guide to the Freshwater Fishes of Australia*', Perth, Western Australian Museum.
- Andrews, S.P., Gratton, G., Quin, D., and Smith, A.P. (1994). Description and assessment of forestry impacts on fauna of the Urbenville Forestry Management Area. Report for State Forests of New South Wales Austeco Environmental Consultants, Armidale.
- Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000). '*Australian guidelines for water quality monitoring and reporting*', Australian and New Zealand Environment and Conservation Council.
- Australian Rainforest Conservation Society (ARCS) (1999). Article on SEQ Regional Forests Agreement. Available from: www.brisrain.webcentral.com.au/rfa.html. Accessed 20 January 2020.
- Atlas of Living Australia (ALA) (2020). *Dichanthium queenslandicum*. Available from: <http://www.ala.org.au/>. Accessed 20 January 2020.
- Australian Native Plants Society (Australia) (ANPS) (2016). *Graptophyllum excellsum*. Available from: http://anpsa.org.au/g-exc.html?sm_au=iVV1MJBfDks1PTTMBNT0NK6RWkLVC. Accessed 20 January 2020.
- Australian Reptile Online Database (AROD) (2017). Vine-thicket fine-lined slider *Lerista cinerea*. Available from: <http://www.arod.com.au/arod/reptilia/Squamata/Scincidae/Lerista/cinerea>. Accessed 20 January 2020.
- Australian Tropical Rainforest Plants (ATRP) (2019). *Solanum sporadotrichum*. Available from: http://www.canbr.gov.au/cpbr/cd-keys/RFK7/key/RFK7/Media/Html/entities/Solanum_sporadotrichum.htm. Accessed 20 January 2020
- Baumgartner, L.J. (2005). '*Effects of weirs on fish movements in the Murray-Darling Basin*', PhD thesis, University of Canberra.
- Baumgartner, L.J., Reynoldson, N and Gilligan, D.M. (2006). '*Mortality of larval Murray cod (Maccullochella peelii peellii) and golden perch (Macquaria ambigua) associated with passage through two types of low-head weirs*', Marine and Freshwater Research, 57: 187-191.
- BirdLife International (2010). Species factsheet: *Plegadis falcinellus*. Available from: <http://www.birdlife.org>. Accessed 20 January 2020.
- Bureau of Meteorology (BoM) (2019). Climate Data Online. Available from: <http://www.bom.gov.au/climate/data/index.shtml?bookmark=201>. Accessed 17 June 2020.
- Cann, J. (1998), '*Australian freshwater turtles*', Singapore, Beaumont Publishing Pty Ltd.
- Clark, N.J. (2008), '*The diving physiological ecology of Australian freshwater turtle hatchlings*', PhD Thesis, Brisbane, University of Queensland.
- Comport, S.S., Ward, S.J., and Foley, W.J. (1996). Home ranges, time budgets and food tree use in a high density tropical population of greater gliders, *Petauroides volans minor* (Pseudocheiridae: Marsupialia). *Wildlife Research* 23: 401-419.

- Department of Agriculture and Fisheries (DAF) (2019). Restricted invasive animals of Queensland. Available from: https://www.daf.qld.gov.au/data/assets/pdf_file/0011/403868/IPA-Restricted-animals-of-Queensland.pdf. Accessed 4 February 2020.
- Department of Agriculture, Water and the Environment (DAWE) (2020). Species Profiles and Threats Database. Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>. Accessed 20 January 2020.
- Department of Environment and Heritage Protection (2009). Queensland Water Quality Guidelines, Version 3, ISBN 978-0-9806986-0-2.
- Department of Environment and Science (DES) (2020). WetlandInfo – Queensland Wetlands Information. Available from: <https://wetlandinfo.ehp.qld.gov.au/wetlands/>. Accessed 20 January 2020.
- Department of Natural Resources and Mines (2001). Queensland Australia River Assessment System (AusRivAS): Sampling and Processing Manual.
- Department of the Environment (DoE) (2014). EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory), Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.
- Department of the Environment (DoE) (2013). Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.
- Duivenvoorden, L.J., Hamilton, D.R., Price, M.D. and Attard, T.B. (2000). 'Temporal Variation of Macroinvertebrate Communities of impounded and riverine sites in Central Queensland', in Noble, RM (ed.), River Health in the Fitzroy Catchment: Community Ownership, Rockhampton, Department of Natural Resources.
- Eyre, T.J. (2002). Habitat preferences and management of large gliding possums in southern Queensland. Ph.D. thesis, Southern Cross University, Lismore.
- Eyre, T.J. (2004). Distribution and conservation status of the possums and gliders of southern Queensland. *The Biology of Australian Possums and Gliders* (Eds R. L. Goldingay and S. M. Jackson), pp. 1-25. Surrey Beatty & Sons, Chipping Norton.
- Gibbons, P. and Lindenmayer, D.B. (2002). Tree hollows and wildlife conservation in Australia. CSIRO Publishing, Collingwood.
- Goldingay, R.L. (2012). Characteristics of tree hollows used by Australian arboreal and scansorial mammals. *Australian Journal of Zoology* 59: 277-294.
- Hamann, M., Schauble, C.S., Limpus, D.J., Emerick, S.P. and Limpus, C.J. (2007). 'Management plan for the conservation of *Elseya* sp. (Burnett River) in the Burnett River Catchment', Queensland, Environmental Protection Agency.
- Hancock, J.A., Kushlan, J.A and Kahl, M.P. (1992). Storks, Ibises and Spoonbills of the world. London, Academic Press.
- Henry, S.R. (1984) Social organisation of the greater glider (*Petauroides volans*) in Victoria. In Possums and Gliders (eds A. P. Smith & I. D. Hume), pp. 221-228. Surrey Beatty and Sons, Chipping Norton.
- Higgins, P.J. and Davies, S.J.J.F. (eds) (1996). Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons. Melbourne, Victoria: Oxford University Press.

- Kavanagh, R.P. (1984). Seasonal changes in habitat use by gliders and possums in south eastern New South Wales. In Possums and Gliders (eds A. P. Smith & I. D. Hume), pp. 527-543. Surrey Beatty and Sons, Chipping Norton.
- Kavanagh, R.P. and Lambert, M. (1990). Food selection by the greater glider: is foliar nitrogen a determinant of habitat quality? *Australian Wildlife Research* 17: 285-299.
- Kavanagh, R.P. (2000). Effects of variable intensity logging and the influence of habitat variables on the distribution of the Greater Glider *Petauroides volans* in montane forest in outeastern New South Wales. *Pacific Conservation Biology* 6: 18-30.
- Kehl, J. and Borsboom, A. (1984). Home range, den tree use and activity patterns in the greater glider (*Petauroides volans*). In Possums and Gliders (Eds. A. P. Smith and I. D. Hume), pp. 229- 236. Surrey Beatty and Sons, Chipping.
- Koetsier, P. and Bryan, C.F. (1995). 'Effects of Abiotic Factors on Macroinvertebrate Drift in the Lower Mississippi River, Louisiana', The American Midland Naturalist, 134: 63-74.
- Larinier, M. (2000), 'Dams and fish migration', contributing paper to the World Commission of Dams Thematic Review II.1 Ecosystems.
- Limpus, C.J., Limpus, D. and Hamann, M. (2002). Freshwater turtle populations in the area to be flooded by the Walla Weir, Burnett River: baseline study. *Memoirs of the Queensland Museum*, 48: 155-168.
- Limpus, C.J., Limpus, D.J., Hollier, C., Savige, M., McAllister, D. (2011). 'Survey of Freshwater turtle populations and nesting habitat', Tartrus Weir Turtleway Project, September – December 2011. Brisbane Department of Environment and Heritage Protection, Queensland Government.
- Lindenmayer, D.B., Cunningham, R.B., Tanton, M.T., Smith, A.P. and Nix, H.A. (1991). Characteristics of hollow-bearing trees occupied by arboreal marsupials in the montane ash forests of the Central Highlands of Victoria, south-east Australia. *Forest Ecology and Management* 40: 289-308.
- Lowe-McConnell, R.H. (1987). 'Ecological studies in tropical fish communities', New York, Cambridge University Press.
- Lucas, M.C. and Baras, E. (2001). 'Migrations of freshwater fishes', Oxford, Blackwell Science.
- Marchant, R. and Hehir, G. (2002). 'The use of AUSRIVAS predictive models to assess the response of lotic macroinvertebrates to dams in south-east Australia', *Freshwater Biology*, 47: 1033-1050.
- Marchant, S. and Higgins, P.J. (1990). Handbook of Australian, New Zealand and Antarctic Birds. Volume One - Ratites to Ducks. Melbourne, Victoria: Oxford University Press.
- Martin, R. (2001). "Koala". In Macdonald, D. (ed.). *Encyclopedia of Mammals* (2nd ed.). Oxford University Press, 852–54.
- Martin, R. and K. Handasyde (1999). The Koala: Natural history, conservation and management. Sydney, NSW: UNSW Press.
- McCarthy, M.A. and Lindenmayer, D.B. (1999). Conservation of the greater glider (*Petauroides volans*) in remnant native vegetation within exotic plantation forest. *Animal Conservation* 2, 203- 209.
- McKenzie, N. and Hall, L. (2008). *Macroderma gigas*. In 'IUCN red list of threatened species.' Version 2012.1. Available from: <http://www.iucnredlist.org>. Accessed 20 January 2020.

- 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. (2019). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.0. Updated March 2019. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.
- Phillips, S. and Callaghan, J. (2011). The Spot Assessment Technique: A tool for determining localised levels of habitat use by koala *Phascolarctos cinereus*, *Australian Zoologist*, 35(3): 774-780.
- Pusey, B., Kennard, M. and Arthington, A. (2004). '*Freshwater Fishes of North-Eastern Australia*', Collingwood, CSIRO Publishing.
- Reynolds, L.M. (1983). 'Migration patterns of five fish species in the Murray-Darling River system'. *Australian Journal of Marine and Freshwater Research*, 34: 857- 871.
- Royle, J. Andrew and Nichols, J. (2003). Estimating Abundance From Repeated Presence Absence Data or Point Counts. *Ecology*, 84: 777-790.
- Santoro, S., Sundar, K.S.G and Cano-Alonso, L.S. (2019). *Glossy ibis ecology and conservation*. SIS Conservation, 1: 1-148.
- Scott, A. (1997). *Relationships between waterbird ecology and river flows in the Murray-Darling Basin*, CSIRO Publishing.
- Squatter Pigeon Workshop (2011). *Proceedings form the workshop for the Squatter Pigeon (southern). 14-15 December 2011*. Toowoomba Office of the Queensland Parks and Wildlife Service.
- Staunton-Smith, J, Robbins J.B., Mayer, D.G., Sellin, M.J. and Halliday, I.A. (2004). '*Does the quantity and timing of fresh water flowing into a dry tropical estuary affect year-class strength of barramundi (Lates calcarifer)?*'. *Marine and Freshwater Research*, 55: 787.
- Stuart, I.G. (1997). 'Assessment of a Modified Vertical-Slot Fishway, Fitzroy River, Queensland', Department of Primary Industries, Queensland. Project report QO97023.
- Stuart, I.G. and Mallen-Cooper, M. (1999). 'An assessment of the effectiveness of a vertical-slot fishway for non-salmonid fish at a tidal barrier on a large tropical/subtropical river', *Regulated Rivers Research and Management*, 15: 575-590.
- Threatened Species Scientific Committee (TSSC) (2013). Conservation Advice *Croton magneticus*. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/16681-listing-advice.pdf>. Accessed 20 January 2020.
- Threatened Species Scientific Committee (TSSC) (2016a). Conservation Advice *Macroderma gigas* ghost bat. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/174-conservation-advice-05052016.pdf>. Accessed 20 January 2020.
- Threatened Species Scientific Committee (TSSC) (2016b). Conservation advice *Petauroides volans* greater glider. Canberra: Department of the Environment: Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-20160525.pdf>. Accessed 20 January 2020.
- Vanderduys, E.P., Kutt, A.S. and Kemp, J.E. (2012). Upland savannas: the vertebrate fauna of largely unknown but significant habitat in north-eastern Queensland. *Australian Zoologist*, 36: 59-74.

- Van der Ree, R., Ward, S.J. and Handasyde, K.A. (2004). Distribution and conservation status of possums and gliders in Victoria. *The Biology of Australian Possums and Gliders* (Eds R. L. Goldingay and S. M. Jackson), 91-110. Surrey Beatty and Sons, Sydney.
- Wheeler, A.P., Angermeier, P.L. and Rosenberger, A.E. (2005). Impacts of new highways and subsequent landscape urbanization on stream habitat and biota, *Reviews in Fisheries Science*, 13: 141-164.
- Wood, P.J. and Armitage, P.D. (1997). Biological effects of fine sediment in the lotic environment

Appendices

Appendix A – Terrestrial fauna survey results

Species	Common name	Status		
		EPBC Act	NC Act	Introduced
Mammals				
<i>Axis axis</i>	Chital deer	-	-	I
<i>Canis lupus</i>	Dingo, domestic dog	-	-	I
<i>Chaerephon jobensis</i>	Northern freetail bat	NL	LC	-
<i>Chalinolobus gouldii</i>	Gould’s wattled bat	NL	LC	-
<i>Chalinolobus nigrogriseus</i>	Hoary wattled bat	NL	LC	-
<i>Macropus agilis</i>	Agile wallaby	NL	LC	-
<i>Macropus dorsalis</i>	Black-striped wallaby	NL	LC	-
<i>Macropus giganteus</i>	Eastern grey kangaroo	NL	LC	-
<i>Macropus robustus</i>	Common wallaroo	NL	LC	-
<i>Macropus rufus</i>	Red kangaroo	NL	LC	-
<i>Miniopterus australis</i>	Little bent-wing bat	NL	LC	-
<i>Miniopterus orianae oceanensis</i>	Large bent-wing bat	NL	LC	-
<i>Myotis macropus</i>	Large-footed myotis	NL	LC	-
<i>Oryctolagus cuniculus</i>	Rabbit	-	-	I
<i>Ozimops lumsdenae</i>	Northern free-tailed bat	NL	LC	-
<i>Ozimops ridei</i>	Ride’s free-tailed bat	NL	LC	-
<i>Petrogale assimilis</i>	Allied rock-wallaby	NL	LC	-
<i>Saccolaimus flaviventris</i>	Yellow-bellied sheath-tail bat	NL	LC	-
<i>Scotorepens sanborni</i>	Northern broad-nosed bat	NL	LC	-
<i>Wallabia bicolor</i>	Swamp wallaby	NL	LC	-
<i>Vespadelus trougtoni</i>	Eastern cave bat	NL	LC	-
Birds				
<i>Alectura lathamii</i>	Australian brush-turkey	NL	LC	-
<i>Anas gracilis</i>	Grey teal	NL	LC	-
<i>Anas superciliosa</i>	Pacific black duck	NL	LC	-
<i>Anhinga novaehollandiae</i>	Australasian darter	NL	LC	-
<i>Anthus novaeseelandiae</i>	Australasian pipit	NL	LC	-
<i>Aprosmictus erythropterus</i>	Red-winged parrot	NL	LC	-
<i>Aquila audax</i>	Wedge-tailed eagle	NL	LC	-
<i>Ardea ibis</i>	Cattle egret	NL	LC	-
<i>Ardea intermedia</i>	Intermediate egret	NL	LC	-
<i>Ardea modesta</i>	Eastern great egret	NL	LC	-
<i>Ardea pacifica</i>	White-necked heron	NL	LC	-
<i>Ardeotis australis</i>	Australian bustard	NL	LC	-
<i>Artamus leucorhynchus</i>	White-breasted woodswallow	NL	LC	-
<i>Cacatua galerita</i>	Sulphur-crested cockatoo	NL	LC	-
<i>Calyptorhynchus banksii</i>	Red-tailed black-cockatoo	NL	LC	-
<i>Centropus phasianinus</i>	Pheasant coucal	NL	LC	-

Species	Common name	Status		
		EPBC Act	NC Act	Introduced
<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike	NL	LC	-
<i>Coracina papuensis</i>	White-bellied cuckoo-shrike	NL	LC	-
<i>Corvus coronoides</i>	Australian raven	NL	LC	-
<i>Corvus orru</i>	Torresian crow	NL	LC	-
<i>Coturnix ypsilophora</i>	Brown quail	NL	LC	-
<i>Cracticus nigrogularis</i>	Pied butcherbird	NL	LC	-
<i>Cracticus tibicen</i>	Australian magpie	NL	LC	-
<i>Dacelo leachii</i>	Blue-winged kookaburra	NL	LC	-
<i>Dacelo novaeguineae</i>	Laughing kookaburra	NL	LC	-
<i>Dicrurus bracteatus</i>	Spangled drongo	NL	LC	-
<i>Dromaius novaehollandiae</i>	Emu	NL	LC	-
<i>Egretta novaehollandiae</i>	White-faced heron	NL	LC	-
<i>Elseyornis melanops</i>	Black-fronted dotterel	NL	LC	-
<i>Entomyzon cyanotis</i>	Blue-faced honeyeater	NL	LC	-
<i>Eolophus roseicapillus</i>	Galah	NL	LC	-
<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	NL	LC	-
<i>Eudynamys orientalis</i>	Eastern koel	NL	LC	-
<i>Eurostopodus argus</i>	Spotted nightjar	NL	LC	-
<i>Eurystomus orientalis</i>	Dollarbird	NL	LC	-
<i>Falco cenchroides</i>	Nankeen kestrel	NL	LC	-
<i>Geopelia cuneata</i>	Diamond dove	NL	LC	-
<i>Geopelia humeralis</i>	Bar-shouldered dove	NL	LC	-
<i>Geopelia striata</i>	Peaceful dove	NL	LC	-
<i>Gerygone albogularis</i>	White-throated gerygone	NL	LC	-
<i>Grallina cyanoleuca</i>	Magpie-lark	NL	LC	-
<i>Grus rubicunda</i>	Brolga	NL	LC	-
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	NL	LC	-
<i>Haliastur sphenurus</i>	Whistling kite	NL	LC	-
<i>Himantopus himantopus</i>	Black-winged stilt	NL	LC	-
<i>Lichmera indistincta</i>	Brown honeyeater	NL	LC	-
<i>Malurus melanocephalus</i>	Red-backed fairy-wren	NL	LC	-
<i>Manorina flavigula</i>	Yellow-throated miner	NL	LC	-
<i>Manorina melanocephala</i>	Noisy miner	NL	LC	-
<i>Melithreptus albogularis</i>	White-throated honeyeater	NL	LC	-
<i>Merops ornatus</i>	Rainbow bee-eater	NL	LC	-
<i>Milvus migrans</i>	Black kite	NL	LC	-
<i>Myiagra rubecula</i>	Leaden flycatcher	NL	LC	-
<i>Ocyphaps lophotes</i>	Crested pigeon	NL	LC	-
<i>Pardalotus rubricatus</i>	Red-browed pardalote	NL	LC	-

Species	Common name	Status		
		EPBC Act	NC Act	Introduced
<i>Pelecanus conspicillatus</i>	Australian pelican	NL	LC	-
<i>Phalacrocorax sulcirostris</i>	Little black cormorant	NL	LC	-
<i>Philemon citreogularis</i>	Little friarbird	NL	LC	-
<i>Philemon corniculatus</i>	Noisy friarbird	NL	LC	-
<i>Platalea regia</i>	Royal spoonbill	NL	LC	-
<i>Platycercus adscitus</i>	Pale-headed rosella	NL	LC	-
<i>Plegadis falcinellus</i>	Glossy ibis	Mig	LC	-
<i>Ptilonorhynchus nuchalis</i>	Great bowerbird	NL	LC	-
<i>Rhipidura leucophrys</i>	Willie wagtail	NL	LC	-
<i>Scythrops novaehollandiae</i>	Channel-billed cuckoo	NL	LC	-
<i>Smicromis brevirostris</i>	Weebill	NL	LC	-
<i>Strepera graculina</i>	Pied currawong	NL	LC	-
<i>Struthidea cinerea</i>	Apostlebird	NL	LC	-
<i>Taeniopygia bichenovii</i>	Double-barred finch	NL	LC	-
<i>Threskiornis spinicollis</i>	Straw-necked ibis	NL	LC	-
<i>Todiramphus macleayii</i>	Forest kingfisher	NL	LC	-
<i>Trichoglossus haematodus</i>	Rainbow lorikeet	NL	LC	-
<i>Vanellus miles</i>	Masked lapwing	NL	LC	-
Reptiles				
<i>Dendrelaphis punctulatus</i>	Common tree snake	NL	LC	-
<i>Heteronotia binoei</i>	Bynoe's gecko	NL	LC	-
<i>Intellagama lesueurii</i>	Eastern water dragon	NL	LC	-
Amphibians				
<i>Litoria caerulea</i>	Green tree frog	NL	LC	-
<i>Litoria rubella</i>	Desert tree frog	NL	LC	-
<i>Platyplectrum ornatum</i>	Ornate burrowing frog	NL	LC	-
<i>Rhinella marina</i>	Cane toad	-	-	I

Key to table: NL – not listed; LC – least concern; I – introduced species.

Appendix B – Likelihood of occurrence

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
Threatened flora and fauna species					
Plants					
<i>Bulbophyllum globuliforme</i> Miniature moss-orchid	V	NT	PMST	Habitat: Host-specific species, only growing on the hoop pine (<i>Araucaria cunninghamii</i>), where it colonises the upper branches of mature trees (DAWE 2020). Distribution: Recorded from near Paluma, north east Queensland and south to the McPherson Range on the Queensland / New South Wales border (DAWE 2020). Detectability: Presence or absence of Hoop Pines can be recorded; however, the ability to detect this species is very limited due to the species habitat requirements.	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded during the field survey. The orchid grows solely on the bark of old hoop pine trees in vine forests, which was not present within the study area.
<i>Croton magneticus</i>	NL	V	WO	Habitat: Grows in deciduous vine thickets (dry rainforest) on soils derived from sandstone, granite or acid agglomerate substrates, often in association with <i>Croton amhemicus</i> and <i>C. phebalioides</i> (DES 2020). Distribution: Occurs between Townsville and Proserpine, but is known to extend inland to Greenvale and Collinsville (TSSC 2013). Detectability: Small tree or shrub growing to 5 m high and is deciduous and perennial, identifiable year round from if vegetative features are present (DES 2020).	Unlikely to occur This species has been historically recorded within the desktop search extent; however, no suitable habitat was present within the study area. The species is known to grow in vine thicket forests, and this habitat type was not recorded during the field survey.

Species	Status			Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act				
<i>Dichanthium queenslandicum</i> King bluegrass	E	V		PMST; WO	Habitat: Occurs on black cracking clay in tussock grasslands mainly in association with other species of blue grasses but also with other grasses restricted to this soil type (DES 2020) Distribution: From north of Cairns to the NSW border and as far west as Hughenden (ALA 2020) Detectability: Perennial, tufted, erect grass to 80 cm tall known to flower throughout the year particularly from March (DES 2020).	May occur This species has been historically recorded within the desktop search extent. Marginally suitable habitat for this species was recorded within the study area. Some areas were recorded as retaining the correct soil type, however those areas have been heavily grazed by cattle and dominated by buffel grass (<i>Cenchrus ciliaris</i>), making the habitat only marginally suitable.
<i>Dichanthium setosum</i> Blue grass	V	LC		PMST	Habitat: Occurs in heavy soils (predominantly cracking clays or alluvium, often in gilgai) in woodland or open woodland usually dominated by <i>Acacia</i> (brigalow) and / or <i>Eucalyptus</i> species (DES 2020). Distribution: Reported from inland NSW and Queensland (DAWE 2020). Detectability: Erect perennial grass to about 1 m tall. A warm season perennial, the species commences growing in spring, flowers in summers and becomes dormant in late autumn (DAWE 2020).	Unlikely to occur This species has not been historically recorded within the desktop search extent. During the field survey, a large depression retaining cracking clays was recorded near a small patch of brigalow (<i>Acacia harpophylla</i>). As this depression was surrounded by open pasture and not directly adjacent to the brigalow community, it is unlikely for the species to occur within the area.
<i>Eucalyptus raveretiana</i> Black ironbox	V	LC		PMST	Habitat: Occurs on the banks of rivers, creeks and other watercourses, on clayey or loamy soils (DAWE 2020). Distribution: South of Townsville to Nebo, around Rockhampton and areas 100 km west of the city (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. The nearest historical record is located approximately 32 km west of the study area along a tributary of the Burdekin River. Suitable habitat along

Species	Status			Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act				
					Detectability: Rough bark on the main trunk and large branches with smooth upper branches. Smallest fruit of any eucalypt (DAWE 2020).	the Burdekin River was confirmed present during the field survey.
<i>Graptophyllum excelsum</i>	NL	NT	WO		Habitat: Mainly grows in semi-evergreen vine thickets (DES 2020). Distribution: Eastern coast and ranges of Cape York and Port Curtis areas of Queensland (ANPS 2016). Detectability: Dense shrub growing to 3 m tall, flowering throughout most of the year with fruits recorded in January, and from July to November (DES 2020).	Unlikely to occur The species has been historically recorded within the search extent; however, no suitable habitat was recorded within the study area. This species prefers semi-evergreen vine thickets, which is not mapped and was not recorded during the field survey.
<i>Marsdenia brevifolia</i>	V	V	PMST		Habitat: Occurs in woodlands, dominated by <i>Corymbia erythrophloia</i> and <i>Eucalyptus crebra</i> with dense <i>Themeda triandra</i> understorey on basalt. The species can occur on rock outcrops, black crumbly soils, granite soils or dark massive acid agglomerate soils (DES 2020). Distribution: North and central Queensland, near Townsville, Springsure and north of Rockhampton (DAWE 2020). Detectability: Small shrub to 1 m high, flowering from November to February with fruits from January to June (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent; however, marginally suitable habitat for this species was recorded within the study area. Areas retaining <i>C. erythrophloia</i> and <i>E. crebra</i> on basalt were recorded during the field survey; however, the understorey was dominated by an exotic grass species, namely buffel grass (<i>Cenchrus ciliaris</i>).
<i>Solanum sporadotrichum</i>	NL	NT	WO		Habitat: Occurs in semi-evergreen vine thicket, notophyll rainforest or littoral rainforest (DES 2020). Distribution: West of Townsville to south of Mt Dryander near Airle beach (ATRP 2019).	Unlikely to occur The species has been historically recorded within the desktop search extent. The nearest historical record is located approximately 21 km north east of the study area. This species

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				Detectability: Erect perennial shrub growing to 4 m high, flowering in January, May to July and September, with fruits in May, June and August (DES 2020).	prefers semi-evergreen vine thickets, which is not mapped and was not recorded during the field survey.
<i>Tephrosia levelleii</i>	V	V	PMST	Habitat: Little is known about the species and its preferred habitat (DAWE 2020). Distribution: Six known collections from north-east Queensland over a range of 400 km (DAWE 2020). Detectability: Perennial herb growing to 30 cm high, flowering in December and January with fruits in December and June (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. The study area occurs along the western border of the species modelled habitat, and only six specimens have been recorded in north-east Queensland, therefore the species is considered unlikely to occur within the study area.
Mammals					
<i>Dasyurus hallucatus</i> Northern quoll	E	LC	PMST	The species inhabits a variety of habitats, ranging from eucalypt woodlands to rainforests (DAWE 2020). Species particularly prefers areas that contain rock crevices, hollow logs and termite mounds (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. The nearest record is approximately 87 km north-east of the study area. Limited suitable denning habitat was observed where rocky outcrops occurred along the banks of the Burdekin River.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Macroderma gigas</i> Ghost bat	V	E	PMST	This species is known to occur in rainforest areas, vine shrub, open woodlands and arid zone (McKenzie and Hall 2008), and roosts in caves, rock crevices and old mine shafts (TSSC 2016a).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable roosting habitat was observed within the study area.
<i>Petauroides volans minor</i> Greater glider (northern)	V	V	WO	The species is largely restricted to eucalypt forests and woodlands, and typically favours habitats containing relatively old trees with an abundance of large tree hollows (TSSC 2016b). Modelling suggests that the species requires native forest patches of at least 160 km ² to maintain viable populations (Eyre 2002).	Likely to occur The species has been historically recorded within the desktop search extent, with one record located along the Burdekin River upstream of the study area. Suitable denning habitat was observed within the study area, with large hollow-bearing trees recorded occasionally along the Burdekin River and within an area downstream of the proposed weir.
<i>Phascolarctos cinereus</i> Koala	V	V	PMST; WO	Within the region, koalas occur in sub-humid <i>Eucalyptus</i> dominated forests and woodlands in riparian and non-riparian environments, and some <i>Acacia</i> dominated forests and woodlands in non-riparian environments (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent. No scratches, faecal pellets or other evidence of koalas were recorded during the field surveys; however, given the presence of suitable food trees, the species is considered likely to occur within the study area.
<i>Pteropus conspicillatus</i> Spectacled flying-fox	E	V	PSMT	Species generally inhabits areas near rainforests and feed primarily on rainforest species, as well as non-rainforest species such as eucalypts in tall open forests adjoining rainforests and tropical woodland ecosystems (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded within the study area during the field surveys.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Rhinolophus robertsi</i> Large-eared horseshoe bat	V	E	PMST	This species is found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, <i>Melaleuca</i> forest with rainforest understorey, open savannah woodland and tall riparian woodland (DAWE 2020). They roost in caves and underground mines, as well as culverts, tree hollows, dense foliage, rock piles and areas beneath creek banks (DAWE 2020). The species forages in open forest, particularly amongst dense vegetation along gullies and creek lines, as well as wattle-dominated ridges in rainforests (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent, and limited suitable foraging and roosting habitat was observed within the study area.
<i>Saccolaimus saccolaimus nudicluniatus</i> Bare-rumped sheath-tailed bat	V	E	PMST	Species inhabits lowland areas, typically in a range of woodland, forest and open environments with roosts typically within tree hollows, caves, overhangs or man-made structures (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species records are located along the north coast of Queensland. Limited suitable habitat was observed within the study area during the field surveys.
Birds					
<i>Calidris ferruginea</i> Curlew sandpiper	CE	E	PMST	The sandpiper mainly occurs along the coastlines of Australia. They occur in smaller numbers across inland waters in Queensland. Known to inhabit sheltered intertidal mudflats, and ephemeral and permanent lakes and dams (Higgins and Davies 1996).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was observed within the study area, the species is known to inhabit lakes and dams.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Erythrotriorchis radiatus</i> Red goshawk	V	E	PMST	The species occurs in a range of habitats, often at ecotones, including coastal and sub-coastal tall open forests, tropical savannahs crossed by wooded or forested watercourses, woodlands, edges of rainforests and gallery forests along watercourses, and wetlands that include <i>Melaleuca</i> and <i>Casuarina</i> species. The species typically nests in tall trees within 1 km of permanent water, and occurs in habitats that support a high abundance of bird species (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. The nearest historically record is located approximately 73 km north- east of the study area. The field survey did not record potentially suitable habitat within the study area.
<i>Geophaps scripta scripta</i> Squatter pigeon (southern)	V	V	WO	The species occurs in open-forests to sparse, open-woodlands and scrub that are dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Acacia</i> or <i>Callitris</i> species, remnant and regrowth within 3 km of water (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, and suitable habitat was recorded within the study area during the field survey.
<i>Neochmia ruficauda</i> Star finch (eastern)	E	E	PMST	The species occurs in low numbers in central Queensland. Mainly inhabits grasslands and grassy woodlands in close proximity to permanent freshwater (DAWE 2020). Species are closely associated to habitats that consist certain tree species, including <i>Eucalyptus coolabah</i> , <i>E. tereticornis</i> , <i>E. tessellaris</i> , <i>Melaleuca leucadendra</i> , <i>E. camaldulensis</i> and <i>Casuarina cunninghamii</i> (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. However, suitable habitat including grassy woodlands retaining preferred tree species in close proximity to semi-permanent water was recorded within the study area.
<i>Numenius madagascariensis</i> Eastern curlew	CE	E	PMST	The eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large	Unlikely to occur The species has not been historically recorded within the desktop search extent, and suitable habitat was not

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				intertidal mudflats or sandflats, often with beds of seagrass (DAWE 2020).	recorded within the study area during the field survey.
<i>Poephila cincta cincta</i> Southern black-throated finch	E	E	PMST	The southern black-throated finch occurs mainly in grassy, open woodlands and forests, typically dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Melaleuca</i> , and occasionally in tussock grasslands or other habitats (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. Limited suitable habitat for the species was observed in the study area. The field survey recorded grassy open woodlands dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Melaleuca</i> species adjacent to semi-permanent water. However, these areas were dominated by an exotic grass, namely buffel grass (<i>Cenchrus ciliaris</i>) and retained a low diversity of native grass species.
<i>Rostratula australis</i> Australian painted-snipe	E	V	PMST; WO	The species generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps, claypans and waterlogged grasslands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent. The Australian painted snipe prefers to inhabit wetlands, lakes and swamps; however, there is potential for the species to inhabit the Burdekin River and other tributaries within the study area.
<i>Tyto novaehollandiae kimberli</i> Masked owl (northern)	V	V	PSMT	The species inhabits riparian forest, rainforest, open forest, <i>Melaleuca</i> swamps, edges of mangroves, margins of sugar cane fields (DAWE 2020). They nest in hollow-bearing trees within closed forest and forage on small to medium-sized terrestrial animals in open woodland (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Limited suitable habitat was recorded within the study area. The field survey observed riparian open woodlands along the Burdekin River and other tributaries; however, a low

Species	Status			Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act				
						abundance of hollow-bearing trees were recorded.
Reptiles						
<i>Acanthophis antarcticus</i> Common death adder	NL	V	WO		The species is found in a wide variety of habitats in association with deep leaf litter, including rainforests, wet sclerophyll forests, woodlands, grasslands, chenopod dominated shrublands, and coastal heathlands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent. Limited suitable habitat was recorded, as only some habitats within the study area retained patches of dense leaf litter.
<i>Denisonia maculata</i> Ornamental snake	V	V	PMST; WO		The preferred habitat is within or adjacent to habitat that is favoured by frogs. The species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions in REs on land zone 4, but also lake margins and wetlands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent. Limited suitable habitat was observed within the study area, as only one large depression with cracking clays was recorded during the field survey.
<i>Egernia rugosa</i> Yakka skink	V	V	PMST		The species is typically found in open dry sclerophyll forest or woodland. This skink uses refuges in dense ground vegetation, in hollow logs, cavities in soil-bound root systems and beneath rocks (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent, and a low abundance of ground-level microhabitats, such as hollow logs and rocks were observed within the study area.
<i>Lerista cinerea</i> Vine-thicket fine-lined slider	NL	V	WO		The species is known to occur within the Charters Towers region, and refuges in leaf litter and loose soil in semi-evergreen vine thickets (AROD 2017).	Unlikely to occur The species has been historically recorded within the desktop search extent; however, semi-evergreen vine thicket was not recorded within the study area during the field survey.

Species	Status			Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act				
<i>Lerista vittata</i> Mount Cooper striped skink	V	V		PMST	The species has been recorded from a range of habitats, including ironbark and bloodwood dominated woodland with shrub and/or grassy ground layers on deep red earths, undulating plains and steep hills on granitic rocks, semi-evergreen vine thickets and spinifex communities (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent, and no suitable habitat was recorded within the study area during the field surveys.
Migratory species						
Birds						
<i>Actitis hypoleucos</i> Common sandpiper	Mig	LC		PMST; WO	Species inhabits coastal wetlands and some inland wetlands. They mostly occur around muddy margins or rocky shores, and occasionally around lakes, billabongs, reservoirs, dams and claypans (DAWE 2020). Species generally forages in shallow water and on bare soft mud edges of wetlands (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with two records located along the Burdekin River downstream stream of the study area. The field survey confirmed potentially suitable habitat within the study area.
<i>Apus pacificus</i> Fork-tailed swift	Mig	LC		PMST	Species is almost exclusively aerial in areas such as inland plains and sometimes foothills or coastal areas (DAWE 2020). They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, health land or saltmarsh (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, potentially suitable habitat including riparian woodland was confirmed present within the study area.
<i>Calidris acuminata</i> Sharp-tailed sandpiper	Mig	LC		PMST	Species inhabits muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grasses, saltmarshes or other low vegetation (DAWE 2020). Their habitat includes lagoons, swamps, lakes and pools near	Unlikely to occur The species has not been historically recorded within the desktop search extent. Potentially suitable habitat was not recorded within the study area.

Species	Status			Source	Habitat requirements	Likelihood of occurrence
	EPBC Act		NC Act			
					the coast, as well as dams, waterholes and salt pans (DAWE 2020).	
<i>Calidris ferruginea</i> Curlew sandpiper	CE, Mig	E		PMST	The sandpiper mainly occurs along the coastlines of Australia. They occur in smaller numbers across inland waters in Queensland (Higgins and Davies 1996). Known to inhabit sheltered intertidal mudflats, and ephemeral and permanent lakes and dams (Higgins and Davies 1996).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species is known to inhabit lakes and dams along the coastlines. Suitable habitat for this species was not recorded within the study area.
<i>Calidris melanotos</i> Pectoral sandpiper	Mig	LC		PMST	Species inhabits shallow fresh to saline wetlands (DAWE 2020). The species is found within coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, creeks, floodplains and artificial wetlands (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. Suitable habitat was recorded within the study area, including the Burdekin River and Lolworth Creek.
<i>Cuculus optatus</i> Oriental cuckoo	Mig	LC		PMST	The species inhabits coastal regions across northern and eastern Australia, as well as offshore islands (DAWE 2020). Species utilises a range of vegetated habitats, including monsoon rainforests, wet sclerophyll forests, open woodlands and along the edges of forests (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was identified within the study area. The species prefers vegetated habitats within the coastal regions of northern and eastern Australia.
<i>Gallinago hardwickii</i> Latham's snipe	Mig	LC		PMST; WO	The species inhabits permanent and ephemeral freshwater wetlands with low, dense vegetation (DAWE 2020). Species sometimes occurs in habitats that have saline or brackish water, such as saltmarshes, mangrove creeks, around bays and beaches (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with one record located along the Burdekin River upstream of the study area. The field survey confirmed potentially suitable habitat within the study area.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Gelochelidon nilotica</i> Gull-billed tern	Mig	LC	WO	This species is found in freshwater swamps, brackish and salt water lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grassland (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent; however, limited suitable habitat occurs within the study area.
<i>Hydroprogne caspia</i> Caspian tern	Mig	LC	WO	This species is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with two records located along the Burdekin River upstream and downstream of the study area. The field survey confirmed potentially suitable habitat within the study area.
<i>Monarcha melanopsis</i> Black-faced monarch	Mig	LC	PMST	Species inhabits rainforest ecosystems that include semi-deciduous vine thickets, complex notophyll vine-forests, tropical rainforests, subtropical rainforests, mesophyll thickets/shrubland, warm and cool temperate rainforest, and dry rainforest (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded within the study area.
<i>Motacilla cinerea</i> Grey wagtail	Mig	LC	PMST	Species inhabits forests and woodlands in close proximity to water, as well as mangroves, city parks and gardens.	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species records are located along the north coast of Queensland. Limited suitable habitat was observed within the study area during the field surveys.
<i>Motacilla flava</i> Yellow wagtail	Mig	LC	PMST	The species is found in highly variable habitats, but typically found in open grassy flats near water. Habitats include, open areas of low vegetation such as	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species records are located

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				grasslands, pastures, sport fields and damp open areas (DAWE 2020).	along the north coast of Queensland. Limited suitable habitat was observed within the study area during the field surveys.
<i>Myiagra cyanoleuca</i> Satin flycatcher	Mig	LC	PMST	The species occurs in heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, typically near wetlands and watercourses (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded within the study area.
<i>Numenius madagascariensis</i> Eastern curlew	CE, Mig	E	PMST	The eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was observed within the study area, the species is known to inhabit lakes and dams.
<i>Pandion haliaetus</i> Osprey	Mig	LC	PMST; WO	The species inhabits littoral and coastal habitats, and terrestrial wetlands. They are known to mostly occur in coastal habitats, however they occasionally travel inland along major rivers (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with three records located along the Burdekin River upstream and downstream of the study area. Suitable habitat occurs along the Burdekin River within the study area.
<i>Plegadis falcinellus</i> Glossy ibis	Mig	LC	WO	The species occurs along the edges of lakes and rivers, floodplains, swamps and sewage ponds, and commonly inhabit inland areas of Australia (DAWE 2020).	Confirmed present The species was confirmed present from one location within the southern extent of the study area.
<i>Rhipidura rufifrons</i> Rufous fantail	Mig	LC	PMST; WO	Species inhabits sclerophyll forests, often in gullies dominated by eucalypts and usually within a dense shrubby	Unlikely to occur The species has been historically recorded within the desktop search

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				understorey that often includes ferns (DAWE 2020).	extent; however, no suitable habitat was recorded within the study area.
<i>Symposiachrus trivirgatus</i> Spectacled monarch	Mig	LC	WO	The species prefers thick understorey habitats in rainforests, wet sclerophyll forests and mangroves (DAWE 2020).	Unlikely to occur The species has been historically recorded within the desktop search extent; however, no suitable habitat was recorded within the study area.
<i>Tringa brevipes</i> Grey-tailed tattler	Mig	LC	WO	This species is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats (DAWE 2020).	Unlikely to occur The species has been historically recorded within the desktop search extent. However, the field survey did not record potentially suitable habitat within the study area. This species is associated with coastal environments.
<i>Tringa glareola</i> Wood sandpiper	Mig	LC	WO	The species occurs in well-vegetated, shallow, freshwater wetlands, and typically prefer habitats that contain emergent, aquatic plants or grasses, dominated by fringing vegetation, including <i>Melaleuca</i> sp. and <i>Eucalyptus camaldulensis</i> (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with one record located along the Burdekin upstream of the study area. Potentially suitable habitat was recorded along Lolworth Creek within the study area.
<i>Tringa nebularia</i> Common greenshank	Mig	LC	PMST; WO	Species is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. Typically occurs in sheltered coastal areas with large mudflats, saltmarshes, mangroves or seagrasses (DAWE 2020). Species also occurs in permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with one record located adjacent to the Burdekin River, approximately 7 km upstream from the study area. Suitable habitat was recorded within the study area.

Species	Status			Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	LC	NC Act			
<i>Tringa stagnatilis</i> Marsh sandpiper	Mig	LC		WO	The species inhabits permanent and ephemeral wetlands, including swamps and billabongs (DAWE 2020). Species generally forages in shallow water and on bare soft mud edges of wetlands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent; however, suitable habitat for this species was not recorded within the study area. This species prefers wetlands.
Reptiles						
<i>Crocodylus porosus</i> Salt-water crocodile	Mig	V		PMST	The species is found in a wide range of habitats including rivers, estuaries, creeks, swamps, lagoons and billabongs up to 150 km inland from the coast (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, the species has the potential to occur in the upper catchment of the Burdekin River. Potentially suitable habitat occurs within the study area.

Key to table: CE – critically endangered; V – vulnerable; E – endangered; NT – near threatened; NL – not listed; LC – least concern; Mig – migratory; PMST – Protected Matters Search Tool; WO – Wildlife Online.

GHD
Level 9
145 Ann Street
T: 61 7 3316 3000 F: 61 7 3316 3333 E: bnemail@ghd.com

© GHD 2020

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

12512214-48485/https://projectsportal.ghd.com/sites/pp10_05/bigrocksw weir/ProjectDocs/02 - Environmental Assessment/Ecological Assessment/Pre-wet Ecology Survey/12512214_REV-A_Big Rocks Weir_Baseline Ecological Assessment Report.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S.Blatchford L.Pratt	N.Clark	<i>N.Clark*</i>	S. Orr	<i>S. Orr*</i>	30/06/2020

www.ghd.com



Appendix D – Baseline Terrestrial and Aquatic Ecology Assessment – Post-wet Assessment



Townsville Enterprise Limited

Big Rocks Weir Business Case

Baseline Terrestrial and Aquatic Ecology Assessment

Post-wet Assessment



August 2020

Abbreviations

Acronym	Abbreviation
BRW	Big Rocks Weir
Bio Act	<i>Biodiversity Act 2014</i>
BPEF	Backpack electro-fishing
CE	Critically endangered
CEMP	Construction Environmental Management Plan
cm	Centimetres
CPESC	Certified professional in erosion and sediment control
DAF	Department of Agriculture and Fisheries
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines and Energy
DAWE	Department of Agriculture, Water and the Environment
DIWA	Directory of Important Wetlands in Australia
E	Endangered
EIA	Environmental Impact Assessment
EMP	Operational phase Environmental Management Plan
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESCP	Erosion and Sediment Control Plan
EVNT	Endangered, vulnerable or near threatened
FSL	Full supply level
GBRWhA	Great Barrier Reef World Heritage Area
GHD	GHD Pty Ltd
ha	Hectares
HES	High Ecological Significance
LC	Least concern
Mig	Migratory
ML	Megalitres
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	<i>Nature Conservation Act 1992</i>
NL	Not listed
NT	Near threatened
PMST	Protected Matters Search Tool
QWQG	Queensland Water Quality Guide
RE	Regional Ecosystem
SAT	Spot Assessment Technique
SSD	Southern saddle dam
SIE	Social Impact Evaluation
SMP	Species Management Plan
TECs	Threatened Ecological Communities
TEL	Townsville Enterprise Limited
V	Vulnerable

Acronym	Abbreviation
VM	<i>Vegetation Management Act 1999</i>
WO	Wildlife Online
WoNS	Weeds of National Significance
WPA	Wetland protection areas

Table of contents

1.	Introduction	1
1.1	Overview	1
1.2	Purpose of this report.....	1
1.3	Scope and limitations.....	2
1.4	Assumptions and limitations	3
1.5	Definitions	3
2.	Methodology.....	5
2.1	Approach.....	5
2.2	Desktop assessment.....	5
2.3	Field assessment.....	5
2.4	Likelihood of occurrence	12
2.5	Predicted habitat for conservation significant species	12
3.	Field survey results	13
3.1	Terrestrial flora.....	13
3.2	Terrestrial fauna.....	23
3.3	Aquatic environment	27
4.	Likelihood of occurrence	37
4.1	Special least concern species	37
4.2	Threatened flora and fauna species	37
4.3	Migratory species.....	38
5.	Conservation significant species.....	39
5.1	Squatter pigeon (southern) (<i>Geophaps scripta scripta</i>).....	39
5.2	Greater glider (northern) (<i>Petauroides volans minor</i>).....	41
5.3	Koala (<i>Phascolarctos cinereus</i>)	43
5.4	Short-beaked echidna (<i>Tachyglossus aculeatus</i>).....	45
6.	Potential impacts and mitigation measures	47
6.1	Overview	47
6.2	Construction phase	47
6.3	Operational phase.....	53
7.	Significance of impacts assessment	62
7.1	Overview	62
7.2	Significance of impact on MNES	62
7.3	Significance of impact on MSES.....	72
8.	Summary.....	74
8.1	Matters of National Environmental Significance	74
8.2	Matters of State Environmental Significance	75
8.3	Impacts, mitigation and significance of impact assessment.....	76
9.	References.....	78

Table index

Table 2-1	Catch effort for fish during post-wet aquatic fauna survey	9
Table 2-2	Catch effort for turtles during post-wet aquatic fauna survey	9
Table 2-3	Likelihood of occurrence criteria	12
Table 3-1	Regional ecosystems considered present within the study area.....	14
Table 3-2	Habitat scores for the post-wet aquatic assessment.....	31
Table 3-3	In-situ water quality during the post-wet field survey.....	32
Table 3-4	Relative abundance of fish species caught during the post-wet field survey	34
Table 3-5	Abundance of turtle species caught during the post-wet field survey	34
Table 4-1	Threatened flora and fauna species likelihood of occurrence	37
Table 4-2	Migratory species likelihood of occurrence.....	38
Table 7-1	Significance of impact on the squatter pigeon (southern)	63
Table 7-2	Significance of impact on the greater glider (northern).....	65
Table 7-3	Assessment of koala habitat using the habitat assessment tool	67
Table 7-4	Assessment of additional factors	68
Table 7-5	Potential impacts on the recovery of the koala	69
Table 7-6	Significance of impact on the koala	70
Table 7-7	Significance impact on migratory species.....	71
Table 7-8	Significance of impact on the short-beaked echidna	73
Table 8-1	MNES confirmed present or likely to occur	74
Table 8-2	MSES confirmed present or likely to occur.....	75

Figure index

Figure 1-1	Locality of the project footprint and study area	4
Figure 2-1	Distribution of survey effort	11
Figure 3-1	Field verified regional ecosystems within the study area	21
Figure 3-2	Habitat types identified within the study area	24
Figure 5-1	Predicted habitat for the squatter pigeon (southern) within the study area	40
Figure 5-2	Predicted habitat for the greater glider (northern) within the study area	42
Figure 5-3	Predicted habitat for the koala within the study area.....	44
Figure 5-4	Predicted habitat for the short-beaked echidna within the study area.....	46

Appendices

Appendix A – Locations of post-wet aquatic assessments

Appendix B – Criteria used to map habitat for conservation significant fauna species

Appendix C – Terrestrial fauna survey results

Appendix D – Likelihood of occurrence assessment

1. Introduction

1.1 Overview

Townsville Enterprise Limited (TEL) is preparing a business case for Big Rocks Weir (BRW). The business case is being undertaken via a tripartite agreement between the Australian Government (North Queensland Water Infrastructure Authority), Queensland Government (Department of Natural Resources, Mines and Energy (DNRME)) and TEL.

The business case is being prepared by KPMG for TEL and will assess the viability of BRW considering a range of information including but not limited to:

- Engineering reference design
- Design quantities and cost estimates
- Asset operation and maintenance schedules
- Land acquisition
- Economic demand modelling
- Cost benefit analysis
- Regulatory approval requirements
- Environmental impact assessment (EIA) outcomes
- Social impact evaluation (SIE) outcomes
- Liaison with project stakeholders.

GHD Pty Ltd (GHD) has provided technical inputs into the business case with regards to the engineering design, capital cost estimates, regulatory approvals pathway, EIA and SIE.

1.1.1 Big Rocks Weir

“Big Rocks” is located on the Burdekin River approximately 26 km north of Charters Towers and 23 km upstream of the existing Charters Towers Weir. The construction of a weir at Big Rocks has been considered previously, as part of separate studies such as the Hells Gates Feasibility Study (SMEC 2018), BRW Concept Plan (GHD 2015) and BRW Preliminary Design Report (McIntyre and Associates 1994). The general concept for BRW is for the construction of a new weir on the Burdekin River with a storage capacity of around 10,000 megalitres (ML).

The objectives of BRW are to provide a new water source that provides additional supply security for the township of Charters Towers and supports the further development of existing irrigated agriculture occurring in the region. The extent and reliability of the water supply provided by BRW is to be determined as part of the business case and will be subject to a range of regulatory, economic and environmental factors.

There will also be an upgrade to the existing 4WD access track to Big Bend Recreational Reserve through the construction of a concrete floodway and culverts. This will provide ongoing public access following construction of the weir.

1.2 Purpose of this report

This report details the methods and results of the baseline ecological survey undertaken in the post-wet season (April/May 2020), to document the existing terrestrial and aquatic environment that has the potential to be impacted by construction and/or operation of BRW. The report also builds on the information collected during the pre-wet field survey (December 2019) and

reported in the Big Rocks Weir Business Case Baseline Terrestrial and Aquatic Assessment Pre-wet Assessment (GHD 2020a) The scope of this work included:

- A desktop review of the ecological values of the study area, including Protected Matters searches, Wildlife Online and other historical databases, and review of Regional Ecosystem (RE) mapping, essential habitat mapping, waterway barrier spatial layer and other government spatial data layers.
- Terrestrial and aquatic field surveys within the study area to provide baseline information on the existing environment, including characterisation of vegetation communities, terrestrial habitats, aquatic habitats, and existing flora and fauna communities. Surveys included targeted methods for conservation significant species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Queensland *Nature Conservation Act 1992* (NC Act).
- Assessment of the likelihood of occurrence of Matters of National and State Environmental Significance (MNES and MSES), including threatened ecological communities, protected areas and conservation significant species.
- Assessment of potential impacts and recommendations for potential mitigation measures to avoid or minimise the magnitude, duration, severity and significance of the projects construction and operation phase.
- Assessment of the significance of impacts on the MNES for the purposes of informing the EPBC referral.
- Identify MSES to inform legislative requirements in subsequent phases of the project.

The study area, as mapped in Figure 1-1, refers to the area over which the ecological values of the area were investigated.

1.3 Scope and limitations

This report has been prepared by GHD for TEL and may only be used and relied on by TEL for the purpose agreed between GHD and the TEL as set out in this report.

GHD otherwise disclaims responsibility to any person other than TEL arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by TEL and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific survey sites. Survey

conditions at other parts of the site may be different from the site conditions found at the specific survey sites.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as land access, geographical constraints and vegetation. As a result, not all relevant site features and conditions may have been identified in this report. Site conditions (including the presence of flora and fauna populations) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.4 Assumptions and limitations

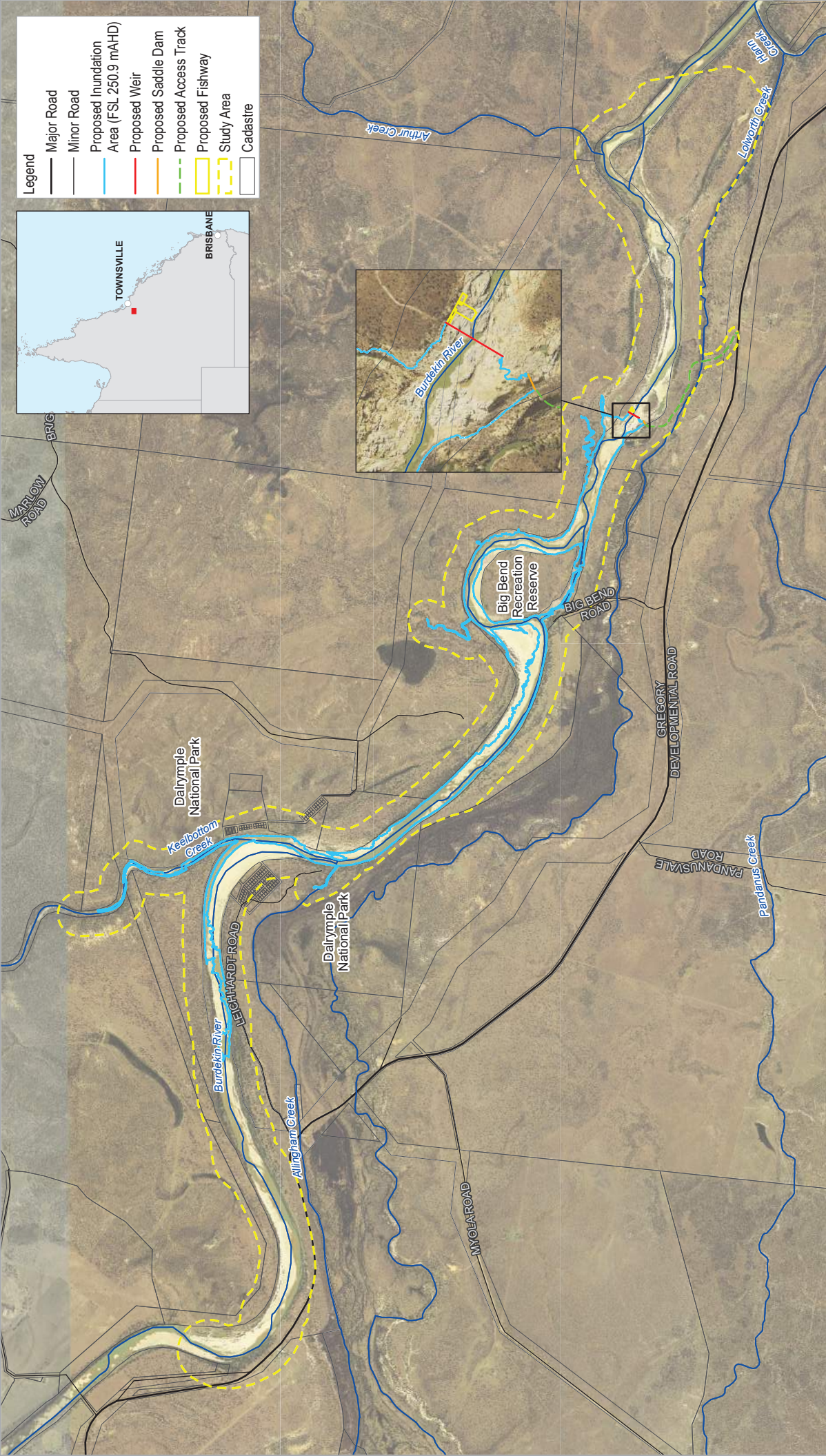
This report should be read with respect to the following:

- Access was not available to all areas within the study area during the field survey. The ecological values of areas that were unable to be accessed has been based on desktop assessments results and ground-truthing of environmental conditions within the broader study area.
- The assessment presents field survey results from one seasonal survey, undertaken in the post-wet season conditions in April/May 2020. The presence and detectability of terrestrial and aquatic flora and fauna species during field assessments is strongly influenced by seasonality and therefore survey results have been interpreted with consideration of this potential variability. The description of environmental values and impact assessment presented in this report are informed by the results of both the pre-wet field survey completed in December 2019 and the post-wet survey completed in April/May 2020.
- The impact assessment presented in this report is based on the draft BRW reference design and potential operating scenarios found in the Big Rocks Weir Business Case Reference Design Report (GHD 2020b)
- The desktop assessment completed in November 2019 before the pre-wet field survey and is still relevant and true.

1.5 Definitions

The following are key descriptors used throughout this report:

- Desktop search extent – This refers to the environment within and adjacent to the inundation area that was subject to desktop ecological assessment. This included areas within a 30 km radius of the approximate centre of the inundation area.
- Project footprint – This represents areas subject to direct impact, including the proposed inundation area, weir structures (Big Rocks weir, southern saddle dam (SSD)) and Big Bend Floodway.
- Study area – This refers to area that has been subject to field survey as indicated in Figure 1-1. This extent of the study area was selected to assess environmental values of the areas within the vicinity of the project footprint.
- Conservation significant species – This term refers to species listed as critically endangered, endangered, vulnerable, or migratory under the EPBC Act as well as species listed as endangered, vulnerable or near threatened (EVNT) under the NC Act.

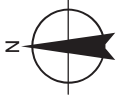


Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Locality of the project
footprint and study area

Project No. 12512214
Revision No. 0
Date 11/08/2020

FIGURE 1-1

2. Methodology

2.1 Approach

The baseline assessment of terrestrial and aquatic ecological values within the study area employed a combination of desktop review of environmental databases and relevant mapping layers, and an ecological field assessment combining survey of terrestrial flora, fauna, and aquatic ecological values.

2.2 Desktop assessment

A desktop review was undertaken to identify and collate existing information on the ecological values of the environment within the study area and surrounding landscape. For most sources, the desktop search extent encompassed areas within a 30 km radius of the approximate centre of the study area on 1 November 2019. This was undertaken to provide context about potential presence of mobile species or cryptic species that are known to occur in similar habitat within the region. Database searches undertaken within the search extent are listed below and are detailed in Section 2.2 of Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

- Protected Matters Search Tool
- Wildlife Online
- Species Profile Search
- Atlas of Living Australia
- Biomaps
- Regulated vegetation mapping
- Essential habitat mapping
- Protected plants flora survey trigger map
- State Planning Policy mapping
- Waterway barriers
- Stream order
- Wetland Info

The desktop assessment results can be found in Section 3 of the Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

2.3 Field assessment

2.3.1 Overview

Terrestrial surveys were undertaken by principle flora ecologist Peter Moonie and fauna ecologist Shannon Blatchford. Peter has a Bachelor of Science in Ecology with over 20 years' of experience in the field of ecology and natural resource management. Shannon has a Bachelor of Science in Ecology and Conservation Biology with 12 years' experience in environmental management and ecological assessments. Aquatic field surveys were undertaken by senior aquatic ecologist Lauren Pratt and aquatic ecologist Rae Quinlan. Lauren has a Bachelor of Marine Studies in Marine Biology and Ecology with Honours, and has 11 years' experience in freshwater aquatic ecosystem monitoring. Rae has a Bachelor of Marine Science and Master of Science in Marine Biology.

Terrestrial field surveys were undertaken over six days from 26 April to 1 May 2020, and aquatic field surveys were undertaken over eight days between 15 and 22 May 2020. Weather conditions during the field survey were warm and dry. During the field survey, the minimum daily temperatures ranged from 13.2 to 18.7 °C, with maximum ranging from 18.9 to 32.9 °C recorded at the Charters Towers weather station (BoM 2020). The Charters Towers weather station received a total of 334.9 mm of rain for January, February and March and April was dry, with a total of 1 mm of rain (BoM 2020).

The survey involved assessments undertaken at key locations across the study area to provide appropriate survey coverage within each of the vegetation communities, terrestrial and aquatic habitats, and geographic locations present within the study area. The methods used are listed in Sections 2.3.2, 2.3.3 and 2.3.4.

2.3.2 Vegetation and flora assessments

Vegetation and flora assessments were undertaken at 125 sites within the study area, and are shown in Figure 2-1. Components assessed during the field survey are listed below and are detailed in Section 2.3.2 of Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

- Threatened ecological communities (TECs)
- REs
- Conservation significant flora species
- Weeds.

2.3.3 Terrestrial fauna assessments

Fauna surveys involved a combination of habitat assessments and rapid survey techniques for fauna species. Assessments were undertaken at 51 sites across the study area, and are shown in Figure 2-1. Survey methods undertaken within the study area are summarised below. Details of each assessment can be found in Section 2.3.3 of Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

- Habitat assessments
- Targeted searches for traces of threatened species
- Bird census
- Active searches for reptiles and frogs
- Nocturnal active searches and spotlighting
- Spot Assessment Technique (SAT)
- Driving/flushing surveys
- Opportunistic searches for wildlife and traces
- Hollow-bearing tree counts
- Deployment of remote surveillance cameras
- Deployment of Anabat detector.

The presence and detectability of terrestrial and aquatic flora and fauna species during field surveys is strongly influenced by seasonality. In this regards, post-wet field surveys were undertaken to capture seasonal variability in the existing environmental values within the study area, as well as to undertake detailed habitat mapping and targeted searches for conservation significant flora and fauna species that are considered likely to occur within the study area.

Spotlighting was conducted over four nights within the study area, and was undertaken in key habitats to target conservation significant fauna species that were considered likely to occur within the study area, including the greater glider (northern) (*Petauroides volans minor*) and koala (*Phascolarctos cinereus*).

Hollow-bearing tree counts were undertaken at 20 sites to determine whether potentially suitable denning habitat occurs within the study area. This involved counting tall, large trees bearing hollows larger than 15 centimeters (cm) in diameter along a 200 m x 50 m transect (1 hectare (ha)). Results assisted in mapping potential suitable habitat for the species.

Remote surveillance cameras were set and baited at two locations, and an Anabat detector was deployed at one location within the study area.

2.3.4 Aquatic assessment

Aquatic assessments were undertaken at 11 sites across the study area as detailed in Appendix A and shown in Figure 2-1. These included:

- Two sites upstream of the proposed weir inundation area (US1 and US3)
- Three sites within the proposed weir inundation area (W1, W2 and W3)
- One at the proposed Big Bend Floodway site (BB)
- Two sites at the proposed weir site (BRW – weir wall and SSD – southern saddle dam)
- Two sites downstream of the proposed weir (DS1 and DS3)
- One site on Lolworth Creek which may require modification to enable access during weir construction (LC).

2.3.5 Aquatic habitat assessment

Habitat assessments were undertaken at 11 sites to describe the presence and condition of key aquatic habitat features and overall condition of each site. Details of each assessment can be found in Section 2.3.4 of the Big Rocks Weir Baseline Terrestrial and Aquatic Assessment Ecology Pre-wet Assessment report (GHD 2020a).

- AusRivAS habitat assessment
- Platypus habitat assessment
- *In-situ* water quality.

2.3.6 Aquatic fauna assessments

Aquatic fauna survey assessments included combination of catching techniques. Fishing and turtle catching methods were undertaken at six sites with an additional two sites having observation only aquatic surveys due to access restrictions (SSD and BRW). Details of each assessment can be found in Section 2.3.4 of the Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

- Box traps
- Fyke nets
- Cathedral traps.

Backpack electro-fishing (BPEF) was an additional method undertaken in the post-wet field survey. This method was not available during the pre-wet assessment. BPEF allows the sampler to target specific (shallow) habitats throughout an aquatic environment.

The catch effort varied between the sites, details on catch efforts for fish and turtles can be found in Table 2-1 and Table 2-2, respectively. The pre-wet field survey did not use BPEF; however, fish assessments used a wider range of nets including increased use of fyke nets and seine nets. Sites were generally shallower and less turbid during the pre-wet assessment and so access for fyke and seine nets was easier. However, during the post-wet field survey, many areas were highly turbid and depth could not be accurately determined therefore the use of BPEF allowed the samplers to access different habitats.

Snorkeling was excluded as a survey method due to the potential risk of crocodiles and high turbidity in the Burdekin River.

Table 2-1 Catch effort for fish during post-wet aquatic fauna survey

Site	Method	Date in	Time in	Date out	Time out	Settings	Effort
US3	BPEF	20/05/2020	9:45	20/05/2020	13:30	300V, 30Hz, 20%	320 s
W1	BPEF	20/05/2020	14:00	20/05/2020	15:30	300V, 30Hz, 20%	957 s
W3	boxtrap (10)	19/05/2020	8:45	19/05/2020	16:30	-	77.5 h
W3	BPEF	19/05/2020	9:00	19/05/2020	11:00	300V, 30Hz, 20%	1208 s
DS1	boxtrap (10)	18/05/2020	8:00	18/05/2020	15:20	-	73.3 h
DS3	boxtrap (10)	17/05/2020	8:30	17/05/2020	14:00	-	56.25 h
DS3	BPEF	17/05/2020	10:45	17/05/2020	12:00	300V, 30Hz, 20%	919 s
LC	boxtrap (10)	16/05/2020	9:00	16/05/2020	16:45	-	77.5 h
LC	fyeke (2)	16/05/2020	10:15	16/05/2020	16:00	-	11.5 h
LC	BPEF	16/05/2020	11:15	16/05/2020	12:30	300V, 30Hz, 20%	1201 s

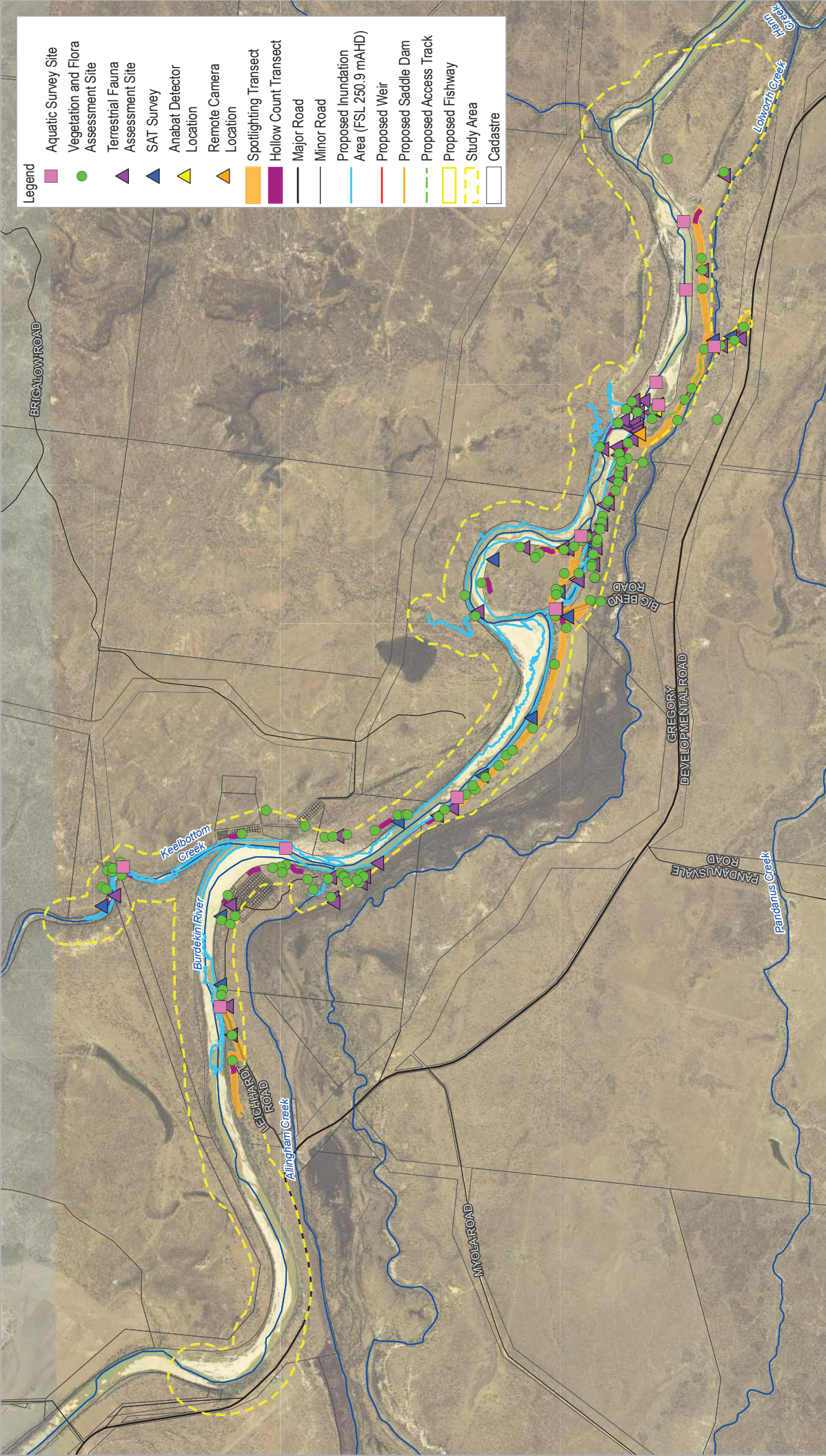
Table 2-2 Catch effort for turtles during post-wet aquatic fauna survey

Site	Method	Date in	Time in	Date out	Time out	Effort
US3	cathedral trap (2)	20/05/2020	9:15	20/05/2020	12:15	6 h
W1	cathedral trap (2)	21/05/2020	9:15	21/05/2020	14:30	10.5 h
W3	cathedral trap (2)	19/05/2020	8:45	19/05/2020	16:45	16 h
DS1	cathedral trap (2)	18/05/2020	7:30	18/05/2020	15:30	16 h
DS3	cathedral trap (2)	17/05/2020	9:45	17/05/2020	15:30	11.5 h
LC	cathedral trap (2)	16/05/2020	8:45	16/05/2020	17:15	17 h

2.3.7 Scientific permits

The ecological field surveys were conducted in accordance with the following permits and approvals:

- Department of Employment, Economic Development and Innovation Scientific Users Registration Certificate (Registration Number 132)
- Queensland Government Scientific Purposes Permit (permit number WISP15723315)
- General Fisheries Permit (permit number 192406)
- Animal Research Authority issued by the accredited GHD Animal Ethics Committee.



Legend

- Aquatic Survey Site
- Vegetation and Flora Assessment Site
- Terrestrial Fauna Assessment Site
- SAT Survey
- Anabat Detector Location
- Remote Camera Location
- Spotlighting Transect
- Hollow Count Transect
- Major Road
- Minor Road
- Proposed Inundation Area (FSL 250.9 mAHd)
- Proposed Weir
- Proposed Saddle Dam
- Proposed Access Track
- Proposed Fishway
- Study Area
- Cadastre

Paper Size ISO A4



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 11/08/2020

Distribution of survey effort

FIGURE 2-1

Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

2.4 Likelihood of occurrence

An assessment was conducted to attribute a 'likelihood of occurrence' rating to conservation significant species (i.e. species listed under the EPBC Act and/or NC Act) that have been previously recorded or were predicted to occur from the desktop searches. The assessment is provided in Appendix D.

The likelihood of occurrence assessment was based on a review of species distributions and habitat requirements, historical records for the region, and the results of habitat assessments and field surveys conducted within the study area. The likelihood of occurrence ranking was based on the framework detailed in Table 2-3.

Table 2-3 Likelihood of occurrence criteria

Likelihood	Criteria
Confirmed present	Species recorded during the field survey.
Likely to occur	Species has been recorded in the desktop search extent and suitable habitat is present in the study area. Comprehensive field surveys have not been undertaken or were undertaken in sub-optimal conditions or the species is highly cryptic and/or very short-lived.
May occur	Species distribution incorporates the study area but only marginal habitat is present or the species has not been recorded in the desktop extent.
Unlikely to occur	Species has not been previously recorded in the desktop search extent and/or current known distribution does not encompass the study area and/or suitable habitat is generally lacking from the study area.

2.5 Predicted habitat for conservation significant species

For all conservation significant fauna species confirmed present or considered likely to occur, the distribution of predicted habitat was mapped based on criteria detailed in Appendix B. For most species, this was based on field verified regional ecosystems that are recognised by the Department of Environment and Science (DES), as essential habitat factors for each species, as a basis for essential habitat mapping.

3. Field survey results

3.1 Terrestrial flora

3.1.1 Threatened ecological communities

The structural and compositional characteristics of mapped regulated vegetation communities were compared with Department of Agriculture, Water and the Environment (DAWE) descriptions of TECs to determine whether any vegetation communities met the diagnostic and condition thresholds necessary to constitute a TEC. No TECs were confirmed present within the project footprint during the field survey.

3.1.2 Vegetation communities

The majority of the RE types and boundaries appeared to be accurately mapped; however, several discrepancies were identified. The most notable discrepancy was within Lot 3 on SP158583 whereby a substantial patch of RE 9.18.13 would be more accurately mapped as 9.8.1a/9.3.3b. On-site observations also suggest that the cut through channel across the neck of Big Bend Recreation Reserve would be more accurately mapped as RE 9.3.12a/9.3.1 rather than RE 9.3.3b and RE 9.11.31. Most other discrepancies observed were attributable to the scale of the DNRME mapping whereby the boundary between the alluvial plain and upper river bank was inaccurate at times. A description of RE communities observed within the project footprint is provided in Table 3-1. Field verified mapping is provided in Figure 3-1.

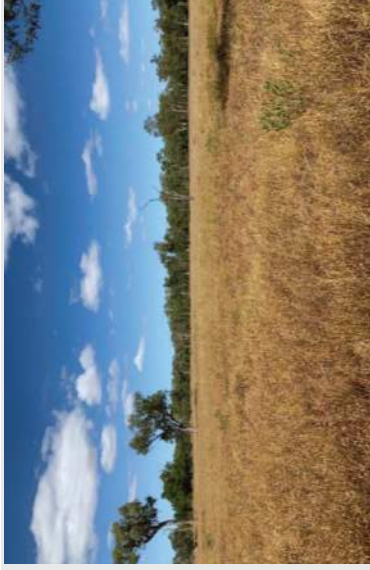
Table 3-1 Regional ecosystems considered present within the study area

RE (VM status)	GHD field description	Photo
9.3.1 / 9.3.12a (LC)	Vegetation: The mid and upper banks typically comprised a woodland to open forest of <i>Eucalyptus camaldulensis</i> with associated <i>Corymbia tessellaris</i> and <i>E. coolabah</i> (to 30 m tall) over a sparse sub-canopy of juvenile canopy species, <i>Pleiogynium timorense</i>, <i>Atalaya hemiglauca</i>, <i>Lophostemon grandiflorus</i>, <i>Cryptostegia grandiflora</i>* and <i>Lysiphyllum hookeri</i> (6 – 10 m tall) over a low tree layer of <i>Acacia salicina</i> and <i>Breynia oblongifolia</i> (2 – 4 m tall). The shrub layer was typically very sparse and was dominated by <i>L. grandiflorus</i>, <i>C. grandiflora</i>* and <i>Parkinsonia aculeata</i>*. The ground layer ranged from sparse to dense and was dominated by <i>Cenchrus ciliaris</i>*, <i>Urochloa mosambicensis</i>*, <i>Parthenium hysterophorus</i>*, <i>Stylosanthes scabra</i>*, <i>Praxelis clematidea</i>*, <i>Malvastrum americanum</i>* and <i>Salsola australis</i>. The lower stream banks and terraces were dominated by canopy of <i>Melaleuca leucadendra</i>, <i>M. fluviatilis</i>, <i>L. grandiflorus</i> and <i>Ficus opposita</i> over a shrub layer of <i>L. grandiflorus</i>, <i>Ricinus communis</i>*, <i>C. grandiflora</i>*, <i>Nicotiana glauca</i>*. The ground layer was often dominated by <i>Xanthium occidentale</i>*, <i>Verbesina encelioides</i>*, <i>Cynodon dactylon</i>*, <i>Urochloa scrobiculatum</i>* and <i>Sida cordifolia</i>*. The stream bed was dominated by a mixture of grasses, herbs and sedges. Common species included <i>Melinis repens</i>*, <i>Heteropogon contortus</i>, <i>Urochloa scrobiculatum</i>*, <i>Dichanthium annulatum</i>, <i>Megathyrsus maximus</i>*, <i>Arundinella nepalensis</i>, <i>Cyperus difformis</i>, <i>Cyperus squarrosus</i>, <i>Cyperus polystachyos</i>, <i>Cleome viscosa</i>, <i>Alternanthera angustifolia</i>, <i>Dysphania</i> sp., <i>Ludwigia octovalvis</i>, <i>Glinus lotoides</i>, <i>Ocimum</i> sp. *, <i>Xanthium occidentale</i>* and <i>Parthenium hysterophorus</i>*. An emergent layer of <i>L. grandiflorus</i>, <i>M. trichostachya</i>, <i>M. viminalis</i>, <i>Casuarina cunninghamiana</i> and <i>E. camaldulensis</i> was often present on stream bed margins and amongst rock outcrop. Landform: Stream bed, banks and lower terraces. Geology/soils: Alluvium (sand and gravels) with exposed rhyolite and basalt rock on lower terraces and stream bed.	 

RE (VM status)	GHD field description	Photo
9.3.1 (LC)	Vegetation: Fringing woodland of <i>E. tessellaris</i>, <i>Ficus racemosa</i>, <i>M. fluviatilis</i>, <i>F. opposita</i>, <i>C. cunninghamiana</i> and <i>P. timorensis</i> over <i>Grewia retusifolia</i>, <i>Abutilon auritum</i>, <i>Ricinus communis</i>*, <i>C. grandiflora</i>*, <i>N. glauca</i>*, <i>Verbesina encelioides</i>*, <i>Asclepias curassavica</i>* and <i>P. hysterothorus</i>*. Landform: Stream banks. Geology/soils: Brown sands.	
9.3.3b (LC)	Vegetation: Woodland to open forest with a sparse to mid-dense canopy cover of <i>C. tessellaris</i> with associated <i>E. crebra</i> and <i>E. camaldulensis</i> (to 25 m tall) over a sparse to mid-dense sub-canopy of canopy (T1) species, <i>P. timorensis</i>, <i>L. grandiflorus</i>, <i>C. erythrophloia</i> and <i>C. clarksoniana</i> (to 14 m tall). The shrub layer was typically very sparse and comprised occasional canopy juveniles, <i>Vachellia farnesiana</i>*, <i>C. grandiflora</i>*, <i>Carissa ovata</i> and <i>Opuntia tomentosa</i>*. The ground layer was generally dense and was dominated by <i>C. ciliaris</i>*, <i>U. mosambicensis</i>*, <i>Heteropogon contortus</i>, <i>M. maximus</i>* and <i>M. repens</i>* with associated <i>Leucas lavandulifolia</i>* and <i>Crotalaria novae-hollandiae</i>. Landform: Alluvial plain. Geology/soils: Alluvium/brown sands.	

RE (VM status)	GHD field description	Photo
9.3.19b (LC)	Woodland to open forest dominated by <i>E. coolabah</i> (9 – 12 m tall) with associated <i>C. dallachiana</i> and <i>E. camaldulensis</i> over a very sparse shrub layer of <i>A. hemiglauc</i>a, <i>C. grandiflora</i>* and <i>V. farnesiana</i>* (1 – 3 m tall) over a dense ground layer of <i>U. mosambicensis</i>*, <i>M. maximus</i>*, <i>H. contortus</i> and <i>Passiflora foetida</i>*. Landform: Alluvial floodplain. Geology/soils: Dark brown clays.	
9.3.22a (LC)	Vegetation: Open woodland dominated by a very sparse canopy of <i>E. crebra</i>, <i>E. brownii</i>, <i>C. dallachiana</i> and <i>C. tessellaris</i> (to 15 m tall) over a very sparse sub-canopy of <i>E. brownii</i>, <i>C. erythrophloia</i> and <i>Terminalia oblongifolia</i> (to 10 m tall) over a very sparse low tree layer of <i>A. hemiglauc</i>a, <i>Santalum lanceolatum</i>, <i>Ventilago viminalis</i>, <i>P. timorensis</i>, <i>Flindersia dissosperma</i> and <i>Eremophila mitchellii</i> (2 – 4 m tall). The shrub layer was very sparse and was dominated by <i>C. ovata</i>, <i>Capparis lasiantha</i>, <i>C. grandiflora</i>*, <i>V. farnesiana</i>* and <i>Erythroxylum australe</i>. Common ground layer species included <i>C. ciliaris</i>*, <i>U. mosambicensis</i>*, <i>Eustrephus latifolia</i>, <i>Aristida</i> spp., <i>Sporobolus actinocladius</i> and <i>S. australasicus</i>. Landform: Gently undulating plain. Geology/soils: Brown clayey sands.	

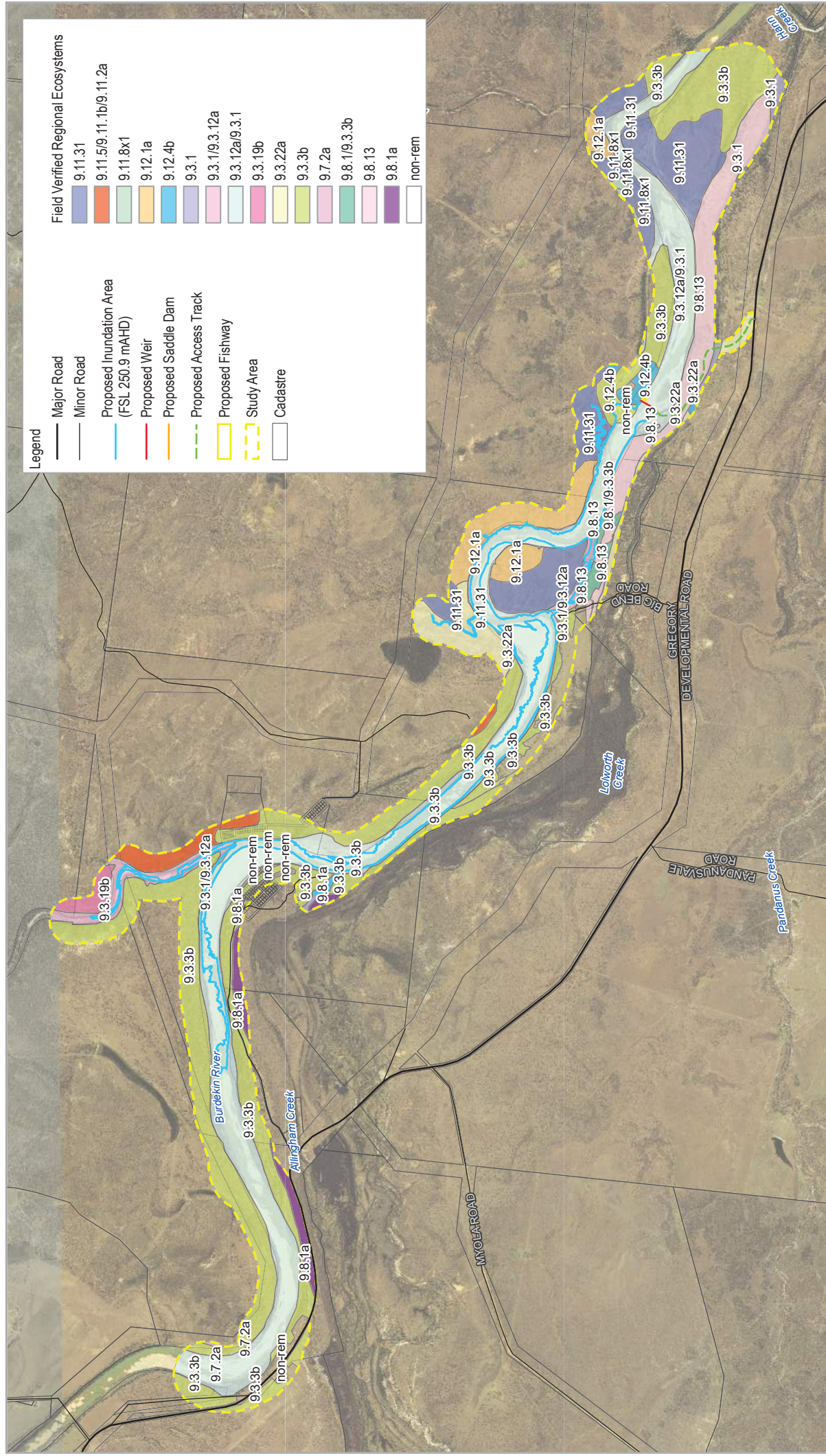
RE (VM status)	GHD field description	Photo
9.8.1a (LC)	Vegetation: Open woodland to woodland dominated by a very sparse to sparse canopy of <i>E. crebra</i> <i>C. erythrophloia</i>, <i>C. dallachiana</i> and <i>P. timorensis</i> (to 15 m tall) over a very sparse sub-canopy of canopy (T1) species, <i>Planchonia careya</i> and <i>Bursaria incana</i> (to 6 m tall) over a very sparse shrub layer of <i>Denhamia cunninghamii</i>, <i>C. grandiflora</i>*, <i>D. oleaster</i>, <i>Grewia retusifolia</i>, <i>S. lanceolatum</i> and <i>C. ovata</i>. Common ground layer species included <i>C. ciliaris</i>*, <i>Melhania oblongifolia</i>, <i>M. americanum</i>*, <i>Sida hackettiana</i>, <i>Dichanthium sericeum</i>, <i>Aristida leptopoda</i>, <i>Pterocaulon serrulatum</i> and <i>C. viscosa</i>. Landform: Gently undulating plain with exposed basalt outcropping (flows). Geology/soils: Dark brown/red loams.	
9.8.1a / 9.3.3b (LC)	Vegetation: Low woodland dominated by <i>E. camaldulensis</i>, <i>C. dallachiana</i> and <i>C. tessellaris</i> with associated <i>E. crebra</i> (8 – 10 m tall) over canopy (T1) species and <i>L. grandiflorus</i> and <i>P. careya</i> (3 – 6 m tall) over a very sparse shrub layer of <i>C. ovata</i>, <i>C. grandiflora</i>* and <i>Grewia retusifolia</i>. Common ground layer species included <i>C. ciliaris</i>*, <i>U. mosambicensis</i>*, <i>P. serrulatum</i> and <i>Sida</i> spp. <i>E. camaldulensis</i> was largely restricted to the alluvial material deposited amongst the basalt outcrop (refer note below in relation to geology/soils). Landform: Gently undulating plain with basalt outcrop. Geology/soils: The unit comprised a mixture of basalt outcrop and coarse loose sands (i.e. alluvial material) occurring between areas of outcrop. This alluvial material is likely to be deposited when the riverbank overtops during major flood events. Note: This unit was mapped by DNRME as RE 9.8.13. The assigned heterogeneous unit (RE 9.8.1a/9.3.3b) is considered to more accurately reflect the integration of land zones (i.e. land zones 3 and 8) as well as the vegetation structure and floristic composition observed within this unit.	

RE (VM status)	GHD field description	Photo
9.8.13 (LC)	Vegetation: Tussock grassland dominated by <i>C. ciliaris</i>* with associated <i>C. novae-hollandiae</i>, <i>M. oblongifolia</i>, <i>Pterocaulon redolens</i>, <i>M. americanum</i>*, <i>Stylosanthes scabra</i>*, <i>U. mosambicensis</i>*, <i>Tridax procumbens</i> and <i>C. viscosa</i>. Scattered emergents included <i>E. crebra</i>, <i>C. erythrophloia</i>, <i>C. dallachiana</i>, <i>C. tessellaris</i>, <i>P. timorensis</i>, <i>P. careya</i>, <i>E. camaldulensis</i>, <i>L. grandiflorus</i>, <i>Petalostigma pubescens</i> and <i>C. grandiflora</i> *. Landform: Flat plain. Geology/soils: Brown/red sandy loam and loose coarse sands on basalt with occasional outcropping.	
9.11.1b (LC)	Vegetation: Low woodland dominated by <i>E. melanophloia</i> / <i>E. shirleyi</i> intermediates (5 – 7 m) over a very sparse sub-canopy of <i>P. careya</i> and <i>L. grandiflorus</i> (2 – 3 m) over a very sparse shrub layer dominated by <i>D. cunninghamii</i>, <i>C. lanceolata</i>, <i>Dolichandrone heterophylla</i>, <i>S. scabra</i>* over a mid-dense ground layer dominated by <i>C. ciliaris</i>*, <i>Aristida</i> sp., <i>A. leptopoda</i>, <i>M. repens</i>* and <i>Enneapogon polyphyllus</i>. Landform: Hills. Geology/soils: Brown sandy loam.	

RE (VM status)	GHD field description	Photo
9.11.31 (LC)	Vegetation: Open woodland dominated by a very sparse canopy of <i>E. crebra</i>, <i>C. terminalis</i>, <i>C. erythrophloia</i> and <i>C. dallachiana</i> with a sub-canopy of canopy (T1) species, <i>Atalaya hemiglauc</i>, <i>P. timorens</i> and <i>P. careya</i>. The shrub layer was sparse and included juvenile canopy species (T1) and <i>C. ovata</i> over a dense ground layer dominated by <i>C. ciliaris</i>*, <i>H. contortus</i>, <i>M. repens</i> and <i>M. oblongifolia</i>. Landform: Undulating plain. Geology/soils: Brown/red sandy loam.	
9.12.1a (LC)	Vegetation: Open woodland to low open woodland dominated a very sparse to sparse canopy of <i>E. crebra</i>, <i>C. erythrophloia</i> and <i>C. dallachiana</i> over a sub-canopy of <i>Acacia excelsa</i>, <i>Grevillia striata</i>, <i>Petalostigma pubescens</i> and <i>Acacia bidwillii</i>. Sparse shrub layer included juvenile canopy (T1) species and <i>Carissa lanceolata</i>*. Ground cover was dominated by <i>C. ciliaris</i>* and <i>H. contortus</i>. Landform: Undulating plain. Geology/soils: Igneous rock.	

RE (VM status)	GHD field description	Photo
9.12.4b (LC)	Vegetation: Low open woodland with a very sparse canopy of <i>Eucalyptus shirleyi</i>[#] with associated <i>C. dallachiana</i> (4 – 7 m tall) over a very sparse shrub layer of <i>P. pubescens</i>, <i>D. cunninghamii</i>, <i>Alphitonia excelsa</i>, <i>A. hemiglauc</i>, <i>Bursaria incana</i>, <i>Indigofera australis</i> and <i>E. shirleyi</i>[#] (0.5 – 2 m tall) over a mid-dense ground layer of <i>C. ciliaris</i>[*], <i>A. holathera</i>, <i>Eriachne mucronata</i>, <i>Fimbristylis dichotoma</i> and <i>Evolvulus alsinoides</i>. Landform: Low hill. Geology/soils: Shallow sandy soils on granite.	

Key to table: RE – regional ecosystem; (*) – introduced flora species; VM Status – *Vegetation Management Act 1999* Status; (#) – species appeared to be an intermediary between *E. shirleyi* and *E. melanophloia*.



Data Disclaimer

©2020. Whilst every care has been taken to prepare this map, GHD and DINRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damages) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214

Project No. 17
Revision No. 0

Date 11/08/2020

Field Verified Regional Ecosystems within the study area

N:\A\Brisbane\Projects\4\212512214\GIS\Maps\APRX\12512214_Ecology_BusinessCase.aprx\12512214_007_Ecol_Field\VerifiedRE
Print date: 11 Aug 2020 - 14:59

Data source: DNRME: Imagery (2016); Roads, Cadastre, Watercourse (2019); GHD: Proposed Infrastructure, Study Area, Field Verified Regional Ecosystem (2020) Imagery, QldBase All Users. Created by: knoble

FIGURE 3-1

3.1.3 Conservation significant flora species

No conservation significant flora species were recorded during the field survey within the study area. The likelihood of occurrence of species predicted to occur through the desktop assessment is discussed in Section 4.

3.1.4 Weed species

Environmental weeds were observed throughout much of the study area, with higher abundances recorded within the vicinity of waterways, tracks and other pastoral infrastructure.

Seven weed species, listed as restricted invasive weeds under the *Biosecurity Act 2014* (Bio Act) and/or are listed as Weeds of National Significance (WONS), were recorded during the pre and post-wet field surveys. These weed species include the rubber vine (*Cryptostegia grandiflora*) (Plate 3-1), moonlight cactus (*Harissa martini*), lantana (*Lantana camara*), velvet tree pear (*Opuntia tomentosa*), Parkinsonia (*Parkinsonia aculeata*) (Plate 3-1), parthenium weed (*Parthenium hysterophorus*) (Plate 3-1) and chinee apple (*Ziziphus mauritiana*) (Plate 3-1). Species general distribution and classification as WoNS or those declared under the Bio Act are listed in Table 4-2 of the Big Rocks Weir Baseline Terrestrial and Aquatic Assessment Pre-wet Assessment report (GHD 2020a).

An additional weed species, namely the giant rat's tail grass (*Sporobolus pyramidalis*), was recorded during the post-wet field survey. This species is listed as a restricted invasive weed (Category 3) under the Bio Act (DAF 2019) and was located along mid-bank of cut through channel of Big Bend Floodway.



Plate 3-1 Parkinsonia (left) and chinee apple; rubber vine and parthenium weed (right)

3.1.5 Culturally significant flora values

The Native Title holders, the Gudjala and Gugu Badhun People of the Burdekin River region consider several flora species within the BRW area as culturally significant. Certain plants are collected by the Gudjala people for food, including berries from the turkey bush, grass seeds to make damper, as well as wild cucumbers and passionfruit. Other plants are collected for traditional medicine, and are still being practiced by the Gudjala People who describe using these plants like pharmaceuticals for healing (NQLC 2020).

Large eucalypt and Melaleuca trees located along the Burdekin River and Lolworth Creek, are described as being over 100 years old, and at Lowes Basin as being over 1000 years old (NQLC 2020).

3.2 Terrestrial fauna

3.2.1 Habitat assessments

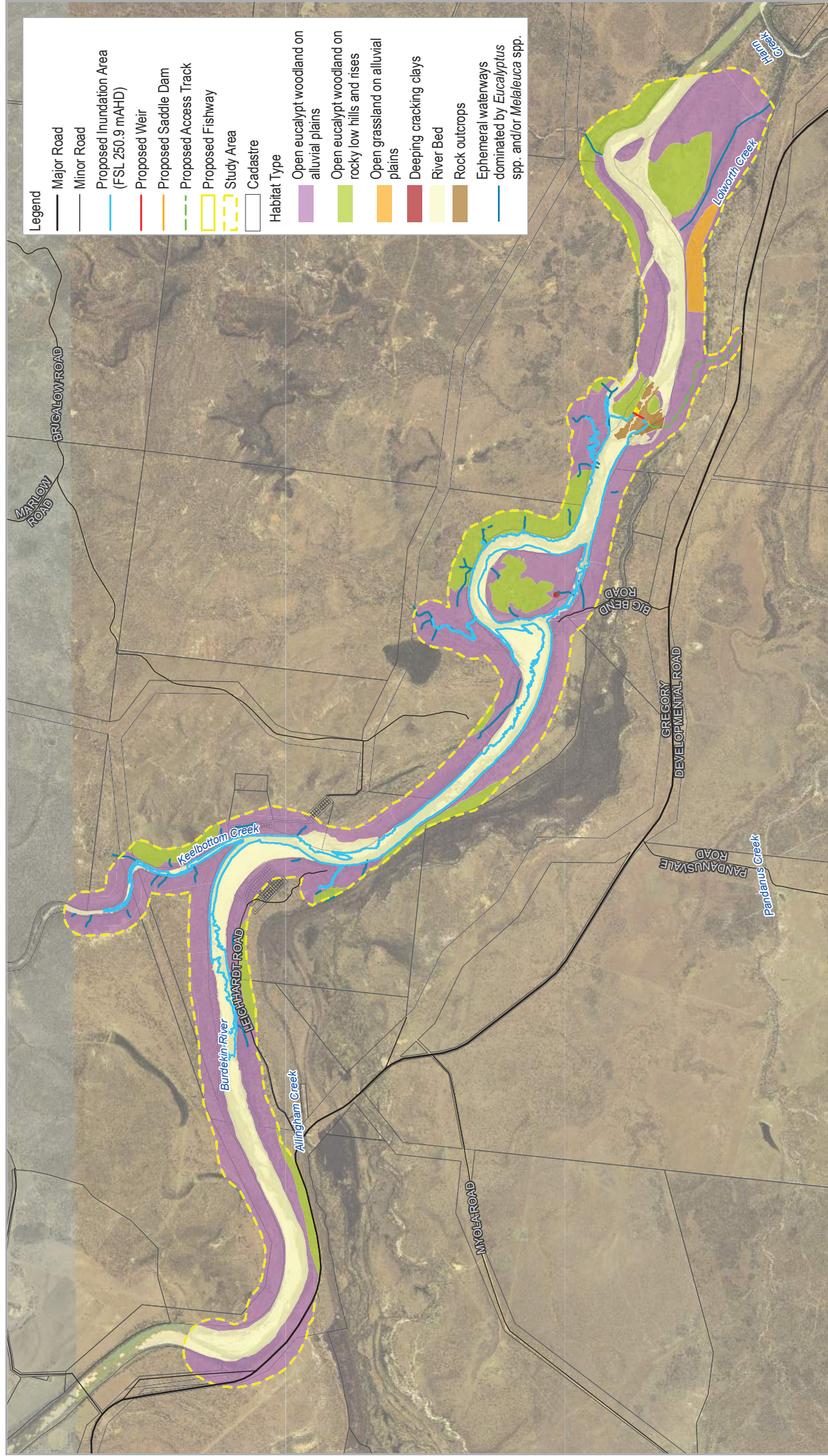
A total of seven habitat types were identified within the study area during the field survey, and are listed below. The ecological values associated with each habitat type are summarised in Table 4-3 of the Big Rocks Weir Baseline Terrestrial and Aquatic Assessment Pre-wet Assessment report (GHD 2020a). Habitat types identified within the study area included:

- Open eucalypt woodland on alluvial plains (Plate 3-2)
- Open eucalypt woodland on rocky low hills and rises (Plate 3-2)
- Open grassland on alluvial plains
- Deep cracking clays
- River bed (Plate 3-2)
- Rocky outcrops
- Ephemeral waterways dominated by *Eucalyptus* spp. and/or *Melaleuca* spp. (Plate 3-2).

Mapping of habitat types within the study area were updated following the post-wet field survey based on RE descriptions and field observations during the pre and post-wet field surveys. Habitat types are mapped in Figure 3-2.



Plate 3-2 Left to right, top to bottom; open eucalypt woodland on alluvial plains; open eucalypt woodland on rocky low hills and rises; river bed; Ephemeral waterways dominated by *Eucalyptus* spp. and/or *Melaleuca* spp.



Legend

- Major Road
- Minor Road
- Proposed Inundation Area (FSL 250.9 mAHD)
- Proposed Weir
- Proposed Saddle Dam
- Proposed Access Track
- Proposed Fishway
- Study Area
- Cadastral

Habitat Type

- Open eucalypt woodland on alluvial plains
- Open eucalypt woodland on rocky low hills and rises
- Open grassland on alluvial plains
- Deeping cracking clays
- River Bed
- Rock outcrops
- Ephemeral waterways dominated by *Eucalyptus* spp. and/or *Melaleuca* spp.

Data Disclaimer

©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the use of the map for any purpose, in whole or in part, in any way and for any reason.

Paper Size ISO A4

0 1 2 3

Kilometres

Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Ghd: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Habitat types identified within the study area

Project No. 12512214
Revision No. 0
Date 11/08/2020

FIGURE 3-2

3.2.2 Conservation significant fauna species

Three conservation significant fauna species, namely the greater glider (northern) (*Petauroides volans minor*) (listed as vulnerable under the EPBC Act and NC Act), squatter pigeon (southern) (listed as vulnerable under the EPBC Act and NC Act) and short-beaked echidna (*Tachyglossus aculeatus*) (listed as special least concern under the NC Act) were confirmed present within the study area during the field surveys. Conservation significant species likely to occur within the study area include the koala (*Phascolarctos cinereus*) (listed as vulnerable under the EPBC Act and NC Act). More information on these conservation significant species is provided in Section 5. The likelihood of occurrence of conservation significant species is provided in Appendix D.

3.2.3 Terrestrial fauna species

A total of 93 fauna species were recorded during the field survey within the study area. This comprised 20 species of mammals, 67 species of birds and six species of reptiles. A description of each of the fauna groups is provided below. A list of fauna species encountered in the post-wet field survey is provided in Appendix C

Mammals

Two conservation significant mammal species, namely the greater glider (northern) and short-beaked echidna were recorded within the study area during nocturnal spotlighting. The greater glider (northern) was recorded in the higher parts of a river red gum (*Eucalyptus camaldulensis*) within the study area, and the short-beaked echidna was recorded within open eucalypt woodland within the study area.

Mammal species recorded during field survey included the eastern grey kangaroo (*Macropus giganteus*), common wallaroo (*Macropus robustus*), agile wallaby (*Macropus agilis*), black-striped wallaby (*Macropus dorsalis*) and swamp wallaby (*Wallabia bicolor*). Nocturnal spotlighting confirmed the presence of the common brushtail possum (*Trichosurus vulpecula*). No small ground mammals were encountered during the field survey. The anabat detector positively identified 12 microbat species, including the hoary wattled bat (*Chalinobius nigrogriseus*), greater broad-nosed bat (*Scoteanax rueppellii*) and white-striped freetail-bat (*Austronomus australis*).

Birds

One conservation significant bird species, namely the squatter pigeon (southern) was recorded along maintained access tracks in northern area of Dalrymple National Park within the study area. The species were identified during the flushing/driving surveys.

A total of 67 bird species were recorded during the field survey within the study area. Bird species that were most abundant and widespread were species naturally adapted to open landscapes, such as the torresian crow (*Corvus orru*), pied butcherbird (*Cracticus nigrogularis*), Australian magpie (*Cracticus tibicen*) and apostlebird (*Struthidea cinerea*).

Grassland bird specialists, including Australasian pipit (*Anthus novaeseelandiae*), Australian bustard (*Ardeotis australis*), and emu (*Dromaius novaehollandiae*) were observed within the open grassland areas. Raptors including the wedge-tailed eagle (*Aquila audax*), nankeen kestrel (*Falco cenchroides*) and whistling kite (*Haliastur sphenurus*) were recorded foraging in open pasture areas within the study area.

Birds encountered in regrowth and open woodland areas included the pheasant coucal (*Centropus phasianinus*) and double-barred finch (*Taeniopygia bichenovii*). Remnant eucalypt woodland within the study area provides nesting and foraging habitat for woodland-dependent birds, including the red-winged parrot (*Aprosmictus erythropterus*), red-tailed black-cockatoo

(*Calyptorhynchus banksii*), blue-winged kookaburra (*Dacelo leachii*) and pale-headed rosella (*Platycercus adscitus*).

Bird species encountered along the Burdekin River and other waterways within the study area included the hardhead (*Aythya australis*), Australasian darter (*Anhinga novaehollandiae*), eastern great egret (*Ardea modesta*), white-bellied sea-eagle (*Haliaeetus leucogaster*) and forest kingfisher (*Todiramphus macleayii*).

Reptiles

Six reptile species, including the wall skink (*Cryptoblepharus virgatus*), copper-tailed skink (*Ctenotus taeniolatus*), tree skink (*Egernia striolata*), Bynoe's gecko (*Heteronotia binoei*), common tree snake (*Dendrelaphis punctulatus*) and carpet python (*Morelia spilota*) were recorded within the study area during the field survey. The common tree snake and carpet python were encountered along the Burdekin River within dense riparian vegetation. The wall skink, copper-tailed skink and bynoe's gecko were located within open eucalypt woodland under woody debris and rock piles, and the tree skink was observed within dense vegetation under large granite rocks.

Least concern reptile species that are likely to occur within the study area due to their regional abundance include the tommy roundhead (*Diporiphora australis*), dubious dtella (*Gehyra dubia*), northern velvet gecko (*Oedura castelnaui*) and fire-tailed skink (*Morethia taeniopleura*).

3.2.4 Pest animal species

Four pest animal species, including the Chital deer (*Axis axis*), wild dog (*Canis lupus*), European rabbit (*Oryctolagus cuniculus*) and cane toad (*Rhinella marina*), were identified within the study area during the pre-wet field survey. The identities, status and distribution of the species observed within the study area is provided in Table 4-4 of the Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

An additional pest animal species, namely the feral pig (*Sus scrofa*), was recorded during the post-wet field survey. This species is listed as a restricted invasive animal (Category 3, 4 and 6) under the Bio Act (DAF 2019). The species tracks, diggings and rootings were observed along the Burdekin River and other tributaries within the study area.

3.2.5 Culturally significant fauna species

The Native Title holders, the Gudjala and Gugu Badhun People of the Burdekin River region consider the fauna species within the BRW area as culturally significant. The Gudjala people hunt for the brushtail possum and short-beaked echidna at Lolworth Plains, and hunt for wallabies and fish at Big Bend (NQLC 2020).

3.3 Aquatic environment

3.3.1 Aquatic habitat

Aquatic habitats identified within the study area were isolated and connected pools, riffle and run habitat (Plate 3-3). Key habitat features observed included overhanging vegetation, large woody debris and in-stream macrophytes (Plate 3-4).

The Burdekin River is a major river (stream order 8) within the Upper Burdekin River sub-catchment. Lolworth Creek (stream order 6) and Keelbottom Creek (stream order 5) which connect with the Burdekin River downstream and upstream of the proposed BRW, respectively are also classified as major waterways. Numerous MSES regulated vegetation (defined watercourses) are present within the study area and surrounding region, both upstream and downstream.

The study area does not occur within a nationally important wetland; however, the Great Basalt Wall DIWA (Directory of Important Wetlands in Australia) is located immediately adjacent to the western extent of the study area. The wetland is located outside the proposed inundation area of the weir. High Ecological Significance (HES) wetlands areas are mapped within the study area, approximately 1 km from the Burdekin River, with ten mapped 1 km from the Burdekin River. Downstream two HES wetlands are approximately 22 km from BRW. While upstream, eight small pockets of HES wetlands are mapped within 10 km of the BRW. Further details on the desktop study results are presented in Section 3.7.2 of Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

Aquatic habitat descriptions of Keelbottom Creek, Burdekin River and Lolworth Creek are presented in Section 2.4.3 of Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a). A description of Big Bend Recreation Reserve is provided in the following section.



Plate 3-3 Left to right, top to bottom; isolated pool (SSD); connected pool (DS3); riffle (LC); run (W1)



Plate 3-4 Left to right, top to bottom; overhanging vegetation (US1); large woody debris (US1); submerged macrophytes (LC); emergent macrophytes (W2)

Big Bend Recreation Reserve

Site BB consisted of a high flow channel that was dry at the time of the survey. The high flow channel is within the Big Bend Recreation Reserve and during flooding events, Big Bend Recreation Reserve becomes an island. The BB site is used as a vehicle crossing point to gain access to the Big Bend Recreation Reserve (Plate 3-5).

Bed substrate was predominantly sand with silt/clay and gravel. The banks consisted of similar substrate and were steep to moderately sloped between 6 m – 10 m high.

The riparian vegetation was moderately to highly disturbed with a width of approximately 120 m. The canopy primarily consisted of *Eucalyptus* spp. and/or *Melaleuca* spp. and grasses in the understory. The riparian vegetation is semi-continuous and would provide shading over the channel when flowing.

Overall, site BB within Big Bend Recreation Reserve was in 'fair' condition with a habitat assessment score of 57 (Table 3-2).



Plate 3-5 Big Bend Recreation Reserve (site BB); downstream and right bank vehicle crossing

Lolworth Creek, Keelbottom Creek and Burdekin River

The Burdekin River and Lolworth Creek had minimal changes to the habitat between the pre and post-wet field surveys. Generally, changes included wider wetted widths in many sections of the Burdekin River, decreases in sand bars and increases in silt/clay content on the banks.

Within the Burdekin River the habitat assessment score category decreased for two sites, W1 decreased from an 'excellent' (114) to 'good' (85) score and BRW from 'good' (86) to 'fair' (70). The main reason for the decreases in habitat assessment scores for both sites was an increase in bottom scouring or deposition, also increase in fine sediments (W1) and lack of stable bottom substrate habitat (BRW). All other sites remained within the same habitat assessment category.

Keelbottom Creek's habitat assessment score also decreased from 'good' (85) to 'fair' (59). The left bank of Keelbottom Creek primarily consisted of bedrock during the pre-wet field survey, however during the post-wet many areas of the bedrock were covered in silt/clay and there were signs of cattle movement along the left bank and through the tributary. The instream habitat also changed with few macrophytes or large woody debris, which were present during the pre-wet field survey.

Table 3-2 Habitat scores for the post-wet aquatic assessment

Habitat variable	Scale*	US1	US3	W1	W2	W3	BB	SSD	BRW	DS1	DS3	LC
Bottom substrate	0-20	6	5	15	13	17	9	11	3	5	15	17
Embeddedness	0-20	3	3	10	9	15	5	15	16	4	14	18
Velocity and depth category	0-20	7	5	16	13	18	0	5	5	5	19	15
Channel alteration	0-15	7	7	6	5	10	5	13	12	8	13	10
Bottom scouring and deposition	0-15	4	7	4	3	11	6	13	5	8	10	13
Pool/riffle, run/bend ratio	0-15	4	5	9	5	13	6	10	8	3	13	11
Bank stability	0-10	6	9	7	7	8	7	10	10	7	7	9
Bank vegetation and stability	0-10	8	9	9	9	8	9	9	9	7	7	9
Streamside cover	0-10	9	9	9	9	9	10	2	2	9	6	9
Totals	0-135	54	59	85	73	109	57	88	70	56	104	111
Habitat score category*		Fair	Fair	Good	Fair	Good	Fair	Good	Fair	Fair	Good	Excellent

* Scale as per AusRivAS habitat assessment method

* Excellent = 111-135, good = 75-110, fair = 39-74, poor = 0-38

Colour categories: excellent = blue, good = green, fair = orange, poor = red

3.3.2 Water quality

In-situ water quality was measured at 10 sites, BB was dry at the time of the survey, and the results presented in Table 3-3.

Water temperature ranged from 21.7°C at site US3 to 23.7°C at site US1. These temperatures are between 7°C – 10°C cooler than the maximum and minimum temperatures recorded in the pre-wet field survey.

The pH exceeded the the *Queensland Water Quality Guidelines 2009* (QWQG) (DEHP 2009) values at all sites with the exception of US3 and W1. pH was highest at site SSD (8.52) and lowest at site US3 (7.47). These sites also had the highest and lowest pH readings in the pre-wet field survey.

Electrical conductivity exceeded the QWQG at all sites with the exception of sites US3 and SSD. Electrical conductivity was lowest at site SSD (215 µS/cm) and highest at site LC (389 µS/cm). The range of electrical conductivity was lower in the post-wet field survey than the pre-wet field survey.

Dissolved oxygen was lower than the guideline value at sites US3 and LC. Dissolved oxygen concentration was lowest at US3 (71.3%) and highest at SSD (100.2%).

Turbidity complied with the QWQG at all sites with the exception of site US3, which was marginally higher than the guideline value. US3 recorded the highest turbidity of 51.5 NTU while all other sites recorded turbidity below 16.7 NTU. The lowest turbidity reading was at site LC (4.6 NTU). Overall, the turbidity in the post-wet field survey was higher than the pre-wet field survey.

Table 3-3 In-situ water quality during the post-wet field survey

Site	Temperature	pH	Electrical conductivity	Dissolved oxygen	Turbidity
Units	°C	pH units	µS/cm	% saturation	NTU
QWQG	–	6.5 – 8.0	120 – 310 ¹	85 – 110	50
US1	23.7	8.17	360	100.1	10.6
US3	21.7	7.47	224	71.3	51.5
W1	22.1	7.89	345	87.8	13.7
W2	22.2	8.21	355	94.1	13.1
W3	21.9	8.10	356	89.5	12.2
SSD	23.0	8.52	215	100.2	9.9
BRW	22.7	8.30	356	100.0	11.5
DS1	22.8	8.27	354	95.1	12.4
DS3	22.1	8.30	351	94.9	16.7
LC	22.1	8.17	389	80.7	4.6

¹ 20th and 80th percentiles from the Queensland water quality guideline for coastal lowland streams (DEHP 2009)

Queensland water quality guideline (2009) Central Coast lowland streams

3.3.3 Aquatic fauna species

No conservation significant aquatic species were recorded within the study area during the field survey.

Of the 25 species of fish known to occur in the Upper Burdekin catchment (Pusey *et al.* 2004), 13 species were captured, four additional species to the pre-wet field survey (Table 3-4). The eastern rainbowfish (*Melanotaenia splendida*) was again the most common species recorded with 253 individuals caught across six sites. The barred grunter (*Amniataba percooides*) was also found across six sites and was also relatively abundant with 126 individuals captured during the field survey. The Hyrtl's tandan (*Neosilurus hyrtlui*), black catfish (*Neosilurus ater*) and flyspecked hardyhead (*Craterocephalus stercusmuscarum*) were the least abundant species with four or less individuals identified at only one site. Site LC recorded the highest abundance of individuals and was dominated by eastern rainbowfish and barred grunter. Two sites (LC and W3) recorded the highest species richness with 10 species recorded.

Two noxious fish species were found during the post-wet field survey. These included tilapia (*Oreochromis mossambicus*) and Eastern gambusia (*Gambusia holbrooki*). Tilapia was found at five sites including upstream, downstream and within the weir inundation area (US3, W1, W3, DS3 and LC). Eastern gambusia was less common and occurred at two sites (W3 and LC).

Red claw (*Cherax quadricarinatus*) was widespread with individuals captured throughout the Burdekin River (W1, W3, DS3), Keelbottom Creek (US3) and Lolworth Creek (LC).

Of the five freshwater turtle species known to occur in the Upper Burdekin catchment (Cann 1998), the Krefft's river turtle (*Emydura macquarii krefftii*) and saw-shelled turtle (*Wollumbinia latisternum*) were confirmed present within the study area (Table 3-5). The Krefft's river turtle occurred in low abundance at all six detailed sites with four sites recording a only single individual. Sites DS1 and LC had the highest abundance of Krefft's river turtle with seven and six individuals, respectively. A single adult, female saw-shell turtle was captured at W3. The majority of turtles were adults (N=13) with a smaller number of juveniles (N=5). The sex ratio of the Krefft's turtle caught was relatively equal between males (N=8) and females (N=9). Seven females and five males were adults.

There were no platypus captured or observed during the pre-wet field survey. However, there is potential platypus habitat present on Lolworth Creek, Keelbottom Creek and the Burdekin River within consolidated sandy silty/clay banks or under rock ledges, roots and woody debris.

Photos of aquatic fauna are presented in Plate 3-6 and Plate 3-7.

3.3.4 Culturally significant aquatic species

There are several aquatic values that the Native Title holders, the Gudjala and Gugu Badhun People of the Burdekin River region consider culturally significant. These include many native fish species such as, the basalt jewfish with freckles on its tummy; black bellied jewfish; sooty grunter, eel tailed catfish; leatherjacket; yellow jewfish/yellow bellied jewfish; and freshwater turtle. The freshwater eel is especially significant, 'The eel is the traditional owner of the river and kept the river clean. There were eels all the way up to Blue Range Station but now there are no eels'. Eels were caught, cooked, skinned, eaten, enjoyed and valued by Gudjala People (NQLC 2020)

Table 3-4 Relative abundance of fish species caught during the post-wet field survey

Common Name	Scientific Name	US3	W1	W3	BRW *	SSD *	DS1	DS3	LC
Eastern rainbowfish	<i>Melanotaenia splendida</i>		2	32		12	26	24	157
Southern purple-spotted gudgeon	<i>Mogurnda adspersa</i>			1					11
Sleepy cod	<i>Oxyeleotris lineolatus</i>	3	21	1				7	6
Barred grunter	<i>Amniataba percoides</i>	1	3	9		2		27	84
Flyspecked hardyhead	<i>Craterocephalus stercusmuscarum</i>							4	
Bony bream	<i>Nematalosa erebi</i>	11		26		4		17	25
Sooty grunter	<i>Hephaestus fuliginosus</i>		2	19			10	22	35
Spangled perch	<i>Leiopotherapon unicolor</i>		13	14				11	25
Gudgeon	<i>Hypseleotris species</i>			1					21
Hyrtl's tandan	<i>Neosilurus hyrtlui</i>			3					
Black catfish	<i>Neosilurus ater</i>			3					
*Sevenspot archer fish	<i>Toxotes chatareus</i>				2	3	1		
Aggassiz's glassfish	<i>Ambassis agassizii</i>								7
Total abundance		15	41	109	2	21	37	108	375
Species richness		3	5	10	1	4	3	6	10

* Observation only

Table 3-5 Abundance of turtle species caught during the post-wet field survey

Common Name	Scientific Name	US3	W1	W3	DS1	LC	DS3
Krefftt's river turtle	<i>Emydura macquarii krefftii</i>	1	1	1	7	6	1
Saw-shelled turtle	<i>Wollumbinia latisternum</i>			1			



Plate 3-6 Left to right, top to bottom; Eastern rainbowfish (*Melanotaenia splendida*); barred grunter (*Amniataba percooides*); southern purple-spotted gudgeon (*Mogurnda adspersa*); bony bream (*Nematalosa erebi*); sooty grunter (*Hephaestus fuliginosus*); Agassiz's glassfish (*Ambassis agassizii*); black catfish (*Neosilurus ater*); tilapia (*Oreochromis mossambicus*)



Plate 3-7 Saw-shell turtle (*Wollumbinia latisternum*) (left); Krefft's river turtle (*Emydura macquarii krefftii*) (right)

4. Likelihood of occurrence

A likelihood of occurrence assessment was undertaken as detailed in Section 2.4. The results of the assessment are provided in Appendix D. A summary of the likelihood of occurrence assessment is provided below. This considers the likelihood of occurrence of conservation significant species predicted to occur within the study area.

4.1 Special least concern species

The short-beaked echidna was **confirmed present** during the field survey within the study area. Species ecology and distribution within the study area for the short-beaked echidna is detailed in Section 5.

4.2 Threatened flora and fauna species

Two threatened fauna species, namely the squatter pigeon (southern) and greater glider (northern), were **confirmed present** during the field survey within the study area. Based upon the desktop assessments and assessments of habitats during the field survey, the koala is considered **likely to occur** and 11 threatened flora and fauna species **may occur** within the study area (Table 4-1). Species ecology and distribution within the study area for the squatter pigeon (southern), greater glider (northern) and koala are detailed in Section 5.

Table 4-1 Threatened flora and fauna species likelihood of occurrence

Species	Common name	Status	
		EPBC Act	NC Act
Confirmed present			
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V
<i>Petauroides volans minor</i>	Greater glider (northern)	V	V
Likely to occur			
<i>Phascolarctos cinereus</i>	Koala	V	V
May occur			
<i>Acanthophis antarcticus</i>	Common death adder	NL	V
<i>Crocodylus porosus</i>	Estuarine crocodile	Mig	V
<i>Dichanthium queenslandicum</i>	King bluegrass	E	V
<i>Erythroriorchis radiatus</i>	Red goshawk	V	E
<i>Eucalyptus raveretiana</i>	Black ironbox	V	LC
<i>Lerista vittata</i>	Mount Cooper striped skink	V	V
<i>Neochmia ruficauda</i>	Star finch (eastern)	E	E
<i>Poephila cincta cincta</i>	Southern black-throated finch	E	E
<i>Rhinolophus robertsi</i>	Large-eared horseshoe bat	V	E
<i>Rostratula australis</i>	Australian painted-snipe	E	V
<i>Tyto novaehollandiae kimberli</i>	Masked owl (northern)	V	V

Key to table: E – endangered; V – vulnerable; NL – not listed; LC – least concern; Mig – migratory.

4.3 Migratory species

One migratory species, namely the glossy ibis (*Plegadis falcinellus*) was **confirmed present** during the pre-wet field survey within the study area. Based upon the desktop assessment and assessments of habitats during the field survey, six migratory species are considered **likely to occur** and seven migratory species **may occur** within the study area (Table 4-2). Species ecology and distribution within the study area are detailed for the glossy ibis and the six species considered likely to occur in Section 6.4 of the Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a).

Table 4-2 Migratory species likelihood of occurrence

Species	Common name	Status	
		EPBC Act	NC Act
Confirmed present			
<i>Plegadis falcinellus</i>	Glossy ibis	Mig	LC
Likely to occur			
<i>Actitis hypoleucos</i>	Common sandpiper	Mig	LC
<i>Gallinago hardwickii</i>	Latham’s snipe	Mig	LC
<i>Hydroprogne caspia</i>	Caspian tern	Mig	LC
<i>Pandion haliaetus</i>	Osprey	Mig	LC
<i>Tringa glareola</i>	Wood sandpiper	Mig	LC
<i>Tringa nebularia</i>	Common greenshank	Mig	LC
May occur			
<i>Apus pacificus</i>	Fork-tailed swift	Mig	LC
<i>Calidris melanotos</i>	Pectoral sandpiper	Mig	LC
<i>Crocodylus porosus</i>	Estuarine crocodile	Mig	V
<i>Gelochelidon nilotica</i>	Gull-billed tern	Mig	LC
<i>Myiagra cyanoleuca</i>	Satin flycatcher	Mig	LC
<i>Rhipidura rufifrons</i>	Rufous fantail	Mig	LC
<i>Tringa stagnatilis</i>	Marsh sandpiper	Mig	LC

Key to table: V – vulnerable; Mig – migratory; LC – least concern.

5. Conservation significant species

Section 5 details the ecology and distribution within the study area for conservation significant species that were confirmed present or considered likely to occur within the study area.

5.1 Squatter pigeon (southern) (*Geophaps scripta scripta*)

5.1.1 Species ecology

The squatter pigeon (southern) (listed as vulnerable under the EPBC Act and NC Act) occurs in remnant and regrowth open forest and woodland dominated by *Eucalyptus*, *Corymbia*, *Acacia* and *Callitris* species with tussock grassy understorey within 3 km of water sources (DAWE 2020). Soils are generally a good predictor of their foraging and breeding habitat (Squatter Pigeon Workshop 2011). Breeding and foraging habitat is generally restricted to well-draining, gravelly, sandy or loamy soils with a tussock-grassy understorey (Squatter Pigeon Workshop 2011). These typically have a patchy ground layer composed of native perennial tussock grasses or a mix of native perennial tussock grasses and low shrubs or forbs (Squatter Pigeon Workshop 2011). Breeding habitats are typically on stony rises within 1 km of permanent water (Squatter Pigeon Workshop 2011). Key threats to the squatter pigeon (southern) are predominately loss and fragmentation of habitat, overgrazing by stock, degradation of habitat by weeds and exotic pasture (e.g. *Cenchrus ciliaris*) and feral herbivores, and predation by feral cats and foxes (DAWE 2020).

5.1.2 Distribution within the study area

Seven squatter pigeons (southern) were confirmed present from two locations in the eastern extent of Dalrymple National Park. All individuals were observed within or adjacent to open woodland within close proximity to the Burdekin River. Essential habitat for the squatter pigeon (southern) is mapped in the eastern and south-western area of Dalrymple National Park (Figure 3-2 of the Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment report (GHD 2020a)). Essential habitat is also mapped in the north-west, approximately 250 m west of the proposed inundation area. A series of low hills and rises with stony soils, woody debris and tussocky native grasses was recorded within the study area as potentially suitable breeding habitat for the subspecies. Areas of potentially suitable foraging habitat was recorded in open eucalypt woodland with grassy understorey. Based on mapping of predicted habitat, a total of 9.21 ha of squatter pigeon (southern) habitat is mapped within the project footprint, representing 2.82 percent of habitat within the project footprint and 0.05 percent of habitat within the regional area (5 km radius of the project footprint). The location of squatter pigeon (southern) sightings and distribution of potential habitat has been mapped in Figure 5-1.



- Legend**
- Squatter Pigeon (Southern)
 - Major Road
 - Minor Road
 - Proposed Inundation Area (FSL 250.9 mAHD)
 - Proposed Weir
 - Proposed Saddle Dam
 - Proposed Access Track
 - Proposed Fishway
 - Study Area
 - Cadastral
 - Squatter Pigeon (Southern)
 - Potential Habitat

Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party in reliance on the map, or for any inaccuracy, incompleteness or unsuitability in any way and for any reason.

N:\A\Brisbane\Projects\421251214\GIS\Map\APRX\12512214_Ecology_BusinessCase.aprx\12512214_010_Ecol_SquatterPigeonHabitat
Print date: 11 Aug 2020 - 16:43

Paper Size ISO A4
0 1 2 3
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Predicted habitat for the squatter pigeon within the study area

Project No. 12512214
Revision No. 0
Date 11/08/2020

FIGURE 5-1

Data source: DNRME Imagery (2016); Roads, Cadastral, Watercourse (2019); GHD: Proposed Infrastructure, Study Area, Potential Habitat, Species Record (2020) Imagery, Outlets, Allotments. - Created by: macle

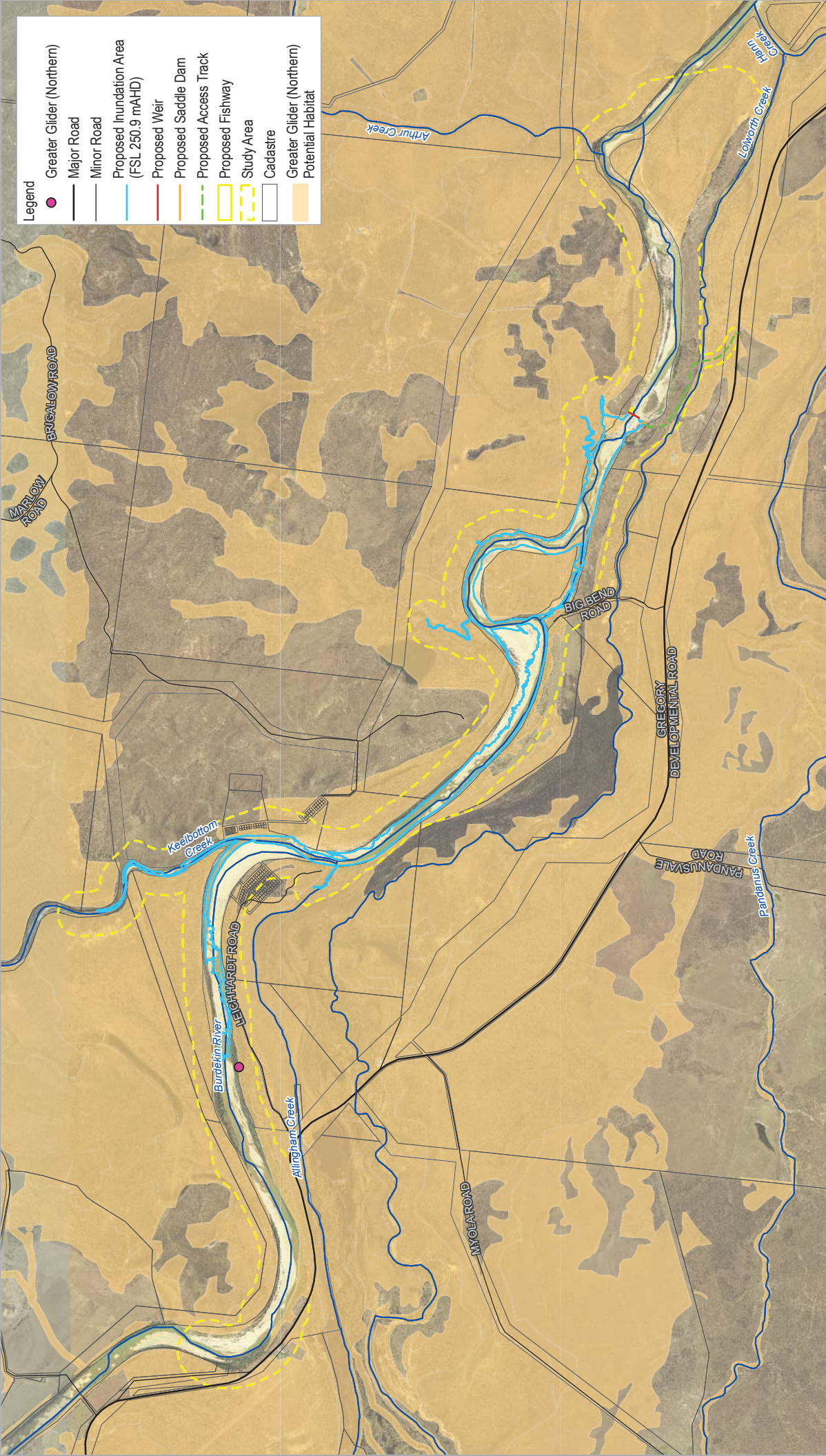
5.2 Greater glider (northern) (*Petauroides volans minor*)

5.2.1 Species ecology

The greater glider (northern) (listed as vulnerable under the EPBC Act and NC Act) is restricted to mature eucalypt forests and woodlands with an abundance of mature, hollow-bearing trees (Andrews *et al.* 1994; Kavanagh 2000; Eyre 2004; Van der Ree *et al.* 2004; Vanderduys *et al.* 2012). The species has a specialist folivorous diet, and displays seasonal food preferences (Kehl and Borsboom 1984; Kavanagh and Lambert 1990). As a result, the species requires access to forests with a diversity of tree species to provide a consistent food source throughout the year (Kavanagh 1984). The species dens in large hollows in mature trees (Henry 1984; Lindenmayer *et al.* 1991). The greater glider has been found to be absent from forests with fewer than six hollow-bearing trees per ha (ARCS 1999). The species has a relatively small home range, typically 1 – 4 ha (Henry 1984; Comport *et al.* 1996; Gibbons and Lindenmayer 2002). Given the species' limited capacity for dispersal, and reluctance to cross vegetation gaps, it is sensitive to habitat fragmentation (McCarthy and Lindenmayer 1999).

5.2.2 Distribution within the study area

The greater glider (northern) was confirmed present during spotlighting within the north-western extent of the study area. One individual was observed in the upper canopy of a *Eucalyptus camaldulensis* along the Burdekin River. Potentially suitable foraging and denning habitat was recorded within areas that retained mature *E. camaldulensis* along the Burdekin River. The species has been historically recorded approximately 15 km south-east of the project footprint, in vegetation immediately adjacent to the Burdekin River. Mapping of predicted habitat within the study area was updated following the post-wet field survey based on detailed mapping of species habitat and more targeted searches (i.e. spotlighting and hollow counts). A total of 9.21 ha of greater glider (northern) habitat is mapped within the project footprint, representing 2.82 percent of habitat within the project footprint and 0.05 percent of habitat within the regional area (5 km radius of the project footprint). The location of the greater glider sighting and distribution of potential habitat has been mapped in Figure 5-2.



Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4
0 1 2 3
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 11/08/2020

Predicted habitat for the greater glider (northern) within the study area

FIGURE 5-2

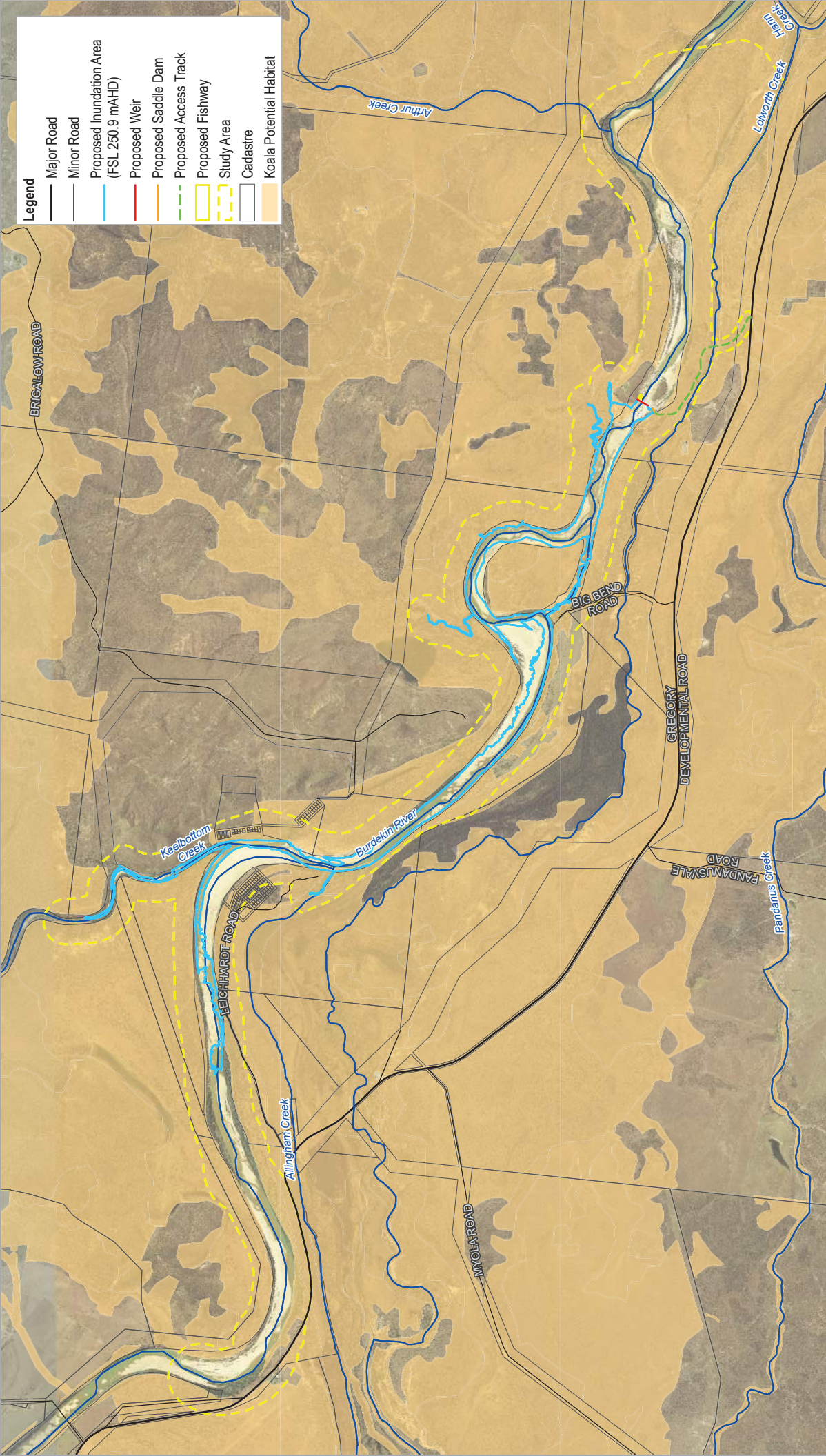
5.3 Koala (*Phascolarctos cinereus*)

5.3.1 Species ecology

The koala (listed as vulnerable under the EPBC Act and NC Act) is an herbivorous, arboreal marsupial known to utilise a range of open woodland habitats throughout temperate, tropical, sub-tropical and semi-arid Australia. The species feeds on the leaves of various *Eucalyptus*, *Corymbia*, *Lophostemon*, *Angophora* and *Melaleuca* species (Martin and Handasyde 1999) and is highly dependent on the distribution and availability of the feeding resource. The koala is regarded as a specialist feeder and exhibits foraging preference towards the tree species with the highly nutritional content, favouring only 30 of the 600 species of eucalypts available across Australia (Martin 2001). On average, the species consumes 500 g of leaves per day and can obtain approximately 50% of their water requirements from their food. Key threats include habitat loss and fragmentation, dog attacks, vehicle strikes, disease and drought (DAWE 2020).

5.3.2 Distribution within the study area

Essential habitat for the koala is mapped approximately 1 km south-east of the study area. The species was not observed during the field survey and no faecal pellets were recorded during the SAT searches. However, potentially suitable koala habitat was recorded within the project footprint and study area during the field surveys. Areas of suitable habitat included *Eucalyptus*-dominated woodlands along and in the vicinity of the Burdekin River and other tributaries. The koala has been considered likely to occur as the species has been historically recorded approximately 7 km south-east of the project footprint and a wide range of koala food trees occur within and adjacent to the study area. Mapping of predicted habitat within the study area was updated following the post-wet field survey based on detailed mapping of species habitat and more targeted searches (i.e. SAT searches). A total of 11.28 ha of koala habitat is mapped within the project footprint, representing 3.46 percent of habitat within the project footprint and 0.07 percent of habitat within the regional area (5 km radius of the project footprint). The distribution of potential habitat for the koala has been mapped in Figure 5-3.



Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4

0 1 2 3 Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Predicted habitat for the koala
within the study area

Project No. 12512214
Revision No. 0
Date 11/08/2020

FIGURE 5-3

5.4 Short-beaked echidna (*Tachyglossus aculeatus*)

5.4.1 Species ecology

The short-beaked echidna is listed as special least concern under the NC Act. The short-beaked echidna is widely distributed throughout Australia, occurring in a broad range of habitats, wherever there is suitable availability of ant or termite prey (Sprent 2012). The species has specialist nursery burrows and shelters in hollow logs but otherwise does not have any fixed nest or shelter sites (Sprent 2012). Given the species' broad habitat tolerances, the short-beaked echidna can occur in almost all landscapes including deserts, closed forest, woodland, rainforest, heath, cleared agricultural and grazing land, and suburbia (Sprent 2012).

5.4.2 Distribution within the study area

The short-beaked echidna was confirmed present within the study area during spotlighting, with one individual recorded within open eucalypt woodland in close proximity to the Burdekin River. Evidence of the species, including scats and characteristic diggings were recorded throughout the study area. Most habitats within the study area represent potentially suitable habitat for the short-beaked echidna. A total of 24.35 ha of short-beaked echidna habitat is mapped within the project footprint, representing 7.47 percent of habitat within the project footprint and 0.09 percent of habitat within the regional area (5 km radius of the project footprint). The location of the short-beaked echidna sighting and distribution of potential habitat has been mapped in Figure 5-4.



- Legend**
- Short-beaked Echidna
 - Major Road
 - Minor Road
 - Proposed Inundation Area (FSL 250.9 mAHD)
 - Proposed Weir
 - Proposed Saddle Dam
 - Proposed Access Track
 - Proposed Fishway
 - Study Area
 - Cadastral
 - Short-beaked Echidna Potential Habitat

Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damages) which are or may be incurred by any party in reliance on the map, or for any inaccuracy, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4
0 1 2 3
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 11/08/2020

Predicted habitat for the short-beaked echidna within the study area

FIGURE 5-4

6. Potential impacts and mitigation measures

6.1 Overview

This impact assessment is based on assessment of current ecological values determined by desktop assessment and results of the post-wet season field surveys, concept design and potential operation. The impacts and mitigations in the present report builds on the pre-wet results and further revised reference design (GHD 2020b). Quantification of impacts have occurred during this processing, facilitating the assessment of impact significance in accordance with guidelines.

Activities associated with constructing BRW have the potential to cause a number of direct and indirect impacts to local terrestrial and aquatic flora and fauna.

Construction activities that pose a potential risk of impact to flora and fauna include:

- Vehicle and plant movement to, from and around the construction site and during the operational phase
- Removal of vegetation within and immediate adjacent to the construction footprint, storage/stockpiling areas, access tracks and within the river bed and banks
- Construction (excavation, dewatering, establishment of coffer dams) within the waterway
- Inadvertent spillage of potentially hazardous materials
- Acquisition of materials (aggregate) for the use in construction.

Potential impacts to flora and fauna resulting from initial filling of the impoundment and operational phase of the weir include:

- Individual fauna injury and mortality
- Disruption to behaviour and restriction of movement of localised wildlife assemblages
- Loss, alteration and degradation of terrestrial and aquatic habitats
- Encroachment of feral animal, pest and weed species increasing predation and competition
- Water capture and storage (impoundment) resulting in changes to downstream flow regimes.

6.2 Construction phase

6.2.1 Loss and degradation of vegetation and terrestrial habitat

Potential impacts

Impacts associated with construction of the project have been avoided as far as practicable and will be minimised by locating the ancillary infrastructure, such as laydown and borrow areas, soil stockpiles, and machinery/equipment storage in open areas that have been previously cleared or degraded. Despite this, construction of the project will involve clearing of some riparian and mixed woodland vegetation within the construction footprint of the weir, saddle dam, access tracks, laydown areas and Big Bend Floodway. No conservation significant REs or TECs are known to occur within the proposed areas of impact. The vegetation communities present are common and well represented within the local landscape.

The loss and degradation of vegetation as a result of project construction activities will decrease the diversity and availability of resources for terrestrial fauna species within the immediate local area. While impacting upon smaller, less mobile animals (i.e. small reptiles, rodents, frogs), the selective clearing of a limited amount of vegetation is unlikely to constitute a substantial impact on local faunal assemblages which are adapted to a fragmented landscape. The existing vegetation at the site of the proposed weir is fragmented and degraded by cattle, and as such, does not represent important fauna habitat for conservation significant species that were confirmed present or are likely to occur. A fauna spotter catcher will be present on site during all vegetation clearing to relocate fauna, and therefore, minimise injury and mortality on less mobile species.

Based on field observations, the largest contributors to habitat degradation within the study area are historic land clearing associated with agriculture, livestock (within the riparian zone and in shallow water areas), feral animals and weeds. Construction activities have the potential to introduce and/or spread weeds, which can increase the edge effects associated with vegetation clearing. Generally, the landscape surrounding the inundation area is partially fragmented, and as such, isolated patches of vegetation are presently exposed to these processes. Earthworks and increased vehicle movements associated with construction activities at the weir site have the potential to exacerbate local levels of weed infestation.

Construction activities may also foster greater utilisation of the area by introduced fauna. The incorrect disposal of rubbish and other refuse may encourage competitive introduced species including pigs, dogs, foxes and cats to the area, which in turn may increase predation pressure on local native wildlife. These species may also out-compete resident native predators. The potential risks from weeds and pest species will be mitigated by the implementation of a site specific Construction Environmental Management Plan (CEMP) governing construction and operation of the project.

Mitigation measures

The loss and degradation of vegetation and terrestrial habitat will be mitigated by:

- Clearly marking vegetation clearing areas on construction plans and in the field. Areas that must not be cleared or damaged must also be identified
- Clearly identifying all fauna breeding habitat (e.g. hollow bearing trees) within the project construction footprint and managing in accordance with conditions of an approved Species Management Plan (SMP) for animal breeding places under the Queensland NC Act
- Retaining important habitat features (hollow bearing trees, timber) to be used as in-stream snag and perch material post-construction
- Where practicable, commencing revegetation activities in and adjacent to construction areas as soon as possible after the completion of construction
- Developing and implementing a stringent and site specific CEMP to detail actions and procedures for the protection of the terrestrial environments. The CEMP will include the following actions below to manage weeds, pests, dust, and waste and hazardous materials:
 - Implementation of a Weed Management Plan to remove existing weeds and prevent the introduction of new weeds, and minimise the spread of declared weeds within the construction footprint prior to construction activities
 - Training key personnel on site to be capable of identifying weed species and preventing their spread and translocation
 - Undertaking daily inspections to monitor control and implementation of appropriate preventative measures for weed and pest species. The construction contractor must control and treat all prohibited and restricted matters in accordance with the Bio Act

- Requiring all plant and equipment to be washed down prior to arriving on site, with a declaration stipulating that the plant and equipment is clean, in accordance with Department of Agriculture and Fisheries (DAF) 'Ways to Prevent Weed Seed Spread' and the 'Weed Hygiene Declaration' forms
- Performing a wash-down of all vehicles, plant and equipment used on site prior to the final departure from site and providing a declaration stipulating that vehicles, plant and equipment is clean
- Minimising the generation of dust through restriction of speed limits and watering of exposed ground surfaces
- Developing and implementing fuel and chemical storage protocols and spill responses
- Managing pest species in coordination with adjacent landholders and catchment management groups. Identification and management of pest species will be undertaken in accordance with the plans and strategies in the Bio Act. Likewise, management of declared local pests will be undertaken in accordance with relevant local government strategies and plans, including the Charters Towers Biosecurity Plan 2019 – 2024. Actions to include:
 - Disposing of all rubbish and other refuse that may potentially attract introduced animals (food scraps) in sturdy waste disposal receptacles that are frequently emptied
 - Preventing access of domestic animals on the construction site
- Where practicable, avoid clearing vegetation for the Big Bend Floodway. Preferentially locate the floodway in disturbed and/or existing cleared areas to minimise the removal of native vegetation and habitat.

6.2.2 Loss and degradation of aquatic habitat

Potential impacts

Excavation of the bed and banks as part of construction activities for BRW, saddle dam and Big Bend Floodway will result in the direct loss of aquatic habitat. Aquatic habitat within the BRW construction area includes shallow and deep isolated pools and slow flowing channels with habitat features such as undercut banks and large woody debris. The area of habitat to be lost as a result of construction activities is, however, relatively small in size compared to the availability of similar habitat upstream and downstream of the sites and no habitat for conservation significant species occurs. Additional loss of aquatic habitat has the potential to occur within Lolworth Creek associated with construction of the access track crossing, however the proposed location will be along the existing track and crossing to minimise the disturbance. Construction footprints should be kept to the minimum amount necessary in order to minimise impacts to aquatic flora and fauna.

Construction works located within and adjacent to the river channel, have the potential to degrade the quality of habitat through increased erosion and run-off and introduction and spread of invasive weed. These activities have the potential to affect water quality resulting in altered water chemistry (including increased turbidity, decreased oxygen levels, reduced light penetration), changes in channel morphology (including filling of pools), alteration of substrate composition and smothering of habitat resources (Wood and Armitage 1997; Wheeler et al. 2005). Unmitigated these impacts may have a localised effect on fauna by reducing habitat value (e.g. amount of refuges, microhabitats and food availability) within the immediate and downstream areas. The potential ecological consequences to the species may include a temporary and localised decrease in fauna abundance and decrease in breeding success. Use of construction machinery in and around aquatic habitats also has the potential to result in the spillage of contaminants, such as fuels and lubricants. In severe cases, chemical pollution of the aquatic environment could result in mortality of aquatic fauna and long-term degradation of

aquatic habitat. Strict environmental controls and management actions will be implemented to avoid and/or minimise the potential for proposed actions to degrade terrestrial and aquatic habitat. These management actions will be embedded within a CEMP.

Mitigation measures

The loss and degradation of aquatic habitat will be mitigated by:

- Minimising the loss of aquatic habitat during the design phase by locating access tracks and ancillary infrastructure outside waterways where possible
- Where crossing waterways is required for construction, in the case of Lolworth Creek, habitat loss can be minimised by developing temporary waterway barrier crossing in accordance with DAF acceptable development requirements
- Locating any additional construction areas or construction sites, such as soil stockpiles, machinery/equipment storage within existing cleared areas and away from the waterway bed and banks
- Retaining large woody debris from vegetation clearing for addition to the Burdekin River and Lolworth Creek to provide instream habitat post-construction
- Using high quality fill for abutments and saddle dam to minimise the introduction of contaminants into Burdekin River
- Restoring bed and banks to pre-existing profiles following completion of works
- Preparing and implementing a stringent and site specific CEMP to detail actions and procedures for the protection of the aquatic environments as described in Section 6.3.1
- Preparing and implementing a project specific Erosion and Sediment Control Plan (ESCP) in accordance with practices described in the International Erosion Control Association, Best Practice Erosion and Sediment Control Guideline and/or Queensland Division of the Australian Institute of Engineers' Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites. The ESCP will be prepared by a highly experienced certified professional in erosion and sediment control (CPESC) and will include the following methods to minimise degradation of aquatic habitats:
 - Installing erosion protection measures in the form of sediment fences where required to minimise the transport of sediment into the Burdekin River, Lolworth Creek and adjacent terrestrial habitats
 - Installing sediment curtains to minimise downstream transport of sediments released during vegetation clearing and earthworks
 - Minimising erosion potential through scour protection treatments at abutments
 - Minimising vegetation clearing and the area of bare ground required for construction to only that which is necessary
 - Appropriately managing and protecting stockpiles.
- Monitoring of water quality conditions (visual and in situ recordings) to identify the potential for water quality degradation within Burdekin River and allow for adaptive management if required.

6.2.3 Individual fauna injury and mortality

Potential impacts

Construction activities associated with the project will involve a temporary increase in vehicular traffic and plant movement to, from and at the site, including traffic on existing and new access

roads. This has the potential to increase the incidence of wildlife and livestock mortality from vehicle strike. Fauna at particular risk of vehicle strike include conservation significant fauna species, such as the squatter pigeon (southern) and koala, as well as ground-dwelling bird species and reptile species that commonly occur on tracks throughout the region.

Clearing to facilitate construction (including along access tracks) may also result in direct mortality to individual animals residing in trees and other vegetation, and within ground cover, litter or debris to be cleared. Similarly, aquatic fauna may experience direct injury and/or mortality if individuals are present within the areas of disturbance at the time of works. Key mitigations for the protection of terrestrial and aquatic fauna are listed below and include the requirement for a fauna spotter catcher to be present on site during vegetation clearing, during initial site works and works within the bed and banks where aquatic fauna risk injury.

Mitigation measures

The risk of fauna injury and mortality will be mitigated by:

- Conducting a pre-construction survey for breeding habitat within disturbance footprints to determine the requirement for SMPs under the NC Act
- A Traffic Management Plan will be developed for the construction site with designated access routes, speed limits and sensitive ecological areas (i.e. particularly areas where squatter pigeons have the potential to occur on access roads)
- All vehicles and plant will adhere to site rules relating to speed limits. Speed limits will be clearly signposted to minimise the potential for road kill
- Given the specific susceptibility of the squatter pigeon (southern) and koala to vehicle collision, warning signs will be erected on all tracks that intersect potential habitat for the squatter pigeon (southern) and koala. Squatter pigeon (southern) and koala awareness will be included in all worker inductions, as well as speed limits and traffic volume in the Traffic Management Plan. A register of squatter pigeon and koala sightings will be maintained to identify current areas that have a risk of collision
- Minimise the need to travel near dawn or dusk by adhering to standard daytime work hours, limit haulage and delivery of materials to the day time and/or where possible, minimise the number of vehicles travelling during this period through the use of car-pooling to transport construction personnel where possible
- Educating employees regarding the presence of conservation significant species and other fauna and livestock on access roads
- Erecting temporary construction fencing to exclude mobile animals such as macropods and livestock from the construction areas
- Checking of trenches, excavations and machinery daily for the presence of mammals and reptiles
- All vegetation clearing will be supervised by suitably qualified and experienced fauna spotter catchers
- Areas mapped as potential habitat for the squatter pigeon (southern) are to be flushed immediately prior to clearing (i.e. fauna spotter catcher to walk in front of clearing machinery)
- Habitat features (i.e. hollow-bearing trees and logs) will be checked by the fauna spotter catcher prior to clearing. Fauna will be relocated to the nearest safe place within suitable habitat prior to clearing

- Fauna spotter catchers present to relocate aquatic fauna where there is risk of injury to fauna prior to and during any works within the river
- If injuries occur, the fauna spotter catcher will capture and transport the injured animal to a qualified veterinarian for treatment or euthanasia (unless suitably-qualified). Prior to clearing for construction, formalise arrangements with local veterinary services to treat and care for injured animals
- Clearly demarcating no-go areas of sensitive vegetation and habitat, including all vegetation and habitat not to be cleared
- Sequential clearing of vegetation to allow resident fauna the opportunity to disperse away from the immediate construction area.

6.2.4 Disruption to behaviour of localised terrestrial and aquatic fauna

Construction activities will cause a temporary localised and intermittent increase in light, noise and vibration adjacent to construction sites. This has the potential to cause short-term disruption to the behaviour and activities of nearby wildlife. There are no noteworthy fauna communal nesting, breeding, roosting or foraging resources directly adjacent to the construction footprints. Nevertheless, construction activities have the potential to deter terrestrial wildlife from foraging, drinking, seeking shelter or nesting within the vicinity of construction activities. Construction activities may require works to be undertaken at night. In the event that lighting is required to facilitate night works (for example concrete pour operations), there is potential for light pollution to disrupt nocturnal fauna behaviour.

Increased levels of disturbance (e.g. from noise, vibration, light, vehicles, machinery, personnel) also have the potential to disrupt the behaviour and dynamics (i.e. foraging, movement) of aquatic fauna inhabiting the river channel within and adjacent to the construction footprints. Behavioural changes expected to occur include avoidance and evasive (startled) movement leading to displacement from habitat and loss of resources within the direct areas of impact.

Water flow within the Burdekin River will be impacted as a result of construction activities and therefore upstream and downstream movement of aquatic fauna is likely to be restricted through the construction period. Weir construction and upgrade of Big Bend Floodway within the river channel will be undertaken during the dry season, for a maximum duration of 6 months, when flows are reduced and the river is more likely to exist as a series of isolated pools. Natural movement of aquatic fauna during this period is likely to be low. An in-stream flow diversion strategy will be developed to maintain flows during construction.

Mitigation measures

Proposed mitigation during the construction phase to minimise the disruption of behaviour of localised terrestrial and aquatic fauna include:

- The in-stream construction duration will be no longer than 6 months during the dry season minimising the duration of the construction period
- Using noise dampening devices on machinery wherever practical and requiring that all equipment is maintained and serviced in accordance with manufacturer's instructions to reduce noise levels
- Requiring soft starts and broadcast of a warning noise so that individuals have a chance to move away from the area before more intense noise and vibrations start
- Restricting night works as far as is possible during the construction phase
- Installing directional lighting and shields minimising light spill outside of the immediate work areas having consideration for health and safety requirements

- Maintaining river flow and aquatic fauna movement within its natural course for as long as possible and in accordance with DAFs '*Accepted development requirements for operational work that is constructing or raising waterway barrier works*'. A flow diversity strategy will be developed to limit river diversion to a single dry season and maintain flows during the construction period.

6.3 Operational phase

6.3.1 Loss and degradation of vegetation and terrestrial fauna habitat

Potential impacts

The construction of BRW will result in the inundation of vegetation within the riparian zone along the Burdekin River. The inundation zone will not exceed the Burdekin River banks which routinely flood naturally. This inundation will result in the loss and alteration of vegetation communities and fauna habitat.

Vegetation will not be cleared prior to impoundment and consequently total habitat loss within the expected inundation area will occur over a prolonged period as the weir fills and is drawn down regularly through operation. On first filling, it is anticipated that an immediate loss of ground cover vegetation within the impoundment will occur. Larger and woody vegetation such as trees will remain for a period of time before dieback occurs. Given that water levels in the impoundment will rise and fall with filling and drawdown, habitat loss at the limits of the impoundment will occur more gradually, in response to intermittent inundation.

The riparian zone within the expected area of inundation is already disturbed through clearing, weed infestation and cattle grazing and no conservation significant REs, TECs or flora species are known to occur. The area of inundation does provide suitable habitat for terrestrial fauna with desktop reviews and field surveys identifying that species present are primarily generalist species that are widespread and relatively abundant in the study area and the wider North Queensland region. Potential impacts on flora and fauna associated with habitat loss and/or alteration within the inundation area may include:

- Loss of mature trees, particularly *Melaleuca* spp., *Eucalyptus* spp. and *Corymbia* spp., over time (months to years) in the riparian zone that provide foraging (leaves, nectar, pollen, fruit, sap and invertebrates), breeding and sheltering/roosting/nesting resources (e.g. tree hollows and shedding bark) for a range of woodland and forest birds, arboreal mammals and bats
- Short-term reduction in dense, low growing riparian vegetation along the main river channels and creeks that provide habitat for small woodland and forest birds and ground-dwelling mammals
- A reduction in availability of habitats supporting a structurally complex ground layer, that is inundation of riparian habitats supporting fallen timber, log piles, leaf litter and borrowing/cracking soils that provide habitat for reptiles
- Short-term loss of overhanging vegetation that provides perching habitat for kingfishers, cormorants, raptors and the eastern water dragon. The loss of this overhanging vegetation also reduces suitable nesting habitat for birds including cormorants and egrets
- Short-term loss of existing marginal and emergent vegetation in shallow water aquatic habitats utilised by waterbirds such as ducks, egrets, herons and storks as well as small fish, macroinvertebrates and turtles
- Inundation of sand banks and rocky outcrops which may support waterbirds, mammals and reptiles

- Creation of habitat for waterbirds such as ducks and pelicans through the increase in permanency of water within the impoundment.

The inundation of riparian vegetation and the disruption to terrestrial habitats bordering the new full supply level (FSL) of the impoundment may also foster habitat degradation. This degradation may result from:

- Edge effects occurring in newly fragmented riparian habitat
- Isolation of remnant vegetation patches, allowing for domination by generalist and invasive plants and animals
- Increased competition for resources in riparian vegetation habitats due to a reduction in the overall extent of this habitat
- Adverse impacts associated with edge effects include:
 - Increased penetration of light and wind into habitat patch, potentially altering vegetation communities
 - Alteration to microclimate
 - Increased invasion of exotic plants and animals
 - Increased sensitivity to fire

For the most part, impacts of habitat loss and degradation are considered to be short-term with fauna having the ability to move between areas of suitable habitat returning once vegetation has re-established above the impoundment.

Conservation significance fauna species confirmed present or considered likely to occur within the study area include the squatter pigeon (southern), greater glider (northern) and koala. Some loss of habitat and habitat resources for these species is expected to occur as a result of the inundation of riparian vegetation within the BRW impoundment. Due to the small area of vegetation that is expected to be lost or altered, impacts to these species are not expected to be significant.

Mitigation measures

As a function of operations of the proposed weir, loss and degradation of vegetation and terrestrial habitat will occur. To minimise and alleviate the potential impacts on flora and fauna, the following mitigation measures should be considered:

- Preventing clearing of vegetation prior to filling of the impoundment to retain habitat above and below FSL
- Reinstating important habitat features (hollow bearing trees, timber) retained during the construction phase
- Developing and implementing a stringent and site-specific operational phase Environmental Management Plan (EMP). Management actions prior to operation of the project to include the preparation of a Weed and Pest Management Plan and ESCP
- Where relevant, providing vegetation offset to ensure no-net-loss of potential habitat for conservation significant species (in regional context)
- Designing the operational strategy of the proposed weir to consider ecological processes occurring within and adjacent to the impoundment. Rapid drawdowns of the storage should be avoided and water levels should be controlled to allow changes to existing habitat about the margins of the storage to proceed more slowly.

6.3.2 Fragmentation of riparian habitat

Potential impacts

Most of the landscape surrounding the inundation area has been partially cleared, predominantly for agriculture. This is particularly the case on lowland alluvial floodplains, where cattle grazing on cleared pasture is the dominant land use. Vegetation in these otherwise cleared or fragmented landscapes tends to be concentrated along the riparian fringe of the Burdekin River and adjoining creeks. Extensive open woodland communities on low rocky hills and rises, and less disturbed open woodland on alluvial plains represent important habitat nodes within the disturbed landscape matrix. These habitats are likely to act as a source for fauna dispersal across the landscape. Fauna dispersal across the fragmented landscape is likely to be facilitated, at least in part, by vegetation corridors adjacent to the Burdekin River and adjoining creeks.

The impoundment of riparian vegetation resultant from the project has the potential to disrupt connectivity between habitats, thereby further fragmenting habitats within the inundation area (and the wider study area). This reduction in connectivity along the riparian zone is likely to be most notable where only a thin strip of fringing riparian vegetation, abutted by cleared agricultural land, occurs. The inundation and drowning of this vegetation will disrupt the corridor along which fauna can move between more extensively vegetated habitats. This is likely to be of particular consequence to more mobile species that undertake occasional to frequent foraging, reproductive and/or dispersal movements, and/or species that may become more exposed to predation due to reduced habitat connectivity.

The increased width of permanent pools within the river channel, and the reduced occurrence of shallow water and seasonally dry riverine habitats will also reduce the ability of terrestrial fauna (namely mammals and reptiles) to move back and forth across the river.

The potential impacts of reduced connectivity and subsequent habitat fragmentation on common terrestrial fauna (namely reptiles, small ground-dwelling and arboreal mammals and birds) and species of conservation significance (such as the squatter pigeon (southern), greater glider (northern) and koala) may include:

- Greater competition (intraspecific and interspecific) for resources in increasingly isolated habitat patches in an already fragmented landscape
- Increased habitat degradation due to concentration of animals in isolated patches
- Dominance of isolated habitat patches by competitive, generalist species (plants and animals)
- Increased exposure to predation for animals that are forced to move across disturbed, open landscapes
- Greater magnitude of impact of environmental changes (fire, drought, disease etc.) when animals are unable to move between habitat patches due to hostile surrounding land use (unsuitable resources, greater risk of predation)

While the impoundment has the potential to disrupt terrestrial fauna movement corridors, bioregional corridors will still prevail directly adjacent to the high water level of the impoundment, and therefore, is it not expected that the project will impact terrestrial fauna movement.

Mitigation measures

As a function of operations of the proposed weir, fragmentation of terrestrial habitat will occur. To minimise and alleviate the potential impacts on fauna, the following mitigation measures should be considered:

- Maintenance and enhancement of movement conduits for terrestrial fauna through implementation of the operational phase EMP which will be prepared prior to operation of the project and rehabilitation of habitat in key movement areas.

6.3.3 Loss and degradation of aquatic habitat

Potential impacts

Aquatic habitat within the Burdekin River will be altered as result of BRW through the conversion of flowing pool-riffle-run sequences to a more homogenous lentic impounded pool. Habitat alteration will occur on commissioning and persist through operations as the weir fills and is drawn down regularly. The lower reaches of the Keelbottom Creek are also likely to experience varying degrees of alteration resulting from changes in connectivity and hydrology. Habitat alteration is expected to include the inundation of periodically dry creek bed and banks. The extent of this alteration will be more notable in and adjacent to the lower reaches of the weir impoundment.

Operation of the proposed BRW can be expected to result in impacts on water quality at the site. Potential water quality impacts arising from the proposed weir operation may include:

- Decomposition of plant material and subsequent release of nutrients in areas of inundation within the impoundment
- A reduction in dissolved oxygen and temperature stratification within the water column as a result of the riverine system changing to deep, slow flowing pools
- Mobilisation of contaminants in areas of contaminated land (if present)
- An increase in the presence of blue-green algae.

Changes in water quality will primarily occur within the impoundment, however, downstream habitats may also be affected should waters of lower quality be released.

No palustrine or lacustrine wetland areas will be directly impacted by the proposed weir. Water levels within the impoundment will remain within the high banks of the existing river with the weir wall drowning out completely during flows above this level. As such, flow events that naturally breakout of the river banks and form overland flows will not be impacted by BRW. No impact to seasonality, duration, frequency and volume of water entering and leaving the off-stream water bodies is expected to occur. Consequently, it is not expected that the proposed weir will impact the specific habitat characteristic of the off-stream water bodies (including the Great Basalt Wall DIWA, wetland protection area (WPA), and HES wetlands) and their value for aquatic flora and fauna.

Aquatic fauna in the Burdekin Basin are adapted to the highly dynamic and variable nature of the system. These adaptations are represented by the specific foraging, breeding and sheltering preferences of the species that occur within the system. A review of the ecology of fish species known to occur within the Burdekin Basin catchment revealed that most species prefer (or are tolerant of) the still or slow flowing conditions that are present in pool habitats (Pusey *et al.* 2004; Allen *et al.* 2003). The conversion of pool-riffle-run sequences to a weir impoundment will most adversely impact species that prefer flowing water and high levels of instream habitat.

The impounded habitat created as a result of the weir will be generally characterised by a deep, wide river channel, slow to zero flow, poorer quality clay/silt substrate, lower density of in-stream

debris and lower density of overhanging riparian vegetation. The deep water benthic areas (5 to 10 m deep) that will dominate the weir pool habitat directly behind the weir wall are expected to be sub-optimal to most aquatic fauna species due to low oxygen levels, little or no light penetration and relatively colder temperatures. The upper water column within the more open inundation area is likely to provide suitable habitat for species such as large bodied fish – sooty grunter, barred grunter, bony bream and the Krefft's river turtle. Many other species are likely use the inundated habitat intermittently with low abundance of micro-habitats and food resources generally limiting permanent occupancy of more open water habitats.

In general, suitable habitat for aquatic fauna will occur within the shallow littoral habitats along the perimeter of the inundated area and within the upper extent of inundation. These areas will contain a higher diversity of in-stream microhabitats such as fallen logs and root mats and food resources. Macrophyte communities are also likely to re-establish in the upper reaches with the frequency of water level fluctuations expected to impact macrophytes growth within the main impoundment.

Overall, the alteration of natural riverine habitats within the BRW footprint will reduce the heterogeneity of the river system and therefore the diversity of habitats available to aquatic fauna. Ecological consequences are expected to include variation in relative abundance of fish and turtle species. An upsurge in macroinvertebrate diversity and abundance within the proposed BRW, is predicted to occur immediately following inundation due to the release of nutrients from newly inundated soil and vegetation (Baumgartner 2005). However, following this initial productivity, nutrient depletion and habitat homogeneity is expected to result in a decline in macroinvertebrate diversity and fewer pollution sensitive taxa when compared with riverine sites (Duivenvoorden *et al.* 2000; Baumgartner 2005).

Mitigation measures

The following management measures are proposed to avoid/minimise the potential impact of habitat alteration on aquatic ecological values:

- Preventing clearing of riparian vegetation prior to inundation to create instream and overhanging habitat at FSL
- Reinstating important habitat features (e.g. large woody debris) retained during the construction phase
- Encouraging re-establishment of aquatic habitat within the impoundment through the following actions:
 - Avoiding rapid drawdowns of the storage area to allow for the stabilisation of aquatic habitat around the margins of the impoundment
 - Promoting the natural regeneration of trees and shrubs
 - Controlling introduced weeds and feral animals in accordance with an operational phase EMP which will be prepared prior to operation of the project
- Developing and implementing an operations Water Quality Management Plan in accordance with the operational phase EMP which will be prepared prior to operation of the project.

6.3.4 Restriction of fauna movement

Potential impacts

The Burdekin River and Lolworth Creek are both categorised as major (purple) waterways which indicates that there is a high risk of impact from waterway barrier works. During operation, in-stream structures such as the weir wall, saddle dam and Big Bend Floodway will represent

an impediment to the movement of aquatic fauna. This disruption to connectivity along the continuum of the river not only has the potential to fragment populations and habitats, but also potentially impedes the life-history behaviour of aquatic fauna occurring within the system.

Tropical freshwater fish regularly move among spawning, feeding and refuge habitats (Lowe-McConnell 1987; Lucas and Baras 2001) and free movement of fish within the river system is thought to be crucial in order to maintain viable populations (Marsden and Power 2007). The diversity of fish within the upper reaches of the Burdekin River has been influenced by existing waterway barriers including Charters Towers Weir and the Burdekin Falls Dam, located approximately 23 km and 180 km downstream of BRW, respectively. Burdekin Falls is a natural barrier to fish movement and as such the fish community upstream is naturally comprised of potamodromous (species that move wholly within the freshwater environment) species only. Some diadromous species (species that move between freshwater and marine environments), have been artificially stocked within Burdekin Falls Dam but do not naturally occur (Pusey *et al.* 2004).

No conservation significant fish species occur at BRW, however, a number of fish species are likely to be negatively impacted by the restriction of movement in the absence of mitigation measures proposed below. These species include, long-finned eels, leathery grunter, spangled perch, Hyrtl's tandan, Rendahl's catfish, eastern rainbowfish and empire gudgeon, all of which undertake spawning migrations during flow events (Reynolds 1983; Stuart 1997; Stuart 1999; Pusey *et al.* 2004). The potential ecological consequence of the restriction of fish movement can include declines in abundance, species distribution truncation, localised extinction events and a reduction in species diversity (Marsden and Power 2007).

Other aquatic fauna, including turtles and macroinvertebrates, are also likely to be impacted by the restriction of movement past the weir wall. The home range size of freshwater turtles is generally relatively small, however, long-distance (>10 km) migrations can occur for the purpose of dispersal, repositioning following flood displacement and reproduction (Tucker *et al.* 2001; Hamann *et al.* 2007). BRW is likely to restrict these migrations which may lead to fragmentation of populations, disruption of breeding and aggregation of some species (particular the Krefft's River turtle) within the stilling basin below the weir wall. A reduction in diversity of macroinvertebrates downstream of BRW is also likely to occur as a result of the impediment of downstream drift (Marchant and Hehir 2002). The height of the BWR is relatively low (less than 15 m), thus the weir will drown out regularly and movement downstream will be restored. Movement will also occur via the overflow channels.

Mitigation measures

The following management measures are proposed to avoid/minimise the restriction of aquatic fauna movement:

- A fishway will be constructed to provide adequate movement of fish species during flow releases from the BRW. The fishway proposed Big Rocks Weir Reference Design Report is a cone-style fishway of 13 lane and 11 resting pools. A detailed fishway design process will be undertaken during the detailed design phases of the project in accordance with DAF's Fishway Design Process criteria. This process involves the selection and refinement of fishway design specifications and success criteria and the development of fishway designs. Fish biologists and technical specialists (suitably qualified and experienced in fish passage biology and fishway design) should participate in the fishway design process to provide key technical input and review. The fishway design options should be assessed against an agreed design specification and success criteria to demonstrate that the fishway design provides adequate fish passage.

- Submission of a waterway barrier works development application and provision of acceptable fish passage for any waterway crossing or auxiliary access
- Maintaining the condition of overflow channels to facilitate fauna movement upstream and downstream of BRW and the Big Bend Floodway during flowing events. Designing and implementing a monitoring program to monitor the effectiveness of aquatic fauna passage infrastructure
- Designing and implementing a monitoring program to monitor the effectiveness of aquatic fauna passage infrastructure.

6.3.5 Fauna injury and mortality

Potential impacts

Injury and mortality of terrestrial fauna may result during rapid filling of the impoundment when less mobile animals are caught within the inundation area. Native fauna in the Burdekin River exist within a system in which flooding (often rapid and extensive) is a regular event and most animals are able to seek refuge above rising flood water and similarly it is expected that animals will move away from rising water within the impoundment. The inundation of terrestrial habitats above typical high flow mark at the proposed BRW is likely to result in the death of less-mobile animals that are unable to retreat from the rising water. Small terrestrial animals within the impoundments such as skinks, geckos, rodents and juvenile animals in nests or burrows, may be trapped by rising water and be injured or drowned.

Beyond the initial filling of the construction of BRW, regular draw-down and filling of the storage during operation is considered unlikely to result in significant fauna mortalities. Vegetation is expected to re-establish on riverbanks at the FSL and loss of vegetation from within the impoundment will deter use of the impoundment for foraging and breeding by terrestrial fauna species. Water levels within the Burdekin River fluctuate annually in their natural state (high flows and flood to no or very low flow) and it is unlikely that the operation of the weir will have a notable long-term impact on upstream terrestrial fauna. During operations, as draw-down occurs, livestock and kangaroos have the potential to become bogged directly behind the impoundment where fines may build up creating soft sediments.

During operation, injury and mortality can occur when aquatic fauna (in particular freshwater turtles and fish species) are swept over the spillway during periods of high flow. The spillway is set to be approximately 13.3 m high. Fish species are particularly susceptible to shearing and abrasion injuries from contact with hard structures in the downstream pool and contact with the spillway during flooding events. Fish are also vulnerable to gill, eye and internal organ damage from the sudden changes in velocity and pressure that occur as the fish are swept over the spillway or through undershot gates (Larinier 2000; Baumgartner *et al.* 2006). Freshwater turtle injury and mortality is commonly associated with entrapment on trash screens, contact with hard surfaces and aggregations of turtles within areas of intermittent flow velocity. Minimising aquatic fauna, injury and mortality will be a key objective during subsequent design phases of BRW.

Mitigation measures

The following management measures are proposed to avoid/minimise the potential for fauna injury and mortality:

- Avoiding key design features responsible for high levels of fauna injury and mortality (stepped spillway, dissipater teeth, high turbulence, insufficient pool length and depth, high velocity trash screens) thereby substantially reducing the risk of injury and mortality to fish and turtles. Further detailed design will be undertaken during the subsequent phases of the

project with submission of a waterway barrier works development application and provision of acceptable fish passage for any waterway crossing or auxiliary access

- Outlet screens will exclude fish and will follow DAF proposed requirements of 20 mm mesh between slats
- Designing the operational strategy of the proposed weir to avoid/minimise risk of fauna injury and mortality. Specific operational actions will include:
 - Controlling the flow of water through release valves to provide gradual increments in water release volume
 - Depending on design, during planned releases, increase water release during dawn and dusk periods when turtles are more likely to be away from weir infrastructure.

6.3.6 Alteration to downstream flow regimes

Potential impacts

The operation of BRW is predicted to result in a change to the downstream flow regime between the weir and upper inundation limit of the existing Charters Towers Weir. The timing and quantity of releases downstream is likely to vary between seasons with the dry winter period expected to trigger the highest demand for water resources downstream. As a result, water flows downstream are likely to increase during the dry season and the frequency and duration of no flow periods will decrease. The increase in flows during the dry season has the potential to improve the quality of aquatic habitat downstream by reducing the duration and severity of pool isolation and prolonging the presence of flowing riffles zones and runs. The increase in habitat availability during the dry season will provide additional resources for aquatic fauna during times when conditions would be limiting under pre-development conditions. The diversity and abundance of macrophytes and macroinvertebrates, is likely to change with a potential increase in species that prefer flowing conditions and a reduction in species that prefer slow flowing and ephemeral habitats.

The operation of the proposed weir is also likely to result in a reduction in the frequency and magnitude of small to medium downstream flood flows. Flood flows entering the impoundment are likely to be captured and stored until the weir reaches its FSL. This will result in the reduction of flows downstream (or at least a lag in the flow downstream) and is most likely to occur at the start of summer when the storage is predicted to be at a minimum in most years. The delay of flood flows continuing downstream of the BRW are expected to be of short duration. Once the weir reaches its FSL, downstream flows will increase however the magnitude of the events will be reduced compared to existing conditions. Large flood flows, i.e. weir drown-out will, however, not be affected by the proposed infrastructure.

Releases of water from the proposed BRW will be made in accordance with environmental flow objectives outlined in the *Water Plan (Burdekin Basin) 2007* and Resource Operations Plan. These environmental flow objectives have been specifically nominated to maintain base flows and other ecologically important flow characteristics, for the protection of environmental values throughout the Burdekin River Basin. Compliance within these objectives will minimise adverse impacts of BRW on ecological values downstream.

Mitigation measures

The following mitigation measures are proposed to avoid and/or minimise potential impacts associated within the alteration to downstream flows:

- Designing the operation strategy of the weir in accordance with environmental flow objectives. Where required, yield adjustments and operating rules will be amended to comply with the objectives, this will be achieved in the further detailed design

- Developing and implementing an operations Water Quality Management Plan in accordance with the operational phase EMP which will be prepared prior to operation of the project. Specific management actions should include:
 - Considering opportunities for multi-level off-takes in weir design, using selective withdrawal outlets to select water of most appropriate quality for downstream release
 - Manipulating flows to prevent the build-up of blue-green algae or to disperse blooms.

7. Significance of impacts assessment

7.1 Overview

This section assesses the significance of the projects' impacts on conservation significant species that have been confirmed present or considered likely to occur within the study area. For species listed under the EPBC Act, an assessment has been made against the Significant Impact Guidelines 1.1 (DoE 2013). For species listed under the NC Act only, the Queensland Significant Residual Impact Guidelines (DSDIP 2014) has been used. Assessments of the significance of impact have been made for the following conservation significant species that have been confirmed present or considered likely to occur within the study area:

MNES:

- Squatter pigeon (southern) (*Geophaps scripta scripta*) (listed as vulnerable under the EPBC Act and NC Act)
- Greater glider (northern) (*Petauroides volans minor*) (listed as vulnerable under the EPBC Act and NC Act)
- Koala (*Phascolarctos cinereus*) (listed as vulnerable under the EPBC Act and NC Act)
- Bird species (listed as migratory under the EPBC Act):
 - Glossy ibis (*Plegadis falcinellus*)
 - Common sandpiper (*Actitis hypoleucos*)
 - Latham's snipe (*Gallinago hardwickii*)
 - Caspian tern (*Hydroprogne caspia*)
 - Osprey (*Pandion haliaetus*)
 - Wood sandpiper (*Tringa glareola*)
 - Common greenshank (*Tringa nebularia*).

MSES:

- Short-beaked echidna (*Tachyglossus aculeatus*) (listed as special least concern under the NC Act).

7.2 Significance of impact on MNES

7.2.1 Squatter pigeon (southern)

The project is unlikely to result in a significant impact on the local squatter pigeon population. The project footprint has been sited outside core breeding and foraging habitat. The project will result in the loss of 9.21 ha of habitat present within the project footprint, representing 2.82 percent of habitat within the project footprint and 0.05 percent of habitat within the regional area (i.e. available within a 5 km radius of the project footprint). Access to water is an important determinant of habitat utilisation for this species (DAWE 2020) and so, the increase of permanent water resulting from the impoundment of water behind the weir may provide long-term benefit to the species. As such, it is unlikely that small, localised losses of habitat along the largely disturbed riparian fringe will adversely impact the regional viability of this species. Construction activities within the project footprint will involve a temporary increase in vehicular traffic and plant movement to, from and at the site. This has the potential to increase the incidence of fauna injury and/or mortality due to vehicle strike. The clearing of a limited amount of vegetation to facilitate construction (including access and laydown areas) may also result in

injury or direct mortality of the squatter pigeon (southern), residing in areas to be cleared. Areas mapped as potential habitat for the squatter pigeon (southern) are to be flushed immediately prior to clearing (i.e. fauna spotter catcher to walk in front of clearing machinery), and a Traffic Management Plan will be developed and implemented during the construction and operational phase to minimise vehicle collision. The project is expected to be relatively benign during the operational phase, with potential for enhanced habitat values through increased levels of land management. A Weed Management Plan will be developed and implemented during the construction and operation phase, providing a greater level of control over weeds than is currently provided. The project is therefore considered unlikely to cause a significant impact given the scale of the loss and context in the context of the surrounding landscape. The justification for this is detailed in Table 7-1, based on the responses to Significant Impact Guidelines 1.1 (DoE 2013).

Table 7-1 Significance of impact on the squatter pigeon (southern)

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of an important population of the species	Unlikely Important populations of the squatter pigeon (southern) are listed as those small, isolated and sparsely distributed sub-populations at the southern extent of the sub-species current range. This includes areas south of the Carnarvon Range (Squatter Pigeon Workshop 2011). The local sub-population occurs approximately 300 km north-east of Carnarvon Range and is well beyond the range of those listed as important populations. The loss of 9.21 ha of habitat (representing 2.82 percent of habitat within the project footprint and 0.05 percent of habitat within the regional area – within a 5 km radius of the project footprint) will not lead to a decline in an important population and is considered unlikely to lead to a significant decline in the population. Increased vehicular movements during construction will increase the risk of mortality and injury of squatter pigeons; however, this will be managed through implementing speed limits and signage in areas that may support the subspecies. The project is expected to be relatively benign in terms operational impacts with negligible noise, vibration, land disturbance and vehicular movements. Permanent speed limits and signage on internal roads and education of staff during inductions will minimise the risk of direct mortality by operational vehicles. As such, the project is therefore unlikely to lead to a long-term decrease in the size of an important population of the species.
Reduce the area of occupancy of an important population	Unlikely While the project will result in a loss of 9.21 ha of potential habitat (representing 2.82 percent of habitat within the project footprint and 0.05 percent of habitat within the regional area – within a 5 km radius of the project footprint), the squatter pigeon (southern) present within the area are not known to form part of an important population of the subspecies. The increase of permanent water resulting from the impoundment of water behind the weirs is considered to provide long-term benefit to the subspecies. Given the relatively benign nature of the project in its operation phase, and the continued presence of suitable habitat within the local area, the project is unlikely to reduce the area of occupancy of an important squatter pigeon (southern) population.
Fragment an existing important population into two or more populations	Unlikely Fragmentation of the existing squatter pigeon (southern) population is not expected, connectivity between habitats will be maintained above the FSL to facilitate species movement between populations. Accordingly, the project is unlikely to fragment the important population into two or more populations.

Impact criteria	Potential to occur
Adversely affect habitat critical to the survival of a species	Unlikely While the project will result in a loss (9.21 ha) of potential habitat for the squatter pigeon (southern), this is not considered to constitute habitat critical to the survival of the subspecies. The increase of permanent water resulting from the impoundment of water behind the weir is considered to provide long-term benefit to the species.
Disrupt the breeding cycle of an important population	Unlikely Breeding habitat for the squatter pigeon (southern) (i.e. hills and rises with rocky, loamy and sandy soils) occurs within the study area. The inundation will not result in the loss of potential breeding habitat for the species; however, clearing of vegetation within the construction footprint of the weir, saddle dam, access tracks and laydown areas will result in the temporary loss of potential breeding habitat during the construction period. Suitable breeding habitat will remain adjacent to the project footprint and as such, the project is unlikely to disrupt the breeding cycle of the local squatter pigeon (southern) population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The loss of open woodland habitat as a result from the project, is not sufficient to threaten the broader availability or quality of habitat for the subspecies such that this could cause a decline in the population of the subspecies. The increase of permanent water is considered to benefit the population in the long-term.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Unlikely The project footprint is currently impacted by weed and pest species that could be harmful to the squatter pigeon (southern). The presence of these invasive species will not be exacerbated by the project, and any risks of their establishment will be managed via a site specific CEMP and operational EMP.
Introduce disease that may cause the species to decline	Unlikely Recognised threats to the squatter pigeon (southern) do not include diseases. It is however, not expected that the project would result in the introduction of disease.
Interfere substantially with the recovery of the species	Unlikely The project is considered unlikely to adversely affect the potential recovery of the species. The loss of habitat is unlikely to be significant at a local or regional scale, representing only 2.82 percent of local habitat present within the project footprint and 0.05 percent of regional habitat present within a 5 km radius. Implementation of a CEMP for the project has the potential to increase the value of local habitats through the control of weed and pest species. Local noise disturbance and mortality threats associated with the project are also expected to be low.

7.2.2 Greater glider (northern)

The project is unlikely to result in a significant impact on the local greater glider (northern) population. The project will result in the loss of 9.21 ha of potentially suitable foraging and denning habitat. This represents 2.82 percent of the habitat present within the project footprint and 0.05 percent of regional habitat (i.e. available within a 5 km radius of the project footprint). Areas impacted are considered to be sub-optimal given the low density of hollow-bearing trees. Suitable denning habitat was recorded on the upper banks of the Burdekin River adjacent to the project footprint. The greater glider (northern) is dependent on the presence of mature hollow-bearing trees to provide den sites (Henry 1984; Kehl and Borsboom 1984; Lindenmayer *et al.* 1991; Goldingay 2012) and typically forages within a 1 – 4 ha area, in proximity to denning

habitat (Henry 1984; Kehl and Borsboom 1984; Comport *et al.* 1996; Gibbons and Lindenmayer 2002). Construction related mortality and injury risks are considered low and can be effectively mitigated through the use of experienced spotter-catchers during clearing of potential suitable habitat. During the operation phase, the inundation of vegetation within the riparian zone along the Burdekin River will result in the loss and alteration of habitat. The project is therefore considered unlikely to cause a significant impact given the scale of the loss and in the context of the surrounding landscape. Justification for this assessment has been detailed in Table 7-2, based on the responses to Significant Impact Guidelines 1.1 (DoE 2013).

Table 7-2 Significance of impact on the greater glider (northern)

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of an important population of the species	Unlikely The concept of important populations has not yet been defined for the greater glider (northern). This assessment has been made on the assumption that the local greater glider population is important. The project will result in the loss of 9.21 ha of potential habitat. This represents 2.82 percent of the local habitat present within the project footprint and 0.05 percent of regional habitat present within a 5 km radius. A low density of hollow-bearing trees were recorded within project footprint, and is expected to be directly impacted by the project. Suitable denning habitat was recorded on the upper banks of the Burdekin River, adjacent to the project footprint. The project will have low background levels of noise and vibration, and is therefore expected to have negligible indirect impacts on the species through the operational phase. Given the small loss of suitable habitat within the project footprint and the relatively benign nature of the project, no long-term decrease in the size of an important greater glider (northern) population is expected.
Reduce the area of occupancy of an important population	Unlikely At most, the project will result in a small localised loss (9.21 ha) of potential habitat for the greater glider (northern). Suitable denning habitat for the species is located on the upper banks of the Burdekin River, and large areas of foraging habitat occur within open woodland habitats adjacent to the project footprint. Given the low level of noise and vibration disturbance associated with the project, it is unlikely to have any significant indirect impact on the local population. The local population is therefore not expected to be impacted by the project. Accordingly, the project is unlikely to reduce the area of occupancy of the local greater glider (northern) population.
Fragment an existing important population into two or more populations	Unlikely Fragmentation of existing greater glider (northern) population is not expected as the loss of connectivity between habitats will be maintained above the FSL level of the impoundment to facilitate species movement between populations.
Adversely affect habitat critical to the survival of a species	Unlikely No habitats observed within the project footprint could be described as habitat critical to the survival of the species, or to the survival of the local population. Habitats subject to direct impact are sub-optimal, hollow-deficient woodland areas that will have only limited value as foraging habitat for the greater glider (northern). Areas of suitable denning habitat occur on the upper banks of the Burdekin River, as well as hilly, forested habitat adjacent to the project footprint. Given the project is expected to have limited noise, light, vibration and other source of potential disturbance, the level of indirect impact is expected to be

Impact criteria	Potential to occur
	negligible, and unlikely to adversely affect habitat critical to the survival of the local population.
Disrupt the breeding cycle of an important population	Unlikely A low density of breeding or denning habitat is expected to occur within the project footprint. Suitable denning habitat for the species was recorded along the upper banks of the Burdekin River, as well as in hilly, forested habitat adjacent to the project footprint. The project is unlikely to have significant indirect impacts on adjacent breeding habitat. As such, the project is unlikely to disrupt the breeding cycle of the local greater glider (northern) population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The loss of 9.21 ha of potential habitat represents 2.82 percent of habitat present within the project footprint and 0.05 percent of regional habitat present within a 5 km radius of the project footprint. The small, localised loss of potential habitat is not likely to impact the species' survival in the region. As such, it is unlikely the project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Unlikely The project is unlikely to result in the introduction or spread of invasive species beyond current levels. The implementation of a site specific CEMP and operational EMP will further reduce potential impacts of invasive species. As such, the project is not expected to result in invasive species that are harmful to the greater glider (northern) becoming established in the species habitat.
Introduce disease that may cause the species to decline	Unlikely Disease is not a known threat to the greater glider (northern). The project is unlikely to introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely Although loss of habitat is described as a major threat to the species, the habitat within the project footprint subject to inundation and clearing, is not considered habitat critical to the species nor is the local population considered an important population. Isolation of a population is not expected as result of habitat loss. As such the project is considered unlikely to interfere with the recovery of the species.

7.2.3 Koala

The significance of the project's impacts on the koala has been assessed using the EPBC Act referral guidelines for the vulnerable koala (DoE 2014) and presented in Table 7-6. This employs a two-step process to determine the significance of impact, based on:

- An assessment of the potential to impact habitat critical to the survival of the koala; and
- An assessment of the potential to interfere with the recovery of the species.

The significance of impacts are then summarised using the framework detailed in the Significance Impact Guidelines 1.1 (DoE 2013) to provide consistency of approach with other conservation significant species list under the EPBC Act.

Assessment of habitat value under the EPBC Act

An assessment of koala habitat value was undertaken using the koala habitat assessment toolkit in the EPBC Act referral guidelines for the vulnerable koala (DoE 2014). This utilised the

scoring guidelines for inland koala populations, as detailed in Section 6 of the EPBC Act referral guidelines for the vulnerable koala (DoE 2014). This found that koala habitats within the study area represent habitat critical to the survival of the species, attaining a score of +6, where any score equal to or greater than 5 constitutes habitat critical to the survival of the koala. Scoring of this assessment is detailed in Table 7-3.

Table 7-3 Assessment of koala habitat using the habitat assessment tool

Attribute	Score	Project habitat appraisal
Koala occurrence	0	<i>Criteria: No koala records within 2 km of the impact area in the last 10 years.</i> Wildlife Online revealed four koala records within 30 km of the project footprint. Of these, two were recorded within 7 km of the project footprint and were both recorded in the 1980's. Essential habitat for the koala is mapped approximately 1 km south-east of the study area. During the field survey, no faecal pellets were detected.
Vegetation composition	+2	<i>Criteria: Forest, woodland or shrubland with two or more koala food trees present.</i> During the field survey, <i>Eucalyptus</i> -dominated woodlands were confirmed present within the project footprint. Two or more koala food tree species were recorded.
Habitat connectivity	+2	<i>Criteria: Part of a contiguous landscape ≥1000 ha.</i> Review of aerial imagery and RE mapping shows that the study area is part of a contiguous landscape ≥ 1000 ha.
Key existing threats	+1	<i>Criteria: Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.</i> Compared with urban koala populations, local threats are likely to be relatively low. Threats from roadkill are expected to be infrequent, although dog attacks may be reasonably frequent due to recent dog sightings within the study area.
Recovery value	+1	<i>Criteria: Uncertain whether the habitat is important for achieving the interim recovery objectives for the species.</i> Review of Biodiversity Planning Assessment mapping shows that the project footprint is within a state significant buffer. The habitat in the project footprint is potentially important for contributing to interim recovery objectives by maintaining corridors and connective habitat between areas of suitable koala habitat.
Total score	6	Habitat critical to the survival of the koala

Significance of impact due to loss of habitat critical to the survival of the koala

The project will result in the direct loss of 11.28 ha of koala habitat with a score of 6. The potential impact is neither above nor below the threshold limits provided in Figure 2 of the EPBC Act Referral Guidelines for the vulnerable koala (DoE 2014) and falls within the 'area of uncertainty'. In this circumstance, the referral guidelines suggest that additional characteristics be considered when deciding if an action should be referred to the DAWE. An assessment of additional factors is provided in Table 7-4.

Table 7-4 Assessment of additional factors

Factor	Project appraisal	Risk profile within range of uncertainty
Habitat score	The project will impact habitat critical to the survival of the koala (habitat score of 6). The high value of the habitat affected would mean a significant impact is likely.	High
Impact area	The project will result in the direct loss of 11.28 ha of koala habitat. This small size of the area affected is not expected to be a significant impact to the koala. The EPBC Act referral guidelines for the vulnerable koala (DoE 2014) suggest by example, that a loss of 5 ha of habitat scoring 9 or 10, or 10 ha scoring 7 or 8, would not represent a significant impact. The project is therefore less likely to have a significant impact on the koala due to the low loss of habitat critical to the survival of the species.	Low
Clearing method	Minimal vegetation clearing is proposed along new access tracks within the project footprint. The majority of habitat loss within the project footprint will be due to inundation within the Burdekin River channel. As the inundation is not permanent and will vary over time with changing water levels, the intensity of impact is not as extreme as would be experienced in the clear-felling of habitat. Some food trees at the upper fringes of the inundation area are likely to persist. Nevertheless, those at the lower extent of the inundation footprint will be permanently impacted and hold no value as koala foraging habitat. Given the low amount of vegetation permanently inundated, a significant impact is less likely.	Low
Density or abundance	Wildlife Online revealed four koala records within 30 km of the project footprint. Of these, two were recorded within 7 km of the project footprint and were both recorded in the 1980s. This is considered to be a relatively low density of koalas, and would mean a significant impact is less likely.	Low
Level of fragmentation	The proposed footprint is surrounded by large areas of remnant vegetation. Some areas within and adjacent to the project footprint are highly fragmented due to flooding events and vegetation clearing of the understorey. Minimal vegetation clearing will occur along new access tracks, the remainder of the impact area is expected to be inundated only within the existing Burdekin River channel. As the project footprint is surrounded by large areas of remnant vegetation and the impact is to occur within the river channel, the fragmentation caused by project is likely to not require referral.	Low
Overall	Unlikely to be a significant impact on the koala	Low

As indicated in Table 7-4, the assessment of additional factors indicates that the project falls within the lower limits of the area of uncertainty for four of the five factors assessed. Accordingly, the project is not expected to have a significant impact on the koala due to the low loss of habitat critical to the survival of the species.

Significance of impact due to interference with the recovery of the species

As detailed in the EPBC Act referral guidelines for the vulnerable koala (DoE 2014), for all areas of koala habitat scoring ≥ 5 on the koala habitat assessment toolkit, an assessment of the

potential interference with the recovery of the species must be undertaken considering the following factors detailed in Table 7-5. Based on this assessment, the project is unlikely to significantly interfere with the recovery of the koala.

Table 7-5 Potential impacts on the recovery of the koala

Impacts	Project appraisal	Likelihood
Will the project increase fatalities due to dog attacks to a level that is likely to result in multiple, ongoing fatalities?	The project is not expected to result in any change in the abundance of wild dogs. While the project will result in the creation of new access tracks that will facilitate local movement of wild dogs, a large number of farm tracks exist in the landscape and are already utilised by wild dogs for movement. Accordingly, the introduction of additional access tracks is not expected to have a measurable impact on local dog numbers or subsequent frequency of dog attacks on koalas.	Unlikely
Will the project increase koala fatalities due to vehicle strikes to a level that is likely to result in multiple ongoing fatalities?	The project will result in a large increase in vehicle movements during the construction period. This carries a risk of increased vehicle strike but will be mitigated through standard controls such as speed limits. The risks of ongoing mortality from vehicle strikes is low, given the project will only result in occasional movements of maintenance vehicles during the projects' operational phase.	Unlikely
Will the project facilitate the introduction or spread of pathogens such as Chlamydia or Phytophthora cinnamomi that are likely to significantly reduce the reproduction output or the carrying capacity of the habitat?	The use of standard hygiene protocols in vehicle movements during construction means that the potential for introduction of Phytophthora is relatively limited. The project is relatively benign during the operational phase and is unlikely to have any impact on levels of Chlamydia in the local koala population.	Unlikely
Will the project create a barrier to movement between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala?	The project will result in minor localised fragmentation of habitat. However, this will pose no barrier to the movement of koala.	Unlikely
Will the project change hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term?	The project will result in the inundation of vegetation within the riparian zone along the Burdekin River. This inundation will result in the loss and alteration of vegetation communities and koala habitat. Given that relatively large areas of koala habitat remain within the surrounding landscape, local koalas are not expected to experience a significant reduction in foraging and breeding success due to any increase in competition for resources.	Unlikely

A general significance of impact assessment is detailed for the koala in Table 7-6, using the criteria detailed in the Significance Impact Guidelines 1.1 (DoE 2013). The project is unlikely to have a significant impact on the koala.

Table 7-6 Significance of impact on the koala

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of an important population of the species	Unlikely The project is not expected to result in a decrease in the size of the local koala population. Based on field surveys and species ecology, koalas are predicted to occur at low densities within the project footprint. Given that relatively large areas of habitat remaining within the surrounding landscape, local koalas are not expected to experience a significant reduction in foraging and breeding success due to any increase in competition for resources.
Reduce the area of occupancy of an important population	Unlikely Large areas of suitable koala habitat will persist within the local area. The project will not disrupt connectivity to the extent that movement between remnant patches will be disrupted. As such, there will be no change in the extent of occurrence of an important population of the species.
Fragment an existing important population into two or more populations	Unlikely Fragmentation of existing koala population is not expected as bioregional corridors will still prevail directly adjacent to the high water level of the impoundment, and therefore, the impoundment will not be of sufficient magnitude to disrupt koala movement between populations.
Adversely affect habitat critical to the survival of a species	Unlikely The project will result in the loss of 11.28 ha of habitat critical to the survival of the koala. The EPBC Act referral guidelines for the vulnerable koala (DoE 2014) suggest by example, that a loss of 5 ha of habitat scoring 9 or 10, or 10 ha scoring 7 or 8, would not represent a significant impact. The project is therefore unlikely to have a significant impact on the koala due to the small area of habitat critical to the survival of the species that will be lost.
Disrupt the breeding cycle of an important population	Unlikely The koala breeding season is generally between September and March, with females giving birth to a single young between October and May. It is unlikely that the construction and operation of the project will disrupt the breeding cycle of the local koala population. During the breeding season, males actively seek female koalas and koala movement is more extensive. Without mitigation, the project could lead to an increase risk of vehicle strike. Traffic volume, speed and visibility influence the koala collision rate. Potential impacts will be mitigated through implementation of on-site speed limits.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely The project will directly impact 11.28 ha of koala habitat. This accounts for only a small proportion of suitable habitat in the broader landscape (i.e. 3.46 percent of habitat within the project footprint and 0.07 percent of habitat within the regional area – within a 5 km radius of the project footprint). Although the project will reduce the area of available habitat, the extent of habitat disturbance is not likely to decrease the availability or quality of habitat available to the local population to the extent that the species will decline.

Impact criteria	Potential to occur
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Unlikely The study area already supports wild dogs that are a key threat to koalas as a species. While the project will result in the creation of new access tracks that will facilitate local movement of wild dogs, a large number of farm tracks exist in the landscape and are already utilised by wild dogs for movement. Accordingly, the introduction of additional access tracks is not expected to have a measurable impact on local dog numbers or subsequent frequency of dog attacks on koalas. The project also has the potential to introduce or spread weeds that could pose a barrier to local koala movement. The potential risks from weed and pest species will be mitigated by the implementation of a site specific CEMP and operation EMP governing construction and operation of the project. The project therefore poses low risks to the local koala population via introduction and spread of invasive species.
Introduce disease that may cause the species to decline	Unlikely The project is not anticipated to introduce new diseases that may cause the species to decline. Stress may lead to an increase in the expression of Chlamydia in koalas; however, the short duration of the construction period, and the implementation of mitigation measure such as sequential clearing will reduce disturbance-related stress and risk of disease.
Interfere substantially with the recovery of the species	Unlikely As detailed above, the project is unlikely to substantially interfere with the recovery of the species. The project is expected to be relatively benign with no substantial long-term increase in mortality or any substantial barrier effects due to loss of habitat connectivity. All impacts are expected to be localised. Accordingly, the project is unlikely to substantially interfere with the recovery of the species.

7.2.4 Migratory species

The project is unlikely to result in a significant impact on migratory bird species. No breeding habitat occurs within the project footprint. Species confirmed present or predicted to occur migrate to the northern hemisphere during breeding season or suitable breeding habitat does not occur for species that breed in Australia (i.e. glossy ibis and eastern osprey). The project will result in the inundation of sub-optimal foraging habitat for migratory species. Construction related mortality and injury risks are considered low. During the operation phase, the inundation of vegetation within the riparian zone along the Burdekin River will result in the loss and alteration of habitat. The project is therefore considered unlikely to cause a significant impact given the scale of the loss and context in the context of the surrounding landscape. Justification for this assessment has been detailed in Table 7-7, based on the responses to Significant Impact Guidelines 1.1 (DoE 2013).

Table 7-7 Significance impact on migratory species

Impact criteria	Potential to occur
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of	Unlikely The initial filling of the impoundment will result in changes to the hydrological regime within the project footprint along the Burdekin River. Migratory birds such as ibis and waders depend on the wetting and drying cycles for foraging habitat, whereas other species, such as fish-eating species prefer permanently inundated areas (Scott 1997). Since changes to the hydrological cycle can alter foraging habitat, this can in turn modify the abundance and diversity of migratory birds (Scott 1997). However, the migratory

Impact criteria	Potential to occur
important habitat for a migratory species; or	species confirmed present or predicted to occur within the project footprint are transient visitors and as such, the area within the project footprint does not contain habitats of unique ecological value to these species. Accordingly, no impacts on migratory birds are predicted. Construction works located within and adjacent to the river channel, have the potential to degrade the quality of habitat through increased erosion and run-off, and spillage of contaminants. These activities have the potential to affect water quality resulting in altered water chemistry (Wood and Armitage 1997; Wheeler <i>et al.</i> 2005). Implementation of an Erosion and Sediment Control Plan will reduce potential impacts to water quality and thereby maintain foraging values for migratory bird species. There is unlikely to be any substantial fragmentation or modification of fire regimes that could adversely impact local habitat for these migratory species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Unlikely The project is unlikely to result in the introduction or spread of invasive species beyond current levels. The implementation of a site specific CEMP and operational EMP will further reduce potential impacts of invasive species. The project is therefore unlikely to have any adverse impact on migratory birds to invasive species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Unlikely The woodland and aquatic habitats within the project footprint are not considered critical breeding, foraging, roosting or shelter habitat for the migratory species known to occur within or near the project footprint.

7.3 Significance of impact on MSES

7.3.1 Short-beaked echidna

The project is unlikely to result in a significant impact on the local short-beaked echidna population. The project will result in the loss of 24.35 ha of habitat present within the project footprint, representing 7.47 percent of habitat within the project footprint and 0.09 percent of habitat within the regional area (i.e. available within a 5 km radius of the project footprint). Habitat for this species is widespread and abundant within the region, and the species is therefore capable of foraging widely over a broad range of environments, including open landscapes. As such, the localised loss of potential habitat due to the construction and operational phase of the project is not expected to limit habitat resources or the species movement within the region. Construction activities within the project footprint will involve a temporary increase in vehicular traffic and plant movement to, from and at the site. This has the potential to increase the incidence of fauna injury and/or mortality due to vehicle strike. The clearing of a limited amount of vegetation to facilitate construction (including access and laydown areas) may also result in injury or direct mortality of any short-beaked echidnas residing in areas to be cleared. Microhabitats, such as hollow logs and termite mounds, are to be inspected prior to clearing by an experienced fauna spotter catcher, and a Traffic Management Plan will be developed and implemented during the construction phase to minimise vehicle collision. The project is therefore considered unlikely to cause a significant impact given the scale of the loss and in the context of the surrounding landscape. Justification for this assessment has been detailed in Table 7-8, based on the responses to the Significant Residual Impact Guidelines (DSDIP 2014).

Table 7-8 Significance of impact on the short-beaked echidna

Impact criteria	Potential to occur
Lead to a long-term decrease in the size of a local population	Unlikely The project will result in the clearance of 24.35 ha of potential habitat for the short-beaked echidna. Habitat for this species is widespread and abundant within the region. The project will pose minimal risk to individuals during construction and negligible risk to individuals during operation. Given these factors, the project is unlikely to lead to a long-term decrease in the size of the local population.
Reduce the extent of occurrence of the species	Unlikely The short-beaked echidna is widely distributed throughout Australia, occurring in a broad range of habitats, and the project is expected to result in a small localised loss (25.35 ha) of potential habitat for the species. Given the relatively benign nature of the project in its operation phase, and the continued presence of suitable habitat within the local area, the project is unlikely to reduce the area of occupancy of the short-beaked echidna.
Fragment an existing population	Unlikely The short-beaked echidna is capable of foraging widely over a broad range of environments, including open landscapes. Therefore, fragmentation of the existing short-beaked echidna population is not expected, as connectivity between habitats will be maintained above the FSL to facilitate species movement between populations. As such, the project is unlikely to fragment the existing population.
Avoid genetically distinct populations forming as a result of habitat isolation	Unlikely The species capacity to move locally and regionally will not be limited by the localised loss of potential habitat during the construction and operational phase of the project. As a result, the project will not cause any loss of gene transfer that would cause genetically distinct populations to form.
Cause disruption to ecologically significant locations (breeding, feeding and nesting sites) of a species	Unlikely As detailed above, the short-beaked echidna is locally ubiquitous. The project will have limited impact on ecological significant locations. While it will be necessary to include the species in any high risk SMP, the risks to the species are considered low.

8. Summary

This report presents the results of desktop and field surveys undertaken to assess the ecological values of the proposed BRW in the Charters Towers Region, in North Queensland. This report also provides a summary of the existing environmental values and impact assessment based on both the pre-wet field survey (December 2019) and post-wet field survey (April and May 2020).

The terrestrial field surveys were undertaken over six days from 26 April to 1 May 2020 by two ecologists, and the aquatic field surveys were undertaken by two ecologists over eight days between 15 and 22 May 2020. The following three sections outline MNES and MSES confirmed present during the field surveys, and the potential impacts and mitigation measures for the protection of such environmental values during the project construction and operation. These environmental values will be of relevance for future statutory and offsetting obligations for the project during future phases.

8.1 Matters of National Environmental Significance

Based on the assessment completed, three listed threatened species and seven listed migratory species considered MNES, have been confirmed present or are considered likely to occur based on previous records within the desktop search extent or suitable habitat being present during the field surveys. MNES confirmed present or considered likely to occur are described in Table 8-1.

Table 8-1 MNES confirmed present or likely to occur

MNES category	Confirmed present / likely to occur
World heritage properties	None present within the project footprint
National heritage places	None present within the project footprint
Wetlands of international importance	None present within the project footprint
Listed TECs	None present within the project footprint
Listed threatened species	Three fauna species listed as vulnerable under the EPBC Act were either confirmed present or considered likely to occur: • <i>Geophaps scripta scripta</i> – squatter pigeon (southern) • <i>Petauroides volans minor</i> – greater glider (northern) • <i>Phascolarctos cinereus</i> – koala
Listed migratory species	Seven fauna species listed as special least concern under the NC Act were either confirmed present or considered likely to occur: • <i>Plegadis falcinellus</i> – glossy ibis • <i>Actitis hypoleucos</i> – common sandpiper • <i>Gallinago hardwickii</i> – Latham's snipe • <i>Hydroprogne caspia</i> – Caspian tern • <i>Pandion haliaetus</i> – osprey • <i>Tringa glareola</i> – wood sandpiper

MNES category	Confirmed present / likely to occur
	<i>Tringa nebularia</i> – common greenshank
Commonwealth marine areas	None present within the project footprint
Great Barrier Reef Marine Park	None present within the project footprint
Nuclear actions	Not relevant to the project
Water resource, in relation to coal seam gas development and large coal mining development	Not relevant to the project

8.2 Matters of State Environmental Significance

Based on the outcomes of the desktop and field assessments, remnant vegetation within a defined distance of a watercourse has been confirmed within the project footprint. Regional biodiversity corridors and essential habitat areas for the squatter pigeon (southern) have been confirmed present within the project footprint. A summary of the MSES confirmed present or considered likely to occur within the study area is presented in Table 8-2.

Table 8-2 MSES confirmed present or likely to occur

MSES category	Confirmed present / likely to occur
Regulated vegetation – endangered or of concern	None present within the project footprint
Regulated vegetation – intersecting a watercourse	Multiple RE watercourses are mapped as intersecting the project footprint. Regulated vegetation that intersects a watercourse comprise an MSES.
Connectivity areas	Project footprint resides within a regional biodiversity area
Wetlands and watercourses	None present within the project footprint
Designated precinct in a strategic environmental area	North Queensland Regional strategic area is within the proposed inundation area, however this is not a designated precinct area.
Protected wildlife habitat – plants that are endangered or vulnerable wildlife under the NC Act	None present within the project footprint
Protected wildlife habitat – animals that are endangered or vulnerable under the NC Act	Three fauna species listed as vulnerable under the NC Act were either confirmed present or considered likely to occur: <i>Geophaps scripta scripta</i> – squatter pigeon (southern) <i>Petauroides volans minor</i> – greater glider (northern) <i>Phascolarctos cinereus</i> – koala
Protected wildlife habitat – animals that are special least concern under the NC Act	Eight fauna species listed as special least concern under the NC Act were either confirmed present or considered likely to occur: <i>Plegadis falcinellus</i> – glossy ibis <i>Actitis hypoleucos</i> – common sandpiper <i>Gallinago hardwickii</i> – Latham's snipe <i>Hydroprogne caspia</i> – Caspian tern

MSES category	Confirmed present / likely to occur
	• <i>Pandion haliaetus</i> – osprey • <i>Tachyglossus aculeatus</i> – short-beaked echidna • <i>Tringa glareola</i> – wood sandpiper • <i>Tringa nebularia</i> – common greenshank
Essential habitat	Essential habitat for the squatter pigeon (southern) is within the project footprint
Protected areas	Approximately 1 ha of a small tributary within the Dalrymple National Park may be inundated from the proposed storage area at FSL.
Declared fish habitat areas and highly protected zones of state marine parks	None present within the project footprint
Waterway providing for fish passage	Major waterways present within the project footprint include the Burdekin River, Lolworth Creek, Keelbottom Creek and Allingham Creek High, moderate and low ephemeral waterways are present within the project footprint
Marine plants	None present within the project footprint
Legally secured offset areas	None present within the project footprint

8.3 Impacts, mitigation and significance of impact assessment

Construction activities have the potential to cause localised impact through vehicle and plant movement, removal of vegetation, construction within the waterway, spillage of hazardous materials, and acquisition of materials for use in construction. The project is expected to be relatively benign in terms of operational phase impacts. However, the initial filling of the impoundment and operational phase of the weir have the potential to cause localised fauna injury and mortality, disruption to behaviour and restriction of movement of wildlife assemblages, loss, alteration and degradation of terrestrial and aquatic habitats, increase in feral animals and weed species, and changes to downstream flow regimes.

Impacts associated with construction of the project will be avoided as far as practicable and minimised by locating the ancillary infrastructure, such as laydown and borrow areas in open areas that have been previously cleared or degraded. Impacts associated with the initial filling of the impoundment have been minimised through the design of the weir, with inundation to be kept within the bed and banks, as well as frequent drownout of the weir with no changes to flood profiles/overland flows. Impacts associated with the operational phase of the project such as aquatic fauna movement, injury and mortality will be a key objective during subsequent design phases of the project to ensure that these impacts are minimised.

These potential construction and operational impacts can be effectively mitigated through routine mitigation measures, and are summarised in Section 6.

A formal significance of impact assessment was undertaken for each conservation significant species, as detailed in Section 7. Following detailed field assessments and habitat mapping, the project is unlikely to have a significant impact on the squatter pigeon (southern), greater glider (northern) and koala. The project, however, will result in a local loss of potential habitat for these species.

The proposed BRW is located 320 km upstream of the Great Barrier Reef World Heritage Area (GBRWHA). The Burdekin River is a significant tributary flowing into the GBRWHA, subsequently the project may have the potential to indirectly impact on GBRWHA values via

changes to water quality and flow regimes. However, due to the small size of the project, the very large distance upstream from the GBRWHA and the presence of the Burdekin Falls Dam between the BRW and GBRWHA, no notable changes are expected to occur to the hydrological regime or water quality at the mouth of the Burdekin River. Water quality conditions will be monitored during the construction and operation phases of the project and associated factors such as, erosion, sedimentation and runoff will be managed. Overall the values of the GBRWHA are not expected to be notably altered, modified, observed or diminished and no significant impact to the GBRWHA is expected to occur.

9. References

- Allen, G.R., Midgley, S.H. and Allen, M. (2003). '*Field Guide to the Freshwater Fishes of Australia*', Perth, Western Australian Museum.
- Andrews, S.P., Gratton, G., Quin, D., and Smith, A.P. (1994). Description and assessment of forestry impacts on fauna of the Urbenville Forestry Management Area. Report for State Forests of New South Wales Austeco Environmental Consultants, Armidale.
- Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000). '*Australian guidelines for water quality monitoring and reporting*', Australian and New Zealand Environment and Conservation Council.
- Australian Rainforest Conservation Society (ARCS) (1999). Article on SEQ Regional Forests Agreement. Available from: www.brisrain.webcentral.com.au/rfa.html. Accessed 20 January 2020.
- Atlas of Living Australia (ALA) (2020). *Dichanthium queenslandicum*. Available from: <http://www.ala.org.au/>. Accessed 20 January 2020.
- Australian Native Plants Society (Australia) (ANPS) (2016). *Graptophyllum excellsum*. Available from: http://anpsa.org.au/g-exc.html?sm_au=iVV1MJBfDks1PTTMBNT0NK6RWkLVC. Accessed 20 January 2020.
- Australian Reptile Online Database (AROD) (2017). Vine-thicket fine-lined slider *Lerista cinerea*. Available from: <http://www.arod.com.au/arod/reptilia/Squamata/Scincidae/Lerista/cinerea>. Accessed 20 January 2020.
- Australian Tropical Rainforest Plants (ATRP) (2019). *Solanum sporadotrichum*. Available from: http://www.canbr.gov.au/cpbr/cd-keys/RFK7/key/RFK7/Media/Html/entities/Solanum_sporadotrichum.htm. Accessed 20 January 2020
- Baumgartner, L.J. (2005). '*Effects of weirs on fish movements in the Murray-Darling Basin*', PhD thesis, University of Canberra.
- Baumgartner, L.J., Reynoldson, N. and Gilligan, D.M. (2006), '*Mortality of larval Murray cod (Maccullochella peelii peellii) and golden perch (Macquaria ambigua) associated with passage through two types of low-head weirs*', Marine and Freshwater Research, 57: 187-191.
- Bureau of Meteorology (BoM) (2019). Climate Data Online. Available from: <http://www.bom.gov.au/climate/data/index.shtml?bookmark=201>. Accessed 18 June 2020.
- Cann, J. (1998). '*Australian freshwater turtles*', Singapore, Beaumont Publishing Pty Ltd.
- Clark, N.J. (2008). The diving physiological ecology of Australian freshwater turtle hatchlings, PhD Thesis, Brisbane, University of Queensland.
- Comport, S.S., Ward, S.J., and Foley, W.J. (1996). Home ranges, time budgets and food tree use in a high density tropical population of greater gliders, *Petauroides volans minor* (Pseudocheiridae: Marsupialia). *Wildlife Research* 23, 401-419.
- Department of Agriculture and Fisheries (DAF) (2019). Restricted invasive animals of Queensland. Available from: https://www.daf.qld.gov.au/data/assets/pdf_file/0011/403868/IPA-Restricted-animals-of-Queensland.pdf. Accessed 4 February 2020.

- Department of Agriculture and Fisheries (DAF) (2019). Restricted invasive plants of Queensland. Available from: https://www.daf.qld.gov.au/data/assets/pdf_file/0004/383818/IPA-Restricted-plants-of-Qld.pdf. Accessed 4 February 2020.
- Department of Agriculture, Water and the Environment (DAWE) (2020). Species Profiles and Threats Database. Available from: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>. Accessed 20 May 2020.
- Department of Environment and Heritage Protection (2009) Queensland Water Quality Guidelines, Version 3, ISBN 978-0-9806986-0-2.
- Department of Environment and Science (DES) (2020). WetlandInfo – Queensland Wetlands Information. Available from: <https://wetlandinfo.ehp.qld.gov.au/wetlands/>. Accessed 20 January 2020.
- Department of Natural Resources and Mines (2001). Queensland Australia River Assessment System (AusRivAS): Sampling and Processing Manual.
- Department of State Development, Infrastructure and Planning (DSDIP) (2014). *Significant Residual Impact Guideline*, Queensland Environmental Offsets Policy. Available from: <http://www.dlgrma.qld.gov.au/resources/guideline/planning/dsdip-significant-residual-impact-guideline.pdf>.
- Department of the Environment (DoE) (2014). EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory), Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.
- Department of the Environment (DoE) (2013). Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.
- Duivenvoorden, L.J., Hamilton, D.R., Price, M.D. and Attard, T.B. (2000), '*Temporal Variation of Macroinvertebrate Communities of impounded and riverine sites in Central Queensland*', in Noble, RM (ed.), *River Health in the Fitzroy Catchment: Community Ownership*, Rockhampton, Department of Natural Resources.
- Eyre, T. J. (2002). Habitat preferences and management of large gliding possums in southern Queensland. Ph.D. thesis, Southern Cross University, Lismore.
- Eyre, T.J. (2004). Distribution and conservation status of the possums and gliders of southern Queensland. *The Biology of Australian Possums and Gliders* (Eds R. L. Goldingay and S. M. Jackson), pp. 1-25. Surrey Beatty & Sons, Chipping Norton.
- GHD (2020a). Big Rocks Weir Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment.
- GHD (2020b). Big Rocks Weir Business Case Reference Design Report. Revision Draft B.
- Gibbons, P. and Lindenmayer, D.B. (2002). Tree hollows and wildlife conservation in Australia. CSIRO Publishing, Collingwood.
- Goldingay, R.L. (2012). Characteristics of tree hollows used by Australian arboreal and scansorial mammals. *Australian Journal of Zoology*, 59: 277-294.
- Hamann, M., Schauble, C.S., Limpus, D.J., Emerick, S.P. and Limpus, C.J. (2007). '*Management plan for the conservation of Elseya sp. (Burnett River) in the Burnett River Catchment*', Queensland, Environmental Protection Agency.
- Hancock, J.A., Kushlan, J.A and Kahl, M.P. (1992). *Storks, Ibises and Spoonbills of the world*. London, Academic Press.

- Henry, S.R. (1984). Social organisation of the greater glider (*Petauroides volans*) in Victoria. In Possums and Gliders (eds A. P. Smith & I. D. Hume), pp. 221-228. Surrey Beatty and Sons, Chipping Norton.
- Higgins, P.J. and Davies, S.J.J.F. (eds) (1996). Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons. Melbourne, Victoria: Oxford University Press.
- Kavanagh, R.P. (1984). Seasonal changes in habitat use by gliders and possums in south eastern New South Wales. In Possums and Gliders (eds A. P. Smith & I. D. Hume), pp. 527-543. Surrey Beatty and Sons, Chipping Norton.
- Kavanagh, R.P. and Lambert, M. (1990). Food selection by the greater glider: is foliar nitrogen a determinant of habitat quality? *Australian Wildlife Research* 17, 285-299.
- Kavanagh, R.P. (2000). Effects of variable intensity logging and the influence of habitat variables on the distribution of the Greater Glider *Petauroides volans* in montane forest in outeastern New South Wales. *Pacific Conservation Biology* 6: 18-30.
- Kehl, J. and Borsboom, A. (1984). Home range, den tree use and activity patterns in the greater glider (*Petauroides volans*). In Possums and Gliders (Eds. A. P. Smith and I. D. Hume), pp. 229- 236. Surrey Beatty and Sons, Chipping.
- Koetsier, P. and Bryan, C.F. (1995). 'Effects of Abiotic Factors on Macroinvertebrate Drift in the Lower Mississippi River, Louisiana', The American Midland Naturalist, 134: 63-74.
- Larinier, M. (2000). 'Dams and fish migration', contributing paper to the World Commission of Dams Thematic Review II.1 Ecosystems.
- Limpus, C.J., Limpus, D. and Hamann, M. (2002). Freshwater turtle populations in the area to be flooded by the Walla Weir, Burnett River: baseline study. *Memoirs of the Queensland Museum*, 48: 155-168.
- Limpus, C.J., Limpus, D.J., Hollier, C., Savige, M., McAllister, D. (2011). 'Survey of Freshwater turtle populations and nesting habitat', Tartrus Weir Turtleway Project, September – December 2011. Brisbane Department of Environment and Heritage Protection, Queensland Government.
- Lindenmayer, D.B., Cunningham, R.B., Tanton, M.T., Smith, A.P. and Nix, H.A. (1991). Characteristics of hollow-bearing trees occupied by arboreal marsupials in the montane ash forests of the Central Highlands of Victoria, south-east Australia. *Forest Ecology and Management*, 40: 289-308.
- Lowe-McConnell, R.H. (1987). 'Ecological studies in tropical fish communities', New York, Cambridge University Press.
- Lucas, M.C. and Baras, E. (2001), 'Migrations of freshwater fishes', Oxford, Blackwell Science.
- Marchant, R. and Hehir, G. (2002). 'The use of AUSRIVAS predictive models to assess the response of lotic macroinvertebrates to dams in south-east Australia', *Freshwater Biology*, 47: 1033-1050.
- Marchant, S. and Higgins, P.J. (1990). Handbook of Australian, New Zealand and Antarctic Birds. Volume One - Ratites to Ducks. Melbourne, Victoria: Oxford University Press.
- Martin, R. (2001). "Koala". In Macdonald, D. (ed.). *Encyclopedia of Mammals* (2nd ed.). Oxford University Press. pp. 852–54.
- Martin, R. and K. Handasyde (1999). The Koala: Natural history, conservation and management. Sydney, NSW: UNSW Press.

- McCarthy, M.A. and Lindenmayer, D.B. (1999). Conservation of the greater glider (*Petauroides volans*) in remnant native vegetation within exotic plantation forest. *Animal Conservation* 2, 203- 209.
- McKenzie, N. and Hall, L. (2008). *Macroderma gigas*. In 'IUCN red list of threatened species.' Version 2012.1. Available from: <http://www.iucnredlist.org>. Accessed 20 January 2020.
- 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. (2019). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.0. Updated March 2019. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.
- North Queensland Land Council (2020). Consultation with indigenous parties report for inclusion in the big rocks weir social impact evaluation and business case. NQLC.
- Phillips, S. and Callaghan, J. (2011). The Spot Assessment Technique: A tool for determining localised levels of habitat use by koala *Phascolarctos cinereus*, *Australian Zoologist*, 35(3): 774-780.
- Pusey, B., Kennard, M. and Arthington, A. (2004). '*Freshwater Fishes of North-Eastern Australia*', Collingwood, CSIRO Publishing.
- Reynolds, L.M. (1983). 'Migration patterns of five fish species in the Murray-Darling River system'. *Australian Journal of Marine and Freshwater Research*, 34: 857- 871.
- Royle, J., Andrew and Nichols, J. (2003). Estimating Abundance From Repeated Presence Absence Data or Point Counts. *Ecology*. 84: 777-790.
- Santoro, S., Sundar, K.S.G and Cano-Alonso, L.S. (2019) *Glossy ibis ecology and conservation*. SIS Conservation, Vol 1, pp. 1 – 148.
- Scott, A. (1997). *Relationships between waterbird ecology and river flows in the Murray-Darling Basin*, CSIRO Publishing.
- Sprent, J.A. (2012). Diet, spatial ecology and energetics of echidnas: the significance of habitat and seasonal variation. PhD thesis, University of Tasmania.
- Squatter Pigeon Workshop (2011). *Proceedings form the workshop for the Squatter Pigeon (southern). 14-15 December 2011*. Toowoomba Office of the Queensland Parks and Wildlife Service.
- Staunton-Smith, J., Robbins, J.B., Mayer, D.G., Sellin, M.J. and Halliday, I.A. (2004). '*Does the quantity and timing of fresh water flowing into a dry tropical estuary affect year-class strength of barramundi (Lates calcarifer)?*'. *Marine and Freshwater Research*, 55: 787.
- Stuart, I.G. (1997). '*Assessment of a Modified Vertical-Slot Fishway, Fitzroy River, Queensland*', Department of Primary Industries, Queensland. Project report QO97023.
- Stuart, I.G. and Mallen-Cooper, M. (1999). '*An assessment of the effectiveness of a vertical-slot fishway for non-salmonid fish at a tidal barrier on a large tropical/subtropical river*', *Regulated Rivers Research and Management*, 15: 575-590.
- Threatened Species Scientific Committee (TSSC) (2013). Conservation Advice *Croton magneticus*. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/16681-listing-advice.pdf>. Accessed 20 January 2020.
- Threatened Species Scientific Committee (TSSC) (2016a). Conservation Advice *Macroderma gigas* ghost bat. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/174-conservation-advice-05052016.pdf>. Accessed 20 January 2020.

- Threatened Species Scientific Committee (TSSC) (2016b). Conservation advice *Petauroides volans* greater glider. Canberra: Department of the Environment: Available from;: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-20160525.pdf>. Accessed 20 January 2020.
- Vanderduys, E.P., Kutt, A.S. and Kemp, J.E. (2012). Upland savannas: the vertebrate fauna of largely unknown but significant habitat in north-eastern Queensland. *Australian Zoologist* 36, 59-74.
- Van der Ree, R., Ward, S.J. and Handasyde, K.A. (2004). Distribution and conservation status of possums and gliders in Victoria. *The Biology of Australian Possums and Gliders* (Eds R. L. Goldingay and S. M. Jackson), pp. 91-110. Surrey Beatty and Sons, Sydney.
- Wheeler, A.P., Angermeier, P.L. and Rosenberger, A.E. (2005) Impacts of new highways and subsequent landscape urbanization on stream habitat and biota, *Reviews in Fisheries Science*, 13: 141-164.
- Wood, P.J. and Armitage, P.D. (1997). '*Biological effects of fine sediment in the lotic environment*', *Environmental Management*, 21: 203-217.

Appendices

Appendix A – Locations of post-wet aquatic assessments

Site	Location	Latitude #	Longitude #
US1	Burdekin River, approximately 14.5 km upstream of the proposed weir wall	-19.80481	146.07583
US3	Keelbottom Creek; approximately 14.2 km upstream of the proposed weir wall	-19.79149	146.09656
W1	Burdekin River; approximately 11.5 km upstream of the proposed weir wall	-19.81406	146.09916
W2	Burdekin River; approximately 8 km upstream of the proposed weir wall	-19.83785	146.10639
W3	Burdekin River; approximately 2.4 km upstream of the proposed weir wall	-19.85520	146.14478
BB	High flow channel of the Burdekin River, located at the Big Bend Recreation Reserve approximately 4 km upstream of the proposed weir wall	-19.85161	146.13389
BRW	Burdekin River; at the proposed weir wall	-19.86435	146.16541
SSD	Burdekin River; SSD	-19.86510	146.16378
DS1	Burdekin River; approximately 1.7 km downstream of the proposed weir wall	-19.86993	146.18078
DS3 ^	Burdekin River; approximately 2.7 km downstream of the proposed weir wall	-19.86946	146.19095
LC	Lolworth Creek; approximately 6.1 km upstream of the confluence with the Burdekin River and proposed creek crossing location during construction	-19.87383	146.17241

Datum: GDA94

^ turtle survey for this site was conducted at latitude -19.86760, longitude 146.20972

Appendix B – Criteria used to map habitat for conservation significant fauna species

Species	Mapping criteria
Squatter pigeon (southern)	Remnant vegetation within the following REs: 9.3.1, 9.3.2, 9.3.3, 9.3.3b, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.18, 9.3.19, 9.3.19b, 9.3.20, 9.3.21, 9.3.22, 9.3.22a, 9.3.23, 9.4.1, 9.4.2, 9.4.3, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.16, 9.7.1, 9.7.2, 9.7.2a, 9.7.3, 9.7.5, 9.7.6, 9.8.1, 9.8.1a, 9.8.2, 9.8.4, 9.8.5, 9.8.6, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.6, 9.10.7, 9.10.8, 9.11.1, 9.11.1b, 9.11.2e, 9.11.2, 9.11.2a, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.11, 9.11.12, 9.11.13, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.23, 9.11.26, 9.11.28, 9.11.29, 9.11.31, 9.11.32, 9.12.1, 9.12.1a, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.26, 9.12.28, 9.12.30, 9.12.31, 9.12.33, 9.12.35, 9.12.37, 9.12.39, 10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.6, 10.3.6a, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13, 10.3.14, 10.3.15, 10.3.19, 10.3.20, 10.3.27, 10.3.28, 10.3.30, 10.3.31, 10.4.3, 10.5.1, 10.5.2, 10.5.4, 10.5.4a, 10.5.5, 10.5.5a, 10.5.7, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.2, 10.7.3, 10.7.5, 10.7.11, 10.7.12, 10.9.1, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7.
Greater glider (northern)	Remnant vegetation within the following REs: 9.3.1, 9.3.2, 9.3.3, 9.3.3b, 9.3.5, 9.3.6, 9.3.8, 9.3.10, 9.3.10a, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.19, 9.3.19b, 9.3.20, 9.3.21, 9.3.22, 9.3.22a, 9.3.24, 9.4.1, 9.4.2, 9.5.1, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.13, 9.5.14, 9.5.15, 9.5.16, 9.5.17, 9.7.1, 9.7.2, 9.7.2a, 9.7.3, 9.7.4, 9.7.5, 9.7.6, 9.8.1, 9.8.1a, 9.8.2, 9.8.4, 9.8.5, 9.8.9, 9.8.10, 9.8.11, 9.10.1, 9.10.3, 9.10.4, 9.10.5, 9.10.7, 9.10.8, 9.11.1, 9.11.1b, 9.11.2, 9.11.2a, 9.11.2e, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.12, 9.11.13, 9.11.14, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.21, 9.11.22, 9.11.23, 9.11.24, 9.11.25, 9.11.26, 9.11.28, 9.11.29, 9.11.30, 9.11.31, 9.11.32, 9.12.1, 9.12.1a, 9.12.2, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.14, 9.12.15, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.25, 9.12.26, 9.12.27, 9.12.28, 9.12.29, 9.12.30, 9.12.31, 9.12.32, 9.12.33, 9.12.35, 9.12.36, 9.12.37, 9.12.38, 9.12.39, 9.12.40, 9.12.44, 10.3.2.
Koala	Remnant vegetation within the following REs: 9.3.1, 9.3.2, 9.3.3, 9.3.3b, 9.3.4, 9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.10, 9.3.10a, 9.3.11, 9.3.13, 9.3.14, 9.3.15, 9.3.16, 9.3.17, 9.3.19, 9.3.19b, 9.3.20, 9.3.21, 9.3.22, 9.3.22a, 9.3.27, 9.4.1, 9.4.2, 9.4.3, 9.5.1, 9.5.3, 9.5.4, 9.5.5, 9.5.6, 9.5.7, 9.5.8, 9.5.9, 9.5.10, 9.5.11, 9.5.12, 9.5.15, 9.5.16, 9.5.17, 9.7.1, 9.7.2, 9.7.2a, 9.7.3, 9.7.4, 9.7.5, 9.7.6, 9.8.1, 9.8.1a, 9.8.2, 9.8.3, 9.8.4, 9.8.5, 9.8.9, 9.8.10, 9.8.11, 9.8.13, 9.10.1, 9.10.3, 9.10.4, 9.10.5, 9.10.7, 9.10.8, 9.11.1, 9.11.1b, 9.11.2, 9.11.2a, 9.11.2e, 9.11.3, 9.11.4, 9.11.5, 9.11.7, 9.11.10, 9.11.12, 9.11.13, 9.11.14, 9.11.15, 9.11.16, 9.11.17, 9.11.18, 9.11.19, 9.11.21, 9.11.22, 9.11.23, 9.11.24, 9.11.25, 9.11.26, 9.11.28, 9.11.29, 9.11.30, 9.11.31, 9.11.32, 9.12.1, 9.12.1a, 9.12.2, 9.12.3, 9.12.4, 9.12.5, 9.12.6, 9.12.7, 9.12.10, 9.12.11, 9.12.12, 9.12.13, 9.12.14, 9.12.15, 9.12.16, 9.12.17, 9.12.18, 9.12.19, 9.12.20, 9.12.21, 9.12.22, 9.12.23, 9.12.24, 9.12.25, 9.12.26, 9.12.27, 9.12.28, 9.12.29, 9.12.30, 9.12.31, 9.12.32, 9.12.33, 9.12.35, 9.12.36, 9.12.37, 9.12.38, 9.12.39, 9.12.44, 10.3.2, 10.3.3, 10.3.5, 10.3.6, 10.3.6a, 10.3.9, 10.3.10, 10.3.11, 10.3.12, 10.3.13,

Species	Mapping criteria
	10.3.14, 10.3.15, 10.3.17, 10.3.20, 10.3.27, 10.3.28, 10.4.3, 10.4.9, 10.5.1, 10.5.2, 10.5.4, 10.5.4a, 10.5.5, 10.5.5a, 10.5.7, 10.5.8, 10.5.9, 10.5.10, 10.5.11, 10.5.12, 10.7.1, 10.7.2, 10.7.3, 10.7.4, 10.7.5, 10.7.9, 10.7.10, 10.7.11, 10.7.12, 10.9.2, 10.9.3, 10.9.5, 10.10.1, 10.10.3, 10.10.4, 10.10.5, 10.10.7.

Appendix C – Terrestrial fauna survey results

Species	Common name	Status		
		EPBC Act	NC Act	Introduced
Mammals				
<i>Austronomus australis</i>	White-striped freetail-bat	NL	LC	-
<i>Axis axis</i>	Chital deer	-	-	I
<i>Canis lupus</i>	Wild dog	-	-	I
<i>Chaerephon jobensis</i>	Northern freetail bat	NL	LC	-
<i>Chalinolobus gouldii</i>	Gould’s wattled bat	NL	LC	-
<i>Chalinolobus nigrogriseus</i>	Hoary wattled bat	NL	LC	-
<i>Macropus agilis</i>	Agile wallaby	NL	LC	-
<i>Macropus dorsalis</i>	Black-striped wallaby	NL	LC	-
<i>Macropus giganteus</i>	Eastern grey kangaroo	NL	LC	-
<i>Macropus robustus</i>	Common wallaroo	NL	LC	-
<i>Miniopterus australis</i>	Little bent-wing bat	NL	LC	-
<i>Miniopterus orianae oceanensis</i>	Large bent-wing bat	NL	LC	-
<i>Myotis macropus</i>	Large-footed myotis	NL	LC	-
<i>Oryctolagus cuniculus</i>	European rabbit	-	-	I
<i>Ozimops lumsdenae</i>	Northern free-tailed bat	NL	LC	-
<i>Ozimops ridei</i>	Ride’s free-tailed bat	NL	LC	-
<i>Petauroides volans volans</i>	Greater glider	V	V	-
<i>Saccolaimus flaviventris</i>	Yellow-bellied sheath-tail bat	NL	LC	-
<i>Scoteanax rueppellii</i>	Greater broad-nosed bat	NL	LC	-
<i>Scotorepens greyii</i> / <i>S. sanborni</i>	-	NL	LC	-
<i>Sus scrofa</i>	Feral pig	-	-	I
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	NL	LC	-
<i>Trichosurus vulpecula</i>	Common brushtail possum	NL	LC	-
<i>Wallabia bicolor</i>	Swamp wallaby	NL	LC	-
Birds				
<i>Anas superciliosa</i>	Pacific black duck	NL	LC	-
<i>Anhinga novaehollandiae</i>	Australasian darter	NL	LC	-
<i>Anthus novaeseelandiae</i>	Australasian pipit	NL	LC	-
<i>Aprosmictus erythropterus</i>	Red-winged parrot	NL	LC	-
<i>Aquila audax</i>	Wedge-tailed eagle	NL	LC	-
<i>Ardea intermedia</i>	Intermediate egret	NL	LC	-
<i>Ardea modesta</i>	Eastern great egret	NL	LC	-
<i>Ardeotis australis</i>	Australian bustard	NL	LC	-
<i>Artamus leucorhynchus</i>	White-breasted woodswallow	NL	LC	-
<i>Artamus minor</i>	Little woodswallow	NL	LC	-
<i>Aythya australis</i>	Hardhead	NL	LC	-
<i>Cacatua galerita</i>	Sulphur-crested cockatoo	NL	LC	-
<i>Calyptorhynchus banksii</i>	Red-tailed black-cockatoo	NL	LC	-

Species	Common name	Status		
		EPBC Act	NC Act	Introduced
<i>Centropus phasianinus</i>	Pheasant coucal	NL	LC	-
<i>Chenonetta jubata</i>	Australian wood duck	NL	LC	-
<i>Chlidonias hybrida</i>	Whiskered tern	NL	LC	-
<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike	NL	LC	-
<i>Corcorax melanorhamphos</i>	White-winged chough	NL	LC	-
<i>Corvus coronoides</i>	Australian raven	NL	LC	-
<i>Corvus orru</i>	Torresian crow	NL	LC	-
<i>Cracticus nigrogularis</i>	Pied butcherbird	NL	LC	-
<i>Cracticus tibicen</i>	Australian magpie	NL	LC	-
<i>Cracticus torquatus</i>	Grey butcherbird	NL	LC	-
<i>Dacelo leachii</i>	Blue-winged kookaburra	NL	LC	-
<i>Dacelo novaeguineae</i>	Laughing kookaburra	NL	LC	-
<i>Dicrurus bracteatus</i>	Spangled drongo	NL	LC	-
<i>Dromaius novaehollandiae</i>	Emu	NL	LC	-
<i>Egretta novaehollandiae</i>	White-faced heron	NL	LC	-
<i>Entomyzon cyanotis</i>	Blue-faced honeyeater	NL	LC	-
<i>Eolophus roseicapillus</i>	Galah	NL	LC	-
<i>Eudynamys orientalis</i>	Eastern koel	NL	LC	-
<i>Eurystomus orientalis</i>	Dollarbird	NL	LC	-
<i>Falco cenchroides</i>	Nankeen kestrel	NL	LC	-
<i>Geopelia cuneata</i>	Diamond dove	NL	LC	-
<i>Geopelia humeralis</i>	Bar-shouldered dove	NL	LC	-
<i>Geopelia striata</i>	Peaceful dove	NL	LC	-
<i>Geophaps scripta scripta</i>	Squatter pigeon	V	V	-
<i>Gerygone albogularis</i>	White-throated gerygone	NL	LC	-
<i>Grallina cyanoleuca</i>	Magpie-lark	NL	LC	-
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	NL	LC	-
<i>Haliastur sphenurus</i>	Whistling kite	NL	LC	-
<i>Lichenostomus flavus</i>	Yellow honeyeater	NL	LC	-
<i>Lichmera indistincta</i>	Brown honeyeater	NL	LC	-
<i>Malurus melanocephalus</i>	Red-backed fairy-wren	NL	LC	-
<i>Manorina melanocephala</i>	Noisy miner	NL	LC	-
<i>Meliphaga lewinii</i>	Lewin's honeyeater	NL	LC	-
<i>Melithreptus albogularis</i>	White-throated honeyeater	NL	LC	-
<i>Merops ornatus</i>	Rainbow bee-eater	NL	LC	-
<i>Milvus migrans</i>	Black kite	NL	LC	-
<i>Myiagra rubecula</i>	Leaden flycatcher	NL	LC	-
<i>Ocyphaps lophotes</i>	Crested pigeon	NL	LC	-
<i>Phaps chalcoptera</i>	Common bronzewing	NL	LC	-
<i>Phalacrocorax sulcirostris</i>	Little black cormorant	NL	LC	-
<i>Philemon buceroides</i>	Helmeted friarbird	NL	LC	-
<i>Philemon citreogularis</i>	Little friarbird	NL	LC	-
<i>Philemon corniculatus</i>	Noisy friarbird	NL	LC	-

Species	Common name	Status		
		EPBC Act	NC Act	Introduced
<i>Platycercus adscitus</i>	Pale-headed rosella	NL	LC	-
<i>Podargus strigoides</i>	Tawny frogmouth	NL	LC	-
<i>Ptilonorhynchus nuchalis</i>	Great bowerbird	NL	LC	-
<i>Rhipidura albiscapa</i>	Grey fantail	NL	LC	-
<i>Rhipidura leucophrys</i>	Willie wagtail	NL	LC	-
<i>Smicronis brevirostris</i>	Weebill	NL	LC	-
<i>Struthidea cinerea</i>	Apostlebird	NL	LC	-
<i>Taeniopygia bichenovii</i>	Double-barred finch	NL	LC	-
<i>Todiramphus macleayii</i>	Forest kingfisher	NL	LC	-
<i>Trichoglossus haematodus</i>	Rainbow lorikeet	NL	LC	-
<i>Vanellus miles</i>	Masked lapwing	NL	LC	-
Reptiles				
<i>Cryptoblepharus virgatus</i>	Wall skink	NL	LC	-
<i>Ctenotus taeniolatus</i>	Copper-tailed skink	NL	LC	-
<i>Dendrelaphis punctulatus</i>	Common tree snake	NL	LC	-
<i>Egernia striolata</i>	Tree skink	NL	LC	-
<i>Heteronotia binoei</i>	Bynoe's gecko	NL	LC	-
<i>Morelia spilota</i>	Carpet python	NL	LC	-
Amphibians				
<i>Rhinella marina</i>	Cane toad	-	-	I

Key to table: V – vulnerable; NL – not listed; LC – least concern; I – introduced species.

Appendix D – Likelihood of occurrence assessment

Species		Status		Source	Habitat requirements	Likelihood of occurrence
		EPBC Act	NC Act			
Special least concern species						
Mammals						
Tachyglossus aculeatus Short-beaked echidna		NL	SLC	WO	The short-beaked echidna is widely distributed throughout Australia, occurring in a broad range of habitats, wherever there is suitable availability of ant or termite prey. The species has specialist nursery burrows and shelters in hollow logs but otherwise does not have any fixed nest or shelter sites.	Confirmed present The species was confirmed present during spotlighting within the study area, with one individual recorded within open eucalypt woodland in close proximity to the Burdekin River. Most habitats within the study area represent potentially suitable habitat for the short-beaked echidna, given its lack of habitat preferences.
Threatened flora and fauna species						
Plants						
Bulbophyllum globuliforme Miniature moss-orchid		V	NT	PMST	Habitat: Host-specific species, only growing on the hoop pine (<i>Araucaria cunninghamii</i>), where it colonises the upper branches of mature trees (DAWE 2020). Distribution: Recorded from near Paluma, north east Queensland and south to the McPherson Range on the Queensland / New South Wales border (DAWE 2020). Detectability: Presence or absence of Hoop Pines can be recorded; however, the ability to detect this species is very limited due to the species habitat requirements.	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded during the field survey. The orchid grows solely on the bark of old hoop pine trees in vine forests, which were not present within the study area.
Croton magneticus		NL	V	WO	Habitat: Grows in deciduous vine thickets (dry rainforest) on soils derived from	Unlikely to occur

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				sandstone, granite or acid agglomerate substrates, often in association with <i>Croton amhemicus</i> and <i>C. phebaloides</i> (DES 2020). Distribution: Occurs between Townsville and Proserpine, but is known to extend inland to Greenvale and Collinsville (TSSC 2013). Detectability: Small tree or shrub growing to 5 m high and is deciduous and perennial, identifiable year round from if vegetative features are present (DES 2020).	This species has been historically recorded within the desktop search extent; however, no suitable habitat was present within the study area. The species is known to grow in vine thicket forests, and this habitat type was not recorded during the field survey.
<i>Dichanthium queenslandicum</i> King bluegrass	E	V	PMST; WO	Habitat: Occurs on black cracking clay in tussock grasslands mainly in association with other species of blue grasses but also with other grasses restricted to this soil type (DES 2020). Distribution: From north of Cairns to the NSW border and as far west as Hughenden (ALA 2020). Detectability: Perennial, tufted, erect grass to 80 cm tall known to flower throughout the year particularly from March (DES 2020).	May occur This species has been historically recorded within the desktop search extent; however, suitable habitat was largely absent from the study area. Only very small extents of black cracking clays were recorded and those areas were dominated by exotic grasses. RE 9.8.13, which is a community known to support the species, was present in the study area but cracking clays were largely absent from this unit. The species was not recorded during surveys.
<i>Dichanthium setosum</i> Blue grass	V	LC	PMST	Habitat: Occurs in heavy soils (predominantly cracking clays or alluvium, often in gilgai) in woodland or open woodland usually dominated by <i>Acacia</i> (brigalow) and / or <i>Eucalyptus</i> species (DES 2020).	Unlikely to occur This species has not been historically recorded within the desktop search extent and suitable habitat was largely absent from the study area. A large depression with cracking clays was recorded near a small patch of

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				Distribution: Reported from inland NSW and Queensland (DAWE 2020). Detectability: Erect perennial grass to about 1 m tall. A warm season perennial, the species commences growing in spring, flowers in summers and becomes dormant in late autumn (DAWE 2020).	brigalow (<i>Acacia harpophylla</i>); however, the community was dominated by introduced pasture grass species. The species was not recorded during surveys.
<i>Eucalyptus raveretiana</i> Black ironbox	V	LC	PMST	Habitat: Occurs on the banks of rivers, creeks and other watercourses, on clayey or loamy soils (DAWE 2020). Distribution: South of Townsville to Nebo, around Rockhampton and areas 100 km west of the city (DAWE 2020). Detectability: Rough bark on the main trunk and large branches with smooth upper branches. Smallest fruit of any eucalypt (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. The nearest historical record is located approximately 32 km west of the study area along a tributary of the Burdekin River. Suitable habitat along the Burdekin River was confirmed present during the field survey. This species was not recorded during the field survey but not all areas of suitable habitat were able to be accessed during the survey.
<i>Graptophyllum excelsum</i>	NL	NT	WO	Habitat: Mainly grows in semi-evergreen vine thickets (DES 2020). Distribution: Eastern coast and ranges of Cape York and Port Curtis areas of Queensland (ANPS 2016). Detectability: Dense shrub growing to 3 m tall, flowering throughout most of the year with fruits recorded in January, and from July to November (DES 2020).	Unlikely to occur The species has been historically recorded within the search extent; however, no suitable habitat was recorded within the study area. This species prefers semi-evergreen vine thickets, which is not mapped and was not recorded during the field survey.
<i>Marsdenia brevifolia</i>	V	V	PMST	Habitat: Occurs in woodlands, dominated by <i>Corymbia erythrophloia</i> and <i>Eucalyptus crebra</i> with dense <i>Themeda triandra</i> understorey on basalt. The species can occur on rock outcrops, black	Unlikely to occur The species has not been historically recorded within the desktop search extent. Areas comprising <i>C. erythrophloia</i> and <i>E. crebra</i> on

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				crumbly soils, granite soils or dark massive acid agglomerate soils (DES 2020). Distribution: North and central Queensland, near Townsville, Springsure and north of Rockhampton (DAWE 2020). Detectability: Small shrub to 1 m high, flowering from November to February with fruits from January to June (DAWE 2020).	basalt were recorded during the field survey; however, these areas were considered to provide only marginal habitat value as they have been subjected to grazing over long periods and the understorey is dominated by buffel grass (<i>Cenchrus ciliaris</i>).
<i>Solanum sporadotrichum</i>	NL	NT	WO	Habitat: Occurs in semi-evergreen vine thicket, notophyll rainforest or littoral rainforest (DES 2020). Distribution: West of Townsville to south of Mt Dryander near Airle beach (ATRP 2019). Detectability: Erect perennial shrub growing to 4 m high, flowering in January, May to July and September, with fruits in May, June and August (DES 2020).	Unlikely to occur The species has been historically recorded within the desktop search extent. The nearest historical record is located approximately 21 km north east of the study area. This species prefers semi-evergreen vine thickets, which were not mapped and not recorded during the field survey.
<i>Tephrosia levelleii</i>	V	V	PMST	Habitat: Little is known about the species and its preferred habitat (DAWE 2020). Distribution: Six known collections from north east Queensland over a range of 400 km (DAWE 2020). Detectability: Perennial herb growing to 30 cm high, flowering in December and January with fruits in December and June (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. The study area occurs along the western border of the species modelled habitat, and only six specimens have been recorded in north-east Queensland; therefore, the species is considered unlikely to occur within the study area.
Mammals					
<i>Dasyurus hallucatus</i> Northern quoll	E	LC	PMST	The species inhabits a variety of habitats, ranging from eucalypt woodlands to rainforests (DAWE 2020). Species particularly prefers areas that contain rock	Unlikely to occur The species has not been historically recorded within the desktop search extent. The nearest record is

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				crevices, hollow logs and termite mounds (DAWE 2020).	approximately 87 km north-east of the study area. Limited suitable denning habitat was observed where rocky outcrops occurred along the banks of the Burdekin River.
<i>Macroderma gigas</i> Ghost bat	V	E	PMST	This species is known to occur in rainforest areas, vine shrub, open woodlands and arid zone (McKenzie and Hall 2008), and roosts in caves, rock crevices and old mine shafts (TSSC 2016a).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Limited suitable roosting habitat was observed within the study area.
<i>Petauroides volans minor</i> Greater glider (northern)	V	V	WO	The species is largely restricted to eucalypt forests and woodlands, and typically favours habitats containing relatively old trees with an abundance of large tree hollows (TSSC 2016b). Modelling suggests that the species requires native forest patches of at least 160 km ² to maintain viable populations (Eyre 2002).	Confirmed present The species was confirmed present during spotlighting within the north-western extent of the study area. The species has also been historically recorded within the desktop search extent, with one record located along the Burdekin River upstream of the study area. Suitable denning habitat was observed within the study area, with large hollow-bearing trees recorded in mature <i>Eucalyptus camaldulensis</i> along the Burdekin River.
<i>Phascolarctos cinereus</i> Koala	V	V	PMST; WO	Within the region, koalas occur in sub-humid <i>Eucalyptus</i> dominated forests and woodlands in riparian and non-riparian environments, and some <i>Acacia</i> dominated forests and woodlands in non-riparian environments (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent. No scratches, faecal pellets or other evidence of koalas were recorded during the pre-wet and post-wet seasonal surveys; however, given the presence of suitable food trees,

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
					the species is considered likely to occur within the study area.
<i>Pteropus conspicillatus</i> Spectacled flying-fox	E	V	PSMT	Species generally inhabits areas near rainforests and feed primarily on rainforest species, as well as non-rainforest species such as eucalypts in tall open forests adjoining rainforests and tropical woodland ecosystems (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded within the study area during the field surveys.
<i>Rhinolophus robertsi</i> Large-eared horseshoe bat	V	E	PMST	This species is found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, <i>Melaleuca</i> forest with rainforest understorey, open savannah woodland and tall riparian woodland (DAWE 2020). They roost in caves and underground mines, as well as culverts, tree hollows, dense foliage, rock piles and areas beneath creek banks (DAWE 2020). The species forages in open forest, particularly amongst dense vegetation along gullies and creek lines, as well as wattle-dominated ridges in rainforests (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, limited suitable foraging and roosting habitat was observed within the study area.
<i>Saccolaimus saccolaimus nudicluniatus</i> Bare-rumped sheath-tailed bat	V	E	PMST	Species inhabits lowland areas, typically in a range of woodland, forest and open environments with roosts typically within tree hollows, caves, overhangs or man-made structures (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species records are located along the north coast of Queensland. Limited suitable habitat was observed within the study area during the field surveys.
Birds					
<i>Calidris ferruginea</i> Curlew sandpiper	CE	E	PMST	The sandpiper mainly occurs along the coastlines of Australia. They occur in	Unlikely to occur

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				smaller numbers across inland waters in Queensland. Known to inhabit sheltered intertidal mudflats, and ephemeral and permanent lakes and dams (Higgins and Davies 1996).	The species has not been historically recorded within the desktop search extent. No suitable habitat was observed within the study area, the species is known to inhabit lakes and dams.
Erythroriorchis radiatus Red goshawk	V	E	PMST	The species occurs in a range of habitats, often at ecotones, including coastal and sub-coastal tall open forests, tropical savannahs crossed by wooded or forested watercourses, woodlands, edges of rainforests and gallery forests along watercourses, and wetlands that include <i>Melaleuca</i> and <i>Casuarina</i> species. The species typically nests in tall trees within 1 km of permanent water, and occurs in habitats that support a high abundance of bird species (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. The nearest historically record is located approximately 73 km north east of the study area. Potentially suitable foraging and nesting habitat was observed within the study area.
<i>Geophaps scripta scripta</i> Squatter pigeon (southern)	V	V	WO	The species occurs in open-forests to sparse, open-woodlands and scrub that are dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Acacia</i> or <i>Callitris</i> species, remnant and regrowth within 3 km of water (DAWE 2020).	Confirmed present Seven squatter pigeons (southern) were confirmed present from two locations in the eastern extent of Dalrymple National Park within the study area. The species has also been historically recorded within the desktop search extent. Suitable breeding and foraging habitat was recorded within the study area.
<i>Neochmia ruficauda</i> Star finch (eastern)	E	E	PMST	The species occurs in low numbers in central Queensland. Mainly inhabits grasslands and grassy woodlands in close proximity to permanent freshwater (DAWE 2020). Species are closely associated to habitats that consist certain tree species,	May occur The species has not been historically recorded within the desktop search extent. However, potentially suitable habitat including grassy woodlands retaining preferred tree species in

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				including <i>Eucalyptus coolabah</i> , <i>E. tereticornis</i> , <i>E. tessellaris</i> , <i>Melaleuca leucadendra</i> , <i>E. camaldulensis</i> and <i>Casuarina cunninghamii</i> (DAWE 2020).	close proximity to semi-permanent water was recorded within the study area.
<i>Numenius madagascariensis</i> Eastern curlew	CE	E	PMST	The eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent, and suitable habitat was not recorded within the study area during the field survey.
<i>Poephila cincta cincta</i> Southern black-throated finch	E	E	PMST	The southern black-throated finch occurs mainly in grassy, open woodlands and forests, typically dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Melaleuca</i> , and occasionally in tussock grasslands or other habitats (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. Limited suitable habitat for the species was observed in the study area. The field survey recorded by open woodlands dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Melaleuca</i> species adjacent to semi-permanent water. However, these areas were dominated by an exotic grass, namely buffel grass (<i>Cenchrus ciliaris</i>) and retained a low diversity of native grass species.
<i>Rostratula australis</i> Australian painted-snipe	E	V	PMST; WO	The species generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps, claypans and waterlogged grasslands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent. The Australian painted prefers to inhabit wetlands, lakes and swamps; however, there is potential for the species to inhabit the Burdekin River and other tributaries within the study area.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Tyto novaehollandiae kimberli</i> Masked owl (northern)	V	V	PSMT	The species inhabits riparian forest, rainforest, open forest, <i>Melaleuca</i> swamps, edges of mangroves, margins of sugar cane fields (DAWE 2020). They nest in hollow-bearing trees within closed forest and forage on small to medium-sized terrestrial animals in open woodland (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. Potentially suitable foraging and nesting habitat was recorded within the study area. The field survey recorded an abundance of hollow-bearing trees adjacent to riparian open woodlands along the Burdekin River.
Reptiles					
<i>Acanthophis antarcticus</i> Common death adder	NL	V	WO	The species is found in a wide variety of habitats in association with deep leaf litter, including rainforests, wet sclerophyll forests, woodlands, grasslands, chenopod dominated shrublands, and coastal heathlands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent. Limited suitable habitat was recorded, as only some habitats within the study area retained patches of dense leaf litter.
<i>Denisonia maculata</i> Ornamental snake	V	V	PMST; WO	The preferred habitat is within or adjacent to habitat that is favoured by frogs. The species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions in REs on land zone 4, but also lake margins and wetlands (DAWE 2020).	Unlikely to occur The species has been historically recorded within the desktop search extent. Limited suitable habitat was observed within the study area, as only one large depression with cracking clays was recorded during the field survey.
<i>Egernia rugosa</i> Yakka skink	V	V	PMST	The species is typically found in open dry sclerophyll forest or woodland. This skink uses refuges in dense ground vegetation, in hollow logs, cavities in soil-bound root systems and beneath rocks (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent, and a low abundance of ground-level microhabitats, such as hollow logs and rocks were observed within the study area.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Lerista cinerea</i> Vine-thicket fine-lined slider	NL	V	WO	The species is known to occur within the Charters Towers region, and refuges in leaf litter and loose soil in semi-evergreen vine thickets (AROD 2017).	Unlikely to occur The species has been historically recorded within the desktop search extent; however, semi-evergreen vine thicket was not recorded within the study area during the field survey.
<i>Lerista vittata</i> Mount Cooper striped skink	V	V	PMST	The species has been recorded from a range of habitats, including ironbark and bloodwood dominated woodland with shrub and/or grassy ground layers on deep red earths, undulating plains and steep hills on granitic rocks, semi-evergreen vine thickets and spinifex communities (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, limited suitable habitat was recorded within the study area.
Migratory species					
Birds					
<i>Actitis hypoleucos</i> Common sandpiper	Mig	LC	PMST; WO	Species inhabits coastal wetlands and some inland wetlands. They mostly occur around muddy margins or rocky shores, and occasionally around lakes, billabongs, reservoirs, dams and claypans (DAWE 2020). Species generally forages in shallow water and on bare soft mud edges of wetlands (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with two records located along the Burdekin River downstream stream of the study area. The field survey confirmed potentially suitable habitat within the study area.
<i>Apus pacificus</i> Fork-tailed swift	Mig	LC	PMST	Species is almost exclusively aerial in areas such as inland plains and sometimes foothills or coastal areas (DAWE 2020). They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, health land or saltmarsh (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, potentially suitable habitat including riparian woodland was confirmed present within the study area.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Calidris acuminata</i> Sharp-tailed sandpiper	Mig	LC	PMST	Species inhabits muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grasses, saltmarshes or other low vegetation (DAWE 2020). Their habitat includes lagoons, swamps, lakes and pools near the coast, as well as dams, waterholes and saltpans (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No potentially suitable habitat was recorded within the study area.
<i>Calidris ferruginea</i> Curlew sandpiper	CE; Mig	E	PMST	The sandpiper mainly occurs along the coastlines of Australia. They occur in smaller numbers across inland waters in Queensland (Higgins and Davies 1996). Known to inhabit sheltered intertidal mudflats, and ephemeral and permanent lakes and dams (Higgins and Davies 1996).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species is known to inhabit lakes and dams along the coastlines. No potentially suitable habitat was recorded within the study area.
<i>Calidris melanotos</i> Pectoral sandpiper	Mig	LC	PMST	Species inhabits shallow fresh to saline wetlands (DAWE 2020). The species is found within coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, creeks, floodplains and artificial wetlands (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent. Suitable habitat was recorded within the study area, including the Burdekin River and Lolworth Creek.
<i>Cuculus optatus</i> Oriental cuckoo	Mig	LC	PMST	The species inhabits coastal regions across northern and eastern Australia, as well as offshore islands (DAWE 2020). Species utilises a range of vegetated habitats, including monsoon rainforests, wet sclerophyll forests, open woodlands and along the edges of forests (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was identified within the study area. The species prefers vegetated habitats within the coastal regions of northern and eastern Australia.
<i>Gallinago hardwickii</i> Latham's snipe	Mig	LC	PMST; WO	The species inhabits permanent and ephemeral freshwater wetlands with low, dense vegetation (DAWE 2020). Species	Likely to occur The species has been historically recorded within the desktop search

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				sometimes occurs in habitats that have saline or brackish water, such as saltmarshes, mangrove creeks, around bays and beaches (DAWE 2020).	extent, with one record located along the Burdekin River upstream of the study area. The field survey confirmed potentially suitable habitat within the study area.
<i>Gelochelidon nilotica</i> Gull-billed tern	Mig	LC	WO	This species is found in freshwater swamps, brackish and salt water lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grassland (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent; however, limited suitable habitat occurs within the study area.
<i>Hydroprogne caspia</i> Caspian tern	Mig	LC	WO	This species is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with two records located along the Burdekin River upstream and downstream of the study area. The field survey confirmed potentially suitable habitat within the study area.
<i>Monarcha melanopsis</i> Black-faced monarch	Mig	LC	PMST	Species inhabits rainforest ecosystems that include semi-deciduous vine thickets, complex notophyll vine-forests, tropical rainforests, subtropical rainforests, mesophyll thicket/shrubland, warm and cool temperate rainforest, and dry rainforest (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was recorded within the study area.
<i>Motacilla cinerea</i> Grey wagtail	Mig	LC	PMST	Species inhabits forests and woodlands in close proximity to water, as well as mangroves, city parks and gardens (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species records are located along the north coast of Queensland. Limited suitable habitat was observed within the study area during the field surveys.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Motacilla flava</i> Yellow wagtail	Mig	LC	PMST	The species is found in highly variable habitats, but typically found in open grassy flats near water. Habitats include, open areas of low vegetation such as grasslands, pastures, sport fields and damp open areas (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. Species records are located along the north coast of Queensland. Limited suitable habitat was observed within the study area during the field surveys.
<i>Myiagra cyanoleuca</i> Satin flycatcher	Mig	LC	PMST	The species occurs in heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, typically near wetlands and watercourses (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, potentially suitable habitat was recorded eucalypt-fringed watercourses within the study area.
<i>Numenius madagascariensis</i> Eastern curlew	CE, Mig	E	PMST	The eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DAWE 2020).	Unlikely to occur The species has not been historically recorded within the desktop search extent. No suitable habitat was observed within the study area, the species is known to inhabit lakes and dams.
<i>Pandion haliaetus</i> Osprey	Mig	LC	PMST; WO	The species inhabits littoral and coastal habitats, and terrestrial wetlands. They are known to mostly occur in coastal habitats, however they occasionally travel inland along major rivers (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with three records located along the Burdekin River upstream and downstream of the study area. Suitable habitat occurs along the Burdekin River within the study area.
<i>Plegadis falcinellus</i> Glossy ibis	Mig	LC	WO	The species occurs along the edges of lakes and rivers, floodplains, swamps and sewage ponds, and commonly inhabit inland areas of Australia (DAWE 2020).	Confirmed present The species was confirmed present from one location within the southern extent of the study area.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
<i>Rhipidura rufifrons</i> Rufous fantail	Mig	LC	PMST; WO	Species inhabits sclerophyll forests, often in gullies dominated by eucalypts and usually within a dense shrubby understorey that often includes ferns (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent; however, limited suitable habitat was recorded within the study area.
<i>Symposiachrus trivirgatus</i> Spectacled monarch	Mig	LC	WO	The species prefers thick understorey habitats in rainforests, wet sclerophyll forests and mangroves (DAWE 2020).	Unlikely to occur The species has been historically recorded within the desktop search extent; however, no suitable habitat was recorded within the study area.
<i>Tringa brevipes</i> Grey-tailed tattler	Mig	LC	WO	This species is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats (DAWE 2020).	Unlikely to occur The species has been historically recorded within the desktop search extent. However, the field survey did not record potentially suitable habitat within the study area. This species is associated with coastal environments.
<i>Tringa glareola</i> Wood sandpiper	Mig	LC	WO	The species occurs in well-vegetated, shallow, freshwater wetlands, and typically prefer habitats that contain emergent, aquatic plants or grasses, dominated by fringing vegetation, including <i>Melaleuca</i> sp. and <i>Eucalyptus camaldulensis</i> (DAWE 2020).	Likely to occur The species has been historically recorded within the desktop search extent, with one record located along the Burdekin upstream of the study area. Potentially suitable habitat was recorded along Lolworth Creek within the study area.
<i>Tringa nebularia</i> Common greenshank	Mig	LC	PMST; WO	Species is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. Typically occurs in sheltered coastal areas with large mudflats, saltmarshes, mangroves or seagrasses (DAWE 2020). Species also occurs in permanent and ephemeral terrestrial wetlands, including swamps,	Likely to occur The species has been historically recorded within the desktop search extent, with one record located adjacent to the Burdekin River, approximately 7 km upstream from the study area. Suitable habitat was recorded within the study area.

Species	Status		Source	Habitat requirements	Likelihood of occurrence
	EPBC Act	NC Act			
				lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains (DAWE 2020).	
<i>Tringa stagnatilis</i> Marsh sandpiper	Mig	LC	WO	The species inhabits permanent and ephemeral wetlands, including swamps and billabongs (DAWE 2020). Species generally forages in shallow water and on bare soft mud edges of wetlands (DAWE 2020).	May occur The species has been historically recorded within the desktop search extent; however, suitable habitat for this species was not recorded within the study area. This species prefers wetlands.
Reptiles					
<i>Crocodylus porosus</i> Salt-water crocodile	Mig	V	PMST	The species is found in a wide range of habitats including rivers, estuaries, creeks, swamps, lagoons and billabongs up to 150 km inland from the coast (DAWE 2020).	May occur The species has not been historically recorded within the desktop search extent; however, the species has the potential to occur in the upper catchment of the Burdekin River. Potentially suitable habitat occurs within the study area.

Key to table: CE – critically endangered; V – vulnerable; E – endangered; NT – near threatened; NL – not listed; SLC – special least concern; LC – least concern; Mig – migratory; PMST – Protected Matters Search Tool; WO – Wildlife Online.

GHD
71 Stanley Street
Townsville
T: 61 7 4720 0400 F: 61 7 4772 6514 E: tsvmail@ghd.com

© GHD 2020

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

12512214-5291-601/https://projectsportal.ghd.com/sites/pp10_05/bigrockswear/ProjectDocs/02 - Environmental Assessment/Ecological Assessment/Post-wet Ecology Survey/12512214-REP-0_Baseline Ecological Assessment Report_Post Wet Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S.Blatchford P.Moonie L.Pratt R. Quinlan	N. Clark	<i>*N.Clark</i>	S. Orr	<i>*S.Orr</i>	14/08/2020

**Denotes file on record*

www.ghd.com



Appendix E – GBRWHA Assessment



Townsville Enterprise Limited

Big Rocks Weir

GBRWHA Assessment



September 2020

Table of contents

- 1. Introduction..... 1
 - 1.1 Overview 1
 - 1.2 Scope and limitations 2
- 2. BRW impacts and mitigation measures 3
- 3. Assessment of significance 5
- 4. Conclusion..... 8
- 5. References 9

Table index

- Table 1 Summary of potential impacts relevant to the GBR and mitigation measures for BRW 3
- Table 2 World Heritage values potentially indirectly impacted by BRW 6

1. Introduction

1.1 Overview

This report provides an assessment of the potential impacts on the Great Barrier Reef World Heritage Area (GBRWHA) as a result of the proposed Big Rocks Weir (BRW). BRW is located on the Burdekin River, 320 km upstream of the GBRWHA. The Burdekin River Catchment has an annual discharge of 9.2 million Megalitres (ML) per annum and is known to be the single largest source of suspended sediment to the Great Barrier Reef (GBR) (Bainbridge et al 2014). The assessment has considered potential impacts to the GBRWHA in association with weir construction and operation.

Potential future water uses associated with BRW have only recently been identified in the Business Case for BRW. The Business Case primarily focuses on an increase in the amount of water storage in the Upper Burdekin water management area (WMA), with the aim to facilitate and support growth in high-value agricultural production and provide additional water security to the town of Charters Towers. This would enable the existing Charters Towers Weir to potentially accommodate future urban and industrial water demands. For the supplemented irrigation scenarios considered as part of the Business Case, the average annual demand was simulated as 12 ML/ha/annum, which roughly equates to an area under irrigation of 833 ha for a 10,000 ML/year abstraction, an irrigation area of 1,250 ha for 15,000 ML/annum and 1,667 ha irrigation area for 20,000 ML/year. In order to maximise the potential economic benefits of BRW, the Business Case recommended that at least 15,000 ML of unallocated water is targeted for release from BRW (Townsville Enterprise Limited 2020).

Any future water users would be required to assess potential impacts to the GBRWHA in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Reef 2050 Long-Term Sustainability Plan*, *Reef 2050 Water Quality Improvement Plan*, and *Queensland Government Reef Protection Regulations*. Given that an irrigation scheme was not included as a project component of the BRW Business Case and the end users, exact location, extents and/or crop types are still largely unknown at this stage of the project, any potential facilitated or cumulative impacts associated with changes in rural land uses from grazing to irrigated agriculture, existing low value cropping to high value perennial or permanent horticulture have not been considered in this assessment for BRW.

The BRW is a broad crested concrete gravity weir approximately 190 m in length, 13 m high and 6 m wide with a mass concrete saddle dam proposed for the southern (right) anabranch as described in the Big Rocks Weir Business Case Reference Design Report (GHD 2020a). The full storage level (FSL) of the BRW is 10,000 ML. The weir includes a single low level outlet with manually operated upstream bulkhead gate and downstream penstock gate for control. The weir design is in accordance with statutory and regulatory requirements, current industry practice and national guidelines. Operation of the weir will include releases for environmental flow objectives and will completely drown out at a 1 in 5 year annual exceedance probability (AEP) event. Overall, the BRW structure and storage capacity is small in size and will have no influence on the size, frequency or duration of moderate to large flows when the weir is drowned.

Burdekin Falls Dam

Burdekin Falls Dam, the largest water storage asset in Queensland, is located approximately 180 km downstream of BRW and 140 km upstream of the GBRWHA. The dam is approximately 876 m in length, 37 m high and holds 1,860,000 ML at FSL. Burdekin Falls Dam only spills infrequently (on average once per year) and does not drown out (Ayre & Gillespie 2009). This dam is a major influence on surface water flows, water quality and aquatic ecology within the Burdekin River Catchment and directly impacts connectivity between the upper catchment and discharges to the GBR. In particular, the Burdekin Falls Dam influences the GBR by:

- Regulating flow (NQ Dry Tropics 2016; Roth et al 2002).
- Trapping sediment and nutrients (Dougall 2014; Lewis et.al. 2009; 2013; NQ Dry Tropics 2016; Queensland Government 2016).
- Restricting fauna movement (Sunwater 2020).

1.2 Scope and limitations

This report has been prepared by GHD for Townsville Enterprise Limited (TEL) and Charters Tower Regional Council (CTRC) and may only be used and relied on by TEL and CTRC for the purpose agreed between GHD, TEL and CTRC as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than TEL and CTRC arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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. GHD disclaims liability arising from any of the assumptions being incorrect.

2. BRW impacts and mitigation measures

Currently, the GBR is in poor condition due to land run-off associated with catchment and coastal development, extreme weather events and climate change impacts (Queensland Government 2017a;b). The Reef 2050 plan has been developed using the independent scientific advice of a multidisciplinary team of scientists led by TropWATER James Cook University to improve the condition of the GBR and prevent further degradation (Queensland Government 2018). Key objectives of the plan include:

- Maintaining and enhancing outstanding universal value in every action
- Basing decisions on the best available science
- Delivering a net benefit to the ecosystem
- Adopting a partnership approach to management

BRW will include an operational water quality monitoring plan to assess compliance with Reef 2050 targets and allow for adaptive management if required.

The potential impacts of BRW on ecological values and proposed mitigation measures are discussed in detail in the Big Rocks Weir Business Case Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment (GHD 2020b) and Big Rocks Weir Business Case Baseline Terrestrial and Aquatic Ecology Assessment Post-wet Assessment (GHD 2020c). The impacts and mitigation measures are also summarised in Table 1.

Table 1 Summary of potential impacts relevant to the GBR and mitigation measures for BRW

Potential impact	Mitigation measures
Alteration to downstream flow regimes (operational phase) The operation of the proposed weir is likely to result in a reduction in the frequency and magnitude of small to medium downstream flood flows.	• Designing the operation strategy of the weir in accordance with environmental flow objectives • Implementing an operational water quality management plan
Loss and degradation of habitat (construction and operational phases) BRW will inundate riparian vegetation and will convert aquatic habitat to impounded habitat. Water quality degradation may result from increased erosion and run-off, introduction and spread of invasive aquatic weeds, conversion of flowing pool-riffle-run sequences to a more homogenous lentic impounded and flow regime alteration.	• Minimising loss of habitat during the design phase (i.e. placement of access tracks, infrastructure and construction areas to prevent clearing of riparian vegetation as much as possible prior to inundation) • Constructing temporary waterway barrier crossings for access across waterways • Retaining large woody debris for post-construction habitat • Restoring bed and banks outside the weir storage area to pre-existing profiles following completion of works

Potential impact	Mitigation measures
	• Implementing a site specific construction environmental management plan (CEMP) and an operational management plan (EMP) • Implementing a site specific Erosion and Sediment Control Plan (ESCP) • Adhering to environmental flow objectives • Implementing an operational water quality management plan
Restriction of fauna movement (operational phase) During operation, in-stream structures such as the weir wall, saddle dam and Big Bend Floodway will represent an impediment to the movement of aquatic fauna. This disruption to connectivity along the continuum of the river not only has the potential to fragment populations and habitats, but also potentially impedes the life-history behaviour of aquatic fauna occurring within the system.	• Construction of a fishway to provide adequate movement for fish and provide adequate fish passage for waterway crossings or auxiliary works • Maintaining the condition of overflow channels • Implementing a monitoring program to monitor the effectiveness of aquatic fauna passage infrastructure

3. Assessment of significance

The GBRWHA is considered relevant to the BRW as a Matter of National Environmental Significance (MNES) and as such the significance of impacts has been assessed in accordance with the Significant impact guidelines 1.1 (DoE 2013) for a World Heritage property. Specifically, this guideline identifies that an action is likely to have a significant impact on a World Heritage property if there is a real chance or possibility that it will cause:

- One or more of the World Heritage values to be lost
- One or more of the World Heritage values to be degraded or damaged
- One or more of the World Heritage values to be notably altered, modified, obscured or diminished.

An assessment of BRW impacts on the GBRWHA values is provided in Table 2. The assessment concluded that with the proposed mitigation and management measures in place, no World Heritage values will be lost, degraded, damaged, notably altered, modified, obscured or diminished as a result of the BRW and therefore no significant impact on a World Heritage property will occur as a result of the proposed development.

Table 2 World Heritage values potentially indirectly impacted by BRW

World Heritage Area values	Outstanding Universal Value (OUV) components of the GBR	Relevance to Project	Potential impacts on World Heritage Area values
Criterion vii Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance	- Water clarity - Scenic vistas - Visible from space - Complex string of reef structures - Unparalleled aerial panorama - Whitsunday Islands - Hinchinbrook Island and Channel - Breeding colonies of seabirds and marine turtles - Over-wintering butterflies - Cod Hole - Coral diversity - Reef fish - Number of whales	- BRW will decrease the frequency and duration of small flow events in the upper catchment through the impoundment of water. - The impoundment may influence sediment transport. Moderate and large flow events are responsible for the majority of sediment transport within the system. As a result, sediment accumulated in the impoundment may be mobilised and pass over the weir during these event and this may decrease water clarity - BRW is located 320 km upstream of the GBR and therefore the infrastructure will not impact upon scenic vistas or the aerial view within the GBRWHA - The Whitsunday Islands, Hinchinbrook Island and Channel, breeding colonies of seabirds, marine turtles and over-wintering butterflies and the Cod Hole are not located in proximity to the BRW - There are no coral reef systems within proximity of the BRW but the Burdekin River delta provides important habitat for fish (DES 2012) - Whales may infrequently feed, rest or calve in Burdekin delta which is listed on the directory of important wetlands (DIWA) or adjacent areas downstream of BRW (DSDMIP 2011). However, direct or indirect disturbance of whales is not expected due to the large distance of BRW from the Burdekin delta	As the weir is small in size (10,000 ML) it will only capture small flows. Moderate and large flow events will overtop the weir with no change to the size, frequency or duration of these flow events as a result of BRW. The Burdekin Falls Dam downstream of BRW is a very large dam which spills infrequently. Flow from the Burdekin River to the GBR is regulated by the dam to comply with environmental flow objectives and irrigation requirements (DES 2018). Therefore, BRW will not have a significant impact on flow to the GBR. As currently occurs, 3.93 million tonnes of suspended sediment moves downstream annually on the Burdekin River. The design of BRW facilitates that sediment will build up at the weir face and be swept over the weir during subsequent high flow events (GHD 2020a). Aside from local areas of lower velocity around weir structures such as towers and intakes, the weir is expected to provide unimpeded transfer of sediment down the river. The Burdekin Falls Dam is known to trap between 60-90% of sediment (Lewis et. al 2009). Therefore, any additional sediment that is initially trapped in BRW and subsequently transported in large flows is likely to settle out during the long distance downstream or get trapped in the Burdekin Falls Dam. Thus, no impact by the BRW is expected on GBR. An Erosion and Sediment Control Plan will be implemented during construction (GHD 2020b;c) and will include control measures to avoid and minimise degradation of water quality from erosion and sedimentation during weir construction. An operational water quality management plan will be implemented and operations will be in line with the Reef 2050 targets. No significant impact on water clarity is predicted from the BRW due to the Burdekin Falls Dam regulating discharge of water to the GBR. No significant impact on scenic vistas and panoramas, visibility from space, reefs and coral, islands and channels, breeding colonies, reef fish and whales within the Burdekin delta is expected due to the distance from BRW.
Criterion viii An outstanding example representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features	- Geomorphological evolution - Reef building/development - Record of sea level change - Inshore fringing reefs, mid-shelf reefs and outer reefs - Continental slope - Beaches	- The proposed BRW is approximately 320 km adopted middle thread distance (AMTD) upstream from the GBRWHA - BRW is not located in proximity to significant coral communities - BRW is not in proximity to features such as inter-reef lagoonal areas - BRW is not in proximity to beach areas or the continental slope	Changes to flow and water quality can have the potential to indirectly impact on ecosystem function in areas where World Heritage features are represented. Flow and water quality to the GBR is currently significantly affected by Burdekin Falls Dam (DES 2018). While flow and water quality may be locally influenced by BRW, this is negated by the much larger Burdekin Falls Dam. No significant change to freshwater flows and the quality of water delivered to the GBRWHA from BRW is expected.

World Heritage Area values	Outstanding Universal Value (OUV) components of the GBR	Relevance to Project	Potential impacts on World Heritage Area values
			No impacts to features of the GBRWHA representing major stages of earth's history or ongoing geological processes are anticipated.
Criterion ix An outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals	- Physical processes - Connectivity - Halimeda beds - Continental islands - Evolutionary history - Hard corals - Island plants - Aboriginal and Torres Strait Islander sea country	- Potential for impact on physical processes through changes to flow and water quality - BRW will not impact on connectivity within the GBRWHA - No Halimeda beds in proximity to BRW - BRW is not located in proximity to significant coral communities - BRW will not alter access or use of Aboriginal and Torres Strait Islander sea country	Changes to flows and water quality to the marine environment have the potential to indirectly impact on ecological and biological processes. No significant change to flow regimes is anticipated as a result of BRW. Similarly, discernible changes in water quality at the Burdekin River mouth are not expected to occur as a result of BRW. As described above, the minimal impact of BRW on the GBR is expected due to the small size of the dam, minimal change in flow regime within the Burdekin River and presence of Burdekin Falls Dam downstream of BRW. Burdekin Falls Dam has already significantly modified flow and water quality of the system with discharges from the upper catchment, where BRW is located, currently regulated by the dam.
Criterion x Contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	100's species of coral - Lagoon floor - Half the world's diversity of mangroves and many seagrass species - Dugong - Whales and dolphins - Marine turtles - Raine Island turtle breeding site - Seabird breeding sites - Flora on continental islands and coral cays	- There are no species of coral or inter-reefal areas in proximity to BRW - Mangroves and seagrass are present in the intertidal areas of the Burdekin River estuary - Marine species populate the mouth of the Burdekin River - Raine Island is not located within or near BRW - The BRW does not impact indirectly on seabird breeding sites or flora on continental islands or coral cays	Changes to water quality can have an impact on habitats utilised by marine species of outstanding universal value. Discernible changes in water quality at the Burdekin River mouth are not expected to occur as a result of the BRW. As noted previously, water quality it significantly affected downstream of the Burdekin Falls Dam which is released to the GBR. BRW will potentially create a barrier to fish passage, however, the proposed fishway will provide passage to the river downstream of the dam. Further, Burdekin Falls was a natural barrier so there is no movement of species, with the exception of eels, between the upper and lower catchment. No significant impact on biological diversity and species of outstanding universal value are anticipated.
Integrity Wholeness, intactness and threats	Wholeness - Size and scale of the GBR ecosystem Intactness - Integrity of coral reef ecosystems in all their diversity - Key ecological, physical and chemical processes Protection from threats - Good state of conservation across the GBR	- BRW will not directly impact the size and scale of the GBR ecosystem - BRW is not located in proximity to significant coral communities - BRW is not in proximity to features such as inter-reef lagoonal areas - BRW may indirectly impact the ecological, physical and chemical processes through changes to flow and water quality	The weir is located 320 km upstream of the GBR, and therefore, the BRW will not directly impact on the size and scale of the GBR ecosystem, including coral communities. Changes to flows and water quality to the marine environment have the potential to indirectly impact on ecological, physical and chemical processes. Flow and water quality to the GBR is currently significantly affected by Burdekin Falls Dam (DES 2018). While flow and water quality may be locally influenced by BRW, this is negated by the much larger Burdekin Falls Dam. No significant change to freshwater flows and the quality of water delivered to the GBRWHA from BRW is expected.

4. Conclusion

BRW will not have any direct impacts on the World Heritage values of the GBR as the BRW is located 320 km AMTD upstream of this MNES. Potential indirect impacts on the GBR resulting from changes to flow, degradation of water quality and restriction of fish passage have been assessed as follows:

- Flow regime will be only locally impacted by BRW. The Burdekin Falls Dam regulates flow/discharge of water to GBR so capture and controlled release of water at BRW will have no impact on the flow regime of GBR.
- BRW is a small weir and therefore only minimal impacts on sediment and nutrient transport are expected. Further, the Burdekin Falls Dam is also known to capture 60-90% of sediment during high flows, nutrients and other contaminants from upstream sources.
- Provision has been made for a fishway as part of BRW to allow fauna movement past the weir. However, there is currently a restriction to fauna movement between marine and freshwater environments by the Burdekin Falls Dam. Consequently, there is no additional impact of BRW on species of value to the GBRWHA moving between marine and freshwater environments.

The impact assessment has concluded that with the management and mitigation measures proposed, no significant impacts to the GBR are expected as a result of BRW. Further, based on the assessment of potential indirect impacts against Great Barrier Reef values, BRW will not significantly impact directly or indirectly on the World Heritage values of the Great Barrier Reef.

5. References

Ayre, R. and Gillespie, S. (2009) Burdekin Falls Dam – Testing the Boundary of Hydrology. ANCOLD

Bainbridge, Z.T., Lewis, S. E., Smithers, S. G., Kuhnert, P.M., Henderson, B. L., Brodie, J. E. (2014) Fine-suspended sediment and water budgets for a large, seasonally dry tropical catchment: Burdekin River catchment, Queensland, Australia, Water Resources research, Vol. 50 Issue 11, pp. 9067-9087.

Department of Environment (2013) Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999

Department of Environment and Science (2012) Declared Fish Habitat Area summary – Burdekin. Accessed 11 August 2020 at <https://parks.des.qld.gov.au/management/managed-areas/fha/area-plans/burdekin>

Dougall, C. (2014) Modelling Reductions of Pollutant Loads due to Improved Management Practices in the Great Barrier Reef Catchments, Burdekin NRM region, Technical Report, Volume 4.

GHD (2020a) Big Rocks Weir Business Case Reference Design Report. Prepared for Townsville Enterprise Limited.

GHD (2020b) Big Rocks Weir Business Case: Baseline Terrestrial and Aquatic Ecology Assessment Pre-wet Assessment. Prepared for Townsville Enterprise Limited.

GHD (2020c) Big Rocks Weir Business Case: Baseline Terrestrial and Aquatic Ecology Assessment Post-wet Assessment. Prepared for Townsville Enterprise Limited.

Lewis, S.E., Bainbridge, Z.T., Kuhnert, P.M., Sherman, B.S., Henderson, B., Dougall, C., Cooper, M. and Brodie, J.E., 2013. Calculating sediment trapping efficiencies for reservoirs in tropical settings: A case study from the Burdekin Falls Dam, NE Australia. Water Resources Research, 49: doi: 10.1002/wrcr.20117.

Lewis, S.E., Sherman, B.S., Bainbridge Z.T., Brodie J.E. and Cooper, M. (2009) Modelling and Monitoring the sediment trapping efficiency and sediment dynamics of the Burdekin Falls Dam, Queensland, Australia. 18th World IMACS / MODSIM Congress, Cairns, Australia 13-17 July 2009.

NQ Dry Tropics (2016) Burdekin Region Water Quality Improvement Plan 2016

Queensland Government (2018) Reef 2050 Water Quality Improvement Plan 2017-2022.

Queensland Government (2017a) Scientific Consensus Statement, Land Use Impacts on Great Barrier Reef Water Quality and Ecosystem Condition.

Queensland Government (2017b) Great Barrier Reef Report Card 2016, Reef Water Quality Protection.

Queensland Government (2016) Great Barrier Reef Catchment Loads Modelling Program.

Roth, C. H., Lawson, G., Cavanagh, D. (2002) Overview of key Natural Resource Management Issues in the Burdekin Catchment, with particular reference to Water Quality and Salinity. CSIRO Land and Water.

Sunwater (2020) Initial Advice Statement Burdekin Falls Dam Raising.

Townsville Enterprise Limited (2020) Big Rocks Weir Business Case

GHD

71 Stanley Street
Townsville

T: 61 7 4720 0400 F: 61 7 4772 6514 E: tsvmail@ghd.com

© GHD 2020

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

12512214-35594-605/[https://projectsportal.ghd.com/sites/pp10_05/bigrockswear/ProjectDocs/02 - Environmental Assessment/EPBC Referral/12512214_REP_GBRWHA Assessment_RevA.docx](https://projectsportal.ghd.com/sites/pp10_05/bigrockswear/ProjectDocs/02-Environmental%20Assessment/EPBC%20Referral/12512214_REP_GBRWHA%20Assessment_RevA.docx)

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	L. Pratt	N. Clark	*N. Clark	S. Orr	*S. Orr	28/09/2020

www.ghd.com



Appendix F – Regulatory Approvals Plan



Townsville Enterprise Limited

Big Rocks Weir Business Case Regulatory Approvals Plan



August 2020

Table of contents

1.	Introduction	1
1.1	Background	1
1.2	Purpose of this report	1
1.3	Scope and limitations	2
1.4	Assumptions	2
1.5	Abbreviations	2
2.	Big Rocks Weir	5
2.1	Scheme overview	5
2.2	Reference design	5
2.3	Weir operating philosophy	9
2.4	Commencement of construction works	9
3.	Environmental assessment	10
3.1	Business case inputs	10
3.2	Commonwealth referral and assessment process	10
3.3	Queensland Government 'coordinated project' process	12
3.4	Bilateral agreement process	14
3.5	North Queensland Regional Plan	14
3.6	Water entitlement options	15
3.7	Native Title	16
3.8	Aboriginal cultural heritage	18
3.9	Land tenure	18
4.	Regulatory approvals framework	22
5.	Recommendations and conclusions	36

Table index

Table 2-1	BRW reference design summary (concept configuration)	7
Table 3-1	Land tenure requirements for BRW	20
Table 4-1	Regulatory approvals plan	23

Figure index

Figure 2-1	Locality of the project footprint and study area	6
Figure 3-1	Coordinated project process	14
Figure 3-2	Native Title determinations	17

Figure 3-3 Land tenure.....19

Figure 4-1 Approvals framework flow diagram.....22

Figure 5-1 Recommended approvals pathway and project timeline37

1. Introduction

1.1 Background

Townsville Enterprise Limited (TEL) is preparing a Business Case for Big Rocks Weir (BRW). The business is being undertaken via a tripartite agreement between the Australian Government (North Queensland Water Infrastructure Authority (NQWIA), Queensland Government (Department of Natural Resources, Mines and Energy (DNRME)) and TEL. The Australian Government have also committed to allocating \$30 million towards the construction of BRW subject to the outcomes of the Business Case which is scheduled for completion by 31 July 2020.

The Business Case is being prepared by KPMG for TEL and will assess the viability of BRW considering a range information, including but not limited to:

- Engineering Reference Design
- Design quantities and cost estimates
- Asset operation and maintenance schedules
- Land acquisition
- Economic demand modelling
- Cost benefit analysis
- Regulatory approval requirements
- Environmental Impact Assessment (EIA) outcomes
- Social Impact Evaluation (SIE) outcomes
- Liaison with project stakeholders.

GHD Pty Ltd (GHD) will be providing technical inputs into the Business Case with regards to the engineering design, capital cost estimates, regulatory approvals pathway, EIA and SIE.

1.2 Purpose of this report

The purpose of this Regulatory Approvals Plan (RAP) is to:

- Identify Commonwealth, State and local government legislation and policies relevant to the different phases of the project including the planning and environmental assessment phase, design, construction, commissioning and operation of BRW.
- Describe the environmental approvals framework and process that will need to be followed for BRW.
- Identify site specific technical investigations, studies and reports required to support the development applications in obtaining the necessary approvals and permits for BRW in a timely manner.

The RAP will be reviewed and amended as required at key milestones throughout the development of BRW. Triggers for these amendments may include the availability of additional or more detailed project information, feedback from regulatory authorities as a result of stakeholder engagement and agency meetings, assessment and approvals processes, lodgement of applications and issue of decision notices.

1.3 Scope and limitations

This report has been prepared by GHD for TEL and may only be used and relied on by TEL for the purpose agreed between GHD and TEL as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than TEL arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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 and 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 section 1.4 of this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by TEL and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.4 Assumptions

This report has been prepared with respect to the following:

- Site details as established through Commonwealth, State and local desktop assessments are correct and reflect current site conditions unless otherwise verified by field investigations and surveys.
- Charters Towers Regional Council (CTRC) have expressed a strong interest in taking responsibility for the delivery, ownership and operations of BRW. Therefore it has been assumed for the purpose of identifying approval and tenure requirement that the project proponent for BRW will more than likely be a public sector entity, public utility provider and constructing authority (such as a local government).
- Construction related activities such as environmentally relevant activities and the source of bulk construction materials (including but not limited to the extraction of quarry material to establish a suitable site access track, creek crossings, bedding sand, and gravels) will be the responsibility of the construction contractor to obtain unless well-defined and understood in the detailed design phase. Non-resident workforce accommodation is considered unlikely to be required given the proximity of BRW from Charters Towers (approximately 26 km).

1.5 Abbreviations

ACH Act	<i>Aboriginal Cultural Heritage Act 2003</i>
BRW	Big Rocks Weir
CEMP	Construction environmental management plan
CG	Office of the Coordinator-General

CHMA	Cultural Heritage Management Agreement
CHMP	Cultural Heritage Management Plan
CLR	Contaminated Land Register
CTRC	Charters Towers Regional Council
DAF	Department of Agriculture and Fisheries
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships
DAWE	Department of Agriculture, Water and the Environment
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines and Energy
DSDTI	Department of State Development, Tourism and Innovation
DTMR	Department of Transport and Main Roads
EAR	Environmental Assessment Report
EFOs	Environmental Flow Objectives
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMR	Environmental Management Register
EO Act	<i>Environmental Offsets Act 2014</i>
EP Act	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ERAs	Environmentally Relevant Activities
FIA	Failure impact assessment
FSL	Full supply level
GHD	GHD Pty Ltd
IAR	Impact Assessment Report
IAS	Initial Advice Statement
ID	Infrastructure Designation
ILUA	Indigenous Land Use Agreement
MCU	Material change of use
MNES	Matters of nation environmental significance
NC Act	<i>Nature Conservation Act 1992</i>
NNTT	National Native Title Tribunal
NQLC	North Queensland Land Council
NQWIA	North Queensland Water Infrastructure Authority
NTA	<i>Native Title Act 1993</i> (Commonwealth)
PIF	Private Infrastructure Facility
RAP	Regulatory Approvals Plan

RIDA	Regional Interest Development Approval
RPI Act	<i>Regional Planning Interests Act 2014</i>
RPI Reg	<i>Regional Planning Interests Regulation 2014</i>
RPP	Riverine Protection Permit
SARA	State Assessment and Referral Agency
SCR	State Controlled Road
SDAP	State Development Assessment Provisions
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i>
SEA	Strategic environmental area
SIE	Social Impact Evaluation
SMP	Species Management Plans
SOW	Scope of work
TEL	Townsville Enterprise Limited
TOR	Terms of Reference
VM Act	<i>Vegetation Management Act 1999</i>

2. Big Rocks Weir

2.1 Scheme overview

“Big Rocks” is located on the Burdekin River approximately 26 km north of Charters Towers and 23 km upstream of the existing Charters Towers Weir. The construction of a weir at Big Rocks has been considered previously, as part of separate studies such as the Hells Gates Feasibility Study (SMEC 2018), Big Rocks Weir Concept Plan (GHD 2015) and Big Rocks Weir Preliminary Design Report (McIntyre & Associates 1994).

The general concept for BRW is for the construction of a new weir on the Burdekin River with a storage capacity of around 10,000 ML and total yield of up to 20,000 ML. This is expected to achieve the desired water reliability targets for existing and future water users and meet Environmental Flow Objectives (EFOs), which will be confirmed as part of the Business Case analyses.

The objectives of BRW are to provide a new water source that provides water supply for irrigation, industrial development and urban water supply. The primary purpose, volume (storage and yield) and reliability of the water supply provided by BRW will be determined as part of the Business Case and is subject to a range of regulatory compliance, economic and environmental factors.

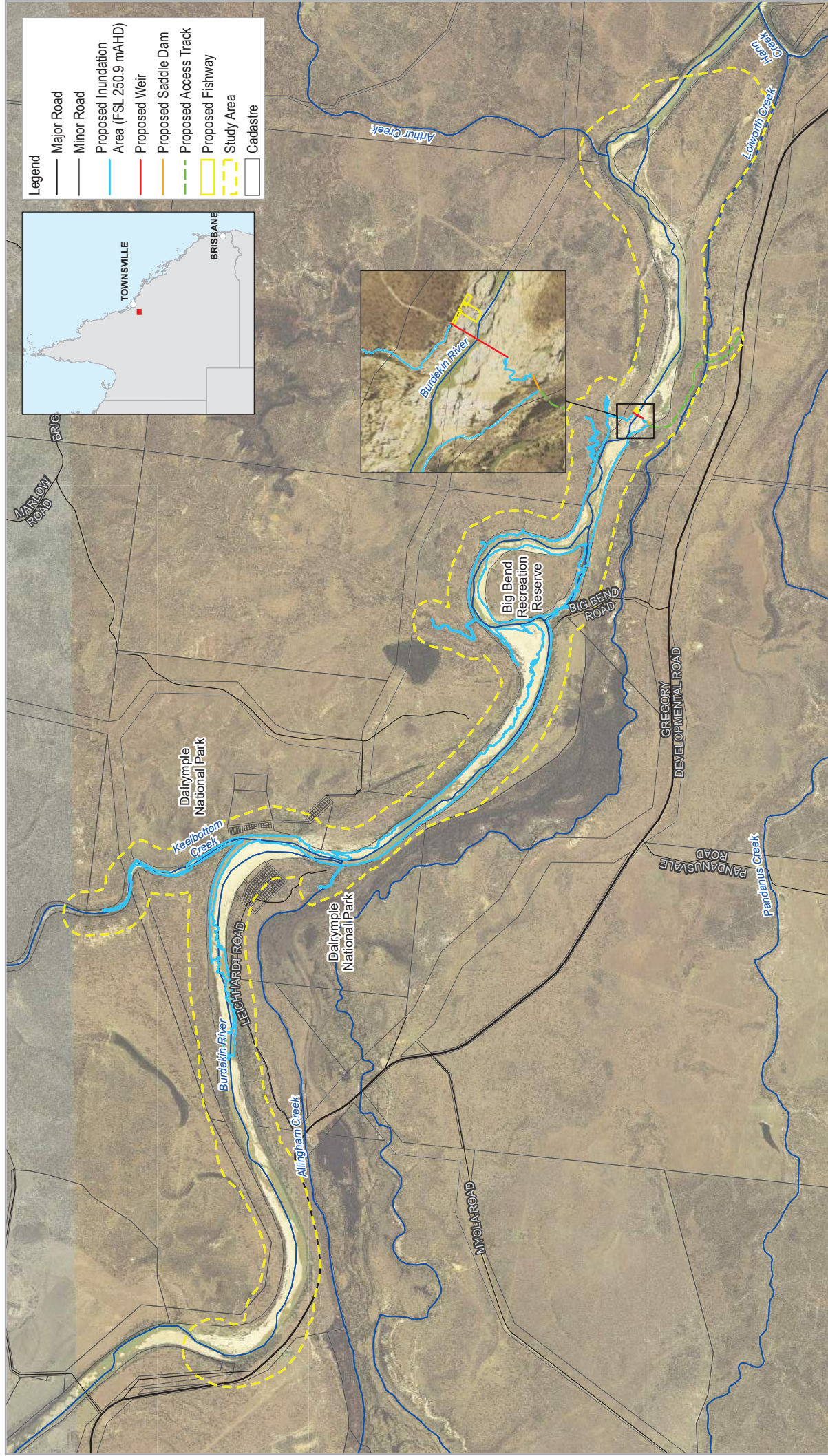
2.2 Reference design

2.2.1 Weir infrastructure

The BRW concept is to construct a new concrete gravity weir at ‘Big Rocks’ capable of storing up to 10,000 ML of water. The BRW comprises a broad crested concrete gravity weir, approximately 190 m in length, and a mass concrete saddle dam on the southern anabranch, which flanks the main Burdekin River on the right bank of the channel. The weir includes a single low level outlet with manually operated upstream bulkhead gate and downstream penstock gate for control.

Following construction, it is intended that BRW will be maintained and operated by the preferred proponent, including maintenance of the weir, associated infrastructure and management of water allocations.

A locality plan with the proposed footprint, layout and study area for BRW is presented in Figure 2-1. The key characteristics of the BRW infrastructure is described in Table 2-1.



Data Disclaimer
©2020. Whilst every care has been taken to prepare this map, GHD and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party in reliance on the map. The map is not intended to be used for any purpose other than for the purpose for which it was prepared, and is not to be used for any purpose for which it is not intended to be used.

Paper Size ISO A4
0 1 2 3
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Locality of the project
footprint and study area

Project No. 12512214
Revision No. 0
Date 17/08/2020

FIGURE 2-1

Data source: GA, Mainlands/Landscapes, Populated Places (2007); DNRME: Roads, Cadastre, Watercourse (2019); GHD: Proposed Infrastructure, Study Area, Locations of Interest (2020) Imagery: OutBase, AllUsers. Created by: xee

N:\AU\Brisbane\Projects\4212512214\GIS\Maps\APRX12512214_RAP.aprx\12512214_001_RAP_Locality
Print date: 17 Aug 2020 - 16:43

Table 2-1 BRW reference design summary (concept configuration)

Characteristic	Reference Project
Weir type	An uncontrolled gravity broad crested weir constructed using conventional concrete and one saddle dam on the right bank high flow channels.
Design life	100 years
Catchment area	36,205 km ²
Full supply level (FSL)	RL 250.87 m AHD
Storage at FSL	10,000 ML
Dead storage volume	444 ML
Yield at FSL	Minimum of 10,000 ML per annum
Proposed allocation	Up to 20,000 ML per annum
Impoundment length (main channel) at FSL	16.6 km
Weir height (above lowest toe)	Approx. 13.3 m
Weir length	188 m
Saddle dam crest level	251.17 m AHD
Saddle dam height (above lowest toe)	4.4 m
Saddle dam weir length	Approx. 56 m
Low level outlet	0.9 m x 0.9 m rectangular conduit with upstream guard gate, inlet debris screens and downstream hydraulically actuated sluice gate.
Aquatic fauna passage type	Primary cone style fishway
Associated infrastructure	Upgrade to the existing access at Big Bend by construction of a concrete floodway and culverts to provide ongoing public access following construction of the weir. Construction access track to the weir.

2.2.2 Access and river crossings

Construction access is proposed to be from Gregory Development Road, utilising parts of the existing access track on the Fletcherview Research Station property where possible, crossing Lolworth Creek (at the same location as the existing bed level crossing) and then arriving at the weir site by following the high bank of the river. Inspection and operation requirements will be kept to a minimum which may involve weekly inspection and operation of the outlet valve when the weir is not overtopping and occasional access to the weir crest to allow installation of the baulk when upstream isolation is required or the screens are required to be cleaned. Access to weir infrastructure within the watercourse would be by foot or potentially an all-terrain vehicle for manual operation of the valve and inspection.

The current gate and access track from the Gregory Development Road is through private property and is locked at all times. The preferred arrangement for access to BRW during and following construction would be the establishment of a public utility easement permitting 24/7 access to the future proponent, owner and operator of BRW and its contractors.

The following upgrades are required to facilitate construction and weir maintenance:

- For the Gregory Developmental Road access it will be necessary to upgrade the intersection and comply with the Department of Transport and Main Roads' (DTMR) requirements, with the increase in traffic volume. The intersection design has been determined from minimum DTMR requirements and involves providing a Basic Left Turn Treatment and Basic Right Turn Treatment. This is subject to further liaison with DTMR.
- The construction access track will be a minimum of 6 m wide along existing routes where possible to minimise clearing.
- Construction of a floodway crossing at Big Bend is recommended to restore access to Big Bend Recreation Area following construction of BRW. The Reference Design has included a series of box culvert cells for the design of the access track. The culverts will be overlaid by a reinforced concrete slab for access and the embankments on each of the abutments will be protected with a reinforced concrete overlay to provide resistance to erosion.
- Basic mooring facilities can be provided at the weir to allow boat access if required.

2.2.3 Fish passage

Due to the semi-remote site location and difficulty of access, a fishway with minimal operational and maintenance requirements is preferred. Fish passage is proposed to be provided with a cone style fishway on the left bank. The Reference Design meets the objective of being readily constructible with relatively simple and low cost operating and maintenance requirements. This type of fishway passage has been selected and designed to cater for as broad a range of viable fish passage scenarios, which is partially limited by the site specific characteristics that act as a natural barrier to fish passage under existing conditions.

The proposed cone fishway is located on the downstream left bank of the weir. It is approximately 250 m long with approximately 1H in 20V grade. This will provide fish passage during all flow releases. Internal fishway hydraulics are favourable and the fishway will continue to operate up until drown out of the fishway. Downstream fish passage will occur over the spillway during all spilling events.

At flow events greater than 300 mm above FSL, fish passage will occur past BRW via the southern and northern auxiliary channels. The provision of fish passage at BRW reflects existing conditions where the rocky outcrop in the main channel is a natural barrier to fish passage during flow events. During post-weir conditions, fish passage via the southern and northern auxiliary channels will occur more frequently (less than a one in one year event) than existing conditions (one in two year event) and therefore the provision of fish passage past the weir is enhanced during these flow events.

The provision of suitable fish passage for BRW will be further investigated in consultation with the Department of Agriculture and Fisheries (DAF) in the subsequent stages of design.

2.3 Weir operating philosophy

The general operating philosophy for the scheme is that whilst the weir is overtopping irrigators or other users may extract water either directly from the storage, from downstream of the weir or from Charters Towers Weir storage. Once flows in the river have ceased, and the storage within the existing weir starts to be depleted, water would be released downstream from BRW from a low-level outlet in the main weir to supplement supply to Charters Towers weir downstream and meet EFOs.

Either farmers or other users would develop their own delivery systems from either the weir storage area or downstream of the weir with flows released through the low-level outlet, depending on the location of the user.

The scope of BRW is limited to the weir and directly associated infrastructure and does not include the development of irrigable land areas or water distribution infrastructure.

2.4 Commencement of construction works

As the project has already received an initial capital funding commitment from the Australian Government, the project timeline requires construction to commence in 2022. This requires the Business Case outcomes to be approved and the majority of tier one (whole of project) approvals to be obtained, or at the least very close to being secured, by the middle of 2021 so that the tier two (State based individual DA rules development permits) and tier three (Non-DA rules, local law and regulatory compliance permits) approvals can be applied for, detailed design can be finalised, construction tendering, mobilisation and early works can progress prior to construction commencement post wet season 2022. Key project milestones and approvals timeframes are summarised in Section 5 and illustrated in Figure 5-1 of this report.

3. Environmental assessment

3.1 Business case inputs

An Environmental Assessment will be undertaken to define the approval framework and further technical study requirements relating to the project. The EIA and SIE outcomes will be prepared for input into the Business Case by 31 July 2020. The EIA and SIE will principally be a desktop assessment including:

- Regulatory approvals plan to identify Commonwealth, State and local government legislation and policies relevant to the planning, design, approvals, construction and operation of BRW.
- Identification of environmental and social values, constraints and impacts relating to:
 - Terrestrial flora and fauna and aquatic ecology assessment results including the pre-wet season field survey results and recommendations for additional survey efforts for the post-wet season field survey
 - Planning, land use and land tenure impacts
 - Native title and indigenous cultural heritage management
 - Non-indigenous heritage values (European and archaeology)
 - Water entitlement options including the process for securing the required water and any potential impacts on surface and groundwater resources
 - Employment and business opportunities
 - Water security and agricultural production
 - Recreation impacts
 - Landscape and amenity impacts
 - Access, Road and transport impacts
 - Construction impacts including water quality, air, noise, vibration, greenhouse gas emissions, waste and the requirement for Environmental Management Plans.

3.2 Commonwealth referral and assessment process

Actions that have, or are likely to have, a significant impact on a matter of national environmental significance (MNES) require referral to the Australian Government Minister for the Environment otherwise known as the Department of Agriculture, Water and the Environment (DAWE) who will decide whether assessment and approval is required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The nine matters of national environmental significance protected under the EPBC Act are:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas

- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

Based on desktop investigations and findings from the pre-wet and post-wet baseline ecological assessments undertaken to date, risks associated with BRW have been assessed to have the potential for low to moderate direct and/or indirect impacts on the following protected species and their habitat:

- Listed threatened species including the Greater glider (northern) (*Petauroides volans minor*), Squatter pigeon (southern) (*Geophaps scripta scripta*) and Koala (*Phascolarctos cinereus*)
- Migratory species including the Glossy ibis (*Plegadis falcinellus*), Caspian tern (*Hydroprogne caspia*), Common greenshank (*Tringa nebularia*), Common sandpiper (*Actitis hypoleucos*), Latham's snipe (*Gallinago hardwickii*), Osprey (*Pandion haliaetus*) and Wood sandpiper (*Tringa glareola*).

Other provisions include the potential for indirect impacts to the Great Barrier Reef (GBR) given that the Burdekin River is located within the reef catchment. Therefore, additional MNES include:

- World Heritage properties for The Great Barrier Reef World Heritage Area (GBRWhA)
- National Heritage places for the GBR
- Ramsar wetland for Bowling Green Bay.

A pre-referral meeting has been held with DAWE to discuss the potential impacts the project may have on MNES and final updates are currently being made to the referral documentation in response to several items DAWE raised in the meeting. Once complete, an online referral form will be completed. The significant impact assessments conducted as part of the baseline ecological assessments and EPBC referral currently being prepared is recommending that the project will not have a significant impact on MNES and that the action should be determined 'a not controlled action'.

In the event that the Minister determines that significant impacts to MNES are considered likely, and the action is deemed to be a controlled action, then the referral will proceed to the next stages of the assessment.

The EPBC Act provides for five different levels of assessment:

- Accredited assessment (e.g. bilateral agreement)
- Assessment on referral information (assessment undertaken solely on the information provided in the referral form)
- Assessment on preliminary documentation (referral form and any other relevant material identified by the Minister as being necessary to adequately assess a proposed action)
- Assessment by EIS or Public Environment Report
- Assessment by public inquiry.

Depending on the outcomes of the determination by DAWE and in conjunction with the 'coordinated project' process described below, the bilateral agreement process outlined in section 3.4 of this report may be applicable for the project.

3.3 Queensland Government ‘coordinated project’ process

For the release of unallocated water from a strategic reserve under Queensland’s water planning framework, it is understood that a ‘coordinated project’ declaration will assist with BRW being able to qualify under the definition of a State purpose and will enable DNRME to enter into a Terms of Sale for the required water entitlement without having to go through a public auction or tender process. The water entitlement options for BRW are discussed further in section 3.6 of this report.

A proponent of a project with one or more of the following characteristics may apply to have a project declared a ‘coordinated project’ under the *State Development and Public Works Organisation Act 1971* (SDPWO Act):

- Complex approval requirements, involving local, State and Commonwealth governments
- Significant environmental effects
- Strategic significance to the locality, region or State, including for the infrastructure, economic and social benefits, capital investment or employment opportunities it may provide
- Significant infrastructure requirements.

The Office of the Coordinator-General (CG) chooses the weight attributed to each of the above factors. However, the CG is not bound to declare a project a coordinated project merely because it satisfies one or more of these characteristics.

In making the declaration decision, the CG must have regard to:

- Detailed information about the project given by the proponent in an initial advice statement (IAS)
- Relevant planning schemes or policy frameworks of a local government, the State or the Commonwealth
- Relevant State policies and government priorities
- A pre-feasibility assessment of the project, including how it satisfies an identified need or demand
- The capacity of the proponent to undertake and complete an environmental impact statement (EIS) or impact assessment report (IAR) for the project
- Any other matter considered relevant.

There are two types of coordinated project declarations:

- Requiring an EIS
- Requiring an IAR.

3.3.1 Scope of an EIS

The EIS is prepared in accordance with the terms of reference (TOR) for the EIS. The EIS provides a comprehensive description of:

- The current environment in the area of the project
- All potential environmental impacts of the project
- The proponent’s commitments to avoid, minimise, mitigate and/or offset those potential residual impacts.

The impacts include direct, indirect, facilitated and cumulative impacts resulting from the construction, commissioning, operation and decommissioning of the project.

The draft TOR for the EIS are prepared by the CG and include consultation with the State government advisory agencies for comment followed by public notification inviting comments on the draft TOR. Once the consultation period closes the CG is required to finalise the TOR and while there are no prescribed legislative timeframes for this process, the TOR can be expected to take up to 4 to 6 months to be finalised. A draft EIS must be accepted by the CG as the final EIS within 18 months of the TOR for the EIS being finalised.

3.3.2 Scope of an IAR

An IAR process may be used if the CG is satisfied that the environmental effects of the project do not, having regard to their scale and extent, require assessment through the EIS process. An IAR may be used for well-defined, low-medium risk projects where the likely impacts are highly predictable and the proponent's commitments to avoid, minimize, mitigate and/or offset those impacts are accepted as best-practice in that industry.

The IAR:

- Has no formal TOR (but a scope of work (SOW) is developed and agreed with the CG)
- Is focused mostly on the:
 - Locations that may be subject to adverse impacts if not appropriately managed
 - Potential impacts that are either uncertain; or
 - Proposed mitigation measures that depart from accepted management practices or standard conditions for that industry.

A draft IAR must be accepted by the CG as the final IAR within 18 months of the declaration being made. The approval timeframe for an IAR should be shorter than the EIS process due to there being no formal TOR and the project being well-defined and of a low to medium risk.

3.3.3 Section 37 of the SDPWO Act

Section 37 of the SDPWO Act provides that the CG's report for a 'coordinated project' is taken to be the concurrence agency response for a material change of use (MCU) of premises under the *Planning Act 2016* until such time that a development approval for the application has effect. And furthermore, that an impact assessable development application made under the *Planning Act 2016* will not require public notification when the development application is lodged with the assessment manager as submissions about the draft EIS or draft IAR are taken to be a properly made submission for an application for the *Planning Act 2016*.

Accordingly, subsequent MCU and operational works development applications will still need to be submitted to the relevant State agencies for development approval under the *Regional Planning Interests Act 2014* (RPI Act), *Planning Act 2016* and other State and local legislation

3.3.4 Declaration and assessment process

Two pre-lodgement meetings have been held with the CG (January and May 2020) to discuss BRW and brief the relevant State Government agencies on the project. A draft IAS has also been submitted to the CG to seek feedback on the application and proposal that the project be declared a 'coordinated project' requiring assessment by an IAR. A final IAS will be prepared based on feedback received from the CG.

The process for the declaration of a coordinated project under the SDWPO Act is set out in Figure 3-1. The draft and final TOR actions for an EIS are replaced by the SOW process for an IAR.

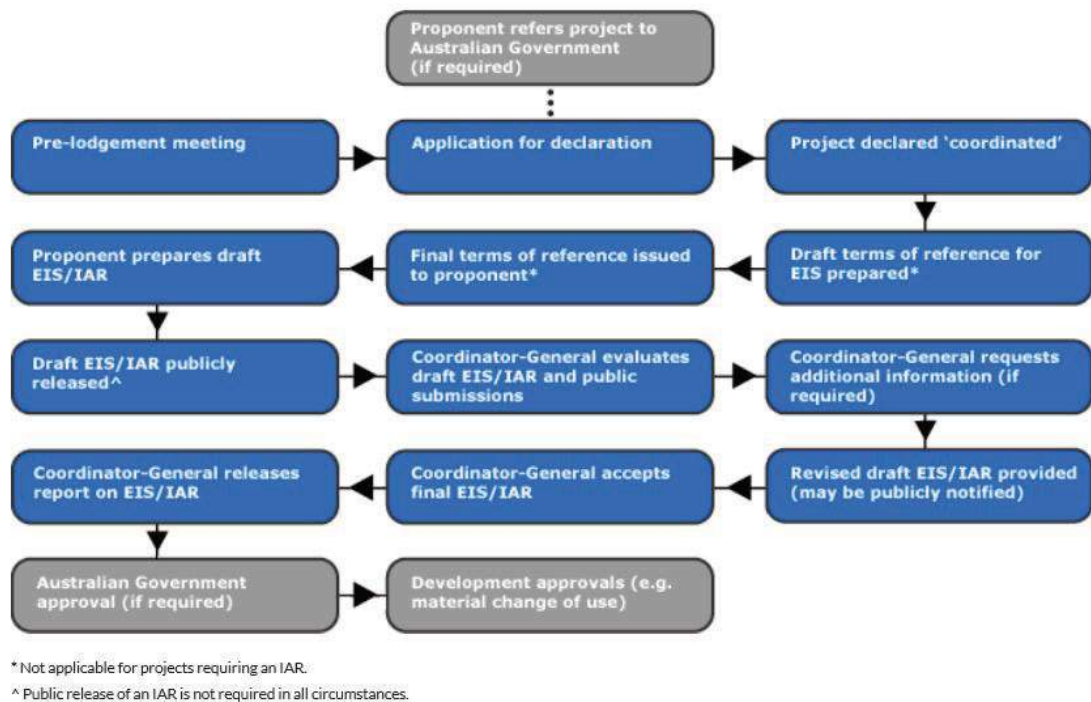


Figure 3-1 Coordinated project process

3.4 Bilateral agreement process

The bilateral agreement process assists agencies in the joint assessment of projects between the Queensland and Commonwealth Government. Depending on the outcomes of decisions made by the CG and DAWE in relation to a 'coordinated project' determination and EPBC Referral, the assessment of BRW may be able to be undertaken in accordance with the bilateral agreement process. However, it is understood that the bilateral agreement only applies to proposals that are 'controlled actions' requiring assessment under Part 8 of the EPBC Act and which are also required to undergo an EIS assessment process similar to that under Part 4 of the SDWPO Act. Should an alternative assessment approach be required under Part 8 of the EPBC Act such as preliminary documentation, the bilateral agreement process may not need to apply.

Typically, the CG is likely to want to wait until a determination on the EPBC Referral has been made by DAWE before making a 'coordinated project' declaration and progressing the IAR SOW or EIS TOR.

3.5 North Queensland Regional Plan

The first North Queensland Regional Plan was given effect on 6 March 2020. The plan provides a 25-year framework to guide growth and support future jobs in North Queensland. The regional plan enables the Burdekin, Charters Towers, Hinchinbrook, Palm Island and Townsville councils to work together to drive a leading economy in regional Australia. It also highlights opportunities for prosperity and liveability.

BRW is recognised in the North Queensland Regional Plan as a future water supply initiative with the ability to have a significant influence on the Charters Towers regions future by providing potable water security and future economic opportunities linked to agriculture, energy and tourism. This will in turn support economic growth in the region and aligns with the vision of

Goal 4 - infrastructure networks support a safe, connected and efficient North Queensland. Under Goal 2 – a rich and healthy environment, approximately 13 km of the water storage area for the project is located within a Strategic Environmental Area (SEA). In addition to this, all of the BRW footprint is located within the regional biodiversity corridor and regional biodiversity value area.

Under section 17 (1)(b) of the RPI Act and section 11 of the *Regional Planning Interests Regulation 2014* (RPI Reg), a regulated activity for a SEA includes broad acre cropping and water storage (dam). As per the RPI Act Statutory Guideline 05/14 ‘a water storage dam includes any barrier that may impound water, plus the water storage area created by the barrier, plus any embankment or other structure that is associated with the barrier and controls the flow of water’.

Regulated activities that have the potential for widespread or irreversible impacts on the environmental attributes of the SEA are considered to be incompatible development. An activity is likely to have a widespread or irreversible impact if it permanently modifies any habitat or ecosystem components, results in a change in water quality, permanently changes surface or groundwater hydrology for a watercourse and impedes the natural transport of sediments along a river system.

On this basis, an assessment application for a Regional Interest Development Approval (RIDA) will be required for the project as a large portion of the storage area is located within a SEA, constitutes a regulated activity and may be considered to have a widespread or irreversible impact. The application will need to address the relevant environmental attributes of the SEA, applicable policies/goals and substantiate the benefits of the project against the overall outcomes of the North Queensland Regional Plan.

3.6 Water entitlement options

In reviewing Queensland’s water planning framework (consisting of the *Water Act 2000*, *Water Regulation 2016*, *Water Plan (Burdekin Basin) Plan 2007*, *Water Amendment Plan (Burdekin Basin) 2019*, *Burdekin Basin Water Management Protocol 2016 (Amended June 2019)* and the *Water Supply (Safety and Reliability) Act 2008*) it is evident that there has been a recent State reform towards establishing a water market for tradeable water allocations within the majority of the Burdekin Basin subcatchments for both supplemented and unsupplemented water.

Water trading is intended to provide greater flexibility for water users to be able to subdivide, amalgamate and transfer existing water allocations or even apply for seasonal assignments so to manage water more sustainably. It is also common practice for the State to now set a price for unallocated water in order to encourage the recognition of water as a valuable resource and promote its highest value and efficient use.

To secure the necessary water entitlement for BRW, the project would be seeking to access unallocated water from both the general reserve (10,000 ML available) and strategic reserve (10,000 ML available) as well as potentially acquiring existing water allocations from existing water users.

The process for DNRME to be able to release unallocated water is by:

- Public auction; or
- Tender; or
- Fixed price sale; or
- Grant for a particular purpose.

Unallocated water from the strategic reserve can only be released by DNRME for a State purpose such as a 'coordinated project', project of regional significance or for town water supply. While unallocated water from the general reserve can be released for any purpose. Although the *Water Plan (Burdekin Basin) Plan 2007* does not contemplate the grant of unallocated water held in the general and strategic reserves for BRW, in obtaining a 'coordinated project' declaration under the SDPWO Act, the project would be able to qualify under the definition of a State purpose and CTRE could request and negotiate access to the water from DNRME without competition (through a Terms of Release/Sale).

Under Queensland's water planning framework and the *Planning Act 2016*, a development permit for the interference and take of water from a watercourse is required from the State Assessment and Referral Agency (SARA) and DNRME. An application to DNRME to enter into a Terms of Sale will need to be made and progressed prior to the lodgement of the development application for the water entitlement (likely to be granted as a water allocation and/or Resource Operations Licence) and necessary permits under the *Water Act 2000* and *Planning Act 2016*.

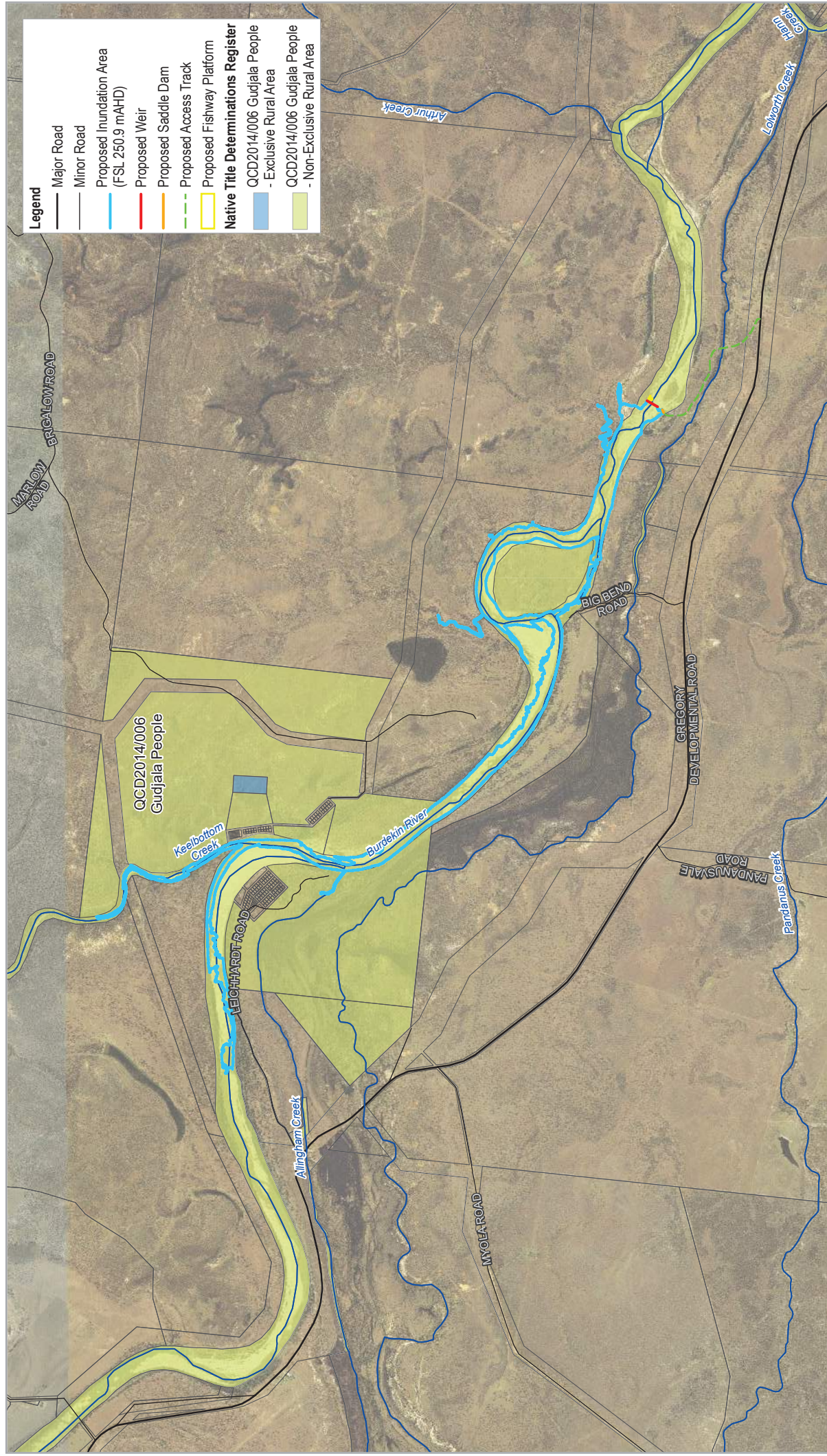
The applications to DNRME will need to address the following matters which are required to be considered in deciding whether to grant a water allocation or licence:

- The purpose for which the water is required
- The efficiency of existing and proposed water use practices
- The extent to which water is being taken under existing authorisations in the plan area
- The availability of an alternative water supply for the purpose for which the water is required
- The impact the proposed taking of, or interfering with, the water may have on existing water users in the plan area
- Whether the proposed taking or interfering is likely to have a direct adverse effect on groundwater flows
- The environmental management rules and provisions including but not limited to maintaining streamflows, protecting terrestrial and aquatic habitats, connectivity of pools and rivers in allowing movement of instream biota, water quality, movement of sediment recreational and aesthetic values and cultural values.

3.7 Native Title

BRW is located entirely within the external boundaries of *the Elizabeth Dodd & Ors on behalf of the Gudjala People Core Country Claim #1 v State of Queensland & Ors* Native Title determination (Federal Court Number: QUD80/2005 and NNTT Number: QCD2014/006) as shown in Figure 3-2. Under the Native Title determination, the Gudjala People do not have exclusive use rights to the Burdekin River watercourse, Keelbottom Creek watercourse, Dalrymple National Park (other than Lot 42 USL48163) and Big Bend Recreational Reserve, with the public able to access and enjoy these areas. The Gudjala People do however have the right to exclusive possession for Lot 42 USL48163. Although BRW is not expected to impact on Lot 42 USL48163.

The *Native Title Act 1993* (Commonwealth) (NTA) recognises the traditional rights and interests of Aboriginal and Torres Strait Islander people in Australia. The NTA prohibits the undertaking of acts that affect Native Title, being acts that are wholly or partly inconsistent with the continued existence, enjoyment or exercise of Native Title, other than in accordance with the provisions of the NTA. Acts that affect Native Title are called 'future acts'. The NTA sets out the processes that apply to enable the carrying out of 'valid future acts' which are informed by the type, or category, of a future act.



Data Disclaimer

©2020. Whilst every care has been taken to prepare this map, GHDI and DNRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214

Project No.
Revision No.

Date 17/08/2020

Native Title Determinations

FIGURE 3-2

N:\AUBrisbane\Projects\421251\2214\GIS\Maps\APRX\1251251214_RAP.aprx
Print date: 17 Aug 2020 - 16:44

Data source: CA: Mainlands/Islands, Populated Places (2007); DNRME: Roads, Cadastre, Watercourse (2019); Imagery (2015); ; NNTT: Native Title Determinations Register (01/2020). GHD: Inundation Area, Proposed Infrastructure (2020). Created by: xlee

BRW is considered to constitute 'valid future acts' and will be subject to compliance with the requirements of section 24KA under the NTA, including claims for compensation for the effect the BRW Future Acts will have on the Gudjala People's Native Title rights and interests. The non-extinguishment principle will apply to the BRW Future Acts on the basis that freehold tenure will not be required for any component of the project. As such, an Indigenous Land Use Agreement (ILUA) is unlikely to be required for BRW unless agreed to by the proponent of BRW at the request of the North Queensland Land Council (NQLC) and the Gudjala People (represented by Ngrragoonda Aboriginal Corporation (NAC)).

3.8 Aboriginal cultural heritage

The *Aboriginal Cultural Heritage Act 2003* (ACH Act) recognises, protects, and conserves Aboriginal cultural heritage. In part, it achieves this protection by providing that any person who undertakes an activity has a 'Duty of Care' to take all reasonable and practicable measures to ensure that the activity does not harm Aboriginal cultural heritage (Duty of Care).

Under the ACH Act, the Duty of Care can be discharged in a number of ways, including:

- At a minimum, adhering to the Duty of Care Guidelines
- Entering into a voluntary Cultural Heritage Management Agreement (CHMA) with an 'Aboriginal party' for the given area; or
- Entering into a Cultural Heritage Management Plan (CHMP) under Part 7 of the ACH Act.

Accordingly, the proponent will be required to comply with the Duty of Care requirements. TEL and GHD have already been commenced consultations with the NQLC and NAC in relation to BRW. A draft CHMA has been prepared for the anticipated upcoming investigative works and is expected to be executed by NAC in the near future. The BRW proponent will also need to consult with NQLC and NAC to establish a separate CHMP for the construction, operation and maintenance of BRW.

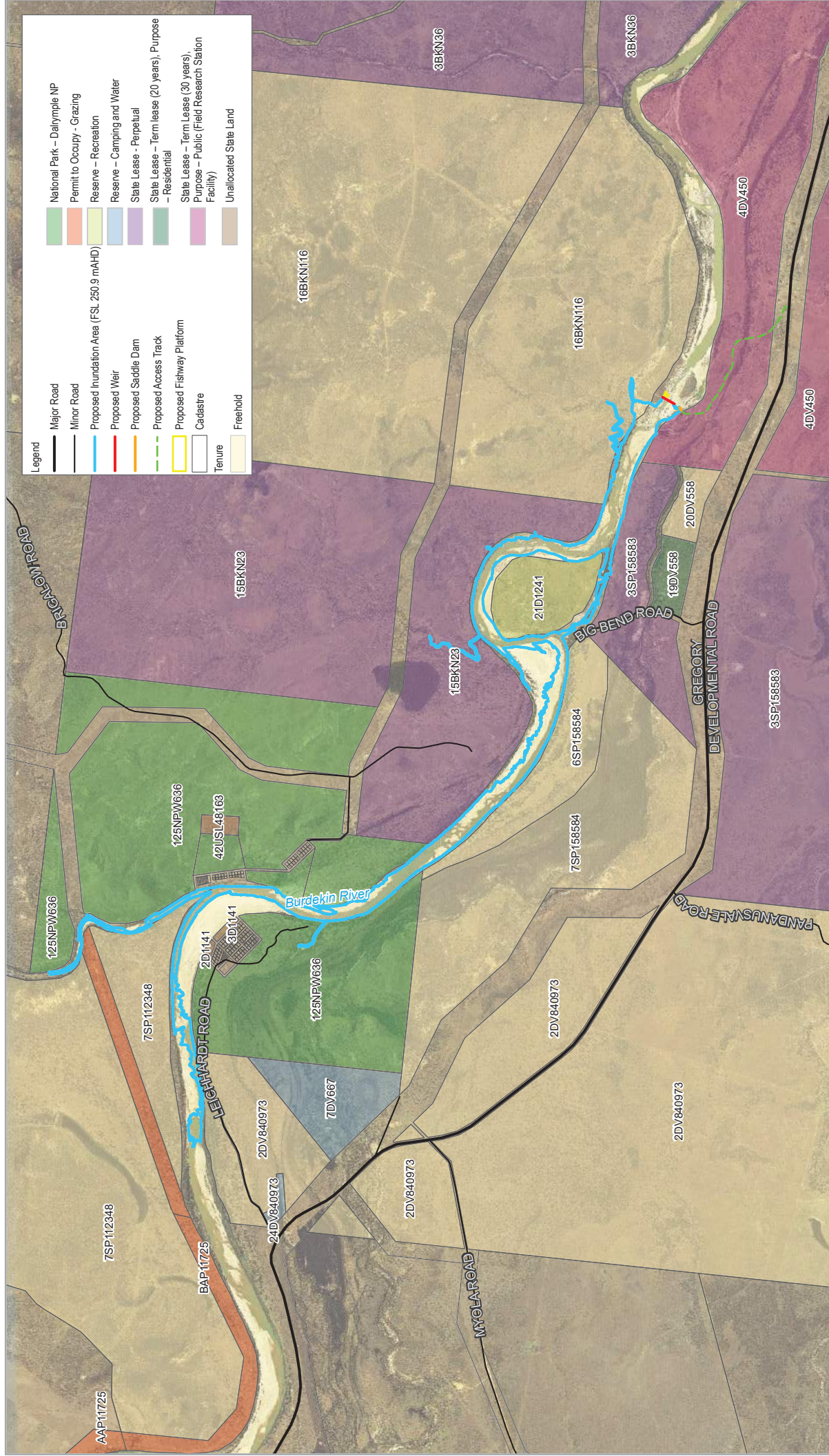
3.9 Land tenure

3.9.1 Existing land tenure

The surrounding land is primarily used for cattle grazing and cultivation. Dalrymple National Park is located towards the upstream reach of the proposed storage area and is best known for ancient lava flows, fossilised limestone and the Burdekin River. It is also the site of the former Dalrymple township which was one of the first inland settlements in northern Australia.

Land tenure within and directly adjoining the BRW study area consists of a combination of private freehold land and non-freehold land otherwise referred to as State land. Surrounding properties are represented by a variety of State land tenures including but not limited to National Park (Dalrymple National Park), reserve land (for recreation), perpetual leases, term leases, watercourses and both State and local road reserve (refer Figure 3-3).

The Burdekin River is defined as a watercourse and will contain the weir infrastructure and storage area. Land directly adjoining the weir to the north is held as freehold land (Burdekin Downs) which may be subject to some minor inundation from the storage area due to the left high flow channel of the Burdekin River and another small watercourse/tributary being located within the cadastral boundary of the property. Fletcherview Research Station is located to the south of the weir and is State leasehold land under a 30 year term lease to James Cook University. Fletcherview Research Station will contain the weir access track as well as some temporary laydown areas.



Data Disclaimer

©2020. Whilst every care has been taken to prepare this map, GHD and DWRME make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party in reliance on the map, or for any inaccuracies, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A4

0 1 2 3

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



Townsville Enterprise Ltd
Big Rocks Weir

Project No. 12512214
Revision No. 0
Date 17/08/2020

Land tenure

FIGURE 3-3

3.9.2 Land tenure requirements

Tenure requirements for BRW have been discussed with DNRME and are considered to require the following applications and arrangements presented in Table 3-1.

Table 3-1 Land tenure requirements for BRW

Infrastructure	Current tenure	Tenure requirements
Weir, saddle dam, fishway and storage area	Watercourse	To the extent that the weir infrastructure and storage area is located within the cadastral boundaries of the watercourse there is no requirement under the <i>Land Act 1994</i> to acquire an interest in the land. However, under section 972D of the <i>Water Act 2000</i>, a development permit, for taking or interfering with water, is taken to include a right to use and occupy the part of the watercourse or lake that: • (a) forms all or part of the boundary of the land to which the development permit attaches; and • (b) on which the works are situated. Therefore the <i>Water Act 2000</i> provides the relevant permit and licencing requirements for the occupation of the watercourse for a weir.
Storage area – property inundation at FSL	State lease land - Grazing Homestead Perpetual Lease (Lot 15BKN23)	A public utility easement is required for water storage under section 362(5) of the <i>Land Act 1994</i> for the potential inundation (at FSL) of a small low lying area within the boundary of an adjacent State lease land parcel.
Storage area– property inundation at FSL	Freehold land (Lot 16BKN116 and 7SP112348)	A public utility easement is required for water storage under section 82 of the <i>Land Titles Act 1994</i> for the potential inundation (at FSL) of some low lying areas of land and tributaries within the boundary of adjacent freehold land parcels.
Storage area– property inundation at FSL	Dalrymple National Park (Lot 125NP2636)	Potential inundation of land and tributaries (at FSL) within the boundaries of Dalrymple National Park will need to be authorised by the Department of Environment and Science (DES) separate to the <i>Land Act 1994</i> . Authorisation for infrastructure in protected areas is granted under sections 34, 35 and 35a of the <i>Nature Conservation Act 1992</i> (NC Act) and must be managed according to the requirements of sections 15 and 34(2) of the NC Act.
Weir access track	State lease land (Lot 4DV450)	The proposed access track to the weir site will require an application to DNRME for a right of way public utility easement under section 369 of the <i>Land Act 1994</i> .
Concrete floodway	Watercourse	The proposed concrete floodway (located approximately 3.5 km upstream of the proposed weir infrastructure) which is required to provide ongoing access to Big Bend Recreation Reserve following the construction of BRW will need to be dedicated as a local government road under section 59 of the <i>Local Government Act 2009</i> . The road reserve should align with and be connected to the existing Big Bend Road reserve.

3.9.3 Requirement for land access agreements

The project proponent will need to enter into access agreements with the landholders and the State or lessee for State lease land to enable cultural heritage surveys to be undertaken and for contractors to temporarily occupy and use the land for investigative works or during construction if the appropriate easement arrangements are still to be formalised or if work is to be carried outside the defined easement areas. The proponent of BRW may be subject to compensation claims for any physical damage caused by the entry, occupation or use of the land during investigative works, construction and/or operation of the project under an access agreement. As such, the relevant access agreements should be prepared and/or reviewed by a solicitor or lawyer.

4. Regulatory approvals framework

The project consists of a number of elements which will likely require approval under Commonwealth, State and local planning regulatory jurisdictions. A breakdown of how, when and where these apply across key elements is shown in Figure 4-1 and described in Table 4-1.

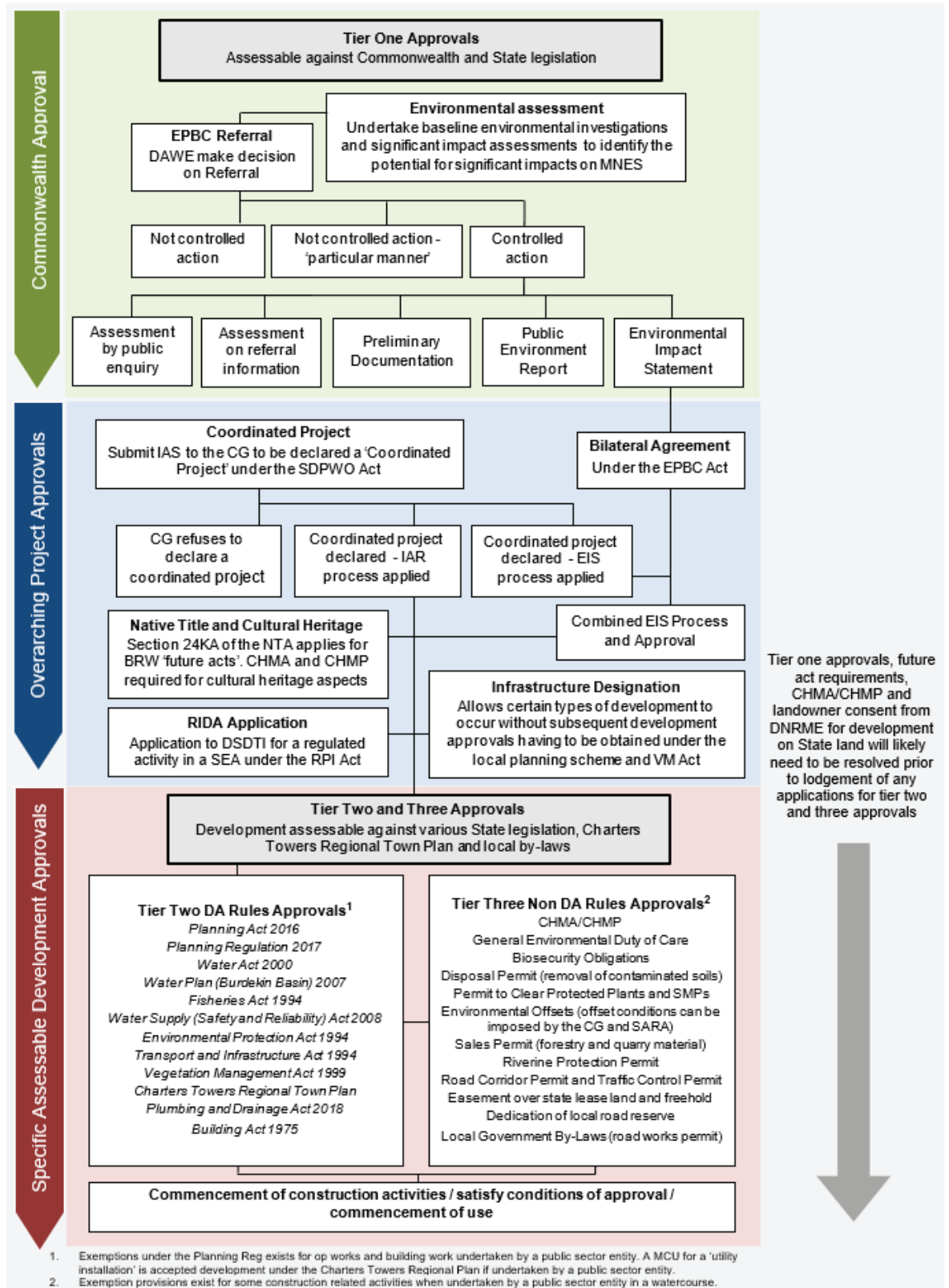


Figure 4-1 Approvals framework flow diagram

Table 4-1 Regulatory approvals plan

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Tier one approvals						
Commonwealth approvals EPBC Referral EPBC Act	Reference Design Pre-construction	Weir wall, saddle dam, storage area and access track.	An EPBC Act referral is required when a project has the potential to significantly impact on a MNES protected under the EPBC Act. Although impacts are not expected to be significant, baseline ecological assessments have indicated that the project has the potential to impact on several MNES, including: • Listed threatened and species and communities • Listed migratory species • World Heritage properties • National Heritage places • Ramsar wetlands. Therefore, a referral is currently being prepared and will be submitted to DAWE for a determination on whether the project constitutes a controlled action or not. The referral is recommending that the action be 'a not controlled action'.	DAWE	Approximately 2 to 3 months for preparation of referral and pre-referral meeting. Once referral is made, DAWE has 20 business days to make a decision on whether approval is required and to determine the level of assessment. If determined to be a 'controlled action' requiring preliminary documentation, allow between 9 to 12 months for assessment and approval/decision. If determined to be a 'controlled action' requiring an EIS and undertaken in accordance with the bilateral agreement, allow between 12 to 15 months for assessment and approval/decision.	A pre-referral meeting was held with DAWE in July 2020 to discuss the potential impacts the project may have on MNES. The referral is currently being updated in response to several items raised by DAWE at the pre-referral meeting. If determined to be a 'not controlled action' or 'not controlled action – particular manner' then the project will be able to proceed in accordance with State and local government approval requirements. If determined to be a 'controlled action' further assessment and approval will be required from DAWE. The Queensland bilateral assessment agreement will likely apply in the event that an EIS is required to be completed under both the EPBC Act and SDPWO Act.
	Reference Design Pre-construction	Weir wall, saddle dam, storage area and access track.	A future act is an act in relation to land or waters which must 'affect' native title. BRW will constitute valid future acts and will require development to be carried out in accordance with the requirements set out in section 24KA of the NTA. The Gudjala People will be entitled to compensation for the effect that BRW future acts will have on their Native Title rights and interests. Where the extinguishment of Native Title is proposed by way of any land acquisitions within the determination areas, an ILUA will be required.	National Native Title Tribunal (NNTT) Attorney-General's Department – Registered Native Title Party	Approximately 12 months.	A commencement meeting to discuss the proposed native title and cultural heritage framework, requirements and approval process for BRW was held with the (NQLC on 1 April 2020. The Gudjala People and NAC are to be informed prior to the formal lodgement of any development applications so that they are provided with an opportunity to express their opinion and make submissions on the project as though they held ordinary title to the land and waters, including the right to be heard in relation to how their Native Title interests may be affected. Compensation will more than likely not be payable at the time of an application being made by the Gudjala People under the NTA.
Valid future acts and suppression of native title NTA <i>Native Title (Queensland) Act 2003</i>	Reference Design Pre-construction	Weir wall, saddle dam, storage area and access track.				

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
State – SDPWO Act, RPI Act approvals and infrastructure designation Application for 'coordinated project' declaration- requiring an IAR or EIS <i>State Development and Public Works Organisation Act 1971 (SDPWO Act)</i>	Reference Design Pre-construction	Weir wall, saddle dam, storage area and access track.	A coordinated project declaration is given to projects with complex approval requirements, significant environmental effects, strategic significance or significant infrastructure requirements. The declaration will also assist with the release of unallocated water from the strategic reserve as described in section 33B of the <i>Water Plan (Burdekin Basin) 2007</i>. In obtaining a 'coordinated project' declaration under the SDPWO Act, BRW would be able to qualify under the definition of a State purpose and CTRC could request and negotiate access to the water from DNRME without competition (through a Terms of Release/Sale) A Draft IAS has been prepared recommending that BRW be declared a 'coordinated project' requiring assessment by IAR.	CG - Department of State Development, Tourism and Innovation (DSDTI)	Approximately 2 to 3 months for preparation of IAS and pre-lodgement meetings. No statutory timeframe for the Coordinator General to decide the application / make the declaration. If declared a 'coordinated project' allow up to 18 months for IAR assessment and between 1 to 2 years for the final TOR and EIS assessment (including under a bilateral agreement). Final TOR could take up to 6 months to be decided.	Two pre-lodgement meetings have been held with the CG (January and May 2020) to discuss the project and preparation of the IAS prior to lodgement of an application for declaration. Discussions with DNRME have also highlighted the importance of obtaining a 'coordinated project' declaration in order to be able to access unallocated water from the strategic reserve. A Draft IAS has been submitted to the CG to seek feedback on the application and proposed level of assessment. A Final IAS will be subsequently prepared based on feedback received from the CG. Following lodgement of the Final IAS, the CG must decide whether or not to make the declaration. If declared to be a 'coordinated project', the assessment process will follow the process decided by the CG (e.g. IAR or EIS).
	Reference Design Pre-construction	Weir wall, saddle dam, storage area and access track.	The proponent of a proposed infrastructure facility can make an application to the CG for approval of a project as a PIF. The definition of a PIF in the Act includes a water storage facility. Approval as a PIF enables the CG to take land under section 153AA of the SDPWO Act if agreement cannot be reached between the proponent and registered owners of the land and/or native title parties. This is unlikely to be required for BRW. Land tenure advice from DNRME has indicated that the relevant permits under the Water Act 2000 will authorise the occupation of the water course for the weir infrastructure and storage area. And application for public utility easement can be sought to accommodate the weir access track and any minor inundation impacts on state lease land and freehold land.	CG - DSDTI	No statutory timeframe.	The application must include evidence that: • The project has been declared a coordinated project for which an EIS is required, the CG has publicly notified the CG's report for the project, the CG's report has not lapsed; and the area of land identified as required for the infrastructure facility is consistent with the land assessed in the EIS for the project. • An adequate environmental assessment has been carried out for the project in accordance with an environmental assessment process under another Act.
	Reference Design Pre-construction	Storage area	In Queensland, the majority of land use planning activities and development proposals are assessed under the <i>Planning Act 2016</i> . The <i>Planning Act 2016</i> is complemented by the RPI Act which extends the consideration of land use policies contained in regional plans to include resource activities (e.g. mining and petroleum) and other regulated activities (e.g.	DSDTI	Approximately 2 to 3 months for preparation of RIDA application and pre-application discussion with the RPI development assessment team. Followed by approximately 3 to 4 months for the assessment of the application by DSDTI depending on if	An assessment application for a RIDA must be made to DSDTI in the approved online form. The RPI Act requires that the assessment application must be accompanied by a report and the applicable fee. The report must assess the projects impact on the SEA and identify any constraints on
Regulated activity in a SEA RPI Act RPI Reg	Reference Design Pre-construction	Storage area				

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
			broadacre cropping and water storage dams) that generally occur outside the jurisdiction of the <i>Planning Act 2016</i> and local planning schemes. Approximately 13 km of the water storage area for BRW is located within an SEA. Regulated activities under the RPI Act that have the potential for widespread or irreversible impacts on the environmental attributes of the SEA are considered to be incompatible development. An activity is likely to have a widespread or irreversible impact if it permanently modifies any habitat or ecosystem components, results in a change in water quality, permanently changes surface or groundwater hydrology for a watercourse and impedes the natural transport of sediments along a river system. Therefore, a RIDA will be required for part of the BRW storage area as it overlaps with a SEA, constitutes a regulated activity for water storage and may be considered to have a widespread or irreversible impact.		public notification is required and if any submissions are received.	the configuration or operation of the activity. The project's impact on the SEA will need to be assessed against the criteria for assessment and decision in Schedule 2 of the RPI Reg. An email containing a project brief was sent to DSDTI seeking advice on the application requirements for BRW. A response from DSDTI was received identifying the specific provisions of the RPI Act and RPI Reg that need to be considered prior to making an application. A pre-application discussion will be held with DSDTI to better understand any potential conflicts and implications for BRW in respect to the SEA mapping and policies under the North Queensland Regional Plan prior to lodgement of the RIDA application.
Designation of premises for development of infrastructure (17 - water cycle management infrastructure) <i>Planning Act 2016 Planning Regulation 2017</i> Schedule 4, Schedule 4—Public notice requirements for consultation - <i>Minister's Guidelines and Rules under the Planning Act 2016</i>	Reference Design Pre-construction	Weir wall, saddle dam, storage area and access track.	An infrastructure designation (ID) is a decision of the Minister, or a local government, that identifies premises for the development of one or more types of infrastructure that are prescribed by regulation. In the case of BRW, it may include establishment of an ID area for the weir infrastructure and any subsequent development of water cycle management or supply infrastructure An ID is only considered to be necessary or beneficial for BRW if the project proponent is not a public sector entity.	DSDTI	Approximately 1 to 2 months for preparation of infrastructure proposal and Environmental Assessment Report (EAR). Once the infrastructure proposal is made, the Minister has 20 business days to make a decision on the level of impact, State interest checks, public consultation period and any further supporting information required to assess the application. Allow approximately 6 to 9 months for the assessment of an EAR and a decision from the Minister.	IAR or EIS to include sufficient information to address all aspects required by the infrastructure proposal and EAR (highlighting environmental values, potential impacts and mitigation measures). The infrastructure proposal and EAR could be submitted while the draft IAR or EIS is being assessed (if a streamlined process is agreed by the Minister) or following the CG's acceptance of the final IAR or EIS which could be after the 31 March 2021.
Tier two approvals						
State – DA rules approvals						
Owner's Consent <i>Planning Act 2016 Land Act 1994</i>	Reference Design Pre-construction	All activities undertaken on land not owned by the proponent.	Where the proponent is not the landholder, owner's consent is required to be obtained and provided to support MCU, reconfiguring a lot and some operational works development applications. For unallocated State land, State lease land and road reserves, consent must be obtained from the State Land and Asset Management Unit (SLAM).	SLAM - DNRME	No statutory timeframe. However, it generally takes up to 2 months to obtain owners consent from SLAM once the required forms have been lodged. - LA00 - Application form part A - LA08 - Application for owner's consent to a development application. Owners consent will also be required from freehold landholders where applicable.	Application to DNRME for owners consent for works within State land (road reserve, watercourse, leasehold) including the following forms: - LA00 - Application form part A - LA08 - Application for owner's consent to a development application. Owners consent will also be required from freehold landholders where applicable.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Development permit for operational works for taking or interfering with water in a watercourse. <i>Planning Act 2016 Planning Regulation 2017</i> <i>Water Act 2000</i> <i>Water Regulation 2016</i> <i>Water Plan (Burdekin Basin) Plan 2007</i> <i>Water Amendment Plan (Burdekin Basin) 2019</i> <i>Burdekin Basin Water Management Protocol 2016 (Amended June 2019)</i>	Reference Design Pre-construction	Weir wall, saddle dam, storage area and any construction related activities.	The will apply to operational works associated with construction of the BRW infrastructure within the Burdekin River and for the take of unallocated water. The proposed water storage is 10,000 ML with the potential for BRW to yield up to a maximum of 20,000 ML per annum. Unallocated water will need to be sourced from both the general and strategic reserve for the Upper Burdekin sub catchment area G to meet the proposed demand. Options for water trading with existing water allocation holders in the same sub catchment and/or water allocation zone will also be critical where each of the whole reserves is not able to be released by DNRME. A Terms of Sale is required to be negotiated with DNRME for the release and purchase of the unallocated water. A resource operations licence will also be required to trade and sell water under water supply agreements to other users.	DNRME	Usually 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process.	Assessment and consideration of water entitlement conditions are to be included as part of the 'coordinated project' process. The subsequent operational works development application will need to include: • DA Form 1 and Template 2: Taking or interfering with water in a watercourse, lake or spring • Drawings • Integrated Quantity and Quality Model • Land suitability studies (where the purpose for the take and cumulative impacts of irrigated agriculture are required to be considered) • SDAP State Code 10: Taking or interfering with water.
Development permit for operational works for constructing waterway barrier works or Compliance with accepted development requirements for operational work that is constructing or raising waterway barrier works <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Fisheries Act 1994</i>	Reference Design Pre-construction	Weir wall, saddle dam, access track and concrete floodway to Big Bend Recreation Reserve. Construction activities resulting in temporary waterway barrier works (e.g. erosion and sediment control structures).	This will apply to permanent and temporary waterway barrier works located within the bed and banks of the Burdekin River and Lowworth Creek. Both watercourses are identified as major waterways (purple).	SARA and DAF as a technical agency.	Usually 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process. Notification must be made prior to but no more than 20 business days before work commences and within 15 business days post-works.	Assessment and consideration of WWBW conditions are to be included as part of the 'coordinated project' process. The subsequent operational works development application will need to include: • DA Form 1 and Template 4: Waterway Barrier Works • Drawings • Hydraulic modelling • Written advice or a statement from a suitably qualified fish passage biologist to develop a suitable fish passage solution) • SDAP State Code 18: Constructing or raising waterway barrier works in fish habitats. Any waterway barrier works during construction that are temporary and meet the Accepted Development Requirements require pre work (prior to but no more than 20 business days) and post work (within 15 business days of completion) notification to DAF. Operational works development approval will be required if the construction timeframe exceeds the 180 calendar days or if the accepted development requirements cannot be met.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Development Permit for a MCU involving Environmentally Relevant Activities (ERAs) <i>Planning Act 2016 Planning Regulation 2017</i> <i>Environmental Protection Act 1994 (EP Act)</i> <i>Environmental Protection Regulation 2019</i>	Reference Design Pre-construction	Weir wall, saddle dam, storage area and laydown areas.	BRW has the potential to trigger the requirement for a number of ERA's including: • 8 Chemical storage • 16 Extractive and screening activities • 41 Cement manufacturing Given that these activities are likely to be dependent of the construction methodology adopted by the construction contractor, details are unlikely to be known prior to or during the 'coordinated project' process. However, if ERAs are applied for by the project proponent as part of the IAR or EIS, section 37 of the SDPWO Act provides that the CG's report can be taken to be the concurrence agency response for the application until a development approval under the <i>Planning Act 2016</i> has effect. As such, the CG's report on the IAR or EIS may be taken as the State response on ERAs until such time that a subsequent development application or environmental authority application is made.	SARA and DES as a technical agency.	Assessment of subsequent MCU development application will usually take 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process.	Assessment and consideration of ERA conditions are unlikely to be included as part of the 'coordinated project' process. If or when required, the MCU development application will need to include: • DA Form 1 • Attachments and supporting information for an application for an environmental authority • Land owner's consent • Drawings • Detail of ERA • Environmental management plans • SDAP State code 22 Environmentally relevant activities • Assessment for significant residual impact on any prescribed environmental matters present to identify any offsets obligations. If ERA's are not well defined during design, these will likely become the Contractor's responsibility to obtain prior to or during construction.
Referable dam <i>Planning Act 2016 Planning Regulation 2017</i> <i>Water Supply (Safety and Reliability) Act 2008</i>	Reference Design Pre-construction	Weir wall	Only applicable if BRW will have a variable flow control structure on the crest of the weir, as it may constitute a referable dam and require a failure impact assessment (FIA). A dam is referable if a FIA determines the dam will have a category 1 or category 2 failure impact rating. This is unlikely to be required for BRW. BRW is likely to require operational work within 25 m of a State transport corridor and the work will relate to access to a State transport corridor.	DNRME	Usually 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process.	Assessment and consideration of referable dam conditions are unlikely to be required as part of the 'coordinated project' process. If required, the operational works development application will need to include: • DA Form 1 • SDAP State code 20: Referable dams • FIA
Development permit for operational work impacting on and for access to a State Controlled Road (SCR) <i>Planning Act 2016 Planning Regulation 2017</i> <i>Transport Infrastructure Act 1994</i>	Reference Design Pre-construction	Weir wall, saddle dam and access track		DTMR	Usually 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process.	Assessment and consideration of SCR conditions are to be included as part of the 'coordinated project' process. The subsequent operational works development application will need to include: • DA Form 1 • SDAP State code 1: Development in a State-controlled road environment and State code 6: Protection of State transport networks • Traffic impact assessment.
Development permit for MCU and operational work triggers for vegetation clearing. <i>Planning Act 2016 Planning Regulation 2017</i> <i>Vegetation Management Act 1999 (VM Act)</i>	Reference Design Pre-construction	Weir storage area and access track. Additional vegetation clearing associated with construction laydown areas. Any other ground clearing associated	This will apply to the loss of any remnant vegetation from construction of BRW and filling of the water storage / impoundment area (including long term die back of vegetation located below the high banks of the Burdekin River). The baseline terrestrial ecological assessments revealed that the BRW study area supports least concern regional ecosystems dominated by open woodlands	SARA and DNRME as a technical agency.	Assessment of a subsequent MCU development application will take 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process. Operational works involving vegetation clearing usually takes 3 to 6 months under the <i>Planning Act 2016</i> but could	Assessment and consideration of vegetation clearing conditions are to be included as part of the 'coordinated project' process. The subsequent MCU and/or operational works development application will need to include: • Relevant purpose determination (where required) • DA Form 1

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
		with construction works.	and existing cleared grazing lands. No conservation significant flora species or TECs were considered likely to occur within these area. For a MCU, section 37 of the SDPWO Act provides that the CG's report can be taken to be the concurrence agency response for the application until a development approval under the <i>Planning Act 2016</i> has effect. As such, the CG's report on the IAR or EIS may be taken as the State response on vegetation clearing matters for a MCU until such time that a subsequent development application is made. For operational work, clearing of native vegetation is prohibited development unless it is for a relevant purpose under section 22A of the VM Act. A relevant purpose includes a project declared to be a 'coordinated project' under the SDPWO Act. Exemptions for clearing native vegetation also exist under Schedule 21 of the <i>Planning Regulation 2017</i>. Clearing vegetation for the construction or maintenance of infrastructure if the clearing is on designated premises is exempt development.		be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process.	- Supporting information (e.g. Vegetation Management Plan Report) - Assessment against SDAP State Code 16: Native vegetation clearing - Significant residual impact assessment. Measures have been recommended in the Baseline Ecological Assessment Reports (pre-wet and post-wet assessments) to avoid and mitigate potential impacts from construction and operational phases of BRW for the protection of terrestrial and aquatic ecological values in the region. A subsequent development permit would not be required for any clearing that can be carried out under an accepted development clearing code (such as for roads and firebreaks) or can be defined as exempt clearing work under Schedule 21 of the <i>Planning Regulation 2017</i> (i.e. if the clearing is on a designated premises as per the ID process). However, the Minister's assessment as part of the ID process would consider any proposed or future vegetation clearing that could be carried out on a designated premises. Note that additional clearing requirements may also apply under the Charters Towers Regional Town Plan.
Development permit for operational work in a wetland protection area. <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> EP Act	Reference Design Pre-construction	Weir storage area and construction activities.	This applies to operational work that is high impact earthworks in a wetland protection area. Examples of activities that involve high impact earthworks include: - Filling or levelling of land, including raising the level of land by the placing of fill material - Excavation of land, including excavation to create a canal, channel or water storage - Construction of a new drain - Overland flow storage and sediment erosion ponds - Construction of a levee, farm dam, weir or other barrier across a waterway - Construction of a road, culvert or causeway. BRW is not expected to impact on any nearby wetlands.	SARA and DES as a technical agency.	Usually 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process.	Assessment and consideration of wetland conditions are unlikely to be required as part of the 'coordinated project' process. If required, the operational works development application will need to include: - DA Form 1 - SDAP State Code 9: Great Barrier Reef wetland protection areas.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Local – DA rules approvals						
Development permit for MCU assessable development under the local government planning scheme <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> Charters Towers Regional Town Plan V.35 Dated 24/07/2019	Reference Design Pre-Construction	Weir wall, saddle dam and lay down areas	Under the Charters Towers Regional Town Plan, an impact assessable MCU application may be required for a 'utility installation' where not undertaken by a public sector entity in the rural zone. If undertaken by a public sector entity, BRW would be accepted development with no assessment benchmarks. The definition of 'utility installation' includes the use of premises for supplying or treating water and a maintenance or storage depot for supplying water. If the ID process is required and successfully undertaken, BRW will not require a subsequent MCU development application under the local planning scheme.	CTRC	If the project proponent is a private sector entity an impact assessable MCU development application will need to be lodged with CTRC for approval, however public notification may not be applicable as per section 37 of the SDPWO Act. On this basis assessment could take 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process. If the project proponent is a public sector entity, BRW would be considered accepted development for which there are no MCU development application requirements. No further assessment is required under the planning scheme if the project has been previously approved under the ID process.	Assessment and consideration of local planning scheme conditions are unlikely to be required as part of the 'coordinated project' process. No applications are required provided the project is undertaken by a public sector entity or approval has been previously obtained as part of the ID process. Assessment during the ID process will need to be included in the EAR against the relevant provisions of the Charters Towers Regional Town Plan. If not approved under the 'ID process and not undertaken by a public sector entity, a MCU development application will be required to be lodged with CTRC. The development application will require owner's consent, submission of design plans / drawings, supporting information / technical studies, and assessment against the relevant planning scheme provisions. Application fees will also be applicable.
Development permit for operational works (earthworks) assessable under the local government planning scheme <i>Planning Act 2016</i> <i>Schedule 6, Part 3, Item 8 of the Planning Regulation 2017</i> Charters Towers Regional Town Plan V.35 Dated 24/07/2019	Detailed Design Pre-construction	Bulk earthworks associated with weir wall, saddle dam, access track and laydown areas.	Bulk earthworks are identified as accepted development subject to complying with the development works codes for any excavation or filling that is (a) less than 1 metre above or below ground level and involving less than 100 m ³ of material; or (b) 1 metre or more above or below ground level and involving less than 50 m ³ of material. Any operational work undertaken by a private sector entity involving excavation or filling above these thresholds will require code assessment. Exemptions exist under Schedule 6, Part 3 of the <i>Planning Regulation 2017</i> for operational work undertaken by a public sector entity which cannot be made assessable under a local planning scheme. If the ID process is required and successfully undertaken, BRW will not require a subsequent operational works development application under the local planning scheme.	CTRC	If the project proponent is a private sector entity and the bulk earth works exceed the accepted development requirements, a code assessable operational works development application will need to be lodged with CTRC for approval. This could take between 3 to 6 months under the <i>Planning Act 2016</i> but could be expedited if previously assessed and conditioned by the CG as part of the 'Coordinated Project' process. If the project proponent is a public sector entity, operational works associated with BRW would be exempt from assessment under the local planning scheme. No further assessment is required under the planning scheme if the project has been previously approved under the ID process.	Assessment and consideration of local planning scheme conditions are unlikely to be required as part of the 'coordinated project' process. No applications are required provided the project is undertaken by a public sector entity or approval has been previously obtained as part of the ID process. Assessment during the ID process will need to be included in the EAR against the relevant provisions of the Charters Towers Regional Town Plan. For earthworks within the allowed thresholds for accepted development, work must comply with the development works code. For earthworks above the thresholds requiring code assessment, a development application must be lodged with CTRC. The development application will require submission of design plans / drawings, supporting information / technical studies, and assessment against the relevant planning scheme provisions. Application fees and payment of Qleave are applicable.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Plumbing and Drainage Work <i>Planning Act 2016</i> Schedule 6, Part 3, Item 8 of the <i>Planning Regulation 2017</i> <i>Plumbing and Drainage Act 2018</i> <i>Plumbing and Drainage Regulation 2019</i>	Detailed Design Pre-construction	Plumbing and drainage works associated with any buildings or structures (should the need for these be identified at a later date).	Only applicable if carrying out plumbing and drainage works. Plumbing and drainage work undertaken by a private sector entity may require an application to be submitted to CTRC under local law requirements. Exemptions exist under Schedule 6, Part 3 of the <i>Planning Regulation 2017</i> for plumbing and drainage work undertaken by a public sector entity which states that the work cannot be made assessable under a local planning scheme.	CTRC	As per the timeframes set out in the <i>Planning Act 2016</i> or <i>Plumbing and Drainage Act 2018</i> where applicable.	Certification of any plumbing and drainage works will be the Contractor's responsibility to obtain. No plumbing or drainage work is currently proposed as part of the Reference Design. Permit Work must be performed by a licensed Plumber and they must only perform the work as covered by their licence. A Standard Application for Permit Work must be lodged with CTRC for assessment and approval with mandatory inspections required prior to a Final Certificate being issued by CTRC's Plumbing Inspector.
Building Work <i>Planning Act 2016</i> <i>Planning Regulation 2017</i> <i>Building Act 1975</i>	Detailed Design Pre-construction	Building works associated with any pump stations, construction camps or maintenance or storage depots (should the need for these be identified at a later date).	Only applicable if carrying out building work. There is no building work regulated by the Charters Towers Regional Town Plan other than where identified in an overlay in section 5.8 of the Town Plan. However, under the <i>Building Act 1975</i> a development permit may be required for building work associated with any new buildings, pump stations, or other construction related activities (i.e. site offices, concrete batching plants, etc.).	CTRC / Private building certifier	As per the timeframes set out in the <i>Planning Act 2016</i> or <i>Building Act 1975</i> where applicable.	Certification of any building works will be the Contractor's responsibility to obtain. No building work is currently proposed as part of the Reference Design. Assessments are made against the National Construction Code and the relevant Australian Standards. Upon lodgement and approval of a Development Application for Building Work (if applicable), the works are then to be carried out by a qualified builder and certified by a Building Certifier.
Tier three approvals						
State – Non DA rules approvals CHMA and CHMP Duty of Care <i>Aboriginal Cultural Heritage Act 2003</i>	Reference Design Pre-construction	Invasive ground disturbance works (such as geotechnical investigations) during detailed design and/or pre-construction. Construction, operation and maintenance of the weir wall, saddle dam, storage area and access track.	This will apply to BRW in order to avoid impacting on any significant Aboriginal cultural heritage sites or places and to minimise the potential for harm to Aboriginal cultural heritage. A CHMA is required to meet the Duty of Care requirements prior to any invasive ground disturbance works occurring for BRW. A Draft CHMA has already been developed in consultation with NQLC and NAC and is expected to be executed by September 2020 in order to allow cultural heritage surveys and the subsequent investigative works for the project to occur this year. The project proponent will also need to develop a CHMP in consultation with NQLC and NAC for execution prior to the commencement of construction works. In addition to the construction works, the CHMP will also need to capture operational and maintenance requirements for the life of BRW.	<i>Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP)</i>	No statutory timeframes. Could take between 6 to 12 months for drafting of the agreement, negotiations and completion of cultural heritage surveys to clear the site for the relevant works to commence.	The CHMA and CHMP process generally requires the services of a native title lawyer to assist with drafting of the agreements and negotiations. In order reach agreement and for execution of the document, several meetings with NAC may be required. Once executed, cultural heritage surveys of the site will need to be undertaken in order to identify and cultural heritage features and agree on appropriate mitigation measures for works to occur.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
General Environmental Duty EP Act	Detailed Design Construction	Construction activities including access tracks, material transport, mobilisation and demobilisation activities and temporary laydown areas.	This applies to BRW. The general environmental duty outlines the duty of care responsibilities of all those undertaking work on the project and the obligation to take all necessary measures to prevent environmental harm.	DES	N/A	The project proponent and construction contractor will need to keep records of compliance and document what measures have been taken to comply with their General Environmental Duty (e.g. construction environmental management plan (CEMP), inspection checklists).
General Biosecurity Obligation <i>Biosecurity Act 2014 Commonwealth pest and weed management strategies</i>	Detailed Design Construction	Construction activities including access tracks, material transport, mobilisation and demobilisation activities.	This will apply to BRW where undertaking activities which may contribute to the spread of invasive plant or animal species.	Biosecurity Queensland DAF	N/A	The project proponent and construction contractor will need to demonstrate that all reasonable and practical steps have been taken to minimise the risks associated with invasive plants under their control. Records should typically consist of a CEMP, work method statements and inspection checklists.
Disposal permit EP Act	Construction	Removal of contaminated soils during construction.	This applies where soils are removed from land listed on the Environmental Management Register (EMR) or Contaminated Land Register (CLR) which exceed investigation thresholds. Contaminated soils may occur in locations of former cattle dips or other agricultural activities. A search of the EMR and CLR Register for Lot 4 DV450 (Fletcherview Research Station) indicates that the site it is not listed on either register. This is likely to be the primary lot for access and construction work. It is unlikely that a disposal permit will be required for BRW unless contamination of land occurs as a result of an incident/spill during the construction phase. This will be the responsibility of the contractor to manage during construction.	DES	Applications are usually decided within 10 business days.	If required, application to include: • Application form for a disposal permit for contaminated soil • Soil volume • Disposal location • Certificate of Title • Management options • Sampling results • Site plan showing contamination sources.
Protected plant clearing permit or exempt clearing notification NC Act	Detailed Design Pre-construction	Weir wall, saddle dam, storage area, access track and laydown areas. Ground clearing for construction.	This applies when clearing areas identified as being within the high risk flora survey trigger areas for protected plants or where protected plants have been detected, a flora survey must be undertaken in accordance with the guideline and a clearing permit or exemption notice obtained. A search of the Protected Plants Flora Survey Trigger Map identifies that the BRW study area does not contain any high risk areas. Baseline ecological assessments involving pre and post wet field surveys have also been undertaken and the presence of protected plants in key areas was not identified. However, further footprint specific surveys are recommended prior to any clearing for the access track, laydown areas and construction of the weir infrastructure within the watercourse.	DES	Approximately 3 months - the statutory timeframe for a decision on an application for a clearing permit is 40 business days (assuming no information requests or public notification requirements); An exempt clearing notification will be required to be submitted to the department at least one week prior to the clearing commencing and within one year of the survey. Receipt of notification typically confirmed within 5 business days.	If required, application for a clearing permit to include: • Application form • Prescribed application fee • Flora survey report • Impact management plan • Significant residual impact assessment • Landowner statement/ consent. An exempt clearing notification will require: • Application form • Flora survey report. Measures have been recommended in the Baseline Ecological Assessment Reports (pre-wet and post-wet assessments) to avoid and mitigate potential impacts from construction and operational phases of BRW for the protection of terrestrial flora values in the BRW footprint and study area.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Species management plan (SMP) NC Act <i>Nature Conservation (Wildlife Management) Regulation 2006</i>	Detailed Design Pre-construction	Weir wall, saddle dam, storage area, access track and laydown areas. Ground clearing for construction.	This applies when undertaking activities which impact on species listed under the NC Act. The BRW study area has the potential to support a small number of conservation significant species based on field survey records, previous records and the availability of suitable habitat within the study area. A likelihood of occurrence assessment and field surveys undertaken as part of the Baseline Ecological Assessment Reports (pre-wet and post-wet assessments) found that: - Three conservation significant fauna species, namely the greater glider (northern) (<i>Petauroides Volans minor</i>), squatter pigeon (southern) and short-beaked echidna (<i>Tachyglossus aculeatus</i>) were confirmed present within the study area - The koala (<i>Phascolarctos cinereus</i>) was considered likely to occur in the study area - One migratory species, the glossy ibis (<i>Plegadis falcinellus</i>) was confirmed present within the study area - Six migratory species were considered likely to occur in the study area No conservation significant aquatic species were considered likely to occur within the study area.	DES	40 business days (non-statutory).	If a High risk SMP is required, application to include: - Application Form - Species management program for tampering with animal breeding places (high risk of impacts) - Animal Breeding Place Report – survey results, mapping and other supporting information - Impact Management Plan - the scope of the activity and any proposed mitigation, rehabilitation or offsets - Landowner statement/consent - Animal breeding place register required to be provided to DES within 6 months of impacts occurring and within 10 business days of SMP expiring. If a Low risk SMP is required, application to include: - Application form - Species management program for tampering with animal breeding places (low risk of impacts) - Animal breeding place register required to be provided to DES annually and within 10 business days of SMP expiring. Measures have been recommended in the Baseline Ecological Assessment Reports (pre-wet and post-wet assessments) to avoid and mitigate potential impacts from construction and operational phases of BRW. This includes conducting pre-construction surveys and clearly identifying all fauna breeding habitat (e.g. hollow bearing trees) within the project construction footprint to determine the requirement for a SMP and then managing works in accordance with any conditions of an approved SMP. A fauna spotter catcher is also recommended to be present prior to and during clearing activities associated with construction to relocate or assist wildlife to disperse into adjacent habitat.
Environmental offsets <i>Environment Offsets Act 2014 (EO Act)</i>	Detailed Design Pre-construction	Residual impacts resulting from clearing activities.	Environmental offsets are required where there are residual impacts following the removal of fauna, flora and habitat that cannot be avoided after applying mitigation and management measures. An assessment of significant residual impacts in accordance with Queensland Environmental Offsets Policy Significant Residual Impact Guideline will be undertaken as part of the 'coordinated project' process through the IAR or EIS.	SAPA, DES and/or DNRME	3 to 4 months.	If offsets are required, these will likely be proportionate-driven (land-based) or require a financial settlement in accordance with the Environmental Offsets Policy. Offsets under this act will likely be conditioned as part of the 'coordinated project' process where not already required under the EPBC Act. A voluntary declaration under the VM Act can also be made to protect areas of high nature conservation, secure areas of land to satisfy offset requirements and to secure exchange areas under the VM Act and other legislation.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Permit to take quarry material from a watercourse <i>Forestry Act 1959</i> <i>Water Act 2000</i>	Detailed Design Pre-construction	Removing material from a watercourse for use in construction or other commercial purposes.	This will apply if material is proposed to be extracted from within the watercourse for use in the construction of access tracks or other construction activities. The requirement for material is to be determined by the construction contractor.	DNRME DAF	3 to 4 months.	If required, an application can be made to DNRME and/or DAF outlining the type and quantity of material to be extracted, the intended purpose, length of time required, and will require a report detailing: • Environmental management procedures • Operational procedures • Site layout • Emergency procedures and reporting.
Riverine Protection Permit (RPP) <i>Water Act 2000</i> <i>Water Regulation 2016</i>	Detailed Design Pre-construction	Clearing, excavation or filling within watercourses for the weir, saddle dam and the access track.	A RPP is required to excavate, place fill or destroy vegetation in a watercourse, lake or spring unless such works are otherwise authorised or exempt. It is assumed that the project proponent undertaking the works will be an approved entity under Schedule 2 of the RPP exemption guideline. If not, a RPP will be required. The purpose of the RPP exemption requirements are to outline when it is permitted to excavate, place fill or destroy vegetation in a watercourse, lake or spring without the need for a RPP under the <i>Water Act 2000</i> . For the exemption to apply vegetation clearing must be: • Carried out under an accepted development vegetation clearing code (other than category A), or • Of an area that is less than 0.5 ha of a least concern RE in a category B area, or • Of an area that is less than 0.5 ha in a category C, R or X area.	DNRME	2 months.	If an RPP is required, an application can be made to DNRME. The application will need to include the relevant application form, details and a plan denoting the area of disturbance and the adjacent landowner consents. If works can be undertaken using the exemption provisions, notification will need to be carried out in accordance with the RPP exemption guideline.
Take of water without a water entitlement <i>Water Act 2000</i> <i>Water Regulation 2016</i>	Detailed Design Pre-construction	Using water from a watercourse for use in construction activities.	This applies to the take of water by a constructing authority without a permit or licence for the purpose of constructing or maintaining infrastructure. It is assumed that the project proponent undertaking the works will be a constructing authority as defined in Schedule 2 of the <i>Acquisition of Land Act 1967</i> . If not, a permit or licence may be required if not captured as part of the development permit for the take of water from a watercourse.	DNRME	Notification required 10 business days before taking any water.	The project proponent and/or construction contractor are to undertake the works in accordance with ' <i>Exemption requirements for constructing authorities for the take of water without a water entitlement</i> '. A record must also be kept with details of the water taken for a period of 2 years.

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Work in a State Road Corridor <i>Transport Infrastructure Act 1994</i>	Detailed Design Pre-construction	Construction transport and logistics as well as construction activities.	A Road Corridor Permit will be required for undertaking an activity, conducting works or erecting a structure within the State-controlled road corridor during construction.	DTMR	4 weeks	Road Corridor Permit application form and any plans or specifications along with any other supporting documents such as public liability insurance.
			A Traffic Control Permit will be required for any required lane closures and traffic controls. These permits are likely to be applied for by the construction contractor prior to or during construction as details are unlikely to be known during the 'coordinated project' process or initial approvals phase. This applies to development on State lease land and freehold land.			Traffic Control Permit application and indemnity form, including traffic management plan.
Public utility easement <i>Land Act 1994</i> <i>Land Title Act 1994</i>	Reference Design Detailed Design Pre-construction	Weir storage area and access track	An application to DNRME will be required to apply for a right of way public utility easement for the weir access track on State lease land under section 369 of the <i>Land Act 1994</i> . A public utility easement will also be required for parts of the water storage area that inundate State lease land and freehold land. This can be applied for under section 362(5) of the <i>Land Act 1994</i> and section 82 of the <i>Land Title Act 1994</i> . To be able to be granted a public utility easement, the grantee needs to be a public utility provider. It is assumed that the project proponent will be a public utility provider as defined under Schedule 6 of the <i>Land Act 1994</i> . If the project proponent is not a recognised public utility provider, an applicant can be made to DNRME to seek approval to be considered as a public utility provider for a particular public utility service.	SLAM - DNRME	No statutory timeframe. Allow between 3-6 months	An application to DNRME for a public utility easement should include: • LA00—Application form part A • LA11—Application for an easement over state land • Application fee • Any additional attachments, as requested (including how native titles have been addressed (if relevant)) • If the easement application is successful, the easement document will need to be signed by all parties and the plan of survey submitted to DNRME. Approval for easements will be provided on a <i>Titles Registry Form 18—General consent</i> which must be registered in the Queensland Titles Registry for the easement to be valid.
			This applies to development (including the building of infrastructure and structures) in protected areas. An application to DES under sections 34, 35 and 35a of the NC Act will be required for the potential inundation of a small area of low lying land and a tributary (at FSL) within the boundaries of Dalrymple National Park. Any infrastructure and development on protected areas must generally be consistent with the management principles for the protected area and any management plan or statement for the area.	DES	No statutory timeframe. Allow between 3-6 months	An application to DES will need to include: •The relevant application form •A submission report •A n environment management plan •A survey plan or administrative plan/map. Where significant residual environmental impacts are likely to result from a proposed infrastructure project on a protected area, an environmental offset may be required under the State Offsets Framework.
Authorisations for the development of infrastructure in a protected area. NC Act						

Approval / Relevant legislation	Project phase	Relevance / Project activities	Trigger / Applicability	Approving authority	Approval timeframes	Approval requirements
Applying to dedicate State land as local road reserve. <i>Land Government Act 2009</i>	Detailed Design Pre-construction	Concrete floodway to Big Bend Recreation Reserve	This applies to the proposed concrete floodway (located approximately 3.5 km upstream of the proposed weir infrastructure). A dedicated road reserve is required where road related infrastructure is to be located on State land and public use and access is proposed. It is assumed that the proposed floodway would become an extension of Big Bend Road.	CTRC and DNRME	No statutory timeframe, Allow between 3- 6 months.	Application requirements to be confirmed with CTCRC. DNRME will also need to be consulted to confirm that no application need to be lodged with them for dedication of a local road on State land.
Local – Non-DA rules approvals						
Work in a local road corridor <i>Local Law No. 1 (Administration) 2011</i> <i>Subordinate Local Law No. 1.15 (Carrying out Works on a Road or Interfering with a Road or its Operation) 2011</i>	Detailed Design Pre-construction	Construction transport and logistics; construction activities	This will apply to the use of local governmental roads during construction. A Road Opening Permit and /or Application for Road Excavation / Road Closure Permit / Carrying out works or interfering with a road approval may be required for construction related activities. These permits are likely to be applied for by the construction contractor prior to or during construction as details are unlikely to be known during the 'coordinated project' process or initial approvals phase.	CTRC	2 weeks	If required, application to CTCRC to include: • Full details of the proposed works or interference including plans and specifications • Details of any building work and other work to be carried out under the approval • Details of the time and place at which the prescribed activity will be undertaken • The proposed term of the approval • The impact, if any, of the prescribed activity on pedestrian or vehicular traffic • The materials, equipment and vehicles to be used in the undertaking of the prescribed activity • Plans and specifications detailing: – The relevant part of the road that is to be used for the undertaking of the prescribed activity; and – The proposed location of each structure and item of equipment to be used in the undertaking of the prescribed activity; and – The type and location of any utility, service or infrastructure to be used in the undertaking of the prescribed activity. • If requested — a traffic management plan • If requested — a report, study or certification from a suitably qualified person.

5. Recommendations and conclusions

In considering the regulatory approvals framework in Section 4 and the relationship between different State legislation (including the available provisions to streamline approval processes for significant infrastructure projects), the following recommendations are provided:

- BRW will need to be declared a 'coordinated project' under the SDPWO Act or a project of regional significance under the *Water Act 2000* in order for DNRME to be able to release unallocated water from the strategic reserve. This has been assessed and described in further detail as part of a separate Water Entitlement Options Report for BRW.
- The preferred approvals pathway is to apply for a 'coordinated project' declaration, in which case an IAS will need to be submitted to the CG to demonstrate that BRW:
 - Has complex (multi-jurisdictional) approval requirements, the potential for significant environmental effects, strategic significance to the locality, region or State, and/or significant infrastructure requirements.
 - Is not inconsistent with relevant local government, State or the Commonwealth planning schemes or policy frameworks.
 - Has alignment with local, State and Commonwealth government priorities.
 - Has a proponent who is capable to provide the necessary engineering, social, economic and environmental detail necessary to achieve regulatory compliance and complete the required level of assessment (IAR or EIS).
 - Has undergone pre-feasibility assessments to demonstrate that there is sufficient need/demand for the water and the investment in the proposed infrastructure will benefit stakeholders and the broader community, and provide resilience and incentive for growth in the regional economy.
 - Will not unnecessarily prevent public access or significantly undermine the existing environmental and cultural value of the Burdekin River system.
 - Will not conflict with or undermine other committed government investments in water resources or other matters the CG considers relevant.
- The following actions will also need to be undertaken prior to or in parallel with the 'coordinated project' declaration and assessment process under the SDPWO Act:
 - Submit the EPBC Referral under the EPBC Act for potential impacts on MNES. Should the determination by DAWE consider BRW to be a 'controlled action', the environmental assessment could be managed under a bilateral agreement with the State.
 - Commence native title discussions and seek to establish a CHMA and CHMP with NQLC and NAC as well as progress the land tenure requirements (i.e. land access consents, protected area authorisations and applications for public utility easements) with DNRME's SLAM unit, DES and impacted landholders.
 - Submit a RIDA application under the RPI Act for a regulated activity in a SEA.
 - Should the proponent of BRW not be a public sector entity, consider seeking an ID for water cycle management infrastructure under the *Planning Act 2016*. The infrastructure proposal and required EAR could be supported by the IAR/EIS documentation and if the ID is granted by the Minister, the project will no longer require subsequent assessment and approvals under the Charters Towers Regional Town Plan or VM Act.

- Following receipt of project approvals under the SDPWO Act, EPBC Act (if a 'controlled action') and RPI Act the proponent for BRW will need to apply for all other DA and non- DA approvals as identified in Table 4-1.

The recommended approvals pathway and project timeline for construction of BRW to commence in 2022 is summarised below in Figure 5-1.

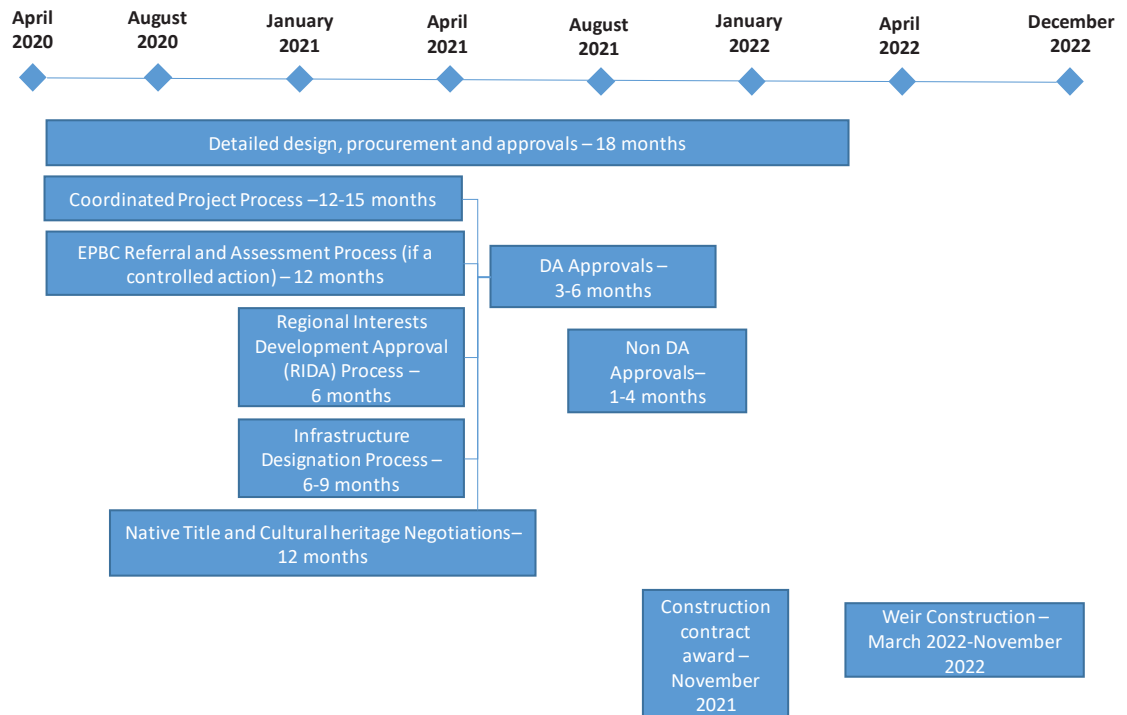


Figure 5-1 Recommended approvals pathway and project timeline

GHD

71 Stanley Street
Townsville QLD 4810
T: 07 4720 0400 F: 07 4772 6514 E: tsvmail@ghd.com

© GHD 2020

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

12512214-82335-611/https://projectsportal.ghd.com/sites/pp10_05/bigrockswear/ProjectDocs/02 - Environmental Assessment/Approvals Register/12512214-REP-1_Regulatory Approvals Plan.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	R. Peardon	P. Bradley	<i>*P. Bradley</i>	S.Orr	<i>*S.Orr</i>	17.04.2020
1	R.Peardon	K.Kerr	<i>*K.Kerr</i>	S.Orr	<i>*S.Orr</i>	19.08.2020

**Denotes record on file*

www.ghd.com



GHD
71 Stanley Street
Townsville
T: 61 7 4720 0400 F: 61 7 4772 6514 E: tsvmail@ghd.com

© GHD 2021

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

12512214-56532-668/https://projectsportal.ghd.com/sites/pp10_05/bigrockswear/ProjectDocs/02 - Environmental Assessment/Initial Advice Statement/12512214-REP-1_Big Rocks Weir_Initial Advice Statement.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	E. Rothwell R. Peardon	P Bradley	<i>*P Bradley</i>	S Orr	<i>*S Orr</i>	29.09.20
1	R. Peardon	N. Thomas-Kinsella	<i>* N. Thomas-Kinsella</i>	S Orr	<i>*S Orr</i>	19.01.21

**Denotes signature on file*

10,000ML

Guaranteed Water Supply

3,000+ ha

New Irrigated Agriculture

172

Construction FTE Jobs

117

Operational FTE Jobs

\$35M

Additional Agricultural
Revenue per annum

