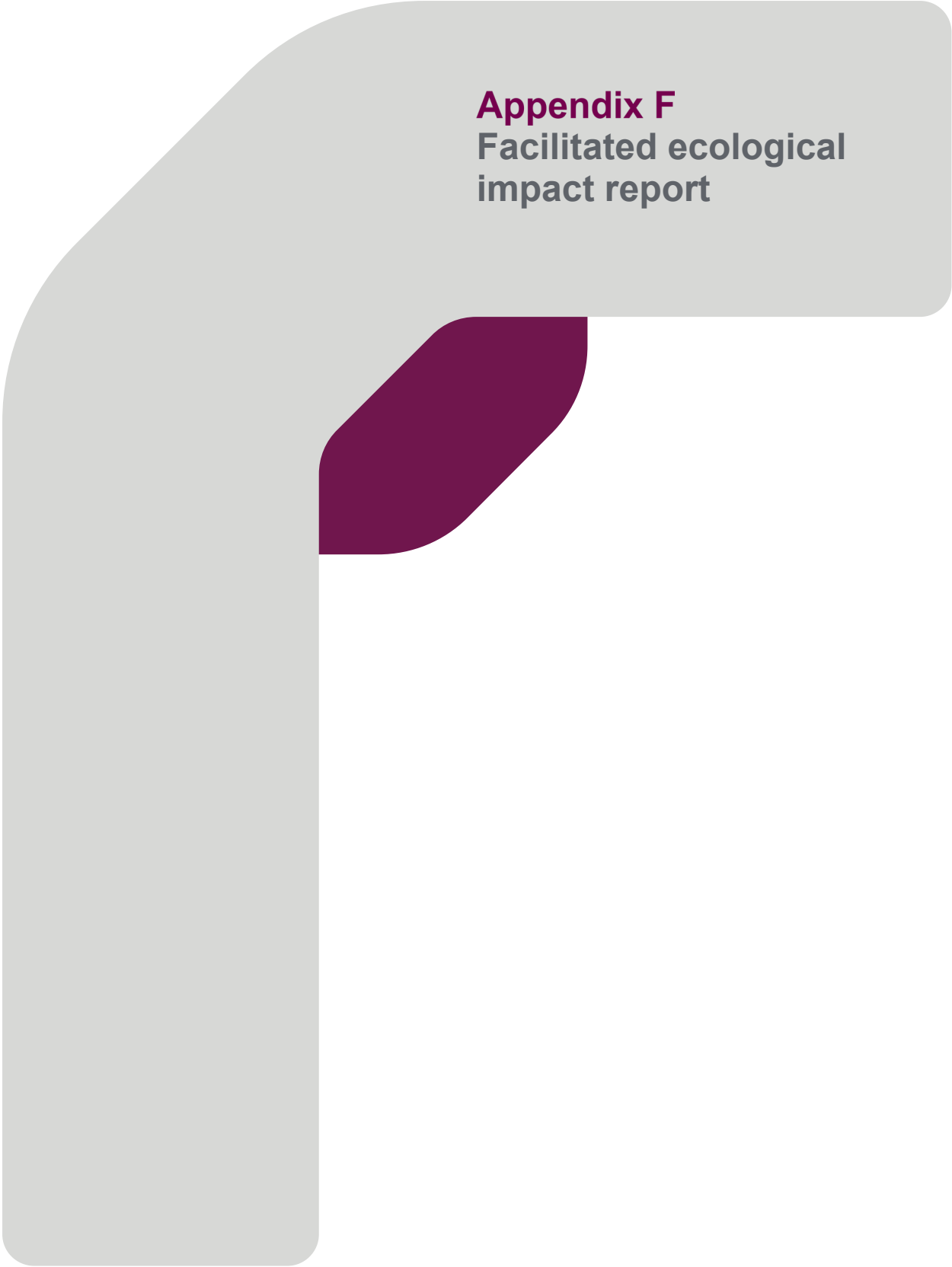




Appendix F

Facilitated ecological impact report



Bowen Pipeline: Facilitated Agricultural (Horticulture) Development — Potential Facilitated Impacts to the Receiving Environment.

Prepared for:

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Summary

Introduction

The proposed Bowen Pipeline Project (the Project) is a new, underground water pipeline, approximately 110 km long, from the Burdekin River at Home Hill to Merinda near Bowen. The pipeline will be capable of supplying 100,000 ML of water per annum. It is anticipated that more than 90% of the water will be used for horticulture and agriculture. Irrigation will be drip and trickle, with no flood irrigation. It is anticipated that the water will be used to irrigate approximately 7,900 ha of horticulture.

In this report, potential impacts to the receiving environment that may result from land-based discharges resulting from horticulture irrigation using water from the Project (i.e. facilitated impacts of the use of irrigation water on the receiving environment).

Values of the Receiving Environment

The receiving environment for potential increased runoff from changes to agriculture facilitated by the Project is the Great Barrier Reef, and in particular the inshore area in the region of the Project. The coastal environment offshore of the Project supports a range of estuarine and marine habitats that include saltmarsh, mangroves, mudflats, seagrass beds and coral reefs. These provide high value feeding, spawning and nursery grounds for a variety of commercially, recreationally and culturally significant plants and animals. The receiving environment is a World Heritage Area, National Heritage Place and Marine Park, and there are a variety of species of significance to conservation in the receiving environment.

Potential Means of Impact

The key potential impacts of FAHD on the receiving environment of the GBRWHA are increased loads of sediment, nutrients and pesticides exported from the catchment to the receiving environment.

Estimation of Likely Changes to Catchment Loads

Annual pollutant loads from the Lower Fitzroy Project were used to estimate potential loads from FAHD for the Bowen Pipeline Project. Annual pollutant loads were calculated using the HowLeaky? Model using best available soil, vegetation, herbicide/pesticide and soil nutrient information for two representative soil types at two locations (Yaamba and Westwood). Three grazing practices were modelled to represent current land use practice,

and an intensive irrigated cropping sequence with two levels of irrigation and horticulture were modelled to represent loads from FAHD. Model input parameters were compared to conditions for the Bowen Pipeline Project, with parameters generally similar except for higher wet season rainfall in the Bowen Pipeline Project Area.

This estimation process indicated that loads of sediment, total P and total N were likely to significantly decrease as a result of increased vegetation cover resulting from the conversion of cleared grazing land to horticulture.

The estimation process also indicated that pesticide loads may increase, however pesticide loads can be reduced via requirements in the Land and Water Management Plans and implementation of current regulations, that will be required for using the water.

Compliance with the Reef 2050 WQIMP

The Reef 2050 WQIP targets for the Burdekin Region are to reduce:

- fine sediment loads by 890 kilo-tonnes (30% reduction)
- particulate phosphorous loads by 490 tonnes (25% reduction)
- dissolved inorganic nitrogen loads by 820 tonnes (60% reduction)
- particulate nitrogen loads by 800 tonnes (25% reduction).

The estimated decreases in sediment, total P and total N loads from FAHD are likely to contribute to meeting these targets.

The Reef 2050 WQIP has a trigger of 90% of land in priority areas under grazing, horticulture, bananas, sugar cane and other broad acre cropping are managed using best practice systems for water quality outcomes (soil, nutrients and pesticides). Under the Water Act 2000, an approved Land and Water Management Plan (LWMP) is required before using water from a new or additional water allocation. All facilitated agricultural customers will be required to develop and operate under an approved LWMP, that includes best practices systems for water quality outcomes. That is, the FAHD supports this trigger of Reef 2050.

The pesticide target in the Reef 2050 is to protect at least 99% of aquatic species at the end of catchments. The receiving environment load estimates indicate there may be an increase in pesticide loads, however this is a low priority for the Burdekin River catchment, and will likely be managed through the implementation of the Chemical Usage (Agriculture and Veterinary) Control Regulation and approved LWMP.

Mitigation Measures

All FAHD operators will be required to implement approved LWMPs, this provides a significant opportunity to implement load reduction strategies by all operators using the new water supply.

Recommended mitigation includes:

- involvement by the Bowen Pipeline Company / SunWater with regional NRM programs as they relate to its operations.
- limiting FAHD to good quality agricultural land (GQAL) in areas that have already been cleared. There are approximately 36,628 ha of GQAL in cleared areas adjacent to the Project.
- building management requirements for the use of pesticides into LWMPs. For example, by introducing mandatory requirements for irrigated horticulture, similar to those for cane farmers. It is mandatory for regulated cane farmers to:
 - apply fertiliser at no more than the amount calculated in accordance with a prescribed methodology, taking into account soil testing. Applying fertiliser in accordance with this methodology minimises the risk of nutrient run off from excess application
 - follow specific controls when using herbicide products containing atrazine, ametryn, hexazinone and diuron, which prevents overspray and run off from herbicide products.
- keeping records of their use of fertilisers and agricultural chemicals to provide evidence to compliance officers of the improvement in practices
- commitment to catchment restoration projects including riparian revegetation, gully repair, streambank stabilisation and coastal wetlands rehabilitation, and
- participation in communication and education programs regarding the benefit of improved practices and water quality.

Assessment of Significant Impact

Estimates of catchment loads resulting from FAHD from the Bowen Pipeline Project based on estimates for the Lower Fitzroy Project, indicate that where mitigation is implemented:

- there is likely to be a decrease in sediment and nutrient loads, contributing to the targets listed in the Reef 2050 WQIMP, and that

- pesticide targets of the Reef 2050 WQIMP could be achieved via current regulations and the required Land and Water Management Plans.

That is, changing land use from predominantly grazing to irrigated horticulture would help achieve the goals of the Reef 2050 WQIMP, and improve the resilience of the GBRWHA and associated MNES, MSES, and key habitats and species.

As such, the discharges to the GBRWHA associated with the FAHD are unlikely to have a significant residual impact on the GBRWHA and associated key species and habitats, and consequently there is not a need to offset negative impacts.

1 Introduction

The proposed Bowen Pipeline Project (the Project) is a new underground water pipeline, approximately 110 km long, from the Burdekin River at Home Hill to Merinda, near Bowen (Map 1). The pipeline will be capable of supplying 100,000 ML of water per annum. It is anticipated that more than 90% of the water will be used for horticulture and agriculture (Adaptive Strategies 2017).

The target market for the water is primarily horticultural, using trickle or drip irrigation, with most of the water from the Project used in this sector. Water from the Project will not be used in flood irrigation (Adaptive Strategies 2017). It is anticipated that the water will be used to irrigate approximately 7,900 ha of horticulture (KPMG 2016).

Under the *Water Act 2000*¹, a Land and Water Management Plan (LWMP) is required to be approved and declared by the Minister before water from a new or additional water allocation may be used. That is, all facilitated agricultural customers will be required to develop and operate under an approved LWMP (SunWater 2009).

In this report, potential impacts to the receiving environment, comprising the Great Barrier Reef World Heritage Area and associated Matters of National and State Environmental Significance (MNES and MSES), that may result from land-based water discharges resulting from horticultural irrigation using water from the Project (Facilitated Agricultural (Horticulture) Development: FAHD) are assessed. All other impacts due to construction and operation of the pipeline are not addressed in this report.

This report provides:

- a summary of the values of the receiving environment (including the Great Barrier Reef World Heritage Area, MNES and MSES)
- a description of the mechanisms and scale of impact based on empirical data
- an assessment of the likely impacts against water quality targets (Reef 2050)
- available mitigation measures (including existing Natural Resource Management (NRM) activities), and
- the assessment of significant residual impacts.

¹ Current as at 18 June 2021

Catchment load estimates from Facilitated Agricultural Development (FAD) for the Lower Fitzroy River Infrastructure Project were used to estimate the range of likely catchment loads resulting from FAHD associated with the Bowen Pipeline Project.

2 Values of the Receiving Environment

2.1 Overview

The receiving environment for potential increased runoff from changes to agriculture facilitated by the Project is the Great Barrier Reef, and in particular the inshore area in the region of the Project.

The coastal environment seaward of the Project supports a range of estuarine and marine habitats that include saltmarsh, mangroves, mudflats, seagrass beds and coral reefs. These provide high value feeding, spawning and nursery grounds for a variety of commercially, recreationally and culturally significant plants and animals (SunWater 2009). The coastal waters offshore of the Project are in the 'high nutrient coastal strip' bioregion of the Great Barrier Reef. This bioregion is characterised by terrigenous mud, high levels of nutrients from the adjoining land, seagrass in sheltered waters and a wet tropic climate (Kerrigan et al. 2010). With the exception of the granite headlands of Cape Upstart, and smaller headlands, the coastline is characterised by low-lying, soft sediment environments, particularly in Upstart and Abbot Bays (SunWater 2009).

Mangroves and mudflats dominate the intertidal, with seagrass in the low intertidal, and shallow subtidal. Mangrove communities are relatively diverse, with closed *Rhizophora stylosa* and open *Ceriops tagal* communities dominating. Seagrass has also been recorded near Abbot Point and in Edgecombe Bay. Seagrass communities are characteristically dominated by *Zostera muelleri*, and *Halophila ovalis*, with other *Halophila* and *Halodule* spp. subdominant (SunWater 2009). The seagrass communities provide important feeding grounds for protected species including marine turtles and dugong, with over 300 dugong recorded in Upstart Bay (SunWater 2009).

Offshore of this coastal strip in the receiving environment of the Project, there is the mid-shelf lagoon, with coral reefs further offshore again. The mid-shelf lagoon is characterised by muddy sediment, with minimal algae and seagrass (Kerrigan et al. 2010).

There are several inshore coral reefs adjacent to the Project area, with the more significant reefs on the inner Great Barrier Reef (GBR) shelf. The closest GBR reefs to the Project area are Old and Stanley Reefs, which are approximately 40 km from the coast (SunWater 2009). Coral reefs offshore of the Project are predominantly classified as 'exposed mid-shelf reefs' and 'strong tidal mid-shelf reefs'. The exposed mid-shelf reefs are exposed to the Coral Sea, with clear water and strong wave action on the outer reef area. Episodic flood plumes from the Burdekin River may reach inner reefs, resulting in greater cross-shelf variation than in other bioregions of the GBR. The strong tidal mid-shelf reefs have high energy tidal movement, water is relatively turbid and productivity in the water column is

high. Leeward parts of these reefs are dominated by filter feeders and there are biologically distinct fish communities (Kerrigan et al. 2010).

Three species of marine turtles are commonly found in the area: green (*Chelonia mydas*), loggerhead (*Caretta caretta*) and flatback (*Natator depressus*). Green and flat back turtles also nest on the beaches of Abbot Bay. Dolphins are found in the area, generally in low density in Upstart and Abbot Bay (SunWater 2009). Dugong and estuarine crocodiles are known from the area, and the region supports significant recreational and commercial fisheries.

2.2 Matters of National Environmental Significance

The Australian Government's key piece of environmental legislation is the EPBC Act. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as Matters of National Environmental Significance (MNES). MNES comprise:

- 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.

The Protected Matters Search Tool (DCCEEW 2023) was used to determine the MNES that may occur within 5 km downstream of the Project, in the receiving environment (Appendix A).

The following MNES relevant to the receiving environment were listed in the Protected Matters search:

- World Heritage Properties – Great Barrier Reef World Heritage Area

- National Heritage Places – Great Barrier Reef
- Wetland of International Importance (Ramsar Wetland): Bowling Green Bay
- Great Barrier Reef Marine Park – Conservation Park, General Use, Habitat Protection and Marine National Park Zones
- listed threatened species, and
- listed migratory species.

Commonwealth marine areas extend from 3 km offshore to the outer edge of the Australian exclusive economic zone, and are not considered to be in the receiving environment for the Project.

2.3 Great Barrier Reef World Heritage Area (GBRWHA), and National Heritage Place

The Great Barrier Reef was inscribed on the World Heritage List in 1981 as it met all four World Heritage Criteria in place at the time of listing, as well as having integrity (DoE 2014). These four criteria were that it is:

- an outstanding example representing the major stages in the earth's evolutionary history
- an outstanding example representing significant ongoing ecological and biological processes
- an example of superlative natural phenomena, and it
- contains important and significant habitats for in situ conservation of biological diversity (DCCEEW 2021a).

While the definition of the natural criteria has changed, the Great Barrier Reef World Heritage Area (GBRWHA) still meets all four natural criteria (Table 2.1).

The GBRWHA covers approximately 348,000 km², and extends from the top of Cape York in north-east Australia to just north of Bundaberg, and from the low water mark on the Queensland coast to the outer boundary of the Marine Park, beyond the edge of the continental shelf, up to 250 km offshore (Map 2).

In May 2007, the Great Barrier Reef World Heritage Area was placed on the National Heritage list (DCCEEW 2022).

The objective in managing National Heritage places is to identify, protect, conserve, present and transmit, to all generations, their National Heritage values.

The official National Heritage Values of this National Heritage Place are (DCCEEW 2021a):

- Criterion A: Events Processes, as this place meets World Heritage criteria vii, viii, ix and x
- Criterion B: Rarity, as this place meets World Heritage criteria x
- Criterion C: Research, as this place meets World Heritage criteria viii, ix and x
- Criterion D: Principal characteristics of a class of places, as this place meets World Heritage criteria viii, ix and x, and
- Criterion E: Aesthetic characteristics, as this place meets World Heritage criteria vii.

Pressures

Climate change is the most significant threat to the GBRs ecosystem and heritage values, and therefore to its outstanding universal value (State of Queensland 2018). Climate change continues to negatively affect all 4 World Heritage natural criteria. While the property remains whole and intact, ecosystem resilience is deteriorating, and the property's size is becoming less effective as a buffer against these disturbances (State of Queensland 2018).

Poor water quality including sediments, nutrients and pesticides flowing into the GBR from activities such as agriculture is also a major threat (State of Queensland 2018). Land-based run-off has been identified as one of the key factors influencing the condition of the Great Barrier Reef's ecosystem and heritage values, and therefore its outstanding universal value (State of Queensland 2018).

The Great Barrier Reef's ecosystem (and therefore its outstanding universal value) remains vulnerable to the effects of past, current and future coastal development, as well as cumulative impacts (State of Queensland 2018). Emerging issues include proposed port expansions, increases in shipping activity, coastal development and intensification, direct commercial and non-commercial use and changes in land use within the GBRWHA catchment; population growth; the impacts from marine debris; illegal activities; and extreme weather events including floods and cyclones (UNESCO 2021).

The observed impacts from direct commercial and non-commercial use of the Great Barrier Reef are mainly localised. However, collectively, there are some clear impacts in some areas. The cumulative effects of extraction and damage to the Great Barrier Reef by direct

use, coupled with smaller windows of recovery, are reducing the resilience of the ecosystem (State of Queensland 2018).

Natural pressures to the GBRWHA include cyclones, crown-of-thorns starfish outbreaks, and sudden large influxes of freshwater from extreme weather events (UNESCO 2021), as well as pressure from human activities such as tourism, shipping and coastal developments (UNESCO 2021).

Integrity

The ecological integrity of the GBRWHA is enhanced by the unparalleled size and current good state of conservation across the property. At the scale of the GBR ecosystem, most habitats or species groups have the capacity to recover from disturbance or withstand ongoing pressures. The property is largely intact and includes the fullest possible representation of marine ecological, physical and chemical processes from the coast to the deep abyssal waters enabling the key interdependent elements to exist in their natural relationships (UNESCO 2021). However, while the Great Barrier Reef remains whole and intact and maintains many of the elements that make up its outstanding universal value, there has been deterioration in significant components since its inscription. This deterioration has affected the integrity of the Reef's outstanding universal value (GBRMPA 2019).

Table 2.1 Statement of Outstanding Universal Value for the Great Barrier Reef World Heritage Area against current criteria (Lucas et al. 1997).

World Heritage Criteria	Description
vii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance	The GBR is of superlative natural beauty above and below the water, and provides some of the most spectacular scenery on earth. It is one of a few living structures visible from space, appearing as a complex string of reefal structures along Australia's northeast coast. From the air, the vast mosaic patterns of reefs, islands and coral cays produce an unparalleled aerial panorama of seascapes comprising diverse shapes and sizes. The Whitsunday Islands provide a magnificent vista of green vegetated islands and spectacular sandy beaches spread over azure waters. This contrasts with the vast mangrove forests in Hinchinbrook Channel, and the rugged vegetated mountains and lush rainforest gullies that are periodically cloud-covered on Hinchinbrook Island. On many of the cays there are spectacular and globally important breeding colonies of seabirds and marine turtles, and Raine Island is the world's largest green turtle breeding area. On some continental islands, large aggregations of over-wintering butterflies periodically occur. Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours; for example, spectacular coral assemblages of hard and soft corals, and thousands of species of reef fish provide a myriad of brilliant colours, shapes and sizes. The internationally renowned Cod Hole near Lizard Island is one of many significant tourist attractions. Other superlative natural phenomena include the annual coral spawning, migrating whales, nesting turtles, and significant spawning aggregations of many fish species.
viii) be outstanding examples 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	The GBR, extending 2,000 kilometres along Queensland's coast, is a globally outstanding example of an ecosystem that has evolved over millennia. The area has been exposed and flooded by at least four glacial and interglacial cycles, and over the past 15,000 years reefs have grown on the continental shelf. During glacial periods, sea levels dropped, exposing the reefs as flat-topped hills of eroded limestone. Large rivers meandered between these hills and the coastline extended further east. During interglacial periods, rising sea levels caused the formation of continental islands, coral cays and new phases of coral growth. This environmental history can be seen in cores of old massive corals. Today the GBR forms the world's largest coral reef ecosystem, ranging from inshore fringing reefs to mid-shelf reefs, and exposed outer reefs, including examples of all stages of reef development. The processes of geological and geomorphological evolution are well represented, linking continental islands, coral cays and reefs. The varied seascapes and landscapes that occur today have been moulded by changing climates and sea levels, and the erosive power of wind and water, over long time periods. One-third of the GBR lies beyond the seaward edge of the shallower reefs; this area comprises continental slope and deep oceanic waters and abyssal plains.
ix) be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	The globally significant diversity of reef and island morphologies reflects ongoing geomorphic, oceanographic and environmental processes. The complex cross-shelf, longshore and vertical connectivity is influenced by dynamic oceanic currents and ongoing ecological processes such as upwellings, larval dispersal and migration. Ongoing erosion and accretion of coral reefs, sand banks and coral cays combine with similar processes along the coast and around continental islands. Extensive beds of Halimeda algae represent active calcification and accretion over thousands of years. Biologically the unique diversity of the GBR reflects the maturity of an ecosystem that has evolved over millennia; evidence exists for the evolution of hard corals and other fauna. Globally significant marine faunal groups include over 4,000 species of molluscs, over 1,500 species of fish, plus a great diversity of sponges, anemones, marine worms, crustaceans, and many others. The establishment of vegetation on the cays and continental islands exemplifies the important role of birds, such as the Pied Imperial Pigeon, in processes such as seed dispersal and plant colonisation. Human interaction with the natural environment is illustrated by strong ongoing links between Aboriginal and Torres Strait Islander peoples and their sea-country, and includes numerous shell deposits (middens) and fish traps, plus the application of story places and marine totems.
x) to contain 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	The enormous size and diversity of the GBR means it is one of the richest and most complex natural ecosystems on earth, and one of the most significant for biodiversity conservation. The amazing diversity supports tens of thousands of marine and terrestrial species, many of which are of global conservation significance. As the world's most complex expanse of coral reefs, the reefs contain some 400 species of corals in 60 genera. There are also large ecologically important inter-reefal areas. The shallower marine areas support half the world's diversity of mangroves and many seagrass species. The waters also provide major feeding grounds for one of the world's largest populations of the threatened dugong. At least 30 species of whales and dolphins occur here, and it is a significant area for humpback whale calving. Six of the world's seven species of marine turtle occur in the GBR. As well as the world's largest green turtle breeding site at Raine Island, the GBR also includes many regionally important marine turtle rookeries. Some 242 species of birds have been recorded in the GBR. Twenty-two seabird species breed on cays and some continental islands, and some of these breeding sites are globally significant; other seabird species also utilize the area. The continental islands support thousands of plant species, while the coral cays also have their own distinct flora and fauna.

2.4 Wetlands of International Importance: Bowling Green Bay

The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. Under the Ramsar Convention, a wide variety of natural and human-made habitat types ranging from rivers to coral reefs can be classified as wetlands. For a wetland to be designated as a Ramsar wetland it must satisfy one or more of the criteria for identifying wetlands of international importance (DCCEEW 2021b).

The Bowling Green Bay Ramsar wetland was listed in 1993 as it met six of the possible nine criteria.

Description

The Bowling Green Bay Ramsar site (BGBRS) covers more than 35 000 ha and includes Cape Bowling Green, parts of Cape Cleveland and the south-eastern proportion of Cleveland Bay (Map 3, (DEHP 2014)). The BGBRS is a diverse complex of coastal wetland systems formed on four broad physiographic types: mountainous areas of Cape Cleveland and Feltham Cone; elevated parallel dune systems; lower lying parts of the coastal plain; and actively prograding sand spit of Cape Bowling Green. There are also extensive areas of forest and woodland, and some closed forest, on the mountainous areas and the coastal dune system (EPA 1999).

Values

This area meets the criteria for the designation of wetlands of international importance as it (EPA 1999):

- contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region
- supports vulnerable, endangered or critically endangered species or threatened ecological communities
- supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region
- supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions
- regularly supports 20 000 or more waterbirds, and

- regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Wetlands in the BGBRS are diverse, with mangrove communities on the foreshore, highly saline communities of salt pans and salt marsh, and brackish and freshwater wetlands of the low lying coastal plain further inland. The site is internationally important for the migration of marine turtles, shorebirds and terns and migratory species such as dugongs and estuarine crocodiles that use the area for feeding and nesting. The site also has significant economic value as a habitat for critical life stages of commercially important fish and crustaceans. The mangrove forests in this area provide protection from cyclone activity, coastal erosion, strong winds, tidal surges and heavy rainfall. The BGBRS is also locally and regionally important for reducing nutrient and sediment flowing to the Great Barrier Reef lagoon (DEHP 2014).

When the Burdekin River floods, water overflows into the surrounding areas before draining into Bowling Green Bay. The Haughton River to the north also has extensive floodplains that are interspersed with many small creeks, which typically drain into Bowling Green Bay (BDTB 2005). During flood conditions, freshwater from the nearby Burdekin and Haughton rivers flow into the bay, reducing the salinity of the water and allowing some plants that usually thrive in very different salinity regimes to grow side by side (DEHP 2014).

Groundwater is stored in two main underground aquifers which are recharged almost entirely by stream flows. The older aquifers are the deepest (15 - 45 metres) and extend from the slopes of Mt Elliott across the Haughton River to the Burdekin delta. The younger aquifers are shallower and limited in extent to the Haughton River riverbed and some recently abandoned channels.

The BGBRS overlaps with the Bowling Green Bay National Park (BGBNP) with all of the coastal part of the BGBNP, including some upland areas such as Cape Cleveland, listed under the Ramsar convention. This imposes certain obligations on the Queensland Government to manage and maintain its values and comply with all relevant State and Commonwealth legislation (Lavarack 2000).

Pressures

The bay's connections with catchments beyond the boundaries of the Ramsar site make it vulnerable to impacts from agricultural, urban and industrial development in the region, as well as fire, recreational activities, pollution, water usage and changes to water flow, pest plants and animals, and climate variability (Ceccarelli et al. 2013; DEHP 2014).

Most of the streams that supply water to the wetlands flow through private land of various use (agricultural, urban and industrial development) (EPA 1999). Any modification to the delivery of freshwater flows impacts the functioning of aquatic ecosystem processes and associated biological, chemical and physical responses (Chilton et al. 2021). Modification of habitat by the grazing industry including the building of low dams enhance the freshwater areas and prevent salt intrusion. This practice also interrupts the natural processes of the salt/fresh water balance, and alterations of a few centimetres in water level can cause broad habitat changes (Lavarack 2000). There are some weed species, such as Aleman Grass (*Echinochloa polystachya*), Olive Hymenachne (*Hymenachne amplexicaulis*), Para Grass (*Urochloa mutica*) and the floating aquatic weed Water Hyacinth (*Pontederia crassipes*), which often outcompete native species and reduce the quality of habitat in wetlands through the accumulation of silt (Lavarack 2000) and reduction of dissolved oxygen levels (Waltham et al. 2020a; Waltham et al. 2020b).

Specific pressures to this Ramsar wetland include:

- groundwater extraction and irrigation impacting the hydrological integrity of the wetlands (BDTB 2005)
- impacts from land management practices (e.g. modifying water flow and water quality) of adjacent landholders (BDTB 2005)
- erosion, particularly in the southern section (BDTB 2005; GBRMPA 2013a)
- weeds, with very high weed density in the surrounding area (DEWHA 2007; Waltham et al. 2020b)
- pest fauna species, with high densities of pest species, and high pest impact levels in the Ramsar area and the surrounding area (DEWHA 2007). potential pest fauna species include cane toad, European red fox, European eild rabbit, feral cats, deer, donkeys, goats, horses and pigs, common myna, mosquito fish, rodents, tilapia and wild dogs (DEWHA 2007).

Much of the BGBRS is in the Bowling Green Bay National Park and is managed and protected to maintain the naturally occurring diversity of flora, fauna, habitat types and other natural features of the area and in particular the wetlands. A primary purpose is to ensure the cultural and spiritual values are not damaged or destroyed. Where compatible with these purposes, management also includes a range of opportunities for nature-based recreational activities. Secondary management purposes include the continuation of the existing infrastructure including the power line, transmission towers and water pipeline. Management of fire and exotic pests are high priorities, with management of recreation a lower priority except in the Alligator Creek area (Lavarack 2000).

Integrity

The BGBRS is surrounded by grazing, agricultural and urban lands. This is likely to have negatively impacted water quality and has led to a decrease in abundance of some native fauna. Cattle have grazed in some areas, altering the vegetation and the habitat has been modified by the construction of low dams (Lavarack 2000). BGB is one of a number of important estuarine areas that are downstream of areas where the risk from pesticide loads entering the marine environment is very high, however the impacts on estuarine plants and animals is largely unmonitored and undocumented (Ceccarelli et al. 2013; Tarte & Yorkston 2020).

Groundwater extraction and irrigation from bordering water supply schemes may affect the hydrological integrity of the Ramsar wetlands of Bowling Green Bay (BDTB 2005).

Weeds such as para grass have invaded some areas, and there are large numbers of feral pigs, which damage the wetlands and turtle nesting areas. Foxes, horses and cane toads have also been recorded in the area, with foxes known predators of birds and turtle eggs and hatchlings (Lavarack 2000).

2.5 Great Barrier Reef Marine Park

The boundary of the Great Barrier Reef Marine Park (GBRMP) extends from the low water mark but, in contrast to the GBRWHA, it excludes internal waters and various small exclusion areas (e.g. ports).

The boundary of the Great Barrier Reef Marine Park (GBRMP) extends seawards from the low water mark (the mean height of the lowest low water at spring tide), but excludes various small areas (e.g. ports) (GBRMPA 2021b). The Great Barrier Reef Coast Marine Park (GBR Coast MP, a State Park) is contiguous with the GBRMP along the landward boundary (GBRMPA 2021a). The GBRMP and the GBRSMMP are subject to the Great Barrier Reef Marine Park Zoning Plan 2003 (GBRMPA 2021a).

The GBRMP and GBRSMMP extend offshore of the Project, with a General Use Zone to seaward, and Conservation Park, Habitat Protection, Marine National Park and General Use zones along the coast. There are also Habitat Protection Zones in the GBRSMMP including Nobbies inlet near Cape Upstart, and Duck, Yeates and Eden Lassie Creek south of Bowen. The Port areas around Bowen and Abbott Point are excluded from the GBRMP (Map 2).

General Use Zones provide opportunities for reasonable use of the GBRMP, while still allowing for the conservation of those areas.

Habitat Protection Zones provide for the conservation of areas of the GBRMP by protecting and managing sensitive habitats and ensuring they are generally free from potentially damaging activities.

Conservation Park Zones allow for increased protection and conservation of areas of the Marine Park, while providing opportunities for reasonable use and enjoyment, including limited extractive use, with additional restrictions for most fishing activities.

Marine National Park Zones are 'no take' areas, and extractive activities like fishing or collecting are not allowed without a permit. No take zones are one of the means in which managers can help maintain biodiversity (GBRMPA 2011).

In 1996 the Great Barrier Reef Marine Park Authority (GBRMPA), established the Representative Areas Program. A representative area is an area that is typical of the surrounding habitats or communities with similar physical features, oceanographic processes and ecological patterns. If such an area becomes a no-take zone, it protects a sample of the habitats and communities that it typifies.

Pressures

Climate change is the single biggest threat to the GBR, and to the key ecological values of the GBRMP (State of Queensland 2018). Climate change is predicted to increase the intensity of rainfall, floods and tropical cyclones which can severely impact marine water quality and ecosystems. An increase in the intensity of extreme weather events will cause more large-scale flood events, which will contribute significant volumes of freshwater to the marine environment, bringing additional sediment, nutrients and pesticides to the Reef. In addition, increasing sea temperatures can make water pollutants more toxic (State of Queensland 2018).

Climate change will also affect the GBRMP through rising sea levels, ocean acidification, and warmer waters. Warmer water causes corals to bleach and impacts the community composition of fauna and flora (State of Queensland 2018). Frequent and / or severe bleaching can cause coral death of less resilient corals. While some corals may recolonise, severe and frequent events can prevent the recovery of slower growing and less resilient corals, leading to changes in community composition.

Poor water quality including sediments, nutrients and pesticides flowing into the GBR from activities such as agriculture is also a major threat. Excessive sediments can increase turbidity and reduce water clarity. As photosynthetic organisms, corals and seagrass are highly sensitive to changes in water clarity, with reduced clarity levels leading to reduced coral biodiversity and decreasing the depth limit and changing the community composition, and stability of seagrass meadows. Fine sediments are of most concern for areas with shallow seagrass meadows and inshore coral reefs as they are lighter, remain suspended for longer, travel further and are resuspended with winds and tides. Excessive amounts of nutrients can upset the natural balance of the reef systems, and pesticides can affect reef organisms such as seagrass by inhibiting photosynthesis, and are likely to impact coral fertility and reproduction (State of Queensland 2018). Catchment modelling indicates moderate progress against nutrient reduction targets and suspended sediment reduction targets (DES 2022).

Changes in freshwater inflow can have significant impacts on coastal habitats by changing the quantity, water quality, and the timing and volume of seasonal fluctuations to the receiving environment (Olsen et al. 2018). Freshwater inflow changes to coastal environments can result in die-off of flora and fauna adapted to saline conditions, disrupt migration cues, change the effective size of the estuary, change sediment loads, or natural nutrient input that in turn may affect productivity (Olsen et al. 2018).

Other pressures to the GBRMP include impacts from coastal development, recreation and fishing, crown-of-thorns starfish (which may be a result of increased nutrients), and physical disturbance (e.g. from boat anchoring) and marine debris (GBRMPA 2021b).

Good water quality increases the resilience of the Reef to pressures from climate change and reduces the Reef's recovery time following catastrophic events (State of Queensland 2018). Consequently, maintaining and improving water quality is integral to maintaining the values of the GBRMP.

Integrity

Key ecosystems in the receiving environment of the project that are likely to have been impacted by these pressures include:

- saltmarsh impacted by sea level rise resulting in the increased inundation of saltmarsh, and consequent colonisation by mangroves (BDTB 2005)
- seagrass communities impacted by poor water quality associated with high rainfall and river discharge decreasing water clarity (BDBT 2005)
- mangroves impacted by poor water quality and pesticides (DES 2020b)
- coral communities impacted by thermal stress, poor water quality and cyclones (BDBT 2005; GBRMPA 2019; The State of Queensland 2022).

2.6 Threatened and Migratory Species

Threatened species are a widely used indicator of the status of biodiversity. Criteria iv. of the World Heritage Convention's natural criteria (i.e. the 1981 criteria applicable at the time the Great Barrier Reef was listed as a World Heritage Area) recognises threatened species as part of the GBRWHA biodiversity values. Aquatic threatened and migratory species and their likelihood of occurrence in the receiving environment are listed in Table 2.3. The likelihood of their occurrence in the area offshore of the Project was assessed according to criteria in Table 2.2.

Table 2.2 Criteria used to assess the likelihood of occurrence of species.

Likelihood of Occurrence	Definition
nil	The species does not occur in the area likely to be impacted
low	The species is considered to have a low likelihood of occurring in the area potentially impacted by the Project, or occurrence is infrequent and transient. Existing database records are considered historic, invalid or based on predictive habitat modelling. The habitat does not exist for the species, or the species is considered locally extinct. Despite a low likelihood based on the above criteria, the species cannot be totally ruled out of occurring in the potentially impacted area.
moderate	There is habitat for the species; however, it is either marginal or not particularly abundant. The species is known from the wider region.
high	The species is known to occur in the potentially impacted area, and there is core habitat in this area.

The values to be considered in regards to listed threatened species include breeding and roosting habitats of each species (DoE 2013).

Table 2.3 Threatened and migratory aquatic species listed in the receiving environment up to 5 km offshore of the Project, as listed by the PMST and WildNet, and the likelihood of their occurrence in the area.

Species	Common Name	EPBC Act Status	Likelihood of Occurrence
Mammals			
<i>Balaenoptera musculus</i>	blue whale	E, M	low
<i>Xeromys myoides</i>	water mouse	V	moderate
<i>Megaptera novaeangliae</i>	humpback whale	M	moderate
<i>Balaenoptera edeni</i>	Bryde's whale	M	low
<i>Dugong dugon</i>	dugong	M	high
<i>Orcaella heinsohni</i>	Australian snubfin dolphin	M	moderate
<i>Orcinus orca</i>	killer whale	M	low
<i>Sousa chinensis</i> ¹	Indo-Pacific humpback dolphin	M	moderate
Reptiles			
<i>Caretta caretta</i>	loggerhead turtle	E, M	high
<i>Chelonia mydas</i>	green turtle	V, M	high

Species	Common Name	EPBC Status	Act	Likelihood of Occurrence
<i>Dermochelys coriacea</i>	leatherback turtle	E, M		low
<i>Eretmochelys imbricata</i>	hawksbill turtle	V, M		moderate
<i>Lepidochelys olivacea</i>	olive ridley turtle	E, M		low
<i>Natator depressus</i>	flatback turtle	V, M		high
<i>Crocodylus porosus</i>	saltwater crocodile	M		high
Sharks and Rays				
<i>Carcharodon carcharias</i>	great white shark	V, M		low
<i>Pristis pristis</i>	freshwater sawfish	V, M		low
<i>Pristis zijsron</i>	green sawfish	V, M		low
<i>Rhincodon typus</i>	whale shark	V, M		low
<i>Sphyrna lewini</i>	scalloped hammerhead	CD, M		low
<i>Anoxypristis cuspidata</i>	narrow sawfish	M		moderate
<i>Carcharhinus longimanus</i>	oceanic whitetip shark	M		low
<i>Lamna nasus</i>	mackerel shark	M		low
<i>Manta alfredi</i>	reef manta ray	M		moderate
<i>Manta birostris</i>	giant manta ray	M		moderate

Source: (DES 2023), (DCCEEW 2023)

CE critically endangered

E endangered

V vulnerable

M migratory species

¹ *Sousa chinensis* is listed in the PMST report (Appendix A) however this is now considered a separate species in Australian waters: *Sousa sahulensis* (Australian humpback dolphin), and is a listed migratory species.

2.7 Matters of State Environmental Significance

Under the Queensland State Planning Policy (SPP)², in the State Interest of Biodiversity, Matters of State Environmental Significance (MSES) are valued and protected, and the

² A policy under the *Planning Act 2016*: State Planning Policy, July 2017. The State of Queensland. Published by the Department of Infrastructure, Local Government and Planning.

health and resilience of biodiversity is maintained or enhanced to support ecological processes.

Under the SPP, MSES must be identified, and development located in areas that avoid adverse impacts; where adverse impacts cannot be reasonably avoided, they are minimised. In addition, ecological processes and connectivity are to be maintained or enhanced by avoiding fragmentation of matters of environmental significance.

The Queensland Spatial Catalogue (QSpatial 2020), the Queensland Government Environmental reports online search tool (DES 2020), and the WildNet search tool (DES 2023) were used to determine MSES in the receiving environment of the Project.

MSES in the receiving environment of the Project comprise:

- 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer zones' under the *Marine Parks Act 2004* (Map 2)
- Regulated Vegetation associated with a watercourse (Map 4)
- the Burdekin Fish Habitat Area (FHA; Map 5), which was declared to protect valuable commercial, recreational and Indigenous fisheries resources; management of diverse habitats in good condition near Ayr. This FHA has extensive mangrove communities with about 20 species dominated by *Rhizophora*, *Avicennia* and *Ceriops* and *Xylocarpus mekongensis*; dense seagrass meadows with at least eight species of seagrass recorded; extensive salt pans (DES 2019).
- the Edgecumbe Bay FHA (Map 5), which was declared to protect important commercial, recreational and traditional fishing grounds; pristine habitats and coastal wetland systems; and diverse habitats, including mangrove forests and seagrass beds. This FHA has mangrove forests with up to 12 species dominated by *Rhizophora* and *Ceriops*; salt pan and marsh; intertidal sand and mud banks; sandy shores; rocky shores; extensive seagrass meadows; coral reefs (DES 2019a).
- High Ecological Significance Wetlands on the Map of Referable Wetlands (Map 5), that are downstream of the Project
- Wetlands and Watercourses in High Ecological Value Waters (Map 5)
- marine plants as defined by the *Fisheries Act 1994* (excluding marine plants in an urban area) (Map 8)
- waterways that provide for fish passage under the *Fisheries Act 1994*, excluding waterways providing for fish passage in an urban area (Map 7), and
- 22 rare or threatened species including:

- Australian humpback dolphin (listed as vulnerable under the *Nature Conservation Act 1992*)
 - Australian snubfin dolphin (vulnerable)
 - dugong (vulnerable)
 - flatback turtle (vulnerable)
 - olive ridley turtle (endangered)
 - hawksbill turtle (endangered)
 - green turtle (vulnerable)
 - loggerhead turtle (endangered)
 - leatherback turtle (endangered), and
 - 13 species of shore / marine birds that are either endangered or vulnerable under the *Nature Conservation Act 1992*.
- areas of essential habitat on the essential habitat map for wildlife prescribed as 'endangered wildlife' or 'vulnerable wildlife' under the *Nature Conservation Act 1992* (Map 6).

3 Potential Means of Impact

The current condition and distribution of MNES and MSES in the coastal zone of the GBRWHA has been influenced by land clearing and extreme weather events (GBRMPA 2013b).

While climate change is the most significant long-term challenge to the GBRWHA, declining water quality from land-based sources, and loss of coastal habitat from coastal development are also recognised as priority issues for management (GBRMPA 2009). Changing land management practices to improve water quality from catchment runoff from agricultural areas and managing impacts of grazing are recognised as key means of protecting MNES (GBRMPA 2013b). This has been a key focus of the Reef Water Quality Protection Plan and associated programs (GBRMPA 2013b). Enrichment with dissolved inorganic nutrients and particulate organic matter, increased sedimentation and exposure to pesticides, cause a cascade of direct and indirect effects (Fabricius et al. 2007).

The key pressures from FAHD on the receiving environment of the GBRWHA are increased loads of sediment, nutrients and pesticides exported from the catchment to the receiving environment.

The Burdekin Region has a medium to high risk for export of suspended sediment, herbicide and dissolved inorganic nitrogen to the GBRWHA receiving environment, in particular from sugarcane (Adaptive Strategies 2017; State of Queensland 2018). The proposed FAHD will be irrigated trickle and drip horticulture (not flood irrigation), and subject to Land and Water Management Plans approved by the State Government (Section 6).

It is estimated that the Burdekin region contributes approximately 4,738 tonnes per year of suspended sediment: about 28 per cent of total GBR sediment export (Kroon et al. 2012 in Adaptive Strategies 2017).

3.1 Sediment

Fine sediment reduces the light available to the seagrass and coral reefs, affecting their growth and health (State of Queensland 2018). Increased levels of sedimentation have severely degraded many coastal reefs around the world, through pathways such as smothering, decreases in photosynthesis and removal of settled particles increasing metabolic costs (Fabricius 2005).

Potential impacts of increased turbidity, sediment suspension and smothering on local communities include:

- reduced growth of marine plants by limiting light for photosynthesis
- reduced respiration and feeding of benthic invertebrate communities (including corals) leading to a reduction in abundance and biodiversity
- traumatization of fish gill tissues affecting growth and survival
- burying of aquatic plants (including roots and mangrove pneumatophores) and invertebrate communities (burrowing polychaetes and crustaceans), and
- reduced algal and coral diversity and reductions in epifaunal densities in coral communities.

The effect of increased suspended solid concentrations and sediment deposition on marine vertebrate communities is likely to be minimal, primarily because mobile organisms tend to avoid unfavourable environments. While some marine vertebrates will avoid areas of high turbidity, these waters may attract a range of fishes, particularly juveniles, as it confers a greater degree of protection from predators (Blaber & Blaber 1980).

3.2 Nutrients

The groups most sensitive to increases in nutrients tend to be early life stages (e.g. coral recruits), nutrient limited phototrophs (e.g. some macroalgae), and nutrient-limited filter feeders (e.g. some internal bio-eroders, some planktonic larvae). Nutrient enrichment promotes otherwise nutrient-limited groups, which then compete or prey upon other groups. Coral reefs grow best in waters that have naturally low concentrations of nutrients (nitrogen and phosphorus) and sediments.

Too much nitrogen in Reef waters is associated with crown-of-thorns starfish outbreaks. Crown-of-thorns starfish are a natural part of the reef ecosystem but when their numbers are boosted as a result of too much nitrogen, they can eat the coral too fast for it to recover (State of Queensland 2018).

Other impacts to aquatic biota that relate to nutrient enrichment include:

- aquatic plants:
 - changes to community composition and distribution of mangrove and saltmarsh communities (Adam 1994; Clough 1992)
 - an initial increase in biomass of mangroves followed by longer-term degeneration of mangrove communities as nutrient saturation levels are reached, and as species composition changes (e.g. Boto & Wellington 1983; Clough et al. 1983; Dunstan 1990; McLaughlin 1987; Onuf et al. 1997)

- increased uptake of other toxic chemicals as a consequence of enhanced growth due to increased nutrient supply (Duke et al. 2003)
- increased biomass of algae such as *Ulva* and *Enteromorpha* within the mangrove habitats, blocking drainage lines and preventing / retarding the establishment and growth of young seedlings (e.g. Tilbury et al. 2001)
- benthic invertebrates:
 - a reduction in community diversity and species richness (Meksumpun & Maksumpun 1999; Pearson & Rosenberg 1978; Rossi 2003; Tsutsumi 1990)
 - trophic shifts toward deposit feeding taxa and the dominance of polychaetes in soft sediment communities (ANZECC & ARMCANZ 2000; Brigitte & Blake 2000; Cardell et al. 1999; Chaiyanate & Montani 2001; López Gappa et al. 2001)
- marine vertebrates:
 - reduced habitat availability due to the deterioration of habitats including mangrove, seagrass and coral communities
 - reduction in the species diversity and production of crustaceans and molluscs can affect fish populations, that are important prey for many vertebrate species (e.g. dolphins).

3.3 Pesticides

Pesticides affect the health of animals and plants in freshwater ecosystems as well as some inshore and coastal habitats (State of Queensland 2018).

The runoff of pesticides (insecticides, herbicides and fungicides) from agricultural lands is a key concern for the GBRWHA. Relatively low levels of herbicide residues can reduce the productivity of marine plants and corals. Elevated herbicide concentrations in the GBR lagoon are particularly associated with sugar cane cultivation in the adjacent catchment (diuron, atrazine, hexazinone and ametryn), while tebuthiuron is clearly linked to beef grazing management practices (Lewis et al. 2009). Restrictions on the list of prescribed and proscribed chemicals and maximum residue limits for chemicals for animal food are regulated by the Chemical Usage (Agricultural and Veterinary) Control Regulation 1999.

4 Estimation of Likely Changes to Catchment Loads

Annual pollutant loads from the Lower Fitzroy Project were used to estimate potential outputs for the Bowen Pipeline Project. Input parameters were compared to assist with range testing of the results.

4.1 The Lower Fitzroy Assessment

The Lower Fitzroy Project approach included (SunWater 2016):

- Facilitated Agricultural Development (FAD) scenarios, land use, potential development areas and agricultural development types
- pollutant load generation: pollutants and generated loads (sediment, nutrients, and farm chemicals / pesticide) from existing and potential changes in land use, and
- modelling: use of HowLEAKY? and determination of model parameters and input assumptions (for example, climate, soils, landform/slope, cropping practices, etc.).

HowLeaky? Is a water balance and water quality conceptual model developed to assess the impacts of different land uses, soil types and management practices and climates on hydrology and water quality. The revised FAD assessment for the Lower Fitzroy used representative samples of climate / soil type / land use / management combinations, to explore likely impacts of moving from grazing to irrigated agriculture. As land use and management practices were unknown, estimates for poor and best practice were used, rather than a literal simulation of each land unit, as the relative changes associated with land use management were important rather than a pseudo-realistic assessment of the whole potential development area (SunWater 2016).

Annual pollutant loads for the Lower Fitzroy Project were calculated with Yaamba and Westwood Store climate data using the HowLeaky? Model. This model was setup using best available soil, vegetation, herbicide/pesticide and soil nutrient information for two representative soil types at two locations (SunWater 2016).

Three grazing practices were modelled to represent current land use practice, and an intensive irrigated cropping sequence with two levels of irrigation and a horticultural tree crop with two variants of land layout were modelled to represent FAD (Table 4.1 and Table 4.2).

Table 4.1 Annual pollutant loads (Yaamba climate).

Landscape, land use and Management	Runoff (mm)	Hill slope erosion (t/ha)	Annual off-site pollutant loads				N
			Sediment (t/ha)	Herbicide (g/ha)	Total P (kg/ha)	Total (kg/ha)	
(1) Floodplains: mix of vertosol/sodosols; based on sodosol (loamy surface; moderate deep A, deep B; slowly permeable (group 210)); 1% slope, 100m slope length							
(a) Low stocking pasture 44% October (B)	108	1.7	0.34	–	1.1	0.68	
(b) Moderate stocking pasture 34% October (C)	121	3.6	0.72	–	1.9	1.44	
(c) Excess stocking pasture 20% October (D)	139	7.9	1.60	–	3.6	3.2	
(d) Irrigated cropping, SWD100 Irrigate 50mm every 21 days, Atrazine	126	1.2	0.23	0.9	1.0	0.46	
(e) Irrigated cropping, SWD100 Fill to FC every 21 days, Atrazine	161	1.5	0.30	2.0	1.2	0.6	
(2) Upland slopes: slopes with sodosols (shallow sand surface; deep A, shallow B; slowly permeable (group 270)); 3% slope, 100m slope length							
(a) Moderate stocking pasture 34% October (C)	123	9.3	1.90	–	4.0	3.8	
(b) Irrigated horticulture – tree crop, Glyphosate	105	0.9	0.18	1.4	0.8	0.36	
(c) Irrigated horticulture – tree crop on contour (0.5%, 300m length). Glyphosate	105	0.3	0.06	1.3	0.6	0.12	

Table 4.2 Annual pollutant loads (Westwood Store climate).

Landscape, land use and Management	Runoff (mm)	Hill slope erosion (t/ha)	Annual off-site pollutant loads			
			Sediment (t/ha)	Herbicide (g/ha)	Total P (kg/ha)	Total (kg/ha)
(1) Floodplains: mix of vertosol/sodosols; based on sodosol (loamy surface; moderate deep A, deep B; slowly permeable (group 210)); 1% slope, 100m slope length						
(a) Low stocking pasture 44% October (B)	33	0.4	0.09	–	0.3	0.18
(b) Moderate stocking pasture 34% October (C)	39	1.0	0.19	–	0.5	0.38
(c) Excess stocking pasture 20% October (D)	49	2.6	0.51	–	1.2	1.02
(d) Irrigated cropping, SWD100 Irrigate 50mm every 21 days, Atrazine	46	0.4	0.08	0.7	0.4	0.16
(e) Irrigated cropping, SWD100 Fill to FC every 21 days, Atrazine	70	0.6	0.13	1.6	0.5	0.26
(2) Upland slopes: slopes with sodosols (shallow sand surface; deep A, shallow B; slowly permeable (group 270)); 3% slope, 100m slope length						
(a) Moderate stocking pasture 34% October (C)	41	2.6	0.53	–	1.2	1.06
(b) Irrigated horticulture – tree crop, Glyphosate	35	0.3	0.07	0.8	0.3	0.14
(c) Irrigated horticulture – tree crop on contour (0.5%, 300m length). Glyphosate	35	0.1	0.02	0.8	0.2	0.04

The differences between the outputs for each current and FAD scenario were then calculated (SunWater 2016).

In summary, the models indicated that changing from current land use to FAD on the flood plains would result in a:

- mean³ increase in hill slope erosion of -1.9 t/ha, with a range of -6.7 to 0.2 t/ha
- mean sediment load of -0.39 t/ha, with a range of - 1.37 to 0.04 t/ha
- mean herbicide load of 1.23 g/ha, with a range of 0.7 to 2.0 g/ha
- mean total P load of -0.67 kg/ha, with a range of -2.6 to 0.2 kg/ha
- mean total N of -0.78, with a range of -2.74 to 0.08,

and that changing from current land use to FAD on the upland slopes would result in a change in:

- mean increase in hill slope erosion of -5.6 t/ha, with a range of -9.0 to -2.3 t/ha
- mean sediment load of -1.13 t/ha, with a range of -1.84 to -0.46 t/ha
- mean herbicide load of 1.08 g/ha, with a range of 0.8 to 1.4 g/ha
- mean total P load of -2.13 kg/ha, with a range of -3.4 to -0.9 kg/ha, and
- mean total N of -2.27, with a range of -3.70 to -0.90.

Combining results for lowland and upland results in:

- mean increase in hill slope erosion of -2.8 t/ha, with a range of -9.0 to 0.2 t/ha
- mean sediment load of -0.58 t/ha, with a range of -1.84 to 0.04 t/ha
- mean herbicide load of 1.19 g/ha, with a range of 0.7 to 2.0 g/ha
- mean total P load of -1.03 kg/ha, with a range of -3.4 to 0.2 kg/ha, and
- mean total N of -1.15, with a range of -3.68 to 0.08 kg/ha.

That is, in general, the estimates indicate that changing land use from grazing to irrigated horticulture is likely to result in:

- reduced sediment, TN and TP loads from the catchment as a result of increased soil cover

³ Mean of the change in loads for of each of the scenarios.

- increased herbicide loads, where herbicides are used (but decreases in tebuthiuron used in grazing).

Further, there is potential for:

- greater runoff in lowland areas, but a decrease in runoff on upland slopes
- a decrease in erosion
- increased deep drainage, although this can be mitigated by a more conservative irrigation regime where groundwater accession is determined to be an issue (SunWater, 2016).

It was concluded that the results of the modelling for the Lower Fitzroy Project were consistent with the results derived from other analyses of other environments (SunWater, 2016).

4.2 Application to the Bowen Pipeline Project

Annual pollutant loads from FAD from the Lower Fitzroy Project were used to provide broad estimates of the potential loads from FAHD for the Bowen Pipeline Project. Input parameters were compared to assist with range testing of the results (Table 4.3, Figure 4.1). Input parameters were generally similar, with the exception of higher wet season rainfall in the Bowen Pipeline Project Area.

Table 4.3 Comparison of parameters Lower Fitzroy and Bowen Pipeline⁴

Parameter	Lower Fitzroy	Bowen Pipeline
Climate	Hot wet summers, warm dry winters	Hot wet summers, warm dry winters
Mean annual rainfall	684 mm	827 mm
Soil type	Vertosol / sodosol mix	Vertosol / sodosol / chromosol / non-cracking clays mix
Soil permeability	Slowly permeable	Slowly permeable

⁴ Mean total annual rainfall was calculated by including data for all years for monitoring stations 33264, 33030 and 33032 for the Bowen Pipeline area and monitoring stations 35026 and 39044 for the Lower Fitzroy.

It was considered that estimates of changes in loads exported from the catchment for the Bowen Pipeline Project were likely to be generally (similar order of magnitude) to the estimates derived for the Lower Fitzroy.

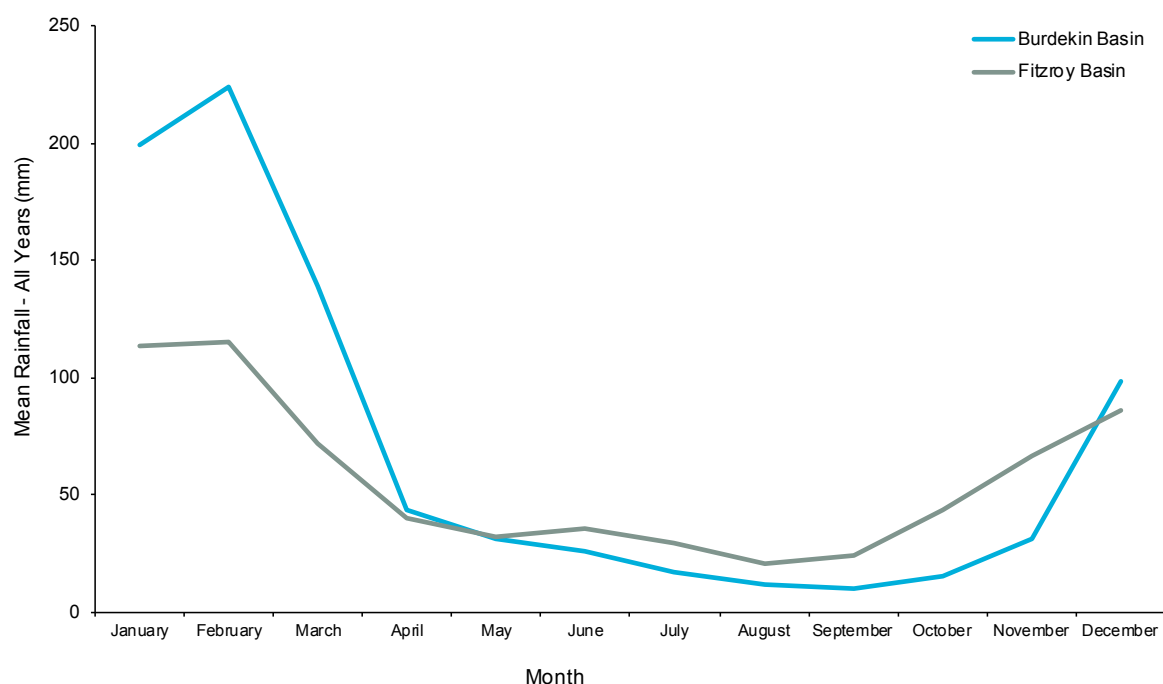


Figure 4.1 Mean monthly rainfall, Burdekin and Fitzroy Basins.

Estimates of the change in net loads to the Bowen Pipeline Project receiving environment were calculated for the conversion of 7,905 ha (Table 4.4) from grazing to irrigated horticulture, and for the conversion of 12,000 ha from grazing to horticulture (Table 4.5).

The estimated impact of FAHD on catchment loads entering the GBRWHA receiving environment for the conversion of 7,905 ha can be summarised as:

- a likely decrease in sediment load in the order of 4,550 tonnes (being the mean estimate, with a range from a decrease of 14,545 tonnes to an increase of 316 tonnes).
- a likely decrease in total P load of 8.1 tonnes (calculated mean, with range from a decrease of 27 tonnes to an increase of 1.6 tonnes)
- a likely decrease in total N load of 9.1 tonnes (calculated mean, with a range from a decrease of 29.1 tonnes to an increase of 0.6 tonnes)
- a likely increase in the herbicide load of 9,387 g (9.4 kg) (calculated mean, with a range from 5,533 g to 15,810 g).

The estimated impact of FAHD on catchment loads entering the GBRWHA receiving environment for the conversion of 12,000 ha can be summarised as:

- a likely decrease in sediment load in the order of 6,908 tonnes (being the mean estimate, with a range from a decrease of 22,080 tonnes to an increase of 480 tonnes).
- a likely decrease in total P load of 12.3 tonnes (calculated mean, with range from a decrease of 40.8 tonnes to an increase of 2.4 tonnes)
- a likely decrease in total N load of 13.8 tonnes (calculated mean, with a range from a decrease of 44.1 tonnes to an increase of 1.0 tonnes)
- a likely increase in the herbicide load of 14,250 g (14.25 kg) (calculated mean, with a range from 8,400 g to 24,000 g).

Table 4.4 Estimates of change in catchment loads entering the GBRWHA from FAHD from the Project based on Lower Fitzroy estimates, assuming conversion of 7,905 ha from grazing to horticulture.

	Estimated change in load per ha from Lower Fitzroy*				Estimated change in loads for 7,905 ha FAHD			
	Sediment (t/ha)	Herbicide (g/ha)	Total P (kg/ha)	Total N (kg/ha)	Sediment (Tonnes)	Herbicide (Grams)	Total P (Tonnes)	Total N (Tonnes)
Mean	-0.58	1.19	-1.03	-1.15	-4550	9387	-8.103	-9.101
Max	0.04	2.0	0.2	0.08	316	15810	1.581	0.632
Min	-1.84	0.7	-3.4	-3.68	-14545	5534	-26.877	-29.090

* Mean, Maximum and minimum of scenario estimates from the Lower Fitzroy Study (Sunwater, 2016).

Table 4.5 Estimates of change in catchment loads entering the GBRWHA from FAHD from the Project based on Lower Fitzroy estimates, assuming conversion of 12,000 ha from grazing to horticulture.

	Estimated change in load per ha from Lower Fitzroy*				Estimated change in loads for 12,000 ha FAHD			
	Sediment (t/ha)	Herbicide (g/ha)	Total P (kg/ha)	Total N (kg/ha)	Sediment (Tonnes)	Herbicide (Grams)	Total P (Tonnes)	Total N (Tonnes)
Mean	-0.58	1.19	-1.03	-1.15	-6908	14250	-12.300	-13.815
Max	0.04	2.0	0.2	0.08	480	24000	2.400	0.960
Min	-1.84	0.7	-3.4	-3.68	-22080	8400	-40.800	-44.160

* Mean, Maximum and minimum of scenario estimates from the Lower Fitzroy Study (Sunwater, 2016).

5 Compliance with the Reef 2050 Water Quality Improvement Plan

The Great Barrier Reef 2050 Long-Term Sustainability Plan (Reef 2050) is the overarching Australian and Queensland government action plan to work with partners to protect and manage the Great Barrier Reef. The Reef 2050 Long-Term Sustainability Plan was released in 2015. The Plan was updated in 2018 following a mid-term review and again in 2021 following its first 5 yearly review in 2020. In December 2021, with the Queensland government, DCEEW jointly released the updated Reef 2050 Long-Term Sustainability Plan 2021-2025, with a greater focus on climate change and increased reflection on, and inclusion of, First Nation peoples aspirations.

The Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) is a joint commitment of the Australian and Queensland Governments to address all land-based runoff flowing from the catchment to the Great Barrier Reef. This Plan now aligns with Reef 2050.

The Reef 2050 WQIP recognises that sediment, nutrients and pesticides that flow to the Great Barrier Reef, affect the health of key habitats such as coral reefs and seagrass, making the Reef less able to withstand or recover from coral bleaching and more severe declines caused by climate change. Improving water quality will improve the resilience of the Reef to these pressures (State of Queensland 2018).

The Reef 2050 WQIP meets the water quality challenge by:

- applying minimum practice standards across all industries and land uses
- supporting industries and communities to build a culture of innovation and stewardship that takes them beyond minimum standards
- restoring catchments through works to improve or repair riparian vegetation, streambanks, gullies, waterways and wetlands (State of Queensland 2018).

5.1 Load Reduction Targets

Targets for improving water quality are set in the Reef 2050 WQIP for each of the catchments flowing to the Reef, for the six regions, and for the whole Reef (State of Queensland 2018). The targets are based on the GBRMPA's reef water quality guidelines and set end of catchment load reductions.

The Burdekin catchment is the second largest contributor of anthropogenic dissolved inorganic nitrogen loads in the region, and is one of the five highest contributors of the 35 catchments that drain to the Great Barrier Reef. Most dissolved inorganic nitrogen comes

from sugarcane. The Burdekin catchment is the largest contributor of anthropogenic fine sediment loads of the 35 catchments that drain to the Great Barrier Reef. It delivers more than double the loads of any other region. Most comes from gully erosion in grazing areas. Independent sediment-tracing studies indicate that the Bowen and Upper Burdekin sub-catchments have sediment erosion rates that are much greater than the long-term natural geological rates: 7.5 times greater in the Bowen, and 3.6 times greater in the Upper Burdekin (Australian and Queensland Governments 2018).

In recognition of the high loads in runoff from the Burdekin catchment into the Great Barrier Reef, the RWQIP (State of Queensland 2018) identifies water quality targets designed to reduce the loads of dissolved inorganic nitrogen, fine sediment, particulate phosphorus and particulate nitrogen. A summary of the targeted reduction in loads for the Burdekin catchment and each basin within is outlined in Table 5.1, with an overall target to reduce the runoff of dissolved organic nitrogen by 60%, fine sediment by 30%, particulate phosphorus by 25% and particulate nitrogen by 25%.

Estimates of catchment loads resulting from FAHD from the Bowen Pipeline Project based on estimates for the Lower Fitzroy Project (Table 4.4 and Table 4.5), indicate that the decrease in sediment, total P and total N from FAHD is likely to contribute to meeting the targets for the Burdekin Region in the Reef 2050 WQIP.

However, there could be an increase in the amount of pesticides discharged to the catchment. The pesticide target in the Reef 2050 WQIP is presented as a concentration and aims to protect 99% of aquatic species, however this is a low priority for the Burdekin River catchment (State of Queensland 2018) and will likely be managed through the implementation of the Chemical Usage (Agricultural and Veterinary) Control Regulation 1999.

Sediment, nutrient and pesticide loads can be further decreased through Land and Water Management Plans.

Table 5.1 End-of-catchment anthropogenic water quality targets for the Burdekin basin and relevant catchments by 2025 and relative priorities for water quality improvement.

Region	Catchment / Basin	Targets								Pesticide Target to Protect 99% Aquatic Species
		Dissolved Inorganic Nitrogen		Fine Sediment		Particular Phosphorus		Particulate Nitrogen		
		Tonnes	% Reduction	Kilo-Tonnes	% Reduction	Tonnes	% Reduction	Tonnes	% Reduction	
Burdekin		820	60	890	30	490	25	800	25	
	Burdekin	100	60	840	30	440	30	720	30	
	Don	MCL	MCL	55	30	43	30	75	30	

MCL = Maintain Current Load, ND = Not Determined

Management Priority: = Very High, = High, = Moderate, = Low, No Shading = Minimal, = Not Assessed

5.2 Land and Water Management Plans

The Reef 2050 WQIP has a trigger of 90% of land in priority areas under grazing, horticulture, bananas, sugar cane and other broad acre cropping are managed using best practice systems for water quality outcomes (soil, nutrients and pesticides) (State of Queensland 2018).

Under the *Water Act 2000*, a Land and Water Management Plan is required to be approved and declared by the Minister before using water from a new or additional water allocation. All facilitated agricultural customers will be required to develop and operate under an approved Land and Water Management Plan (LWMP; SunWater 2009). This provides an opportunity to ensure that best practices systems for water quality outcomes are used.

SunWater has committed to assist both new and expanding irrigation ventures with the development and implementation of LWMPs. This will reduce loads by incorporating measures such as protection of the riparian zone and inclusion of vegetated filter strips in the farm drainage network.

The Queensland State Government is responsible for assessing and approving LWMPs as well as periodically reviewing the performance of approved LWMPs in consultation with the proponent.

As a consequence, the supply of additional water via the Bowen Pipeline Project for irrigated agriculture provides a significant opportunity to implement load reduction strategies by all operators using the new water supply, and progress towards the Reef 2050 WQIP triggers.

6 Mitigation Measures

The range of likely catchment load estimates is broad – due to the methods used, the high variability of some input parameters, and the variation in loads exported from the catchment between and within years.

Nevertheless, implementation of the Project is likely to significantly contribute to compliance with catchment load targets in the Reef 2050 WQIP, for sediment, total nitrogen and total phosphorus. However, there may be an increase in herbicide loads.

The target market for the water is horticultural supply, using trickle or drip irrigation, with most of the water from the Project used in this sector. Drip and trickle irrigation minimises water runoff as a result of horticultural activities. Water from the Project will not be used for flood irrigation. Instead, the supply of water will be subject to strict terms and conditions requiring best practice environmental management of water (Adaptive Strategies 2017).

While land management targets are being reviewed, and consequently no longer assessed in annual report cards (DES 2022) the Report Card 2015 indicated that almost half of horticulture and grains sectors were already managed using best management practice systems (DES 2016). Catchment modelling in the Burdekin Catchment indicates moderate progress against nutrient reduction targets and poor progress against sediment reduction targets, with the greatest reductions recorded for dissolved inorganic nitrogen loads (2.8%) (DES 2022). Overall, there has been an accumulated reduction in dissolved inorganic nitrogen of 34%, suspended sediment reduction of 18.8% and particulate nitrogen and phosphorus reduction of approximately 17%, which are each more than halfway to the 2025 catchment targets (DES 2022). The pesticide concentrations within the Burdekin Catchment protect 97.7% of aquatic species, only slightly less than the target 99% of aquatic species (DES 2022). This suggests that current regulations and land management practices are effective at reducing catchment loads to the GBR.

FAHD operators using water from the Project will be required to implement approved Land and Water Management Plans, this provides an ideal opportunity to implement load reduction strategies by all operators using the new water supply (Section 5.2).

Further, Bowen Pipeline Company has indicated supply contracts with the end water users will include terms and conditions requiring best practice in water use and management, to ensure that the water supplied is used efficiently and in an environmentally sustainable manner, and that water from the Project will not be used in flood irrigation.

Other recommended mitigation measures include:

- Involvement by the Bowen Pipeline Company / SunWater with regional NRM programs as they relate to its operations.
- Limiting FAHD to good quality agricultural land (GQAL) in areas that have already been cleared. There are currently approximately 36,628 ha of GQAL in cleared areas adjacent to the Project. This cleared GQAL is currently predominantly used for grazing.
- Building management requirements for the use of pesticides into LWMPs. For example, by introducing mandatory requirements for irrigated horticulture, similar to those for cane farmers. It is mandatory for regulated cane farmers to (Sunwater 2016):
 - apply fertiliser at no more than the amount calculated in accordance with a prescribed methodology, taking into account soil testing. Applying fertiliser in accordance with this methodology minimises the risk of nutrient run off from excess application.
 - follow specific controls when using herbicide products containing atrazine, ametryn, hexazinone and diuron, which prevents overspray and run off from herbicide products.
 - keep records of their use of fertilisers and agricultural chemicals to provide evidence to compliance officers of the improvement in practices.
- Commitment to, and financial support of, catchment restoration projects including riparian revegetation, gully repair, streambank stabilisation and coastal wetlands rehabilitation.
- Participation in communication and education programs regarding the benefit of improved practices and water quality.

7 Assessment of Significant Residual Impacts

The potential impacts to the receiving environment, comprising the GBRWHA and associated key species and habitats, that may result from land based water discharges resulting from irrigation from the pipeline area were assessed with reference to *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013). It is recognised that the GBRWHA and associated key species and habitats are sensitive to increases in sediment, nutrients and herbicides, and that their resilience will be improved by the reduction in concentration of these parameters.

It was considered that, when the above mitigation (Section 6) was implemented:

- the FAHD associated with the Bowen Pipeline Project would likely result in a decrease in sediment and nutrient loads, contributing to the targets listed in the Reef 2050 WQIMP, and that
- pesticide targets of the Reef 2050 WQIMP could be achieved via the required Land and Water Management Plans.

That is, changing land use from predominantly grazing to irrigated agriculture would help achieve the goals of the Reef 2050 WQIMP, and improve the resilience of the GBRWHA and associated habitats and species.

As such, the discharges to the GBRWHA associated with the FAHD are unlikely to have a significant residual impact on the GBRWHA and associated key species and habitats, and consequently there is not a need to offset negative impacts.

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Appendix A Protected Matters and WildNet Search Results



Australian Government

Department of Climate Change, Energy,
the Environment and Water

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. Please see the caveat for interpretation of information provided here.

Report created: 11-Jan-2023

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

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

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	7
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	43
Listed Migratory Species:	63

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 <https://www.dcceew.gov.au/parks-heritage/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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	102
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	6
Regional Forest Agreements:	None
Nationally Important Wetlands:	4
EPBC Act Referrals:	42
Key Ecological Features (Marine):	None
Biologically Important Areas:	5
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties			[Resource Information]
Name	State	Legal Status	Buffer Status
Great Barrier Reef	QLD	Declared property	In feature area

National Heritage Places			[Resource Information]
Name	State	Legal Status	Buffer Status
Natural			
Great Barrier Reef	QLD	Listed place	In feature area

Wetlands of International Importance (Ramsar Wetlands)			[Resource Information]
Ramsar Site Name		Proximity	Buffer Status
Bowling green bay		10 - 20km upstream from Ramsar site	In feature area

Great Barrier Reef Marine Park			[Resource Information]
Zone Type	Zone ID	IUCN	Buffer Status
Conservation Park	CP-19-4064	IV	In feature area
Conservation Park	CP-19-4068	IV	In feature area
General Use	GU-16-6004	VI	In feature area
Habitat Protection	HP-19-5174	VI	In feature area
Habitat Protection	HP-19-5179	VI	In feature area
Marine National Park	MNP-19-1105	II	In feature area
Marine National Park	MNP-19-1107	II	In feature area

Commonwealth Marine Area		[Resource Information]
Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.		
Feature Name		Buffer Status
EEZ and Territorial Sea		In feature area

Listed Threatened Ecological Communities		[Resource Information]
For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.		
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.		

Community Name	Threatened Category	Presence Text	Buffer Status
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur	In feature area within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur	In feature area within area

Listed Threatened Species

[[Resource Information](#)]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In feature area
Erythroriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area	In feature area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat likely to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area
Turnix olivii Buff-breasted Button-quail [59293]	Endangered	Species or species habitat may occur within area	In feature area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area	In feature area
MAMMAL			
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Petauroides minor Greater Glider (northern), Greater Glider (north-eastern Queensland) [92008]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature 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]	Endangered	Species or species habitat known to occur within area	In feature area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat likely to occur within area	In feature area
PLANT			
Aristida granitica [4065]	Endangered	Species or species habitat known to occur within area	In feature area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat known to occur within area	In feature area
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Omphalea celata [64586]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area	In feature area
Solanum graniticum Granite Nightshade [84819]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area	In feature area
SHARK			
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus Common Noddy [825]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Migratory Marine Species			
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area	In feature area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area	In feature area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sousa sahalensis as Sousa chinensis Australian Humpback Dolphin [87942]		Breeding known to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In feature area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In feature area
Limicola falcinellus Broad-billed Sandpiper [842]	Critically Endangered	Roosting known to occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]		Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area	In feature area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In feature area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area	In feature area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa incana Wandering Tattler [831]		Roosting known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area	In feature area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat likely to occur within area	In feature area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]		
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anous stolidus Common Noddy [825]		Species or species habitat known to occur within area	In feature area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In feature area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In feature area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In feature area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Monarcha melanopsis Black-faced Monarch [609]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]		Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area overfly marine area	In feature area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In feature area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area overfly marine area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area overfly marine area	In feature area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In feature area
Tringa incana as Heteroscelus incanus Wandering Tattler [831]		Roosting known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area	In feature area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat likely to occur within area overfly marine area	In feature area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area overfly marine area	In feature area
Fish			
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area	In feature area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area	In feature area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area	In feature area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area	In feature area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area	In feature area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area	In feature area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area	In feature area
Corythoichthys paxtoni Paxton's Pipefish [66204]		Species or species habitat may occur within area	In feature area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area	In feature area
Cosmocampus darrosanus D'Arros Pipefish [66207]		Species or species habitat may occur within area	In feature area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area	In feature area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area	In feature area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area	In feature area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area	In feature area
Halicampus spirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area	In feature area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area	In feature area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area	In feature area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area	In feature area
Hippocampus bargibanti Pygmy Seahorse [66721]		Species or species habitat may occur within area	In feature area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area	In feature area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area	In feature area
Hippocampus zebra Zebra Seahorse [66241]		Species or species habitat may occur within area	In feature area
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish [66253]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Micrognathus brevirostris thortail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area	In feature area
Nannocampus pictus Painted Pipefish, Reef Pipefish [66263]		Species or species habitat may occur within area	In feature area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area	In feature area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area	In feature area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area	In feature area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area	In feature area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area	In feature area
Mammal			
Dugong dugon Dugong [28]		Species or species habitat known to occur within area	In feature area
Reptile			
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area	In feature area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area	In feature area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area	In feature area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area	In feature area
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may occur within area	In feature area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area	In feature area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area	In feature area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area	In feature area
Hydrophis macdowelli as Hydrophis mcdowelli Small-headed Seasnake [75601]		Species or species habitat may occur within area	In feature area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area	In feature area
Laticauda colubrina a sea krait [1092]		Species or species habitat may occur within area	In feature area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area	In feature area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area	In feature area

Whales and Other Cetaceans			[Resource Information]
Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]	Endangered	Species or species habitat may occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Orcaella heinsohni as Orcaella brevirostris Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Sousa sahalensis as Sousa chinensis Australian Humpback Dolphin [87942]		Breeding known to occur within area	In feature area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Abbot Bay	Conservation Park	QLD	In feature area
Burdekin	Fish Habitat Area (B)	QLD	In feature area
Cape Upstart	National Park	QLD	In feature area

Protected Area Name	Reserve Type	State	Buffer Status
Edgecumbe Bay - Bowen	Dugong Protection Area (B)	QLD	In feature area
Great Barrier Reef Coast	Marine Park	QLD	In feature area
Upstart Bay	Dugong Protection Area (A)	QLD	In feature area

Nationally Important Wetlands		[Resource Information]	
Wetland Name		State	Buffer Status
Abbot Point - Caley Valley		QLD	In feature area
Burdekin Delta		QLD	In feature area
Great Barrier Reef Marine Park		QLD	In feature area
Southern Upstart Bay		QLD	In feature area

EPBC Act Referrals			[Resource Information]	
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Bowen Orbital Spaceport	2021/9071		Assessment	In feature area
Controlled action				
Abbot Point Coal Terminal 0	2011/6194	Controlled Action	Post-Approval	In feature area
Abbot Point Coal Terminal Project	2012/6250	Controlled Action	Completed	In feature area
Abbot Point Dredging and onshore placement of dredged material, Abbot Point, Qld	2014/7356	Controlled Action	Completed	In feature area
Abbot Point Growth Gateway Project, Qld	2015/7467	Controlled Action	Post-Approval	In feature area
Abbot Point Port and Wetland Enhancement Project, Abbot Point, Qld	2014/7355	Controlled Action	Completed	In feature area
Abbot Point Stormwater Return Dam	2010/5561	Controlled Action	Post-Approval	In feature area
Abbot Point Terminal 0, 2 & 3 Capital Dredging	2011/6213	Controlled Action	Post-Approval	In feature area
Alpha Coal Project - Mine and Rail Development	2008/4648	Controlled Action	Post-Approval	In feature area
Alpha Coal Project - Port Options Development	2008/4647	Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Aurukun Bauxite Project Abbot Point Infrastructure	2008/4595	Controlled Action	Completed	In feature area
Aurukun Bauxite Project Abbot Point Refinery	2008/4594	Controlled Action	Completed	In feature area
Aurukun Bauxite Project Abbot Point Transport Corridor	2008/4593	Controlled Action	Completed	In feature area
Bowen Pipeline	2021/8993	Controlled Action	Referral Decision	In feature area
Central Queensland Integrated Rail Project	2012/6321	Controlled Action	Completed	In feature area
Coal Terminal 2	2011/6185	Controlled Action	Completed	In feature area
Coal Terminal Expansion, and Associated Infrastructure	2008/4468	Controlled Action	Post-Approval	In feature area
Cooper to Abbot Point liquid natural gas (LNG) facility, Capling Project, QLD	2014/7175	Controlled Action	Completed	In feature area
Establishment of Galilee Coal Mine and Associated Infrastructure	2009/4737	Controlled Action	Post-Approval	In feature area
expansion of fish farm activities	2003/1274	Controlled Action	Completed	In feature area
Galilee Infrastructure Corridor Project	2012/6489	Controlled Action	Guidelines Issued	In buffer area only
Koonandah Hard Rock Quarry, Bowen, QLD	2018/8366	Controlled Action	Further Information Request	In buffer area only
New Multi Cargo Facility, Abbot Point, Queensland	2009/4837	Controlled Action	Completed	In feature area
North Galilee Basin Rail Project, Qld	2013/6885	Controlled Action	Post-Approval	In feature area
Proposed Guthalungra Aquaculture Facility	2001/138	Controlled Action	Post-Approval	In feature area
The Burdekin Cassava Project	2010/5514	Controlled Action	Post-Approval	In feature area
Water for Bowen project	2006/2527	Controlled Action	Completed	In buffer area only
Not controlled action				
Abbot Point Marine Offloading Facility Beach Nourishment and Maintenance Dredging, Qld	2016/7692	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Abbot Point Marine Offloading Facility Maintenance and Renewal Works, Qld	2016/7691	Not Controlled Action	Completed	In feature area
Abbot Point to Bogie River Rail Upgrade (GAP 50) Project	2010/5482	Not Controlled Action	Completed	In feature area
Highway re-alignment and reconstruction	2001/461	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Molongle Creek Dredging	2001/355	Not Controlled Action	Completed	In feature area
Molongle Creek Navigation Channel Improvement	2019/8523	Not Controlled Action	Completed	In feature area
Mount Luce Quarry, Bowen QLD	2011/5924	Not Controlled Action	Completed	In feature area
Offshore geotechnical investigations	2011/5994	Not Controlled Action	Completed	In feature area
Salisbury Plains Light Industrial Infrastructure Facilities Development, Bowen, QLD	2014/7270	Not Controlled Action	Completed	In feature area
Stage 3 Expansion of Abbot Point Coal Terminal, near Bowen	2005/2154	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Additional Components to Stage 3 Expansion Abbot Point Coal Terminal	2007/3884	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Apron and Berth Dredging	2008/4438	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Offshore Geotechnical Investigations Abbot Point	2010/5774	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Off-shore Sonar and Seismic Survey	2008/4289	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Biologically Important Areas				
Scientific Name		Behaviour	Presence	Buffer Status

Scientific Name	Behaviour	Presence	Buffer Status
Dolphins			
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Breeding	Known to occur	In feature area
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Breeding	Likely to occur	In feature area
Marine Turtles			
Natator depressus Flatback Turtle [59257]	Nesting	Known to occur	In feature area
Seabirds			
Sterna sumatrana Black-naped Tern [800]	Breeding	Known to occur	In feature area
Whales			
Megaptera novaeangliae Humpback Whale [38]	Breeding and calving	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

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

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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](#)
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- [-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](#)
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- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

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

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

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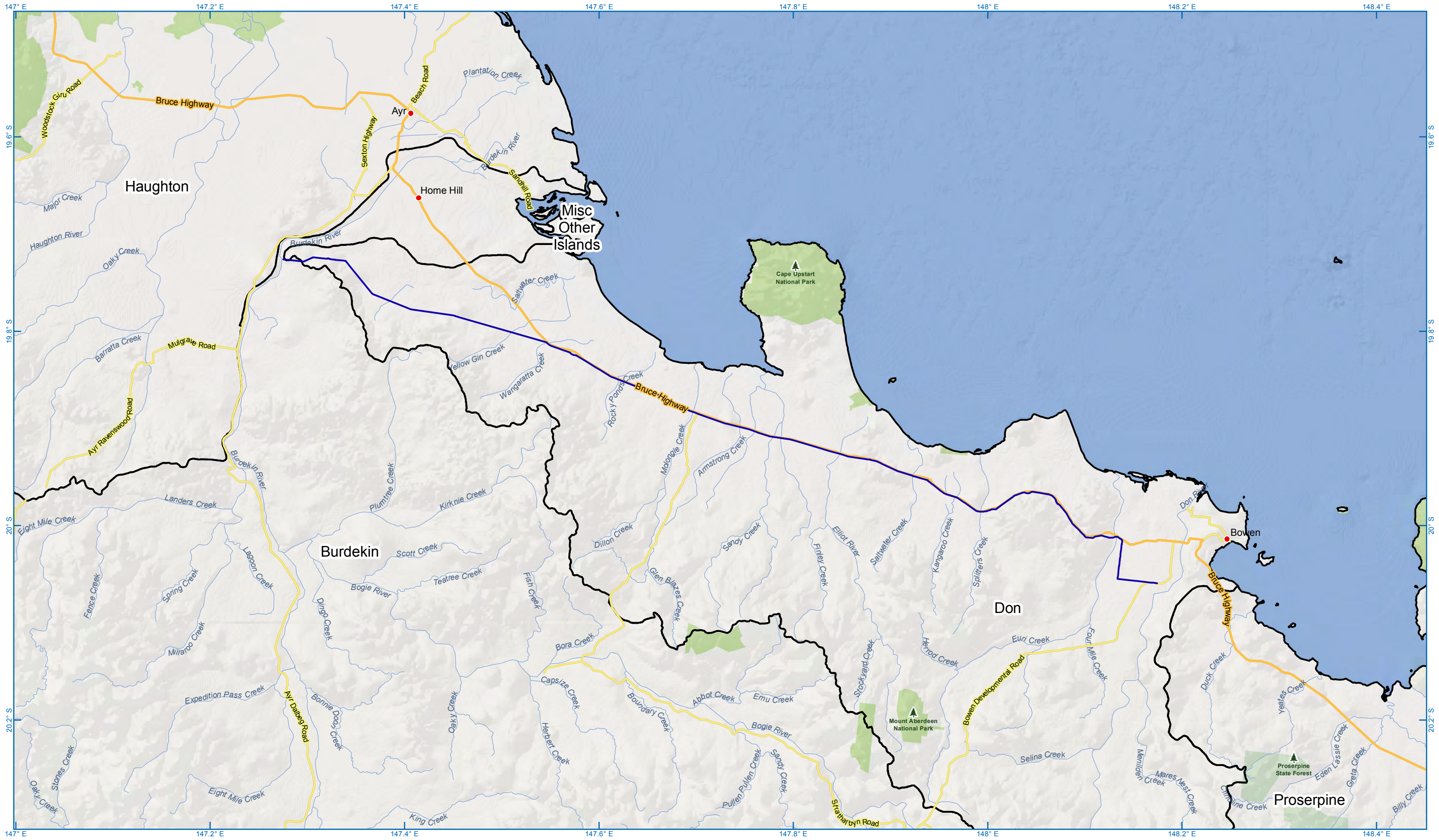
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Appendix B Maps

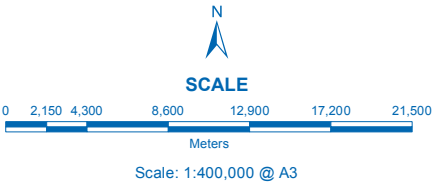


**230107 - Bowen Pipeline: Facilitated
Agricultural (Horticulture) Development**

Map 1: Proposed Pipeline

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- LEGEND**
- Proposed bowen water pipeline alignment
 - Drainage basins
 - Watercourse
 - Road Network Mid**
 - Highway
 - Main Road
 - Protected Area**
 - National Park
 - Other Reserve

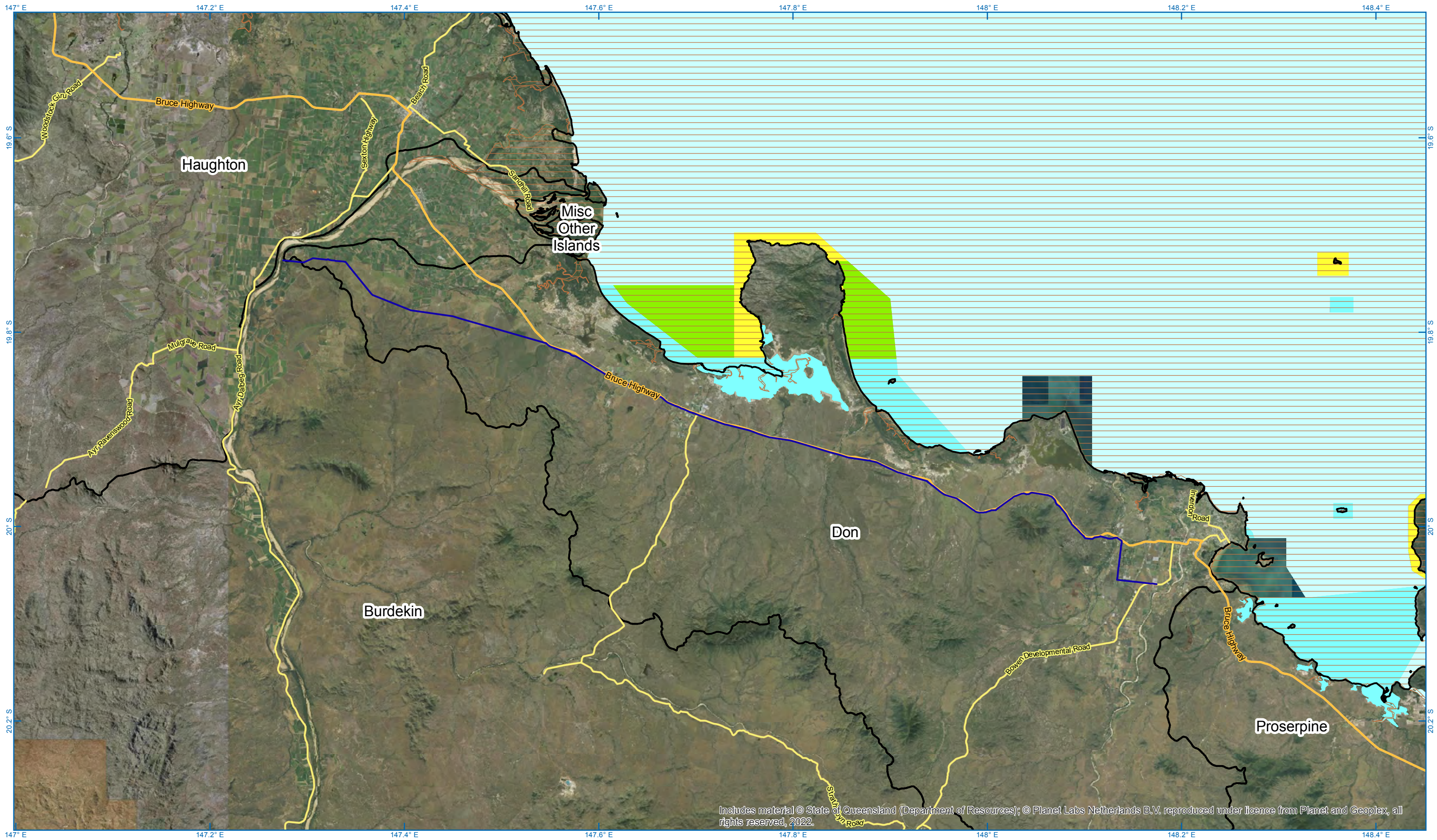


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Map 2: Great Barrier Reef Marine Park and World Heritage Area

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LEGEND

- Proposed bowen water pipeline alignment
- Drainage basins
- GBR World Heritage Area and National Heritage Place

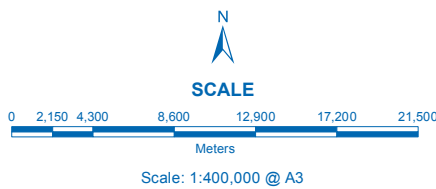
GBR Marine Park and Coast Marine Park Zoning

- General Use Zone
- Habitat Protection Zone

- Conservation Park Zone
- Marine National Park Zone

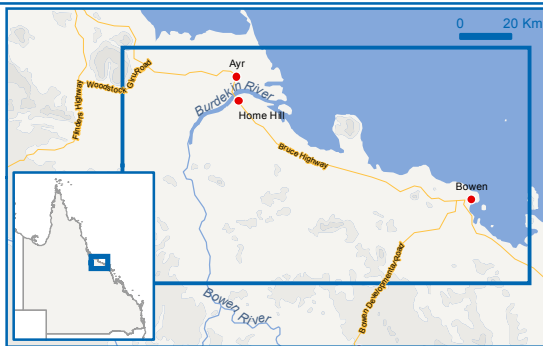
Road Network Mid

- Highway
- Main Road



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Map 3: Ramsar Wetlands

SOURCES

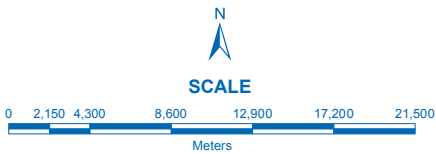
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LEGEND

- Proposed bowen water pipeline alignment
- Ramsar wetland sites

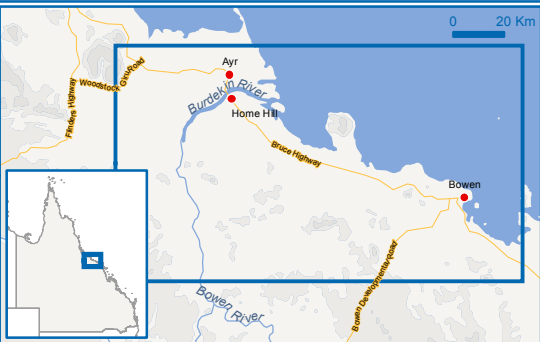
Road Network Mid

- Highway
- Main Road



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**Map 4: MSES Regulated Vegetation Associated
with a Waterway**

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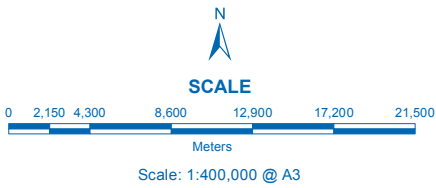
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- Proposed bowen water pipeline alignment
- MSES regulated vegetation [defined watercourse]
- MSES regulated vegetation [category R- GBR riverine]
- MSES regulated vegetation [100m from wetland]

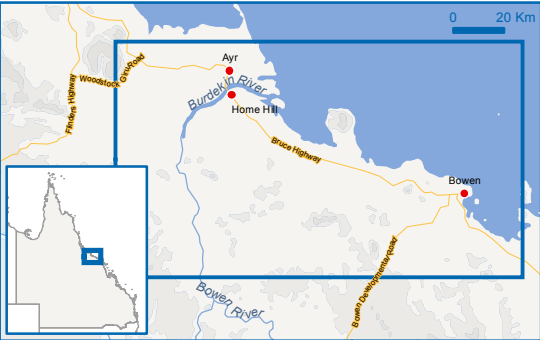
Road Network Mid

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Map 5: MSES Fish Habitat Areas, Wetlands and Watercourses

SOURCES

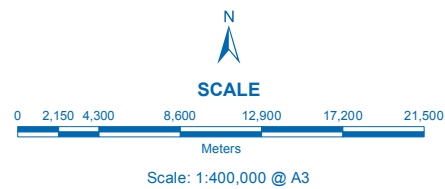
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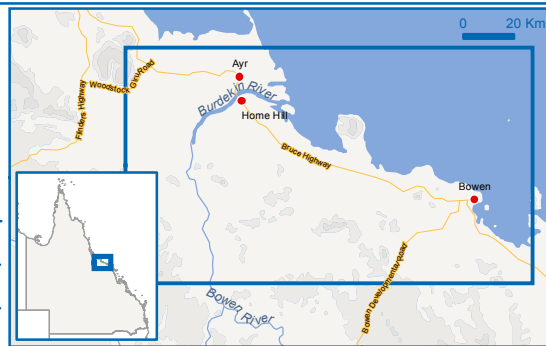
- Proposed bowen water pipeline alignment
- MSES declared fish habitat area [A and B areas]
- MSES declared high ecological value waters [watercourse]
- MSES declared high ecological value waters [wetland]
- MSES high ecological significance wetlands

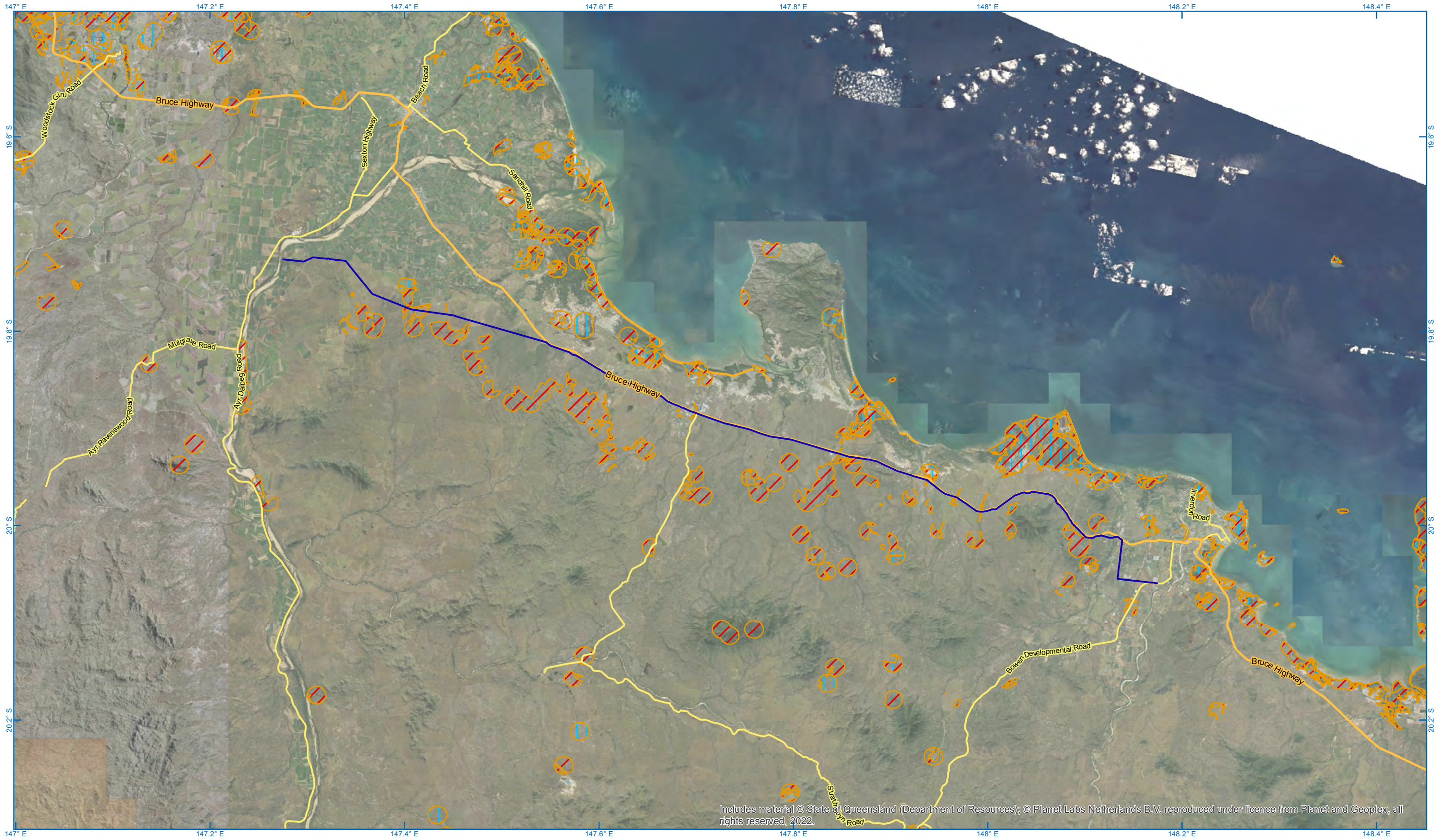
- Road Network Mid**
- Highway
 - Main Road



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Map 6: MSES Wildlife Habitat

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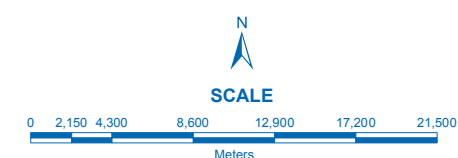
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LEGEND

- Proposed bowen water pipeline alignment
- MSES wildlife habitat [endangered or vulnerable]
- MSES wildlife habitat [special least concern animal]
- MSES wildlife habitat [sea turtle nesting areas]

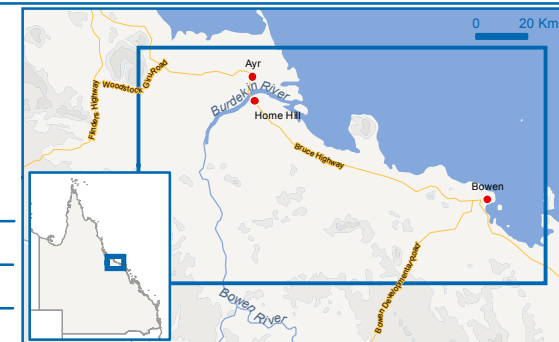
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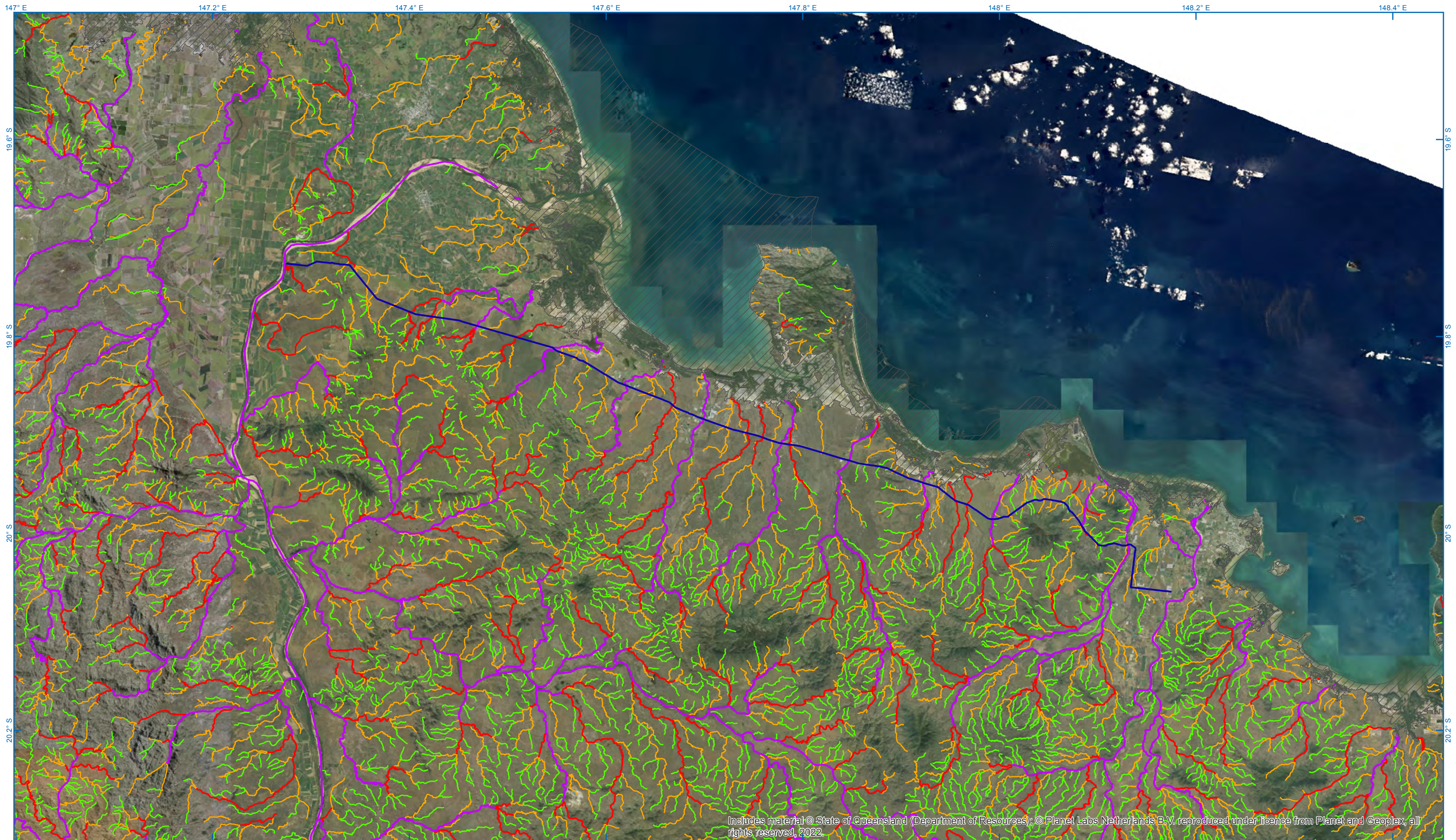
- Highway
- Main Road



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Map 7: Waterways Providing for Fish Passage

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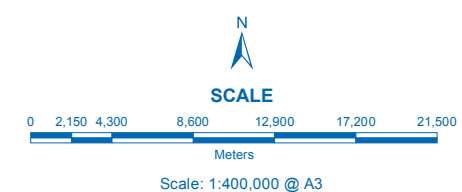
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LEGEND

— Proposed bowen water pipeline alignment

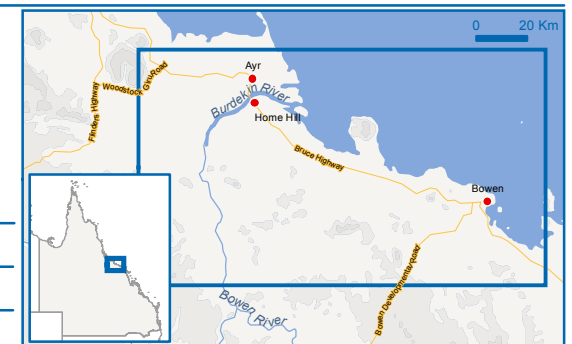
Queensland waterways for waterway barrier works

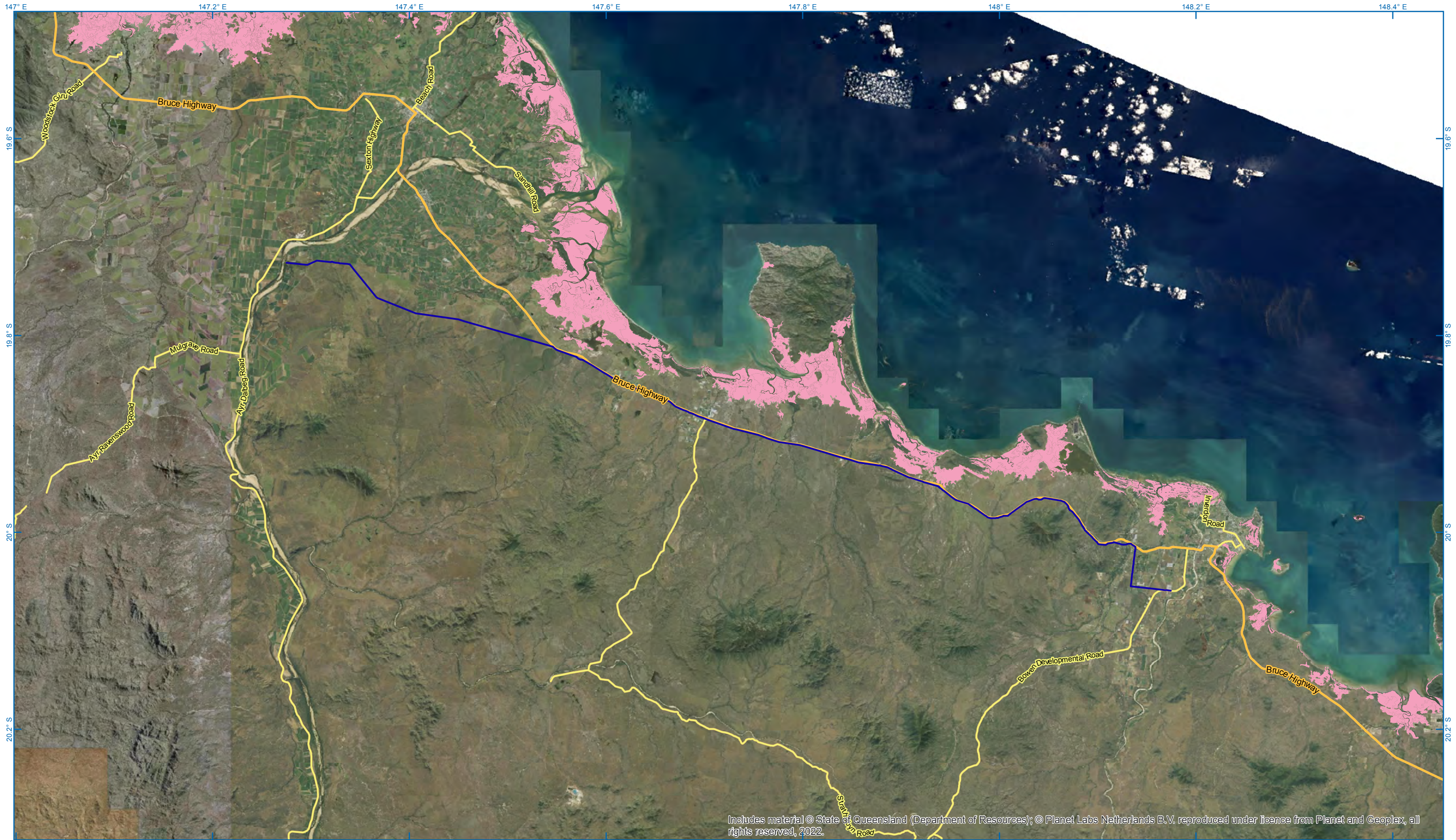
- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- ▨ Tidal waters



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Map 8: Marine Plants

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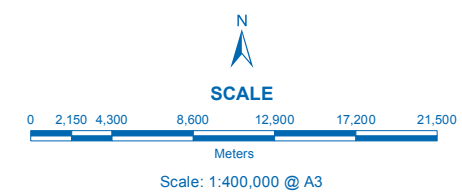
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LEGEND

- Proposed bowen water pipeline alignment
- Marine plant Regional Ecosystems

Road Network Mid

- Highway
- Main Road



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