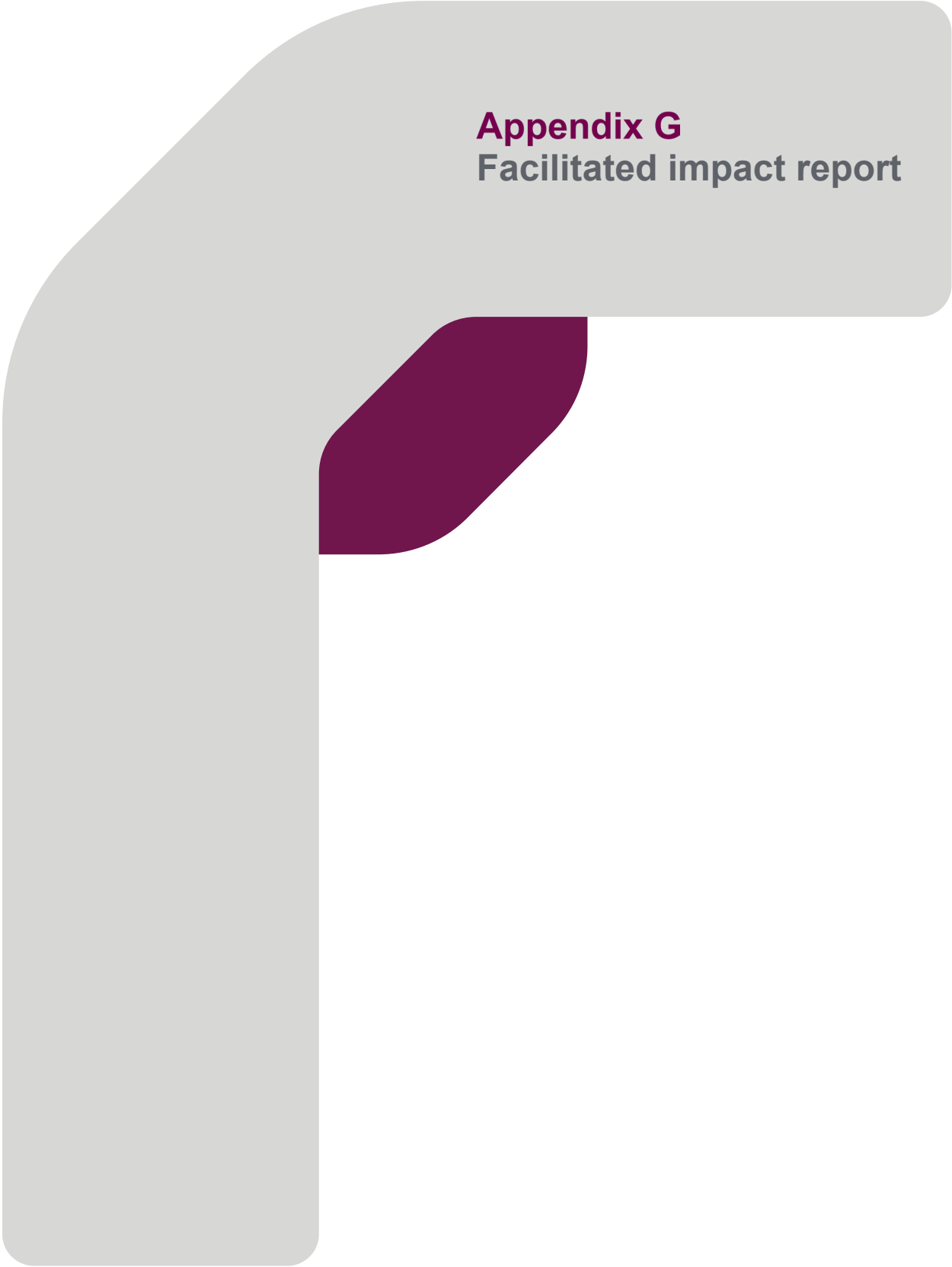




Appendix G

Facilitated impact report

Bowen Pipeline Project Facilitated Impacts Assessment

Report for the Bowen Pipeline Company Pty Ltd

March 2023

DOCUMENT TRACKING

TITLE:	Bowen Pipeline Project Facilitated Impacts Assessment
PREPARED BY:	Tom Kaveney (Adaptive Strategies)
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INTRODUCTION

This report is provided for the Bowen Pipeline Project in order to provide an assessment of the potential facilitated impacts of the project from end users of the supplied water. Consideration of facilitated impacts, particularly on Matters of National Environmental Significance, is required as part of the coordinated assessment under State and Commonwealth legislation.

PURPOSE

Adaptive Strategies Pty Ltd has been engaged by the Bowen Pipeline Company Pty Ltd to review, assess and develop a framework to consider potential facilitated impacts of the project.

While the construction of the pipeline is generally viewed as low impact or manageable in environmental terms, an area of potential concern for the Commonwealth Government is assessment of any facilitated impacts likely to flow from the project, in particular in relation to possible impacts within, or with implications for, the Great Barrier Reef World Heritage Area (GBRWhA) via land-based water discharges.

This assessment is additional to other studies that are examining the direct impacts of the proposed project on Matters of National Environmental Significance. The assessment of facilitated impacts has been guided by the assessment and conditions of approval adopted for the Lower Fitzroy Infrastructure Project as part of that project's assessment of facilitated impacts, as an example of the comprehensive and suitable approach.

APPROACH

The opinion provided in this report is based on a combination of:

- personal industry and environmental knowledge and experience
- desktop literature research – in particular information from the previous environmental and social impact assessments of the Bowen area, Abbot Point State Development Area (SDA) and Port of Abbot Point
- consideration of the preliminary report of the possible economic benefits of the Bowen Pipeline Project undertaken by KPMG (KPMG 2017)
- consideration of the conditions of approval for the Lower Fitzroy Infrastructure Project.

The key focus has been to identify the reasonably likely facilitated impacts of the Bowen Pipeline Project on the Bowen area and Abbot Point State Development Area (SDA), assess the possible related environmental impacts on the GBRWhA and consider appropriate management approaches to reduce any identified risks to the environment and the GBRWhA.

PROJECT DESCRIPTION

The Bowen Pipeline Project proposes the construction of approximately a 110km pipeline from the Burdekin River to Bowen to provide additional water to landowners, industry and community services. The pipeline will generally run adjacent to the Bruce Highway, mainly on land that is part of the highway reserve, and over private land. The pipe will be a 1 metre or up to 1.6 metre diameter HDPE pipe, and is expected to include three pump stations. A water intake structure will be located within the Burdekin River. The project is being designed to ensure longevity and minimal maintenance with as little environmental impact as possible.

The project anticipates that the additional water provided to the Bowen region will be used by

- existing agriculture and horticulture in the Bowen Basin
- potential and expanded aquaculture
- new or expanded agriculture and horticulture
- industrial
- non-potable water for the Bowen area, including the township.

The project proponent, the Bowen Pipeline Company Pty Ltd, will build and own the pipe and then sell the secured, cost effective water supply.

The target market for the water to be supplied by the project is horticultural supply using trickle or drip irrigation and it is expected that, as the water supply from the pipeline will be finite, most will be used by this sector. The Bowen Pipeline Company Pty Ltd will not allow agriculture to be supplied with water for unrestricted flood irrigation, that is water must be supplied to a storage and not allowed to flow into creeks or other waterways. Instead, the supply of water will

be subject to strict terms and conditions requiring best practice environmental management of water. There is no current planned supply to the Abbot Point SDA (noting that there is currently no industry requiring such water supply in that area), although the project could provide a reliable water source in the future.

The Pipeline will commence at the Burdekin River and traverse a range of tenures including private freehold land, unallocated state land and leasehold land. The Pipeline will extend approximately 110 km to the south with the termination point just south of Merinda. The majority of the proposed alignment is intended to be within unformed road reserve to the west of the Bruce Highway and adjacent to the Queensland Rail corridor.

The proposed underground HDPE pipeline will be capable of supplying 100,000 ML of water per annum. Of the total capacity of the Pipeline, it is anticipated that more than 90 per cent of the water would be used for horticulture and agriculture, with the remainder to be used for other commercial, aquaculture, residential or industrial uses.

The Pipeline will generate income for Bowen Pipeline Company Pty Ltd through the resale of water to users. This water use will be subject to regulatory controls, as well as supply.

REGULATORY FRAMEWORK

ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central environmental legislation. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places that are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The EPBC Act is triggered when a development proposal has the potential to have a significant impact on MNES. The provisions of the EPBC Act transcend state, regional and local planning instruments. If a development is likely to have a significant impact on MNES, it requires referral to the Commonwealth Minister for assessment as a Controlled Action.

The Australian Government published the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (Significant Impact Guideline) to assist proponents understand when significant impacts may result.

The guidelines describe a 'significant impact' as an impact that is:

"important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance."

FACILITATED IMPACTS

A project will have direct impacts from construction and operation and may also have indirect impacts that are not a direct result of the proposed action. For example a project changing water flows may have impacts on migratory species from changes to the hydrology of estuarine areas located off-site or downstream from the project itself.

The term 'facilitated' impact refers to those impacts that result from further actions that are made possible by the project, including actions of third parties that are facilitated by a proposed project. For example, the construction of a marina may increase boat and road traffic, with the increase in these activities then having their own impacts on environmental or other values. Facilitated impacts are sometimes also referred to as consequential impacts.

Facilitated impacts can be difficult for a project proponent to assess when there may be information limitations and the range of third parties involved may not be able to be fully established in the planning stage. It is not usually possible for a project to be able to foresee all developments arising from their own action. Project proponents must, however, consider any impacts that can 'reasonably be predicted' as a consequence of their action.

A key consideration in examining facilitated impacts should be whether there is an opportunity within existing planning laws to assess any consequential activities or actions that develop. Where such provisions exist to assess and regulate future activities the ability to manage and mitigate facilitated impacts is greatly enhanced and can be more easily dealt with directly. For most new developments there is almost always an approval process that must be followed, equally for expansions of intensifications of urban, aquaculture and industrial actions this is also the case. Increases in intensification of alterations to farming practices or changes in cropping or grazing arrangements may not be as closely regulated.

The Significant Impact Guideline notes that the consideration of the impacts of facilitated actions as part of the original project has no effect on the requirement of a proponent of a later facilitated action to make a referral when that action eventuates.

MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE RELEVANT TO THE PROJECT

The EPBC Act provides protection for MNES. There are nine MNES listed under the EPBC Act. These are:

1. World heritage properties
2. National heritage places
3. Wetlands of international importance (often called 'Ramsar' wetlands)
4. Nationally threatened species and ecological communities
5. Migratory species
6. Commonwealth marine areas
7. Great Barrier Reef Marine Park
8. Nuclear actions (including uranium mining)
9. Water resources, in relation to coal seam gas development and large coal mining development.

Direct impacts from the project will be assessed via a separate study. For the purposes of this assessment of facilitated impacts the focus of this report is on the Great Barrier Reef (GBR), which is listed under a number of MNES. The GBR is listed as a World Heritage property, a National Heritage place and the GBR Marine Park is an individual MNES in its own right. As such, this study has focused on the GBR generally and also the GBRWHA as this area is slightly larger than the Marine Park.

The Great Barrier Reef Coastal Zone Strategic Assessment Report (GBRMPA, 2013) states that:

“the current extent and condition of MNES in the GBR coastal zone is primarily a result of past land clearing and the impact from extreme weather events (direct impacts). This has resulted in permanent loss of ecosystems (through the establishment of agricultural and urban areas) and temporary loss while ecosystems respond following an extreme weather event. Ongoing land management practices both within the coastal zone and in the middle and upper GBR catchments generate continuous indirect impacts through diffuse and point source rural and urban water pollution and the impacts of pests, diseases and changed fire regimes. The sum of these, together with the projected future impacts associated with climate change (more intense extreme weather events, sea level rise and seawater temperature rise), are cumulative impacts.

There has been a significant loss of terrestrial, fresh-water aquatic and estuarine ecosystems as a result of past land use decisions, particularly the development of agriculture. Minimising habitat loss and changing land management practices to improve the quality of water running off agricultural areas, managing pests and fire, and the impacts of grazing in rangeland areas, are key means of protecting MNES.”

This is in line with the conclusions of the Scientific Consensus Statements of both 2013 and 2017 (State of Queensland 2013 and 2017). These statements, prepared by more than 40 leading scientists, found that declining water quality from catchment runoff was the major cause of the 'current poor state of many of the key ecosystems'. The three major risks were nitrogen, fine sediment, and pesticide discharge with broadscale agriculture the major source of the key pollutants. Nitrogen was identified in the statement as the main risk to coral, because of its influence on crown of thorns starfish outbreaks, with sediment being a greater risk to seagrass (State of Queensland 2017).

Changes to agricultural land management practices can significantly reduce pollutant loads and address declining water quality and this has been the focus of The Reef Water Quality Protection Plan (Reef Plan) and associated programs (GBRMPA, 2013).

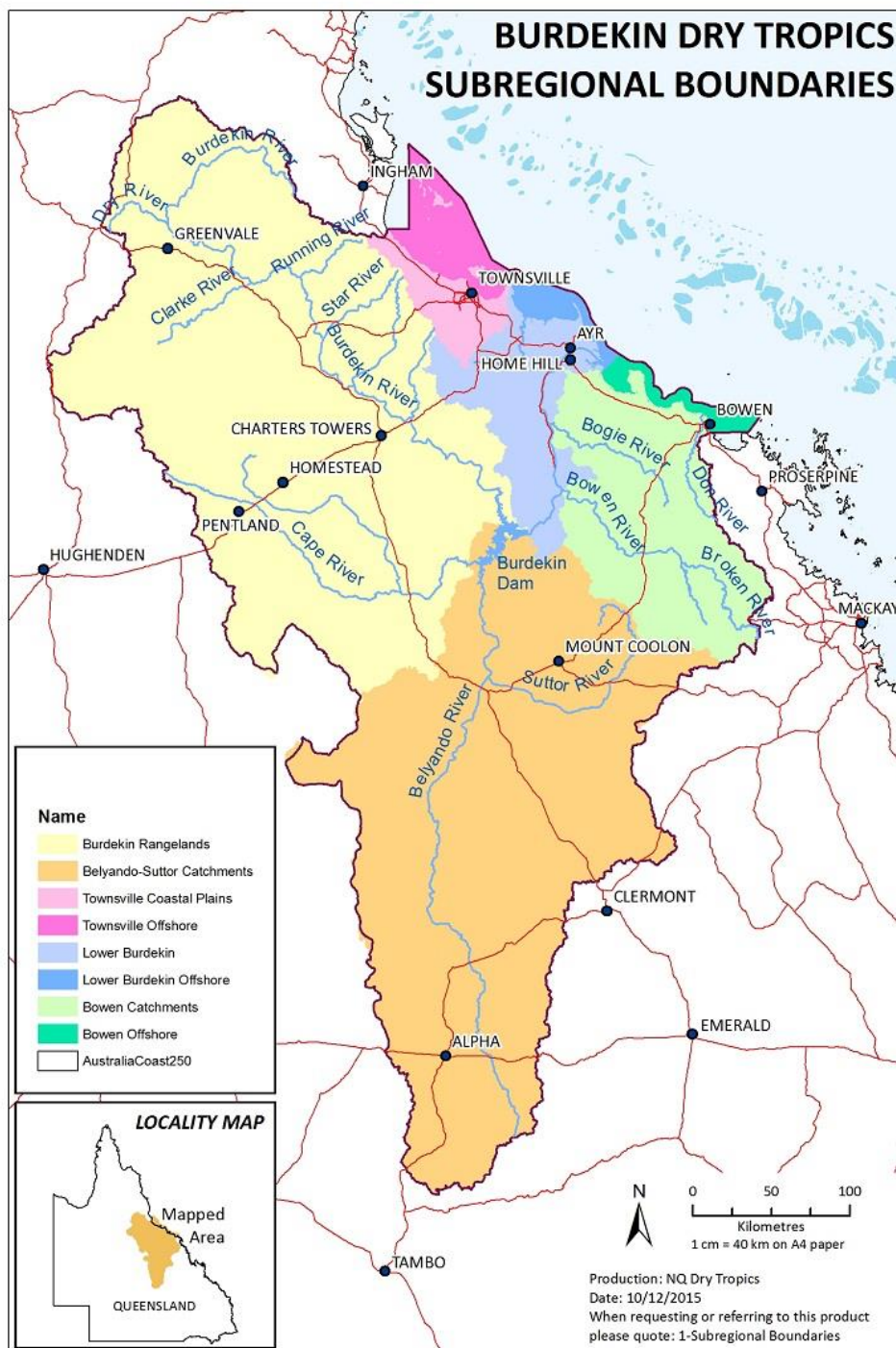
THE POLITICAL-HUMAN ENVIRONMENT

THE BOWEN REGION

The town of Bowen is situated on a peninsula, with ocean to the north, east and south. The soils within the area are some of the richest and most diverse in Queensland and the alluvial plain of the Don River to the west supports significant farming and horticulture industries.

The Burdekin Dry Tropics Natural Resource Management (NRM) plan describes the Don River as draining an inland area to the immediate south of the town and west of the Bowen River. The Bowen and Broken Rivers are tributaries of the Burdekin River. Adjacent marine areas to the region are included within the GBR Marine Park and World Heritage Area.

Figure 1: The Bowen region, rivers and catchments



The town of Bowen has a population of around 9,500 and its economy is based mainly on agriculture, horticulture, fishing, tourism, and mining. Its important horticulture industry includes small crops such as tomatoes, rockmelons and capsicums. Further inland, the major land use is cattle grazing. The Bowen Basin is also rich in coal with rail connections to the Abbot Point coal terminal, 25 km north of Bowen.

Figure 2: Map of the Don River sub basin

Source: <https://wetlandinfo.ehp.qld.gov.au/wetlands/facts-maps/sub-basin-don-river/>



The NRM plan notes that the sub-region has potential to expand mining and agricultural development, although any expansion would need to carefully consider implications for natural resources, including water availability, land capacity, and the need to protect adjacent coastal wetland, marine and reef environments.

The strategies in the NRM plan for the region aim to:

- ensure that water resources are sustainably managed, and that planning decisions incorporate environmental values, and pressures from climate change, increased demand and development
- promote the adoption of water-efficient technology and water-efficient urban and industrial use and farming practices
- manage environmental flows for the health of natural ecosystems, for example to allow for drying and wet seasonal flushes of coastal wetland ecosystems
- promote activities that ensure groundwater table levels and salinity concentrations in the Lower Burdekin are maintained at optimum levels
- support efforts to reduce nutrient and sediment loads to the GBR, to achieve targets identified in the Burdekin Water Quality Improvement Plan (2016) and Reef 2050 Plan
- remediate and control gully erosion in high priority areas as identified in the Water Quality Improvement Plan
- support land managers to implement best management practices to conserve water resources and incorporate environmental outcomes into their management systems
- establish a systems repair and prevention approach for the wider NRM community to address holistic sub-catchment and ecosystem health issues – identifying what is needed to restore and maintain the function of coastal wetland ecosystems.

As of July 2017, the Burdekin Shire is drought declared and the Mackay Whitsunday Shire, of which Bowen forms a part, is partially drought declared (Queensland Department of Agriculture and Fisheries, 2017).

The Burdekin Dry Tropics NRM Plan notes that the region's community has identified water as the most important resource requiring management and protection. At the same time, the Burdekin River catchment generates the single largest source of suspended sediment to the whole GBR (Bainbridge et al, 2013 in the Burdekin Dry Tropics NRM Plan).

THE BOWEN-GUMLU AGRICULTURAL AND HORTICULTURAL DISTRICT

Bowen is the largest winter vegetable growing region in Queensland and has a growing aquaculture industry. The region is able to produce tomatoes all year round and is Australia's biggest winter producer of fresh tomatoes. April to end of November is picking season. Local farms produce tomatoes, capsicum, chillies, button squash, cucumber, beans, corn, rockmelons, honeydew melons, eggfruit, zucchini, pumpkins, peanuts, and mangoes (Bowen Gumlu Growers Association, 2017).

In 2013-14 the Bowen and Gumlu region contributed more than \$450 million to the Australian horticulture sector. In addition, the region contributes an estimated \$278 million to the state economy through its production of crops including sugar cane, coffee and cereal. The value of Australian horticultural production is expected to increase over the medium term largely due to new and larger export markets. Between 2015-16 and 2021-22, ABARES expects the gross value of Australian horticultural production to increase from \$9.3 billion to \$10 billion (in current prices).

In the growing area, water is harvested during flow events and also from local groundwater systems. Adoption of new farm management approaches aimed at sustainability of natural resources have supported growth of approximately 20 per cent in a decade despite limited availability and quality of water (Mullins, 2016 in Burdekin NRM plan). The Burdekin NRM plan reports that water use is approximately two megalitres per hectare compared to 10-12 megalitres per hectare in the Lower Burdekin area. Best management irrigation practices in this region include determining crop water use, drip systems, fertigation, as well as evaporation reduction methods (NQ Dry Tropics, 2016, p63).

AQUACULTURE

Aquaculture is a growing sector in the Bowen Region. Current operations include the Pacific Reef Fisheries (PRF) Hatchery and Coral Coast Barramundi (CCB) Farm.

Aquaculture is the farming of both marine and freshwater aquatic organisms such as fish, shellfish and even plants. Its operations can range from land-based to open-ocean production. The determinant of the production system used is the species being farmed. Aquaculture relies on the good availability of clean coastal water but production systems may use freshwater, brackish or marine water. Production systems may be marine or land based and may operate as open or closed systems. (CIE-Report-Aquaculture-in-Queensland-(Feb-13)

PRF operates a hatchery at Guthalungra, in North Queensland, which supplies its total seed stock needs each year. This ensures full biosecurity is maintained. The PRF farm facility is at Ayr, immediately adjacent to the GBR Marine Park, from where the water is drawn to grow Black Tiger Prawns and North Queensland Cobia. PRF claim to have developed world's best water treatment technologies to ensure it operates sustainably and protects reef water.

CCB is located two kilometres from the coastline of Abbot Bay, between Guthalungra and Bowen. The farm is fully integrated with its own breeding stock hatchery and nursery rearing facility, growout raceways and HACCP approved processing facility. The farm uses oceanic seawater with an intake pumping station located on a sandy beach that ensures salt water is available all year. The farm has implemented technology to clean its water before it is released back into the environment.

PORT OF ABBOT POINT

Located 25 km from Bowen is the Port of Abbot Point, an existing coal port and one of the very few locations along Queensland's eastern seaboard where deep water (>15 m) is close inshore. The port is located within the GBRWHA and contains numerous environmental, cultural and social values. Accordingly, the area requires careful and sustainable planning and management.

The Port was planned and designed in the early 1980s to support the export of coal from the Collinsville and Newlands mines. The Port was approved by the Queensland Government to develop as a deepwater port facility in 1981. Operations commenced in 1984 and by 2010, the Port was exporting up to 15 million tonnes per annum (Mtpa). In 2011, an upgrade to the existing coal terminal increased the export capacity of the port to 50 Mtpa. Currently the port comprises a single terminal with rail in-loading facilities, coal handling and stockpiling areas and a single 2.8 kilometre offshore trestle jetty and conveyor connecting to two offshore berths and two shiploaders. The existing terminal (T1) is currently owned and operated by Adani Abbot Point Terminal (AAPT).

The Port has been identified under the *Sustainable Ports Development Act 2015* (Qld) as a priority port requiring a master plan. As a vital node in Queensland's trade supply chain, the Port forms one of the state's major gateways to international energy markets.

THE ABBOT POINT STATE DEVELOPMENT AREA

Declared by the Coordinator-General in 2008, the 16,885 hectare Abbot Point State Development Area (SDA) is located approximately 20 kilometres north-west of Bowen, in North Queensland. It was established to facilitate large-scale industrial and port-related development of regional, state and national significance.

The Abbot Point SDA is managed by the Coordinator-General to support enterprise and job creation in a way that considers environmental, cultural, and social issues as well as existing industry and surrounding infrastructure within the region.

The current Development Scheme for the Abbot Point SDA was approved in November 2014. The development scheme controls land-use and infrastructure planning and development within the SDA and sets out the processes and procedure for the assessment of applications for the use of land in the SDA.

NATURAL ENVIRONMENT

GREAT BARRIER REEF WORLD HERITAGE AREA

The GBRWHA is adjacent to the Bowen region and Don River basin. The GBRWHA is the world's third largest World Heritage property and was inscribed on the World Heritage List in 1981. It covers an area of approximately 348 000 km² and extends:

- along the coast of Queensland for 2 000 km from the top of Cape York to just north of Fraser Island
- from the low water mark on the Queensland coast seaward to the outer boundary of the Marine Park, beyond the edge of the continental shelf.

The GBRWHA includes the GBR Marine Park (managed by the Great Barrier Reef Marine Park Authority), as well as many islands, cays and intertidal areas protected by Queensland Government legislation.

The *Great Barrier Reef Marine Park Act 1975* (GBRMP Act) is the primary legislation relating to the protection of the GBR and is administered by the Great Barrier Reef Marine Park Authority (GBRMPA). The GBRMP Act provides a framework for the management and protection of the GBR Marine Park and prohibits particular activities including mining exploration and extraction within the park.

The Australian and Queensland Governments released the Reef 2050 Plan for the GBRWHA in March 2015 (<https://www.environment.gov.au/marine/gbr/publications/reef-2050-long-term-sustainability-plan>). The Reef 2050 Plan builds on the finding of the Great Barrier Reef Strategic Assessment Report and will guide the sustainable management of the GBR the next 35 years.

The Reef 2050 Plan incorporates the following four elements:

- A vision for the GBRWHA that reflects the diversity of use and interest in the property, protects the outstanding universal value of the reef, sustains its integrity and integrates the three pillars of sustainability (environmental, social and economic).
- An outcomes framework that includes desired outcomes and targets for protection of the property's outstanding universal value.
- Adaptive management actions to deliver outcomes and targets (primarily drawn from the two strategic assessments and with a focus on critical areas of new work).
- Integrated monitoring and reporting programs to measure the success of the plan.

The Reef 2050 Plan is the overarching framework for the future protection and management of the GBR. It includes targets for water quality improvements, an implementation plan and an outline of an integrated monitoring and reporting program.

The targets identified in the Reef 2050 Plan for anthropogenic, end-of-catchment water quality flow from priority areas to the GBR for 2018 include a:

- 50 per cent reduction in dissolved inorganic nitrogen, on the way to achieving up to 80 per cent reduction by 2025
- 20 per cent reduction in sediment, on the way to achieving up to a 50 per cent reduction by 2025
- 20 per cent reduction in particulate nutrients
- 60 per cent reduction in pesticide loads.

OUTSTANDING UNIVERSAL VALUE

All World Heritage properties have Outstanding Universal Value (OUV). The concept of OUV underpins the basis for listing properties on the World Heritage List and protecting and managing World Heritage properties. OUV is defined in the *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO 2013). The definition states that OUV is “cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity.”

For a World Heritage Property to be considered to have OUV, it must:

- meet one or more of the ten World Heritage criteria listed in the Guidelines
- meet the conditions of integrity and/or authenticity (noting that authenticity is not relevant to the GBR as a natural area)
- have an adequate protection and management system.

In relation to the World Heritage criteria, the GBRWHA meets four of the ten criteria, being:

- Criterion (vii) - contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
- Criterion (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.
- Criterion (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.
- Criterion (x) - 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 GREAT BARRIER REEF CATCHMENT AREA

The Great Barrier Reef Catchment Area consists of 40 drainage basins covering a total area of 425,964 km², and drains directly into the Great Barrier Reef lagoon. The size of each of the catchments varies greatly from the smallest, the Mossman Basin, at 533 km², to the largest, the Fitzroy Basin, at 142 460 km². The two largest basins, the Fitzroy and the Burdekin Basins, make up 64 per cent (272 504 km²) of the total Great Barrier Reef Catchment Area (GBRMPA, 2001).

The GBR Catchment Loads Modelling Program estimates average annual loads of key pollutants (sediment, nutrients and pesticides) for each of the 35 catchments draining to the GBR as part of the Paddock to Reef program. It reports on baseline levels and the change in loads for each subsequent year due to adoption of improved land management practices. This assesses progress towards the Reef 2050 Plan water quality targets (State of Queensland, 2016).

CALEY VALLEY WETLANDS

The Caley Valley Wetlands has an estimated area of 5,154 ha and is located within the Don River basin (BMT 2014). The Caley Valley Wetlands and its surrounding catchment dominates the aquatic ecosystem around the Port of Abbot Point. It provides an important mosaic of diverse and variable habitats for many species listed under Commonwealth and State legislation, including a number that are endangered.

The Caley Valley Wetlands are listed as a palustrine wetland of national significance in the Directory of Important Wetlands in Australia (DIWA) and is one of the largest wetland systems between Townsville and Bowen. It forms part of a larger wetland system that extends north to Cape Upstart. The Caley Valley Wetlands are a modified natural system that comprises four out of the five main wetland systems within the Great Barrier Reef catchment, including – Estuarine (brackish waters at the marine-freshwater interface 66.5% of the wetlands); Lacustrine (lakes and dams); Palustrine (marsh or swamp – 32.6 % of the wetlands) and Riverine (rivers or deepwater habitats in a channel – 0.3% of the wetlands).

Four artificial bund walls were constructed in 1956 to enhance duck shooting opportunities. These walls have impounded freshwater to their east, creating a large fresh and brackish water wetland. Abundance and diversity of wetland birds increased shortly after the bund walls were constructed (ELA and Open Lines 2013).

The wetlands are sensitive to the high variation in rainfall in the region, and the nature and relative severity of threats and pressures may change seasonally and in response to longer-term rainfall patterns.

WATER QUALITY

Declining water quality is recognised as a major threat to the GBR (State of Queensland, 2017). Land use in the catchments that make up the GBR coastal catchment can be a significant contributor to declining water quality. In particular, agricultural land uses have significant implications for water quality. Cattle grazing causes erosion and therefore greater sediment loads and crops such as sugar can be the source of high levels of nitrogen. Other crops and horticulture may add to pesticide loads.

The strategic assessment of the GBR undertaken in 2013 ranked the relative risk of degraded water quality between the regions in the GBR (from highest risk to lowest) as: Wet Tropics, Fitzroy, Burdekin, Mackay Whitsunday, Burnett Mary, Cape York (GBRMPA, 2013, p171). It assessed that the priority areas for managing degraded water quality in the GBR were the Wet Tropics for nitrogen management; Mackay Whitsunday and the lower Burdekin for photosystem II inhibiting herbicide management; and Burdekin and Fitzroy for suspended sediment management.

Higher rainfall during the wet season increases inflows of fresh water bearing sediment and other contaminants. This drives a seasonal fluctuation in turbidity, salinity and nutrient levels. Cyclones also have a significant impact on water quality, providing high intensity rainfall and strong winds, which can transport sediment that has previously settled on the sea floor (WPC 2014).

Water monitoring at Abbot Point conducted over 16 months in 2013 and 2014 found that several parameters were regularly outside water quality guidelines, including total suspended solids (TSS), nutrients, and dissolved oxygen (WPC 2014). Other parameters were found to be outside the guidelines on a seasonal basis (typically in the wet season), including chlorophyll *a* and pH. Seasonal variations in water quality (especially chlorophyll *a* and nutrient levels) are common in the GBR lagoon (GHD 2012).

Whether carried in flood plumes, or resuspended by waves, suspended solids create a turbid water column that reduces the light available to seagrass and corals. High turbidity affects approximately 200 inshore reefs and most seagrass areas. Seagrass loss severely impacts green turtle and dugong populations. On a regional basis, the Burdekin and Fitzroy regions present the greatest risk to the GBR in terms of sediment loads. At smaller scales, particularly in coastal seagrass habitats and freshwater and estuarine wetlands, pesticides can pose a high risk. Concentrations of a range of pesticides exceed water quality guidelines in many fresh and estuarine water bodies downstream of cropping lands.

At approximately 140,000 km², the Burdekin NRM region, of which the Bowen area is a part, forms about 33 per cent of the total GBR area of 423,134 km². The region is drained by five basins with the Burdekin basin making up 93 per cent of the area. The smaller basins, being the Black, Ross, Haughton and Don basins, form the remaining seven per cent (Dougall et al, 2014).

The Burdekin region is assessed as a medium to high risk for suspended sediment, herbicide and dissolved inorganic nitrogen. Suspended sediments are dominated by grazing inputs while herbicides and dissolved inorganic nitrogen are mainly sourced from the Burdekin irrigation area. In the wet season, the Burdekin River can produce flood plumes that extend far into the GBR lagoon. The Burdekin region has been estimated as contributing 4,738 t/yr of suspended sediment at end of valley: about 28 per cent of total GBR sediment export (Kroon et al. 2012). The Burdekin basin contributes most of this load.

With sugarcane a major agricultural activity in the region, there are high concentrations and loads of nitrogen reported in streams and groundwater. Most dissolved inorganic nitrogen (primarily nitrate) in streams that drain sugarcane areas is considered to come from fertiliser residue (State of Queensland, 2013, p30). The Burdekin irrigation area is the primary source of herbicide loads from the Burdekin region. The major herbicides of concern in the GBR lagoon are atrazine, ametryn, hexazinone and diuron (Davis et al. 2012).

WATER QUALITY IMPROVEMENT PLANS

All GBR catchments have a Water Quality Improvement Plan (WQIP) that identify regional water quality issues, establish catchment-specific environmental values and water quality objectives and targets. WQIPs also include recommended management actions to achieve targets. These actions include the adoption of best management practices as well as education and engagement and extension. The Burdekin WQIP covers all catchments in the Burdekin Dry Tropics region, including the Don River catchment.

Water quality concerns in the region include erosion from grazing land that causes high sediment load, high levels of dissolved nutrient loads from irrigated cropping and significant levels of herbicide loads (NQ Dry Tropics, 2016, p60). Grazing land areas in the Bowen Broken Bogie, Lower Burdekin and Don catchments are identified as contributing significantly to gully, stream bank and hillslope erosion, with poor land condition causing a significant loss of fine sediment into the waterways.

The Burdekin WQIP therefore aims to promote the implementation of best management practices in the region targeted at reducing erosion by 'maintaining, improving and restoring river frontage, and soil and pasture condition'. In relation to sugar cropping, the WQIP endeavours to encourage practices that reduce excess irrigation, nitrogen surplus and herbicide losses.

BURDEKIN WATER PLAN

The Burdekin Basin Water Plan (BBWP) provides a framework for defining and managing the availability of water in the Burdekin Basin area. The BBWP has the largest water supply scheme in Queensland and covers an area of approximately 133,600 square kilometres. The BBWP area is divided into seven major sub-catchment areas: Haughton, Belyando-Suttor, Cape-Campaspe, Upper Burdekin, Lower Burdekin, Bowen, and Broken. The Burdekin is the second largest catchment neighbouring the GBR Lagoon. It spans several climatic regions and supports a range of industries, ranging from mining, agriculture, tourism, energy and mining.

Most water used in the region is irrigation for sugarcane but it also supports mining and urban supplies for Charters Towers, Townsville and Thuringowa. Urban, stock, domestic and industrial demand comprises approximately 20 per cent of total water use.

The Burdekin Basin water plan indicates that water from the Lower Burdekin sub-catchments is to be made available for:

- (ii) growth in irrigated agriculture in the Lower Burdekin, Gumlu and Bowen areas; and
- (iii) water supplies for other urban, industrial and mining uses.

CLIMATE CHANGE PROJECTIONS

The Mackay Whitsunday and Isaacs region has high natural climate variability, higher than other parts of Australia and is known globally as having the highest natural climate variability in the world (Reef Catchments, 2016, p19).

Work by CSIRO and the Bureau of Meteorology on the possible impacts of climate change on precipitation, runoff and streamflow notes that in the last 60 years or so, Queensland has experienced a steady trend of reduced average annual rainfall (2015). Over the long-term this is expected to continue. However, intense periods of rainfall during La Nina events will continue to result in periodic extreme floods.

Modelled projections indicate with high confidence projected climate alterations, these can be summarised as:

- i. Temperature increases will continue in all seasons.
- ii. Drought will continue to be a feature of the regional climate variability.
- iii. Tropical cyclones are projected to become less frequent, but the proportion of the most intense storms is projected to increase (medium confidence).
- iv. Sea level rise and extreme sea events (e.g. storm surges) will increase and have impact further inland.
- v. The primary determinant of bushfire is fuel availability, which varies mainly with rainfall. Changes to future rainfall will be the determining factor of change to fire frequency. When fire does occur, there is high confidence fire behaviour will be more extreme.
- vi. Potential evapotranspiration is projected to increase in all seasons as warming progresses (high confidence).
- vii. There is little change projected in relative humidity until later in the century under a high emission scenario, where a decrease in relative humidity is projected (medium confidence).

It is expected that rainfall patterns in the region will decline, creating further demand for freshwater from an increasing population and cropping. At the same time, the availability of freshwater will decline due to increasing evaporation, sea level rise, seawater intrusion into freshwater coastal aquifers and contamination during flood events (Reef Catchments, 2016, p21).

POTENTIAL FACILITATED IMPACTS OF THE PROJECT

The Initial Advice Statement for the Bowen Pipeline Project recognises that there is currently no reliable water supply servicing the Bowen region beyond bore water or on-site water capture and storage. Availability of water in the region is fundamental to both the security of existing production, and expansion of the horticulture, aquaculture and industry sectors. Previous proposed projects to supply water to this region, supported by the state government, have faltered due to budgetary constraints.

Preliminary economic studies for the Bowen Pipeline Project indicate that the project would be expected to foster increased levels of development in the Bowen region. Those studies anticipate the following benefits:

- provision of a reliable water supply for existing horticulture and agriculture
- expansion of horticulture, agriculture and aquaculture (through both new crops and expansion of the current profile)
- establishment of water security for the Abbot Point SDA
- reduced dependency on the Peter Faust Dam (Lake Proserpine) for Bowen.

It is expected that provision of a secure water supply through the Bowen Pipeline Project could be a catalyst for greater economic development in the Bowen region. In particular the region has existing infrastructure capable of accommodating increased horticultural production.

As part of the current Bowen Pipeline Project proposal, KPMG (2016) has undertaken a preliminary assessment of the anticipated benefits of the Pipeline. This includes the possible opportunities for horticulture and aquaculture production from a greater availability of water. The report assessed the current horticulture and aquaculture production along the pipeline corridor, the implications of a secure and reliable water supply for the horticulture and aquaculture sectors in the catchment, and an estimate of increases in production value and employment that might be associated with an expansion of irrigated horticulture enabled by the pipeline.

It is estimated that the potential economic expansion due to the Bowen Pipeline Project could support up to 3,031 jobs directly and indirectly through the expansion of the horticulture sector alone. It could also be expected to improve income security for the region's current producers. An earlier Environmental Impact Statement for a previously proposed project, the 'Sunwater pipeline', noted that the region's water use was at capacity.

Further, it is likely that access to a stable water supply as a result of the Bowen Pipeline Project will allow for a significant increase in intensity of existing under-utilised horticultural and agricultural land, better margins for producers, and an increased diversity of produce. Greater diversification of local production would improve the resilience of the local horticultural industry to market demand and supply changes.

In order to consider what facilitated impacts may result from the Bowen Pipeline Project, the feasibility or otherwise intensification of activities within the region should be considered. The range of developments that might be facilitated by the Bowen Pipeline Project has been examined. The potential for various industries to become more feasible can be assessed, as well as whether other development might be facilitated by the provision of water via the pipeline or due to intensification of agriculture or industry as a result of the pipeline.

A secure non-saline water supply, such as the Bowen Pipeline Project, would help facilitate the expansion of the growing horticulture sector and potentially the aquaculture sector in the region. A stable water supply will support crop diversification and year-round employment and income security for the region's producers. Consultation with current operators by KPMG found that there is a benefit to aquaculture producers to the extent that the project can provide access to a cheaper water alternative than is currently accessed through desalination or treated water.

Preliminary economic analysis of the Bowen Pipeline Project notes that in 2015 horticulture in the region generated \$445 million (KPMG 2016). Total current horticultural production area in the region is 12,014 hectares. The additional water sourced from the Bowen Pipeline Project could lead to an additional 7905 ha of land coming under production. The KPMG analysis makes the conservative estimate that 26,000 ML would readily be demanded if available. The price point of the water will be fundamental to the final demand for water and the areas of development.

In addition to the above, the water could service the Abbot Point SDA, currently without a water source but with good proximity to transport. Through the introduction of the Bowen Pipeline Project, the SDA could facilitate large-scale industrial development. Potential access to a secure water supply could assist industrial users to fully develop. The existing transport connectivity of the region would also support increased development into agriculture and other industries.

It is also anticipated that the Bowen Pipeline Project will supply Bowen with a secure year-round water supply by connecting to the edge of the WRC trunk water main, providing an alternative to the Peter Faust Dam, which has historically had intermittent supply issues.

The price of the water supplied by the Bowen Pipeline Project will have a major impact on what facilitated development will arise as a consequence of the project.

Facilitated impacts from the project are possible across a range of sectors and uses. The potential for facilitated impacts to occur to the GBR related MNES from these uses is discussed below.

GROUNDWATER RESOURCES

The groundwater systems in the Bowen area (Bowen Groundwater Management Area (BGMA)) are made up of a combination of alluvial aquifers as well as those associated with the weathered granite. The granite bedrock is assumed to be an aquiclude, with no groundwater of relevance. The alluvial aquifers are the main water storage units and the varying nature of the sediment has resulted in most of these aquifers being semi-confined. There are occasions where these aquifers have become unconfined where they are directly exposed to the surface or watercourses. Alluvial thickness varies between 10 and 30 m while that of the weathered granite varies from zero to 30 m. Total saturated thickness varies between 0 and 25 m across the BGMA (Parsons Brinckerhoff 2007).

Depth to groundwater depends on location within the BGMA and with time of year (related to seasonal recharge). The levels vary from over 30 m in the upper Don catchment to near zero in the lower catchment, with occasional expressions above ground surface level. This has significant implications for the interaction of groundwater and surface water, meaning there is a greater likelihood of groundwater discharge to streams in the delta while the reverse is true on the floodplain or in the upper catchment.

The direction of groundwater flow is approximately south to north with considerable convergence in the northern delta. The gradient of the water table is generally static in wet or dry periods except in this northern area where a 5 km advance of the 2.5 m AHD isoheight was observed in the wet period of February 2000 compared to the dry period of November 1995 (URS 2005). The delta region reacts to drought and wet season recharge periods with appreciable fluctuation and this will have an effect on the potential for seawater intrusion in any given year.

The Water for Bowen environmental impact statement (Parsons Brinckerhoff 2007) identified the largest groundwater outflow as seepage to the river (average 76.2 GL per annum). Bore extraction represented 13.6 GL on average. Seaward discharge was a very small component of outflow, averaging 1.7 GL per annum.

Clearly, as 13.6 GL is extracted for irrigation on average and none re-enters the groundwater during the dry season but 4.4 GL re-enters from summer rainfall, extraction exceeds recharge so the groundwater levels show a net seasonal decrease as a result of irrigation. This loss is compensated for in the long term by flood/cyclone related rainfall recharge but in a sequence of dry years with low recharge, it can lead to the saltwater intrusion and irrigation induced salinity issues noted earlier.

During times of lowered water tables and increased groundwater extraction, the poorer water quality of the weathered granite is accessed and applied to crops. Salts can be left in the soil profile when insufficient flushing (by rainfall) occurs.

Pressures on the groundwater resource from irrigation during dry periods has resulted in yield and water quality being compromised. Water quality issues relate to:

- salt water intrusion
- upward leakage of poor water quality groundwater from the fractured granitic basement
- irrigation salinity caused by continued re-use of groundwater without sufficient recharge/flushing, particularly during low recharge years.

The possible use of imported surface water to compensate for the poorly performing groundwater was seen as a potential solution to these issues.

The URS (2005) modelled groundwater water balance suggested that irrigation is a small proportion of the inflow, which is dominated by rainfall. Evapotranspiration is the major loss component, being particularly significant in dry years.

Seepage averaged 10% of rainfall (plus irrigation) but varied between 0 and 28% depending on soil type and vegetation cover. URS also noted that 'irrigation is applied during the dry season and is applied efficiently using trickle methods, so should have little impact on seepage to groundwater'.

The current efficient irrigation techniques (mainly drip) do not lead to any tailwater discharge but maintain the soil water profile near the root zone of the crop and this is expected to continue, if not improve in efficiency over time. As such, water supplied will not alter local or regional hydrology.

A major reason the Project is being undertaken is to relieve stress on the groundwater system from current levels of usage and to provide for future growth in the region through provision of an alternative water source. Source

substitution has benefits of reducing the threat and reality of seawater intrusion, re-establishing the relationship between groundwater and surface watercourse baseflow, minimising the economic impact of water restrictions and flushing accumulated salts in surface soils.

POSSIBLE WATER USERS

Agriculture and horticulture

Irrigated horticulture production is currently spread across 12,000ha of land in the Bowen region (KPMG, 2016, p12). Production is centred around key water sources being the Elliot River (Guthalungra), Molongle Creek and Rocky Ponds Creek (Gumlu) and the Don River (Bowen). Bores and on-farm storages largely supply the industry's water. Generally this is adequate to maintain current levels of production, however in dry seasons water entitlements for groundwater are reduced. A long history of irrigation and limited water resources has facilitated the implementation of low-rate watering techniques and water efficient practices in the horticultural sector in the region.

The production value of the horticulture industry within the Bowen region has grown by 67 per cent (from \$270 million to \$450 million) between 2006 and 2015. The current major crops in the region include tomatoes (\$162 million), capsicums (\$92 million) and beans (\$68 million). Improved water security will increase certainty of supply, limit the impact of extended drought periods on local production, and improve production yield due to the quality of water (comparative to bore water).

The 'Water to Bowen' project (Parsons Brinckerhoff, 2007) and the recent reporting by KPMG (2016) have identified that the horticultural and agricultural industries need additional water to continue operating at current levels, with the current extent of supply being generally adequate to maintain production only in non-dry seasons. The SunWater proposal also reports that reduced water levels in the bore water aquifers for the Don River and Euri Creek have resulted in increased levels of groundwater salinity. Should this continue, particularly in light of predicted climate alterations, without supplementary water supply it is possible that the Bowen farming industry will not be able to continue operating at its current level.

Bowen region horticulture is currently mainly supplied with water from bores, or on farm storage plants capturing rainwater and surface flows. Captured water is mixed with bore water to reduce salinity levels to a useable level. Piped water may replace bore water currently used for agriculture leading to improved environmental outcomes. Replacement of groundwater currently used for irrigation by water from the proposed pipeline may result in (Douglas Partners 2018):

- groundwater seepage to the ocean along the coastline of the Bowen Groundwater Management Area should increase, thereby alleviating saltwater intrusion over time
- groundwater levels within the alluvial aquifer should rise, thereby reducing the upward migration of saline groundwater from the granitic basement
- better quality water from the pipeline should reduce soil salinity in the root zone and soil profile by flushing with lower salinity water.

Piped water would also reduce uncertainty related to seasonality and weather patterns, which are forecast to see a reduction in rainfall over time.

Consultation undertaken with local horticultural producers found that they would be able to increase production to meet demand from emerging domestic and overseas markets, particularly in the Asian region, if additional water was available. Additionally, access to a secure water supply was likely to support an increase in the production of existing crops as well as diversification into new crops (KPMG 2016).

The potential for the Bowen Pipeline Project to facilitate additional agriculture in the area is expected to mostly be existing operators who will increase their operations rather than new agricultural development. Within the horticulture industry it is expected that current drip irrigation practices will continue with any increase in water supply. Such measures are considered best practice and pose a low risk to MNES. Ensuring the continuation of these measures will be important in reducing the likelihood of water wastage and increased surface flows into coastal waterways.

Land suitability would not be a limiting factor for expansion of agriculture as the region has good growing conditions and soils. There is more suitable agricultural land in the catchment than can be serviced with the current volume of water available. Proposals to clear land for agricultural purposes would require separate planning and environmental approval, including a consideration of the impacts this may have on catchment drainage and water quality alterations.

Expansion of sugarcane is a possibility, but is likely to be discouraged by the price of the water (KPMG, 2016) and purchase contracts restricting the use of pipeline water in flood irrigation. These restrictions are important as notes of consultations indicated that a number of horticulture producers in the Bowen region would consider diversifying into sugar cane if water was available, with it being seen as a 'safer', more reliable crop. Sugarcane could readily grow within

the pipeline catchment area although it has a high water requirement and is a lower value crop per hectare. Any increase in sugarcane farming, using flood irrigation techniques, could lead to increased sediment, nutrient and pesticide runoff into the nearby waterways and ultimately the waters of the GBR. The restrictions on water usage in flood irrigation significantly nullify this risk.

As part of the Reef 2050 Plan efforts to address declining water quality in GBR catchments, horticulturalists have been encouraged and supported to implement best management practice systems to reduce the risk of soil erosion, use of pesticides, nutrient loss, and improve irrigation efficiency.

Under the Paddock to Reef program management practice benchmarks have been developed and are monitored, supporting change for major agricultural industries of the reef catchments—sugarcane, grazing, horticulture, grains and dairy. Reporting of the implementation of improved management practices is made against industry and regional specific management practice frameworks (water quality risk frameworks).

Practices are ranked from lowest risk (innovative practices that have the lowest water quality risk) to high risk (superseded practices that have the highest water quality risk) for sugarcane, horticulture and grains. They are ranked from very low soil erosion and water quality risk to moderate-to-high soil erosion and water quality risk for grazing.

The horticulture best management practice program 'Hort360', established by Growcom, is accepted as the industry best practice. It helps growers identify potential areas of operation (specifically within water use efficiency, soil nutrient, water quality and energy) that could be improved, and to provide guidance on how to improve them. Growcom and the Paddock2Reef (P2R) Program identified a subset of practices within Hort360 that have the greatest influence on the risk of off-farm movement of sediment, nutrients, pesticides, and water (Healthy Rivers to Reef Partnership Mackay-Whitsunday, 2016, pp8-9). These practices form the Horticulture Water Quality Risk framework (available at www.growcom.com.au/uploads/PJCT/Horticulture-Water-Quality-Risk-Framework.pdf).

The Reef Plan's 2015 report card reported that, by June 2015, best management practice systems were used on approximately 60 per cent of horticultural land for pesticides (15,000 hectares), 19 per cent for nutrients (4700 hectares) and 67 per cent for soil (17,000 hectares).

In the Burdekin region in 2014-15, 38 horticulture producers improved management practices across 4352 hectares with Australian Government financial incentives and the support of the NQ Dry Tropics NRM.

In particular the 2015 report card notes that:

- 13 farms reduced the risk of soil erosion through reducing tillage in-crop and/or increasing cover in fallow periods, and through the installation of sediment traps
- five farms improved the efficiency of pesticide applications over 1384 hectares
- 12 farms improved irrigation method and/or efficiency over 445 hectares
- five farms installed fertigation systems covering 543 hectares, which can significantly reduce the risk of nutrient losses through drainage and runoff.

Aquaculture

On the whole, aquaculture production in the region primarily uses salt water.

The environmental impacts of aquaculture vary according to the species cultivated, the management practices used and location of the production system. The industry is strongly regulated relative to other agricultural activities and effluent standards are required to meet license conditions which are set in accordance with the statutory *Environment Protection (Water) Policy 2008*. Effluent discharge quality is generally considered to be the major potential ongoing impact of aquaculture. There are also potential one-off impacts from new aquaculture development from clearing and draining of natural ecosystems (State of Queensland, Department of State Development, Infrastructure and Planning, 2013).

While the pipeline project would provide cheaper water for aquaculture than desalination or treated water, consultations with producers (KPMG 2017) seems to indicate that supported expansion with more readily available freshwater may not be significant to the industry as their greater demand is for clean sea water. Accordingly, the likelihood of substantial increases in aquaculture, including any expansions to the Guthalungra Aquaculture Project, due to the supply of freshwater is low and the risk of facilitated impacts is therefore also low.

Port of Abbot Point

The Port of Abbot Point is one of four priority ports within the GBR region (the others are Gladstone, Hay Point/Mackay and Townsville). The current Port contains a single coal export terminal with a capacity to export 50 million tonnes of coal per annum.

Water supplies for the current coal terminal are drawn from a borefield at Splitter's Creek, around 14km west of the existing facilities (NQBP 2010). The current terminal operations require approximately 550ML of water per annum. The Splitters Creek borefield provides an annual allocation of 250ML per annum, although actual extraction rates may be less than this depending on seasonal surface water supplies. A stormwater return dam located inside the Abbot Point rail balloon loop, which has a storage capacity of approximately 560ML, provides additional water resources.

Sediment levels in the aquatic environment of Abbot Point are generally low, but increase in response to storms or periods of high rainfall. Stormwater and runoff from the existing coal port is collected and treated to remove sediments (including coal) and held in two settlement ponds before eventually being discharged to the Caley Valley Wetlands (NQBP 2010).

The dependence on bore and rain fed water supplies is not fully guaranteed and has potential risks in the future, should climate predictions and seasonal variations occur. A piped reliable source of water could supplement existing supplies and reduce the dependence on bore water.

The terminal has a highly regulated storm and industrial water use regime that looks to capture and recycle water where possible, with any water releases being highly regulated.

Two new coal terminals have been approved at the Port of Abbot Point. These proposals have undergone thorough environmental impact assessment and have been approved with stringent conditions. This assessment has examined all aspects of the proposals, including likely impacts to MNES. The supply of piped water to these future operations would not alter the impacts of these operations beyond those already assessed and approved.

The likelihood of further coal or mineral export facilities being proposed for the Port of Abbot Point in the near to medium term (5 to 10 years) is extremely low. The provision of a piped reliable water source, while convenient and useful, is unlikely to be a significant factor in promoting new developments (market forces and infrastructure costs of port and rail will be a much more significant factor).

Any new developments would also need to undergo environmental assessment and approval, this is likely to include requirements on water usage and management, particularly water storages and release conditions on quantity and quality.

Industrial

A key regional strategy on the part of the Queensland Government has been to plan for water resourcing that could underpin industrial development in the Bowen region and the Abbot Point SDA. State infrastructure planning has identified the securing of a water supply as a priority for the Bowen region.

The Abbot Point SDA is considered to offer a suitable location for industrial and port-related development that is large scale and requires proximity to a port and separation from human receptors.

Industries that have been assessed as suitable for the Abbot Point SDA include:

- large-scale, value-adding industrial development
- bulk mineral resource unloading and stockpiling facilities
- mineral processing
- liquefied natural gas (LNG) facility
- fuel storage and associated infrastructure.

Initial concept proposals for the Abbot Point SDA included some interest in establishing LNG facilities, but there have been no formal applications. There was also an early proposal for an iron and steel smelting facility that does not appear to have progressed through feasibility. Other projects that progressed to the development of EIS related to the export of coal from the Galilee Basin via rail networks.

Any new developments are likely to have a high demand for water and may well see the proposed Pipeline as a convenient source. However, as with port related development the availability of a piped reliable water source, while convenient and useful, is unlikely to be a significant factor in promoting new developments (market forces and infrastructure costs are likely to be the main constraint or catalyst for development). Should industrial activity be proposed then in accordance with the SDA Planning Scheme each development will need to be assessed and approved separately, including likely impacts to watercourses, the GBR and the environment generally.

Urban growth and development

The Mackay, Isaac and Whitsunday (MIW) Regional Plan (State of Queensland, 2012), identified that the Whitsunday region is forecast to have an additional 19,750 people and an additional 10,200 dwellings by 2031 as well as new tourism based developments and new business that will place an increased demand on the available water supply. The growth

in the region will likely place additional pressure on the Peter Faust Dam at Proserpine, which currently supplies water to Bowen. The Plan notes that that water supply and sewerage facilities in the region are 'development constraints'.

The KPMG (2016) report only assesses the likely impact of the provision of piped water on the horticulture and aquaculture industries. It estimates a possible increase in employment from 1795 to 3031 in the Bowen region related to the estimated increase in agricultural production from the provision of additional water. Such employment increases may lead to other development in the region, in particular increased residential housing construction.

Residential development affects land surface characteristics and the hydrological balance, with the impacts often occurring on farmland located lower in the landscape. The increase of impermeable surfaces and changes to drainage patterns can accelerate soil erosion, siltation and sedimentation; and increase the risk of flooding. Techniques to alleviate conflict due to downstream effects of residential development include suitable erosion, sediment and stormwater control during the construction and operational stages of a development. Such controls are imposed through development approvals and are unlikely to be affected by the availability of relatively high priced piped water.

The water allocations available through the proposed pipeline do have the potential to provide additional non-potable water to the Bowen community to reduce the reliance on the Peter Faust Dam. This water is likely to replace other current and less reliable water allocations rather than be a source to stimulate future development.

All future urban areas, infrastructure and industrial development are subject to separate planning assessment and approval, which is better suited to assess the direct impacts of such developments. Additionally the cost of the piped water will be a disincentive for inefficient use and wastage that may lead to outflows into local watercourses and ultimately the GBR. Any water discharge is likely to be immeasurable in comparison to stormwater and rainfall runoff.

SUMMARY OF POTENTIAL FACILITATED IMPACTS

Activities such as agriculture, urbanisation and industrial development can increase the magnitude and timing of freshwater flows into the GBR lagoon. For example, the smooth surfaces of roads and other urban infrastructure can increase the volume and speed of freshwater flow compared to natural vegetation and soil.

Large freshwater inflows can have negative effects, for example widespread damage to seagrass meadows or the loss of estuarine areas, largely salt and mud flats. However increased freshwater can also have positive effects, for example on breeding and recruitment of estuarine and marine fish of commercial and recreational value including barramundi and king threadfin.' (GBRMPA, 2013). In context, altered flow is considered to have low effect on MNES for the GBRWHA in comparison to decline in water quality issues that has a much high effect.

If not properly managed, water provided by the project for irrigated cropping may exit farm properties carrying sediment, nutrients and farm chemicals into coastal waterways and leaching nutrients and chemicals into shallow aquifers. With higher water prices and increasing pressure from the broader community to improve agricultural practices, however, application of new technologies and water capture and reuse practices are becoming commonplace. Table 1 provides a summary of potential risks and measures by industry sector.

Table 1: Analysis of risks and measures

Industry	Harm created	Current measures	Proposed measures
Horticulture	Sediment nutrient and pesticide runoff – medium risk	Best practice application of drip irrigation and fertigation currently employed in the region.	Current practices are considered appropriate for mitigating risk to the GBR. Proponent will enter into water supply agreements that bind users to best practice applications and cooperation with NRM bodies to improve water management practices more broadly.
Agriculture (incl sugar cane)	Sediment nutrient and pesticide runoff - high risk	Adoption of best practice measures is limited.	Proponent will enter into water supply agreements that prohibit flood irrigation techniques and that bind users to best practice applications and cooperation with NRM bodies to improve water management practices more broadly.
Aquaculture	Release of large quantities of fresh or polluted water – low risk	Highly regulated industry sector. Future developments require separate assessment and approval.	No additional measures necessary.
Industrial	Release of large quantities of fresh or polluted water – low risk	Highly regulated industry sector. Future developments require separate assessment and approval.	No additional measures necessary.
Urban	Release of large quantities of fresh or polluted water or waste water runoff – low risk	Water pricing makes release or waste water discharge highly unlikely.	No additional measures necessary.
Port	Release of large quantities of fresh or polluted water – low risk	Highly regulated industry sector. Future developments require separate assessment and approval	No additional measures necessary.

Overall, there is the limited potential for the project to facilitate consequential development that is not regulated or assessed through existing planning and development schemes. Development may also be able to proceed through alternate means of water supply.

At the same time, further, management of the effects of agricultural development within GBRWHA catchments is being improved as a result of direct regulation at local, state and federal government level, as well as adoption of management practices through the implementation of actions identified in the Reef 2050 Long Term Development Plan (Commonwealth of Australia 2015) and specific programs such as the Reef Water Quality Protection Plan (State of Queensland 2013). With the application of water user agreements on horticulture and to prohibit flood irrigation activities, it is considered that the project is unlikely to facilitate significant impacts on MNES.

The Lower Fitzroy Infrastructure Project is an example of how anticipated facilitated agricultural use from a project may be handled. In February 2017 the Commonwealth approved the project subject to conditions (see text box below).

Lower Fitzroy Infrastructure Project

The Lower Fitzroy Infrastructure project will raise the existing Eden Bann Weir and construct a new weir at Rookwood on the Fitzroy River in central Queensland. The project seeks to address future water demands from urban populations, industry and agriculture within the region. Together, the weirs would supply 76,000 megalitres per annum (ML/a), of which up to 42,000 ML/a may be allocated for irrigated agriculture.

The Fitzroy Basin is a large contributor of contaminants to the GBR lagoon, particularly during floods. Agriculture accounts for almost 90 per cent of land use in the Fitzroy Basin and land degradation, habitat disturbance and alteration and impacts to water quality resulting mainly from agricultural activities are a pressure on the GBR. Fitzroy River water flows impact on marine waters of the GBRWHA that support a variety of habitats, including seagrass, that in turn supports a range of fauna, including dugong and marine turtles.

The Queensland Coordinator General assessed the Lower Fitzroy Infrastructure Project as having the potential to impact on marine ecosystems and species in the GBRWHA. Therefore the project was asked by the Coordinator-General to provide additional information on:

- impacts on water quality from potential intensive agriculture development
- commitment to further analysis and assessment to validate predicted results with impacts associated with facilitated agricultural development
- commitments to benefiting the Reef 2050 Long Term Sustainability Plan (Reef 2050 Plan) targets and water quality improvement with regard to potential facilitated agricultural development.

Additional modelling study was undertaken to estimate the impact on water quality assuming increases in cattle feedlot development, additional irrigated broad-acre cropping for fodder and grain crops on alluvial flats and additional irrigated tree crops (e.g. macadamia and avocado) on the better quality adjacent lower hills. The modelling tool used for the estimates is one that is regularly applied by government agencies for policy, planning and program work for the GBR Marine Park. The model comparison was made against the dominant existing land use (cattle grazing).

The modelling found that changing land use from grazing to broad-acre cropping on the river flats, and to tree cropping on the more arable hills would marginally increase herbicide and pesticide loads, but it would not necessarily increase sediment and nutrient loads.

The modelling assumed the adoption of common contemporary good farming practices and the Coordinator-General noted that there would be no barrier to such practices being required as a condition of the sale of water from the weirs to new facilitated agricultural development.

In commenting on the potential impacts of the project on water quality, the Coordinator-General recommended that the proponents be required to:

- implement a water nutrient monitoring program to measure changes that may arise from the decay of vegetation within the impoundments
- use the results of that program to inform any potential management or offset program
- develop and implement a land management code of practice that is to be attached as a condition of sale of water for irrigated agriculture aimed at achieving the water quality objectives of the Reef 2050 Long Term Sustainability Plan
- implement a water quality monitoring program that would inform a future water quality offsets program if required by the Commonwealth Environment Minister to address any impacts of consequential facilitated agricultural development on water quality entering the Fitzroy River.

The Commonwealth accepted the imposition of conditions as suggested by the Queensland Coordinator-General's evaluation report on the environmental impact statement.

It should be noted that the major concerns reflected in the Coordinator-General's report on the Lower Fitzroy Infrastructure project were water quality issues and land management practices related to irrigated agriculture and to intensive animal husbandry (e.g. piggeries or cattle feedlots).

ENVIRONMENTAL RISK MITIGATION

The major risk of the facilitated impacts likely to arise from the Bowen pipeline project are reductions in water quality and subsequent negative impacts on the OUV of the GBRWHA. The risk of reduced water quality is raised primarily by the high likelihood of increased agricultural and horticultural production in the Bowen sub basin. These activities carry with them known risks of increases in sediment and nitrogen, as well as pesticide loads, flowing to the waters of the GBR.

The project proponents recognise these concerns and know that any new horticulture and agriculture practices must be sensitive to potential environmental impacts on the GBR and compliant with all government regulations.

The Bowen Pipeline Company undertake that water use will not be available for flood irrigation. Contracts will be attached to the sale of water requiring water users to implement best land use practices.

Many producers in the region have adopted best practice management and the provision of water via the pipeline could play a role in ensuring that any new or increased production implements these practices.

BPC has indicated its intention to enter into supply contracts with the end water users that will include terms and conditions requiring the end users to utilise best practice in water use and management, to ensure that the water supplied is used efficiently and in an environmentally sustainable manner.

Current irrigation technologies that maximise the use of available water tend to use drip and trickle irrigation, which results in zero water runoff as a result of the horticultural activities. The key natural resource management pressures deriving from horticulture and agriculture are the loss of nutrients, pesticides and sediments and export of these into water and waterways that feed into the GBR lagoon, mainly from both diffuse and point sources of pollution. The use of inorganic fertilisers and petroleum based pesticides for sustained crop production is associated with loss of direct nutrients/pesticides or their derivatives in soluble forms. Such use is attributed to a lack of targeted application of such supplements, and a lack of awareness or resources to enable compliance with environmental best practice.

BPC could also undertake to develop a relationship with the regional NRM organisation and peak industry bodies to support their capacity and technical expertise in implementing industry extension and on-ground activities to deliver water quality benefits their work under the Australian Government's Reef Rescue and Reef Programme.

The North Queensland Dry Tropics NRM notes that substantial investment has been made to better understand local and regional water resources, including their quality, quantity, demand, supply and interactions with environmental processes. Continued coordinated effort is still needed, however, to improve management practices that deliver sustainable water resources that are efficiently used and delivered. As innovative technologies and improved water management practices become more affordable, a whole-of-community effort at a landscape scale could ensure the future sustainability of our water resources (NQ Dry Tropics, 2016).

FRC Environmental (2018) have undertaken an assessment of potential impacts to Great Barrier Reef values from facilitated agricultural development, and in particular from sediment, nutrient and pesticides. The assessment found that with the application of mitigation measures through management plans that:

- the facilitated agricultural development 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 Use Management Plans.

FRC Environmental (2018) noted that changing land use from predominantly grazing to irrigated agriculture would support 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 FAD 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.

REFERENCES

- Australian Government Department of Environment, 2013, *Significant impact guidelines 1.1: EPBC Act Matters of National Environmental Significance*.
- Australian Government and Queensland Government, 2015, *Reef 2050 Long-Term Sustainability Plan*, <https://www.environment.gov.au/marine/gbr/publications/reef-2050-long-term-sustainability-plan>
- BMT WBM (BMT), 2014, 'Abbot Point Dredging and Onshore Placement of Dredged Material Preliminary Documentation for Wetland Hydrology, Water Quality and Aquatic Ecology Components', prepared for Worley Parsons.
- Bowen Gumlu Growers Association, 2017, <http://www.bowengumlugrowers.com.au> accessed 25 August 2017
- Bowen Pipeline Company, 2017, Initial Advice Statement - Bowen Pipeline Project
- Burdekin Water Basin Plan, *Water Plan (Burdekin Basin) 2007*, <https://www.legislation.qld.gov.au/LEGISLTN/CURRENT/W/WaterReBuBP07.pdf>
- CSIRO, 2012, Climate Adaptation Flagship Working Paper 12D, September 2012
- CSIRO and Bureau of Meteorology, 2015, *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*, <https://www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/>
- CSIRO and Bureau of Meteorology, 2017, Climate Change in Australia website, <http://www.climatechangeinaustralia.gov.au/>, accessed September 2017
- CIE, 2013, *Aquaculture in Queensland: Prioritising regulatory reform*, prepared for the Queensland Office of Best Practice Regulation, [http://www.qca.org.au/getattachment/4f7c7bfb-d9a5-4580-8b8f-9aabfb1dc968/CIE-Report-Aquaculture-in-Queensland-\(Feb-13\).aspx](http://www.qca.org.au/getattachment/4f7c7bfb-d9a5-4580-8b8f-9aabfb1dc968/CIE-Report-Aquaculture-in-Queensland-(Feb-13).aspx)
- Davis, A. M., Lewis, S. E., Bainbridge, Z. T., Glendenning, L., Turner, R. D., & Brodie, J. E., 2012, 'Dynamics of herbicide transport and partitioning under event flow conditions in the lower Burdekin region, Australia', *Marine pollution bulletin*, 65(4), pp182-193, <https://research.jcu.edu.au/tropwater/resources/Davis%20et%20al%20Dynamics%20of%20herbicide.pdf>
- Dougall, C., Ellis, R., Shaw, M., Waters, D., Carroll, C., 2014, *Modelling reductions of pollutant loads due to improved management practices in the Great Barrier Reef catchments – Burdekin NRM region*, Technical Report, Volume 4, Queensland Department of Natural Resources and Mines, Rockhampton, Queensland, <http://www.reefplan.qld.gov.au/measuring-success/paddock-to-reef/assets/burdekin-catchment-modelling-report.pdf>
- Douglas Partners Pty Ltd 2018, Report on Burdekin River to Bowen Pipeline Groundwater Assessment. Prepared for Bowen Pipeline Company Pty Ltd. July 2018.
- Eco Logical Australia (ELA) and Open Lines Environmental Consulting (Open Lines) 2013. Abbot Point Cumulative Impact Assessment. Prepared for North Queensland Bulk Ports Corporation Limited. February 2013.
- GHD 2012. Abbot Point Terminal 0, Terminal 2 and Terminal 3 Capital Dredging Draft Public Environment Report. Technical Report for Abbot Point Cumulative Impact Assessment. Working Group Draft.
- Great Barrier Reef Marine Park Authority (GBRMPA), 2001, Population and Major Land Use in the Great Barrier Reef Catchment Area: Spatial and Temporal Trends, December 2001 <http://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/385/1/Population-and-major-land-use-in-the-Great-Barrier-Reef-catchment-area-spatial-and-temporal-trends.pdf> accessed 25 August 2017
- Great Barrier Reef Marine Park Authority (GBRMPA), 2013, *Great Barrier Reef Region Strategic Assessment: Strategic assessment report*, accessed 27 August 2017, <http://www.environment.gov.au/protection/assessments/strategic/great-barrier-reef>, in particular Chapter 5, 'Pressures and impacts on MNES' pp152-192
- Healthy Rivers to Reef Partnership Mackay-Whitsunday, *Methods for the Mackay-Whitsunday Report Card 2015: Stewardship and Cultural Heritage*, November 2016, <http://healthyriverstoreef.org.au/wp-content/uploads/2016/12/Development-of-Methods-for-the-Mackay-Stewardship-and-cultural-2015.pdf>
- KPMG, 2016, Bowen Pipeline Preliminary Economic Analysis: Final report
- Kroon, Frederieke J., Petra M. Kuhnert, Brent L. Henderson, Scott N. Wilkinson, Anne Kinsey-Henderson, Brett Abbott, Jon E. Brodie, Ryan D.R. Turner, 2012, 'River loads of suspended solids, nitrogen, phosphorus and herbicides delivered to the Great Barrier Reef lagoon', *Marine Pollution Bulletin* 65, pp167-181 <https://research.jcu.edu.au/tropwater/resources/Kroon%20et%20al%202012%20River%20loads.pdf/view>

- Moise, A et al., 2015, 'Monsoonal North Cluster Report', *Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports*, eds. Ekström, M et al., CSIRO and Bureau of Meteorology, Australia, <https://www.climatechangeinaustralia.gov.au/en/climate-projections/future-climate/regional-climate-change-explorer/sub-clusters/?current=MNEC&popup=true&tooltip=true>
- National Landcare Program, The Australian Government Reef Programme, Australian Government, <http://www.nrm.gov.au/national/continuing-investment/reef-programme>
- North Queensland Bulk Ports Corporation (NQBP) 2010. Environmental Management Plan. Port of Abbot Point. January 2010.
- NQ Dry Tropics NRM, 2016, *The Burdekin Dry Tropics Natural Resource Management Plan 2016-2026*, July 2016, <http://nrm.nqdrytropics.com.au>
- Parsons Brinckerhoff (PB) Australia for SunWater Limited, 2007, Environmental Impact Statement (EIS) 'Water for Bowen', <https://www.statedevelopment.qld.gov.au/resources/project/water-for-bowen/water-for-bowen-eis-executive-summary.pdf>
- Queensland Coordinator General, 2010, Land and Infrastructure Planning Study for the Central Portion of the Abbot Point State Development Area November 2010
- Queensland Coordinator General, 2016, Lower Fitzroy River Infrastructure project: Coordinator-General's evaluation report on the environmental impact statement, December 2016, <http://eisdocs.dsdip.qld.gov.au/Lower%20Fitzroy%20River%20Infrastructure/CGER/lower-fitzroy-cger-final.web.pdf>
- Queensland Department of Agriculture and Fisheries, 2017, 'Drought declarations July 2017', <https://www.longpaddock.qld.gov.au/queenslanddroughtmonitor/queenslanddroughtreport/>
- Reef Catchments, 2016, *Climate Sustainability plan 2016-2020 Mackay Whitsunday Isaac*, http://reefcatchments.com.au/files/2016/12/ELECTRONIC_Reef-Catchments_Climate-Change-Plan_FINALlores.pdf
- State of Queensland, 2013, *Reef Water Quality Protection Plan 2013: Securing the health and resilience of the Great Barrier Reef World Heritage Area and adjacent catchments*, Reef Water Quality Protection Plan Secretariat, 2013, <http://www.reefplan.qld.gov.au/resources/assets/reef-plan-2013.pdf>
- State of Queensland, 2013b, *2013 Scientific Consensus Statement: Land use impacts on Great Barrier Reef water quality and ecosystem condition*, <http://www.reefplan.qld.gov.au/about/assets/scientific-consensus-statement-2013.pdf>
- State of Queensland, 2015, Great Barrier Reef Report Card 2015, Reef Water Quality Protection Plan, <http://www.reefplan.qld.gov.au/measuring-success/report-cards/2015/>
- State of Queensland, 2015b, 'Paddock to Reef Management practices', accessed 25 August 2017 <http://www.reefplan.qld.gov.au/measuring-success/paddock-to-reef/management-practices/>
- State of Queensland, 2016, Great Barrier Reef Report Card 2015 Results, prepared by the Australian and Queensland governments, <http://www.reefplan.qld.gov.au/measuring-success/report-cards/2015/assets/gbr-2015report-card-detailed-results.pdf>
- State of Queensland, 2016b, Paddock to Reef, Catchment loads modeling program website, accessed 25 August 2017, <http://www.reefplan.qld.gov.au/measuring-success/paddock-to-reef/catchment-loads/>
- State of Queensland, Department of State Development, Infrastructure and Planning, 2013, November 2013, Great Barrier Reef Coastal Zone Strategic Assessment Report <http://www.statedevelopment.qld.gov.au/resources/great-barrier-reef-coastal-zone-strategic-assessment-final-reports.html>
- State of Queensland, 2012, *The Mackay, Isaac and Whitsunday (MIW) Regional Plan* (February 2012), prepared by the Queensland Government in consultation with the Mackay, Isaac and Whitsunday Regional Planning Committee, <https://www.dilgp.qld.gov.au/resources/plan/miw/miw-regional-plan.pdf>
- State of Queensland, 2017, *2017 Scientific Consensus Statement: Land use impacts on Great Barrier Reef water quality and ecosystem condition*, <http://www.reefplan.qld.gov.au/about/scientific-consensus-statement/>
- UNESCO (2013) Operational Guidelines for the Implementation of the World Heritage Convention. World Heritage Committee, Paris. Available from <http://whc.unesco.org/archive/opguide13-en.pdf>.
- Worley Parsons Consulting (WPC) 2014. Abbot Point Baseline Water Quality Monitoring Report.