



HUMMOCK HILL ISLAND DEVELOPMENT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2

NOVEMBER 2007





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Rail	Supplied 03/2006
Major Roads	Supplied 03/2006
Waterbodies	Supplied 02/2006
Coastline	Supplied 02/2006
Cadastre	Supplied 07/2007
Drainage	Supplied 02/2006
Geology	Supplied 08/2006

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Great Barrier Reef Marine Park Authority

Data Layer	Currency
Dugong Sanctuary	During project

Department of Primary Industries

Data Layer	Currency
Nationally Important Wetlands	Supplied 07/2007
Queensland Wetlands	Supplied 07/2007
Fish Habitat Areas	Supplied 07/2007
Seagrass Meadows	Supplied 07/2007

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Internal Data Sets

Data Layer	Currency
Soils	During project
Cultural Heritage	During project



The following sub-consultants contributed data to this project:

Central Queensland University

Data Layer	Currency
Flora and Fauna Survey Locations	Supplied 07/2005

ML Designs

Data Layer	Currency
Precinct Plan	During project
Development Footprint	During project
Concept Plan A 2004	During project
Concept Plan B 2004	During project
Master Plan C 2005	Supplied 02/2005
Master Plan H 2005	Supplied 01/2006

Cardno

Data Layer	Currency
Catchments	Supplied 08/2007
Flow Routes	Supplied 08/2007
Stormwater Drainage	Supplied 08/2007

Tod Group and AGC WWC

Data Layer	Currency
Development Plan Circa 1993	Supplied 1993
Bore and Groundwater Data	Supplied 1993

QASCO

Data Layer	Currency
Contours	Supplied 10/2006

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List of Abbreviations

µg	microgram (one millionth of a gram)
AADT	Average Annual Daily Traffic
ABS	Australian Bureau of Statistics
ACH Act	<i>Aboriginal Cultural Heritage Act 2003</i>
ACMER	Australian Centre for Mining Environmental Research
AEMSC	Australian Explosives Manufacturer Safety Committee
AGCSA	Australian Gold Course Superintendents' Association
AGO	Australian Greenhouse Office
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
ARI	Annual Return Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
ASC	Australian Soil Classification
ASFB	Australian Society for Fish Biology
ASMP	Acid Sulfate Management Plan
ASS	Acid Sulphate Soils
ASSMP	Acid Sulfate Soil Management Plan
AWQG	Australian Water Quality Guidelines
BA	Birds Australia
BCC	Brisbane City Council
BEMP	Best Environmental Management Practices
BOD	Biological Oxygen Demand
BoM	Bureau of Meteorology
BoM	Bureau of Meteorology
BPA	Environmental Protection Agency Biodiversity Planning Assessment
BPA	Biodiversity Planning Assessment
BZ	Buffer Zone
C, L, R	Consequence, Likelihood, Risk
Ca:Mg	Calcium: Magnesium ratio
CAMBA	China-Australia Migratory Bird Agreement
CG	Coordinator General of the Department of Infrastructure of the State of Queensland
CHMP	Cultural Heritage Management Plan
CHRIS	Coastal Habitat Resources Information System database
CLR	Contaminated Land Register
CO	Carbon Monoxide
CO ₂	Carbon dioxide
CO ₂ -e	Carbon dioxide equivalents
CoG	Coordinator General

CQ	Central Queensland
CQU	Central Queensland University
CRC Reef	Cooperative Research Centre Reef
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dBA	Decibels
DEH	Department of Environment and Heritage (now Department of Environment and Water Resources (DEW))
DEOs	Desired Environmental Outcomes
DEW	Department of Environment and Water Resources (Commonwealth)
DEWR	Department of Environment and Water Resources
DI	Department of Infrastructure (formally the Office of the Coordinator General)
DLGPSR	Department of Local Government, Planning, Sport and Recreation
DLGPSR	Department of Local Government, Planning, Sport and Recreation
DMR (also QDMR)	Department of Main Roads
DNRM	Department of Natural Resources and Mines
DNRW	Department of Natural Resources and Water
DO	Dissolved Oxygen
DoS	Degree of Saturation
DPA	Dugong Protection Areas
DPI&F	Department of Primary Industries and Fisheries
DSDTI	Queensland Department of State Development, Trade and Innovation
E, V, R, (NCA)	Endangered, Vulnerable and Rare under the Nature Conservation Act
EA	Environmental Authority
EHMP	Ecosystem Health Monitoring Program
EIL	Environmental Investigation Level
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMR	Environmental Management Register
EP Act	Environmental Protection Act 1994
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
EPM	Exploration Permit for Minerals
EPP (Noise) 1997	<i>Environmental Protection (Noise) Policy 1997</i>
EPP (Waste) 1997	<i>Environmental Protection (Waste) Policy 1997</i>
EPP(Air) 1997	<i>Environmental Protection (Air) Policy 1997</i>
ERA	Environmentally Relevant Activity under the <i>Environmental Protection Act 1994</i>
ESCP	Erosion & Sediment Control Plan
ESD	Ecologically Sustainable Development
EV	Environmental Value
EVR	Endangered, Vulnerable or Rare listed species under the <i>Nature Conservation Act 1992 (Qld)</i>
FHA	Fish Habitat Areas
GBRCMP	Great Barrier Reef Coastal Marine Park
GBRMP	Great Barrier Reef Marine Park

GBRWA	Great Barrier Reef World Heritage Area
GP	Gross Pollutants
GSDA	Gladstone State Development Area
Ha	Hectare
HAT	Highest Astronomical Tide
HHI	Hummock Hill Island
HIL	Health-based Investigation Level
IAS	Initial Advice Statement
IDAS	Integrated Development Assessment System
ILUA	Indigenous Land Use Agreement
IPA	<i>Integrated Planning Act 1997</i>
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
Kg	Kilograms
kL	Kilolitre
LGA	Local Government Area
M	Metre
M, Ma (EPBC)	Migratory and Marine listed species under the EPBC Act
mAHD	Metres above Australian Height Datum
MDL	Mineral Development Licence
Mg	Milligrams
Mg/l	Milligrams per litre
MHHS	Mid-Holocene High Stand
ML	Megalitre
Mm	Millimetres
MR	Department of Main Roads
Mt (Air Quality)	Metatonnes
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NCA	<i>Nature Conservation Act 1992 (Qld)</i>
NEPM	National Environmental Protection Measure
NES	National Environmental Significance as defined by the <i>Environmental Protection and Biodiversity Conservation Act 1999 (Cth)</i>
NHMRC	National Health and Medical Research Council
NLWRA	National Land and Water Resource Audit
NOC	Not of Concern species under the <i>Vegetation Management Act 1999 (Qld)</i>
NOX	Oxides of nitrogen
NTA	<i>Native Title Act 1993 (Cth)</i>
OC	Of Concern species under the <i>Vegetation Management Act 1999 (Qld)</i>
PASS	Potential Acid Sulfate Soil
PCCC	Port Curtis Coral Coast
PIFU	Population Information and Forecasting Unit
PM	Particulate matter

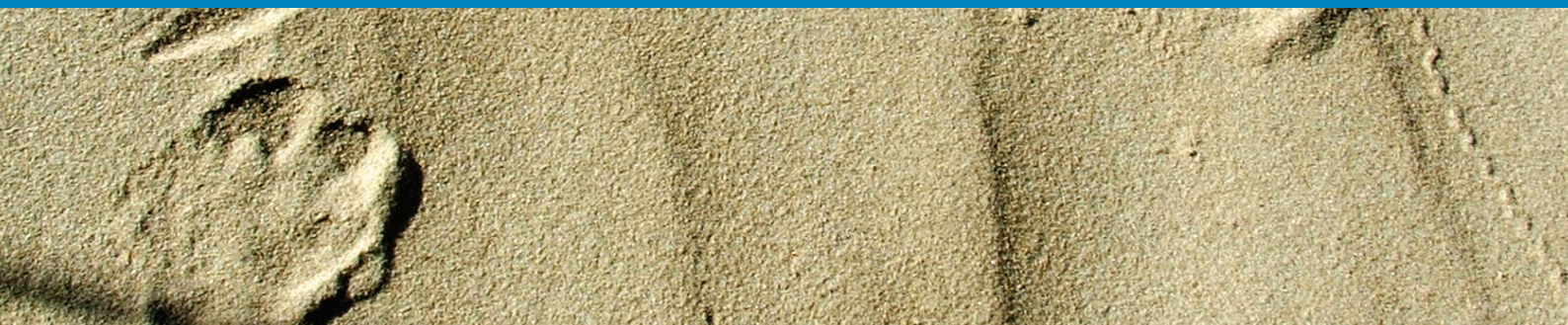


QASSIT	Queensland Acid Sulfate Soils Investigation Team
QEPA or EPA	Queensland Environmental Protection Agency
QH Act	<i>Queensland Heritage Act 1992</i>
QUAKES	Queensland University Advanced Centre for Earthquake Studies
QUDM	Queensland Urban Drainage Manual
QWQG	Queensland Water Quality Guidelines
RCMP	Regional Coastal Management Plan
RE	Regional Ecosystem
RGMF	Regional Growth Management Framework
RTC	Rural Transaction Centre
RVMC	Regional Vegetation Management Code
SCMP	State Coastal Management Plan
SDA	State Development Area
SDPWO Act	<i>State Development and Planning Works Organisation Act 1971 (Qld)</i>
SLA	Statistical Local Area
SMP & SWMP	Stormwater Management Plan
SPP	State Planning Policy
SPTR	Standard Percolation Test Rate
SS	Suspended Solids
TA	Technical Advisors
TN	Total Nitrogen
TOFO	Traditional Owner Field Officers
ToR	Terms of Reference as described in Part 4 of the <i>State Development and Public Works Organisation Act 1971 (Qld)</i>
TP	Total Phosphorus
TSM	Total Suspended Matter
TSP	Total Suspended Particulate Matter
TSS	Total Suspended Solids
UN	United Nations
V (Ecology)	Vulnerable under the <i>Nature Conservation Act 1992 (Qld)</i>
VMA or VM Act	<i>Vegetation Management Act 1999 (Qld)</i>
VPD	Vehicles Trips per Day
VPH	Vehicles Trips per Hour
WBBRP (Social)	Wide Bay Burnett Regional Planning Unit
WMCP	Wetland Mapping and Classification Program
WQO	Water Quality Objectives
WSUD	Water Sensitive Urban Design
WWTP	Waste Water Treatment Plant



SECTION 9

COASTAL ENVIRONMENT





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9. Coastal Environment

9.1 Environmental Values Assessment

9.1.1 Coastal Protection and Management Act 1995

The coastal zone is defined in the *Coastal Protection and Management Act 1995* (Coastal Act) as “coastal waters and all areas to the landward side of coastal waters in which there are physical features, ecological or natural processes or human activities that affect, or potentially affect, the coast or coastal resources.” Effectively this definition can include all lands to the catchment boundary, although in practice it is limited to areas adjacent to the coastline or closely linked through features such as watercourses. Certain public infrastructure such as pedestrian access to beaches, boat ramps and construction of the proposed access bridge will require assessment under the CPM Act. The Coastal Act specifically regulates structures in tidal areas and development in Coastal Management Districts (CMD).

The coastal management district (including tidal water) is the primary area to which development controls under the CPM Act apply as discussed in Section 2. Current coastal management districts (CMD) are listed in the *Coastal Protection and Management (Coastal Management Districts) Regulation 2003* and lists four current districts, Curtis Coast, Cardwell Hinchinbrook, Wet Tropical and South East Queensland coastal management districts. Hummock Hill does not fall into any of these districts, being situated adjacent the southern boundary of the Curtis Coast CMD.

9.1.2 State Coastal Management Plan

The State Coastal Management Plan is a policy document which provides policy direction for government decision-makers within the coastal zone. Particular decision-maker roles include:

- Within the coastal management district - EPA, under the *Coastal Management and Protection Act 1995*, is either a concurrence agency or assessment manager for certain development applications. EPA also is the responsible agency for resource allocations associated with quarry material. Where local government is involved in the application, the EPA's jurisdiction does not include amenity and aesthetic issues;
- Within local government boundaries (and prescribed tidal works outside local government boundaries) - Local government is the assessment manager for development applications under a planning scheme. EPA only has a concurrence agency role outside of a coastal management district where artificial waterways extend outside the coastal management district; and
- Approvals required under other legislation - for example DNRW would consider relevant coastal management policies in assessing applications under the Water Act and Vegetation Management Act and the EPA would consider coastal management policies in assessing applications under the Environmental Protection Act and Marine Park Act.

The State Coastal Management Plan sets out a range of principles, policies and outcomes for the management of the coastal zone, which are set out under ten broad topics. Policies of particular relevance to the Hummock Hill Island Development are addressed in Section 2, Table 2.1.



The responses to the relevant policies of the State Coastal Plan demonstrate broad compliance with the plan. The key policies outcomes relate to:

- Protection of the erosion prone area - all residential and tourism buildings would be located outside of the erosion prone area with only the bridge, boat ramps, water infrastructure and recreational access facilities located inside. These facilities would be designed to avoid or minimise any impacts to coastal processes and coastal resources;
- Development outside of current designated urban areas - the State Government has granted this Special Lease outside existing designated urban areas. Its location and style of development provides for a range and diversity of housing types and settings that is not provided for in the existing urban areas. Through this EIS, it is demonstrated that impacts to coastal resources are avoided where possible and minimised and managed otherwise; and
- Benefit to the state - the benefits of this development have been analysed and considered against the possible adverse impacts. It was found that the development has significant benefits to the State while minimising any adverse impacts.

Hummock Hill Island is located within the Shoalwater Coast Marine bioregion and the South East Queensland Coast Terrestrial bioregion, as illustrated in the *State Coastal Management Plan – Queensland's Coastal Policy – Qld EPA (SCMP)*. The Shoalwater Coast Marine bioregion falls within the Whitsunday Coast region. Section 2.2 of this report outlines the overall objectives and aims of the SCMP.

The SCMP sets out a range of principles, policies and outcomes for the management of the coastal zone, which are set out under ten broad topics. The policies of particular relevance to the Hummock Hill Island Development are addressed in Section 2 and in other relevant Sections of this EIS.

9.1.3 Regional Coastal Management Plans

Colosseum Inlet to the west of the Island forms the boundary between the Curtis Coast region and Wide Bay region with the Island falling inside the northern boundary of the Wide Bay region. As discussed in Section 2, Colosseum Inlet is identified as a key coastal site in the Curtis Coast RCMP and also identifies regionally important coastal habitats as discussed in Section 9.1.3.1.

As discussed in Section 2, the Wide Bay Burnett Regional Coastal Management Plan is currently being prepared by the Environmental Protection Agency but has not been released for public consultation as of October, 2007.

9.1.3.1 Curtis Coast Regional Coastal Management Plan

As stated above the CCRCMP identifies Wild Cattle Island (a sand Island west of Hummock Hill island) and the western most waters of Colosseum Inlet adjacent to Hummock Hill Island as a key coastal site. The CCRCMP identifies EVs for Colosseum Inlet that includes:

- Indigenous Traditional Owner cultural resources;
- Scenic coastal landscapes;



- Natural resources;
- Significant coastal resources (natural and cultural) and their values such as:
 - The Great Barrier Reef World Heritage Area and Queensland Mackay/Capricorn Marine Park;
 - Part of the Rodds Bay Dugong Protection Area;
 - Turtle nesting which occurs along beaches of Wild Cattle Island;
 - Significant biodiversity values associated ‘endangered’ and ‘of concern’ regional ecosystems including eucalyptus woodlands, littoral scrubs and coastal wetlands;
 - Indigenous Traditional Owner cultural resources;
- Significant social and economic resources and their values include:
 - Significant social and economic resources and their values include;
 - Outdoor recreational opportunities including fishing and camping; and
 - The Colosseum Fish Habitat Area.

Whilst the above significant resources and EVs have been developed under the CCRCMP, their use as a guide for establishing EVs for estuarine and marine waters around the Island, and will be considered in the EV process.

9.1.3.2 Wide Bay Burnett Regional Coastal Management Plan

The Wide Bay Burnett Regional Coastal Management Plan is currently being prepared by the Environmental Protection Agency but has not been released for public consultation as of November, 2007. Hummock Hill Island would be covered by this plan. It would support the State Coastal Management Plan in providing direction for coastal management in the region. This Plan would provide regional coastal management policies and mapping for the Wide Bay Region. Depending on the release of the draft plan for consultation and its finalisation, it may need to be considered in future planning for the development.

9.1.4 Environmental Protection Policy (Water)

The *Environmental Protection (Water) Policy 1997* (EPP (Water)) applies to all Queensland waters and provides a framework for:

- identifying Environmental Values (EVs) for Queensland waters, and deciding the Water Quality Objectives (WQO) to enhance and protect those EVs; and
- including the identified EVs and WQO under Schedule 1 of the EPP (Water).

The EPP (Water) also ensures that identified EVs for a water are protected through the use of a measurable indicator such as pH, conductivity, nitrogen concentration etc. Site specific documents are the preferred source of identifying measurable indicators for EVs under the EPP (Water), where these are regional documents such as the Queensland Water Quality Guidelines (2006) are preferred



followed by the National ANZECC (2000) Water Quality Guidelines. These are discussed further in Section 9.2.8.

Estuarine and marine waters around Hummock Hill Island or the surrounding estuarine and marine receiving waters are not listed in Schedule 1 of the EPP (Water). The EPP (Water) does state that for waters not listed in Schedule 1 the EVs to be enhanced or protected are the:

- biological integrity of a pristine or modified aquatic ecosystem;
- suitability for recreational use;
- suitability for minimal treatment before supply as drinking water;
- suitability for agricultural use; and
- suitability for industrial use.

A series of default EVs that may be used for assessment are also provided by the Qld EPA Guideline (2003) and the QWG (2006), and expand on those identified in the EPP (Water). These include:

- Aquatic ecosystems;
 - High conservation value (HCV);
 - Slightly to moderately disturbed systems (SMD);
 - Highly disturbed systems (HDS);
- Primary industries;
 - Irrigation;
 - Water for farm use:
 - Stock watering;
 - Aquaculture;
 - Human consumption of wild or stocked fish or crustaceans;
- Recreation and aesthetics;
 - Primary recreation (swimming);
 - Secondary recreation (boating, fishing);
 - Visual appreciation;
- Drinking water;
- Industrial uses; and
- Cultural and spiritual values.

Where a WQO is not listed in Schedule 1 of the Policy “*the set of water quality guidelines for all indicators that will protect all environmental values stated in the document*” will be used. Water quality guidelines can be derived from site specific data or the ANZECC/ARMCANZ (2000) Water Quality Guidelines. In the absence of a listing in Schedule 1 of the EPP Water, the *Queensland*



Water Quality Guidelines (2006) (QWQG) are used. In the case of waters around the Island the Central Coast Region guidelines are used.

9.1.5 Great Barrier Reef Water Quality Protection Plan

The Great Barrier Reef Water Quality Protection Plan (RWQPP, 2003) “is aimed at addressing diffuse pollution from broadscale land use” with the goal of “halting and reversing the decline in water quality entering the reef within 10 years”. The RWQPP identifies actions, mechanisms and partnerships to build on existing Government policies and industry and community initiatives to assist in halting and reversing the decline in the quality of water entering the reef.

Key objectives of the RWQPP are:

- reduce the load of pollutants from diffuse sources in water entering the Reef; and
- rehabilitating and conserving areas of the reef catchment that have a role in removing water borne pollutants.

The RWQPP notes that “urban diffuse sources of pollution such as sewage, waste from ore processing as part of mining and aquaculture are dealt with separately under a range of legislation and strategies and are not dealt with in the Plan.” Whilst the proposed development falls outside the scope of the RWQPP the objectives of the plan will be incorporated into the Master planning. This will assist in preserving areas of catchment that have a role in removing water borne pollutants, such as riparian vegetation, freshwater wetlands and intertidal wetlands such as those present around the Island.

9.1.6 National Land and Water Resources Audit

The National Land and Water Resources Audit (NLWRA, 2001) classified Colosseum Inlet as a ‘near-pristine’ estuary with a ‘slightly affected’ ecological status. This classification is based on assessment against disturbance criteria, e.g. no impediments to tidal flow and natural catchment cover is >90% (note: natural cover of catchments discharging to Colosseum Inlet is substantially less than 90%). The OzEstuaries Database of Australian Estuaries¹ for Colosseum Inlet and Rodds Bay summarises NLWA data and is presented in Table 9.1. No data was available from this database for Boyne Creek or Seven Mile Creek.

Table 9.1 – OzEstuaries/NLWA Summary Information

Data	Colosseum Inlet	Rodds Bay
Estuary Number	489	490
Condition	Near Pristine	Near Pristine
Classification	Tide Dominated	Tide Dominated
Sub-Classification	Tide Dominated Estuary	Tide Dominated Estuary
Estuary length	13.75 km	16.1 km

¹ <http://www.ozestuaries.org> accessed 30/01/06



Data	Colosseum Inlet	Rodds Bay
Catchment Area	475km ²	231 km ²
Tidal Period	Semi-Diurnal	Semi-Diurnal
Water Area	55 km ²	48.9 km ²
Protected	Yes (Fish Habitat)	Yes (Fish Habitat)
Amenities value	Moderate	Moderate
Conservation value	High	Moderate
Conservation threat	None	None
Ecological Status	Slightly Affected	Slightly Affected
Water Quality Assessment	No data	No data
Fisheries Value	High	Moderate
Fisheries Threat	None	None

Source: OzEstuaries Database

9.2 Existing Environment

9.2.1 Regional Setting

Hummock Hill Island is separated by 200m from the mainland by a shallow tidal estuary to the south (Boyne Creek) and slightly deeper tidal estuaries east and west, namely Colosseum Inlet and Seven Mile Creek. A small tidal creek called Sandfly Creek almost divides the Island in two. This is unlike the more typical continental islands of the GBR WHA which are more distant from the mainland such as Whitsunday Island (12km), Magnetic Island (approx 5km), or are separated from the mainland by a deep channel such as Hinchinbrook Island.

Continental Islands within the immediate region that are similar to Hummock Hill, being separated by relatively narrow tidal creeks include Curtis Island, Wild Cattle Island, Rodds Peninsula, Middle Island and Eurimbula. Of these Islands Hummock Hill has the greatest similarity with Curtis Island together with Facing Island that also have a central rock core with sand and intertidal edges. Wild Cattle Island, Rodds Peninsula and Eurimbula are National Parks and protected under the Nature Conservation Act, 1992.

The Island lies entirely within the Great Barrier Reef World Heritage Area (GBR WHA) and adjoins the Great Barrier Reef Coast Marine Park, the Great Barrier Reef Marine Park and the Colosseum Fish Habitat Area. Further detail on the relative locations of these areas can be found in Section 15.

9.2.2 Coastal Landforms and Coastal Resources

Identified landforms and landscape character units of Hummock Hill Island are described in detail in Section 5 and include specific coastal units such as:

- LCU 7 - Coastal Headland, located on the northern tip of the Island, formed from granodiorite;
- LCU 1 - Fore dunes and beaches located along the northern coastline of the Island and extending partially into Colosseum Inlet and Seven Mile Creek consisting of Qb1 to Qb3 units as described in Section 5.1 with a general transition of Spinefex spp., Casuarina spp., Pandanus spp. and Melaleuca spp. to littoral vine forest and open eucalypt woodland (refer to Section 15);and



- LCU 2 - Tidal Flats located within Colosseum Inlet, Boyne Creek, Sandfly Creek and Seven Mile Creek consisting of intertidal banks and bars with seagrass meadows, a band of mangrove species and supratidal salt pans.

These coastal units form the transitional zone between terrestrial land uses and the marine environment offshore. Both the mainland coastline and Island coastline has extensive intertidal wetlands (resources) consisting of:

- High Intertidal/Supratidal Claypan Flats (20.7 km²);
- Mid-tidal Mangroves (44.1 km²);
- Low Intertidal/Shallow Subtidal Mud Flats and seagrass meadows;
- Low Intertidal Rocky Outcrops; and
- Subtidal Creek and Channel Floors with predominantly muddy bottoms.

The Island also has open coastal habitats that predominate on the northern side of the Island, consisting of:

- Sand Beaches;
- Low Intertidal/Shallow Subtidal Spits, Banks and Shoal;
- Rocky Reefs and Stacks;
- Offshore Subtidal Areas with mostly sandy bottoms; and
- Offshore Disturbed Areas (Port of Gladstone channel and dredge spoil ground).

Intertidal resources surrounding the Island and border the mainland act as a buffer between terrestrial and marine processes and are a complex mixing zones where terrestrial outputs from watercourses are processed, filtered, stored, converted and utilised in one form or another. These areas also provide habitat for a number of listed State and Commonwealth species.

Intertidal resources surrounding the Island and border the mainland provide habitat for commercial

Vegetation on the Island consists of 'not of concern', 'of concern' and 'endangered' ecosystems as discussed in Section 15. The Island has a history of clearing and use for pastoral activities since the 19th century. A number listed terrestrial and aquatic species utilise both terrestrial and aquatic resources as habitat for refuge, feeding and nesting (refer to Section 14 and 15). Aquatic species include dugong, green turtle, flatback turtle and shorebirds. A more detailed description and assessment of intertidal flora and fauna resources may be found in Section 15.

An assessment of ecological value for estuarine waters, based on assessment criteria outlined in Guidelines for Protecting Australian Waterways (Bennett et al, 2002), is presented in Table 9.2. Based on the preliminary assessment conducted in Table 9.2, estuarine and marine waters around the Island return a high ecological value.

Table 9.2 – Draft Ecological Value Assessment of Estuarine and Marine Waters

Criteria	Question	Y/N/U	Rating
Naturalness	Is the watercourse free from (or signs of): ■ Cattle disturbance ■ Rubbish ■ Poor water quality ■ Clearing of natural vegetation ■ Presence of weeds ■ Erosion ■ Dams or weirs ■ Channel modification	Y N U Y N Y Y N	Medium
Representativeness	In comparison with similar watercourses in the area is the watercourse a good example of: ■ Flow patterns ■ Water quality ■ Native vegetation in the watercourse and on the banks ■ Aquatic wildlife ■ Channel features	Y U Y Y Y	High
Diversity	Does the area support a large number of native species Does the area have a range of estuarine and marine habitats Are there a variety of native birds commonly seen/heard in the area Are there a variety of streamside plants found in the area	Y Y Y Y	High
Rarity	Does the area (watercourse) support a rare, threatened or vulnerable species or those known locally or regionally as being significant Does the site have unusual natural features	Y N	Medium
Special Features	Are there any features present in the watercourse that makes it special	Y	High

Note: modified from Bennett et al (2002)

9.2.3 Estuarine and Coastal Waters

Colosseum Inlet and Seven Mile Creek are tide dominated estuaries located west and east of the Island respectively. Boyne Creek is an east west oriented tidal channel that connects Colosseum Inlet with Seven Mile Creek via a shallow channel. Sandfly Creek is a tidal channel that effectively divides the Island into an eastern and western portion.

Colosseum Inlet is 13.75 km in length and has a water area of 55 km². The estuary runs north to south with a shallow entrance in the north located between the western coast of the Island and eastern coast of Wild Cattle island. South of the shallow entrance bar the estuary deepens to around 20 m depth and branches into a number of ephemeral and tidal creeks such as Wild Cattle Creek to the west and Boyne Creek to the south east.

Both Colosseum Inlet and Seven mile Creek are tide dominated estuaries dominated by tidal flows rather than freshwater flows. Watercourses feeding the estuaries are ephemeral discharging to the estuaries during rainfall events. As discussed in Section 8, watercourses on the Island are also ephemeral and discharge to Boyne Creek and Colosseum Inlet (refer to Section 8 Figure 8.2). With little freshwater flow into the estuaries, stratification of denser saline layers and less dense fresh

water is not found under normal dry weather conditions. Stratification is likely to occur during periods of discharge.

A conceptual model of typical negative conditions in a tide dominated estuary is presented in Figure 9.1 below. Observations of vertical profiles for salinity and temperature collected at various locations in Colosseum Inlet during field investigations by SKM (2005) confirmed the absence of stratification within Colosseum Inlet under normal dry conditions (refer to Figure 9.1).

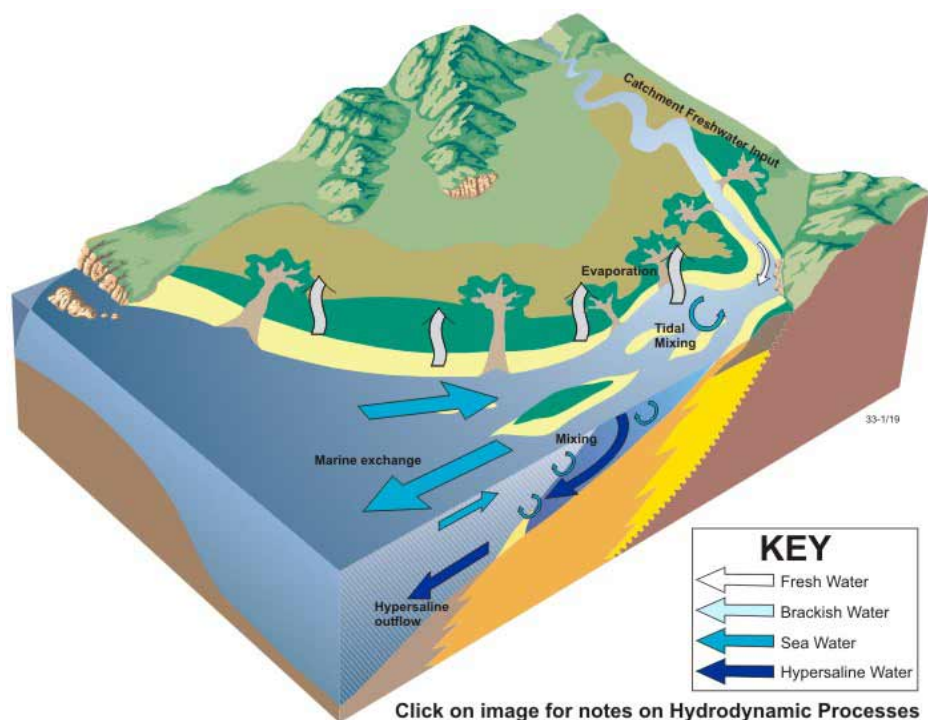


Figure 9.1 – Tide Dominated Estuary: Hydrodynamics – Negative Conditions

Source: www.ozestuaries.com.au

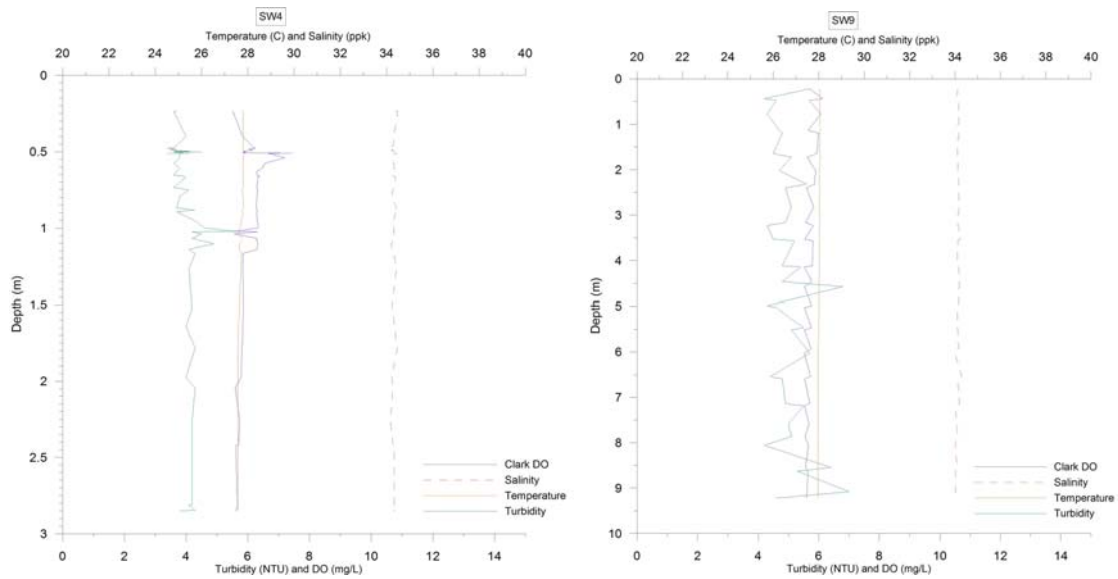


Figure 9.2 – Typical Vertical Profile at Boyne Creek (SW4) and Colosseum Inlet (SW9)

9.2.3.1 Tides and Tidal Flows

Tides within the Gladstone region are semi-diurnal; that is two high tides and two low tides per day with one high tide greater than the other. Table 9.1 presents typical tide heights for Gatcombe Head, the nearest tidal station to the Island.

Table 9.3 – Gatcombe Head Tidal Levels

Tide	Height (mAHD*)
Mean High Water - Spring	3.5
Mean High Water - Neap	2.8
Mean Sea level	2.1
Mean Low Water - Neap	1.4
Mean Low Water - Spring	0.7

* - from lowest astronomical tide

Connolly et al (2006) found that estuaries in the Port Curtis (Gladstone) region were tide dominated with very little freshwater flow under normal dry conditions. As noted in Section 8, freshwater systems on the Island are limited to ephemeral watercourses that only flow to the adjacent estuaries during large storm events.

With so little freshwater inputs under normal dry conditions, currents within the estuaries around the Island are driven by tides rather than freshwater flows. During large storm events when freshwater flows become more significant, the additional water will increase tide based discharge from the estuaries essentially ‘flushing’ the estuary. Local winds will provide some minor modification to tide driven flows, particularly in Boyne Creek where the predominant south east wind (refer to Section 7) blows down the length of the Creek. However wind driven currents will be small in comparison to tidal currents.

Currents in Boyne Creek at the current causeway location are strongest near the mid, as the channel width decreases concentrating flows. At low tide the existing causeway acts as a weir, obstructing tidal flow that travels from east to west. Anecdotal evidence from local residents suggests Boyne Creek has silted up since installation of the causeway but there is no baseline against which to assess this.

Tidal flow across supratidal saltflats are currently obstructed by the existing causeway



Figure 9.3 - Existing Clarks Road Causeway across Supratidal Saltflats

Tidal flows within mangrove lined tributaries to main estuary channels and generally connect with ephemeral watercourse discharge points, will be limited to relatively small currents on the flooding tide as water runs in over the mangrove flats. As these flats drain on the outgoing tide water is directed to the tidal channel where it is “flushed” back into the adjacent estuary. During storms freshwater discharge from ephemeral watercourses will be directed down these small mangrove channels increasing flushing flows towards the estuaries where tidal flows carry the flushed water away to the main estuarine channels and out to sea. The level of flow in mangrove channels at the discharge point of ephemeral watercourses will be proportional to the storm intensity and duration.

9.2.3.2 Estuarine Cycling and Processes

Tidal mixing and marine water exchange are considered to be the dominant processes governing water quality within estuaries surrounding the Island, followed by trophic process associated with tidal flushing from intertidal wetlands. Within Port Curtis, and similarly Colosseum Inlet, Stratford and Connolly (2006) note that tidal process, freshwater flows (during storms), trophic links, severe storm/cyclone events are the key processes sustaining the function of intertidal wetlands.

Within the estuarine systems surrounding Hummock Hill, tidal processes drive the cycling of particulate nutrients and carbon as shown in the conceptual model in Figure 9.4. Without freshwater inputs from ephemeral watercourses on the Island bringing new sources of nutrients and carbon into the estuary system, nutrient cycling is limited to this tidal process together with tidal mixing from coastal waters. Terrestrially generated nutrients such as phosphorous are generally limited within Colosseum Inlet due to the lack of freshwater inputs from ephemeral watercourses.

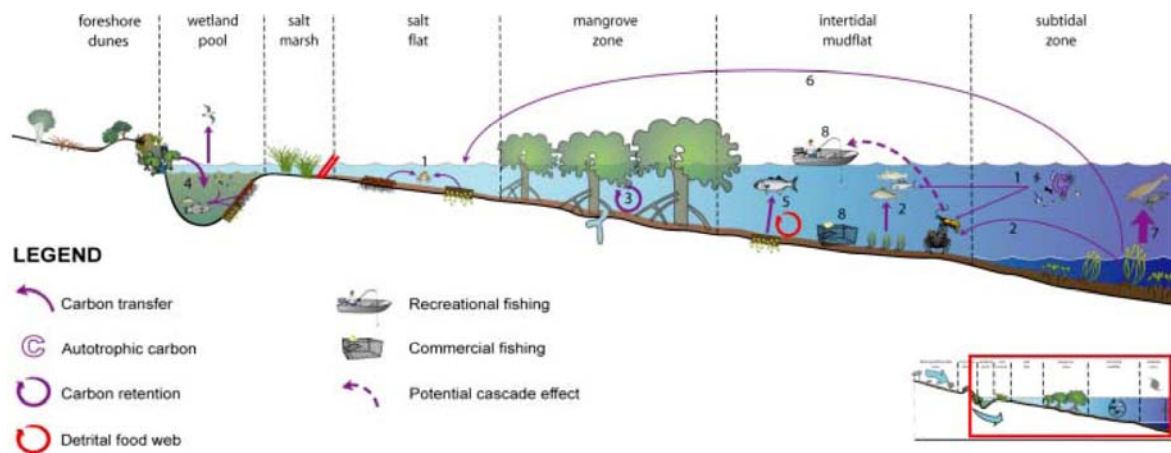


Figure 9.4 – Transfer Processes Associated with Tidal Movement (Stratford & Connolly, 2006)

Periodic storm events cause ephemeral watercourses to flow and discharge freshwater laden with suspended sediments, carbon and nutrients into the estuarine system via three main tidal channels/creeks as discussed in Section 8. These discharge points are located in Boyne Creek and Colosseum Inlet. These stormwater flushes provide an important additional source of nutrients and carbon for the adjacent estuarine ecosystem around the Island which acts as a carbon and nutrient sink, cycling these products through the ecosystem as shown Figure 9.4. It is this processing that makes the estuaries productive.

MUSIC modelling of ephemeral watercourse on the Island by Cardno (2007) returned typical loads of total suspended solids, total phosphorous and total nitrogen shown in Table 9.4. An important factor to note in data presented in Table 9.4 is that not all ephemeral watercourses on the Island flow to Colosseum Inlet, as such actual loads to Colosseum Inlet will be less. Freshwater inputs from land based catchments will also represent a larger proportion of inputs to Colosseum Inlet.

Table 9.4 – MUSIC and SedNet Results for pre-development Conditions for the Island

Potential Pollutant	Undeveloped (existing) case	SedNet (Undeveloped) ¹
Total Suspended Solids	270,000 kg/yr	3,800,000 kg/yr
Total Phosphorous	249 kg/yr	2,200 kg/yr
Total Nitrogen	3,010 kg/yr	8,480 kg/yr

¹SedNet Results are for Colosseum Inlet only and do not include Boyne Creek, Sandfly Creek or Seven Mile Creek

9.2.4 Marine Structures

Existing marine infrastructure within the estuarine and coastal environment around Hummock Hill Island includes the existing causeway access to the Island at the end of Clarks Road and public boat ramps/access points at Turkey Beach, Foreshores Estate and Wild Cattle Creek.

The existing causeway across Boyne Creek consists of filled earthen ramps leading through saltpans and mangroves to a filled causeway reinforced with logs as shown in Figure 9.5. At low tide the causeway restricts tidal movement through Boyne Creek creating a weir effect. Anecdotal evidence suggests that the presence of the causeway has caused siltation in Boyne Creek reducing the channel depth.



Figure 9.5 – Existing Causeway Across Boyne Creek at Low Tide

Existing boat ramps providing access to estuarine and coastal waters around Hummock Hill Island are located at Turkey Beach (concrete), Foreshores Estate (compacted earth) and Wild Cattle Creek (earth ramp). The Wild Cattle Creek boat ramp will be upgraded to a concrete ramp as part of an approved residential development south of Tannum Sands. No other marine structures are located within the estuaries or marine waters around Hummock Hill.

9.2.5 Coastal Hazards

9.2.5.1 Storm Tide Flooding

Reference to Table 2 of Queensland Climate Change and Community Vulnerability to tropical Cyclones: Ocean Hazards Assessment - Stage 3: The Frequency of Surge Plus Tide During Tropical Cyclones for Selected Open Coast Locations Along the Queensland East Coast provides the following storm surge height scenarios for Tannum Sands, located 20 Km north of Hummock Hill Island:

- 100 year ARI Storm event = 2.5 m for tide + storm surge effects with an additional 0.45 m (2.95 m) allowing for climate change increase in sea level;
- 500 year ARI Storm event = 3.05 m for tide + storm surge effects and additional 0.59 m (3.64 m) allowing for climate change increases in sea level; and
- 1000 year ARI storm event = 3.31 m for tide + storm surge effects with an additional 0.63 m (3.94 m) allowing for climate change increases in sea level.

Further review of potential storm surge levels by CES (2005) found predicted storm surge levels in the above document did not allow for wave set-up (the extra height of water from wave action). An additional 0.3 m to 0.6 m increase on predicted 100 year ARI tide plus storm surge levels was recommended by CES, resulting in a 3.3 to 3.6 m storm surge height for the Tannum Sands and Hummock Hill Island area.

9.2.5.2 *Erosion Prone Areas and Coastal Dunes*

The shallow seabed approach slope on the northern coastline of the Island regulates the amount of wave energy that reaches the foreshore by causing larger waves in the sea state to break and dissipate their energy before impinging on the sandy foreshore (CES, 2005). Offshore rocks approximately 100 m off the beach on the eastern side of the northern headland further dissipate wave energy and increase sand deposition forming a salient² (Figure 9.6) clearly observable at low tide. The offshore rocks and resulting salient further protect the shoreline from erosion during storm events.



Figure 9.6 – Salient East of the Northern Headland

West of the northern headland inter-tidal flats are greater in extent with 200-300 hundred metres of beach exposed at low tide. Tidal sand flats are interspersed with granodiorite bedrock outcrops. A sand beach is perched above the intertidal flats with the beach toe being approximately at Mean Sea level (MSL). The sand beach slopes up onto a low foredune system which is typically vegetated by coastal grasses. This foredune system is higher and more developed at the western end of the northern beach (and is outside the proposed development). Observed changes in dune height from the base of the northern headland to Tiber Point is potentially reflective of a concurrent increase in wave energy away from the shelter of the headland and intertidal beach.

² A salient is an area of deposition resulting in a “bulge” in the shoreline that forms behind the offshore obstacle such as rocks or small island.



Figure 9.7 – Tidal Flats West of the Northern Headland

Queensland EPA has designated erosion prone areas along the Queensland coastline in areas that may be vulnerable to sea erosion or tidal inundation within the next 50 years. The fore dune system is noted as being the most susceptible to disturbance and/or development and should remain free of development other than access ways that enable access to the beach (Qld EPA³). Hind dunes and dune ridges behind the foredune are considered by Qld EPA to be more tolerant to disturbance and development. However Qld EPA does state that permanent structures such as housing etc should be located outside these areas.

The current Erosion Prone Area map for Miriam Vale Shire (ref: SC3378F) shows an erosion prone area of 55 m around the northern headland and 80 m along North Beach (measured from the Toe of the Primary Dune). Recent calculations by Coastal Engineering Solutions (CES, 2005) confirm an Erosion Prone Area of 80m (refer to Appendix A7.8) is appropriate for this area being sufficient to protect the area up to a 1:100 year storm event. However, this area does not include allowance for increases in sea level from global warming scenarios.

The 80 m erosion buffer area covers the existing active dune system that incorporates the backshore, incipient fore dune, primary swale, older incipient foredune/s and subsequent swale/s that represents the current active dune system. This buffer zone also includes some of the remaining relict beach ridge and swale system that has been stabilised and vegetated by trees as discussed in Section 5.

Erosion prone areas behind the North Beach and Main Beach are not part of the lease area. As such, these areas are not included as part of the lease area or proposed development works on Lot 3 on FD841422 and will remain untouched. It is noted that some public access and drainage infrastructure will be required through the erosion prone area. Details of potential impacts from these access routes are discussed in Section 9.2.6.

9.2.6 Public Access and Use

Current public access to estuarine and marine waters around the Island are limited to boat ramps at Turkey Beach (concrete), Foreshores Estate (compacted earth) and Wild Cattle Creek (earth ramp). Other than these sites boating access requires launching from Tannum Sands or Boyne Island and requires passage over the shallow bar at the mouth of Colosseum Inlet. The landward side of the



existing causeway may also be used for small boat access from high to mid tide. Details of the above public boat ramps are provided in Table 9.5.

Table 9.5 – Public Boat Ramp Tide Access and Distances to Estuaries

Ramp	Tidal Limitations	Access	Distance* to Seven Mile Ck	Distance* to Boyne Ck	Distance* to Colosseum Inlet
Turkey Beach	All Tide	Sealed Road Concrete Ramp	10 km	16 km	25 km
Foreshores	Part Tide	Sealed & Dirt Road Dirt Ramp	7 km	5 km	0 km
Wild Cattle Creek	Part Tide	Dirt Road Dirt Ramp	17 km	10 km	5 km
Tannum Sands	Part Tide	Sealed Road Sand Ramp	20 km	15 km	10 km
Boyne Island	Part Tide	Sealed Road Concrete Ramp	22 km	17 km	12 km

* -linear distance, real distances will require navigation of various waterways and can be longer.

No suitable all tide boat access is currently available within a short distance of Colosseum Inlet, Boyne Creek or Seven Mile Creek. Turkey Beach is currently the only all tide boat ramp within the immediate vicinity of the Island that also has sealed road access. Community consultation has revealed that the estuaries around the Island are becoming increasingly popular for recreational boating with both the local and regional community. The annual Tannum Hookup fishing competition, that draws competitors from State wide, regularly uses the waters around the Island. Shallow entries to Colosseum Inlet and parts of Seven Mile Creek also currently limit access to these water from the ocean for recreational craft.

Access to the Island for recreational activities discussed in Section 5, namely camping, is currently by boat from the above departure points. Public access to the Island by vehicle can only be achieved on extremely low tides via the causeway and is not commonly carried out.

Social uses of the Island is discussed in Section 5 and is limited to camping on the Colosseum Inlet shoreline opposite the Esplanade, in Sandfly Creek and on the southern tip of the Island, all outside the current Development Lease. Water based recreational activities are conducted in coastal and estuarine waters adjacent to the Island. In particular the area is becoming an increasingly popular area for boating and fishing activities as population increases in the Tannum Sands and Turkey Beach area.

9.2.7 Estuarine and Marine Waters Environmental Values

Section 9.1.3 to 9.1.5 provides a range of potential EVs that may be applied to estuarine and marine waters. Review of the existing natural and social environmental conditions of estuarine and marine waters has confirmed that many of the potential EVs identified in Section 9.1.3 to 9.1.5 are applicable for the purpose of establishing Water Quality Objectives under the EPP (Water). A draft assessment of the ecological values of estuarine waterways and marine waters around the Island



returns the waters to be high conservation value waters, primarily due to the relatively undisturbed nature of the estuaries and coastal habitat and presence of a number of protected species within.

Based on the existing condition, preliminary assessment of ecological value and current human uses of identified watercourses draft EVs are outlined in Table 9.6.

Table 9.6 - Draft EVs for Estuarine and Coastal Waters around Hummock Hill Island

Watercourse Type	HCV Aquatic Ecosystems	Human Consumers of Aquatic Foods	Primary Recreation	Secondary Recreation	Visual Appreciation	Cultural & Spiritual
Estuarine Waters						
Coastal Waters						

It is noted that estuarine and coastal waters of Hummock Hill Island are contained in the Baffle Creek catchment. The Baffle Creek catchment has an area of 3,996 km² of which 80% is cleared for agricultural purposes, mainly pastoral activities. Ephemeral watercourses discharging to estuaries around the Island would be classed as slightly to moderately disturbed systems.

9.2.8 Water Quality Objectives

Water Quality Objectives for estuarine and marine waters around the Island are required to protect the identified draft EVs in Table 9.6 and identified in Section 9.1.3 to 9.1.5. As estuarine and marine waters around the Island are not listed in Schedule 1 of the EPP (Water), the WQO will be the “*the set of water quality guidelines for all indicators that will protect all EVs for the water*”. Consideration is also given to the objectives of the Reef Water Quality Protection Plan (RWQPP) issued by the Great Barrier Marine Parks Authority (GBRMPA).

Draft Interim Marine Water Quality Guidelines have been compiled by GBRMPA but have not yet been released for public comment. Whilst they cannot be incorporated into the development of WQO for the project at this stage their incorporation can be reviewed once fully released to assist in setting WQO consistent with objectives of the RWQPP.

The following objectives, aligned with draft EVs will form the basis for establishing specific WQO:

- reduce the load of pollutants from diffuse sources in water entering the Reef;
- rehabilitating and conserving areas of the reef catchment that have a role in removing water borne pollutants;
- maintain identified ecological values and resources of estuarine and marine waters in their current condition;
- maintain visual and recreational aesthetics of estuaries and marine waters;
- maintain existing cultural and spiritual values of estuarine and marine waters; and
- protect the GBR WHV.

The level of protection required for high ecological value (HEV) waters such as those around the Island the Queensland Water Quality Guidelines (QWQG, 2006) requires “*no change from current conditions*”. This is consistent with WQO outlined in Section 8 for stormwater discharges and the



goal of the RWQPP and is considered suitable for achieving the above objectives and protecting draft EVs.

Assessment of changes from natural conditions is defined by the QWQG (2006) as “*deviations from natural 20/50/80 percentiles should not occur even over a period of several weeks, except where this is due to natural fluctuations.*” The level of deviation for HEV waters is the 75% confidence interval. In other words, the parameter being assessed must fall within $\pm 75\%$ of each percentile of background conditions. A minimum of 24 data for each parameter are required to be able to accurately assess changes from natural conditions by this method. These data will be collected as part of establishing sub-regional WQO for the proposed development, specific to the estuarine and marine waters around the Island.

Until such a data set is achieved, through the proposed water quality monitoring plan, default regional guidelines for the Central Coast Queensland Region and ANZECC (2000) will be used as interim WQO for estuarine and marine waters, these are summarised in Table 9.7.

Table 9.7 – Central Coast Queensland

Parameter	Units	WQO - Estuarine	WQO - Coastal
Physio-chemical ¹			
Ammonia (NH ₃)	µg/L	10	6
Oxidised N (NO ₂ ⁻ + NO ₃ ⁻)	µg/L	10	3
Total N	µg/L	300	140
Filtered Reactive P	µg/L	8 °C	6
Total P	µg/L	25	20
Chl-a	µg/L	4.0	1.0
DO	%	85 - 100	95 - 105
Turbidity	NTU	8	1
Secchi depth	m	1.0	5.0
Suspended Solids	mg/L	20	10
pH		7.0 - 8.4	8.0 - 8.4
Toxicants ²			
Lead	µg/L	2.2	2.2
Zinc	µg/L	7	7
Cadmium	µg/L	0.7	0.7
Copper	µg/L	1.0	1.0
Cyanide	µg/L	2	2
Primary recreation ³			
Enterococci (primary)	cfu/100ml	35 ⁴	35 ⁴
Enterococci (secondary)	cfu/100ml	230 ⁵	230 ⁵

1) QWQG (2005) Central Queensland Region - enclosed coastal

2) ANZECC (2000) 99th percentile for marine water

3) ANZECC (2000) Recreational Water Quality and Aesthetics

4) ANZECC (2000) median value over the bathing season (max = 60 - 100 cfu)

5) median value over the boating season (max = 450 - 700 cfu)



9.2.9 Water Quality

9.2.9.1 Factors Affecting Water Quality

Diffuse suspended sediment and nutrient runoff within catchments is considered to be an important issue by GBRMPA as reflected in the objectives of the RWQPP. The Colosseum Inlet and Seven Mile Creek estuaries receive discharges during and following rainfall events from ephemeral watercourses in the northern section of the Baffle Creek catchment.

Colosseum Inlet receives ephemeral freshwater discharges from Twelve Mile Creek whilst Seven Mile Creek receives ephemeral freshwater discharge from Scrubby Creek. Both these catchments may be considered as modified from their natural state due to clearing of vegetation, pastoral activity and low density residential development.

Ephemeral/periodic discharges from these watercourses will influence water quality within Colosseum Inlet and Seven Mile Creek, introducing suspended sediment, nutrients, heavy metals, road runoff and anthropogenic chemicals such as pesticides to estuarine waters. These contaminants are flushed into the estuaries during storms or periods of rain where they are processed as part of the estuary tidally driven geochemical cycle. During large storms where the quantities of freshwater input to the estuaries are greater, suspended sediment nutrients and other contaminants are flushed very quickly out to sea with little processing within the estuaries.

Low density residential development on the southern end of Wild Cattle Island (the Esplanade) and fishing shacks on the southern side of the mouth of Wild Cattle Creek rely on septic tanks or similar systems for disposal of sewage waste. These systems are located in permeable sands within 50 m of Colosseum Estuary. Similarly a small number of houses at Mundoolin Rocks also process sewage waste via septic tank systems adjacent to Boyne Creek. Leaching of nutrients is likely from these settlements, adding a relatively small contribution to the existing nutrient load of Colosseum Inlet and Boyne Creek.

Intertidal wetland vegetation within the estuaries around the Island remain relatively intact, with very little physical disturbance. Intertidal vegetation such as mangroves are an important part of the estuarine processing system. Intertidal vegetation acts as part of the estuarine system taking up nutrients and converting them to biomass and carbon that eventually cycles back to the estuary as detritus (refer to Figure 9.4). This important process is recognised by the RWQPP objectives that aims to preserve intertidal vegetation as a sink and processing mechanism for diffuse pollution sources.

As discussed in Section 8, Hummock Hill Island has partly cleared catchments that contain small ephemeral watercourses that discharge primarily to Boyne Creek and Colosseum Inlet. Suspended sediment and nutrient loads from these catchments are provided in Table 9.4. Discharge from these small catchments

9.2.9.2 Existing Water Quality

Water quality sampling was conducted by SKM in September and November 2005 from a number of estuarine and marine water locations around Hummock Hill Island (refer to Figure 9.8). Based on



catchment land uses being predominantly pastoral land use, initial water quality sampling focussed on physico-chemical parameters and nutrients within estuarine and coastal waters.

Physico chemical measurements such as pH, turbidity, dissolved oxygen were collected using a Troll 9000 (In-Situ) multi-parameter meter. Water samples were also collected to be analysed for nitrogen and phosphorous based nutrients. Physico-chemical field measurements were obtained either at two different depths (during September sampling) or continually monitored through the entire water column (November sampling).

Physico-chemical parameters were consistent with estuarine waters dominated by marine tidal inflows as demonstrated by electrical conductivities at all monitoring locations being around ranging from 60.99 to 65.45 mS/cm. Conductivities over depth displayed little variation indicating well mixed water. Dissolved oxygen concentrations ranged between 5.59 to 7.3 mg/L, were well saturated and within both the draft marine and estuarine WQO. Dissolved oxygen concentrations were consistent between surface and deeper waters within both estuarine and coastal waters. support a well mixed system with little evidence of poorly mixed areas where dissolved oxygen is likely to decline. Turbidity measured during the September sampling round exceeded the draft marine WQO in W2 and draft estuarine WQO in W4 and W5 located in Boyne Creek. Turbidity during September sampling exceeded respective estuarine and marine draft WQO however, all turbidity values were below respective draft WQO in November sampling. Turbidity displayed little variation with depth, indicating a well mixed vertical profile in all locations as would be expected in a well mixed estuary. Physico chemical results from field monitoring are presented in Table 9.8.

Table 9.8 – Physico-chemical Results of Estuary and Marine Water Quality Sampling

Site #	Location	Depth (m)	Temp (°C)	EC mS/cm	DO (mg/L)	DO (% Sat)	ORP (mV)	Turbidity (NTU)	pH
	Marine Draft WQO (C)	-	-	-	-	95-105	-	1	8.0-8.4
	Estuary Draft WQO (E)	-	-	-	-	85-100	-	8	7.0-8.4
Date of Sampling = 09/05									
W1	Colosseum Inlet (E)	0.3	22.4	64.95	6.5	96.4	NT	NT	7.75
		3.0	22.1	65.45	6.4	95.5	NT	NT	NT
W2	North Beach (C)	0.3	22.6	63.95	6.8	101.6	NT	18.6	NT
		3.0	22.3	63.77	7.0	103.3	NT	18	NT
W4	BC Causeway (E)	0.3	24.2	62.9	7.3	109.3	NT	31.4	NT
		2.5	23.7	63.1	7.3	110	NT	26	NT
W5	Mangrove Channel (E)	0.3	25.5	63	6.4	98.8	NT	12.5	NT
Date of Sampling = 30/11/05									
W1	Boyne Creek (E)	0.21	28.02	61.65	7.08	NT	196	4.4	7.78
		9.5	27.75	61.21	5.79	NT	195	6.5	7.76
W4	BC Causeway (E)	0.15	27.75	61.29	7.05	NT	192	3.6	7.77
		2.8	27.58	61.29	6.02	NT	192	4.2	7.73
W6	Mangrove Channel (E)	0.53	28.00	61.39	6.52	NT	200	5.2	7.85
		2.9	28.13	61.95	6.19	NT	194	5.8	7.81
W7	Colosseum inlet (E)	0.29	28.07	61.21	6.48	NT	190	3.8	7.87



Site #	Location	Depth (m)	Temp (°C)	EC mS/cm	DO (mg/L)	DO (% Sat)	ORP (mV)	Turbidity (NTU)	pH
		6.06	27.94	61.19	5.93	NT	190	7.8	7.79
W9	Entrance Col. Inlet (E)	0.44	28.05	60.82	6.13	NT	197	4.2	7.98
		9.22	27.96	60.99	5.59	NT	192	4.6	7.93

Note: Cells in grey exceed respective WQO

Initial water quality sampling for nutrients in September and November 2005 are summarised in Table 9.9. Ammonia concentrations ranged from 41 µg/L to 104 µg/L, exceeded the draft WQO in all sampling locations and on occasion by up to an order of magnitude. Oxides of nitrogen (NO_x) exceeded the respective draft WQO at all sites during September sampling and W7 located in the central portion of Colosseum Inlet during November sampling. Total nitrogen concentrations were greater than the marine WQO in coastal waters (W2) and one location in Colosseum Inlet (W1) located near the confluence with Boyne Creek.

Total phosphorous concentrations was greater than respective draft WQO in all location bar W1. slightly higher concentrations of total phosphorous were detected in W4 located adjacent the causeway in Boyne Creek. Reactive filterable phosphorous (the more bioavailable dissolved form) exceeded the respective draft WQO in all location tested during November.

Table 9.9 – Nutrient Water Quality Results

Site #	Location	NH ₄ (µg/L)	NO ₂ (µg/L)	NO ₃ (µg/L)	NO _x (µg/L)	TKN (µg/L)	Total N (µg/L)	Total P (µg/L)	Reactive P (F) (µg/L)	TOC (µg/L)
	Marine Draft WQO (C)	6	-	-	3	-	140	20	6	-
	Estuary Draft WQO (E)	10	-	-	10	-	300	25	8	-
Date of Sampling = 09/05										
W1	Colosseum Inlet (E)	50	<10	24	24	<100	<100	60	<10	1000
W2	North Beach (C)	70	<10	34	34	200	200	60	<10	2000
W5	Mangrove Channel (E)	87	<10	26	26	100	100	80	<10	1000
Date of Sampling = 30/11/05										
W1	Colosseum Inlet (E)	44	<10	<10	<10	2800	2800	10	10	NT
W2	North Beach (C)	NT	NT	NT	NT	NT	NT	NT	NT	NT
W4	BC Causeway (E)	104	<10	<10	<10	<100	<100	70	21	NT
W5	Mangrove Channel (E)	NT	NT	NT	NT	NT	NT	NT	NT	NT
W6	Mangrove Channel (E)	41	<10	<10	<10	<100	<100	60	10	NT
W7	Colosseum inlet (E)	50	<10	15	15	<100	<100	70	10	NT
W9	Entrance Col. Inlet (E)	43	<10	<10	<10	<100	<100	70	10	NT

Note: Cells in grey exceed respective WQO



LEGEND

- Proposed Freshwater Monitoring Locations
- Marine Monitoring Locations
- Discharge Points
- Index Contour (5m)
- Intermediate Contour (1m)
- Drainage Line

This figure must be read in conjunction with the data disclaimer located at the front of this report. The data acquired for this project is known to be of low spatial resolution and as such no representation or warranties about its accuracy, reliability or suitability are given. Assumptions and conclusions made from this figure and the associated data must be made with full understanding of the data limitations. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data

0 1 2 km



Figure 9.8 - Marine Water Quality Monitoring Locations



Results of initial water quality sampling for nutrients has returned concentrations of key nutrients such as ammonia, NO_x and phosphorous that exceed the draft WQO for these waters. These results suggest that water quality in Colosseum Inlet and marine waters north of the Island are not indicative of a HEV system. However such a statement has to be considered in the light of the Central Queensland Regional water quality guidelines (the basis for the draft WQO) being a regional guideline and not necessarily representative of the local conditions within Colosseum Inlet.

The extent to which the detected concentrations of nutrients are the product of natural nutrient cycling within the estuaries is not currently known and would require further study, as is proposed to derive sub-regional WQO. Colosseum Inlet, Boyne Creek and Seven Mile Creek have large areas mangrove and few freshwater inputs, outside storm events. The extent to which existing biological cycling of nutrients between intertidal wetlands and estuarine waters are responsible for the observed nutrient concentrations will require further assessment.

9.3 Potential Coastal Environment Impacts and Mitigation

9.3.1 Impact Identification

9.3.1.1 Coastal Landforms and Coastal Resources

Potential impacts to coastal landforms and identified resources from construction activities will be limited to the access bridge and boat ramp in Boyne Creek and boat ramp in Colosseum Inlet. The proposed development does not directly impact any other area of coastal landform being limited to the boundaries of Lot 3 and excludes erosion prone areas along the northern coastline of the Island and 100m buffer zones between HAT and Lot 3. Potential impacts to relict beach ridges on the western strandplain of the Island are assessed in Section 5.

In order to provide access to the Island it is proposed to replace the existing causeway in Boyne Creek with a balanced cantilever bridge. The proposed bridge will be located at the northern end of Clarks Road and will require upgrade of the existing causeway across supratidal saltflats. The existing causeway and across supratidal saltflats and Boyne Creek are excluded from the Colosseum Fish Habitat Area, with a 100m buffer either side of the existing road alignment.

Upgrade of the existing causeway from the landward end of Clarks Road to the bridge abutment will require raising of the existing track surface further above HAT with an allowance for any storm surge heights, currently 3.3 m AHD in the Tannum Sands area including a climate change factor. Tidal flow across the existing supratidal saltflats in the location of the causeway currently occurs during larger tides, such as spring high tides. Outside these times tidal water does not reach the height of the existing causeway as seen in Figure 9.3. East west flows during spring tide inundation are currently blocked by the existing causeway.

Upgrade of this causeway will have a small permanent impact in relation to adjacent supratidal habitat loss. Upgrade of the causeway will result in a permanent loss of less than 0.04 ha of supratidal saltflat (refer to Section 15.2). Improvements in high tide flow through the causeway will be achieved by removing a number of sections of the existing causeway and placing crossings that will re-establish connectivity between the eastern and western side of the road. This will re-establish high tide flows and re-establish east west flows in this area.



The proposed access bridge will be constructed across Boyne Creek within the existing alignment, to minimise any additional clearing of intertidal wetlands, particularly mangroves (refer to Section 15). Formation of Bridge abutments will require trimming or removal of 0.86 ha of mangrove from both the northern and southern abutment.

The proposed bridge is anticipated to consist of three spans of 40 m, 70 m and 40 m with a superstructure of variable depth, single cell post tensioned concrete box girder. Bridge spans will be supported on two reinforced concrete piers founded in Boyne Creek on bored or driven piles. Construction details are provided in Table 9.13. Once the bridge is constructed it is proposed to remove the central section of the existing causeway from Boyne Creek to allow natural flows in Boyne Creek to be re-established.

The proposed bridge construction sequence and potential impacts are outlined below:

- Formation of north and south bridge abutments from engineered fill
 - Filling activities for the northern and southern bridge abutments will require the loss of saltpan and mangrove vegetation as discussed in Section 15.2;
 - The southern bridge abutment will not extend past the current mangrove edge and will be placed on the existing causeway. The northern bridge abutment will launch from the existing causeway 150 m from the southern abutment;
 - Resulting changes to existing tidal flows will be minimal as the bridge will have the same footprint as the existing causeway;
- A temporary access jetty/bridge will be constructed across Boyne Creek using H sections placed on the bedrock with steel planking to provide access for plant and equipment constructing bridge piers and northern abutment:
 - Some small scale disturbance of sediment may result as H-sections are lowered in place to found on rock;
 - Changes to tidal flow and currents will be minimal due to the H section footings having a small footprint. Impacts will also be short term, limited to the duration of bridge construction;
- Drilling of bored piles within Boyne Creek to found the bridge pier footings;
 - Bored piles for foundations will be constructed through casing placed onto the Creek bed with boring conducted through the casing to minimise water quality impacts.
 - Casing is a short term temporary structure that will have minimal impact on tidal flows.
 - Bored piles required as foundations for bridge piers have the potential to disturb sediment and introduce cuttings to adjacent marine water
- Construction of the bridge piers
 - Bridge piers will be constructed in pre-cast caissons and will form a permanent feature within the creek. At around 4 m width the bridge piers will provide minimal disturbance to tidal flow within Boyne Creek.



On completion of construction works, it is proposed to remove³ the centre section of the existing causeway (approx. 100 m) and allow the central part of Boyne Creek to re-establish natural unrestricted flows in this location.

The proposed Boyne Creek Boat Ramp will be constructed on the western side of the existing causeway and future bridge. Formation of the public boat ramp will require the trimming and/or clearing of supratidal saltflat and mangrove as discussed in Section 15.2. The proposed boat ramp will extend into Boyne Creek from the northern bank following the western of the existing causeway and will grade into the Creek below the grade of the existing causeway. As the boat ramp will be constructed adjacent the western side existing causeway and in the lee of the proposed bridge abutment, changes to existing tidal flows will be minimal. Further details of the proposed Boyne Creek boat ramp can be found in Section 3.

Tidal flow changes resulting from the construction of the access bridge and boat ramp in Boyne Creek are expected to be minimal. Boyne Creek is a 190 m wide channel, measuring from mangrove edge to mangrove edge. The northern section of the existing causeway extends approximately (depending on tide) 50m into the Creek, restricting high tide flows to a 140 m channel width. Proposed bridge piers are likely to be a maximum of 4 m width and founded directly into the shallow bedrock below the Creek. The combined width bridge piers represent less than 5% of the modified channel width of 140 m in Boyne Creek. Subsequently changes to Boyne Creek tidal flows are anticipated to be minimal due to installation of bridge piers. An overall positive impact is anticipated following removal of the current causeway obstructing low tide flows through Boyne Creek.

Construction of the Colosseum Inlet boat ramp (refer to section 3.4) will require the permanent clearing of less than 1 ha of terrestrial vegetation on Unallocated State Land (refer to Section 15.2). No clearing of intertidal vegetation will be required for this boat ramp. Changes to tidal flows in Colosseum Inlet will be minimal due to the small scale of the boat ramp. Colosseum Inlet is 1.4 km wide at the proposed location of the boat ramp approximately 500 m north of Yacht Creek (refer to Figure 9.8) and south of Bangalee. The proposed boat ramp will extend approximately 30 m from the shoreline and representing less than 2% of the channel width. The estuary widens at the proposed location from around 500m width at Bangalee, subsequently tidal velocities are reduced and will not be significantly altered at the proposed location.

Intermittent stormwater derived from the Town, Lagoon and Eco Homes area on the Island is proposed to utilise existing drainage within this area, utilising the ephemeral watercourse that intermittently discharges to North Beach (refer to Figure 9.8 and Appendix A7.2). Ephemeral stormwater discharges will be controlled in all storm events up to the 100-year occurrence to resemble existing flows (Cardno, 2007). Impacts from increased stormwater flows to North Beach will be ameliorated by the incorporation of WSUD features (discussed in Section 8.4) that will reduce the discharge flows to slightly less than current conditions.

³ A small portion of the existing causeway will be preserved for heritage reasons (refer to Section 13)



The proposed outlet structure for stormwater draining the Town Zones will be located at the base of the headland, discharging intermittently to the intertidal portion of the beach (refer to Appendix A7.2). The proposed outlet structure will have minimal interference with tidal flows.

The current outlet for the ephemeral watercourse draining the Bay and Lagoon zones is not permanent or stable, having been sealed by the advancement of the frontal dune systems in this area (refer to Section 8.2). As part of proposed development stabilisation of the ephemeral watercourse outlet will be required to provide safe discharge of stormwater.

Stormwater discharges from this outlet will be intermittent, limited to larger rainfall events. The proposed outlet structure will be permanent and of a small scale. The proposed outlet will discharge at the seaward base of the primary dune, into the swash zone. Changes to tidal flows of North Beach will be minimal and will not impact the tidal hydrodynamics of the area.

9.3.1.2 *Water Quality*

Construction activities within Boyne Creek and Colosseum Inlet that may impact water quality include:

- filling activities on supratidal salt flats for the upgrade of Clarks Road;
- Installation of a temporary jetty across Boyne Creek to act as a work platform;
- clearing of mangrove vegetation for the northern and southern bridge abutments;
- construction of bridge abutments using engineered fill;
- construction of bridge piers within Boyne Creek;
- construction of the Boyne Creek Bridge;
- engineering works for the proposed boat ramp in Boyne Creek;
- engineering works for the proposed boat ramp in Colosseum Inlet; and
- engineering works associated with construction of the stormwater drains to North Beach.

Much of the above work is programmed for initial infrastructure building with public boat ramps being constructed later in the development period (refer to Section 3.5). Construction impacts from these activities will be limited to the short construction duration. No other construction is proposed in intertidal areas.

Potential contaminants of concern during construction activities will include:

- suspended sediments from sediment disturbance and engineered fill;
- disturbance of acid sulphate soils during construction activities;
- organic material from vegetation clearing activities;
- litter from construction activities; and
- incidental and accidental spills of fuels and chemicals from construction plant.



Potential impacts to, and mitigation of, stormwater discharges to estuarine and marine waters via ephemeral watercourse is discussed in Section 8. Proposed mitigation measures of ephemeral watercourse quality utilising site specific ESCP and WSUD for permanent stormwater controls will minimise both changes to existing flows and water quality of the receiving waters. Proposed WSUD modelling conducted by Cardno (2007) achieves existing water quality conditions prior to release to estuarine and marine waters. Details of stormwater quality are found in Section 8.3.

Suspended Sediments

Proposed construction of infrastructure within the intertidal zone for the access road and public boat ramps will disturb soils and sediment that can generate additional sediment loads to existing conditions within intertidal waters. Where increased suspended sediment loads are generated direct and down stream impacts to EVs can occur if not mitigated. Suspended sediment generated during construction can impact EVs, such as smother adjacent intertidal vegetation, increase turbidity in the water column reducing light levels for aquatic plants such as seagrass, reduce visual amenity in the immediate area etc (refer to Section 15.2). Suspended sediment generation and impacts are likely to be greater in Boyne Creek where sediments are finer and more easily disturbed, than Colosseum inlet where sand is the predominant material disturbed.

Access road and bridge construction will occur in the first year of development with works and potential impacts limited to this duration. The Colosseum Inlet public boat ramp will be constructed a year after initial works and the Boyne Creek public boat ramp scheduled five years after initial development, limiting potential cumulative impacts to discrete times of construction. Disturbance of sediment and soils will be limited to a short time during construction of the physical ramp, around eight weeks.

Due to the relatively high tidal range of around 3.5m, work areas will be partly inundated (at least initially) by tidal water twice a day. Sediment plumes can be generated in tidal waters from work areas either through direct disturbance or from uncontrolled stormwater runoff during rain events. Tides can transport disturbed sediment from the site and deposit sediment away from the site or reduce light conditions in downstream waters impacting sensitive receptors such as seagrass meadows in the eastern section of Boyne Creek (refer to Section 15).

The proposed construction areas for the access road, bridge and public boat ramps will be relatively small. Less than 0.45 ha of ground will be disturbed for the southern bridge abutment and road and 0.4 ha for the northern bridge abutment. Potential sediment generation from bridge construction areas will be for a relatively short period of time, around 6 months, and will not be permanent. The amount of potential sediment generation will also be relatively small, due to the small area of disturbance; resulting sediment plumes would also be relatively small and limited to the immediate vicinity of the Boyne Creek work site.

Construction of the public boat ramp in Boyne Creek will require excavation of the thin veneer (0.5 - 1.5 m) of existing sediment to found the ramp on underlying rock. Excavation will be limited to the lower tide period and will be conducted by a bucket excavator. The extent of impact from excavation works for the proposed boat ramp will be limited in duration and extent. Off site transport of re-suspended sediment during this construction period will be limited to the immediate



vicinity of Boyne Creek due to the limited excavation area that can be achieved between tidal inundation. Potential receptors include intertidal mangroves, seagrass meadows located approximately 500 m west of the work area and associated fauna (refer to Section 15.2).

Construction of the Colosseum Inlet public boat ramp will be less than 0.15 Ha, with construction conducted in sands that generate less suspended sediment and plumes of sediment. Mangroves and seagrass beds are absent from the immediate vicinity of the works area. Whilst these EVs are absent from the area estuarine fauna may be present, such as fish. Disturbance to visual amenity will also require mitigation during this period due to the work site being visible from Bangalee.

Potential impacts from suspended sediment generated during construction of public infrastructure such as the access bridge and public boat ramps will be limited in duration and scale during construction. Recognition of the EVs and WHV of the immediate area will trigger mitigation measures to minimize and manage the generation of sediment within estuaries and marine waters where possible.

Potential Acid Sulphate Soils

Acid sulfate soil disturbance issues are addressed under the *SPP 2/02 – Planning and Managing Development Involving Acid Sulfate Soils* and is triggered under the *Integrated Planning Act, 1997* when for excavation greater than 100m³ below 5m AHD and/or filling of land involving 500m³ or greater occur. Both filling of ground for the bridge abutments and excavation of material for the Boyne Creek public boat ramp will trigger a detailed investigation of acid sulfate soils.

Potential acid sulphate soils (PASS) within sediments of Boyne Creek will be disturbed during initial ground preparation works for bridge abutments and piers. Disturbance of acid sulphate soils can lead to oxidation of sulfidic sediments resulting in acidification of waters and the generation of toxic quantities of aluminium, iron and heavy metals. Impacts to marine fauna such as fish and flora such as intertidal vegetation can occur, as a result if not mitigated.

PASS disturbance will be limited to the proposed bridge and boat ramp area within Boyne Creek primarily during construction. Results of soil testing within this area returned net acidity ranging between 0.36 and 1.12 %S (action levels are 0.03 %S for soils with ≤ 5% clay). Such soils may be classified as Very High and Extremely High under the SPP Guideline (2002). Whilst the high potential for acid generation raises a risk of impact to adjacent water bodies from acid sulphate soils, the level of proposed disturbance is likely to be relatively small and limited to the construction of bridge abutments and Boyne Creek public boat ramp. The duration of PASS disturbance and exposure will also be of a short duration further mitigating impacts.

Sediments in Colosseum Inlet are not considered to have a high PASS risk based the sandy nature of the substrate, however it is likely that some excavation will be required to achieve the 1:8 grade for the boat ramp and detailed investigation under SPP 2/02 will be triggered during the IDAS process. Management strategies and plans for managing and mitigating PASS disturbance will be developed as part of detailed design. Management measures include minimizing oxidation of PASS and the application of neutralizing lime to excavated sediments prior to disposal or re-use.



Litter

Construction and subsequent boating activities within Boyne Creek and Colosseum Inlet can generate litter ranging from food waste to containers and construction off-cuts. These items can find their way into adjacent estuarine waters and impact identified EVs such as intertidal wetlands, marine fauna such as turtles (refer to Section 15.2) and visual amenity of the estuaries. Potentially the most mobile litter will be paper and plastic food and drinks wrappers, whereas less mobile containers and off-cuts such as lumber are less likely to be transported far from the site of generation.

Litter generation during operational activities will also be an issue. An increased public presence within the estuaries and coastal zone will result from the proposed development. Whilst litter generated on land will be mitigated through WSUD measures as discussed in Section 8.3, some litter can still be generated adjacent boat ramps by the public. Litter can also be disposed directly from recreational boats using the estuaries if not controlled.

Paper and plastic may not have a direct chemical impact on aquatic organisms, the presence of litter within Colosseum Inlet and Boyne Creek can degrade the aesthetic value of the estuarine and marine system and identified EVs. Some direct impact to aquatic fauna can also result as is discussed in Section 15.2. Issues of litter generation from construction and operational activities in Boyne Creek and Colosseum Inlet will require management during construction and operation to minimise impacts to identified EVs such as the aesthetic values of Boyne Creek and Colosseum Inlet, intertidal wetlands and aquatic fauna.

Fuel and Chemical Spills

Construction activities for upgrading Clarks Road, the access bridge and public boat ramps will require construction plant to operate within and adjacent to the tidal waters of Boyne Creek and Colosseum Inlet. Incidental (small spillages from re-fuelling etc) and accidental spillages (ranging from small to large spillages) can impact adjacent estuarine fauna and flora (as discussed in Section 15) and impact water quality.

Work lay down areas will be required during the initial construction of infrastructure. Small quantities of chemicals such as oils and grease will be stored in these areas for maintenance purposes. Incidental spillages can occur within these areas that can be transported to adjacent sensitive areas such as mangroves and aquatic fauna as discussed in Section 15. Potential spillages from such areas will be managed under the EMP.

An increase in boating traffic will occur as a result of increased accessibility resulting from the proposed development and also population growth in the region generally. Development south of Tannum Sands also provides boat access to Colosseum Inlet via the upgraded Wild Cattle Creek boat ramp. This boat ramp provides access to Colosseum Inlet from Tannum Sands via Tannum Sands Road and Broadacres Drive.

Current Boat registrations for Gladstone, Calliope and Miriam vale LGA are outlined in Table 9.10. Average boat ownership for the three LGAs is 12.7%. Over three quarter of these boats are below 5 m in length and will likely use a two stroke outboard motor. Based on this figure 203 additional



boats may be owned by the eventual permanent population of the Island (1,600). Based on anecdotal existing boat use in the Gladstone area it is likely that 10 to 15% (20 - 30) of the 203 additional boats will be launched on any day. These anecdotal reports of boat usage rates are consistent with overall usage patterns from Qld Maritime safety 2003 data shows that 15.3 % of Queensland boat owners launch on a weekly basis and 40.5 % launch between 2 -3 times a month.

Over 90% of small boats use a two stroke outboard engine that are inefficient at burning fuel. Typically these engines vent their exhaust gases to the water and can emit unburnt hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), nitrogen oxides, carbon monoxide, carbon dioxide, oil and grease and BTEX compounds (benzene, toluene, ethylbenzene, (xylenes).

Table 9.10 – Current Boat Registrations in Gladstone, Calliope and Miriam Vale LGA

Boat length	Gladstone	Miriam vale	Calliope	Combined	Cumulative %
< 3.0m	104	38	76	218	-
3.01 - 4.0m	932	427	861	2,220	38.55%
4.01 - 4.5m	817	240	614	1,671	64.97%
4.51 - 5.0m	403	92	286	781	77.32%
5.01 - 6.0m	421	110	301	832	90.48%
6.01 - 8.0m	173	66	117	356	96.11%
8.01 - 10.0m	50	20	38	108	97.82%
10.01 - 12.0m	45	7	14	66	98.86%
12.01 - 15.0m	45	7	12	64	99.87%
15.01 - 18.0m	5	0	2	7	99.98%
18.01 - 20.0m	1	0	0	1	100.00%
20.01 - 25.0m	0	0	0	0	100.00%
Over 25.0m	0	0	0	0	100.00%
Total Boats	2,996	1,007	2,321	6,324	
Total Population (2006)	28,946	5,626	15,054	49,626	
% Boat Owners	10.35%	17.90%	15.42%	12.74%	

Whilst most volatile compounds discharged in the exhaust stream evaporate quickly some oily residue can remain on the water surface. In areas of dense water traffic and low tidal flushing such as harbours, boating traffic can impact water quality with the above emissions. Colosseum Inlet and Boyne Creek are tide dominated estuaries in a macro-tidal environment where large volumes of water are exchanged during each tidal cycle.

An increase of 20 to 30 boats over the 48.9 km² of Colosseum Inlet would result in a very small impact to water quality. The large tidal range and associated flushing will also ameliorate boat emissions. Suppliers of two stroke engines are also becoming more aware of their emission.

In recognition of the sensitivity of the estuarine and marine EVs management of increased boating usage will be conducted through community education such as letter and leaflet drops, information signage at public boat ramps and beach access points.



9.3.1.3 Coastal Hazards

Storm Tide Flooding and Erosion Prone Areas

The proposed development can only be conducted on Lot 3 on FD841422 and will not occur in any erosion prone area or buffer zone. Some beach access and stormwater drainage infrastructure will require construction through the designated erosion prone area for public access to the beach and allow discharge of stormwater. Construction works in these areas can impact vegetation and destabilise frontal dune systems increasing risk from storm surge ingress.

Clarks Road will be sole entry method to the Island. The existing causeway level is around 3 m AHD and will require raising to provide access during the defined storm tide event (DSTE) of 3.3 m to 3.6 m AHD. The *State Coastal Management Plan Guideline – Mitigating the Adverse Impacts of Storm Tide Inundation* (2006) does not provide a height above DSTE, however, the Draft Miriam Vale Shire Planning Scheme Policy No. 1 states that roads should be designed in accordance with the Queensland Urban Drainage Manual (1994). As the road is the sole access to the Island a design requirement above the 100 year ARI (read DSTE for storm surge risk) will be used. Based on these requirements the access road will need to have a minimum pavement level of 4.1m AHD.

Assessment of current erosion prone area widths by CES (2005) noted that land behind the currently designated Erosion Prone Area rises from around RL+3.3m to RL+3.6m and is an appropriate height to protect properties from storm surge effects from the DSTE. This height is approximately the same level as the predicted 100 year average recurrence interval (ARI) storm tide event of RL+3.3m to RL+3.6m AHD and represents the Natural Hazard Management Area (with a climate change allowance) for the ARI. Based on the current survey levels, the designated erosion prone area and areas between 3.3m and 3.6m AHD would be considered to have a low storm tide severity as defined in the *State Coastal Management Plan Guideline – Mitigating the Adverse Impacts of Storm Tide Inundation* (2006).

Development within areas of Lot 3 behind the current erosion prone areas such as the Bay Zone is not considered to be significantly impacted by potential storm surge for up to a 100 year event. It is proposed that some filling, using sand material derive from excavation of the proposed lagoons, will be conducted to provide an additional safety factor in areas that are in the 3.3 m to 3.6 m AHD range. Reference to the Miriam Vale Shire Planning Scheme Policy No. 1 requires building floor levels to be 0.4 m above the storm surge level of 2.5m, i.e. 2.9m AHD. Whilst this figure does not agree with the reported 100 year storm surge levels of CES, building floor levels will constructed 0.4 m above the RL+3.3 m to RL+3.6 m AHD to ensure protection from such events and ensure future sustainability of these areas.

Placement of fill will be limited to areas within the Bay Zone and a relatively small area of the Lagoon Zone that fall under the above AHD heights. South of this are elevation increases to 5 m - 7m AHD and is not at risk from storm surge. The proposed design levels are not considered to present a serious impediment or constraint on the future development of this area (CES, 2005).

9.3.1.4 Public Access

Public access will be increased to the Island and surrounding estuarine and marine waters as a result of the proposed development. The addition of an upgraded road and an all tide boat ramp will allow enhanced opportunity for visitors and the local population to access estuarine waters around the Island with minimum impact from construction. Public access points will also be constructed to Main Beach and North Beach in accordance with Qld EPA guidelines (refer to Figure 9.9), providing controlled access that minimises disturbance to coastal dunes. The provision of public access to the coast will incorporate relevant policies within the SCMP.

The provision of all tide boat access to the deep waters of Colosseum Inlet and the shallower waters of Boyne Creek is considered an essential part of the proposed development. Such access will allow both tourism and local based boat owners to utilize the recreational opportunities provided by these estuaries with minimal traveling distances and times to alternate launching points. The nearest alternative launching point is currently Foreshores Estate, a tide limited boat ramp.



RECOMMENDED SURFACING			
Hind Dune <i>Woodland/Forest Zone</i>	Secondary Dune <i>(She-oak Zone)</i>	Foredune <i>(Sand Spinifex Zone)</i>	Pedestrian Use Level
nil ¹	nil	board & chain walkway	low
organic mulch ² or fine aggregate ³	organic mulch, on-ground timber pallets	board & chain walkway	medium
concrete, pavers, organic mulch, fine aggregate, on-ground timber pallets	organic mulch, fine aggregate, on-ground timber pallets	board & chain walkway, on-ground timber pallets	high

Figure 9.9 – Recommended Treatments for Pedestrian Beach Access to Minimise Dune Erosion

Source: Qld EPA

9.3.2 Impact Mitigation

9.3.2.1 Coastal Landforms and Resources Impact Mitigation

Mitigation of potential construction impacts to coastal landforms and resources are summarised in Table 9.11.

Table 9.11 – Proposed Mitigation Summary of Construction and Operation Impacts to Coastal Landforms and Resources

Potential Impact	Mitigation
Loss of tidal connectivity on supratidal salt pans	Insertion of culverts or crossings in proposed Clarks Road causeway to re-establish tidal connectivity either side of causeway.
Direct loss of habitat in Boyne creek.	Mitigation of lost habitat is discussed in section 15. Construction will clear minimal area of intertidal habitat necessary for works.
Changes to tidal flows due to temporary structures.	Temporary access structures will be designed to minimise tidal flow interference. Footprint of temporary access structures will be minimised to reduce interference with tidal flows
Removal of existing causeway	Positive impact on tidal flow
Changes in tidal flows around Colosseum Inlet Public Boat Ramp	Construction of public boat ramp will be based on minimal footprint required Construction of boat ramp will key into bank to minimise ramp disturbance to tidal flow.
Disturbance to coastal dunes during construction of stormwater outlets to North Beach	Construction of stormwater outlet through erosion prone area will utilise the minimum disturbance footprint possible. Re-habilitation program of dune vegetation to be conducted following completion of construction. One way valves to be placed on stormwater outlet to eliminate tidal ingress into the stormwater drain on completion

9.3.2.2 Estuarine and Coastal Water Quality Impact Mitigation

Mitigation of potential construction impacts to coastal water quality are summarised in Table 9.12.

Table 9.12 - Proposed Mitigation Summary of Construction and Operation Impacts to Estuarine and Coastal Water Quality

Potential Impact	Mitigation
Increased soil erosion and associated suspended sediment and sediment loads associated with Clarks Road Causeway construction Increased soil erosion and associated suspended sediment and sediment loads associated with bridge construction	Proposed construction will clear minimal vegetation area required to complete works. Construction activities to be conducted within the minimal footprint possible. Construction works will be conducted in accordance with EMP and ESCP requirements utilising as a minimum: Minimise the extent and duration of works within tidal waters Silt fences at the toe of all batters; Containment bund constructed on geofabric at the base of bridge abutments; Silt curtain and boom anchored outside the containment bund; and Rapid reestablishment of vegetation on finished batters to minimise soil erosion, use of hydromulching to establish soil cover on batters (using local species).
Increased suspended sediment loads from boat ramp excavation	Excavation for foundations to progress from the bank outwards. Clearing of intertidal vegetation to be limited to the minimum required to progress works. Excavation in tidal waters to be conducted inside a double silt curtain and boom. Excavation works to be conducted on the falling tide only. Construction works will be conducted progressively during low tide only and within a double silt curtain and boom.
Disturbance of acid sulphate soil	Development and implementation of an Acid Sulphate Soil Management Plan in accordance with Section 4.8 and 4.9 of the QLD State Planning Policy Guideline (2002).

Potential Impact	Mitigation
	Mitigation of potential impacts will include: Excavations will occur during low tide only; Oxidation of sediments to be minimised by keeping sediment wet or by placing a guard layer of lime on open excavation faces; Excavated material will be placed on land on a guard layer of lime and mixed with the appropriate amount of lime (based on detailed investigation results) prior to re-use as fill.
Litter generation during construction of infrastructure	Inclusion of gross pollutant traps in ESCP plan and post construction WSUD treatments Education program for construction workers during induction Provision of waste facilities in all break-out areas Provision of waste facilities within proposed boat ramps with educational signage to minimise post construction litter.
Fuel/oil Spills from plant maintenance	Development and implementation of practical mitigation and emergency response measures as part of the construction EMP. Measures may include but not be limited to: Absorbent mats during refuelling operations; Spill response kits to be carried by all field maintenance vehicles; Spill awareness training during site inductions.

Potential impacts and proposed mitigation measures associated with Clarks Road Causeway and bridge construction from the temporary jetty also outlined in Table 9.13.

Table 9.13 – Proposed Mitigation Summary of Causeway and Bridge Construction Impacts

Feature	Potential Impact	Mitigation Measures (if required)
Formation of bridge abutments	Filling activities for bridge abutments will require the loss of saltpan and mangrove vegetation Filling for bridge abutments will expose fill material to erosive rain and tidal forces generating sediment.	Refer to Section 15 for vegetation loss mitigation. Filling activities for bridge abutments will require placement of geofabric and rock armour to minimise tidal erosion effects. Batters of bridge abutments will be treated to reduce erosion potential as required in the site ESCP.
Access Jetty construction	Some small scale disturbance of sediment may result as H-sections are lowered in place to found on rock.	As the potential disturbance is likely to be small in scale and of limited extent no mitigation is proposed beyond conducting activities during low or slack water.
Bored Piles	Bored piles required as foundations for bridge piers have the potential to disturb sediment and introduce cuttings to adjacent marine water	Prior to boring piers a tubular casing will be inserted into the Creek bed to bedrock. Boring will occur within the tubular case with cuttings spilling onto a catch platform where they are placed into a truck for offsite transport. Following an initial thin layer of sediment, cuttings will be weathered and fresh granodiorite cuttings.
Bored Piles	Reinforcement and concrete pouring may spill over to adjacent waters.	Concrete will be poured into the cased boring via a tremmy pipe minimising any potential spillage to adjacent waters. Pouring will be with casing in place, isolating estuarine waters.
Placement and pouring of pile cap	Construction of pile cap may disturb bottom sediments and spill concrete into the adjacent estuary.	The outer casing of the pile cap will be pre-cast and placed over the piles to rest on the estuary bed. Excess sediment will be excavated prior to pouring concrete into the pile cap mould (form). Concrete pouring will be conducted during low tide to both

Feature	Potential Impact	Mitigation Measures (if required)
		minimise water seepage into the pile cap mould and minimise potential disturbance to adjacent waters from the activity.
Bridge Walled Piers	Walled Piers construction will not disturb marine sediments. Some minor concrete spillage may be possible.	Walled piers will be built within form-work. Construction management via enforcement of the Construction EMP will minimise potential disturbance to marine waters.

9.3.2.3 Coastal Hazards Impact Mitigation

Mitigation of potential construction impacts to Coastal Hazards are summarised in Table 9.14.

Table 9.14 - Proposed Mitigation Summary of Construction and Operation Impacts from Coastal Hazards and Public Access

Potential Impact	Mitigation
Construction of stormwater outlets through erosion prone areas can erode and destabilise dunes increasing erosion and susceptibility to storm surge.	Construction of stormwater outlets will be designed in accordance with the Queensland Urban Drainage Manual Construction activities to be conducted within the minimal footprint possible. Construction works will be conducted in accordance with EMP and ESCP requirements utilising as a minimum: Minimise the extent and duration of works within erosion prone area Silt fences at the toe of all batters and down wind of work areas. Rapid reestablishment of vegetation on re-profiled dunes in accordance with Qld EPA Management Guidelines for Dune Use (V04.1) Maintenance of re-established dunes until vegetation has re-established.
Construction of buildings in areas of elevation between 3.3m and 3.6m AHD can be susceptible to a 100 year defined storm tide event (DSTE) designated for the area (including climate change allowance)	Building floor levels will be constructed 0.4 m above the DSTE (100 year storm surge height) identified for the area. Access roads road levels will be above the DSTE identified for the area. Essential infrastructure such as electricity, gas, water supply and telecommunications will be placed above the DSTE level
Construction of public infrastructure such as beach access walkways can destabilise dune systems in the erosion prone area leading to increased risk from storm surge and shoreline retreat.	Public beach access will be constructed in accordance with Qld EPA Management Guidelines for Dune Use (V02.2) Pedestrian flow to public beach access will utilise pedestrian control fences in accordance with Qld EPA Management Guidelines for Dune Use (V02.5)

9.3.2.4 Operational Impact Mitigation

Operational activities that are likely to impact coastal waters will be intrinsically linked to upstream ephemeral watercourse catchment activities post development as discussed in Section 8. Ephemeral watercourse discharges released to estuarine and marine waters will not change the existing receiving water quality conditions. It is noted that existing water quality conditions within Colosseum Inlet and Boyne Creek exceed default Queensland water quality guidelines as discussed in Section 9.2.9.

Potential impacts to the physical estuarine and coastal waters during operation will be limited to activities associated with the public boat ramps and recreational and tourism based boating emissions. Mitigation of potential impacts to estuarine and marine waters during operation are outlined in Table 9.15 below.

Table 9.15 – Potential Operational Impacts and Mitigation of Coastal Environments

Potential Impact	Mitigation Measures (if required)
Uncontrolled beach access can erode beach dune systems	Control public access by constructing pedestrian fences and provide controlled access through coastal dunes. Prohibit vehicle use on beaches and limit access to emergency vehicles only. Public beach access will be constructed in accordance with Qld EPA Management Guidelines for Dune Use (V02.2) Pedestrian flow to public beach access will utilise pedestrian control fences in accordance with Qld EPA Management Guidelines for Dune Use (V02.5)
Estuarine water quality - hydrocarbons releases can have direct and indirect inputs of hydrocarbons from boating activity and public boat ramps may introduce petroleum hydrocarbons to marine waters.	Drainage at public boat ramp parking areas will be directed to detention basins prior to discharge to estuarine waters. Public awareness signage at boat ramps will raise potential contamination issues associated with fuelling activities and emissions from 2-stroke engines and provide advice such as: Refuelling and connecting fuel tanks within the parking area; Draining and washing boats away from the waters edge in areas where the drainage water can flow to t triple interceptor trap.
Estuarine water quality -Surface runoff from public areas such as boat ramps and associated parking facilities may incorporate discarded litter that is released to adjacent estuarine and marine waters potentially impacting identified sensitive receptors such as C. mydas and D. dugong, marine wetlands and WHA	Permanent storm water controls will incorporate WSUD principles to capture litter prior release to estuarine and marine waters. MUSIC modelling results (Cardno, 2007) estimate 100% removal efficiencies of gross pollutants (including litter) prior to discharge to estuarine and marine environments.

9.3.3 Recommended Monitoring Program

A comprehensive baseline monitoring program prior to construction is proposed for the following reasons:

- Initial baseline water quality monitoring has found that background concentrations of ammonia, total nitrogen and phosphorous exceed Queensland guidelines for estuarine waters in central Queensland. As such further baseline monitoring will provide sufficient information to calculate a site specific WQO as outlined in Appendix D of QWQG (2005) and would provide a more robust set of guidelines that reflect the natural conditions and variations of the receiving waters of around Hummock Hill Island; and
- Baseline conditions for specific chemicals may be established for comparison during construction and operation from which action triggers may be developed and included in final Construction EMPs.

Monitoring of estuarine and marine water quality during construction and operation at specific locations outlined in Figure 9.8 will:

- assess the effectiveness of proposed mitigation measures;
- develop site specific WQO to replace default WQO outlined in Section 9.2.8; and
- provide triggers for actions outlined in the EMP.



A Water Quality Monitoring Plan (WQMP) will be developed prior to construction to establish sub-regional WQO in accordance with the QWQG (2006) and Draft Miriam Vale Shire Planning Scheme Policy No.1. The proposed WQMP will consider the GBRMPA *Draft Interim Marine Water Quality Guidelines* (as yet unpublished). The WQMP will identify key contaminants of concern to be monitored during both construction and operation, proposed sampling locations, including reference sites. The WQMP will dictate the frequency of monitoring to ensure that sufficient data is obtained to establish the 20th and 80th percentile of each contaminant of concern in accordance with procedures outlined in QWQG (2006).

Monitoring of intertidal wetlands within the vicinity of proposed construction works and ephemeral watercourse discharge points will also be required to assess any potential impact to identified EVs in these areas. This monitoring will be conducted in accordance with Qld Herbarium requirements.

9.4 Conclusions

The impact assessment has identified a number of activities that can impact identified EVs within the coastal environment; these include:

- Loss of less than 0.1 ha of supratidal saltflat and 0.8 ha of intertidal mangrove;
- Disturbance of coastal dunes for public infrastructure and stormwater drainage;
- Minor interference with tidal flow from bridge piers and boat ramps;
- Minor increases of suspended sediments within Boyne Creek and Colosseum Inlet during construction activities (limited in area and time);
- Disturbance of acid sulfate soils;
- Litter from construction and operational activities released directly to the marine environment;
- Increased boat usage in the estuaries around the Island with associated emissions; and
- Potential inundation risk from storm-tide.

Many construction impacts are limited in both area of disturbance and duration of impact, for example excavation for the public boat ramps will be limited to a few weeks duration and associated impacts consequently short in duration. Proposed mitigation and management has taken due regard of the EVs and world heritage status of the area. Mitigation methods have been provided to minimize impacts and risks to both identified EVs and WHV of the estuaries and coastal environment.

Positive benefits to Boyne Creek tidal flows and navigation are likely to be attributed with the removal of the existing causeway following construction of the access bridge. Tidal flows within Boyne Creek will regain their natural state and allow tidal flows to establish to pre-causeway installation rates. Proposed bridge piers and abutments are not considered to have an impact on tidal flows within Boyne Creek.

Operational impacts from boat traffic and in particular 2-stroke engine emissions are considered to be negligible on the basis of the small increase in boat numbers and high tidal flushing rates within the estuaries anticipated from the proposed development.

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SECTION 10

AIR QUALITY



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Figure 10.1 – Existing Sensitive Receptors in the Hummock Hill Island Air Shed (A3 Insert)

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Table 10.1 – Ambient Air Quality Goals for selected pollutants

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10. Air Quality

10.1 Existing Environment

10.1.1 Existing Environmental values

Air quality in Queensland is administered under the *Environmental Protection (Air) Policy 1997* (EPP Air) (State of Queensland 1997). The intention of EPP Air is to support the *Environmental Protection Act 1994* by:

- Identifying environmental values to be enhanced or protected;
- Specifying air quality indicators and goals to protect the environmental values;
- Providing a framework for making consistent and fair decisions about management of the air environment; and
- Involving the community in achieving air quality goals that best protect Queensland's air environment.

Environmental values of the air environment to be enhanced or protected under this policy are the qualities of the air environment that are conducive to suitability for the life, health and wellbeing of people.

Table 10.1 presents relevant ambient air quality objectives, as shown in Schedule 1 of the EPP (Air), which have been set to protect environmental values. Also listed are the goals outlined in the *National Environmental Protection Measure (NEPM) for Ambient Air Quality* (NEPC 1998). Air quality objectives outlined in the NEPM goals are intended as regional air quality goals for population centres greater than around 20,000 rather than project specific limits. However, every project should aim to achieve compliance with these goals.

In addition to the EPP Air, the EPA has developed a guideline for the assessment and management of odours within Queensland, titled *Odour Impact Assessment from Developments* (EPA 2004). This Guideline relates to developments with the potential to release nuisance odours, rather than odour impacts which may be experienced from natural sources, such as mangrove odours.

The Guideline contains target odour emission levels aimed at limiting annoyance and nuisance from complex mixtures of compounds and states that modelled odour concentrations at the “*most exposed existing or likely future off-site sensitive receptors*” should be compared against the criteria of 5 ou¹ for tall stacks and 2.5 OU for ground level sources or short stacks (at the nose response time) or a perceived odour intensity level of “weak”.

¹ 1 hour, 99.5th percentile. One odour unit (ou) is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions



The Odour Guideline will be applicable to the assessment of the proposed sewage treatment plant on the Island and its application will be undertaken during the detailed design stage of these facilities. This EIS considers odour impacts from a planning perspective, aiming at reducing the potential for odour impacts on adjacent land use by appropriate selection of adjoining uses and highlighting the importance of appropriate design odour performance specifications for the facilities.

Table 10.1 – Ambient Air Quality Goals for selected pollutants

Pollutant	EPP (Air) 1997 Goal	NEPM Ambient Air	Averaging Period
Total Suspended Particulate (TSP)	90 µg/m ³	-	Annual
Particulate (PM ₁₀)	150 µg/m ³ 50 µg/m ³	50 µg/m ³ (5 allowable exceedances)	24 hours Annual
Particulate (PM _{2.5}) ^a	-	25 µg/m ³ (goal to gather data for review) 8 µg/m ³ (goal to gather data for review)	24 hours Annual
Sulphur dioxide	700 µg/m ³ 570 µg/m ³ 60 µg/m ³ -	- 570 µg/m ³ (1 allowable exceedance) 57 µg/m ³ (no allowable exceedances) 228 µg/m ³ (1 allowable exceedance)	10 Minutes 1 hour Annual 24 hours
Nitrogen Dioxide	320 µg/m ³ 95 µg/m ³ 30 µg/m ³	250 µg/m ³ (1 allowable exceedance) - 60 µg/m ³ (no allowable exceedances)	1 hour 4 hour Annual
Ozone	210 µg/m ³ - 65 µg/m ³	214 µg/m ³ (1 allowable exceedance) 171.2 µg/m ³ (1 allowable exceedance) -	1 hour 4 hour 24 hour
Hydrogen sulphide	7.0 µg/m ³	-	30 minutes

Source: Schedule 1 - Environmental Protection (Air) Policy 1997, NEPM Ambient Air (EPHC 2003)

^a Commencement date 1 January 2004

10.1.1.1 Existing air quality

Hummock Hill Island is currently undeveloped with no significant air pollution sources on the island. The main air emissions within the local environment are primarily natural sources, including particulates from ocean salt spray and wind transport of soil from exposed areas. A description of the meteorological influences on air quality and pollution dispersion within the region is provided in Appendix A7.9. Due to its coastal location, Hummock Hill Island is generally considered to have relatively good air dispersion conditions.

Industrial activities in Gladstone area, 30 km north-west of Hummock Hill Island, generate a range of air emissions from material handling, processing and fuel burning activities, most notably particulate matter, nitrogen oxides and sulfur dioxide, and have the potential to influence air quality at Hummock Hill Island.



Queensland EPA undertakes air quality monitoring at a number of sites within the Gladstone region to monitor trends in air quality. Current ambient levels of all major pollutants at Targinie and South Gladstone are generally well below the ambient air quality guidelines, with one exceedance of the annual average ozone goal occurring at Targinie during 2003 (which is located inland of Gladstone, and generally downwind of the main air emissions sources for the majority of time). Further detail on the EPA's ambient air quality monitoring is provided in Appendix A7.9.

Despite monitoring results stating safe ambient levels in Gladstone, air quality remains a community concern and has been the subject of recent news articles over potential links between industrial air emissions and increased cancer risk. These concerns have prompted the Queensland Government to initiate a two year study of ambient air quality within Gladstone City to be monitored by Queensland EPA and Queensland Health.

Given these air pollution concentrations and the fact that Hummock Hill Island is generally upwind of Gladstone air emission sources, air quality at the Island is unlikely to pose significant amenity or health impacts to the proposed residential uses associated with the development. A "clean" air shed is likely to be an attractive option to potential visitors and residents.

Identified sensitive receivers are restricted to small communities such as Mundoolin Rocks, south of the Island and Bangalee on the south eastern tip of Wild Cattle Island and transient visitors within the local estuarine system. The Locations of existing sensitive receptors are presented in Figure 10.1.

10.1.1.2 Greenhouse Gas Emissions

Increasing concentrations of greenhouse gases in the atmosphere have the potential to cause climate change (refer to Section 6). In response to potential social, economic and environmental implications of climate change the Queensland Government has developed the *Queensland Greenhouse Strategy* (EPA, 2004).

Key objectives of the Queensland Greenhouse Strategy are to:

- Foster increased knowledge and understanding of greenhouse issues and climate change impacts;
- Reduce greenhouse gas emissions; and
- Lay the foundation for adaptation to climate change.

The concern with greenhouse gas emissions is generally restricted to the potential impact of increased greenhouse gas emissions associated with human induced activities, including new development.

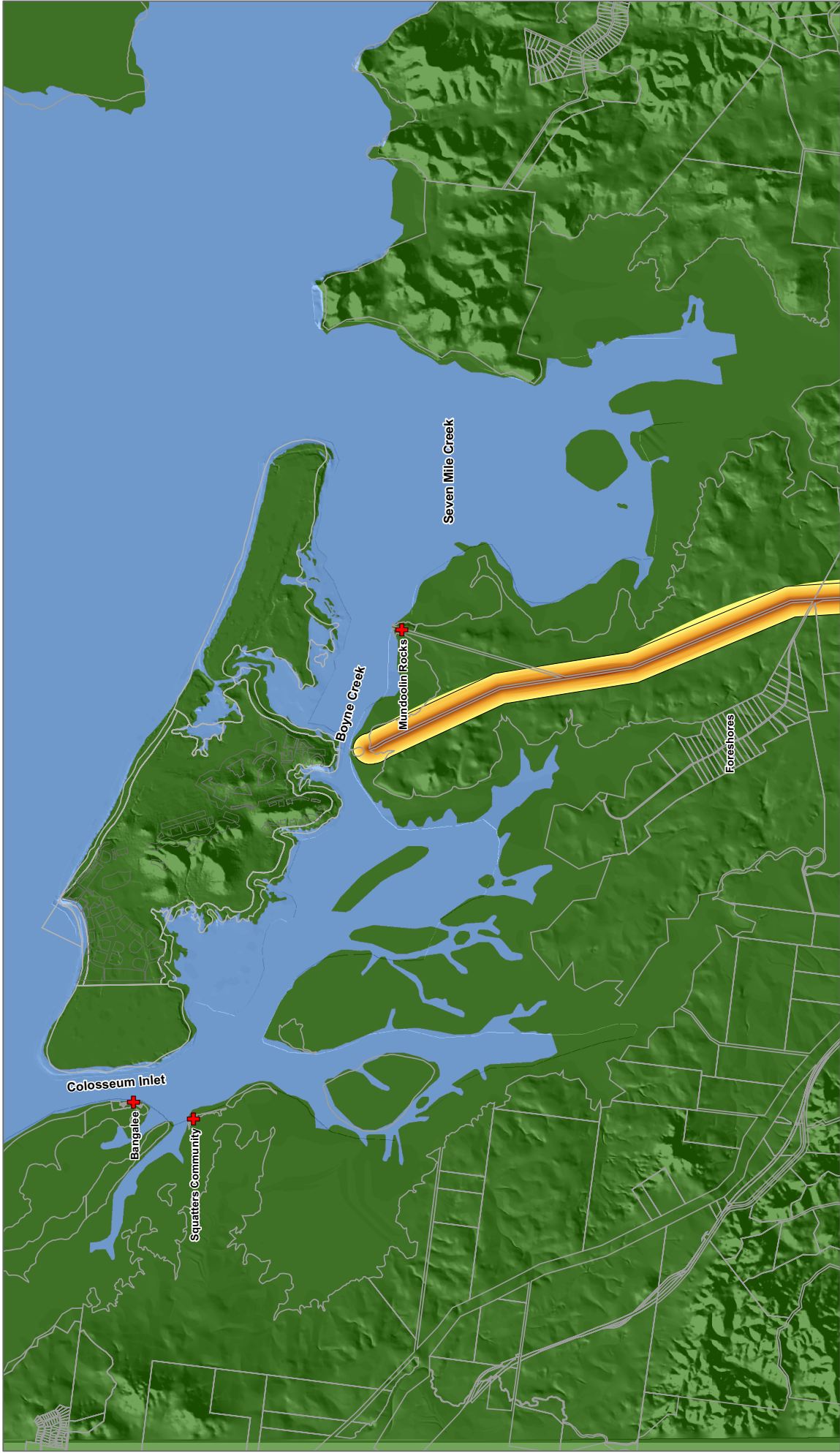
In April 2007 the Council for the Australian Federation agreed that national greenhouse emissions reporting would commence by 1 July 2008 in every Australian State and Territory. Reporting would ultimately be undertaken under a Commonwealth Government National Greenhouse and Energy Reporting System and as an interim measure may be included as part of State and Territory National Pollutant Inventory reporting. All facilities required to report under the National Pollutant



Inventory would also be required to report their greenhouse gas emissions from 1 July 2008 and this may apply to various components of the construction and operation of the project, depending on the scale and nature of activities.

AGO (2007) have calculated that in 2005 Queensland emitted 157 Mt CO₂-e (around 28 % of Australia's total greenhouse gas emissions). Queensland's emissions consisted of 47.6 Mt CO₂-e from electricity generation, 18.7 Mt CO₂-e from the transport sources, and 5.6 Mt CO₂-e from industrial processes. Land use change, forestry and agriculture accounted for approximately 56.0 Mt CO₂-e.

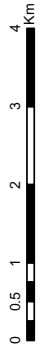
Due to the currently limited human activity on the Island, greenhouse gas emissions within the existing environment will be limited to natural sources and boat traffic in estuaries and marine waters surrounding the Island. These emissions are not generally quantified under current national carbon accounting schemes.



LEGEND

- + Sensitive Receptors
- Cadastre
- 300m Sensitivity Boundary Along Clarks Road
- Precinct Plan

This figure must be read in conjunction with the data disclaimers located at the front of this report. The data acquired for this project is known to be of low spatial resolution and as such no representation or warranties about its accuracy, reliability or suitability are given. As assumptions and conclusions made from this figure and the associated data must be made with full understanding of the data limitations. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data



Hummock Hill

Figure 10.1 - Existing Sensitive Receptors In The Hummock Hill Island Air Shed



10.2 Potential Impacts and Mitigation Measures

10.2.1 Potential Impacts During Construction

10.2.1.1 Air Quality

Proposed development works will be progressively staged over a period of 16 years. Installation of infrastructure and site services (roads, power, water, waste treatment and storage facilities, etc.) will occur in the initial stages of construction, followed by commercial facilities and some short-stay residential and tourist accommodation to follow over the remaining time period.

The main potential for construction phase air quality impacts is likely to arise from dust generation during earthworks and vehicle movement over unsealed surfaces and would occur following the initial stages of construction, as residential receivers begin to inhabit the island.

Large-scale earthworks associated with site preparation for residential and road construction projects typically produces dust from grading, dozing, excavation, drilling/piling, concrete batching, trucks transporting equipment to and from the site and vehicles moving around the site. The extent of dust related impacts would depend on:

- prevailing weather conditions (including wind speed, wind direction, rainfall and residual soil moisture);
- the extent and intensity of construction activity occurring at a particular time;
- proximity of works to sensitive receivers for air quality; and
- the level of dust controls included in these activities.

Due to the Island's isolation from residential receivers and the short-term nature of bulk earthworks associated with the construction, nuisance dust impacts from these sources are not expected to be significant during initial stages of development. However, given that the development will be staged over a number of years, potential nuisance dust impacts may occur during the latter stages of construction, as the number of newly constructed residential receivers increase and construction works are carried out adjacent to these receivers.

Provided appropriate dust management measures are incorporated as part of proposed earthworks and construction, impacts on adjacent vegetation communities and ecosystems are expected to be managed to acceptable levels. However, further investigation into potential dust impacts and appropriate mitigation strategies specific to the types of construction methods to be employed would be undertaken by the construction contractor(s) during further design development. Measures such as those outlined in Appendix A7.9 could be considered in the development of detailed air quality management plans.

Use of on-site batching plants (concrete, asphalt), etc. will be at the discretion of individual contractors. These activities are regulated under the *Environmental Protection Act 1994*. Contractors will be required to obtain a development approval and registration certificate to operate these facilities and these will likely be subject to conditions setting out the environmental requirements. Air emissions from this activity would be assessed as part of the EA application for the works and appropriate controls incorporated as part of the approvals.



10.2.1.2 Greenhouse Gases

A detailed greenhouse gas inventory has not been prepared for the construction of the project, given that the development design is preliminary to support an MCU application and has not been developed to a stage where detailed accounting is possible. An indication of the sources of greenhouse gas emissions likely during construction of the development has been provided below and Appendix A7.9 to highlight areas which must be considered during detailed design.

Construction greenhouse gas emissions would primarily relate to activities involving the consumption of diesel (on-site construction equipment such as trucks, dozers, scrapers, compactors, mulchers, water carts etc to clear vegetation, stockpile topsoil and perform bulk earthworks) and off-site consumption through transportation of materials and workers to and from the site. Electricity consumption would occur within site offices, workshops and ablutions facilities though this consumption would be very minor.

Greenhouse gas emissions during construction would vary, depending on the stage of works and the types and duration of activities occurring. The main contribution to construction related greenhouse gas emissions is expected to be indirect emissions from workers driving to and from the site and deliveries of materials.

If the construction works required ten truck visits per hour over an 8 hour day, every day for one year approximately 1,700 tonnes of CO_{2e} would be emitted. If 100 workers also travelled from Gladstone to the site each day in their own light duty petrol cars approximately 450 tonnes of CO_{2e} could occur each year. For comparison, if an excavator operated 8hrs per day, 5 days per week for 50 weeks per year, approximately 160 tonnes of CO_{2e} would be emitted. A fleet of 10 similarly sized items of mobile construction equipment could result in approximately 1600 tonnes of CO_{2e} per year.

Greenhouse gas estimates of this order represent a small fraction of Queensland's annual greenhouse gas emissions; however the detailed design of the project components will investigate energy efficiency measures and incorporate appropriate strategies to maximise energy efficiency and limit greenhouse gas emissions. Controls such as considering bus transport of workers to the site from a pickup point in Gladstone could be considered during the construction phase. The construction EMP, which would be prepared by the Construction Contractor(s), will include measures to minimise unnecessary GHG emissions (refer to Section 20).

10.2.2 Potential Impacts During Operation

10.2.2.1 Air Quality

Operational air emissions associated with the majority of proposed Hummock Hill Island Development activities are expected to be minor, and would include:

- Minor exhaust emissions from private motor vehicles, power boats, commercial vehicles delivering supplies to the site and light aircraft using the airstrip (less than 6 per day);
- Emissions from domestic sources, including lawn mowing, cooking and the like;
- Exhaust vents from commercial kitchen facilities and emergency (backup) generators associated with retail and licensed premises; and



- Odour emissions associated with the operation of the wastewater treatment facility (and potentially irrigation of treated waste water) – this would require detailed assessment as part of the specific development approvals and EAs for these facilities.

Exhaust emissions from vehicles and boats are not expected to have a significant impact on local or regional air quality, given the relatively low usage expected (and therefore low quantity of emissions) and the generally good daytime dispersion conditions experienced at this coastal location due to consistent south easterly prevailing winds.

Emissions from domestic sources are unlikely to be significant within the regional airshed due to the relatively small population (approximately 4,019 people) expected as part of the development, the low level of emission associated with these activities and the intermittent nature of these activities.

Commercial, retail and licensed facilities having significant emissions to local and regional airshed will be required to obtain an Environmental Authority and/or Building Approval prior to commencement of their operations. These facilities would include any wastewater treatment, fuel burning, power generation and activities outlined in Schedule 1 of the *Environmental Protection Regulation 1998*. The impact of emissions from such facilities, and appropriate control measures, will be addressed separately as part of the process for the individual development and when detailed design information is available.

However, due to the limited number of activities outlined above for the proposed Hummock Hill Island Development, emissions from these activities are not expected to pose significant impacts on the local or regional air shed. Potential impact of any stationary fuel burning or power generation activities would need to be investigated in further detail if triggered as requiring an EA.

The potential exists for odour emissions from the proposed wastewater treatment plant to impact on the amenity of residential areas proposed as part of the development. In order to minimise potential odour nuisance on residential, recreational and tourist receivers the proposed wastewater treatment plant will utilise dedicated utilities space outside any proposed residential precinct. Due to the prevailing winds at the island being easterly to south-easterly, this location is downwind of potential receivers for the majority of the time.

The wastewater treatment plant will treat effluent to tertiary Class A+ standards and the process would be enclosed. As such, odour emissions from storage of treated effluent, which are traditionally significant sources of odour (due to their exposed surface area) are expected to be minimal. Similarly, the use of treated wastewater for irrigation (proposed for the golf course) has the potential for odour emissions. However, due to the high quality of treated water, odour emissions from this source are not considered to be significant. Master planning generally recommends buffer distances of at least 300 – 500 m from nearest residences.

Impacts of air emissions from existing adjacent developments such as Bangalee and Mudoolin Rocks will be minimal. Industrial activities located in Boyne Island and Gladstone poses the greatest potential for impact on air quality for the Island. However, prevailing winds in the surrounding area are typically south easterly to north easterly throughout the year and the transport of air emissions



from the Gladstone industrial area would generally be in the direction away from Hummock Hill Island. As such emissions from industrial activities on Boyne Island and around Gladstone would have a negligible impact on the air shed of Hummock Hill Island. This is considered an important asset of the proposed development due to concerns of the local population with air quality within Gladstone.

The north-western and north-eastern area of Hummock Hill Island (either side of the main central ridgeline) is currently has a mineral development lease for mineral sand deposits. The location of possible future mining and processing activities on Hummock Hill Island is unknown at this stage. Particle emissions from mining and processing operations may impact the Hummock Hill Island Development, however the extent of impact would depend on wind conditions, vehicle routes, the type and location of mining practices (and proximity to nearest receivers) and intervening topography. A buffer between the nearest point of the mine lease to the proposed residential areas should be maintained and appropriate air quality management practices should be adopted to minimise potential nuisance dust impacts on residential areas.

10.2.2.2 Greenhouse Gases

Operational greenhouse gas emissions would primarily result from activities involving the consumption of electricity (households, commercial centres, public lighting) and transportation to and from the Island. As with the construction greenhouse gas assessment, the quantity of greenhouse gas emissions would vary, depending on the development staging and energy efficiency measures incorporated into the design of the project. A detailed inventory of greenhouse gas emissions has therefore not been undertaken at this preliminary design stage, however a discussion of the energy efficiency design options has been provided (refer to Appendix A7.9).

The majority of greenhouse gas emissions generated from the development would arise from domestic residential activities (refer to Section 3.4.3 of the EIS), which would occur independent of where the population lived. Master planning for the development incorporates the principles of Ecologically Sustainable Development and energy efficiency (refer to Section 3.3.4). These principles include commitments to incorporating renewable energy and energy efficiency in design measures such as designing buildings to 5 star standards for energy conservation, including solar hot water heating, use of gas to generate the Islands electricity and cooking, public awareness for programs focused on ways of avoiding the need for space cooling, and architectural building design which maximises natural lighting and ventilation and incorporates energy efficient appliances (refer to Section 3.4.3.3).

In selecting energy efficiency measures in design, annual greenhouse gas emissions from the development would be maintained at a minimum and would represent emissions reductions in comparison with a similar sized development which did not include such measures.

The relative benefits associated with transport related greenhouse gas emissions from establishing a community on Hummock Hill Island compared with an alternative satellite suburb at a different location surrounding Gladstone would depend on the distance between Gladstone and the development (given that the majority of residents would be expected to commute to Gladstone). Public transport options for commuters travelling between the Island and Gladstone would be



investigated to minimise greenhouse emissions from transport, along with bus services for transport around the Island itself.

The annual greenhouse gas emissions generated from the development is likely represent a small fraction of Queensland's annual greenhouse gas emissions with the incorporation of appropriate energy efficiency measures in the design measures. Further investigation into potential greenhouse gas emissions, energy efficiency measures and management plans for each component of the development are critical components in minimising greenhouse gas emissions from the development and would be undertaken as part of subsequent investigations and approvals processes.

10.2.3 Mitigation Air Quality - Construction

Bulk earthworks associated with the proposed development will be staged and will largely require activity at locations remote from nearby sensitive receivers (nearest residence is a number of kilometres from the Island works).

Site access infrastructure such as the access road and bridge will be constructed (and sealed) in the initial stage of the project schedule, minimising the potential for wheel generated dust from construction vehicles moving around the site.

Staged development will reduce the area of exposed land and volumes of material moved around the site at any time, and with the incorporation of appropriate dust management measures (such as water spraying), vehicle generated dust and wind blown dust emissions will be minimised.

Water used for dust suppression would initially be sourced from external recycled water suppliers or mains until on-site recycling and management systems are installed.

In order to minimise impacts on receivers throughout the duration of the proposed development, a dust management plan will be prepared and implemented by the construction contractor. The management plan will vary, depending on the stage of works and proximity to receivers (including sensitive terrestrial and marine ecosystems, where necessary), but will include measures to limit dust emissions from the activities, such as:

- Construction of a sealed site access road will be undertaken during the initial stage of construction works and works will be staged to minimise the extent of disturbed land at any one time.
- Use on-site watering sprays to control visible dust emissions from disturbed and unsealed trafficked areas as required. This will be particularly important during dry and windy conditions.
- Use dedicated site entry and exit points, and defined roadways only and install truck wheel shaker pads or washer sprays at the access / egress points to unsealed trafficked areas in order to minimise tracking dirt onto the adjacent paved road network;
- Progressive rehabilitation of disturbed areas will be undertaken to minimise the potential for windblown dust;
- In the event of a valid complaint in relation to construction dust, perform dust investigation monitoring to assist with the development of more appropriate dust management measures.



10.2.4 Mitigation Air Quality - Operation

In order to minimise potential impacts of air emissions associated with the proposed development adequate buffer distances (typically 300-500 m from the facilities) between the residential (short and long term) areas and the wastewater treatment plant would be maintained and further investigation into the risk of odour nuisance and emissions controls would be undertaken during the detailed design.

Commercial facilities would be required to adequately maintain exhaust filters from cooking facilities and regulated devices, including emergency fuel burning equipment.

Any Environmentally Relevant Activities proposed will have emissions control technology installed and the design and operation of power generator(s) will be such that emissions comply with the *State Environmental Protection (Air) Policy 1997* and the National Environmental Protection Measure for Air Quality (GHD 2006).

The Wastewater Treatment Plant is located away from proposed residential areas and generally downwind of areas proposed for activity to minimise the potential risk of odour impacts. In addition to this, these facilities will be further designed and operated so as to minimise generation of odour (GHD 2006).

10.3 Conclusions

Existing air environment on the Island is primarily influenced by natural sources with emissions from within the Gladstone industrial area, approximately 30 km northwest of the island, also having the potential to influence air quality at times. As the Island develops the management of air emissions during construction and operation will form an important component of the project. Construction air quality impacts are expected to be primarily related to dust. A range of dust mitigation initiatives have been identified further investigation will take place as part of a detailed design for the project. Specific Dust Management Plans will be developed and implemented to ensure minimal dust impacts to the receiving environment.

Direct and indirect greenhouse gas emissions will also occur during construction and operation of the project. Greenhouse gas emissions would represent a small fraction of Queensland's annual greenhouse gas emissions, and the project detailed design would further investigate energy efficiency measures and strategies to be incorporated to maximise energy efficiency and limit greenhouse gas emissions during construction and operation.

Operational air emissions would largely be restricted to domestic activities, transport to and from the Island and emergency power supply generators for commercial facilities. Air emissions from these activities are expected to be minor.

Potential odour emissions from the waste water treatment plant will be managed by the sealed treatment process proposed and maintaining a buffer area around these activities. Odour Management Plans will be developed as part of the detailed design of the water treatment plants to ensure emissions from these sources are management to minimise odour nuisance.

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SECTION 11

WASTE MANAGEMENT



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11. Introduction

11.1 Waste Management Strategies

11.1.1 Legislative Requirements

Environmental Protection Act 1994

The Queensland *Environmental Protection Act 1994* (EP Act), administered by the Queensland Environmental Protection Agency (EPA), was established to protect the environment while allowing development that improves the total quality of life, now and in the future, in a way that maintains the ecological processes on which life depends, often referred to as 'ecologically sustainable development'.

The EP Act utilises a number of mechanisms to achieve its objectives, these include:

- granting of development permits for material change of use in relation to Environmentally Relevant Activities (ERAs);
- licensing or approving ERAs;
- issuing Environmental Protection Policies (EPPs);
- regulations; and
- creating a general environmental duty. Section 319 of the EP Act establishes a duty for a person to take all reasonable and practicable measures to prevent or minimise environmental harm when carrying out an activity.

Environmental Protection (Waste Management) Regulation 2000

The regulatory requirements concerning waste management are provided within the EP Act and *Environmental Protection Regulation 1998*, but more specifically the *Environmental Protection (Waste Management) Regulation 2000*.

The regulation provides provision for the following:

- offences for littering, waste dumping, unlawful disposal of hypodermic needles and unlawful activities at waste facilities;
- a waste tracking system that collects data on waste generation, transportation and disposal within Queensland and interstate;
- a procedure for approval of wastes for beneficial reuse;
- approval processes for beneficial use of wastes; and
- design rules for waste equipment.

The *Environmental Protection (Waste Management) Policy 2000* (EPP Waste) outlines the waste hierarchy which moves from the most preferred — waste avoidance, to reuse, recycling, and energy recovery, through to waste disposal, the least preferred.



The three main principles of the EPP Waste are:

- 1) The "polluter pays principle" — all costs associated with waste management should, where possible, be borne by the waste generator.
- 2) The "user pays principle" — all costs associated with the use of a resource should, where possible, be included in the price of goods and services developed from that resource.
- 3) "Product stewardship principle" — the producer or importer of a product should take all reasonable steps to minimise environmental harm from the production, use and disposal of the product.

The EPP Waste and the *Environmental Protection (Waste Management) Regulation 2000* are the primary legislative instruments governing waste management in Queensland.

The EPP Waste provides for the preparation of waste management programmes to minimise waste generation, promote the efficient use of non-renewable resources and promote the use of waste as a resource in order to achieve the objectives of the *Environmental Protection Act 1994*. The EPP Waste outlines a hierarchy of waste management to be adopted in preparing waste management programs. This hierarchy lists waste management practices in the preferred order of adoption. These include waste avoidance as a first option, then reuse, recycling and energy recovery with waste disposal as a last option.

11.2 Waste Management Hierarchy

11.2.1 Waste Avoidance

Waste avoidance may be achieved by preventing or reducing the amount of waste generated by an activity through process redesign or substitution of raw materials. This may include the following practices:

- Waste avoidance measures and sustainable housing principles will be incorporated in to the design;
- Providing appropriate space at each property for temporary storage of recyclables and garbage;
- Efficient use of non-renewable resources including improved equipment use;
- Accurate estimation of raw material quantities to avoid excessive unused materials requiring disposal;
- Selection of materials on the basis of waste minimisation (quantity of packaging etc);
- Installation of appliances and fittings to reduce operational waste; and
- Alternatives to plastic bags will be provided at retail outlets.

Waste avoidance provides the greatest opportunity for limiting waste during construction and operation of the development.



11.2.2 Waste Reuse

Waste reuse refers to the further use of waste products without further processing. The promotion of multi-use containers and pallets are examples of resource conservation measures. Such measures may include the following.

- The reuse of material containers;
- Purchase in bulk to avoid individual packaging;
- Promotion of the use of container return programs such as the delivery of materials on crates that are then returned to the manufacturer for reuse; and
- Mulching of vegetation and other organic waste to be reused as landscaping material on the Island.

11.2.3 Waste Reduction

Waste reduction can be implemented in the initial stages of the development during design, construction and operation. Opportunities for waste reduction during the design of the buildings and the construction methodology employed shall consider the following measures.

- Retention of vegetation during design and construction.
- Project management control during construction.
- Management of estimating and ordering, such as material ordering, delivery, placement and tracking of materials.
- Implementation of supplier and service provider contracts which focus on environmental performance, such as “just in time” ordering of construction materials and supplies, reduction in packaging materials.

11.2.4 Waste Recycling

Waste recycling refers to the reprocessing of waste materials to produce new products. Materials should be selected on the basis of recyclability including end-of-life recyclability. Opportunities for waste recycling may include the following measures.

- Materials salvaged and reused where possible;
- Purchasing recyclable or recycled materials;
- Separation and collection of recyclable materials; and

All wastes will be transferred to the Benaraby Landfill where they will be sorted into re-usable, recyclable and waste disposal streams.

There are options for recycling of waste stream elements at the development during construction. There is the potential for reuse or re-milling of timber materials collected from construction sites. Timber may also be reused onsite or chipped for use in landscaping (though it is not recommended that CCA treated timber is reused onsite).



Operators of the development may encourage waste reuse and recycling through provision of waste separation facilities and collection of recyclable materials. This element of the waste hierarchy provides the greatest opportunity for limiting waste during construction and operation of the development.

11.2.5 Cleaner Production

The EPP Waste defines 'Cleaner Production' as program to identify and implement ways of improving a production process so that the process:

- uses less energy, water or another input; or
- generates less waste; or
- generates waste that is less environmentally harmful.

Opportunities for cleaner production and best practice waste management techniques may include the following measures.

- Sustainable housing principles incorporated into the design controls and guidelines for development of each lot;
- Selecting renewable resources for construction materials, where possible;
- Including a proportion of renewable fuel sources for construction vehicles, plant and equipment.
- A network of pedestrian and cycle pathways will be provided to reduce the reliance on motor vehicle transport on the Island;
- Reuse of greywater will be conducted on large lots;
- A tertiary wastewater treatment plant will be installed on the Island, and treated effluent will be polished to class A and A+ for reuse in irrigation and approved uses via a dual reticulation system;
- Golf course irrigation water will be entirely sourced from treated effluent;
- Packaging and environmental measures will be used as a selection criterion for suppliers;
- Colour-coded and/or labelled wheelie bins will be used for recyclable waste streams such as paper, cardboard and aluminium cans; and
- Waste storage and recycling areas will be located and designed to complement the streetscape.

Sustainable housing principles will promote self sufficiency at the household, community and Island level by maximising water and energy efficiency and minimising waste generation throughout the lifecycle of each house.

11.2.6 Waste Disposal

Waste disposal refers to the final deposit of waste when the material is of no further use. This may include disposal by landfill. This is considered the least preferred and final option for the



management of waste and should only be used where the waste cannot be otherwise reused or recycled.

Waste for disposal will be transported off the Island, using appropriately licensed waste contractors. Domestic and general waste will be disposed of at the Benaraby Landfill within the Calliope Shire. The Benaraby Landfill has enough capacity to accommodate the waste generated from the development and future growth in Miriam Vale Shire.

11.3 Waste Streams

In order to facilitate the waste avoidance, reuse, reduce and recycle options of the waste management hierarchy a centralised waste collection area on the Island will be provided for storage of waste materials. The management of some waste streams is well defined, such as colour-coded waste receptacles for paper, cardboard and general wastes.

Waste disposal is only considered when the implementation of the above principles is not practicable. In selecting a waste disposal method, the characteristics of the waste and the transport pathway for potential contamination is considered.

Typically domestic waste comprises approximately 50% of the volume of waste generated and disposed to landfill, construction and demolition waste consists of 25% of waste generated and the remaining 25% of waste streams are re-usable and/or recyclable. Due to the staging of the development over a 20 year period construction and operational waste will be generated simultaneously.

11.3.1 Construction Wastes

Where practicable construction will include the use of modular components, purchase of materials cut to standard sizes or pre-fabricated materials to reduce the need for off-cuts. Material choices for building construction shall include a proportion of renewable or recyclable components, although use of renewable and recyclable components shall not compromise the construction of the buildings in accordance with the relevant development codes and the Building Code of Australia.

Construction site disturbance will be limited to minimise unnecessary excavation and removal of vegetation. It is anticipated that a neutral surplus of fill will result. If however, there is surplus fill it will be used for topsoil during landscaping. Landscaping for the development will utilise mulch from the vegetation removed during site preparation for construction activities.

Separate skip bins will be provided within the construction site compound to facilitate waste segregation and maximise economic reuse and recycling.

Contracts for builders and suppliers shall include an environmental performance component. Contractors and suppliers will have to pre-qualifying for tendering based on environmental performance and consideration of potential environmental impact of supplying the material or good. Builders and suppliers shall also be required to identify the source of the material or good, seek to provide alternatives and not just automatically using new materials, provide options for pre-fabrication, minimize packaging materials and access to "just in time" ordering.



Construction project management is also important for managing waste streams. For example, works scheduling organising trades, material delivery and placement, construction site compound layout and organisation can contribute to effective reuse and minimisation of wastes.

Plastic waste will be kept to a minimum with alternatives to plastic being a selection criterion for suppliers delivering materials for construction. For example metal strapping may be used instead of plastic wrapping or shrink wrap. Any plastic waste generated will be recycled, where possible.

Fuel storage will be kept to a minimum and will be used for refuelling of equipment during construction. Storage and handling of fuels will be conducted in accordance with AS1940 – 2004 *The storage and handling of flammable and combustible liquids*. Where possible, a proportion of the fuel used in the construction vehicles, plant and equipment shall include renewable fuels and/or ethanol based fuel.

Any construction waste that cannot be recycled or reused and requires disposal, will be transported to the Calliope Shire Council's Benaraby Landfill. A waste acceptance agreement must be sought from the Landfill Manager prior to dispatch of waste from the Island. Records of approval will be kept on file as part of the recording requirement of the Waste Management Plan Appendix A7.3.

If wastes suitable for reuse can not be reused on site, off site reuse options will be investigated. There are a number of waste asset databases where a contractor can list wastes available for reuse so other contractors can use them, where possible.

Life cycle analysis is another method for ensuring wastes and minimised or reused wherever possible.

An inventory of wastes likely to be generated during the construction of the development is outlined in Table 11.1 below. Actual waste estimates may vary from that anticipated.

Table 11.1 – Inventory of Solid and Liquid Wastes Produced on the Island during Construction

Waste Description	Anticipated Waste Volume Generated (% of total materials ordered)	Waste Storage	Waste Management Technique	Frequency of Collection
Fill and soil (not contaminated)	Cut and fill activities will be minimised and it is anticipated that no surplus fill or soil will require removal from the Island.	Dedicated stockpile location at each stage of construction located away from overland flowpaths.	Reused on the Island where possible.	As required.
Fill and soil (contaminated)	Cattle dip contaminated area near the headland.	Dedicated stockpile located away from overland flowpaths.	Disposal destination to be specified in the Disposal Permit issued under the conditions of the Contaminated Land section Chapter 7, Part 8 of the EP	As per Disposal Permit.

Waste Description	Anticipated Waste Volume Generated (% of total materials ordered)	Waste Storage	Waste Management Technique	Frequency of Collection
			Act. Disposal destination off the Island.	
Timber and vegetation	5%	Dedicated green waste storage bay in construction site compound.	Timber off cuts to be reused where possible, otherwise will be transported and processed at the Waste Transfer Station at Benaraby Landfill.	Weekly during construction.
Scrap metal	3-5%	Metal recycling skip bin in construction site compound.	Metal recycling contractor off the Island.	Weekly during construction.
Cable and wire	1%	Metal waste segregated into metal recycling skip bin. Plastic waste segregated into dedicated plastic skip bin. Other waste not capable of reuse or recycling to placed in the general waste skip bin within the construction site compound.	Metal Recycling Contractor off the Island. Plastic Recycling Contractor off the Island. Other waste disposed to Benaraby Landfill.	Weekly during construction.
Concrete, bricks, tile and rubble	5-20%	Dedicated construction waste skip bin within the construction site compound.	Disposal to Benaraby Landfill.	Weekly during construction.
Plasterboard	5-20%	Dedicated construction waste skip bin within the construction site compound.	Reused on the Island, where possible or disposed of at Benaraby Landfill.	Weekly during construction.
Packaging wastes, plastic, glass and timber	5%	Separate skip bins provided for plastic, glass and timber within the construction site compound.	Recycled off the Island.	Weekly during construction.
Domestic and	50%	Dedicated general	Disposal to	Twice weekly

Waste Description	Anticipated Waste Volume Generated (% of total materials ordered)	Waste Storage	Waste Management Technique	Frequency of Collection
general waste		waste skip bins within the construction site compound.	Benaraby Landfill.	during construction.
Organic and food waste	2%	Licensed waste contractor until tertiary wastewater treatment plant is constructed and operational.	Treated effluent will be polished to class A and A+ for reuse in irrigation and approved uses via a dual reticulation system. Greywater will be reused on large lots.	Continuous.
Wastewater	140 litres per Equivalent Person (EP), per day.	Bunded drum store within construction site compound.	To be collected, transported and recycled by a Fuel Recycling Contractor off the Island.	Monthly during construction.
Diesel and other fuels	1%	Bunded drum store within construction site compound.	To be collected, transported and disposed of by an EPA licensed waste contractor off the Island.	As required.
Paints and other chemicals	1%	Asbestos material to be appropriately bagged by a licensed asbestos removal contractor.	"Supervised special burial" at Benaraby Landfill.	As required.
Asbestos	As identified	Dedicated green waste storage bay in construction site compound.	Timber off cuts to be reused where possible, otherwise will be transported and processed at the Waste Transfer Station at Benaraby Landfill.	Weekly during construction.

11.3.1.1 Waste Collection

Wastes will be temporarily stored in the construction site compound prior to being transported to the Waste Transfer Station at the Benaraby Landfill by an appropriately licensed waste contractor. Wastes will be sorted and stored according to waste stream. The Contractor will be responsible for



relocating construction waste from the temporary waste storage location within the construction site compound to the Waste Transfer Station at the Benaraby Landfill.

Timber pallets and packaging material shall be collected and returned to the suppliers at the time of the next delivery.

11.3.1.2 Waste Transportation

The majority of wastes that can not be reused or recycled on the Island will be transported to the Waste Transfer Station and Landfill at Benaraby. The distance of the landfill to the Island is not more than 50 kilometres, therefore, the travel cost and time will not significantly impact on the reuse, reduction, recycling and disposal of wastes.

The *Environmental Protection (Waste Management) Regulation 2000* provides the framework for waste tracking in Queensland of “trackable wastes”. Trackable wastes are outlined in Schedule 1 of this Regulation.

Wastes are tracked and reported to the EPA in order to protect the environment by minimising the impact of waste on the environment and human health. A waste tracking system enables regulatory agencies to track waste from the place of generation to the place of storage, recycling, treatment or disposal. The objectives of waste tracking are to ensure that all parties involved with the management of the waste take a responsible attitude towards this management and to ensure that the waste is transported and managed appropriately so as to prevent environmental harm.

Waste generators, transporters and receivers provide information to the EPA about the transport of trackable waste by paper or electronic systems.

The EPP Waste outlines the issues to be addressed when transporting regulated and trackable waste, such as:

- the type of waste;
- the vehicles, storage tanks, containers and other equipment used for the transportation;
- sampling of the waste;
- monitoring and reporting of matters concerning the waste;
- emergency response planning; and
- keeping of records about the transportation.

Wastes generated by the supply and delivery of raw materials and wastes disposed off the Island will be minimised. As far as practicable, the transport of raw materials, products and waste will involve full loads, so as to minimise fuel use.

All outgoing wastes from the Island will be transported by road using appropriately licensed waste transporters and a copy of the waste tracking documentation will be completed and retained, as per the Waste Management Plan outlined in Appendix A7.3. All waste loads transported off the Island will be covered, where practicable.



11.3.1.3 Waste Disposal

All wastes will be segregated and stored according to waste streams within the construction site compound before their transport to the Benaraby Landfill. Benaraby Landfill is capable of accepting construction and demolition wastes and provides recycling where possible at the Waste Transfer Station within the Benaraby Landfill. Alternatively there are licensed waste collectors in the region that can collect, segregate and recycle most waste streams generated during the construction of the proposed development.

No burial of wastes will be conducted on the Island, all construction waste will be disposed of at Benaraby Landfill within the Calliope Shire. This landfill has the capacity to receive waste from the proposed development following completion. No hazardous waste will be disposed of on the Island. Waste management disposal options for construction wastes are identified in Table 1, Section 3.1.

Waste management disposal options for construction wastes are identified in Table 11.1.

Waste disposal records will be retained as part of the Waste Management Plan, outlined in further detail in Appendix A7.3 of this report.

11.3.2 Operational Wastes

Domestic and general waste will be the largest waste stream generated during operation of the development. The remaining wastes streams generated include recyclable wastes such as paper, cardboard, plastics, glass, metals and organic waste.

Colour-coded and/or labelled wheelie bins will be provided to segregate and collect these wastes streams. These bins will be located at temporary waste compounds to be designed and located at each residential lot, tourist resort and commercial area. These temporary bin compounds will be designed and located to ensure that they are easily accessible from each part of the building and from the collection point and includes adequate access and manoeuvring space, at least an area equivalent to the combined footprint of the bins.

Plastic waste will be kept to a minimum and retail outlets will be encouraged to supply alternatives to plastic bags, such as biodegradable or cotton bags. Any plastic waste generated will be recycled, where possible.

Use of hazardous chemicals will be minimal, however, some pesticides and other chemicals may be used during maintenance of the golf course and other open space areas, as part of municipal duties to be undertaken by the Operator of the development. Wastewater treatment plant chemicals and additives will also be required on the Island for treatment of sewage. Storage and handling of hazardous and other chemicals will be in accordance with the relevant Australian Standard.

An inventory of wastes likely to be generated during the operation of the development is outlined in Table 11.2 below. Actual waste estimates may vary from that anticipated.

Table 11.2 – Inventory of Solid and Liquid Wastes Produced on the Island during Operation

Waste Description	Anticipated Waste Volume Generated	Waste Storage	Waste Management Technique	Frequency of Collection (during normal operation)
Domestic and general waste	1.05 tonnes per person, per annum ¹	Individual general waste bins at each residence and at temporary bin compounds at commercial and tourist sites.	To be collected and transported to Benaraby Landfill by waste contractor.	Twice weekly.
Organic and food waste		Promotion of composting at individual residence/premises, where feasible.	Reuse as landscaping material and soil conditioners on the Island.	As Required.
Green waste	Not known	Storage at individual residence/premises.	To be collected and transported to the Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	Scheduled clean up days.
Wastewater	140 litres per EP, per day ²	Tertiary wastewater treatment plant.	Treated effluent will be polished to class A and A+ for reuse in irrigation and approved uses via a dual reticulation system. Greywater will be reused on large lots.	Continuous.
Metals	0.75 tonnes of recyclable waste per person, per annum ¹	Dedicated metal recycling bins at various locations around the Island.	To be collected and transported to the Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	Fortnightly.
Plastics		Recycling bin provided at each residence/premises.	To be collected and transported to the Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	Monthly.
Glass		Recycling bin provided at each	To be collected and transported to the	Fortnightly.

Waste Description	Anticipated Waste Volume Generated	Waste Storage	Waste Management Technique	Frequency of Collection (during normal operation)
		residence/premises.	Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	
Paper and cardboard		Recycling bin provided at each residence/premises.	To be collected and transported to the Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	Weekly.
Diesel and other fuels	5,000 litres	Storage appropriately in bunded storage areas within marine and commercial precincts.	To be collected and transported to the Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	Quarterly.
Hazardous and other chemicals	2,000 litres	Storage appropriately in bunded storage areas within marine and commercial precincts, resort/hotel, and golf course.	To be collected and transported to the Waste Transfer Station at Benaraby Landfill by a licensed waste contractor.	Annually, or as required.
Electrical and electronic equipment (E-waste)	Not known	Dedicated e-waste bin at a central location on the Island.	Recycled off the Island by a licensed waste contractor.	Annually, or as required.
Waste by-products from the tertiary wastewater treatment plant	Dependant on throughput	Storage tank(s) provided at the tertiary wastewater treatment plant.	Disposed of at an appropriately licensed waste disposal facility off the Island.	Dependant on throughput.

¹ Source: Australian Bureau of Statistics (4613.0 – Australia's Environment: Issues and Trends, 2006).

² Source: AS/NZS 1547:2000 On-site domestic wastewater management.

11.3.2.1 Waste Collection

It is anticipated that commercial waste collection operations will be utilised during construction and operation for the collection and appropriate disposal of generated commercial waste. It will be the responsibility of the construction contractor or commercial operation/enterprise to engage the commercial waste collection service.



Domestic waste collection will be conducted by the Local Government Authority as part of domestic waste collection services.

11.3.2.2 Waste Transportation

The *Environmental Protection (Waste Management) Regulation 2000* provides the framework for waste tracking in Queensland of “trackable wastes”. Trackable wastes are outlined in Schedule 1 of this Regulation.

Wastes are tracked and reported to the EPA in order to protect the environment by minimising the impact of waste on the environment and human health. A waste tracking system enables regulatory agencies to track waste from the place of generation to the place of storage, recycling, treatment or disposal. The objectives of waste tracking are to ensure that all parties involved with the management of the waste take a responsible attitude towards this management and to ensure that the waste is transported and managed appropriately so as to prevent environmental harm.

Waste generators, transporters and receivers provide information to the EPA about the transport of trackable waste by paper or electronic systems.

The EPP Waste outlines the issues to be addressed when transporting regulated and trackable waste, such as:

- the type of waste;
- the vehicles, storage tanks, containers and other equipment used for the transportation;
- sampling of the waste;
- monitoring and reporting of matters concerning the waste;
- emergency response planning; and
- keeping of records about the transportation.

Wastes generated by the supply and delivery of raw materials and wastes disposed off the Island will be minimised. As far as practicable, the transport of raw materials, products and waste will involve full loads, so as to minimise fuel use.

All outgoing wastes from the Island will be transported by road using appropriately licensed waste transporters and a copy of the waste tracking documentation will be completed and retained, as per the Waste Management Plan outlined in Appendix A7.3. All waste loads transported off the Island will be covered, where practicable.

11.3.2.3 Waste Disposal

All wastes will be segregated and stored according to waste streams at the temporary bin compounds before their transport to the Waste Transfer Station and landfill at Benaraby. All wastes will be segregated and stored in colour-coded and/or labelled bins according to waste streams at this facility.



No burial of wastes will be conducted on the Island, all domestic and general waste will be disposed of at Benaraby Landfill within the Calliope Shire. No hazardous waste will be disposed of on the Island. Waste management disposal options for operational wastes are identified in Table 11.3.

Waste disposal records will be retained as part of the Waste Management Plan, outlined in further detail in Appendix A7.3 of this report.

11.4 Potential Impacts and Mitigation Measures

Hummock Hill Island is located within the Great Barrier Reef World Heritage Area and Marine Park, and Rodds Bay Dugong Protection Area. The proposed development area on the Island is currently unused and the only known previous use is pastoral activities.

Some risks to the environment can occur as a result of waste management activities if not controlled. The environmental risks range from potential environmental harm, such as pollution of waterways, to environmental nuisance, such as odour complaints. The potential impacts of the proposed development on the identified environmental values are listed below.

- Waste spills and loss of containment of waste resulting in impacts to soils, surface water, groundwater, terrestrial and marine fauna, and human health;
- Littering and contamination of waterways;
- Plastic waste causing mortality to marine fauna;
- Waste spills and related incidents from transportation of waste on and off the Island;
- Cross contamination of wastes, making wastes unsuitable for reuse and/or recycling, thus increasing the quantity of waste being disposed of to landfill;
- Increasing the pressure on regional landfills;
- Odour and noise generation from waste handling and storage; and
- Propagation of pests, vermin and disease vectors.

To minimise the impacts outlined above, the following mitigation measures will be undertaken during construction and operation of the proposed development:

- Wastes to be managed in accordance with the *Environmental Protection (Waste Management) Regulation 2000*;
- Waste avoidance, minimisation, reuse and recycling principles to be utilised wherever possible;
- Wastes to be segregated to assist in recovery and recycling;
- Construction and demolition wastes to be reused and recycled, wherever possible;
- No disposal of solid or hazardous wastes on the Island;
- Materials to be fabricated off site where possible to minimise the generation of waste;
- In order to reduce waste volumes, where possible, all wastes generated from construction and operational activities will be reused on site or sent to recyclers. Disposal to appropriately licensed waste facilities will only be undertaken where reuse or recycling is not possible or feasible;



- Where appropriate waste generators will be encouraged to segregate wastes at the source to minimise cross contamination of waste streams;
- Waste will only be transported by appropriately licensed waste transporters;
- A centralised construction waste collection area will be provided as part of the development. The collection area will be constructed on a concrete hardstand and roofed, where practicable;
- Colour-coded and/or labelled bins will be provided for each waste stream to assist in the segregation of wastes and maximise waste recovery and recycling;
- Alternatives to plastic bags to be provided at retail outlets;
- Records of waste quantities removed from the Island are to be maintained;
- A waste audit will be conducted when the development is operational and when each new stage of development becomes operational. The purpose of the waste audit will be to identify:
 - types and volumes of wastes generated;
 - further opportunities for waste avoidance, reuse reduction and recycling;
 - waste storage and segregation methods;
 - waste treatment and disposal techniques; and
 - destination of waste materials.

A Waste Management Plan will be developed and implemented, which incorporates the mitigation measures outlined in the previous and current sections of this report.

A summary of the wastes generated during construction and operation of the development and their proposed waste management technique is provided in Table 11.3.

Table 11.3 – Waste Management Summary

Waste Source	Waste Type	Waste Management Technique
Construction	Fill and soil (not contaminated)	Reuse
Construction	Fill and soil (contaminated)	Disposal
Construction	Timber and vegetation	Reuse
Construction	Scrap metal	Recycle
Construction	Cable and wire	Recycle or disposal
Construction	Concrete, bricks, tiles and rubble	Disposal
Construction	Plasterboard	Reuse or disposal
Construction	Packaging wastes, plastic, glass and timber	Recycle
Construction	Domestic and general waste	Disposal
Construction	Organic and food waste	Compost
Construction	Wastewater	Post treatment reuse
Construction	Diesel and other fuels	Recycle



Waste Source	Waste Type	Waste Management Technique
Construction	Paint and other chemicals	Disposal
Construction	Asbestos	Disposal
Operation	Domestic waste	Disposal
Operation	Organic and food waste	Compost
Operation	Green waste	Reuse
Operation	Wastewater	Post treatment reuse
Operation	Metals	Recycle
Operation	Plastics	Recycle
Operation	Glass	Recycle
Operation	Paper and cardboard	Recycle
Operation	Diesel and other fuels	Recycle
Operation	Hazardous and other chemicals	Disposal
Operation	Electrical and electronic equipment (E-waste)	Recycle
Operation	Waste by-products from the tertiary wastewater treatment plant	Disposal

11.5 Conclusion

Based on the sensitive nature of environmental values surrounding the Island, waste management during both construction and management will be required. Potential construction impacts will be managed through the development and implementation of a waste management plan that incorporates the principles of the *Environmental Protection (Waste Management) Regulation 2000*. Residual impacts to identified environmental values following proposed mitigation requirements in the Waste Management Plan are considered to be negligible.

Operational waste management impacts will also be controlled via the Waste Management Plan, utilizing both commercial and Council waste collection services to transport waste off-site to the Benaraby Landfill or other suitable transfer station for disposal or recycling. The Benaraby Landfill Residual impacts to identified environmental values following the proposed Waste Management Plan and commercial and Council waste collections are considered negligible.

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SECTION 12

NOISE AND VIBRATION



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12. Noise and Vibration

12.1 Existing Environment

12.1.1 Description of Environmental Values

The noise environment in Queensland is protected under the *Environmental Protection Act 1994*. The *Environmental Protection (Noise) Policy 1997* (EPP Noise) is subordinate legislation to the EP Act. The values to be protected under this policy include:

- Wellbeing of the community or a part of the community including its social and economic amenity; or
- Wellbeing of an individual, including the individual's opportunity to have sleep, relaxation and conversation without unreasonable interference from intrusive noise.

The EPP Noise does not specify any absolute or relative sound pressure level criteria for development or construction work, instead an acoustic quality objective of achieving an ambient level $L_{eq}(24\text{hour})$ of 55 dBA or less for the majority of Queensland's residential population is specified.

Construction Noise

Construction noise level limits are generally not specified in Queensland, however, the Queensland Nuisance Laws, outlined in Section 6 of the *Environmental Protection Regulation 1998* (EPR, 1998), provide time restrictions for construction, maintenance and building works having the potential to affect residential premises:

- 6:30 am-6:30 pm Monday to Saturday building works are permitted.
- Building works outside of these hours are permitted, as long as they do not result in audible noise at the nearest noise sensitive place.

In areas where construction noise is likely to impact on nearest sensitive receivers, more stringent construction noise level limits and allowable operating times are determined on a case by case basis and managed as part of an Environmental Management Plan for the works (Refer to Section 20).

For the proposed development, restrictions may be required for the transport of construction materials to the site, if the main transport route travels close to residential receivers such as residents living along Turkey Beach Road and Foreshores Road (generally within 300 m) and significant works outside the recommended working hours (6:30am – 6:30pm) are proposed.

Blasting

The EPP (Noise) 1997 and the EPA Guideline titled *Noise and Vibration from Blasting* (EPA 2004) provide guidance on noise limits for blasting activities. Table 12.1 provides a summary of the noise and vibration limits from blasting operations.

Table 12.1 – Airblast Overpressure and Ground Vibration Limits

Source	Noise	Ground Vibration
Environmental Protection (Noise) Policy 1997	Noise from blasting is not unreasonable if: the air-blast overpressure, measured outside the most exposed part of an affected noise sensitive place, is not more than 115 dB (Linear) peak for four out of any five consecutive blasts	Ground vibration from blasting is not unreasonable if: - for vibrations of more than 35 Hz - not more than 25 mm/s ground vibration, peak particle velocity; or - for vibrations of not more than 35 Hz - not more than 10 mm/s ground vibration, peak particle velocity
EPA Guideline – Noise and Vibration from Blasting	If blasting noise propagates to a noise sensitive place the airblast overpressure must: - not be more than 115 dB(linear) peak for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and - The airblast overpressure must not exceed 120 dB(linear) peak for any blast	If ground vibration propagates to a noise sensitive place the ground-borne vibration must: - not exceed a peak particle velocity of 5 mm/s for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts; and - not exceed a peak particle velocity of 10 mm/s for any blast

Operational Noise

Queensland Nuisance Laws (EPR, 1998) provide time restrictions and noise level limits for the operation of specific activities or items of plant having the potential to create nuisance noise impacts. These limits have been summarised in Table 12.2 as relevant to the proposed development.

Table 12.2 – Operational Noise Limits for Plant / Activities

Plant Item	Time Restriction	Limit on Audible Noise	Source
Air Conditioning Equipment	7 am - 10 pm	50 dB(A)	6Z EPR, 1998
	10 pm - 7 am	the greater of 40 dB(A) or background + 5	
Refrigeration Equipment	7 am - 10 pm	50 dB(A)	6ZA EPR, 1998
	10 pm - 7 am	the greater of 40 dB(A) or background + 5	
Regulated Devices ¹	7 am - 7 pm Monday – Saturday	50 dB(A)	6X EPR, 1998
	8 am – 7 pm, Sunday & Public Holidays	the greater of 40 dB(A) or background + 5	
Amplifier Device (PA Systems)	8 am-6 pm, Saturday, Sunday or Public Holiday	background + 10 dB(A)	6ZB EPR, 1998
	7 am-10 pm, business days	background + 10 dB(A)	
	other times	no audible noise	
Indoor Venues (sporting, musical or other entertainment, excluding educational institutions)	Prior to 7 am any day	no audible noise	6ZB EPR, 1998
	7 am-10 pm, any day	50 dB(A)	
	after 10 pm any day	the lesser of 40 dB(A) or background + 10	

¹Under the meaning of the EPR 1998 a regulated devices include: a compressor, a ducted vacuuming system, a generator, grass-cutter, impacting tool, leaf-blower, mulcher, oxyacetylene burner, electrical, mechanical or pneumatic power tool.



No specific limits exist for the movement of boats or use of a boat ramp. Operational limits and time restrictions do, however, exist for the operation of power boat engines at premises.

Table 12.3 summarises the requirements of Section 6ZE, *EPR 1998*.

Table 12.3 – Noise from Power Boat Engines at Premises

Time Period	Noise Level Limit
6:30 pm – 8 am, Sundays and Public Holidays	no audible noise
7:00 pm – 7:00 am, Saturday or Business Days	no audible noise

The majority of nuisance laws have been derived to minimise the occurrence of audible noise within the most exposed room of the nearest affected sensitive receiver, particularly during night-time hours, when sleep disturbance impacts may result.

Noise From Licensed Premises

Noise, including music and entertainment noise, from licensed areas associated with retail and hotels, is currently controlled by the Liquor Licensing Division. Section 40 of the *Liquor Regulation 2002* prescribes limits for noise that constitutes unreasonable noise, as outlined in Table 12.4.

Table 12.4 – Noise from Licensed Premises

Time Period	Noise Level Limit
6 am-10 pm	$L_{A_{MAX}adj, T}$ (including adjustments for tonal and impulse components) must not exceed a level of background (L_{A90}) + 10 dB(A)
10 pm –6 am	$L_{OCT10, \#i}$ in a full octave band with centre frequencies from 63 Hz to 2000 HZ, shall not exceed a background (L_{OCT90}) by more than 8 dB in any octave band

the linear (flat) frequency rating for a stated octave band that is equalled or exceeded for 10% of the specified time interval.

Specific noise limits for the operation of the Hotel and commercial retail facilities associated with the proposed development would be specified as part of their operating licences.

Road Traffic and Aircraft Noise

The EPP Noise outlines acceptable road traffic and airport noise levels for Queensland, while recognising that these infrastructure services are beneficial assets, necessary for the community's environmental, social and economic wellbeing, but which may have significantly adverse effects on environmental values. Acceptable road traffic noise levels are outlined as:

- L_{A10} (18 hour) 68 dB(A) for state controlled road
- L_{A10} (18 hour) 63 for another public road
- L_{Aeq} (1 hour) 60 dB(A) assessed as the highest 1hr level between 10 pm – 6am.
- $L_{P max}$ 80 dB(A)

Acceptable planning noise levels for an airport are also outlined in the EPP Noise, however due to the low numbers of aircraft using the proposed airstrip on the Island the “*Environmental Principles*



And Procedures For Minimising The Impact Of Aircraft Noise (AirServices Australia 20002) are considered more appropriate to the development.

AirServices Australia (2002) provides a screening level assessment framework for determining whether detailed environmental assessment is required for proposed new airfield arrangements. It also provides information for designing standard departure and arrival procedures for aircraft to avoid over flying residential areas and minimise noise impacts in these areas.

AirServices Australia (2002) states that Noise is not considered significant if exposure amounts to less than 40 dB(A) $L_{Aeq\ 24\text{hour}}$ and there are less than 50 over flights per day. Potential flight movements associated with the proposed airstrip are anticipated to be around 6 flights a day. Typically these flights will be by small single engine aircraft as described in Section 3.

Noise from Industrial Premises

The Planning for Noise Control Guideline (EPA 2004) is applicable to noise emissions from industrial and commercial premises and aims to limit continuing increases in noise levels and intrusive noise impacts in an area by establishing planning noise levels for the proposed activities. These guidelines would be applicable to the operation of facilities requiring an environmental authority to operate, such as the water treatment, waste water treatment plant and waste transfer facilities on the island. The assessment of noise impacts and specification of appropriate operational level noise limits for the areas of the development would occur as part of the Development Approvals and operating licences for the relevant facilities.

12.1.2 Existing Noise and Vibration Environment

The existing noise environment at the site is expected to be typical of a natural rural environment, dominated by: insects, birds and other wildlife; wind rustling leaves; and wave noise from the nearby ocean.

Transient noise from visiting boats and leisure craft would also contribute to the noise environment within the area surrounding the proposed development. Distant noise from occasional aircraft over flights on their approach to and departure from Gladstone may also occur on occasion.

Given the dominance of natural sources and the absence of industrial or transport related noise contributions to the existing noise environment (which are often associated with nuisance impacts) no baseline noise monitoring was undertaken for the project. Background noise levels were estimated from *AS-1055 - Description and Measurement of Environmental Noise* for areas with negligible transportation density to assist with developing noise level objectives for the project.

Sensitive sites to the development are likely to be residences and holiday homes at Bangalee on the southern tip of Wild Cattle Island, residences at Munoolin Rocks and isolated rural residential properties adjacent Clarks Road, Foreshores Road and Turkey Beach Road.

12.1.3 Potential Construction Noise and Vibration Sources

As outlined in Section 3 of this EIS, construction works will be staged, with the majority of works being completed within 8 years of commencement. Initial works will involve installation of site



infrastructure and services, including a bridge over Boyne Creek, the main Island access road, power supply to the Island plus the desalination plant and the wastewater treatment plant. Hotel and short-term residential style accommodation, including holiday villages and apartments, and the hotel and Island resorts, will then be constructed. Long-term residential accommodation, educational facilities, community services and care facilities will then be constructed, followed by the airfield and additional residential accommodation.

Potential noise and vibration generation from the construction site will be variable, depending on the stage of the works and the types of equipment operating at a particular time.

The main noise and vibration generating activities during the construction works are expected to include:

- The use of mobile heavy equipment for vegetation clearing, topsoil removal and bulk earthworks;
- Civil works, involving the use of cranes, concrete trucks, piling equipment, heavy vehicles and the like during the construction of dwellings, roads and services; and
- Transport of fill and materials from the site.

A detailed construction noise management plan will be undertaken by the construction contractor when appointed prior to the finalisation of detailed designs. The noise and vibration impact assessment undertaken to date adopts a risk based approach investigating the potential for impacts at nearest sensitive receivers as works progress.

12.1.4 Potential Operational Noise Sources

As outlined in Section 2, the proposed Hummock Hill Island Development will involve a number of different land uses including general public use, commercial activities, short and longer term tourist accommodation, residential accommodation and infrastructure services. Noise emissions and limits for each type of activity associated with retail and commercial operations and Code Assessable activities (water supply and treatment and waste handling), would be defined, where relevant, at the time that each individual facility applies for a Building Approval or Environmental Authority for the proposed development.

The main potential sources of noise associated with operation of the proposed development include:

- Personal watercraft and small watercraft using the Boyne Creek Boat ramp and Colosseum Inlet boat ramp;
- Possible boat maintenance and repair activities near the Boyne Creek Boat Ramp;
- The operation of air conditioning equipment, refrigeration plant, generators and outdoor speaker / PA systems at the proposed commercial and retail areas;
- The operation of mechanical plant associated with waste and water treatment facilities;
- Entertainment activities at the proposed Hotel, resorts, Golf Club etc (possibly including live bands and outdoor music);



- Road traffic travelling to and from the proposed residential area, retail premises and hotel; and
- Aircraft using the proposed airstrip.

Vibration impacts are not expected to occur as a result of the proposed development operation. The selection of stationary plant would include consideration to potential vibration emissions as part of the design and incorporate appropriate mitigation measures.

12.2 Potential Impacts and Mitigation Measures

12.2.1 Potential Construction Impacts

Potential noise and vibration generation from construction activities will be variable, depending on the stage of works, type of equipment operating at a particular time and the proximity to sensitive noise receptors.

During initial works, potential impacts are likely to be restricted to receivers adjacent to the mainland access route to the Island. Given that there are currently no identified noise receptors on Hummock Hill Island, construction noise and vibration impacts from proposed earthworks and civil works are not expected to be significant during the initial stages of construction.

However, as the development progresses and tourist/residential accommodation expands on the Island, a potential exists for construction activities to impact on new Island residents. If construction occurs within 50-100m of residential uses, minor annoyance (or disturbance) from noise and vibration may be experienced by building occupants.

Construction traffic, associated with limited earthworks and materials to and from development areas has the potential to result in noise and vibration impacts at residential dwellings adjacent to the mainland access and egress route. Potential noise and vibration impacts from heavy vehicle movements will be restricted to locations within close proximity to roads and maximum noise and vibration levels generated from construction vehicles travelling to and from the Hummock Hill Island would not be significantly different to those which would currently occur during existing heavy vehicle movements. Although there is likely to be an increase in the number of heavy vehicle movements during the construction period, vibration impacts from construction traffic travelling along the access route to the Island are not expected to be significant for this project.

Given that there are currently no sensitive receptors identified on Hummock Hill Island, construction vibration impacts are not expected to be significant during the initial stages of construction. If, during the later stages of development on the Island, construction occurs within 50-100 m of residential uses, minor annoyance (or disturbance) from vibration may be experienced by building occupants. Potential structural damage to buildings is unlikely at distances of greater than 50 m from structures, however further consideration of vibration impacts will be addressed by the construction contractor and managed as part of the construction environmental management plans.



12.2.2 Potential Operational Impacts

Potential intrusive noise impacts associated with boat engine noise may occur at the proposed residential dwellings near boat ramps and waterways. The level of impact would depend on the time of day, the power rating of the engine, the speed at which the power boats are being driven; and the distance to the receivers. A combination of the required 100 m buffer above HAT and distance from the navigable waters edge to HAT will ameliorate noise levels. Boat servicing, maintenance and repair facilities may occur adjacent to the Boyne Creek Boat ramp. Noise associated with these activities may include the use of pumps, regulated devices such as hand held power tools (angle grinders, circular saws etc) and the like.

Proposed commercial and retail components of the development are likely to include air conditioning and ventilation plant, refrigeration units, emergency generators and the like. Due to the nature of these noise sources (usually involving fans and motors with the potential for tonal components) these noise sources have the potential to result in noise impacts at nearby residential receivers. Noise from these items can be controlled using acoustically designed plant rooms, strategically positioned barriers, duct silencers and the like and would require further consideration during detailed design for these facilities.

Similarly noise from pumps, generators, fans etc associated with the operation of the water treatment and waste facilities have the potential to result in noise impacts at nearby receivers and would require further consideration during detailed design. Noise controls for these facilities would be specified in the development applications and approvals for these facilities.

Retail, public space and entertainment areas may also include outdoor Public Address (PA) systems, music and possibly live bands. Noise from these sources has the potential to cause noise impact, particularly during night-time hours and would required detailed consideration during the design of these areas.

The proposed development will generate traffic travelling to and from the Island and within the proposed development. The proposed road network allows for one main access route into and out of the Island, via a bridge on the south-eastern end of the Island. Due to the relatively low population (approximately 4,000 people peak capacity) expected on the Island, and the nature of traffic being dispersed "local" traffic occurring in a number of areas over the Island (rather than through traffic focused around a single road), road traffic noise impacts are not expected to be significant. Residential building design would consider minimising the potential for road traffic noise intrusion.

Light aircraft visiting the Island is expected to be primarily associated with private owners and tourism activities associated with an unregistered airstrip. Aircraft would comprise mainly small propeller engines delivering travellers and taking scenic joy flights. Noise impacts from these aircraft are likely to vary, depending on the engine type, aircraft configuration and the take-off / landing paths and flight directions and would also be generated during engine testing and aircraft maintenance.



The expected level of aircraft patronage would be typical of a small offshore Island and is expected to be around 6-8 propeller aircraft movements per day. Flights and maintenance activities are expected to be limited to daytime hours. As such, noise impacts associated with the operation of the facility are not expected to be significant provide planning for the airstrip and Island development prevents noise sensitive land use beneath approach and departure flight path corridors.

Vibration impacts are not expected to occur as a result of the operation of the proposed Development. The selection of stationary plant should include consideration to potential vibration emissions.

12.3 Recommended mitigation measures

12.3.1 Noise - Construction

It is recommended that the following noise management controls and mitigation measures be incorporated in the construction noise and vibration management plans to limit the potential for construction noise impacts:

- All practical steps be taken to silence construction equipment;
- Works be restricted to the hours of 6:30 am – 6:30 pm Monday to Saturday, and no work outside these hours if audible at the nearest sensitive place;
- Tailgates of all vehicles transporting materials to and from the site would be securely fixed prior to loading and immediately after unloading;
- All mobile plant equipment used on site shall be maintained in an efficient condition and operated in a proper manner;
- All equipment used on site would have evidence of compliance with recommended noise levels outlined in AS2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*;
- Maintain a complaints register and investigate if a community complaint regarding excessive noise or vibration levels is received;
- Review the Construction Noise Management Plan periodically to ensure it remains appropriate to the current stage of construction activities; and
- Implement a community consultation program, informing residents of the construction schedule, progress and alerting them to times of unusually noisy activities or out of hours work.

During the latter stages of development, when sensitive receivers are located within close proximity to the works on the Island, the following additional noise and vibration controls will be considered:

- No 'warming up' of plant and machinery would occur near residential dwellings before specified working hours;
- Ensure all noise suppression devices are maintained to manufacturers specifications;
- Fit all exhausts of mobile plant operating within close proximity to sensitive receivers, with suitable mufflers;



- Consider further limiting the allowable hours of operation; and
- Consideration to fitting adjustable reversing alarms (which are set at a margin above background level).

Provided construction vehicles travel to and from the site during daytime hours and appropriate community consultation is undertaken (informing residents of the time and duration of activities), traffic noise impacts are expected to be manageable to reasonable levels.

The Construction Contractor would be responsible for managing construction activities and ensuring that the construction environmental management plan includes minimisation of noise and vibration emissions.

12.3.2 Noise - Operation

In order to mitigate the potential impacts from powerboat activities restrictions to the speed at which these vessels travel and the allowable times of use of boat ramp facilities could be applied as part of the development.

If the boat maintenance and repair facility proceeds as part of the development, design of the facility would consider maximising shielding provided to nearest receivers through appropriate building orientation, etc.

To reduce the potential for noise impacts from the commercial, retail and tourist areas noise emissions and appropriate time and level restrictions would be considered (in detail) as part of the Building Approvals for these facilities.

The implementation of appropriate noise management measures at the mining site will also minimise the potential for noise impacts at proposed future residential receivers. It is expected that noise emissions from the sand mining operations, should they occur, can be maintained at an acceptable level provided the adoption of appropriate building design considerations as part of the development.

Noise from the use of boats and watercraft can be minimised by:

- Placing restrictions on the speed at which these vessels travel within Boyne Creek;
- Placing restrictions on the allowable times of use for boat ramps and associated facilities;
- Installing appropriate signage at locations around boat ramps and near sensitive areas, which request patrons to minimise undue noise between the specified night-time hours (10 pm-6 am);
- Observation of the Qld Nuisance Laws, which restrict times of use for powerboat engines at residential premises (refer Noise Report Appendix A7.9));



Noise impacts from boat maintenance and repair activities, should these proceed as part of the Development, can be minimised through:

- Complying with the allowable time restrictions for use of regulated devices under the Qld Nuisance Laws;
- Complying with the allowable noise level restrictions for regulated devices;
- Performing high noise or tonal activities (tools using constant speed motors such as angle grinders) inside acoustic enclosures or appropriately designed buildings (to minimise breakout noise to nearest receivers); and
- Maximising shielding and buffer distances to nearest receivers, as part of the facility layout and design.

To reduce the potential for noise impacts from the commercial, retail and tourist areas the following recommendations are made:

- Noise emissions and appropriate level restrictions from the operation of the proposed hotel and licensed facilities would be considered (in detail) as part of the Building Approvals for these facilities;
- Noise level restrictions to entertainment venues would apply during night-time hours (10 pm – 6 am);
- PA systems and outdoor sound systems would be controlled to the levels outlined in Table 12.2
- Layout of precinct areas should consider locating noisy plant and outdoor entertainment areas away from residential sleeping areas;
- Refrigeration units, ventilation fans, air conditioners, generators and the like would be required to comply with the levels outlined in Table 12.2;
- Consideration should be given to acoustically designed plant rooms, strategically positioned barriers, duct silencers and building layouts for the commercial, retail and accommodation areas, where necessary; and
- Use of appropriate buffer distances between the plant and receptor, where relevant.

Transport noise from vehicles travelling within the Island, and aircraft using the airfield, can be minimised through:

- Reducing traffic speeds;
- Locating houses some distance from the main access roads across the Island;
- Facade treatments in high risk areas (window, ceiling, wall and roof treatments, air conditioning etc);
- Locating aircraft engine testing facilities in areas which maximise the distance to nearest receivers and shielding provided by intervening buildings; and
- Restricting aircraft maintenance activities and flights to and from the Island to daytime hours.



Noise impacts from external sources on the proposed development can be minimised through considering the following controls:

- Detailed design of the development within close proximity to sand mining lease areas should incorporate locating non-sensitive landuses such as open space and parklands, commercial activities adjacent to these areas; and
- If residential development occurs within close proximity to sand mining areas the building design should consider incorporating façade treatments to minimise potential intrusive and amenity noise impacts.

12.4 Conclusions

The main noise and vibration impacts during construction on HHI are likely to be from the use of heavy equipment for transport, earthworks and vegetation clearing and other civil works following construction of early stages of the development and as tourist and residential accommodation expands. To limit the potential for noise and vibration impacts the Construction Contractor would be responsible for managing construction activities and ensuring that the construction environmental management plan includes minimisation of noise and vibration emissions.

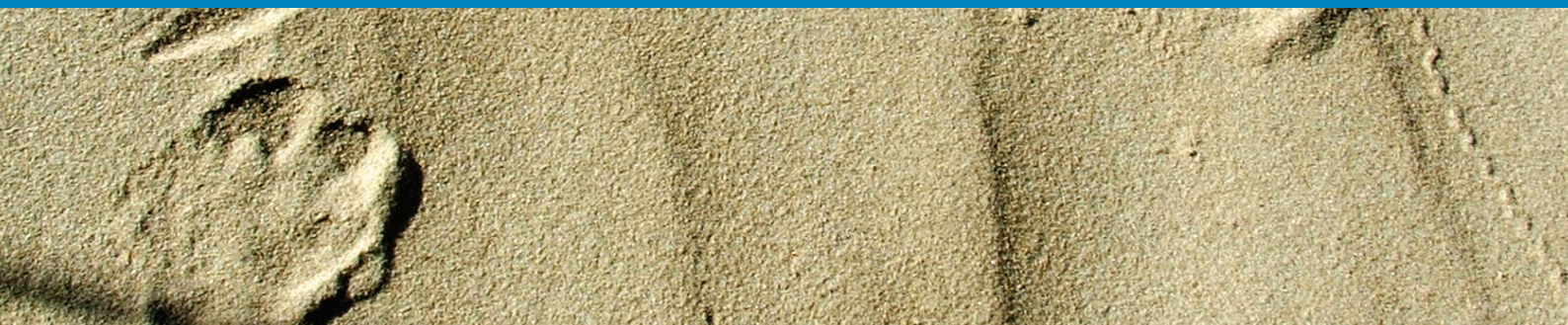
Operational activities also have the potential to cause noise and vibration impacts at the new residential areas. Further investigation of detailed noise management measures will take place as part of a detailed design for the project components and management measures, including appropriate siting of noise generating items to maximise shielding provided to residences and restricting potentially nuisance noise sources to least sensitive times of the day, would be incorporated to ensure that noise and vibration impacts are not significant.

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SECTION 13

CULTURAL HERITAGE





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13. Cultural Heritage

13.1 Existing Environment

13.1.1 Indigenous Cultural Heritage

13.1.1.1 Methodology

In keeping with requirements of the part 7 of the *Aboriginal Cultural Heritage Act 2003*, the preparation of an EIS is a trigger for the requirement of a Cultural Heritage Management Plan (CHMP). The CHMP was formally notified to the Port Curtis Coral Coast (PCCC) (QC 01/29 [Q 6026/ 01]) native title claimant group through their applicants. One response was received from Mr Colin Johnson. Mr Johnson was then endorsed by Eaton Place Pty Ltd to be the Aboriginal Party to assist with the development of the CHMP. The CHMP was approved by the Qld DNRW on 17 January, 2007.

Mr Johnson instructed that he wished to work through Gidarjil Aboriginal Corporation and requested that other representatives from the native title claimant group also be involved. In response to these instructions, Eaton Place Pty Ltd contacted Gidarjil and informed them of the nature of the project. Gidarjil took responsibility for informing the representatives of the Aboriginal Party of the nature of the project and for the allocation of representative field researchers for the project. The Aboriginal Party nominated ARCHAEO Cultural Heritage Services as technical advisor to the project and agreed that the survey could take place.

A survey of the Island was instigated by Eaton Place Pty Ltd in response to the requirements of the *Aboriginal Cultural Heritage Act 2003*. The survey was conducted over five days from November 6 through to November 10, 2006 and was restricted to the physical inspection of those sections of the project area that will be directly disturbed by the proposed development. Details of the Survey are provided in Appendix A7.10.

13.1.1.2 Site Searches

A search of both the DNRW administered Register and the Database resulted in a number of registered sites being located on Hummock Hill Island, both inside and outside the development area. These sites are outlined below in Table 13.1 and Figure 13.1.

Note: Discrepancies often occur in relation to the co-ordinates of sites recorded on the register and database.



Figure 13.1 - Cultural Heritage Sites

LEGEND

- Quartz Flake
- Single Platform Core
- Artefact
- Ceremony Rocks
- Core Silcrete
- Grindstone
- Historic Rocks
- Midden
- Development Footprint

This figure must be read in conjunction with the data disclaimer located at the front of this report. The data acquired for this project is known to be of low spatial resolution and as such no representation or warranties about its accuracy, reliability or suitability are given. Assumptions and conclusions made from this figure and the associated data must be made with full understanding of the data limitations. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data.

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Table 13.1 – List of DNRW Registered Sites within the Project Area on Hummock Hill

Site ID	Site Type	Recorder	Location	Notes
JE:A04	Stone Arrangement	G. Alfredson	24°00'43" 151°28'30"	A stone arrangement on the summit of Hummock Hill. Alfredson (1993) identified this site 'as a probable surveyor's trig point' although subsequent research failed to locate supporting evidence Relocated - HH Site 9 - S12A
JE:A41	Shell Midden/Artefact Scatter	H. Johnson	23°59'54" 151°28'20"	Alfredson Site 1 Relocated - HH Site 7- S09
JE:A42	Shell Midden	H. Johnson	24°02'18" 151°29'29"	Alfredson Site 1 Relocated? - HH Site 13- S17?
JE:A43	Shell Midden/Artefact Scatter	H. Johnson	24°02'18" 151°29'22"	Alfredson Site 2 Relocated - HH Site 10- S13
JE:A62	Artefact Scatter	C. Burke	24°00'43" 151°28'44"	Unable to be relocated during present survey
JE:A65	Shell Midden	C. Burke	24°02'18" 151°29'36"	Shell mound with a depth of up to 40 cm. Burke (1993) noted that only a small portion of the site had not been damaged by development activities and water erosion. References: Burke (1993). Alfredson Site 2 Relocated - HH Site 13 - S18&19

13.1.1.3 Field Survey Results

Seventeen specific cultural heritage sites were located during the field survey as presented in Figure 13.2. These sites consisted of:

- 5 x isolated stone artefacts;
- 1 x possible ceremonial area;
- 3 x artefact scatters (under five artefacts);
- 1 x background degraded shell scatter with associated artefacts;
- 4 x shell midden deposits in various levels of erosion and/or disturbance (some with associated stone artefacts including one containing 8 artefacts [HH Site 13 SO17]);
- 2 x stone arrangements (1 consisting of four individual arrangements - S12A-D); and
- 1 x mound (possible midden mound).

The primary characteristics of each of these 17 areas of cultural heritage significance are outlined in Appendix A7.10. TOFOs also noted the significance of remnant vegetation across the entirety of the study area and subsequently raised direct concerns relating to the potential impact of the project on such areas. The importance of creek systems, drainage lines and seasonally inundated wetlands were also raised, particularly in relation to the probability that elevated areas located in the vicinity of these waterways would have represented ideal locations for activities such as camping and therefore possess a higher archaeological potential.

Emphasis was placed specifically on the following areas:

- Sand ridges, swales and the associated stream and riparian vine thicket located on the northern boundary of the project area east of the headland;
- Beach ridges, swales and associated creeks and wetlands west and southwest of the headland;
- The foreshore and associated eroded/remnant beach ridges and adjacent areas of elevated land on granodiorite deposits located on the southern, central section of the Island;
- The summit of Hummock Hill; and
- Elevated areas surrounding two dammed creek systems still retaining fresh water (see Figure 13.2).



Figure 13.2 – Cultural Heritage Sites and Archaeological Potential (Source: Archaeo, 2006)

13.1.2 Non-Indigenous Cultural Heritage

13.1.2.1 Historical Background for the Study Area

Leasehold of Hummock Hill Island

The first known records relating to the tenure of Hummock Hill Island include an 1877 telegraph from Mr. Thomas Farmer, requesting clarification of the nature of land tenure for 'Hummocky Island' to the Under Secretary for the Lands Department in Brisbane. At this time it seems that the official nature of land tenure for the Island is unclear.



Correspondence from the District Surveyor in Gladstone in October of 1877 reveals that there was *“currently no lease or ownership over Hummock Hill Island, however cattle from this run (Rodds Bay) do graze over it”* including, *“the running of brood mares.”*

A five year lease for the whole Island was offered for the first time at public auction on the 19 February, 1878. The lease was for 9 square miles and bids were reserved at 2 pound per sq. mile. John McLean Bruce was the successful bidder with a final bid of 54 Pounds. Bruce struggled to pay the rent and forfeited the lease in January 1880. The lease was offered once again at public auction on 18 March, 1880 and Thomas Williman Wade secured a five year pastoral lease over the Island. Wade transferred his lease to Henry Missing of ‘Goochy’ via Maryborough on 17 January, 1882. Missing secured a further 10 year lease for Island (9.sq miles) in March 1883.

The pastoral lease for the Island was resumed and split into two 6 sq. mile runs in 1886 (refer to Figure 13.3). One of the new leases was registered to James Worthington in 1886. It is not clear whether Missing continues on the Island and it is possible that Worthington took over both 6 sq. mile leases from this time however there is no clear correspondence in the pastoral lease file related to Missing from this time.

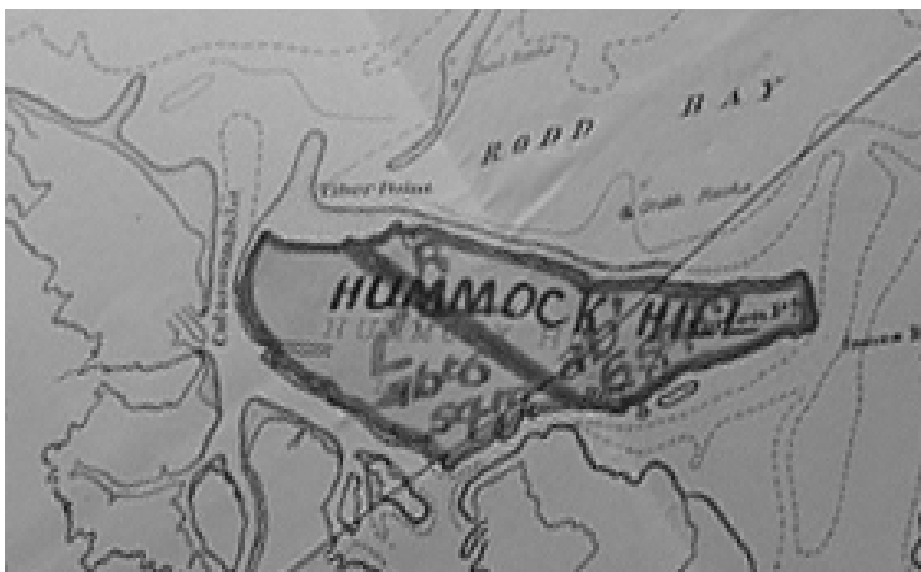


Figure 13.3 – 6 sq. mile lease on Hummock Hill Island in 1886 (Pastoral Lease file 1219)

Worthington died in 1897 and his lease was resumed. It appeared that the Island was unoccupied from his death and according to a Lands Dept Letter from July 1898, *“Presently there are no inquiries for it.”* This situation continued for a decade until a new 10 ½ sq. mile lease was offered for sale on 22 January, 1908. A 14 year lease was acquired by Thomas Farmer of Diamantina via Gladstone on 29 April, 1908. Farmer is believed to have lived on the Island until his death in 1916.

Leases become more frequent from this point, most likely the result of severe lantana infestation experienced on the Island. The lease transferred to Mortimer Moore Mackellar of Casuarina Island



Bajool on 12 February 1917 and subsequently to Otto Christensen of nearby Iveragh on 20 August 1917. Christensen's lease was transferred to John James Athelstanes Murray on 15 November 1920. Murray extinguished his lease on the 6 January 1922, but acquired a new lease almost immediately. This is most likely a renegotiation of his lease conditions due to the hardships related to lantana infestation. Murray died in 1931/32 and his estate was passed to his son's Matthew John Murray and Valentine James Murray who continued the pastoral lease with beef cattle for several decades until Mr. Colin Ross Graving acquired the lease in 1961.

More recent leaseholders included Alexander and Ruth Neilson who took over the lease from Graving on 13 November 1970. The Neilson's were succeeded by Allan and Daphne Pedwell on 6 February 1974, Bunny Holdings P/L from 8 March 1982 and Walsteam P/L from 11 December 1985. Hummock Hill Island P/L was the new leaseholder for the Island, purchasing the lease from Walsteam in 1991. Conversion of the pastoral lease to special lease was undertaken in November 1991.

Day to day life on the Island

Early leaseholders appear to have used the Island for grazing of cattle, but do not appear to have lived there permanently. Correspondence from leaseholder Henry Missing during the 1880s is drafted on letterhead from a station 'Goochy' via Maryborough.

There is no mention of a residence on the Island in the 1891 valuation however a similar valuation of the Island in 1917 identifies a substantial 6 room cottage, (32 x 27 foot) with verandahs all around, detached kitchen and bathroom under. This design describes a dwelling most likely to be built during the 1880s or 1890s, suggesting the likelihood of Worthington as the leaseholder responsible for its construction.

This original homestead is believed to have been moved from Hummock Hill Island to Middle Island and possibly later to Gladstone in the 1930s or 1940s. The house site is believed to have been located within the vicinity of the date palm and mango trees surviving to the east of the existing homestead. A causeway was constructed at the narrowest point of the estuary that divides the Island from the mainland and is possibly mentioned as early as 1886. Either way, site inspection revealed that improvements or alterations have most likely occurred to it over several decades.

The 1891 survey describes the 6 sq. mile lease as having "3. Sq. miles of sloping ridges lightly timbered with ironbark and thickly grassed, approx. 2 sq. miles of level sandy country, tea tree swamps and box and tea tree forest. The remainder mangrove swamps and mudflats." Lack of a reliable supply of water is a constant problem. The survey describes "no natural occurring water, but water can be stored at various places at a very reasonable cost...and a small tank which holds water for about 3 months." The run is therefore "only fit for fattening bullocks as cows and calves cannot be crossed in the event of the water failing as the water on the crossing is too deep."

A Men's hut and stalls for shearing, milking yards and calf pens, 2 dams, 2 wells and significant fences are also described in the 1917 valuation, suggesting a change in pastoral use of the Island to include sheep and dairy, possibly the result of a more reliable water supply and the possible introduction to the causeway at an earlier point.

Later leaseholders seem to focus to beef cattle once again on the Island. Figures from the 1920s and 1930s show that the Murray's kept an average of 450 head of cattle and 20 horses. This included pastoral activities on other property leases as well, of which approximately 200 head are shown to reside on the Island. The Murray's hired several Aboriginal people of Gurang descent as stockmen and domestic servants, including Mabel and Jim Williams, who lived on the Island with their family during this period.

The 1993 survey of the Island conducted by Mabel and Jim's son, Cedric Alfredson discusses possible remnants of a flying fox in the homestead location, believed to have been used to carry milk to the foreshore for daily collection by boat.

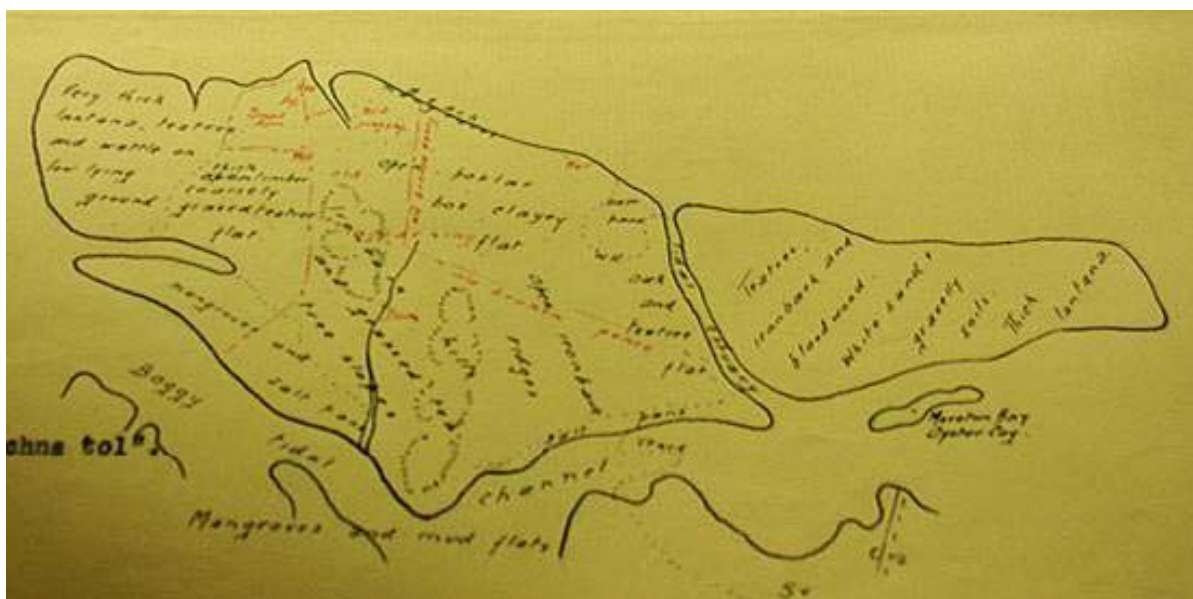


Figure 13.4 – Lantana infestation on Hummock Hill Island (showing also existing vegetation) 1937

Lantana infestation

Probably the greatest effect on the Island and its landscape was lantana infestation. First reported in 1905, by 1917 the situation threatened the viability of pastoral lease on the Island.

Correspondence from the Rockhampton District Land Office Rockhampton in March, 1917 states that "If left unchecked, the Island will become impenetrable in a few years."

The Queensland Government released trial flies introduced from Honolulu onto the Island in 1917, in an attempt to eradicate the lantana. This trial was conducted in conjunction with additional conditions imposed on the leaseholders to clear large areas of land on the Island and keep them clear. Application to ring bark 2000 acres of gum and Moreton Bay Ash at the north of the Island was administered in 1917. Later records reveal clearing of at least 600 acres of this application was completed within the study area in a short period soon after.



The eradication of lantana was rapid. A report from the Land Agent in December, 1921 reveals the “Lantana flies making good progress” with large areas of land clear of all vegetation across the Island. It is assumed that lantana infestation improved from this time and included clearing of much of the remaining native vegetation from the Island. Field survey in 2007 revealed no infestation of lantana.

The Island in more recent times

Personal communications with former leaseholder Daphne Pedwell during this study confirmed the following aspects of her family’s time on the Island in the early 1970s.



Figure 13.5 – Looking north to Hummock Hill – approximately 1973



Figure 13.6 – Daphne Pedwell at Homestead complex gates – approximately 1973

The Pedwell’s ran approximately 500 cattle and 10 horses and also had 2 trucks, 1 Land Rover, two tractors, a radio telephone, two of generators, a kerosene deep freeze, a gas stove, gas fridge and $\frac{3}{4}$ of a 44 gallon drum on the roof for heating water on the Island. The cattle were beef cattle which were mustered by Allan Pedwell and several friends once a year over 3 days. The cattle were crossed to and from the Island via the causeway at low tide. The Pedwell’s marked the center edge

of the causeway with two metal posts, so as not to risk going over the edge when crossing by vehicle.

Water supply consisted of seven dams and Daphne recalls Dam 1 (Figure 13.12) to be spring fed. Dam 4 was the largest Dam and included a hut nearby when the Pedwell's arrived. There were also two windmills on the Island which were regularly used to pump for water. Discussions with Daphne confirm that the water often ran dry during this time.

At the homestead site, Daphne and her family lived what was known as the purple house which was there when they arrived. Nearby was a small green shack and a large tin shed, which housed the generator. Daphne recalls a cement foundation with four wooden stumps existing near the green house. The purple house burnt down following the Pedwell's departure from the Island. Daphne's daughter used to bring supplies to the Island once a week from Gladstone, where she worked as a Police Officer.

Daphne recalls that the majority of the Island was cleared at the time, with the exception of pandanas trees and mangroves surrounding the foreshore areas. The Pedwells fished off the rocks on the Island and often took a 'tinny' across to Seal Rocks for shell collecting and oysters. Daphne also remembers barramundi, cod, sharks, dugongs and turtles which laid eggs on beach. The Pedwell's built a protected bay pool enclosure in the ocean near the homestead with wooden posts and wire mesh driven into the ocean at low tide.



Figure 13.7 – The Pedwell residence – approximately 1973



Figure 13.8 – Looking north toward the homestead - approximately 1973

Daphne also described an old man, nicknamed ‘Robinson Crusoe’, living at the eastern end of the Island. He was there when the Pedwell’s arrived and remained after they left. He did not wear clothes and built himself a decent size dwelling, consisting of three large rooms and a couple of water tanks. The Island was found to be uninhabited during the field survey in 2007.



Figure 13.9 – Beach enclosure constructed by the Pedwells approximately 1973.



Figure 13.10 – Looking east from Pedwell residence approximately 1973.

Residential development

Bunny Industries first explored the possibility of residential development on the Island and did some exploration for water on the Island and constructed the airstrip in the final six months of the Pedwell’s lease. Plans for residential development have continued from this time, with the current application by Eaton Place Pty Ltd to include an integrated tourist and residential development with a golf course and access roads (refer to Section 3 for further information).

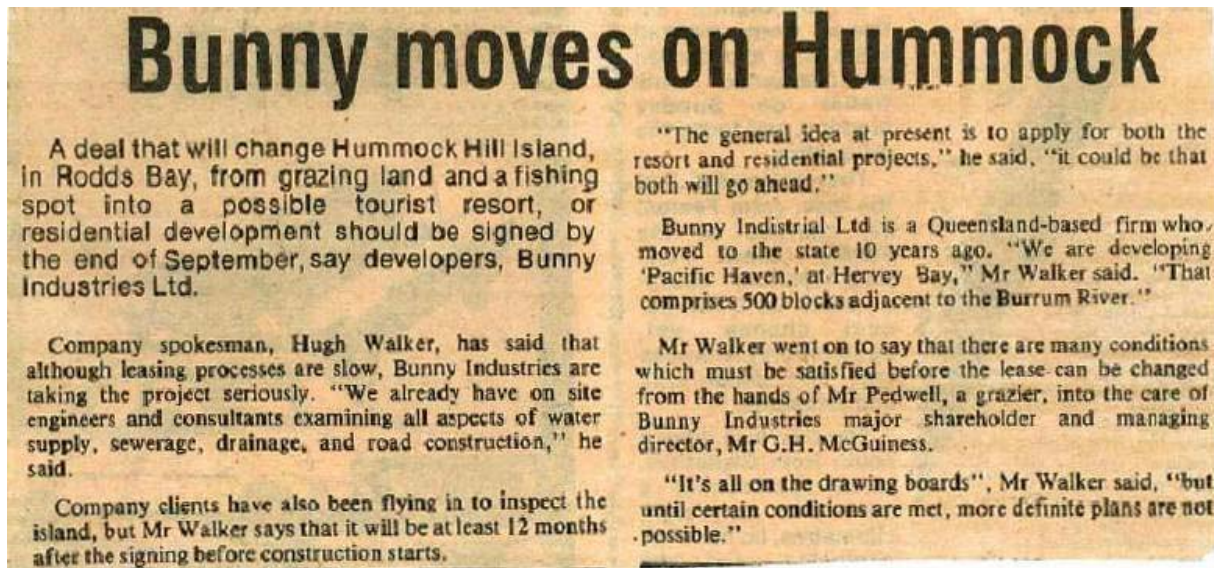


Figure 13.11 – Local Newspaper article (publisher unknown – approximately 1974)

13.1.2.2 Relevant recorded heritage sites

On-line searches of the Register of the National and Commonwealth Heritage Registers, Register of the National Estate and the Queensland Heritage Register web sites were conducted to identify places and sites of cultural heritage significance that may be impacted upon by the proposed development plans.

The National and Commonwealth Register and the Register of the National Estate is compiled by the Australian Heritage Council and is an inventory of Australia's natural and cultural heritage places that are worth conserving for the future. The Queensland Heritage Register is maintained by the Cultural Heritage Branch of the Environmental Protection Agency (EPA), with the aim of protecting historic cultural heritage for future generations. All places, trees, natural formations and buildings of historic (non-Indigenous) cultural heritage significance listed on the register are protected under the *Queensland Heritage Act 1992*.

These searches revealed no sites of historic significance have been recorded in these databases within the study area.

13.1.2.3 Identified sites and places relevant to the study area

The following sites and places were identified during the field survey component of this study. Levels of significance are discussed in Section 13.3, including particular discussion relating to sites and places directly affected by the proposed project.

- Site 1 – Homestead Complex, Cattle Dip and Yards
Location: Northern, central headland overlooking ocean. Northern extent of granodiorite ridge running roughly north south through the Island.
- Site 2 – Historic Trig Point



Location: Summit of Hummock Hill.

- Site 3 – Historical Survey Tree (blazed tree)

Location: A blazed survey tree was located adjacent to the main access track from the causeway to the main homestead site at its junction with two other tracks.

- Site 4 – Causeway
- Site 5 – Airfield

Location: Running approximately east west for 200 m from the centre point.

- Site 6 – Various Dams
- Site 7 – Unknown Stone Arrangement

Location: Elevated headland overlooking ocean to north and west in the vicinity of beach shack (original homestead area).

13.1.2.4 Interpretation of Data

The field survey has identified seven sites and places of cultural heritage significance within Hummock Hill Island, affected by the proposed project. Five of these sites or places are affected by the project and are outlined in Table 13.2.

Table 13.2 – Historic sites impacted by the project

Impact type (likely)	Impacted site/s or places
Direct impact	Site 1, 3, 4, 5, 6*
Indirect impact	Site 2, 6*
Unknown	Site 7.

* Site 6 – Direct impact relates to dam 1, 2, 3, 4, and 5. Indirect impact relates to dam 6, 7.

Figure 13.12 illustrates the relationship between relevant sites and the proposed development. Direct impact on these sites and places of potential cultural heritage significance by the project will generally be in the nature of surface and sub-surface excavation, clearing of vegetation, ground preparation and other associated activities related with residential development. Indirect impacts will occur in adjoining areas of the site from the introduction of additional population onto the Island and increased human interaction by the general nature of the project.

Importantly, several sites identified in the 1993 survey which are considered to be of significance were unable to be located during this study due to poor levels of ground surface visibility (GSV). These include the original homestead site and flying fox remnants, which are assumed to be located within the homestead complex area (site 1).



Figure 13.12 – Historic sites impacted by the project

This report also suggests that there is some potential for further historic items to exist within the study area as GSV did not allow for a comprehensive survey of this area during the field survey. Detailed discussion relating to impact on items and potential items of cultural heritage significance by the project will be discussed in the Section 13.4.

13.2 Impacts and Significance

13.2.1 Indigenous Cultural Heritage Impacts

Areas and sites of cultural heritage significance occur within the proposed development footprint as shown in Figure 13.2, these areas include:

- Sand ridges, swales and the associated stream and riparian vine thicket located on the northern boundary of the project area east of the headland;
- Beach ridges, swales and associated creeks and wetlands west and southwest of the headland;
- The foreshore and associated eroded/remnant beach ridges and adjacent areas of elevated land on granodiorite deposits located on the southern, central section of the Island; and
- Elevated areas surrounding two dammed creek systems still retaining fresh water.

Initial vegetation clearing and earthworks can disturb or destroy sites considered to be of indigenous cultural heritage significance. Vegetation clearing can disturb and destroy vegetation considered to be of significance, such as vegetation in the relict beach ridge system to the southwest of the northern headland. It is noted that these areas are given a medium level of significance and also take in the existing erosion prone areas behind the Northern Beach. This area is proposed to include riparian eco-home sites and beachfront holiday homes and will require mitigation as recommended in Section 13.4.1.

Ground disturbance from initial earthmoving activities will be an issue around the northern headland and southern sections of the proposed development that contain areas of high cultural



heritage significance as shown in Figure 13.2. These areas include shell middens within the northern abutment of the proposed bridge, headland holiday homes, town centre and resort village townhouses. It is noted that outside the immediate bridge area high value sites next to the shoreline are outside the development footprint, being within the 100 m buffer zone. Areas within the headland zone and bridge footprint will require mitigation measures in accordance with Section 13.4.1.

13.2.2 Non-Indigenous Cultural Heritage Impacts

The Cultural Heritage Survey Report (ARCAHEO, 2007) completed for the project has provided the following discussion relating to non-Indigenous cultural heritage significance.

13.2.2.1 Aesthetic Value

Existing in what has remained a relatively remote and picturesque coastal Island, Hummock Hill Island presents aesthetic qualities related to an undeveloped Island environment, including, but not limited to:

- A series of impressive sandy beaches and dunes approximately 13km in length to the east of the Island;
- Substantial views from various locations on the Island to the mainland and Pacific Ocean;
- Mount Hummock is a significant local landmark;
- A series of tidal estuaries, mud flats and mangrove areas;
- A series of natural and man made dams and watercourses on the Island.

Taking these aspects into consideration, Hummock Hill Island is considered by this report to have moderate levels of aesthetic value to the local area and shire.

13.2.2.2 Historic Value

Comparative to other outlying mainland and Island settlements in Queensland, pursuits on Hummock Hill Island since the 1870s has seen the historical aspects of the Island form, not only as a venue for pastoral pursuits, but in many cases the habitation of the Island by the Leaseholders' and their families. With the development of many surrounding Islands into residential areas in more recent times examples of comparatively undeveloped Islands are considered rare in today's climate.

Isolated in many respects from outside contact and services, settlement on the Island for former leaseholders presented many challenges, including the lack of a reliable water supply, access to the mainland and infestation of lantana, each presenting significant hardship and requiring a suitable response. Although limited amounts of the early fabric of the leaseholders remain, their endeavours are an important component of the Island and local areas history. Additionally, the site was an important part of the trials for the introduced Honolulu fly in the fight to eradicate lantana.

In conclusion, Hummock Hill Island is considered by this report to have moderate levels of historic value to local area and shire. Although limited, surviving elements, most especially the causeway, remnant plantings from the original homestead complex such as date palms, cabbage palms and



mango trees and other surviving remnants such as the flying fox spike (not located in this survey) remain as important reminders of the historic pursuits.

13.2.2.3 Scientific Value

Although the site of State Government experiment for the introduced Honolulu Fly to eradicate lantana infestation in 1917, no known evidence of this scientific experiment remain, although one could argue that there is some potential to draw conclusion from the state of the current environment on the Island related to lantana. Additionally, few elements of the place, with the exception of the causeway and flying fox, display any level of technical flare and ingenuity unusual for their time. Hummock Hill is therefore considered by this report to have low levels of scientific value to the local area and shire.

13.2.2.4 Social Value

From its first lease holding in 1877, Hummock Hill Island has no doubt had a direct effect on the social environment of the small number of lessees, their families and associated workers and families on the Island. Participation by the broader local community has been limited. Although Hummock Hill Island contains high levels of social significance to the former lessees and residents of the Island, this report concludes that Hummock Hill Island provides a low to moderate level of social significance to the local area and shire.

13.2.3 Statement of Non-Indigenous Heritage Significance

The following statement of significance has been provided to reflect the sites status within the current legislative frameworks existing today. Hummock Hill Island is significant because:

- Representing the pastoral lease and associated activities on the Island since the 1870s, including the many challenges and challenges and activities associated with remote Island life and pastoral pursuits from this time. The Island was also part of the trials for the introduced Honolulu fly in the fight to eradicate lantana on the Island. *Hummock Hill Island is important in demonstrating the evolution or pattern of the local areas history;*
- Surviving as a relatively remote and picturesque costal Island, Hummock Hill Island presents many aesthetic qualities related to a relatively undeveloped Island environment. *Hummock Hill Island is important to the local community for its aesthetic qualities;*
- Engaged in pastoral activities since the 1870s, including Gurang people. *Hummock Hill Island has a strong association with former lessees, employees and their families, and is important to the local community for social and cultural reasons;*
- Surviving as a picturesque and secluded coastal Island of relatively natural environment, the place demonstrates rare, uncommon or endangered aspects of the local areas cultural heritage.

Hummock Hill Island has been assessed by the Cultural Heritage Survey Report (ARCHAEO 2007) to have the levels cultural heritage significance as outlined in Table 13.3.



Table 13.3 – Summary of cultural heritage significance for Hummock Hill Island.

Value	Rating	Justification	Suggested Legislative Status
Aesthetic	Moderate	Existing in what has remained a remote and picturesque coastal Island, Hummock Hill Island presents aesthetic qualities related to a relatively natural and somewhat secluded Island environment.	Satisfies criteria for listing on the Local Heritage Register (currently unlisted); Does not satisfy criteria for listing on the State or National Heritage Register (currently unlisted).
Historic	Moderate	Representing the pastoral lease and settlement activities on the Island since the 1870s, including the many challenges and challenges and activities associated with remote Island life and pastoral pursuits from this time. The site was an important part of the trials for the introduced Honolulu fly in the fight to eradicate lantana.	Satisfies criteria for listing on the Local Heritage Register (currently unlisted); Does not satisfy criteria for listing on the State or National Heritage Register (currently unlisted).
Scientific	Little	With the exception of the causeway and potentially aspects of flying fox (not located in this study), the Island is considered to demonstrate little scientific value.	Does not satisfy criteria for listing on the Local, State or National Heritage Register (currently unlisted).
Social	Little -Moderate	From its first lease holding in 1877, Hummock Hill Island has no doubt had a direct effect on the social environment of the small number of lessees, their families and associated workers on the Island. Participation by the local community has been less involved.	May satisfy criteria for listing on the Local Heritage Register (currently unlisted); Does not satisfy criteria for listing on the State or National Heritage Register (currently unlisted).

13.3 Levels of Cultural Heritage Significance Relevant to the Project

Alongside the Significance Assessment provided for the nature of the whole Island in the previous section, it is important to look at the individual sites and places directly impacted by the project. These significance ratings for individual sites and places provide the final layer of assessment and allow informed decisions regarding management of potential impact by the project in the following sections.

This section attributes individual significance ratings for the individual sites and places identified in Table 13.2, which are directly affected by the project. Assessment of these sites and places is completed using information gathered during background research, field survey and other relevant information, along with significance assessment frameworks. Table 13.4 outlines the levels of significance attributable to the abovementioned sites.



Table 13.4 – Significance ratings for individual sites and places directly affected by the project.

	Description of site or place	Individual Significance Rating
1	Former Homestead complex, (including, palms and mango trees).	Moderate
2	Trig point	Little
3	Blazed tree	Moderate
4	Causeway	Moderate
5	Airstrip	Little
6	Dams * Dam 1 is also discussed within the context of the Homestead complex and is therefore attributed with a moderate level of significance.	Little - Moderate*
7	Stone arrangement * It is unclear whether the stone arrangement is Indigenous or historic at this point and therefore rated accordingly.	Moderate-High*

There were several sites identified in the 1993 survey by Alfredson which were considered to be of significance at the time but were unable to be located during this survey due to poor levels of GSV, especially the location of the original homestead site and flying fox remnants. This report suggests that there is some potential for further historic items to exist within the study area as ground surface visibility (GSV) did not allow for a comprehensive survey of this area during the field survey. Detailed discussion relating to impact on items and potential items of cultural heritage significance by the project will be discussed in the Section 13.4.

13.4 Impact Mitigation and Recommendations

13.4.1 Indigenous Cultural Heritage Mitigation

Management options for impacted sites identified in Table 13.1 and Section 13.1.1.3 and values vary according to the level of impact and the ability of the proponent to adjust proposed works to avoid heritage sites. In general, site avoidance is the best management option for avoiding impact to significant Aboriginal heritage values. Site avoidance should always be considered in the first instance. A consistent system of site monitoring by the Aboriginal community should be developed and implemented at the planning stages for works in all areas deemed sensitive for heritage values.

Construction works that impact directly on dense artefact scatters or midden material, or areas suspected to contain significant sub-surface archaeological deposits, can generally be mitigated through a program of test excavations followed, if necessary, by full-scale excavation. Artefacts removed from a site are analysed, and an artefact handling and a curatorial agreement negotiated between the Aboriginal community and the Queensland Museum. Mitigation works should be planned and implemented by the Aboriginal groups with technical input from an archaeologist.

Although it is suspected that tangible aspects of the Aboriginal values can be mitigated through the collection of artefacts or archaeological excavation, it is possible that intangible aspects - such as site setting - may require the avoidance of an area.



13.4.1.1 Vegetation Impact Mitigation

Due to the significance of some vegetation located within the study area diligence should be practiced during any clearing or construction phases associated with future development of the site. This diligence should include minimising areas to be impacted on by the project by utilising existing cleared areas for activities such as stockpiling and establishment of ancillary works areas as well as repairing any environmental damage directly resulting from activities associated with the project.

13.4.1.2 Earthworks Impact Mitigation

Due to the medium to high potential for archaeological sites to remain within sections of the project area, work crews will be specifically instructed of their obligations to look for cultural heritage material, including handing out educational leaflets at Workplace Health and Safety meetings. These leaflets should inform the workers what archaeological material may look like, and give them clear instructions on what to do if they find anything.

An earthworks monitoring program will be developed as part of the Construction EMP and will involve representatives of the participating Traditional Owners during initial vegetation removal and grubbing activities in nominated areas to a recommended depth of 30 cm. These areas incorporate respectively:

- A 250 metre wide strip extending inland from the lease boundary inclusive of and located both east and west of the headland (Area 1);
- A 100 metre wide strip extending inland from that area of the development incorporating the high-water mark situated adjacent to tidal flats located southwest of the headland (Area 2);
- The entire area to be developed in the immediate vicinity of the causeway (Area 3);
- A 100 metre wide strip extending inland from the lease boundary and incorporating the lower reaches of the headland/ridgeline located to the west of the causeway and incorporating that area immediately south of the dammed watercourse identified in Figure 13.2(Area 4);
- A 100 metre wide section of the development area incorporating elevated land immediately north of the dammed watercourse (Area 5); and
- A 100 metre wide strip extending inland from that area of the proposed golf course incorporating the high-water mark situated adjacent to tidal flats located northwest of the causeway.

13.4.1.3 Exclusion Zones

Exclusion zones will be established for the following sites both during and following construction activities:

- All sites noted in Appendix A7.10 that are situated outside the immediate development area [HH05 - HH07 and HH10-12, HH16 and sections of HH13]. This mitigation action is particularly relevant in relation to the design and construction of any planned beach access in the vicinity of Sites HH07, HH10 and sections of HH13 are at particular risk of impacts from increased visitation;



- Stone arrangements located at sites HH03 (S04) and HH09 (S12A-D). While it is understood that no development is planned for the immediate area containing HH09, impacts of HH03 may be unavoidable. If impact on HH03 cannot be avoided it is recommended that a more detailed archaeological investigation and recording of the feature be undertaken prior to any disturbance to determine the significance and/or origins of the feature;
- Site HH04, which has been noted as having particular significance to the Traditional Owners, will require further consultation in relation to the form and dimensions of a permanent exclusion zone; and
- In the case of HH04 (S05) it has been requested by the Traditional Owners that this object remain in its present location and that protection of this object be incorporated into the project design process. Details of these processes should be specifically addressed in the CHMP agreement required for the project.

These exclusion zones will vary in form and dimensions according to each site but should initially incorporate a minimum buffer zone of 20 metres in width extending out from the outer perimeter of each site e.g. in the case of isolated artefacts an exclusion zone with a radius of 20 metres would be appropriate. These exclusion zones should be clearly marked and cordoned-off throughout the construction phase of the project.

Traditional Owners will be consulted regarding the exact type, specifications and location of exclusion zones and have particularly emphasised the importance of this consultation process in relation to Sites HH03, HH05, HH06, HH07, HH09, HH10 and HH13. The way in which this consultation process is undertaken with the Traditional Owners is specifically addressed in the CHMP or agreement required for the project.

All artefacts located during the survey within the confines of the project area, excluding Site HH04, be collected by nominated representatives of the Traditional Owners prior to the commencement of the project. These include HH01, HH02, HH08, HH13 (S18) and HH17.

13.4.1.4 Ongoing Consultation

Management is dependent on consultation occurring between all stakeholders enabling each to gain an understanding of the relevant issues. A Cultural Heritage Management Plan (CHMP) or agreement is the most effective way of managing cultural heritage issues and of disseminating relevant information amongst the various stakeholders. A Cultural Heritage Management Plan (CHMP) has been developed for the project and accepted by DNRW (refer to Appendix A7.10). Incorporation of the above mitigation measures in accordance with the CHMP will effectively manage potential impacts to cultural heritage sites within the proposed development.

13.4.2 Non-Indigenous Cultural Heritage Mitigation

Specific mitigation measures are provided to manage identified areas impacted by the proposed project, along with general mitigation measures for potential impact on unknown sites within the study area.



13.4.2.1 Homestead complex values

Archaeo suggests detailed mapping and photographic recording of all remaining historic features located within the homestead complex (i.e. the headland) should be undertaken prior to the commencement of development.

It is also recommended that where possible historic plantings be preserved and incorporated as a design feature of the new development, in particular several date and cabbage palms located behind the tin sheds to the southeast of the fibro shack on the northern headland.

Opportunities also exist for the incorporation of interpretation signage reflecting the history of the Island and the location of the former buildings and infrastructure in this location. These should be appropriately incorporated into the development with the assistance of a suitably qualified heritage professional.

13.4.2.2 Causeway (Site 4)

A new road bridge is proposed within the vicinity of the causeway which will require removal of the majority of causeway. Additionally, environmental reports associated with the proposed project have established issues with tidal flow and estuary health related with the causeway.

This report recommends a strategy be adopted which allows a small and relative component of the causeway crossing to remain in-situ for interpretation. This should be preserved and incorporated as a design and interpretation feature of the new development. At minimum, a small section of the causeway and ramp should remain as a suitable remnant. This report also recommends detailed recording of the causeway be undertaken by a suitably qualified heritage professional prior to the commencement of development in the vicinity.

13.4.2.3 Stone Arrangement (Site 7)

At present it has not been determined when, why and by whom this stone arrangement was constructed. Accordingly it is recommended that impact on this feature be avoided by establishing a small, permanent exclusion zone to ensure protection of this site. If impact cannot be avoided it is recommended that a more detailed archaeological investigation and recording of the feature be undertaken prior to any disturbance to determine the significance and/or origins of the feature. The possibility remains that it may represent Aboriginal cultural heritage and a small possibility that this feature may represent a historic grave and as such should be protected from future development until it is adequately assessed.

13.4.2.4 Unexpected finds as part of the project

This report has found that the study area still retains some potential for historic cultural heritage material to remain in sub-surface deposits, particularly in the vicinity of the Homestead Complex.

Unexpected cultural heritage material or sites may be managed using the following measures:

- All work at the location of the potential find must cease and reasonable efforts to secure the site should be made – a buffer zone of ten metres around the find is suitable.



- Work can continue at the distance of twenty meters from a find area. Note that the material should not be removed or disturbed any further. (Barriers or temporary fences may be erected as a buffer around the find if required).
- The Site Manager should be notified. They will then notify the Historical Archaeologist appointed to the project.
- The Historical Archaeologist will provide a management recommendation to the Site Manager, and will undertake appropriate actions, as outlined in the associated EPA permit.

Additionally, this study recommends that diligence should be practiced during works conducted within the study area, particularly during any clearing or development phases associated with initial preparation of the project area. This diligence should include specifically instructing crews of their obligations to look for cultural heritage material, and handing out educational leaflets at Workplace Health and Safety meetings. These leaflets should inform the workers what archaeological material may look like, and give them clear instructions on what to do if they find anything.

13.4.2.5 Collection and storage of artefacts

Collection and storage of artefacts found during development should be managed by an appropriately qualified cultural heritage professional. At the conclusion of this study, no sites or places have been identified which currently require collection or storage of artefacts.

13.4.2.6 Variation to the assessed development

Due to the nature of the study, variation of the footprint of the proposed development greater than 30 metres within the currently defined project area will require reassessment of the impacted areas.

13.5 Cultural Heritage Conclusions

Areas of indigenous cultural heritage and non-indigenous heritage have been identified within the proposed development footprint, especially construction activities within the northern abutment of the proposed bridge, headland holiday homes and town centre which coincide with area of high indigenous cultural heritage significance.

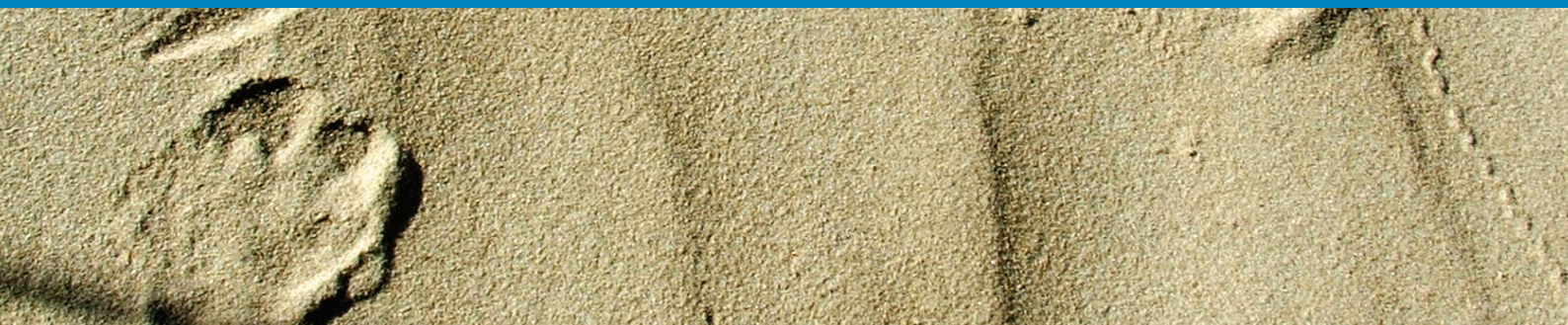
A CHMP has been accepted by Qld DNRW in January 2007. Construction works will be conducted in accordance with the requirements of the CHMP. Incorporation of recommended mitigation and management measures outlined above and in Appendix A7.10 will manage impacts to areas of cultural heritage significance to acceptable levels.

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SECTION 14

NATURE CONSERVATION – TERRESTRIAL





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14. Nature Conservation

14.1 Existing Environment - Terrestrial Flora and Fauna

14.1.1 Methodology

14.1.1.1 Review of Existing Maps and Databases

The following maps and databases were reviewed:

- Plant community conservation status at the regional level is based on the Regional Ecosystem Description Database (EPA 2007). This assessment describes Regional Ecosystems¹ (RE), in context of the South-east Queensland Bioregion² and its Provinces³. A current certified Regional Ecosystem (RE) Map (Version 5.0) produced by Department of Natural Resources and Water (NRW) was reviewed to determine the distribution of Regional Ecosystems (REs) in the locality of the site;
- A list of significant flora species known from the locality was generated from a Queensland Government Herbrecks Database search completed in 2006 for the study area, incorporating a 30km radius of the subject site. A search was also carried out using the Protected Matters Search Tool from the Commonwealth Department of Environment and Water Resources (DEW) website to determine if any listed flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) were likely to occur within 50km of the subject site.
- Queensland Government Wildnet and Commonwealth Department of the Environment and Water Resources (DEW) Database searches were completed in 2006 for an area within a 50 km radius of the subject site.

Field Surveys

AGC Woodward Clyde (1993)

AGC Woodward Clyde completed flora and fauna surveys in 1993. The following methods were employed:

- Diurnal avifauna surveys over four days;
- Elliott trapping at five sites, utilising 25 traps per site for four nights;
- Hair tubes were deployed at each of the five mammal trapping sites;
- Spotlighting was completed for 2.5 hours per night over three nights;
- Recording of frog calls for later identification;
- Searches for scats, tracks and traces of terrestrial fauna.

¹ A vegetation community in a bioregion that is consistently associated with a particular combination of geology, landform and soil (Sattler & Williams 1999).

² The bioregions described by Stanton & Morgan (1977) represent the primary level of biodiversity classification in Queensland.

³ Provinces delineate significant differences within the bioregion in landscape pattern. They are usually associated with geology and geomorphology or finer climatic differences.



Dames and Moore (1995)

Dames and Moore completed supplementary flora and fauna surveys of the Island in December 1994. The study comprised a bird surveys at 54 survey sites, with 10 minutes survey effort expended at each site. Bird surveys at 54 sites, over a total of 540 minutes (9 hours) are considered adequate to have recorded a representative suite of avifauna from the island. When combined with the opportunistic and targeted observations of CQU and SKM, overall search effort for birds must be considered adequate.

Central Queensland University (2006)

Central Queensland University Completed flora and fauna surveys in 2005/2006, involving the following methods:

- Methodology for the flora surveys was based on the Queensland herbarium methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland (EPA 2005). The Island was traversed on foot over a 6 day period between 23rd and 28th May 2005 to describe the vegetation structure and composition;
- Site data was collected as quaternary sites during traverses whenever the vegetation communities changed. Dominant woody species and significant herbaceous species were recorded for each site and the vegetation structure was classified according to Walker and Hopkins (1990) for non-rainforest communities, and Webb (1978) was used for rainforest communities. The site locations were recorded using a Garmin 12XL GPS and additional site data were also noted including locality, landform and soils;
- The vegetation communities recorded were related to the regional ecosystem types depending on the land zone they occurred within, vegetation structure and species present. Only terrestrial plant communities were surveyed. Intertidal and sub tidal communities were not mapped in detail as these are not within the development footprint. The majority of the field effort was focused on the proposed areas of development on the Island, however an effort was made to classify each vegetation community occurring on the Island; and
- A 6 day terrestrial fauna survey was undertaken in conjunction with the flora survey. The survey focused on the likelihood of species of significance occurring on the Island and within the area of proposed development or areas likely to be influenced by the development. This fauna survey involved the search for fauna and signs of fauna such as tracks and traces.

Sinclair Knight Merz (2007)

Sinclair Knight Merz (SKM) completed targeted field surveys in 2007 to review the status of regional ecosystems and a number of threatened species (considered potential occurrences based on database records) on the Island. The methodology included the following:



- Review of current Regional Ecosystem Mapping across the development area. This involved walked traverses of each mapped remnant polygon in the development area, and collection of quaternary data⁴ at 22 sites;
- Elliott trapping to target the Water Mouse in potential habitat at the proposed bridge site to the Island. A single transect of 25 small Elliott traps was established and traps were baited with cat food. Traps were set for four nights, with a total of 100 trap nights;
- Systematic 30min searches for the Black-breasted Button Quail at ten sites in littoral vineforest communities. These search plots comprised active searches over a 50m radius around a central search point;
- Spotlighting for two hours per night over five nights, incorporating approximately 8km of walked or driven transect per night;
- Nocturnal call playback at six sites over five nights for nocturnal birds and mammals including the Powerful Owl, Masked Owl, Barking Owl, Koala, Squirrel glider and Yellow-bellied glider;
- Anabat survey using two Anabat units for five nights per unit, with a total of 10 recording nights at separate 10 sites.
- The Herpetofauna survey methodology was designed to target significant species such as the Yakka Skink (*Egernia rugosa*), as listed under the EPBC Act (1999) and/or NCWR (1994). Survey methodology included physical searches (diurnal) in all habitats for a total of approximately 20 person hours on the subject site; and
- A series of Koala search plots were established. These plots generally coincided with quaternary vegetation plots and involved searches for animals, scats and scratches over a 50m transect, completed by two observers. A total of 26 Koala search plots were completed.

14.1.1.2 Results

Review of Existing Mapping and Databases

Wildnet records revealed that six (6) species considered Endangered, Vulnerable, Rare are known from the search area. Significant species from the Wildnet database are listed in Table 14.1 below.

⁴ Quaternary site data are used primarily as a record of field traverses and to verify regional ecosystem/vegetation mapping. These sites are generally entered on spreadsheets or databases. Quaternary sites may be collected at regular intervals along a traverse, and/or made where REs/vegetation communities change. Quaternary sites are recorded via a proforma.

Table 14.1 – Rare or Threatened Flora and Fauna listed in the HERBRECS/ Wildnet Databases

Group	Scientific Name	Common Name	Status*
Flora	<i>Pratia podenzanae</i>	-	R
	<i>Xylosma ovatum</i>	-	R
	<i>Cupaniopsis shirleyana</i>	Wedge-leaf tuckeroo	V
	<i>Cycas megacarpa</i>	Cycad palm	E
Birds	<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	R
	<i>Esacus neglectus</i>	Beach stone-curlew	V
	<i>Numenius madagascariensis</i>	Eastern curlew	R
Mammals	<i>Xeromys myoides</i>	False Water Rat/Water Mouse	V
	<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V
Reptiles	<i>Caretta caretta</i>	Loggerhead Turtle	E

E, V, R = State (Endangered, Vulnerable, Rare)

Commonwealth Department of the Environment and Water Resources Database records revealed five flora species and ten fauna species considered Endangered or Vulnerable are possible occurrences in the site locality. These species are listed in Table 14.2 below. Migratory and marine species have not been included in this table but are shown in Appendix A3.

Table 14.2 – Significant flora and fauna listed in the DEW database

Group	Scientific Name	Common Name	Status
Flora	<i>Bulbophyllum globuliforme</i>	Miniature moss-orchid	V
	<i>Cupaniopsis shirleyana</i>	Wedge-leaf tuckeroo	V
	<i>Cycas megacarpa</i>	Cycad palm	E
	<i>Germainia capitata</i>	A germainia	V
	<i>Quassia bidwilli</i>	Quassia	V
Birds	<i>Pterodroma neglecta neglecta</i>	Kermadec petrel (western)	V
	<i>Rostratula australis</i>	Australian painted snipe	V
	<i>Erythrotriorchis radiatus</i>	Red goshawk	V
	<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V
	<i>Turnix melanogaster</i>	Black-breasted button-quail	V
Mammals	<i>Dasyurus hallucatus</i>	Northern quoll	E
	<i>Chalinolobus dwyeri</i>	Large-eared pied bat	V
	<i>Xeromys myoides</i>	False water rat/Water Mouse	V
Reptiles	<i>Egerrnia rugosa</i>	Yakka skink	V
	<i>Furina dunmalli</i>	Dunmall's snake	V

V, E = Vulnerable, Endangered



The EPA's Biodiversity Planning Assessment (BPA) for South-east Queensland identifies the majority of Hummock Hill Island as an area of State Significance for biodiversity conservation based on the occurrence of a range of values including:

- Proximity to wetlands;
- The presence of endangered regional ecosystems;
- Presence of habitat of endangered or vulnerable species; and
- Forming a major bioregional corridor.

Field Surveys - Flora

AGC Woodward Clyde 1993

Ecosystem mapping completed by AGC Woodward Clyde (1993) reported nine broad vegetation communities across Hummock Hill Island:

- 1) **Western Sand Dunes (Beach Ridge Eucalypt Open Forest)** – summarised as Eucalypt Open Forest which was dominated by *E. tereticornis*, *E. tessellaris*, *E. intermedia*, to a height of 20 m on beach ridges and Melaleuca forest (*M. quinquenervia*, *M. dealbata*, *M. viridiflora*) in the lower swales;
- 2) **Central Northern Coastal Littoral Vine Scrub** – located south of Tiber Point and consisting of three zones, the beach strandline vegetation, littoral vine scrub behind the frontal dune system (noted to be the most diverse community on the Island) and a discontinuous fresh water swamp that runs along the landward edge of the littoral vine forest and eucalypt open forest occurring adjacent the granodiorite shelf;
- 3) **Granodiorite Substrate Zone** – observed in 1993 studies on the elevated parts of Hummock Hill Island underlain by solodic and skeletal (Lithosols) soils over the granodiorite parent material and noted to consist of five types of Eucalyptus woodland, recognised by the following dominant canopy species:
 - 4) **Ironbark** (*E. crebra/dreponaphylla*) dominated woodland with minor *E. intermedia*;
 - 5) **Poplar Box** (*E. populnea*) dominated woodland with minor *E. tereticornis*, *E. intermedia*, *E. crebra*, *M. viridiflora*, *C. glauca*;
 - 6) **Gum topped Box** (*E. molluccana*);
 - 7) **Silver Leafed Ironbark** (*E. melanophloia*);
 - 8) **Mixed Eucalypt** (*E. intermedia*, *E. trachypholia*, *E. crebra*, *E. dreponaphylla*, *E. tereticornis*, *E. tessellaris*); and
- 9) **Melaleuca Shrubland/Open Forest** – was noted to occur on coastal flats adjacent to the saltpans.

Dames and Moore (1995)

Dames & Moore (1995) expand further on the significance of identified ecosystems from the 1993 EIS, in particular the Poplar Box (*E. Populnea*) and Gum-topped Box (*E. mollucana*) dominated



woodland on the granodiorite substrate zone and the littoral vine forest on the coastal sand dune communities. In relation to these communities, Dames and Moore (1995) state that:

- “Poplar Box is an extremely common species in Queensland and NSW...there is a wide range of Poplar Box communities throughout their area of distribution...the occurrence of *E. populnea* at Shoalwater Bay has provided an opportunity for the species to be conserved...it appears that conservation status is accorded to disjunct occurrences of this species such as this because the formation of communities which are not known to exist elsewhere...there is an argument that similar communities may occur elsewhere as the area between Gladstone and Fraser Island is understudied in terms of botanical survey”.
- “The vegetation communities occurring on Hummock Hill Island which support Gum-topped Box are not considered to have conservation significance in terms of their size or location, or to warrant specific strategies for their preservation as representative Gum-topped Box communities.”
- “The littoral vineforest on the Island does not support any regionally significant species. The conservation status of these vegetation communities is primarily related to the following: they occur in narrow bands along the coastline in the region and therefore do not form a large total area; despite their relatively small total area, they contribute to floral species diversity; and their contribution to coastal stability.”

Dames and Moore (1995) provide an estimation of areas for the main vegetation types, repeated here in Table 14.3.

Table 14.3 – Vegetation Areas (Dames & Moore, 1995)

Vegetation Type	Total Island (Ha)	Lease Area (Ha)
Cleared and/or heavily grazed	66.5	65.5
Littoral Scrub	213.6	93.3
Mosaic of Eucalypt Woodland Forest Types	682	122.4
Saltpan	371.3	54.31
<i>E. populnea</i> , <i>E. teriticornis</i> , <i>E. drepanophylla</i> tall open woodland	62.4	62.4
<i>E. populnea</i> woodland	59.4	59.4
Parallel beach ridge vegetation	477.6	82.4
<i>Allocasaurina</i> / <i>Melaleuca</i> low woodland and low open forest	166.2	75.7
<i>E. teriticornis</i> tall open forest	19.0	19.0
<i>E. mollucana</i> open forest	18.2	18.2
<i>Sporobolus virginicus</i> low grassland	6.6	1.8
<i>P. cayera</i> woodland with emergent <i>E. teriticornis</i> and <i>E. tessellaris</i>	123.9	18.4
<i>Melaleuca</i> open forest	28.5	9.1
Mangroves	407.4	11.9
Strand vegetation	47.8	-



As the vegetation communities described by Dames and Moore do not correspond with contemporary RE descriptions, it is not possible to provide a comparative analysis.

Central Queensland University 2006

Mapping of the Island's Regional Ecosystems (RE) was completed by Central Queensland University (CQU) in 2005. CQU mapped 13 Regional Ecosystems on 4 Land Zones within the lease boundary, these being outlined in Table 14.4. Survey of REs for the Island was based on data collected from 143 sites within the lease area over a 6 day period as shown in Figure 14.1 and based on Qld Herbarium Methodology. Approximately 103 terrestrial plants species were recorded during the CQU study.

Table 14.4 – Regional Ecosystems Mapped on Hummock Hill Island (CQU, 2005)

RE Type	Status	Short Description
Landzone 1 - Tidal flats and beaches		
12.1.1	Of Concern	Casuarina glauca on estuarine deposits
12.1.2	Not of Concern	Sporobolus virginicus on estuarine deposits
12.1.3	Not of Concern	Mangrove shrubland/forest on estuarine deposits
Landzone 2 - Coastal dunes		
12.2.2	Of Concern	Microphyll rainforest on coastal dunes
12.2.7	Not of Concern	Melaleuca quinquenervia open forest on alluvial plains
12.2.11	Not of Concern	Eucalyptus tereticornis dominated forests on sands
12.2.14	Not of Concern	Foredune complexes of Allocasuarina spp. and Spinifex spp.
Landzone 3 - Alluvium		
12.3.3	Endangered	Eucalyptus tereticornis dominated forests on alluvial plains
12.3.6	Not of Concern	Melaleuca spp. dominated woodlands on alluvial plains
12.3.10	Endangered	Eucalyptus populnea dominated forests on alluvial plains
Landzone 12 - Hills and lowlands on granitic rocks		
12.12.7	Not of Concern	Eucalyptus crebra and E. erythrophloia woodland on hills
12.12.8	Of Concern	Eucalyptus melanophloia woodland on hills
12.12.12	Of Concern	Eucalyptus tereticornis and E. crebra dominated forests
12.12.28	Of Concern	Eucalyptus moluccana open forest on alluvial plains

Assessment of Current Regional Ecosystem Map

Floristic data collected by CQU (May, 2005) was used to apply for an update to the lease area 2003 RE map, held by the Department of Natural Resources and Water (DNRW). Significant differences to mapping provided by CQU and final DNRW mapping can be observed. Interpretation of assemblage composition and areal distribution (polygon shape) differs significantly between the two surveys. The map amendment request triggered a field assessment by Qld Herbarium staff.



The confirmatory survey completed by Qld EPA/Herbarium (Joy Brusche) resulted in an amendment to the 2003 vegetation coverage. The current update to 2003 RE mapping is presented in Figure 14.2. REs are listed in Table 14.5.

Field survey (SKM in 2007) found that the current regional ecosystem map held by Qld DNRM is an accurate representation of vegetation patterns across the study area. Although there are minor disparities relating to regional ecosystem extents, the regional ecosystem map is considered to be of sufficient accuracy to be relied upon for planning purposes.

Table 14.5 – Regional Ecosystems Present in the Study Area

Label	Status	Area (Ha)	Short Description
Landzone 1 - Tidal flats and beaches			
12.1.1	Of Concern	7.92	Casuarina glauca on estuarine deposits
12.1.2	Not of Concern	161.73	Sporobolus virginicus on estuarine deposits
12.1.2	Of Concern	2.33	Sporobolus virginicus on estuarine deposits
12.1.1			Casuarina glauca on estuarine deposits
12.1.3			Mangrove shrubland/forest on estuarine deposits
12.1.3	Not of Concern	106.07	Mangrove shrubland/forest on estuarine deposits
Landzone 2 - Coastal Dunes			
12.2.11	Not of Concern	23.47	Eucalyptus tereticornis dominated forests on sands
12.2.11		3.78	Eucalyptus tereticornis dominated forests on sands
12.1.1			Casuarina glauca on estuarine deposits
12.2.11		2.72	Eucalyptus tereticornis dominated forests on sands
12.2.2			Microphyll rainforest on coastal dunes
12.2.14	Not of Concern	9.65	Foredune complexes of Allocasuarina spp. and Spinifex spp.
12.2.2		29.79	Microphyll rainforest on coastal dunes
12.2.11			Eucalyptus tereticornis dominated forests on sands
Landzone 3 - Alluvium			
12.3.10	Endangered	12.07	Eucalyptus populnea dominated forests on alluvial plains
12.3.10		25.09	Eucalyptus populnea dominated forests on alluvial plains
12.3.3			Eucalyptus tereticornis dominated forests on alluvial plains
12.3.3	Endangered	22.44	Eucalyptus tereticornis dominated forests on alluvial plains
12.3.3		16.11	Eucalyptus tereticornis dominated forests on alluvial plains
12.12.12			Eucalyptus tereticornis and E. crebra dominated forests
12.3.6		1.43	Melaleuca spp. dominated woodlands on alluvial plains
12.3.6		7.5	Melaleuca spp. dominated woodlands on alluvial plains
12.1.1			Casuarina glauca on estuarine deposits

Label	Status	Area (Ha)	Short Description
Landzone 12 - Hills and lowlands on granitic rocks			
12.12.12	Of Concern	1.16	Eucalyptus tereticornis and E. crebra dominated forests
12.12.19		0.98	Themeda triandra grassland and wind-sheared shrubland and woodland
12.12.28		28.69	Eucalyptus moluccana open forest on alluvial plains
12.12.7	Not of Concern	79.02	Eucalyptus crebra and E. erythrophloia woodland on hills
12.12.7 12.12.12		19.68	Eucalyptus crebra and E. erythrophloia woodland on hills Eucalyptus tereticornis and E. crebra dominated forests
12.12.7 12.12.12 12.3.3	Of Concern	23.91	Eucalyptus crebra and E. erythrophloia woodland on hills Eucalyptus tereticornis and E. crebra dominated forests Eucalyptus tereticornis dominated forests on alluvial plains
12.12.8	Of Concern	10.58	Eucalyptus melanophloia woodland on hills

Field Surveys - Terrestrial Fauna

Amphibians

A total of five amphibian species has been recorded from the Island by the collective surveys of AGC Woodward-Clyde (1993), Dames and Moore (1995), Bill Carter and Associates (1988), CQU (2005) and SKM (2007) these are listed in Table 14.6. None of the species recorded are considered to be rare or threatened in Queensland or at a National level. A substantial nocturnal survey effort has been expended by numerous observers over an extended period, suggesting that amphibian survey effort has been adequate and that the low diversity of species recorded is indicative of low habitat quality.

Table 14.6 – Amphibians recorded from the study area

Family	Scientific Name	Common Name	EPBC	NCA
Myobatrachidae				
	Limnodynastes peroni	Striped Marsh Frog	N	N
Hylidae				
	Litoria fallax	Eastern Dwarf Tree Frog	N	N
	Litoria gracilenta	Dainty Tree Frog	N	N
	Litoria rubella	Desert Tree Frog	N	N
Bufonidae				
	Bufo marinus	Cane Toad	N	N



LEGEND

- Survey Location
- Development Footprint

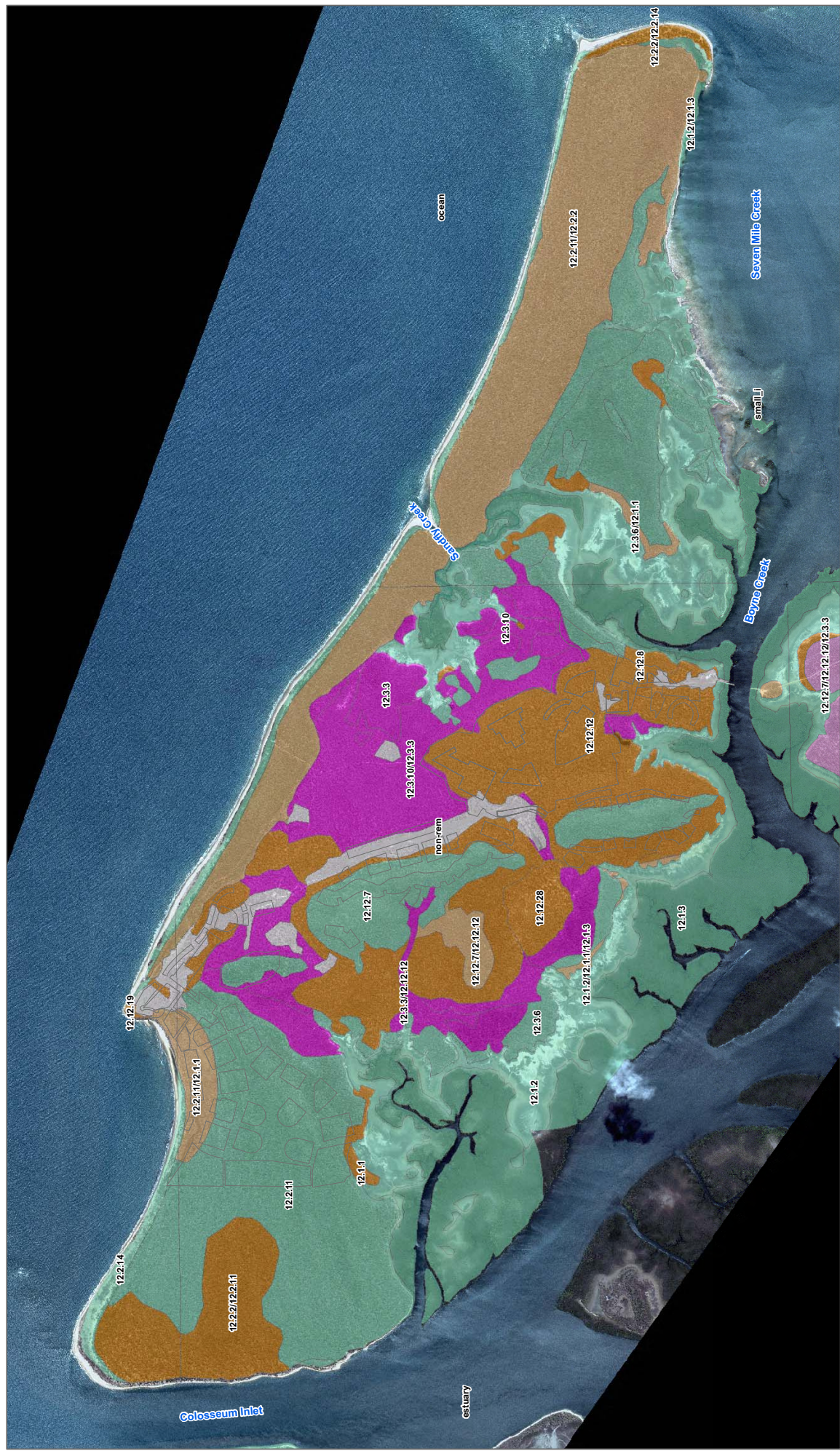
This figure must be read in conjunction with the data disclaimer located at the front of this report. The data acquired for this project is known to be of low spatial resolution and as such no representation or warranties about its accuracy, reliability or suitability are given. Assumptions and conclusions made from this figure and the associated data must be made with full understanding of the data limitations. SHM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data.

0 0.5 1 2
km



Figure 14.1 - Flora and Fauna Survey Locations





Reptiles

A total of fourteen terrestrial reptile species has been recorded from the Island by the collective surveys of AGC Woodward-Clyde (1993), Dames and Moore (1995), Bill Carter and Associates (1993), CQU (2005) and SKM (2007), these are listed in Table 14.7. None of the species recorded are considered to be rare or threatened in Queensland or at a National level.

Table 14.7 – Reptiles recorded from the study area

Family	Scientific Name	Common Name	EPBC	NCA
Scincidae				
	<i>Carlia folorium</i>	No common name	N	N
	<i>Carlia pectoralis</i>	No common name	N	N
	<i>Cryptoblepharus virgatus</i>	Wall Skink	N	N
	<i>Ctenotus robustus</i>	Eastern Striped Skink	N	N
	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	N	N
	<i>Lerista fragilis</i>	Eastern Mulch-slider	N	N
Gekkonidae				
	<i>Gehyra dubia</i>	Tree Dtella	N	N
	<i>Heteronotia bynoei</i>	Bynoe's Gecko	N	N
	<i>Oedura rhombifer</i>	Zigzag Velvet Gecko	N	N
Agamidae				
	<i>Diporiphora australis</i>	Eastern Two-lined Dragon	N	N
	<i>Pogona barbata</i>	Bearded Dragon	N	N
Varanidae				
	<i>Varanus gouldi</i>	Sand Monitor	N	N
Colubridae				
	<i>Denrelaphis punctulata</i>	Common Tree Snake	N	N
Elapidae				
	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	N	N

Birds

One-hundred and twenty-five species of avifauna have been recorded from the Island by the collective surveys of AGC Woodward-Clyde (1993), Dames and Moore (1995), Bill Carter and Associates (1993), CQU (2005) and SKM (2007), these are listed in Table 14.8. Several rare or threatened species have been recorded, namely the Black-breasted Button-quail, Beach Thick-knee and Eastern Curlew.

The diversity of species observed is typical of a coastal habitat mosaic which includes terrestrial and marine ecosystems.

Table 14.8 – Avifauna recorded from the study area

Family	Scientific Name	Common Name	EPBC	NCA
Megapodidae				
	<i>Alectura lathami</i>	Australian Brush-turkey	N	N
Phasianidae				
	<i>Coturnix ypsilophora</i>	Brown Quail	N	N
Turnicidae				
	<i>Turnix melanogaster</i>	Black-breasted Button-quail ⁵	V	V
Anatidae				
	<i>Dendrocygna eytoni</i>	Plumed Whistling-Duck	N	N
	<i>Anas gibberifrons</i>	Grey Teal	N	N
	<i>Cygnus atratus</i>	Black Swan	N	N
	<i>Chenonetta jubata</i>	Australian Wood Duck	N	N
	<i>Anas superciliosa</i>	Pacific Black Duck	N	N
Podicipedidae				
	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	N	N
Anhingidae				
	<i>Anhinga melanogaster</i>	Darter	N	N
Phalacrocoracidae				
	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	N	N
	<i>Phalacrocorax varius</i>	Pied Cormorant	N	N
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	N	N
	<i>Phalacrocorax carbo</i>	Great Cormorant	N	N
Podicipedidae				
	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	N	N
Pelecanidae				
	<i>Pelecanus conspicillatus</i>	Australian Pelican	Ma	N
Ardeidae				
	<i>Egretta novaehollandiae</i>	White-faced Heron	N	N
	<i>Ardea alba</i>	Great Egret	M, Ma	
	<i>Ardea intermedia</i>	Intermediate Egret	Ma	
	<i>Ardea ibis</i>	Cattle Egret	M, Ma	
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron	N	N
Threskiornithidae				
	<i>Threskiornis molucca</i>	Australian White Ibis	Ma	N
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	Ma	N
	<i>Platalea regia</i>	Royal Spoonbill	N	N
Accipitridae				

⁵ The characteristic platelets of a Button-quail have been recorded throughout the Littoral Vineforest community. Based on habitat preferences in the region, these are likely to have been made by *Turnix melanogaster*. Other, more common quail species do not create platelets.

Family	Scientific Name	Common Name	EPBC	NCA
	<i>Accipter cirrhocephalus</i>	Collared Sparrowhawk	N	N
	<i>Accipter fasciatus</i>	Brown Goshawk	N	N
	<i>Aviceda subcristata</i>	Pacific Baza	N	N
	<i>Pandion haliaetus</i>	Osprey	M, Ma	N
	<i>Elanus axillaris</i>	Black-shouldered Kite	N	N
	<i>Haliastur sphenurus</i>	Whistling Kite	Ma	N
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M, Ma	
	<i>Aquila audax</i>	Wedge-tailed Eagle	N	N
Falconidae				
	<i>Falco cenchroides</i>	Nankeen Kestrel	Ma	N
Rallidae				
	<i>Porphyrio porphyrio</i>	Purple Swamphen	Ma	N
	<i>Gallinula tenebrosa</i>	Dusky Moorhen	N	N
	<i>Fulica atra</i>	Eurasian Coot	N	N
Scolopacidae				
	<i>Numenius madagascariensis</i>	Eastern Curlew	M	R
	<i>Numenius phaeopus</i>	Whimbrel	M	N
	<i>Tringa nebularia</i>	Common Greenshank	M	N
	<i>Tringa stagnatilis</i>	Marsh Sandpiper	M	N
	<i>Limosa lapponica</i>	Bar-tailed Godwit	M	N
Jacanidae				
	<i>Irediparra gallinacea</i>	Comb-crested Jacana	N	N
Buhinidae				
	<i>Burhinus neglectus</i>	Beach Thick-knee	V	V
Haematopodidae				
	<i>Haematopus longirostris</i>	Pied Oystercatcher	M	N
	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	M	N
Charadriidae				
	<i>Elseyornis melanops</i>	Black-fronted Dotterel	M	N
	<i>Vanellus miles</i>	Masked Lapwing		
	<i>Charadrius mongolus</i>	Lesser Sand Plover	M	N
	<i>Charadrius leschenaultii</i>	Greater Sand Plover	M	N
	<i>Charadrius ruficapillus</i>	Red-capped Dotterel	M	N
Laridae				
	<i>Sterna caspia</i>	Caspian tern	N	N
	<i>Sterna albifrons</i>	Little tern	N	N
	<i>Sterna bergii</i>	Crested tern	N	N
Columbidae				
	<i>Phaps chalcoptera</i>	Common Bronzewing	N	N
	<i>Ocyphaps lophotes</i>	Crested Pigeon	N	N
	<i>Geopelia striata</i>	Peaceful Dove	N	N
	<i>Geopelia humeralis</i>	Bar-shouldered Dove	N	N

Family	Scientific Name	Common Name	EPBC	NCA
Cacatuidae				
	<i>Calyptrorhynchus banksii</i>	Red-tailed Black-Cockatoo	N	N
	<i>Calyptrorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	N	N
	<i>Cacatua roseicapilla</i>	Galah	N	N
	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	N	N
Psittacidae				
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	N	N
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	N	N
	<i>Glossopsitta pusilla</i>	Little Lorikeet	N	N
	<i>Aprosmictus erythropterus</i>	Red-winged Parrot	N	N
	<i>Platycercus adscitus</i>	Pale-headed Rosella	N	N
Cuculidae				
	<i>Cacomantis variolosus</i>	Brush Cuckoo	N	N
	<i>Cuculus saturatus</i>	Oriental Cuckoo	N	N
	<i>Eudynamys scolopacea</i>	Common Koel	Ma	N
	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	Ma	N
Centropodidae				
	<i>Centropus phasianinus</i>	Pheasant Coucal	N	N
Strigidae				
	<i>Ninox connivens</i>	Barking Owl	N	N
	<i>Ninox novaeseelandiae</i>	Southern Boobook	N	N
Tytonidae				
	<i>Tyto alba</i>	Barn Owl	N	N
Podargidae				
	<i>Podargus strigoides</i>	Tawny Frogmouth	N	N
Caprimulgidae				
	<i>Eurostopodus mystacalis</i>	White-throated Nightjar	Ma	N
Agothelidae				
	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	N	N
Alcedinidae				
	<i>Alcedo azurea</i>	Azure Kingfisher	N	N
Halcyonidae				
	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	N	N
	<i>Todiramphus macleayi</i>	Forest Kingfisher	Ma	N
	<i>Halcyon chloris</i>	Collared Kingfisher	N	N
Meropidae				
	<i>Merops ornatus</i>	Rainbow Bee-eater	M	N
Coraciidae				
	<i>Eurystomus orientalis</i>	Dollarbird	Ma	N
Maluridae				
	<i>Malurus lamberti</i>	Variegated Fairy-wren	N	N
	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	N	N

Family	Scientific Name	Common Name	EPBC	NCA
Pardalotidae				
	<i>Pardalotus punctatus</i>	Spotted Pardalote	N	N
	<i>Pardalotus striatus</i>	Striated Pardalote	N	N
	<i>Gerygone laevigaster</i>	Mangrove Gerygone	N	N
	<i>Gerygone olivacea</i>	White-throated Gerygone	N	N
	<i>Gerygone palpebrosa</i>	Fairy Gerygone	N	N
	<i>Smicrornis brevirostris</i>	Weebill	N	N
Meliphagidae				
	<i>Philemon citreogularis</i>	Little Friarbird	N	N
	<i>Philemon corniculatus</i>	Noisy Friarbird	N	N
	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	N	N
	<i>Manorina melanocephala</i>	Noisy Miner	N	N
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	N	N
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	N	N
	<i>Lichenostomus fscigularis</i>	Mangrove Honeyeater	N	N
	<i>Melithreptus albogularis</i>	White-throated Honeyeater	N	N
	<i>Lichmera indistincta</i>	Brown Honeyeater	N	N
	<i>Myzomela obscura</i>	Dusky Honeyeater	N	N
Pomatostomidae				
	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	N	N
Pachycephalidae				
	<i>Pachycephala pectoralis</i>	Golden Whistler	N	N
	<i>Pachycephala rufiventris</i>	Rufous Whistler	N	N
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	N	N
	<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	N	N
Dicruridae				
	<i>Monarcha leucotis</i>	White-eared Monarch	N	N
	<i>Monarcha melanopsis</i>	Black-faced Monarch	Ma	N
	<i>Myiagra rubecula</i>	Leaden Flycatcher	N	N
	<i>Grallina cyanoleuca</i>	Magpie-lark	Ma	N
	<i>Rhipidura rufifrons</i>	Rufous Fantail	Ma	N
	<i>Rhipidura leucophrys</i>	Willie Wagtail	N	N
	<i>Dicrurus bracteatus</i>	Spangled Drongo	Ma	N
Campephagidae				
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	Ma	N
	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	Ma	N
	<i>Coracina tenuirostris</i>	Cicadabird	Ma	N
	<i>Lalage leucomela</i>	Varied Triller	N	N
Oriolidae				
	<i>Oriolus sagittatus</i>	Olive-backed Oriole	N	N
	<i>Sphecotheres viridis</i>	Figbird	N	N
Artamidae				

Family	Scientific Name	Common Name	EPBC	NCA
	Artamus leucorhynchus	White-breasted Woodswallow	N	N
	Cracticus torquatus	Grey Butcherbird	N	N
	Cracticus nigrogularis	Pied Butcherbird	N	N
	Gymnorhina tibicen	Australian Magpie	N	N
Corvidae				
	Corvus orru	Torresian Crow	N	N
Corcoracidae				
	Corcorax melanorhamphos	White-winged Chough	N	N
Passeridae				
	Taeniopygia bichenovii	Double-barred Finch	N	N
	Neochmia temporalis	Red-browed Finch	N	N
Dicaeidae				
	Dicaeum hirundinaceum	Mistletoebird	N	N
Hirundinidae				
	Hirundapus caudacutus	Spine-tailed swift	M	N
	Hirundo neoxena	Welcome Swallow	Ma	
	Hirundo ariel	Fairy Martin	N	N
Motacillidae				
	Anthus novaeseelandiae	Richard's Pipit	N	N
Sylviidae				
	Megalurus timoriensis	Tawny Grassbird	N	N
	Cisticola exilis	Golden-headed Cisticola	N	N
Zosteropidae				
	Zosterops lateralis	Silvereye	Ma	N

N = Not Listed

Ma = Marine

M = Migratory

V = Vulnerable

Mammals

Thirty-three species of mammal have been recorded from the Island by the collective surveys of AGC Woodward-Clyde (1993), Dames and Moore (1995), Bill Carter and Associates (1993), CQU (2005) and SKM (2007), these are listed in Table 14.9. The species assemblage observed is typical of coastal habitats in the region.

A single threatened species has been recorded, namely the Grey-headed Flying Fox which is considered Vulnerable under the EPBC Act. This species was observed foraging on the island, but no roosts of this or other bats (Flying fox or Microbat) species were observed.

Flying fox camps may be established and may have occurred on the Island over time, however, the proposed development will not intrude into the preferred wetland/riparian roost sites of these species and as such poses no current or future threat to the viability of flying fox camps.

Table 14.9 – Mammals recorded from the study area

Family	Scientific Name	Common Name	EPBC	NCA
Tachyglossidae				
	Tachyglossus aculeatus	Echidna	N	N
Peramelidae				
	Isoodon macrourus	Northern Brown Bandicoot	N	N
Phalangeridae				
	Trichosurus vulpecula	Common Brushtail Possum	N	N
Petauridae				
	Petaurus breviceps	Sugar Glider	N	N
	Petaurus norfolcensis	Squirrel Glider	N	N
Pseudocheiridae				
	Petauroides volans	Greater Glider	N	N
	Pseudocheirus peregrinus	Common Ringtail Possum	N	N
Macropodidae				
	Macropus giganteus	Eastern Grey Kangaroo	N	N
	Macropus parryi	Whiptail Wallaby	N	N
	Wallabia bicolor	Swamp Wallaby	N	N
Pteropidae				
	Nyctimene robinsoni	Eastern Tube-nosed Bat	N	N
	Pteropus poliocephalus	Grey-headed Flying Fox	V	
	Pteropus scapulatus	Little Red Flying Fox	N	N
Rhinolophidae				
	Rhinolophous megaphyllus	Eastern Horseshoe Bat	N	N
Molossidae				
	Saccolaimus flaviventris	Yellow-bellied Sheath-tail Bat	N	N
	Tadarida australis	White-striped Mastiff Bat	N	N
Vespertilionidae				
	Chalinolobus gouldi	Gould's Wattled Bat	N	N
	Chalinolobus morio	Chocolate Wattled Bat	N	N
	Chalinolobus nigrogriseus	Hoary Wattled Bat	N	N
	Miniopterus australis	Little Bentwing Bat	N	N
	Mormopterus beccari	Becarri's Mastiff Bat	N	N
	Mormopterus norfolkensis	Eastern Freetail Bat	N	N
	Mormopterus species 2.	A Freetail Bat	N	N
	Myotis macropus	Southern Myotis	N	N
	Nyctophilus bifax	Northern Long-eared Bat	N	N
	Scotorepens sanborni	Northern Broad-nosed Bat	N	N
	Vespadelus pumilis	Eastern Forest Bat	N	N
Muridae				
	Mus musculus	House Mouse	N	I



Family	Scientific Name	Common Name	EPBC	NCA
	<i>Rattus fuscipes</i>	Bush Rat	N	N
Canidae				
	<i>Canis familiaris</i>	Dog	N	I
Felidae				
	<i>Felis cattus</i>	Cat	N	I
Bovidae				
	<i>Bos taurus</i>	Cattle	N	I
Leporidae				
	<i>Oryctolagus cuniculus</i>	Hare	N	I

N = Not Listed

Ma = Marine

I = Introduced

M = Migratory

V = Vulnerable

Migratory Species

Seventeen Migratory species (listed as Migratory under the provisions of the EPBC Act 1999) are known from Hummock Hill Island, including a reasonable diversity but low abundance of migratory shorebirds. Surveys conducted by SKM during March 2007 recorded a concentration of shorebird activity on the landward side of the Island, where extensive intertidal wetlands, marine plains and saltmarshes occur.

A targeted search effort over five days on the eastern and northern ocean beaches, the proposed bridge site and other accessible intertidal areas recorded only a small number of Lesser and Greater Sand Plovers and Red-capped Plovers, which are common species on sandy beaches in the region. Other species are likely to occur occasionally, however, habitat of highest quality is associated with marine deposits.

The proposed development is not proximate to any significant areas of migratory shorebird habitat. As such a significant increase in the level of threat posed from construction, habitat loss, domestic animals, human interference, ongoing noise and lighting is not expected.

14.1.2 Discussion

14.1.2.1 Conservation Status of Regional Ecosystems

A number of REs recorded from Hummock Hill Island are considered special value due to providing habitat for rare and endangered fauna or are generally accepted as being representative of unique floristic assemblages limited in extent within QLD and or the region. As such many of the identified RE are subject to specific threats, mostly from human interference. Table 14.10 outlines known threats to and special values of the REs known from the Island, as described in the EPA Regional Ecosystem Description Database (REDD).



Table 14.10 – Threats and Special Values of REs

Regional Ecosystem	Known Threats/Observed Threats	Special Values/Observed Values	Conservation Status
12.1.1	Subject to weed invasion, particularly groundsel <i>Baccharis halimiflora</i> . <i>Baccharis halimiflora</i> is present on Hummock Hill Island within this RE.	Provides estuarine wetland habitat.	Of concern
12.1.2		Habitat for Water Mouse <i>Xeromys myoides</i> in southern part of the bioregion particularly in areas immediately adjacent to mangroves. The Water Mouse is likely to occur on Hummock Hill Island, but was not recorded from any area to be affected by the proposed development.	No concern at present
12.1.3		Habitat for water mouse <i>Xeromys myoides</i> in southern part of the bioregion particularly in areas immediately adjacent to salt pans. The Water Mouse is likely to occur on Hummock Hill Island, but was not recorded from any area to be affected by the proposed development.	No concern at present
12.2.2	Continues to be threatened by clearing for coastal residential development. Also subject to extensive weed invasion over 90% of its pre-clear distribution (<i>Rivina humilis</i> , <i>Passiflora suberosa</i> , <i>Lantana camara</i> , <i>Catharanthus roseus</i> , <i>Panicum maximum</i> , <i>Asparagus</i> spp., <i>Salvia</i> spp.) and localised human disturbance from recreational and vehicle tracks.	Habitat for rare and threatened flora species including <i>Acianthus amplexicaulis</i> , <i>Alyxia sharpei</i> , <i>Xylosma ovatum</i> , <i>Dansiea elliptica</i> and <i>Acronychia littoralis</i> . None of these species has been recorded from Hummock Hill Island, however, suitable habitat is present and they may occur. Intensive survey of areas of this RE removed from the development area has not been completed.	Endangered
12.2.7		Habitat for rare and threatened flora species including <i>Phaius australis</i> , <i>P. bernaysii</i> and <i>Durringtonia paludosa</i> . These species have not been recorded from Hummock Hill Island.	No concern at present
12.2.11		Rainforest species sometimes present as sub canopy or understorey. This is the case on Hummock Hill Island.	No concern at present
12.2.14			No concern at present

Regional Ecosystem	Known Threats/Observed Threats	Special Values/Observed Values	Conservation Status
12.3.3	Eucalyptus tereticornis will regenerate readily but there is a lack of recruitment to replace old trees in stands that are logged, thinned or grazed and regularly burnt.	While Eucalyptus tereticornis remains common in the landscape, very few intact stands remain. Eucalyptus tereticornis grows into a very large hollow-forming tree and has a special significance for fauna species, especially in drier areas. Large, hollow forming examples of this species are present on the Island.	Endangered
12.3.10	Cleared and thinned for grazing and agriculture.	Largely confined to western margins of bioregion. Some relatively intact remnants present in road reserves.	Endangered
12.12.7		Habitat for rare and threatened flora species including Acacia grandifolia. This species has not been observed on Hummock Hill Island.	No concern at present
12.12.8	Less steep areas have been extensively cleared for pasture.		Of concern
12.12.12	Extensively cleared for pasture.		Of concern
12.12.28	Data on clearing rate between 1995 and 1997 indicates that the RE continues to experience an annual loss in excess of 1% of current extent per year. The area remaining is likely to fall below 30% within 5-10 years.		Of concern

14.1.2.2 Restricted or Threatened Regional Ecosystems

There are three regional ecosystems on Hummock Hill Island which are restricted (in terms of extent) within the sub region or region, namely RE 12.2.7 (Broad-leaved Paperbark on sand), RE 12.12.8 (Silver-leaved Ironbark on Igneous Rocks) and RE 12.3.10 (Poplar Box on alluvium).

RE 12.2.7 and RE 12.12.8 are relatively extensive at the bioregional (Southeast Queensland [SEQ]) level, however, RE 12.3.10 is restricted in its occurrence in SEQ, and is generally restricted to the overlap zone between SEQ and the Brigalow Belt Bioregion.

Eucalyptus populnea is one of the species characteristic of the broad overlap between the Southeast Queensland and Brigalow Belt bioregions, and is a dominant component of numerous REs in the Brigalow Belt Bioregion, including RE 11.3.2, 11.3.17, 11.3.18, 11.4.2, 11.4.2, 11.4.7, 11.4.12, 11.5.3, 11.5.13 and 11.9.7.

14.1.2.3 Ecological Condition and Threats

Evidence of historical grazing and logging activity is obvious across the study area, with substantial areas of sub-mature or regrowth vegetation, including many areas which barely qualify as remnant



vegetation under the *Queensland Vegetation Management Act (1999)* based on their low height⁶ in comparison to undisturbed vegetation elsewhere on the Island.

Historical disturbance is particularly evident on lower slopes and alluvial plains of Hummock Hill Island, where many canopy Eucalypts are of even age and exhibit none of the indicators of old growth vegetation (e.g. tree hollows).

The 1993 EIS noted that sleeper cutters had operated on the Island in the past and concentrated on ironbark species to the extent that few commercially viable specimens remained at the time of survey. The dry climate and relatively harsh growing conditions do not favour the rapid growth of plant species to maturity, and the relatively short period of time (15 years) which has passed since these observations were made has not resulted in an obvious increase in the number of large specimens of ironbark in the proposed development area.

14.1.2.4 Occurrence of Rare or Threatened Flora Species

No Rare or Threatened (Endangered or Vulnerable) Flora species have been recorded from the Island, although exhaustive surveys of the entire Island have not been completed. It is noteworthy that targeted survey effort in the proposed development area between 1993 and 2007 has not recorded any significant flora species.

The likelihood of occurrence of significant flora is discussed below.

Table 14.11 – Likely occurrence of significant flora species

Group	Scientific Name	Common Name	Likelihood of Occurrence
Flora	<i>Pratia podenzanae</i>	-	This rare herb is poorly known and may be present on the Island, however, it has not been recorded from the proposed development area.
	<i>Xylosma ovatum</i>	-	This species occurs in littoral vineforest, and may be present on the Island. It has not been recorded from the proposed development area.
	<i>Cupaniopsis shirleyana</i>	Wedge-leaf tuckeroo	Present on the mainland at Turkey Beach within dry rainforest gullies. Such habitats are absent from the proposed development area.
	<i>Cycas megacarpa</i>	Cycad palm	Present on the adjacent mainland in dry Eucalypt forest. Very conspicuous species which has not been recorded and must be considered an unlikely occurrence.

⁶ To meet the remnant criteria, the predominant vegetation layer must attain a height of at least 70% of the height of the predominant undisturbed canopy.



In terms of unique flora values, Batianoff and Dillewaard (1996) investigated the flora of Great Barrier Reef Continental Islands, with some surprising results, including the following:

- There are only three endemic species across the entire Great Barrier Reef Marine Park, of a total of 2195 species known from the continental Islands. The vast majority of the continental Island flora (99.86%) is also represented on the mainland;
- There are low levels of dissimilarity (in terms of species composition) between and across continental Islands of the Great Barrier Reef, spanning from the wet tropics south to the Capricorn region.

14.1.2.5 Groundwater dependant ecosystems

A number of discharge zones have been identified on the Island, as discussed in Section 5, and these areas have the potential to support groundwater dependent ecosystems such as *melaleuca spp.*

14.1.2.6 Essential Habitat for EVR Taxa

The primary use of Regional Ecosystem maps is to regulate the clearing of remnant vegetation in Queensland under the *Queensland Vegetation Management Act (1999)*. An additional purpose of the *Vegetation Management Act 1999* is to regulate vegetation clearing in a way that prevents the loss of biodiversity. To fulfil this obligation, the Department of Natural Resources and Water uses “essential habitat maps” as a tool when assessing vegetation clearing applications to assist in determining whether the vegetation is habitat for endangered, vulnerable, rare or near threatened species.

Essential habitat is vegetation in which a species has been known to occur that is endangered, vulnerable, rare or near threatened. The essential habitat of species is mapped by the Environmental Protection Agency (EPA). The EPA maintains a database of Essential Habitat Factors for all Endangered, Vulnerable and Rare (as listed in the *Qld Nature Conservation [Wildlife] Regulation 1994*) taxa in Queensland.

The conservation of Essential Habitat is achieved primarily through performance-based criteria contained in Regional Vegetation Management Codes. Vegetation clearing on Hummock Hill Island is governed by the Regional Vegetation Management Code, Southeast Queensland Bioregion (the RVMC).

Essential Habitat Factors have been compiled for all Endangered, Vulnerable and Rare taxa in Queensland. These cover the biological and/or non-biological habitat requirements of species. They could include but are not limited to:

- Vegetation: The species or types of vegetation that the species is associated with.
- Regional ecosystem: the regional ecosystem(s) that the species is most commonly associated with.
- Land zone: This is the underlying geology associated with a regional ecosystem.
- Altitude: The range of altitudes at which the species is found.
- Soils: The type of soils on which a species is most commonly found.



- Position in landscape: A more precise description of the landscape features the species is commonly associated with. For example creek banks, levees, lower slopes, hillsides and ridges.

Each species has at least three essential habitat factors listed. There may also be one or more factor listed as 'mandatory'.

As with all performance requirements in the RVMC, the essential habitat performance requirement can be met by either adopting the acceptable solution, or by providing another solution that meets the performance requirement. Under the RVMC, an applicant has the ability to propose an alternative solution to the performance requirement that involves proving that:

- At least three of the essential habitat factors, including any mandatory factor(s), do not occur within the application area; and
- The species at any stage of its/their life cycle do not occur within the application area.

Hummock Hill Island is mapped as containing Essential Habitat for the Koala (*Phascolarctos cinereus*) and the Wallum Froglet (*Crinia tinnula*). Neither species has been recorded during five separate fauna surveys. In addition, there are no records of either species within relevant databases and both appear to be absent from the Island. This view is supported by the following observations:

- Extensive spotlighting effort has been expended on the Island, and several arboreal mammal species has subsequently recorded. The Koala is readily detectable during spotlighting surveys, but has not been sighted on Hummock Hill Island.
- In the absence of site records, the Koala can be detected by indirect evidence of occurrence, including the presence of faecal pellets and characteristic scratch marks on tree trunks. None of the observers who have completed survey on the Island have noted any such evidence of Koala occurrence.
- Despite the extensive suite of regional ecosystems listed as providing essential habitat for the Wallum Froglet, the species occurs in comparatively few REs and is limited by the presence of certain critical microhabitats, including the presence of a dense understorey of sedges or ferns, presence of suitable breeding sites (ponds of low pH with a deep humic layer) and proximity to semi-permanent or permanent wetlands. None of these essential microhabitats are present on Hummock Hill Island.
- It is clearly the case that "The species at any stage of its/their life cycle do not occur within the application area" therefore, the essential habitat mapping is invalid.

14.1.2.7 Koala Habitat Areas under the Nature Conservation (Koala) Conservation Plan 2006

The SEQ Regional Plan requires certain new development occurring in Koala Habitat Areas and captured by the Integrated Development Assessment System under the Integrated Planning Act, to be assessed against Koala conservation criteria contained in this Koala Management Program. The



Koala conservation criteria are based on the Koala Habitat Area, type of development activity and whether the development is committed or uncommitted.

The Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006–2016 contains Koala conservation criteria applying to assessable development in Koala Habitat Areas. The SEQ Regional Plan identifies Koala Habitat Areas as being Koala Conservation Areas, Koala Sustainability Areas and Urban Koala Areas. Koala Conservation Areas and Koala Sustainability Areas are identified in Map 5 – Koala Management Areas, within the SEQ Regional Plan.

The Nature Conservation (Koala) Conservation Plan 2006 defines each category of Koala Habitat Area. It specifically addresses Urban Koala Areas and requires the chief executive to show each Urban Koala Area on a map, being the State map. The State map may also show Koala Conservation Areas and Koala Sustainability Areas.

The State Map (Koala Districts) was reviewed and Hummock Hill Island is not recognised as a Koala habitat area.

Koala Living Areas occur outside the Koala Habitat Areas and are not subject to any statutory processes to protect Koalas and their habitat under the Koala Plan. Koala Living Areas are areas outside the Koala Conservation Areas, Koala Sustainability Areas and Urban Koala Areas that support pockets of highly fragmented Koala habitat where Koala populations generally occur in low densities. These areas have no statutory intent (i.e. they are not subject to any statutory planning processes to protect Koalas or their habitat under the Koala Plan). There are no Koala Living Areas currently recognised on Hummock Hill Island.

Whilst the Qld EPA have suggested a relationship between the Koala Plan and the Essential Habitat Maps produced under the Vegetation Management Act (1999)(and administered under the Regional Vegetation Management Codes at the time that an Operational Works Vegetation Clearing Application is made), there is no link between the assessment requirements of these quite separate policies.

To avoid duplication, the Department of Natural Resources and Water will not consider the essential habitat map in relation to koalas when assessing vegetation clearing applications under the Vegetation Management Act if the clearing is proposed to occur within a Koala Habitat Area. However, in the case of Hummock Hill Island, the area to be cleared is not located within a Koala Habitat Area, and the Essential Habitat mapping will be considered by NRW at the application stage.

Hummock Hill Island is located within district B of the Koala Plan. The only applicable policy contained within the Koala Policy is that the clearing of koala habitat trees be undertaken in a sequential manner, allowing koalas present to move out of the site of their own accord in preference to being moved.

14.1.2.8 Likely occurrence of significant fauna

Significant fauna are those listed as Endangered, Vulnerable, Rare, Migratory or Marine in the schedules of the EPBC Act or *Nature Conservation Act* and Regulations.

Based on the field survey and the ecological requirements of fauna species listed in the database searches, the species listed in Table 14.12 below are either known to occur or could potentially occur on the subject site.

Species are considered as possible or likely occurrences. Possible occurrences are species which may occur sporadically or are provided with small areas of potentially suitable habitat. Likely occurrences are provided with habitat of high quality on the subject site. Species considered unlikely occurrences are not provided with suitable habitat in the study area.

Table 14.12 – Likely occurrence of significant fauna species

Group	Scientific Name	Common Name	Likelihood of Occurrence
Birds	<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	Possible. This species may utilise freshwater dams on the Island.
	<i>Esacus neglectus</i>	Beach stone-curlew	Known. Recorded by CQU during site surveys. This species was recorded on a single occasion from the ocean beach to the north of the proposed development. It has not been recorded subsequent to the CQU survey, despite targeted search effort.
	<i>Numenius madagascariensis</i>	Eastern curlew	Known. This species inhabits tidal mudflats, sand spits of estuaries, mangroves, lake shores and ocean beaches.
	<i>Pterodroma neglecta neglecta</i>	Kermadec petrel (western)	Unlikely. This species breeds on South Pacific Islands and is a vagrant to eastern coastal waters.
	<i>Ninox strenua</i>	Powerful owl	Possible. This species inhabits a variety of eucalypt woodlands and open forest types and is relatively common on the adjacent mainland. Failure to detect this species can not be considered conclusive evidence that it does not occur.
	<i>Rostratula australis</i>	Australian painted snipe	Unlikely. This species inhabits densely vegetated wetland margins (both saline and fresh). Such habitats are absent from the development area.
	<i>Erythroriorchis radiatus</i>	Red goshawk	Possible. This species inhabits open forest and lightly wooded areas often with water courses.
	<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	Unlikely. Not recorded during any of five fauna surveys on the Island. Typically detected with relative ease, therefore likely to be absent despite the occurrence of suitable habitat.
	<i>Turnix melanogaster</i>	Black-breasted button-quail	Known. This species inhabits dry forests and thickets.

Group	Scientific Name	Common Name	Likelihood of Occurrence
Mammals	<i>Xeromys myoides</i>	False Water Rat/Water Mouse	Possible. This species is known to inhabit mangrove forests, freshwater lagoons, sedged lakes and swamps. Not recorded in impact areas, despite targeted survey effort.
	<i>Dasyurus hallucatus</i>	Northern quoll	Unlikely. This species inhabits rocky, sparsely vegetated areas and open woodlands which are present, however, there is a lack of recent records of the species from the region, indicating that it may be locally extinct.
	<i>Chalinolobus dwyeri</i>	Large-eared pied bat	Possible. This species inhabits dry open forests and woodlands.
	<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	Known.
	<i>Chalinolobus picatus</i>	Little pied bat	Possible. This species inhabits dry open forests and woodlands.
	<i>Egernia rugosa</i>	Yakka skink	Possible. This species inhabits dry open forest, woodlands and rocky areas.
	<i>Furina dunmalli</i>	Dunmall's snake	Unlikely. This species inhabits mixed Eucalypt/Callitris woodland and brigalow scrub.

14.1.2.9 Movement Corridors

Background

Based largely on the patch-matrix-corridor model of landscape ecology (Forman and Gordon 1986, Forman 1995), wildlife corridors are a frequently discussed landscape feature and recommended management tool to enhance landscape connectivity (Beier and Noss 1998, Bennett 1998, Lindenmayer 1998). The assessment of conservation value of remnant vegetation often includes a discussion of corridor values.

The fundamental question that must be asked in the discussion of such corridors is whether the particular corridor is capable of facilitating sufficient delivery of the target species to the recipient habitat patch(es). It is implicit that corridor capability can only be measured or evaluated on a site by site and species by species basis. A given strip of habitat may be effective for one species and ineffective for another.

Wildlife corridors are a frequently debated option to enhance landscape connectivity (e.g. Noss 1987; Simberloff *et al.* 1992; Beier and Noss 1998; Bennett 1998; Lindenmayer 1998). In Australia, several studies have investigated the value of corridors for birds (Cale 1990; Saunders and de Rebeira 1991; Leach and Recher 1993; Bentley and Catterall 1997; Fisher and Goldney 1997; Fortin and Arnold 1997). However, corridors will not always be synonymous with connectivity.

This is the case in particular for highly mobile species, which can move rapidly over extensive and often fragmented landscapes (Law *et al.* 2000). For such animals, patches of remnant vegetation in the matrix may act as stepping stones to aid their movement.



While the theoretical importance of stepping stones has been hypothesised on several occasions (e.g. Kitchener et al. 1982; Thiollay 1993; Forman 1995), Fischer and Lindenmeyer (2002) presented one of few studies which has explicitly documented a stepping stone effect (e.g. Saunders 1980; Date et al. 1985; Rowley and Chapman 1991; Strong and Bancroft 1994). They found that for some species, the provision of scattered vegetation could enhance landscape connectivity. However, as is the case for movement corridors, stepping stones will not be suitable for all animals. For example, paddock trees may be rarely used by shrub-foraging birds, including some that are common in consolidated woodland patches in the surrounding landscape (e.g. White-browed scrubwren [*Sericornis frontalis*], see Fischer and Lindenmayer 2002). The same is likely to be true for habitat specialists or cryptic species from other groups.

Recognition of Corridor Values on Hummock Hill Island

State, regional and local corridors in South East Queensland have been identified in the Biodiversity Planning Assessment (BPA): South East Queensland South Landscape Expert Panel Report (EPA 2005b). No corridors as defined by this document have been mapped as occurring on the Island. The Biodiversity Planning Assessment itself does, however, recognise Hummock Hill Island as a part of a major Bioregional Corridor

Site Assessment

Although subjected to long-term ongoing disturbance by grazing and logging activity, Hummock Hill Island remains largely vegetated, with few canopy gaps exceeding 100m in width. Fauna movement across the Island is considered to be relatively unrestricted at present due to this high level of connectivity. Exceptions to this general pattern include the following:

- Specialist inhabitants of the littoral vineforest (e.g. Black-breasted Button Quail) are likely to be largely restricted to that vegetation type, with the exception of larger scale dispersal movements (for example, dispersal from the natal range or dispersal following habitat destruction).
- Species typical of riparian zones and wetlands are not provided with an intra-island dispersal pathway, as there are no extensive wetland or waterway systems.

The Island is a part of the east Australia flyway for migratory shorebirds, and extensive marine habitats on the landward side of the Island are significant in this regard.

Movement of birds and bats to and from the Island and the mainland are expected to be relatively unrestricted given relatively short dispersal distances. Smaller terrestrial herpetofauna and mammal populations on the Island are likely to be effectively isolated, with a considerable crossing distance across a hostile habitat (estuary) likely to prevent dispersal. Larger terrestrial mammals are capable of crossing to the Island on low tide, either by swimming and wading or directly across the constructed causeway. Many larger terrestrial mammals are accomplished swimmers, and would have little difficulty navigating a narrow channel.



14.1.3 Insects and associated health risk

14.1.3.1 Potential Source Populations

Hummock Hill Island supports several habitat types which favour Mosquito and Biting Midge, including ocean beaches, tidal mudflats, mangroves, saltmarshes and estuarine habitats. These habitats therefore represent potential sources of insect pests. Site observations indicate that the greatest abundance of biting insects occurs in estuarine habitats, consistent with patterns of abundance elsewhere. There are very few sources of freshwater which could support populations of floodplain mosquitoes, and this group is unlikely to represent an ongoing management issue.

The proposed development is predominantly located in portions of the Island which are either removed from potential source populations or located on elevated areas with consistent windy conditions. As such, biting insects are considered unlikely to represent a major management issue for the project.

A relatively small proportion of the proposed development is located in an area which could receive insect pests during ideal conditions for dispersal from wetland habitats. Prevailing south-easterly winds could move insect pests into the near-coastal precincts of the development.

No physical modification of biting insect habitat or chemical control is considered necessary or appropriate, given the sensitivity of receiving environments.

14.2 Potential Impacts

14.2.1 Terrestrial fauna & Flora

14.2.1.1 Nature and Extent of Impacts

Potential direct and indirect project impacts will occur in the short-term and over the long-term. Short-term impacts are those occurring as a direct or indirect result of construction and operation of the project, whilst long-term impacts will occur over a more extended period of time (in the order of years).

Identified short-term impacts include:

- Injury and death of flora and fauna during clearing works;
- Potential disturbance to fauna from construction activities, noise and vibration;
- Potential traffic related wildlife mortality on roads within and around the project area;
- Potential spread of weeds into cleared and disturbed areas; and
- Potential injury/ death during tree clearing.

The long-term impacts include:

- The loss of remnant and regrowth vegetation and habitat as a result of vegetation clearing;
- Fragmentation of the landscape affecting flora connectivity and fauna movement; and
- Potential for increased proliferation of exotic species, including weeds and pests.



14.2.1.2 Loss of Remnant Vegetation

The proposal will require the clearing of both non-remnant and remnant vegetation within the study area. The areas of regional ecosystems and essential habitat to be impacted are provided in Table 14.13, and a development overlay on remnant vegetation is shown in Figure 14.3.

The loss of around 313 ha of remnant vegetation associated with the proposed development will have the following impacts:

- Displacement of a variety of fauna species which currently range through areas to be cleared. This will include a range of amphibians, reptiles, birds and mammals. The immediate effect of clearance on plant and animal species can be significant. For vertebrate animals, comparative estimates of woodland bird densities indicate that between 1000 to 2000 birds permanently lose their habitat for every 100 ha of woodland cleared (Bennett 1993), while it has been estimated that the clearing of mallee for wheat kills more than 85 per cent of the resident reptiles – on average, more than 200 individual reptiles per hectare (Cogger 1991);
- Longer term effects of native vegetation clearance on species result from habitat loss and fragmentation working in combination with other threats;
- Disruption/fragmentation of a relatively unfragmented tract of vegetation. This will reduce the permeability of the landscape (dispersal pathways) for all flora and fauna which currently occur on the Island;
- Fragmentation has two primary effects. First, it creates new edges between remnants and cleared or disturbed land leading to ‘edge’ effects. These include physical changes to the remnant in the border region, such as different levels of exposure to the sun and wind and changes in water cycles and the local air temperature. Biotic changes include invasion by opportunistic species with good dispersal or colonising abilities such as weeds and feral animals. Second, it isolates and creates barriers between remnants. In most cases, recently isolated remnants can be expected to continue losing species. For some species the loss of a population of a species made too small to be viable may take considerable time due to the relatively long life of individuals. For example, it may take several hundred years to lose some species such as long living trees, particularly since adult plants are often less sensitive to changed environmental conditions than plants in seedling and juvenile stages. This phenomenon also applies to fauna;
- Loss of relatively extensive areas of Ironbark woodland (RE 12.12.7 and 12.12.12) and mixed Sclerophyll forest on quaternary sands (12.2.11). Both REs will remain well represented on the Island post development;
- Loss of comparatively small areas of the Endangered Queensland Blue Gum and Poplar Box REs, both of which will remain well represented on the Island in the post development scenario;
- Extensive areas of remnant vegetation will be conserved surrounding the proposed development, and major corridor systems are a key feature of the master plan. These fundamental elements of the proposal will largely mitigate the impacts of habitat loss and fragmentation; and
- Minor losses of vegetation associated with the airstrip. This area was cleared historically and is fringed by regrowth vegetation which may require some trimming. There is limited habitat



present for species which pose an air-strike hazard (e.g. Ibis, ducks, gulls) with the exception of diurnal raptors (such as Wedge-tailed Eagle). As such, very minor habitat modification will be required to support the establishment of the airstrip. The extent of trimming required will be determined at the detailed design stage and will be minimised and avoided wherever possible such that the total area of disturbance is reduced.

Table 14.13 – Areas of Regional Ecosystems in the Development Footprint

Regional Ecosystem	VM Status	RE Impacted (ha)	Total Island RE (ha)	%
12.1.1	Of Concern – Dominant	0.99	26.97	3.69
12.12.12	Of Concern – Dominant	160.32	381.01	42.08
12.12.19	Of Concern – Dominant	0.12	0.98	11.78
12.12.8	Of Concern – Dominant	5.86	12.26	47.81
12.3.10/12.3.3	Endangered - Dominant	6.93	164.48	4.21
12.3.3	Endangered - Dominant	3.83	154.80	2.47
12.3.3/12.12.12	Endangered - Dominant	0.19	16.11	1.21
12.2.11/12.1.1	Of Concern – Sub-dominant	13.75	32.00	42.98
12.12.7	Not of Concern	26.61	127.83	20.82
12.2.11	Not of Concern	94.52	562.29	16.88
Cleared	Non Remnant/Regrowth		72.84	
Total (Remnant)		313.12	2434.34	-

The areas given above must be viewed with caution for several reasons. The spatial resolution of Regional Ecosystem Mapping is low, and not appropriate for detailed site planning and design. The areas of loss listed above should be viewed as indicative only. Secondly, Endangered REs will be avoided at the detailed design stage. The boundaries of these REs will be refined through the preparation of a Property Map of Assessable Vegetation (PMAV) and the ultimate development layout will respect areas of high constraint.

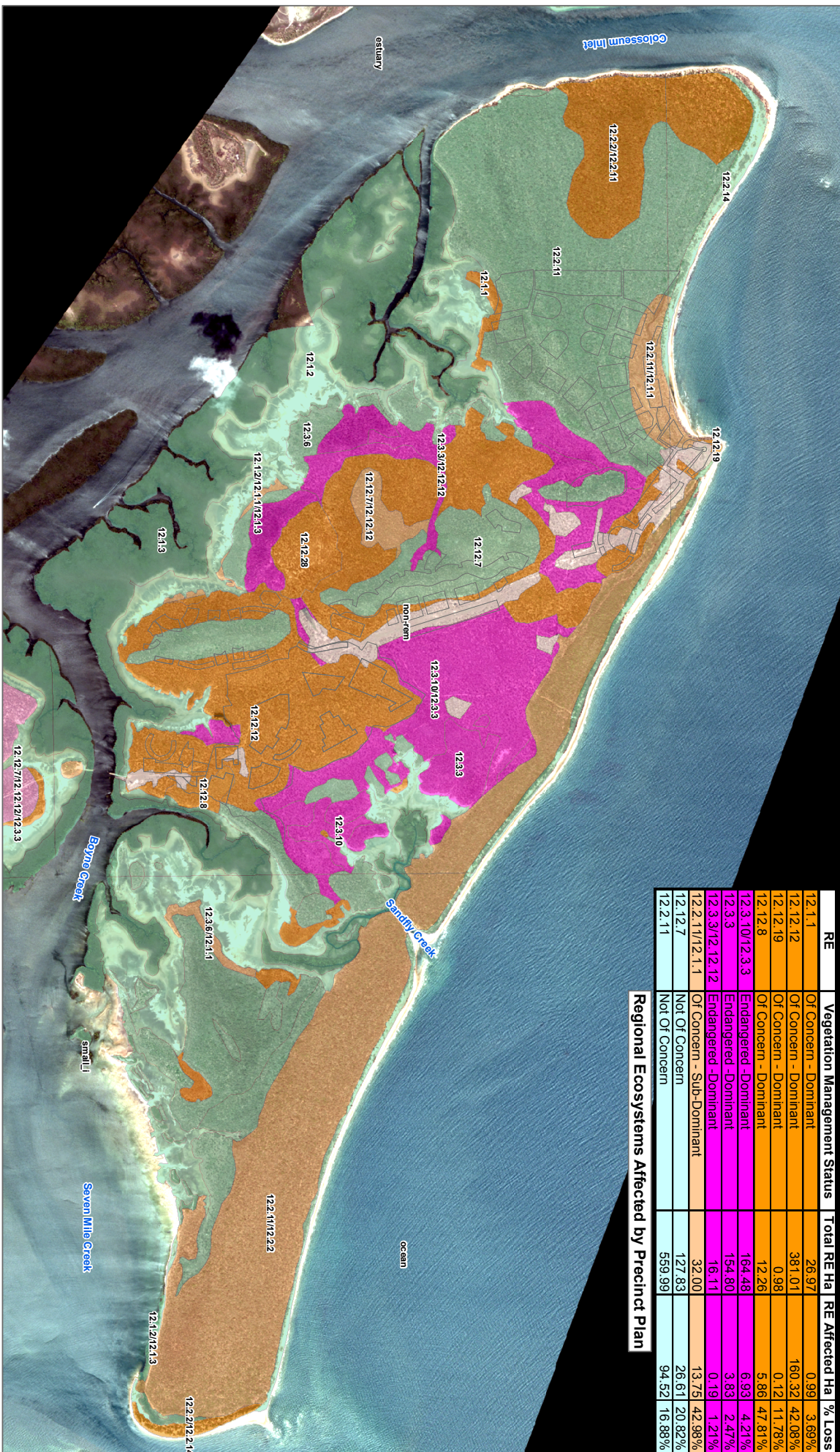
In addition to the areas specified above, there will be some loss of remnant vegetation and non-remnant vegetation for the installation of services. These areas can not be quantified at this early planning stage, however, the disturbance could be largely contained within a road reserve which has been heavily disturbed in the past. If required clearing is carried out by the infrastructure provider, it is likely to be exempt from the provisions of the Vegetation Management Act.

14.2.1.3 Construction Noise

Noise and vibration from the construction activities may have a short-term detrimental affect on local fauna inhabiting the area. This could cause additional stress, causing animals to leave their home ranges, disruption to breeding cycles and restrictions in foraging behaviour. It is expected that mobile fauna would temporarily shift into nearby habitat during working hours. Less mobile species would be more significantly affected by noise and vibration, however, the majority of terrestrial fauna (other than birds) are nocturnal and daily activity patterns are considered unlikely to be compromised.

RE	Vegetation Management Status	Total RE Ha	RE Affected Ha	% Loss
12.1.1	Of Concern - Dominant	26.97	0.99	3.69%
12.12.12	Of Concern - Dominant	381.01	160.32	42.08%
12.12.19	Of Concern - Dominant	0.98	0.12	11.78%
12.12.8	Of Concern - Dominant	12.26	5.86	47.81%
12.3.10/12.3.3	Endangered - Dominant	164.48	6.93	4.21%
12.3.3	Endangered - Dominant	154.80	3.83	2.47%
12.3.3/12.12.12	Endangered - Dominant	16.11	0.19	1.21%
12.2.11/12.1.1	Of Concern - Sub-Dominant	32.00	13.75	42.98%
12.12.7	Not Of Concern	127.83	26.61	20.82%
12.2.11	Not Of Concern	559.99	94.52	16.88%

Regional Ecosystems Affected by Precinct Plan



LEGEND

- Endangered - Dominant
- Endangered - Sub-Dominant
- Of Concern - Dominant
- Of Concern - Sub-Dominant
- Not Of Concern
- Non-Remnant
- Precinct Plan

This figure must be read in conjunction with the data disclaimer located at the front of this report. The data acquired for this project is known to be of low spatial resolution and as such no representation or warranties about its accuracy, reliability or suitability are given. Assumptions and conclusions made from this figure and the associated data must be made with full understanding of the data limitations. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data.

Figure 14.3 - Areas of Regional Ecosystems/Vegetation Communities Impacted By Development



14.2.1.4 Weeds

There is potential for spread of declared weeds during construction and vegetation clearance. The potential for this to occur could be minimised by development of a weed management plan.

14.2.1.5 Impacts on Significant Fauna

There will be a loss of habitat for several fauna species of conservation significance, although these species are generally mobile and provided with extensive habitat on the balance (undeveloped) portions of the Island. The potential impacts on the rare and threatened fauna that were identified as known or possible inhabitants of the study area are presented in Table 14.14.

Table 14.14 – Potential Construction and Operational Impacts on Significant Fauna

Species	Potential Impact
Species Identified During Surveys	
Black-breasted Button Quail (V)	The preferred habitat of this species (littoral vineforest) will remain undisturbed. Minimal impacts expected on this species.
Eastern Curlew (R)	Known from tidal mudflats and salt flats around the Island. Minimal impacts are expected on this species as there will be less than 0.01 ha loss of preferred habitat. No recreational activities envisaged for tidal mudflats, so minimal disturbance related impact expected.
Grey-headed Flying Fox (V)	The Grey-headed Flying Fox is commonly encountered whilst foraging in the region and is listed as Vulnerable as a result of the incremental loss of roosting habitat. The eucalypt forests that occur across the study area provide foraging habitat for this species. It is not anticipated that the loss of the foraging habitat as a result of project will have a significant impact on the Grey-headed Flying Fox, as this species is highly mobile and can forage on eucalypt forests abundant in the area. Less than 30% of vegetation will be disturbed. This species is also known to forage in urban habitat.
Beach Thick-knee (V)	Recorded from the ocean beach north of the proposed development on a single occasion. There is no evidence that a resident breeding pair is present, or that the single record represents any more than the isolated occurrence of an individual. Given the very low population size, lack of breeding records (or even a pair of birds on the island) and infrequent foraging in the study area, it is considered unlikely that important habitat for this species is present or will be impacted by the proposal.
Species Not Recorded but Suitable Habitat Present	
Australian Painted Snipe (V)	The Australian Painted Snipe was not detected during the field survey or previous surveys, however this species may utilise marine habitats (salt flats) on the landward side of the Island. Minimal impacts are expected on this species as there will be less than 0.01 ha disturbance to its preferred salt flat habitat. Increases in traffic movements along Clarks Road can also disturb this species within the immediate vicinity of the road.
Black-necked Stork (R)	Though not sighted during surveys to date this species may utilise the existing freshwater dam on the site, and is considered likely to continue to do so in the post-development scenario. Minimal impacts are expected on this species as there will be no disturbance to preferred habitat.
Powerful Owl (V)	Habitat for this species is present on the Island, despite a lack of records during surveys. Several pairs are known from Turkey Beach (on the mainland to the south) and local populations are therefore present. The species will incur the loss of potential habitat, however, there will be minimal disturbance to the preferred roost sites of the species (gullies), and the most productive habitats in terms of prey abundance and availability (alluvial flats) will be modified as part of airstrip



Species	Potential Impact
	construction. As no occurrence of this species was identified on the Island impacts are considered negligible.
Red Goshawk (E)	This species was not identified during surveys. Preferred nesting habitat (tall alluvial forests and woodlands) is absent from the Island. The species may forage over the study area if a local pair is present and freshwater is available. Impacts on this species are considered likely to be minimal. As no occurrence of this species was identified on the Island impacts are considered negligible.
Water Mouse (V)	Intertidal habitats and their margins, which represent the habitat of this species will incur minimal impact as a result of the proposal. Minor areas of habitat disturbance adjacent to the existing causeway are unlikely to compromise local populations if present.
Large-eared Pied Bat (V)	Though not observed during surveys, habitat suitable for this species occurs across the Island. Potential den trees are relatively widespread on the Island and localised impacts on these resources are unlikely to adversely impact on this species. The loss of foraging habitat is unlikely to compromise population viability because significant vegetated areas (>70 %) will be retained both within and external to the development site itself.

14.2.1.6 Habitat Fragmentation

As discussed previously, the Island is currently characterised by a relatively contiguous vegetation cover. Potential habitat fragmentation of individual species populations and currently interconnecting patches of remnant vegetation can occur through the introduction of roads, buildings, cleared areas and miscellaneous infrastructure unless mitigated during Master Planning.

Habitat fragmentation typically reduces the formerly more continuous natural distribution of a species to a series of smaller and more isolated populations that occur in smaller and more isolated habitat patches. Such populations are often exposed to a range of additional processes that may threaten their viability, such as changes to disturbance regimes, environmental conditions and interactions with other species. However, our current understanding of the complex effects and interactions of these processes is poor. Species responses vary widely and most studies investigate only one or two processes that may affect viability. Consequently, we are unable to make accurate predictions about the likely impacts of habitat fragmentation on population and species viability.

14.2.1.7 Introduction of Artificial Night Lighting

The extent of ecological light pollution (as a result of artificial night lighting) is global and includes direct glare, chronically increased illumination and temporary, unexpected fluctuations in lighting. A brief appraisal of the impacts of artificial night lighting on plant, reptiles and amphibians, birds and terrestrial mammals is provided below.

Higher plants rely heavily on environmental signals to guide their development, and those signals that come from the light environment are amongst the most significant. In the course of evolution, plants have acquired a wide range of photoreceptors that receive and respond to light signals in the ultraviolet, blue, red and near infra-red regions of the electromagnetic spectrum. The photoreceptors allow the plant to respond to four parameters of their light environment: light spectral quality, light intensity, light direction and light duration. Whether artificial night lighting poses any short-term consequences to an individual plant or long-term consequences to any



particular species remains largely unknown, however, mitigation strategies aimed at vertebrate fauna are likely to benefit other associated organisms, including plants.

The effects of artificial night lighting on amphibians are likely to be subtle, complex and difficult to predict. Changes in lighting may cause a cascade of effects in natural communities containing frogs if frog prey or predators change in abundance in response to changes in natural lighting. In general terms, nocturnal amphibians should be considered sensitive to changes in lighting, and it is therefore important to reduce the amount of artificial light entering their habitat.

Nocturnal activity is widespread in reptiles, with clear taxonomic patterns in distribution. Some clades, such as Geckoes show strong tendencies towards nocturnal activity, whilst others (such as skinks) are strongly diurnal. For nocturnal species, artificial night lighting may increase visibility and ultimately reduce levels of activity. Conversely, some species may exploit increased foraging opportunities at night lights, which attract abundant invertebrate prey. Introduced species such as the Asian House Gecko may benefit from altered night lighting.

Many bird species typically migrate at night and it is well known that fires and artificial lights attract birds during migration, particularly when the sky is cloudy and the ceiling is low. Light associated mortality of nocturnal avian migrants involving collisions of hundreds or thousands of birds with lights and lighted structures have been documented for over a century. Many nocturnal seabirds for example, are attracted to artificial light. The attraction of nocturnal feeding seabirds has been suggestively linked to a predisposition to exploit bioluminescent prey.

All bats, most rodents and 80% of marsupials are nocturnal. It could therefore be reasonably assumed that artificial night lighting would have direct and significant impacts on mammals, however, there has been limited research into the impact of night lighting on mammals in the wild. Likely effects include disruption of foraging patterns, increased predation risk, disruption of biological clocks, increased mortality on roads and disruption of dispersal patterns through artificially lighted landscapes.

A suite of general mitigation strategies can be adopted to reduce the impacts of artificial night lighting on the biota of the development area, including the following:

- The intense glow of street lights can be reduced by ensuring that all light is directed to the ground wherever possible.
- Thick areas of vegetation such as hedges could be effective at reducing the rapidly shifting illumination associated with vehicles passing through habitat at night.
- Shielding lights to eliminate skyward illumination could greatly reduce the catch basin of light attraction for migratory birds, particularly oceanic species.
- Floodlights on the ground that face upward to illuminate structures are harmful and should be avoided.
- Lighting systems should be programmed to be extinguished for as long a period as possible during the night. Alternatively all external lights could be triggered by sensors.



- Changing red warning lights (on towers etc) to white strobe lights may reduce impacts on migratory bird species.
- Incorporation of streetlight filters which permit only the transmission of longer wavelengths may benefit some turtle species.

14.2.1.8 Traffic Related Wildlife Mortality

Few empirical studies describe the extent of vehicle-induced mortality of wildlife throughout Australia. Goldingay and Taylor (2004) investigated road kills on a 100 km circuit of three major roads in northern NSW, and recorded 0.3 road kills per km/week or one road kill every 3.8 km per week across all seasons. Medium sized terrestrial mammals such as the Northern Brown Bandicoot were the most heavily impacted in their study, however, their study area was located in a region which consists largely of modified landscapes, and impacts on other groups (e.g. Macropods) may have been significantly underestimated.

The introduction of vehicular traffic to the Island, and a major increase in traffic on Clarks Road, will result in wildlife mortality across all fauna groups. Impacts will be greatest where dense vegetation occurs on both sides of the road. Woodlands and open forests with sparse mid and lower strata represent less of a hazard because fauna are more obvious to vehicles and vehicles, presumably, are more visible to fauna.

14.2.1.9 Domestic Animals

The cat is a common but elusive predator that occurs throughout Australia in virtually all terrestrial habitats. The main determinants of local population size appear to be the availability of food and shelters. Cats may be categorised as domestic, stray or feral. Feral cats are free-living; they have minimal or no reliance on humans for their ecological requirements, and survive and reproduce in self-perpetuating populations. Feral cats are carnivorous and capable of killing vertebrates up to 2-3kg. Preference is shown for mammals weighing less than 220g. and birds less than 200g. but reptiles, amphibians and invertebrates are also eaten. Carrion and other scavenged material is taken if live prey is not available. Predation by feral cats has been implicated in the extinction and decline of many species of mammals and birds around Australia and in other parts of the world. The status of cats on the island is unknown, however, they may already be present. Cats will not be permitted within the proposed development and therefore pose limited threat to the nature conservation values of the Island.

Wild dogs may have a number of impacts on native environments. They may hunt native animals, breed with purebred dingos, causing the hybridisation of this native species, carry diseases and parasites may compete with native carnivores, such as quolls. Dogs are already present on Hummock Hill Island and pose a threat to nesting turtles and other fauna.

Whilst the development will increase the total number of dogs on the Island, it will not introduce a new threatening process.



14.3 Mitigation Measures

14.3.1 Terrestrial Fauna & Flora

14.3.1.1 Master Planning and Design

The proposed Hummock Hill Island Development incorporates numerous design elements which seek to minimise or mitigate potential impacts on terrestrial flora and fauna communities, including the following:

- Location of proposed buildings and associated infrastructure outside of Endangered Regional Ecosystems particularly Poplar Box woodland and Littoral Vineforest communities;
- Exclusion of development from the habitat known to support significant fauna species, particularly Black-breasted Button Quail (Vineforest communities), which is the most significant vertebrate species known from the Island;
- Minimal disturbance to marine/tidal habitats, known to be of importance to both local and migratory shorebirds and potentially the Water Mouse;
- Incorporation of vegetated corridors within the master plan design to permit flora and fauna dispersal across the Island particularly the maintenance of riparian corridors adjacent ephemeral creeks (Figure 14.4). Three categories of wildlife corridor have been considered during master planning:
 - Major Linkage – several hundred metres in width and containing no buildings or major structures. These areas provide significant opportunity for dispersal;
 - Inter-urban Linkage – corridors of 100-200m in width through a predominantly urban matrix, but containing large areas of green space such as golf course;
 - Local Linkage – Corridors of less than 100m in width through urban and non-urban matrices;
- Incorporation of formal fauna crossing points at potential road-strike points, particularly within the proposed corridors described above;
- Incorporation of fauna crossings in designed ephemeral watercourse crossings; and
- Maximisation of tree retention across the development area to increase landscape permeability for flora and fauna particularly in and around the proposed wild golf course.

14.3.1.2 Compensatory Habitat Strategy

A compensatory habitat strategy is to be developed for the project. The strategy objectives will be twofold:

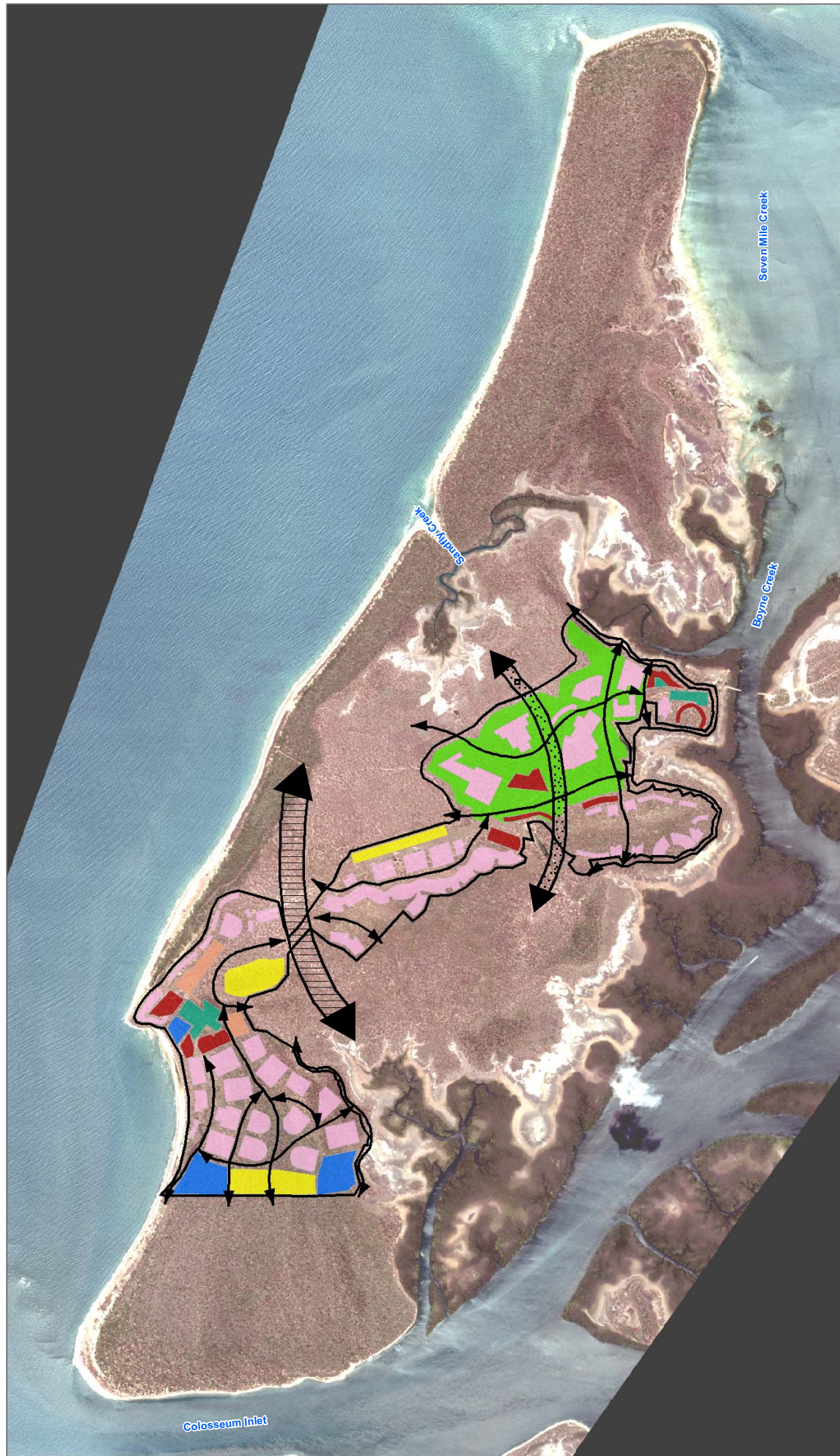
- a) the strategy will seek to comply with the requirements of the *Queensland Vegetation Management Act 1999* and associated Codes and Policies; and
- b) the strategy will aim to provide tangible conservation benefits at the local and shire-wide scale, with an emphasis on threatened species conservation.

The project will require the clearing of mapped remnant vegetation. In order to comply with the Regional Vegetation Management Code (RVMC) for Southeast Queensland Bioregion (DNRW, 2006),



the applicant will be required to maintain the current extent of “Endangered” REs, “Of Concern” REs (Performance Requirement [PR] S7), Threshold REs (PRS9), riparian (watercourse) REs (PRS3) and Essential Habitat (PRS8).

It is acknowledged that the endangered regional ecosystems to be cleared under the proposal are considered areas of “State Significance” under the State Coastal Management Plan (the Coastal Plan). The Coastal Plan also allows for the clearing these ecosystems if the development is of net benefit to the state. As detailed in Section 5.2.1 the project is considered to be of a net benefit to the State.



LEGEND

Hummock Hill Island Precinct Plan		Wildlife Corridor Type	
Precincts	Low Density Residential	Open Space/Golf Course	Local Linkage
	High Density Residential	Conservation	Major Linkage
	Medium Density Residential	Development Footprint	Inter-Urban Linkage
	Town/Village Centre		
	Education/Community		
	Tourism		

This figure must be read in conjunction with the data disclaimers located at the front of this report. The data acquired for this project is known to be of low spatial resolution and may not be suitable for detailed planning or design purposes. As such, the data should be used as a general guide only. The data is provided as a service and the user must make their own decisions regarding the use of the data. The user must be made with full understanding of the data limitations. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data.



Figure 14.4 - Potential Wildlife Corridors - Post Development





“Maintain the current extent” is defined as follows in the RVMC:

- a) not clearing; or
- b) ensuring the regional ecosystem structure and function are maintained; or
- c) providing an offset in accordance with the policy in force at the date the application was properly made for vegetation management offsets administered by the Department of Natural Resources and Water.

Not clearing is an unfeasible option for this project and it is difficult to satisfy clause (b) whilst clearing remnant vegetation. As such, Eaton Place Pty Ltd has opted to provide an offset in accordance with the NRW Policy for Vegetation Offsets (the Offset Policy) released in November 2006.

The offset strategy will form the basis of the compensatory habitat strategy for the project and will seek to comply with the performance criteria set out in the Offset Policy.

The compensatory habitat strategy is likely to involve a combination of the following options:

- Securing advanced regrowth (near remnant) vegetation within and outside the Shire which is representative of the REs and essential habitat to be cleared for the project. The properties will be either be purchased by Eaton Place Pty Ltd or secured via registered covenant. In both cases the properties would be actively managed until such time as they reach remnant status;
- Securing REs of equivalent conservation status to those to be cleared for the project within and outside the shire and managing these areas until such time as they meet remnant status;
- Strategic purchase of key land parcels which have been identified as key linkages or habitats for EVR taxa at the local, sub-regional or regional scale;
- Revegetation and rehabilitation of existing cleared areas of land within the study area, with a view to re-instating pre-clearing vegetation types.

The Offset Policy sets targets for the condition, area, configuration and status of vegetation offsets, and the Compensatory Habitat Strategy seeks to meet these targets. The proposed targets for the compensatory habitat strategy are outlined in Table 14.15.

Table 14.15 – Offset/Compensatory Habitat Targets

Attribute to be Offset	Area Lost (ha)	Minimum Offset ratio	Minimum Offset Area (ha)	Additional Requirements
Endangered Regional Ecosystem 12.3.3	3.83	1: 1.5	5.75	The proposed offset would ideally be the same regional ecosystem as the area proposed for clearing; The proposed offset would ideally be within 20 kilometres of the area proposed for clearing; The site must be non-remnant vegetation, or remnant vegetation that is otherwise committed to development; The proposed offset site should have weed cover; The proposed offset site should demonstrate the capacity to reach remnant status (with management), attain remnant status within a reasonable timeframe; and; Ideally, the proposed offset site would require minimal revegetation.
Endangered Regional Ecosystem 12.3.10	6.93	1:1.5	10.4	As above
'Of Concern' regional ecosystem 12.12.12	160.32	1:1.5	240.5	As above
'Of Concern' regional ecosystem 12.3.11	13.75	1:1.5	20.63	As above
Threshold regional ecosystem 12.12.7	26.61	1:2	53.22	As above
TOTAL	211.44		330.5	

The EPBC Act does not make direct reference to the requirement for offsets. However, recent amendments made to the EPBC Act, have broadened the types of conditions that are attached to development approvals. This allows voluntary compensatory actions and financial contributions to be made to help offset the impacts of developments in situations where impacts are unavoidable.

A 'Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999', was recently released (August 2007). This document sets out the Governments position on the use of offsets under the EPBC Act. Essentially the document outlines eight principles used to assess proposed environmental offsets, these principles can also be used as a guide for deciding if offsets are required and if so their nature. The eight principles are:

- 1) Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted.



- 2) A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.
- 3) Environmental offsets should deliver a real conservation outcome.
- 4) Environmental offsets should be developed as a package of actions - which may include both direct and indirect offsets.
- 5) Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.
- 6) Environmental offsets should be located within the same general area as the development activity.
- 7) Environmental offsets should be delivered in a timely manner and be long lasting.
- 8) Environmental offsets should be enforceable, monitored and audited.

The ultimate compensatory habitat package will include initiatives which seek to comply with both the VMA and EPBC Act offset policies.

14.3.1.3 Vegetation Management

This section outlines the recommended measures to minimise identified impacts on vegetation within and adjacent to construction zones and includes measures to ensure the identification and demarcation of vegetation to be retained; installation of vegetation protection measures and vegetation management strategies prior to, during and following site preparation works. The following strategies will be employed prior to and during proposed construction works:

- Prior to the commencement of any vegetation clearance, the Contractor shall identify all areas to be cleared on construction plans and in the field.
- Prior to commencement of the Works, the applicant shall fence or clearly mark with tape, the limits of all protected vegetation. Within these zones the following activities shall not be permitted:
 - Storage and mixing of materials;
 - Vehicle parking;
 - Liquid disposal;
 - Machinery repairs and/or refuelling;
 - Construction site office or shed;
 - Combustion of any material;
 - Stockpiling of soil, rubble or debris;
 - Any filling or excavation including trench line, topsoil skimming and/or surface excavation, unless otherwise approved by the Project Manager; and
 - Unauthorized pesticide, herbicide or chemical applications.



- All activities in an area adjacent to any protected tree or area shall be carried out in such a manner as to minimise any damage to trees and / or the conserved area. The following procedures will ensure that retained trees adjacent to development areas will survive construction works and will remain in a healthy condition. The procedures will also ensure that any activity taking place within the drip line of any retained tree will not significantly impact on the survival of the tree. In order to protect retained trees during construction activities, the following procedures can be applied:
 - *Identifying a Tree Protection Zone:* All retained trees likely to be impacted upon by development works will be marked prior to construction works. The size and shape of a particular protection zone will vary according to individual tree species. 95% of a tree's active roots are found within 200mm of the surface. In general, a healthy tree can tolerate up to 30% loss of its root system. The size and shape of a particular protection zone will vary according to individual tree species and the soils on the site.
 - *Pruning:* Prior to establishing a tree protection zone, trees to be protected will be pruned focusing on removal of dead or broken branches. The purpose of this activity is primarily safety, but it serves as a monitor for any damage that may occur during construction. Construction contractors are prohibited from undertaking any additional pruning as this activity, if not performed properly, can be harmful to the tree.
 - *Establishing the Tree Protection Zone:* The following measures are to be taken to protect the tree, in the long term;
 - *Fencing* – Secure posts with 1.8m high chain link or equivalent sturdy fencing to be erected, maintained and removed by the contractor to the outer edges of the protection zone.
 - *Trunk protection* – 1.8m high palings strapped to the trunk.
 - *Mulching* – 100mm of composted mulch cover over the ground within the tree protection zone in order to retain soil moisture and encourage microbial activity. *Irrigation* – natural moisture levels should be maintained during construction activities. This may necessitate temporary irrigation of the tree.
 - *Drainage* – the natural drainage patterns around the root zone should not be altered. To prevent waterlogging of the tree drip zone, heavy overland flow should be diverted around the tree.
 - *Activities Within the Tree Protection Zone:* If during the course of a project, it becomes unavoidable for activities to take place inside the protection zone, then consent should first be gained from a qualified arborist. Such activities may include the erection of scaffolding, vehicle movement, trenching or excavation. An arborist can determine whether it is appropriate to undertake that activity and advise of the most appropriate way to undertake such activities or suggest possible alternatives. Pruning of branches and/or roots may be required; if so these activities should be undertaken under the direction of an Arborist.
 - *Trenching and Excavation:* In general, removal of 5cm of topsoil from 1.5 m from the base of the tree will cause minimal disturbance to the health of the tree, provided that adequate water is supplied during excavation. When trenching or excavation is to be undertaken within the root zone of any tree, roots will be severed cleanly rather than torn



with a backhoe or other excavation equipment. All roots are to be exposed first and then cut cleanly with a sharp saw or loppers. Exposed roots are to be kept moist and covered with hessian for the duration of the exposure. Where roots with a diameter larger than 50 mm are encountered excavation should be undertaken by hand and such roots tunnelled under.

- *Monitoring and Reporting:* Regular monitoring is necessary for long-term projects. A monthly site inspection will be conducted to ensure that protection measures are being adhered to and that retained trees are not showing signs of damage or stress. Such inspections shall be completed by a qualified arborist.
- *Soil Injections:* If deemed necessary by an Arborist a soil injection treatment will be applied to the root zone of any tree that has been adversely affected by a project. The soil injection treatment is a combination of water, nutrients and other agents that promote root growth such as; rooting hormones, humic acids, soil microflora and mycorrhizae. The use of nitrogenous fertilisers must not be used where *Phytophthora cinnamomi* (root rot fungus) is suspected or known.
- *Cuts:* Cuts lower the soil level and remove the topsoil layer along with feeder roots. The amount of damage cuts have on a root system depends on the texture of the original soil. The coarser the soil texture, the deeper the roots tend to be, and the deeper a cut can be made before serious damage is done. Excavate the finish grade by hand and prune exposed roots. Mulch the area immediately after the cut is completed. If the cut causes inadequate soil moisture by redirecting water flow or lowering the water table, add supplemental irrigation. If large grade changes are needed, a retaining wall or crib can be used. Retaining walls allow deep fills and cuts while still protecting the original soil level within the critical root area.
- Trees deemed to be potentially impacted upon, shall be protected by the application of carpet underlay and/or corrugated iron or some other similar material to encase that trunk of the tree.
- Prior to commencement of the works, the applicant shall arrange a pre-start meeting with Council Environmental Assessment Officers or other relevant Council Officer. The applicant shall tag all trees to be retained and shall install all approved protection measures.
- No clearing shall occur outside nominated clearing zones.
- Clearing shall occur in the sequence of cutting, shearing of felled vegetation and tub grinding.
- Upon completion, grubbing operations shall ensure the site is left free draining with no ponding of stormwater.
- Erosion & sediment control works shall be undertaken in accordance with the relevant Environmental Management Plan.
- The erosion and sediment control measures shall not be dismantled until the disturbed areas have been covered by mulch to a minimum depth of 100 mm.
- Each zone shall be mulched immediately upon completion of clearing & grubbing works.
- All mulch produced on site by mulching cleared vegetation and trees shall specifically exclude material from weed species.



- Soil disturbance shall be kept to a minimum to avoid weed proliferation.
- Management of weeds will include the use of suitable control measures (i.e. chemical and/or physical) in accordance with appropriate strategies recommended by Council. The Redland Shire Council Pest Management Plan and Vegetation Enhancement Strategy will guide the control of declared plants and environmental weeds if present on the site.
- Re-vegetation/landscaping of areas shall be completed in accordance with an approved landscape plan for the area. Plant densities, species, schedules and timing will be specified on approved landscape plans. Details on fertilizer and chemical usage will be detailed on specifications attached to the approved landscaping plan.

14.3.1.4 Fauna Management

The Queensland *Nature Conservation Act 1992* and *Nature Conservation (Wildlife) Regulation 1994* require that protected animals whose habitat has been or is about to be destroyed by human activities or natural disasters are cared for and rehabilitated. Compliance with these Acts will be required. This section outlines the recommended measures to minimise potential impacts on fauna during construction works.

- Prior to the selective clearing operations, habitat trees shall be identified. Habitat trees are defined as those trees that provide suitable foraging, refuge and nesting resources for arboreal and avian fauna and microbats. These include hollow-bearing trees, trees with fissures, trees with food resources (e.g. pollen, nectar, foliage, arthropods). Larger, old growth trees are also considered to be habitat trees as they are likely to provide greater amounts of foraging resources, cover, and a high number of potential hollows. Dead (stag) trees are also regarded as important habitat trees as they provide roosting and nesting resources.
- Once this has been completed, clearing shall be conducted using a staged approach where the smaller non-habitat trees are removed in the first stage with the larger remaining habitat trees removed three to five days after the initial clearing. This staged method provides a disturbance stimulus and provides fauna with time to leave the site thus maximizing the chances of fauna survival while reducing the need for human intervention for translocation or rescue purposes.
- At least 14 days prior to the pre-start meeting, an appropriately qualified person (i.e. accredited by QPWS for capture and release) 'Spotter-catcher' shall be appointed and assess the site for wildlife habitat. Before this meeting, the 'Spotter-catcher's' curriculum vitae shall be provided to Council. After the pre-start meeting, the 'spotter catcher' shall provide a plan to Council indicating the broad range of fauna expected in the site, the proposed method of operation, and any expected constraints. All operational works involving habitat removal are to be supervised until satisfied that native fauna have been suitably relocated, and shall instruct the contractor when no further action is required. Council will confirm with the appointed person that no habitat removal occurred without supervision shall be present to inspect the trees and relocate remaining fauna where possible. The applicant shall be responsible for fees payable to the 'Spotter-catcher'.
- If any denning, roosting or nesting animals are observed within hollow limbs, but cannot be readily removed by an ecologist, it is recommended that, where appropriate, the hollow end of the limb be blocked with porous material and a chainsaw be used to remove the limb. The limb

should then be relocated to a suitable place, determined in consultation with QPWS and the hollow end unblocked at an appropriate time of day to minimise fauna predation. In the case that a colony of microchiropteran bats are located, then the roost will either be felled at night (once bats have vacated) or the entry points shall be blocked, and the roost will be moved to an appropriate area of vegetation to be retained on or adjacent to the site.

- Prior to tree removal, an appropriately qualified ecologist shall attempt to “flush out” any denning or nesting animals not observed during the initial hollow inspection. This may involve hitting target trees with a sledgehammer or another similar technique.
- Following felling, a second inspection of the relevant trees shall be carried out to relocate fauna disturbed by the clearing process or remaining within the felled timber to a suitable location determined in consultation with QPWS.
- Where possible, the actual felling of the habitat trees shall be conducted in a manner that will maximize the chances of survival for any fauna remaining within the tree hollows. This shall involve pushing rather than cutting, and cushioning the tree fall with other felled timber and foliage.
- All injured animals shall be immediately removed and taken to an appropriately qualified veterinary surgeon. Should any orphaned or injured native fauna be discovered at a later stage during operational works, then matter shall be immediately reported to the Central Moreton District Officer of the QPWS.
- Following completion of the selective clearing stage, capture and release records shall be supplied to QPWS in accordance with their licensing conditions. A copy of these records, if requested, shall be supplied to Council.

14.3.1.5 Weed Management

A Weed Management Plan will ultimately be prepared for the project. Management measures to prevent the movement of declared weeds to and from the construction site include:

- Use of wash-down facilities for vehicles and equipment entering and leaving the dam construction site and those areas proposed for vegetation clearance.
- All machinery, equipment and vehicles shall be certified as “clean” prior to entering the site by trained personnel in accordance with DNRW practices.
- Weeds are not to be used as mulch for landscaping, but are to be disposed of and burnt to prevent reseeding.
- Soil, earth and landscaping material brought onto the site must be from a source that is clean and weed free.
- The monitoring of revegetated areas to identify new infestations and eradicate any declared weeds found.
- Weed monitoring to ensure that new weed species are not introduced into the immediate development area or surrounding sites.

14.3.1.6 Vector Management

Biting insects are a management problem along the entire eastern seaboard of Australia, particularly in areas within 1km of suitable breeding sites such as tidal waterways, mangroves and



saltmarsh systems. There are several strategies which can be implemented at the design stage to avoid the creation of potential breeding sites, whilst residents and visitors can adopt a suite of straightforward measures to mitigate personal risk of biting insect attack. To help minimise biting insect nuisance in those portions of the development located near biting midge or mosquito breeding areas the following design strategies are suggested:

- Biting insects, particularly biting midge, will follow vegetated corridors from breeding areas to residential areas. It is therefore suggested that breaks are provided in any continuous vegetation lines leading to residential areas.
- Roadway embankment construction should be designed to eliminate (if possible) any standing water impoundment or redirection of water flows into potential mosquito breeding areas.
- Consideration of stormwater drainage design and route. Drains should be designed to avoid silt accumulation and be free draining. Exit points from drains into waterways or wetlands should be designed to avoid habitat changes at discharge points such as will occur if organically enriched drainage from urban areas is directed into mangrove areas or *Melaleuca* wetlands. Misdirected stormwater into these habitats can create new midge and mosquito breeding sites or increase existing breeding by favouring certain aquatic and semi aquatic vegetation species that restrict drainage flow. Silt accumulation at stormwater estuary discharge points, combined with regular low flow water discharge particularly suite the biting midge species *C. sumimmaculatus*. Care must be taken to avoid increasing tidal influence back up drains into freshwater wetlands as this increases saltmarsh mosquito favourability.

An overall low risk of mosquito and midge nuisance (within the development area) suggests that more passive measures of management are more appropriate than physical or chemical approaches. Following are some suggestions for residents/visitors affected by biting midge and mosquito nuisance to help alleviate or minimise the problem:

- Keep vegetation surrounding the dwelling to a minimum. This reduces insect harbouring areas and increases air flow surrounding the house. Also keep lawns well mowed as any activity that reduces sheltering sites and lowers humidity surrounding the house will help to deter mosquitoes and biting midges.
- Keep insect screens well maintained. If biting midge is a problem entering through fly screens, smaller mesh sizes such as found in products like "Solar Mesh" may stop entry. Screens can also be sprayed with insecticide barriers to deter midges. The newer lower toxic surface sprays containing synthetic pyrethroids can be very effective.

It is most likely that biting midge will enter dwellings on the leeward side of the dwelling where lower air pressures and wind speed are created by the wind blowing over the dwelling. It will also be from this side of the dwelling that carbon dioxide respired by the inhabitants (a strong attractant to midge) will emanate. Close leeward windows or keep more window area on the windward side of the dwelling open as this will tend to pressurise the dwelling and increase draft from the leeward side reducing the midges ability to enter.



14.3.1.7 Vehicular Collision

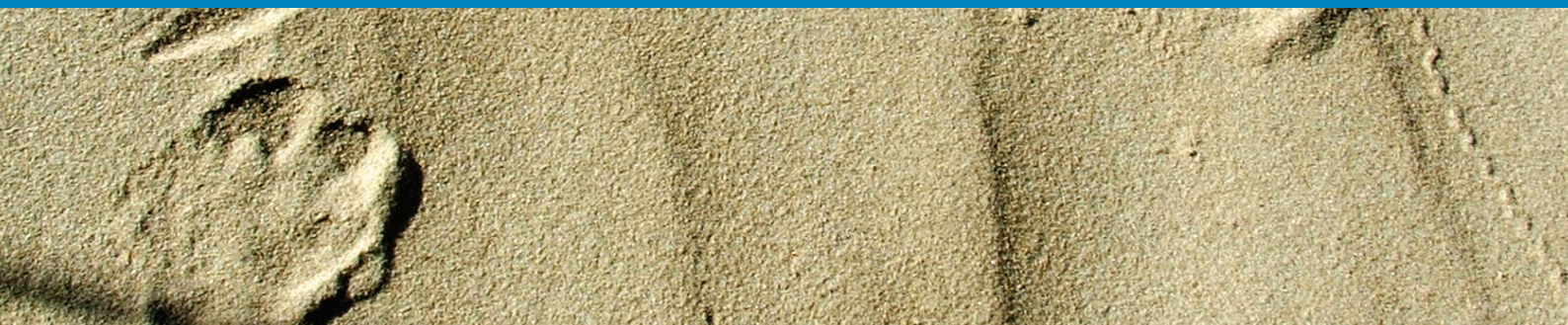
A complementary suite of mitigation strategies will be employed to reduce the impact of traffic on wildlife. These may include the following:

- Construction of elevated bridges over designated crossing points. These are commonly referred to as underpasses;
- Construction of culverts beneath the final road surface;
- Establishment of traffic “go slow” zones;
- Construction of overpasses; and
- Installation of exclusion fencing to prevent fauna entering the roadway and guide fauna towards the crossing points and associated infrastructure.

These strategies should be further refined as the ultimate form of the development is confirmed. Once the design layout of the development is confirmed, it will be possible to map likely fauna crossing points and potential conflict areas. Development of a road strike reduction strategy which fully documents the configuration of these structures could be made a condition of approval.



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NATURE CONSERVATION – MARINE





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15. Nature Conservation - Marine

15.1 Existing Environment - Marine Flora and Fauna

15.1.1 Areas of Marine Conservation Significance

A number of sources were referenced in establishing Marine Conservation and Protected Areas relevant to the proposed development of Hummock Hill Island, including:

- *Nature Conservation Act 1992* and associated Regulations;
- *Marine Parks Act 2004*;
- *Marine Parks Regulation 2006*;
- *Fisheries Act, 1994*;
- State Coastal Management Plan;
- Curtis Coast Regional Coastal Management Plan;
- Commonwealth Department of Environment and Water Resources databases, in particular:
 - Australian Heritage Database (formerly Register of the National Estate);
 - Australian Natural Resources Atlas;
 - Collaborative Australian Protected Areas Database;
 - Australian Wetlands Database;
 - EPBC Protected Matters Search Tool;
 - Environmental Reporting Tool. and
- Queensland Department of Primary Industry and Fisheries, Coastal Habitat Resources Information System (CHRIS) database.

A search of the Commonwealth EPBC Act Protected Matters¹ (Refer to Appendix A3) returns the results outlined in Table 15.1 for the area around Hummock Hill Island.

Table 15.1 – Summary Results of Conservation and Protected Areas Searches

Matters of National Environmental Significance	No.	Details
World Heritage areas	1	Great Barrier Reef, Qld
National Heritage places	0	
Wetlands of International Significance (Ramsar sites)	0	
Commonwealth Marine Areas	1	Great Barrier Reef Marine Park
Threatened ecological communities	0	
Threatened species	21	Refer to section 15.1.3 & Appendix A3
Migratory species	27	Refer to section 15.1.3 & Appendix A3

¹ www.deh.gov - accessed 12/04/2006

Other matters protected by the EPBC act		
Commonwealth lands	0	
Commonwealth Heritage places	0	
Places on the Register of the National Estate (RNE)	1	Great Barrier Reef
Listed marine species	71	Refer to section 15.1.3 & Appendix A3
Whales and other cetaceans	12	Refer to section 15.1.3 & Appendix A3
Critical habitats	0	
Commonwealth reserves	0	
Extra information		
State and territory reserves	4	Colosseum Fish Habitat Area, Qld Great Barrier Reef Coastal Marine Park, Qld Rodds Bay Dugong Protection Area, Qld Wild Cattle Island National Park, Qld
Other commonwealth reserves	1	
Regional forest agreements	1	
Nationally important wetlands	2	Colosseum Inlet - Rodds Bay, Qld129 Great Barrier Reef Marine Park, Qld

15.1.1.1 Great Barrier Reef Marine Park

Hummock Hill Island is situated on the landward boundary of the Great Barrier Reef Marine Park (GBRMP) Zone MPZ17 - Gladstone. The GBRMP boundary runs from offshore to the northern tip of the Island, along the northern shoreline, and to the southern tip of the Island where it cuts across the entrance of Rodds Bay to Rodds Peninsula (Figure 15.1, also see Figure 1.3). The area of the GBRMP adjacent to Hummock Hill Island is jointly administered by the Great Barrier Reef Marine Park Authority (GBRMPA) and Queensland. The landward limit of the GBRMP boundary on the island is the low-water mark; areas between the low-water mark and highest astronomical tide (HAT) are classified as "internal waters of Queensland", areas above the low water mark on the Island are not part of the GBRMP but are in the Great Barrier Reef Coastal Marine Park administered by Queensland State (Section 12.1.8.3). The boundaries of the GBRMP are presented in Figure 15.1.

Creek Rocks (24-001) lies 1.3 km northeast of Sandfly Creek, which divides Hummock Hill Island. Creek Rocks is classed as a GBRMP Habitat Protection Zone (HPZ). Seal Rocks (23-067), another GBRMP Habitat Protection Zone, is located approximately 2 km northeast of the Northern Headland on the island (see Figure 1.3). 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. The above habitat protection zones are located over 5 km from the Island.

The Rodds Bay area of the GBRMP (excluding the above Habitat Protection Zones) is designated a General Use Zone (GUZ) with the objective to provide opportunities for reasonable use of the GBRMP, while still allowing for the conservation of the area. Allowable activities in these marine park zones are outlined in Table 15.2.



LEGEND

- Great Barrier Reef World Heritage Area
- Intertidal Wetlands
- Marine Park Zoning**
 - Habitat Protection Zone
 - Combined State and GBRMPA Administration
 - General Use Zone

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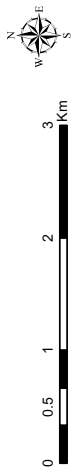


Figure 15.1 - Great Barrier Reef World Heritage Area, Great Barrier Reef Marine Park and Great Barrier Reef Coastal Marine Park Boundaries



Table 15.2 – Allowable Activities within Habitat Protection Zones (HPZ) and General Use Zones (GUZ)

Activity	HPZ	GUZ
Aquaculture	Permit	Permit
Bait Netting	Y	Y
Boating, diving, photography	Y	Y
Crabbing (trapping)	Y	Y
Harvest fishing for aquarium fish, coral and beachworm	Permit	Permit
Harvest fishing for sea cucumber, trochus, tropical rock lobster	Permit	Permit
Limited collecting	Y	Y
Limited impact research	Y	Y
Limited spearfishing (snorkel only)	Y	Y
Line fishing	Y	Y
Netting (other than bait netting)	Y	Y
Research (other than limited impact)	Permit	Permit
Shipping (other than a designated shipping area)	Permit	Y
Tourism program	Permit	Y
Traditional use of marine resources	Permit (TUMRA)	Permit (TUMRA)
Trawling	N	Y
Trolling	Y	Y

The Great Barrier Reef Marine Parks Authority (GBRMPA), in its State of the Great Barrier Reef Online (2006), lists the following as the main pressures currently affecting identified environmental values within the GBRMP:

- Coastal development (physical habitat damage or removal, and changes in hydrology and salinity regimes)
- Declining water quality (increased levels of sediments, nutrients, pesticides and litter);
- Shipping and oil spills (increased levels of petrochemicals);
- Aquaculture (increased siltation, erosion and nutrients);
- Disturbance events (severe weather events and invasion of pest species);
- Climate change (sea level rise and increase in storm/cyclone frequency and intensity);
- Human use (fishing, collecting, traditional hunting, boat strike);
- Habitat loss and degradation; and
- Incidental catch (dugong and marine turtles).

15.1.1.2 Great Barrier Reef Coastal Marine Park

Hummock Hill Island also lies on the boundary of the Queensland State Great Barrier Reef Coastal Marine Park (GBRCMP), which covers all waters of Seven Mile Creek, Boyne Creek and Colosseum Inlet to the highest astronomical tide (HAT). The GBRCMP provides protection for Queensland tidal lands and tidal waters within the Great Barrier Reef Area and includes tidal rivers, creeks and mangrove areas. The GBRCMP in the Hummock Hill Island area imposes the same restrictions that



apply to the General Use Zone of the Commonwealth Great Barrier Reef Marine Park, and there is a joint management plan for the State and Commonwealth parks. The boundaries of the GMRMP and

15.1.1.3 Great Barrier Reef World Heritage Area

The Great Barrier Reef World Heritage Area (GBRWHA) includes Hummock Hill Island itself as well as the surrounding waters including Colosseum Inlet, Boyne Creek and Rodds Bay (Figure 15.1). On the mainland the landward boundary of the GBRWHA is HAT.

Most of the values identified for the GBRWHA against the World Heritage Area listing criteria relate to the marine ecosystem, in particular the large number and biological and geomorphological diversity of coral reefs, the geomorphological and biological interconnectivity of reefs and islands, north-south marine biodiversity gradients, spectacular reef and island seascapes, and the presence of key habitats for species of conservation significance. The detailed values for GBRWHA listing are presented in Appendix A3.

15.1.1.4 Nationally Important Wetlands

Colosseum Inlet is listed in the DEWR administered Important Wetlands Database as Colosseum Inlet - Rodds Bay - QLD129. Figure 15.2 shows the Colosseum Inlet - Rodds Bay area referred to within the Directory, which comprises 24,307 ha. This area also falls within the GBRMP and GBRCMP and is subject to management as a General Use Zone.

The Colosseum Inlet - Rodds Bay wetland includes eight identified categories of marine and coastal wetlands and is included as a nationally important wetland on five of the six listing criteria (refer to Appendix A7.11). The listing is due in part to the presence of species of flora and fauna designated as rare, vulnerable or endangered at the national or state levels. Directory entries include, amongst others:

- seagrass beds;
- 2 - 5 % of the world population of Eastern Curlew (*Numenius madagascariensis*) (Sr²);
- various migratory waders;
- dugong (*Dugong dugon*) (Sv); and
- green turtle (*Chelonia mydas*) (Nv, Sv) feeding grounds.

Management responsibilities for the various environmental values within the Colosseum Inlet - Rodds Bay wetland lie with Queensland Department of Primary Industries & Fisheries, Department of Natural Resources and Water, Queensland Environmental Protection Agency, Queensland Parks & Wildlife Service, Great Barrier Reef Marine Park Authority, leaseholders, freehold land owners and Miriam Vale Shire Council.

² Refer to Glossary for definition



LEGEND

 Intertidal Wetlands

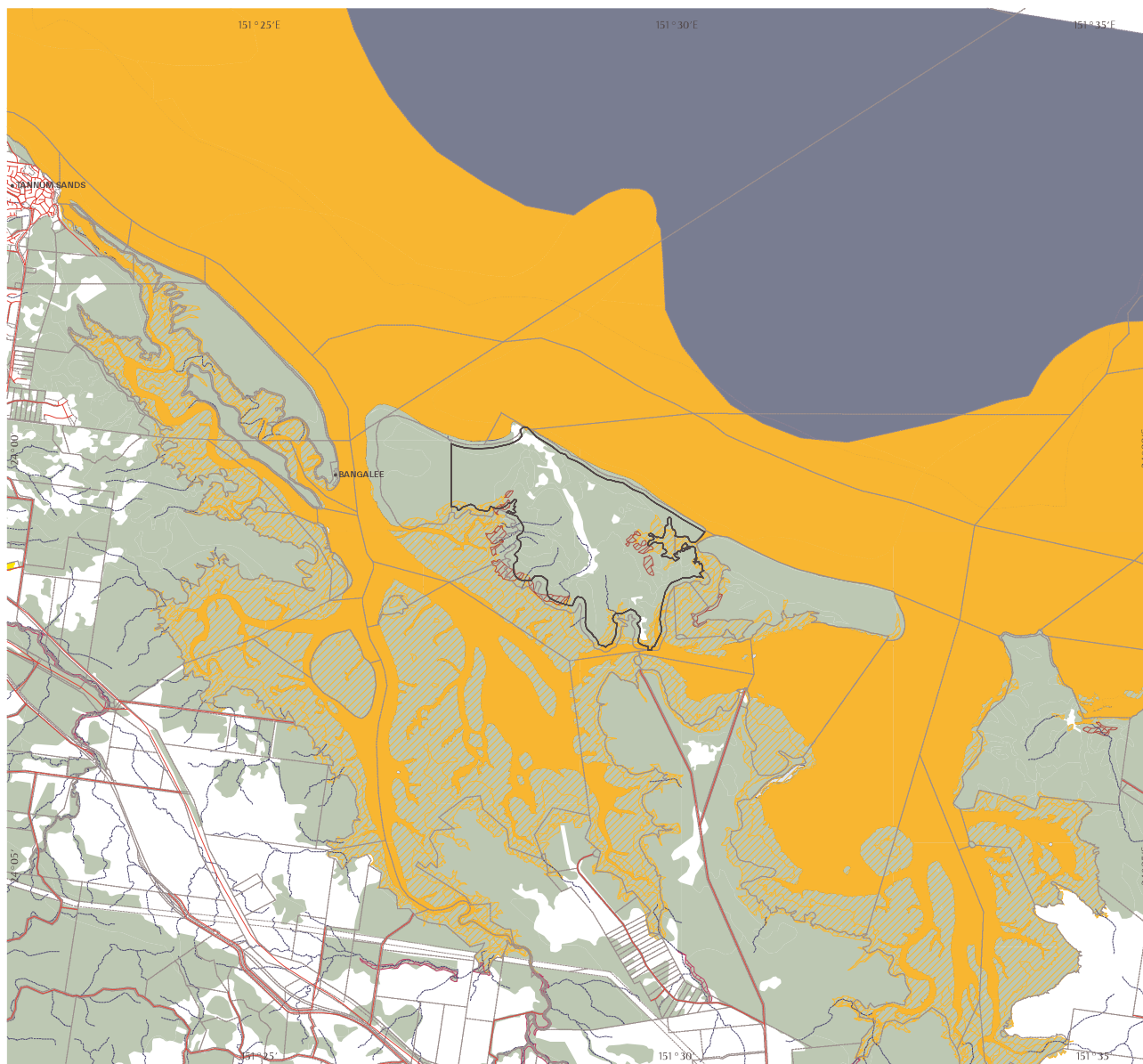
 Coastal Seagrass Meadows

Figure 15.2 - Nationally Important Wetlands Around Hummock Hill Island

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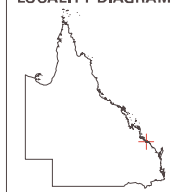




LEGEND

- Wetland Regional Ecosystem
 - Estuarine
 - Marine
 - Riverine
 - Lacustrine
 - Palustrine
- Wetland Water Body System
 - Estuarine
 - Marine
 - Riverine
 - Lacustrine
 - Palustrine
- 2003 Regional Ecosystems of Queensland
 - Plantations
- Subject Lot
- Drainage
- Roads
- © MapInfo Australia Pty Ltd 2003
- Cadastral Boundaries
 - The maximum spatial error of parcels extracted for this map from the Digital Cadastral Data Base(DCDB) range from: 14m to 251m at a 95% confidence level. Property boundaries shown are provided as a locational aid only.
- ▲ Springs
- Towns

LOCALITY DIAGRAM



Digital wetland data and mapping methodology is available from www.epa.qld.gov.au/wetlandmapping

The positional accuracy of wetland data mapped at a scale of 1:100 000 is +/-100 metres with a minimum polygon size of 5 ha or 75 metres wide for linear features, except for areas along the east coast which are mapped at the 1:50 000 scale with a positional accuracy of +/-50 metres, with a minimum polygon size of 1 ha or 35 metres wide for linear features. Wetlands smaller than 1 ha are not delineated on the wetland data. NB: Consideration of the effects of mapped scale is necessary when interpreting data at a larger scale, (eg: 1:25,000). For property assessment, digital linework should be used as a guide only.

The extent of wetlands depicted on this map is based on rectified 2001 Landsat ETM+ imagery (supplied by SLATS, Department of Natural Resources, and Water). The extent of water bodies is based on the maximum extent of inundation derived from available Landsat imagery up to and including the 2001 imagery.

Disclaimer: While every care is taken to ensure the accuracy of this product, the Queensland Government and Australian Government and MapInfo Australia Pty Ltd make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which might be incurred as a consequence of reliance on the product, or as a result of the product being inaccurate or incomplete in any way and for any reason.

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2000 0 2000 m



15.1.1.5 Regionally Important Wetlands

Reference to the Qld EPA Wetland Mapping and Classification Program (WMCP) shows that Colosseum Inlet and Rodds Bay contain the following:

- Estuarine Wetland Regional Ecosystem; and
- Palustrine Wetland Regional Ecosystem.

No estuarine wetland ecosystems are mapped within the lease boundary of the proposed development (Lot 3 on FD841442). Some palustrine wetland is mapped within the lease boundary but outside the development footprint with a 50 - 100 m buffer strip of native vegetation. Estuarine and palustrine wetland systems are mapped immediately adjacent the boundary of Lot 3 on FD841442 (refer to Figure 15.3).

15.1.1.6 Fish Habitat Areas

Declared Fish Habitat Areas (FHAs) are declared to give protection to inshore and estuarine fish habitats that are important for sustaining local and regional fisheries. Once an area is declared as a FHA, it equally protects all habitat types (e.g. vegetation, sand bars and rocky headlands) from direct physical disturbance and coastal development.

Queensland Department of Primary industries and Fisheries (QLD DPIF) has developed two levels of management for declared FHAs, each of which may be applied to the entire declared FHA or to zones within a declared FHA.

- Management level 'A' is used for locations where very strict management arrangements can be achieved.
- Management level 'B' is used for locations where existing or planned uses require a more flexible management approach.

Activities that are permitted within each habitat protection zone are outlined in Table 15.3 below. Permits are required for any of these activities.

Table 15.3 – Summary of activities that may be authorised within each declared FHA management level.

Activity	Management level 'A'	Management level 'B'
Limited impact construction of facilities for 'a fisheries purpose' (e.g. Public boat ramps, public jetties).	+	+
Maintenance of existing facilities	+	+
Construction of educational facilities (e.g. Boardwalks)	+	+
Scientific research	+	+
Works for public health and safety reasons	+	+
Restoration of disturbed fish habitats	+	+
Other limited impact public and private structures that are assessed as having an overriding requirement to be on tidal land or within the FHA (e.g. Private jetty, public bridge).	-	+



Activity	Management level 'A'	Management level 'B'
Construction of public facilities that require only minimal, temporary disturbance to the fha that can be totally restored (e.g. Fully buried submarine pipeline).	+	+

The Colosseum Inlet FHA includes Wild Cattle Creek, Colosseum Inlet, Boyne Creek, Seven Mile Creek and Thorton Creek as defined on QLD DPIF Plan FHA-037 (Figure 15.4). Colosseum Inlet and the eastern part of Boyne Creek and Seven Mile Creek are zoned Management A. Wild Cattle Creek, northwest of Hummock Hill Island, and the eastern part of Boyne Creek and Sandfly Creek, which divides Hummock Hill Island, are zoned Management B (refer to Appendix A7.11). The causeway linking the mainland and the Island and 100 m either side are excluded from the FHA.

15.1.1.7 Dugong Protection Areas

Dugong Protection Areas (DPAs) were declared in legislation under the Queensland *Nature Conservation Act 1992* and Queensland *Fisheries Act 1994* and the areas that are protected are gazetted under the Fisheries Regulations 1995. DPAs are also designated as Special Management Areas under the Great Barrier Reef Marine Park Regulations 1983 and the Great Barrier Reef Marine Park Zoning Plan 2003. DPAs were established to protect dugongs from injury and mortality from fishing activities. DPAs are subject to two levels of protection: Zone 'A' and Zone 'B'.

Zone 'A' DPAs include all significant dugong habitats in the southern Great Barrier Reef and collectively contain over 50% of dugong numbers. In these areas, the use of offshore set, foreshore set and drift nets are prohibited, except in the Hervey Bay - Great Sandy Strait DPA, where specialised fish netting practises are allowed to continue with modifications. The use of river set nets is allowed with modifications in Zone 'A' DPAs, except in two key areas where river set nets are prohibited (the Hinchinbrook and Shoalwater Bay DPAs). Other netting practices such as ring, seine, tunnel and set pocket netting, which are not considered to pose a serious threat to dugongs, are unaffected.

In Zone 'B' DPAs, mesh netting practices are allowed to continue, but with more rigorous safeguards and restrictions than before. Zone 'B' DPAs have been shown to contain about 22% of the dugong population in the southern Great Barrier Reef. The protective measures in both DPA management zones are being kept under review to ensure protection of dugongs in these areas (QLD DPI³).

Hummock Hill Island is located within the Rodds Bay Dugong Protection Zone B, as shown in Figure 15.4. The protection zone includes Colosseum Inlet, Boyne Creek, Seven Mile Creek and Rodds Bay, which border the proposed development area.

³ http://www.qbrmpa.gov.au/corp_site/info_services/publications/dugong/sanctuaries.html accessed April 2006

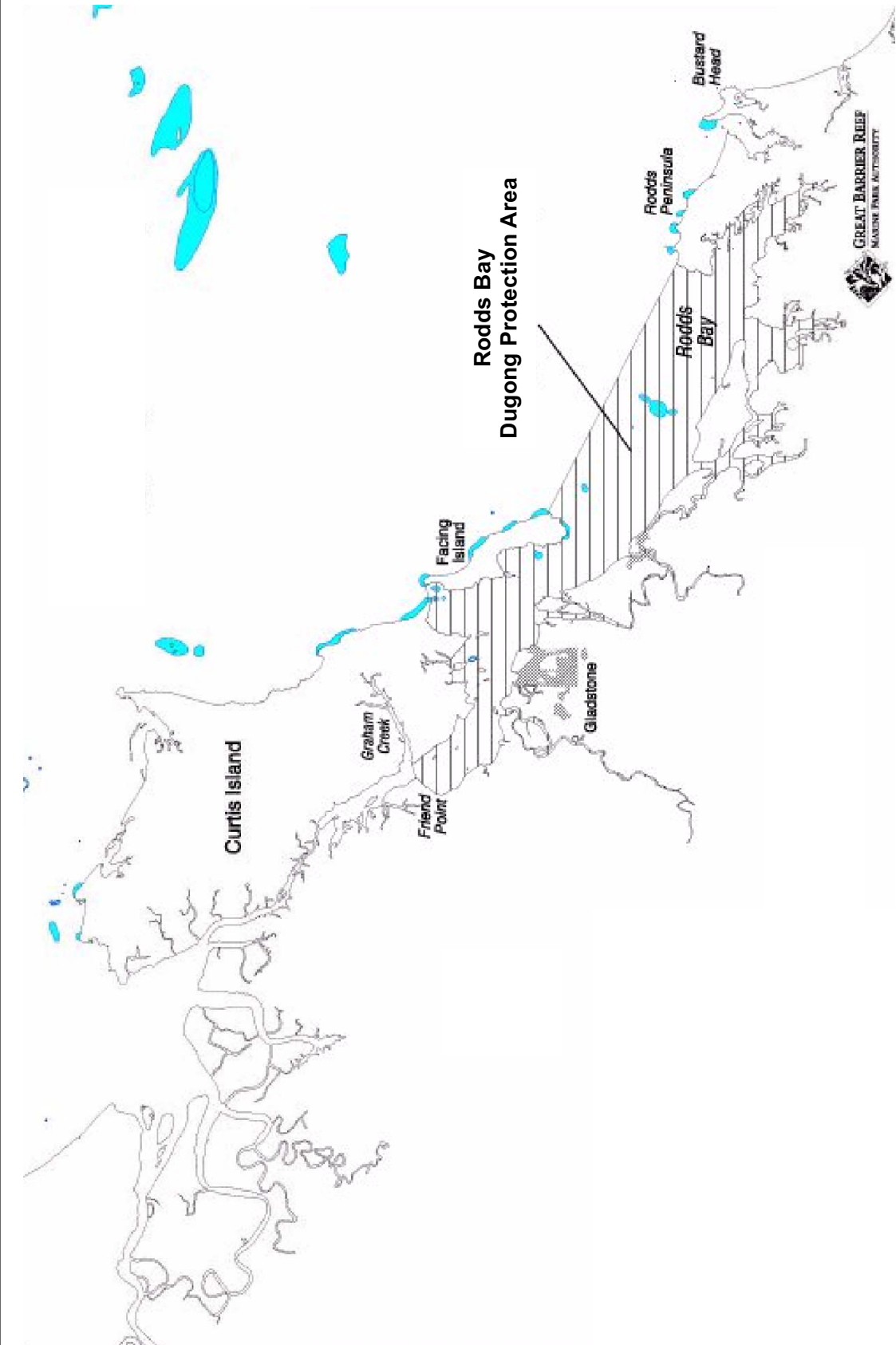


Figure 15.5 - Rodds Bay Dugong Protection Zone

LEGEND

-  Dugong Sanctuary 'B': The boundaries on this map are indicative only. For specific details please contact the local Boating and Fisheries office on the number included in this brochure.
-  Reefs and Shoals

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Hummock Hill



NOT TO SCALE



15.1.1.8 Areas of State Significance (Natural Resources)

Areas of State Significance (Natural Resources) where they are located on the coast, or within the coastal zone and linked to the coast through their contribution to protecting the coastal resources and their values, are defined as ‘areas of State significance (natural resources)’ for the purposes of coastal management. The following features have been identified as possible areas of State significance (Natural Resources):

- (a) significant coastal wetlands (refer to Section 15.1.1.4 and 15.1.1.5;
- (b) significant coastal dune systems (refer to Section 5.2 ;
- (c) endangered regional ecosystems (refer to Section 14.2); and
- (d) protected areas (State land), land declared critical habitat, and areas of major interest as defined under the *Nature Conservation Act 1992*.

Areas of State Significance (Natural Resources) are identified in regional coastal management plans (RCMP). The Curtis Coast RCMP identifies the following as significant coastal resources:

- Significant coastal wetlands associated with Colosseum Inlet;
- Small low, linear sand island; and
- Fish Habitat Area B.

The Wide Bay Burnett RCMP has not been released for public comment (as of November, 2007), however significant coastal resources are likely to be similar to the Curtis Coast RCMP such as:

- Significant coastal wetlands associated with Colosseum Inlet;
- Beach Ridge Systems associated with the Holocene strandplains discussed in Section 5; and
- Fish Habitat Area A.

Critical habitat for marine species has not been listed in the SCMP or Curtis Coast RCMP or identified within estuarine or marine waters around the Island. Endangered regional ecosystems are mapped on the Island and are discussed in Section 14.

15.1.2 Aquatic Habitats

Marine and estuarine habitats around the Island are dominated by high-salinity (35 ppt) marine conditions with little freshwater influence, low terrestrial input of total suspended matter (TSM) and medium nutrient loads in existing estuarine and marine waters. There is also an absence of stratification within the water column due to the lack of low-density fresh water from creeks and terrestrial runoff flowing over more dense, saline water.

Principal intertidal habitats surrounding the Island may be separated into two primary units with associated sub-units:

- 1) Sheltered (estuarine) habitats that predominate to the south and west of Hummock Hill Island in the estuaries, consisting of;
 - High Intertidal/Supratidal Claypan Flats;
 - Mid-tidal Mangroves;
 - Low Intertidal/Shallow Subtidal Mud Flats and seagrass meadows;
 - Low Intertidal Rocky Outcrops; and
 - Subtidal Creek and Channel Floors with predominantly muddy bottoms.
- 2) Open coastal habitats that predominate on the eastern and northeastern sections of the Island, consisting of;
 - Sand Beaches;
 - Low Intertidal/Shallow Subtidal Spits, Banks and Shoal;
 - Rocky Reefs and Stacks;
 - Offshore Subtidal Areas with mostly sandy bottoms; and
 - Offshore Disturbed Areas such as the Port Curtis entrance channel and spoil ground.



Figure 15.6 – Typical zonation patterns on the southern side of Hummock Hill Island

Reference to the Queensland Wetlands map (v. 01) for Miriam Vale Shire (9249) and Calliope Shire (9149) presents the following wetland types as being present around Hummock Hill Island:

- Estuarine Systems (e.g. Mangroves, salt flats and estuaries) - wetlands with oceanic water that are significantly diluted with freshwater derived from land drainage; and

- Palustrine Systems (e.g. vegetated swamps) - wetlands dominated by persistent emergent vegetation or where water in the deepest part of the basin is less than 2 m, active wave-formed shores and bedrock features are lacking.

15.1.2.1 Palustrine Wetland

Palustrine systems are noted as occurring on the landward transition zone of Hummock Hill Island in some discrete areas of Colosseum Inlet. Figure 15.8 presents current Queensland Wetlands Programme mapping for Hummock Hill Island as conducted by Qld EPA. Palustrine wetlands on the Island are located in two areas, generally just above the HAT line. Palustrine wetlands on the eastern side of Sandfly Creek are located around 50 - 100 m from the edge of the development and are not within the development footprint.

15.1.2.2 High Intertidal/Supratidal Claypans and Salt Flats

This vegetation zone (estimated at 2,077 ha) located on the landward side of the mangrove communities described above contain claypans, salt flats and salt marsh grasses in the areas where tidal inundation is only occasional (Dames & Moore, 1993), generally on high spring tides and during heavy rainfall (Dames & Moore, 1995). The claypan areas are generally devoid of vascular plants as can be seen in Figure 15.7, except in the areas directly adjacent to mangrove communities where some salt marsh plants occur.



Figure 15.7 – Supratidal Claypans Adjacent to Clarks Road

Teasdale *et al.* (2006) describe the salt flats around Port Curtis as occupying the highest elevation within the intertidal zone and being characterised by hypersaline groundwater and high evaporation rates. They describe a clear distinction between mangrove and salt flat habitat, with mangroves on this boundary often being stunted due to the hypersaline conditions. They state that the salt flats are extremely level, typically with longitudinal surface gradients of around 10:4. Teasdale *et al.* (2006) found that in general, salt flat surface sediment was relatively unconsolidated clay with highly cohesive, low permeability clay below approximately 15 cm. The very low permeability equated to very slow transport of groundwater through the sediment, which affected salt and nutrient fluxes. They state that salt flats may not be covered by seawater for periods of a fortnight



to several months, depending on the tidal curve, and that during this period porewater salt concentrations sometimes increases greatly, to as high as 200 ppt, due to evaporation. A sharp decrease in groundwater salt content from up to 200 ppt below salt flats to around 50 ppt has been found on similar salt flats in Townsville (Teasdale *et al.*, 2006).

The Queensland Wetlands Program (Qld EPA, 2006) describes bare salt flats as being indicative of hypersaline conditions and having relatively low species diversity for floral species occupying this zone. The program also states that no plant or animal is known to be endemic only to saltmarshes and salt flats of Queensland. Microbial mats (algal and bacterial) on bare salt flats are not well understood though the Program notes that such mats may contribute to the diets of several common estuarine fish and crustaceans including the banana prawn.

Typical vegetation reported by Dames & Moore (1993 & 1995) in mangrove areas on the salt flats of Hummock Hill Island includes low scrub of *Ceriops tagal* var *australis*, tall scrub of *A. marina* var *australasica*, low closed forest of *A. marina* var *australasica*, low scrub of *A. marina* var *australasica*, benthic mat communities consisting of the cyanobacteria (blue-green algae) *Microcoleus* and *Porphyrosiphon* and halophytes such as *Sporobolus* salt couch.

Studies of similar habitat (Morton *et al.*, 1988) found that relatively few fish utilised the salt marsh and salt flat habitat due to the ephemeral nature of inundation, being around once a fortnight or less as described above, and a lack of food sources.

The Queensland Wetlands Program note that saltmarsh wetlands provide the following ecosystem services:

- Protecting inhabited coastal areas from storm surge;
- Removing and diluting storm and wastewater from urban and irrigation areas;
- Providing aesthetic values;
- Education and recreation services where interpretive boardwalks have been constructed;
- Providing food-web support such as the supply of nutrients and food, such as plant matter, crab, gastropod and mosquito larvae, on which marine fauna of the lower intertidal zone may depend.

15.1.2.3 Mid-Tidal Mangroves

The Queensland Wetlands Program (Qld EPA, 2006) notes that ecosystem services provided by mangroves include:

- "Provisioning services" such as providing food for humans in the form of finfish and shellfish;
- "Regulating services" such as sequestering carbon (CO₂) and net oxygen production;
- "Cultural services" such as opportunities for nature conservation; and
- "Supporting services" such as cycling of nutrients to adjoining marine lagoons and reefs.



The Queensland Wetlands Program (Qld EPA, 2006) describes mangrove communities as being important fish nurseries where the exposed roots and tree trunks provide shelter for the juveniles of estuarine, nearshore and ocean-going fish and invertebrates. It also notes that mangroves provide abundant food for juvenile fish, and that crustaceans and molluscs are particularly abundant in mangroves, with 60 species of crabs potentially present. Mud crabs (*Scylla serrata*) are an important species associated with the mangrove zone. Mangroves are not noted as supporting a high diversity or number of birds compared to more open wetlands, but are important to some nesting species.

Hummock Hill Island has extensive mangrove areas on the western and southern sides of the Island, particularly in Colosseum Inlet and Boyne Creek. Some 89% of the mangrove area mapped by Olsen *et al.* (1980) between Tannum Sands and Round Hill Head was comprised of dense stands of *Rhizophora*, which also forms >85% of the mangrove area on Hummock Hill Island itself (Dames & Moore, 1995). The *Rhizophora* zone is the widest and usually most seaward component of the mangrove fringe. It consists mainly of dense stands of the red mangrove (*Rhizophora stylosa*), usually 4 to 6 meters in height. Ground cover is generally *Rhizophora* seedlings (Dames & Moore, 1995). These mangrove areas are considered of high importance as nursery areas for juvenile stages of a number of species including invertebrates, fishes and crustaceans that are of recreational and commercial importance (SKM, 2003).

Mangroves around Hummock Hill Island have a typical pattern of zonation, described by Dowling (1993), as follows:

- 1) A *Rhizophora* zone consisting mainly of *Rhizophora stylosa* (Figure 15.9) with some *Avicennia marina* var. *australasica* (grey mangrove) present at the seaward edge. *Aegiceras corniculatum* (river mangrove) is also commonly present towards the landward edge of this zone;
- 2) A *Ceriops* zone immediately behind the *Rhizophora* zone consisting of *Ceriops australis* (yellow mangrove) in the form of a narrow fringe generally forming a low open shrubland. Some areas within this zone may be dominated by *Avicennia marina* var. *australasica* (grey mangrove). This zone is generally at the seaward edge of the claypan zone;
- 3) An intermittent *Ceriops* fringe at the high water mark above the claypan zone consisting of a thin fringe of *C. tagal* var. *australis*, with the fringe varying considerably in structural form and species composition with *Lumnitzera racemosa* (black mangrove) and *Excoecaria agallocha* (blind-your-eye mangrove) also present.

Based on current regional ecosystem mapping (DNRW, 2006) the area of mangrove around Hummock Hill Island is 106 ha (mapped as 12.1.3). This compares with 4,410 ha within Colosseum Inlet as mapped by DPI (2006) (refer to Figure 15.8).

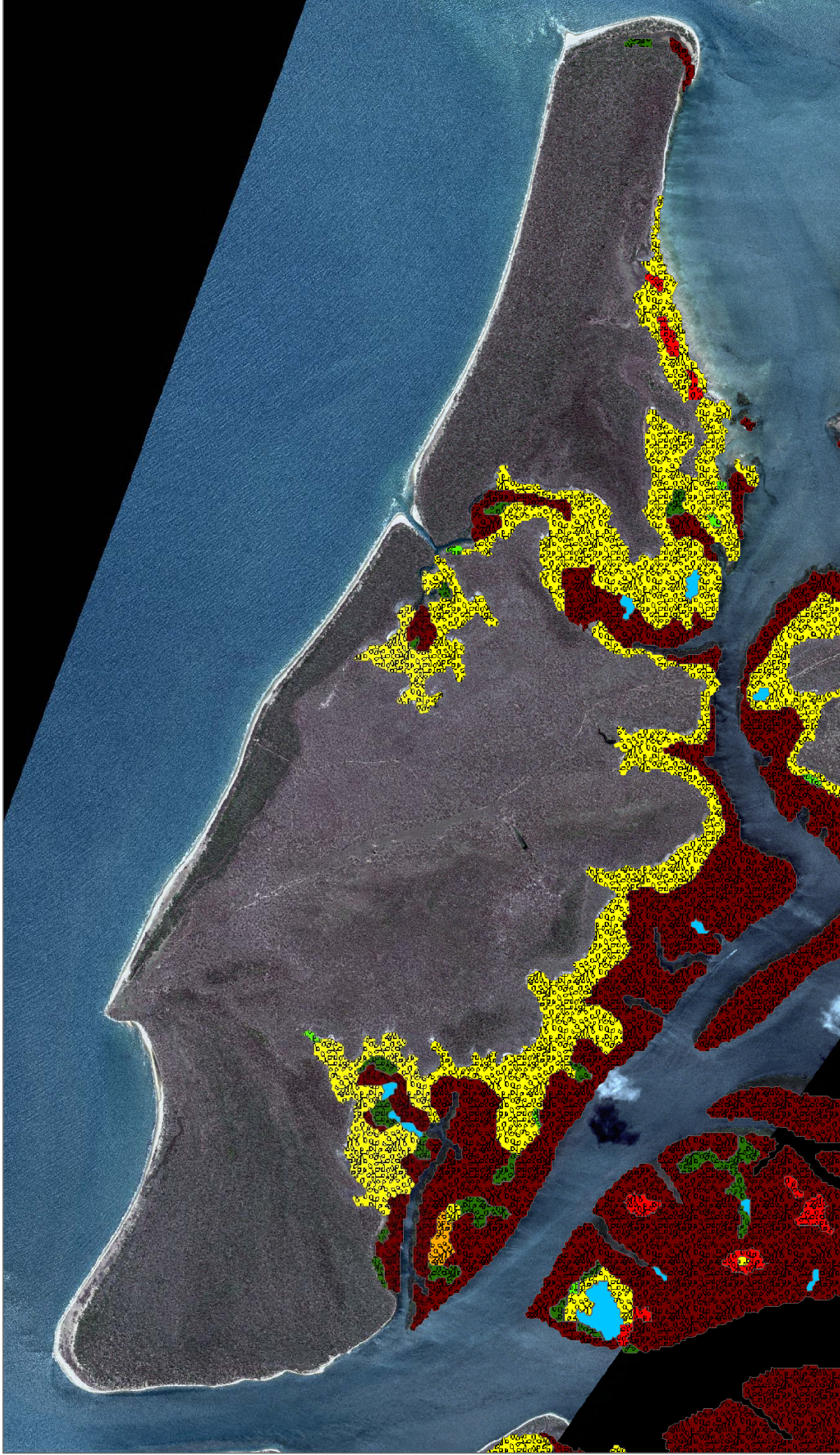


Figure 15.8- Intertidal Wetlands Mapped by the DPI (2003)

LEGEND	
Intertidal Wetlands	
Mangroves	Open Avicennia
Closed Rhizophora	Closed Ceriops
Closed Avicennia	Open Ceriops
Saltmarsh & Substrate	Other
Saltmarsh	Water and Terrestrial

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Figure 15.9 – *Rhizophora stylosa* (Red Mangrove) in Boyne Creek

15.1.2.4 Intertidal Beaches, Banks, Shoals and Seagrass Meadows

Intertidal banks and shoals within Colosseum Inlet, Boyne Creek and Seven Mile Creek display a variety of habitats including:

- Sand beaches;
- unvegetated mud and sand flats and bars;
- boulder-strewn mud and sand flats; and
- seagrass meadows of varying density.

A number of sand beaches occur at the high and middle intertidal level on Hummock Hill Island. The beaches are unvegetated but support several species of fauna including ghost crabs (*Ocypode* spp.), sand bubbler crabs (*Scopimera* spp.) and soldier crabs (*Mictyris* spp.), and in the middle intertidal burrowing whelks and bivalves (Dames & Moore, 1995). The beaches are also used by nesting turtles (see Section 15.1.3.2).

The intertidal sand and mud flats and bars typically extend seaward from beaches or form spits and sand bars extending from the mouth of Colosseum Inlet and Seven Mile Creek. Oysters occupy the boulders on boulder-strewn flats (see foreground of Figure 15.7).

Queensland Department of Primary Industries and Fisheries (Qld DPIF) conducted a detailed survey of intertidal and subtidal seagrass beds around Hummock Hill Island and in Rodds Bay in November



and December 2002 (Rasheed *et al.*, 2003). A total of 27 seagrass beds were identified by helicopter and free-diver. A mixture of both intertidal and deep-water (>5m depth) seagrass beds were identified in locations within Colosseum Inlet, Boyne Creek, Seven Mile Creek and Rodds Bay. The area of these seagrass beds ranged from 0.1 to 484 ha. Most beds were composed of aggregated patches, meaning that the seagrass meadow consisted of numerous patches of seagrass separated by gaps of unvegetated sediment. There were, however, three meadows (sites 77, 78 and 79) with continuous seagrass cover in the Twelve Mile Creek estuary mouth.

A summary of seagrass areas around Hummock Hill Island identified by Rasheed *et al.* (2003) are summarised in Table 15.4 and Figure 15.10.

Table 15.4 – Summary of Seagrass Meadows Identified Around Hummock Hill Island (Rasheed *et al.*, 2003)

ID #	Cover	Species	Biomass (g- dw/m ²)	Area (Ha)
72	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	4.9 ± 1.0
73	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	5.9 ± 1.1
74	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	-
75	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	3.1±0.7
76	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	40.6±3.3
77	Continuous cover	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	0.1±0.1
78	Continuous cover	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	2.8±0.7
79	Continuous cover	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	13.4±1.4
80	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	2.5±1.3
81	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	2.2±0.7
82	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	18.5±3.5
83	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	69.7±11.0
86	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	75.2±9.3
		<u>Colosseum Inlet Total</u>		<u>238.9±34</u>
84	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	12.6±3.0
85	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i> , <i>H. uninervis</i> (Wide)	NA	13.7±3.4
		<u>Boyne Creek Total</u>	<u>=</u>	<u>26.3±6.4</u>
87	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	2.0±0.4
98	Aggregated patches	<i>Z. capricorni</i> , <i>H. uninervis</i> (thin), <i>H. uninervis</i> (wide), <i>H. ovalis</i> , <i>H. minor</i>	8.5±2.4	160.7±9.5
99	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	20.2±1.8
100	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	23.5±3.9	115.3±2.6
101	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	3.2±0.8	20.5±1.4
102	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	NA	6.7±0.7
103	Aggregated patches	<i>Z. capricorni</i> , <i>H. ovalis</i>	3.5±1.0	171.8±7.2
106	Aggregated patches	<i>Z. capricorni</i>	2.4±1.4	0.8±0.2
111	Aggregated patches	<i>H. spinulosa</i> , <i>H. uninervis</i> (thin), <i>Z. capricorni</i> , <i>H. ovalis</i>	7.2±2.9	4.1±1.7
112	Aggregated patches	<i>H. spinulosa</i> , <i>H. uninervis</i> (wide)	10.7±5.9	15.3±1.7
		<u>Seven Mile Creek Total</u>		<u>517.4±27</u>
71	Aggregated patches	<i>H. uninervis</i> (thin), <i>H. ovalis</i> , <i>Z. capricorni</i>	2.1±0.4	484.8±12.4

ID #	Cover	Species	Biomass (g- dw/m ²)	Area (Ha)
110	Aggregated patches	<i>H. uninervis</i> (thin), <i>H. ovalis</i> , <i>Z. capricorni</i>	4.2±0.6	202.3±14.4
129	Isolated patches	<i>H. decipiens</i>	6.5±1.0	0.1±0
		<u>Rodds Bay Total</u>		<u>687.1±27</u>

NA = Biomass not assessed at this site

The two seagrass areas in closest proximity to the proposed development (sites 84 and 85) occur in the western part of Boyne Creek, commencing approximately 200 m east of the existing causeway (Figure 15.10).

Key findings of the Port Curtis and Rodds Bay survey conducted by Rasheed *et al.* (2003) are summarised below:

- Healthy seagrass communities occurred in close proximity to Port facilities, channels subject to regular maintenance dredging and dredge spoil disposal grounds, together with high-density macroinvertebrate communities;
- Seagrass communities in the Port included meadows of species preferred as food by dugongs, as well as dense, high-biomass meadows known to be important as nursery grounds for juvenile fishes and prawns;
- The high-density seagrass areas have a high fisheries value due to their importance as nursery grounds;
- Seagrass was generally confined to shallow intertidal banks, with only small areas of sub-tidal seagrass identified. This distribution was attributed to the relatively narrow intertidal areas and strong currents in adjacent deeper channels;
- Coastal seagrass meadows suitable for dugong feeding occurred throughout the survey area, with feeding trails often evident. Dugongs were observed feeding between Fishermans Landing and Wiggins Island in Port Curtis and in Rodds Bay; and
- Large numbers of green sea turtles, which feed on seagrass, were observed over seagrass beds in Seven Mile Creek and Boyne Creek.



LEGEND

- Coastal Seagrass Meadows
- Precinct Plan

This figure must be read in conjunction with the data disclaimers located at the front of this report. The data acquired for this project is known to be of low spatial resolution and as such no representation or warranties about its accuracy, reliability or suitability are given. Assumptions and conclusions made from this figure and the associated data must be made with full understanding of the data limitations. SKM accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon the figure and the associated data

Figure 15.10 - Mapped Seagrass Meadows Around Hummock Hill Island



15.1.2.5 Low Intertidal Rocky Outcrops

A number of rocky outcrops (bommies) are located within Boyne Creek and Seven Mile Creek. Generally these outcrops are exposed during lower tides and are relatively free of aquatic vegetation, being populated by oyster beds.



Figure 15.11 – Typical Intertidal Rocky Outcrop (mid-distance) in Boyne Creek

Anecdotal evidence from local commercial and recreational fisherman and community groups suggests that some of these outcrops, particularly in western sections of the estuary adjacent and south of Bangalee, may be colonised by live coral colonies. These areas have not been previously mapped identified by previous studies and are not located within the immediate vicinity of the proposed project or associated infrastructure.

15.1.2.6 Subtidal Banks and Shoals

Subtidal banks and shoals within 4 km of the northern shores of Hummock Hill Island were found to be relatively devoid of vegetation by Rasheed *et.al.* (2003). Areas of subtidal seagrass were, however, found further offshore in a range of environments, including the dredge disposal area and navigation channel for Port Curtis. These include an area of subtidal seagrass (area 110) north of the entrance to Sandfly Creek (Table 15.4, Figure 15.10).

15.1.2.7 Rocky and Coral Reefs

A number of coral reefs are present in near shore waters located 4.5 km north of Hummock Hill Island, in particular Seal Rocks 2 km northeast of Northern Headland and Creek Rocks 1.3 km northeast of Sandfly Creek. Seal Rocks and Creek Rocks are both classified as Habitat Protection Zones under current GBRMPA Zoning (see also Section 15.1.1.1).



Figure 15.12 – Patch Rock Reef Located off Shore from North Beach

A number of small rock reefs occur off the northern coastline of the Island, identified from visual inspection from shore and historical aerial photography. These patch rock reefs appear to occur between the island and both Creek Rocks and Seal Rocks within 50 m of the low tide mark, as shown in Figure 15.12. Video surveys by Rasheed *et al.* (2003) revealed rubble areas around Seal Rocks, except to the southeast, with medium-density macroinvertebrate communities (see 15.1.3.4). Rasheed *et al.* (2003) did not survey the area around Creek Rocks. Anecdotal evidence also suggests a patchwork of subtidal rock reefs connecting Seal Rocks to Tiber Point.

15.1.3 Aquatic Fauna

15.1.3.1 Marine Mammals

Marine mammals such as whales, dolphins and dugongs are known to either migrate through or inhabit the Rodds Bay area. Anecdotal evidence suggests whales and dolphins in the area are observed in offshore waters and dugongs within estuarine and near shore waters, generally around seagrass beds meadows.

Waters surrounding Hummock Hill Island are incorporated into the Gladstone - Rodds Bay Dugong Protection Area. Anecdotal evidence from local commercial and recreational fishermen indicates that dugongs have been seen within Colosseum Inlet and Seven Mile Creek, though not frequently. Little data is available on the permanent and transient populations of dugong in this area, though with their food being the more digestible *Halophila* and *Halodule* species of sea grass they are intrinsically linked to sea grass meadows.

Stranding and mortality data records conducted by Qld PWS⁴ show most recorded stranding incidents in the region occur in the Port Curtis area with one stranding recorded in 1995 on the southern tip of Wild Cattle Island. Stranding and mortality data from 2005 is presented in

⁴ Queensland Parks and Wildlife Services



Table 15.5 and shows the majority of recorded strandings of dugong are of an undetermined or unidentified cause.

Table 15.5 Causes of Dugong Stranding or Death in 2005 for all of Queensland (Greenland & Limpus, 2006)

Cause	Number
Disease & ill health	2
Boat strike	2+2?
Netting	4
Hunting	1
Qld DPI&F shark control nets	1
Undetermined/unidentified	26+2?

? - unconfirmed boat-strike incident

Tagging studies have tracked dugongs up to 600 km from their point of capture, though typically the range is around 100 km. Where local food becomes scarce due to the ephemeral nature of seagrass meadows or impacted by natural events such as floods and cyclones, dugong are known to relocate to new areas. Such relocations have been recorded between Hervey Bay and Moreton Bay in 1992 following flooding and a cyclone that reduced available food (CRC Reef, 2002). As such they may be considered transient between a number of seagrass meadows within a region. Whilst no particular studies have been conducted on dugong populations in Rodds Bay and waters around the Island, anecdotal evidence suggests from community consultation notes occasional sightings in the area.

15.1.3.2 Marine Reptiles

Marine reptiles that occur or may occur in waters adjacent to Hummock Hill Island include sea turtles and the saltwater crocodile. The EPBC Act Protected Matters Report (refer to Appendix A7.11) lists five species of sea turtle that may occur or have suitable around Hummock Hill Island; these species and their conservation status are listed in Table 15.6.

Table 15.6 – Turtle species found around Hummock Hill Island

Common name	Scientific name	EPBC status	Qld cons. Status
Loggerhead turtle	<i>Caretta caretta</i>	Endangered	Endangered
Green turtle	<i>Chelonia mydas</i>	Vulnerable	Least concern
Leatherback turtle	<i>Dermochelys coriacea</i>	Vulnerable	Endangered
Hawksbill turtle	<i>Eretmochelys imbricata</i>	Vulnerable	Vulnerable
Flatback turtle	<i>Natator depressus</i>	Vulnerable	Vulnerable

Turtle species that are confirmed to occur within the vicinity of Hummock Hill Island include the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), and flatback turtle (*Natator depressus*). In the absence of detailed, site-specific survey data, anecdotal data from local fishermen and boat operators suggests *C. mydas* to be the most abundant turtle species within estuarine and marine waters around the Island. The leatherback turtle (*Dermochelys coriacea*) is a

pelagic oceanic species that rarely ventures inshore except to nest; no leatherback turtle nesting sites have been identified in the vicinity of Hummock Hill Island. The presence of hawksbill turtles (*Eretmochelys imbricate*) in the vicinity of Hummock Hill Island has not been verified.

Previous aerial surveys by Queensland Parks and Wildlife Service (Qld PWS) identified low levels of nesting by the flatback turtle (*Natator depressus*) on the Main Beach of the Island (Limpus *et al.* 2000). Qld PWS conducted a survey of turtle nesting on the Island over a three-day period in December, 2006 (Hodge *et. al.*, 2007). The 2006 Qld PWS survey confirmed low-density nesting activity (2 fresh tracks and 5 old tracks) by flatback turtles on the Main Beach east of the northern headland. Nesting activity was limited to the northeast-facing beach between Sandfly Creek and the northern headland. No nesting activity was observed on the north-facing beach west of the northern headland. Whilst the beaches of the Island are suitable for turtle nesting they are not considered by Qld PWS to be a major nesting area.

Observations of return tracks from nesting attempts were reported by Qld PWS to display evidence of disorientation. Return tracks consistently kinked to the northwest as shown in Figure 15.13. QLD PWS attributed the cause of the disorientation to light pollution from the Boyne Smelter or QAL Refinery, which are visible on the horizon 18 km to the west.



Figure 15.13 – Return Flatback Turtle Tracks Showing Possible Disorientation to N

A summary of Qld EPA stranding and mortality data for marine turtles throughout Queensland in 2001/2002 is presented in Table 15.7. A total of 529 (2001) and 526 (2002) recorded and reported incidents of turtle mortality were included for these years.

Table 15.7 – Marine Turtle Summary Stranding and Mortality Data for Queensland, 2001/2002

Cause	Total 2001	% of total	Total 2002	% of Total
<u>Natural Causes</u>				
Disease	22	4	14	3
Depredation	1	0.2	4	1
Other	6	1	4	1
<u>Human Related</u>				
Boat Strike	83	16	65	12
Dredging	5	1	7	1
Shark Contact	4	1	5	1
Tangled Rope/Fishing Line/Bags, Ghost Nets	11	2	23	5
Tangled In Crab Pots & Floats	18	4	29	6
Ingested Foreign Material	7	1	9	2
Non-Permitted Indigenous Hunting	9	2	4	1
Other	2+1?	0.4	7	1
Undetermined	360+3?	68	354+17?	67
TOTAL	529+4?	-	526+17?	-

? - unconfirmed report

Undetermined causes of mortality within Queensland waters represent the greatest number recorded for these two years; boat strikes were the most frequent cause of stranding and mortality when the cause could be identified. Where the cause could be attributed to human activities, green turtles were the most frequently affected species, followed by loggerhead turtles and hawksbill turtles.

C. mydas also has the highest incidence of recorded entanglement in and ingestion of marine litter in Queensland waters (Qld EPA, 2001/2002). The higher numbers recorded for *C. mydas* is due to the natural occurrence of this species in the near-shore and estuarine environment. As such *C. mydas* will be the most common species interacting with human activities in estuarine and near shore waters. Management of interaction impacts will be required for this species in particular.

Anecdotal evidence from the local community suggests the presence of saltwater crocodiles (*Crocodylus porosus*) within the Colosseum Inlet and Seven Mile Creek Systems, though population numbers are thought to be very low. The area is near the southern limit of the range of saltwater crocodiles, and Qld EPA (2007) state for the Fitzroy catchment region “*because of the area's climate, it is questionable whether this region ever had the capacity to maintain a large crocodile population without a continuing influx of migrants from more productive coastal systems to the north, most of which are now affected by agriculture.*”

Records from 2 surveys conducted by Qld EPA (2007) within the Fitzroy River (north of Gladstone) region show that populations within the area are likely to have an average density of 0.1, or 0.1 non-hatchlings (>70 cm length or >1 year old) counted per square kilometre of waterway surveyed.



15.1.3.3 Marine Fishes

At the regional level coastal waters of the Curtis Coast form the zoo-geographical boundary between northern tropical waters and southern temperate waters, leading to a large biodiversity within the regions fisheries (Olsen *et al.*, 1980). Previous surveys (Dames & Moore (1995) found 19 estuarine/coastal fish species and 10 reefal/pelagic species were targeted by recreational and commercial fisheries within waters around Hummock Hill Island. Yellowfin bream (*Acanthopagrus australis*), mullet (*Mugil spp.*), whiting (*Sillago spp.*), flathead (*Platycephalus fuscus*) and garfish (*Hemiramphus spp.*) have been noted as particularly dependant on tidal wetlands, which are present around the Island, as nursery grounds. Reference to the Qld DPIF Declared Fish Habitat Summary for Colosseum Inlet notes barramundi, blue salmon, bream, estuary cod, flathead, grey mackerel, grunter, jewfish, king salmon, mangrove jack, queenfish, sea mullet, school mackerel, whiting, banana prawns, endeavour prawns, king prawns, mud crabs as being key fisheries values.

Although the area as a whole has a relatively high diversity of fish species targeted by fisheries, species diversity and abundance in Colosseum Inlet at given individual sites appear to be relatively low. Currie & Connolly conducted trawl survey of shallow-water demersal fishes by for the study *Intertidal Wetlands of Port Curtis* (Connolly *et al.*, 2006). The mean abundance of fishes at four sites adjacent Hummock Hill Island, including two sites in Colosseum Inlet immediately west of the Island and two sites immediately offshore of the northern coastline, was in the range 0-3 individuals per species per 600-m trawl. Species richness was also low at these four sites, at 0 - 3 taken per trawl. Three sites further offshore of the north shore of the Island displayed higher mean abundances, of 4 - 21 individuals/species/trawl, and generally higher species richness, of 2--3 specie/trawl and one site and 5 - 9 species/trawl at the other two.

15.1.3.4 Macroinvertebrates

Key commercial macroinvertebrates in estuarine and marine waters adjacent to Hummock Hill Island are sand crabs (*Portunus pelagicus*), mud crabs (*Scylla serrata*), banana prawns (*Penaeus merguensis*) and saucer scallops (*Amusium balloti*) (Tod Group. 1993).

Video surveys by Rasheed *et al.* (2003) revealed medium-density macroinvertebrate communities (macroinvertebrates visible in 10-80% of video frames) on rubble reefs surrounding Seal Rocks, except to the southwest. An area of rubble north and west of Seal Rocks (region 14) was dominated by bryozoans, hard corals, hydroids and echinoids, with a low density (<6 individuals per site) of colonial hard corals and a medium density (6 - 20 individuals per site) of solitary hard corals. Another area (region 17), west of Seal Rocks, consisted of rubble reef and coral bommies interspersed with open substrate; hard coral density in this area was medium for colonial hard corals and low for solitary hard corals. Rasheed *et al.* (2003) did not survey the area around Creef Rocks. Table 15.8 outlines the species found in these areas, as well as two areas (regions 11& 12) of low macroinvertebrate density (macroinvertebrates visible in <10% of video frames) adjacent to the rubble areas. Site 11 was located in the lowest macroinvertebrate density community consisting of bare open substrate with small holes created by burrowing worms, crustacean or fish. Site 12 was located in a low density benthic community dominated by large areas of open substrate, interspersed with occasional groups of macroinvertebrates.

Table 15.8 – Macroinvertebrate Densities around Seal Rocks. (Rasheed et al. 2003)

		Region 11	Region 12	Region 14	Region 17
Annelida	Polychaeta	-	L	M	L
Ectoprocta	Encrusting bryozoan	-	L	H	H
	Erect byrzoan	-	L	L	M
Cnidaria					
Zoantharia	Zoanthids	-	L	L	-
Anthozoa	Anemones	-	-	L	-
	Colonial hard corals	-	-	L	M
	Solitary hard corals	-	L	M	L
	Soft coral	-	L	L	M
Hydrozoa	Hydroids	-	L	M	H
Echinodermata	Asteroid	-	-	L	-
	Crinoid	-	L	L	L
	Echinoid	-	M	M	L
	Holothuroid	-	-	L	-
	Ophiuroid	-	L	L	L
Urochordata	Ascidians	-	L	L	L
Porifera	Sponges	-	L	L	M
Arthropoda					
Crustacea	Brachyuran (crab(s))	-	-	M	-
	Penaeid prawn	-	L	L	L
	Stomatopod	-	-	L	L
	Amphipod	-	L	L	M
Pycnogonida	Sea spiders	-	-	L	-
Mollusca	Bivalves	-	L	L	M
	Gastropods	-	L	L	M
	Cephalopods	-	L	L	L
	Mollusc egg mass	-	L	L	-

L = low, average of <6 individuals per site

M = medium, average of 6 - 20 individuals per site

H = high, average of >20 individuals per site

Each site constitutes a 4-minute video tow, representing a transect approximately 100 m long of unreported width

15.1.4 Rare, endangered and migratory listed marine species

A number of aquatic species are listed under either State or National conservation legislation that either inhabit or migrate to or through Rodds Bay and Colosseum Inlet. Table 15.9 shows nearshore aquatic species listed under State or Federal Legislation that have been confirmed or suspected to occur in the immediate vicinity of Hummock Hill Island.

Table 15.9 – Species listed under State or Federal Conservation Legislation that are likely to use habitat in the vicinity of Hummock Hill Island

Common name	Scientific name	EPBC status	Qld cons. Status	Confirmed inhabitant/migrant	Habitat
Loggerhead turtle	<i>Caretta caretta</i>	Endangered & migratory	Endangered	Confirmed	Pelagic
Green turtle	<i>Chelonia mydas</i>	Vulnerable * migratory	Vulnerable	Confirmed	Nearshore / Estuarine
Leatherback turtle	<i>Dermochelys coriacea</i>	Vulnerable * migratory	Endangered	Probable, suitable habitat	Pelagic
Hawksbill turtle	<i>Eretmochelys imbricata</i>	Vulnerable * migratory	Vulnerable	Confirmed	Pelagic
Pacific Ridley or olive Ridley turtle	<i>Lepidochelys olivacea</i>	Endangered & migratory	Endangered	Probable, suitable habitat	Nearshore
Flatback turtle	<i>Natator depressus</i>	Vulnerable * migratory	Vulnerable	Confirmed	Nearshore
Dugong	<i>Dugong dugon</i>	Migratory & listed	Vulnerable	Confirmed	Nearshore / Estuarine
Indo-Pacific humpback dolphin	<i>Sousa chinensis</i>	Migratory	Rare	Probable, suitable habitat	Pelagic
Estuarine crocodile	<i>Crocodylus porosus</i>	Not listed	Vulnerable	Probable, suitable habitat	Nearshore / Estuarine

Source: EPBC protected matters report (Appendix A3)

15.1.5 Recreational Fisheries

The waters of Colosseum Inlet and Boyne Creek are predominantly used for recreational line fishing and crab-pot setting (Dames & Moore, 1995). Access to local waters is typically via boat ramps from Foreshores estate, Boyne Island, Tannum Sands, Turkey Beach and the causeway at the end of Clarks Road.

Local Sports Fishing clubs hold around 6 events per year within Colosseum Inlet & Boyne Creek targeting a range of fish species. Table 15.10 presents catch data for this recreational fishing in the Wide Bay-Burnett Statistical Division.

Table 15.10 – Recreational Fishing Statistics for the Wide Bay-Burnett Statistical Division

Species	No. individuals caught	No. individuals harvested	No. individuals released
Australian bass	40842	8039	32802
Barramundi	1045	267	778
Bream	488717	165027	323690
Catfish	113714	42132	71582
Cod	85085	41228	43858
Coral trout	11332	7925	3407
Crab	443907	113857	330050
Flathead	146671	56488	90183
Mackerel	53565	34343	19223
Others	905107	300816	604291

Species	No. individuals caught	No. individuals harvested	No. individuals released
Prawns	75176	75176	0
Redclaw crayfish	0	0	0
Southern snapper	138842	41302	97540
Spangled perch	71416	7162	64255
Sweetlip	215419	67419	148000
Tailor	325487	253749	71739
Trevally	143177	82655	60522
Tropical snapper	366908	109117	257791
Whiting	1450587	896989	553598
Yellowbelly	56827	17400	39428

(Source: Qld DPI, 2006)

Data for recreational fishing effort at the annual Boyne-Tannum Hookup competition (Sawynok & Platten, 2006) held in fresh, coastal and off-shore waters show yellowfin bream to be the most common species hooked between 2000 and 2006, followed by pikey bream and dusky flathead. It is likely that some bias to estuarine and freshwater species occurs due to the greater number of competitors fishing these environments. No data were available for corresponding line numbers or location of fishing effort. Anecdotal evidence from community consultation with local stakeholders has raised recreational fishing as being of value to the local population.

15.1.6 Commercial Fisheries

Waters adjacent to the Hummock Hill Island region consist of the southernmost reaches of commercial tropical species such as barramundi (*Lates calcarifer*), threadfin salmon (*Polydactylus sheridani*) and the northern most reaches of southern temperate species such as winter whiting (*Sillago maculata*) and snapper (*Pagrus auratus*). Mud crabs are the main species targeted within Colosseum Inlet and Boyne Creek by commercial operations, with banana prawns targeted in offshore waters. All of these species use shallow inshore and/or estuarine habitats during at least part of their life cycles.

Inspection of Department of Primary industries and Fisheries (DPIF) data held on the CHRIS database⁵ found that four fisheries units covered marine waters adjacent the Island, these being units S30, S31, T30 and T31. Each fisheries grid unit is subdivided into 25 smaller units on a 6 nautical mile grid. Estuarine and inshore waters immediately adjacent Hummock Hill Island consists of four identified sub-units:

- Unit S30.25 - waters to the north west of Hummock Hill Island;
- Unit S31.5 - waters to the south west of Hummock Hill Island, incorporating the majority of Colosseum Inlet and the western section of Boyne Creek;

⁵ Accessed 16/04/06



- Unit T30.25- waters to the north east of Hummock Hill Island including Rodds Harbour and Rodds Bay; and
- Unit T31.1 - waters to the south east of Hummock Hill Island, incorporating the eastern section of Boyne Creek and Seven Mile Creek.

Inspection of the CHRIS database (administered by Qld DPIF) for commercial fisheries reveals that offshore commercial fishing activity (Units S30 and T30) target a number of species within the Hummock Hill Island area. Table 15.11 summarises 2003 data for offshore and inshore waters around Hummock Hill Island. No catch data for individual species are available.

Table 15.11 – Summary of 2003 commercial fisheries type, effort and value for Hummock Hill Island waters

Site	Fishery	Species	Tonnes	Boats	Days	Gross value of product (Aus \$)
Off shore waters - total gross value of product (estimated) = \$71,500						
S30.25	Trawl - otter	All species	4.9	9	34	\$48,800.00
S30.25	Total trawl	All species	4.9	9	34	\$48,800.00
T30.21	Trawl - otter	All species	2.3	5	15	\$22,700.00
T30.21	Total trawl	All species	2.3	5	15	\$22,700.00
Colosseum inlet, boyne creek and seven mile creek						
S31.5	Total trawl	All species	-	< 5	-	-
S31.5	Trawl - beam	All species	-	< 5	-	-
T31.1	Total trawl	All species	-	< 5	-	-
T31.1	Trawl - beam	All species	-	< 5	-	-
T31.1	Trawl - otter	All species	-	< 5	-	-

As shown in Table 15.11, the waters offshore of the Island are exploited by otter trawlers of the East Coast Trawl Fishery (ECTF) targeting species such as banana prawns and scallops. Combined, the estimated commercial value of this fishery for 2003 in immediate offshore waters adjacent to the Island was \$71,500 for a total of 7.2 tonnes landed by 14 boats over 49 days effort.

Commercial fishing effort within Colosseum Inlet, Boyne Creek and Seven Mile Creek consists of smaller beam trawlers, otter trawlers and crab potters. A total of less than five boat landings were recorded for 2003, consequently tonnage and estimated value were not released.

Around 4 to 6 commercial mud crab operations are licenced to operate in the Boyne Creek, Seven Mile Creek and Colosseum Inlet area. Each license allows the commercial operator to set a maximum of 150 crab pots. Mud crab catch data for Colosseum Inlet (Grid S31) and Rodds Bay (Grid T31) are presented in Table 15.12. Colosseum Inlet is contained wholly in Grid S31 and provides a true representation of catch data. Grid T31 contains Seven Mile Creek and the remainder of Rodds Bay and as such does not provide a true representation of catch data for Seven Mile Creek.

Table 15.12 – Mud Crab Pot Data for Grids S31 (Colosseum Inlet) & T31 (Rodds Bay)

Year	Grid	Tonnes	Boats	Days	Gvp (aus \$)	Grid	Tonnes	Boats	Days	Gross value of product (Aus \$)
1988	S31	-	< 5	-	-	T31	5.6	11	463	58,900.00
1989	S31	-	< 5	-	-	T31	7.8	10	543	81,500.00
1990	S31	-	< 5	-	-	T31	12.4	10	689	130,400.00
1991	S31	11	5	466	115,100.00	T31	15.8	11	720	165,400.00
1992	S31	13.3	5	559	139,200.00	T31	13.2	10	685	138,400.00
1993	S31	-	< 5	-	-	T31	15.4	13	1022	161,600.00
1994	S31	10.3	5	573	108,300.00	T31	19.2	17	1118	201,800.00
1995	S31	12.2	5	720	128,500.00	T31	11.6	12	808	121,400.00
1996	S31	11.5	5	572	121,200.00	T31	16.8	13	805	176,100.00
1997	S31	12.1	6	674	126,800.00	T31	24	18	1070	252,500.00
1998	S31	-	< 5	-	-	T31	23.8	14	917	250,100.00
1999	S31	7.9	6	405	82,800.00	T31	39.3	23	1480	413,000.00
2000	S31	-	< 5	-	-	T31	50.2	24	1834	526,900.00
2001	S31	-	< 5	-	-	T31	56.4	18	1641	592,200.00
2002	S31	-	< 5	-	-	T31	46.1	18	1387	484,200.00
2003	S31	-	< 5	-	-	T31	54.2	26	1817	569,200.00
2004	S31	8.2	6	394	86,500.00	T31	43.3	19	1581	454,300.00
2005	S31	-	< 5	-	-	T31	20.8	17	824	218,200.00

Source: Department of Primary Industry and Fisheries

Based on the above data the average mud crab annual fishery value is \$113,550 for Colosseum Inlet (Grid S31) and \$277,561 for Seven Mile Creek and Turkey Beach. Anecdotal evidence from local commercial fisherman suggests that fishing effort is also conducted in other grids and for other species to supplement mud crab income.

15.2 Impacts - Marine Flora and Fauna

15.2.1 Nature and Extent of Impacts

Section 15.1.1 identified a number of potential pressures on identified environmental values of the GBRMP. The following are the main pressures facing identified environmental values within the GBRMP:

- Coastal development (physical damage or removal, and changes in hydrology and salinity regimes)
- Declining water quality (increased levels in sediments, nutrients, pesticides and litter);
- Shipping and oil spills (increased levels of petrochemicals);
- Aquaculture (increased siltation, erosion and nutrients);
- Disturbance events (severe weather events and invasion of pest species);
- Climate change (sea level rise and increase in storm/cyclone frequency and intensity);



- Human use (fishing, collecting, traditional hunting, boat strike);
- Habitat loss and degradation; and
- Incidental catch (dugong and marine turtles).

The assessment of the potential impacts of the proposed development in the context of these pressures has required consideration of the various sources and an integrated approach to mitigation. Some potential impacts are direct, such as habitat loss associated with construction of the required access bridge and public boat ramps. Other potential unmitigated impacts are indirect, such as discharges from ephemeral watercourses within catchments that are disturbed by construction and operation activities.

Potential indirect impacts associated with ephemeral watercourse discharges have been discussed in Section 8. These sections have also provided mitigation measures that will result in no significant change in ephemeral watercourse discharge or water quality.

For the purpose of assessing potential impacts to marine fauna and flora within the local estuarine and marine environment surrounding the Island the following are considered:

- Direct intertidal and subtidal habitat loss within the access bridge alignment Boyne Creek public boat ramp and Colosseum inlet public boat ramp access during construction of infrastructure;
- Increased sediment load in surface runoff during construction of physical infrastructure within Boyne Creek and Colosseum Inlet;
- Increased inputs of nutrients, pesticides and herbicides in surface runoff during construction and operation;
- Disturbance of acid sulphate soils during construction activities in Boyne Creek;
- Fuel/oil spills from plant re-fuelling and maintenance in the field during construction activities within Boyne Creek and Colosseum Inlet;
- Litter generation during infrastructure construction and operation;
- Changes in natural lighting;
- Increased disturbance of natural areas from population and boat traffic; and
- Increased fishing access

These potential impacts are consistent with potential issues considered by GBRMPA in Section 15.1.1 and are discussed further below.

15.2.2 Habitat Loss

Marine wetland habitat loss during construction activities will be limited to the proposed access road and bridge across Boyne Creek, the adjacent public boat ramp in Boyne Creek and the public boat ramp in Colosseum Inlet.

Whilst the loss of supratidal salt flat and mangrove habitat for public infrastructure will be permanent, the limited extent of this loss in relation to the overall habitat within the area is considered minimal. Table 15.13 outlines the area impacted in relation to the total area within Colosseum Inlet, Boyne Creek, Sandfly Creek and Seven Mile Creek. Based on these results the overall impact to intertidal wetlands, including WHA, GBRCMP, Nationally and Regionally Significant Wetlands is considered to be negligible.

Table 15.13 – Mangrove and Supratidal Salt Flat Habitat Loss.

Habitat	Total Area Lost (Ha)	Local Extent (Ha)	% Loss
Mangrove	0.86	6,140	0.014
Supratidal salt flat	0.04	2,700	0.002

Supratidal Salt Flats

Supratidal salt flat and mangrove habitat loss will occur during construction of the proposed access road, bridge and public boat ramp due to filling activity for the road, bridge abutments, casements/piers and also filling for construction of the public boat ramp in Boyne Creek. Upgrade of Clarks Road (refer to Figure 15.14) will require construction of a two lane trunk Collector Street 25 m in width (Cardno, 2007). The current access track width is around 15 m across supratidal salt flats; resulting additional habitat loss will be 0.01 ha. Approximately 0.03 ha of supratidal salt flat on the northern side of Boyne Creek will also be lost due to construction of the access bridge and public boat ramp in the first 2 years of public infrastructure construction. Together these two areas represent less than 0.002 % of supratidal salt flat habitat within the Colosseum Inlet, Boyne Creek, Sandfly Creek and Seven Mile Creek intertidal wetland system. It is proposed to utilise the existing causeway for part of the proposed public boat ramp with the northern abutment of the access bridge located adjacent to the east. As such the ecological functions of supratidal salt flats of Boyne Creek, outlined in Section 15.1.2 are not considered to be significantly impacted.



Figure 15.14 – Clarks Road Crossing Supratidal Saltflats on the S Side of Boyne Creek



Mangroves

Bridge abutments are likely to require a basal width of 40 m, requiring clearing of an extra 25 m width of *R. stylosa* on the southern side of Boyne Creek and 40 m of *R. stylosa* on the northern side of Boyne Creek. Total mangrove clearing for bridge abutments is expected to be 0.8 ha, representing less than 0.014 % of total mangrove habitat within the Colosseum Inlet, Boyne Creek, Sandfly Creek and Seven Mile Creek system. Bridge piers will be placed within Boyne Creek and will not require mangrove clearing. Some widening of the existing causeway within the mangrove zone on the northern side of Boyne Creek will be required, approximately by 10 m width. Resulting mangrove habitat loss will be approximately 0.06 ha. Thus, the total area of mangrove loss will be 0.86 ha, or 0.014% of the total mangrove area of the system.

15.2.3 Sediment Loads and Turbidity

Construction activities within Boyne Creek and Colosseum Inlet, particularly earthmoving activities, have the potential to increase suspended sediment loads to adjacent marine waters and WHA if not controlled as discussed in Section 9.2. In particular potential impacts from construction activities for the proposed access bridge and public boat ramps can increase sediment loads and subsequently turbidity in adjacent marine waters.

Although the transport of turbidity plumes by tidal currents to seagrass meadows in Boyne Creek has the potential to impact these meadows (refer to Section 15.1.2), the relatively high tidal flows within Boyne Creek and associated dilution of the turbidity plume will reduce potential effects. It is also noted that the identified seagrass meadows in Boyne Creek are intertidal, resulting in a very shallow water column through which turbidity-associated light attenuation can occur at high tide. At low tide the seagrasses will be exposed and their photosynthesis will be unaffected by turbidity. Despite these natural mitigation measures the sensitivity of the receiving environment and identified EVs require mitigation from potential impacts from increased suspended sediment loads generated during construction of infrastructure in tidal waters.

Construction works in tidal waters will require various permits, as outlined in Section 2. A detailed erosion and sediment control plan for proposed construction works will be required as a condition of permitting. This plan will include mitigation measures, such as lined rock bunds and silt curtains, that are standard practice for construction sites in estuarine environments and will reduce impacts on marine fauna and flora from increased suspended sediment to minimal (refer to Section 8.2).

15.2.4 Acid Sulphate Soils

Potential acid sulphate soil (PASS) disturbance within the estuarine and marine environment of Hummock Hill Island will be limited to the proposed access bridge and public boat ramp construction activities within Boyne Creek. These activities will occur within the first two years of the proposed development after which, no further disturbance of PASS will occur. Results of soil testing within this area returned net acidity ranging between 0.36 and 1.12%S (action levels are 0.03 %S for soils with $\leq$ 5% clay). Such soils may be classified as Very High and Extremely High under the SPP Guideline (2002).



The current survey was a preliminary study where the sampling analysis was completed under the QASSIT guidelines whilst the sampling density was not. A detailed survey will occur at the detailed design stage that will be developed in accordance with the QASSIT guidelines.

Disturbance of PASS can impact adjacent marine fauna located in estuaries and the GBR WHA from the release of toxic metals such as aluminium, leached from the soil by oxidised sulfides. Acidification (pH reduction) is not expected because of the high buffering capacity of high-salinity marine waters. Construction activities for the proposed access bridge and public boat ramp within Boyne Creek will require an Acid Sulphate Soils Management Plan (ASSMP). The ASSMP will determine the most appropriate management during construction. Based on the relatively small amount of PASS disturbance for construction activities and requirement for an ASSMP the residual impact to marine fauna is considered negligible.

Operational activities will not disturb PASS.

15.2.5 Fuel Spills and Hydrocarbons

Incidental hydrocarbon contamination of Boyne Creek and Colosseum Inlet could occur during construction from plant re-fuelling operations and spills and other accidents if not mitigated. Such incidental spills are most likely to occur during construction activities associated with the bridge and boat ramps and be discharged indirectly to the marine environment via surface runoff. Such incidental spills can impact sensitive fauna and flora within the estuarine waters of Boyne Creek and Colosseum Inlet if not controlled and mitigated.

Supratidal salt flats and mangroves are considered to have the highest risk of direct impacts from hydrocarbons associated with construction, particularly from construction of the Boyne Creek Bridge and later the public boat ramp. Impacts to remaining marine fauna and flora receptors are considered to be ameliorated by distance and lack of direct connectivity, in the case of fuel spillage within construction zones.

Construction ESCP measures and management of fuel storage and plant operation activities will control incidental releases of fuels and hydrocarbons to marine waters that may impact adjacent fauna and flora. These will include the use of spill kits during construction activities, installation of silt curtains and booms to capture any floating product and storage of any fuels away from estuarine areas in appropriately constructed bunds as discussed in Section 15.3.

During operation primary impacts from hydrocarbons will be from urban runoff, incidental spills on boat ramps, fuel storages and recreational boating emissions. Hydrocarbon impacts and mitigation from urban runoff are discussed in Section 8.3. Incidental spills of hydrocarbons on boat ramps are discussed in Section 9.3. Spillage from hydrocarbon storages are unlikely due to anti-spill measures regulated under various codes and standards.

Recreational boating hydrocarbon emissions from 2-stroke engine exhausts have been recognised by the United States Environmental Protection Agency (USEPA) as an issue in heavily trafficked areas and possibly one of the main sources of hydrocarbons to recreational boating areas. Typically these engines vent their exhaust gases to the water and can emit unburnt hydrocarbons, polycyclic



aromatic hydrocarbons (PAHs), nitrogen oxides, carbon monoxide, carbon dioxide, oil and grease and BTEX compounds (benzene, toluene, ethylbenzene, (xylenes)).

Volatile BTEX compounds and gases will be lost to the atmosphere with very little dissolving in the estuarine water where fish and invertebrates may be impacted by the compound toxicity. Less volatile compounds such as many of the PAH are not overly soluble and will prefer to attach to suspended sediment where it is added to the estuary sink, and subsequently less available to fish and invertebrates. Bottom sediment feeders may be exposed to sediment bound PAH, however, the concentrations will be low and mixed in with natural PAH sources from bushfire sediment.

An increase of 20 to 30 boats over the 48.9 km² of Colosseum Inlet would result in a very small impact to water quality. The large tidal range and associated flushing will also ameliorate boat emissions. Suppliers of two stroke engines are also becoming more aware of their emission

In recognition of the sensitivity of the estuarine and marine EVs management of increased boating usage will be conducted through community education such as letter and leaflet drops, information signage at public boat ramps and beach access points. Engine emissions are recognised as a potential water quality issue, their effect on marine fauna and flora of the estuaries and marine environment around the Island are considered to be extremely minor due to the low boating increase in the area and the large tidal flushing that naturally occurs in the estuaries.

15.2.6 Litter

Marine debris has often been associated with the morbidity and death of dugongs, turtles, cetaceans and seabirds, amongst other marine species. In the Hummock Hill Island area, marine mammals and marine turtles have the highest risk of direct impacts from litter. Marine litter and debris impacts on marine mammals and turtles include the ingestion of foreign material mistaken as food, with consequent choking or blockage of the digestive system, and entanglement in rope, fishing line, plastic bags and other domestic litter, nets and crab pots. Plastics particularly plastic bags and packaging, are likely to form the most common form of litter associated with construction and operation of the proposed development.

The primary marine mammal within estuarine and marine waters around the Island is the dugong (*D. dugon*). Based on Qld EPA (2005 & 2006) stranding and morbidity data, the major litter issue associated with *D. dugon* is entanglement in nets. Queensland EPA Wildlife Stranding and Mortality Database (Qld EPA, 2005) records between 0 (2002) and 9 (1999) strandings or deaths of *D. dugon* attributable to entanglement in netting throughout Queensland annually. Litter issues within the estuarine environment of the Island are not likely to involve fishing nets as these activities are controlled within the Rodds Bay DPA (refer to Figure 15.5), as such potential impacts from netting entanglement is considered negligible. Dugongs are unlikely to mistake litter for seagrass, their primary food, and ingestion of litter is not identified as a major issue for *D. dugon* by QLD EPA.

Marine turtles, are more susceptible to marine debris. Queensland EPA recorded 6 % (2001), 3.4% (2002) and 11% of all recorded sea turtle strandings and mortalities in Queensland to be due to entanglement in marine debris, in particular crab pots and float lines. Again *C. mydas* represents the most recorded species in the Queensland data and, based on the EVs of adjacent marine and



estuarine waters, mitigation will be required despite the relatively low number of recorded incidents in the Queensland data.

Based on the 2001/2002 Marine Turtles stranding and mortality database report (Qld EPA, 2002) litter ingestion represents a minor component of marine turtle mortality, approximately 1% of all recorded Queensland incidents for 2001 and 2% for all recorded Queensland incidents in 2002. Like dugongs, *C. mydas*, the most common turtle in the area, feeds primarily on seagrass and is unlikely to mistakenly ingest litter. Although flatback and loggerhead turtles, which feed on a variety of invertebrates, may be more at risk of litter ingestion, ingestion of plastics and other litter is considered to be a negligible impact associated with the proposed development given the mitigation measures described below.

Litter in mangroves within Boyne Creek and Colosseum Inlet is considered an aesthetic impact rather than a direct physiological impact to the mangrove tree itself. Unmitigated litter generation from the proposed development may have a moderate impact on the aesthetic values of the mangrove system and subsequently adjacent intertidal wetlands, WHA values and the GBRCMP. Primary sources of litter to the estuarine and marine environment around the Island are considered to be via stormwater flows from construction sites and developed areas, as discussed in Section 8 and Section 9. Incorporation of GPTs in construction erosion and sediment control measures and permanent WSUD measures effectively eliminate litter discharge via stormwater runoff, as discussed in Section 8. Mitigation of potential litter impacts from stormwater flows is outlined in Section 8.

Whilst litter associated with stormwater flows and ephemeral watercourse discharges is effectively controlled by ESCP and WSUD, some litter can be generated from recreational boating activities, such as bait bags being disposed to waters. Whilst the proposed increase in boating traffic is likely to be relatively small in relation to the adjacent population, litter generation from this source requires consideration. Public education is likely to be the most effective method of minimising litter discharges from recreational boating.

The mitigation measures proposed to reduce litter impacts on dugongs, turtles, and mangroves will also be effective in reducing any potential impacts on seabirds and other species.

15.2.7 Nutrients

Potential nutrient sources to the estuarine and marine environment around the Island are discussed in Section 8 and Section 9 with proposed mitigation measures. The proposed mitigation measures during both construction and operation are considered to be effective in maintaining the current water quality status of estuarine and marine waters around the Island and as such potential impacts to marine fauna and flora from terrestrial runoff are considered to be controlled and minimal.

As discussed in Section 3.4.1 the proposed sewage treatment plant (STP) will be sized to cater for an ADWF of 1.0 ML/d (includes a 20% additional safety factor) with additional storage provided to handle up to 3 times ADWF. Flows greater than 3 times ADWF (3 days storage) will require an emergency outlet. The emergency outlet is located in an ephemeral watercourse that discharges to Colosseum Inlet via intertidal wetlands and mangroves.



As discussed in Section 8.3.1.4 the proposed STP will comprise of 2 units and storage for 3 days output. Emergency overflows are highly unlikely due to the remote chance of both plants failing. If one plant fails the wet weather storage can store 3 days of waste that the second unit can process during low demand periods, avoiding the need to discharge to the emergency overflow.

In the event of extreme weather causing an emergency discharge, such as during severe storm events and will therefore be concurrent with large ambient flows from ephemeral watercourses both on the Island and from adjacent mainland catchments. Discharges from the proposed wastewater treatment plant will therefore be subject to significant dilution by the much larger flows from the catchments, and will be rapidly transported to coastal waters further offshore in an outwardly flowing freshwater surface layer. This dilution and transport will minimise impacts to marine fauna and flora around the Island. Such incidents are considered to be within the required design capacity for proposed infrastructure and potential impacts are considered minimal due to the infrequent occurrence of such incidents and their short duration.

15.2.8 Pesticides, Herbicides and Fungicides

Uncontrolled releases of pesticides, herbicides and fungicides to the marine system would have the potential to impact environmental values of Colosseum Inlet, Boyne Creek, Seven Mile Creek system, causing a range of potential toxicological responses within the various plants and animals present. Stormwater is the primary potential mechanism for the transport of potential contaminants to the estuarine and coastal environment.

Stormwater discharge from the proposed development will be from ephemeral watercourses flowing to Boyne Creek, Colosseum Inlet and beaches of the northern coastline (where linkages exist) as discussed in Section 8. Typically the most sensitive species to the residual effects of diffuse discharges containing pesticides, herbicides and fungicides will be seagrasses. Broadacre spraying of agricultural chemicals, particularly the pre-emergent herbicide diuron, has been implicated as a main source of contamination within GBRMP catchments. Agricultural use of Diuron within the proposed development will not occur and is not considered a risk associated with the proposed development.

As discussed in Section 8, proposed upstream mitigation of pesticides and herbicide application via Integrated Turf Management principles and degradation of contaminants within the WSUD controls are considered to mitigate concentrations at the point of discharge to estuarine and marine waters. Impacts by these chemicals to estuarine fauna and flora are considered negligible.

15.2.9 Population Impacts

Population increases resulting from the proposed Hummock Hill Island Development will occur over an 15-year period between 2008 and 2026; this increase will be concurrent with additional population increases south of Tannum Sands and at Turkey Beach. Potential impacts to estuarine and marine fauna and flora from population increases include:

- Increased incidence of boat strikes on marine mammals and turtles;
- Increased recreational fishing pressure; and



- Increased competition for commercial species reducing viability of commercial fishing operations.

It is estimated that approximately 190 small boats will be owned by the permanent population of the proposed development based on boat ownership rates in the surrounding coastal communities, with an estimated 19 - 29 boats in use on any given day (refer to Section 9.3). The 190 additional boats represents an increase of about 3% over total 2006 boat ownership in the Gladstone, Calliope and Miriam Vale LGA, though the additional boats are likely to be more concentrated in the Colosseum Inlet, Boyne Creek and Seven Mile Creek. As noted in 15.1.3.1 and 15.1.3.2, where the cause of injury and death can be identified boat strike is an identified cause of direct human impacts on dugongs and the most frequent source of such impacts on marine turtles, particularly green turtles. Boat strikes on marine mammals and turtles are typically associated with high boat speeds. Large areas of Colosseum Inlet, Boyne Creek and Seven Mile Creek, particularly the seagrass feeding grounds of dugongs and green turtles, are shallow intertidal areas where boats are less likely to travel at high speed. Increased boat traffic, however, may increase the frequency of boat strikes in the deeper channels.

Based on proposed tourist and population numbers and current boat ownership in Queensland, approximately 24 % (around 384) of the permanent population of Hummock Hill Island are likely to participate in recreational fishing, with at least 8 % (128 people) fishing weekly. These estimates are consistent with the estimated boat use based on local boat ownership and usage rates. Recreational fishing by the tourist population is likely to be greater though no data is available to estimate numbers. Recreational fishing pressure is likely to peak at weekends and holiday times, a trend that is already prevalent in local waters around Hummock Hill Island.

Qld DPIF stated in consultations that, despite the anticipated increase in recreational fishing, they consider that current bag limits for recreational fishers are adequate to ensure sustainable catches. Potential impacts to recreational fish stocks from increased use of adjacent estuarine and marine waters are considered minimal.

Anecdotal evidence collected during community consultation also suggests recreational fishing accounts for a decrease in commercial mud crab catch numbers during key holiday periods such as Christmas and Easter. Qld DPIF indicated in consultations that this may result from poaching of commercial crab pots rather than from increased crab harvest. In any case, it is likely that the trend of decreased commercial catches during times of high recreational use will continue with increasing population both on Hummock Hill Island and surrounding areas such as Tannum Sands and Turkey Beach.

The co-existence of recreational and viable commercial fishing operations is common in adjacent population centres such as SE Queensland, Hervey Bay, Whitsunday Coast and Cairns. Current recreational limits are considered by Qld DPIF to ensure sustainable commercial as well as recreational harvests. The gradual increase in population over the duration of the development period will allow for a suitable transition time for commercial operations to adjust to potential recreational competition. Queensland DPIF considers current commercial and recreational limits to be sustainable.



15.2.10 Artificial Night Lighting

Light pollution is detrimental to sea turtles because it alters critical nocturnal behaviours, namely, how sea turtles choose nesting sites, how they return to the sea after nesting, and how hatchlings find the sea after emerging from their nests. Both circumstantial observations and experimental evidence show that artificial lighting on beaches tends to deter sea turtles from emerging from the sea to nest.

This “seafinding” is directed by two visual cues; light intensity and horizon elevation. Light intensity is an orientation cue mediated by a positive phototaxis. Put simply, light is reflected from the ocean (providing a visual cue) and absorbed by vegetation behind the beach (thereby dimming the landward horizon).

On beaches without the influence of artificial lighting, hatchlings crawl away from the dimmer landward horizon and crawl toward the brighter seaward horizon. Horizon elevation is a second cue. Turtles crawl away from a higher dune and its associated shrubbery, and toward the lower, oceanic horizon.

Marine turtle navigation, nesting and hatchling behaviour is influenced by a series of factors (not simply the brightness of lights at distance from the source), including, but not limited to:

- 1) Phase of the moon;
- 2) Background illumination;
- 3) Brightness of lights;
- 4) Shape of lights;
- 5) Colour (wavelength) of lights;
- 6) Horizon elevation, both landward and seaward horizons;
- 7) Profile of the landward side of the beach (dune, vegetation, or buildings) using elevation cues;
- 8) Nature of the natural/constructed silhouette on the landward horizon (i.e. whether broken or unbroken, providing continuity or lack thereof in darker horizon);
- 9) Influence of sky glow from sub-coastal development.

Marine turtle experts Witherington and Martin note in their 1996 paper (which deals exclusively with this issue) that “accurately quantifying light pollution is not necessary to diagnose a potential problem.” These authors offer the simple rule: “if light from an artificial source is visible to a person standing anywhere on a beach, then that light is likely to cause problems for the sea turtles that nest there.”

Furthermore, Witherington and Martin (1996) note that:

“because there is no single, measurable level of artificial brightness on nesting beaches that is acceptable for sea turtle conservation, the most effective conservation strategy is simply to use best available technology (BAT: a common strategy for reducing other forms of pollution by using the best of the pollution-reduction technologies available) to reduce effects from lighting as much as practicable.”



15.3 Impact Mitigation - Aquatic Fauna & Flora

As described in Section 15.2, some construction and operational aspects of the proposed development, if unmitigated, have potential impacts upon identified EVs and WHV of marine flora and fauna in the area surrounding Hummock Hill Island.

15.3.1 Minimisation of Habitat Clearing

Clearing within supratidal salt flats and mangroves for the access road and public boat ramp will be restricted to the minimum width required to accommodate the road design and storm water controls.

Works on the causeway across salt flats at the northern end of Clarks Road will be restricted to the causeway alignment. Vehicle access will be controlled by use of temporary fencing delineating the works zone. Guard rails will be installed along the causeway and on approaches to the salt flat area to halt vehicle access to salt flats following construction.

Clearing of mangrove vegetation will be conducted in under an appropriate permit issued by Qld DPI (and any other relevant permit) and will be conducted in accordance with the recommended mitigation required under the Qld DPI Fish Habitat Management Operational Policy 005 (2002): Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss. Under this policy large sized projects (>0.5 ha clearing) will require one or more of the following mitigation requirements:

- selective pruning instead of removal of mangroves;
- best environmental management practice;
- timing of works to accommodate least disruption to fisheries resources e.g. fish passage/ or use of area (spawning and migration), seagrass flowering, mangrove settlement periods; and/or
- providing buffers between works and fish habitat.

Other strategies include:

- undertaking restorative or rehabilitative works within an agreed plan; and/or
- proposal will provide community fisheries benefits (e.g. boat ramp, fishing platform); and/or

Off site compensation, including:

- seek to offset losses through Land exchange or Land acquisition of productive wetlands (links should be made to FHA program and/or Acquisition Program); and/or
- creation of replacement/ alternate fish habitat and monitoring of the effectiveness of habitat; and/ or
- contribution to a Statewide Compensation Program (to fund research or extension on fish habitats).



It is noted that two public boat ramps are proposed as part of the development. Further liaison with Qld DPI will be conducted during detailed design and permitting stages to assess the suitability of public boat ramps as the appropriate compensatory measure for permanent habitat loss.

15.3.2 Water Quality

Identified potential impacts on water quality, whilst sourced from different activities within the proposed development area, have a common theme via their transport mechanism to the marine environment - via storm water flows in identified ephemeral watercourses discharging to Boyne Creek and Colosseum Inlet from disturbed areas within the proposed development area. Development of erosion and sediment control plans (ESCP) and Water Sensitive Urban Design (WSUD) for permanent storm water controls will be effective in mitigating sedimentation, suspended sediment, hydrocarbons, litter, nutrients, pesticides, herbicides and fungicides through various proposed treatment trains. Proposed mitigation measures are discussed further below.

15.3.2.1 Erosion and Sediment Controls

Erosion and sediment control during construction activities are discussed in Section 8 and summarised here as follows:

- Construction activities within ephemeral watercourse catchments that discharge to estuarine or marine waters will utilise erosion and sediment controls in accordance with Soil Erosion and Sediment Control Guidelines - Engineering Guidelines for Queensland Construction Sites (IEAust (Qld) 1996) minimising potential downstream impacts;
- A 10 m buffer will be maintained on all ephemeral watercourses within the proposed construction areas as required by the SE Qld RVMC. Maintenance of Riparian buffers will help reduce contaminant loads to adjacent marine waters derived from surface runoff and minimise downstream estuarine and marine impacts;
- No construction activity will occur in the 100 m buffer zone above HAT, bar public access infrastructure such as boat ramps and the proposed Boyne Creek Bridge. These works will be subject to a site specific Erosion and Sediment Control Plan that will include additional controls for working in a sensitive marine environment;
- Construction activities within Boyne Creek for the proposed bridge and boat ramp will be conducted using construction methods and protection measures outlined in Section 8;
- Ephemeral watercourse discharges will be required to meet WQO for estuarine waters derived from existing and ongoing proposed monitoring.

In addition to erosion and sediment control measures on terrestrial areas of the Island, a detailed erosion and sediment control plan will be developed for all construction works proposed in tidal areas, as described in Section 15.2.3. This plan will include standard and effective mitigation measures such as lined rock bunds and silt curtains.

Based on the incorporation of these mitigation measures potential impacts to identified estuarine and marine EVs, flora and fauna are considered to be negligible.



15.3.2.2 Water Sensitive Urban Design

Water sensitive urban design (WSUD) principles are discussed in Section 8 and will be used for all permanent control measures to mitigate litter, sediment, nutrient, hydrocarbon and chemical releases to adjacent estuarine and marine environments. Construction of WSUD features will utilise ephemeral watercourses (as required by the SL) that discharge to Boyne Creek, Colosseum Inlet and the marine environment. Proposed control measures will be constructed in accordance with *Draft Water Sensitive Urban Design Engineering Guidelines: Stormwater* (BCC, 2006). Reference should be made to Appendix A7.11 and Sections 3 and 8 for details of WSUD stormwater controls.

Based on modelled removal efficiencies and considering existing sediment and nutrient loads of stormwater flow from ephemeral watercourses on the Island to adjacent estuarine and marine waters, minimal impacts to identified EVs and estuarine marine fauna and flora are anticipated during construction and operation of the proposed development.

15.3.2.3 Integrated Turf and Pest Management

Construction and operation of the proposed wild golf course will utilise both Class A+ waste water for irrigation and supplementary fertilisers to maintain tees and greens. Turf pest management will utilise a range of pesticides, herbicides and fungicides.

The proposed Wild Golf Course will operate watering, fertilising and pest control in accordance with the *Australian Golf Course Superintendent's Association and QLD EPA Improving the Eco-efficiency of Golf Course in Queensland* (2001) (AGCSA). The AGCSA handbook is designed to minimise the impacts of golf course management and has been applied successfully to golf courses around Queensland. Operation of the proposed golf course on the Island utilising these principles will minimise impacts to downstream estuarine and marine EVs, flora and fauna.

15.3.2.4 Intertidal Wetland Values and Functions

Intertidal wetlands of estuarine and marine waters around the Island have a range of values associated with their amenity and ecological function as discussed in various Sections of the EIS. Many of these values and functions are concordant with world heritage values of the Great Barrier Reef. A summary of post mitigation impacts to these values and functions are provided in Table 15.14.

Table 15.14 – Mitigated Impact Levels to Environmental Values and Functions Associated of Intertidal Wetlands

Value	Potential Impact
Scenic amenity	Negligible impact due to minimal loss of intertidal wetlands (<0.5 ha) for access infrastructure
Recreational amenity	Negligible impact with a net gain in recreational amenity due to increased access opportunities
Groundwater Recharge (Regional)	Negligible - no regional groundwater systems
Biological diversity and productivity	Negligible Impact to biological diversity and productivity following proposed mitigation strategies such as WSUD and permanent ESCP measures
Habitat for native and migratory animals	Negligible impact due to minimal loss of intertidal

Value	Potential Impact
	wetlands (<0.5 Ha) for access infrastructure and maintenance of pre-development water quality
Habitat for native plants (and animals)	Negligible impact due to minimal loss of intertidal wetlands (<0.5 Ha) for access infrastructure and maintenance of pre-development water quality
Nursery habitat	Negligible impact due to minimal loss of or disturbance to nursery habitat within estuarine and coastal areas and maintenance of pre-development water quality
Shore and sediment stabilisation	Negligible impact due to minimal loss of or disturbance within estuarine and coastal areas
Dissipative barrier to erosive forces	Negligible impact due to no loss of or disturbance to erosion prone areas
Sediment sink and source	Negligible impact due to no loss of sediment sinks or sources identified either within erosion prone areas or estuarine systems
Nutrient sink and source	Negligible impact due to incorporation of WSUD and ESCP plans that maintain pre-development nutrient levels within adjacent intertidal wetlands
Moderates flood and water flows	Negligible impact due to incorporation of WSUD features in final master plan that minimise changes to natural ephemeral watercourse hydrodynamics
Fishing	Some minor impact on fisheries stocks due to increased recreational fishing. Existing DPIF size and catch limits are designed to maintain recreational stocks at sustainable levels
Indigenous Traditional Owner cultural resource values, Spiritual significance and cultural heritage	Negligible impact following surveys by traditional owners and completion of a DNRW approved Cultural Heritage Management Plan

15.3.3 Recreational and Commercial Fisheries Management

During consultations Qld DPIF indicated that existing fisheries management measures in the areas around the Island are adequate to maintain sustainable commercial and recreation fisheries. Qld DPIF stated that current size and bag limits are considered to be sustainable and are designed to maintain populations targeted by recreational fisheries. Qld DPIF also noted the co-existence of viable and sustainable commercial and recreational fisheries in densely populated areas such as Moreton Bay, and indicated their view that impacts on commercial fisheries around the Island are anticipated to be slight.

15.3.4 Increased Population

The proposed development will increase opportunities for utilisation of the coastal environment. Social aspects of the recreational opportunities include increased access to beaches of the Island and provision of safe and controlled access to surrounding estuarine waters. Both these impacts may be considered positive and consistent with the intent of Policy 2.3.1 of the State Coastal Management Plan. Details of public-access infrastructure to beaches on the Island are discussed in Section 3.



It is estimated that following the completion of the integrated tourist and residential development on Hummock Hill Island a peak capacity of around 4,500 people will be present. Of these, 1,600 (35%) will be permanent residents. As discussed in Section 9, from boat ownership in the surrounding LGA it is estimated that 203 boats are likely to be owned by Island inhabitants, and anecdotal reports of local use rates indicate that 10 - 15% of these, or 20 - 30 boats, are likely to be in use on a given day. These anecdotal reports of usage rates are consistent with overall usage patterns from Qld Maritime safety 2003 data shows that 15.3 % of Queensland boat owners launch on a weekly basis and 40.5 % launch between 2 -3 times a month. Few data are available on the likely boat numbers associated with tourists visiting the proposed development.

Potential impacts from increased population pressures on estuarine and marine EVs, fauna and flora will be controlled by:

- No access for vehicles to salt flats though the 100 m vegetation buffer zone. Community education programs and interpretative signs will raise public awareness of salt flats role in the estuarine system;
- Maintaining a 100m buffer zone between HAT and housing within Colosseum Inlet and Boyne Creek to act as a buffer zone between residences and estuarine wetlands. This buffer zone will also raise house levels above the mangrove canopy minimising the potential for illegal trimming of mangroves for views;
- Clear interpretative signage will be placed on all boat ramps providing maps of seagrass meadow locations within the estuarine system and explaining the risks of dugong and turtle collisions within these areas to increase public knowledge of potential harm that may occur from boat propeller damage and that reduced speeds and increased awareness will reduce the risk of boat strikes;
- Speed restrictions will be recommended within Boyne Creek and high trafficked areas of Colosseum Inlet to reduce the occurrence of boat strike with marine mammals and turtles in areas of seagrass meadows;
- Consultation with Queensland Parks and Wildlife will be conducted with the view to designating special dugong and turtle areas within Colosseum Inlet and Seven Mile Creek where vessel operation restrictions will exist.

15.3.5 Areas of State Significance (Natural Resources)

Areas of State Significance (Natural Resources) exist within Colosseum inlet and on Hummock Hill Island and are identified in Section 15.1.1.

Potential impacts to Areas of State Significance (Natural Resources), in particular intertidal wetlands are considered minimal based on identified values in Table 1 of the SCMP, following proposed mitigation strategies. Table 15.15 outlines a summary of identified significant natural resources within estuaries around the Island and residual impacts following recommended mitigation strategies.



Table 15.15 – Mitigated Impact Levels to Areas of State Significance (Natural Resources)

Value	Potential Impact
Significant Coastal Wetlands associated with Colosseum inlet	Negligible impact due to minimal loss of intertidal wetlands (<1.0 ha) for access infrastructure
Beach ridge systems associated with Holocene strandplains on the Island	Refer to Section 5 for a detailed discussion of this feature.
Fish Habitat Area A	Some minor impact on fisheries stocks due to increased recreational fishing. Existing DPIF size and catch limits are designed to maintain recreational stocks at sustainable levels

15.3.6 Artificial Night Lighting

Mitigation of potential light interference with the low density nesting of turtles on the Main Beach will be incorporated at the planning stage and will include recommendations outlined by Witherington and Martin (1996), such as:

- Eliminating unnecessary light sources such as decorative lighting, flood lighting of footpaths beach access lighting;
- Use of low wattage directional lighting (directed away from nesting beaches;
- Use long wavelength lighting sources such as low-pressure sodium vapour lighting;
- Use of shields on lights visible from beaches;
- Use of recessed directional lighting to reduce light spillage;
- Use of low pole mounted or waist height and shielded lighting on beach access and public pathways;
- Place lights behind natural screens such as trees;
- Use of motion triggered switches and timers on outdoor security lighting;
- Installation of tinted windows on houses facing the main beach;
- Rehabilitation of low screening vegetation below headland housing to block lights visible from beach level whilst maintaining views; and
- Educating house owners of the potential impacts from household lighting during nesting season, such as the use of flyers during nesting season.

Use of the above mitigation strategies have been effective in other areas of the Queensland coastline where turtle nesting coincides with urban development.

Tuxbury and Salmon (2004) demonstrated that if the cues promoting normal orientation are enhanced, seafinding will occur even in the presence of artificial lighting. Thus, restoration may not require control over all sources of artificial lighting. Rather, it might be accomplished by pairing light management (controlling as many lights as possible) with dune restoration to increase silhouette darkness and/or elevation, thus reinstating the historical contrast between landward and seaward horizons.



Hick and Caccetta (1997) in studying the lights of a petroleum production facility on Varanus Island (Western Australia) concluded that those lights that were visible and a potential problem to turtles could be dealt with by relatively inexpensive means such as shielding, repositioning and installing timed light switching devices.

15.4 Conclusions

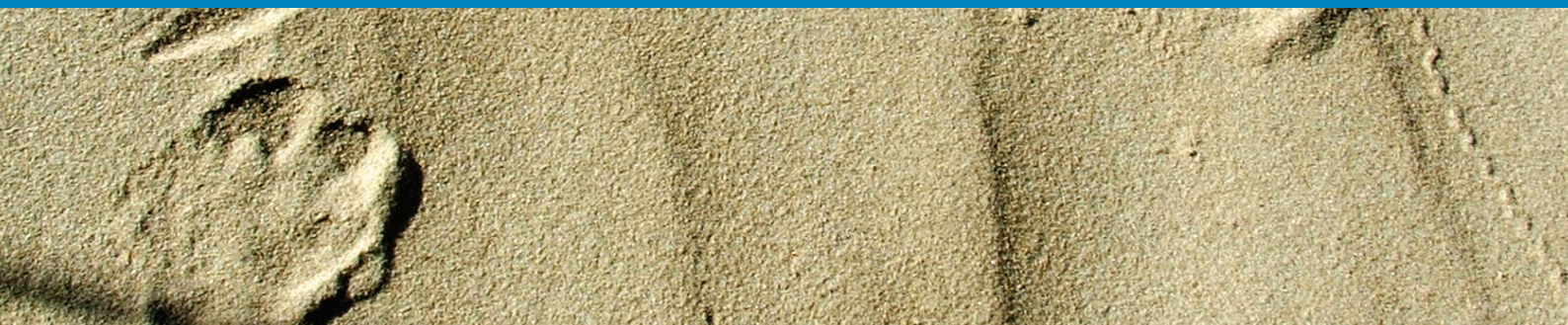
The proposed Master Planning and mitigation strategies and measures identified in the previous sections are considered to effectively reduce potential adverse impacts on identified EVs and WHV of estuarine and marine fauna and flora surrounding Hummock Hill Island associated with the proposed development to minimal or negligible levels.

Some residual risk remains for increased boat traffic and marine turtle and dugong that feed on and migrate between areas of seagrass meadows that will require re-enforcement using public awareness initiatives. Proposed mitigation of lighting impacts associated with low density turtle nesting on the Main Beach are based on commonly used strategies in coastal urban areas and have been demonstrated to be effective in existing urban areas, such as Bargara south of Mon Repos.



SECTION 16

SOCIAL ENVIRONMENT





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16. Social Environment

16.1 Existing Environment

Hummock Hill Island is located within the Miriam Vale Local Government Area¹ (LGA). Miriam Vale LGA is situated in the Wide Bay-Burnett Statistical Division (SD) and is adjacent to the Fitzroy SD, which includes the LGAs of Calliope and Gladstone. As part of the proposed LGA reform Miriam Vale LGA will be amalgamated with the LGAs of Calliope and Gladstone to form the Gladstone Regional Council. Changes to the current LGA boundaries will take affect at the next local government elections in March 2008.

Hummock Hill Island is currently uninhabited, with a fishing shack (used during weekends and holidays) located midway along the northern beach. The Island is used mostly by local visitors for camping and day visits, particularly areas adjacent to Colosseum Inlet and Seven Mile Creek. Current access to the Island from the Bruce Highway is via Turkey Beach Road, Foreshores Road and Clarks Road with a causeway to the Island in Boyne Creek in the north east of the Miriam Vale LGA.

Residents of the Miriam Vale LGA are the communities closest to the Island and most likely to be impacted or benefited by the Project. The nearest settlement (coastal holiday houses) is located at Bangalee on the northern side of Colosseum Inlet. A small permanent settlement of around seven dwellings is also located at Mundoolin Rocks east of Clarks Road. A rural residential subdivision (Foreshores Estate) has been developed along Foreshores Estate and Intrepid Drive, and contains about 20 dwellings.

The nearest townships to Hummock Hill Island are:

- Turkey Beach, a small coastal community with about 130 permanent residents in 2006, a general store and public boat ramp; and
- Bororen on the Bruce Highway, which has a shop and a service station.

Miriam Vale township had a population of approximately 360 people at the 2006 Census. The township is located approximately 30 minutes drive south from Hummock Hill Island via the Bruce Highway, and has basic shops, service station, a primary school and lower secondary school, and access to basic community services. Miriam Vale Shire Council provides a range of services and facilities throughout the Shire (described in Section 16.1.4).

The nearest major city to the site is Gladstone, which had a population of approximately 29,000 people at the 2006 Census. Gladstone is an important centre for commercial and light industrial activities servicing industrial development in Gladstone and mining in Central Queensland.

Tannum Sands/Boyne Island area in Calliope Shire is located approximately 50km north of Hummock Hill. This area is now largely developed and has become a significant suburb for Gladstone. In 2006,

¹ The ABS designated "Miriam Vale Local Government Area" is the same boundary as the Miriam Vale Shire.



the area had a combined population of approximately 8,600 people. Tannum Sands has a range of services including a major shopping centre, high school and community services and facilities, which serve a district catchment.

Agnes Water and Seventeen Seventy (1770) are located approximately 60km south of Hummock Hill. The townships had populations of approximately 1,600 people and 260 people respectively in 2006. The main uses of the land include residential lots and towns, tourism, environmental appreciation, commercial and recreational fishing and camping.

16.1.1 Local and Regional Community Values

This section describes the social environmental values, demographic profile, housing capacity, access and mobility, social and recreational infrastructure and tourism uses in the study area.

Landscape value and visual amenity are discussed in Section 5. The implications of aircraft noise on the social environment are discussed in Section 12.

16.1.1.1 Miriam Vale

The Miriam Vale community takes pride in its wealth of natural capital, level of biodiversity, and ecological integrity, and identifies these natural assets as fundamental values of the local community. Residents like the family-oriented, rural and healthy lifestyle and would like to see this sustained². Residents also value a cohesive and inclusive community, one which involves both young and older people and those with disabilities. This is approached through policies, new developments and urban design which facilitate interaction, community involvement and cultural celebration.

Local employment and business prosperity was identified as an important value, particularly in relation to the protection and encouragement of small businesses (cottage industries/craft), enhancement of tourism opportunities and development of young people's talents and skills. The Community Plan also notes that economic growth in the area needs to be sustainable and generate employment. Residents prefer to see development that is compatible with their lifestyle, sustainable and well-planned³.

The Community Plan also highlighted accessibility within and between local towns as an important value. Public transport, cycle paths and footpaths, currently limited in extent, have been identified as essential to facilitate access around the Shire and the region.

There is an extensive network of volunteer and special interest groups in Miriam Vale and surrounding areas. These include Surf Life Saving Association, Marine Rescue groups, tourism, commerce, environmental, community progress associations and ratepayer groups. Other interest groups include social clubs, dance groups, quilting and craft, seniors' organisations, Country Women's Association, Landcare, RSL, and the Miriam Vale Historical Society. Local and regional

² Miriam Vale Shire Council (2004) Miriam Vale Community Plan.

³ Ibid.



cultural interest groups include opera, museum, library, heritage, art gallery and regional winery groups. A more detailed list of community groups is included in Appendix A5.

Local governments and regional organisation and groups also host a number of community festivals and market days supporting local produce, art and crafts. Annual events include the Seventeen Seventy Commemorative Festival, Sunrise Longboard Classic (Agnes Water), Boyne-Tannum 'Hookup' fishing competition, Gladstone Harbour Festival, and the Brisbane to Gladstone Yacht Race.

16.1.1.2 Regional area

The draft Wide Bay-Burnett Regional Plan 2006-2026 (WBBRP) and the Central Queensland Regional Growth Management Framework 2002 (CQRGMF) mirror many of the local values. Identified social values for the region are summarised in Table 16.1.

Table 16.1 – Identified Social Values within the Local Community

Community Value	Details
Community identity	A relaxed, balanced community with a range of both urban and rural lifestyles, distinct in Queensland. One where there is a strong sense of community and the richness of heritage is recognised and conserved.
High quality natural environment	A well managed and accessible natural environment underpinning the identity of the community.
Well-planned community	A community where there is a high standard of delivery of community services, sporting and recreational facilities, utility, and transport infrastructure accessible to the community. Residential and commercial development is ecologically sustainable, appropriate and of a density that provides effective public transport and freight system between centres and throughout the region.
Inclusiveness	A community where government services, housing, education, health and other services are accessible to all, on demand and at a reasonable cost. There is recognition of all cultural identities, particularly of Indigenous people and those areas culturally significant to them.
Community Vitality and safety	A community where residents are actively involved, with high social capital, embodied in the networks, trust and interactions between individuals and groups within the region, creating a safe and healthy community. Community members have access to education and knowledge, contributing to a dynamic economy.

16.1.1.3 Social Policy Objectives

The Gladstone Region is one of the fastest growing regions in Queensland due to population and industry growth. Gladstone City is considered the future major centre for the lower Surat Basin due to it being the rail head and deep water port for the coal and gas fields as well as for alumina (Local Government Reform Commission, 2007).

The CQRGMF identified the need to be responsive to changing demographics in the region, particularly the aging population, which would have an impact on settlement patterns, social services, lifestyle and the economy. The draft WBBRP identifies that new wealth-creating initiatives are urgently required to meet the present and future regional opportunities, particularly employment generation. Tourism has been highlighted for its capacity to capitalise on the region's



natural advantages. Tourism involves “a complex set of activities and providers, and an equally complex consumer demand” and thus would generate a diversity of businesses and activity.

The WBBRP also cautions the need for regional strategies to regulate the rapid development currently being experienced, to maintain the balance of economic, social, environmental, and infrastructure services. Climate change has also been identified as having the potential to pose additional stress on coastal areas, due to sea level rise and possible changes in the frequency and intensity of extreme climatic events’ (DLGPSR 2006).

Locally, Miriam Vale Shire Council's Community Plan (2004) identifies that future developments need to consider:

- encouragement of local employment for all age groups, particularly for young and older people;
- development that is compatible with, and promotes, ecologically sustainable outcomes;
- facilitation of the community’s sense of identity, image and pride;
- contribution to the community’s social and economic facilities and services, dispersed throughout the communities;
- provision of adequate transport systems, not just for private transport but pathways and public transport;
- recognition and enhancement of the community’s natural and built heritage;
- accommodation of the various lifestyles;
- community engagement; and
- provision of a range of tourism facilities.

16.1.2 Demographic Profile

16.1.2.1 Population and growth

Miriam Vale LGA had a population of 4,813 people in 2001⁴ and 5,126 people in 2006⁵. This was an increase of approximately 6.5%, lower than the overall Queensland growth rate of 8.9 % over the same period.

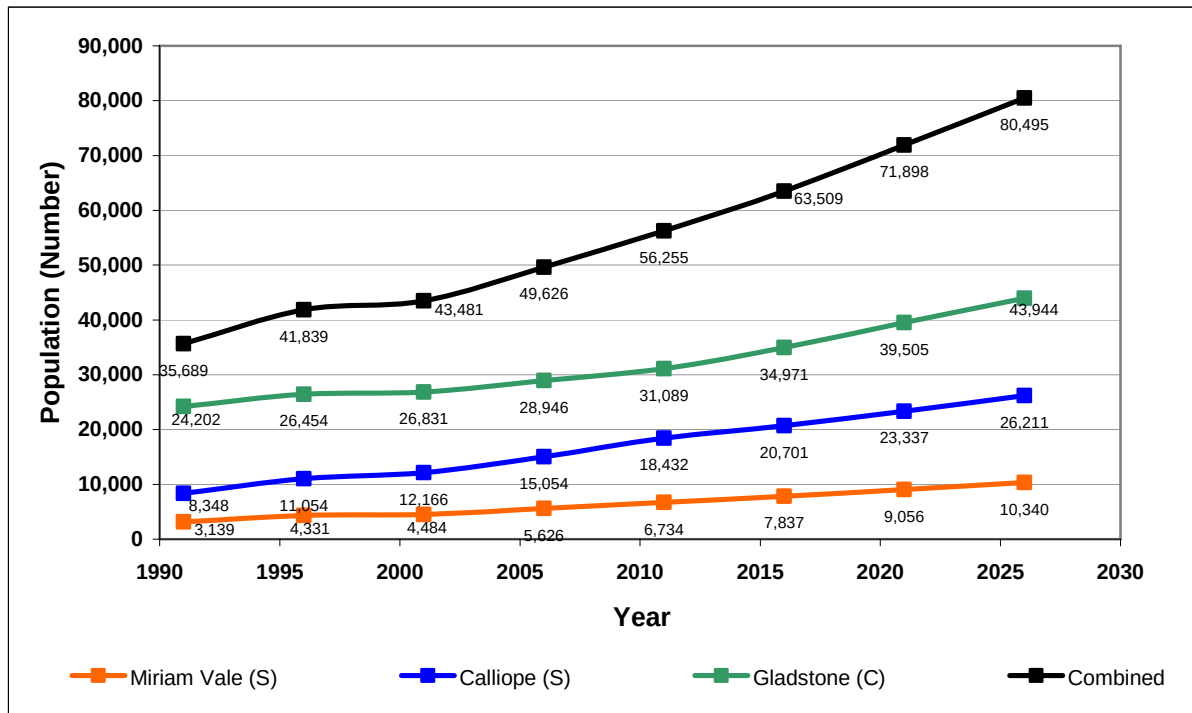
The LGA’s population is expected to more than double by 2026 to over 10,000 people, with an average annual growth rate of 3.4% between 2001 and 2026 (PIFU, 2006). Calliope and Gladstone are also expected to grow to approximately 26,000 and 44,000 respectively by 2026, providing annual average growth rates of 2.3% and 2.2% respectively⁶. These growth rates are higher than the projected Queensland average of 1.7% per annum over the same period. This growth is expected to be fuelled by the economic growth in the mining, manufacturing and tourism industries of the

⁴ ABS Census 2001

⁵ ABS Census 2006

⁶ Medium growth projection (PIFU, 2006)

region and also due to the 'sea change' phenomenon. This latter trend is characterised by increasing numbers of people moving to regional coastal areas which is perceived to provide more relaxed and comfortable lifestyle options.



Source: OESR, 2007

Figure 16.1 – Projected Population Growth, 1991-2026

16.1.2.2 Age Profile and Cultural Diversity

Miriam Vale generally has an older population. The median age of people in Miriam Vale LGA at the 2006 Census was 43 years which was higher than median ages recorded in Calliope (36 years), Gladstone (32 years) and Queensland (36 years). Table 16.2 shows the population distribution of Miriam Vale, Calliope, Gladstone City LGA's and Queensland by age groups.

Table 16.2 – Age Profile, 2006 (%)

Age group	Miriam Vale	Calliope	Gladstone	Queensland
0-14 years	20.5	24.9	24.1	20.7
15-24 years	7.5	11.6	14.5	13.8
25-44 years	24.4	28.7	30.4	28.2
45-64 years	36.5	26.1	23.2	25.0
65+ years	11.1	8.7	7.8	12.4

Source: ABS Census, 2006



In 2006, people aged between 45-64 years represented the largest age group in the Miriam Vale LGA, with more than one third (36.5%) of the total population in this age category. Miriam Vale also had the highest proportion of people in the region aged over 65 years. This is likely to be associated with the “sea change” phenomenon, as people nearing the age of retirement make up a large proportion of this group. These factors are consistent with the aged profile for the Wide Bay-Burnett SD, which also had higher proportions of people aged 45-64 years and 65 years as compared to Queensland.

In both Miriam Vale and Calliope shires, the population had lower proportions of people aged 20-24 years, influenced by the trend of younger people moving from rural to metropolitan areas and mining towns.

Gladstone and Calliope had a population breakdown similar to the overall Queensland breakdown, with population spread relatively evenly between age groups. This could be attributed to the relatively large number of employment opportunities in Gladstone and the Gladstone State Development Area (GSDA) located west of Gladstone. There is a greater population of males as compared to females throughout the Gladstone Region, a feature consistent with mining and manufacturing communities (see Section 16.1.2.3). This population is also usually highly transient.

The most prevalent family type in Miriam Vale LGA was couple families without children, which represented more than half of Miriam Vale families at the 2006 Census. This was higher than in Gladstone (35.8%), Calliope (37.8%) and Queensland (39.1%). This is reflected in the average household size (2.4 people per household), which is lower than the Queensland average household size of 2.6 people per household (Table 16.3). In contrast, Gladstone and Calliope had greater proportions of couple families with children, compared to both Miriam Vale and Queensland.

Table 16.3 – Family Type, 2006

Family Type	Miriam Vale	Calliope	Gladstone	Queensland
Couple family with no children	52.3	37.8	35.8	39.1
Couple family with children	34.4	52.0	47.8	43.3
One parent family	12.4	9.7	15.3	15.9
Other family	0.9	0.4	1.1	1.7
Average household size	2.4	2.9	2.7	2.6

Source: ABS Census 2006

Miriam Vale LGA had a low percentage of Indigenous residents (1.8%), and resident who were born overseas (12.5%) or who spoke a language other than English at home (2.2%), indicating residents are of largely similar cultural background. Gladstone had the largest proportion of Indigenous residents (3.7%), which was higher than the Queensland average (3.3%). All three communities showed lower than Queensland averages of people either being born overseas or speaking other languages.



Although the Indigenous population is not large, the draft Wide Bay Burnett Regional Plan (2005) states that Indigenous population is “of particular concern”⁷ due to relative socio-economic disadvantage.

16.1.2.3 Income, Workforce and Employment Characteristics

In 2006, the median weekly household income in the Miriam Vale LGA was \$638, which was lower than Queensland (\$1,033), and the LGAs of Gladstone (\$1,189) and Calliope (\$1,278). All median weekly incomes (individual, family and household) in the Wide-Bay Burnett SD were lower than Queensland rates in 2006.

Mean taxable income in Miriam Vale Shire for the 2004-2005 financial year was \$36,154⁸, lower than the State mean of \$42,094 (OSER, 2007). Mean taxable annual incomes for Gladstone and Calliope LGAs were also higher than the State mean at \$46,998 and \$46,706 respectively (OSER, 2007a; 2007b).

At the 2001 Census, the unemployment rate in the Miriam Vale LGA was 15.5%, compared with 8.2% for Queensland. The overall workforce participation rate for the Miriam Vale LGA was 52.0%, lower than that recorded for Queensland (63.1%).

Significant jobs growth in the region has seen the rate of unemployment reduce since 2001, although the rate of unemployment in Miriam Vale remains above the unemployment rate for Queensland, Calliope and Gladstone (refer Table 16.4). At the June 2007 quarter, Miriam Vale LGA had an unemployment rate of 6.0%. This is compared to 3.3% in Gladstone, 3.4-3.7% in Calliope and 4.0% in Queensland.

Table 16.4 – Unemployment Rate, June 2006 – June 2007

Locality	June 2006	September 2006	December 2006	March 2007	June 2007
Miriam Vale	8.8	8.4	7.4	6.8	6.0
Calliope (Part A)	4.1	3.7	3.7	3.6	3.4
Calliope (Part B)	4.0	3.8	3.9	3.8	3.7
Gladstone	3.9	3.6	3.5	3.4	3.3
Queensland	5.0	4.9	4.7	4.4	4.0

Source: Department of Employment and Workplace Relations, 2007

At the 2001 Census, managers and administrators was the occupation with the largest proportion of employed persons in the Miriam Vale LGA. This group comprised 15.6 % of employed persons, compared to 8.5% for Queensland as a whole. Other occupational categories with high proportions

⁷ Wide Bay Burnett Regional Plan 2002-2026.

⁸ Based on ATO data



of workers included labourers and related workers (15.6 %), intermediate production and transport workers (14.1%) and intermediate clerical, sales and service workers (12.7%)

The 'Agriculture, Forestry and Fishing' was the industry with the highest proportion of workers in Miriam Vale in 2001, with 19% of employed people working in this sector (refer to Table 16.5). Much of the land within Miriam Vale LGA is under pastoral agricultural land use. Rodds Bay and its surrounds are used as a commercial and recreational fishing area. There are currently six commercial fishermen based at Rodds Bay and four based in the Colosseum Inlet area. The next highest industries of employment were retail trade (11.3%), construction (9.7%), and accommodation, cafes and restaurants (8.6%).

In comparison, the manufacturing industry was the largest employer in Calliope and Gladstone in 2001, as it was in Queensland. In Calliope, nearly one in four employees worked in the manufacturing industry and in Gladstone, approximately one in five employees worked in the manufacturing industry.

Table 16.5 – Employment by Industry Type, Miriam Vale, Calliope, Gladstone and Qld (%)

Industry	Miriam Vale	Calliope	Gladstone	Qld
Agriculture, forestry, fishing	19.0	5.7	1.1	4.9
Mining	0.4	1.2	1.0	1.2
Manufacturing	7.4	24.2	18.5	10.7
Electricity, gas and water supply	1.3	1.6	2.7	0.8
Construction	9.7	8.8	8.5	7.1
Wholesale trade	3.6	3.6	5.3	5.1
Retail trade	11.3	12.7	16.1	15.3
Accommodation, cafes and restaurants	8.6	5.3	4.5	5.6
Transport and storage	6.3	5.7	8.1	4.9
Communication services	1.1	0.6	0.7	1.5
Finance and insurance	0.9	1.1	1.8	2.8
Property and business services	6.9	7.7	9.0	9.8
Government administration and defence	4.6	2.7	2.8	4.8
Education	7.0	7.3	7.2	7.6
Health and community services	5.0	5.9	6.5	9.6
Cultural and recreational services	1.2	1.0	1.4	2.4
Personal and other services	2.2	2.6	2.9	3.7
No-classifiable economic units	0.4	0.5	0.6	0.5
Not stated	3.1	1.9	1.3	1.8

Source: OESR Local Government Area Profiles (October, 2007)

Regionally, retail and wholesale trade and accommodation comprised the most prominent industry group in the Wide Bay-Burnett SD employing 25.8% of the region's work force. This was followed by the government, education and health sectors, accounting for 22.5%.

16.1.2.4 Education

Formal qualifications held by residents in the Miriam Vale LGA were similar to the State average for Certificate, Diploma and Advanced Diploma level qualification and lower than the State average for Bachelor degree or higher qualifications. Comparison of the Miriam Vale LGA formal qualification level was similar with that of Gladstone and Calliope as shown in Table 16.6 and Figure 16.2.

Table 16.6 – Highest Post-School Educational Qualifications, 2001^a

	Miriam Vale LGA		Gladstone LGA		Calliope LGA		Qld
	Persons	%	Persons	%	Persons	%	%
Postgraduate Degree	17	0.4%	144	0.7%	56	0.6%	1.4%
Graduate Diploma and Graduate Certificate	26	0.7%	179	0.9%	95	1.1%	1.1%
Bachelor Degree	143	3.7%	1,304	6.5%	538	6.0%	8.3%
Advanced Diploma and Diploma	174	4.6%	812	4.0%	398	4.4%	5.5%
Certificate Level, nfd	15	0.4%	98	0.5%	25	0.3%	-
Certificate III & IV	589	15.4%	3,646	18.1%	1,699	18.9%	16.0%
Certificate I & II	47	1.2%	320	1.6%	147	1.6%	-
Not stated ^b	504	13.2%	1,827	9.1%	719	8.0%	10.8%
Not applicable ^c	2,306	60.4%	11,786	58.6%	5,292	59.0%	56.8%
Total	3,821		20,116		8,969		

(a) Excludes schooling up to Year 12

(b) Includes 'Inadequately described'.

(c) Includes persons who do not have a qualification and persons who have a qualification out of scope of the Australian Standard Classification of Education

Source: Australian Bureau of Statistics – Census of Population and Housing 2001

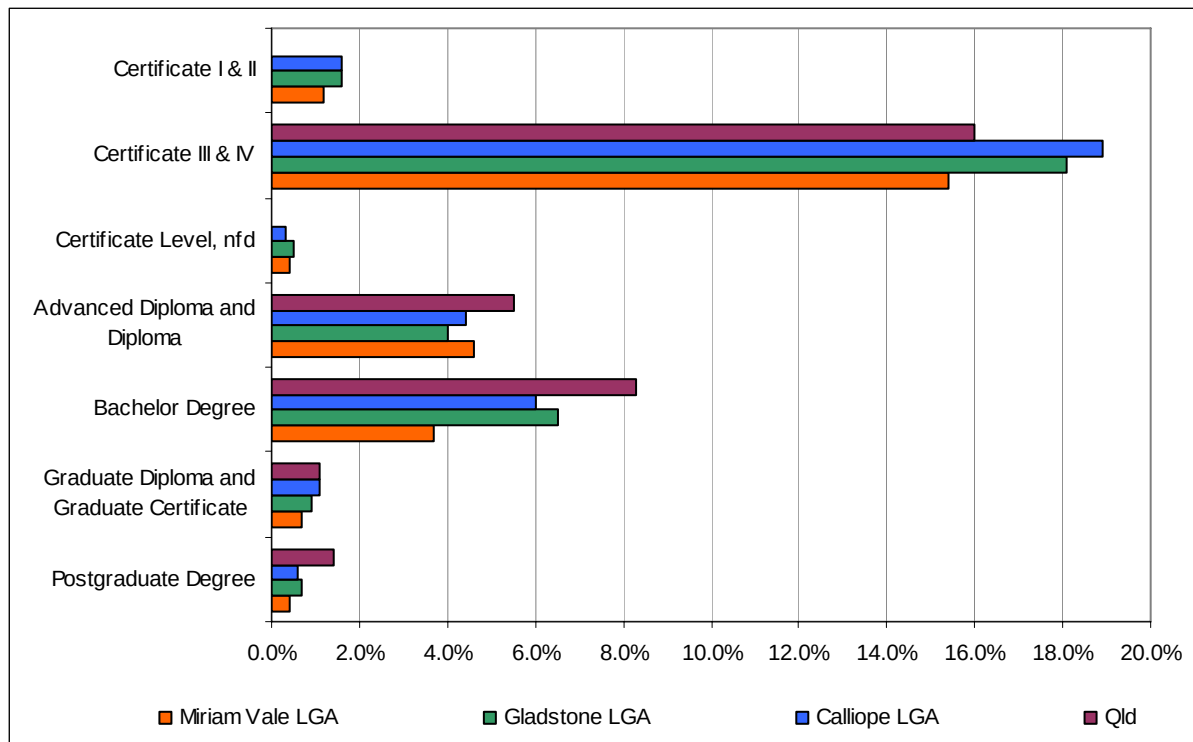


Figure 16.2 – Highest Post School Qualification, 2001

Source: Australian Bureau of Statistics – Census of Population and Housing 2001

16.1.3 Housing and Accommodation

16.1.3.1 Housing Type and Tenure

There were 2,951 dwellings in the Miriam Vale LGA at the 2006 Census, of which approximately 2,255 dwellings (76.4%) were occupied.

Table 16.7 shows dwelling type of occupied private dwellings at the 2006 Census. Detached houses were the most predominant dwelling type, comprising 79.8% of occupied dwellings. Semi-detached dwellings and flats/units each comprised approximately 2% of occupied dwellings, while “other dwellings” comprised approximately 15.3% of occupied dwellings. This denotes the existence of a range of less formal dwellings, including caravans and improvised housing. The Miriam Vale LGA had a high proportion of unoccupied private dwellings at the 2006 Census (23.6%), indicating a high number of holiday houses and temporary accommodation.

Calliope and Gladstone had higher proportions of detached dwellings than Miriam Vale, at 86.0% and 82.3% respectively. Gladstone also had higher proportions of semi-detached dwellings and flats/units, with these comprising 3.1% and 11.6% of occupied dwellings respectively, reflecting the City’s more urbanised development pattern. The LGA’s had lower proportions of “other dwellings” with these comprising 9.4% of occupied dwellings in Calliope, and 3.0% in Gladstone.

Table 16.7 – Dwelling Type, 2006

Dwelling Type		Miram Vale	Calliope	Gladstone	Qld
Separate House	Number	1,800	5,077	8,933	1,154,403
	% of dwellings	79.8	86.0	82.3	76.5
Semi detached house	Number	48	56	334	113,459
	% of dwellings	2.1	0.9	3.1	7.5
Flat, unit or apartment	Number	48	217	1,256	196,584
	% of dwellings	2.1	3.7	11.6	13.0
Other	Number	345	554	325	42,890
	% of dwellings	15.3	9.4	3.0	2.8
Not Stated	Number	14	0	10	1,186
	% of dwellings	0.6	0.0	0.1	0.1
Unoccupied private dwelling	Number	696	753	1,202	152,228
	% of dwellings	23.6	11.3	10.0	9.2

Source: ABS Census, 2006

Houses in newly developed estates in the area tend to comprise four-bedroom brick dwellings, whilst the usual range of housing styles found in regional Queensland (elevated “Queenslanders”, weatherboard and-brick homes and a smaller number of units/apartments) is common across the area⁹.

16.1.3.2 Housing Tenure

Table 16.8 shows the housing tenure of occupied private dwellings at the 2006 Census in the region.

At the 2006 Census, 42% of occupied private dwellings in Miriam Vale LGA were fully owned. This was higher than the proportion of fully owned dwellings in Queensland (30.4%), Gladstone (23.5%) and Calliope (33.0%). Approximately one in four dwellings in the Miriam Vale LGA were being purchased, which was also lower than Queensland, Gladstone and Calliope.

Miriam Vale LGA had lower proportions of occupied private dwellings that were being rented (21.2%) compared to Queensland (30.0%) and Gladstone (32.4%), but similar to the proportion of dwellings being rented in Calliope.

⁹ Department of State Development (2007) State Development Centre, Gladstone Region at a glance

Table 16.8 – Housing Tenure (Occupied Private Dwellings), 2006

Tenure Type	Miriam Vale		Calliope		Gladstone		Qld
	Number	% of total	Number	% of total	Number	% of total	% of total
Fully owned	946	42.0	1,948	33.0	2,554	23.5	30.4
Being purchased	551	24.4	2,439	41.3	4,004	36.9	31.4
Rented	477	21.2	1,256	21.3	3,515	32.4	30.0
Other tenure type	40	1.8	24	0.4	35	0.3	1.0
Not stated	243	10.8	237	4.0	750	6.9	7.3
Total	2257		5,904		10,858		

Source: ABS Census 2006

Miriam Vale Shire Council manages 10 two-bedroom aged care independent living units located in Miriam Vale Township, but this accommodation is at capacity and waiting lists apply.

16.1.3.3 Rental Housing

In 2006, there were 5,248 occupied dwellings in the Miriam Vale, Calliope and Gladstone region being rented, of which 477 were located in the Miriam Vale LGA, 3,515 were in the Gladstone LGA, and 1,256 were in the Calliope LGA. An average of 25% (of the total area's dwelling stock was rented, which was lower than the Queensland percentage for the same period.

There were 683 residential dwelling unit approvals in the three LGAs combined in the year ending June 2007 (OESR). At an average rental rate of 24%, an additional 171 occupied dwellings would have been rented between July 2006 and June 2007. Combined with the 2006 rental total current dwellings rented in the three LGA's would be 5,419.

The current rental vacancy rate for Queensland areas outside Brisbane and the Gold Coast is around 3.4%¹⁰. However, the Gladstone region is experiencing high demand for rental housing as the result of mining and infrastructure development in the area. At the June 2007 quarter, housing vacancy rates in Gladstone were 2.1%, an increase from 1.7% in the June 2006 quarter. At the June 2007 quarter, units/townhouses vacancy rates in Gladstone were 1.8%, decreasing from 3.1% in the June 2006 quarter (REIQ, Summer 2006/2007; Spring 2007).

Applying the average (1.95%) of these vacancy rates to the estimated current rental dwelling stock of around 5,419 dwellings, approximately the current available rental stock in the three areas would be around 106 dwellings.

¹⁰ OSER (2007) Information brief Rental Housing Vacancy Rates Qld June 2007

16.1.3.4 Housing costs

At the 2006 Census, the median housing loan repayment for dwellings in the Miriam Vale LGA was \$867 per month. This was lower than the median monthly housing loan repayment in Gladstone LGA (\$1,192), Calliope LGA (\$1,300) and Queensland (\$1,300).

Median rental costs in the Miriam Vale LGA were \$150 per week at the 2006 Census. This was lower than median weekly rental costs in Gladstone (\$170), Calliope (\$190) and Queensland (\$200).

Figure 16.3 shows quarterly median weekly rental costs in Gladstone between June 2004 and June 2007. As a consequence of increasing housing prices and demand for rental housing, rental costs have also increased over the past few years.

Median weekly rental costs for a three bedroom house in Gladstone have increased steadily since the September 2005 quarter, from \$190 per week to \$280 per week, an increase of approximately 47% over this period. Median weekly rental costs in Gladstone were below those for Queensland for each quarter. However, the gap in rental costs between Gladstone and Queensland has been decreasing over the past 6-12 months.

Rental costs have increased in Gladstone (and probably in adjacent regions) by twice the average rate experienced across Queensland. This is due to low availability, and high demand for rental housing in Gladstone. As incomes have not increased commensurately in the region in that time, housing stress is likely to have suffered as a result of the housing price increase.

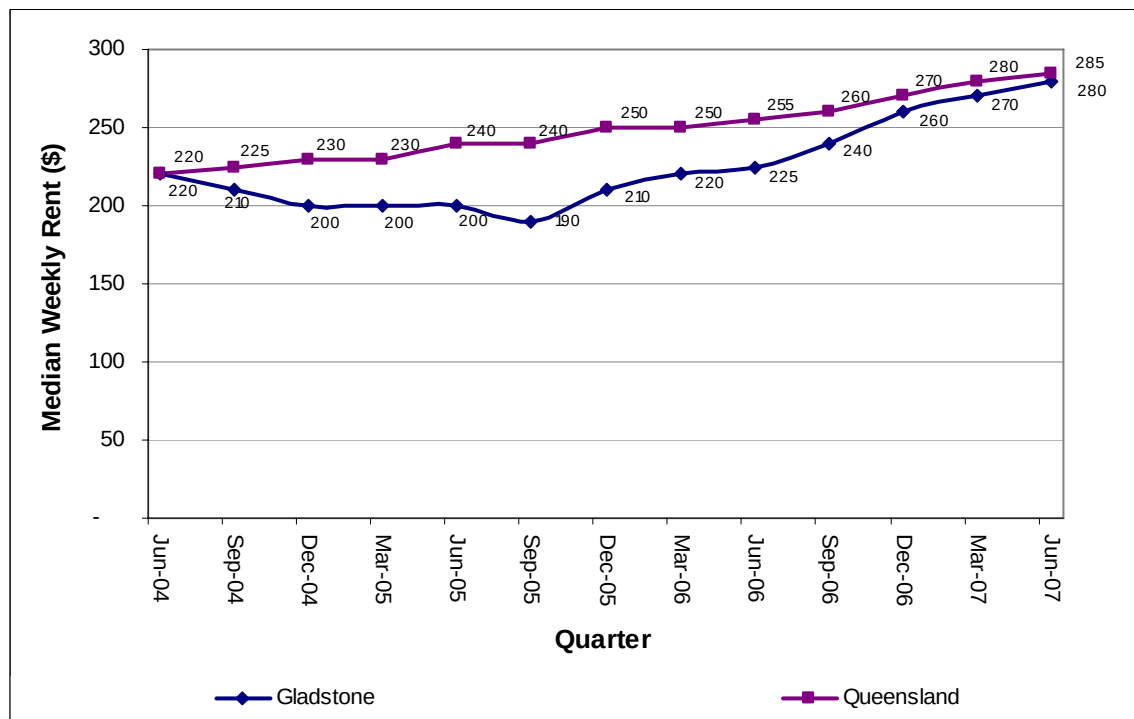


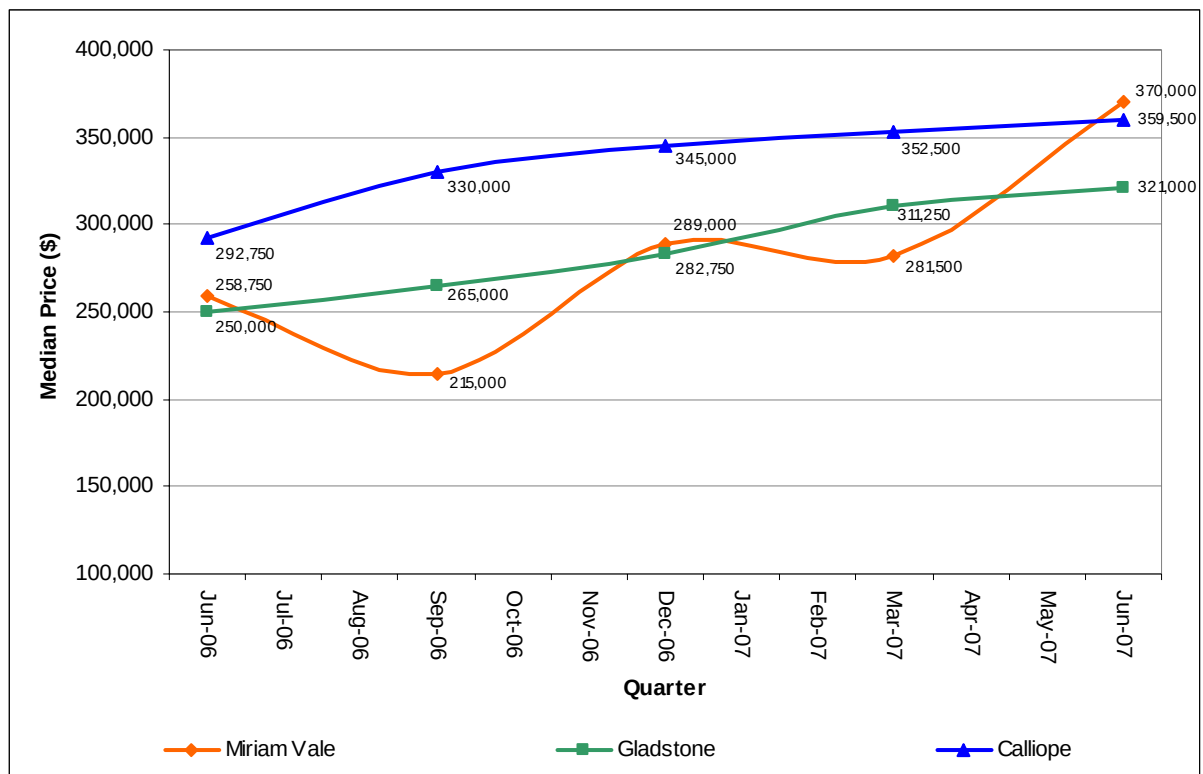
Figure 16.3 – Median Weekly House Rental Costs, Gladstone and Queensland 2004 - 2007

Source: Residential Tenancies Authority

16.1.3.5 Property prices

Median house prices at the June 2007 quarter ranged from \$321,000 in the Gladstone LGA to \$370,000 in the Miriam Vale LGA.

Figure 16.4 shows quarterly median house prices between June 2006 and June 2007. Over this period, median house prices rose steadily in the Gladstone and Calliope LGAs. In the Miriam Vale LGA, median house prices fluctuated between \$215,000 and \$370,000. However, overall median house prices in the Miriam Vale LGA increased by 43% over the 12 months to the June 2007 quarter. This was higher than the increase in property prices over the same period in Calliope (22.8%) and Gladstone (28.4%).



Source: REIQ Queensland Property and Lifestyle, Issues 20, 22 and 23

Figure 16.4 – Median House Purchase Prices in Study Area, 2006-2007

Property prices in selected locations in the region for the six months to February 2007 and to August 2007 are shown in Table 16.9. Overall, median house prices increased over the two six month periods for each of the localities, with the exception of Agnes Waters. Increases in house prices ranged from 4% in Gladstone City and Boyne Island to 18% in Calliope. In Agnes Waters, property prices over the two six month periods decreased by 8%.



Information on median unit price was not available for many of the localities. However, Tannum sands displayed a strong growth of 32% over the two six month periods. Agnes Waters displayed a decrease in unit prices of 11%.

Long term trends for all localities display growths in property prices between 12% and 17% for houses and 17% and 25% for units. Long term growth rates for houses are comparable with the regional trend of 12%. Long term growth trends for units are generally greater than the regional trend of 11%, possibly due to a greater demand for units that are more affordable than housing.

Table 16.9 – Property Prices 2006 to 2007 for Selected Areas within the Region (\$,000)

	Agnes Waters	Miriam Vale	Tannum Sands	Boyne Island	Calliope	South Gladstone	Gladstone City	Region
Six Months to February 2007								
Median House Price	\$368	\$154	\$396	\$350	\$285	\$244	\$340	\$ 273
Days on market	60	30	74	47	51	39	151	93
Discount Rate (%)	5	7	4	4	4	4	SNR	7
Median Unit Price	\$495	SNR	\$199	\$285	SNR	\$215	\$225	\$ 265
Days on market	SNR	SNR	87	27	SNR	34	SNR	86
Discount Rate (%)	SNR	SNR	1	2	SNR	3	SNR	6
Six Months to August 2007								
Median House Price	\$338	SNR	\$445	\$364	\$338	\$280	\$353	\$ 285
Days on market	118	SNR	52	57	81	51	74	106
Discount Rate (%)	7	SNR	4	2	2	6	6	7
Median Unit Price	\$445	SNR	\$263	SNR	SNR	SNR	SNR	\$ 270
Days on market	SNR	SNR	9	SNR	SNR	SNR	36	86
Discount Rate (%)	SNR	SNR	2	SNR	SNR	SNR	9	5
% Change								
Median House Price	-8%	SNR	13%	4%	18%	15%	4%	5%
Long term trend	12%	SNR	14%	12%	17%	16%	12%	12%
Median Unit Price	-11%	SNR	32%	SNR	SNR	SNR	SNR	2%
Long term Trend	25%	SNR	17%	SNR	SNR	20%	19%	11%

SNR = Statistically Not Reliable

Discount rate is the % by which the vendor reduces from the original asking price.

No data was available for Turkey Beach, Foreshores Estate or Bororen.

Source: Australian Property Monitors (www.homepriceguide.com.au - accessed September, 2007)

Unimproved capital values (UCV) of land for selected localities in the region are outlined in Table 16.10. Between the March 2007 quarter and June 2007 quarter, UCV of land in Agnes Waters declined by 20%. UCV in Miriam Vale also decreased over this period, from \$175,000 to \$172,000, a decrease of 12.7%. Boyne Island and Gladstone LGA experienced increases in UCV of land between



the March 2007 and June 2007 quarters, of 31.2% and 16.7% respectively. Increasing land costs are evidence of the area's increasing desirability for both retirement and family housing, particularly in relation to 'sea-changers' and industrial development in the area.

Table 16.10 – Unimproved Land Values for Selected Suburbs within the Study Area (\$,000)

Suburb	March Qtr 2007	June Qtr 2007	% Change over Qtr	12 Months to end of June 2007	12 Months to end of June 2002
Agnes Waters	\$215	\$175	-20.5	\$182	\$95
Miriam vale	\$175	\$172	-12.7	\$175	\$91.4
Tannum Sands	\$35\$	ND	ND	\$185	\$39.5
Boyne Island	\$175	\$225	31.2	\$181.25	\$37.75
Calliope	ND	\$100	ND	\$83	ND
South Gladstone	ND	\$160	ND	\$145	\$115
Gladstone LGA	\$120	\$140	16.7	\$120	\$110

Source: REIQ, *Queensland Property and Lifestyle*, Issue 23 – Spring 2007

Estimated UCV of land for the proposed project are (based on average lot value):

- \$200,000 – 250,000 for Standard Bushland, Golf Course Resort, Lagoon Villas and Riparian Eco-homesites;
- \$400,000 - \$900,000 for Ridgetop Housing, Seaside Cottages, Beachfront Holiday Homes and Headland Holiday Homes; and
- \$30,000 - \$75,000 for townhouses and apartments.

Estimated UCV of land values for the proposed project are comparable with the current surrounding market. Observed UCV of land data for Tannum Sands for the March 2007 quarter exceeds the estimated UCV of land for the standard residential sites on the proposed project.

16.1.3.6 Tourist Accommodation

The Miriam Vale, Calliope and Gladstone LGAs offer a range of tourist accommodation options, including resorts, hotels and motels, apartments and holiday homes, backpackers, and camping and caravan sites. These are mostly concentrated in Agnes Waters, 1770 and Gladstone City. Tourist accommodation is also available in Boyne Island and Tannum Sands, although this is at lower numbers than experienced in the other areas.

Table 16.11 provides an overview of tourist accommodation with 15 or more rooms in the region at the December quarter 2006. There were 28 tourist accommodation establishments¹¹ with 15 or more rooms located within the region at the December quarter 2006, providing a total of 988 rooms. The majority of tourist accommodation establishments were located in Gladstone LGA, which included 17 establishments providing approximately 540 rooms. Six tourist accommodation

¹¹ Includes hotels, motels, resorts, guest houses, and serviced apartment accommodation establishments

establishments were located in the Miriam Vale LGA, providing 260 rooms, and five were located in Calliope LGA, providing approximately 190 rooms.

Table 16.11 – Tourist Accommodation for the Study Region, December Quarter 2006.

LGA	Establishments	Rooms
Gladstone	17	539
Calliope	5	189
Miriam Vale	6	260
Region Total	28	988

Source: OESR.

The above data undercounts the actual number of tourist accommodation establishments in the region, as many accommodation establishments would include less than 15 rooms. A review of various tourist and holiday accommodation websites, estimates that there are about 120 tourist accommodation establishments in the region, as shown in Table 16.12.

About half of the tourist accommodation establishments identified are located in the Miriam Vale LGA, with the majority of these comprising apartments, houses and cottages.

There were 43 hotels, motels and resorts identified in the region, with the majority of these located in Gladstone City. Sixteen caravan and camping areas were also identified, including six in Gladstone, four in the Miriam Vale LGA and six in the Calliope LGA.

Table 16.12 – Tourist Accommodation Establishments in the Region

Towns	Apartments, houses, cottages	Back- packers	B&B/ farm-stay	Caravan/ camping	Hotels, motels, resorts	Total
Gladstone City	8	1	2	6	24	41
<u>Miriam Vale LGA</u>						
Miriam Vale	0	-	-	-	2	2
1770	19	2	-	2		23
Agnes Waters	21	3	-	1	4	29
Turkey Beach	1	-	-	-	1	2
Bororen	0	-	-	1	3	4
Total Miriam Vale LGA	41	5	0	4	10	60
<u>Calliope LGA</u>						
Calliope	0	-	-	1	1	2
Benaraby	0	-	-	3	3	6
Boyne Island	0	-	-	1	1	2
Tannum Sands	3	-	-	1	4	8
Total Calliope LGA	3	0	0	6	9	18
Total Region	52	6	2	16	43	119

Data source – various holiday accommodation websites



In the 12 months to the December quarter 2006, visitors had stayed approximately 100,000 guest nights within the region. Room occupancy rates for tourist accommodation with 15 or more rooms, ranged from 50.2% in Miriam Vale LGA to 73.7% in Calliope LGA for the same period (refer Table 16.13).

Table 16.13 – Occupancy Rate of Tourist Accommodation, December Quarter 2006.

LGA	Guest Nights	Occupancy Rate (%)
Gladstone	43,108	64.8
Calliope	26,367	73.7
Miriam Vale	30,675	50.2
Region Total	100,150	-

Source: OESR.

Room occupancy rates fluctuate throughout the year. Figure 16.5 shows monthly room occupancy rates for 2006, for tourist accommodation establishments in Gladstone LGA and Miriam Vale LGA with 15 or more rooms. In Gladstone, room occupancy rates range from 54% to 81.7%, with higher occupancy rates in the winter months (June-October) and lower occupancy over the summer months.

In Miriam Vale, room occupancy rates vary between 36.6% and 68.9%. While data on room occupancy rates is not available for the full 12 months, the available data shows higher occupancy during the holiday periods in April and December, and low occupancy rates in the winter months.

Limited data was available on room occupancy rates for Calliope over the 12 months. However, between August and December, room occupancy rates in Calliope LGA were between approximately 72% and 78% (QRSIS).

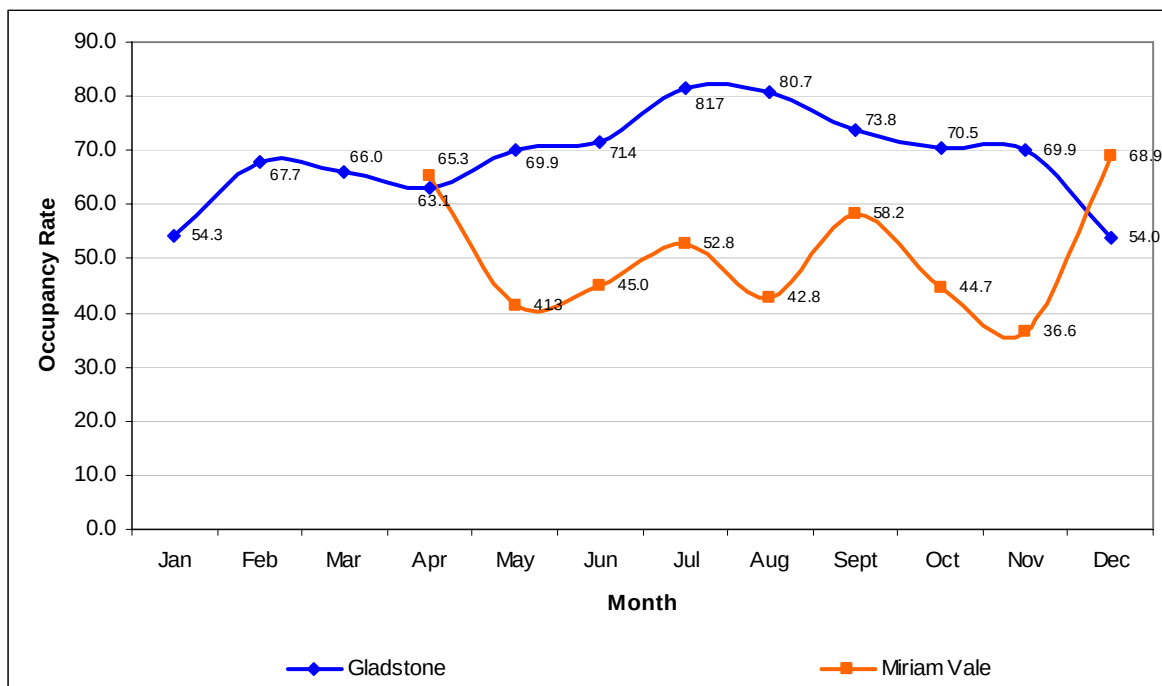


Figure 16.5 – Room Occupancy Rates 2006, Gladstone and Miriam Vale

Source: QRSIS

16.1.3.7 Future supply of housing and accommodation

There is currently a shortage of accommodation and rental housing supply in the Gladstone region, particularly in the coastal townships. The pressure for housing is mainly due to population growth from the 'sea change' phenomenon and the expansion of industries in the Gladstone region.

Based on the medium PIFU population growth projection (refer to Section 16.1.2), it is anticipated that 8,800 additional allotments/entitlements would be required for the (proposed) Gladstone Regional LGA over the 20 between 2006 and 2026.

Recent industrial development activity coupled with the desirability of Agnes Water/1770 and other regional locations, is currently contributing to escalating property prices as discussed in Section 16.1.3. This in turn can lead to 'gentrification' of the area, whereby existing residents may no longer be able to afford increasing housing costs. Similar situations are also being encountered in regional mining centres as a result of increased workforce's service the requirements of the resource boom. Anecdotal evidence suggests that residents not able to afford the high housing prices in such regional mining centres are opting to move to the more affordable regional centres, such as Gladstone and Bundaberg¹².

¹² Miriam Vale Shire Council.



The regional areas of Gladstone and Calliope are also susceptible to the adverse affects of rapid growth pressures such as social displacement through gentrification and the subsequent implications for local housing markets. The loss of accessible, affordable housing and shortages of rental accommodation in these areas has been well documented by the Queensland Department of Housing¹³. In particular, the social environment including affordable housing availability in Gladstone is intensified by the 'boom/bust' effects of industry related economic cycles.

Dwelling approvals have increased steadily in the Gladstone, Calliope and Miriam Vale LGAs in the last 10 years¹⁴. In the 12 months to June 2007, there were almost 700 approvals for the three LGAs, including 96 residential dwelling approvals in the Miriam Vale LGA. Construction can take up to 12 months in the Gladstone area once subdivision is approved, due to the shortage of skilled construction sub-contractors. Increases in stock notwithstanding, housing supply in the Gladstone region is under intense pressure.

16.1.4 Community Facilities, Services and Infrastructure

Miriam Vale township itself has a range of community services such as:

- aged care facilities;
- child care and family day care;
- community housing;
- home and community nursing;
- a public library;
- Meals on Wheels; and
- youth services/groups.

Local residents access regional centres such as Gladstone for more extensive and higher order services and facilities. The multi-purpose Rural Transaction Centre (RTC) is located at Agnes Waters and offers a variety of State Government services including Department of Housing; Justice and Attorney-General; Tourism; Racing and Fair Trading; Electoral Commission; Legal Aid; Office of State Revenue; Public Trustee; Registry of Birth, Deaths and Marriages; Workcover; Senior's Card and Transport. Access to Commonwealth Government services such as the Australian Taxation Office, Centrelink and Medicare is also available at the RTC.

A summary of local and district shopping/commercial and community facilities in proximity to Hummock Hill Island are outlined in Table 16.14.

¹³ Source: Queensland Government Department of Housing, Housing Action Plan for Gladstone/Calliope 2002 and Update No: 1 February 2003.

¹⁴ Population and Housing Fact Sheet - Gladstone and Calliope Shires. <http://www.cqris.com.au>

Table 16.14 – Local Shopping and Community Facilities (by Location)

Miriam Vale Township	Agnes Water/Seventeen Seventy	Tannum Sands/Boyne Island
■ Council office and Community Health Service; ■ Tourist information centre; ■ Community centre, bowling club, QCWA, golf course, park and oval; ■ Police station; ■ Primary school; ■ Church; ■ Post office, railway station and show grounds. ■ Sporting oval; and ■ Parks and a playground.	■ Rural Transaction Centre; (central facility for Local and State government service; provision) ■ Post office; ■ Service station; ■ Tourist shops; ■ Community centre; ■ Tourist information centre; ■ Museum; ■ Shopping centre; ■ Real estate agency; and ■ Parks.	■ Banks: National, ANZ, Commonwealth and Westpac; ■ Shopping centre including two major supermarkets; ■ Takeaway food shops; ■ Restaurants ; ■ Clothing stores; ■ Post office, sports ■ Sports complex, bowling club, golf driving range, skate way centre; ■ Tourist information centre; and ■ Parks and reserves.

16.1.4.1 Emergency services

The emergency and health services available in the Gladstone region are described in Table 16.15. These services are considered by the relevant emergency services to be generally adequate for existing and projected demand in the short term¹⁵, but additional facilities may be required if the population grows at its current rate.

Table 16.15 – Services and Locations in the Study Area

Service	Location
Emergency Services	
Queensland Ambulance Service	Miriam Vale, Agnes Waters, Calliope, Boyne Island, Gladstone
Emergency rescue helicopter	Bundaberg, Rockhampton
Police	Miriam Vale, Agnes Waters, Calliope, Gladstone, Tannum Sands
Fire and rescue	Miriam Vale, Calliope, Boyne Island, Gladstone
Volunteer fire and rescue	Agnes Water/1770, Turkey Beach, Tannum Sands, Bororen, Captain Creek, Colosseum, Rosedale, Wartburg, Foreshores and Lowmead
State Emergency Services	Miriam Vale and Gladstone/Calliope
Volunteer Marine Rescue	1770
Health	
Hospital	Gladstone Hospital
Community health service	Agnes Waters

¹⁵ Confirmed in consultation, refer to Appendix A5

16.1.4.2 Education

The region includes a number of educational facilities, including primary and secondary schools and tertiary education institutions.

Table 16.16 shows primary and secondary schools in the region, with student enrolment numbers at July 2007. There are 18 primary and preschools in the Miriam Vale, Calliope and Gladstone LGAs, offering education for students in preschool to Year 7. Three schools provide education for both primary and secondary students, and three schools provide education for secondary students, in Years 8-12.

Rosella Park School provides programs for primary school students with disabilities. A number of other schools also offer special education programs however, no students were enrolled in these programs as at July 2007.

Table 16.16 – Primary and Secondary Schools in the Region

School Name	Preschool and Primary School Students (Prep-Year 7)	Secondary School Students (Year 8-Year 12)	Total Students
Miriam Vale LGA			
Agnes Water State School	267		267
Wartburg State School	65		65
Bororen State School	45		45
Lowmead State School	14		14
Rosedale State School	79	172	251
Miriam Vale State School	84	35	119
Calliope LGA			
Tannum Sands State School	634*		634
Calliope State School	429		429
Boyne Island State School	323		323
Benaraby State School	142		142
Ambrose State School	55*		55
Yarwun State School	49		49
Ubobo State School	26*		26
Builyan State School	13		13
Nagoorin State School	7		7
Mount Larcom State School	65	50	115
Tannum Sands State High School		1,052	1,052
Gladstone LGA			
Kin Kora State School	765		765
Gladstone West State School	729*		729
Clinton State School	688*		688
Gladstone South State School	325		325
Gladstone Central State School	305		305



School Name	Preschool and Primary School Students (Prep-Year 7)	Secondary School Students (Year 8-Year 12)	Total Students
Rosella Park School (Special School)	61*		61
Gladstone State High School		1,072	1,072
Toolooa State High School		965*	965

* includes full-time and part-time student numbers

Source: Education Queensland (www.education.qld.gov.au)

Tertiary educational institutions include Central Queensland Institute of TAFE (CQ TAFE) and Central Queensland University. While CQ TAFE is expanding due to increasing demand, enrolment in Central Queensland University is relatively stable. The closest traineeship opportunities are available through local employers and are supported by neighbouring TAFE colleges and training bodies such as the Gladstone Area Group Apprentices Ltd.

16.1.4.3 Recreational and Cultural Facilities

A variety of recreational activities operate in the Miriam Vale township and surrounding areas within proximity to the development site, including fishing, scuba diving, netball, rugby league, little athletics, horse riding, cricket, motor-cross, golf, tennis, and lawn bowls.

Agnes Waters and the 1770 contain a number of the recreational tourism and cultural facilities within the Miriam Vale LGA including:

- surf beaches;
- the Miriam Vale Shire Museum (Agnes Water);
- the Garden Art Gallery (Agnes Waters);
- the Southern Great Barrier Reef, including Lady Musgrave Island/ Reef and Fitzroy Reef; and
- Deepwater National Park, Eurimbula National Park and Sir Joseph Banks Conservation Park.

Recreation tourism opportunities are also emerging in other areas of the LGA, notably Baffle Creek and Rules Beach which are largely conservation areas. Popular visitor and recreational activities include:

- Bushwalking and picnics;
- Guided tours to the Great Barrier Reef and nearby wilderness areas;
- 4W Driving and camping;
- Shore, estuary and offshore fishing;
- Beach swimming and surfing,
- snorkelling and scuba diving;
- Exploring the townships and local hospitality; and
- Dugong sanctuary at Rodds Harbour.



Hummock Hill Island is a popular fishing, boating and camping area. Recreational uses of the Island and surrounds are briefly described in Table 16.17.

Table 16.17 – Location and Associated Recreational Activities

Location	Recreational Activity
Rodds Bay	Dugong sanctuary, migratory birds, National Park, camping
Boyne Creek	Fishing, boating, dugong/ turtle/ bird sighting
Colosseum Inlet	fishing and crabbing, recreational boating, camping
Hummock Hill Island	Camping, fishing, recreational boating
Sandfly Creek	Camping, fishing, prawning
Seal Rock	Fishing, diving
Seven Mile Beach	Fishing
Wild Cattle Creek	Boat Ramp, Fishing

16.1.5 Tourism Uses

Tourism is a key industry in the both the Central Queensland and Gladstone regions. Approximately 356,300 visitors travelled to the Gladstone region¹⁶ in the year to December, 2006 (TQ, 2006). A total of 308,000 (86%) domestic visitors and 48,300 (14%) international visitors came to the Gladstone region in YE December 2006 (TQ, 2006). Approximately 68% of domestic visitors were from within regional Queensland (excluding Brisbane) and 19% from interstate (refer to Figure 16.6). International visitors made up 14% of visitors to the Gladstone Region in the YE December 2006. Visitors to the Gladstone Region stayed a total of approximately 1.4 million visitor nights (TQ, 2006).

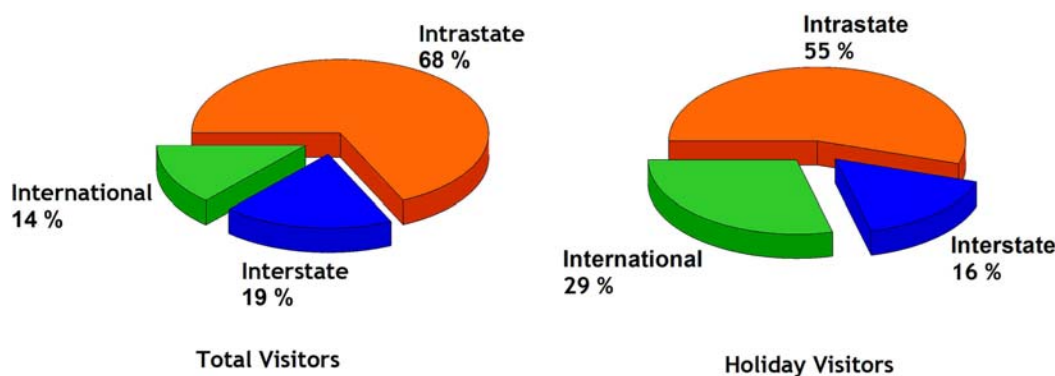


Figure 16.6 – Gladstone Region Total and Holiday Visitor Sources (Source QT, 2006)

Of the 356,500 visitors to the Gladstone region 146,165 (41%) came for a holiday, 121,210 (34%) came to visit friends and family and 64,170 (18%) came for business purposes. People visiting the

¹⁶ The Gladstone Region incorporates the LGAs of Miriam Vale, Calliope, Banana and Gladstone



region on holiday were primarily from intrastate (55%) followed by international (29%) and interstate (16%) sources (TQ, 2006).

Total domestic visitor numbers to the Gladstone region were relatively stable between YE 2003 and YE 2005 (366,000 and 362,000 respectively) and decreased slightly (308,000) in the YE 2006. International visitors have increased significantly between YE 2003 (25,000) and YE 2006 (48,000). Overall the total visitor trend for the region appears to be relatively stable, despite some proportional changes between domestic and international visitors.

Total expenditure by domestic visitors to the central Queensland region for the YE 2006 was \$475 million, representing around 5% of the total Queensland expenditure. International visitor expenditure for the same period was \$44 million, representing 2% of total Queensland expenditure. Current total tourist expenditure for the Gladstone region increased as a proportion of the total Queensland expenditure by 5% between YE, 1999 and YE, 2006.

Standard Visitor Surveys (SVS) conducted by Tourism Queensland (March/April, 2004) found the most appealing aspects of the Gladstone region, in descending order, to be the beaches and water (30%), scenery and natural environment (15%), climate (13%) and quiet and peaceful area (11%). Key areas of interest for visitors include the Southern Great Barrier Reef, including Lady Musgrave Island/Reef and Fitzroy Reef, National Parks (i.e. Deepwater National Park, Eurimbula National Park and Sir Joseph Banks Conservation Park), fishing, and surf beaches. Overall satisfaction results from SVS for the Gladstone region scored the reef (4.65¹⁷), friendliness of locals (4.47), botanical gardens (4.35), picnic/BBQ facilities (4.33) and locals knowledge of the area (4.31) as the most satisfactory items of the region (TQ, 2006).

Tourism facilities and infrastructure within the region remains relatively undeveloped outside the Agnes Waters/1770 area. Tourism related operations are primarily concentrated in the Agnes Water/1770 and Gladstone City areas, reflecting the two primary tourist centres for the region.

16.1.6 Access and Mobility

The Bruce and Dawson Highways principally service the local and regional road network for Miriam Vale Shire and surrounding areas. Gladstone is situated approximately 15 km from the Bruce Highway which by passes the City centre. Boyne Island, Tannum Sands and Miriam Vale are located approximately 20 km, 25 km and 70 km south of Gladstone respectively. Calliope is accessible via the Dawson Highway approximately 20km southwest of Gladstone. The extensive road network into Gladstone provides three access points to the Bruce Highway and extractive industry areas of Central Queensland.

Queensland Rail operates daily services from Brisbane to Maryborough and Bundaberg, with links to the hinterland including Miriam Vale which is also serviced by the Tilt Train. Four airports service the region including Gladstone, Bundaberg, Hervey Bay and Maryborough. These provide regular passenger and freight flight connections to Brisbane and linkages to the north and south coast.

¹⁷ Scores out of 5



Community consultation and the Miriam Vale Shire Council Community Plan (2004) indicated community desires for improved public transport between townships in the immediate vicinity of Hummock Hill Island, in particular Turkey Beach, Baffle District and the Rosedale, Lowmead and Berajondo areas.

Improved daily public transport to Gladstone and Bundaberg were also identified as important, to enable improved mobility and commuter access for residents in Miriam Vale, Agnes Water and 1770. The Miriam Vale Shire Community Plan (2004) indicates that despite local community endeavours, a regular public bus service to Bundaberg has not yet been established, as the current local population is not sufficient to support a viable service. The establishment of a community bus linking townships within the Miriam Vale LGA also received a strong response during consultation for this assessment.

School transport was also identified as an issue. The Education Queensland currently provides free school bus services for school students (up to year 10) in the Turkey Beach and the Foreshore's area to the nearest state school. These include Bororen State School (Turkey Beach) and Miriam Vale High (Foreshore's area). Many families are also sending children to schools in Tannum Sands. A private bus company current runs this school bus route, however parents have indicated a desire for Education Queensland to consider providing bus services to these schools.

Other transport issues that received a strong community response during Council's community consultation process for the community plan included:

- need for improvement to and upgrading of inter-township roads (i.e. sealed, all weather standard);
- the need for a link road connecting to Agnes Water; and
- need for local pedestrian and cycle networks, including national park trails.

16.2 Impact Assessment

This section provides an assessment of potential benefits and impacts of the Project. Mitigation measures are also identified to maximise the benefits of the Project and minimise potential construction and operation impacts.

16.2.1 Consultation Findings

Consultation undertaken for the EIS is detailed in Appendix A5. Issues identified during consultation for the EIS in relation to potential social impacts include:

- potential for increased traffic on existing roads, including Turkey Beach Road, Foreshores Road and Clarks Drive, and the need for speed limits (road and water) to minimise wildlife accidents¹⁸;
- potential impact of aircraft noise on nearby residents¹⁹;

¹⁸ This is discussed in the EIS Chapter on Traffic and Transport.



- possible degradation of landscapes and visual amenity²⁰;
- loss of open space and recreational opportunities on and around the Island, including fishing, and camping;
- capacity of schools and community facilities, including health facilities, to meet the demands of an increased population;
- concern over access for and provision of emergency services;
- the need for a mixed range of residential housing and/or lots to be provided which cater for varying levels of affordability; and
- potential for adverse impacts on the local housing market, which is already under pressure.

A number of benefits relating to the Project were also identified during community consultation, including:

- potential for improved access to and utilisation of Hummock Hill Island;
- potential for increased property value for nearby landowners;
- improved tourism and recreational opportunities;
- increased residential development to support employment growth in the region; and
- potential employment opportunities for local residents during the construction and operation phases of the Project.

16.2.2 Impact on Properties and Business

There are no existing dwellings on Hummock Hill Island, and therefore no direct impacts on any dwellings.

An existing fishing shack is located on the north coast of the Island within the erosion prone area. An increase in accessibility and population on the Island would impact on the seclusion of the fishing shack. However, it is expected that the general amenity of the area near the shack would increase with regard to improved access to facilities and services.

The Project is proposed to provide a range of housing options as detailed in Chapter 3. The Project would increase the availability of residential properties in the region and provide residents with improved access to a range of residential property options, including affordable units through to high value headland homes.

It is expected that the Project would benefit existing landowners on the Island and in adjacent areas through increases in equity and/ or land values of existing properties. However, an increase in property prices in the vicinity of the Project may impact on housing affordability for prospective property owners, particular if increases in property prices exceed increase in income. This may

¹⁹ This is discussed in the EIS chapter on Noise and Vibration.

²⁰ This is discussed in the EIS Chapter on Land Use and Visual Amenity.



reduce opportunities for entry into the property market, particularly for lower income earners. Further comment on housing impacts are dealt with in Section 16.2.6.

Existing commercial crab fishing operations may be impacted by the Project through increased competition from recreational fishers, associated with the Project and expansion of Tannum Sands, including an upgrade of the Wild Cattle Creek boat ramp (refer to Chapter 15). However, some commercial fishing operators have also identified possible businesses opportunities arising from increases in the number of tourists, including the provision of recreational fishing services and facilities.

A number of existing tourism businesses such as accommodation providers, are located in the region, including at 1770, Agnes Water and Gladstone City. The Project would increase competition for these facilities. However, it is proposed that the Project would offer a range of different tourism products currently not available within the region, improving the range options available for visitors. Anecdotal evidence suggests that community members are supportive of the additional tourism facilities proposed to be provided by the Project (see Appendix A5).

16.2.2.1 Mitigation

The following strategies are recommended to mitigate potential impacts and maximise potential benefits of the Project for local communities:

- consultation with local commercial fishing operators to identify particularly issues associated with the construction and operation of the Project, and to identify specific strategies to minimise potential impacts; and
- liaison with the Queensland Rural Adjustment Authority to identify possible options to mitigate potential impacts for local commercial fishing operators, for communication to affected fishing operators.

16.2.3 Local Community Values and Lifestyles

A total of 194 landowners were identified in locations closest to the Project, including at Turkey Beach Road, Foreshores Road, Clarks Drive, Intrepid Drive, Bells Road; and Harbour Drive. These included permanent residents and property owners using their properties for holiday accommodation (either for themselves, or for a small proportion, to tourists.)

As discussed in Appendix A5, community values in the area surrounding Hummock Hill Island relate to the area's natural assets, community lifestyle including access to quiet townships and local social networks, and access to extensive natural recreational areas. Hummock Hill Island has a high frequency of visits from local community members, for recreation activities such as camping and fishing.

The Project would change the scenic and recreational amenity of Hummock Hill Island and the nearby coastline during construction, and intensify the level of activity in the area. This is not expected to affect community networks and cohesion in existing coastal settlements, but may impact on the quiet lifestyle of existing residents. During construction, recreation access to the island and parts of its coastline may be inhibited.



The proposed upgrade of Clarks Road would not directly impact properties and proposed improvements would provide improved road access for properties on Clarks Road.

It is likely that some construction workers would choose to locate to the region for the period of construction. As the region has already experienced a substantial inflow of construction workers related to other major projects, this is not expected to affect community values.

In the longer term, the project would improve the range of facilities available to existing neighbourhoods, including retail and hospitality outlets for their use, and contribute to economic vitalisation in the immediate area. The Island community is expected to retain a 'small-town' coastal lifestyle with the convenience of access to a range of community services and facilities, including recreation, retail, emergency services, community hall and meeting places. Further discussion on community services proposed is outlined in Section 16.2.7).

The new island community would have particular characteristics (as described elsewhere in this chapter), including a higher than the Queensland average proportion of people aged over 65 years, and a proportion of short-stay residents and long stay visitors. As such it would be important to encourage participation by new residents and where appropriate, visitors, in the development of social networks, community facilities and community events, to encourage a sense of community. It would also be important to encourage participation by other local and regional residents in island events and activities, to build a wider sense of community and inclusion.

The Project includes redevelopment of the Island's grassed airstrip to accommodate private single turboprop aircraft. Less than 6 aircraft movements a day are anticipated for this facility. Noise issues associated with aircraft movements are discussed in Section 12.

16.2.3.1 Impacts on Indigenous Community Values

The Island is an important landscape for local Indigenous people, due to the cultural values that are attached to it, including dreaming stories and ceremonies.

Sites on the Island were found to have Indigenous artefacts and markers during Cultural Heritage surveys for the project as discussed in Section 13. While uses of these sites are infrequent, access to these sites are important to local Indigenous people. A Cultural Heritage Management Plan is being developed to protect significant Indigenous sites, and the master plan for the development has taken these areas into consideration.

Opportunities exist during both the construction and operation phases for training and employment, including for local Indigenous people. Skills and experience gained in this process would be transferable to other projects in the region, such as in the Gladstone State Development Area and the construction industry.

Consultation with existing Indigenous businesses and enterprises should be undertaken to identify opportunities for local Indigenous people in the construction and operation phases of the Project. It is also recommended that an Employment and Training Strategy be prepared to identify the skills required for construction and operation and trainings needs to enable local employees to gain the



necessary skills. This should include strategies to maximise employment and training opportunities for local Indigenous people.

16.2.3.2 Mitigation

The following strategies are recommended to mitigate potential impacts and maximise possible benefits of the Project.

Construction

- early consultation and communication residents in adjacent townships should be undertaken to raise community awareness of construction activities, potential changes arising from construction activities (i.e. to road access and access to recreational uses) and proposed environmental management measures;
- consultation with local Indigenous organisations should be undertaken to identify and facilitate training and employment opportunities associated with the Project; and
- ongoing consultation with local Indigenous groups, to ensure access to places and sites of importance is maintained.

Operation

- community development strategies to build an 'island' sense of community and integrate residents with the surrounding shire communities; and
- ensure public access to services and facilities is promoted to local and regional residents.

16.2.4 Community Profile

Existing demographic characteristics of note in the Miriam vale LGA include:

- a population of 5,626 people at the 2006 Census;
- a higher median age and a smaller proportion of people age 15-24 years;
- higher unemployment rates compared to the wider Region; and
- lower median incomes in Miriam Vale and Wide Bay-Burnett region compared to Queensland, Calliope and Gladstone.

The permanent residential population of the Island is estimated to be 264 people by 2011, and increasing to 881 people by 2016, and 1,597 people by 2021. This would increase the population of the Miriam Vale LGA by 28% over existing population levels. The projected population of the Miriam Vale LGA is currently expected to reach 6,734 by 2011, 7,837 by 2016 and 9,056 by 2021. The permanent population of the Island would represent approximately 18% of the additional growth projected for the area by 2021.

The tourist (peak) 'population' on the Island is expected to be equivalent to approximately 540 people in 2011, 1,300 people in 2016, and 1,980 people in 2021, peaking at a maximum of around



2,300 people in 2024. These would include tourists ranging from overnight to long-stay tourists and holiday home owners²¹.

Table 16.18 indicates the expected total population of the Island to 2021.

Table 16.18 – Expected Population of Hummock Hill, 2011-2021

People	2011	2016	2021
Permanent Residents	264	881	1,597 (maximum)
Tourists/short stay residents	547	1,303	1,980
Total	811	2,184	3,577

On completion of the project the total (tourist and permanent) 'population' of the Island would reach approximately 4,019 people. This is equivalent to an increase of more than 60% of the current population of the Miriam Vale LGA, and would represent significant extra demands on social and physical infrastructure in the LGA as discussed below. However, LGA amalgamations proposed for March, 2008 and formation of the Gladstone Regional Council will consolidate social and physical infrastructure within the region, providing a greater range of social infrastructure to support the region.

It is expected that approximately 20% of Hummock Hill residents would be aged over 60 years, that people of working and child-rearing age would represent approximately 60% of residents, and that children and young people would represent approximately 20% of residents. This would accelerate the rate of population ageing in the Miriam Vale LGA. The proportion of people over 65 years at the 2011 census in the Miriam Vale LGA was slightly less than the Queensland average, so this is not considered likely to create significant issues in relation to community vitality. Conversely, the additional population is likely to add to the population base from which volunteer workers and community group members can be drawn, and increase the vitality of community organisations and networks. The implications for community services and facilities are discussed in Section 16.2.7.

The Project is planned to be an open community (as opposed to a gated community) allowing public access to all parts of the Island to create an inclusionary atmosphere.

16.2.5 Workforce and Employment Opportunities

The development of the major infrastructure and urban services is projected to occur over an 16 year period, commencing in 2008 and finishing in 2023. This would include installation of access roads, a bridge, and water, power generation and wastewater management. The construction of resort facilities and buildings would also be spaced over this period.

²¹ Projected population breakdown in Hummock Hill Island extrapolated based PIFU produced 'Projected resident population for Local Government Areas - 2006 edition' and against the projected population of Hummock Hill Island in 2025.



The Project is expected to generate direct and indirect employment opportunities during both the construction and operation phases of the Project. A discussion on potential employment opportunities provided by the construction and operation of the Project is provided in Chapter 17.

It is estimated that an average of 190 jobs per year from 2008 to 2024 would be directly generated during construction, and a peak employment of 350 persons. When indirect employment is included, construction is estimated to generate an average of 260 jobs per year, and a peak employment of 460 persons. At a state level, the project is estimated to directly and indirectly generate an average of 300 jobs per year, and a peak employment of 550 persons. Employment opportunities expected to be generated during construction include both skilled and unskilled positions, including in engineering design, construction supervision and trades, earthmoving, equipment operation, transport and building and landscaping.

Following construction, employment opportunities would also arise from tourism activity generated by the project. It is estimated that over the period 2008 to 2035, the number of jobs created directly and indirectly by the Project is expected to rise steadily to the peak level in 2024, in the order of 700 persons. At a state level, the tourism expenditure is estimated to directly and indirectly generate up to 850 jobs per annum by 2024. Employment opportunities generated during the Project's operation are expected to include administration and management (i.e. resort and facilities management), service-orientation (i.e. hospitality, retail, tourism operators), environmental management and landscaping.

Construction workers are likely to be sourced regionally, attracting 'outsiders' to this small community. Anecdotal evidence²² suggests that there is currently a lot of competition for skilled and semi-skilled workers throughout the region, particularly from Gladstone and mining industries. This provides a number of difficulties in securing a stable workforce. This is further discussed in Section 17. Construction jobs on Hummock Hill Island may not fit with the projected future population demographic (i.e. consist mostly of retirees and older people) so workers would need to be sourced from outside the local area for ongoing construction.

The Project is expected to allow for employment and skills training opportunities during construction, and facilitate a range of business and employment opportunities following construction within the Village/Town Centres and resort facilities. It is likely that employment options available as a result of the project during both construction and operation would increase job opportunities, employment diversity and training opportunities in the area. This is likely to lead to a gradual increase in median incomes, and potentially help to retain younger people (15-24 years) in the area.

²² Calliope Shire Council, see consultation notes in Appendix 3.



Skill shortages may be addressed through apprenticeships and training programmes. In the 2006 and 2007 budgets, the State and Federal governments²³ respectively announced several packages to address skills shortages through apprenticeships and training, including:

- the \$1 billion *Queensland Skills Plan* (State)- this plan responds to skills shortages across Queensland, and includes provision of \$3.3million to provide 850 extra training places in the Wide Bay Burnett region by 2010. This includes the announcement of a new 'Skilling Solutions Queensland' centre in Bundaberg to provide face to face advice to workers on training and career opportunities; and
- the \$3.5 billion *Realising Our Potential* package (Federal) - \$342.5m of this will be allocated to apprentice training, and a further \$58.5 million to assist industry and employers to develop and implement 'fast-track apprenticeships'.

The Hummock Hill Island development could potentially take advantage of these packages to deliver social and economic benefits to the wider community.

16.2.5.1 Mitigation

The following mitigation measures are recommended:

Construction

- preparation of an Employment and Training Strategy, including:
 - a skills audit of existing local community to identify gaps in skills and workforce capacity required for construction,
 - identification of the skills required for construction and operation and trainings needs to enable local employees to gain the necessary skills;
 - identification of opportunities to work through State and Federal government apprenticeship and training programmes to address skills shortages and benefit community; and
 - identification of opportunities to facilitate skills development for local residents through local training facilities such as CQ TAFE and other local training providers, to enable local residents' employment in construction and operational aspects of the project; and
- early consultation and communication with local businesses in Miram Vale and Calliope LGAs to maximise the benefit of local supply arrangements to the Project.

Operation

- Facilitate employment opportunities suitable for older people or retirees, such as part-time or casual employment.

²³ State Government: 2006-2007 Regional Budget Statement: Wide Bay Burnett, p. 4; Federal Government: 2007-2008 Budget: Realising Our Potential, p.12.



16.2.6 Housing and accommodation

16.2.6.1 Impacts on housing

Construction

The Miriam Vale, Gladstone and Calliope region is currently experiencing significant housing shortages resulting from increases in population and economic growth associated with the growth in mining, manufacturing and tourism industries in the region and the “sea change” phenomenon.

As a result, housing affordability has suffered, particularly for rental housing, leading to the displacement of some existing rental households and increasing levels of housing stress, particularly for people on low incomes. Continued increases in housing demand and housing costs are expected with continued economic growth and shortage of locally available skilled workers, further increasing levels of housing stress.

The lack of affordable housing and rental housing is a matter of concern for Queensland Housing and to local community groups. Recently announced major project expansions have increased concern that housing supplies in the region are inadequate to meet the growing needs of the population, particularly housing provision for low income households²⁴.

It is estimated that an average of 160 jobs per year from 2007 to 2024 would be directly generated during construction, and a peak employment of 320 persons. Maximising the use of local labour would help to minimise the influx of workers during construction and minimise impacts on the local rental housing market, and subsequent impacts on low income households. However, the existing availability of appropriately skilled and qualified workers, may impact on the ability for construction workers to be sourced locally. Further discussion on employment and training needs for construction workers is discussed in Section 16.2.5.

The use of tourist accommodation such as motels, apartments and guest houses for short-term construction workers would also help to minimise potential impacts on rental accommodation in the region. However, early consultation with local accommodation providers and tourism development associations should be undertaken to ensure that accommodation demands can be managed, particularly during peak tourist times, such as the Easter and Christmas holiday periods in Miriam Vale and the winter months in Gladstone.

An accommodation management strategy should be prepared in consultation with the Department of Housing to ensure that adequate housing is available for construction workers and their families, and to ensure that potential housing-related impacts on the broader community are appropriately managed. The accommodation management strategy should consider the timing and development of other major projects in the region to ensure that the cumulative impacts on housing are managed in a coordinated manner. The accommodation management strategy should also consider the need for the provision of a worker village, to meet the housing demand of the Project’s construction.

²⁴ ABC Regional Radio 5 July 2007: Charity fears Gladstone faces more housing pressure



In the longer term, surrounding areas have considerable capacity to expand housing development to meet future workforce demand in the Region. This capacity is contained in a number of other residential developments currently being developed or proposed in northern part of Miriam Vale Shire and southern part of Calliope Shire. These include residential subdivisions at Turkey Beach and “Foreshores” estate. It is likely that the construction workforce would contribute to demand for and potentially accelerate the rate at which subdivisions are brought to the market.

Operation

Hummock Hill Island would provide a net increase in residential land for the area. Based on the medium PIFU population growth projection (refer to Section 16.1.2), it is anticipated that 8,800 additional allotments/entitlements would be required for the (proposed) Gladstone Regional LGA over the 20 between 2006 and 2026. The Hummock Hill Island development is able to supply around 25% of the anticipated demand, within commuting distance to employment centres within Gladstone and Boyne Island. This additional supply may decrease overall pressure on housing supply in the longer term, which may help keep property prices and rental costs in nearby areas at more affordable levels²⁵.

The Hummock Hill Island development is expected to provide 2,042 dwellings by 2023, of which approximately 60% would be holiday accommodation, and approximately 40% would be permanent dwellings (units, townhouses, villas). The project is planned to offer a mix of housing options which can be taken up for either permanent or temporary accommodation, including by residents in the growing mining and retail sectors. The type of housing stock to be constructed includes:

- two storey apartments;
- ‘golf course resort’ sites with lots ranging in size from 600 to 1,000 m² with the average lot size 850 m²;
- premium ridgetop residential lots;
- hillside terrace lots with lot sizes average 750 m² allowing modest homes;
- beachfront holiday homes lot size of 1000 m²; and
- higher density ‘seaside cottages’ with smaller lot sizes.

As such, the range of dwelling types would cater to a variety of needs, and increase the diversity of housing options in the Miriam Vale LGA and wider region. The addition of more than 2,000 dwellings would alleviate some of the housing shortages currently experienced in the region, with a mix of housing type and affordability.

It is estimated that over the period 2008 to 2024, the number of jobs created directly and indirectly by the Project’s operation is expected to rise steadily to the peak level in 2024, in the order of 700 persons. It is expected that the operational staff would be sourced locally, either from

²⁵ Hummock Hill Islands provides a net increase in residential land for the area. Some people that will reside at Hummock Hill Island would reside in nearby areas in its absence. This additional demand would tend to add to land and housing prices and rentals in these nearby areas, in the absence of Hummock Hill.



residents living within the development or within the region. It is expected that the additional housing provided by the Project would meet the housing demands of operational staff that may relocate to the area. Maximising the use of local labour would help to minimise the number of workers required to relocate to the region, and minimise impacts on the local rental housing market. It is expected that incorporation of affordable housing within the proposed development would meet the housing demands of operational staff that relocate to the area.

An accommodation management strategy should be prepared in consultation with the Department of Housing to ensure that adequate housing is available for operational staff, and to ensure that potential housing-related impacts on the broader community are appropriately managed. This should include the consideration of providing accommodation for operational staff as part of the resort and hotel developments.

16.2.6.2 Impacts on tourist accommodation

Construction

The construction phase is also expected to increase demand for temporary accommodation options, such as motels, apartments and other 'guest' accommodation, in those localities close to the Project worksite. The use of some of the available, under-utilised tourist accommodation for temporary workforce accommodation would provide some economic benefits for accommodation owners by providing a base load demand. The workforce accommodated in temporary accommodation would also increase demand for goods and services to local businesses such as local shopping, personal and related services, and entertainment and leisure facilities.

Early consultation with local accommodation providers and tourism development associations should be undertaken to ensure that demands on tourist accommodation can be appropriately managed, particularly during peak tourist times, such as the Easter and Christmas holiday periods in Miriam Vale and the winter months in Gladstone.

Operation

Tourist accommodation with beach access is limited for Tannum Sands with the majority being located in Agnes Waters and 1770. Outside Gladstone the range of available tourist accommodation that satisfies the preferred activities of tourists and has easy access to key transport routes such as the Bruce Highway, are very limited.

The project would provide a range of tourism accommodation options over a range of affordability, including camping grounds, caravan parks, holiday apartments, a five star hotel and resort/ convention centre. This would increase the range of affordable holiday options for families in the region.



16.2.6.3 Mitigation

The following mitigation measures will be incorporated into the proposed development:

Construction

- Development of an accommodation management strategy in consultation with the Department of Housing for the construction, including consideration of the construction of a worker village;
- Encourage local employment through up-skilling of existing unskilled workers; and
- Where possible, tourist accommodation should be used for the accommodation of short-term construction workers, with consideration of existing tourist accommodation demands.

Operation

- Development of an accommodation management strategy in consultation with the Department of Housing for the operation, including consideration of providing accommodation for operational staff as part of the resort and hotel developments.

16.2.7 Impact on Social Infrastructure

16.2.7.1 Community services and facilities

Construction impacts

The project would not have a direct impact on existing community services and facilities on Hummock Hill Island. However, potential impacts on community services and facilities could occur as a result of an increase in population during the construction phase, with workers relocating to the area.

The existing community services and facilities in Miriam Vale LGA are generally considered as only adequate for the existing population and are highly utilised²⁶. An increase in the population during the construction phase could increase demand for existing services and facilities, placing additional pressure on existing services and potentially impacting service levels. Consultation should be undertaken with Queensland Health, Department of Communities, Miriam Vale Council and community service providers to ensure that potential increases in population and demand for community services and facilities during construction can be appropriately managed.

An increase in the number of children relocating to the area for the duration of the construction phase could impact on child care services and local schools, particularly smaller schools in the region. Early consultation should be undertaken with Education Queensland, local schools and child care providers to manage potential impacts of increased numbers of children during the construction phase.

²⁶ Director, Discovery Coast Community Service. Interview. 2005.



Operation

When completed, Hummock Hill Island is expected to deliver a range of community facilities. Prior to completion, however, new Hummock Hill Island residents and construction staff would have to rely on existing services within the local community. For the operational period, local level community facilities generally required include:

- a primary school;
- a hall or neighbourhood centre;
- a sport or recreation reserve;
- an access point for family health, income support and home care services;
- a child care centre and/or kindergarten; and
- links to district and regional facilities.

With the exception of State-provided facilities such as schools and health clinics, local social infrastructure is usually planned in partnership between developers, community organisations and local governments and funded through a combination of funds and in-kind support from stakeholders. The exception is childcare centres, which are most often provided by the private sector. As population forecasts for the Hummock Hill Island community are clarified, consultation with local community organisations and government agencies would be required to identify the likely demand emanating from the Island's population and co-operative methods of addressing local needs on the island. It would also be necessary to consult with the Department of Communities regarding access to early years services, child care and family support services.

The project would provide a number of community facilities as part of the Town Centre development accessible to both Hummock Hill residents and adjoining communities. The range of facilities envisaged for the Town Centre would include:

- outlets for food & beverage, convenience retail, tourist retail, and a supermarket,
- emergency services such as fire and ambulance facilities, a medical centre, and surf lifesaving facilities;
- a display centre, main plaza, beachfront restaurant; and
- a community hall.

Community recreation facilities would include sporting fields, public parks, 18 hole wild golf course and country club, tennis courts, cycling paths, a lawn bowls green, beaches, boating facilities, camping grounds etc.

It is proposed that the Project would support the establishment of a primary school through the provision of land for a school, if required. The potential need for a primary school would need to be determined when the balance between permanent and temporary residents is ascertained.

“The establishment of new schools is subject to detailed access and viability criteria. Decisions are made through the application of DETA standards to projections of student population at the local



level. Whilst a rough rate of provision of one primary school per 3,000 households has been used in the past, significant variation is being introduced in new communities, where the range of dwelling types and densities are taken into account”²⁷.

Early consultation and communication with DETA would be required to identify future population projections for the Project, the feasibility of providing a school, and school access for children living on the island in the intervening period. Secondary education in the region is currently provided at:

- Rosedale State School and Miriam Vale State School in the Miriam Vale LGA;
- Mount Larcom State School (to year 10) and Tannum Sands High School in Calliope LGA; and
- Gladstate State High School and Toolooa State High School in the Gladstone LGA.

Consultation and communication regarding the future needs of secondary school students in the region would also need to be undertaken with the DETA.

16.2.7.2 Safety and Emergency Services

The Island is removed from existing established emergency and health facilities. Local services are currently reaching capacity, and therefore a lack of services may be an issue for the viability of the development due to low response times and perceptions of isolation²⁸.

Development of a combined emergency services facility, incorporating Ambulance, Police, Surf-Lifesaving, and rural fire brigade, would reduce risk to health and safety due to inadequate access to emergency services. Consultation with the relevant emergency service provider would be required in planning for emergency services facilities, to ensure compatibility with longer-term plans of the relevant agencies.

Bushfire risks, management regimes and control services would need to be established for the Project, and this is discussed in Section 18. It would also be necessary to establish safeguards in relation to beach use and marine stingers, and these are noted in the mitigation measures outlined below.

16.2.7.3 Services for Seniors

Older people (65+) would require aged care and health services, such as medical centres, and allied health services, and recreational facilities. The Project proposes to provide formal and informal recreational activities for older people and participation in ongoing educational opportunities offered at the Island’s education precinct.

²⁷ South East Queensland Regional Plan Implementation Guideline No. 5—Social Infrastructure Planning p. 104, SGS Economics and Planning Pty Ltd, Elliott Whiteing Pty Ltd, Briggs and Mortar Pty Ltd, Andrea Young Planning Consultants, and the State of Queensland (the Department of Infrastructure), 2007.

²⁸ According to the QPS, towns with two thousand people usually have a police presence.



Consultation and communication with Queensland Health and the Department of Communities would be required during the planning of services and facilities for older people, to ensure that adequate provision is made for government and community services for older people, and to ensure that agencies responsible for the planning of aged services are cognisant of future population projections.

Proximity to Gladstone would allow access to medical and government services and private practitioners specialising in servicing and supporting retirees' financial and other needs, providing public transport access is available.

Designs for community services and facilities should also be disabled-and aged- friendly, to ensure continued mobility and access for older people.

16.2.7.4 Public transport

Investigations for this assessment indicated a need for improved public transport between townships in the immediate vicinity of Hummock Hill Island, in particular Turkey Beach, Baffle District and the Rosedale, Lowmead and Berajondo areas, and within the region. There are current no plans by Queensland Transport to provide public transport access to the area near the Island, as existing population levels do not warrant services.

As the population increases, public transport access would be required to ensure young residents, school students, seniors, low income households and people with disability have access to services on the mainland. Public transport is particularly important as the projected population may consist of higher than average number of older people that may depend on such services.

Consultation should be undertaken with Queensland Transport and private and community bus operators to determine future public transport access needs and provision.

16.2.7.5 Mitigation

The following mitigation measures are recommended to maximise potential benefits and manage or avoid potential impacts on community services and facilities:

- Further analysis of the threshold levels for the provision of on-Island services, to be undertaken in conjunction with relevant Local and State Government agencies;
- Consultation and communication with relevant Local and State Government agencies to identify and gain commitment for provision of and contribution to social infrastructure requirements to meet the expected increase in population, including upgrading of emergency services;
- Consultation and communication with the Department of Emergency Services to identify and agree provision for emergency services;
- Liaison with Rockhampton and/or Bundaberg emergency helicopter services to be included on the helicopter landing register and to develop protocols;
- Consultation and communication with health authorities regarding needs of older residents, including health care, and to identify and agree on-Island health service responses, including home care services;



- Design and provide office space to allow for private health providers;
- Facilitate development of community groups, support networks and events to build social capital within the community;
- incorporate universal design and Crime Prevention through Environmental Design (CPTED) principles to into the design of residential, commercial and community facilities and outdoor spaces;
- consultation and communication with Surf Lifesaving Queensland to investigate and determine the level of provision of private, funded or volunteer surf lifesaving services;
- Investigate and establish required beach safety measures, including lifeguard tower, and potential need for swimming enclosure to avoid marine stingers; and
- Consultation with Queensland Transport regarding the demand for and supply of public transport services for island residents.

16.2.8 Mitigation

Changes to the social environment during construction would be managed by the Proponent so as to ensure that any impacts experienced are avoided, reduced or mitigated to the extent that is possible and may be reasonably expected.

A range of mitigation measures to address identified impacts on the social environment are identified above. In addition, the following outlines environmental objectives, performance criteria and mitigation measures required to address general social impacts of the Project. These have also been incorporated into the Environmental Management Plan contained in Section 20 of this EIS.

Table 16.19 – Summary of Social Impacts and Mitigation

Social - Construction	
Environmental Objective	Avoid or mitigate and manage construction impacts on local residents and visitors to the Island.
Performance Criteria	■ Local residents and visitors to the Island are notified in advance of construction activities, changes arising from construction activities (i.e. to local access), and possible management measures. ■ Local residents and visitors have access to a communication and complaints process to address and respond to social impacts.
Mitigation Measures	■ Provide a communication program targeted to local residents and visitors to the Island, and including: ■ regular construction updates; ■ advice on construction schedules; and ■ the results of monitoring required by the EMP. ■ Develop, promote and implement an effective complaints response system for receiving, handling and responding to complaints received during construction of the Project, including: ■ Provision and promotion of a phone contact with construction management staff during hours of construction; and ■ A follow up procedure which notifies complainants within 24 hours of the intended response to the issue raised.
Monitoring	Evaluate effectiveness of construction, liaison and mitigation strategies.



Social - Construction	
Reporting	Report to the complainant within 24 hours of what action, if any, would be undertaken in response to the issue raised. Provide monthly reports (publicly accessible on request) regarding communication activities, residents' complaints and resolution of complaints.
Responsibility	Contractor

16.3 Conclusions

Changes to the social environment during construction and operation of the proposed development would be managed by the Proponent to ensure that any impacts experienced are avoided, reduced or mitigated to the extent that is possible and may be reasonably expected.

Proposed mitigation measures to address identified impacts on the social environment are considered to manage potential impacts to the social environment of the Island and immediate area. Continued liaison and communication with local residents and visitors in advance of construction activities, about changes arising from construction activities, and possible management measures will be conducted as part of mitigation. Liaison with relevant Local and State Government agencies to identify and gain commitment for provision of and contribution to social infrastructure requirements to meet the expected increase in population will also manage social environment impacts associated with the proposed project.



SECTION 17

ECONOMICS



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17. Economics

17.1 The Economic Environment

17.1.1 The local economies

The proposed project is situated approximately 30km south-east of Gladstone by road. With a population of 28,946 in 2006, the city of Gladstone is the regional centre closest to Hummock Hill Island. The closest urban centre is Tannum Sands, which is located approximately 10km north of Hummock Hill Island. With a population of 3,623 in 2001, Tannum Sands is a seaside dormitory town for people working in the Gladstone and Boyne Island areas.¹

Following the highway south, the next closest urban centre from Hummock Hill is almost 40 km away at Miriam Vale. The town is the administration centre of Miriam Vale Shire, and had a small population of 381 in 2001. Agnes Waters, a township of 1,239 in 2001, is well off the highway and a further 60 km by road from Miriam Vale. Bundaberg, with a population of 47,451 in 2006, is the closest regional centre south of Hummock Hill. The city is a further 120 km south on the highway from Miriam Vale.

Hummock Hill Island itself is in Miriam Vale Shire, just within the northern boundary with Calliope Shire. Calliope Shire surrounds (but excludes) the city of Gladstone, and has a population more than twice that of Miriam Vale Shire. Both Calliope and Miriam Vale Shires have experienced a population growth rate above that for Queensland in recent years, and the high rate of population growth is expected to continue (refer to Section 16). The population of Miriam Vale Shire is officially projected to grow at 3.4% p.a. from 2001 to 2026, while the population of Calliope Shire is projected to grow at 2.2% p.a. over the same period. The comparable projected growth rate for the state is 1.7% p.a., while it is 2.0% p.a. for Gladstone City.

Since 1996 Calliope Shire has achieved a lower unemployment rate than the Queensland average. As of June 2006, the Shire's unemployment rate was a low 4.0%, significantly below the 5.0% rate for Queensland. In Miriam Vale, the unemployment rate was more than double the Queensland rate in 1991, and has remained relatively high subsequently. As of June 2006, the Shire's unemployment rate was 8.8% (Refer to Section 16 and Focus Economics 2007).

Calliope Shire has a much younger population than the state as a whole. In 2001, 9.3% of the population was aged 65 years or older, compared to 12.3% for the state, while 25.1% was 15 years or below, compared to 21.1% for the state. This is a long term trend and is a reflection of the new employment opportunities provided by the growth of the region through an emphasis on industrial-based development.

The industrial emphasis north of Hummock Hill Island is reflected in the employment data. Metal product manufacturing accounted for 18% of employment in Calliope Shire in 2001. Miriam Vale

¹ Demographic data presented in this section is sourced from Queensland Office of Economic and Statistical Research (OESR), Queensland Regional Profiles, Fitzroy and Wide-Bay Burnett Statistical Divisions, generated March 2007 and Australian Bureau of Statistics (ABS), 2001 Census of Population and Housing, Community Profiles: Time Series Profile

Shire has a broad agricultural-base, with the industry accounting for 14% of employment in 2001. Other important sources of employment in the two shires include accommodation, cafes and restaurants, education, construction and business services (Figure 17.2).

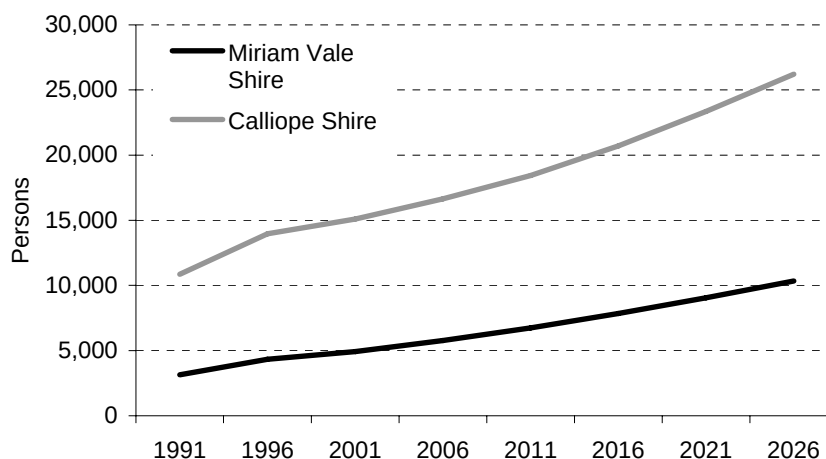


Figure 17.1 – Population projections for the local area

Sources: Office of Economic and Statistical Research (OESR), Queensland Regional Profiles, Fitzroy and Wide-Bay Burnett Statistical Divisions, generated March 2007 and ABS, 2001 Census of Population and Housing, Community Profiles:Time Series Profile.

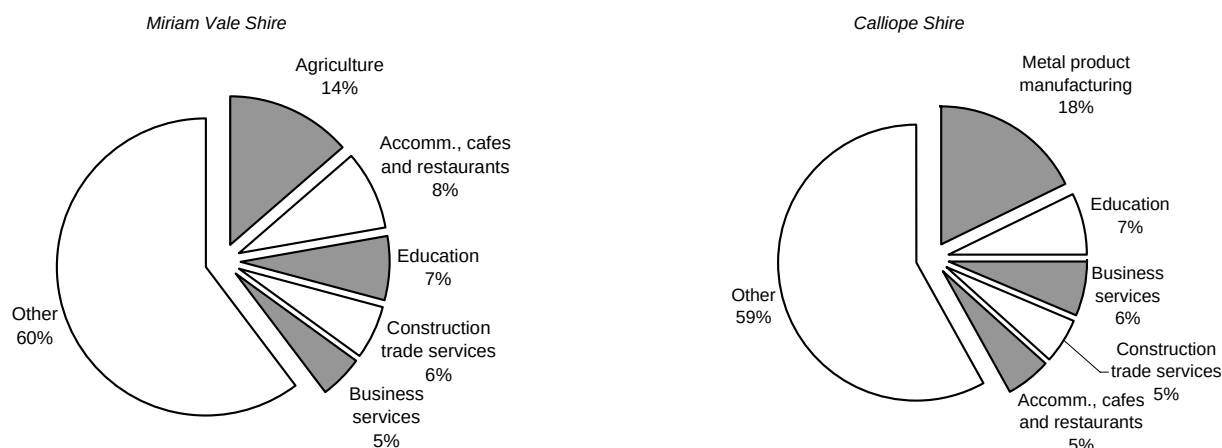


Figure 17.2 – The main sources of local employment in 2001

Source: ABS, 2001 Census of Population and Housing, QuickStats

Miriam Vale Shire has a near typical age-profile, with the age distribution close to the State average. One of the Shire's distinguishing characteristics is a rising emphasis on non-employment



lifestyles. In 1991, 28.4% of the Queensland population was not in the labour force. The figure for Miriam Vale Shire in the same year was close to this at 30.0%. By 2001 the share of the state population not in the labour force had declined to 27.4%, but the share had risen in Miriam Vale Shire to 34.9%. In contrast, in Calliope Shire the share not in the workforce has been steady (it was 26.4% in 1991 and 25.8% in 2001).

17.1.2 The regional economies

Hummock Hill Island is on the boundary of the Wide Bay Burnett and Fitzroy (or Central Queensland) regions.² The Wide Bay Burnett region has a larger population of 263,211, as of June 2006, compared to the 191,959 in the Fitzroy region. The populations of the coastal areas of both regions are growing at an above average rate, but most inland areas are growing slowly. Overall, Wide Bay Burnett's population has grown at just below the state-wide rate, with Fitzroy's population growing at a below-average rate. This trend is expected to continue. Wide Bay Burnett's population is projected to grow at 1.6% p.a. from 2001 to 2026, while Fitzroy is projected to grow at 1.3% p.a. over the same period, widening the population gap between the two regions (refer to Figure 17.3). This compares to the 1.7% annual growth projected for Queensland from 2001 to 2026.

The slow growth in inland areas is linked to the structural change in the Queensland economy away from agriculture. More recently, the downturn in agriculture arising from drought has added to relative weakness in rural areas. Agriculture remains an important source of employment in both regions (refer to

Figure 17.4 -), but the better growth prospects appear to be in the industrial activities based on mining and mineral processing, along with the growing services sector.

Some of the key differences between Miriam Vale and Calliope shires are also evident at the regional level. Unemployment is well above the state-wide average in the Wide Bay Burnett region, at 8.3% as of June 2006, compared to 5.0% in the Fitzroy region. Labour force participation rates are substantially higher in Wide Bay Burnett, at 35.0% in 2001 compared to 26.5% in Fitzroy. For Wide Bay Burnett, this largely reflects the high share of retirees in the southern coastal areas such as Hervey Bay (Refer to Focus Economics 2007).

The visitor industry is slightly larger in the Fitzroy region. For example, there were 153,727 guest arrivals to the Fitzroy region in the June Quarter of 2006, compared to 131,120 in Wide Bay-Burnett in the same quarter.³ Activity is currently concentrated in the northern, coastal areas of Fitzroy (e.g. around Rockhampton) and the southern, coastal areas of Wide Bay Burnett. Visitor numbers are mainly made up of business travelers and tourists. Business travel is larger in the Fitzroy region while tourist travel is probably larger in the Wide Bay Burnett.

² Miriam Vale Shire is on the northern boundary of the Wide Bay Burnett region, with Calliope Shire on the southern boundary of the Fitzroy region.

³ OESR, Queensland Regional Profiles, Fitzroy and Wide Bay Burnett Statistical Divisions, generated March 2007

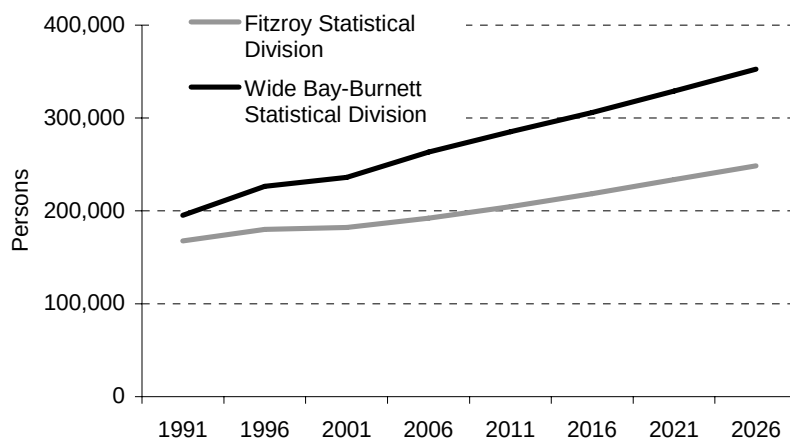


Figure 17.3 – Population projections for the regional economies

Sources: OESR, Queensland Regional Profiles, Fitzroy and Wide-Bay Burnett Statistical Divisions, generated March 2007 and ABS, 2001 Census of Population and Housing, Community Profiles:Time Series Profile.

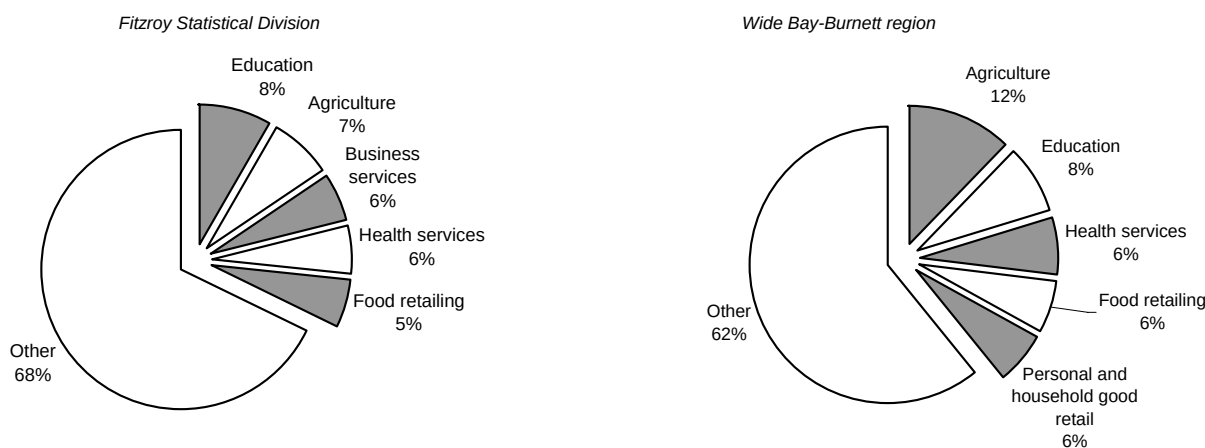


Figure 17.4 - The main sources of regional employment in 2001

Source: ABS, 2001 Census of Population and Housing, QuickStats

The proximity of Hummock Hill Island to Gladstone, the most southern regional center of the Fitzroy region, suggests that the proposed development may form closer economic links with the Fitzroy region than with Wide Bay Burnett, as reflected in the proposed LGA amalgamations due in March 2008. Such links are likely to form on both the demand and supply sides. The proposed project is targeting the intrastate demand from within the Gladstone region and coal mining areas to the west for a high quality tourist and recreational facility with good quality beach access. The project proponents are of the view that such a facility is not available in the region, and its absence is a



significant problem for employers seeking to attract employees to Gladstone (refer to Section 4). On the supply side, the Gladstone and Calliope Shires are good sources of construction skills and materials, of the labour required by the development's facilities, and of the goods and services that would be required by both residents and visitors to the Island.

Significant links are, however, also likely to form with the Wide Bay Burnett region. This region is noted for its agricultural industries, and is likely to supply produce to the Island. The region is also a source of construction skills and materials, of labour and of other goods and services. Wide Bay Burnett's higher population and unemployment rate, in part fuelled by an ongoing departure of the younger population from rural areas, suggests the region offers a potentially larger pool of labour. The region's long term economic prospects appear less secure than in the Fitzroy region given the industrial and mining potential of the latter (refer to Box 17.1 and Box 17.2). This suggests there may be a greater interest in pursuing new opportunities in the Wide Bay Burnett region than in the Fitzroy region. The development may in fact facilitate the northern progression of the tourism and retiree-based activities already well established in Wide Bay Burnett.

The proximity of Hummock Hill Island to employment opportunities offered by Gladstone and surrounding areas suggest it is likely to develop a higher share of the population that is of working age than in comparable areas, such as Agnes Waters and 1770.

Box 17.1 – The economy of the Fitzroy region

The economic opportunity presented by the region is arguably unparalleled in Australia – extensive areas of good quality agricultural land, water, strategic industrial development sites at Aldoga, Stanwell and Biloela, extensive coal and mineral deposits, strategic transport infrastructure, in excess of 50% of Queensland's electricity generation capacity, a supply of water from the Fitzroy Basin and a supply of gas from south-west Queensland. The natural deep water port of Gladstone handles in excess of 52 million tonnes of cargo per year and is one of the largest seaports on the eastern seaboard. The region also boasts a number of production industries including the world's largest alumina refinery and Australia's largest aluminum smelter, Queensland's largest manufacturer of cement and Australia's second largest meat processor.

Agricultural industries (particularly beef cattle production), cover approximately 85% of the land area of the Central Queensland/Fitzroy region. The total gross value of agricultural production in the region for the year 1999/2000 was \$841.7 million representing 12.4% of the Queensland total. Livestock disposals and products comprised 64.8% of the total value of agricultural production in the region.

The region contributed approximately 39.9% of Queensland's total value of mineral production in 2000. Black coal was the most valuable mineral mined in the region for the 2000 period (\$2 687 million) followed by natural gas (\$76.9 million), salt (\$22.5 million), and magnesite (\$17.1 million). In 2001, Central Queensland's exports accounted for 19.7% of Queensland's total overseas commodity exports, principally due to coal, beef, cotton and grain.

Industry structure in the region has been continually changing with a shift in the last decade toward mineral processing, retail trade, health and education. New technologies, climatic conditions and international markets are shifting the focus of the traditional industries of beef and grain production and coal mining.

The Gladstone and Calliope sub-region makes a disproportionately large contribution to the Australian and Queensland economies. In value terms it accounts for approximately 17.9% of the nation's exports and 19.3% of Queensland's international trade. This area possesses an international advantage as a resource processing, metals smelting and light metals founding location. It has the advantage of a location that is adjacent to a significant coal based energy province whilst also possessing a world class port. Reliable competitively priced electricity is available from the Queensland electricity grid, to which Gladstone supplies in excess of 30% of the state's usage. The area is also serviced with natural gas.



Whilst the area's economy is principally based on industrial development, and agriculture, forestry and fishing make a significant contribution, tourism is an important and growing industry. Industrial tourism is a developing opportunity, while coastal attractions include the diving mecca of Heron Island and easy access to the most southerly part of the Great Barrier Reef.

Two key areas of the region are expected to experience significant investment in industrial activities – the Gladstone State Development Area and that part of the Fitzroy Shire generally situated as a corridor between Gracemere and Stanwell. The Gladstone State Development Area includes approximately 8,500 hectares of largely undeveloped land and is in close proximity to the existing industrial facilities in the Yarwun industrial estate. The synergy that exists from the co-existence of these industrial areas and their location relative to Gladstone and its port will ensure the area will be the home of large scale industries of both national and international importance. Expansion in these areas together with support from industrial development in Rockhampton, Biloela, Emerald and elsewhere in the region, will further Central Queensland's role as one of the state's and the nation's prime economic generators.

Source: Department of Local Government and Planning (DLGP) (2002)

Box 17.2 – The economy of the Wide Bay Burnett region

Agricultural production has been the traditional mainstay of the Wide Bay Burnett region's economy. More recently, population growth largely through migration to the region has been a significant driver of economic growth; however, the impact until the past few years has been uneven, with most of the population growth occurring in the coastal communities.

Agriculture in the region has changed significantly, with declines in the contribution of traditional industries such as sugar and dairy – and growth and change in the horticulture, pork and beef industries. There has been significant structural adjustment in the sugar, dairy and timber industries.

Manufacturing has developed, with growth in food processing and manufacturing, aviation and engineering. Tourism has also grown, both in the 'headline' areas (Hervey Bay whales, Fraser Island and South Burnett food/wine) and in smaller recreation, accommodation and related services.

While the high unemployment which characterised much of the region (particularly the coastal areas) for most of the 90s has declined, the rate of population growth continues to outstrip the ability of the region to provide for future employment needs. Economic activity, particularly in large coastal centres is growing at lower rates than the Australian average while the population is growing at a greater rate than the Australian average. Significant labour market variations between different subregions impact on economic growth differently. Young people have tended to leave the rural areas and, while this reduces unemployment levels, it has other, negative impacts on these areas.

As a result of the region's demographic characteristics, a number of structural difficulties have emerged. Employment opportunities for youth in the region continues to be a problem, as does availability of trained and skilled labour required by businesses. The high demand/low spend pattern associated with significant growth in the retired population continues to impact on the region's ability to develop urban infrastructure and expand the region's economy. Rural centres and communities which have recently experienced population growth are struggling to provide and maintain infrastructure and community service levels. Continued population growth over the next 20 years will place even greater pressure on rural community infrastructure and services.

Increased exports are vital to economic development, both directly in terms of cash flow and increased employment, and indirectly in terms of flow-on effects of employment and growth in industries supplying to or servicing exporting businesses. Agricultural products remain the region's biggest export earners and there are opportunities to further develop exports from some of these industries. Tourism is a significant driver for growth throughout the region. While the general image of tourism in the region centres on the key beach and island-related activities, tourism is now expanding throughout the whole of the region, particularly in the caravan and camping sector, and as a result of regional airport expansions. This is impacting on all local government areas and influencing the economies and development patterns of areas which have, until recent years, seen declining populations. Drivers for tourism relate significantly to consumer opportunity and disposable income; consumers are often well informed and respond to effective marketing and packaging. Many



of the natural tourism advantages of the region are underdeveloped, under-packaged and under-promoted. Small operators typify much of the region's tourism operations, yet the continued growth of the industry depends on a high profile regional and sub-regional identity and effective promotion and marketing. A further significant driver for growth throughout the region is the aggregation of patterns of migration to and within the region.

Source: Department of Local Government, Planning Sport and Recreation (DLGPSR) (2006)

17.2 Project Benefits

17.2.1 Valuing Benefits

Investment projects can have important direct effects on an economy through the creation of new income earning opportunities. They can also have important indirect effects on an economy, where these are often captured by what are termed economic multiplier effects. Multiplier effects arise as the expenditure generated by a project feeds through the network of interdependent industries that make up the economy.

In this instance one source of the multiplier effects is the purchase by the project of inputs for construction. For example, an expansion in construction activity brought about by the project would require additional building materials. The rise in demand for building materials would result in increased business for local suppliers of inputs such as the sand and gravel used in concrete, the timber required for formwork and in buildings, and the metal products required for concrete reinforcing, through to fittings and roofing. A rise in demand for these building materials would see an expansion in activities that support the suppliers of building materials – from transport to vehicle maintenance, to banking and other business support services. Similarly, the ongoing demand for inputs to the development, from restaurants through to waste management, can generate multiplier effects.

There would also be multiplier effects when the extra income generated by the project is spent on personal and household items. For example, the need to house workers in nearby areas would see demand rise for accommodation, with a consequent expansion in the residential industry. Retail activity would grow, retailers would demand more stock from wholesalers and other sources of supply, transport demand would rise, and so on. And the workers in the retail industries would then spend their money on a variety of goods and services, creating demand for others, and so on. Importantly, additional employment opportunities would also be created in the economy via the multiplier effects.

Economic multiplier effects can be estimated through the use of multipliers derived from input-output models.⁴ Three types of multipliers are normally derived for an input-output model:

⁴ Input-output models provide a disaggregated description of an economy, identifying important inter-relationships between industries. An input-output model identifies an industry's inputs to production as intermediate materials and services, which are purchased from other industries, and the factor inputs of land, labour and capital. An industry's output is either sold to other industries or the 'final demand' categories of consumption, investment, government and exports. An input-output table also shows the level of imports in an economy and the level of indirect commodity taxes paid. Input-output multipliers measure the impact of a change in sales by an industry or the value added (i.e. wages, salaries and supplements and gross operating surplus) of an industry on key economic aggregates. These aggregates are typically total sales, value added, labour income (i.e. wages, salaries and supplements) and the number of persons employed. For example, an income multiplier for



- An initial multiplier. This looks at the direct effect of a change in industry sales, such as a change in income paid to those working in the industry or to the number of workers;
- A Type I multiplier. This captures both the direct and indirect, production-induced effect. The latter refers to the industry's purchase of inputs from other businesses, and the further purchase of inputs by those other businesses; and
- A Type II multiplier. This captures the direct and indirect effect of the Type I multiplier, and also captures an indirect consumption effect that flows from the expenditure of the income that is earned.

The initial multiplier captures only the direct effects of an industry's expansion, while the Type I and Type II multipliers capture this direct effect and the flow-on effect as expenditure feeds through the economy. It is best practice to apply Type I multipliers, as Type II multipliers are generally seen to over-state potential impacts.⁵ Multipliers are available for aggregates such as sales, value-added (i.e. income) and employment to show the impact of a unit change in the value of sales by an industry.

The total of the direct and indirect effect of a project on value-added, derived through multiplier analysis, provides a measure of the total benefits of a project. That is, a project's benefits can be assumed to equal the additional value-added or income generated by a project. This can be treated as the equivalent to the monetary wealth or, as all income is ultimately spent, consumption generated by the project.

Ideally, an economic assessment would utilise input-output multipliers drawn from an input-output model of the relevant local and regional economies. Input-output models are not available for the local economy, but they are available for the Wide Bay Burnett and Fitzroy regions and for Queensland. Consequently, for this economic assessment, economic benefits can be estimated at the regional and state level.⁶

In this case, benefits would arise from expenditure on construction and tourism-related expenditure. Importantly, ongoing expenditure from permanent residents of the project is not treated as a benefit. It is assumed that all such expenditure would occur even in the absence of the project, as it is assumed that permanent residents would reside elsewhere in the region in the absence of the Hummock Hill Island development. Their expenditure is effectively assumed to be generated by other activities in the region (e.g. their work in mineral processing in Gladstone or in the coal mining areas), rather than by the Hummock Hill Island development itself.

retail of 0.5 would imply that for every \$1 increase in retail sales, total income in the economy would increase by \$0.50.

⁵ The input-output model is based on a number of simplifying assumptions that have the effect of imposing few constraints to economic expansion. As a result, Type II multipliers can over-state the potential effect of an expansion in expenditure (see for example the guide provided by the Queensland Office of the Government Statistician (OGS), 2002a).

⁶ The regional and State-level multipliers used in the analysis are presented in Annex B.



17.2.2 Construction-Driven Benefits

The development of major infrastructure and urban services is projected to take place over an 16 year period, commencing in 2007 and finishing in 2023. This would include installation of access roads, a bridge, and water, power generation and wastewater management. The construction of resort facilities and buildings would also be spaced over this period.

The development is to be undertaken and marketed on the basis that two-thirds of the hotel rooms, apartments, townhouses and houses would be focused on tourism. The remainder would be occupied by permanent residents.

The proposed scheduling of building and construction work is summarized in Figure 17.5. The site development is projected to cost \$190 million in constant 2006 prices, or \$132 million in net present value terms (NPV).⁷ This comprises expenditure of \$43 million on the physical infrastructure (\$38 million in NPV terms), \$44 million on social infrastructure (\$28 million in NPV terms) and \$103 million on resort and residential land development (\$66 million in NPV terms). Most of this expenditure, notably the major infrastructure, is to be built in the first stage of the development.

Most expenditure would be incurred on the construction of tourist accommodation. This is valued at \$288 million (\$167 million in NPV terms). Construction expenditure on permanent residential accommodation is valued at \$158 million (\$90 million in NPV terms). Total construction and building expenditure is valued at \$635 million, or \$390 million in NPV terms.

The estimated benefits to the regional economy are summarized in Figure 17.6. It is estimated that construction and building work would make a direct contribution to regional value-added of \$270 million (\$167 million in NPV terms). The total direct and indirect (or multiplier) contribution to regional value-added is estimated as \$390 million (\$240 million in NPV terms).⁸ It is estimated that approximately 60% of the benefits would be attributable to tourism-based development, with the remainder attributable to residential-based development. The estimated time profile of benefits follows the time profile of construction expenditure.

While it is estimated that these benefits would be shared between the Wide Bay Burnett and Fitzroy regions, it is not possible to reliably estimate the distribution between the regions. This problem arises from the position of the development on the border of the two regions and uncertainty as to exactly how regional economic links would emerge.

⁷ In the absence of a project specific discount rate, the assessment assumes a 6.0% real discount rate, following the 1997 Queensland Treasury Project Evaluation Guidelines (Queensland Treasury, 1997). All net present values are expressed as of the start of 2007.

⁸ The value-added generated directly and indirectly by construction is found by multiplying the value of expenditure by the relevant Type I multiplier. For example, the (weighted average) regional Type 1 multiplier for construction and building expenditure is approximately 0.62. For a construction and building expenditure of approximately \$340 million (in NPV terms at 6% real discount rate), the total direct and indirect effect is approximately 0.62 times \$340 million, which is approximately \$210 million.

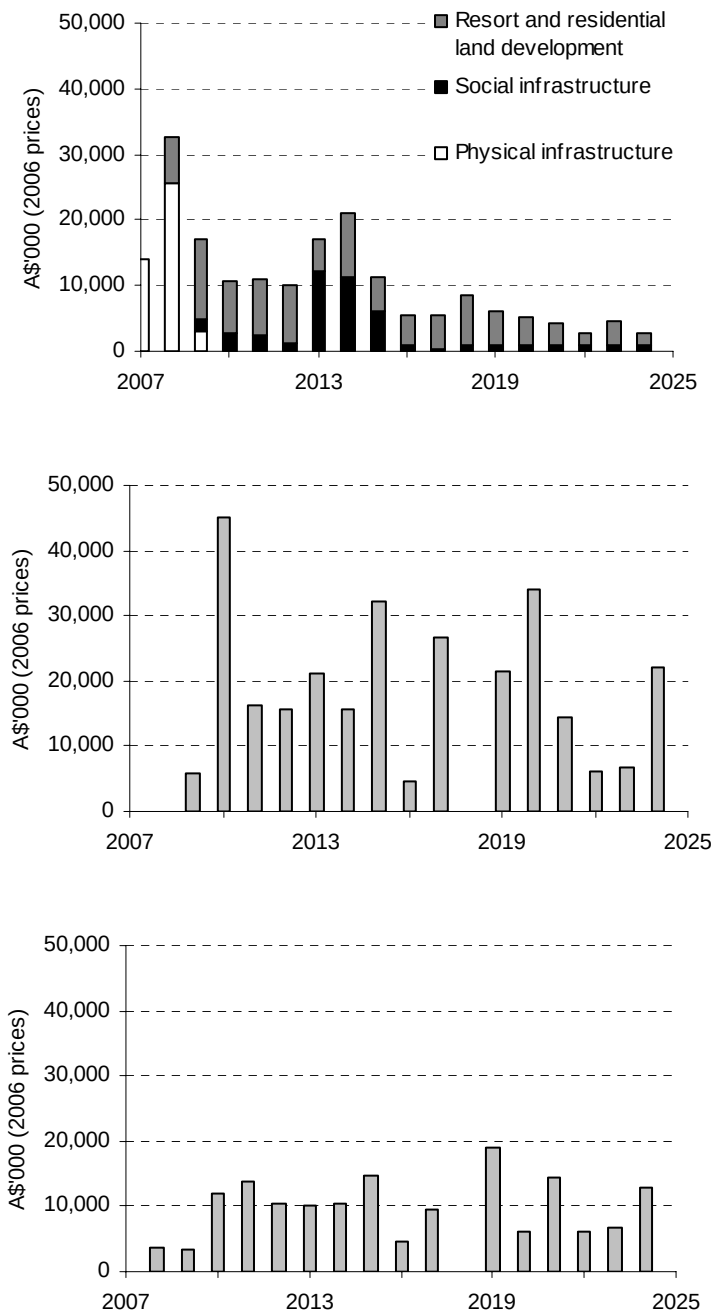


Figure 17.5 – Building and construction expenditure

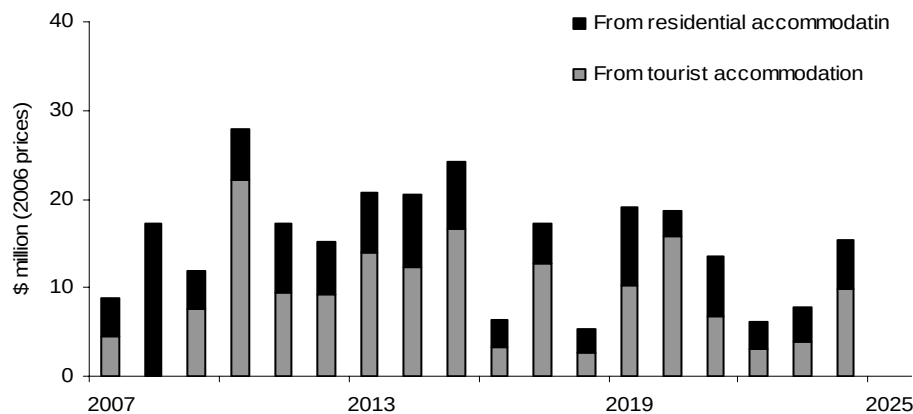
Note: The average cost of tourist and residential accommodation is set equal to the average value of new residential building work in the Fitzroy Statistical Division for the 12 months ended September 2006 (i.e. \$186,000 per building/unit)

Source: Author's estimates based on project information supplied by Eaton Place Pty Ltd and OESR, Queensland Regional Profiles, Fitzroy Statistical Division, generated March 2007.

The total benefits for the state are slightly higher than the estimated regional impacts. Multipliers will normally be higher for regions with a broader economic base, because more of the flow-on

opportunities are captured by the region itself. For example, for the Queensland regions, the multipliers for Brisbane-Moreton are significantly higher than for the Wide Bay Burnett and Fitzroy regions. So multipliers for Queensland would be higher than for individual regions. It is estimated that construction and building work would make a total direct and indirect contribution to Queensland value-added of \$460 million (\$280 million in NPV terms).⁹

Direct impact on value-added



Direct and indirect impact on value-added (Type I multiplier)

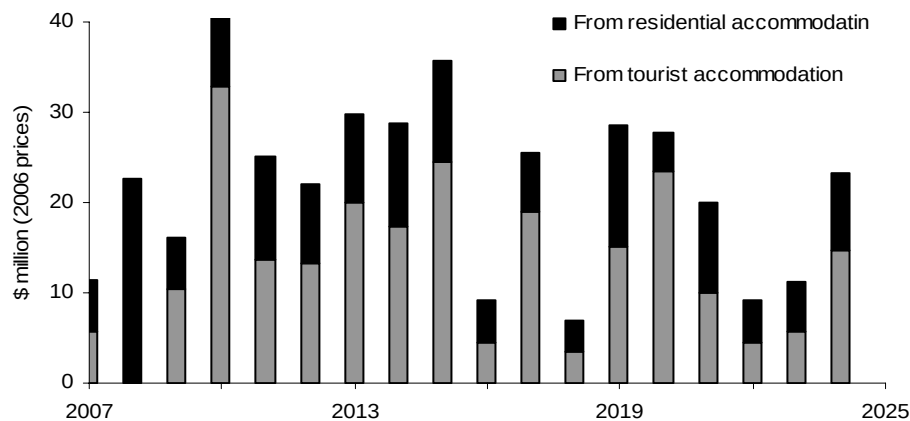


Figure 17.6 – Regional economic benefits from building and construction

Note: Direct and indirect effects are based on the average direct and Type I multipliers for the Wide Bay Burnett and Fitzroy regions, for the residential building construction and other construction industries. The distribution of expenditure in a year on physical infrastructure, social infrastructure and land development between tourism and residential accommodation is based on the split of total building work between tourism and residential accommodation in the same year.
Source: Author's estimates based on project information supplied by Eaton Place Pty Ltd and the Office of the Government Statistician (OGS) (2002b).

⁹ State-wide multipliers are prepared on a basis comparable to the regional multipliers, and sourced from OESR (2002c).

17.2.3 Tourism-driven benefits

To estimate the benefits for the economy from the tourism activity generated by the proposed project, it is necessary to estimate the value of tourist expenditure. This is a function of occupancy rates, the number of tourists per accommodation unit, the split between international and domestic tourists and their expenditure per night.

These parameters vary significantly across the regions. For example, in the June Quarter of 2006, occupancy rates varied from 36% in Cardwell Shire (the home of the Port Hinchinbrook development) to 74% in the city of Mackay. In the same quarter, guests per room varied from 1.65 in Hinchinbrook Shire to 2.56 in Miriam Vale Shire (Focus Economics 2007). Most visitors in Queensland are domestic (Intrastate) tourists (refer to Section 4 and 16.1.5). In the central and northern tourist areas, international tourists account for 30% to 40% of total guest nights. On average domestic visitors have been found to spend more than international visitors per night, and on average expenditure is lower in regional Queensland than on the Gold Coast, but higher than in Brisbane (Figure 17.7). Once allowance is made for the number of tourists and their average length of stay, international visitors have been estimated to spend less in Queensland than intrastate visitors, who in turn spend less than interstate overnight visitors (Figure 17.8).

Estimated tourism expenditure from the project is shown in Figure 17.9. The site is projected to accommodate approximately 1,600 tourists per night, on average¹⁰, once fully developed. Their expenditure while staying at the development is projected to grow as the development of tourism accommodation units progresses, and reach \$80 million by 2024. At this level, 30% is attributable to international tourism, 31% to intrastate tourism and 39% is attributable to interstate tourism.

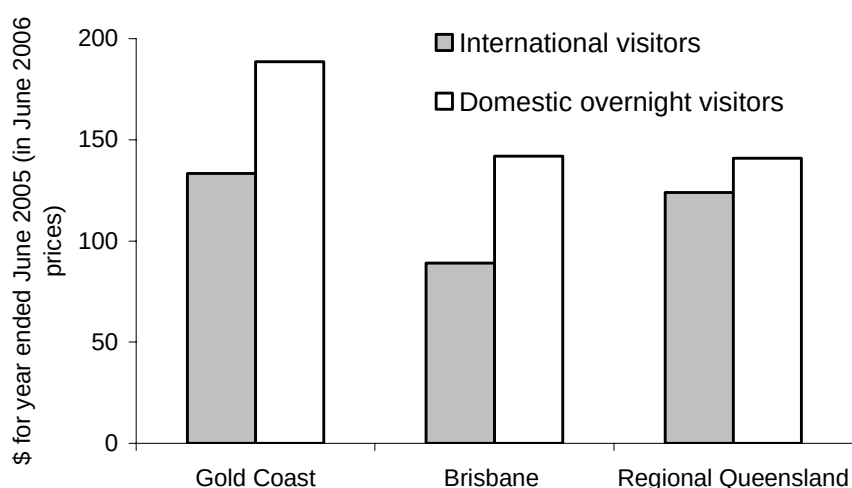


Figure 17.7 – Expenditure per night per tourist

¹⁰ Equates to a 70% occupancy rate for total holiday accommodation

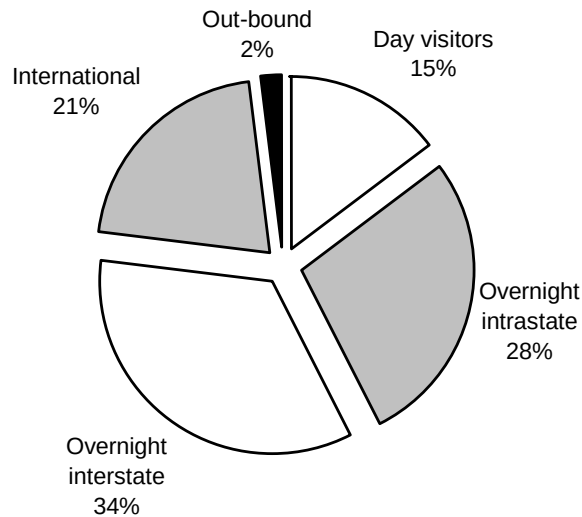


Figure 17.8 – Split of total tourism expenditure in Queensland in 2003-04

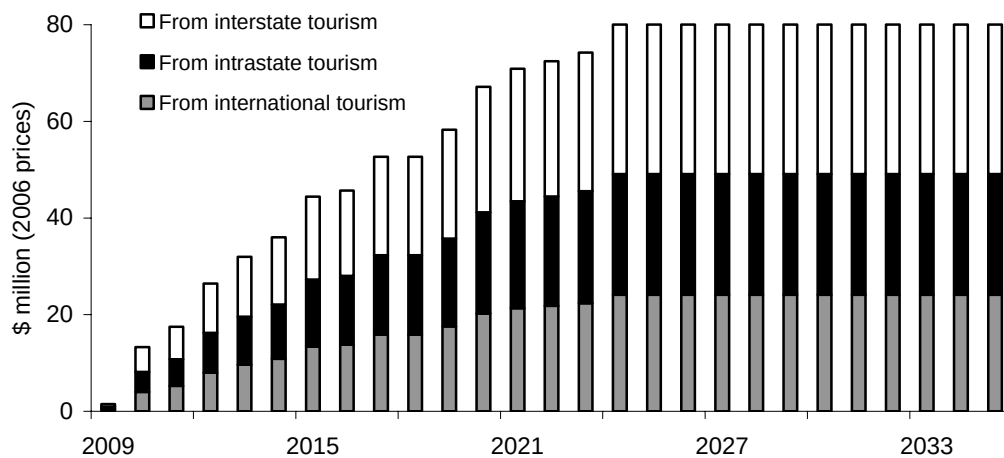


Figure 17.9 – Estimated tourism expenditure

Note: Estimates assume: room occupancy rates and guests per room as for the Fitzroy Statistical Division in the June Quarter of 2006; expenditure per night is based on data for the 12 months to June 2005 for regional Queensland; the share of international tourists in the total is as for the Mackay area for 2003 (data for Fitzroy are not statistically reliable); and the split of domestic tourism between interstate and intrastate tourism is based on the split of total tourist expenditure for Queensland in 2003-04. Source: Author's estimates based on project information supplied by Eaton Place Pty Ltd, OESR, Queensland Regional Profiles, Fitzroy and Mackay Statistical Divisions, generated March 2007, OESR (2006) and Collins and Carter (2005)

The estimated benefits for the regional economy are shown at Figure 17.10, for the period to 2035. It is estimated that tourism expenditure would make a direct contribution to regional value-added of \$810 million (\$290 million in NPV terms). The total direct and indirect (or multiplier) contribution to regional value-added is estimated as \$1,060 million (\$380 million in NPV terms). The estimated benefits are distributed fairly evenly between international, intrastate and interstate tourism.

While it is known that these benefits would be shared between the Wide Bay Burnett and Fitzroy regions, it is not possible to reliably estimate the distribution between the two regions.

As for construction, the estimated benefits for the state are higher than the estimated regional impacts. It is estimated that the tourism expenditure generated by the project would make a total direct and indirect contribution to Queensland value-added of \$1,240 million (\$450 million in NPV terms).

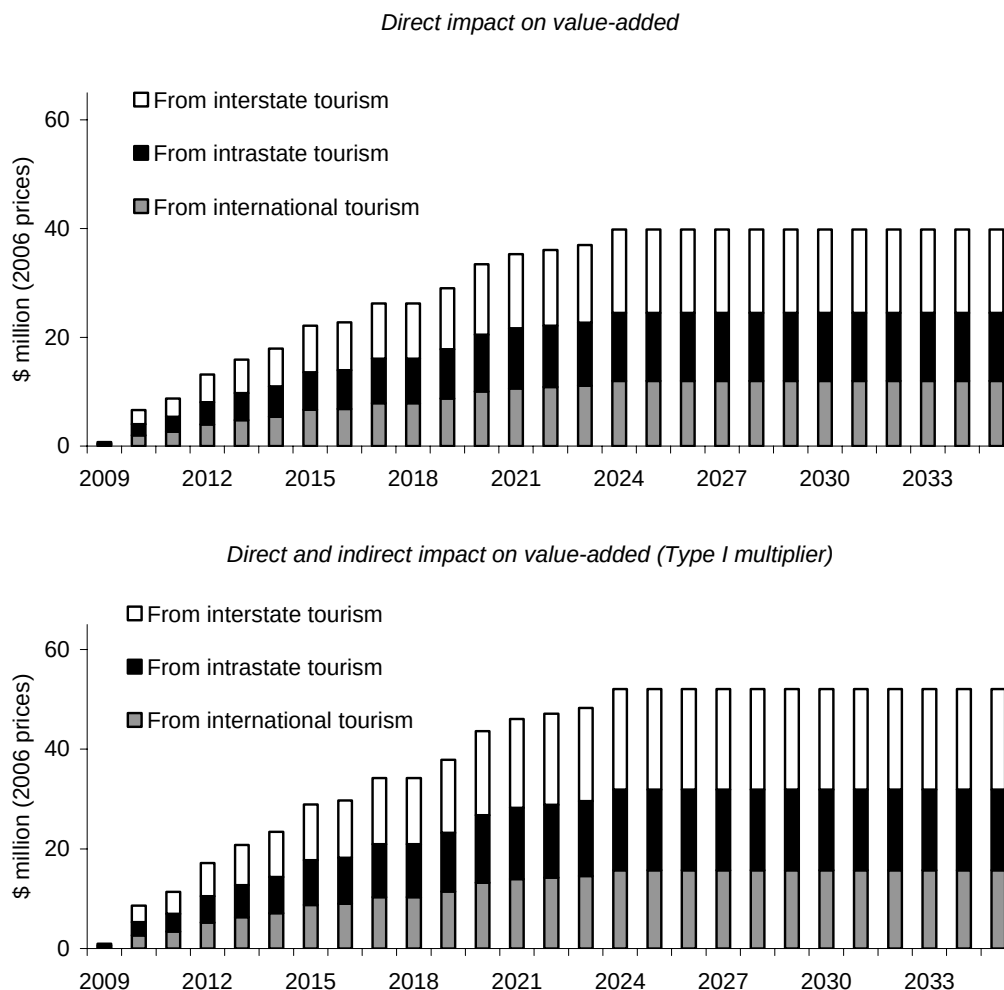


Figure 17.10 – Regional economic benefits from tourism expenditure

Note: Direct and indirect effects are based on the average direct and Type I multipliers for the Fitzroy regions for relevant industries, weighted by tourist expenditure by item (Table B.5).
Source: Author's estimates based on project information supplied by Eaton Place Pty Ltd and OGS (2002b).

17.2.4 Employment Impacts

The estimated regional employment impact from construction activity is summarised in Figure 17.11. It is estimated that more than 3,300 person years of direct employment would be generated in construction, with an average of 190 jobs per year from 2007 to 2024, and a peak employment of 350 persons. Once indirect effects are taken into account, construction is estimated



to generate almost 4,700 person years of employment, with an average of 260 jobs per year, and a peak employment of 460 persons. At a state level, the project is estimated to directly and indirectly generate almost 5,400 person years of employment in construction, with an average of 300 jobs per year, and a peak employment of 550 persons.

Substantial employment opportunities would also arise from the tourism activity generated by the project. It is estimated that over the period 2007 to 2035, more than 11,000 person years would be created directly, and a total of approximately 14,500 person years of employment would be created directly and indirectly. The number of jobs created is expected to rise steadily to the peak level in 2024, of the order of 700 persons. At a state level, the tourism expenditure is estimated to directly and indirectly generate up to 850 jobs per annum by 2024, or more than 17,000 person years of employment to 2035.

The creation of new jobs by the proposed development over a 16 year period would present substantial opportunities for the local labour market. With the combined population of Miriam Vale and Calliope Shires estimated to grow from 22,000 in 2006 to 36,500 by 2026, the project has the potential to provide an important source of employment for the large number of future, local residents that will enter the labour force.

Construction would create employment opportunities that include skilled and unskilled positions in engineering design, construction supervision and trades, earthmoving, equipment operation, building and landscaping. It is difficult to predict the long-term, potential impact on the skill and occupation mix of the local labour market, as comparable, tourism-based regions present a diverse picture on occupation mix (Focus Economics 2007). However, it is likely that the operation phase would see a rising service-orientation in the local area, as service jobs are created in retailing through to the provision of professional services. At a regional level the proposed development would provide new opportunities for those seeking to leave agricultural activities, particularly in the younger age groups.

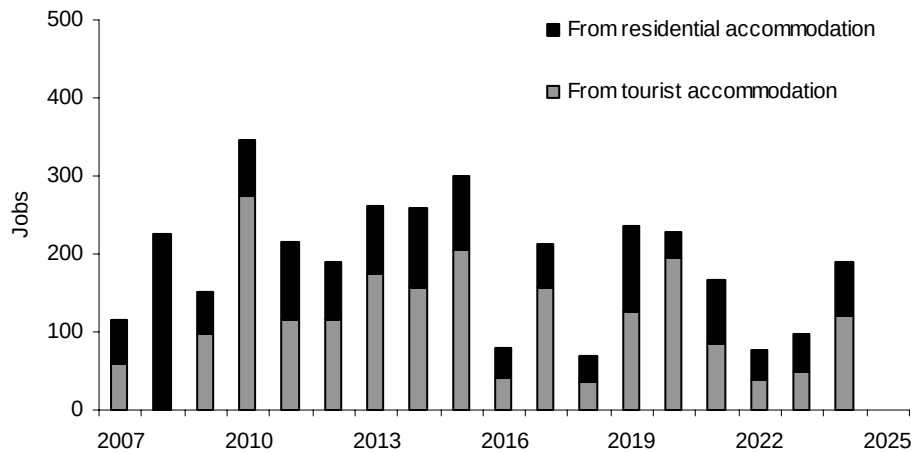
The phased nature of the development would provide the local labour market considerable time to adjust to the opportunities created and to build required skills through established systems (e.g. the apprentice and vocational education systems). Whether the jobs are secured by local residents or by labour from other regions would in part depend on how capable the region is in building the needed skills. For example, as noted in the Central Queensland economic plan:

“Central Queensland has a sound technical skill and knowledge base in many of the industries that have traditionally driven the region’s economy. The challenge is to continue to enhance these valuable skills to better match the skill level required by employers and proposed developers.”
DLGP (2002) p.34)

The key labor market pressures arising from the project are likely to be in the areas of technical trade and skilled workers, who are currently in high demand in central Queensland and elsewhere in Australia. It is difficult to predict how well these pressures are likely to be managed over the 16 year development phase. However, the long development phase and the relatively small size of

the development (compared to other major projects in the region) suggest these pressures would be within the capacity of the labour market to manage.

Direct impact on employment



Direct and indirect impact on employment (Type I multiplier)

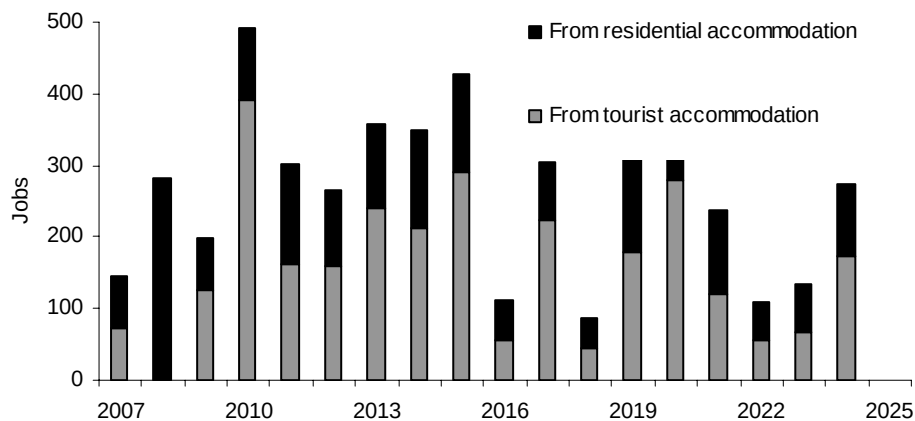


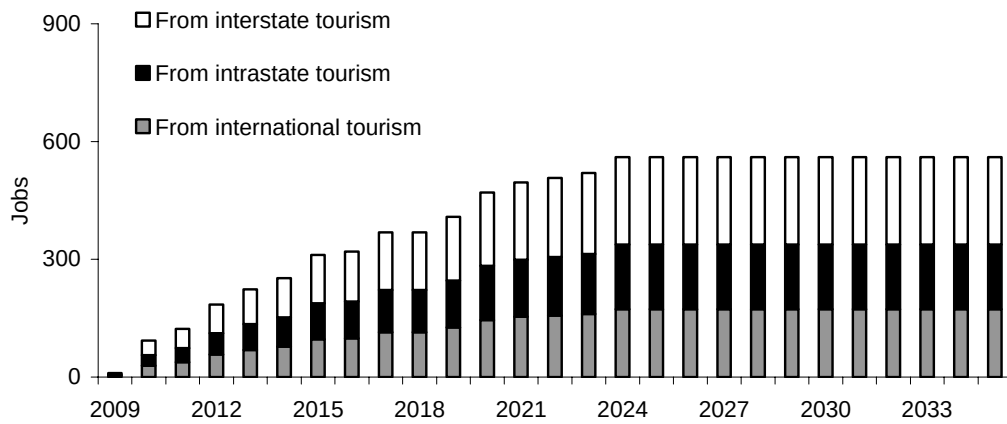
Figure 17.11 – Regional Employment from building and construction

Note: Direct and indirect effects are based on the average direct and Type I multipliers for the Wide Bay Burnett and Fitzroy regions, for the residential building construction and other construction industries. The distribution of expenditure in a year on physical infrastructure, social infrastructure and land development between tourism and residential accommodation is based on the split of total building work between tourism and residential accommodation in the same year.

Source: Author's estimates based on project information supplied by Eaton Place Pty Ltd and OGS (2002b)



Direct impact on employment



Direct and indirect impact on employment (Type I multiplier)

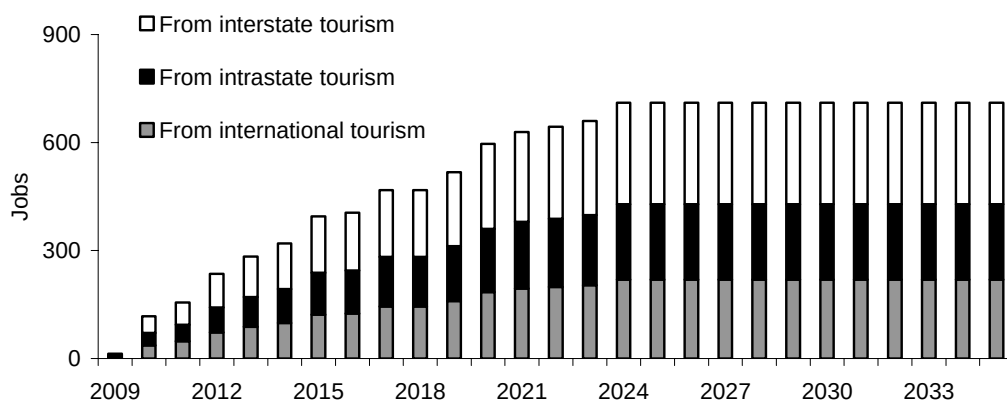


Figure 17.12 – Regional Employment from Tourism Expenditure

Note: Direct and indirect effects are based on the average direct and Type I multipliers for the Fitzroy regions for relevant industries, weighted by tourist expenditure by item (Table B.5).

Source: Author's estimates based on project information supplied by Eaton Place Pty Ltd and OGS (2002b).

17.3 Environmental Costs

17.3.1 Unpriced goods and services

In undertaking benefit-cost analysis attention is paid to both direct market costs and to unpriced goods and services. The direct costs are those that are easily identified as the costs of traded goods and services – the costs of labour, building hardware, earthworks and so on. These are the costs that underpin financial analysis. Unpriced goods and services can also be important to a community but are excluded from financial analysis.

As noted by Tisdell (1993) and most authors writing on benefit-cost analysis, unpriced goods and services and “inadequately” priced commodities provide substantial challenges to analysts trying to apply benefit-cost analysis. Two categories of cost, which often overlap to a substantial extent, are particularly relevant here.



The first is that of externalities, which are often referred to as spillover effects. These are the consequences of a project or activity on the welfare of others. Pollution is a common example: a factory that is emitting pollutants into the atmosphere or a waterway may ignore the fact that these emissions impact on the welfare of others. From the point of view of a private enterprise, an externality is a beneficial or damaging affect from the operation of the enterprise for which no payment is received or made, respectively. Note that externalities can be positive if the welfare of non-intended recipients of a good or service benefit from it. The possibility of external impacts is a chief reason for the requirement of an environmental impact statement.

The second category of unpriced goods and services is that of environmental goods and services. Many unpriced or inadequately priced commodities involve environmental factors for which prices are difficult to derive.

From an efficiency viewpoint, costs such as those associated with externalities and environmental goods should be considered in benefit-cost analysis. The issue is how they are measured and included in the analysis.

17.3.2 Valuing Environmental Impacts

Environmental effects in general do not have a price, but this does not mean they do not have a value. This is the difference between financial analysis, which is only concerned with goods and services traded in markets, and economic analysis which is concerned with the overall efficiency of resource use and the welfare of society. If environmental values are not accounted for one of three outcomes will occur:

- The net environmental effect could be negative – resources are degraded, there is excessive pollution, loss of species, etc;
- The net environmental effect could be positive – there could be under-investment in or underutilisation of the environment's productive capacity; or
- The net environmental effect could be neutral – the value of the degradation is the same as the value of use; in this case decision makers need only consider non-environmental factors in making their decisions.¹¹

The question is how to value environmental resources or effects? What price can be put on them when there is no market in their use? A range of methods have been developed (summarised in Focus Economics 2007), with two of the so-called “market value approaches” of relevance in the case of Hummock Hill. These are:

- Replacement cost: individuals, groups or society replace an asset in its entirety or in part, or change the quality of an asset; and

¹¹ Department of the Environment, Sport and Territories (1995).



- Preventative Expenditure: individuals, groups or society spend money to defend the environment.

Campbell and Brown (2003) explained that the replacement cost method infers the value of environmental quality from the cost of replacing or restoring the degraded environment to its level before the damage occurred. If wetlands, forest or coral reefs were removed or degraded during development of Hummock Hill, the environmental quality would be estimated as the cost of replacing or restoring those areas lost or damaged. This method assumes that incurring a cost to replace or repair produces a benefit at least as great as the value of the environmental cost, or loss of benefit to society.¹²

The preventative cost method assumes that the value of the environmental asset is equal to the cost of preventing or mitigating the environmental damage, replacing or restoring the asset, or relocating the environmental activity.¹³ Use of this method assumes that the preventative expenditure and environmental quality are perfect substitutes. In some cases the preventative expenditure may produce a net gain in environmental quality, such as when erosion that was occurring without the project is subsequently controlled.

17.3.3 Valuing the Hummock Hill Island Environment

Hummock Hill Island has a number of important environmental attributes. Approximately half of the development site is 'of concern' vegetation. Key conclusions raised by the Flora and Fauna Survey of 2006 (Central Queensland University) and GHD's 2006 identification of environmental issues include:

- No rare or threatened flora species were identified within the development footprint;
- A number of fauna species of international, national and state significance were identified as occurring on the Island, mainly migratory wader and shoreline birds;
- There are few if any likely impacts on water quality, groundwater or other environmental assets such as visual amenity;
- Habitats, such as those for endangered species are not likely to be impacted directly or indirectly by the proposed development; and
- The Island has historically been used for beef cattle production under a pastoral lease since 1887, although such use is no longer important.

The project is planned around endangered ecosystems and will have a no net loss of "of concern" ecosystems through off sets. Construction and operational impacts to adjacent endangered and of concern ecosystems will be minimised through management measures and Master Planning.

¹² This relates also to the fact that in many cases there is imperfect knowledge or information about environmental costs.

¹³ Campbell and Brown (2003) p. 272



Reflecting the environmental value of the Island, the proposed project has been designed as a near 'closed' system aimed at reducing potential impacts on the natural environment. It is proposed that most of the island would remain undeveloped and managed for conservation values and compatible recreational usage.

The environmental values of the Island make it important, however, to factor in un-priced goods and services. In this case the preventative expenditure approach offers an appropriate proxy for the value of the potential environmental costs of the development. That is, the value of the environmental assets of the Island can be assumed to equal the cost of preventing or mitigating the environmental damage, replacing or restoring the asset, or relocating the environmental activities.

Many of the activities incorporated into the development include a preventative component. Key environmental impacts of concern for the development are listed in Table 17.1, with the specific preventative measures associated with those concerns also shown.

Table 17.1 – Preventative Expenditure

Environmental Concern or Cost	Preventative Expenditures
Reduced Great Barrier Reef World Heritage values and reduced value of marine and coastal areas, including a loss in vegetation 'of concern'	Purchase of off-Island land as an environmental offset Securing of water supply from a local desalination facility Development and implementation of a management plan in consultation with GBRMPA and QPWS
Reduced quality and increased quantity of stormwater discharges to freshwater and coastal ecosystems	Development and implementation of a water management plan Establishment of integrated stormwater and wastewater management systems Water sensitive urban design measures incorporated into stormwater management to manage pollutant loads and maintain water quality ¹
Erosion impacts lead to reduced water quality	Disturbed areas would be reinstated or stabilised immediately after earthworks Stormwater management devices incorporated in developed areas to control sediment
Accidental spills of hazardous materials	Hazardous material management plans developed and implemented during construction and operation
Bushfires' impact on ecosystems	Bushfire management plan developed Fire fighting services would be provided
Increased traffic exceeds capacity of local roads	Necessary upgrades to roads to support increased traffic associated with the development
Increases in weed invasion and pest populations	Development and implementation of a weed and pest management plan
Generation of greenhouse gases	Adoption of solar hot water heating and passive building design
Damage from increased recreational use of the area	Development and implementation of a recreation management plan
Degradation of both Aboriginal and European Cultural Heritage items and sites	Preparation of a cultural heritage management plan, further investigations if required

Note: 1. The preventative expenditure is the additional (marginal) cost of such systems over and above the 'normal' costs.



In addition to those preventative measures embodied in building and construction activities, land will be purchased off-Island to offset lost vegetation. This land is expected to cost approximately \$1 million. In line with recommendations of the EIS, a number of management plans and strategies are to be developed to mitigate the potential impacts of the development on the natural values of the Island. For example, fire, weed and pest, recreation and water management plans are to be developed and implemented. The expected cost of the management plans and strategies recommended by the EIS – fire, weed and pest, recreation and water management plans – are summarised in Table 17.22. Costs of the offset and implementation of these plans comprise preventative expenditures that need to be included in the economic analysis as costs to the project.¹⁴

Construction and building activities associated with storm water management, road and bridge construction, boat ramp construction, the development of the water supply, environmentally sensitive building design, the educational precinct (with the inclusion of an environmental studies centre), landscaping, and so on, all include a component of preventative expenditure. Many of these costs are, therefore, factored into development costs (and consequently are automatically included in the benefit-cost analysis reported below). That is, many of the environmental management initiatives are embodied within the development cost.

It is difficult to separate out the preventative components and hence to put a figure to the environmental values. However, once the land offset and management plans are factored in, it is estimated that preventative expenditures are likely to total at least \$10 million.

Table 17.2 – The additional costs of management plans

Item	Estimated Costs		
	2007	2008	2009
World Heritage Area and Coastal Management Plan	\$60,000	\$60,000	
Weed/Pest Management Plan		\$50,000	\$50,000
Recreation Management Plan			\$100,000
Water Management Plan	\$60,000	\$60,000	
Cultural Heritage Investigations and Management Plan	\$100,000	\$75,000	

Source: Central Queensland University, 2006 and author's estimates

¹⁴ It is also theoretically valid because it is a proxy for the environmental opportunity costs associated with the development.



17.4 Economic Impact Assessment

17.4.1 A benefit-cost approach

The benefits and costs of the proposed project can be assessed by comparing the value-added generated by the project with the cost incurred in generating this value-added. The costs include the investment in the Hummock Hill Island development itself, in supporting an expansion in tourism, the environmental cost, and any social costs.¹⁵

The value-added generated by construction is derived from the estimated direct impact (from the multiplier analysis).¹⁶ It is not possible to include in the analysis the indirect multiplier effects from construction, as it is not possible to estimate with confidence the investment that would be required to realise these benefits. The investment incurred by the range of parties involved in construction is embodied within the project's construction costs.

The value-added generated by tourism expenditure is estimated as the total of the direct and indirect effect derived from the multiplier analysis.¹⁷ The investment incurred in generating this value-added is derived from estimates of investment ratios in the tourism industry. The investment rate for the Australian tourism industry (i.e. capital expenditure per unit of value added) is estimated to have ranged from 29% to 23% from 1990 to 2002, respectively.¹⁸ This assessment is based on an assumed investment ratio of 26%.¹⁹

The loss of environmental values is approximated by preventative expenditures required to address the potential impacts on the natural environment. Most of these expenditures are included in the project's development cost. Additional expenditure on the land offset and environmental management plans also need to be factored in. These additional expenditures are valued at approximately \$1 million (in NPV terms).

It is assumed there are no social costs from the project. As the project is being developed in a sparsely populated area, there are few if any adverse impacts on nearby residential areas to factor in (such as may arise for example from extra traffic). Surrounding areas have considerable capacity to expand housing to meet worker demand. This capacity is contained in a number of other residential developments occurring or proposed in northern Miriam Vale Shire and southern Calliope Shire, including residential subdivisions at Turkey Beach and "Foreshores" estate. The phased nature of the proposed development will provide good opportunities for the local land and housing

¹⁵ This benefit-cost test is the equivalent to asking whether the additional consumption generated by the project (which equals the value-added generated) outweighs the total of consumption forgone (i.e. investment) in generating that consumption, and the non-market costs. The estimated benefit-cost can be thought of as an approximation of the net addition to the community's monetary wealth from the project. A project is considered to pass the benefit-cost test if it adds to the community's monetary wealth (i.e. the benefits are greater than the costs).

¹⁶ The value-added directly generated by construction is found by multiplying the value of expenditure by the relevant direct multiplier. For example, the (weighted average) regional direct multiplier for construction and building expenditure is approximately 0.43. For a construction and building expenditure of approximately \$340 million in NPV terms (at 6% real discount rate), the total direct effect is approximately 0.43 times \$340 million, which is approximately \$145 million.

¹⁷ The value-added directly and indirectly generated by tourism is found by multiplying the value of tourism expenditure by the relevant Type I multiplier.

¹⁸ Salma (2003) p.14

¹⁹ Hence the cost of other, tourism related expenditure is equal to 26% of the value of tourism expenditure.



market to adjust to the changes. The additional development at Hummock Hill Island will itself add to the available residential land, and this additional supply will tend to keep land prices and house prices and rentals in nearby areas to no more than what they would otherwise be.²⁰ The project appears more likely to be a source of social benefits than social cost, given the employment opportunities to be created by the project. Marginalised members of the community are likely to share in these employment opportunities without systematically bearing additional costs.

The results of the regional level benefit-cost analysis are summarised in Table 17.33. It is estimated that the net benefits from the project for the region are approximately \$55 million (in NPV terms, at a real discount rate of 6%). That is, the project benefits are estimated to outweigh the project costs. A significant share of these net benefits are likely to be secured in the local area given the business and employment opportunities offered by the development. At a state level the net benefits are estimated as approximately \$87 million (in NPV terms, Table 17.44).

Sensitivity analyses have been undertaken at higher real discount rates of 8% and 10%. The finding of positive net benefits remains at the 8% level for the regional analysis, but net benefits become negative at 10%. The benefits exceed the costs at the state level for all three discount rates.

Table 17.3 – Regional Benefits Cost Analysis

	NPV in \$ million (in 2006 prices), at a real discount rate of		
	6%	8%	10%
Benefits	550	430	345
Construction - tourism related	99	85	74
Construction - residential related	70	62	55
Tourism expenditure	380	283	215
Costs	495	418	358
Construction - tourism related	233	201	175
Construction - residential related	161	142	126
Other investment - tourism related	99	74	56
Additional preventative measures (environmental)	1	1	1
Benefits less costs	54	13	-13

²⁰ Hummock Hill Island provides a net increase in residential land for the area. Some people who will reside at Hummock Hill Island would reside in nearby areas in its absence. This additional demand would tend to add to land and housing prices and rentals in these nearby areas, in the absence of Hummock Hill.

Table 17.4 – State Benefit Cost Analysis

	NPV in \$ million (in 2006 prices), at a real discount rate of		
	6%	8%	10%
Benefits	599	465	370
Construction - tourism related	90	78	68
Construction - residential related	64	56	50
Tourism expenditure	445	331	251
Costs	512	430	368
Construction - tourism related	233	201	175
Construction - residential related	161	142	126
Other investment - tourism related	116	86	65
Additional preventative measures (environmental)	1	1	1
Benefits less costs	87	35	2

17.4.2 An opportunity cost approach

An opportunity cost approach compares the potential benefits of the project to the potential benefits of an alternative use of the development site. The alternative use assumed in this assessment is to leave the site undeveloped as a nature conservation area.

Under the alternative, it is assumed that the residential development planned for Hummock Hill Island would take place in the local area. There are a number of other residential developments occurring or proposed in northern Miriam Vale Shire and southern Calliope Shire. These include residential subdivisions at Turkey Beach and “Foreshores” estate. Under the alternative, it is assumed these or similar sites are large enough to house the potential Hummock Hill Island residential population and considered to provide an equivalent, attractive lifestyle. Under this assumption, the benefits estimated from residential development at Hummock Hill Island would also be generated under the ‘alternative’ project.

It is possible that, under the alternative, a tourism development would emerge in the region as a replacement for Hummock Hill Island. In this case the alternative would offer similar tourism benefits to those offered by the proposed project. However, this outcome is considered unlikely. It is understood that there is no viable alternative for large-scale, high quality tourism development in the local area, given a lack of suitable beach access and natural areas. Further, it is reasonable to assume that any large, ‘alternative’ developments that did exist would proceed even in the presence of the Hummock Hill Island development. The region accounts for only a small share of total tourism demand in Queensland and the size of the regional tourism industry is more likely to be constrained by the supply of suitable facilities than by demand.



Consequently, under the alternative, it is considered that the net benefits of the proposed project would be lost to the local and regional economies – the recipients of the economic benefits of the Hummock Hill Island development.

This assumption carries less weight at a state-level. When the tourism market is considered from a state perspective, total tourism activity is more likely to be demand constrained. From Queensland's perspective, the proposed Hummock Hill Island development may thus take place at the expense of an alternative tourism development, at least to some extent.

Under the alternative, the full environmental cost of the Hummock Hill Island development would be avoided. Inclusive of preventative measures already in the construction cost, this saving is likely to be valued as at least \$10 million.

The key implication is that at a regional level the potential net benefits from tourism activities at Hummock Hill Island would be lost under the alternative. As these potential net benefits are estimated to be larger than the environmental costs avoided under the alternative, the 'alternative' project would offer lower net benefits to the region than the proposed development. On this basis the development is considered to pass the opportunity cost test at a regional level.

It is, however, less clear that the project would pass the opportunity cost test at the State level. This is because some of the key, tourism-related benefits of the proposed project may be generated in its absence, and without incurring the cost of the reduction in natural value of Hummock Hill Island. Such a test cannot be undertaken in this instance with confidence. There is considerable uncertainty as to how much tourism activity generated by the Hummock Hill Island development would be retained in the state in its absence. Moreover, the environmental cost of the 'alternative' project required to retain this tourism activity cannot be estimated and hence cannot be factored into the test.

17.4.3 Conclusion

It is apparent that the potential benefits for the local and regional economies of the proposed Hummock Hill Island development are substantial. Over the life of the project (and in net present value terms) the project could inject some hundreds of millions of dollars of income into the regional economy. This would provide substantial job opportunities and funding for expanded publicly and privately provided community services. This result is largely driven by additional tourism activity the development would create for the region, and the economic stimulus provided by the construction work on the development.

The potential costs of the project are largely attributable to the potential adverse impact on the natural environment. The project has been designed to minimise such impacts, and the costs are estimated to be small and well below the potential benefits for the region.

It is estimated that the net benefits from the project for the region are approximately \$80 million (in NPV terms). That is, the project benefits are estimated to substantially outweigh project costs. At a regional level, the project is thus a worthwhile development.



At a state level, the net benefits of the project are estimated through economic multiplier analysis as approximately \$115 million (in NPV terms). This estimate may over-state the potential benefits at the State-wide level. Over the long-term, the project may displace at least some activity elsewhere in the state, notably tourism-based activity. In which case, in net terms the project may actually create less new income at a state level than at a regional level. Nevertheless the project's net benefits would probably remain significant at a state level.

Were the project to be largely residential-based, the potential benefits would be much less. This is because it would be reasonable to expect other residential development to emerge in the region if the proposed development did not proceed. Hence, under these conditions the project would create less new economic activity (ie it would determine the location of activity rather than the level or value of activity). However, the assumed tourism-intensity of the development is comparable to that achieved elsewhere in the State and the underlying assumptions of the economic assessment are considered to be reasonable.

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SECTION 18
HEALTH AND SAFETY HAZARD AND
ENVIRONMENT



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18. Health and Safety Hazard and Risk

18.1 Health and Safety

18.1.1 Existing Environmental Values and Characteristics

Existing sensitive receptors within the area are limited to existing inhabitants of Bangalee on the southern tip of Wild Cattle Island and Mundoolin Rocks on the mainland side of Boyne Creek.

Existing sensitive receptors are shown in Figure 10.1 (refer to Section 10). Health and safety issues will also require action during the various phases of development. Tourists and residents can be exposed to health and safety hazards from construction sites if not managed correctly.

Based on community consultation responses current environmental values that may be associated with health and safety include:

- Concern that water taken for desalination supply may not be of suitable quality;
- Location and methods for storage and removal of waste;
- Possible air quality impacts depending on prevailing breezes;
- Increased boat traffic on waterways presents additional risks; and
- Need for a lifeguard/surf lifesaving presence on surf beach.

Additional health and safety matter considered include:

- Construction site management;
- Erosion and sediment control measures safety;
- Grey water re-use safety;
- Vector management; and
- Wild animal management.

The issues identified above are discussed in the relevant Section of the EIS as referenced in Appendix A3. Mitigation of the above health and safety issues are outlined in Table 18.1.

18.1.2 Potential Impacts and Mitigation Measures

Construction of the proposed Hummock Hill Island Development will occur over a 16 year period between 2008 and 2023 as shown in Section 3. Initial construction of access infrastructure, power supply, water and sewerage reticulation prior to construction of buildings is an SL requirement. Construction of tourist infrastructure and residential precincts will occur concurrently over the proposed development period.

Occupational Health and Safety (OH&S) management of construction activities will be limited initially to the construction workforce due to the isolation of the construction site from the mainland and limited site access. Once construction of tourist facilities and residential precincts begins, OH&S issues from construction activities will apply to the construction workforce and tourist /residential population. Reference to the relevant Section of the EIS must be made for discussion



of issues associated with health and safety aspects of the project. Proposed mitigation of health and safety issues identified in Section 18.1.1 are outlined in Table 18.1.

Table 18.1 – OH&S Management & Mitigation

OH&S Matter	Management/Mitigation
Desalination Water Supply Suitability	Refer to Section 3 for management details Drinking water supplies from the proposed desalination plant will be required to meet NHMRC Australian Drinking Water Quality Guidelines (2004)
Waste storage and removal	Refer to Section 3 and Section 11 for management details
Air and Dust Emissions from construction and site related transport activities	Refer to Section 9 for management details.
Noise emissions from construction and site related transport activities	Refer to Section 11 for management details Minimum OH&S standards are to be met with respect to construction noise.
Site Preparation and Daily Construction Activities	Construction activities will be conducted in accordance with the Construction OH&S Plan which outlines responsibilities for OH&S management, minimum OH&S standards to be met for the site, training (including contractors), reporting and compliance checks.
Increased boat traffic risks	Refer to Section 15 for ecological management Boating traffic will be subject to Queensland maritime laws and regulations. Additional community education signage will be displayed at public boat ramps.
Beach Safety	Master Planning has included provision for council and volunteer lifeguard services for public beaches.
Plant and Equipment use	All plant operators (including contractors) will be certified to operate their designated equipment.
Unauthorised work site access by visiting tourist and resident population	Site management will be in accordance with Queensland OH&S Legislation and Policy which includes site security, warning signs prohibiting unauthorised access.
Emergency Response (workplace incidents)	Refer to Section 18.2 for management details.
Handling of chemicals and other hazardous substances	Refer to Section 18.2 for management details.
Increased road accident risk from construction traffic	A site traffic management plan will address matters such as traffic flow, direction and speeds for construction traffic in residential areas and Clarks Road, in conjunction with the local Police Force and Local Government.
Erosion and Sediment Control Safety	Refer to Section 3 for management Water storages and detention basins will be designed in accordance with <i>Water Sensitive Urban Design Technical Design Guidelines for South East Queensland</i> , (Healthy Waterways,2006)
Primary and Secondary contact to Class A+ recycled water within storages	Refer to Section 3 for details Recycled water will be treated to Class A+ in accordance with the Queensland Recycled Water Guidelines (2005) as such waters will comply with the

OH&S Matter	Management/Mitigation
	Guidelines for Managing Risks in Recreational Water (NHMRC, 2006)
Airstrip operations	Airstrip operations will be in accordance with CASA requirements.
Increased mosquito breeding habitat	Temporary water storages will be constructed in accordance with the Draft Water Sensitive Urban Design Engineering Guidelines, (BCC, 2005). Permanent water storages will be constructed in accordance with the Queensland Recycled Water Guidelines (2005) and the Australian Mosquito Control Manual (Mosquito Control Association of Australia 2002).
Wild animal management	Refer to Section 14 for details No evidence of feral pigs on the Island were found during fauna surveys.

18.2 Hazard and Risk

This section sets out a summary of the detailed risk assessment outcomes as part of the EIS to assess potential hazards and risks associated with the proposed Hummock Hill Island Development. It deals with the methodology employed in the study, the identification of hazards and an assessment of reasonably anticipated risks to the local community and environment.

18.2.1 Methodology

The hazard and risk assessment involved:

- the identification of potential hazardous incidents associated with construction and operation of the development;
- the identification of potential hazards and operational risks using a risk assessment approach;
- summarising potential hazards and operational risk scenarios in the form of a risk register;
- identification of possible causes and consequences from potential hazards, their detection and control;
- a semi-quantitative analysis of the risks based on consequence and likelihood associated with key hazardous scenarios, including impacts that could involve sensitive off-site receptors such as people and environment;
- a series of recommendations required for the most appropriate management systems related to key scenarios and potential impacts; and
- an outline of key items for an emergency response plan.

The methodology adopted for the assessment of risk for the Project followed a traditional risk assessment approach. Potential hazards were identified for each activity through the use of hypothetical scenarios, document review, study or via historical industry information in line with standard Queensland practice. Identified potential hazards were reported in the form of a risk register. The risk register for each activity outlines prevention, detection and protection mechanisms appropriate for identified potential hazards.



The critical issues which might have important impacts on natural, social and infrastructure systems can be extracted from the risk register and be subject to consequence analysis using prediction models to assess the impact or hazard range for the potential hazard. The risk analysis criteria adopted for this EIS include a five-point scale for measuring consequence in relation to health and safety to humans, animals in the marine and terrestrial environment (in particular rare and endangered species) air and sea traffic, communications facilities and networks and damage to the environment.

The intention of the risk assessment was to identify key events which might have an impact on proposed development as related to construction and operational activities. The study considered reasonably anticipated relevant hazards, both minor and major, for each potential incident scenario.

18.2.2 Risk Assessment

The risk assessment was carried out in accordance with the appropriate “*Guidelines for Hazard Analysis*” and *Australian Standard AS/NZS 4360:2004 Risk Management*. The risk assessment outlines the implications for, and the impact on, the surrounding land uses from the proposed project. The risk assessment incorporates:

- Reasonably anticipated relevant hazards associated with construction and operational activities (minor and major);
- The possible likelihood of potential hazards, accidents, spillages and abnormal events occurring;
- An indication of cumulative risk levels to surrounding land uses; and
- An envisaged list of the hazardous substances to be used, stored, processed or produced contained and licensing required in Table 18.2.

Potential incident scenarios from operations were identified through consideration of:

- The range of activities likely to be carried out and facilities anticipated during the construction and operation phase; and
- The range of potentially hazardous incidents that might be associated with each of the activities/facilities identified at the site.

Identification of potential hazards is aided through the application of a prompt list. The list is based upon the possibility of a loss of control of energy causing subsequent damage or loss.

Having identified the range of reasonably anticipated hazards likely to occur, the following matters were considered for each hazard:

- Appropriate controls and mitigation factors expected to be put in place for the management of each hazard. These may include prevention and response measures;
- The consequences of each of the potential hazardous incidents if they were to occur. Consequences might include direct impacts of incidents and the potential for propagation and



secondary incident. Assessment of the severity of the consequences takes into consideration the proposed mitigation measures listed;

- Possible causes and the likelihood of these causes occurring and leading to the hazardous incident identified. The likelihood of each hazardous incident occurring takes into consideration the proposed control measures;
- This information was then tabled to prioritise the risks and evaluate these risk levels against acceptable risk criteria; and
- Where an extreme or high risk was identified, appropriate, controls and mitigation measures were identified to reduce the risk further and/ or provide monitoring to identify changes to the risk.

Potential incident scenarios, including potential consequences and prevention, protection or mitigation measures are outlined in Table 18.3.

Outcomes of the assessment are presented as semi-quantitative risk tables, where the risk is a combination of the severity of the event and the likelihood of its occurrence. The generation of risk contours was not considered necessary as no existing non-natural hazards were identified in the 'potential incident scenario'.

18.2.2.1 Risk Analysis and Risk Register

Risk analysis was conducted based on AS/NZS 436:2004 Risk Management Guidelines. The hazard or event prevention, detection or protection measures for the proposed development are listed below along with related comments. Hazards associated with the development fall into three categories – Natural Systems, Social Systems and Infrastructure Systems.

The following definitions are in the following Tables, C is consequence, L is Likelihood and R is the level of Risk. H&S is Health and Safety risk, T & U is Transport and Utilities risk and Env is Environmental risk.

18.2.2.2 Legislative Compliance

The risk register in Section 18.2.5 has identified the need for legislative compliance in a number of areas. The specific legislative references are covered comprehensively in the Hummock Hill Island Development Master Plan Section 6 and will not be duplicated in this report. However, the following legislation was referred to in the risk assessment process;

- Aboriginal Communities (Justice and Land Matters) Act 1984;
- Agricultural Chemicals Distribution Control Act 1966;
- Ambulance Service Act 1991;
- Chemical Usage (Agricultural and Veterinary) Control Act 1988;
- Coastal Protection and Management Act 1995;
- Dangerous Goods Safety Management Act 2001;
- Environmental Protection Act 1994;



- Exotic Diseases in Animals Act 1981;
- Explosives Act 1999;
- Fire and Rescue Service Act 1990;
- Gas Pipelines Access (Queensland) Act 1998;
- Gas (Residual Provisions) Act 1965;
- Health Act 1937;
- Integrated Planning Act 1997;
- Land Act 1994;
- Liquid Fuel Supply Act 1984 ;
- Local Government Act 1993;
- Local Government (Community Government Areas) Act 2004;
- Major Sports Facilities Act 2001;
- Marine Parks Act 1982;
- Marine Parks (Great Barrier Reef Coast) Zoning Plan, 2004;
- Native Title (Queensland) Act 1993;
- Nature Conservation Act 1992;
- Petroleum Act 1923;
- Public Safety Preservation Act 1986;
- Terrorism (Commonwealth Powers) Act 2002;
- Water Act 2000; and
- Workplace Health and Safety (Miscellaneous) Regulation, 1995

18.2.3 Potential Incident Scenarios

Potential incident scenarios from operation of the proposed development were identified through the following process:

- Step 1: List the proposed development into environmental areas (e.g. natural, social, infrastructure etc);
- Step 2: For each environmental area, list the potentially hazardous incidents that may result in an incident;
- Step 3: For each incident identified in Step 2, list possible causes and/or relevant comments;
- Step 4: Mitigating factors are applied for each case. These factors may include the adequacy of the prevention/detection/protection systems that are currently in place. Allowance is also made for the possibility of intervention based on hazard warning systems being activated;
- Step 5: Once the hazardous incidents and controls have been identified, the consequences of the incidents are estimated. The consequence analysis addresses both the direct impacts of incidents and the potential for propagation and secondary incident;



- Step 7: Consideration was then given to identifying the event frequency for each incident based on these controls being in place. This information was then tabled to prioritise the risks and evaluate these levels against the concept of As Low As Reasonably Practical (ALARP); and
- Step 6: Where appropriate, recommendations are included in the Hazard Identification table.

The following sections discuss key incident scenarios that may be reasonably anticipated for the proposed development.

18.2.3.1 Storage and Handling of Dangerous Goods

Key potential hazards are associated with the type of substances that would be expected to be stored and used during the construction and operational phases of the proposed development. The proposed development will use several common hazardous substances which are regulated by the *Australian Dangerous Goods Code* (Commonwealth) and *Codes of Practice* under the *Workplace Health and Safety Act 1995*(Qld).

Table 18.2 lists the principal anticipated dangerous goods, dangerous goods class and packaging group and their quantities that require specific licensing or rates of usage (where known). Other water treatment chemicals, maintenance chemicals and proprietary substances are also likely to be used in the three components of the development.

These can contain proportions of classified dangerous goods or dangerous substances however, most are unclassified materials. It is vital that handling, storage and separation distances be maintained in accordance with Australian Standards and industry codes of practice, such as:

- AS 1692: Tanks for flammable and combustible liquids
- AS 1940: The storage and handling of flammable and combustible liquids
- AS 2187: Explosives - Storage, transport and use
- AS 3780: The storage and handling of corrosive substances
- AS 4452: The storage and handling of toxic substances

Given the correct controls on these materials, there is negligible risk to nearby land uses or to the social and natural environments. All effects from incidents are expected to be contained and mitigated within the development precincts.

Table 18.2 – Indicative List of Dangerous Goods and Hazardous Substances

Chemical Name/ Shipping Name	DG Class	Storage amounts requiring local Govt. license	Storage conc. (wt%)	Annual Usage	UN Number	Packaging group	Purpose/ Use
Diesel Fuel Oil	C1	10,000L DGL					Fuel supply
Sulphuric Acid	8	250L DGL			1830	II	pH adjustment
Caustic soda (sodium hydroxide)	8	250L DGL			1824	II	pH adjustment
Chlorine	2.3 Sub class 8	50L DGL			1017	None	Disinfectant
Ammonium Hydroxide	8	1000L DGL			2672	III	pH adjustment
Sodium Hypochlorite	8	1000L DGL			1791	III	Disinfectant
Ferric chloride	8	1000L DGL			2582	III	Flocculant
Hydrogen Gas	2.1	500L DGL			1049	None	Generator cooling
Liquid Alum	8						Water treatment
LP Gas	2.1	500L DGL			1075		
Oxygen	2.2	500L DGL					welding
Acetylene	2.1	500L DGL			1001		welding

18.2.3.2 Emergency Management and Response Plans and provision of Emergency Services

Designated first aid and emergency rescue facilities and equipment will be available during the construction and operation phases of the proposed development. Appropriately trained personnel will be on-site throughout the construction life of the proposed development, as part of principal contractor requirements, to provide first aid and respond to on site emergencies. First aid response and provision will be included in the site induction training that will be provided to all construction employees. A permanent emergency services presence will occur after the third year of construction with inclusion of a combined Police, Ambulance and Fire Brigade building located in are adjacent the town centre.

The general approach to emergency response on-site can be summarised as:

- There will be a team in the construction employees to provide a first response capability (e.g. occupational first aid and basic fire fighting);
- For specialist emergency response services, the Project will rely on the service provided by the local QPOL, QFRS and QAS officers stationed in Gladstone, Boyne Island, Calliope and Miriam Vale (i.e. via the 000 service) and once established the emergency services present on the Island;



- The emergency controller, who will be the on-duty operations team leader, will control and coordinate emergency response actions on site until such time as the incident is either effectively managed or handed over to external emergency services;
- Stores, restaurants, commercial premises and offices will be fitted with approved and certified fire detection (smoke detectors) and sprinkler systems;
- First aid fire fighting equipment (hand held extinguishers and fire hoses) will be installed at strategic points at the development;
- All fire fighting facilities and equipment will be serviced, maintained and inspected by a certified body;
- Site induction training will include emergency response actions;
- Fire drills will be undertaken on a regular basis where necessary by construction personnel;
- Permanent facilities, such as fuel storage areas, will have a dedicated fire alarm, suppression and fire fighting systems;
- Site fire fighting capabilities also will be addressed in the Emergency Response Plan; and
- The Principal Contractor will liaise with local State Emergency Services and local ambulance and hospital services with respect to planning for Emergency Response.

18.2.3.3 The Relationship Disaster between Disaster Control Organisations including Command and Control

The Queensland State Disaster Management System is a whole-of-Government system that requires commitment from all levels of Government to deliver a comprehensive framework responsive to community needs.

The *Disaster Management Act 2003* (Qld) represents prescriptive guidance to disaster management. The *Disaster Management Act 2003* (Qld) provides a consistent and comprehensive framework in which all levels of Government can link networks and work together to deliver effective disaster management across the state.

A number of agencies and groups undertake disaster management, associated studies, and preparation work in their current functions and responsibilities. The local disaster management plan will support existing activities. However, where gaps are found to exist in the current framework and practices, and where local governments do not have existing policies, the *Queensland Disaster Management Planning Guidelines 2005* provide a consistent approach to local disaster management planning across the State.

As local disaster management plans have the force of law under the *Disaster Management Act 2003* (Qld), agencies and individuals with responsibilities under jurisdictions covered by local disaster management plans will need to have regard to the provisions contained within these plans.

The Queensland Disaster Management System consists of three levels of disaster management existing at Local Government, Disaster Districts (based on 23 police districts throughout Queensland) and State Government levels, along with the ability to seek assistance at a Commonwealth level.

The system is designed around disaster management arrangements, including planning, preparation and response being delivered in the first instance by Local Government. Local Governments are the closest level of government to the community, possess a detailed knowledge of the community they serve on a day-to-day basis and of the environment in which they operate.

When the Local Disaster Management Group (LDMG) expends its resources, assistance is sought from District Level and when then District expends its resources, assistance is sought from State level and so on.

A Queensland State Disaster Management Plan has been developed which documents a whole of government approach to disaster management arrangements. This plan details prevention/mitigation, preparedness, response, and recovery arrangements in Queensland, to ensure cooperation within the various agencies that play a functional role in times of disaster.

The foundation of Queensland's disaster management system exists as a system of committees representing each level of disaster management:

- State Disaster Management Group (SDMG);
- Disaster District Management Group (DDMG); and the
- Local Disaster Management Group (LDMG).

Figure 18.1 outlines the Disaster Management System in Queensland.

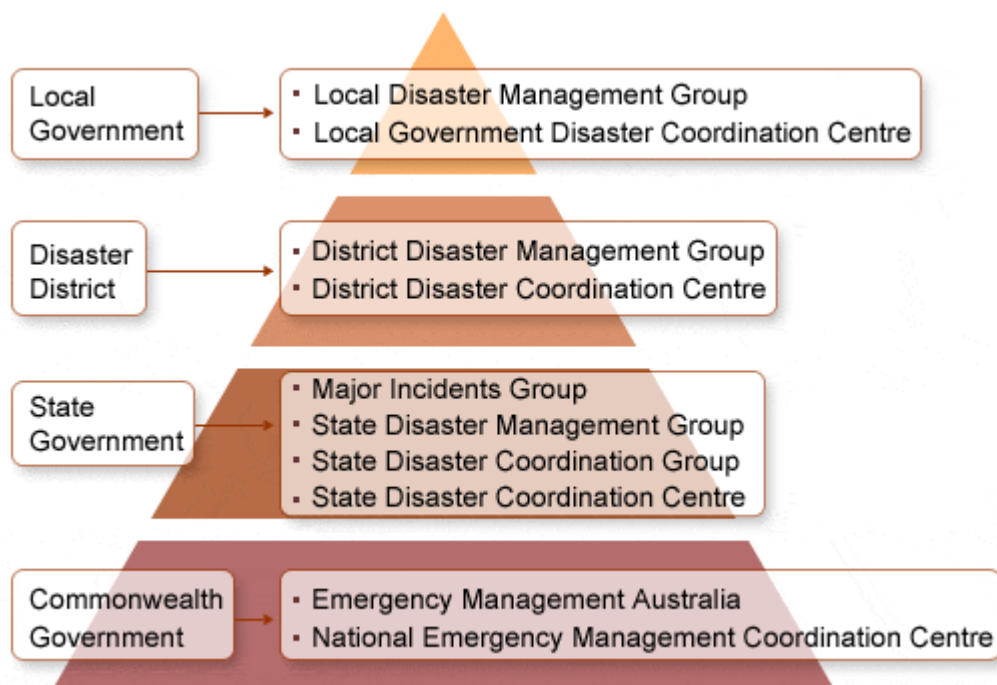


Figure 18.1 – Queensland Disaster Management System

(Source: Queensland Disaster Management Planning Guidelines 2005 for Local Government.)



18.2.3.4 Description of Natural Hazards and Emergency Situations

Identified natural emergency situations are:

- Tropical cyclones and severe wind: The main area of concern lies along the coastal strip in which shielding from the wind and storm tide is likely to be minimal. Overall wind risk is considered to be greatest in the headland and ridge-top areas due to their relative exposure;
- Storm tide inundation: At the 1% annual exceedance probability level, the development concentrations that have a high storm tide risk index are considered to be low lying areas, however based on preservation of existing coastal management districts as development free areas and the remaining area being above the 100 yr storm tide level the risk is considerably reduced;
- Bushfires: Whilst bushfires in the Gladstone area have not been as severe as fires in the southern states, bush fires have occurred in the region during most months of the year. Bushfires do destroy property (including urban property) and are a threat to public safety in Queensland. The overall risk of bushfire damage is higher in rural areas and urban areas near the interface with the 'bush' than in built-up areas further from the vegetation boundary. Areas with a medium to high bush fire risk based on SPP 1/03 (such as the western slopes of the central ridge) have either been avoided or incorporate the designated cleared buffer distance required under SPP 1/03;
- Heatwaves: In the period between 1803 and 1992 at least 4,287 people died in Australia as a direct result of heat waves. Given the lack of detailed information about the incidence of heat wave in the Hummock Hill Island area, it is not possible to provide a specific risk assessment, however safety in design features of housing will be considered to mitigate effects of extreme heat Reference should be made to Section 6 for information on climate extremes; and
- Earthquakes: The northern margin of the Wide Bay – Burnett is the most active earthquake area in Queensland. Earthquake hazard for Gladstone and surrounding area, as read from a national map, is relatively high for an urban centre in Australia, being only marginally lower than that for Newcastle or Adelaide. Reference should be made to Section 4 for further details on Earthquake Risk.

18.2.4 Airstrip Hazards and Risk Data

The proposed airstrip on the Island will be retained and managed by the proponent as part of the tourist infrastructure. It is anticipated that less than 6 private flights by small planes a day will occur from the airstrip.

A review of both Australian and International statistics formed the basis of the data used to assess risks in Table 18.3. Data utilised in the risk assessment process can be summarised as:

- In Queensland, between 1997 – 2006, there were 167 private and business general aviation accidents (36% of total aviation accidents) of which 23% resulted in a fatality;
- Regional Aerodromes in Australia have experienced a 58% increase in bird strikes (within a 5 km radius of the aerodrome) between 2000-2004;
- 62.5% of bird strikes recorded in Australia took place in Townville, Mackay and Rockhampton;



- The greatest number of fatalities (25% & 16% respectively) occurs during the climb from and final approach to the aerodrome;
- 53% of all fatal accidents where a specific cause could be identified were attributed to total pilot error;
- General aviation trips have a fatality rate of 13 per 1 million trips and the odds of being killed on a single trip of 73,187 to 1 (international statistic);
- Air crashes near airfields are more likely to have survivors; and
- 60% survival rate in aircraft ditching in water during flight.

18.2.4.1 Bird and Animal Hazard Management Plan

Research indicates that a prescriptive Bird and Animal Hazard Management Plan (*Civil Aviation Safety Authority (CASA) Manual of Standards Pt 139 – Aerodromes 10.14*) is the standard for the control of bird strikes at aerodromes. The manual states that the airstrip operator must monitor and record, on a regular basis, the presence of birds or animals on or in the vicinity of an airstrip. Monitoring personnel must be suitably trained for this purpose.

Where regular monitoring confirms existence of a bird or animal hazard to aircraft operations, or when CASA so directs, the airstrip operator must produce a Bird and Animal Hazard Management Plan, which would be included as part of the Airstrip Manual. The management plan must be prepared by a suitably qualified person such as an ornithologist or a biologist, etc. The management plan must address:

- hazard assessment, including monitoring action and analysis;
- pilot notification;
- liaison and working relationships with land use planning authorities;
- on-airport bird and animal attractors which provide food, water or shelter;
- suitable harassment methods; and
- an ongoing strategy for bird and animal hazard reduction, including provision of appropriate fencing.

The Bird and Animal Hazard Management Plan must be reviewed for effectiveness, on a regular basis, at least as part of each technical inspection. Where the presence of birds or animals is assessed as constituting an ongoing hazard to aircraft, the airstrip operator must notify the Aeronautical Information Service (AIS) in writing, to include an appropriate warning notice in the Enroute Supplement Australia (ERSA). Where a bird or animal hazard is assessed as acute, of short term or seasonal nature, additional warning must be given to pilots by Notice to Airmen (NOTAM).

As a point of reference, Cairns Airport has introduced the following controls to manage wildlife interfaces which may be considered in the hazard management plan:

- ornithological surveys – day and night;
- dedicated bird & wildlife officer (Safety Officer);



- decoy vehicles;
- natural predators (Nth Qld style);
- follow-up on reported strikes on departure;
- airman database system;
- generation of bird strike forms; and
- reports and statistics enables detailed analysis of contributory factors.

18.2.4.2 Aerodrome Serviceability and Hazard Management

The operator of the airstrip is required to arrange for airstrip serviceability inspections to be carried out each day and after a severe wind or rain storm, or when requested by air traffic control or by CASA. Subject to CASA agreement, the frequency of inspections may be reduced to not less than 2 per week, at airstrips with low numbers of traffic movements.

Airstrip reporting is the notification of changes to the published airstrip information or any other occurrence or emergency affecting the availability of the airstrip and safety of aircraft using the airstrip. The occurrences may be known beforehand, as planned airstrip works, or discovered during an inspection of the airstrip or obstacle limitation surfaces (OLS).

Particulars of the procedures for carrying out serviceability inspections, including the use of a checklist, and for reporting any changes to airstrip information or for requesting the issue of a NOTAM; are to be included in the airstrip manual.

The CASA Manual of Standards Pt 139 – Aerodromes Chapter 13 contains prescriptive dimensions and obstacle information regarding aerodrome standards that may be used as a guideline for non-certified airstrip.

18.2.5 Environmental Impact Statement Risk Register

Table 18.3 presents the results the reasonably anticipated risks associated with the proposed development and outlines expected control measures to be implemented by the project.

Table 18.3 – Natural, Social, Infrastructure Systems and Airstrip Hazards and Risks

Potential Incidents	Causes	Expected Controls	Cons Cat	Most Likely Risk		
				C	L	R
Natural Systems						
1.1. Erosion	Erosion as a result of earthworks and construction operations	Development to avoid steep slopes, implementation of construction EMP and ESCP	Env	3	D	17
		Limit access to dunes and beaches to people (no vehicles), limit vegetation clearing, implementation of VMP				
1.2. Topography and Landform	Removal of vegetation through earthworks	Limit access to dunes and beaches to people (no vehicles),, limit vegetation clearing, implementation of VMP	Env	3	D	17
	Erosion as a result of construction and operation	Development to avoid steep slopes, implementation of construction EMP and ESCP				
1.3. Climate and Natural Hazards	Weather- storms, cyclones and flooding	Locate development outside of flood and affected areas and coastal management district	Env	2	E	16
	Seismic activity	Construction in accordance with appropriate standards				
1.4. Marine and Coastal Flora	Reclaiming and/or Damage to mangrove areas	Infrastructure to be designed and sited to minimise disturbance to both marine and terrestrial habitats	Env	3	D	17
	Indirect runoff from construction into marine environment	Construction methods and works to be in accordance with the site ESCP				
	Scouring and erosion from coastal infrastructure	Implementation of Sediment Control Plan				
	Spills of and other hazardous substances fuels, oils, nutrients	No discharge of human waste to aquatic environment				

Potential Incidents	Causes	Expected Controls	Cons Cat	Most Likely Risk		
				C	L	R
		Implementation of Storm water Management Plan and WSUD				
		Regular maintenance and inspections undertaken				
		Implementation of storage, handling and spill management plan for all potentially contaminating substances				
1.5. Marine and Coastal Fauna	Loss of habitat and vegetation from construction and operation	Limit access to dunes and beaches to people (no vehicles),, limit vegetation clearing, implementation of VMP	Env	3	D	17
	Noise from construction affecting marine and coastal animals	Implementation of construction EMP				
	Sediment runoff during construction and operation	Construction methods and works to comply with ESCP, WSUD and receiving WQO				
	Lighting affecting nocturnal and nesting animals	Implementation of Lighting Spilling Management Strategy				
	Nutrient and sediment runoff from developed areas	Construction methods and works to comply with WSUD and receiving WQO				
	Increase in boating traffic increasing potential collision with dugongs and turtles	Boat controls (eg. speed, access and signage)				
	Spills of and other hazardous substances fuels, oils, nutrients	Implementation of storage, handling and spill management plan for all potentially contaminating substances				
1.6. Terrestrial Floral and Fauna	Loss of vegetation and/or habitat	Limit access to dunes and beaches to people (no vehicles),, limit vegetation clearing, implementation of VMP	Env	3	D	17

Potential Incidents	Causes	Expected Controls	Cons Cat	Most Likely Risk		
				C	L	R
	Change of draining systems affect on water flow	Only public infrastructure to be constructed within 10 m buffer zone of ephemeral watercourses				
	Increased habitat for midges and mosquitoes	Implementation of Vector Management Plan				
	Weed encroachment	Implement VMP, Bush Fire Management Strategy and Lighting Spilling Management Strategy				
	Bush fire impacts					
	Light spillage into habitat areas					
1.7. Ground Water Quality	Interaction with groundwater during excavations	Implementation of storage, handling and spill management plan for all potentially contaminating substances	Env	3	C	13
	Reduction in recharge potential of groundwater	Implement groundwater and waste water management plans				
	Contamination of groundwater with fuels, oils, nutrients					
1.8. Surface and Marine Water Quality	Changes in surface drainage patterns leading to changes in freshwater/salt water composition of waterways and wetlands	Implementation of WSUD principles	Env	4	C	18
	Sediment and pollution laden runoff	Construction methods and works to comply with WSUD and receiving WQO				
	Liquid waste and chemical spillage	Development to avoid steep slopes, implementation of construction EMP				
	Sediment and pollution laden runoff into artificial water bodies	Construction methods and works to comply with WSUD and receiving WQO				
	Nutrient and sediment runoff from golf course	Management of “Wild Course” in				

Potential Incidents	Causes	Expected Controls	Cons Cat	Most Likely Risk		
				C	L	R
	Spills of and other hazardous substances fuels, oils, nutrients	accordance with AGSA management eco-efficiency principles Implement community education programme as part of waste management service				
1.9. Acid Sulfate Soils	Disturbance of acid sulfate soils	Earthworks below the 5m AHD contour to be conducted in accordance with ASSMP	Env	4	D	21
	Exposure of acid sulfate soils	Earthworks below the 5m AHD contour to be conducted in accordance with ASSMP				
Social Systems						
2.1. Cultural Heritage	Discovery of artefacts during earthworks, construction and operation	Develop Cultural Heritage Management Plan	Env	5	C	22
	Discovery of artefacts during earthworks, construction and operation	Construction Management Plan to include actions for artefact discovery that include liaison with local indigenous community.				
2.2. Demographics	Increased demand for low cost housing due to construction workforce and possibly their families	Maximise use of local employment opportunities	T&U	3	C	13
	Increase demand on community services due to the significant increase in population	Liaise with health and education authorities regarding population increase				
2.3. Transport and Traffic	Increase in heavy vehicle movements and required access upgrading	Develop Traffic Management Plan including accident response procedures (air, road and sea)	T&U	3	D	17
	Requirement to construct bridge to gain access to the Island	Bridge construction in accordance with appropriate standards				
2.4. Infrastructure	Impact on vegetation, streams and wetlands due to increased infrastructure required	Development to avoid steep slopes, implementation of construction EMP and ESCP	Env	3	D	17

Potential Incidents	Causes	Expected Controls	Cons Cat	Most Likely Risk		
				C	L	R
		Implement groundwater and waste water management plans				
2.5. Waste Management	Increased waste collection and disposal during construction and operation	Implement waste management plans	Env	3	D	17
	Impact of waste storage and treatment	Implement community education programme as part of waste management service				
		No discharge of human waste to aquatic environment				
		Implementation of construction EMP				
		Utilise Qld EPA Waste management Hierarchy to identify and assess waste management options				
Infrastructure						
3.1. Buildings	Design of private and public buildings is not in harmony with the natural environment	Design of buildings will need to be compatible with overall Hummock Hill Island ESD development principles and Master Plan	Env	4	D	21
	Buildings do not follow environmental sustainability guidelines					
3.2. Sea	Construction of boat ramps	Boat controls (e.g. speed, public information signage)	Env	3	D	17
		Bridge and boat ramp construction in accordance with appropriate standards				
3.3. Water Supply	Reliance on water resources from the mainland	Implement of sustainable water supply (refer to Section 2)		3	D	17
	Golf Course irrigation requirements do not effect community requirements	Management of “Wild Course” in accordance with AGSA management eco-efficiency principles and WSUD				
		Locate development outside of flood affected areas.				

Potential Incidents	Causes	Expected Controls	Cons Cat	Most Likely Risk		
				C	L	R
3.4. Energy	Lack of capacity of electrical grid connection to provide subsequent power	Renewable energy options allow some degree of energy self sufficiency for Hummock Hill Island	Env	3	D	17
	Ability to augment electricity with solar, reticulated LPG and wind power	Other power sources will minimise loss of power				
3.5. Communications	Ability for internal/external communication to the mainland and across the Island	Telecommunications lines may need to be constructed from the mainland to Hummock Hill Island	T&U	3	D	17
Airstrip Hazards and Risk						
4.1. Transport and Traffic	Bird strikes on aircraft taking off and landing	Bird and Animal Hazard Management Plan	H&S	1	E	11
		Qualified Personnel				
4.2. Terrestrial Floral and Fauna	Bird strikes on aircraft taking off and landing	Bird and animal hazard management plan	Env	3	C	13
		Qualified Personnel				
4.3. Terrestrial Floral and Fauna	Aircraft crashing into terrestrial (non developed area)	Adherence to CASA standards	Env	2	E	16
		Maintenance of Aircraft				
		Qualified Personnel				
4.4. Marine and Coastal Fauna	Aircraft crashing into coastal environment	Qualified Personnel	Env	2	E	16
		Maintenance of Aircraft				
		Adherence to CASA standards				
4.5. Demographics	Aircraft crashing into residential area	Maintenance of Aircraft	H&S	1	E	11
		Adherence to CASA standards				
		Qualified Personnel				
4.6. Infrastructure	Aircraft crashing into industrial area	Qualified Personnel	T&U	1	E	11
		Adherence to CASA standards	H&S	1	E	11
		Maintenance of Aircraft				



Information contained in the above risk register shows that residual risk profile for the proposed development, with proposed mitigation/management strategies in place, is generally “Low” or “Moderate”. The following were listed as returning a high risk from the risk assessment process:

- Climate and Natural Hazards – Storms, cyclones and flooding. Proposed management by building on land outside designated erosion prone areas and designing buildings in accordance with relevant building codes above the 100 year event storm tide will reduce large scale damage. Residual risk will concordant with existing developed areas;
- Climate and Natural Hazards – Seismic activity : construction of public infrastructure in accordance with seismic guidelines for the region will minimise impacts;
- Groundwater Systems – Water sensitive urban design will retain natural areas that will allow groundwater recharge to occur post development and mitigate this impact;
- Groundwater systems – Groundwater contamination: Implementation of the Construction EMP will include chemical storage controls and spill response plans to reduce the risk potential risk;
- Social Systems – Increased demand for local housing for the construction workforce: Maximum use of local skilled workforce will minimise increased demand on local housing;
- Social Systems – Increased demand on community services due to increased population: The proponent has, and will continue to liaise with health and educational authorities to provide additional facilities as part of the proposed development when population numbers merit;
- Airstrip hazards and risk scenarios: these are considered representative of the interface between aircraft and the natural system that would be present at any aviation facility and may be managed as recommended in Section 18.2.4.

These risks remain high as the consequence from an event, if it were to happen, are beyond the direct control of the project, or natural events where there is no control of its likelihood. Hence the management of risk in the incident scenarios, where there is some control, focuses on ensuring the consequence of the event is reduced utilising the expected controls and meets the concept of As Low As Reasonably Practical (ALARP).

18.2.6 Recommendations

The following recommendations are considered important in treating the risks identified in this report:

- As a minimum, the Civil Aviation Safety Authority “Guidelines for Aeroplane Landing Areas” No:92-1(1) should be referenced in the airfield development;
- All plans identified in this report needs to monitored and reviewed systematically, particularly where the consequence as opposed to likelihood is the main area of control (e.g. natural events);
- The recent decision of Rio Tinto Aluminium for the \$2.1b expansion to its Yarwun Refinery in Gladstone highlights the relevance of the high ranking to skills shortages and the availability of qualified labour for the Hummock Hill Island Development. Workforce planning and accommodation will require significant planning and appropriate high labour costs considered; and
- Existing controls, processes and relationships within the Queensland's disaster management system should be utilised in the emergency planning for the development.



SECTION 19

TERMS OF REFERENCE



Terms of Reference Section		Relevant EIS Section
Executive Summary 1. The section should convey the most important aspects and options relating to the proposed Hummock Hill Island Development to the reader in a concise and readable form. 2. The structure of the executive summary must follow that of the EIS, and focus strongly on the key issues and conclusions.		1. 2.
Glossary of Terms 1. A glossary of technical terms, acronyms and abbreviations must be provided.		1.
1. INTRODUCTION This section should: 1. Provide reference to the location of the Project, explains why the EIS has been prepared and what it sets out to achieve. In particular, the introduction will address the level of detail of information required to meet the level of approval being sought (for example, the proponent is seeking only a preliminary approval through the Integrated Development Assessment System (IDAS)). 2. Meet the requirements of the SDPWO Act, Part 4 Environmental Coordination for the Environmental Impact Assessment. 3. Define the audience to whom it is directed and contain an overview of the structure if the document. 4. Factual information contained in the document is to be referenced.		1. Section 1, 1.6.1, 2.1, 2.2.1, 2.2.2 2. Section 1.4.1 3. Section 1 4. Section 23
1.1 Project Proponent 1. Provide details of the Project proponents, including details of any joint venture partners.		1. Section 1.1
1.2 Project Description This section should: 1. Provide a brief description of the key elements of the Project and any major associated infrastructure requirements (include illustrations). 2. Provide a brief description of studies or surveys that have been undertaken for the purposes of developing the Project and preparing the EIS. Must include reference to relevant baseline studies or investigations undertaken previously.		1. Section 1.2, 3 2. Section 1.2, 3.2.1, 3.2.2, 3.5.3
1.3 Project Objectives and Scope This section should: 1. Provide a statement of the objectives which have led to the development of the Project and a brief outline of the		1. Section 1.3, 4.8 2. Section 1.3 3. Section 1, 1.3

Terms of Reference Section	Relevant EIS Section
events leading up to the Project's formulation, including alternatives, envisaged time scale for implementation and Project life, anticipated establishment costs and actions already undertaken within the Project area. - Describe the current status of the Project and outline the relationship of the Project to other developments or actions that may relate whether or not they have been approved. - The consequences of not proceeding with the Project must also be discussed, incorporating an economic and social assessment.	Section 4.8
1.4 The EIS Process The purpose of this section is to make clear the methodology and objectives of the environmental impact statement under the relevant legislation.	Section 1.4
1.4.1 Methodology of the EIS This section should: - Provide a description of the EIS process steps, timing and decisions to be made for relevant stages of the Project. - Indicate how the consultation process would integrate with the other components of the impact assessment, including the stages, timing and mechanisms for public input and participation.	- Section 1.4.1 - Section 1.4.1, 1.4.3
1.4.2 Objectives of the EIS This section should: - Outline the structure of the EIS as an explanation of how the EIS will meet its objectives. - Ensure the reader can distinguish the EIS as the key environmental document providing advice to decision makers considering approvals for the Project. - Ensure the main text is written in plain English avoiding jargon as much as possible. The main text must not assume that a reader would have a prior knowledge of the Project site. It must not be necessary for the reader to have visited the site to understand the issues involved in the Project. - In brief, the EIS objectives must be a discussion of options and alternatives and their likely relative environmental management outcomes is a key aspect of the EIS. - Describe the role of the EIS in providing the Project's EM Plan, with particular reference to the EM Plan's role in providing management commitments and measures that can be carried over into conditions that would attach to any approval(s), environmental authorities and permits for the Project.	- Section 1.4.1, 1.4.2, 1.4.3 - Section 1.4.2 - Section 1.4.2 - Section 1.4.3, 4.4.1, 4.8 - Section 1.4.1, 20
1.4.3 Submissions The reader must be informed as to how and when public submissions on the EIS will be addressed and taken into	Section 1.4.1, 1.4.4

Terms of Reference Section		Relevant EIS Section
account in the decision making process and the standing of any such submission made in regard to any application submitted by the proponent for statutory approval.		
1.5 Public Consultation Process		
1. Details of the public consultation process and the major issues emerging from that process must be clearly addressed in the EIS.		1. Section 1.5
1.6 Project Approvals		
1.6.1 Relevant Legislation and Policy Requirements		
This section should:		
- Describe and list Commonwealth and State legislation and local policies relevant to the planning, approval, construction and operation of the Proposal. - Discuss triggers for the application of each of these and relevant approval requirements identified. - Provide a brief explanation of the scope and legislative basis for the EIS, including the role of the EIS in the Government's decision making process and an explanation of the relationship between Part 4 of the SDPWO Act and the IDAS of the IPA with regard to the Project. - Provide a brief discussion of the Australian Government's accreditation of the SDPWO Act process, under section 87(4) of the EPBC Act. - Describe Local Government planning controls, local laws and policies applying to the development, and a list provided of the approvals required for the Project and the expected program for approval of applications.		- Section 1.6.1, 2.1, 2.2, 2.3 - Section 1.6.1, 2.1, 2.2, 2.3.2 - Section 1.6.1, 2.1 - Section 1.6.1 - Section 1.6.1, 2.3
1.6.2 Planning Processes and Standards		
This section should:		
- Discuss the Project's consistency with existing land uses or long-term policy framework for the area (e.g. as reflected in local and regional plans), and with legislation, standards, codes or guidelines available to monitor and control operations on site. - Refer to all relevant State and regional planning policies with specific attention provided to demonstrating the Project's consistency with the draft Miriam Vale Shire Planning Scheme, the transitional planning scheme and Strategic Plan, the Wide Bay Burnett Regional Plan 2006- 2026, relevant State Planning Policies and the State Coastal Plan and any Regional Coastal Management Plan. - Specifically, provide planning grounds to justify the Project against the statements of intent for each preferred dominant land use designation of the draft Miriam Vale Shire Council Transitional Planning Scheme – Strategic Plan,		- Section 2.1, 2.2.3, 2.3.1, 2.3.2 - Section 2.1, 2.2.2, 2.2.3, 2.3.2 - Section 2.1, 2.2.3, 2.3.2 - Section 2.2.2, 2.2.3, 2.3.1, 2.3.2 - Section 1.4.2, 2 - Section 2.2.3 - Section 3.2.2, 4.8 5.1.1

Terms of Reference Section	Relevant EIS Section
which applies to the subject site. 4. Discuss any planning controls, by-laws and policies relating to the study area and adjacent lands; 5. Discuss details of all licences, planning and environmental approvals required; 6. Discuss regional strategies or plans that relate to the study area or Project (existing or in preparation); and 7. Discuss relationship to other significant developments (existing or proposed) in the study area or surrounding areas.	
1.7 Accredited Process for Controlled Actions under Commonwealth Legislation 1. The EIS must include a stand-alone report as an appendix that exclusively and fully addresses the issues relevant to the controlling provisions. 2. Describe the current status of the matters protected under the EPBC Act be described in sufficient detail, to inform the analysis of the proposal's impact on these matters. 3. The EIS must thoroughly address the potential impacts of the Project on listed threatened species and communities, listed migratory species and World Heritage values. With regard to threatened species and communities listed under the EPBC Act, the EIS will need to address: ■ The presence of any listed species or community and its associated habitat; ■ The potential direct and indirect impacts of the Project; and ■ Mitigation measures proposed. 4. With regard to listed migratory species, the EIS will need to address: ■ The current species distribution; ■ Relevant information about the ecology of the species (habitat, feeding and breeding behaviour etc); ■ Information about any populations of the species or habitat for the species in the area affected by the proposed Project; ■ Current pressures on the species, especially those in the area to be affected by the Project; ■ Relevant controls or planning regimes already in place; and ■ Any mitigation measures proposed to minimise the potential impacts. 5. With regard to World Heritage, the EIS needs to provide: ■ A description of the values of the Great Barrier Reef World Heritage Area in the Hummock Hill Island region, and the particular values of Hummock Hill Island and the surrounding estuarine and marine environments; ■ An outline of the potential impacts of the Project on these values, including the potential changes to surface water flows and groundwater hydrology and the consequential impacts on the terrestrial and aquatic elements of the Great Barrier Reef World Heritage Area (including Hummock Hill Island) and marine animals including dugongs and turtles;	1. Appendix A3 2. Section 1.6.1, Appendix A3 3. Section 11.1.2, 11.1.3, 11.3.1, 11.3.2, Appendix A3 4. Section 11.1.1, 11.1.2, 11.4.1, 11.4.2, Appendix A3 5. Section 3.2.1, 3.4.1, 10.5, 11.3.2, 15.1, Appendix A3 6. Appendix A3

Terms of Reference Section	Relevant EIS Section
- Address the discharge of chemicals, nutrients and sediment from the development site, and the potential impact of such discharges on the aquatic elements of the Great Barrier Reef World Heritage Area. - Any outline of any mitigation measures proposed to minimise the potential impacts. 6. The EIS must also address all matters mentioned in Division 5.2 and Schedule 4 of the Environment Protection and Biodiversity Conversation Act Regulations 2000.	
2 DESCRIPTION OF THE PROJECT - The elements of the Project must be described in the text and illustrated with maps, diagrams, architectural plans (at a suitable scale) and artist's impressions, as required. Issues to be addressed must include - Layout, size and number of residential lots; - Layout of both golf courses and associated club houses; - Location of and extent of all waterways (including lakes, watercourses, lagoons, estuaries and drainage paths detailing water runoff and management); - Location of public infrastructure such as swimming facilities; - Extent of vegetation areas and buffer zones in and surrounding the development and wildlife corridors; - Location and concepts for the retail and commercial precinct; - Location, size and likely footprint and layout of the proposed resorts; - Location and details of infrastructure and service provision for the development; - Location of education facilities; - The location and extent of vehicular access and traffic and car parking impacts associated with the development; - Location, depth, volume and ground-level-AHD of all significant excavations; - The location, layout and description of the airstrip; - All major and minor infrastructure, including marine and coastal structures and activities; - Appropriate scaled plan/s (or overlay) showing the location of: - The levels of the Highest Astronomical Tide, Mean High Water Spring Tide, and Low Water Spring Tide; - Any marine plants; - The declared Colosseum Inlet Fish Habitat Area FHA-037 Boundaries; - The location of proposed structures in relation to the Great Barrier Reef Marine Park boundary, Mean Low Water and Lowest Astronomical Tide; and - Buffers between development activities and aquatic features, marine plants and declared Fish Habitat Areas within and adjacent to the development site in relation to current and proposed property boundaries.	- Section 3.1, 3.3 - Section 3.3.2, 3.3.3, 3.3.4 - Section 3.3.2, 3.3.3, 3.3.4 - Section 3.2.1, 3.2.3, 3.3.1, 3.3.5, 3.4.1, 3.4.2 - Section 3.2.2, 3.3.2 - Section 3.2.1, 3.3.1, 3.3.4, 3.3.5, 3.5.3 - Section 3.3.2, 3.3.3, 3.3.4, 3.5.4 - Section 3.3.2, 3.3.3, 3.3.4, 3.3.6 - Section 3.1, 3.2.1, 3.3.2, 3.3.3, 3.3.4, 3.3.5, 3.4, 3.6.3 - Section 3.3.2 3.3.4 - Section 3.4.4 - Section 3.3 - Section 3.2.3, 3.6.4 - Section 3.2, 3.3, 3.4, 3.5, 3.6 - Section 15 - Section 3

Terms of Reference Section	Relevant EIS Section
16. Concept and layout plans must provide details and illustrations of proposed buildings and structures in relation to existing natural features to be retained and excavations.	
2.1 Overview of the Project 1. An overview of the Project to put the Project into context. 2. Provide a description of the key components of the Project. 3. Provide the expected Project cost and overall expected Project duration and timing. 4. Include details of the concept master plan for the development, the staging of the development, and the planning and infrastructure required to facilitate development and design details of all elements of the Project, taking into account the ultimate population and traffic thresholds associated with the Project. 5. Summarise the expected employment opportunities from the Project. Provide a summary of any environmental design features of the Project. 6. A description of the overall concept and development plans must be provided, including details of the following matters, with appropriate illustrations: 7. The overall concept plan; 8. The proposed master plan layout described in words and plans, illustrating all the components; 9. Expected resident and visitor population including day visitors and overnight stays; 10. Accessibility and transportation systems and networks, including roads, footpaths, cycle paths, buggy paths and equestrian paths; 11. Provisions for visually and mobility impaired people; 12. Landscaping and reinstatement of disturbed areas; 13. Details of fuels and other chemicals stored and/or used including quantity, chemical characteristics and classifications and storage requirements; 14. Methods for protecting environmental values and characteristics within the overall development site and surrounding areas, measures to permanently protect the natural values of undeveloped parts of the lease; 15. Provision of infrastructure and essential services, including anticipated demand for infrastructure and essential services (including water, power, roads, telecommunications, waste) 16. Provision of community infrastructure and services in the public and private sectors, including commercial facilities, recreational, education and health services; 17. Development schedule; and 18. Estimates of operations staff (permanent, temporary and dependants), contractors, movements, travel arrangements, composition, expected sources and local availability of employees.	1. Section 1, 3.1, Executive Summary 2. Section 3.3.2 3. Section 3.5.1, 3.5.2, 3.5.3, 3.5.4, 4.3 4. Section 3.3.1, 3.5.2, 3.5.3, 4.1, 4.2 5. Section 3 6. Section 3.1 7. Section 3.3, 16.1 8. Section 3.3 9. Section 4.2 10. Section 3.4.3 11. Not applicable at this stage, addressed in Relevant Building Codes 12. Section 3.4.2, 3.5.3, 3.5.4 13. Section 17.3.1 14. Section 3 15. Section 3.2.3, 3.4 16. Section 3.2.2, 3.3.2, 3.3.4 17. Section 3.5.2 18. Section 3.5, 4.3

Terms of Reference Section	Relevant EIS Section
2.1.1 Residential Development A description of the concept and development plans for the residential development component must be provided, including details on the following matters, with appropriate illustrations: 1. The proposed layout of the residential development components, described in words and plans; 2. Specific characteristics and attributes of the residential and associated open space precincts 3. Proposed facilities, buildings and other constructed features, including identification of those available for public access; 4. Building parameters and restrictions, architectural and urban design features, natural hazard design parameters; 5. Capacity and/or proposed densities; 6. Access and parking; 7. Crime prevention through urban design measures; and 8. Proposed land tenure of each precinct including information on the tenure, purpose, management arrangements and responsibilities.	1. Section 3.3.2, 3.3.3 2. Section 3.3.3 3. Section 3.2.1, 3.3.2, 3.3.3 4. Section 3.3.2, 3.5.3 5. Section 3.3.2, 3.3.3, 3.3.4, 3.3.6 6. Section 3.3.2, 3.3.3, 3.3.4, 3.4.3, 3.4.4, 3.4.5 7. Section 16.2 8. Section 3.3.5
2.1.2 Hotel Provide a description of the concept characteristics and attributes of the hotel including: 1. Proposed hotel facilities including identification of those available for public access; 2. Building parameters and restrictions, such as height, architectural and urban design features, natural hazard design parameters; 3. Capacity (for example, type and number of rooms); 4. Access and parking; and 5. Proposed land tenure.	1. Section 3.3.1, 3.3.3 2. Section 3.3.2 3. Section 3.3.4, 3.3.6 4. Section 3.3.2 5. Section 3.3.5
2.1.3 Golf Course Provide a description of the concept characteristics and attributes of the golf course, including: 1. Construction and ongoing maintenance requirements; 2. Architectural, building and urban design principles, and role of the proposed club house, natural hazard design principles; 3. Golf course operation, including irrigation, pest management and fertilisation; 4. Location of fairways in relation to natural water bodies, creeks, streams or drainage paths; 5. Details and location of natural buffers to manage the impacts of golf course operation on ground and surface water quality.	1. Section 3.3.2 3.6.5 2. Section 3.6.5, not applicable at this stage of approval 3. Section 3.3.2, 3.6.1 3.6.5 4. Section 3.3.4, 3.4.2 3.6.5 5. Section 3

Terms of Reference Section		Relevant EIS Section
2.1.4 Town and Village Centres Provide a description of the concept characteristics and attributes of the commercial components, including: 1. Intended role of and relationship between the town and village centres; 2. Proposed facilities including identification of those available for public access; 3. Building parameters and restrictions, architectural and urban design features, natural hazard design parameters; 4. Crime prevention through urban design measures; 5. Access and parking; and 6. Proposed land tenure and/or management of each centre.		1. Section 3.3.2 2. Section 3.3.2 3. Section 3.3.2 4. Section 16.2.2, 16.2.6 5. Section 3.3.2, 3.3.4 6. Section 3.3.5
2.1.5 Education Campus The purpose, concept design and operation of the Education Campus must be discussed, including: 1. Location of the campus; 2. Size, scale and layout of the campus; 3. Likely range of activities to be carried out; 4. Organisations involved in activities, links with similar facilities elsewhere in Australia and internationally; 5. Description of the education campus, including: ■ Proposed facilities including identification of those available for public access; ■ Building parameters and restrictions, architectural and urban design features, natural hazard design parameters; ■ Access and parking; ■ Proposed land tenure; ■ Access for mobility and visually impaired people; and ■ Landscaping and reinstatement of disturbed areas; 6. Methods for protecting environmental values and characteristics within the campus and surrounding areas including visual amenity and rehabilitation; and 7. Estimates of operations staff (permanent, temporary and dependants), contractors, movements, travel arrangements, composition, expected sources and local availability of employees.		1. Section 3, 2. Section 3 3. Section 3.2.2, 3.3.2 4. Not applicable at this stage 5. Section 3.3.2, 3.3.4, Not applicable at this stage, Appendix A7 6. Section 3.3.2, 3.3.4, 5 7. Section 3, 17
2.1.6 Airstrip <i>2.1.6.1 Design and construction of the airstrip</i> The design and construction of the airstrip and associated infrastructure must be discussed, including: 1. The adoption or implementation of a plan for aviation airspace management		1. Section 18.3.5 2. Section 2 3. Not applicable 4. Section 3.6.4

Terms of Reference Section	Relevant EIS Section
2. The Project's interaction with local and regional planning aims 3. An analysis of other runway options to the extent necessary to clearly demonstrate why the preferred option has been selected over other options taking into account environmental impacts, aircraft noise impacts, impact on airspace management arrangements for other airstrips in the region, cost and any other relevant factors. 2.1.6.2 Operation of the airstrip The operation of the airstrip must be discussed, including: 4. The preferred operating modes for the runway (for both day and night, noting any seasonal variations); 5. Flight frequency on the runway, including expected number and percentage of aircraft movements by type, typical annual and daily movements; 6. Daily and seasonal variations in aircraft movements and potential effects of varying weather conditions on operations and runway utilisation; 7. Operating hours and flexibility of operating arrangements; 8. The responsible party for the development and costing of operating procedures (eg. noise abatement and instrument approach); 9. Possible legislative/regulatory enforcement of operating procedures (e.g. for noise abatement purposes); 10. A description of the potential effects and likely timing of implementation of new technology and changes to operational standards and procedures for runway and airspace utilisation; 11. Flight paths and other operational procedures governing aircraft movements, including an estimate of normal variability of movements on defined flight paths, and locational criteria governing flight path selection; 12. Aircraft operating heights for approaches and departures, discuss variability of aircraft heights for given locations; 13. Ground activities associated with runway operation; and 14. Underlying assumptions and forecast reliability. 2.2 Ecologically Sustainable Development 1. Provide a comparative analysis of how the Proposal conforms to the objectives for "ecological sustainable development" and other relevant policy instruments such as the "standard criteria" as defined by the EP Act should be presented. 2. This analysis should consider the cumulative impacts (both beneficial and adverse) of the Proposal, taking into consideration the scale, intensity, duration or frequency of the impacts to demonstrate a balance between environmental integrity, social development and economic development. 3. A life-of-project perspective should be shown. 4. This information is required to demonstrate that sustainable development aspects have been considered and	5. Section 18.3.5 6. Not applicable for the intended airstrip size 7. Not applicable for the intended airstrip size 8. Not applicable for the intended airstrip size 9. Not applicable for the intended airstrip size 10. Not applicable for the intended airstrip size 11. Not applicable for the intended airstrip size 12. Not applicable for the intended airstrip size 13. Not applicable for the intended airstrip size 14. Not applicable for the intended airstrip size
	1. Section 3.7 2. Section 3.7 3. Section 3.7 4. Section 3.7

Terms of Reference Section	Relevant EIS Section
incorporated during the scoping and planning of the Proposal.	
2.3 Project Need and Alternatives 1. This section must discuss all components of the Proposal in the context of regional and local development and market potential, and the existence of similar developments at these levels. 2. The discussion needs to include identification and assessment of alternatives as well as demonstration of need from a social and economic perspective and demand from a market perspective.	1. Section 2.2.3, 2.3.1, 4.2, 4.3, 4.8 2. Section 4.8, 17
2.3.1 Project Justification 1. The justification for the Project must be described, with particular reference made to the economic and social benefits. The status of the project should be discussed in a regional, State and national context. The demonstration of need and demand must be a comprehensive assessment with consideration of relevant local, regional, state and national plans including the current and draft Miriam Vale Shire Planning Schemes and Strategic Plan, the Wide Bay Burnett Regional Plan 2006-2026, the State Coastal Management Plan and the draft Wide Bay-Burnett Regional Coastal Management Plan. The detailed assessment should include: 2. An assessment of the demographic profile for the region and locally, provides the basis for arguing need based on community characteristics; 3. Estimated population and growth trends including age profiles; 4. Building investment (lot creation, take up rates and dwelling unit approvals); 5. Labour force, employment (by occupation and income); 6. Any other economic indicators to indicate support for the development; 7. Justification for the scale of residential and tourist development proposed within the local and regional context; 8. Justification for the amount of retail and commercial floor space proposed within the local and regional context; 9. Suitability for the location proposed; 10. Impact of the proposed commercial precinct on existing retail centres in the shire; 11. Educational needs; 12. Demonstration of the need/demand for an airstrip; 13. Relevance of the proposed educational facility to the locality and region and demonstration that the facility is complementary to other educational opportunities in Queensland; 14. Short, medium and long term demands for community services, employment access, and recreation that are not provided by the proposed development should be clearly identified along with their implications for future development within the lease, on Hummock Hill, and on the adjacent mainland;	1. Section 4.3, 4.4, 16 2. Section 4.1, 16 3. Section 4.4, 4.5, 16 4. Section 4.3, 16 5. Section 4.3, 16 6. Section 4.3, 16 7. Section 4.6, 4.7, 16 8. Section 4.6, 4.7, 16 9. Section 4, 16 10. Section 4.5, 16 11. Section 4.3.3, 16 12. Section 4, 16 13. Section 4.3.3, 16 14. Section 4.5, 16 15. Section 4.6, 16 16. Section 4.7, 16

Terms of Reference Section		Relevant EIS Section
15. The site in regional context – proximity to major centres, transport facilities – airstrips, train stations, road access – include a review of similar residential developments and associated facilities in the surrounding area and if possible make comment on their success; and 16. The site in the local context – role (size, facilities and services – including shopping, banking and community services, recreation facilities etc).		
2.3.2 Alternatives to the Project 1. The EIS must outline the basis for selection of the Hummock Hill Island location. It must describe any feasible alternatives to the Project, as well as the alternative of not proceeding with the Project. Alternatives considered may include: ■ The 'no project' option; ■ Alternative locations; ■ Alternative master planning and site arrangements; ■ Larger or smaller scale development; and ■ Alternatives for infrastructure and essential service provision, including the range of options considered for access, water, electricity, and waste management. 2. The reasons for choice of the preferred option must be explained, including a comparison of the adverse and beneficial effects (both to the environment and community) used as a basis for selection, and compliance with government policy and with the principles and objectives of ESD. 3. This section must describe feasible alternatives, including conceptual, technological and locality alternatives to the Project, and discussion of the consequences of not proceeding with the Project. Alternatives must be discussed in sufficient detail to enable an understanding of the reasons for preferring certain options and courses of action and rejecting others. Comparative environmental impacts of each alternative must be summarised. 4. The interdependencies of the Project components must be explained, particularly in regard to how each of any developments, or various combinations of components, and any infrastructure requirements relate to the viability of the components and the Project as a whole. This section must include a description of and rationale for infrastructure associated including water supply, power, transport and storage infrastructure. 5. Reasons for selecting the preferred options must include technical, commercial, social and natural environment aspects.	1. Section 4.8 2. Section 4.8 3. Section 4.8 4. Section 4.8 5. Section 4.8	
2.4 Location		
2.4.1 The Site 1. A brief overview of the Project site must be presented, showing existing natural and human made features		1. Section 3.3

Terms of Reference Section		Relevant EIS Section
(including existing infrastructure and improvements) and relevant named locations. Maps and rectified aerial photographs must be included as necessary to illustrate the site. 2. Site context must also be discussed in terms of distances from nearby towns and urban centres and other key locations of the region.		2. Section 1
2.4.2 Regional context		1. Section 4.1
1. The regional context of the Project is to be described and illustrated on maps at suitable scales.		
2.4.3 Local context		
The local description of the Project site must include real property descriptions. Maps at suitable scales must show the precise location of the Project area, and in particular: 1. The location and boundaries of land tenures, in place or proposed, to which the Project area is or will be subject; 2. The location and boundaries of the Project footprint; 3. The road network servicing the area including road names; 4. The location of any proposed buffer areas or buffer zones surrounding the Project's working areas; 5. The location of the coastal management district and the erosion prone area; 6. The local government boundary; and 7. The location of environmentally sensitive receptors potentially affected by the development such as residences, National Park, Marine Park (including zoning information) and World Heritage areas, remnant vegetation on and off the site, natural water, erosion prone areas, wetlands, significant dune systems, extent of marine vegetation and essential habitat for rare and threatened species. 8. These features must be overlain on rectified air photograph enlargements (in separate outline and infill maps) to illustrate components of the Project in relation to the natural and built features of the area.		1. Section 3.3.1 2. Section 3 3. Section 3.4.4, 6 4. Section 3 5. Section 3 6. Section 3 7. Section 3 8. Section 3
2.4.4 Land tenure		
1. Describe the Native Title status of the site. 2. Maps at suitable scales must be provided showing the precise location of the Project area, and in particular: - The location and boundaries of land tenures, in place or proposed, to which the Project area is or will be subject, including adjoining land tenure and/or legislative boundaries such as the Great Barrier Reef World Heritage Area boundary, State Marine Park boundary, Great Barrier Reef Marine Park boundary and fish habitat areas; 3. The location and boundaries of the Project footprint within and outside the lease, including development necessarily occurring as a consequence of approval of the proposed development, showing all key aspects including excavations, stockpiles, areas of fill, crossings and built structures within waterways including all services infrastructure, plant locations, water storages, buildings, bridges, culverts, hardstands, car parks, etc;		1. Section 1.6.1, 2.1, 13 2. Section 3.3, 13.1 3. Section 3.3, 13.1 4. Section 3.3 5. Section 3.3 6. Not required for this stage 7. Section 3.3 8. Section 3

Terms of Reference Section		Relevant EIS Section
4. The location of any proposed buffers surrounding the working areas; and 5. Lands identified for mitigation, either through retention in their current natural state or to be rehabilitated. 6. Sufficient survey data should be provided to accurately (0.5 metre) define the location of the lease boundaries and the area subject to development or set aside for conservation purposes, and to allow correction of the cadastre (DCDB) if required. 7. Consideration must be given to providing a rectified aerial photo enlargement to illustrate components of the Project in relation to the land tenures and natural and built features of the area. Digital orthophotos with 0.5 metre pixels are preferred as the basis for mapping. Details of the final tenure of the land following development including details of future reconfigurations, Community Title, Body Corporate Management and Conservation Covenants/Agreements, Reserves or Nature Refuges over the land and including a supporting plan, for the entire site. Such details must include: 8. The nature and structure of any future reconfigurations or the tiered body corporate arrangements to be established for the various components of the development, including the private road system; 9. Further information concerning proposed legal arrangements for the governance of the site and the ability of a body corporate or other managing entity to: ▪ manage the development, and manage the operational infrastructure and delivery of services at all stages through to completion of the project, including provision for ownership changes; ▪ prohibit domestic animals and dumping of garden waste; ▪ set standards and control the design and finish of structures and roads; ▪ manage traffic; ▪ manage the production of interpretative material and signage; ▪ control and condition access to manage visitor impacts; and ▪ prevent future vegetation destruction, pollution and pest incursion into waterways; 10. The general terms to form part of the Body Corporate structure for the protection and maintenance of the private open space areas, and in particular, the areas to be retained under native vegetation; and 11. A statement clearly defining the responsibility (if any) of Council or any other State Agency in on-going maintenance of infrastructure established within or outside the lease area	9. Section 3 10. Section 3 11. Section 3	
2.5 Construction The nature of the Project's construction at each stage must be described to the greatest extent possible. The description is to describe the construction of each component of the Project and associated facilities, including: 1. Expected size, source and control of the construction workforce accommodation, services (water, sewage,		1. Section 3.5, 4.3 2. Not applicable at this stage 3. Section 6

Terms of Reference Section	Relevant EIS Section
communications, power, recreation) and safety requirements; 2. The types of construction equipment expected to be used and the numbers of plant to be transported onto the construction site ; 3. Transport infrastructure requirements for construction and transportation/material logistics; 4. Location and construction material and equipment storage and servicing facilities; 5. Materials fabrication works (e.g. concrete batching plants), details of air, water and waste emissions; 6. Construction standards, techniques, and Project management, including construction staging, and the location of sensitive residential and commercial premises during each stage of construction; 7. The sources, quantities, transport and storage of construction materials on and off-site; 8. The nature, scale and timings for earthworks, including any borrow pit or quarry requirements (and the potential to disturb acid sulfate soils); 9. The nature, scale and timings for vegetation clearance, with cross-references to the vegetation types; 10. Any near shore operations, including need for dredging, and construction of any marine support facilities; 11. All temporary works (eg. tidal works) associated with the development; 12. An outline of overall environmental site management arrangements (dust and other air emissions, noise, runoff, erosion, earth stabilisation, aquifer dewatering, acid sulfate soils, spills, fire, disposal of wastes both on and off the island, effluent, heritage and cultural sites, emergencies, rehabilitation of construction areas); 13. Estimates of the quantity of freshwater required for construction purposes and the sources from which this water will be obtained; 14. If blasting is to be used, provide justification for this activity and a detailed management plan; 15. Estimates of construction workers (permanent and temporary and dependants), contractors, movements, travel arrangements and composition, expected sources and local availability of employees; and 16. Need and potential patronage on current trends. 17. Describe separately the proposed construction methods to be used for structures within tidal waters and the potential impact on coastal processes, including tides, and currents. Where there are alternative construction methods available provide a comparison against the different methods and justify the reasons for the preferred method. 18. Any staging of the Project must be described and illustrated showing site boundaries, development sequencing and timeframes. The estimated numbers of people to be employed in the Project construction phase must also be provided with a brief description of the skills required. 19. A detailed discussion of alternative construction methodologies and recommended methodologies, justified in terms	4. Not applicable at this stage 5. Section 8, 10, 11 6. Section 2, 3 7. Not applicable at this stage 8. Not applicable at this stage 9. Section 3, 14 10. Section 9 11. Section 9 12. Whole document 13. Not applicable at this stage 14. No blasting, Section 5 15. Section 16, 17 16. Not applicable at this stage 17. Section 9 18. Not applicable at this stage 19. Not applicable at this stage



Terms of Reference Section		Relevant EIS Section
of minimising adverse impacts on water quality, marine and terrestrial biodiversity and the community must also be described.		
2.6 Infrastructure Requirements 1. This section must provide descriptions, with concept and layout plans, of requirements for constructing, upgrading or relocating all infrastructure in the vicinity of the Project area. The matters to be considered include such infrastructure as roads, bridges, jetties, marine transport facilities, ferries, tracks and pathways, dams and weirs, bore fields, power lines and other cables, wireless technology, conveyors and pipelines for any services. 2. Provide an assessment of the impact on Council's road network. This assessment must examine all roads extending from the site boundary, along the full length of Clarks Drive and Foreshores Road to Turkey Beach Road and to the intersection of the Bruce Highway. The assessment must also examine the intersection of Foreshores and Turkey Beach Road east to Turkey Beach. Particular emphasis is to be placed on the impact of the additional traffic on pavement life, and existing intersection design capacity, flood immunity, pavement width and vertical and horizontal alignments. 3. Describe arrangements for the transport of equipment, products, wastes personnel and patrons during both the construction phase and operational phases of the Project. The description must address the use of existing facilities and all requirements for the construction, upgrading or relocation of any road transport related infrastructure. 4. Describe arrangements for the transport of plant, equipment, products, wastes and personnel during both the construction phase and operational phases of the Project. The description must address the use of existing facilities and all requirements for the construction, upgrading or relocation of any transport related infrastructure, including: 5. Pedestrian or cycle paths within 30 kilometres of the site boundaries; 6. Public passenger transport services within 30 kilometres of the site boundaries, including school bus, public bus, taxi and ferry; and provide details of timetables, contract areas, patronage, and associated infrastructure; 7. Marine usage within 30 kilometres of the site boundaries, including both recreational and commercial boating; 8. Usage patterns of existing marine infrastructure within 30 kilometres of the site boundaries, including details of peak use periods (hours/days/seasons); 9. Rail infrastructure within 30 kilometres of the site boundaries, including usage patterns for freight traffic, passenger traffic, and railway level crossings; and 10. Aviation facilities and services within 50 kilometres of the site boundaries, including civilian airstrip, navigational aids and communication facilities; and their usage patterns.		1. Section 3 2. Section 6, Appendix A7 3. Section 6, 4. Not Applicable at this stage 5. Section 6 6. Section 6 7. Section 6 8. Section 6 9. Section 6 10. Section 6

Terms of Reference Section	Relevant EIS Section
2.6.1 Road Transport Information must be provided on road transportation requirements on public roads (both State and local, particularly the Turkey Beach Road intersection with the Bruce Highway) for both construction and operations phases, including: 1. The volume, composition (types and quantities), origin and destination of goods to be moved including raw materials, wastes, and hazardous materials; 2. The volume of traffic generated by workforce personnel, visitors and service vehicles; 3. Method of movement (including vehicle types and number of vehicles likely to be used); 4. Anticipated times at which movements may occur; 5. Details of vehicle traffic and transport of heavy and oversize indivisible loads (including types and composition); 6. The proposed transport routes (including waterway crossings); 7. Need for increased road (and waterway crossing) maintenance and upgrading; 8. Need for increased road maintenance, and 9. Communication of these issues to the public. 10. Describe site specific roadwork relating to road access to the development and the method of providing for pedestrian/cyclist access to and from the development (both directions). 11. Provide a description of the proposed access bridge to Hummock Hill Island including the size, type of bridge, materials expected to be used, and details on the long term responsible entity for maintenance of the bridge. 12. Department of Main Roads' "Guidelines for the Assessment of Road Impacts of Development Proposals" must be referred to when assessing road impacts. 13. The EIS will need to detail public transport requirements and links to, or development of pedestrian and cycle networks to reduce dependency on cars (more transport choices); reduce emissions and therefore improve air quality; and provide opportunities for recreation and contribute to social and community wellbeing.	1. Section 6 2. Section 6 3. Section 6 4. Section 6 5. Section 6 6. Section 6 7. Section 6 8. Section 6 9. Section 6 10. Section 6 11. Section 6 12. Section 6 13. Section 6
2.6.2 Shipping/Waterborne Transport Provide details of the infrastructure requirements for the transport of fill or other materials to the site by coastal barge and details of any marine transport infrastructure, whether temporary or permanent, that is required for construction and ongoing use of the development, or likely to be demanded as a result of the development. Details should include: 1. Type of infrastructure; 2. Location; 3. Anticipated usage and design capacity; 4. Ancillary facilities such as access, vehicle parking, boat storage; and 5. Any dredging requirements.	1. Section 6 2. Section 6 3. Section 6 4. Section 3, 6 5. Section 6

Terms of Reference Section	Relevant EIS Section
2.6.3 Energy 1. The EIS must describe all energy requirements, including electricity, natural gas, and/or solid and liquid fuel requirements for the construction and operation of the Project. The location, design and capacity of power generation and transmission infrastructure for construction and ongoing use should be detailed. The locations of any easements must be shown on the infrastructure plan. Energy conservation must be briefly described in the context of any Commonwealth, State and local government policies.	1. Section 3.4.3
2.6.4 Water supply and storage 1. The EIS must provide information on the proposed water usage by the Project, including details on the water supply design, the ultimate supply required by full occupancy of the development, the quality and quantity of all water supplied to the site during the construction and operational phases, fire fighting flows required, a site plan be provided outlining actions to be taken in the event of failure of the main water supply, and the potential for recycling of treated waste water. In particular, the proposed sources of water supply must be described given the implication of any approvals required under the <i>Water Act 2000</i> . Emphasis must be placed on demand and supply variability to demonstrate the proposed self-sufficiency of the Project. 2. Estimated rates of supply from each source must be given. Any proposed water conservation and management measures must be described. 3. Determination of potable water demand must be made for the Project, including the temporary demands during the construction period. Details must be provided of any existing town water supply to meet such requirements. Describe any proposed on site water storage and treatment for use by the site workforce during construction and operational phases. 4. Provide a description of how onsite water supplies are to be treated, contaminated water is to be disposed of and any decommissioning requirements and timing of temporary water supply/treatment infrastructure is to occur.	1. Section 3 2. Section 3.4 3. Section 3.4 4. Section 3.4
2.6.5 Stormwater drainage 1. A description must be provided of the proposed stormwater drainage system, and the proposed disposal arrangements, including any off site services. 2. The EIS must detail the sources of stormwater and the quantity, quality and location of discharge to watercourses. Details should be provided to demonstrate that the proposed stormwater treatment systems will maintain natural drainage flow paths and flow volumes.	1. Section 3.4.2 2. Section 3.4.2
2.6.6 Sewerage This section must describe the sewerage infrastructure required by the Project. Provide detailed information on:	1. Section 3.4.1 2. Section 3.4.1 3. Section 3.4.1, 3.4.2

Terms of Reference Section	Relevant EIS Section
1. The options proposed for wastewater treatment; 2. The peak design capacity evaluation of the wastewater treatment system and associated infrastructure using equivalent persons; 3. Determination of the potential emergency effluent storage that would be required in an extended rain event (50 and 100 year ARIs); 4. The proposed disposal and/or reuse of the treated effluent and the management of such use. Provide an irrigation plan detailing where the use of treated effluent is likely. Provide details of the likely impacts of treated effluent on groundwater quality; 5. The siting and maintenance regime for the system; and 6. Treated effluent quality, particularly nutrient content; and treated effluent flow rates and volume available at different development stages. 7. Provide details, including design parameters of the on site treatment of grey water including ownership, maintenance safeguards to be used, how discharge standards are to be met, details of proposed wet weather storage (locations and capacities proposed) and any emergency discharges into or sewerage crossings of waterways or major drainage paths. 8. Provide details on the level of spare capacity in the existing Council reticulated water infrastructure to support this proposal (taking into account other developments, whether approved and not yet commenced or applied for), if it is proposed that Council reticulated water assets are to supplement the Project.	4. Section 3.4.1, 3.6.4 5. Section 3.4.1 6. Section 3.4.1, 3.6.5 7. Section 3.4.1 8. Section 3.4
2.6.7 Telecommunications 1. The EIS must describe any impacts on existing telecommunications infrastructure and identify the owners of that infrastructure. 2. The EIS must describe any proposed telecommunications infrastructure and identify the ultimate owners of that infrastructure. Provide details of the location of existing and proposed telecommunications infrastructure including access points from the mainland.	1. Not applicable at this stage 2. Not applicable at this stage
2.6.8 Accommodation and other infrastructure A description must be provided of any other developments directly related to the Project not described in other sections, such as: 1. Site offices and construction camps; 2. Permanent or temporary fuel storage areas (e.g. diesel, petrol, oil, etc); 3. Other construction material storage areas; 4. Permanent or temporary chemical storage areas;	1. Not applicable at this stage 2. Section 3.4.3, 3.5.4, 3.6.4 3. Not applicable at this stage 4. Not applicable at this stage

Terms of Reference Section	Relevant EIS Section
5. Equipment hardstand and maintenance areas; and 6. Technical workshops or laboratories. 7. The method of operation and decommissioning of these areas, throughout all stages of construction must also be addressed.	5. Not applicable at this stage 6. Not applicable at this stage 7. Not applicable at this stage
2.7 Waste Management	
2.7.1 Character and quantities of waste materials 1. Provide an inventory of all wastes to be generated by the Project during the construction and operational phases of the Project. In addition to the expected total volumes of each waste produced, include an inventory of the following per unit volume of product produced: ▪ Amount of resulting wastes; and ▪ Volume and tonnage of any re-usable by-products. 2. Having regard for best practice waste management strategies and the Environmental Protection (Waste) Policy 1997, the proposals for waste avoidance, reuse, recycling, treatment and disposal must be described in the appropriate sub-section below. Information must also be provided on the variability, composition and generation rates of all waste produced at the site and how the waste hierarchy has been applied. 3. Detail how the principles of cleaner production and natural resource use efficiency will be applied for the development during construction and operation, especially as to how these concepts have been applied to preventing or minimising environmental impacts. The impacts need to be quantified, and mitigation measures need to be provided. This information is required to enable the resource management agencies and other stakeholders to assess the efficiency of resource use, and allocation issues. 4. Provide details on the methods and responsibility for collection, transport and disposal of solid waste during construction and ongoing use and details on the likely impacts to the capacity and life of any existing landfill used during construction and operation of the development. 5. Air emissions ▪ Discuss the expected air emissions (including particulates, fumes and odours) from the Project during construction and operation (including aircraft and associated airstrip infrastructure emissions). Particulate emissions include those that would be produced by any construction or industrial process at the site or	1. Section 3.5.8, 3.6.1, 11 2. Section 3.5.8, 11 3. Section 11.2 4. Section 3.6.1, 11.2 5. Section 10.2 6. Section 11 7. Section 3.4.1, 3.5.8, 11 8. Section 3.6.1, 11

Terms of Reference Section		Relevant EIS Section
disturbance by wind action on spoil stockpiles or by transportation equipment. Monitoring at sensitive receptors must be undertaken and dust suppression and mitigation measures proposed to address these results. 6. Solid waste disposal ▪ The proposed location and suitability of any existing or proposed landfill to receive solid waste from construction and operational phases of the Project must be identified. ▪ Methods to be employed to prevent leachate from sites where solid waste has been deposited need to be identified and documented. These must include physical, impermeable barriers that are established as part of any waste disposal site. 7. Liquid waste ▪ A description must be presented of the origin, quality and quantity of wastewater and any immiscible liquid waste that may originate from the Project. A water balance for the Project is required to account for the estimated usage of water. 8. Management of waste ▪ The proposed management of these wastes must be detailed with consideration given to the suitability of available waste disposal options. Particular attention must be given to the capacity of wastes to generate acidic, saline or sodic conditions.		
2.8 Financial Feasibility 1. This section shall detail the financial feasibility of the Project, including details of costs of development and ongoing maintenance and operational costs; the capacity of the proponents to satisfactorily develop the Project; fair pricing structures and cash-flow projections; estimated losses in income due to climatic conditions and both natural and human induced hazards; applicable commercial and Government fees; financial assurances and Joint Venture arrangements; and Foreign Investment Review Board issues. 2. An assessment of financial feasibility will be based on industry knowledge and experience to incorporate maintenance and long term costs and on demonstration that the staging of the development will deliver all infrastructure commitments necessary to support the residential, tourism and commercial elements of the development in good time.		1. Section 4.3, 17 2. Section 17
3.0 ENVIRONMENTAL VALUES, CHARACTERISTICS AND MANAGEMENT OF IMPACTS The functions of this section are: 1. Describe the existing environmental values and characteristics of the area which may be affected by the Project. - Environmental values and characteristics must be described by reference to background information and studies,		1. Section 2.2, 8, 9, 10, 14, 15, 16 2. Section 7.2, 8, 12.2



Terms of Reference Section	Relevant EIS Section
which must be included as appendices to the EIS; 2. Describe the potential adverse and beneficial impacts of the Project on the identified environmental values and characteristics. 3. Describe any cumulative impacts on environmental values and characteristics caused by the Project, either in isolation or by combination with other known existing or planned sources of contamination or activities; 4. To present environmental protection objectives and the standards and measurable indicators to be achieved; and 5. To examine viable alternative strategies for managing impacts. 6. This section must detail the environmental protection measures incorporated in the planning, construction, operations, rehabilitation and associated works for the Project. Measures must maintain environmental values and characteristics outside the area subject to development, minimise environmental impact, and maximise socioeconomic and environmental benefits of the Project. 7. Environmental protection objectives. Special attention must be given to those mitigation strategies designed to protect the values of any sensitive areas and any identified ecosystems of high conservation value within the area of possible Project impact. This section must address all elements of the environment. To achieve this, the following issues should be considered for each environmental value relevant to the Project: 8. Environmental values and characteristics affected: describe the existing environmental values and characteristics of the area to be affected including values and areas that may be affected by any cumulative impacts (refer to any background studies in Appendices - note such studies may be required over several seasons). It must be explained how the environmental values and characteristics were derived (e.g. by citing published documents or by following a recognised procedure to derive the values); 9. Impact on environmental values and characteristics. The cumulative impacts of the Project must be considered over time or in combination with other (all) impacts in the dimensions of scale, intensity, duration or frequency of the impacts.; 10. Cumulative impacts on the environmental values and characteristics of land, air and water and cumulative impacts on public health and the health of terrestrial, aquatic and marine ecosystems, must be discussed in the relevant sections; 11. Where impacts from the Project will not be felt in isolation to other sources of impact, it is recommended that the proponent develop consultative arrangements with other industries in the Project's area to undertake cooperative monitoring and/or management of environmental parameters. Such arrangements must be described in the EIS; 12. Environmental protection objectives: describe qualitatively and quantitatively the proposed objectives for	3. Throughout the document 4. All sections 5. All sections 6. All sections 7. Section 2.3, 20 8. All sections 9. All sections 10. All sections 11. Not relevant 12. All sections 13. All sections 14. All sections, where relevant 15. Section 20 16. Section 20 17. Throughout the document

Terms of Reference Section	Relevant EIS Section
enhancing or protecting each environmental value. Include proposed indicators to be monitored to demonstrate the extent of achievement of the objective as well as the numerical standard that defines the achievement of the objective (this standard must be auditable). The measurable indicators and standards can be determined from legislation, support policies and government policies as well as the expected performance of control strategies. Objectives for management of contaminated land, and progressive and final rehabilitation must be included; 13. Control strategies to achieve the objectives: describe the control principals and proposed actions to be implemented that are likely to achieve the environmental protection objectives; include designs, relevant performance specifications of plant, equipment and structures; 14. Monitoring programs: describe the monitoring parameters, monitoring points, frequency, data interpretation and reporting programs, and the adequacy of the program in assessing the impacts; 15. Auditing programs: describe how progress towards achievement of the objectives will be measured, reported and whether external auditors will be employed. Include scope, methods and frequency of auditing proposed, and how auditing recommendations will be considered and employed; 16. Management strategies: describe the strategies to be used to ensure the environmental protection objectives are achieved and control strategies implemented; and 17. Information quality: information given under each element must also state the sources of the information, how recent the information is, how any background studies were undertaken, how the reliability of the information was tested, and what uncertainties (if any) are in the information.	
3.1 Land	
3.1.1 Description of environmental values and characteristics 1. This section describes the existing environment values of the land area (including seabed where applicable) that may be affected by the Project. It must also define and describe the objectives and practical measures for protecting or enhancing land-based environmental values and characteristics, describe how nominated quantitative standards and indicators may be achieved, and how the achievement of the objectives will be monitored, audited and managed. 3.1.1.1 <i>Topography/geomorphology/bathymetry</i> 2. Maps must be provided locating the Project in both regional and local contexts. The topography of the Project site must be detailed with contours at suitable increments, shown with respect to Australian Height Datum (AHD) and showing slope for all development areas on land. Significant features of the locality must be included on the maps. Commentary on the maps must be provided highlighting the significant topographical features: ■ All levels between Highest Astronomical Tide (HAT) and Lowest Astronomical Tide (LAT); and	1. Section 3.2 2. Section 5.1.2, 9.3 3. Section 5.1 4. Section 5.1 5. Section 5.1 6. Section 5.1 7. Section 5.1 8. Section 5.1 9. Section 5.1 10. Section 5.1

Terms of Reference Section	Relevant EIS Section
■ Depth increments at 0.5m intervals from HAT throughout any works area.	11. Section 14, 15
3. In tidal areas, show the location of the limit of HAT, Mean High Water Springs, and LAT and depth increments at 0.5m intervals throughout any works area and 100m beyond. Where structures are proposed in marine waters, provide a bathymetric survey of the seabed below and 100m beyond the extent of the structure. Soundings are to be shown with respect to AHD and show depth increments at 0.5m intervals.	12. Section 5.1.2, 14.1 13. Section 5.1.2, 14.1
3.1.1.2 <i>Geology</i>	14. Section 5.1.2
4. The EIS must provide a description, map and a series of cross-sections of the geology of the Project area relevant to the Project components.	15. Section 5.1.2, 15.1 16. Section 5.1.2
3.1.1.3 <i>Soils</i>	17. Section 5.1.2
5. A soil survey of the sites affected by the Project must be conducted at a suitable scale, with particular reference to the physical and chemical properties of the materials that will influence erosion potential, storm water run-off quality, rehabilitation and agricultural productivity of the land. Information must also be provided on soil stability and suitability for construction of Project facilities.	18. Section 15.3 19. Section 5.1.2
6. Soil profiles are to be mapped at a suitable scale and described according to the “ <i>Australian soil and land survey field handbook</i> ” (McDonald et al, 1990) and “ <i>Australian soil classification</i> ” (Isbell, 1996). An appraisal of the depth and quality of useable soil must be undertaken and a discussion presented of their influence in the erosion potential, stormwater run-off quality and site stability.	20. Section 5.1.2 21. Section 5.1.2
7. An acid sulfate soil investigation, that meets the standards set out in “ <i>Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998</i> ” Ahern, Ahern and Powell or any subsequent updates as they become available, must be undertaken.	22. Section 5.1.2 23. Section 5.1.2 24. Section 5.1.2
3.1.1.4 <i>Land use</i>	25. Section 5.1.2 26. Section 5.1.2 27. Section 5.1.2
8. Maps at suitable scales showing existing land uses and tenures, and the Project location, must be provided for the entire Project area and surrounding land that could be affected by the development. The maps must identify areas of conservation value, marine areas and State and Commonwealth Marine Park zoning. The location of existing dwellings and the zoning of all affected lands according to any existing town or strategic plan must be included.	28. Section 5.1.2 29. Section 5.1.2 30. Section 5.1.3
9. Identify and map all existing and proposed tracks and trails on the island. Describe current recreational use of the island and likely future use based on natural features and anticipated community recreational demands	31. Section 5.1.3 32. Section 5.1.4 33. Section 5.1.4
10. Describe and map currently degraded sites (e.g. old tracks, rubbish dumps, coastal erosion) to provide a baseline for future assessment of impacts, support commitments to rehabilitation, and to give background to commitments to manage future recreational and other uses of the island outside the developed area, especially along the coastline.	34. Section 5.1.4 35. Section 5.1.4 36. Section 5.1.4 37. Section 5.1.4

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11. Provide a land suitability map of the proposed and adjacent area, and setting out land suitability and current land uses, e.g. for grazing of native and improved pastures and horticulture. Land classified as Good Quality Agricultural Land in the Department of Natural Resources and Water land classification system is to be shown in accordance with the planning guideline, The Identification of Good Quality Agricultural Land, which supports State Planning Policy 1/92.
- 3.1.1.5 *Sensitive environmental areas*
The EIS must identify whether areas that are environmentally sensitive could be affected, directly and indirectly, by the Project.
12. Habitats of species listed under the NC Act or EPBC Act as presumed extinct, endangered, vulnerable or rare;
13. Regional ecosystems listed as 'endangered' or 'of concern' under State legislation, and/or ecosystems listed as presumed extinct, endangered or vulnerable under the EPBC Act;
14. Good representative examples of remnant regional ecosystems or regional ecosystems which are poorly represented in protected areas;
15. Sites listed under international treaties such as Ramsar wetlands and World Heritage areas;
16. Sites containing near threatened or bio-regionally significant species or essential, viable habitat for near threatened or bio-regionally significant species;
17. Sites in, or adjacent to, areas containing important resting, feeding or breeding sites for migratory species of conservation concern listed under the Convention of Migratory Species of Wild Animals, and/or bilateral agreements between Australia and Japan (JAMBA) and between Australia and China (CAMBA);
18. Sites adjacent to nesting beaches, feeding, resting or calving areas of species of special interest; for example, marine turtles and cetaceans;
19. Sites containing common species which represent a distributional limit and are of scientific value or which contains feeding, breeding, resting areas for populations of echidna, koala, platypus and other species of special cultural significance;
20. Sites containing high biodiversity that are of a suitable size or with connectivity to corridors/protected areas to ensure survival in the longer term;
21. A site containing other special ecological values, for example, high habitat diversity and areas of high endemism;
22. Ecosystems which provide important ecological functions such as: wetlands of national, state and regional significance; coral reefs; riparian vegetation; important buffer to a protected area or important habitat corridor between areas;
23. Sites of palaeontologic significance such as fossil sites;

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24. Sites of geomorphological significance, such as lava tubes or karst; 25. Erosion prone areas declared under section 70(1) of the CPM Act; 26. Areas of remnant vegetation classified as being of State or regional significance for biodiversity conservation by the Environmental Protection Agency under a Biodiversity Planning Assessment using the Biodiversity Assessment and Mapping Methodology; 27. Significant coastal dunes, and significant coastal wetlands as defined by the State Coastal Management Plan and mapped by the draft Wide Bay-Burnett Regional Coastal Management Plan; 28. Protected areas which have been proclaimed under the NC Act and <i>Marine Parks Act 2004</i> or are under consideration for proclamation; and/or; and 29. Areas of major interest, or critical habitat declared under the NC Act or high nature conservation value areas or areas vulnerable to land degradation under the VM Act. 3.1.1.6 <i>Landscape character</i> 30. This section must describe in general terms the existing character of the landscape that will be affected by the Project. Comment on any changes that have already been made to the natural landscape since European settlement. It must 'set the scene' for the description of particular scenic values in the following section on visual amenity. 31. The landscape character of the property and its surrounds must be described in the context of landscape ecology and incorporate the concepts of patch-corridor-matrix in describing the pattern of existing vegetation. 3.1.1.7 <i>Visual amenity</i> 32. This section must describe existing landscape features, panoramas and views that have, or could be expected to have, value to the community whether of local, regional, State-wide, national or international significance, with particular consideration to retention of the aesthetics value criteria of the Great Barrier Reef World Heritage Area, and having regard to guidance provided by Schedule 2 of the State Coastal Management Plan. 33. Major views, view sheds, existing viewing outlooks, ridgelines and other features contributing to the amenity of the area, including assessment from vessels entering and leaving Gladstone Harbour private residences in the Tannum Sands area; 34. Focal points, landmarks (built form or topography), gateways associated with the Project site and immediate surrounding areas, waterways, and other features contributing to the visual quality of the area and the Project site; 35. Character of the local and surrounding areas including character of built form (scale, form, materials and colours) and vegetation (natural and cultural vegetation) directional signage and land use; 36. Identification of the areas of the Project that have the capacity to absorb land use changes without detriment to	

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the existing visual quality and landscape character; and 37. The value of existing vegetation as a visual screen.		
3.1.2 Potential impacts and mitigation measures		
1. This section must describe how nominated quantitative standards and indicators may be achieved, and how the achievement of the objectives will be monitored, audited and managed.		1. Section 5.2 2. Section 5.2.1, Appendix A7
3.1.2.1 Land use suitability		
2. The potential for the construction and operation of the Project to change existing and potential land uses (terrestrial and marine) of the Project site and adjacent areas must be detailed. Post construction land use options must be detailed including suitability of the surrounding area to be used for agriculture, or nature conservation.		3. Section 5.2.1 4. Section 5.2.1 5. Section 5.2.2 6. Section 5.2.2 7. Section 5.2.2
3. The potential environmental impacts caused by the Project on the adjacent areas currently used for agriculture, urban development, recreation, tourism, other business and the implications of the Project for future developments in the impact area including constraints on surrounding land uses must be described.		
4. Outline incompatible land uses, whether existing or potential, adjacent to all aspects of the Project, including essential and proposed ancillary developments or activities. Areas directly or indirectly affected by the construction and operation of these activities must be identified and measures to avoid unacceptable impacts defined.		8. Section 5.2.2 9. Section 5.2.2 10. Section 5.2.3 11. Section 5.2.3
3.1.2.2 Land disturbance 5. A strategy must be developed with a view to minimising the amount of land disturbed at any one time. The strategic approach to progressive development must be described.		12. Section 5.2.3 13. Section 5.2.3
6. The methods to be used for the Project, including backfilling, covering, re-contouring, topsoil handling and revegetation, must be described. Consideration must be given to the use of threatened plant species during any landscaping and revegetation.		14. Section 5.2.3 15. Section 5.2.3
7. Proposals for the reinstatement of the creeks must be provided if the diversion of creeks during construction or operations is expected. Where temporary dams and roads and other infrastructure are to be constructed, works programs for the management of these structures after the completion of the Project must be given.		16. Section 5.2.3 17. Section 5.2.4, Appendix A7
8. An ASS management plan must be prepared for any works that have the potential to disturb ASS. Assess the likely effectiveness of the proposed mitigation measures and the likely consequences for the surrounding environment.		18. Section 5.2.4 19. Section 5.2.4
9. If geological conditions are conducive, the proponent must consider the possibility that significant fossil specimens (such as of dinosaurs or their tracks) may be uncovered during construction/operations and propose strategies for protecting the specimens and alerting the Queensland Museum to the find.		20. Section 5.1 21. Section 5, 8, 9 22. Section 5, 8, 9
3.1.2.3 Land contamination 10. A preliminary site investigation of the site consistent with the EPA's <i>Draft Guidelines for the Assessment and</i>		23. Section 5.2.4

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<i>Management of Contaminated Land in Queensland</i> must be undertaken to determine background contamination levels. 11. Mapping of any areas listed on the Environmental Management Register or Contaminated Land Register under the EP Act; 12. Identification of any potentially contaminated sites not on the registers which may need remediation; and 13. A description of the nature and extent of contamination at each site and a remediation plan and validation sampling. 14. The EIS must address management of any existing or potentially contaminated land in addition to preventing and managing land contamination resulting from Project activities. 15. Methods proposed for preventing, recording, containing and/or remediating any contaminated land must be outlined. 16. Proponents must refer study projects to the EPA for review prior to commencement. 3.1.2.4 <i>Soil erosion</i> 17. For all permanent and temporary landforms, possible erosion rates and management techniques must be described. For each soil type identified, erosion potential (wind and water) and erosion management techniques must be outlined. An erosion-monitoring program, including rehabilitation measures for erosion problems identified during construction, must also be outlined and acceptable mitigation strategies provided. The report must include an assessment of likely erosion effects, especially those resulting from the removal of vegetation, and construction of retaining walls both on-site and off-site for all disturbed areas such as: 18. The site, including buildings; 19. Access roads or other transport corridors; 20. Any waste dumps; 21. Dams, banks and creek crossings; and 22. Tidal and subtidal areas. 23. Summarise methods proposed to prevent or control erosion with regard to: (a) the Soil erosion and sediment control, Engineering Guidelines for Queensland Construction Sites (Institute of Engineers Australia (Qld Division) 1996), (b) preventing soil loss in order to maintain land capability/suitability, and (c) preventing degradation of local waterways, Rodds Bay and Colosseum Fish Habitat Area by suspended solids. 3.1.2.5 <i>Landscape character</i> 24. Describe the potential impacts of the Project landscape character of the site and the surrounding area. Particular	24. Section 5.2.5 25. Section 5.2.5 26. Section 5.2.5 27. Section 5.2.5 28. Section 5.2.6 29. Section 5.2.6 30. Section 5.2.6 31. Section 5.2.6

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mention must be made of any changes to the broad-scale topography and vegetation character of the area and vegetation clearing. 25. Details must be provided of measures to be undertaken to mitigate or avoid the identified impacts. 3.1.2.6 <i>Visual amenity</i> 26. This section must analyse and discuss the visual impact of the Project on particular panoramas and outlooks, including but not limited to the Great Barrier Reef Coast Marine Park, Great Barrier Reef Marine Park and World Heritage areas. The assessment is to address the visual impacts of the Project structures and associated infrastructure, using appropriate simulation. Special consideration is to be given to vessels entering and departing Gladstone Harbour, public recreation areas at Tannum Sands, public roads, public thoroughfares, and places of residence or work, which are within the line-of-sight of the Project. 27. Detail must be provided of all management options to be implemented and how these will mitigate or avoid the identified impacts. 3.1.2.7 <i>Lighting</i> Management of the lighting of the Project, during all stages, is to be provided, with particular reference to objectives to be achieved and management methods to be implemented to mitigate or avoid: 28. The visual impact at night; 29. Night operations/maintenance and effects of lighting on terrestrial and marine fauna and residents; 30. The potential impact of increased vehicular traffic; and 31. Changed habitat conditions for nocturnal terrestrial and marine fauna and associated impacts. 3.2 Infrastructure 1. The location and owner/custodians of all tenures for infrastructure such as reserves, roads and road reserves and the like, covering the affected land must be shown on maps of a suitable scale. 2. Indicate locations of gas and water pipelines, power lines and any other easements. 3. Describe the environmental values and characteristics affected by this infrastructure. In particular, with respect to the coastal access route, any adverse impacts associated with vegetation clearing for vehicular access and services requirements must be identified. 4. Adverse impacts to species from vegetation clearing, edge effects and vehicle-wildlife collisions must be identified. 3.3 Transport 3.3.1 Road 1. The EIS must provide sufficient information to make an independent assessment of how the State-controlled and local government road networks will be affected. The impact on stakeholders along the whole route must be	
	1. Section 6 2. Section 6 3. All sections, not relevant, 15 4. Section 15
	1. Section 6 2. Section 6, 15

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detailed and how any impacts will be managed. Details must be provided of the impacts on environmental values and characteristics of any new roads or road realignments. The EIS must include detailed analysis of probable impact of identified construction and operational traffic generated by the Project with particular concern to impacts on road infrastructure, road users and road safety. The EIS needs to identify impacts on the State-controlled and local government road networks and to indicate clearly the corrective measures necessary to address adverse road impacts and the costs involved. This will require the proponent to compare the traffic situation and road conditions with, and without, the Project. Provide information on product spill contingency plans and the adequacy of equipment and facilities to deal with possible spills for the transport nodes of the Project. Indicate whether there is a need to update the plans based on increase in frequency of traffic and volumes to be transported. Information about the impacts and proposed measures for dealing with those impacts must be prepared by the proponent in close consultation with the Department of Main Roads and EPA. The EIS must outline details of any potential impacts on existing or proposed transport, within 30 kilometres of the site boundaries, as follows: ▪ Public passenger transport services and infrastructure, including school bus, scheduled bus, taxi and ferry; ▪ Marine usage and infrastructure, including jetties, wharves, marinas, docks, navigational aids, recreational boating and commercial boating; ▪ Rail services or infrastructure, including freight traffic, passenger services and railway level crossings; and ▪ Transport of agricultural produce; and within 50 kilometres of the site boundaries, as follows: ▪ Aviation facilities and services, including civilian airstrips, navigational aids, and communication facilities.	3. Section 6 4. Section 6 5. Section 6 6. Section 6 7. Section 6
3.3.2 Water/Air based The EIS must also address the following transport issues: 1. The potential of the Project to impact on recreational and commercial activities within and adjoining Rodds Bay, and Colosseum Fish Habitat Area including: ▪ The need for additional public boat ramps, facilities and parking (for vehicle and trailers); ▪ All-tide ramp status; ▪ Current mooring owners; ▪ Management and control of boat ramps (include ownership proposals); 2. A review of the need for this Project to provide additional recreational boat launching facilities to ensure reasonable availability of boat launching facilities in the region; and	1. Section 3.4.4 2. Section 6 3. Section 6

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3. Aircraft/airstrip operations noise and emission impacts and potential offset options.	
3.4 Climate 1. This section must describe the rainfall patterns (including magnitude and seasonal variability of rainfall), air temperatures, humidity, wind (direction and speed) and any other special factors (e.g. temperature inversions) that may affect air quality within the region of the Project. 2. Extremes of climate (droughts, floods, cyclones, etc) must also be discussed with particular reference to water management at the Project site. 3. The vulnerability of the area to natural or induced hazards, such as storm surge, floods, cyclones and bushfires must also be addressed be evaluated against SPP 1/03 Mitigating the impacts of flood, bushfire and landslide, and against section 2.2.4 Coastal Hazards in the State Coastal Management Plan with reference to the EPA guideline “Mitigating the adverse impacts of storm tide inundation” . 4. The storm tide hazard area and high risk area must be mapped. 5. The relative frequency, magnitude and risk of these events must be considered. 6. The impacts of rainfall on soil erosion must be addressed in Section 3.1. 7. The impacts of storm events on the capacity of waste containment systems (e.g. site bunding/stormwater management) must be addressed in Section 3.5 with regard to contamination of waterways. 8. The impacts of winds, rain, humidity and temperature inversions on air quality must be addressed in Section 3.7. 9. Provide information on historic fire regimes on the island and the likely changes to these regimes resulting from the development including: ■ The cause, frequency, intensity and extent of fires (last 10 years); ■ A wildfire protection strategy for all stages of the development (including additional clearing requirements, and controlled burning regime); ■ A general overview of the impact of the historic fire regime on the natural environment and the potential impact based on the wildfire protection strategy; and ■ Commitments to fire management services (fire crews & equipment).	1. Section 7.1 2. Section 7.1.6 3. Section 7.1.6 4. Section 9 5. Section 7.1.6, 7.2 6. Section 7.2.1 7. Not applicable 8. Section 10 9. Section 7.1, 7.2
3.5 Water resources	
3.5.1 Description of environmental values and characteristics 1. This section describes the existing environment for water resources that may be affected by the Project in the context of environmental values and water quality objectives as defined in such documents as the EP Act, Environmental Protection (Water) Policy 1997, Queensland Water Quality Guidelines (2006) and ANZECC 2000 and	1. Section 8.1, 8.2 2. Section 8 3. Section 8.3

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any relevant regional water quality improvement strategies.		4. Section 8.2.1
2. Sufficient baseline water quality information is to be presented (in consultation with the Environmental Protection Agency and the Great Barrier Reef Marine Park Authority) to set long term water quality goals, and to set limits on contaminants in water discharged from the Project site.		5. Section 8.2.1, 8.3
3. Where a licence or permit will be required under the <i>Water Act 2000</i> to take or interfere with the flow of water, this section of the EIS must provide sufficient information for a decision to be made on the application.		6. Section 8.2.1, 8.3
3.5.1.1 <i>Surface waterways</i>		7. Section 8.2.1, 8.3
4. A description must be given of the perennial and ephemeral creeks/wetlands, their environmental values and characteristics, physical integrity and riparian vegetation affected by the Project with an outline of the significance of these waters to the system in which they occur. The location, extent, frequencies and durations to which the highest astronomical tides and the mean high water spring tides penetrate into surface water systems must also be described.		8. Section 8.2.1
5. The EIS must provide a description, with photographic evidence, of the geomorphic condition of any watercourses and wetlands likely to be affected by disturbance or stream diversion, including a description of any likely barriers to fish and aquatic wildlife movement likely to be affected by disturbance or stream diversion.		9. Section 8.2.1
6. An assessment is required of existing water quality in surface waters and wetlands likely to be affected by the Project. The basis for this assessment must be a monitoring program, with sampling stations located upstream and downstream of the Project where applicable. Results of water quality monitoring must be referenced against established or derived long term water quality goals. Complementary stream-flow data must also be obtained from historical records (if available) to aid in interpretation.		10. Section 8.2.1
7. Describe the water quality, including seasonal variations or variations with flow where applicable. A relevant range of physical, chemical and biological parameters must be measured to gauge the potential environmental impacts on any affected creek or wetland system.		11. Section 8.2.1
Describe the environmental values and characteristics of the potentially affected surface waterways of the area in terms of:		12. Section 8.2.2
8. Values identified in the Environmental Protection (Water) Policy;		13. Section 8.2.2
9. Sustainability, including both quality and quantity;		14. Section 8.2.2
10. Physical integrity, fluvial processes and morphology of watercourses, including riparian zone vegetation and form; and		15. Section 8.2.2
11. Any water resource plans, land and water management plans relevant to the affected catchment.		16. Section 8.2.2
3.5.1.2 <i>Groundwater</i>		17. Section 8.2.2

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12. The EIS must review the quality, quantity and significance of groundwater in the Project area. The review must include a survey of existing groundwater aquifers and must include reference to: 13. Nature of the aquifer/s ▪ geology/stratigraphy - such as alluvium, volcanic, metamorphic; ▪ aquifer type - such as confined, unconfined; and ▪ depth to and thickness of the aquifers. 14. Hydrology of the aquifer/s ▪ depth to water level and seasonal changes in levels; ▪ inferred groundwater flow directions (defined from water level contours); ▪ potential interaction with surface water; ▪ potential interaction with sea/salt water; ▪ possible sources of recharge; and ▪ vulnerability to pollution. Describe the environmental values and characteristics of the underground waters of the affected area in terms of: 15. Values identified in the Environmental Protection (Water) Policy and long term water quality goals; 16. Sustainability, including both quality and quantity; and 17. Physical integrity, fluvial processes and morphology of groundwater resources.	
3.5.2 Potential impacts and mitigation measures 1. This section is to assess potential impacts on water resource environmental values and characteristics identified in the previous section. It will also define and describe the objectives and practical measures for protecting or enhancing water resource environmental values and characteristics, to describe how nominated quantitative standards and indicators may be achieved, and how the achievement of the objectives will be monitored, audited and managed. 2. The EIS must describe the potential environmental impacts caused by the proposed Project to environmental values and characteristics for water as expressed in the Environmental Protection (Water) Policy. 3. Water management controls must be described, addressing surface and groundwater quality, quantity, drainage patterns and sediment movements. The beneficial (environmental and recreational) use of nearby marine, surface and groundwater must be discussed, along with the potential for the diversion of affected creeks, and the stabilisation of those works. Monitoring programs must be described which will assess the effectiveness of management strategies for protecting water quality during the construction, and operation of the Project. Key water management strategy objectives include:	1. Section 8.3, 8.4 2. Section 8.3, 8.4 3. Section 8.3, 8.4 4. Section 8.3, 8.4 5. Section 8.3, 8.4 6. Section 8.3, 8.4 7. Section 8.3, 8.4 8. Section 8.3, 8.4 9. Section 8.3, 8.4 10. Section 8.3, 8.4 11. Section 8.3 12. Section 8.3



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4. Protection of the integrity of the marine environment, and ultimately the Great Barrier Reef Marine Park and World Heritage property;		13. Section 2
5. Protection of the integrity of wetlands that have the potential to be affected by the Project;		14. Section 8.3
6. Protection of important local aquifers and protection of their waters;		15. Section 8.3
7. Assessment of the potential need for access to surface or groundwater resources at different stages of the development, to supplement the runoff collection that is proposed as the water supply for the development;		16. Section 8.3
8. Maintenance of sufficient quantity, persistence and quality of surface waters to protect existing beneficial downstream uses of those waters; and		17. Section 8.3
9. Minimisation of impacts on flooding levels and frequencies both upstream and downstream of the Project.		18. Section 8.3
10. Conduct a risk assessment for uncontrolled releases (e.g. water storage failure) to water due to system or catastrophic failure, implications of such releases for human health and natural ecosystems, and list strategies to prevent, minimise and contain impacts.		19. Section 8.3
3.5.2.1 <i>Surface water and water courses</i>		20. Section 8.3
11. Proposed modifications or impacts to waterways both on and adjacent to the site, including infrastructure required for road crossings, drainage, pipelines and if any waterway barriers are required. Timeframes for any temporary waterway barriers must be nominated. This section must address the infrastructure associated with any lagoons and lakes.		21. Section 8.4
12. The potential environmental impacts caused by changes in the flow and the quality of perennial and ephemeral waters and excavations, placement of materials or destruction of vegetation within and beside waterways or extraction of quarry material from within waterways associated with all phases of the Project must be discussed.		22. Section 8.4
13. The need or otherwise for licensing and permitting of any diversions, water impoundments, extraction of quarry materials or the excavation, placement of fill or destruction of native vegetation within any watercourse, lake or spring under the <i>Water Act 2000</i> and the <i>Fisheries Act 1994</i> must be discussed. The location and extent of watercourses both longitudinal and lateral, water and quarry material allocations, water sources and the type and location of infrastructure associated with any crossings of or stormwater outlets into such features must be established in consultation with Department of Natural Resources and Water. Survey plans depicting the ground levels within waterways and lines depicting the locations of the top of the high and low banks of these features for the purposes of such permits must be provided.		23. Section 8.4
14. The hydrological impacts of the Project must be assessed, particularly with regard to stream diversions, crossings, scouring and erosion, both upstream and downstream of the Project (including off-site where required for infrastructure crossings), for both permanent or temporary works. Assessment of impacts on the flow and the		24. Section 8.4

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quality of perennial and ephemeral waters and effects on associated ecosystems must include an assessment of the likely effects on mangrove and other estuarine habitats and fish passage as a result of any temporary diversion of existing water courses. The potential environmental impacts caused by water quality changes within near coastal freshwater environments due to any changes in the interactions between the freshwater hydrological regime and/or changes to the penetration of seawater over or through coastal dunes into brackish waterways resulting from the Project must also be discussed.

15. Where it is proposed that creeks be diverted, the EIS must detail how rehabilitation will affect both the physical and ecological condition of the creek's bed and banks and the quality of water in it. Furthermore, the EIS must describe the monitoring that will be undertaken after construction, and who will have responsibility for management measures and corrective action, to ensure that rehabilitated creeks do not degrade.
 16. Provide details of seawater quality monitoring at points of outflow and water quality within any near coastal lakes that have the potential to be affected by the Project. Quality characteristics discussed must be those appropriate to the downstream and upstream water values that may be affected. Chemical and physical properties of any waste water (including concentrations of constituents) at the point of entering natural surface waters must be discussed along with toxicity of effluent constituents to flora and fauna.
 17. Provide details on the proposed road network and design of bridges and culverts and their potential impacts as barriers or impediments to water flows and to wildlife movement or mitigations (either permanently or seasonally) and to any special habitat requirements of significant aquatic species, especially fish (e.g. for breeding purposes).
 18. Having regard for the requirements of the Environmental Protection (Water) Policy, the EIS must present the methods to avoid stormwater contamination and the means of containing, recycling, reusing, treating and disposing of stormwater.
 19. The EIS must identify any water quality changes associated with the development arising from nutrients, chemicals, or biophysical changes such as pH, turbidity, etc.
 20. Options for mitigation and the effectiveness of mitigation measures must be discussed with particular reference to sediment, acidity, salinity and other emissions of a hazardous or toxic nature to human health, flora or fauna.
- 3.5.2.2 Groundwater**
21. The EIS must include an assessment of the potential environmental impacts caused by the Project to local groundwater resources.
 22. The impact assessment must define the extent of the area within which groundwater resources are likely to be affected by the proposed operations and the significance of the Project to groundwater depletion or recharge, and propose management options available to monitor and mitigate these effects.

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23. An assessment must be undertaken of the impact of the Project on the local ground water regime caused by the altered porosity and permeability of any land disturbance. 24. An assessment of the potential to contaminate groundwater resources and measures to prevent, mitigate and remediate such contamination must be discussed.		
3.6 Coastal environment		
3.6.1 Description of environmental values and characteristics 1. This section describes the existing coastal environment, which may be affected by the Project in the context of coastal values identified in State of the Coastal Zone Reports, State and Regional Coastal Management Plans and environmental values and characteristics as defined by the EP Act and environmental protection policies. The Environmental Protection (Water) Policy has a set of default environmental values and characteristics for waterways that include aquatic ecosystem protection. 2. This section must also identify actions associated with the Project that are assessable development within the coastal zone and will require assessment under the provisions of the CPM Act. 3.6.1.1 Water quality Describe the environmental values and characteristics of the coastal seas of the affected area in terms of: 3. Values identified in the Environmental Protection (Water) Policy; 4. Queensland Water Quality Guidelines 2006; and 5. The State Coastal Management Plan and any Regional Coastal Management Plan (draft or final). 6. Define and describe the water quality objectives (WQO) required to protect the environmental values identified, (protocols must be consistent with the Environmental Protection (Water) Policy 1997). Specific details should be provided on how the WQO have been developed and derived. 7. Provide baseline information on water quality in estuaries below the limit of tidal influence surrounding Hummock Hill Island, consistent with the identified environmental values and WQOs. Discuss the interaction of freshwater flows with marine waters and its significance in relation to marine flora and fauna adjacent to the Project area. 8. Provide a comprehensive discussion of physical factors affecting marine water quality in the area including interactions with surface waters from land, tides, cyclones, sea level rise, winds and waves. 9. Discuss the dominant ecological processes, including nutrient and organic matter cycling and the key limiting physical factors to the ecological processes. 10. Provide an assessment of existing water quality of waters within adjacent coastal and estuarine reaches within the Rodds Bay and Colosseum Fish Habitat Area through either monitoring or using recent available published data. The assessment is to include parameters relevant to the identified environmental values and characteristics and long	1. Section 9 2. Section 9 3. Section 9.2 4. Section 9.2 5. Section 9.2 6. Section 9.2, 9.3, 9.4 7. Section 9.3 8. Section 9.3 9. Section 9.3 10. Section 3, 8, 9.3.4 11. Section 9.1 12. Section 3, 9 13. Section 9.3	

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term water quality goals for the areas, but not limited to total and dissolved organic carbon, pH, dissolved oxygen, suspended solids, turbidity, total nitrogen, total phosphorous, total and dissolved aluminium, total and dissolved iron, faecal coliforms, and chlorophyll-a. 3.6.1.2 Coastal processes 11. Describe the environmental values and characteristics of the coastal resources of the affected area in terms of the physical integrity and morphology of landforms created or modified by coastal processes. 12. Provide an assessment of physical and chemical characteristics of sediments within the littoral and marine zone where works are to occur below the level of the Highest Astronomical Tide. 13. Provide a discussion of physical factors and processes affecting marine waters in the area including currents, tides, storm surges, cyclones, sea level rise, winds and waves	
3.6.2 Potential impacts and mitigation measures 1. This section defines and describes the practical measures for protecting or enhancing coastal environmental values and characteristics, to describe how the achievement of established long term water quality goals will be monitored, audited and managed through nominated quantitative standards and indicators. It should assess potential impacts of construction and operational activities on the coastal zone, identified environmental values and characteristics and long term water quality goals. 2. Describe the long term water quality goals used (including how they were developed), and how predicted activities will meet these objectives (refer to the Queensland Water Quality Guidelines 2006; and the Australian and New Zealand guidelines for fresh and marine water quality, ANZECC, 2000). 3. The potential environmental impacts caused by the Project on coastal resources and processes must be described in the context of controlling such effects. The State Planning Policy – Planning and Managing Development involving Acid Sulfate Soils 2002, the State Coastal Management Plan 2001, any Regional Coastal Management Plan (draft or final) and QDPI Guidelines for Marine Areas must be addressed. 4. Discuss the subsequent likely impact from use of the proposed structures such as the jetty and boat ramp on the future need for dredging and impact on coastal processes and describe the measures proposed to minimise impacts from construction of tidal works on coastal processes and resources. 5. The role of buffer zones in maintaining connectivity between coastal and riparian vegetation and estuarine and freshwater reaches of catchments must be discussed.	1. Section 9.4.1 2. Section 9.4.1 3. Section 9.4 4. Section 9.4 5. Section 9.4
3.7 Air quality and greenhouse gases	
3.7.1 Description of environmental values and characteristics 3.7.1.1 Air quality	1. Section 10.1.1

Terms of Reference Section	Relevant EIS Section
- This section describes the existing air environment and environmental values and characteristics that may be affected by the Project. - A description of the existing air shed environment must be provided having regard for particulates and gaseous and odorous compounds and local meteorology conditions including air temperature, wind speed and direction, atmospheric stability, mixing depth and other parameters necessary for input into later studies or for the modelling of air quality within the air shed.	Section 10.1.1
3.7.2 Potential impacts and mitigation measures 3.7.2.1 Air quality - This section describes the objectives and practical measures for protecting or enhancing environmental values and characteristics for air, to describe how nominated quantitative standards and indicators may be achieved, and how the achievement of the objectives will be monitored, audited and managed. - The objectives for air emissions must be stated in respect of relevant standards (ambient and ground level concentrations), relevant guidelines, and any relevant legislation. - Potential air quality impacts from emissions must be discussed reference to the National Environmental Protection Measures (NEPM) for ambient air quality (1998), the Environmental Protection (Air) Policy 1997 and relevant Australian Standards. The assessment of the Project's impact on air quality must include a discussion of at least the following matters: - Features of the Project designed to suppress or minimise emissions, including dusts and odours; and - A potential dust and odour emissions during both construction conditions. 3.7.2.2 Greenhouse gas emissions and abatement This section of the EIS must: - Provide a discussion of potential emissions during construction for each relevant greenhouse gas from construction equipment and plant, with total emissions expressed in 'CO₂ equivalent' terms; - Provide a discussion of expected operational emission sources (including aviation and related activities) and emissions expressed in 'CO₂ equivalent' terms; - Estimate emissions from upstream activities associated with the construction of the proposed Project, including fossil fuel based electricity consumed; and - Briefly describe method(s) by which estimates were made. This section of the EIS must also propose and assess greenhouse gas abatement measures. It must include: - A description of the proposed measures (alternatives and preferred) to avoid and/or minimise greenhouse gas emissions directly resulting from construction activities of the Project;	- Section 10.2 - Section 10.1 - Section 10.2.1 - Section 10.2 - Section 10.2 - Section 10.1.1 - Section 10.2.1 - Section 10.2 - Section 10.2 - Section 10 - Section 10 - Section 10 - Section 10 - Section 20 - Section 10.2.1 - Section 18 - Section 10.2.1 - Section 10.2.1

Terms of Reference Section	Relevant EIS Section
11. An assessment of how the preferred measures minimise emissions and achieve energy efficiency; 12. An indication of how the preferred measures for emission controls and energy consumption compare with practice in the relevant sector of industry with a view to achieving best practice environmental management; and 13. A description of any opportunities for further offsetting greenhouse gas emissions (including aviation and other operational gas emissions) through indirect means. The environmental management plan in the EIS must include a specific module to address greenhouse abatement. That module must include: 14. Commitments to the abatement of greenhouse gas emissions from the Project with details of the intended objectives, measures and performance standards to avoid, minimise and control emissions; and 15. Commitments to monitor, audit and report on the success of offset measures. 3.7.2.3 Climate change adaptation The EIS must provide an assessment of the Project's vulnerabilities to climate change and describe possible adaptation strategies for the activity including: 16. A risk assessment of how changing patterns of rainfall and hydrology, temperature, extreme weather and sea level (where appropriate) may affect the viability and environmental management of the Project; 17. The preferred and alternative adaptation strategies to be implemented; and 18. Commitments to undertaking, where practicable, a cooperative approach with government, other industry and other sectors to address adaptation to climate change.	
3.8 Waste 1. This section must complement other sections of part 3 of the EIS by providing technical details of waste treatment and minimisation, with proposed emission, discharge and disposal criteria, while other sections describe how those emissions, discharges and disposals would impact the relevant environmental values and characteristics.	1. Section 11
3.8.1 Description of environmental values and characteristics 1. This section describes the existing environment values that may be affected by the Project's wastes. Refer to each of the waste streams described in section 2.7 and provide references to environmental values and characteristics described in other sections of part 3 of the EIS.	1. Section 11
3.8.2 Potential impacts and mitigation measures 1. This section defines and describes the objectives and practical measures for protecting or enhancing environmental values and characteristics from impacts by wastes, describes how nominated quantitative standards and indicators may be achieved for waste management, and how the achievement of the objectives will be monitored, audited and managed.	1. Section 11.5 2. Section 11.3, 11.5 3. Section 11.5 4. Section 11.3, 11.4

Terms of Reference Section	Relevant EIS Section
This section must assess the potential impact of all wastes to be generated and provide details of each waste in terms of: - Operational handling and fate of all wastes including storage; - On-site treatment methods proposed for the wastes; - Methods of disposal (including the need to transport wastes off-site for disposal) proposed to be used for any trade wastes, liquid wastes and solid wastes; - The potential level of impact on environmental values and characteristics; - Proposed discharge/disposal criteria for liquid and solid wastes; - Methods to prevent, seepage and contamination of groundwater from stockpiles and/or dredge spoil must be given; - Expected frequency and nature of discharges into waterways from emergency sewerage outfalls or the failure of sewerage infrastructure particularly at crossings of waterways and major drainage paths; - Market demand for recyclable waste (where appropriate) must be addressed; and - Waste minimisation techniques proposed. - Having regard for the Environmental Protection (Waste) Policy, the EIS must indicate the results of investigation into the feasibility of using waste minimisation and cleaner technology options during all phases of the Project. The EPA draft guidelines covering aspects of waste management under this EPP must also be addressed. - Waste minimisation and treatment, and the application of cleaner production techniques, must also be applied to gaseous wastes, particularly particulates and carbon dioxide. Particular attention must be paid to measures that will maximise energy efficiency and minimise internal energy consumption in the Project. - Waste management planning must be detailed especially as to how the concepts have been applied to preventing or minimising environmental impacts at each stage of the Project. Details on natural resource use efficiency, integrated processing design, co-generation of power and by-product reuse (as shown in a material/energy flow analysis) are required.	- Section 11.5 - Section 11.3 - Section 11.3, 11.4, 11.5 - Section 3.4.1, 11.5 - Section 11 - Section 11.2, 11.3, 11.5 - Section 11.1, 11.2, 11.3 - Section 3 - Section 11
3.9 Noise and vibration	
3.9.1 Description of environmental values and characteristics 3.9.1.1 General - This section describes the existing environment values that may be affected by noise and vibration from the Project. - The locations of sensitive sites must be identified on a map at a suitable scale. - Comment must be provided on any current activities near the Project area that may cause a background level of ground vibration (for example: major roads, quarrying activities, etc). - If the proposed activity could adversely impact on the noise environment, the daily variation of background noise	- Section 12.1 - Section 12 - Section 12 - Section 12.1 - Section 12.1, 12.2 - Section 12.2.2

Terms of Reference Section	Relevant EIS Section
levels at nearby sensitive sites must be monitored and reported in the EIS, with particular regard given to detailing variations at different periods of the night. Baseline monitoring should also be described with reference to AS1055-Description and Measurement of Environmental Noise (1997). 3.9.1.2 Aircraft noise environment 5. Describe the existing environmental values and characteristics that may be affected by noise and vibration and assess noise and vibration impacts arising from the airstrip construction and operation. 6. Provide an assessment of aircraft noise predictions for the airstrip during the operational phase of the Project. This assessment should include seasonal predictions and predictions based on the predominant operating modes under prevailing meteorological conditions. Different levels of airstrip and runway usage and flight paths must be considered. 7. The assessment of aircraft noise impacts should consider matters raised in “<i>Australian Standard AS 2021-2000 Acoustics – Aircraft noise intrusion-Building siting and construction</i>” and in Australian Department of Transport and Regional Services (DOTARS) material. Discuss issues relating to existing ambient noise levels and characteristics and identify noise sensitive facilities and areas, including: 8. Relevant meteorological conditions and any topographic features which may influence noise or vibration impacts; 9. Existing, developing and potential or proposed areas of residential development which may be exposed to aircraft noise; 10. Community facilities which may be noise sensitive, indicating the location of the facilities using maps and other suitable means and where possible, the number of people potentially exposed at each facility; and 11. Environmentally sensitive areas (e.g. wildlife habitat) which may be noise or vibration sensitive.	7. Section 12.1 8. Section 12 9. Section 12.1 10. Section 12.1 11. Section 12.1, 12.2
3.9.2 Potential impacts and mitigation measures 3.9.2.1 General 1. This section defines and describes the objectives and practical measures for protecting or enhancing environmental values and characteristics from impacts by noise and vibration, describes how nominated quantitative standards and indicators may be achieved for noise and vibration management, and how the achievement of the objectives will be monitored, audited and managed. 2. The likely noise impacts upon existing residents from both construction and operation of the Project must be detailed. 3. The potential environmental impact of noise and vibration at all potentially sensitive places, in particular, any place of work or residence must be assessed in terms of noise objectives and standards to be achieved. Particular	1. Section 12.2, 12.3 2. Section 12.2, 12.3 3. Section 12.2, 12.3, 14, 15 4. Section 12.1 5. Section 12.1, 12.2, 12.3 6. Section 12.1, 12.2, 12.3 7. Section 12.1 8. Section 12.1 9. Section 12.1

Terms of Reference Section	Relevant EIS Section
consideration must be given to emissions of low-frequency noise; that is, noise with components below 200Hz. The assessment must also include environmental impacts on terrestrial and marine animals and avifauna, particularly migratory species. Proposed measures for the minimisation or elimination of impacts must be provided, including details and illustrations of any screening, lining, enclosing or bunding. 4. Information must be supplied on blasting which might cause ground vibration or fly rock on or adjacent to, the site with particular attention given to places of work, residence, recreation, worship general amenity and fauna, particularly migratory marine fauna. The magnitude, duration and frequency of any vibration must be discussed. 5. The assessment must also address off-site noise and vibration impacts that could arise due to increased road transportation directly resulting from the Project. 3.9.2.2 Airstrip 6. In addition to expressing noise impact in terms of average measures, the EIS must include information and discussion about peak noise levels, frequency of overflights, and the times of day overflights could occur, compare maximum aircraft noise levels to existing ambient noise levels and characteristics without impacts from airstrip/aircraft noise, and discuss the effects of changes in noise exposure. 7. Fully assess the potential disturbance to everyday activities of the proposed development created by aircraft noise with reference to current research. This must include, but not necessarily be limited to: 8. Discussion of the impact of changes to the noise environment on interruptions to everyday activities (in particular, sleep disturbance resulting from night-time operations), level of annoyance and effects on the physical and psychological health of the affected population and groups of people who may be especially vulnerable to such effects. 9. Discussion on the implications of aircraft noise on sensitive times of the day (e.g. late evening and early morning) and any proposed noise mitigation strategies; and 10. Discussion of aircraft noise impacts on existing or proposed recreational, conservation, residential, heritage or wilderness areas, including impacts on amenity and the wildlife using those areas. 3.10 Nature conservation 3.10.1 Description of environmental values and characteristics 1. This section describes the existing environment values for nature conservation that may be affected by the Project, including indirect or subsequent impacts on parts of Hummock Hill Island outside the lease and development footprint, surrounding waters, and ecosystems affected by infrastructure corridors. Describe the environmental values and characteristics of nature conservation for the affected area in terms of:	10. Section 12.1.1, 12.2
3.10.1 Description of environmental values and characteristics 1. This section describes the existing environment values for nature conservation that may be affected by the Project, including indirect or subsequent impacts on parts of Hummock Hill Island outside the lease and development footprint, surrounding waters, and ecosystems affected by infrastructure corridors. Describe the environmental values and characteristics of nature conservation for the affected area in terms of:	1. Section 14.1, 15.1 2. Section 14.2, 15.1, Appendix A3, Appendix A7 3. Section 14.2, 15.1

Terms of Reference Section	Relevant EIS Section
2. Integrity of ecological processes, including habitats of terrestrial, aquatic and marine rare and threatened species or geographically restricted, locally endemic or scientifically significant species or populations; 3. Conservation of resources; 4. Biological diversity, including vegetation communities and habitats of rare and threatened species geographically restricted, locally endemic or scientifically significant species or populations; 5. Integrity of landscapes; and 6. Aquatic, riparian, riverine, freshwater, marine and terrestrial ecosystems. 7. The nature conservation values of the areas likely to be affected by the Project. 8. The EIS must identify issues relevant to sensitive areas, or areas, which may have, low resilience to environmental change. Project proximity to any biologically sensitive areas must be described. 9. Reference must be made to both State and Commonwealth endangered species legislation and the location of the area within a World Heritage property. 10. The VM Act and the findings of any regional vegetation management plan must also be referenced. 11. The occurrence of pest plants and animals in the Project area must be described. 12. Provide details on the likely occurrence of and impacts from mosquito and biting midge populations on future residents of the Project and the proposed mitigation measures to be employed. 13. Key flora and fauna indicators must be identified for future ongoing monitoring. 3.10.1.1 <i>Flora</i> 14. A map at a suitable scale must be provided for terrestrial and intertidal vegetation. The Regional Ecosystems and vegetation management and biodiversity conservation status must be described. Sensitive or important vegetation types must be highlighted. The existence of rare or threatened species must be specifically addressed. The surveys must include species structure, assemblage, diversity and abundance. 15. Any variation between regional ecosystem mapping in the EIS and the current regional ecosystem mapping prepared by the Environmental Protection Agency must be highlighted and justified. 16. The existence of important local and regional weed species must also be discussed with consideration given to identify weed species and potential for establishment of weeds arising from the importation of fill. 17. Vegetation mapping must provide vegetation mapping for all relevant Project sites including new infrastructure routes. 18. The vegetation communities within the affected areas must be described at an appropriate scale with mapping produced from aerial photographs and ground truthing, showing the following: ▪ Location and extent of vegetation types using the EPA's regional ecosystem type descriptions in accordance	4. Section 14.2, 15.1 5. Section 14.2, 14.3 6. Section 14.2.2, 15.1 7. Section 14.2.2, 14.3.1, 15.1.1, 15.1.3 8. Section 14.2.1, 14.2.2, 15.1 9. Section 14.2.2, 14.2.3, 15.1.1, 15.1.3, 15.1.4 10. Section 14.2.3 11. Section 14.3.1 12. Section 14.2.4 13. Section 14.2.3 14. Section 14, 15 15. Section 14 16. Section 14.2.3, 14.3.1, 14.4.1 17. Section 14.2.2, 15.1.1, 15.1.2 18. Section 14 19. Section 14.2.1, 14.2.2, Appendix A7 20. Section 14.2.2 21. Section 14.2.2 22. Section 14.2.2 23. Section 14.2.2 24. Section 5, 14.2.3, 14.4.1 25. Section 14.2.2

Terms of Reference Section	Relevant EIS Section
with the Regional Ecosystem Description Database [REDD] available at the EPA's website; ▪ Location of vegetation types of conservation significance based on EPA's regional ecosystem types and occurrence of species listed as protected plants under the Nature Conservation (Wildlife) Regulation 1994 and subsequent amendments, as well as areas subject to the VM Act; ▪ The current extent (bioregional and catchment) of protected vegetation types of conservation significance within the protected area estate (national parks, conservation parks, resource reserves, nature refuges); ▪ Any plant communities of cultural, commercial or recreational significance must be identified; and ▪ Location and abundance of any exotic or weed species. 19. Site data must be recorded in a form compatible with the Queensland Herbarium CORVEG database; 20. A complete list of species present at each site must be recorded; 21. The relative abundance of plant species present must be recorded; 22. Any plant species of conservation, cultural, commercial or recreational significance must be identified; and 23. Specimens of species listed as protected plants under the Nature Conservation (Wildlife) Regulation 1994, other than common species, are to be submitted to the Queensland Herbarium for identification and entry into the HERBRECS database. 3.10.1.2 Terrestrial fauna 24. The terrestrial and riparian fauna occurring in the areas affected by the Project must be described, noting the broad distribution patterns in relation to vegetation, topography and substrate. The description of the fauna present or likely to be present in the area must include: 25. Species diversity and abundance of animals, including amphibians, birds, reptiles, mammals and bats; 26. Any rare or threatened species that is suspected (but not confirmed) to occur on the site; 27. Habitat requirements and sensitivity to changes; including movement corridors and barriers to movement; 28. The location and estimated population of feral or exotic animals; 29. Existence of any rare, threatened or otherwise noteworthy species/communities in the study area, and specifically any species for which essential habitat has been mapped for the purposes of the VM Act, including discussion of range, habitat, breeding, recruitment, feeding and movement requirements, and current level of protection; and 30. Use of the area by migratory birds, nomadic birds, fish and terrestrial fauna. 31. The EIS must indicate how well any affected communities are represented and protected elsewhere in the province where the site of the Project occurs. 3.10.1.3 Aquatic biology General	26. Section 14.2.2 27. Section 14.2.2 28. Section 14.3.1 29. Section 14.2.2 30. Section 14.2.2 31. Section 14.2.3 32. Section 15.1 33. Section 15.1.3 34. Section 15.1.4 35. Section 15.13 36. Section 15.1.2 37. Section 15.1.2 38. Section 15.1.2 39. Section 15.1.5, 15.1.6 40. Section 15.1.1, 15.1.2, Appendix A7 41. Section 15.1.1, Appendix A7 42. Section 15.1.1, 15.1.2, 15.1.3 43. Section 15.1.1, 15.1.5, 15.1.6 44. Section 15.1.1, 15.1.5, 15.1.6, Appendix A7 45. Section 15.1.5, 15.1.6 46. Section 15 47. Section 15.1.1, 15.1.2, 15.1.3

Terms of Reference Section	Relevant EIS Section
32. The aquatic flora and fauna occurring in the areas affected by the Project must be described from recent biota surveys/studies using quantitative and qualitative ecological data, noting the patterns and distribution in the waterways and/or associated lacustrine and marine environments. The description of the fauna and flora present or likely to be present in the area must include: 33. Fish species, mammals, reptiles, amphibians, crustaceans and aquatic invertebrates occurring in the waters within and adjoining the affected area, and/or those in any associated lacustrine and marine environment; 34. Any rare or threatened marine species, particularly dugong, marine turtles and their habitats; 35. The location and frequency of use (historical and current) of turtle nesting beaches, and the species of turtles using the rookery; 36. Aquatic plants, cyanobacterium (e.g. <i>Lyngbya</i> sp.) and marine algae; 37. Aquatic and benthic habitats; and 38. Habitat downstream of the Project or potentially impacted due to currents in associated lacustrine and marine environments. <i>Fisheries Impacts</i> 39. Detail the commercial, recreational and indigenous fishing activities in the Hummock Hill Island area that have the potential to be impacted. Specific points to include: 40. Nature and extent of fish habitats, including seagrass (permanent and ephemeral), macro-algae, mangrove and saltcouch communities and sand bars/mudflats, mapped relative to existing features for reference; 41. Location of declared Fish Habitat Areas proximal to the proposed development site; 42. Types and spatial distribution of economically important fish species, inc their migration requirements; 43. Nature, timing and spatial distribution of the respective fishing sectors; 44. Immediate and longer term impacts on existing fish habitats, fish populations, migrations and sectoral fishing activities; 45. Benefits to the fishing sectors; and 46. Measures to be employed to minimise the impacts on fisheries resources in and adjacent to the proposed development footprint both during and post construction. 47. Surveys for seagrass and algae should reflect the seasonal variation in occurrence and density of these communities. The location and density of marine plants should be mapped at an appropriate scale. 48. Detail the potential environmental impacts in the short term to flora and fauna communities from the direct effects of any dredging works.	48. Section 15.1.2 49. Section 15.3

Terms of Reference Section	Relevant EIS Section
49. Any offsets (mitigation) for impacts on fish habitats, fish and fisheries activities needs to be identified and quantified with regard to government policies, including the Department of Primary Industries and Fisheries policy "Mitigation and compensation for activities causing marine fish habitat loss."	
3.10.2 Potential impacts and mitigation measures - This section defines and describes the objectives and practical measures for protecting or enhancing nature conservation values, describes how nominated quantitative standards and indicators may be achieved for nature conservation management, and how the achievement of the objectives will be monitored, audited and managed. - The EIS must address any actions of the Project or likely impacts that require an authority under the NC Act, and/or would be assessable development for the purposes of the VM Act. - The discussion must cover all likely direct and indirect environmental impacts due to the Project on flora and fauna particularly environmentally sensitive areas and species that have local, state, national and international significance. - Identify the location of existing bat colonies, and the location of historically used colony sites, relative to the proposed development. Describe the risk to any colony sites as a result of community health concerns related to droppings and intolerance of noise and odour. - The potential environmental impacts on flora and fauna due to any alterations to the long term hydrodynamic processes of adjacent coastal environments must be discussed with specific reference to environmental impacts on riparian vegetation or other sensitive vegetation communities including mangrove stands and seagrass meadows. - Assess impacts on the nature conservation values of the marine park values through increased marine traffic and visitation, with specific consideration of boat strike frequency for dugong and turtle. The potential demand for high speed ferry connection to Gladstone and marina facilities should be discussed in relation to potential future impacts on marine park values. - Discuss potential human impacts resulting from recreational use of the island, unauthorised activities such as tree clearing and waste disposal, use of trail bikes, horses and four wheel drives, and introduction of domestic animals. Strategies for protecting the Great Barrier Reef Marine Park and World Heritage Property in the vicinity of Hummock Hill Island, and any rare or threatened species must be described, and any obligations imposed by State or Commonwealth legislation or policy or international treaty obligations must be discussed. - An assessment of the potential impacts of altered lighting and noise environments on terrestrial and marine fauna, including a discussion of measures to reduce such impact must be undertaken. - An assessment on the extent of direct and potential long term remnant vegetation degradation/ loss, including a description of its vegetation management and biodiversity conservation status must be performed.	- Section 14.3, 14.4 - Section 14.4 - Section 14.3 - Section 14.2.3, 14.3.1, 14.4.1 - Section 8, 14, 15 - Section 15 - Section 14 - Section 14.3.1 - Section 14.3.1 - Not applicable - Section 14.3.1, 14.4.1 - Section 11, 14.3.1, 15 - Section 14 - Section 14 - Section 14.3.1, 14.4.1 - Section 18.2.4 - Section 14.3.1, 14.4.1 - Section 14.3.1, 14.4.1

Terms of Reference Section

Relevant EIS Section

10. Strategies for collecting and preserving any significant fossils must be described.
11. Potential environmental impacts to the ecological values of the area arising from the construction and operation of the Project including clearing, salvaging or removal of vegetation must be described, and the indirect effects on remaining vegetation must be discussed. Short-term and long-term effects must be considered with comment on whether the impacts are reversible or irreversible. Mitigation measures and/or offsets must be proposed for adverse impacts.
12. Assessment of potential impacts from construction and operation of the development must cover the lease area, remaining land on the island, and areas affected by infrastructure associated with the development and consider ongoing issues such as fire management, recreational management, unapproved waste disposal, domestic animal control and weed control.
13. Mitigation assessment must be addressed in terms of avoidance, redesign or relocation, onsite offsets and offsite offsets.
14. The responsibility and commitment for post-construction mitigation measures need to be clearly defined.
15. The potential environmental impacts on flora and fauna due to any alterations to the local surface and ground water environment must be discussed with specific reference to environmental impacts on riparian vegetation or other sensitive vegetation communities.
16. Quantify the extent of vegetation clearing and trimming required to achieve aircraft obstacle limitation surface requirements and to limit the risk of impact with flying fauna. Quantify the hazard to aircraft presented by birds and bats and discuss measures proposed to achieve acceptable risk.
17. The provision of buffer zones and movement corridors, and strategies to minimise environmental impacts on migratory, nomadic and aquatic animals must be discussed. Particular consideration must be given to the movement of fauna between the eastern and western sections of the island and the effect of opening a road to the proposed jetty site.
18. Weed management strategies are required for containing existing weed species and ensuring no new declared plants are introduced to the area. Feral animal management strategies and practices must also be addressed. The EIS must outline strategies to ensure that the Project does not contribute to increased encroachment of a feral animal species.

3.11 Cultural heritage

3.11.1 Description of environmental values and characteristics

1. This section describes the existing cultural heritage values that may be affected by the Project.

3.11.1.1 Indigenous Cultural Heritage

1. Section 13.1, 13.3
2. Section 13.1.1, 13.2

Terms of Reference Section	Relevant EIS Section
2. An Indigenous cultural heritage study must be conducted by a suitably qualified expert that must include the following: ▪ Notification, as required by the ACHA, to the Chief Executive of NR&W, Miriam Vale Shire Council (only if owner or occupier of the subject land), and the registered Native Title Claimants, who are the Aboriginal Parties under the ACHA; ▪ Endorsement of those Aboriginal Parties who respond to the notification; ▪ Consultation with the Aboriginal Parties about their involvement in the development of the CHMP, and about outcomes; ▪ Compliance with the Duty of Care Guidelines and the CHMP Guidelines as gazetted; ▪ Seeking approval of the CHMP from the Chief Executive, NR&W, through the EIS process; ▪ Liaison with the Aboriginal Parties concerning: places of significance to that community (including archaeological sites, natural sites, story sites etc; and appropriate community involvement in field surveys; ▪ Any requirements by communities and /or informants relating to confidentiality of site data must be highlighted. Non-Indigenous communities may also have relevant information; ▪ A search of both the Cultural Heritage register and the Cultural Heritage database; ▪ A systematic survey of the proposed development area to locate and record Indigenous cultural heritage places; ▪ Significant assessment of any cultural heritage sites/places located; ▪ The impact of the proposed development on cultural heritage values; and ▪ A report of work done which includes background research, relevant environmental data and methodology, as well as results of field surveys, significance assessment and recommendations. 3.11.1.2 <i>Non-Indigenous Cultural Heritage</i> 3. The cultural heritage study must be conducted by a suitably qualified expert and will require: A systematic survey of the proposed development area to locate and record non-Indigenous cultural heritage places; Significance assessment of any cultural heritage sites/places located; The impact of the proposed development on cultural heritage values; Consultation regarding non-indigenous cultural heritage values within the study area with relevant community groups (eg historical society, museum organisation, and conservation groups); and A report of work done which includes background research, relevant environmental data and methodology, as well as results of field surveys, significance assessment and recommendations.	3. Section 13.1.2, 13.2

Terms of Reference Section	Relevant EIS Section
3.11.2 Potential impacts and mitigation measures 1. This section defines and describes the objectives and practical measures for protecting or enhancing cultural heritage environmental values and characteristics, describes how nominated quantitative standards and indicators may be achieved for cultural heritage management, and how the achievement of the objectives will be monitored, audited and managed. The CHMP must address and include the following: 2. A process for including Aboriginal/Torres Strait Islander people associated with the development areas in protection and management of Indigenous cultural heritage; 3. Processes for mitigation, management and protection of identified cultural heritage places and material in the Project areas, including associated infrastructure developments, both during the construction and operational phases of the Project; 4. Provisions for the management of the accidental discovery of cultural material, including burials; 5. The monitoring of foundation excavations and other associated earthwork activities for possible subsurface cultural material; 6. Cultural awareness training or programs for Project staff; and 7. A conflict resolution process.	1. Section 13.3, 13.4 2. Section 13.1 3. Section 13.4 4. Section 13, Appendix A7 5. Section 13.2 6. Section 20 7. Section 13, Appendix A7
3.12 Social	
3.12.1 Description of environmental values and characteristics 1. Describe the social values for the affected area in terms of the integrity of social conditions, including amenity and liveability, harmony and well-being, sense of community, access to recreation, and access to social and community services and infrastructure. 2. The social amenity and use of the Project area and adjacent areas for rural, agricultural, forestry, fishing, recreational, industrial, educational or residential purposes must be described. Provide details on: 3. Community infrastructure and services, access and mobility; 4. Population and demographics of the affected community; 5. Local community values, vitality and lifestyles; 6. Recreational, commercial, tourism, indigenous, cultural, leisure and sporting facilities and activities in relation to the affected area; 7. Health and educational facilities;	1. Section 16.1.1 2. Section 16 3. Section 16.1.6 4. Section 16.1.2 5. Section 16.1.1, 16.1.9 6. Section 16.1.1, 16.1.6, 16.1.8 7. Section 16.1.6 8. Section 16.1.5 9. Section 16.1.5 10. Section 16.1.2

Terms of Reference Section	Relevant EIS Section
8. Current property values; 9. Number of properties directly affected by the Project; and 10. Number of families affected by the Project, this must include not only property owners but also families of workers either living adjacent the site or workers where the area is their primary employment.	
3.12.2 Potential impacts and mitigation measures 1. This section is to define and describe the objectives and practical measures for protecting or enhancing social values, describes how nominated quantitative standards and indicators may be achieved for social impacts management, and how the achievement of the objectives will be monitored, audited and managed. 2. The social impact assessment of the Project must describe the Project's impact, both beneficial and adverse, on the local community. The impacts of the Project on local and regional residents, community services and recreational activities are to be analysed and discussed for all stages of the development. The nature and extent of the community consultation program are to be described and a summary of the results incorporated in the EIS. 3. The summary must discuss how the impacts of population increase on public services, particularly health, emergency services and education, would be mitigated. 4. The social impact assessment must describe the likely response of affected communities and identify possible beneficial and adverse impacts. These impacts must be considered both at the regional and local level. The EIS must address the following matters: 5. Include an assessment of impacts on local residents, current land uses and existing lifestyles and enterprises; 6. A baseline analysis of the existing housing market; 7. Impacts of both construction and operational workforces and associated contractors on housing demand, community services and community cohesion is to be addressed. The capability of the existing housing stock, including rental accommodation, to meet any additional rental demands created by the Project is to be discussed; 8. Existing housing market, particularly rental accommodation which may be available for the Project workforce; 9. Development of an accommodation management strategy, where necessary, in consultation with the Department of Housing; 10. How much service revenue and work from the Project would be likely to flow to existing communities in the area of the Project; 11. An assessment of impacts on local and state labour markets, with regard to the source of the workforce; 12. The EIS must address impacts of both construction and operational workforces and associated contractors on housing demand, community services and community cohesion; 13. The assessment of impacts must take account of relevant demographic, social, cultural and economic profiles;	1. Section 16.2 2. Section 16.2 3. Section 16.2.5 4. Section 16.2 5. Section 16.2 6. Section 16.2.4 7. Section 16.2 8. Section 16.2 9. Section 16.2 10. Section 16.2 11. Section 16.2.3 12. Section 16.2 13. Section 16.2 14. Section 16.2 15. Section 16.2.2 16. Section 16.2.8 17. Section 16.2 18. Section 16.2 19. Section 16.2.5 20. Section 16.2 21. Section 16

Terms of Reference Section	Relevant EIS Section
14. Identify any new skills and training to be introduced in relation to the Project. Adequate provision must be made for apprenticeship and worker training schemes; 15. Include an assessment of impacts on existing local residents' values and aspirations; and 16. In regard to affected Indigenous and non-Indigenous communities respectively, particular attention must be paid to the effects on: ▪ the ability of both indigenous and non-indigenous people, to live in accordance with their own values and priorities; ▪ the use of and access to culturally important areas and landscapes; ▪ the access to existing human and commercial services and housing; and ▪ the ability to participate in regional and local employment and training opportunities; 17. Describe the effects of the Project on local and regional residents, including land acquisition and relocation issues and property valuation and marketability, community services and recreational activities. 18. Discuss the potential environmental impacts on the amenity of adjacent areas used for cropping, grazing, forestry, recreation, industry, education, aesthetics, and scientific or residential purposes. The educational impacts of the proposed development are to be analysed and described, particularly in regard to: 19. Primary, secondary and tertiary educational sectors; 20. Improved appreciation of conservation areas; and 21. Environmental education for the general public.	
3.13 Health and safety	
3.13.1 Description of environmental values and characteristics 1. This section describes the existing community values for public health and safety that may be affected by the Project. 2. Consideration must also be given to health and safety aspects of erosion control structures and water storages or other structures that may impact on public health and safety especially for children in and near waterways and drainage infrastructure.	1. Section 18.1.1 2. Section 18.1
3.13.2 Potential impacts and mitigation measures 1. This section defines and describes the objectives and practical measures for protecting or enhancing health and safety community values and how nominated quantitative standards and indicators may be achieved for social impacts management, and how the achievement of the objectives will be monitored, audited and managed. 2. The EIS must assess the effects on the Project workforce of occupational health and safety risks and the impacts on the community in terms of health, safety, and quality of life from Project operations and emissions.	1. Section 18.1.2 2. Section 18.2 3. Section 9 Figure 9.1 4. Section 18.1.2, 18.2.5 5. Section 18.1.2

Terms of Reference Section	Relevant EIS Section
3. Map(s) must be provided showing the locations of sensitive receptors. 4. The EIS must address the Project's potential for providing disease vectors. Measures to control mosquito and biting midge breeding must be described. Any use of recycled water must be assessed for its potential to cause infection by the transmission of bacteria and/or viruses by contact, dispersion of aerosols, and ingestion. Similarly, the use of recycled water must be assessed for its potential to cause harm to health via the food chain due to contaminants such as heavy metals and persistent organic chemicals. 5. Any health or safety issues associated with the feral pigs that frequent the site must be assessed. 6. Practical monitoring regimes	6. Section 18.2
3.14 Economy	
3.14.1 Description of environmental values and characteristics This section describes the existing economic environment that may be affected by the Project. The character and basis of the local and regional economies must be described including: 1. Economic viability (including economic base and economic activity, future economic opportunities, current local and regional economic trends, in particular drought and rural downturn etc); and 2. Historical descriptions of large-scale developments and their effects in the region and the likelihood that similar effects may occur from the proposed development. 3. The economic impact statement must include estimates of the opportunity cost of the Project and the value of ecosystem services provided by natural or modified ecosystems to be disturbed or removed during development.	1. Section 17.1 2. Section 17.1 3. Section 17.4.2
3.14.2 Potential impacts and mitigation measures 1. The function of this section is to define and describe the objectives and practical measures for protecting or enhancing economic values and to describe how nominated quantitative standards and indicators may be achieved for economic management, and how the achievement of the objectives will be monitored, audited and managed. 2. The effect on local and State labour markets must be discussed with regard to the source of the workforce. In relation to the source of the workforce, clarification is required as to whether the proponent, or contractors, are likely to employ locally or through other means and whether there are initiatives for local employment opportunities. The capability of the existing housing stock, particularly rental accommodation, to meet any additional demands created by the Project must be discussed. 3. Any new skills and training to be introduced in relation to the Project must be identified. Adequate provision must be made for apprenticeship and worker training schemes. 4. An economic analysis, including a cost-benefit analysis, must be presented from national, state, regional and local perspectives as appropriate to the scale of the Project.	1. Section 17.2 2. Section 16.2, 17.2 3. Section 16.2, 17.1 4. Section 17.4.1 5. Section 17.2, 17.4 6. Section 17 7. Section 17.2 8. Section 17 9. Section 17.3 10. Section 17 11. Section 16.1

Terms of Reference Section	Relevant EIS Section
At a level of detail appropriate to the scale of the Project, the analysis is to consider: - The significance of this Project on the local and regional economic context; - The long and short-term beneficial and adverse impacts that are likely to result from the development; - The cost to all levels of government of any additional infrastructure provision; - Implications for future development in the locality; - The distributional effects of the Project including proposals to mitigate any negative impact on disadvantaged groups; - The value of lost opportunities or gained opportunities for other economic activities anticipated in the future; and - Impacts on local property values. - Attention must be directed to the long and short-term effects of the Project on the land-use of the surrounding area and existing industries, regional income and employment and the state economy. - For identified negative impacts to economic values, suggest mitigatory and enhancement strategies and facilitate initial negotiations towards acceptance of these strategies.	- Section 17.2 - Section 17.2, 17.3
3.15 Hazard and risk	
3.15.1 Description of environmental values and characteristics <i>3.15.1.1 General</i> - This section describes the potential hazards and risk that may be associated with the Project. - Detail the environmental values and characteristics likely to be affected by any hazardous materials and actions incorporated in the Project. - An analysis is to be conducted into the potential impacts of both natural and induced emergency situations and counter disaster and rescue procedures as a result of the Project on sensitive areas and resources such as forests, water reserves, State and local Government controlled roads, places of residence and work, and recreational areas. Additional issues to be discussed include: - Security issues (during construction and once operational); - Identification of types of dangerous goods to be used both during the construction and during operational stages including any additional onsite refuelling storage, procedures to minimise adverse environmental impacts; - An assessment of fire risks and discuss fire control and management proposals along with details of fire safety measures for treatment of hazardous material spills; - Development and implementation of emergency plans, procedures and notifications and the identification and provision of emergency services and resources both on and off-site; - Information on access points to the airstrip for accidents and/or Medivac retrievals during the construction and	- Section 18.2, Appendix A7 - Section 18.2 - Section 18.2.3 - Section 18 - Section 18.2.3 - Section 18.2.3 - Section 18.2.3 - Section 18 - Section 18.2.3 - Section 18.2.3 - Section 18.2.4 - Section 18.2.4 - Section 18.2.4 - Section 14

Terms of Reference Section	Relevant EIS Section
operational stage, including alternative access in the event of gridlock during construction; 9. A description of relationships with disaster control organisations including command and control; and 10. Measures to reduce the risk of hazardous incidents affecting the public and environment. 3.15.1.2 Airstrip hazards and risk Quantitative risk assessment to assess the impacts on individual and societal risk levels. This must include the following: 11. Probability analysis of aircraft accidents with reference to aircraft incidents within Australia; 12. Consequences of aircraft accidents; 13. The effect of flight paths and frequency of aircraft movements on the risk of accidents involving residential and industrial areas; 14. Identification of sites on or near the airstrip that attract birds or bats and the typical routes used by birds and bats taking into account seasonal variation; and 15. The relative risk of bird strike, including quantitative and qualitative discussion of: ▪ How the risk of bird strike is to be managed; ▪ How successful planned measures are likely to be; and ▪ What the consequences of that level of risk are expected to be.	15. Section 18.2.4
3.15.2 Potential impacts and mitigation measures 3.15.2.1 General 1. This section defines and describes the objectives and practical measures for protecting people and places from hazards and risk, describes how nominated quantitative standards and indicators may be achieved for hazard and risk management, and how the achievement of the objectives will be monitored, audited and managed. The EIS must provide a discussion of the classes of substances listed in the Australian Dangerous Goods Codes that are expected to be held on-site. Details must be provided, to the greatest extent possible, of: 2. Safeguards proposed on the transport, storage, use, handling and on-site movement of the materials to be stored on-site; 3. The capacity and standard of bunds to be provided around the storage tanks for classified dangerous goods and other goods likely to adversely impact upon the environment in the event of an accident; and 4. The procedures to prevent spillages, and the emergency plans to manage hazardous situations. 5. The proponent must develop an integrated risk management plan for the whole of the life of the Project including construction and operation phases. The plan must include a preliminary hazard analysis, conducted in accordance with appropriate guidelines for hazard analysis. The assessment must outline the implications for and the impact on the surrounding land uses, and must involve consultation with Department of Emergency Services, Queensland Fire	1. Section 18.2.2, 18.2.5 2. Section 18.2.3 3. Section 18.2.3 4. Section 18.2.3 5. Section 18.2.3 6. Section 18.2.2, 18.2.3 7. Section 18.2.3 8. Section 18.2.2 9. Section 18.2.3 10. Section 18.2.3 11. Section 14, 15, 18 12. Not applicable at this stage 13. Section 18.2.3

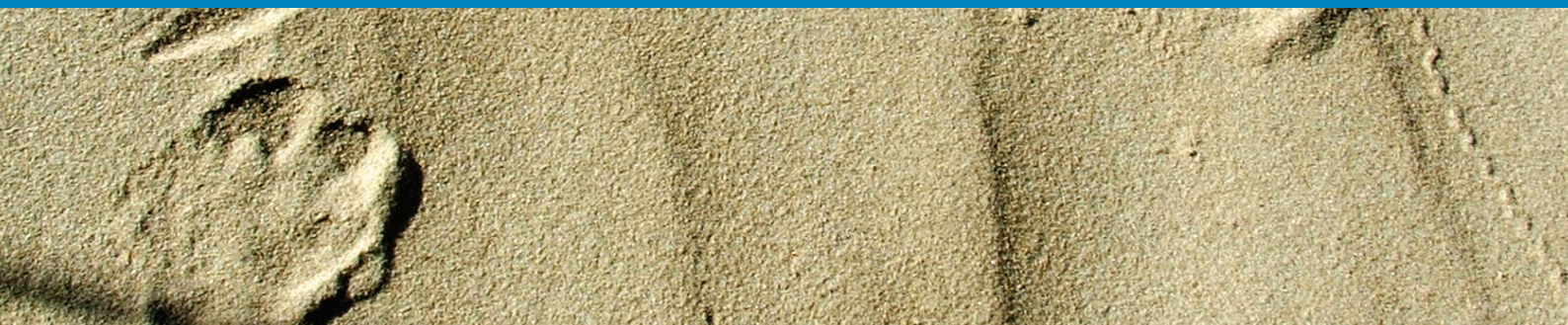
Terms of Reference Section	Relevant EIS Section
and Rescue Authority, and Queensland Ambulance Service. The preliminary hazard analysis must incorporate, where appropriate: 6. All relevant major hazards both technological and natural; 7. The possible frequency of potential hazards, accidents, spillages and abnormal events occurring; 8. Indication of cumulative risk levels to surrounding land uses; 9. A list of all hazardous substances to be used, stored, processed, produced or transported, life and the rate of usage; 10. Description of processes, type of the machinery and equipment used; 11. Potential wildlife hazards such as crocodiles, snakes, and disease vectors; and 12. Public liability of the State for private infrastructure and visitors on public land. 13. The plan must include the following components: ▪ Operational hazard analysis; ▪ Regular hazard audits; ▪ Fire safety, emergency response plans; ▪ Qualitative risk assessment; and ▪ Construction safety. 14. Describe the possible risks of a single access road for the proposed development, e.g. access by emergency vehicles if the road is blocked as a result of a natural disaster. 15. Report on consultation with Emergency Management Queensland regarding the proposed utilisation of the onsite airstrip for helicopter evacuation in relation to emergency response issues. 16. State Planning Policy 1/03 - Mitigating the adverse impacts of flood, bushfire and landslide must be addressed. 3.16 Cross-reference with the terms of reference 1. This section provides a cross reference of the findings of the relevant sections of the EIS, where the potential impacts and mitigation measures associated with the Project are described, with the corresponding sections of the ToR.	14. Section 6 15. Appendix A5 16. Section 18.2.3
4.0 ENVIRONMENTAL MANAGEMENT PLAN The EM Plan is to provide: 1. Commitments by the proponent to practical and achievable strategies and design standards (performance specifications) for the management of the Project to ensure that environmental requirements are specified and complied with; 2. An integrated plan for comprehensive monitoring and control of impacts; 3. Local and State authorities, stakeholders and the proponent with a common focus for approvals conditions and	1. Section 19
4.0 ENVIRONMENTAL MANAGEMENT PLAN The EM Plan is to provide: 1. Commitments by the proponent to practical and achievable strategies and design standards (performance specifications) for the management of the Project to ensure that environmental requirements are specified and complied with; 2. An integrated plan for comprehensive monitoring and control of impacts; 3. Local and State authorities, stakeholders and the proponent with a common focus for approvals conditions and	1. Section 20 2. Section 20 3. Section 20 4. Section 20 5. Section 20 6. Section 20

Terms of Reference Section	Relevant EIS Section
compliance with policies and conditions; and 4. The community with evidence that the environmental management of the Project is acceptable. EM Plans must commit to manage, enhance or protect identified environmental values and characteristics. The commitments must contain the following components for performance criteria and implementation strategies: 5. Environmental protection objectives for enhancing or protecting each relevant value; 6. Indicators to be measured to demonstrate the extent to which the environmental protection objective is achieved; 7. Environmental protection standards (a numerical target or value for the indicator), which defines the achievement of the objective; and 8. An action program to ensure the environmental protection commitments are achieved and implemented. This will include strategies in relation to: ▪ continuous improvement; ▪ environmental auditing; ▪ monitoring; ▪ reporting; ▪ staff training; and ▪ a rehabilitation program for land proposed to be disturbed under each relevant aspect of the proposal. 9. It is expected that all EM Plans will be prepared in accordance with the EPA Guideline "Preparing Environmental Management Plans" and its recommended structure for EM Plans. While this EPA guideline has been developed primarily for the mining industry, the principles are in general applicable to this proposal. The general contents of the EM Plan must comprise: 10. The proponent's commitments to acceptable levels of environmental performance, including environmental objectives, i.e. levels of expected environmental impacts, performance standards and associated measurable indicators, performance monitoring and reporting; 11. Impact prevention or mitigation actions to implement the commitments; and 12. Corrective actions to rectify any deviation from performance standards. 5.0 PROPONENT'S ENVIRONMENTAL RECORD This section must provide: 1. Eaton Place Pty Ltd needs to provide details of any Australian proceedings relating to an environmental law against it, its parent company or members of the Board of Directors. 2. Eaton Place Pty Ltd. must supply information regarding any applicants for permits under an environmental law for the Project.	7. Section 20 8. Section 20 9. Section 20 10. Section 20 11. Section 20 12. Section 20
	1. Section 1.2 2. Section 1.2 3. Section 1.2

Terms of Reference Section		Relevant EIS Section
3. Furthermore, details of Eaton Place Pty Ltd's environmental policy and planning framework must be incorporated into the EIS.		
6.0 CONCLUSIONS AND RECOMMENDATIONS This section must: 1. Make conclusions and recommendations with respect to the proposal, based on the studies presented, the Environmental Management Plans and conformity of the proposal with legislative and policy requirements.		1. Section 21
7.0 REFERENCES 1. All references consulted must be presented in the EIS in a recognised format such as the Harvard standard		1. Section 22



SECTION 20 ENVIRONMENTAL MANAGEMENT PLANS





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20. Environmental Management Plans

20.1 Project Description

The proposed Hummock Hill Island Development is a master planned integrated tourism and residential development to provide a holiday destination for tourists and recreational facilities for residents of the Gladstone district. The project will consist of two resort hotels, camping grounds, holiday accommodation and residential development, golf course and associated sporting facilities, education precinct, a small commercial centre, and small scale marine commercial facilities. The proposed community will consist of an estimated 2,300 tourists and 1,600 residents (at 100% capacity). This population will be achieved over a period of 15 years.

The development will provide public access to the beach between 1770 and the Capricorn Coast. This beach and the surrounding waterways are presently only accessible by boat. However, once the access road and the bridge to the Island are constructed, residents and workers of Gladstone will be able to access the Island in 45 minutes.

Hummock Hill Island and adjacent estuaries are located within the Great Barrier Reef World Heritage Area, the State administered Great Barrier Reef Coastal Marine Park and borders the Mackay/Capricorn Great Barrier Reef Marine Park (administered by the Commonwealth). Directly East of the Island is the Eurimbula National Park which is situated on Rodds Peninsula and to the north west is Wild Cattle Island National Park.

About two thirds of the development lease and the remainder of the Island will not be developed and will be managed (via a special area levy) for conservation values and compatible recreational usage. Development will avoid areas of endangered regional ecosystems. Areas that are disturbed for development will be managed to maximise preservation and maintenance of existing ecological functions. Appropriate guidelines (as a deed of covenant) will be developed to provide strategies and methods to reduce disturbance of ecosystems to a minimum and ensure that ecological function is maintained. Where disturbance does occur, guidelines will establish criteria for the rehabilitation and ongoing maintenance, with an emphasis on compatible species and water efficient irrigation.

The many elements of the proposed development have been located with careful consideration to the existing conservation areas, topography of the site, utilisation of views and vistas, and integration within the natural landscape.

The development has been designed to fit in and around the existing environment, with minimal disturbance, and a sustainable outcome has been achieved. Ecologically Sustainable Development (ESD) principles have been the driver behind the design with Hummock Hill Island supporting a low impact master planned community.

20.2 EMP Overview

A number of recommendations have been made in this Environmental Impact Statement (EIS) in relation to the management of environmental impacts during the construction and operation of the



master- planned integrated tourist and residential community on Hummock Hill Island. These recommendations will require actions to be taken during the design, construction and operational life of the proposed community and associated infrastructure.

In order to ensure that these recommendations are implemented, a Draft Environmental Management Plan (EMP) has been developed for the project.

An outline of the Draft EMP is provided in this EIS to demonstrate the commitment of Eaton Place Pty Ltd (Eaton) to ensuring that the recommendations of this EIS are implemented. The implementation of the EMP will ensure that concepts and commitments given in the EIS are achieved so that the potential impacts of the construction and operation of the proposed infrastructure on the environment are minimised.

An EMP is a management tool used to assist in minimising impact to the environment. This EMP is therefore a dynamic document. It will be regularly updated to incorporate changes in environmental management procedures in light of ongoing monitoring results, new techniques and applicable technologies, legislation and environmental policies of the proponent in consultation with the relevant authorities. This EMP provides for ongoing environmental performance review and compliance monitoring.

The recommendations contained in this EMP will require key actions to be taken during the construction of the facilities on Hummock Hill Island. Where appropriate, contractors will take responsibility for further developing and implementing their individual (Environmental Management Plans (EMPs)). Such EMPs will also need to be updated to reflect specific conditions of permits and approvals issued for the project as well as changes in project design, construction methods or operating techniques. Where appropriate, a qualified environmental specialist should review any such changes to identify appropriate modifications to management strategies.

20.2.1 *Purpose and Objectives of the EMP*

The EMP reflects current:

- Regulatory requirements;
- Approval conditions and related policies commonly applied to this type of project to minimise identified environmental impacts; and
- industry practice environmental management.

The purpose of this EMP is to provide an environmental management framework and the procedures to minimise actual and potential environmental impacts arising from construction and operational activities.

It should be noted that the performance criteria, management actions and other requirements set out in this framework is based on current professional practice for environmental management. These requirements may be amended as additional information becomes available, provided that the overall intent of EMP is still achieved.



20.2.2 *Environmental Policy*

Eaton Place Pty Ltd recognises that environmental management is one of the primary management elements to be considered during the planning, design, construction and operation of the proposed community on Hummock Hill Island. Eaton Place Pty Ltd is committed to continual improvement of environmental performance as detailed in the Safety, Health and Environment (SHE) Policy. This EMP is developed in accordance with the SHE policy.

20.2.3 *Regulatory and Other Related Compliance Obligations*

In carrying out the activities related to the development of the master - planned Hummock Hill Island community, all parties involved have legal obligations in relation to the management of the environmental issues, risks and impacts arising from such activities. The concept of due diligence applies, i.e. all reasonable care must be taken to ensure that compliance with the relevant legislation is achieved. This EMP serves to ensure not only that such compliance is achieved, but that it can be clearly demonstrated. The Project environmental management representative will hold copies of relevant legislation, guidelines and standards on site during construction.

The paragraphs below highlight the environmental and other legislation, regulations and guidelines that are applicable to environmental management during the development of the community . The key aspects of these documents as they form the basis of this EMP are:

Legal responsibilities

- Compliance with the conditions of development approvals issued under the *Integrated Planning Act 1997* (IPA);
- Compliance with all other permits and approvals that have been obtained for this project, e.g. storage of fuels, oils and other dangerous goods,;
- Compliance with general environmental duty requirements stated in the *Environmental Protection Act 1994* (EPAAct): in carrying out any activity on the site that has the potential to cause environmental harm, all persons must implement all reasonable and practical measures to prevent or minimise that harm;
- Duty to notify environmental harm: if in carrying out activities on the construction site, environmental harm has been caused or is threatened, then notification of this must be given to the environmental administering authority.

Penalties under the legislation

- Under the IPA, penalties are primarily restricted to monetary fines for non- compliance with development approval conditions and enforcement notices that can require activities to be stopped, changed or newly undertaken;
- Under the EPAAct, penalties can range from low – level monetary fines (Penalty Infringement Notices) for initial, minor non-compliance with development approval or other permit



conditions to significant monetary fines and imprisonment (up to 2 years) for major non – compliance matters and/or causing environmental harm;

- A conviction under the EPAct is a ‘criminal’ conviction, resulting in a ‘criminal’ record that can have serious implications for other aspects of people’s lives, such as holding certain organisational positions, obtaining other environmental permits/approvals, etc.
- Being able to clearly demonstrate due diligence is the only defence to a (criminal) charge under the EPAct.

20.2.3.1 Commonwealth Legislation and Policies

Commonwealth Legislation, Strategies and Measures that have been considered in the development of this EMP, include:

- *Environmental Protection and Biodiversity Conservation Act 1999*;
- *Native Title Act 1993*;
- National Greenhouse Strategy 1998;
- National Waste Minimisation and Recycling Strategy 1992;
- National Environmental Protection Measure for Ambient Air (Air NEPM) 1998;
- National Environmental Protection (Assessment of Site Contamination) Measure 1999 (Contamination NEPM); and
- The National Strategy for Ecologically Sustainable Development 1992.

The commitments and guidance in this EMP provide direction in fulfilling the management practices and measures contained in the above documents.

20.2.3.2 Queensland State Legislation and Policies

Queensland Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) is the umbrella legislation for the regulatory management of the environment in Queensland. The spirit of the EP Act is based on self-regulation and duty of care which places the responsibility for protection of the environment on all persons during the conduct of all activities. The EP Act provides for the licensing of Environmentally Relevant Activities (ERAs) and the granting of Environmental Authorities for the operation of the regulated activities.

The EP Act also allows for the preparation of Environmental Protection Policies (EPPs). The following EPPs have been proclaimed:

- *Environmental Protection (Water) Policy 1997*;
- *Environmental Protection (Noise) Policy 1997*;
- *Environmental Protection (Air) Policy 1997*; and
- *Environmental Protection (Waste Management) Policy 2000*.



Other Queensland Legislation

In addition to the EP Act, other major legislation under which approvals may be required for either the construction or operation of the project includes the following:

- *Aboriginal Cultural Heritage Act 2003;*
- *Integrated Planning Act 1997;*
- *Nature Conservation Act 1994;*
- *Queensland Heritage Act 1992;*
- *Transport Infrastructure Act 1994;*
- *Vegetation Management Act 2000;*
- *Water Act 2000;*
- *Fisheries Act 1994;*
- *Dangerous Goods Safety Management Act 2001: and*
- *Workplace Health and Safety Act 1995.*

Guidelines

Other relevant Guidelines include:

- Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland (Dept of Environment, 1998);
- National Greenhouse Strategy, Queensland Implementation Plan 1999; and
- Soil Erosion and Sediment Control, Engineers Guidelines for Queensland.

The legislation, policy and guidelines listed above may either contain the required construction techniques and standards, or provide direction and guidance to those techniques and standards.

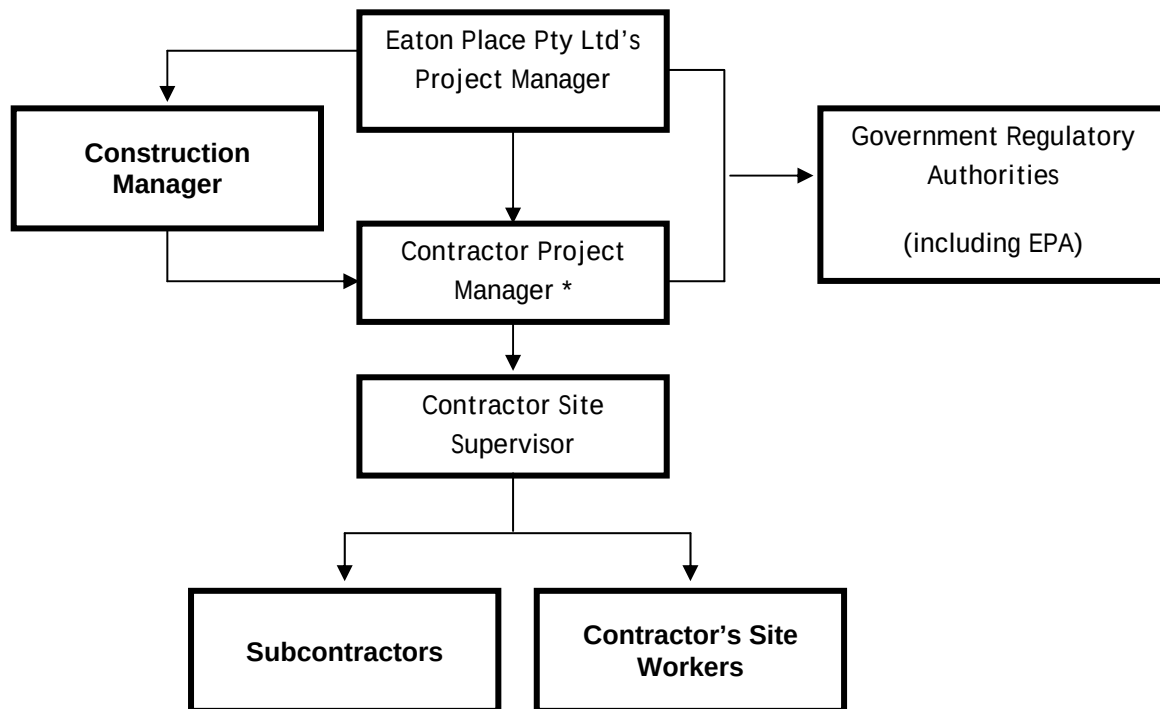
Australian and International Standards that are relevant to environmental management include:

- The Storage and Handling of Flammable and Combustible Liquids (AS 1940:2004). This standard sets out the requirements for the design, construction and operations for the storage and handling of flammable and combustible liquids and includes matters relating to operations and management of emergencies;
- Risk Management (AS 4360: 2004). The standard provides a generic guide for the establishment and implementation of the risk management process involving establishing the context and the identification, analysis, evaluation, treatment, communication and ongoing monitoring of risks;
- The Storage and Handling of Corrosive Substances (AS 3780:1994). The standard sets out the requirements and recommendations for the safe storage and handling of corrosive substances that meet the Class 8 classification of the Dangerous Goods Code; and
- AS/NZ ISO 14001 International Standard for Environmental Management Systems (EMS).

20.2.4 Organisation and Responsibilities

The organisation structure for the project is detailed in **Figure 2.1**. Additional details on specific responsibilities of key personnel are detailed below in **Table 8.1**. It should be noted that one or more positions may be amalgamated, or the responsibilities shared, under a modified arrangement as advised by Eaton Place Pty Ltd.

■ **Figure 2.1 Project Organisation Structure**



* it is expected that a number of different contractors will be on site simultaneously during the construction of the master-planned Hummock Hill Island community.

■ **Table 8.1 Personnel Responsibilities**

<i>Position</i>	<i>Responsibilities</i>
Eaton Place Pty Ltd 's Project Manager	■ Ensure EMP is prepared in accordance with Eaton Place Pty Ltd's SHE Policy and quality procedures. ■ Issue and maintain environmental site practices, instructions and procedures. ■ Serve as contact point for external regulatory bodies and the community. ■ Review and maintain register of complaints, and manage as required. ■ Review environmental incidents and respond in accordance with the EMP. ■ Manage and notify authorities of environmental incidents if necessary.



<i>Position</i>	<i>Responsibilities</i>
Construction Manager	■ Ensure compliance with the EMP. ■ Ensure site workers have a clear understanding of the EMP requirements relevant to their area of work. ■ Serve as contact point for each Contractor Project Manager. ■ Prepare environmental reports to the authorities as required. ■ Maintain suitable records of environmental management issues. ■ Notify each Contractor Site Supervisor of environmental complaints, incidents and improvement opportunities. ■ Initiate corrective action where necessary. ■ Ensure environmental monitoring is carried out.
Contractor Project Manager (various contractors)	■ Serve as contact point for Eaton Place Pty Ltd's Project and Construction Managers. ■ Ensure site workers have a clear understanding of the EMP requirements relevant to their area of work. ■ Have the authority to stop work and/or require other reasonable steps to be undertaken to avoid and minimise adverse environmental impacts. ■ Ensure compliance with the EMP. ■ Manage installation of appropriate environmental controls. ■ Report all environmental incidents to the Eaton Place Pty Ltd Project Manager. ■ Facilitate induction and training programs for construction personnel. ■ Supervise the commencement of all critical construction activities to ensure safeguards are implemented and effective. ■ Determine when event-based environmental monitoring is required.
Contractor Site Supervisor (various contractors)	■ Ensure compliance with the EMP. ■ Install and maintain environmental controls as directed. ■ Inspect environmental controls daily.
Subcontractors	■ Adhere to the requirements of the EMP. ■ Notify the Site Supervisor of all environmental incidents.
Contractor's Site Workers	■ Install and maintain environmental controls as directed. ■ Notify the Site Supervisor of all environmental incidents.

20.2.5 *Environmental Training, Awareness and Competence*

The EMP will only be successful where all those responsible for its implementation and review are thoroughly conversant with its content, interpretation and performance measurement. Eaton is committed to providing training for its site workforce and ensuring that the contractual arrangements with the contractor specify the need for adequate training to be provided to all contracted members of the dam workforce.

Training programs will be in place throughout the construction period to ensure that relevant employees and contractors are aware of the environmental requirements set out in the EMP and have sufficient knowledge to achieve compliance.

All site personnel will attend an induction that covers health, safety, environment and cultural heritage requirements. All staff and contractors engaged in any activity with the potential to cause environmental harm (e.g. handling of hazardous materials) will receive task specific environmental training.



Prior to the commencement of work, all site Eaton and Contractor personnel will receive a site induction. One objective of site induction and training is to ensure that all personnel working on the site understand and are committed to effective implementation of the EMP. Records of staff training will be compliance checkable and available for inspection, on request

Specific elements to be addressed in the site induction include:

- SHE policy;
- Content and intent of the EMP;
- Roles and responsibilities in achieving conformance with the EMP;
- Legal responsibilities, penalties under the legislation and the concept of due diligence;
- On-site and off-site environmental issues, risks and impacts (actual or potential) of work activities;
- Environmental management techniques for key elements of the works;
- Waste minimisation and recycling; and
- Environmental incident management and emergency response procedures.

Attendees will be expected to sign an appropriate induction form. Should any modifications to the EMP be required during construction, these will be made aware to personnel on site as soon as practicable.

20.2.6 *Communication*

Internal project communications will be agreed between the Eaton Project Manager and each Contractor's Project Manager. At a minimum, this will include weekly communication of environmental matters, including incidents, complaints, emerging issues and monitoring results.

In addition, the regular meetings held to discuss operational aspects will include a review of environmental performance and issues. These will include project meetings with the contractor, for which environmental matters will be an agenda item, and these meetings will be minuted.

20.2.6.1 *External Communication*

External communications will be managed as follows:

- Contractor staff – direct all communications, for example, from the general public, to the Contractor Site Supervisor.
- Contractor Site Supervisor – provide immediate response to comments and concerns about site operations, particularly to address issues that can be resolved easily and quickly. Ensure all communications are directed to Eaton Place Pty Ltd's Project Manager.
- Eaton Project Manager – to handle all communications with regulatory authorities related to project scope and objectives, or related to issues associated with contractor operations.



20.2.6.2 Internal Communications

Environmental protection should be achieved through clear and concise internal communications, which will be subject to periodic compliance checks to ensure that the communication structure is performing adequately and all actions are performed and recorded. The compliance checks should also provide for follow-up on specific or corrective actions raised during previous compliance checks to ensure responses are complete.

The EMP will be held in a prominent location and will include at the start of the document a list of the names, affiliations, phone numbers and fax numbers (including after hours numbers where necessary) of the people within the designated environmental management reporting structure.

The Contractor will submit the following as part of their Monthly Report to Eaton containing a summary of:

- works undertaken;
- monitoring results;
- compliance with approvals, licences and the EMP;
- complaints; and
- corrective actions and contingency, and success of implemented measures.

Significant communications, including all reports, incident forms and complaints will be documented and kept up to date.

20.2.6.3 Complaints Register

The environmental management process managed by the Contractor is to include a procedure for receiving and acting upon complaints. Attention to complaints should be carefully managed, prompt and effective, and should form a key part of the environmental reporting mechanism. Responsibility for maintaining the complaints procedure will rest with the Alliance.

Basic requirements of the EMP and complaints register will include:

- a procedure for receiving and responding to complaints which is acceptable to Eaton, the Coordinator-General and the Environmental Protection Agency (EPA);
- the Contractor maintaining, during the construction phase, a complaints telephone service (24 hr 7 days a week Customer Contact number);
- a process for registering and handling all complaints received in terms of:
 - o time and date of complaint;
 - o the identity of the complainant and the recorder of the complaint;
 - o the specific action or activity causing the complaint;
 - o whether environmental compliance requirements are being met;
 - o the action taken to address the complaint if necessary;
 - o a database for tracking of complaints and actions taken in response;
 - o immediate communication of the complaint to the contractor;



- o details on how the action taken is to be communicated to the complainant and the Proponent and the Contractor;
- o feedback to the complainant and the Proponent, the Coordinator-General as required and the EPA within a specified time period;
- o any subsequent remedial action required to avoid cause for future complaints if relevant;
- o regular reporting to the Coordinator-General, the EPA and Eaton on complaints and corrective actions; and
- o monitoring and auditing of the complaint handling system.

The Complaints Register will be made available for inspection by approval/consent authorities on request.

20.2.7 *Emergency Preparedness and Response*

The key to effective management of incidents and emergencies is the effectiveness of the preventative actions taken before any situation reaches a reportable or critical level. Therefore, monitoring and surveillance activities are extremely important. While activities are conducted on the site during the construction period, the following inspection or preventative actions will be performed by the Contractor(s):

- weekly and daily inspection of works; and
- an induction process for all site personnel that includes relevant information on site emergency procedures.

Contractors must maintain written records of these inspections and must make these available for inspection upon request by Eaton Place Pty Ltd's Construction Manager.

Additionally, a site – specific Emergency Response Plan will be developed prior to construction and operation of the development. The Plan will include at least provisions for:

- A team in the construction employees to provide a first response capability (e.g. occupational first aid and basic fire fighting);
- An emergency controller, who will be the on-duty operations team leader, will control and coordinate emergency response actions on site until such time as the incident is either effectively managed or handed over to external emergency services;
- Stores, restaurants, commercial premises and offices will be fitted with approved and certified fire detection (smoke detectors) and sprinkler systems;
- First aid fire fighting equipment (hand held extinguishers and fire hoses) will be installed at strategic points at the development;
- All fire fighting facilities and equipment will be serviced, maintained and inspected by a certified body;
- Site induction training will include emergency response actions;
- Fire drills will be undertaken on a regular basis where necessary by construction personnel;



- Permanent facilities, such as fuel storage areas, will have a dedicated fire alarm, suppression and fire fighting systems; and
- A permanent emergency services presence will occur after the third year of construction with inclusion of a combined Police, Ambulance and Fire Brigade building located in are adjacent the town centre.

The Principal Contractor will liaise with local State Emergency Services and local ambulance and hospital services with respect to planning for Emergency Response.

Appropriate materials such as oil spill kits, absorbent materials and sand bags will be kept available at the construction site office site at all times. The contractor's site supervisor will be responsible for initiating (where required) an immediate emergency response using the resources available on the site. Where external assistance is required, the relevant emergency services will be contacted. Contact details for key personnel who may be involved in an environmental emergency response are provided in Error! Reference source not found.. Contact details will be supplemented and amended as required.

Incidents and near incidents must be reported.

■ Table 2.2 Contact Details

<i>Name</i>	<i>Contact Details</i>
Emergency Services - Emergency	000
Police	07 4974 5155
Fire Brigade (Community Contact Centre)	1300 369 003
Ambulance (Community Contact Centre)	1300 369 003
Poisons Information Centre	13 11 26
Queensland EPA 24 hour emergency number	1300 130 372
Eaton Place Pty Ltd 's Project Manager	To be finalised
Eaton Place Pty Ltd 's Construction Manager	To be finalised

Note: This table is to be completed by each contractor prior to commencement of works and regularly updated.

20.2.8 Monitoring

Measuring, monitoring and evaluating will be key activities of each element within the EMP. Monitoring shall mean the setting in place and operation of various procedures to monitor, measure and record the level of impact on the environment during the execution of the project.

The monitoring of environmental impacts shall be carried out in accordance with the monitoring requirements for each element throughout the EMP, relevant legislation and the conditions of any permit, where relevant.



Monitoring procedures will be developed in accordance with standard protocols and the requirements of the EPA, Department of Primary Industries & Fisheries, Department of Natural Resources & Water, and other relevant agency's as appropriate. All equipment used for environmental monitoring will be calibrated and maintained to the standards recommended by the supplier/manufacturer. Records of calibration and maintenance for each piece of monitoring equipment will be held on site.

Environmental monitoring samples, if taken, will be sent for analysis to a National Association of Testing Authorities (NATA) registered laboratory where applicable. All records of laboratory analysis results and quality assurance will be auditable and available for inspection, on request, by regulatory agency officials or their representatives.

20.2.9 *Corrective and Preventive Action*

All personnel are encouraged to report all incidents and near misses, as this is a valuable method of addressing deficiencies in procedures, training or equipment. It is an offence not to report to the EPA, incidents that may cause serious and / or material harm to the environment.

An incident investigation includes the following basic elements:

- identifying the cause and extent of the incident;
- identifying the personnel responsible for carrying out the corrective action;
- identifying and implementing the necessary corrective action;
- implementing or modifying controls necessary to avoid repetition;
- recording any changes in written procedures required; and
- advising the relevant environmental authority(s) of any substantial pollution that has occurred.

20.2.10 *Compliance Assessment*

20.2.10.1 *Compliance Checking*

In order to allow a continuous improvement cycle to be implemented, compliance checks of the construction site against this EMP will be undertaken on a regular basis, i.e. at least monthly. This compliance check will be undertaken by the environmental personnel assigned to the project by Eaton Place Pty Ltd 's Project Manager. Compliance check outcomes will be reported at the Steering Committee meeting following the compliance check date and actions (e.g. changes to the EMP or other project documentation and activities) decided and implemented, as required.

20.2.10.2 *Compliance Auditing*

Aspects of the project with a potential for environmental impact will be subject to periodic environmental first and second party audits. The audit objectives will be to verify compliance with applicable Commonwealth, State and Local government environmental permits, approvals and regulations issued for the project as well as the requirements of the EMP

Each compliance audit will be internally reviewed by Eaton senior management and all recommendations/actions raised will be addressed. Copies of audit reports and details of corrective actions will be made available for regulatory inspection, on request.



20.2.10.3 EMP Auditing

The EMP itself will be periodically subjected to a systematic first and/or second party examination to determine whether the EMP achieves the environmental management objectives set by Eaton and the relevant regulatory parties.

Each compliance audit will be internally reviewed by Eaton senior management and all recommendations/actions raised will be addressed. Copies of audit reports and details of corrective actions will be made available for regulatory inspection, on request.

20.2.11 Reporting

20.2.11.1 Environmental Incident Reporting

Environmental incidents and near misses shall be reported via the Contractor Project Manager to the Eaton Construction Manager at the time of occurrence. Eaton's standard incident management procedure shall be used. Any incidents that may cause environmental harm shall be reported to the EPA.

Non-Conformance Reports or Corrective Action Requests shall be issued where appropriate.

20.2.11.2 Environmental Reporting

Monthly environmental summary reports will be produced for the duration of the works. Copies of the reports shall be held on site and will be available for regulatory agency inspection, on request. The report shall include, but is not limited to the following:

- Record of inspections;
- A list of any performance criteria that have not been met, the corrective action taken and a description of the magnitude of any possible environmental impact;
- A register of complaints detailing:
 - Origin of the complaint;
 - Complaint investigation (personnel, date and summary of action/s taken); and
 - Response to actions and suggested changes to practices or procedures.
- Results of any surveys carried out;

An annual Environmental Summary Report will be prepared each calendar year by the Operator (for the first five years of operation), containing, in part, the following information:

- Summary of the monthly Environmental reports;
- Fluctuations in water storage levels;
- Releases;
- Water quality monitoring;
- Operation of fish lift / lock; and
- Operation of Turtle way.



Non-compliance and Corrective Actions

The monitoring and reporting will incorporate continual improvement in requirements identified through a non-compliance and corrective action procedure. These will be nominated in the Project's quality procedures and EMPs, and should specify methods for recording and reporting non-conformances and ensuring that corrective actions are implemented to rectify the problem.

20.3 Environmental Management Strategy

20.3.1 Introduction

Detailed management strategies have been developed to mitigate potential environmental impacts that were identified in the original development application. These environmental safeguards, developed for the following issues and detailed in this sub-section, will form the basis of the environmental controls for the project.

- Coastal management;
- Water management (including hydrology);
- Geology and Soils (including Acid Sulphate Soil);
- Sediment and erosion control;
- Land contamination;
- Flora and Fauna Management;
- Cultural Heritage;
- Air Quality;
- Noise and vibration;
- Traffic and Transport; and
- Waste Management.

Additional environmental issues may be scoped and included in the EMP as required.

20.3.2 Draft Environmental Management Plan Outline

20.3.2.1 Overview

This Draft EMP is presented within the EIS, on the understanding that detailed EMPs for construction and operation, as well as relevant EP's are to be prepared by the Contractor and reviewed by Eaton and either the EPA or State agency exercising its powers under legislation. The detailed EMPs for construction and operation will need to include, but not be limited to, mitigation measures which address the Environmental Objectives and Performance Criteria of this Draft EMP and any conditions imposed either by the Coordinator-General evaluation report or other agencies under other approvals. The detailed EMPs will also need to refer to expressed community needs and issues as identified in the draft EIS and any Supplementary Report.

The purpose of the Draft EMPs is to set out the project commitments to avoid or minimise potential environmental impacts of the project as identified in the EIS, including identification of



environmental aspects to be managed and how environmental values may be protected and enhanced.

The Construction and Operational Environmental Management Plans, CEMP and OEMP respectively, are dynamic documents as they incorporate continuous improvement. Each plan will be updated to incorporate further information, approval conditions, and changes in environmental management procedures in the light of ongoing monitoring results, new techniques, and relevant legislative requirements.

20.3.2.2 Planning for Ecologically Sustainable Development

The Project will pursue the achievement of the following overall objectives for Ecologically Sustainable Development during the design, construction and operational stages of the project, specifically through the following measures:

- adopt and integrate good management practices for design, construction and operation of all aspects of the Project including:
 - o energy efficient measures (e.g. power demand management during construction, natural lighting and ventilation in appropriate locations);
 - o waste minimisation, management and recycling;
 - o wise use and re-use of natural resources (e.g. building materials, rock and other spoil);
 - o avoidance or minimisation and mitigation of impacts on ecological processes and habitat values adjacent to construction works (e.g. waterways and forests); and
 - o seek to achieve community benefits (e.g. re-establishment of recreational areas).
- comply with all applicable laws, regulations, standards and guidelines for protection of the environment;
- adopt best management means available to prevent or minimise adverse environmental impact;
- describe incident response protocols and procedures; and
- provide project employees and contractors with adequate and contemporary training in safety, hazard and risk management and environmental procedures.

20.3.2.3 Implementation

The CEMP and OEMP demonstrate how potential impacts may be addressed during the construction and operational phases of the project. The preparation of specified actions, strategies and recommendations implemented through each EMP includes:

- recommendations made in the EIS to minimise identified environmental impacts;
- good practice environmental management;
- general content requirements of ISO 14001; and
- management and responsibility for performance.

An outline of how each EMP element is considered and presented is shown in **Table 3-1**.

■ Table 3-1 Outline of EMP Tables

EMP Component	Description	Example
Environmental Element	The aspect of the environment requiring targeted environmental management.	<i>Terrestrial Flora</i>
Environmental Objective	A short description of the high level aim of the project with respect to this environmental element.	<i>Implementation of vegetation clearance, stockpiling, recycling or disposal practices that maximise the re-use of native vegetation and minimise environmental harm.</i>
Performance Criteria	The performance criteria are results contributing to the overall objectives. This provides a benchmark against which management performance can be evaluated. Where possible these criteria should be measurable and monitored to assess level of achievement.	<i>Retained vegetation is not compromised by site clearing works, gross mechanical disturbance or impacts associated with sedimentation and/or pollutant export from the dam construction area.</i>
Mitigation Measures	The management actions to be undertaken to achieve the objectives of the plan. Mitigation measures may include a wide range of measures such as, but not limited to, changes in work procedures and practices, physical interventions to separate or buffer from predicted construction impacts, physical containment measures, and plans/procedures to minimise impacts. Such measures must be directed to achieving the Environmental Objectives and Performance Criteria, the statutory requirements, and must be consistent with the conditions of an approval from the Coordinator-General.	■ <i>Identify clearing exclusion zones.</i> ■ <i>Minimise damage to retained vegetation.</i> ■ <i>Implement sediment and erosion control measures.</i>
Monitoring	Establishes the parameter to be monitored, the type and frequency of monitoring.	<i>Contractor to monitor vegetation clearance and earthworks and periodic monitoring of vegetation and sediment and erosion control devices.</i>
Reporting	Purpose and frequency of reporting to demonstrate achievement of the environmental objectives and satisfaction of the performance criteria. The distribution of reports when generated.	<i>Monthly Construction Report</i>
Responsibility	The responsible entity for undertaking the activities and actions that has to be implemented.	<i>Contractor</i>
Corrective Action	This section establishes the corrective action that must be implemented if performance indicators are not achieved. It also provides guidance for contingency actions.	<i>Rehabilitate areas if cleared within the exclusion zones</i>

20.4 Draft Construction Environmental Management Plan

There are a number of activities taking place during the construction phase of the master-planned Hummock Hill Island community which have the potential to impact on environmental values in the area. These are:



- Upgrade of external (mainland) road network including Foreshores Road and Clarks Road;
- Construction of bridge over Boyne Channel;
- Construction of internal road network – Trans-Island boulevard and associated services;
- Construction of minor road network (collector and access streets);
- Installation of power supply – external, above ground powerlines, 12 km;
- Installation of gas supply – external, 16.5 km;
- Installation of power supply – internal (underground);
- Installation of water and wastewater reticulation infrastructure;
- Installation of gas reticulation infrastructure;
- Construction of water and wastewater treatment plants, evaporation pond (18,500 m²);
- Construction of boat ramp – Colosseum Inlet;
- Construction of boat ramp – Boyne Channel;
- Construction of associated boat/trailer parking;
- Construction of queuing pontoons; and
- Construction of Golf Course

The environmental elements addressed in this Draft EMP in relation to environmental management controls for these activities are:

- Coastal management;
- Water management (including hydrology and water quality);
- Geology and Soils (including Acid Sulphate Soil);
- Sediment and erosion control;
- Land contamination;
- Flora and Fauna Management (including pest and weed control);
- Cultural Heritage;
- Air Quality;
- Noise and vibration; and
- Waste Management.

The CEMP is to incorporate sub-plans that comply with the relevant industry standards for environmental management and must include at least:

- A soil erosion and sedimentation management plan for each worksite and for spoil placement areas;
- A construction stormwater drainage and water quality management plan;
- A construction dust management plan;
- A construction noise and vibration management plan;

- A construction vehicle management plan;
- A construction traffic management plan;
- A construction incident management response plan;
- A construction waste management plan; and
- Other management plans necessary to achieve the environmental objectives and performance criteria.

At this time, each of the environmental management elements relevant to proposed construction activities is highlighted below. The recommendations and commitments outlined in the EIS and commitments to sub-management plans have been included in the addressing of the elements. It is recognised that sub-management plans, like this EMP, are dynamic documents and improvements in approaches are expected to be incorporated as details of the actual construction activities and definitive design information come to hand.

20.4.1 Coastal Management

Construction impacts within the coastal environment are likely to be direct from construction activities of the access bridge and public boat ramp in Boyne Creek and Colosseum Inlet. Remaining construction impacts are likely to be indirect as a result of upstream activities within ephemeral watercourse catchments that discharge to the estuarine environment.

Environmental Objective - Coastal Management	
Minimise environmental impact by managing construction aspects within the coastal zone	
Performance Criteria	■ Manage and mitigate the impacts of spoil removal, haulage and placement in spoil retainment areas. ■ Manage and mitigate the risks of soil erosion impacts from all work areas where vegetation is removed or the soil disturbed during construction works.
Mitigation Measures	<i>Direct loss of habitat in Boyne creek:</i> ■ Minimisation of native vegetation clearance; • Avoidance of rare and endangered species/habitats. <i>Disturbance of acid sulphate soil:</i> • Development and implementation of an Acid Sulphate Soil Management Strategy in accordance with Section 4.8 and 4.9 of the QLD State Planning Policy Guideline (2002). • Also refer to Acid Sulphate Soil EMP sub plan. <i>Fuel/oil Spills from plant maintenance:</i> • Development and implementation of practical mitigation and emergency response measures as part of the construction EMP. Measures may include but not be limited to: - o Absorbent mats during refuelling operations; - o Spill response kits to be carried by all field maintenance vehicles; - o Spill awareness training during site inductions. <i>Litter generation:</i> ■ Inclusion of gross pollutant traps in ESCP plan ■ Education program for construction workers during induction;

Environmental Objective - Coastal Management

Minimise environmental impact by managing construction aspects within the coastal zone

	■ Provision of waste facilities in all break-out areas. <i>Increased soil erosion, associated suspended sediment and sediment loads:</i> ● Construction works for public boat ramps and bridge abutments will utilise silt curtains to contain sediment and potential contaminants that can be released during construction. ● Ephemeral watercourse discharges will be required to meet WQO for estuarine waters derived from existing and ongoing monitoring. ● A minimum 10 m buffer will be maintained on all ephemeral watercourses that help to reduce pollutant loads to adjacent marine waters derived from surface runoff. <i>Herbicide and Pesticide laden runoff</i> ● Use of non-persistent herbicides and pesticides within the development area, their storage; ● handling and application to minimise/eliminate potential leaching during construction activities. <i>Hydrodynamics and tidal flows:</i> ● Construction of a temporary access jetty within Boyne Creek for construction access will incorporate H-Sections and steel decking resulting in minimal impact to hydrodynamics.
Monitoring	■ Regular inspection of sediment and erosion control structures and measures. In wet weather or when using large quantities of water in construction works more frequent monitoring may be necessary. ■ Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	■ Monthly Report prepared and submitted to Eaton to include details of monitoring results, audits, training and incidents. ■ Immediate reporting to Contractor Site Supervisor and Project Manager of any incident, spill or release of materials to the environment. ■ Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
Responsibility	■ Contractor
Corrective Action	■ Timely rehabilitation. ■ Appropriate control measures implemented where unacceptable sediment or erosion is identified or may occur. ■ Necessary corrective action implemented following incident or complaint. ■ The Contractor will ensure that all appropriate personnel undertake adequate environmental awareness and training covering the requirements of the CEMP regarding soil management and erosion control. ■ The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.

20.4.2 Water Management

Potential physical and hydrodynamic impacts to ephemeral creeks identified within the project footprint during construction may include:



- Impact to riparian vegetation from development precincts;
- Culverts and crossings may impact creek hydraulics and fauna passage; and
- Changed hydrodynamics including reduced time of concentration (t_c) and increased peak discharge (Q_y) due to receipt of concentrated flows from cleared areas.

Potential water quality impacts to ephemeral creeks from construction activities may occur from the following sources:

- Construction works and in particular land clearing and associated earthworks increasing suspended sediment;
- Construction litter entering receiving waters;
- Potential impacts from plant maintenance such as refuelling and general site activities;
- Nutrient increases from rehabilitation and irrigation of disturbed, turfed and green spaces; and
- Weed control chemicals used during rehabilitation.

Environmental Objective - Water Quality	
To preserve water quality of groundwater and the freshwater courses/gullies existing on Hummock Hill Island and maintain the Environmental Values (EVs), including compliance with local Water Quality Objectives (WQOs) during the construction phase.	
Performance Criteria	• Water quality objectives as per the <i>Environmental Protection (Water) Policy 1997</i>, Hummock Hill Island Environmental Values and Water Quality Objectives. ■ Aquatic ecosystem environmental values as per the <i>Environmental Protection (water) Policy 1997</i>, Hummock Hill Island Environmental Values and Water Quality Objectives. ■ Primary and secondary contact recreation as per the <i>Environmental Protection (water) Policy 1997</i>, Hummock Hill Island Environmental Values and Water Quality Objectives. ■ The overarching performance criterion is to maintain existing ecosystem attributes and water quality within Hummock Hill Island's Catchment throughout construction period.
Mitigation Measures	<i>Sediment and Erosion Control</i> A Sediment and Erosion Management Plan will be developed in accordance with the <i>Queensland Urban Design Manual</i> (1993), the Water Sensitive Urban design Technical Guidelines for South East Queensland (2006, WSUD Guidelines) and the Soil Erosion and Sediment Control Guidelines – Engineering Guidelines for Queensland Construction Sites (IEAust Qld, 1996). With respect to sediment control/water quality management this plan will address at least the following elements: • Diversion bunds and/or drains to limit off-site stormwater flowing across construction areas. Clean stormwater diverted around the construction areas; ■ Stormwater collected within the construction areas, and where applicable, diverted into holding/ settlement ponds for treatment and reuse; ■ Exposed soils stabilised by using materials such as mulch, biodegradable matting, and geotextile fabrics; ■ Revegetation of areas impacted by construction activities; ■ Rate of stormwater flow within the construction area reduced by using energy dissipation techniques (i.e. whoa boys, rock rip-wraps, surface profiling etc); ■ Measures implemented to minimise sediment taken offsite by construction vehicles, via

Environmental Objective - Water Quality

To preserve water quality of groundwater and the freshwater courses/gullies existing on Hummock Hill Island and maintain the Environmental Values (EVs), including compliance with local Water Quality Objectives (WQOs) during the construction phase.

	the use of wash down bays or similar; ■ A number of procedures shall be implemented to treat sediment laden water including: – Filtering runoff from the site, using geotextile fabrics, vegetation and silt curtains (if the sediments are introduced into the waterway); and – Use of sedimentation basins (i.e. settlement ponds) where sediment settles prior to discharge. – Sediment basins may require regular maintenance to maintain effective capacity. Sediment removed from sediment basins will be dewatered on site and used as construction fill material; ■ Sedimentation basins must be designed for a 24 hour storm event of a return period of 1 year for sediment retention and a one hour storm event of a return period of 100 years for flow. They are to be inspected and cleaned out on a regular basis and managed to ensure the required retention capacity is maintained; ■ Use of gross pollutant traps and trash baskets to capture litter; and ■ Use of WSUD structures to reduce nutrient loads. <i>Chemicals</i> ■ Locate fuel, oil and chemical stores and concrete washouts away from discharge points; ■ Bunding and appropriate storage of fuels and other hazardous/ flammable materials; ■ Spill containment kits to be available on site; ■ Set up temporary concrete washout areas if required; when use of a concrete washout area has ceased: – All waste concrete will be removed and sent to a concrete recycler; – Soil on bottom and sides of the washout that has come into contact with the concrete will be removed and treated if necessary; – Any excavation will be filled and remediated (revegetated, etc.); ■ Oil containment booms and oil spill recovery equipment available when working on or near water. <i>Riparian vegetation</i> • Maintenance of required riparian vegetation buffer as per Acceptable Solution S.3.1-d in the Regional Vegetation Management Code; • Riparian buffer zones will be marked as no clearing zones; • Crossings will be constructed in accordance with the Road Drainage Manual (Main Roads, 2002). <i>Ephemeral watercourse hydraulics</i> • Culverts and crossings will be designed in accordance with Road Drainage Manual (Main Roads, 2002) with a 30% climate change buffer in the relevant calculation of discharge (Q). <i>Fauna passage</i> • Culverts and crossings will be designed in accordance with Road Drainage Manual (Main Roads, 2002) with incorporation of fauna passages of appropriate height and including dry passage ways for fauna.
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Environmental Objective - Water Quality		
To preserve water quality of groundwater and the freshwater courses/gullies existing on Hummock Hill Island and maintain the Environmental Values (EVs), including compliance with local Water Quality Objectives (WQOs) during the construction phase.		
		<i>Ephemeral watercourse hydrodynamics</i> Implementation of erosion and sediment controls outlined above.
Monitoring		- Conduct surface water quality monitoring at discharge points from the construction site to evaluate the effectiveness of the proposed mitigation measures and provide triggers for implementation of additional control; measures. - In the event that an unplanned spill or incident occurs within the construction area or as part of associated activities of the Hummock Hill Island development project, targeted water quality monitoring will be carried out up and down stream to determine potential impacts from the event. - A visual inspection of the construction site is to be undertaken during and after rainfall to ensure that mitigation measures are in place and no major erosion is occurring. Additional monitoring may be required to determine the extent of stormwater runoff after pulse events. - Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting		- Immediate reporting to Supervisor of any incident, spill or release of materials to the environment. - Incidents, complaints and any (potential) environmental harm reported to regulatory body/ies where required.
Responsibility		Contractor Environmental Manager On-site personnel (environmental team) will be required to undertake the routine water quality monitoring and reporting. Separate personnel (suitably trained environmental scientists) shall independently audit the program on an annual basis.
Corrective Action		- Contaminated waters (elevated turbidity, suspended solids etc) observed flowing from the construction site into Hummock Hill Island's Catchment, will be identified and the appropriate action taken by the Environmental Adviser. - Adverse impacts to downstream water quality shall be reported to the EPA and any impacts to potable water supply off- takes, reported to the relevant local administering authorities. - Rehabilitation will be conducted on areas where unacceptable sedimentation has occurred. - The Contractor will ensure that the appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding water quality management, sediment and erosion control and spill management procedures. - The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.

20.4.3 Land Management

20.4.3.1 Land Erosion

Potential disturbance to land, and in particular clearing of vegetation may lead to exposure of erosion prone soils. Loss of cover, disturbance of surface soils and exposure of sub-soils will typically result in erosion and sedimentation. Erosion of these soils result in releases of fine sand and clay particles and suspended sediment materials to local drainage lines and streams. Sedimentation of the waterways results in the deterioration in water quality and aquatic habitat



values and, in more severe cases, effects on flows and flooding characteristics of these watercourses. Sedimentation will also impact on marine water quality and habitat values in the adjacent World Heritage Area. Specific details of erosion hazards and impacts during construction are dealt with in the erosion management sub – plan below.

Environmental Objective - Erosion Management	
Minimise environmental impact by preventing soil loss and erosion.	
Performance Criteria	■ Manage and mitigate the impacts of spoil removal, haulage and placement in spoil retainment areas. ■ Manage and mitigate the risks of soil erosion impacts from all work areas where vegetation is removed or the soil disturbed during construction works. ■ To develop an Earthworks Strategy that will schedule disturbance and minimise risk during the wet season ■ To implement and maintain effective erosion and sediment control measures. ■ To minimise the extent of disturbed land at any one time. ■ To minimise the impact of construction activities on surface and groundwater quality.
Mitigation Measures	A Sediment and Erosion Management Plan will be developed in accordance with the <i>Queensland Urban Design Manual</i> (1993), the Water Sensitive Urban design Technical Guidelines for South East Queensland (2006, WSUD Guidelines) and the Soil Erosion and Sediment Control Guidelines – Engineering Guidelines for Queensland Construction Sites (IEAust Qld, 1996). With respect to erosion management this plan will address at least the following elements: ● Implementation of construction techniques, such as: – Fit the development to the existing topography, soils, and vegetation as much as is possible; – Schedule construction operations in order to minimize soil exposure during the rainy season; – Minimize disturbance and soil exposure by retaining natural vegetation, adopting phased construction techniques, and using temporary cover; – Vegetate and mulch all denuded areas to protect the soil from rainfall (the <u>primary</u> effort for controlling sediment pollution from construction sites should be to minimize raindrop impact on bare soil); – Utilize appropriate grading, barriers, or ditches to minimize concentrated flows and divert runoff away from denuded slopes or other critical areas; – Minimize the steepness of slopes and control the length of slopes by utilizing benches, terraces, contour furrows, or diversion ditches; – Utilize riprap, channel linings, or temporary structures in the channel to slow runoff velocities and allow the drainage ways to handle the increased runoff from disturbed and developed areas; – Keep the sediment on-site by utilizing sediment basins, traps, or sediment barriers; and – Monitor and inspect sites frequently to assure the measures are functioning properly and correct problems promptly. ● Work should be scheduled to ensure that any temporary erosion control works are in place by the end of work each day, especially before weekends, if rain is imminent or when permanent erosion control works are not in place. ■ Construction activities must be scheduled so that work in sensitive areas can be completed and rehabilitated as quickly as reasonably possible. ■ Mitigation measures developed and implemented to manage the risk of erosion during construction to minimise: – potential surface water quality impacts from sediment and contaminants entrained in surface runoff;

Environmental Objective - Erosion Management		
Minimise environmental impact by preventing soil loss and erosion.		
		– loss of topsoil material during site preparation and from stripping and stockpiling for extended periods; – erosion due to vegetation clearing and soil disturbance; and – erosion of exposed vulnerable soils by wind or water action. ■ Construction of access roads with suitable scour protected and drainage for heavy vehicles. ■ Planning of construction works to provide for the progressive and timely stabilisation and rehabilitation of disturbed areas. ■ Undertaking of erosion risk assessment to identify flow paths, suitable stockpile locations, soil cover type, and soil stability. ■ Undertaking of finishing and landscaping requirements for on-going sediment and erosion control around the worksites following construction.
Monitoring		■ Regular inspection of sediment and erosion control structures and measures. In wet weather or when using large quantities of water in construction works more frequent monitoring may be necessary. ■ Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting		■ Monthly Report prepared and submitted to Eaton to include details of monitoring results, audits, training and incidents. ■ Immediate reporting to Project Supervisor and the Environmental Adviser of any incident, spill or release of materials to the environment. ■ Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
Responsibility		■ Contractor
Corrective Action		■ Appropriate control measures implemented where unacceptable sediment or erosion is identified or may occur. ■ The erosion and sediment control plans should be amended to account for changes in site conditions or treatment methods in the case of the failure of a device. ■ Necessary corrective action implemented following incident or complaint. ■ The Contractor will ensure that all appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding soil management and erosion control. ■ The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.

20.4.3.2 Groundwater Discharge Zones

Groundwater discharge zones identified for the Hummock Hill development have a natural tendency for waterlogging and possibly increased salinity. Clearing of vegetation during construction works in these areas may increase water logging of soils. Vegetation lowers the water table and reduces evaporation at the soil surface through evapotranspiration. Management of potential water logging issues in groundwater discharge zones is dealt with in the groundwater management sub – plan below.

Environmental Objective - Groundwater Impact Management
Ensure preservation of groundwater quality and quantity during construction.

Environmental Objective - Groundwater Impact Management	
Ensure preservation of groundwater quality and quantity during construction.	
Performance Criteria	■ Minimisation of impacts on groundwater quality by ensuring all practical measures have been taken to prevent contamination as a result of construction activities. ■ Adequate monitoring and management of groundwater levels through out the dewatering program.
Mitigation Measures	• No construction/development is to occur in discharge zone or up gradient recharge zones; • Avoid clearing vegetation in discharge areas; • Avoid clearing vegetation in upslope recharge areas where possible in catena systems; • Retain as many mature trees as possible, particularly in recharge and discharge areas; • Diversion of runoff from hard surfaces directly into storage basins rather than infiltrated in grassed swales in areas identified as discharge zones; • Storage structures should not be located where they may cause discharge downslope; • Lining of some storage structures; • Ensure groundwater monitoring program is developed prior to construction to monitor groundwater levels as part of geotechnical program.
Monitoring	■ Groundwater monitoring program carried out to assess any changes in groundwater levels and in accordance with approval conditions; ■ Groundwater monitoring program carried out during any dewatering activities for the lake construction to monitor recharge performance ant potential changes in groundwater quality; ■ Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	■ Monthly Report prepared and submitted to Eaton to include details of monitoring results, audits, training and incidents. ■ Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
Responsibility	Contractor
Corrective Action	■ Significant changes to groundwater levels outside of the zone of influence investigated and the appropriate action taken by the Construction Manager. ■ Groundwater Quality Monitoring Programme introduced in the event that any significant spill may affect the groundwater. ■ The Contractor will ensure that the appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding groundwater monitoring and storage and handling of hazardous substances. ■ The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or at risk of occurring.

20.4.3.3 Acid Sulphate Soils

Two areas of potential acid sulphate soils have been identified within Lot 3. Construction activities for the Boyne Creek boat ramp and bridge are may directly disturb PASS soils due to excavation activities for bridge abutments and bored piers. Construction activities within the relict beach ridge system will trigger requirements for an ASSMP on the basis of potential excavation and/or filling activities, even though the potential for PASS to be present is considered low.

Environmental Objective – Acid Sulphate Soil (ASS) Management	
Ensure management of acid sulphate soil and potential impacts during construction.	
Performance Criteria	■ Accurate identification of ASS to minimise the potential for inappropriate material handling; ■ Treatment of disturbed ASS to minimize the potential environmental harm; ■ To minimise the potential for environmental harm of discharges from ASS impacted surface to surface water and/or leachate from the site; ■ To minimize the potential for environmental harm from discharging of impacted groundwater from the site; ■ To prevent any net increase in existing soil acidity due to oxidation of in-situ or excavated materials; and ■ To ensure there is no direct or indirect release of runoff waters or leachate that do not meet the established water quality parameters.
Mitigation Measures	• Identification of Potential Acid Sulphate Soils (PASS) and ASS in accordance with the <i>Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils (ASS)</i> in Queensland 1998; • Preparation and implementation of an ASS Management Plan (ASSMP) that addresses at least the following matters: – Minimising the disturbance of PASS and ASS; – Neutralisation of excavated soils with pure fine agricultural lime (CaCO₃) at the nominated rate outlined in Table 4 of the <i>SPP 2/02 Guideline</i>; – Application of lime to open excavation faces; – Storage of excavated PASS material in a dedicated bunded area to capture stormwater flowing from stockpiles; – Re-use of neutralised soils as general fill (pending geotechnical assessment).
Monitoring	• Laboratory testing of soils using a NATA accredited laboratory to assess the potential net acidity through acid base accounting; • Water quality testing to meet the established water quality parameters; • Neutralising agents are of sufficient quantity and quality to neutralize potential acidity; • Validation sampling will be repeated on the lime treated material until satisfactory results are obtained. • Water quality potentially impacted by ASS will be monitored regularly during the construction period, particularly following substantial rainfall events.
Corrective Action	If performance targets are not being met as indicated by the validation testing of treatment and water quality testing: • Is the ASSMP effectively implemented? If not, ensure compliance with ASSMP. • Does the plan need to be changed? (ie due to changed procedures) If yes, then ensure that ASSMP is changed and changes appropriately communicated to relevant personnel.
Responsibilities	Construction Contractor will be the responsibility of the Project Supervisor.
Reporting	Monthly Report prepared and submitted to Eaton to include details of monitoring results, compliance checks and corrective actions.

20.4.3.4 Land Contamination

Historical activities conducted around the former homestead included a number of potentially contaminating activities as described in Section 3.1.2.5 of the EIS. The scale of soil and groundwater contamination may not be widespread due to the limited volumes of hazardous contaminants used. Potential areas of impact may be limited to areas of initial contamination. Land contamination issues and their management are outlined in the land contamination management sub-plan below.

Environmental Objective - Land Contamination (Spills & Clean Up)	
Prevention of spills from occurring at project site. Contain, clean up and, if necessary, remediation of any spills that do occur. Recognition and remediation, where necessary, land contamination having resulted from historical activities such as cattle dip operations, fuel storage and building material application (asbestos).	
Performance Criteria	■ All fill used on site is 'inert' and must be free from contaminants. ■ Containment of all spills involving materials that may cause environmental and effective cleaned up and measures taken to prevent the incident from recurring. ■ All contaminated land is remediated to the extent necessary to allow the relevant land use of the development.
Mitigation Measures	<i>Contaminated Soils</i> ● Remediated contaminated soils in accordance with an EPA approved Remediation Action Plan (RAP). ● Obtain an approval and a disposal permit by the EPA (Contaminated Land Unit) for the removal of contaminated soil, in accordance with the <i>Environmental Protection Act 1994</i> where removal of the soil from land listed on the EMR is required. ■ Prepare and implement procedures for the remediation of contaminated soil spills that may occur during transport. <i>Asbestos</i> ● Qualified person to inspect buildings and services for presence of asbestos; ● Licenced/qualified contractor to remove asbestos where found; ● Create and maintain an asbestos register for any asbestos found during construction; ● Implement procedures to minimise exposure risks during asbestos removal.
Monitoring	● Preparation and supply to the EPA of a validation report, demonstrating that the RAP has been successfully implemented. ● Recording of any spills that occur as an incident, as well as the follow up actions, any results and reporting to authorities. ■ Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	■ Any environmental incidents involving spills recorded including time of incident, persons involved, details of incident, mitigation measures and actions taken to minimise the probability of recurrence. Immediate reporting to the Alliance Environmental Adviser of any significant spills or potential risk of spills. ■ Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.



Environmental Objective - Land Contamination (Spills & Clean Up) Prevention of spills from occurring at project site. Contain, clean up and, if necessary, remediation of any spills that do occur. Recognition and remediation, where necessary, land contamination having resulted from historical activities such as cattle dip operations, fuel storage and building material application (asbestos).	
Responsibility	Contractor - implementation of mitigation measures; Construction Manager - supervision of remediation activities and preparation of relevant reports.
Corrective Action	■ Ensure that the appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding waste management, spill procedures and the storage and handling of hazardous substances and materials with the potential to cause environmental harm. ■ The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.

20.4.4 *Flora and Fauna Management*

20.4.4.1 *Terrestrial Flora*

Commonwealth Department of the Environment and Water Resources Database records revealed five flora species and ten fauna species considered Endangered or Vulnerable are possible occurrences in the site locality. Wildnet records revealed that six (6) species considered Endangered, Vulnerable, Rare are known from the search area. Management of potential impacts on the identified terrestrial flora within the Hummock Hill development area is outlined below.

Identified (short-term) impacts include:

- Injury and death of flora and fauna during clearing works; and
- Potential spread of weeds into cleared and disturbed areas.

The long-term impacts include:

- The loss of remnant and regrowth vegetation as a result of vegetation clearing;
- Fragmentation of the landscape affecting flora connectivity; and
- Potential for increased proliferation of exotic species, including weeds and pests.

Management of potential impacts on the identified terrestrial flora within the Hummock Hill development area is outlined below.

Environmental Objective - Terrestrial Flora

Implementation of vegetation clearance, stockpiling, recycling or disposal practices that maximise the re-use of native vegetation and minimise environmental harm.

Performance Criteria	- Felled vegetation should be re-used on site wherever possible. - Retained vegetation is not compromised by site clearing works, gross mechanical disturbance or impacts associated with sedimentation and/or pollutant export from the development area. - Weed spread and/or invasion is prevented both within the construction site and in surrounding areas. - Harm to fauna is minimised. - Pest spread and/or invasion is prevented both within the construction site and in surrounding areas.
Mitigation Measures	<i>Vegetation Clearing</i> - Relevant plans detailing the staging of works, areas to be retained, significant areas of exclusion and other relevant issues shall be provided to the Construction Manager, Environmental Advisor and clearing contractor prior to any site preparation activities within the proposed construction area; - Prior to the commencement of any vegetation clearance, the clearing contractor, in consultation with the Construction Manager and Environmental Advisor, to discuss all areas to be cleared on construction plans and in the field; - All areas to be cleared shall be clearly identified on the ground by the Environmental Advisor prior to the commencement of any site preparation activities. Areas to be retained will therefore be clearly identified and no unauthorised access permitted; - Implementation of an on-site Vegetation Clearance Management / permitting system; - Clearing within supratidal salt flats and mangroves will be minimised to the minimum width required to accommodate the road design and storm water controls. Clearing will be conducted in accordance with recommendations within the <i>Wetland Management Profile - Salt marsh Wetlands issued by the Queensland Wetlands Programme.</i>; - A 100 m vegetation buffer zone at the salt flats and between HAT and housing within Colosseum Inlet and Boyne Creek will be designated to prevent vehicle access; and - No clearing shall occur outside nominated clearing zones. <i>Identifying a Tree Protection Zone</i> - All retained trees likely to be impacted upon by development works will be marked prior to construction works. - Prior to establishing a tree protection zone, trees to be protected will be pruned focusing on removal of dead or broken branches. - Construction contractors are prohibited from undertaking any additional pruning as this activity, if not performed properly, can be harmful to the tree. - The following measures are to be taken to protect the tree, in the long term: - Fencing – Secure posts with 1.8m high chain link or equivalent sturdy fencing to be erected, maintained and removed by the contractor to the outer edges of the protection zone; - Trunk protection – 1.8m high palings strapped to the trunk; - Mulching – 100mm of composted mulch cover over the ground within the tree protection zone in order to retain soil moisture and encourage microbial activity;

Environmental Objective - Terrestrial Flora

Implementation of vegetation clearance, stockpiling, recycling or disposal practices that maximise the re-use of native vegetation and minimise environmental harm.

- Irrigation – natural moisture levels should be maintained during construction activities. This may necessitate temporary irrigation of the tree;
- Drainage – the natural drainage patterns around the root zone should not be altered. To prevent waterlogging of the tree drip zone, heavy overland flow should be diverted around the tree;
- Trees considered suitable for retention must be identified. Within these zones the following activities shall not be permitted:
 - storage and mixing of materials;
 - vehicle parking;
 - liquid disposal;
 - machinery repairs and/or refuelling;
 - construction site office or shed;
 - combustion of any material;
 - stockpiling of soil, rubble or debris;
 - any filling or excavation including trench line, topsoil skimming and/or surface excavation, unless otherwise approved by the Construction Manager; and
 - unauthorised pesticide, herbicide or chemical applications.

Minimising damage to retained vegetation

- All activities in areas adjacent to any vegetation to be retained are to be carried out in such a manner as to minimise damage to the vegetation.
- Vegetation to be retained is to be clearly identified. Each tree or groups of trees to be retained investigated at the appropriate time by an Ecologist/Arborist.

Sediment and Erosion Control

- As construction activities may impact on retained vegetation it is important to ensure sediment fencing is in place before site preparation and other earthworks commence. Prior to any site preparation operations, the Environmental Advisor (or other suitably qualified personnel) is to undertake an inspection of all sediment fencing.
- Upon completion, grubbing operations shall ensure the site is left free draining with no ponding of stormwater.
- Erosion & sediment control works shall be undertaken in accordance with the relevant Environmental Management Plan.
- The erosion and sediment control measures shall not be dismantled until the disturbed areas have been covered by mulch to a minimum depth of 100 mm.

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Trenching and Excavation

- When trenching or excavation is to be undertaken within the root zone of any tree, roots will be severed cleanly rather than torn with a backhoe or other excavation equipment.
- All roots are to be exposed first and then cut cleanly with a sharp saw or loppers.
- Exposed roots are to be kept moist and covered with hessian for the duration of the exposure. Where roots with a diameter larger than 50 mm are encountered excavation should be undertaken by hand and such roots tunnelled under.

Weed Management

- All mulch produced on site from cleared vegetation and trees specifically exclude

Environmental Objective - Terrestrial Flora

Implementation of vegetation clearance, stockpiling, recycling or disposal practices that maximise the re-use of native vegetation and minimise environmental harm.

	material from weed species. Vegetation mulching suitably controlled to avoid contamination. Mulch containing weed species material shall be treated separately and not used on site for regeneration/ revegetation works. ■ Soil disturbance within retained vegetation must be kept to a minimum to avoid weed recruitment. Areas to be regenerated (weed control) or revegetated completed under strict supervision to avoid unnecessary soil disturbance. ● A Weed Management Plan will be prepared for the project. Management measures to prevent the movement of declared weeds to and from the construction site include: - Use of wash-down facilities for vehicles and equipment entering and leaving the dam construction site and those areas proposed for vegetation clearance. - All machinery, equipment and vehicles shall be certified as "clean" prior to entering the site by trained personnel in accordance with DNRW practices. - Weeds are not to be used as mulch for landscaping, but are to be disposed of and burnt to prevent reseeding. - Soil, earth and landscaping material brought onto the site must be from a source that is clean and weed free. - The monitoring of revegetated areas to identify new infestations and eradicate any declared weeds found. - Weed monitoring to ensure that new weed species are not introduced into the immediate development area or surrounding sites. <i>Protection of Trees within Construction Zones</i> ■ Prior to commencement of the Works, the applicant shall arrange a pre-start meeting with Council Environmental Assessment Officers or other relevant Council Officer. The applicant shall tag all trees to be retained and shall install all approved protection measures. ■ Contractor to provide fences and/or trunk girdles to prevent unintended physical damage to the root system, trunk or canopy of native vegetation identified for retention, which may be impacted upon by clearing works. ■ Trees deemed to be potentially impacted upon, shall be protected by the application of carpet underlay and/or corrugated iron or some other similar material to encase that trunk of the tree. ■ All works carried out on either foliage or root systems of trees in consultation with a qualified arboriculturist or horticulturist. ■ All works to adhere to the Australian Standards (AS) 4373 - 1996 (Pruning of Amenity Trees). The subject trees are not to be topped nor lopped. Spur climbing of any tree to be pruned should be avoided. ● Excavate the finish grade by hand and prune exposed roots. Mulch the area immediately after the cut is completed. If the cut causes inadequate soil moisture by redirecting water flow or lowering the water table, add supplemental irrigation. If large grade changes are needed, a retaining wall or crib can be used. Retaining walls allow deep fills and cuts while still protecting the original soil level within the critical root area.
Monitoring	■ Monitoring by Contractor of vegetation clearance, earthworks components and the above Performance Objectives of the proposed works on a continual basis to confirm that specific controls have been implemented and appropriate work practices are being adopted to achieve the specified performance objectives. ■ Periodic condition monitoring by Contractor of all retained vegetation, with a maximum interval between inspections of one month, addressing the health and vigour of all retained vegetation for one year after the commencement of operational works. ■ Disturbed areas are inspected monthly for weed growth, with appropriate weed control

Environmental Objective - Terrestrial Flora		
Implementation of vegetation clearance, stockpiling, recycling or disposal practices that maximise the re-use of native vegetation and minimise environmental harm.		
		measures implemented when warranted. - Regular inspection of cleared areas and contractor's methods during clearing to ensure compliance with EMP. - Auditing of the EMP conducted quarterly (internally) and annually (externally).
	Reporting	- Monthly Report prepared and submitted to Proponent to include details of monitoring results, audits, training and incidents. - Immediate reporting to Supervisor and Alliance Environmental Advisor of any incident which contravenes the objectives of the EMP. - Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
	Responsibility	Contractor
	Corrective Action	- Appropriate control measures implemented where unacceptable sediment or erosion is occurring or may occur. - The Contractor will ensure that the appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding vegetation clearing and weed management. - The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or at risk of occurring. - If deemed necessary by an Arborist a soil injection treatment will be applied to the root zone of any tree that has been adversely affected by a project. The soil injection treatment is a combination of water, nutrients and other agents that promote root growth such as; rooting hormones, humic acids, soil microflora and mycorrhizae. The use of nitrogenous fertilisers must not be used where <i>Phytophthora cinnamomi</i> (root rot fungus) is suspected or known.

20.4.4.2 Terrestrial Fauna

Potential direct and indirect project impacts will occur in the short-term and over the long-term. Short-term impacts are those occurring as a direct or indirect result of construction and operation of the project, whilst long-term impacts will occur over a more extended period of time (in the order of years).

Identified short-term impacts include:

- Injury and death of flora and fauna during clearing works;
- Potential disturbance to fauna from construction activities, noise and vibration;
- Potential traffic related wildlife mortality on roads within and around the project area; and
- Potential injury/ death during tree clearing.

The long-term impacts include:

- The loss of habitat as a result of vegetation clearing; and
- Fragmentation of the landscape affecting flora connectivity and, thus fauna movement.



Management of potential impacts on the identified terrestrial fauna within the Hummock Hill development area is outlined below.

Environmental Objective - Terrestrial Fauna	
Ensure that tree clearing and other construction operations are completed in a manner that provides maximum protection of the health and livelihood of native fauna.	
Performance Criteria	■ The risk (of injury and death) to fauna is managed and minimised during site clearing operations. ■ Retained habitat is not compromised by site clearing works, gross mechanical disturbance or impacts associated with sedimentation and/or pollutant export from the construction area. ■ Fauna species continue to utilise the retained habitat area post-development.
Mitigation Measures	<i>Compliance with the Code of Practice</i> ■ The program undertaken in compliance with Queensland Parks and Wildlife Service (QPWS) guidelines and the Draft Queensland Code of practice for the welfare and management of wild animals affected by land-clearing and the modification or destruction of wildlife habitats and wildlife spotter/catchers. <i>Identification of Habitat Trees</i> ■ Habitat trees must be identified prior to the selective clearing operations. (Habitat trees are defined as those trees that provide suitable foraging, refuge and nesting resources for arboreal and avian fauna and micro-bats. These include hollow-bearing trees, trees with fissures, trees with food resources (e.g. pollen, nectar, foliage, arthropods). Larger, old growth trees are also considered to be habitat trees as they are likely to provide greater amounts of foraging resources, cover, and a high number of potential hollows. Dead (stag) trees are also regarded as important habitat trees as they provide roosting and nesting resources.) ■ Once this has been completed, clearing must be conducted using a staged approach where the smaller non-habitat trees are removed in the first stage with the larger remaining habitat trees removed three to five days after the initial clearing. (This staged method provides a disturbance stimulus and provides fauna with time to leave the site thus maximizing the chances of fauna survival while reducing the need for human intervention for translocation or rescue purposes). <i>Removal of Tree Hollows</i> ■ If any denning, roosting or nesting animals are observed within hollow limbs, but cannot be readily removed by an ecologist, it is recommended that, where appropriate, the hollow end of the limb is blocked with porous material and a chainsaw be used to remove the limb. The limb should then be relocated to a suitable place, determined in consultation with QPWS and the hollow end unblocked at an appropriate time of day to minimise fauna predation. In the case that a colony of microchiropteran bats are located, then the roost will either be felled at night (once bats have vacated) or the entry points shall be blocked, and the roost will be moved to an appropriate area of vegetation to be retained on or adjacent to the site. ■ Hollow logs must not be mulched until inspected by a qualified Ecologist. ■ As many hollow logs as possible relocated to areas within an approved Conservation Open Space Area as habitat features. <i>Removal of Fauna</i> • Develop and implement a compensatory habitat strategy for the project. The strategy objectives will: - seek to comply with the requirements of the <i>Queensland Vegetation Management</i>

Environmental Objective - Terrestrial Fauna

Ensure that tree clearing and other construction operations are completed in a manner that provides maximum protection of the health and livelihood of native fauna.

	<i>Act 1999 and associated Codes and Policies; and</i> - aim to provide tangible conservation benefits at the local and shire-wide scale, with an emphasis on threatened species conservation. ■ Assessment of the site for wildlife will be undertaken by an appropriately qualified person (i.e. accredited by QPWS for capture and release) at least 14 days prior to pre-start meetings for construction. After the pre-start meeting, the 'spotter catcher' shall provide a plan to Council indicating the broad range of fauna expected in the site, the proposed method of operation, and any expected constraints. All operational works involving habitat removal are to be supervised until satisfied that native fauna have been suitably relocated, and shall instruct the contractor when no further action is required. Council will confirm with the appointed person that no habitat removal occurred without supervision shall be present to inspect the trees and relocate remaining fauna where possible. <i>Flushing of Denning Fauna</i> ■ Prior to tree removal, an appropriately qualified ecologist attempt to "flush out" any denning or nesting animals not observed during the initial hollow inspection. This may involve hitting target trees with a sledgehammer or another similar technique. Following felling, a second inspection of the relevant trees carried out to relocate fauna disturbed by the clearing process or remaining within the felled timber to a suitable location determined in consultation with QPWS. ■ Where possible, the actual felling of the habitat trees conducted in a manner that will maximise the chances of survival for any fauna remaining within the tree hollows. This involves pushing rather than cutting, and cushioning the tree fall with other felled timber and foliage. <i>Care of Injured Fauna</i> ■ All injured animals immediately removed and taken to an appropriately qualified veterinary surgeon. Any orphaned or injured native fauna discovered at a later stage during operational works immediately reported to the QPWS. <i>Pest Control</i> ● A Vector Management Plan will be developed and implemented which addresses at least the following matters: - breaks in any continuous vegetation lines leading to residential areas; - roadway embankment construction should be designed to eliminate (if possible) any standing water impoundment or redirection of water flows into potential mosquito breeding areas; - stormwater drainage should be designed to avoid silt accumulation and be free draining. Exit points from drains into waterways or wetlands should be designed to avoid habitat changes at discharge points.
Monitoring	■ Monitoring of vegetation clearance, earthwork components and requirements of this EMP on a continual basis to confirm that specific controls have been implemented and appropriate work practices are being adopted to achieve the specified Environmental Objectives. ● Regular monitoring is necessary for long-term projects. A monthly site inspection will be conducted to ensure that protection measures are being adhered to and that retained trees are not showing signs of damage or stress. Such inspections shall be completed by a qualified arborist.



Environmental Objective - Terrestrial Fauna	
Ensure that tree clearing and other construction operations are completed in a manner that provides maximum protection of the health and livelihood of native fauna.	
	Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	- Monthly report prepared and submitted to EATON to include details of monitoring results, audits, training and occurrence of any incidents. - Immediate reporting to Supervisor and Alliance Environmental Adviser of any incident, spill or release of materials to the environment. - Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
Responsibility	Contractor
Corrective Action	- Ensure that the appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding fauna management. - The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or at risk of occurring.

20.4.4.3 Aquatic Fauna and Flora

Hummock Hill Island is included within the Queensland State Great Barrier Reef Coastal Marine Park which covers all waters of Seven Mile Creek, Boyne Creek and Colosseum Inlet to the highest astronomical tide (HAT). The Coastal Marine Park in the Hummock Hill Island area imposes the same restrictions for the General Use Zone that the Commonwealth Great Barrier Reef Marine Park does.

The significance of Colosseum Inlet –Rodds Bay wetland vegetation is due to the presence of rare (Sr), vulnerable (Sv) and endangered (Se) flora and fauna. Directory entries include flora such as seagrass beds and fauna such as 2 – 5 % of the world population of Eastern Curlew (*Numenius madagascariensis*) (Sr), various migratory waders, dugong (*Dugong dugong*) (Sv) presence, Green Turtle (*Chelonia mydas*) (Nv Sv) feeding grounds, amongst others being present within the wetland area.

The proposed management strategies for potential impacts on aquatic fauna and flora are outlined below.

Environmental Objective - Aquatic Flora & Fauna

Minimise and mitigate, as far as is practicable, the adverse impacts on aquatic fauna and flora, during construction of the project.

Where unavoidable impacts occur, develop and implement strategies to mitigate these impacts to an acceptable level.

Minimise the opportunity for aquatic weed growth and increases in abundance or diversity of other pest species.

Performance Criteria	■ No discharge of materials through stormwater runoff from construction and operational areas, with particular regard to suspended sediments, fuels, chemicals, and oils. ■ No waste materials (general and construction rubbish etc) entering waterways from construction and operational areas. ■ A program must be implemented to monitor and treat aquatic weeds and other pest species that may enter the dam from a work site. ■ No uncontrolled or untreated release of water or sediment from a work site.
Mitigation Measures	<i>Sediment and Erosion Control</i> ■ Implementation and maintenance of the Water Quality EMP, with particular reference to the management of stormwater and exposed soils. <i>Chemicals, Fuels, and Oils</i> ■ Implementation and maintenance of the Water Quality and Hazards/Risks EMPs with particular reference to the appropriate storage measures of hazardous materials. <i>Waste Materials</i> ■ Implementation and maintenance of the Waste Management EMP. <i>Aquatic Weed Control</i> ■ Implement and maintain a program to monitor and control aquatic weed growth including those found in tributaries that will become inundated by the dam. This program will include a survey to determine the distribution and abundance of declared weeds within the project area (including the inundation zone). <i>Movement of Vehicles/Plant from Weed Infested Areas</i> ■ Implement and maintain the EMP for Weed Management. This plan will include protocols for management of vehicle and machinery movement protocol to reduce the likelihood that weeds are spread as a consequence of this project. <i>Protection of Sea Turtles</i> ● Develop and implement a lighting plan to protect sea turtles. The plan should consider: - Minimising work that requires use of lighting; - Turning off light sources where not required and minimising number and wattage where night time work is required; - reposition lights behind structures, or shielding, redirecting, lowering, or recessing so that their light does not reach the beach.
Monitoring	<i>Aquatic Weeds</i> ■ Implement and maintain the Weed Management EMP, to determine the distribution of known declared weeds and, where practicable, control these infestations, in accordance with the <i>Land Protection (Pest and Stock Route Management) Act 2002</i>. <i>Pest Species</i> ■ Implement and maintain a program to monitoring and control pest species in waterways (both flora and fauna); ■ Control measures for other pest species (flora or fauna) will be implemented. When it can be identified that the abundance of a priority pest species is discernibly higher in the vicinity of the operations than in regional areas and a discernable actual or

Environmental Objective - Aquatic Flora & Fauna

Minimise and mitigate, as far as is practicable, the adverse impacts on aquatic fauna and flora, during construction of the project.

Where unavoidable impacts occur, develop and implement strategies to mitigate these impacts to an acceptable level.

Minimise the opportunity for aquatic weed growth and increases in abundance or diversity of other pest species.

	potential impact is detected.
	<i>Auditing</i> Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	- Monthly report prepared and submitted to Eaton to include details of monitoring results, audits, training and the occurrence of any incidents. - Incidents, complaints and any significant environmental harm to aquatic environment reported to regulatory body/ies where required. - Assessment of performance against the identified indicators will be determined by auditing and reporting on a monthly (internally) and three monthly (externally) basis during construction.
Responsibility	Contractor
Corrective Action	- Measures undertaken to protect the aquatic environment where unacceptable impacts or risk of environmental harm becomes apparent. - Immediate reporting to Supervisor and Environmental Adviser of any incident which contravenes the objectives of the EMP. - The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.

20.4.5 Cultural Heritage

Seventeen specific indigenous cultural heritage sites were located during the field surveys conducted on Hummock Hill Island. These sites consisted of:

- 5 x isolated stone artefacts;
- 1 x possible ceremonial area;
- 3 x artefact scatters (under five artefacts);
- 1 x background degraded shell scatter with associated artefacts;
- 4 x shell midden deposits in various levels of erosion and/or disturbance (some with associated stone artefacts including one containing 8 artefacts [HH Site 13 SO17]);
- 2 x stone arrangements (1 consisting of four individual arrangements – S12A-D); and
- 1 x mound (possible midden mound)

The proposed management strategies for potential impacts on cultural heritage aspects are outlined below.

Environmental Objective - Cultural Heritage	
To manage the known and unknown components of indigenous archaeological records and areas.	
Performance Criteria	■ All known indigenous archaeological records, as identified within Section 13 of the EIS, are preserved and not impacted upon by the project. ■ All unknown indigenous archaeological records found during the course of the project are reported to the Department of Natural Resources and Water (DNRW) and Eaton Cultural Heritage Senior Project Officer.
Mitigation Measures	<i>Induction</i> ■ Conduct cultural heritage awareness training for all on-site personnel identifying areas and items of cultural heritage significance. ■ Work crews will be specifically instructed of their obligations to look for cultural heritage material, including handing out educational leaflets at Workplace Health and Safety meetings. These leaflets should inform the workers what archaeological material may look like, and give them clear instructions on what to do if they find any items of (potential) cultural and heritage significance. <i>Excavation activities</i> ■ All site operations are to be carried out in accordance with the Cultural Heritage Investigation and Management Strategy (CHIMS) as agreed between Eaton and the Traditional Owners for the area. The CHIMP will address at least the following matters: - an earthworks monitoring program involving the representatives of the participating Traditional Owners during initial vegetation removal and grubbing activities. These areas to be included in the monitoring program include: ■ A 250 metre wide strip extending inland from the lease boundary inclusive of and located both east and west of the headland (Area 1); ■ A 100 metre wide strip extending inland from that area of the development incorporating the high-water mark situated adjacent to tidal flats located southwest of the headland (Area 2); ■ The entire area to be developed in the immediate vicinity of the causeway (Area 3); ■ A 100 metre wide strip extending inland from the lease boundary and incorporating the lower reaches of the headland/ridgeline located to the west of the causeway and incorporating that area immediately south of the dammed watercourse (Area 4); ■ A 100 metre wide section of the development area incorporating elevated land immediately north of the dammed watercourse (Area 5); and ■ A 100 metre wide strip extending inland from that area of the proposed golf course incorporating the high-water mark situated adjacent to tidal flats located northwest of the causeway. ● Establish exclusion zones for the following sites during construction activities: - All sites noted in Appendix A7.13 that are situated outside the immediate development area [HH05 - HH07 and HH10-12, HH16 and sections of HH13]. - Stone arrangements located at sites HH03 (S04) and HH09 (S12A-D); and - HH04 (S05). - Traditional Owners will be consulted regarding the exact type, specifications and location of exclusion zones and have particularly emphasised the importance of this consultation process in relation to Sites HH03, HH05, HH06, HH07, HH09, HH10 and HH13. <i>Discovery of Artefacts</i> ■ An artefact handling and a curatorial agreement will be negotiated between the Traditional Owners and the Queensland Museum.

Environmental Objective - Cultural Heritage	
To manage the known and unknown components of indigenous archaeological records and areas.	
	All artefacts located during the survey within the confines of the project area, excluding Site HH04, will be collected by nominated representatives of the Traditional Owners prior to the commencement of the project. These include HH01, HH02, HH08, HH13 (S18) and HH17.
Monitoring	- Updating of archaeological records as appropriate. - Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	- Report any findings of any indigenous archaeological items to the Site Supervisor immediately. - Report any findings of any indigenous archaeological items to Cultural Heritage Coordination Unit, DNRW and Eaton Cultural Heritage Senior Project Officer.
Responsibility	All site personnel
Corrective Action	Non-compliances to be followed to completion.

20.4.6 Air Quality

The main potential for construction phase air quality impacts is likely to arise from dust generation (both larger particles described as 'dust' and finer particulate matter described as PM₁₀) during earthworks and vehicle movement over unsealed surfaces and would occur following the initial stages of construction, as residential receivers begin to inhabit the island.

Large-scale earthworks associated with site preparation for residential and road construction projects typically produces dust from grading, dozing, excavation, drilling/piling, concrete batching, trucks transporting equipment to and from the site and vehicles moving around the site.

Due to the Island's isolation from residential receivers and the short-term nature of bulk earthworks associated with the construction, nuisance dust impacts from these sources are not expected to be significant during initial stages of development. However, given that the development will be staged over a number of years, potential nuisance dust impacts may occur during the latter stages of construction, as the number of newly constructed residential receivers increase and construction works are carried out adjacent to these receivers.

The proposed management strategies for potential impacts resulting from nuisance dust emissions are outlined below.

Environmental Objective - Air Quality	
To minimise the potential to generate air quality impacts during construction	
Performance Criteria	<i>Aim to achieve:</i> - PM₁₀ (24 hr average) - 50 µg/m³ <i>Not to be exceeded:</i> - PM₁₀ (24 hr average) - 150 µg/m³

Environmental Objective - Air Quality To minimise the potential to generate air quality impacts during construction	
	■ PM₁₀ (annual average) - 50 µg/m³ ■ Dust Deposition - 120 mg/m²/day When measures at relevant receptors.
Mitigation Measures	<i>General Work Practices</i> ■ Newly established stockpiles in the construction site seeded and stabilised as soon as practical. Water sprays used on stockpiles and should be activated during dry and windy conditions; ■ Hydro-mulch, mulch or hydro-seed should be applied to batters adjacent to haul roads to stabilise these areas and minimise wind-blown dust; ■ Retention of existing vegetation, where practical, between construction activities and sensitive receivers to reduce particulate concentrations and dust deposition rates at receivers; ■ Burning of cleared vegetation must only be undertaken if other disposal options are not feasible. ■ Prevailing meteorological conditions should be considered before undertaking any burn event to minimise potential air quality impacts from this activity. These events to be undertaken in consultation with the Queensland Rural Fire Service and QPWS; ■ Sealed access roads to the worksite sheds kept relatively dust free by regular sweeping and washing if needed; and ■ Locate stationary dust generating activities (including concrete batching, rock crushing) as far as practical from sensitive receivers. <i>Construction Dust</i> ● A Dust Management Plan will be developed and implemented. The plan will address at least the following matters: - Construction of a sealed site access road will be undertaken during the initial stage of construction works and works will be staged to minimise the extent of disturbed land at any one time; - Use dedicated site entry and exit points, and defined roadways only and install truck wheel shaker pads or washer sprays at the access / egress points to unsealed trafficked areas in order to minimise tracking dirt onto the adjacent paved road network; - Progressive rehabilitation of disturbed areas will be undertaken to minimise the potential for windblown dust; - Haul roads will be sealed or watered regularly using truck water carts to reduce emissions of wheel generated dust (recycled water will be used preferentially for dust suppression purposes); - The size of cleared areas should be kept to a minimum to limit exposed areas available for dust emissions by wind erosion; - Haul trucks should be speed limited (<20 to 40km/h) to control wheel-generated dust from haul roads, if visual inspection indicates that significant quantities of dust are being generated and transported off-site; - Haul truck loads are to be covered when travelling on public roads, the load it to be lower than the sides of the truck and the truck is to be free of loose mud and dirt before entering public roads; - Use barriers along side roads to deter driving off nominated access roads; - Enclosures around cement truck unloading bays (at least 2 sides for drive through plant and three sides for rear unload plant) or sealed transfer processes to be implemented; - Storage of aggregate within protected stockpile areas (two or three sided bins, with aggregate loaded to more than 0.5m below bin wall height); - Cement and fly ash handling to be undertaken within dust tight systems (including filters on discharge from delivery trucks to storage silos and weigh hoppers etc); and

Environmental Objective - Air Quality To minimise the potential to generate air quality impacts during construction	
	- Ensure any other necessary dust controls and enclosures are incorporated, including semi enclosing the crushing plant and batching plants and including dry collection systems (fabric filters etc). <i>Excavation and Stockpiling</i> - Surface excavation works are to incorporate consideration of prevailing meteorological conditions wind speed and direction, with works potentially ceasing if high winds are blowing in the direction towards sensitive receivers; - Stockpiles or material stores should be kept damp by water sprays and/or covered and should be located as far from sensitive receptors as possible; - Any stockpiles should be stored in sheltered locations where possible, with the slope of the upwind surface minimised; - Regular watering of spoil stockpiles prior to stabilisation; and - Dust/wind fencing should be provided around stockpile areas, where suitable <i>Vehicle Emissions</i> - Develop and implement a Construction Traffic Management Plan to manage the movement of construction vehicles entering and leaving the construction sites and queuing along local roads adjacent to residential dwellings; - Minimise extended engine idling and queuing adjacent to residential dwellings; - Regularly maintain diesel exhaust equipment and ensure compliance with appropriate design emission standards for in service vehicles; and - Maintain diesel powered stationary plant to ensure appropriate levels of air emissions and consider fitting emission controls where required.
Monitoring	- Establish a meteorological monitoring station at the site. - Visual inspections throughout workday. - Continuous Meteorological Data recorded from an on site station. - Use of dust deposition gauges. - Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).
Reporting	- Monthly Report prepared and submitted to Eaton to include details of air quality monitoring results, audits, training and the occurrence of any complaints. - Immediate reporting to Alliance Manager of significant dust event that will require mitigation measures to be implemented. - Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
Responsibility	Contractor
Corrective Action	- Air quality mitigation measures must be implemented immediately or as soon as practicable where air quality objectives are not being met. - Ensure that the appropriate personnel undertake adequate environmental awareness and training covering the requirements of the EMP regarding air quality management and monitoring. - The Project Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.



20.4.7 Noise and Vibration

Potential noise and vibration generation from construction activities will be variable, depending on the stage of works, type of equipment operating at a particular time and the proximity to sensitive noise receptors.

During initial works, potential impacts are likely to be restricted to receivers adjacent to the mainland access route to the Island. Given that there are currently no identified noise receptors on Hummock Hill Island, construction noise and vibration impacts from proposed earthworks and civil works are not expected to be significant during the initial stages of construction.

However, as the development progresses and tourist/residential accommodation expands on the Island, a potential exists for construction activities to impact on new Island residents.

Construction traffic, associated with limited earthworks and materials to and from development areas has the potential to result in noise and vibration impacts at residential dwellings adjacent to the mainland access and egress route. Although there is likely to be an increase in the number of heavy vehicle movements during the construction period, vibration impacts from construction traffic travelling along the access route to the Island are not expected to be significant for this project.

Given that there are currently no sensitive receptors identified on Hummock Hill Island, construction vibration impacts are not expected to be significant during the initial stages of construction. If, during the later stages of development on the Island, construction occurs within 50-100m of residential uses, minor annoyance (or disturbance) from vibration may be experienced by building occupants.

The proposed management strategies for potential impacts resulting from nuisance noise and vibration are outlined below.

Environmental Objective - Noise & Vibration To minimise noise and vibration impacts from construction activities at residential locations near the Dam construction areas.	
Performance Criteria	<i>Aim to achieve</i> ■ Noise and vibrations from early construction activities are to be minimised so as to not create nuisance. ■ Noise from construction activities during the latter stages of the development would aim to achieve a level of 55 dB(A) $L_{Aeq\ 11\ Hr}$ during the day and evening and an internal noise level of $L_{Amax}\ 52\ dB(A)$ (equivalent to an external noise level of $L_{Amax}\ 62\ dB(A)$) during the night.
Mitigation Measures	<i>Hierarchy of Control</i> ■ A Construction Noise Management Plan will be developed and implemented . The plan will address the following hierarchy of noise and vibration controls: - Ameliorative measures would be implemented based on a hierarchy of control firstly by elimination then substitution and finally modification of the noise source; - Where these methods cannot produce the desired result, secondary measures would include blocking the path of the sound transmission between the receiver and the source; - When all of the above methods of reducing noise impacts are exhausted then noise

Environmental Objective - Noise & Vibration

To minimise noise and vibration impacts from construction activities at residential locations near the Dam construction areas.

- control at the receiver location must be considered; and
- Identification of noise impacts and subsequent remedial actions are to be based on consultation with the relevant members of the community.
- During later stages of construction the following additional mitigation measures should also be incorporated into the plan:
 - No 'warming up' of plant and machinery would occur near residential dwellings before specified working hours;
 - Ensure all noise suppression devices are maintained to manufacturers specifications;
 - Fit all exhausts of mobile plant operating within close proximity to sensitive receivers, with suitable mufflers;
 - Consider further limiting the allowable hours of operation; and
 - Consideration to fitting adjustable reversing alarms (which are set at a margin above background level).

Controls at Receivers

- Due to the mobile nature of the proposed construction works, effective source noise controls may not be possible. Where the extent of noise mitigation which can practically be implemented at the site cannot achieve acceptable noise levels, noise mitigation at receivers will then be considered to assist with minimising the impact to acoustic amenity;
- The implementation of noise controls at a receiver location would be based on several factors including the construction of the residence and must be considered in light of the project noise goal. Where mitigation measures at the source or in the path of the noise emission has reduced noise levels to be within 3 dB(A) of the Project specific noise goal, additional treatment would not generally be considered based on the additional cost to provide only a marginal benefit.

Operating Times

- Works be restricted to the hours of 6:30 am – 6:30 pm Monday to Saturday, and no work outside these hours if audible at the nearest sensitive place;

General work practices and scheduling of activities

- In general, construction works and consideration of quite work practices would be carried out in accordance with AS2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*;
- Appropriate selection of construction processes / methodologies and equipment which minimise the generation of noise would be further considered during the development of the project schedule;
- Employ respite periods for particularly noisy activities where possible;
- Maintain a site activity log, recording the type of activities occurring during various times of the day to assist with the retrospective investigation of community complaints relating to noise complaint;
- Tailgates of all vehicles transporting materials to and from the site would be securely fixed prior to loading and immediately after unloading;
- All mobile plant equipment used on site shall be maintained in an efficient condition and operated in a proper manner;

Worker Education & Awareness

- Regularly educate workers and contractors (such as during tool box/pre-start meetings) to maximise awareness of project noise goals and nuisance noise generating activities and

Environmental Objective - Noise & Vibration

To minimise noise and vibration impacts from construction activities at residential locations near the Dam construction areas.

	encourage minimisation of these activities, including: - unnecessary or overuse of PA devices, horns - use of compression air brakes adjacent to sensitive areas; - shouting and swearing at shift start/end; and - efficient material handling procedures to reduce unnecessary loud banging sounds. <i>Traffic Noise Management</i> ■ Reduce the potential for impacts from construction traffic by: - Establishing designated access route/s to the site and informing drivers of these routes, parking lots and acceptable delivery times; - Undertaking regular site road maintenance (and inspections) to minimise impact noises from trucks travelling over irregularities in the road surface (such as pot-holes, washouts or ruts); - Limiting vehicle speeds in critical areas both on and off site; - Allowing for one-way traffic flow through the site to minimise the use of reversing alarms as much as possible and minimise traffic delays; - The use of 'smart', reversing alarms (as above); - Limiting excessive acceleration from site exits; - Ensure that vehicles required within compounds do not "queue" outside the worksite close to residential areas. This particularly applies in the commencement of shift during morning hours, where sleep disturbance issues may arise; - Entry and departure of heavy vehicles to and from the site are restricted to the standard daytime construction times; and - Best available controls over engine noise emissions by maintaining the vehicle fleet in compliance with Australian Design Rule 28/01 for engine noise emissions, tested in accordance with the National Road Transport Commission document Stationary Exhaust Noise Test Procedures for In-Service Motor Vehicles.
Monitoring	<i>Environmental Noise Monitoring</i> ■ Due to the varying nature of the construction activities to be undertaken throughout the project the effectiveness of the construction noise mitigation measures and management procedures would be reviewed regularly. ■ Monitoring and review of the site noise management practices would be undertaken: - At the commencement of construction activities; - In response to a valid community complaint regarding construction noise; or - Where review of upcoming construction schedule indicates a high likelihood for impact at nearest sensitive receiver locations. - The purpose of monitoring is as a proactive management tool to assist with: - Investigating the likely sources of construction noise impact; - Quantifying the extent of likely impact (through comparison with the project noise level goals); - Identifying the need for further controls or modified site noise management practices; and - Establishing the effectiveness of noise mitigation implemented. ■ Noise monitoring would also be undertaken in response to noise complaints or where new activities are initiated, as required. Where noise monitoring is required in response to valid community complaints investigations it would be performed at a location representative of the nearest affected sensitive receiver to the site or a location representative of the complainant(s) dwelling. ■ The L_{Amax}, L_{A10}, L_{A1}, L_{A90}, L_{Aeq} noise levels would be reported and construction noise levels would be compared with the project noise level goals. ■ Compliance checking of EMP conducted quarterly (internally) and auditing conducted annually (externally).

Environmental Objective - Noise & Vibration	
To minimise noise and vibration impacts from construction activities at residential locations near the Dam construction areas.	
Reporting	- General monitoring information is for the use of the Project Environmental Advisor, however, the results of noise level measurements and investigations undertaken in response to community complaints would be summarised and included with other environmental reporting documentation (as required) and provided to the EPA on request. Reporting would note: - The time of monitoring; - The type and location of activities occurring on site at the time of monitoring; - The location of monitoring positions with respect to site noise sources (also marked on a plan); - Noise generating activities audible at the monitoring location; - Other extraneous noise sources which could influence the noise level measurements; and - Weather conditions prior to and during the monitoring (or complaint). - Where site activities are identified as the probable cause of concern or complaint, action would be taken to minimise future events by revising noise management procedures (involving modification to work practices or further controls at source or at receiver) for the activities identified as contributing to the nuisance or high noise event. - Management measures outlined above would be revised and the updated commitments implemented to reduce potential for future impacts as a result of similar activities
Responsibility	Contractor Environmental Manager would be responsible for compliance monitoring and complaint investigation.
Corrective Action	- If complaints are received in relation to a short-term unavoidable event/s or emergency the community engagement and awareness of the possibility of such future activities would be improved. - Where construction noise level investigations in response to community complaints show unacceptable project noise levels, revision to the noise mitigation measures and management commitments would be undertaken to further control noise impacts. - The project noise level goals would be used to assist with determining the need for further corrective actions. - Where further source noise controls or mitigation in the sound transmission path are not possible or ineffective in further controlling noise levels, controls at the receiver would be investigated. Detailed investigation of façade attenuation would be required as part of these investigations.

20.4.8 Waste Management

The waste streams expected to be generated by proposed construction activities are:

- Fill and soil (not contaminated);
- Fill and soil (contaminated);
- Timber and vegetation;
- Scrap metal;
- Cable and wire;
- Concrete, bricks, tile and rubble;
- Plasterboard;
- Packaging wastes, plastic, glass and timber;
- Domestic and general waste;



- Organic and food waste;
- Wastewater;
- Diesel and other fuels;
- Paints and other chemicals; and
- Asbestos

Uncontrolled generation and management of such waste materials can result in risks to the environment. The environmental risks range from potential environmental harm, such as pollution of waterways, to environmental nuisance, such as odour complaints. The potential impacts of the proposed development on the identified environmental values are listed below.

- Waste spills and loss of containment of waste resulting in impacts to soils, surface water, groundwater, terrestrial and marine fauna, and human health;
- Littering and contamination of waterways;
- Plastic waste causing mortality to marine fauna;
- Waste spills and related incidents from transportation of waste on and off the island;
- Cross contamination of wastes, making wastes unsuitable for reuse and/or recycling, thus increasing the quantity of waste being disposed of to landfill;
- Increasing the pressure on regional landfills;
- Odour and noise generation from waste handling and storage; and
- Propagation of pests, vermin and disease vectors.

The proposed management strategies for potential impacts relating to waste generation and control are outlined below.

Environmental Objective - Waste Management	
To prevent or minimise the generation of wastes, where practicable and to appropriately contain, control and dispose of all waste generated.	
Performance Criteria	■ Implementation of waste management principles (Reduce, Re-use, Recycle) and effective and sustainable disposal strategies on site. ■ Reasonable and practicable steps to minimise the impacts of handling and disposal of construction waste will be carried out; such as: – Minimisation of the production of waste and amount of waste requiring disposal; – Minimisation of the impact to the environment from waste; – Maximisation of the opportunities to reuse waste on-site; – Correct disposal of all wastes produced; and – Reduction of waste generated on site through re-use and recycling. ■ All waste must be disposed of lawfully. ■ Construction and storage areas clean and tidy.
Mitigation Measures	■ Prepare and implement a Waste Management Plan to deal with all construction waste streams. The plan will address at least the following matters: – Wastes to be managed in accordance with the Environmental Protection (Waste Management) Regulation 2000; – Waste avoidance, minimisation, reuse and recycling principles to be utilised wherever possible; – Wastes to be segregated to assist in recovery and recycling; – Provision of waste facilities in all break out areas; – Construction and demolition wastes to be reused and recycled, wherever possible; – No disposal of solid or hazardous wastes on the island;

Environmental Objective - Waste Management

To prevent or minimise the generation of wastes, where practicable and to appropriately contain, control and dispose of all waste generated.

- Materials to be fabricated off site where possible to minimise the generation of waste;
- In order to reduce waste volumes, where possible, all wastes generated from construction and operational activities will be reused on site or sent to recyclers. Disposal to appropriately licensed waste facilities will only be undertaken where reuse or recycling is not possible or feasible;
- Where appropriate waste generators will be encouraged to segregate wastes at the source to minimise cross contamination of waste streams;
- Waste will only be transported by appropriately licensed waste transporters;
- A centralised waste collection area will be provided as part of the development. The Waste Transfer Station will be constructed on a concrete hardstand and roofed, where practicable;
- The Waste Transfer Station location and design has taken into consideration appropriate containment and engineering, buffer distances to receiving environments and ongoing operation of the facility and environmental monitoring programs;
- Colour-coded and/or labelled bins will be provided for each waste stream to assist in the segregation of wastes and maximise waste recovery and recycling;
- Alternatives to plastic bags to be provided at retail outlets; and
- Records of waste quantities removed from the Island are to be maintained.

Reuse

- Identify and implement strategies for the re-use of waste products during construction.
- Spoil will be generated from excavations for dam and road foundations. Where possible, this material will be incorporated into the dam embankments or road design with waste material placed and compacted in designated disposal areas. The surfaces of the waste areas will be suitably sloped and revegetated to prevent erosion of the cover material.
- All commercially millable timber and other useable material will be offered for sale to local timber millers who will undertake logging operations under the supervision of the construction contractor. Vegetation unsuitable for timber will be chipped on site to provide mulch for landscaping, or made available to local revegetation projects.
- Building materials, timber and metal off cuts and plastics from construction and demolition will be reused on site where practicable.

Recycle

- Identify and implement recycling strategies for construction waste material; and
- Implement training for employees in the waste management plan and recycling opportunities.

Regulated Waste

- The regulated wastes generated during the construction of the dam include waste oils, fuels, lubricants, tyres, batteries, oily air filters, paints, resins, solvents, sewage sludges and residues, spill clean up materials and water, soiled rags, drums and soils containing regulated wastes.
- The management of regulated wastes (collection, transport, tracking, treatment and disposal) will be in accordance with the EPA Guidelines, including appropriate licensing of the contractor, transport vehicles and facilities.

Disposal

- Disposal of all waste material that is unable to be reused or recycled onsite, within an approved land fill;



Environmental Objective - Waste Management To prevent or minimise the generation of wastes, where practicable and to appropriately contain, control and dispose of all waste generated.	
	- No vegetation waste is to be burnt on site without a 'Permit to Burn' issued by the Rural Fire Brigade; and - Ensure the transport of regulated wastes, contaminated soils or other materials is conducted by licensed contractors for disposal at licensed facilities, in accordance with requirements of Part 2 of the <i>Environmental Protection Regulation 1998</i>. <i>Waste Transport</i> - Restriction of site works and surface truck movements for transport of waste material to designated hours; and - Ensure the movement of hazardous materials and regulated wastes occurs at non-peak times to minimise the possibility of traffic conflicts and associated risks.
Monitoring	- Regular inspection of on-site facilities to ensure waste is being generated, stored, handled, disposed and transported in accordance with this EMP. - Registers and manifests maintained to track waste material. This documentation subject to internal or external audit, especially for any regulated waste material. - Any discharges from site that could impact on the environment monitored in accordance with EPA's requirements. - Records kept of any regulated waste removed from the site, including name and licence number of waste transporters, volume and description of waste transported, destination of waste and licence number of the waste treatment operator. - Waste contractors to provide certification (licence) records verifying their registrations and points of discharge of waste. - Assessment of actual waste results and comparison with predicted impacts and mitigation measures. Provide baseline data to enable continuous improvement of waste avoidance, reduction and management measures throughout the project. - Monitoring for potential environmental impacts. - Auditing of the EMP conducted quarterly (internally) and annually (externally).
Reporting	- Monthly Report prepared and submitted to Proponent to include details of monitoring results, audits, training and incidents. - Any environmental incidents involving spills recorded including time of incident, persons involved, details of incident, mitigation measures and actions taken to minimise the probability of recurrence. Immediate reporting to Alliance Environmental Advisor of any large spills or potential risk of spills. - Incidents, complaints and any significant environmental harm reported to regulatory body/ies where required.
Responsibility	Contractor
Corrective Action	- Ensure that the appropriate personnel undertake adequate environmental awareness training covering the requirements of the EMP regarding waste management. - The Construction Manager can request the cessation of works at any time should a breach of performance criteria of the EMP be occurring or is at risk of occurring.

20.5 Draft Operations Environmental Management Plan

Environmental Management Plan Element Strategies describes proposed objectives, performance criteria and identified mitigation measures for the operational phase of the Hummock Hill Island development. Some of the environmental elements suggest specific monitoring requirements and/or statutory requirements.

The environmental element topics for this Draft Operational Environmental Management Plan (OEMP) are:



- Water Resources and Quality;
- Transport and Roads;
- Geology and Soils;
- Waste Management;
- Hazardous Substance Management;
- Visual Amenity.

20.5.1 *Water Resources and Quality Management*

Potential impacts on surface water resources and water quality resulting from the operation of the development are:

- Potential clearing of riparian vegetation during construction activities will expose soils to erosive forces creating sediment sources;
- Changes in freshwater flows changing vegetation community type;
- Impacts from contaminants (nutrients, heavy metals and pesticides) on watercourse and riparian vegetation;
- Installation of storm water management devices and systems may change existing hydrodynamics;
- Installation of erosion and sediment control measures and retention basins may alter flows to downstream environments;
- Installation of culverts and crossings in ephemeral watercourses may reduce fauna pathways along riparian zones;
- Storm water drainage from developed areas may concentrate flows and encourage soil erosion with subsequent increases in suspended sediments that ;
 - degrade ephemeral watercourse environmental values; and
 - are transported to adjacent estuaries and impact on marine EV;
- Maintenance of public areas, parks, green space and Golf Course may introduce nutrients from fertiliser applications to maintain vegetation growth and also irrigation of grey water;
- Emergency Waste Water Treatment Plant overflows;
- Animal waste inputs;
- Golf course maintenance may introduce nutrients from turf management practices and grey water irrigation;
- Operational activities may introduce litter from populated areas and be transported to downstream transitional wetlands and estuarine waters impacting receptors and EVs of these waters;
- Surface runoff from roads may contain and transport heavy metals and hydrocarbons to adjacent ephemeral watercourses;
- Maintenance of public areas can include weed control using pesticides that may be washed downstream during storm events to dam, estuarine and marine receiving waters; and



- Golf course maintenance can introduce weed and pest control chemicals to ephemeral watercourses during heavy rainfall events;
- Direct and indirect inputs of hydrocarbons from boating activity and public boat ramps may introduce petroleum hydrocarbons to marine waters;
- Surface runoff from public areas such as boat ramps and associated parking facilities may incorporate discarded litter that is released to adjacent estuarine and marine waters potentially impacting identified sensitive receptors such as C. mydas and D. dugong, marine wetlands and WH.

Surface water releases from the proposed development to both ephemeral watercourse and adjacent transitional estuarine and marine waters will comply with the requirements of the EPP (Water) as discussed in the EIS. Environmental management strategies are therefore geared towards this end.

No groundwater in the Island is proposed to be used for any part of the development. Impacts to world heritage values and associated sensitive receptors are not anticipated to occur as the existing hydrogeological regime is unlikely to be altered as a result of the proposed development.

Environmental Objective - Water Resources and Quality	
• To maintain environmental values associated with the estuarine and coastal waters (high conservation value, human consumption of aquatic foods, primary and secondary contact recreation, visual appreciation and cultural and spiritual values); • To preserve water quality established in section 9.2.7 of the EIS within the identified ephemeral watercourses and adjacent transitional estuarine and marine waters, permanent water storages in the Lagoon Villas Precinct, existing and proposed storages around the golf course; and • Maintain the Environmental Values (EVs), including compliance with the Water Quality Objectives (WQOs) established in section 9.2.7 of the EIS.	
Performance Criteria	■ Water quality objectives as per the <i>Environmental Protection (Water) Policy 1997</i>, Hummock Hill Environmental Values and Water Quality Objectives. ■ Aquatic ecosystem environmental values as per the <i>Environmental Protection (water) Policy 1997</i>, Hummock Hill Environmental Values and Water Quality Objectives. ■ Primary and secondary contact recreation as per the <i>Environmental Protection (Water) Policy 1997</i>, Hummock Hill Environmental Values and Water Quality Objectives.
Mitigation Measures	<i>Design</i> • Design and implement stormwater drainage measures in accordance with the <i>Queensland Urban Drainage Manual</i> (1993) and <i>Healthy Waterways Water Sensitive Urban Design Technical Guidelines for South East Queensland</i> (2006) (WSUD Guidelines). The objectives of permanent stormwater control measures will be: - Achievement of the SPP (Water) requirements; - minimising ecological impacts on waters in the locality (complying with required WQO); - acceptable health risks, aesthetics, protection from flooding, public safety and other social concerns; - making use of stormwater for recycling and water conservation; - making use of drainage corridors for improved recreational values and open space or landscape areas (refer to Section 42 of the EPP (Water));

Environmental Objective - Water Resources and Quality

- To maintain environmental values associated with the estuarine and coastal waters (high conservation value, human consumption of aquatic foods, primary and secondary contact recreation, visual appreciation and cultural and spiritual values);
- To preserve water quality established in section 9.2.7 of the EIS within the identified ephemeral watercourses and adjacent transitional estuarine and marine waters, permanent water storages in the Lagoon Villas Precinct, existing and proposed storages around the golf course; and
- Maintain the Environmental Values (EVs), including compliance with the Water Quality Objectives (WQOs) established in section 9.2.7 of the EIS.

	■ Culverts and crossings will be designed in accordance with <i>Queensland Urban Drainage Manual</i> (1993) with a climate change buffer in the relevant calculation of discharge (Q) if not already factored and will incorporate fauna passages of appropriate height and including dry passage ways for fauna; ■ Road drainage will be developed utilising both <i>Road Drainage Manual</i> (Main Roads, 2002) and the <i>Draft Water Sensitive Urban Design Engineering Guidelines: Stormwater</i> (BCC, 2006) with the aim to reduce contaminant loads to receiving estuarine and marine waters and meet WQO; • All commercial storages for hydrocarbons will be designed in accordance with AS 1940-2004 and associated standards; and • Drainage at public boat ramp parking areas will be directed to detention basins prior to discharge to estuarine waters. <i>Nutrient Loading</i> ■ Ensure buffer zones are well vegetated, to retard surface runoff and to act as a sink for nutrients; ■ Management of upstream nutrient sources, such as those that come from human sewerage. <i>Golf Course Management</i> • Develop and implement Integrated Turf Management Plans (ITMPs) as recommended by the <i>Improving the Eco-efficiency of Golf Courses in Queensland</i> (AGCSA & Qld EPA, 2001).
Monitoring	<i>Routine water quality monitoring program</i> • Develop and implement a routine monitoring program that includes regular sampling and contaminant analyses: – at discharge points from the development or the final storage to assess effectiveness of proposed mitigation measures and provide triggers for actions; – within permanent water storages in the Lagoon Villas Precinct, existing dam and proposed storages around the golf course. <i>Event base monitoring</i> ■ Event-based monitoring may also be carried out in order to understand the inflow of contaminants where an event discharge has occurred and to re-assess the success of water quality management practices.
Reporting	■ Monitoring results should be compared to the WQOs that support the EVs; ■ During and after rainfall, a visual inspection of rehabilitated areas undertaken to ensure no major erosion is occurring; ■ Additional monitoring and reporting may be required to determine the extent of stormwater runoff after pulse events; ■ Quarterly water quality reports prepared by operational personnel which report on water



Environmental Objective - Water Resources and Quality - To maintain environmental values associated with the estuarine and coastal waters (high conservation value, human consumption of aquatic foods, primary and secondary contact recreation, visual appreciation and cultural and spiritual values); - To preserve water quality established in section 9.2.7 of the EIS within the identified ephemeral watercourses and adjacent transitional estuarine and marine waters, permanent water storages in the Lagoon Villas Precinct, existing and proposed storages around the golf course; and - Maintain the Environmental Values (EVs), including compliance with the Water Quality Objectives (WQOs) established in section 9.2.7 of the EIS.	
	quality conditions within the development; Reports issued to include any action to be implemented in the case of non-compliance and the person/ organisation responsible for action to be highlighted.
Responsibility	- Resort Operator; - Other appropriate on-site operations personnel will be required to undertake the routine water quality monitoring and reporting.
Corrective Actions	- Where WQOs and EVs are not met management action must be taken to ensure objectives are met. - Any elevated physico-chemical parameters, or nutrient or metal concentrations, observed at upstream sources (e/g storage dams, WWTP discharge point) will be identified and the appropriate action taken; - Any detrimental impacts to downstream water quality shall be reported to the EPA.

20.5.2 *Transport and Roads*

The peak traffic generated by the proposed development will generally coincide with the peak hours of the external road network which is mainly centred on work and school. The development is also expected to generate predominantly light vehicle traffic as the bulk of the development is residential in nature. It should be noted that the peak hour from these various land uses will not generally coincide in reality.

The intersection of the Bruce Highway and Turkey Beach Road will operate within capacity with full development of Hummock Hill Island to 2033 with modifications to a Type 'CH' layout to accommodate the turning movements. With simultaneous development of the development in Turkey Beach, however, the intersection will need to be upgraded to a roundabout in order to operate satisfactorily during peak hour.

The intersection of Turkey Beach Road and Foreshores Road will also need to be upgraded to a Type 'CH' intersection to allow for turning movements expected. It is envisaged that an Infrastructure Cost Sharing agreement be reached between Eaton Place and the developer of the 1,300 lot subdivision in Turkey Beach which reflects the amount of traffic that will be generated.

The access route between the Bruce Highway and Hummock Hill Island, including Clarks Road, will have to be upgraded to a suitable rural road standard with a minimum 7.0m of traffic lanes (2 x 3.5 m lanes) and 1.0 m of sealed shoulders and an additional 1.0m of unsealed shoulders on each side.

Environmental Objective - Transport & Road	
Maintain, or exceed the current level of road safety and transport efficiency in the road network and intersections surrounding the Project area.	
Performance Criteria	Manage traffic flows in order to achieve safe and efficient movement throughout the Project area.
Mitigation Measures	<i>Traffic</i> - Consult with Queensland Transport regarding demand for and supply of public transport services for island residents; - Prepare and implement local area traffic management measures where necessary in order to maintain the role and the function of the roads. <i>Airstrip</i> - Airstrip operations will be in accordance with CASA requirements. - A Bird and Animal Hazard Management Plan will be developed (included as part of the Airstrip Manual) and implemented. The Plan will be prepared by a suitably qualified person such as an ornithologist or a biologist, etc and will address: - hazard assessment, including monitoring action and analysis; - pilot notification; - liaison and working relationships with land use planning authorities; - on-airport bird and animal attractors which provide food, water or shelter; - suitable harassment methods; and - an ongoing strategy for bird and animal hazard reduction, including provision of appropriate fencing.
Monitoring	- Monitor local area traffic impacts during the peak periods (weekends and during major competitions/events in the region). - Regular auditing undertaken to ensure compliance with objectives of the EMP.
Reporting	Resort Operator to report operations as required.
Responsibility	Resort Operator
Corrective Action	Plan and implement traffic control measures in advance of forecasted increased traffic events if required, such as major maintenance or recreational events on the dam.

20.5.3 **Geology and Soils**

The primary concern with respect to management of soils during the operational stage of the development is the risk of erosion. Risks of erosion following construction of each development stage will be primarily derived surface runoff during storm events and inadequate storm water control measures.

Environmental Objective - Geology & Soils	
Permanent facilities and project property maintained post-construction and during normal operation to avoid any impacts associated with soil erosion (i.e. decrease in land condition or increase in water turbidity or increase in sedimentation).	
Performance Criteria	■ Maintenance soil and water control devices for long-term surface stability and protection against erosion.
Mitigation Measures	<i>Soil erosion</i> ■ Maintenance of permanent soil and water control devices for long-term surface stability and protection against erosion by wind or water. ■ A Topsoil Management Plan implemented; ■ Landscaping Plan for the new recreational areas implemented to accommodate proposed recreation activities. <i>Design</i> ● Maximum building footprint of 50% for residential lots to be maintained as required by Miriam Vale Shire Council Transitional Planning Scheme and proposed Plan of Development.
Monitoring	<i>Soil erosion</i> ■ Regular monitoring of permanent soil and water control devices installed during operational phase for evidence of soil erosion and sedimentation; and ■ Regular inspections by qualified person of structures to ensure compliance with the design specifications. ■ Regular compliance checking undertaken to ensure compliance with objectives of the EMP.
Reporting	■ To be finalised
Responsibility	■ To be finalised
Corrective Action	■ Appropriate action will be taken if impacts are found to be unacceptable in terms of adjoining stability, sedimentation or erosion. Depending on the circumstances, appropriate action could include: – structural maintenance; – removal of accumulated sediment; – measures to entrap sediment upstream at a site more accessible for sediment removal; – measures to improve stream bank stability upstream; or – source point management measures to minimise erosion from sediment sources.

20.5.4 Waste Management

Domestic and general waste will be the largest waste stream generated during operation of the development. The remaining wastes streams generated include recyclable wastes such as paper, cardboard, plastics, glass, metals and organic waste.

Environmental Objective - Waste Management	
■ Minimise the production of waste and amount of waste requiring disposal. ■ Minimise the impact to the environment from waste disposal. ■ Maximise the opportunities to reuse wastes on-site. ■ Correct disposal of all wastes produced.	
Performance Criteria	■ Implementation of waste management principles (reduce, re-use, recycle) where possible and effective and sustainable disposal strategies. ■ Minimisation of the impacts of handling and disposal of operational waste. ■ Reduction of waste generated on site through re-use and recycling, where practical.

Environmental Objective - Waste Management - Minimise the production of waste and amount of waste requiring disposal. - Minimise the impact to the environment from waste disposal. - Maximise the opportunities to reuse wastes on-site. - Correct disposal of all wastes produced.	
	- All waste disposed of lawfully. - Storage areas clean and tidy.
Mitigation Measures	<i>Waste Minimisation</i> - Prepare and implement Operations Waste Management Plan prior to completion of development addressing issues such as location and methods of storage, transport and disposal; - Implementation of training for employees in the waste management plan and recycling opportunities. - On-site waste management practices highlighted during employee inductions. <i>Disposal</i> - Waste minimisation encouraged and staff training and awareness provided in correct identification and disposal of wastes; - Bins provided that are suitable for the type of waste that will be produced, of the correct size and strategically placed to receive the waste that will be disposed; - Disposal bin not overfilled and waste compacted as much as possible before disposal; - Waste bins on-site monitored and arrangement for their replacement to occur on a regular basis and/or when full; - Prevent animals from accessing the bins using specially designed lids and strategic placement where necessary; - Housekeeping procedures, (including spillage control, litter pick up and tidying up of site areas) implemented to minimise the generation of waste; - All domestic and general waste generated at the construction site removed from the site and disposed of at the nearest licensed disposal facility, as required; - Recycling bins for glass, plastic and metal transported to a local council facility. - Dispose of waste that is unable to be reused or recycled in a certified land fill site; - Ensure the transport of regulated wastes and contaminated soils or other material is conducted by licensed contractors for disposal at licensed facilities, in accordance with legislative requirements; <i>Waste Transport</i> - Waste only removed from the premises and disposed of in a lawful manner in accordance with the requirements of the EPA and the appropriate shire council. <i>Incidents</i> - Preparation of waste management procedures (as part of the Operations Waste Management Plan) to deal with any potential incident during operation in which waste material with the potential to cause environmental harm is released to the environment; - In the event of an environmental incident, take such corrective or remedial action as is required to render the area safe and avoid or minimise environmental harm.
Monitoring	- Regular inspection of on-site facilities to ensure waste is being generated, stored, handled, disposed and transported in accordance with this EMP. - Registers and manifests maintained of hazardous substances and regulated waste. This documentation is subject to internal or external audit, especially for any regulated waste material. - Records kept of any regulated waste removed from the site, including name and licence number of waste transporters, volume and description of waste transported, destination of waste and licence number of the waste treatment operator. - Waste contractors to provide certification (licence) records verifying their registrations

Environmental Objective - Waste Management	
	- Minimise the production of waste and amount of waste requiring disposal. - Minimise the impact to the environment from waste disposal. - Maximise the opportunities to reuse wastes on-site. - Correct disposal of all wastes produced.
	- and points of discharge of waste. - Regular auditing undertaken to ensure compliance with objectives of the EMP.
Reporting	To be finalised
Responsibility	To be finalised
Corrective Action	Ensure that all dam personnel are reminded of the requirements regarding waste transport, storage and management, and shall endeavour to ensure that the situation is improved by the allocation of staff and other resources to rectify any non-conformance.

20.5.5 Hazardous Substance Management

Operation of the tourist and residential development will include a number of activities that will require hazardous chemicals. Such activities include:

- Potable water treatment chemicals;
- Sewage treatment chemicals such as ClO₂ (Chlorine Dioxide) or H₂O₂ (Hydrogen Peroxide);
- Aviation fuel storage for small turboprop planes;
- Miscellaneous chemicals associated with the boating commercial precinct such as resins and thinners;
- Small quantities of miscellaneous commercial cleaning chemicals;
- Small quantities of miscellaneous residential cleaning chemicals; and
- Miscellaneous water treatment chemicals for swimming pools such as calcium hypochlorite.

Control of operational chemical storage will be subject to Hazardous Goods permitting and regulation.

Use of hazardous chemicals will be minimal, however, some pesticides and other chemicals may be used during maintenance of the golf course and other open space areas, as part of municipal duties to be undertaken by the Operator of the development. Wastewater treatment plant chemicals and additives will also be required on the island for treatment of sewage. Storage and handling of hazardous and other chemicals will be in accordance with the relevant Australian Standard.

Environmental Objective - Hazardous Substances	
	- Management of the purchase, quantities, storage, use and disposal of hazardous substances that may cause environmental harm. - Prevent spills from occurring, and contain, clean up and, if necessary, remediate any spills that do occur.
Performance Criteria	- Storage areas clean and tidy. - Storage, use and disposal of any chemicals, fuels, solvents or other hazardous materials or substances which may cause pollution, done so in such a way as to not cause environmental harm. - Requirements of the Flammable and Combustible Liquids Regulations and the relevant Australian Standards are met, such as: - AS 1692: Tanks for flammable and combustible liquids

Environmental Objective - Hazardous Substances	
- Management of the purchase, quantities, storage, use and disposal of hazardous substances that may cause environmental harm. - Prevent spills from occurring, and contain, clean up and, if necessary, remediate any spills that do occur.	
	- AS 1940: The storage and handling of flammable and combustible liquids - AS 2187: Explosives - Storage, transport and use - AS 3780: The storage and handling of corrosive substances; - AS 4452: The storage and handling of toxic substances - All spills involving materials that may cause environmental harm to be contained and effectively cleaned up and measures taken to prevent the incident from recurring. - Recording and reporting of incidents accurately and describing the extent of spill that occurred. - Correctly sized bunds that are structurally sound and free from materials.
Mitigation Measures	- Undertake storage and transport of materials according to relevant Australian Standards. - Ensure transport and storage of dangerous goods are in accordance with dangerous goods standards and guidelines. - Storage area for chemicals, fuels, lubricants, oils, wastes and hazardous materials covered and banded/appropriately sized drip trays, have an impervious floor and appropriate signage to meet the requirements of AS1940 <i>Storage and Handling of Flammable and Combustible Liquids</i>. The location of these areas should not be in close proximity to drainage lines. - Containment areas to be set up so that spills can be recovered, and containment areas will be kept clean and free from other wastes. - Fire fighting equipment to be checked and maintained at all times. - Containers clearly labelled. - Chemicals which may react with each other stored separately in clearly marked containers as per Australian Standards. - All fuel, lubricant and hydraulic fluid spills, including drips, cleaned up immediately. - Fuels and other flammable liquids store away from sources of ignition. - All waste fuels/oils/grease/chemicals stored in appropriate storage facilities and collected by licensed contractor for recycling, treatment or disposal. - Storage areas inspected regularly for any defects with bunding, floor, cover, structure, hoses, valves and associated infrastructure. - Operators of vehicles, boats and other equipment and machinery to regularly check equipment for evidence of leak and fitness of hydraulic hoses and seals, and conduct maintenance or repairs as necessary to prevent drips, leaks or likely equipment failures. - MSDS's readily available for all employees and contractors and personnel made aware of the environmental and safety requirements of these materials. - Maintenance of list by Site EHS Officer that gives full details of any hazardous materials, oils, chemicals and petroleum products used on site. - Emergency spill kits containing absorbent materials, neutralising chemicals and other spill containment equipment will be strategically located around the site and on board equipment and in vehicles for the types of spills likely to be encountered. - All personnel provided with Environmental Awareness training during induction sessions and taught spill control and containment procedures. - All plant operations and maintenance personnel instructed in the range of materials, methods of storage, location and the handling procedures in the event of spills, toxicity and fire control requirements. - Any visible or reasonably suspected fuel, lubricant or hydraulic fluid loss treated as an "incident" and handled accordingly. - Signs erected on roadways within the catchment stating that the route is within a drinking water catchment and that all spills are to be reported to the nearest emergency services, with contact details for emergency providers listed on the sign. - Prepare and implement spill response measures in accordance with the Emergency Management Response Plan
Monitoring	Chemical and fuel storage areas and equipment inspected regularly to ensure the structures, containers and components are not faulty or pose any threat from loss or leakage, and to ensure cleanliness and security.

Environmental Objective - Hazardous Substances	
	■ Management of the purchase, quantities, storage, use and disposal of hazardous substances that may cause environmental harm. ■ Prevent spills from occurring, and contain, clean up and, if necessary, remediate any spills that do occur.
	■ Recording of any spills that occur as an incident, as well as the follow up actions, any results and reporting to authorities. ■ Regular auditing undertaken to ensure compliance with objectives of the EMP.
Reporting	■ Resort Operator, WWTP Operator to report on operations as required.
Responsibility	■ Resort Operator, WWTP Operator
Corrective Action	■ Ensure that all dam personnel are reminded of the requirements regarding hazardous substance transport, storage and management, and shall endeavour to ensure that the situation is improved by the allocation of staff and other resources to rectify any non-conformance.

20.5.6 Visual Amenity

During the operational phase, matters likely to be most relevant to the management of environmental aspects of the landscape and visual impacts include:

- Bridge causes moderate/substantial localised impacts when viewed from close proximity.
- Building form and physical elements of the development including the physical dimensions, shape, bulk, patterns, edges, orientation, complexity and symmetry;
- Building materials including texture, colour, shade, reflectivity and opacity;
- Illumination of roads and buildings;
- Landform changes such as excavation and fill of private and public spaces;
- Vegetation changes including the extent of existing vegetation retained and the type and position of new landscaping elements such as screening vegetation along roads;
- Increase in the number of participants undertaking outdoor activities on the water such as boating and recreational fishing;
- Vehicle lights and movement; and
- The design and layout of the proposed development including factors such as layout, scale, style, distinctiveness and numbers of scheme components.

Environmental Objective - Visual Amenity	
Ensure that site rehabilitation works are undertaken and landscaping completed to assist in the restoration of the visual environment of the dam and its surrounds	
Performance Criteria	■ Disturbed areas are rehabilitated with native endemic vegetation. ■ Recreation facilities are established and completed prior to opening of the site for public access and use. ■ Areas cleared around the full supply level of the dam are maintained clear of dying vegetation.
Mitigation Measures	<i>Design</i> • Bridge should be designed to achieve visual permeability. This means that the receptor should maintain some view of the landscape beyond the bridge. • Buildings and infrastructure including road cuttings should be sited below any prominent

Environmental Objective - Visual Amenity

Ensure that site rehabilitation works are undertaken and landscaping completed to assist in the restoration of the visual environment of the dam and its surrounds

	ridge line or hilltop so that there are no visible changes in the skyline. • The location and design of access roads and driveways should conform to the landform and cause minimum visual impact or erosion hazard. Screen plantings on the sides of roads can mitigate any disturbance caused by initial loss of vegetation. • The roof tops of buildings should not protrude above the canopy height of the surrounding vegetation. • Where the cladding of any part of a house (including the roof and rain water tanks) is proposed to be in metal sheet, this cladding be required to be colorbond or painted in muted tones to reduce reflection. • Where the wall cladding of a house is proposed to be in excess of 25% timber siding or fibre cement siding or metal sheet, the cladding can be required to be painted or stained in muted tones prior to occupation of the house or within a specified time thereafter. • Reflective factory finished metal sheets i.e. untreated galvanised sheet, aluminium, zincalume, or white, off white or silver paint finishes will not be permitted for roofs unless the slope of the roof is 10% or less. • Existing vegetation should be retained on site and selected clearing undertaken for building envelopes and public spaces. • Landscaped areas in public and private spaces planted using species that are native and occur locally on the island. • Additional plantings can be undertaken including mature trees of a height above 10 metres increasing density and screening qualities of vegetation. A dense under storey can also be planted. • Restrict development on the elevated sections of the island and cluster development on the lower plains. • Limit development on the hills and slopes to single storey residences reducing vertical bulk and scale. • Limit development to two storey dwellings or 8.5 metres above natural ground level allowing a greater diversity of housing types and design options. • All lights in buildings and in public spaces will be focussed on the areas required and where possible be equipped with motion sensor switches to minimise light duration. • External lighting will be shielded to limit extraneous light where necessary or faced away from coastal and habitat areas. • All external lighting of the site should conform to the following Australian standards: - AS 1158 - Road lighting; and - AS 4282 - Control of the obtrusive effects of outdoor lighting.
Monitoring	■ Inspections carried out to assess the health of the seedlings (growth rates, foliage status and survival rates) within revegetation areas to ensure that maintenance of planted individuals has occurred. Within both regeneration and revegetation areas, weed abundance, chemical usage, any significant problems and status of protective fences to be monitored. ■ Two years after regeneration works/planting, site management will determine if the stated objectives of this management plan have been achieved. If not, a report will need to be prepared by site management identifying the works and the time frames required to ensure that the regeneration and revegetation plan meets the stated

**Environmental Objective - Visual Amenity**

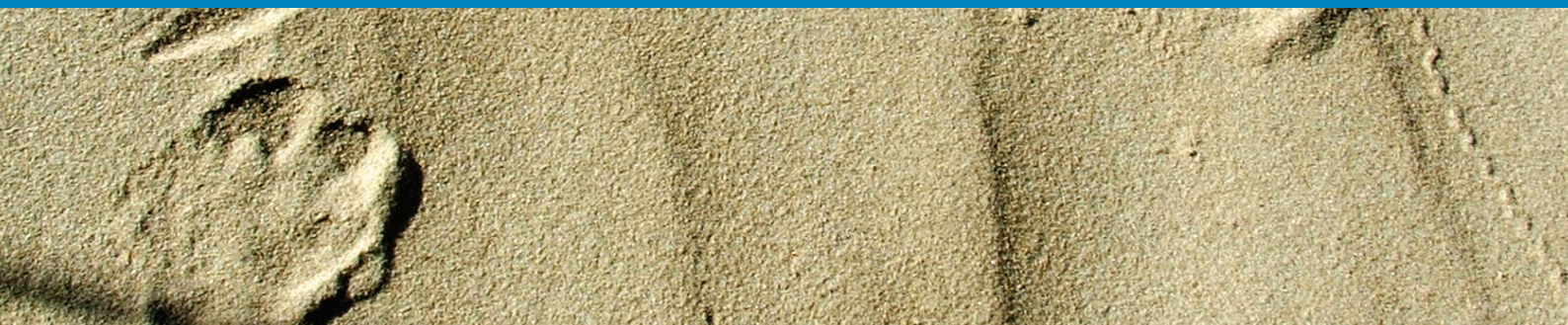
Ensure that site rehabilitation works are undertaken and landscaping completed to assist in the restoration of the visual environment of the dam and its surrounds

	objectives and that, most importantly, a self sustaining population is established within revegetation areas. ■ Undertake waste management in accordance with the Waste Management EMP. ■ Regular compliance checking undertaken to ensure compliance with objectives of the EMP.
Reporting	■ TBA
Responsibility	■ Resort Operator
Corrective Action	■ Implement contingencies where propagation or plantings are failing.



SECTION 21

CONCLUSION AND RECOMMENDATIONS





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21. Conclusions and Recommendations

21.1 Conclusions

Conclusions drawn from the environmental impact assessment process relate primarily to the key issues underlying the Hummock Hill Island Development in terms of:

- economic implications for housing and tourism;
- construction impacts and mitigation measures; and
- the environmental management approach proposed during project construction and operation.

21.1.1 *Economic Implications*

Hummock Hill Island is on the boundary of the Wide Bay Burnett and Fitzroy (or Central Queensland) regions. Both regions' coastal populations are growing at an above average rate, 2.2%, 2.3% and 3.4% per year respectively for Calliope, Gladstone and Miriam Vale respectively. The proximity of Hummock Hill Island to Gladstone and the proposed amalgamation of Miriam Vale Shire LGA into the Gladstone Regional Council LGA mean the proposed development will form closer economic links with the Fitzroy region than with Wide Bay Burnett. The proposed project is targeting the intrastate demand from within the Gladstone region and coal mining areas to the west for a high quality tourist and recreational facility with good quality beach access.

The project proponents are of the view that such a facility is not available in the region, and its absence is a significant problem for employers seeking to attract employees to Gladstone (refer to Section 4). On the supply side, the Gladstone and Calliope Shires are good sources of construction skills and materials, of the labour required by the development's facilities and of the goods and services that would be required by both residents and visitors to the Island.

The development will provide sufficient tourism capacity to account for 5% of the projected visitor expenditure target, 12% of the Fitzroy tourism gross regional product target and 5% of the tourism jobs target for the Fitzroy region set by Queensland Tourism and the Queensland Government. The residential component of the project will provide 5% of the future residential stock required for the region based on projected population growth.

In summary economic analysis of the proposed development has revealed a:

- \$635 million (\$390 million in NPV) value for total construction and building work;
- \$270 million (\$167 million NPV) direct regional value added income from building and construction;
- \$390 million (\$240 million NPV) direct and indirect (or multiplier) to regional value-added income from building and construction;
- Approximately 60% of the benefits are attributable to tourism-based development, with the remainder to residential-based development.
- A \$460 million (\$280 million NPV) direct and indirect (or multiplier) to Queensland value-added income from building and construction;



- \$810 million (\$290 million in NPV terms) direct regional value-added income from tourism expenditure;
- An average of 190 construction jobs per year directly with a peak of 350 jobs over 16 years;
- An average of 260 jobs (direct and indirect) per year in the region until 2024;
- Generate directly and indirectly an average of 300 jobs per year, and a peak employment of 550 persons over 16 years at the State level; and
- Tourism activity will generate employment opportunities in the order of 700 jobs by 2024.

The potential benefits for the local and regional economies of the proposed Hummock Hill Island development are substantial. Over the life of the project (and in net present value terms) the project could inject some hundreds of millions of dollars of income into the regional economy. This would provide substantial job opportunities and funding for expanded publicly and privately provided community services. This result is largely driven by additional tourism activity the development would create for the region, and the economic stimulus provided by the construction work on the development.

The potential costs of the project are largely attributable to the potential adverse impact on the natural environment and costs required to install mitigation measures to address such issues. The project has been designed to minimise such impacts, and the costs are estimated to be small and well below the potential benefits for the region.

21.1.2 Construction Impacts and Mitigation Measures

The construction of the Hummock Hill Island Development will potentially generate a range of environmental, economic and social impacts. A summary of the more significant potential impacts and the proposed mitigation measures are provided in this section.

World Heritage Values

Hummock Hill Island lies within the Great Barrier Reef World Heritage Area (WHA) and is located adjacent to the Great Barrier Reef Marine Park and Great Barrier Reef Coastal Marine Park. Although within the WHA, the Island does not have any formal conservation status, nor has it come under any kind of management plan in relation to its World Heritage status. Historically the Island was overlooked when National Parks and Conservation Areas were created in the region due to the lesser conservation value of the Island compared with nearby areas.

The Great Barrier Reef WHA has been included on the World Heritage List on the basis of meeting four criteria. The Island contains some features that may be considered aligned with the listing criteria as summarised below:

- 1) An outstanding example of a major stage of the earth's evolutionary history;
 - Fringing reefs are absent from the Island together with major evolutionary geological processes or evolutionary history that have isolated unique flora and fauna from mainland populations. The proposed development will not impact the WHA listing under this criterion.



- 2) An outstanding example representing significant ongoing geological processes, biological evolution and mans interaction with his natural environment;
 - In general, features listed under this criterion have limited representation on the Island in the context of the sub-region and/or entire WHA. Surrounding waters do contain features listed under this criterion, such as mangroves and seagrass meadows, the latter being habitat for dugong and turtles. Impact to these features from the proposed development and human interaction are minimal and do not impact the overall WHA values.
- 3) Contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty;
 - In general, unique, rare and superlative natural phenomena listed under this criterion are not represented on the Island in the context of the sub-region and/or entire WHA. In comparison to other areas in the WHA such as the Whitsunday region or Great Keppel Island, Hummock Hill would not be considered “*superlative*”. Adjacent waters contain mangroves systems and habitat for dugong and turtles that will have minimal impact from the proposed development following management and mitigation measures; and
- 4) Provide habitats where populations of rare and endangered species of plants and animals still survive.
 - In general features listed under this criterion have limited representation on the Island in the context of the sub-region and/or entire WHA. Mangroves and seagrass meadows are present in adjacent estuarine and marine waters. Species of conservation significance that have representative habitat on the Island and/or adjacent waters include the black breasted button quail, dugong and marine turtles. Habitat for these species is outside the special lease and development area. Mitigation and management measures proposed for these species will minimise impacts to the WHV.

The Environmental Management Plans (EMPs) set out recommended measures to protect the environmental values (EVs) of the World Heritage Area and marine parks.

Coastal Dunes

The proposed development will impact 12% of the relict beach ridge systems on the Island, which are also subject to an Exploration Permit for Mineral (EPM, #7164) and Mineral Development Licence (MDL, # 310). Whilst the proposed development will sterilise 12% of the mineral deposits, the Islands deposits are not a viable option (under current prices) as a single resource and require combination with other resources such as Middle Island to the south and Byfield to the north. Avoidance of resource sterilisation can be mitigated by exploiting the resource prior to development in these areas, an option that requires further discussions with relevant agencies and the EPM/MDL holder.

Relict beach ridge systems within the development footprint have been assessed as a significant coastal dune system under the definition in the State Coastal Management Plan. Relict beach ridges are not considered to demonstrate a “*high degree of ecological integrity and biodiversity conservation values*” due to historical pastoral uses, extensive historical clearing, lantana



infestation and the Island being singled out for mineral and resort development in the 1990's due to its lack of conservation value. Retention of 88% of the Island relict beach ridge systems is will maintain the overall function of these systems on the Island. The project is also considered to demonstrate a net benefit to the State in terms of socio economic value as noted above.

Topography, Geomorphology, Geology and Soils

Proposed construction works will minimise the removal of vegetation and movement of soil, thus reducing the potential for erosion and sedimentation to affect water quality and land condition in development areas and downstream receptors. The phased nature of the proposed development over 16 years will minimise large expanses of vegetation and/or soil disturbance at any one time, reducing potential impacts from erosion issues. A site-specific erosion and sediment control plan will be developed prior to construction activities to minimise erosion and sedimentation during construction. Permanent WSUD measures will control long-term erosion issues associated with the proposed development.

Potential groundwater discharge zones have been identified within the southern section of the Golf Course Precinct. Mitigation of potential changes to these areas will involve maintaining existing vegetation to the maximum extent possible and/or planting native species in accordance with the landscape plan to maintain existing groundwater levels and reduce salinisation risks.

Some minor disturbance of potential acid sulphate soils will occur in the vicinity of the proposed access bridge and public boat ramp in Boyne Creek. These impacts will be managed through the development and implementation of erosion and sediment control plans, landscaping plan, water sensitive urban design of permanent stormwater drainage and an acid sulphate soil management plan.

A limited amount of contaminated soils exist in the vicinity of the former cattle dip, fuel storage shed and isolated historical fuel/oil spill. These areas will be remediated as part of construction works and a validation report provided to Queensland EPA.

Visual Amenity

The aspect of the proposed development that will have the most significant visual impact on sensitive receptors in the WHA is the construction of the bridge across Boyne Creek. Other construction works including vegetation clearing, earthworks and installation of services such as reticulated water, sewerage and electricity infrastructure and the operation of the proposed development including the building form and layout, illumination of roads and buildings will also require visual impact mitigation.

Mitigation measures based on the retention of existing vegetation screens and/or sensitive landscaping design will reduce the visual effects of the project. Development on the gentle undulating low hills, colluvial plains and strandplains will be substantially screened by the surrounding vegetation. On the northern and southern sides of the Island the low shrubs, mangroves and coastal she-oaks provide the initial buffer followed by woodland vegetation with tree heights of approximately 10 metres. However, there are still certain elements of the proposal that potentially affect visual amenity to a degree. Mitigation measures have been proposed to reduce their impact.



Traffic and Transport

Construction traffic for the proposed development is estimated to increase heavy vehicle traffic to the site by 17 trips a day. Operational traffic is estimated to increase to around 750 trips per day by 2013 and 2,040 trips per day by 2023. The Bruce highway junction will be upgraded to a roundabout with 'short' turning lanes on each approach and two circulating lanes. This intersection treatment will be sufficient to cater for the expected traffic volumes.

Public boat ramps proposed for Colosseum inlet and Boyne Creek will provide increased opportunities for public access to estuarine waters. In particular, the Colosseum Inlet public boat ramp will provide safe all tide access that is currently absent in the estuary.

Climate and Climate Change

Master planning of the development is based on sustainable architectural principles that maximise the use of design such as cross ventilation and lightweight structures. These principles will minimise the requirement for energy intensive artificial cooling, reducing the ecological footprint at the household level. Buildings will be required to have a minimum 5 star energy rating as a requirement of master planning.

Bushfire and storm surge hazards have been assessed for the proposed development and are generally considered to be low. Areas identified as having some risk from either bushfire or storm surge are mitigated in accordance with requirements SPP1/03 of the Miriam Vale Shire Planning Scheme. Areas of high bushfire risk will either be relocated to reduce the hazard score and/or incorporate appropriate clearance buffers. Areas with an existing ground or pavement level less than the defined storm tide event (DSTE) of RL 3.6 m will be raised 0.4 m above this height to ensure adequate mitigation and safety during such events.

Surface Water Resources and Water Quality

Ephemeral watercourses have been identified on the Island and will not be physically disturbed outside that required for road crossings. Potential changes in watercourse flows will be controlled through incorporation of WSUD treatments such as grassed swales, bioretention swales, bioretention basins and sedimentation basins for stormwater drainage. It will also employ the use of site specific erosion and sediment control plans to control identified impacts during the various construction phases to achieve the requirements of the EPP (Water) and in particular WQO at identified discharge points of ephemeral watercourses to estuarine and marine receiving waters.

Operation of the proposed golf course will be based on the principles outlined in the AGSCA and Qld EPA (2001) Improving the Eco-Efficiency of Golf Courses in Queensland, and will include a Golf Course Management Plan and Integrated Pest Management Plan. These plans control the application of fertilizer and chemicals in a hierarchical manner, minimizing residual releases to the surrounding environment. Surface water runoff from the golf course area will also pass through WSUD treatments to further reduce suspended sediment, nutrient and chemical loads. Residual contamination of surface waters from these sources will be effectively managed with minimal impact on receiving EVs of estuarine waters including the GBR WHA.



The proposed wastewater treatment plant (WWTP) will be sized to cater for an ADWF of 1.0 ML/d (includes a 20% additional safety factor) with additional storage provided to handle up to 3 times ADWF. It is proposed that the plant will be constructed in two stages of 500 kL capacity each to provide redundancy in the case of mechanical breakdown. Emergency overflow releases will be infrequent due to the available storage and ability of one plant to effectively catch up overnight in the case of mechanical breakdown.

Extreme weather overflows will only occur during wet weather events, the impact of the discharges would be minimised as the sewage flow during these events is dilute and would receive further rapid dilution as it discharges into the receiving waters and will have short-term minimal impacts. Tidal flushing within the estuaries will rapidly disperse floodwater further, minimising impacts to receiving waters.

Surface water releases from the proposed development to both ephemeral watercourses and adjacent estuarine and marine waters will be managed and controlled using WSUD treatments to maintain existing nutrient loads to these waters, thus maintaining the existing water quality. This approach is consistent with the intent of both the EPP (Water) and Great Barrier Reef Water Quality Protection Plan. Additional water monitoring will be conducted to establish a sub-regional WQO in accordance with the Queensland Water Quality Guidelines (2006) that will protect the identified EVs of receiving waters, including the GBR WHA.

There will be positive benefits to tidal flows and navigation of Boyne Creek, attributed to removal of the existing causeway following construction of the access bridge and increased accessibility for the general public from proposed boat ramps. Operational impacts from boat traffic and in particular 2-stroke engine emissions are considered to be negligible on the basis of tidal flushing rates within the estuaries and relatively low levels of boating traffic anticipated from the proposed development.

Groundwater Resources and Quality

Potable quality groundwater exists within the relict beach ridge systems of the Island. Western precincts of the proposed development are located on the western aquifer of the Island. Groundwater resources will not be used as a source of either potable or irrigation water. Impacts to groundwater and associated EVs will be controlled through WSUD treatments such lined grass swales, bioretention devices and detention basins.

Irrigation of Class A+ wastewater within the golf course will not exceed the modelled application rate for soils in this area. Additional in-ground sensors installed as part of the Golf Course Management Plan will further refine irrigation rates to have minimal impact on groundwater quality and maintain existing groundwater conditions in identified groundwater discharge zones.

Coastal Environment

Estuarine waters around the Island are within the Great Barrier Reef Coastal Marine Park (Qld) and coastal waters from the low water mark are contained in the Great Barrier Reef Marine Park (Cwlth). Intertidal wetlands such as supratidal saltflats and mangroves, as well as intertidal and subtidal seagrass meadows are present around the Island.



Ephemeral watercourse discharges and quality from the proposed development will be controlled using WSUD treatments as discussed above and will have nutrient loads slightly less than existing discharges, maintaining the existing nutrient dynamics of the receiving estuarine waters and minimising changes to existing conditions and EVs.

Construction in tidal waters such as the bridge and public boat ramps will be controlled with site specific erosion and sediment control plans that will control and minimise impacts to EVs including WHV in these estuarine waters. Construction works will be of short duration and limited area, operating outside the Colosseum Fish Habitat Area.

Once the access bridge is constructed the existing causeway will be partially removed, resoring tidal flows within Boyne Creek and allowing free passage at all tides.

Air Quality and Greenhouse Gases

Potential impacts to air quality are limited to construction dust issues and odour issues associated with the proposed WWTP. Site specific erosion and sediment control plans will include management for dust from works sites with dust suppression water sourced from re-cycled water suppliers during early development stages and Class A+ recycled water during later stages of the development. The proposed WWTP will be a sealed system as currently used at Agnes Waters south of the project. Odour Management Plans will be developed as part of the detailed design of the water treatment plants to ensure emissions from these sources are managed to minimise odour nuisance to sensitive receptors and minimize impacts to EVs and WHA.

Waste Management

Waste minimisation during construction will be based around the Wastewise Construction Program, Waste Reduction Guidelines issued by DEW and Queensland EPP (Waste) hierarchy. Where practicable construction will include the use of modular components, purchase of materials cut to standard sizes or pre-fabricated materials to reduce the need for off-cuts. Material choices for building construction shall include a proportion of renewable or recyclable components, although use of renewable and recyclable components shall not compromise the construction of the buildings in accordance with the relevant development codes and the Building Code of Australia.

Domestic and general waste will be the largest waste stream generated during operation of the development. The remaining wastes streams generated include recyclable wastes such as paper, cardboard, plastics, glass, metals and organic waste. Commercial waste collection operations will be utilised during construction and operation for the collection and appropriate disposal of generated commercial waste. It will be the responsibility of the construction contractor or commercial operation/enterprise to engage the commercial waste collection service. Domestic waste collection will be conducted by the Local Government Authority as part of domestic waste collection services. All waste materials will be transported from the island to either the nearest recycling facility or landfill.



Noise

The main noise and vibration impacts during construction on HHI are likely to be from the use of heavy equipment for transport, earthworks and vegetation clearing and other civil works following construction of early stages of the development and as tourist and residential accommodation expands. To limit the potential for noise and vibration impacts the Construction Contractor would be responsible for managing construction activities and ensuring that the construction environmental management plan includes minimisation of noise and vibration emissions. Noise management will form part of the requirements within the construction EMP.

Operational activities also have the potential to cause noise and vibration impacts at the new residential areas. Further investigation of detailed noise management measures will take place as part of a detailed design for the project components and management measures, including appropriate siting of noise generating items to maximise shielding provided to residences and restricting potentially nuisance noise sources to least sensitive times of the day, would be incorporated to ensure that noise and vibration impacts are not significant.

Cultural Heritage

Areas and sites of cultural heritage significance occur within the proposed development footprint including:

- Sand ridges, swales and the associated stream and riparian vine thicket located on the northern boundary of the project area east of the headland;
- Beach ridges, swales and associated creeks and wetlands west and southwest of the headland;
- The foreshore and associated eroded/remnant beach ridges and adjacent areas of elevated land on granodiorite deposits located on the southern, central section of the Island; and
- Elevated areas surrounding two dammed creek systems still retaining fresh water.

Initial vegetation clearing and earthworks may disturb or destroy sites considered to be of indigenous cultural heritage significance. Mitigation measures are proposed to minimise potential impacts on indigenous cultural heritage. The proposed management options for impacted sites vary according to the level of impact and the ability of the proponent to adjust proposed works to avoid heritage sites. These mitigation measures include:

- site avoidance and establishment of exclusion zones;
- site monitoring;
- artefact excavation;
- education of construction workforce;
- ongoing consultation with the Traditional Owners; and
- implementation of the Cultural Heritage Management Plan.

Construction activities within the northern abutment of the proposed bridge, headland holiday homes and town centre coincide with areas of high indigenous and non-indigenous cultural heritage



significance and have potential to impact them. The incorporation of recommended mitigation measures will manage impacts to areas of cultural heritage significance to acceptable levels. All works will be conducted in accordance with the Cultural Heritage Management Plan accepted by Qld DNRW.

Terrestrial Ecology

The proposal will require the clearing of both non-remnant and remnant vegetation within the lease area. The Project will involve the loss of less than 341 ha of remnant vegetation (within the meaning of the *Queensland Vegetation Management Act 1999*), comprising seven regional ecosystems listed as either “endangered”, “of concern” or “not of concern”.

There will be a minor loss of habitat for several fauna species of conservation significance, although these species are generally mobile and provided with extensive habitat on the balance (undeveloped) portions of the Island.

The mitigation approach involves a set of complementary actions including:

- design elements such as location of buildings and minimal clearing within individual lots, incorporation of fauna crossings, vegetation planting and tree retention to the maximum extent possible;
- implementing weed and fire management within retained habitats (for the protection of populations of EVR flora and fauna contained therein);
- development of a compensatory habitat strategy for remnant vegetation in accordance with the SE Qld Regional Vegetation Management Code; and
- implementation of EMPs during both construction and operational phases of the Project.

The compensatory habitat strategy to be developed for the project will involve a combination of actions including the securing and management (through purchase or registered covenant) of advanced regrowth or remnant vegetation, strategic purchase of land parcels identified as key linkages or habitats for EVR taxa and revegetation and rehabilitation of existing cleared or disturbed areas.

Marine Fauna and Flora

Minor clearing of less than 1 ha of intertidal vegetation will be conducted for the proposed access road, bridge and public boat ramp in Boyne Creek. These works will occur outside the Colossus Fish Habitat Area and represent a permanent loss of less than 0.05% of the intertidal wetlands of the Island and surrounding waters and WHA.

Construction works in estuarine waters will be limited to the access road, bridge and public boat ramps and for a limited construction period based on the phased construction schedule. Potential impacts from construction activities will be controlled through the implementation of a site specific erosion and sediment control plan that incorporates floating silt curtains, geofabric lined bunds or similar measures. Impacts to identified environmental values of estuarine waters and WHA will be subsequently managed and minimal.



Discharges to estuarine and marine waters from the proposed development will be managed using WSUD principles that will maintain existing water quality conditions and minimise changes to the receiving environment and EVs. A water quality monitoring plan will be conducted to provide sufficient information to establish sub-regional water quality objectives specific to the estuaries and coastal waters of the area.

Increased boat traffic within estuarine waters around the Island is anticipated to be relatively minor with a subsequent minor increase in boat strike risk to turtles and dugong. Mitigation of potential impacts will include public education, signage at boat ramps showing locations of seagrass meadows, potential species that use these areas as habitat and when they are likely to occur and how to minimise risk of collision. Speed restrictions within Boyne Creek and high risk areas of Colosseum Inlet will also be considered in consultation with Qld DPI and QPWS.

Mitigation of potential light interference with low density turtle nesting on the Main Beach will be based on the recommendations of the use of light shielding, low pressure sodium lighting, fitting of timer switches and motion detector switches or other methods currently used in similar coastal areas where residential communities and turtle nesting occur.

The proposed Master Planning and mitigation strategies and measures are considered to effectively reduce potential adverse impacts on identified EVs and WHV of estuarine and marine fauna and flora surrounding Hummock Hill Island.

Social Environment

Changes to the social environment during construction and operation of the proposed development would be managed by the Proponent in close consultation with relevant Government agencies and the LGA to ensure that any impacts experienced are avoided, reduced or mitigated to the extent that is possible and may be reasonably expected.

Proposed mitigation measures to address identified impacts on the social environment are considered to manage potential impacts to the social environment of the Island and immediate area. Continued liaison and communication with local residents and visitors in advance of construction activities, about changes arising from construction activities, and possible management measures will be conducted as part of mitigation. Liaison with relevant Local and State Government agencies to identify and gain commitment for provision of and contribution to social infrastructure requirements to meet the expected increase in population will also manage social environment impacts associated with the proposed project.

21.1.3 Approach to Environmental Management

Management of the impacts of construction of the Project will be delivered using an Environmental Management Planning process. This is to ensure that environmental values are retained and community concerns are addressed.

The objective of the draft EMP is to ensure all potential environmental impacts that could reasonably be expected to occur during the Project are managed and fall within acceptable and agreed limits. This will be achieved through pro-active environmental management. Accordingly,



emphasis is placed upon integrating the environmental management planning with design, construction methods and operation planning.

The requirements of this EMP are applicable to all on-site work carried out. All subcontractors and suppliers will be bound to comply with the requirements of this EMP, as far as they are applicable to the nature and scope of their work.

In particular the EMP will:

- establish procedures that will minimise adverse environmental, social and economic impacts;
- facilitate compliance with the relevant Legislation;
- provide practical and achievable plans for managing the Project to ensure that environmental requirements are complied with, by providing an integrated planning framework for comprehensive monitoring and control of construction and operational impacts; and
- provide documented evidence that the Project is being managed in an environmentally acceptable manner.

A draft EMP has been prepared to provide input into the detailed planning and design phase of the Project.

The EMP provides the State and Local authorities and the proponent with a framework to confirm compliance with relevant legislation, regulations, policies and requirements. The plans also provide the community with evidence that the management of the Project will be undertaken in an environmentally responsible manner.

21.2 Recommendations

Having regard for the benefits and the impacts of the Project presented in this EIS, it is a recommendation of the EIS that the Project proceeds subject to:

- a) developing and implementing detailed EMPs and Specific Management Plans for the construction phase and the operational phase; and
- b) developing and implementing a scheme of effective mitigation measures and proponent commitments such as those set out below.

In making the recommendation, the Coordinator-General is requested to:

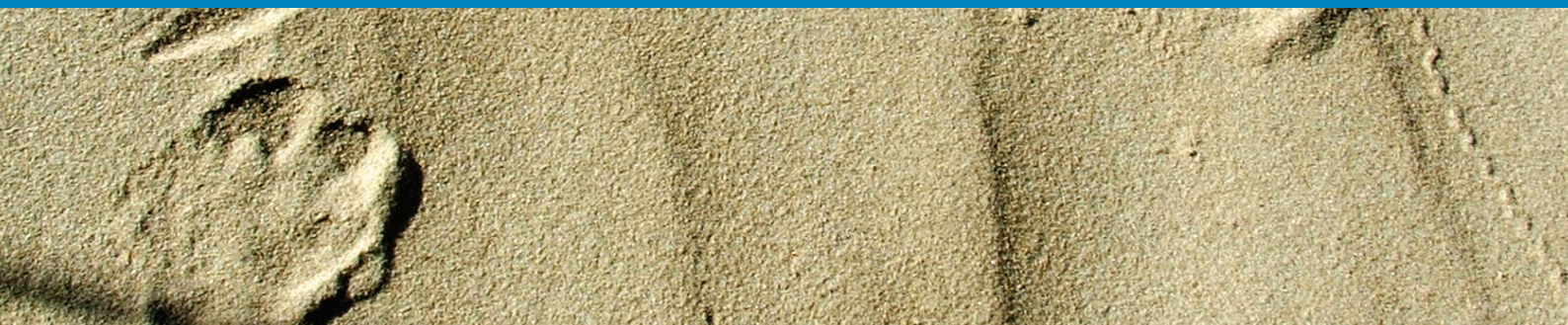
- 5) Assess the EIS;
- 6) Recommend the Project proceed; and
- 7) State conditions for the Project under section 39(1)(a) of the *State Development and Public Works Organisation Act 1971*.

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SECTION 22

REFERENCE LIST





22. Reference List

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