3.4 Matters of National Environmental Significance

3.4.1 Introduction

This chapter describes the matters of national environmental significance associated with the Project, assesses the potential impacts of the Project and associated risks, and outlines the management and mitigation measures proposed to minimise such impacts and risks. It draws upon and summarises the findings of various environmental impact investigations, particularly those of the terrestrial and aquatic environments, as detailed in **Appendix AB – Flora and Fauna Technical Report, AL – Visual Assessment Technical Report** and **W – Aquatic Ecology Technical Report.**

3.4.1.1 Controlled Action and Environmental Assessment Process

On 1 June 2010, the Project was referred for consideration under the EPBC Act. The assessment process commenced following a determination on 4 July 2010 by the then Federal Minister for Environment Protection, Heritage and the Arts, the Hon Peter Garrett MP, that the Project was a "controlled action" under the provisions of the EPBC Act. The controlling provisions for the Project under the EPBC Act include:

- World Heritage properties (Sections 12 and 15A);
- National Heritage places (Sections 15B and 15C);
- GBRMP (Sections 24B and 24C);
- Listed threatened species and communities (Sections 18 and 18A);
- Listed migratory species (Sections 20 and 20A); and
- Commonwealth marine areas (Sections 23 and 24A).

As a consequence, the proposed actions require assessment and approval under the EPBC Act. Further, the Minister announced that the Project would be assessed by EIS under the EPBC Act (rather than via the bilateral agreement with the Queensland Government). The EIS process is therefore being administered in parallel by:

- The Office of the Coordinator-General (OCG) on behalf of the Queensland State Government; and
- SEWPaC on behalf of the Australian Government.

The environmental assessment process for the proposed action has been undertaken in accordance with the TOR issued by the OCG in June, 2011 and the Guidelines issues by SEWPaC in February, 2011.

3.4.1.2 Context

The Island is a 1,308 hectare continental island within 12 kilometres of the mainland of Rosslyn Bay, within the Rockhampton Regional Council area in Central Queensland. It is also within the GBRMP and the GBRWHA. The Island is the largest of the islands in the Keppel Group, but the only island in that group which is not a National Park. In the wider context of the GBR, it is one of more than 600 continental islands and 300 coral cays within the World Heritage Area, of which more than 96 percent are protected as National Parks.

A significant part of the Island has been subject to grazing and associated disturbance. The Island also has an existing node of tourism and visitor facilities, well-located for access from Rockhampton and the Capricorn Coast. A resort, golf course and associated facilities (including an airstrip), have operated at Fisherman's Beach for many years, although the Resort is currently shut down pending proposed redevelopment. The Planning Scheme recognises and encourages tourist development in this area, and redevelopment of a resort node on GKI presents an opportunity for 'presentation' of World Heritage Values to visitors. There is also a small settlement and tourist facilities associated with Fisherman's and Putney beaches. Notwithstanding this development node and the impacts of rural uses, most of the Island has a natural appearance and character, and makes a significant contribution to World Heritage Values in the southern part of the GBR.

3.4.1.3 Constraints Based Project Planning

The land based Project area of approximately 941 hectares, will occupy a large proportion of the GKI land area (72 percent). A significant proportion of the Project area (575 hectares) will be set aside for protection in perpetuity, the Environmental Protection Precinct, as described in **Chapter 2**. This represents approximately 60 percent of the land based Project area and approximately 44 percent of the total Island area. The remaining 350 hectares (approximately) of the land based Project area will incorporate the two terrestrial development precincts (Fisherman's Beach Precinct and Clam Bay Precinct). However, within these broad precincts only a small proportion will be cleared and developed. The development footprints respond to the constraints and opportunities identified through investigation of the Island's environmental and scenic values. The area required for the infrastructure (buildings, roads, airstrip and other impervious physical infrastructure) is approximately 46 hectares or 3.5 percent of the Island and the area required for the golf course is approximately 38 hectares or 2.9 percent of the Island. In addition to this infrastructure footprint, additional areas will be impacted upon by vegetation clearing, earthworks and other direct disturbance. Potential environmental impacts, including vegetation clearing necessary to facilitate the GKI Revitalisation Plan is provided in **Section 3.2**.

In addition to the Island-based impacts discussed above, marine-based impacts will also result from the Project as a result of developing the marina which will have a footprint of approximately 20.8 hectares and a submarine utilities services corridor be laid across part of Rosslyn Bay to Kinka Beach on the mainland as described in **Section 2**. A hydrographic survey has been completed between the mainland and the Island (refer **Appendix W**) to determine the likely alignment for the submarine services. The preliminary alignment has been selected to avoid ecologically sensitive marine communities such as coral reefs and seagrass beds and to minimise impacts on the marine environment.

Habitat, visual sensitivity and other natural values have constrained the location and extent of the proposed development footprint and its low-rise built form. This constraints-based approach to project planning has reduced potential visual and other environmental impacts, and a risk management approach has also been adopted. The latter has identified environmental management measures, which together with initiatives in sustainable design and operation, are appropriate for the World Heritage Values of the Island and surrounding waters.

The GKI Revitalisation Plan will have environmental impacts, but these should be acceptable if the recommended mitigation measures are implemented. The existing facilities on the Island, counterbalanced by the enhanced accessibility and World Heritage value presentation opportunities afforded by the accessibility of the Island.

3.4.2 World Heritage Areas and National Heritage Places

3.4.2.1 Citation and Description

(a) Great Barrier Reef World Heritage Area

The GBR was inscribed as a World Heritage Area (the GBRWHA) in 1981 by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) due to its 'outstanding universal values'. The GBRWHA covers approximately 347,800 square kilometres and stretches for over 2,000 kilometres along the north-eastern coast of Australia. Under a Memorandum of Understanding (MoU), the GBRMPA acts as a lead agency for the Commonwealth in matters relating to the GBRWHA.

The GBRWHA was nominated for all four natural criteria set out in Article 2 of the World Heritage Convention under the 'Operational Guidelines for the Implementation of the World Heritage Convention', as follows:

- **Criterion vii**: Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- **Criterion viii**: Outstanding examples representing the major stages of Earth's history or significant geomorphic or physiographic features;
- **Criterion ix**: Outstanding examples of on-going evolution; and
- **Criterion x**: Contains important and significant habitats for in-situ conservation of biodiversity, including threatened species.

The Island forms part of the Keppel Group, within the southern part of the GBRWHA (refer **Figure 3.43**).

Figure 3.43 GBRWHA IN RELATION TO THE PROPOSED PROJECT

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SOURCE: MODIFIED FROM 'AQUATIC ECOLOGY' (2011) - frc environmental

An overview of the values and attributes of the GBRWHA, as taken from the GBRMPA website, 2011, is provided in **Table 3.53**.

TABLE 3.53 GBR WORLD HERITAGE CRITERIA AND EXAMPLES OF VALUES:

World Heritage criteria	Examples of values / attributes
Exceptional natural beauty and aesthetic importance.	• Spectacular seascapes and landscapes for example, Whitehaven Beach, Whitsunday islands, Hinchinbrook Island, mosaic patterns on reefs. • Spectacular coral assemblages (hard and soft corals). • More than 1,500 species of fish providing a myriad of colours, shapes and sizes.
Significant geomorphic or physiographic features.	• The world's largest coral reef ecosystem, extending over 14 degrees of latitudinal range about 3,000 separate coral reefs, ranging from inshore fringing reefs to mid-shelf, exposed outer reefs and deep water reefs and shoals. • Deep water features of the adjoining continental shelf including canyons, channels, plateaux and slopes.
Significant ongoing ecological and biological processes.	• An extensive diversity of reef morphologies and ongoing geomorphic processes. • Approximately 900 islands ranging from small coral cays (in various stages of geomorphic development) to large continental islands. • Complex cross-shelf, longshore and vertical connectivity facilitated by dynamic current flows, incorporating important ecological processes such as larval dispersal. • Breeding and spawning grounds for unique coral reef associated species, including threatened and vulnerable species of turtles, whales and fish, including the humphead Maori wrasse.
Significant natural habitat for in-situ conservation of biological diversity.	• Over 2,000 square kilometres of mangroves including 54 percent of the world's mangrove diversity. • Approximately 43,000 square kilometres of seagrass meadows in both shallow and deep water areas supporting one of the world's most important dugong populations and six of the world's seven species of marine turtle. • 70 bioregions (broad-scale habitats) have been identified comprising 30 reef bioregions and 40 non-reef bioregions, these include algal and sponge gardens, sandy and muddy bottom communities, continental slopes and deep ocean troughs. • The reef bioregions contain one third of the world's soft coral and sea pen species (80 species). • 800 species of echinoderms (for example sea stars) equalling 13 percent of the world's total species. • The location of the world's largest green turtle breeding area, other key breeding areas, regionally important seabird nesting islands, significant spawning ground (for example black marlin) and a significant area for humpback whale calving and rearing.

(b) National Heritage Places

The Australian Commonwealth Government developed legislation to establish a heritage system to complement and enhance the World Heritage management regime. The system includes the establishment of a National Heritage List of Places that have outstanding national heritage values, including cultural, natural and Indigenous heritage values. The GBR's corresponding National Heritage Criteria to the World Heritage property values xii, xiii, ix and x (described above) are (a), (b), (c), (d) and (e) as outlined below:

- **Criterion A**: the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history. GBR is taken to meet this National Heritage criterion because it meets World Heritage criteria (vii), (viii), (ix) and (x).
- **Criterion B**: the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history. GBR is taken to meet this National Heritage criterion because it meets World Heritage criteria (x).
- **Criterion C**: the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history. GBR is taken to meet this National Heritage criterion because it meets World Heritage criteria (vii), (viii), (ix) and (x).
- **Criterion D**: the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:
    - a class of Australia's natural or cultural places; or
    - a class of Australia's natural or cultural environments.
    - GBR is taken to meet this National Heritage criterion because it meets World Heritage criteria (viii), (ix) and (x).
- **Criterion E**: the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group. GBR is taken to meet this National Heritage criterion because it meets World Heritage criteria (vii).

The National Heritage values are discussed in terms of the World Heritage Values throughout this chapter, given the values are linked as identified above.

3.4.2.2 World Heritage Values – Aesthetic (Criterion vii)

(a) Literature Review

The subjective aesthetic values of World Heritage Areas have proven difficult to define at the same level of precision as applies to the more 'scientific' and cultural World Heritage values. There has been little research into the marine and coastal aesthetics of the GBRWHA, as noted in Lucas *et al* (1997) and Kenchington and Hegerl (2005).

The Wold Heritage values of the GBRWHA were clarified by Lucas *et al* in 1997, in order to provide a basis for guiding management decisions. The authors noted that attributes that satisfy the aesthetic criterion are difficult to measure and relate more to a social construct than some physical or biological phenomenon. The aesthetic values of the GBRWHA were reviewed and assessed by the authors, referring to the scenic quality criteria developed by Brouwer and Chenoweth (1994) and EDAW Australia (1996). While noting that these studies were largely restricted to visual amenity and scenic quality of just the terrestrial components, and commenting that *" …little work had been completed which allows the full range of aesthetic values which relate to the GBRWHA to be identified"*, Lucas *et al* list the phenomena of high scenic quality and aesthetic importance as including:

- expansive water views;
- the contrast and diversity of the land water interface;
- movement and diversity in the water, particularly at its edge; and
- diversity due to coastal form.

Lucas *et al* also concluded that aesthetic significance included community held perceptions and 'existence value', as well as the scenic and iconic values associated with the GBRWHA.

Kenchington and Hegerl (2005) assessed World Heritage Values and attributes of Magnetic Island and surrounding waters, including aesthetic values. They recognised that, while aesthetic perception is personal and subjective, they are related to other social and cultural values and are also strongly linked with natural qualities, such that "*the outstanding universal value of the Island derives from a combination of these qualities*". Their "World Heritage Scorecard" rated 'expressions' of the four natural criteria as:

- unique values – only expressed on Magnetic Island;
- regionally Important Values – where Magnetic Island contains a highly significant expression or the majority of expressions in the GBRWHA; and
- values for which Magnetic Island is a minor component of total expressions in the GBRWHA.

Magnetic Island was rated as "Unique" (a value expressed uniquely on Magnetic Island) for the aesthetic Criterion "*contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*" (note that this was the wording of former Criterion (iii), which differs slightly from the current Criterion (vii)). The reasons for the "Unique" assessment were that "*The Island has mountainous terrain and a shoreline with a rich variety of landscapes and seascapes of exceptional beauty*".

Furthermore, because Magnetic Island is readily accessible by an urban population, it provides opportunities for presentation of World Heritage Values which are not available elsewhere in the GBRWHA. "*…its accessibility makes it a key place for presentation, appreciation and enjoyment of values that, although widespread, are effectively inaccessible to most people*". The authors consider that World Heritage qualities and values, even those which are relatively common, are significant where they occur in combination and are accessible. This "*obligation of 'presentation' can mean that widespread values are particularly important in accessible areas*" (Kenchington and Hegerl 2005).

This 2005 assessment of Magnetic Island is relevant to the World Heritage Values of GKI in that:

- it considers combinations of scenic qualities associated with island landscapes, shoreline and seascape features, each of which may be widespread and not necessarily of outstanding universal value in and of itself (and which do not include aerial vistas over patterns of reefs and lagoons), but which in combination 'express' World Heritage values; and
- it considers that the accessibility of such combinations is important in the 'presentation' of such values to the public.

(b) World Heritage Aesthetic Values of Great Keppel Island

The Visual Assessment report (**Appendix AL**) describes the main landscape feature and values of GKI and surrounding waters, and the views of and from the Island.

Key features are:

- visually prominent mountain ridges and rocky headlands, which divide the Island into distinct viewsheds and landscape/shoreline settings;
- a varied shoreline with beaches, bays and coves;
- a central valley which is largely screened from external views; and
- a dominance of undeveloped and natural character.

These have been analysed and mapped in the visual assessment report as landscape character types, 'landscape settings' (12 defined) with viewsheds from offshore and onshore (western, south-eastern, eastern and central) described. Sensitive receptors and visual absorption capacity were also assessed. All parameters were combined into five categories of visual amenity constraints, as follows:

1. Priority viewsheds;
2. Highly constrained;
3. Sensitive;
4. Limited visibility; and
5. Semi-secluded.

The contribution of the Island to the World Heritage aesthetic values of the GBR are broadly:

- views to the Island and its mountains, headlands and beaches as seen from the water, mainland and other Islands;
- views from the Island to surrounding waters, headlands and islands, as seen from elevated viewpoints or from the beaches;
- contrast and diversity of the land water interface, ranging from steep rocky headlands and rocky coves to gently shelving sand beaches and tidal wetlands;
- contrast and diversity of coastal form, ranging from the large mountainous landform, tidal wetlands and sand dunes to the smaller adjacent islands, rocks and fringing reefs;
- accessible combinations of landscapes and seascapes, including views over the Keppel Group and fringing reefs as seen from the air; and
- "existence value" in that the Island is perceived as natural and a remote 'escape' from the mainland.

In combination these present a 'package' of landscape values which is not common on a single island in the southern part of the GBRWHA. While the 'superlative natural phenomena' referred to in the World Heritage citation are those associated mainly with vast areas of coral reefs and lagoons, that are not *per se* represented on the Island, the above combination of features contribute to and extend the scenic diversity.

Overall, the natural scenery of the Island and surrounding Islands and waters exhibit many of the World Heritage aesthetic values of the GBRWHA, and its variety of internal and shoreline landforms and seascapes extend and contribute to World Heritage values. Importantly, these attributes are close to the mainland, readily accessible by air and sea, and available to residents and tourists based at an existing node of development. As noted by Kenchington and Hegerl (2005) for Magnetic Island, such accessibility allows the 'presentation' obligation of World Heritage Area management to be met.

3.4.2.3 Impacts and Mitigation – World Heritage Aesthetic Values

As indicated in **Section 3.4.1.2**, an iterative process of constraints-based planning by the EIS team identified and avoided areas of visual sensitivity when siting the proposed development precincts and designing the low-rise built form.

The three development precincts (Fisherman's Beach, Clam Bay and the Marine Services Precincts) are each in separate viewsheds, and within each of these only a small proportion of land will be cleared and developed. The combined infrastructure footprint (buildings, roads, airstrip and associated services) will be approximately 46 hectares or 3.5 percent of the Island, part of which is within the existing Fisherman's Beach development node and airstrip, and the golf course fairways will occupy an additional 38 hectares or 2.9 percent of the Island. These total approximately 84 hectares or 6.42 percent of the terrestrial part of the Island. The golf course and associated villas in the Clam Bay Precinct are located in the central valley, largely screened from external views; and the proposed marina at Putney Point is in a location with a limited viewshed. The submarine cable to Kinka Beach will have no visual impacts.

Substantial reduction of potential visual impacts on the World Heritage Area has been achieved by a constraints-based approach to project planning and design, and by designation of a large Environmental Protection Precinct. Many of the World Heritage aesthetic values are associated with parts of the Island outside the proposed development footprint of each of the precincts. However vegetation clearing, earthworks and development within the precinct footprints, and indirect effects of project development and operation, will cause some visual impacts on the Island and views from adjacent waters, as indicated in the visual assessment report (**Appendix AL**). These impacts will be relatively minor because development will not take place on ridges or visually exposed 'outer' hillslopes, the buildings will be at generally low elevations and will all be low-rise (maximum three-storeys). As seen from offshore (i.e., from World Heritage waters), most of the Island will maintain its existing natural undeveloped appearance. The part of the Island which is already developed (the Fisherman's Beach area and existing airstrip) is proposed for substantial new development, but it will have no greater visual impact than at present. The existing visually-prominent hillside villas (refer **Photograph 3.11**) will be removed and replaced by more visually integrated units.

Photograph 3.11 VISUALLY PROMINENT HILLSIDE VILLAS

The elements likely to be visible from offshore will be part of the marina breakwater and Marine Services Precinct buildings and lighting, as seen from the ferry route and a limited viewshed arc.

Specifically proposed visual impact reduction measures, as detailed in the Visual Assessment report (**Appendix AL**), include:

(a) Airstrip

- vegetation clearing and earthworks will be promptly revegetated with native shrubs; and
- revegetation will be designed as irregular patches for additional visual diversity.

(b) Marine Services Precinct

- marina location and building heights have been planned to ensure screening by Putney Point, Sand Spit and Middle Island, which restrict the visibility from offshore waters;
- buildings will have staggered setbacks from the marina edge, plus variation in height, scale and groupings of buildings, such that only part of the complex will be visible from Putney Beach. Street trees and vertical elements (eg. lighting, flagpoles) have also been incorporated so the built form will not appear as single bulky mass; and
- generally subdued colours and tones to enhance visual integration with the headland and forested mountain backdrop.

(c) Lighting

- maximum use of bollard lighting, with taller mast lighting used only where necessary and then downward-directed with minimal glare spillage, with no flood-lighting of trees or external walls above the surrounding vegetation screening height;
- lighting of rooms associated with decks and large picture windows (if any) in the hillside Eco Resort Villas will be fitted with dimmers and timers;
- marina lighting will be screened by the Putney Point ridge and the Sand Spit trees, with minimal glare apparent from beaches and ocean outside this arc; and
- lighting in the Marine Services Precinct will be downward-directed, with glare restricted to local parts of Putney Beach and the Passage.

(d) Golf Course

- clearing and earthworks for greens and fairways will be restricted to land of less than five percent slope and will not affect the hillslopes on either side of the central valley;
- bands of trees will be retained, such that the external views will not include swathes of visible lawn or grassed fairways; and
- fairway edges will be integrated with adjacent bushland to avoid sharp edges, and seaward edges will be landscaped to avoid parts of the golf course being visible from the south.

(e) Eco Resort Villas

- building height (roof ridge line) restricted to 8.5 metres, with non-reflective roofs of varied form and pitch;
- articulated facades and balconies, deep overhangs, generally dark subdued colours and tones, visual integration with island vegetation; and
- bands of remnant trees are to be retained (supplemented by screen planting), plus street trees provided along roadways.

(f) Hotel and Apartments

- buildings of small legible units with an indoor/outdoor integration and tropical design features, non-bulky in form, longer than tall, relating visually to their setting;
- articulation, overhangs, low pitched roofs with some variation in the horizontal line, to avoid any impressions of a 'wall' of uniform built form;
- generally subdued colours and tones to enhance visual integration with surrounding vegetation and the forested mountain backdrop; and
- reflective solar panels on roofs in positions and at angles where they will not be visually intrusive with respect to lookouts, sensitive receptors or external view sectors.

(g) Roads and Infrastructure

- road alignments avoid linear hillside scarring within view of sensitive receptors and external viewpoints;
- road cuttings on hillsides minimise vegetation clearing and earthworks, have dark-coloured retaining walls with planted terraces, soil nailing or gabion supports; and
- minimum area of bare earth exposed at any one time during construction.

(h) Views from Walking Tracks

- walking tracks through natural and rehabilitated vegetation to have vegetation screening where required; and
- built form to complement the natural landscape with appropriate bulk, scale, building materials and colours, and heights generally below tree canopies.

Likely visual impacts on World Heritage aesthetic values, taking into account the proposed mitigation measures, are summarised in **Table 3.54**.

TABLE 3.54 VISUAL IMPACTS ON WORLD HERITAGE AESTHETIC VALUES

Scenic Features and Values	Likely Impacts (Post-Mitigation)
Views to the Island from offshore.	(a) From Rosslyn Bay and ferry route: the proposed Marine Services Precinct will be visible from parts of the ferry route, although screened from most of Rosslyn Bay. There will also be some additional visual impact of proposed new buildings in the existing Fisherman's Beach former resort area, with parts of the three-storey hotel visible between and above foreshore trees, and sensitively-designed hillside two-storey villas replacing the existing visually intrusive resort villas. (b) From the south: currently undisturbed natural viewsheds will continue to have no visible built form, apart from some Clam Bay Precinct hillside villas which may be visible between retained trees as seen from a restricted arc of view, and then only until screening vegetation takes effect. (c) From the east: the currently undisturbed natural viewsheds will continue to have no visible built form. (d) From the north: the viewshed is predominantly natural and undisturbed (apart from Svenden's homestead) and will have no additional visible built form. (e) From the north-west (across Leeke's Beach): the central valley currently appears undeveloped, notwithstanding past rural uses, and the viewshed will be changed by the development of a golf course (screened from offshore views) and by some villas and associated lighting visible at the far end of the valley and on the distant skyline, although these will be part-screened and integrated by bands of tree retention and planting. (f) From the Passage and Middle/Miall Island: views to Putney Beach and Putney Point will be significantly changed by development of the marina and associated buildings up to three storeys, and also by marina complex lighting, although visual impacts will affect a relatively small landscape setting confined by the Putney Point landform and Sand Spit trees.
Expansive views from the Island's peaks and ridges over GBRWHA waters and adjacent islands.	No visual impacts – the view north from First Lookout over Leeke's Beach and estuary to Creek Rocks will remain unchanged, the view south from First Lookout and the view from Morris Lookout will continue to include some of the existing settlement houses and part of the airstrip, and most of the ridges and peaks will continue to offer opportunities for expansive views outwards over the Island shoreline, bay, islands and GBRWHA waters with no visible built form.
Contrast and diversity of shoreline and water's edge.	Visual impacts will be limited to the marina site (a small proportion of the Island's coastline), plus some minor increase in built form visible from Fisherman's Beach. Other development will be set well back and screened from the shore at Putney Beach, Leeke's Beach, Long Beach and Clam Bay, and all other isolated bays, coves, headlands and beaches will remain in their existing pristine condition.

TABLE 3.54 VISUAL IMPACTS ON WORLD HERITAGE AESTHETIC VALUES (CONTINUED)

Scenic Features and Values	Likely Impacts (Post-Mitigation)
Diversity of coastal form including mountains, headlands, sand dunes, mangroves, beaches and fringing reefs.	Very little of the Island's landform will be altered. Visual impacts will be limited to removal of a small hill and re-shaping of part of a hillside, needed for the new airstrip and clearance zones. The hill to be removed is visible from only a limited arc of view from offshore Putney Beach, and while earthworks during the construction phase will be seen, there will be no permanent impact after it is removed, apart from the absence of a minor landform feature. With respect to the clearance zone re-shaping, the hillside is not in a visually prominent location and the disturbed areas will be formed and revegetated for visual integration. The Island peaks, ridges, headlands, mangrove, sand dunes and fringing reefs will remain unaffected. The inter-precinct road will require clearing and earthworks, but the temporary visual scarring will not be visible from First Lookout, from offshore or from sensitive receptors.
Aerial vista over island and reef systems.	The Project will have moderate visual impacts, in that views from the air will reveal a more extensive area of buildings and golf course than at present. However the aerial vista will also reveal the large proportion of the Island maintained in natural condition, the pattern of islands in the Keppel Group and (under suitable weather conditions) the fringing reef in Clam Bay.
Unique accessible combinations of landscape, shoreline and seascape, as an opportunity for 'presentation' of World Heritage values.	Development will have a net positive impacts on this 'aesthetic' value, in that the unique combination of natural scenic features of the GBRWHA within close proximity to the mainland will become even more accessible and 'presentable' to the public with expansion of resort accommodation and day trip opportunities, and development of a marina, longer airstrip and the golf course.
'Existence Value' as a relatively undisturbed island.	Where this can be regarded as an 'aesthetic' value, development will have a minor impact on the 'perceived naturalness' of the Island. The central valley will be developed as a golf course and associated Eco Resort Villas and management of walking trails through natural areas will include supplementary planting to screen views over the Clam Bay Precinct where possible.

The forest communities, areas of regrowth and cleared grazing land in the southern part of the central valley do not contribute significantly to the aesthetic values listed for the GBRWHA. Consequently their partial clearing for development of the Clam Bay Precinct is not considered to be a visual impact on World Heritage values.

In summary, the Project will have little impact on World Heritage aesthetic values, and these limited impacts will be mainly associated with a discrete node of shoreline development at the marina and to a lesser extent with some golf course villas visible at the far end of the central valley. These visual impacts will be restricted to relatively confined arcs of view, because the Island landform offers opportunities for 'visual absorption' in the central valley between two ridges, and opportunities for a marina 'tucked' behind Putney Point. There will also be visual impacts associated with the Fisherman's Beach Precinct, however, the low rise built form and landscaping will ensure it is better integrated visually than the visually-intrusive former resort buildings that are sited in the location presently. These visual impacts on World Heritage aesthetic values are capable of being addressed and managed through design, landscaping, screening and other conditions. The natural beauty of the GBRWHA (as seen from offshore waters, from the mainland and from the ferry route) will not be significantly affected.

3.4.2.4 World Heritage Values – Geomorphic and Coastal Processes (Criterion viii)

The Island is an offshore continental island with diverse landforms including two main mountain ridges and several hard rock headlands, sand dunes and tidal wetlands. As the largest and highest continental island in the Keppel Group, it is an important representation of this aspect of GBR physiography. The geomorphology comprises a bedrock of mainly Carboniferous metamorphic quartzose and lithic sandstones (the Shoalwater Formation), overlain by a relatively thin veneer of Quaternary sands, as described in the Coastal Environment report (refer **Appendix Y**) and **Section 3.6**. These terrestrial features contribute to the geomorphological diversity of the GBRWHA, but are not per se unique or outstanding. Most of these features and combinations are well represented on the mainland and on other large continental islands, with the exception of the old low beach ridges behind Putney Beach (outside the Project area). The geological map indicates that these include chenier land forms, which are relatively unusual in the context of the GBR islands.

The main geomorphic or physiographic features of the GBR which are of World Heritage value are the vast extent, structure, diversity, evolutionary development and relatively young age of the coral reef systems. These include the fringing reefs of continental islands, which generally exhibit high species diversity around island groups such as the Keppel Group (DeVantier in Lucas et al 1997). The fringing reefs of Middle Island are good examples of their type and are protected by Marine Park zoning by GBRMPA. However as reported in the Aquatic Ecology report (refer **Appendix W**), "Coral communities were dominated by branching and massive growth forms, together with some plate / foliose, soft, mushroom and encrusting growth forms. The corals of Putney Beach were dominated by *Turbinaria sp*. and the soft coral *Sarcophyton sp*. Coral cover was highest at Middle Island and Passage Rocks. Severely bleached corals were most abundant at Clam Bay during the wet season survey." The fringing reefs of the Island (such as Clam Bay) are in a 'high nutrient status coastal strip' bioregion subject to repeated disturbance from mainland floods and coral bleaching, with relatively low species diversity but capacity for rapid recovery. Their capacity for recovery following disturbance may be associated with nearby coral refuge areas with higher diversity and connectivity.

In terms of World Heritage values, the coastal and geomorphic processes associated with coral reefs around the Island are not those of high species diversity or vast extent. However as examples of fringing reefs under stress from high nutrient inshore waters, with high capacity for rapid recovery, they are of research interest and extend the overall diversity of coral-related processes in the GBRWHA.

3.4.2.5 Impacts and Mitigation – Geomorphic and Coastal Processes

The Project will be set well back from the shoreline and will not affect coastal processes or geomorphic features associated with beaches, dune fields or headlands (such as wave-cut platforms), with only one relatively small node of marina development impacting on 2.33 percent of the Island's coastline.

(a) Marina

As indicated in the Coastal Environment report (refer **Appendix Y**), the proposed marina at Putney Beach will cause localised changes to current, tide, wave and sediment patterns in the passage, affecting Putney Beach. Marina construction is expected to cause local turbidity, mainly within the basin but also occasionally affecting water quality at Putney Point and Sand Spit. During operation, siltation is likely to occur within the marina, and water quality has the potential to be impacted upon, but generally the marina has been designed to maintain good water circulation and flushing.

Mitigation measures include:

- maintenance dredging of the entrance channel expected to be required every five years on average;
- the periodic bypassing of sand from Putney Point to Putney Beach to maintain the long-term sediment continuity along Putney Beach;
- a sediment trap will be constructed to prevent sediment from Putney Creek being transported into the marina basin during flood flows;
- during marina excavation, the use of small to medium Cutter Suction Dredge (CSD) will limit the amount of suspended sediment generation;
- the use of the dredge material to fill geotextile bags to provide the core of the breakwater and marina revetments will prevent the need for ocean disposal of the material and assist in filtering and settling out a significant amount of the fines that would have otherwise gone into suspension during sea disposal;
- a Dredge Management Plan will be developed incorporating real time turbidity monitoring at key locations and trigger levels for cessation of dredging;
- construction of the western breakwater in Stage 1 will significantly assist to contain the extent of the turbid plumes generated to within the marine facility; and
- investigation into the potential application of silt screens at the entrance to the marina, following Stage 1 will be undertaken.

(b) Coral Reefs

The Project will not affect the coastal and geomorphic processes associated with fringing coral reefs around the Island, including those associated with Middle Island and Passage Rocks. The Aquatic Ecology Technical Report (**Appendix W**) reports that "*The coral communities in the vicinity of the proposed marina are likely to be largely unaffected by increased suspended solid concentration and sediment deposition*" associated with marina construction, but nonetheless will be monitored during the construction phase.

(c) Chenier Landforms

The chenier landforms behind Putney Beach are of interest. These are not within the Project area and will not be directly impacted by the proposed development, but they may currently be at risk from further erosion of sand from Putney Beach and shoreline recession associated with climate change, as foreshadowed in the Coastal Environment Technical Report (refer **Appendix Y**).

With respect to the coastal processes at Putney Beach, hydrodynamic and sedimentation modelling has demonstrated that it is likely that the proposed marina construction will stabilise the Beach and will allow beach ridges and chenier landforms behind Putney Beach to continue to be an example of geomorphic coastal processes. The Coastal Environment Technical Report (refer **Appendix Y**) concludes that "*Construction of the marina is expected to reduce the net sediment transport potential along Putney Beach to close to zero, or potentially, a minor reversal in the net transport back towards Putney Point. The impact of the change in the net sediment transport potentials is expected to be a reduction in the rate of shoreline recession along Putney Beach and over the long-term, gradual accretion of sand along Putney Beach and progradation of the Putney Beach shoreline between the spit head and the western breakwater of the marina*" and that "*The periodic bypassing of sand from Putney Point to Putney Beach will also serve to increase the beach volumes and widths and improve the amenity of this beach.*"

It is also proposed to revegetate the environs of Putney Creek. If there are any surface features of the beach ridges and cheniers which can be identified as part of the revegetation planning, these will be incorporated in and enhanced by rehabilitation.

(d) Other Geomorphic Features

The terrestrial parts of the Island have no "**outstanding examples representing the major stages of Earth's history or significant geomorphic or physiographic features**", but as indicated above the chenier landforms are of interest. Notwithstanding this assessment, the geomorphology of the Island contributed to the overall diversity of continental island landforms in the GBRWHA.

The main impacts of the GKI Revitalisation Plan on the Island's geomorphology will arise from construction of the new airstrip and marina, and to a lesser extent the land clearing and earthworks required for the development precincts. However, these activities will not result in impacts on significant geomorphic or physiographic features that contribute to the GBRWHA values.

Deep water features of the adjoining continental shelf will also not be impacted, except along the narrow route of the proposed submarine cable.

With respect to the proposed airstrip, earthworks will include the removal of a small spur hill and re-shaping of approximately 11.5 hectares of the adjacent hillside, and filling of an area behind Putney Creek. The alignment and slope of the airstrip have been designed to minimise cut and fill, but aircraft safety clearance zones require alteration of the landform. However the areas affected are not considered to be particularly significant examples of the earth's history, and the main potential impacts on World Heritage Values are visual, as outlined in **Section 3.2.2**. As indicated in **Table 3.54**, the visual impacts are capable of mitigation through appropriate revegetation.

The Project will have little impact on World Heritage Values under this criterion, and these limited impacts will be mainly associated with a single Project element restricted to relatively confined arcs of view, because the Island landform offers opportunities for 'visual absorption'.

The above minor visual impact will be offset by the enhanced World Heritage value presentation opportunities afforded by the accessibility of the Island and enhanced enjoyment of the Island.

3.4.2.6 World Heritage Values – Ecological Processes, Habitat and Biodiversity (Criterion ix and x)

NOTE: Responses to Criteria (ix) and (x) have been combined in this Section in order to reduce repetition, as the values of and impacts on species, habitats and ecological processes are closely linked.

(a) Terrestrial

The Island has a range of terrestrial habitats and ecological processes associated with the foreshore, watercourses and remnant vegetation. Detailed flora surveys and vegetation mapping confirmed the presence of the Commonwealth listed 'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia'. There are 11 Regional Ecosystems of which six are 'Of Concern', plus two 'major vegetation communities, and High Value Regrowth areas, as listed in Flora and Fauna Technical Report (refer **Appendix AB**). Several communities have State-wide conservation status of 'Least Concern' but are nonetheless important in the context of the GBRWHA, because the Island communities are a significant proportion of their representation on continental islands. Vegetation mapping also confirmed that some bushland areas are non-remnant, owing to historical clearing.

This diversity at community level, and the relatively large size of the Island, supports a diversity of flora and fauna species. Field surveys at 273 sites, including targeted surveys for threatened species, identified 408 plant species of which 81 (almost 20 percent) were weed species. No flora species scheduled under Commonwealth or State legislation were recorded during the assessments. A number of species of local significance or interest were recorded including the trees *Eucalyptus robusta and Ficushispida,* and the grass *Eriachnestipacea*.

Detailed fauna assessments undertaken in wet and dry seasons in addition to wader studies and targeted surveys for nesting Beach Stone Curlew (*Esacusneglectus*) provided the most comprehensive study of the Island's fauna assemblages ever undertaken. A total of 104 terrestrial fauna species were recorded, including 17 species of Commonwealth or State significance and four pest species. Two 'Priority species' were recorded on the Island – the Beach Stone Curlew and the Rusty Monitor (*Varanusse miremex*). Communities and species listed under Commonwealth legislation are discussed separately in **Section 3.4.4** and **Section 3.4.5**. The studies confirmed that Leeke's Estuary (outside the Project area) provides habitat for a diversity of fauna including migratory and threatened bird species. The terrestrial environments support habitat for mostly common species and whilst some migratory species utilise these habitats it is not regarded as highly significant for these species. Significantly, the Island appears free of the pest cane toad (*Rhinella marina*). However historically the Island has not been free of pest animals and is impacted by a population of feral goats (refer **Photograph 3.12**).

Photograph 3.12 FERAL GOATS

As with most islands, the terrestrial biota has less species diversity than equivalent areas of similar habitat on the mainland, but is nonetheless significant in the context of other GBR islands, and is an important component of GBRWHA biodiversity. In general, the fauna of the land-water interface are specialised in some way for those habitats, and those using the 'inland' part of the Island are mainly 'generalists' and more tolerant of environmental change.

(b) Marine and Freshwater

Investigations of the marine and freshwater environments, as detailed in **Appendix W** indicate that the Island is surrounded by waters of significant ecological and conservation value. Habitats include seagrass meadows, fringing coral reefs, intertidal mangroves, saltmarshes and rocky shores, the sandy or muddy substrates for benthic invertebrates, and open waters for fish, crustaceans and marine mammals and reptiles. In terms of World Heritage values, these habitats provide the basis for considerable aquatic biodiversity, notwithstanding that some communities are reportedly affected by repeated disturbance (refer **Appendix W**). In context of the GBRWHA, these habitat types are relatively widespread, and their representation on and around the Island is relatively minor. The GBRWHA contains over 43,000 square kilometres of seagrass meadows, 2,000 square kilometres of mangroves, 70 bioregions, 800 species of echinoderms, regionally important seabird nesting island and a significant area for humpback whale calving.

The following values of the Island contribute to the biodiversity and World Heritage Values of the GBR:

- seagrass communities (four species) were identified and surveyed at nine locations, all of which had sparse and patchy distribution at the time of survey, consistent with a substantial decrease in cover and extent since the 1970s;
- coral communities were identified and surveyed at 10 sites. As indicated in **Section 3.4.2.3**, species diversity is relatively low in these 'high nutrient coastal strip' waters, but the communities exhibit a capacity for rapid recovery following disturbance;
- the Island does provide for turtle nesting, with 29 activities recorded in the 2010 to 2011 nesting season. Leeke's Beach, Long Beach, Second Beach and Butterfish Bay are the most important sites, although nesting also occurs on Putney Beach;
- the Leeke's Creek estuary and wetlands represent a particularly important area, with 49 hectares of mangroves (10 species) and saltmarsh (six species). However. the Putney Creek intertidal communities are in poor health and its 1.3 hectares mangrove and saltwater couch community accounts for only two percent of this vegetation type on the Island; and
- the freshwater streams support a biota characteristic of moderately disturbed ecosystems, and are of lesser ecological significance. They are however important for ecological processes and water quality draining to the bays and World Heritage waters.

Habitat types potentially affected by the Project are widely represented within broader regional area and it is considered unlikely that any particular marine, aquatic or intertidal habitat or individual species is restricted to areas that would be directly modified by the Project.

3.4.2.7 Impacts and Mitigation – Ecological Processes, Habitat and Biodiversity

(a) Terrestrial

The Island has a total area of approximately 1,308 hectares, of which only a minor proportion (approximately 203 hectares, excluding the offshore marina footprint of approximately 21 hectares) will be affected by clearing, earthworks, roads, buildings and infrastructure. This represents approximately 15 percent of the Island, but these figures include areas already developed and disturbed for the existing resort and airstrip (approximately 22 hectares), and areas which will be cleared for earthworks and subsequently revegetated, and the golf course open space. It should be noted that the majority of this area will be revegetated. The actual infrastructure footprint (including roads, buildings, airstrip and associates services) will comprise only 46 hectares or 3.5 percent of the Island. A further 38 hectares, or 2.9 percent of the Island, will comprise the golf course fairways and greens, with intervening patches and bands of managed

habitat. As much as practical, the development avoids areas of 'Of Concern' regional ecosystems and confirmed wetlands. Some vegetation clearing will occur, but most of this area will be revegetated and will have an overall minor impact on representation of individual vegetation associations within the GBRMP islands. As indicated by CEPLA 2011, (refer to **Appendix AB**), this will not result in the direct loss of habitat of threatened fauna. Some of this area will be revegetated with endemic species and it is also proposed to offset clearing of 'Of Concern' vegetation as outlined in **Appendix P**.

No flora species scheduled under Commonwealth or State legislation were recorded during the EIS investigations. A number of locally significant species were recorded, but all of these species are abundant on the island and design considerations will ensure their persistence. *Eucalyptus robusta* and *Ficushispida* occur mainly outside the proposed development footprint. The grass *Eriachnestipacea*, is at its southernmost distribution on the Island. The known occurrence of the species is largely within, or adjacent to the proposed development footprint, therefore it is potentially at risk of extinction from the Island. However, in order to ensure its survival, specific identification and monitoring of its presence in relation to areas of clearing will be conducted, with the footprint adjusted wherever possible to protect the species. In addition, the species will be included in the landscape planting palette.

The biota of the 'inland' parts of the Island, while they contribute to the overall biodiversity of the GBRWHA, are in the main relatively common, well-represented elsewhere, relatively tolerant of the small extent of disturbance proposed and/or will be well-protected in the proposed Environmental Protection Precinct. These considerations apply to the few species and communities of national or local significance including the Littoral Rainforest and Coastal Vine Thickets, Rusty Monitor, Bush Stone Curlew, migratory non-wading birds, raptors and other birds. The Island appears to be currently free of cane toads, a known threat to Rusty Monitor, migratory Rainbow Bee Eaters and other native fauna. Measures are proposed to minimise the risks of introducing cane toads to an environment currently free of this pest.

The GKI Revitalisation Plan includes a significant Environmental Protection Precinct of approximately 575 hectares, or 44 percent of the Island (and 65 percent of Lot 21), most of which is currently undisturbed. The purpose of the Environmental Protection Precinct is to ensure habitat protection and the viability of biological populations is maintained. The Environmental Protection Precinct will include large viable areas of a wide range of regional ecosystems and habitat types, that will be protected and managed for conservation to a higher standard than has occurred to date.

The GKI Revitalisation Plan comprises several other distinct precincts and areas, with wide areas of bushland between and with buffers to watercourses, such that habitat severance and fragmentation (including the golf course) are unlikely to inhibit wildlife movement, and existing corridor processes will continue.

The Project has been designed to avoid or minimise impacts on significant vegetation and habitat, including those associated with the Leeke's Estuary, and to provide buffers to waterways draining into this complex. Vegetation proposed to be cleared will have an overall minor impact on representation of individual vegetation associations within the GBRMP islands, and areas to be cleared in 'Of Concern' regional ecosystems will be offset. The areas of Littoral Rainforest and Coastal Vine Thickets are outside areas affected by the Project. A number of locally significant plant species were recorded, but all of these species are abundant on the Island and design considerations will ensure their persistence.

In addition to avoiding, minimising and offsetting impacts, the Proponent has committed to several mitigation measures, such as integration of landscaping predominated by plants indigenous to the Island, and a monitoring program that will enable ongoing adaptive management of vegetation communities and reduce indirect impacts on significant fauna species and their habitat.

In summary, the Project will not threaten any communities or species on the Island, if the proposed mitigation measures are adopted. Although it will have some localised impacts it will not permanently modify ecological and biological processes. A number of factors will contribute to ensuring that the relative proportions of natural and developed areas is a sustainable balance:

- a low proportion of the Island proposed for development (up to 203 hectares or approximately 15 percent of the terrestrial part of the Island will be impacted, but only 84 hectares or 6.42 percent will comprise buildings, roads, golf course, and infrastructure);
- localised nodes of development and activities;
- protection and buffering of these nodes from areas of environmental significance and sensitivity;
- protection and conservation management proposed for approximately 44 percent of the Island; and
- impacts to remnant vegetation can be offset through the use of environmental offsets off the Island as outlined in **Appendix P**.

Together, these actions will avoid broad scale degradation, although there will be limited modification of ecosystems around the edges of the development footprint. Potential impacts on World Heritage ecological processes and Criterion ix (*Outstanding examples of on-going evolution*) are considered to be minor, in that the constraints-based approach to project design, siting of development precincts and substantial buffers to sensitive areas will allow natural processes to continue in most parts of the Island.

(b) Marine and Freshwater

The fringing reefs of the Island have a recent history of major changes associated with bleaching and flood-plume impacts, but these impacts have not been linked to resort development or visitor use. Most of the reefs surrounding the Island will not be directly affected by the proposed development to any greater extent than was the case with previous recreational and resort use.

With respect to coral reefs, construction and operation of the GKI Revitalisation Plan will not interfere with any reefs directly and it is anticipated that indirect impacts will be negligible. The complex nature of the cross-shelf, longshore and vertical connectivity of the GBRWHA is facilitated by dynamic current flow that incorporate important ecological processes such as larval dispersal. Potential impacts from the construction and operation of the GKI Revitalisation Plan is not expected to interrupt the current flows that support this ecological process.

Development in the proposed Marine Services Precinct, including the marina, will occupy approximately 20.8 hectares offshore at Putney Point. As reported in the *Aquatic Ecology Technical Report* (refer **Appendix W**), construction and operation of the Resort has the potential to cause direct and indirect impacts on marine ecosystems through:

- loss and / or gain of habitat: marina dredging will remove approximately 9.60 hectares of substrate with patchy seagrass (less than 0.1 percent of seagrass in the region) and approximately 20 hectares of unvegetated soft sediment. Marina construction will remove approximately 0.98 hectares of rocky intertidal habitat, but create a greater area of hard surfaces (breakwalls, piles, pontoons, etc.) as suitable conditions for algae, hard and soft coral, sponges and associated fauna. In addition, construction of the submarine cable and pipes will disturb approximately 0.004 hectares of sparse seagrass and up to 0.04 hectares of mangrove removal at Kinka Beach;
- increased turbidity and sediment deposition: the dredge plume will be contained within the marina but may extend beyond the footprint for short periods. A very small area of seagrass to the south of the marina (less than one hectare) may be affected by silt, but coral, fish, turtles and marine mammals are highly unlikely to be significantly impacted;
- spills of hydrocarbons and other contaminants including copper contamination;
- nutrient enrichment;
- artificial lighting, potentially affecting turtles and other marine fauna;
- human activities, boat traffic, waste and litter;
- introduction of marine pests; and
- generation of acid sulfate soils, although in this case no sediments proposed for dredging are considered likely to be potential acid sulfate soils.

Likely positive impacts (environmental benefits) include the additional rocky substrates created by the marina breakwater walls, and Putney Creek water quality improvements arising from the reopening of the creek mouth.

Potentially detrimental impacts on marine habitat will be minimised and managed by 'best practice' assessment, design, engineering and environmental management and monitoring practices generally, and specifically by:

- offsets for marine habitat (fish habitat enhancement or restoration) plus natural regeneration following disturbance, and/or by or financial contribution to offset acquisition or exchange, and for research and education for example the construction of a Research Centre and the establishment of a Biodiversity Fund;
- light spillage will be minimised as design development is set back and well-buffered by beaches used for turtle nesting, except in the Marine Services Precinct where turtle hatching is unlikely to be affected by marina lights;
- a dredging Environmental Monitoring Plan will be developed and implemented, including; measures to manage and contain any turbidity plume, and monitoring regimes for seagrass, mangroves, coral communities and soft-sediment macrobenthic communities during the construction phase, then annually thereafter, focusing on community structure and health in areas likely to be affected by the Project.;
- the risks of spills and contaminants will be minimised through ESD design and management practices for the construction and operation phases, consistent with an overall high standard of environmental protection. The potential for nutrient enrichment will be minimised in that the golf course will be developed and operated with treated effluent and minimum other fertiliser application, with water quality of irrigation and runoff waters monitored, and wide buffers to the downstream Leeke's Estuary wetlands;
- visitor impacts will be managed through regulation of operators, visitor education, signage and other awareness programs. Integrated management of visitor activities, boating use and nature interpretation will aim to ensure that increased levels of reef visitation and appreciation will not be associated with increased impacts; and
- the marina basin will be monitored for marine pests, and immediate action triggered should any pest species be inadvertently introduced.

The Project is distant from other proposed major developments and is, therefore, unlikely to contribute to significant cumulative impacts. It will however trigger flow-on business opportunities within the Capricorn Coast and Rockhampton.

(c) Land / Water Interface

In overview, the Island-based ecological and biological processes which affect or interact most with GBRWHA and significant fauna (such as Beach Stone-Curlew, turtles, dugong and migratory wading birds), are those associated with the beaches, fringing reefs, seagrass beds, rocky headland and intertidal zones. These will be almost entirely unaffected by the Project and will be well-buffered, except for a small area at Putney Point where the marina will be developed.

Ecological surveys (refer to **Appendix AB**) have confirmed the significance of the 57.5 hectare Leeke's Estuary as an important habitat for a diversity of fauna, including migratory and threatened bird species. There will be no direct impacts on this habitat as a consequence of the development with roads setback at least 40 metres from the edge of the wetland and all other development setback at least 200 metres. A minor area (1.3 hectares) of mangrove and saltwater couch is associated with the mouth of Putney Creek, accounting for two percent of this vegetation type on the Island, but as indicated above these communities are currently in poor health. The beaches fringing the Island include a mixture of sandy and rocky shores that serve as foraging habitat for marine and some migratory bird species. The proposed marina will result in the loss of approximately 2.8 percent of this foraging habitat from the Island.

The main impacts will be associated with airstrip and marina construction and their effects on the Putney Creek system, which is already degraded and undergoing dynamic changes since construction of the existing airstrip. Although the Putney Creek catchment will be impacted by clearing and land filling, the beach is likely to be stabilised by works proposed for the marina. Over time a new equilibrium will be established at the creek mouth, and a more stable ecotone between freshwater and saltwater ecosystems will develop.

3.4.2.8 World Heritage Values – Summary of Impacts

The Island is located in the southern that any of the identified World Heritage Values are associated with the terrestrial areas of freehold land, most will be better protected and managed as an outcome of the Project than they are at present.

Additional areas will be protected as coastline setbacks and buffer areas, as required by the Coastal Management Plan.

It should also be noted that the GBR Zoning Plan does not apply to the terrestrial areas of the Island, which are covered under the Rockhampton Regional Council planning scheme.

Notwithstanding the above broad context, the Island contributes to the diversity of World Heritage Values and there will be specific project impacts, as assessed in detail in the appended Technical Reports, and in a preliminary risk matrix on the potential effects of the proposed development on World Heritage Values (as presented in **Table 3.55**).

TABLE 3.55 WORLD HERITAGE VALUES SUMMARY RISK MATRIX

Criterion	Description of Impact	Mitigation Measures	Impact Level (Unmitigated)	Impact Level (Mitigated)
Criterion vii: Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.	• All identified potential visual impacts associated with the Project (refer **Table 3.13 Section 3.2.2.2**).	• Refer **Section 3.2.2.2 (a)**.	**(9) Medium**	**(4) Low**
Criterion viii: Outstanding examples representing the major stages of Earth's history or significant geomorphic or physiographic features.	• Potential visual impacts associated with noticeable changes to landform for the new airstrip (refer item 2 of **Table 3.13 Section 3.2.2.2**).	• Refer **Section 3.2.2.2 (a)**.	**(8) Medium**	**(4) Low**
Criterion ix: Outstanding examples of on-going evolution.	• Potential indirect impacts on EPBC listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (refer **Table 3.56 Section 3.4.4.2 (a)**). • Potential impacts on marine ecology, and in particular EPBC listed marine migratory species identified in **Table 3.58 Section 3.4.5.2 (b)** (refer **3.4.3.2 (c)** for impacts).	• Refer **Table 3.27 section 3.3.2.2 (c)** Mitigation measures d), e), f), g), h) and i). • Refer **Table 3.48 section 3.3.4.10** Mitigation measures to impacts identified in **Table 3.58 Section 3.4.5.2 (b)**	**(10) Medium**	**(4) Low**
Criterion x: Contains important and significant habitats for *in-situ* conservation of biodiversity, including threatened species.	• Potential impacts on biodiversity, and in particular EPBC listed migratory species identified in **Table 3.57 Section 3.4.5.2 (a)**, **Table 3.25** in **Section 3.3.2.2 (b)** and **Table 3.3 Section 3.3.3.2 (b)** • Potential impacts on marine ecology, and in particular EPBC listed marine migratory species identified in **Table 3.58 Section 3.4.5.2 (b)** (refer **3.4.3.2 (c)** for impacts).	• Refer **Table 3.27 Section 3.2.2.2** (All mitigation measures) and **Table 3.34** and **section 3.3.3.2 (a)** (All mitigation measures) • Refer **Table 3.48 Section 3.3.4.10** Mitigation measures to impacts identified in **Table 3.58 Section 3.4.5.2 (b)**	**(9) Medium**	**(3) Low**

3.4.2.9 Natural Heritage Values – Summary of Impacts

Similar context considerations apply to National Heritage Values as to World Heritage Values.

An overview of the National Heritage Values, impacts and mitigation is provided in **Table 3.56**.

TABLE 3.56 NATIONAL HERITAGE VALUES AND IMPACTS / MITIGATION SUMMARY

Outstanding Heritage Value	Values, Impacts and Mitigation
The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural cultural history.	The Island has a variety of habitats. A rigorous constraint-based design process has avoided direct impacts on significant vegetation associated with the Leeke's Estuary and provides buffers to waterways draining into this complex. With respect to other native vegetation and habitat, the overall building footprint has been kept to a minimum with a total infrastructure footprint representing approximately 6.4 percent of the Island area. The direct and indirect impacts of clearing and disturbance will be avoided and offset by revegetation and a large Environmental Protection Precinct, and minimised through buffering. The Proponent has also committed to a monitoring program that will enable ongoing adaptive management of vegetation communities, and other mitigation measures including integration of landscaping predominated by plants indigenous to the Island. Rigorous visual impact modelling has also resulted in the Project being situated in areas of low visual impact on the Island and as seen from offshore.
The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history.	No flora species scheduled under Commonwealth or State legislation were recorded during the assessments. A number of locally significant species were recorded, but all of these species are abundant on the Island and design considerations will ensure their persistence. Vegetation mapping confirmed the presence of the Commonwealth listed 'Littoral Rainforest and Coastal Vine Thickets of Eastern Australia' outside of areas affected by the Project. This mapping also concluded that whilst some areas are non-remnant, owing to historical clearing, that there are patches of 'Of Concern' regional ecosystems. As much as practical, the Project avoids areas of 'Of Concern' regional ecosystem and confirmed wetlands however some impacts will occur. It has been demonstrated that impacts to remnant vegetation can be offset through the use of environmental offsets off the Island. Furthermore analysis of impacts prior to offsets indicates that the proposed clearing with have an overall minor impact on representation of individual vegetation associations within the GBRMP islands. Furthermore, there are no direct impacts on the 57.5 hectares Leeke's Estuary as a consequence of the development with roads setback at least 40 metres from the edge of the wetland and all other development setback at least 200 metres.

TABLE 3.56 NATIONAL HERITAGE VALUES AND IMPACTS / MITIGATION SUMMARY (CONTINUED)

Outstanding Heritage Value	Values, Impacts and Mitigation
The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history.	The Island is surrounded by waters of significant ecological and conservation value, whilst the Island's fresh waters are of lesser conservation significance. The major drivers of coastal ecosystem health are broad-scale climate and flood flows of mainland river systems. The Project, through carefully considered siting, scale and design has been modelled to show minor impacts on the ecosystem health and biodiversity of both coastal and fresh-water systems. The improved access infrastructure on the Island and the improved accessibility around the Island will significantly improve the opportunity for visitors to experience the Island.
The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of: • a class of Australia's natural or cultural places; or • a class of Australia's natural or cultural environments.	The Island is part of the GBRWHA that is internationally recognised as having a large and significant expanse and diversity of coral reef formations. The GBR is important for its cultural heritage for Indigenous populations within Australia in providing habitat for species used as a food source and for culturally significant events. Mitigation measures were consistent in minimising the footprint of the GKI Revitalisation Plan and associated infrastructure. In addition, the Proponent will conduct site inspections of the Project area in consultation with Traditional Owners.
The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristic values by a community or cultural group.	The Island offers an aesthetically natural environment that is in relatively good condition. Impacts on the outstanding heritage value from the GKI Revitalisation Plan are unlikely to impact these values.

3.4.3 Great Barrier Reef Marine Park

The GBRMP was established in 1975 with the passing of the GBRMP Act 1975 (refer to **Section 3.3.1.1(b)**). This act allowed the establishment of the GBRMP Authority and outlined management of the marine park.

In 2003 the Federal government passed the GBRMP Zoning Plan which refined and extended previous zoning within the GBRMP.

3.4.3.1 Description and Values

(a) Description of Zoning

Zoning reserves currently surrounding the Island include Marine National Park Zones, Conservation Park Zones, General Use Zones and Habitat Protection Zones (refer **Figure 3.44**), described below:

- currently the marine boundary to the north and east of the Island is surrounded by Habitat Protection Zone and is largely un-influenced by the proposed project footprint (refer to **Figure 3.45**). On the south-east boundary is Marine National Park Zone MPZ-23-1159 which will have parts of the proposed Golf Course in close terrestrial proximity that may influence marine water quality in high flow events (refer to **Figure 3.46**);
- part of the southern boundary is Habitat Protection Zone with a limited amount of General Use Zone. This area will be influenced by the close terrestrial proximity of the Hotel and villa which may increase recreational use of marine waters; and may be directly impacted by the proposed location of an ocean outfall pipe (refer to **Figure 3.47**);
- the south-western boundary is a combination of Marine National Park Zone MNP-23-1161, Conservation Park Zone CP-23-4102 with special designation as a Public Appreciation Area and Habitat Protection Zone (refer to **Figure 3.48**). The Conservation Park Zone will be influenced by the terrestrial location of the Resort facilities which may increase recreational use of the marine waters; and
- located just off the coast to the north-west of the island is also a Marine National Park Zone MNP-23-1158. This zone may be influenced by the construction and use of the marina and construction of the submarine cable.

The submarine cable will be located through Habitat Protection Zone, Conservation Park Zone CP-23-4102, General Use Zone and Conservation Park Zone CP-23-013 (refer to **Figure 3.48** and **Figure 3.49**). It is anticipated that the construction of the submarine cable will impact on these areas as described in **Section 3.3.4.12 (a) (i)**.

Each of these zoning jurisdictions allows different activities to occur with or without a permit as identified in **Table 3.57**. This list is not exhaustive and most other activities not listed do require a permit (e.g. installation of structures, dredging).

TABLE 3.57 GUIDE TO AS OF RIGHT AND PERMITTED ACTIVITIES WITHIN THE GBRMP

Activity	General Use Zone	Habitat Protection Zone	Conservation Park Zone	Buffer Zone	Scientific Research Zone	Marine National Park Zone	Preservation Zone
Aquaculture.	Permit	Permit	Permit	X	X	X	X
Bait netting.	✓	✓	✓	X	X	X	X
Boating, diving, photography.	✓	✓	✓	✓	✓	✓	X
Crabbing (trapping).	✓	✓	✓	X	X	X	X
Harvest fishing for aquarium fish, coral and beachworm.	Permit	Permit	Permit	X	X	X	X
Harvest fishing for sea cucumber, trochus, tropical rock lobster.	Permit	Permit	X	X	X	X	X
Limited collecting.	✓	✓	✓	X	X	X	X
Limited spearfishing (snorkel only).	✓	✓	✓	X	X	X	X
Line fishing.	✓	✓	✓	X	X	X	X
Netting (other than bait netting).	✓	✓	✓	X	X	X	X
Research (other than limited impact).	Permit	Permit	Permit	Permit	Permit	Permit	Permit
Shipping (other than a designated shipping area).	✓	Permit	Permit	Permit	Permit	Permit	X
Tourism programme.	Permit	Permit	Permit	Permit	Permit	Permit	X
Traditional use of marine resources.	✓	✓	✓	✓	✓	✓	X
Trawling.	✓	X	X	X	X	X	X
Trolling.	✓	✓	✓	✓	X	X	X

Source: GBRMPA website.

All of these zones are designated from the mean low water and include the water column, the subsoil beneath the seabed and the air space to 915 metres above the surface. In addition to the GBRMP, the Great Barrier Reef State Coast Marine Park as designated under a zoning plan in 2004 also has complementary zoning which extends from the mean high water mark and include internal waters.

Figure 3.44 GBRMP ZONING

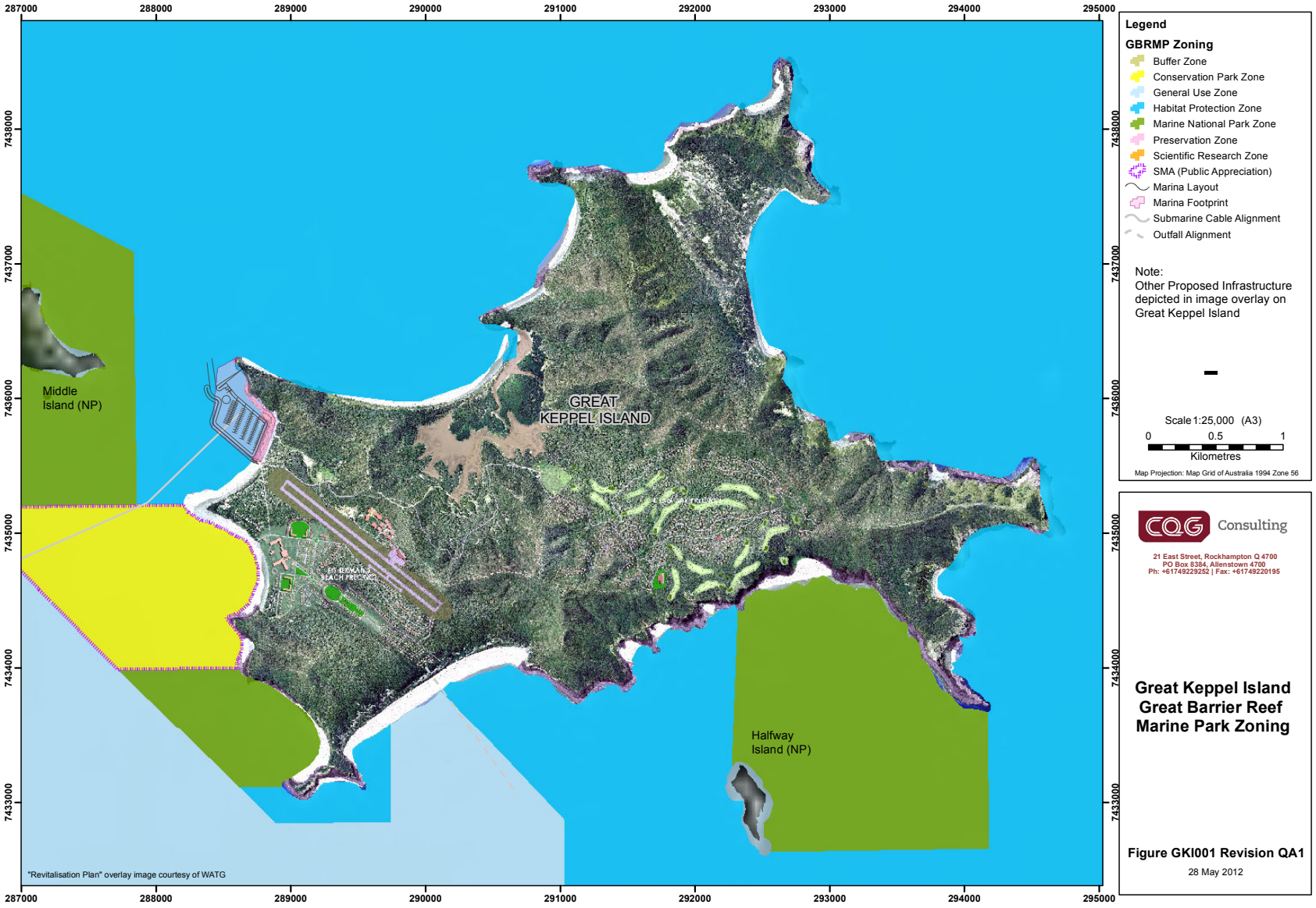


Figure 3.45 NORTH-EAST REGION GBRMP ZONING

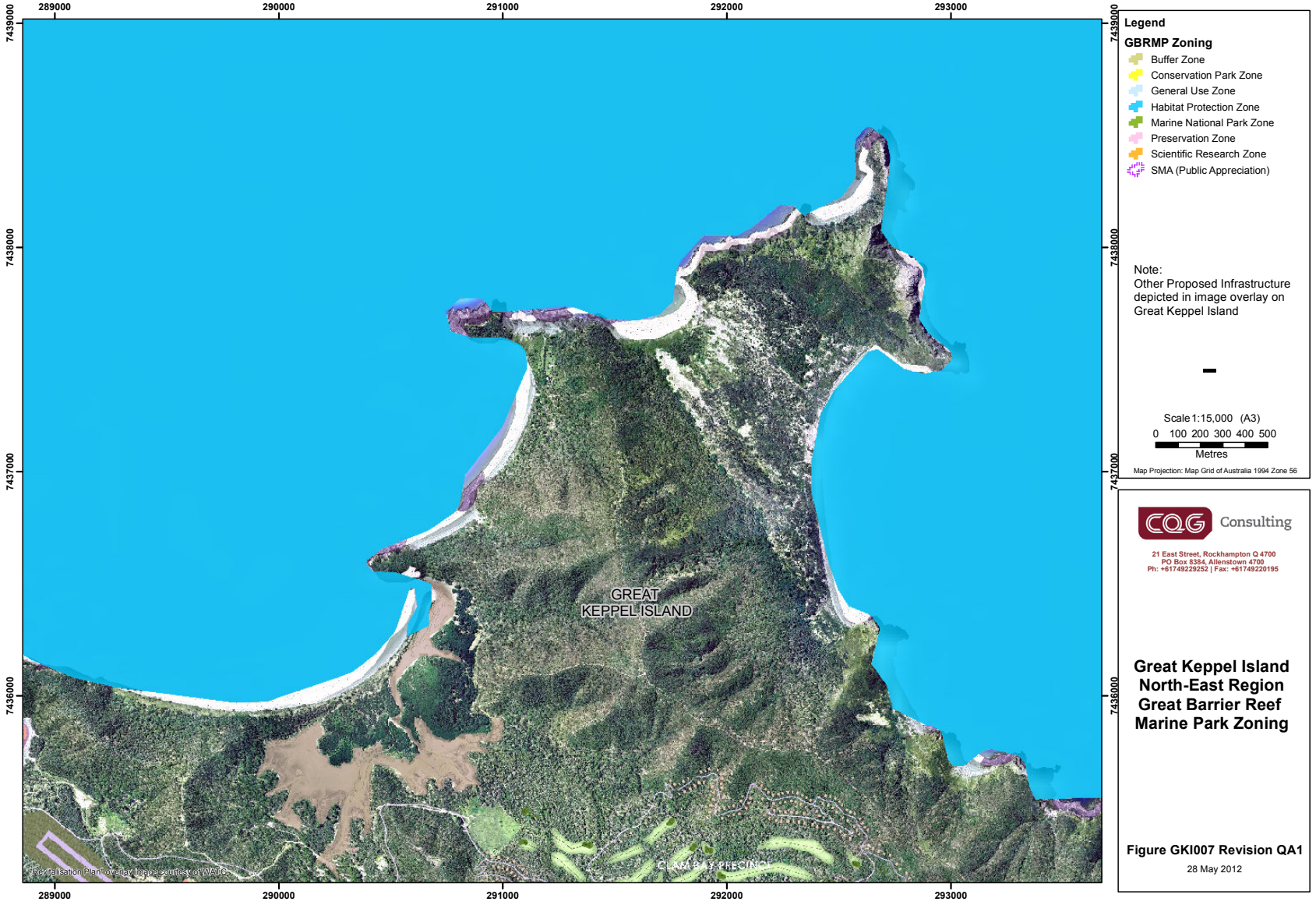


Figure 3.46 SOUTH-EAST REGION GBRMP ZONING

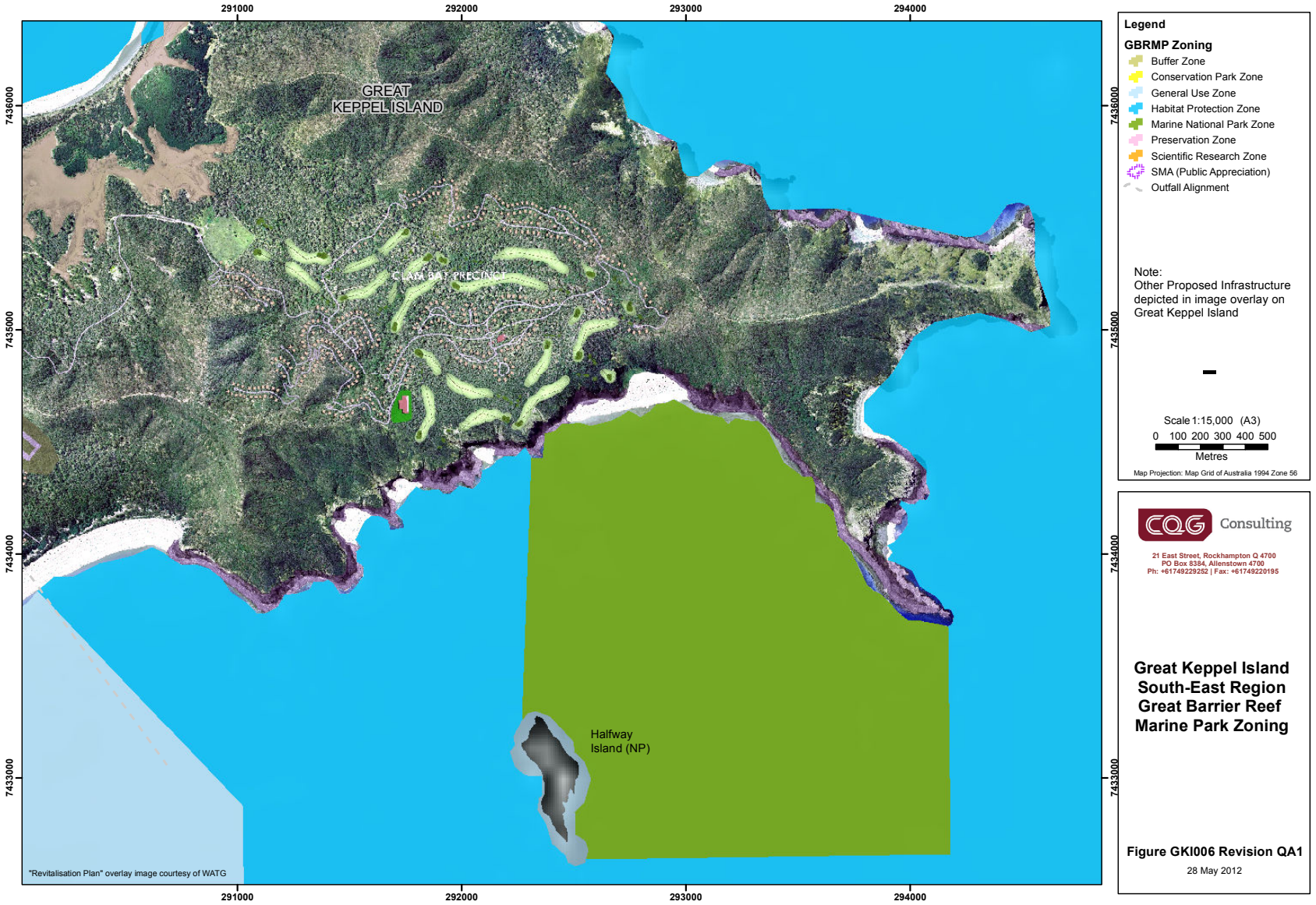


Figure 3.47 SOUTH-WEST REGION GBRMP ZONING

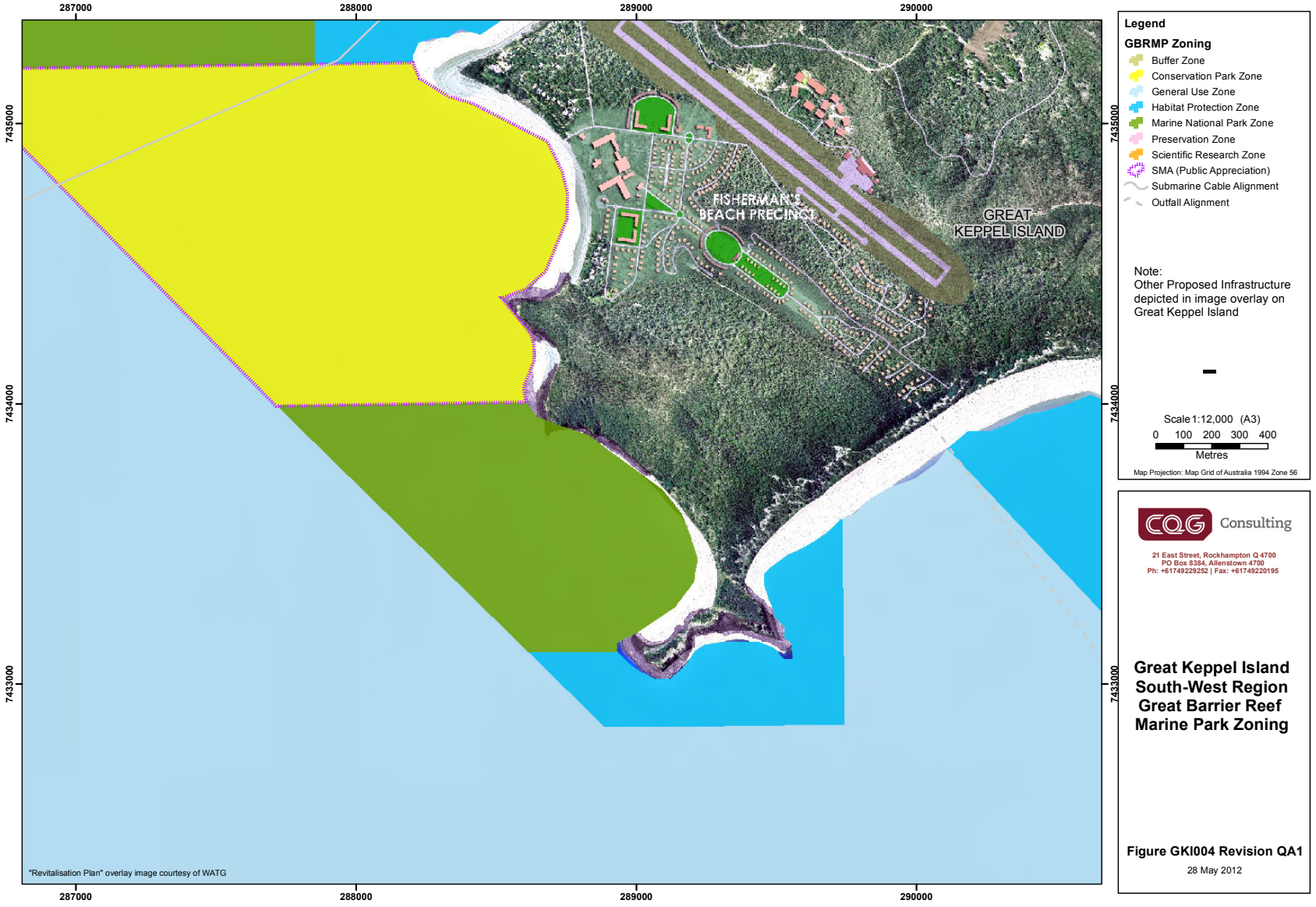
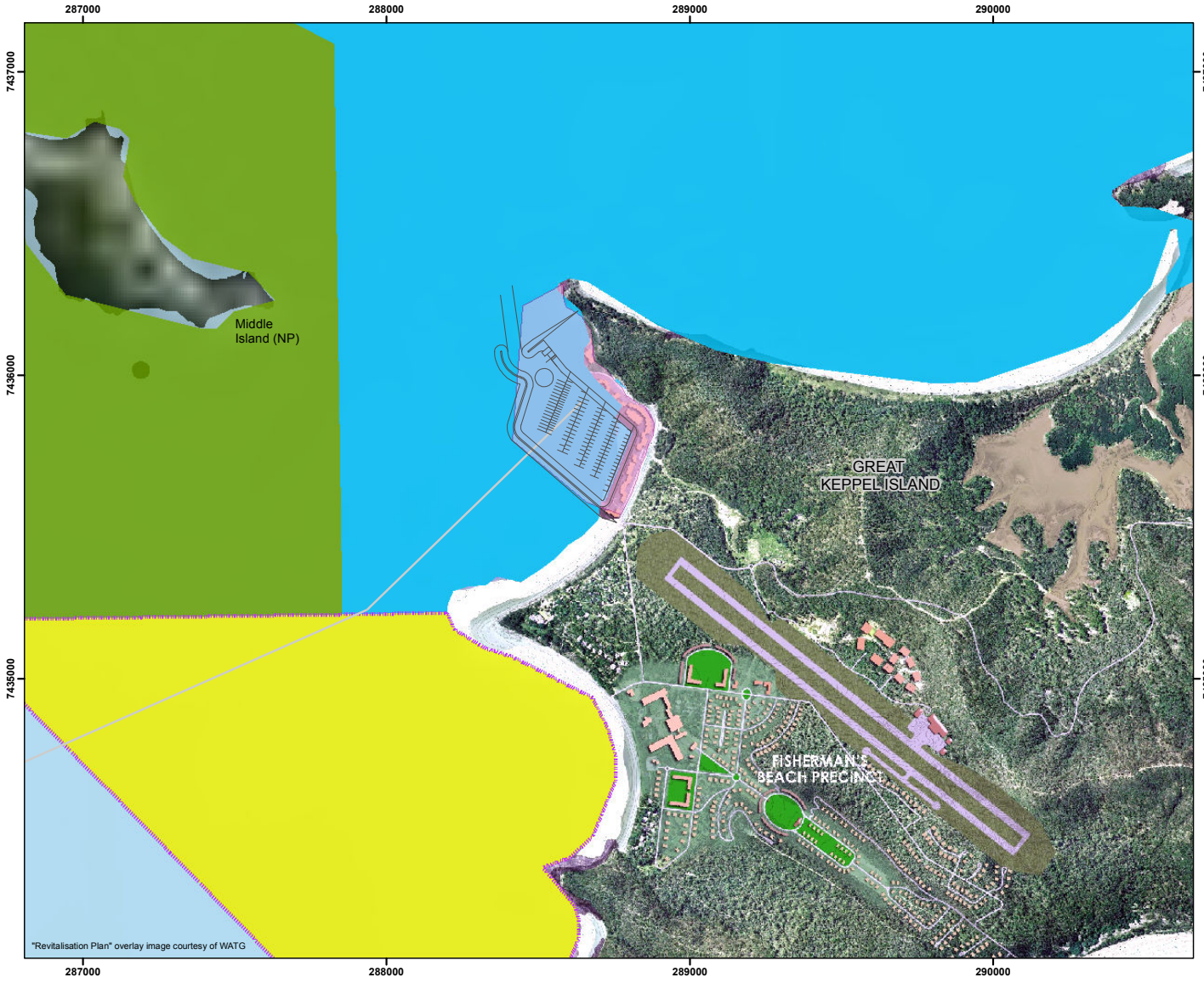


Figure 3.48 NORTH-WEST REGION GBRMP ZONING



Legend

GBRMP Zoning

- Buffer Zone
- Conservation Park Zone
- General Use Zone
- Habitat Protection Zone
- Marine National Park Zone
- Preservation Zone
- Scientific Research Zone
- SMA (Public Appreciation)
- Submarine Cable Alignment
- Marina Layout
- Marina Footprint

Note:
Other Proposed Infrastructure depicted in image overlay on Great Keppel Island

Scale 1:12,000 (A3)

0 100 200 300 400

Metres

Map Projection: Map Grid of Australia 1994 Zone 56

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Great Keppel Island North-West Region Great Barrier Reef Marine Park Zoning

Figure GKI005 Revision QA1

28 May 2012

Figure 3.49 SUBMARINE CABLE ALIGNMENT AND MARINA LOCATION

Legend

- Submarine Cable
- Marina Layout
- Marina Footprint
- Mean Low Water Springs

GBRMP Zoning

- Buffer Zone
- Conservation Park Zone
- General Use Zone
- Habitat Protection Zone
- Marine National Park Zone
- Preservation Zone
- Scientific Research Zone
- SMA (Public Appreciation)

Note:
Other Proposed Infrastructure depicted in image overlay on Great Keppel Island

Scale 1:5,000 (A3)

0 50 100 200

Metres

Map Projection: Map Grid of Australia 1994 Zone 56

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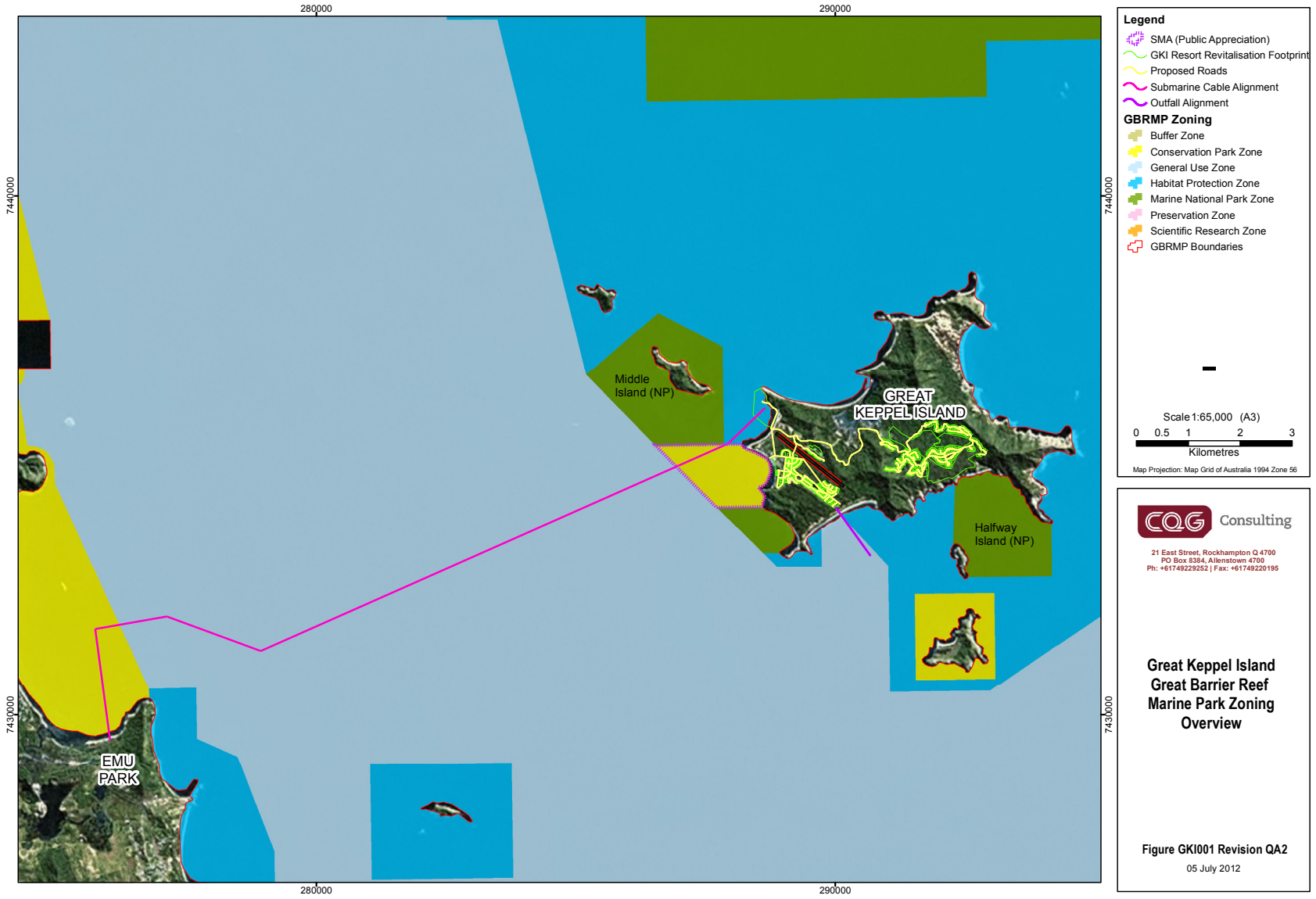
Great Keppel Island Great Barrier Reef Marine Park Zoning Submarine Cable Alignment and Marina Location

Figure GKI003 Revision QA2

05 July 2012

Figure 3.50 SUBMARINE CABLE ZONING OVERVIEW



(b) Description of GBRMPA Policies, Guidelines and Position Statements for Project

The GBRMPA has a range of policies, guidelines and position statements that were considered in the development of the Project including design modifications and mitigation measures. Of the 31 policies, guidelines and position statements those described in **Table 3.58** were most closely considered for their potential impact on the Project.

TABLE 3.58 IMPACT OF POLICIES, GUIDELINES AND POSITION STATEMENTS FOR THE GBRMPA ON THE PROJECT

Policy/Guideline	Description of Policy/Guideline	Impact on Development
Managing Tourism Permissions to Operate in the GBRMP.	Gauge anticipated management response to further tourism permit applications within vicinity of the Resort.	Each tourism operator will be obliged to gain their own permit and be assessed for cumulative impact on the GBRMP.
Policy on Managing Bareboat Operations in the GBRMP.	Required written permission (permit) of the Authority prior to operating in the Marine Park. Comply with relevant legislation and regulatory requirements of the Commonwealth and Queensland. Bareboat permits are given on a 'first come first serve' basis. The Authority can introduce a trigger limit for the size of the relevant bareboat fleet. Flotilla tours of greater than seven vessels attract requirements and will be assessed on a case-by-case basis.	Each tourism operator will be obliged to gain their own permit and be assessed for cumulative impact on the GBRMP.
Policy on Managing Scientific Research.	Research activities in the Marine Park require an environmental assessment in accordance with the precautionary principle. Proposals identifying sampling numbers greater than those listed in the limited research sampling table in the Regulations require written permission to the Authority further detailing information on: relative abundance of the species or habitat; the species conservation status or vulnerability to over-collecting and local depletion; and the level of environmental impact that may result from the activity. The Authority may introduce permit application assessment fees for research activities. Research conducted in Buffer Zone, the Marine National Park Zone or the Preservation zone must have regard to the level of environment impact associated with the activity. Adopt best environmental practices and standards.	Scientific research permits will be required to be obtained on an individual basis but the Project commits to keeping a record of all data obtained from research activities and their locations for the long term monitoring and health of the GBR.

TABLE 3.58 IMPACT OF POLICIES, GUIDELINES AND POSITION STATEMENTS FOR THE GBRMPA ON THE PROJECT (CONTINUED)

Policy/Guideline	Description of Policy/Guideline	Impact on Development
Dredging and Material Disposal Policy.	Comply with the National Assessment Guidelines for Dredging 2009. Dredge methods should minimise the impacts on the environment. Disposal of dredge material in the Marine Park is to only occur at a GBRMPA approved dumping ground. Dredge material above the Maximum Levels defined in the National Ocean Disposal Guideline for Dredged Materials 2002, must not be disposed into the marine park. The proponent will pay an environmental levy based on environmental risk alternatives and cubic metre of dredge material disposed to the Marine Park. Consideration must be given to all alternatives before ocean disposal.	Dredging for the Project will comply with NAGD Guidelines and will use alternative methods than ocean disposal.
Environmental Impact Policy.	Discuss, with interested groups, initial concepts, designs alternatives and potential mitigation of impacts for the Resort which impact on the Marine Park. Complete an application form and pay a Permit Application Assessment Fee (PAAF). GBRMPA will assign a Project Manager to commence notification and assessment and liaise with the Proponent. Creation of an EMP including potential environmental impacts of the Resort and how these activities will be managed to reduce these impacts; Independent experts directly contracted by GBRMPA will review EMP's. An Environmental Site Supervisor must be funded by the Proponent, but independent of the Proponent and be without conflict of interest. An Advisory Committee will be established to provide and provide advice to GBRMPA. A bond will be required and must be lodged with GBRMPA in the form of a cash bond or bank guarantee. The Proponent will be responsible for all reasonable costs associated with the environmental impact management.	The Project is committed to continuous improvement under the EMP and an active engagement program with stakeholders and the general community to achieve environmental objectives.
Position Statement on Indigenous Participation in Tourism and its Management.	Consultation with Traditional Owners with respect to cultural heritage values in aspects of tourism operation and inclusion of Traditional Owners within tourism program to develop the public understanding of the cultural heritage of the region and GBRMP.	The Project is committed to ongoing liaison and employment for Traditional Owners and active collaboration and inclusion on facilities pertaining to tourist engagement.
Structures Policy.	Proposals for the location of structures in the GBRMP will be assessed in accordance with the GBRMPA's policy for Environmental Impact Management.	The Revitalisation Plan involves a marina, pipeline and outfall pipeline structures. These structures, as far as practical, will be designed and sited so as to avoid impacts on sensitive environments. Structures will not be treated with toxic compounds such as anti-fouling paints. An Environmental Management Plan and appropriate on-site clean up equipment will be utilised where fuel or any other hazardous substance is stored.

(c) Social, Cultural and Heritage Values

Little research work has occurred to identify Non-Indigenous social values of the GBRMP, however it has been recognised that such values are expressed by social practices. Thus assessing the impacts on uses of the area: recreational activities, fishing, tourism, traditional and scientific use, contribute to knowledge of the impact on social values. In addition:

The aesthetic values of the GBRMP are strong, and the Project has been designed to minimise impact on visual amenity (refer to **Section 3.2.2**).

Knowledge of historic values, other than Indigenous heritage, also suffer from a paucity of data, though the Register of Historic Shipwrecks identifies their value GBR-wide. No shipwrecks are associated with the Keppel Group of islands as per the Australian National Shipwreck Database (2012). Some of the previous pastoral and tourism history associated with the island will be secured through protection of Leeke's Homestead.

The Indigenous cultural values of the GBR are identified in the GBRMP Heritage Strategy 2005 and include:

- sea estates;
- fish traps;
- burial grounds;
- traditional cultural lifestyles;
- places of aesthetic value;
- important grounds for traditional use of marine resources and breeding grounds;
- sacred sites of significance;
- ceremony sites;
- totems;
- storylines and songlines;
- practice of cultural protocols in sea country;
- travel routes- ritual paths through land and sea country;
- place names/ area names; and
- native title rights and interests.

For GKI many of these values are managed under a Traditional Use of Marine Resources Agreement (TUMRA).

(d) Traditional Use of Marine Resources Agreements (TUMRA)

A TUMRA is a voluntary agreement entered into by Traditional Owners and accredited by the GBRMPA and DEHP. Each TUMRA operates for a set time and it then re-negotiated. The agreement sets out how the Traditional Owners will work with Australian and Queensland Governments to manage traditional use activities within their sea country.

There are currently five TUMRA regions in the GBRMP the Dharumbal (Darumbal) TUMRA – Woppaburra Section is located around the Keppel Group of Islands (refer to **Figure 3.51**), the key focus of this TUMRA is to:

- limit green turtle harvest;
- not take dugongs;
- prohibit hunting by other Indigenous peoples within the Dharumbal (Darumbal) TUMRA – Woppaburra Section; and
- work with government to work against illegal hunting.

The TUMRA will continue to allow:

- access to all zones in the marine park for activities not involving the take of animals /plants or marines products; and
- traditional fishing and collecting to be conducted 'as of right'.

Therefore potential impacts of the Project in relation to the TUMRA include:

- construction of the marina which will reduce the area available to traditional hunting;
- increased access of Government Agency patrols to assist with illegal hunting issues;
- increased access opportunities for elders which under current transport arrangements may not be able to return to country; and
- impacts on cultural sites and values.

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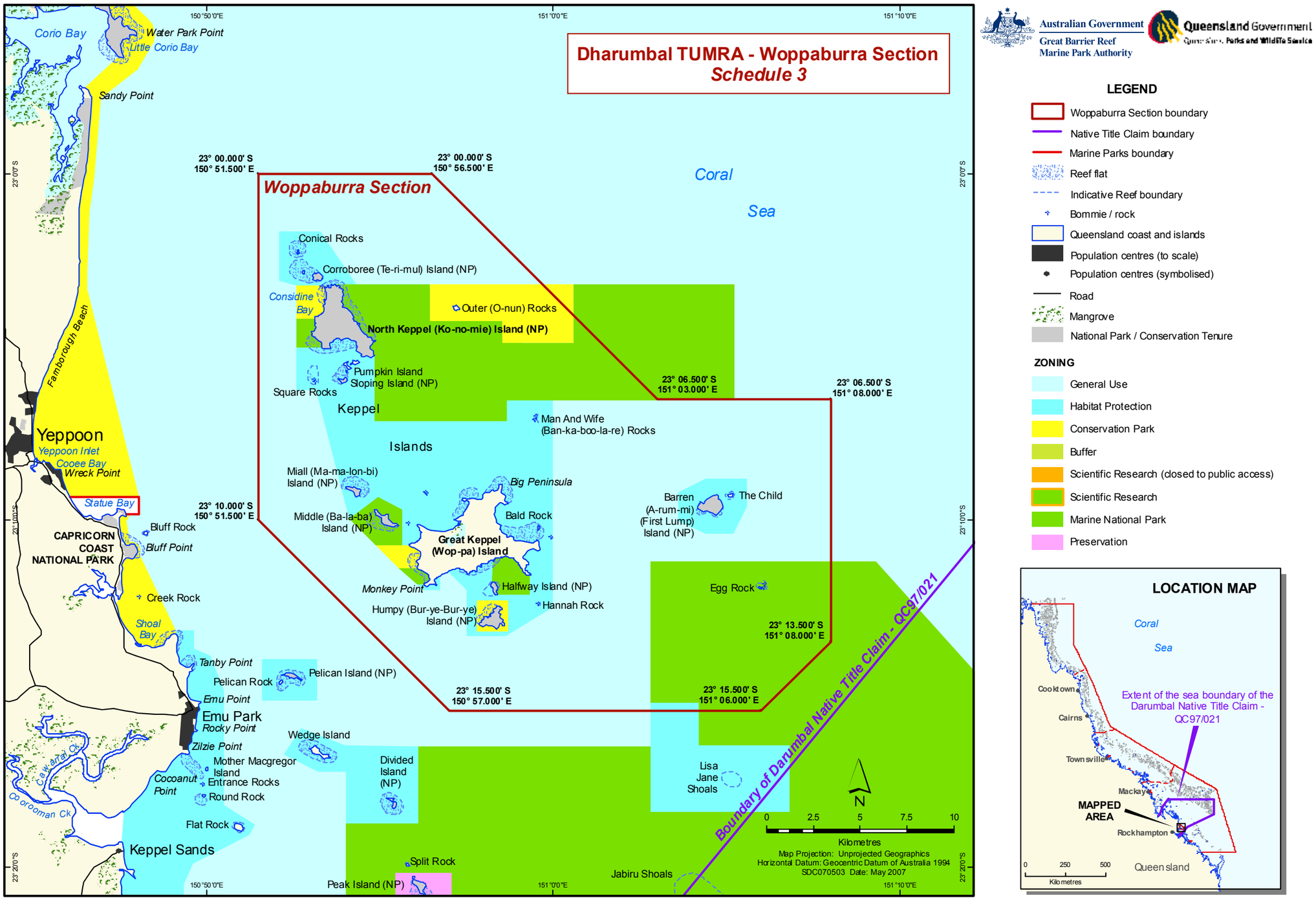
Figure 3.51 DARUMBAL TUMRA WOPPABURRA SECTION



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3.4.3.2 Impacts and Mitigation

Potential direct and indirect marine impacts from the Project on the GBRMP include:

- public appreciation, understanding and enjoyment of the GBRMP;
- marine pests;
- other marine users;
- climate change;
- orderly and proper management of the GBRMP;
- placement of material/infrastructure during construction; and
- impacts to the environment (refer to **Section 3.3.4** - Aquatic Ecology).

(a) Impacts on Public Appreciation understanding and enjoyment of the GBRMP

Putney Beach is currently used by residents and tourists alike. Activities that occur on the beach range from snorkelling, fishing, boating and swimming. With the development of the proposed marina it is anticipated that these activities will be impacted upon during the construction and operational phase.

It is anticipated that the Project will result in the achievement of positive results in terms of public appreciation, understanding and enjoyment of the GBRMP. These goals will be achieved through the realisation of the Research Centre (refer to **Figure 3.52**) which will also double as a marine interpretative centre for visitors and guests to learn more about the environment they are visiting and the OUV of the GBRWHA. The centre and surrounding resort facilities will contain interpretive material that will guide visitors on important animal behaviours and ecological phenomenon to be mindful of. Staff will also undergo regular environmental training including possible eco-certification as identified under the GBRMPA Tourism Program. This will deliver high quality certified teaching and engagement with the public on environmental topics. The marina facility will also contribute as it will allow access to the Island by a larger range of people including those with a disability.

The Research Centre will also provide an opportunity for interpretative material to be displayed regarding historical aspects of the Island, such as the early tourism and pastoral activities. It also presents an opportunity to inform visitors of the much longer historic association with the area by Indigenous peoples.

The range of resort facilities will also allow a range of economic choices regarding holidays allowing more people to experience and appreciate the GBRMP. The facilities in general and the conscious way they have been designed with recognition of the GBRMP will protect and enhance social value. With inherent values of scenic amenity at the forefront of the design will allow enjoyment of the natural setting whilst including all available facilities.

Putney Beach in particular is currently used by residents and tourists alike. Activities that occur on the beach range from snorkelling, fishing, boating and swimming.

The construction of the marina will result in the reduction of available area on the northern part of Putney Beach and Bay which can be used for recreational purposes. However, the construction of the marina will also result in the significant improvement of the eroded state of the southern part of Putney Beach which will greatly improve the public appreciation and enjoyment of this area. In addition, the marina will also significantly improve access to the Island for the public which in turn will increase the public enjoyment of the entire Island.

Figure 3.52 ARTISTS IMPRESSION OF THE GKI RESEARCH AND HISTORIC CENTRE

(b) Impacts of Marine Pest on the GBRMP

The introduction of exotic flora and fauna can threaten the integrity of natural communities, the existence of rare and endangered species, the viability of living resource-based industries, and pose risks to human health. The proposed marina that will be utilised mainly by recreational craft will not serve as a point of entry to Australia and will not service international commercial shipping; therefore, the risk of introductions via ballast water is negligible.

The most probable port from which vessels may pick up and introduce exotic marine species, during the transport of construction material, is Port Curtis (Gladstone Harbour). As identified in **Section 3.3.4.8** Port Curtis has nine recorded introduced marine pest species including bryozoans (*Amathia distans, Bugula neritina, Cryptosula pallasiana,* and *Watersporia subtoraquata*), ascidians (*Botrylloides leachi* and *Styela plicata*), isopod crustaceans (*Paracerceis sculpta*), *hydrozoans* (*Obelia longissima*), and dinoflagellates (*Alexandrium* sp.) (Lewis et al. 2001).

In the National priority pests: Part II Ranking of Australian marine pests (Hayes *et al.* 2005) the invasion potential for the introduction and translocation of marine pests was calculated. It was identified that for ballast water and hull fouling "the frequency of introduction is (perhaps) most closely correlated with the volume of ballast water discharged into recipient ports and the fouled surface area of vessels that enter the port." However it was also noted that the volume of ballast discharged by recreational vessels is negligible.

The database of marine past species was analysed within this report to identify domestic target species associated with ballast water. Of these species *Alexandrium catenella* and *Alexadrium tamerense* are listed as target species (ballast water vectors) however the dinoflagellate found within Port Curtis was not identified to species level. Therefore a precautionary approach is required for all vessels entering the GKI Marina from Port Curtis. The International Maritime Organisation (IMO) recommends an exchange of ballast water three times before entering a new port facility. The practicality of this under operational conditions will have to be explored with maritime operators.

The database of marine past species was analysed within this report to identify domestic target species associated with hull fouling. Of these species identified *Obelia longissima, Botrylloides leachi* and *Styela plicata* are identified as target species (hull fouling vectors) that are found within Port Curtis. It is noted within the report that the extent of fouling upon a vessel is highly dependent on:

- the vessels activity patterns;
- time since it was last cleaned and antifouled; and
- the type of antifoulant used.

Therefore to mitigate the impacts of hull fouling vectors it may be a condition of contract in which the currency of cleaning and antifoulant application is identified and documented before commercial vessels transporting goods and materials enter the marina. Hull cleaning will also be prohibited within the marina.

(c) Impacts on other Marine Users

It is not anticipated that the Project will significantly impact current marine or coastal users of the area. Current uses of the area include:

- recreational fishing including spearfishing;
- commercial fishing including netting, trawling, line fishing and collecting;
- tourism;
- traditional use;
- research; and
- recreational activities including boating, snorkelling, diving and photography.

Some of these activities are currently restricted in their location due to the GBRMP Zoning Plan 2003; others are restricted under Fisheries legislation including spearfishing, netting and collecting; and some are further restricted by GBRMPA Policy or the number of available GBRMP permits or commercial licenses.

(c) (i) *Recreational Fishing and Activities*

The only potential impact anticipated for recreational fishing is an increase in recreational fishing numbers and other activities surrounding the Island as access to the Island is improved through both the marina and upgraded walking tracks to previously remote beaches. Under current GBRMP zoning, fishing cannot occur within Marine National Park Zones and can only occur in a limited capacity in Conservation Park Zones (refer to **Table 3.56**). Spearfishing is also limited in CP-23-4102 and two other areas as identified under Fisheries legislation. It is anticipated that the Project will have a positive impact on other recreational activities through greatly improved access to the island and its surrounds.

(c) (ii) *Commercial Fishing*

Concern was raised during community engagement that the submarine cable may interfere with line and trawl fishing apparatus. The cable will be buried on the seabed with a trench as described in **Table 3.49** Summary of potential impacts on marine ecosystems to avoid this risk.

(c) (iii) *Tourism*

Tourism activities within marine waters will be limited under the conditional permitting agreements as identified by the GBRMPA. Historically, GKI was a popular tourist destination with visitor nights peaking at over 150,000 per annum in 1987/88. A steady decline occurred to two thirds of that by 1990/91. No data is available since that time, however it is safe to assume that since the closure of the Resort it would have dramatically dropped. Current facilities allow for a minimal number of visitors and construction of the new resort will enhance current tourism opportunities.

The Island is one of the few in the GBRMP where people have permanent residences on freehold title. Less than twenty permanent and holiday homes exist on the Island. Though an increase in staff numbers and holiday facilities will occur, no further residential facilities are anticipated in the Park as a result of the Project due to the limited availability of further land. (The GKI Revitalisation Plan does not include any residential development).

(c) (iv) *Traditional Use*

Of note is that the construction of the marina will occur within the Woppaburra Sea Country. Under both the *Native Title Act 1993* and a voluntary TUMRA with GBRMPA, the Woppaburra People are entitled to collect marine resources and maintain all values as identified in **Section 3.4.3.1 (b) (i)**. Further assessment regarding impacts on Indigenous Cultural Heritage is discussed in **Section 3.12**. **Section 3.12** does not identify any middens in close proximity to Putney Beach of the proposed marina location demonstrating the likelihood that marine resources of the Putney Beach system were not so highly utilised as those of Monkey Beach and Long Beach where large middens exist. Therefore the impact of the marina on cultural resource values is anticipated to be low.

In **Table 3.102** it identifies that potential canoe and scar trees were seen in a survey by Creighton (1984) when the construction of the current airstrip occurred and changed the hydrology of the area, this may have caused trees exhibiting these markings to die in the Putney wetland area.

(c) (v) *Research*

GKI has no designated Scientific Research Zone at present, however scientific research is currently undertaken quite extensively by various universities and research bodies within Keppel Bay with high emphasis on the unique environmental conditions for corals. Research has included green zone spawning dispersion of different fish species and ground breaking insights into new species of seaweeds, invertebrates, soft corals and water quality monitoring. The location of a research facility on the Island to support and further these endeavours would provide the local community, CQUniversity, schools and management agencies with the means to investigate the local and regional environment at a reduced cost outlay, with little impact on other current uses.

In the event that the amount of research activity increases in the area, this could result in additional environmental impacts. However, any future research activities will be required to obtain permits through appropriate government agencies prior to commencing.

(d) Impacts from Climate Change

frc environmental reported the impacts of Climate Change to the GBR within the Project area (refer to **Appendix W**). Climate change is associated with an enhanced 'greenhouse effect', i.e. increased levels of greenhouse gases (mostly carbon dioxide) trap more heat and warm the Earth. There is now consensus that emissions from human activities are largely responsible for increased greenhouse gas concentrations and contributing to the associated global warming. Climate change is a global issue that is likely to have a catastrophic effect on the GBR and coastal ecosystems, specific threats include:

- rising sea level;
- increasing sea temperature;
- increasing ocean acidification; and
- more extreme weather events such as flooding and storms (GBRMPA 2009a; Hoegh-Guldberg and Bruno 2010 and references cited within).

(d) (i) *Sea Level Change*

Sea level across the GBR has risen by approximately three millimetres per year since 1991. Rising sea level poses a threat to low-lying islands, coral cays and coastal ecosystems such as mangroves, saltmarsh, seagrass beds and coral reefs (Hoegh-Guldberg and Bruno 2010). Most coral reefs will probably survive sea level rise of three millimetres per year, as the maximum rate of reef growth is approximately twice this rate. However the rate of sea level rise is predicated to increase and coral reefs may not be able to survive at predicted depths, and the shape and existence of some coral reef islands may change. Sea level rise may also extend the landward extent of marine communities such as mangroves and saltmarsh at the expense of freshwater communities (Lovelock and Ellison 2007; GBRMPA 2009a) and references cited within). Rising sea level poses a significant risk to conservationally significant species such as turtles and sea birds through erosion of critical nesting and roosting habitat on may low-lying coral cays and islands, especially when combined with more extreme storms which will cause increased erosion of these habitats (GBRMPA 2005).

(d) (ii) *Sea Temperature*

In the last century, the average sea surface temperature of the GBR has increased by 0.4 degrees celcius. Sea temperature is critical to coral reef growth and survival. When sea temperature thresholds are exceeded, physiological processes breakdown, for example the symbiotic association between coral and clam (animal) and the symbiotic zooxanthellae (which live within the animal tissue) breakdown when water temperatures reach thresholds. This temperature stress, in combination with sunlight, causes mass

bleaching in corals and other reef organisms that have symbiotic algae in their tissues (e.g. clams) (GBRMPA 2009a and references cited within). Increased sea temperature can also cause seagrass burning (i.e. loss of biomass and meadow extent), with flow-on effects to marine turtles, dugongs and juvenile fishes and invertebrates that rely upon seagrass meadows for food and refuge (GBRMPA 2005).

(d) (iii) *Ocean Acidification*

In the last century, the pH of the ocean has decreased by 0.1 units (i.e. become more acidic) and recent studies on the GBR suggest that coral growth is already being affected. Unprecedented declines in calcification of 14.2 percent in Porites *spp*. Have been reported since 1900, and appear to be related to both increasing temperature stress and acidification (GBRMPA 2009a and references cited within). Other calcifying species such as molluscs, crustaceans and other plankton taxa may also be impacted. The interaction with ocean acidification and increased storms may also pose a problem for corals. Increased acidification has the potential to weaken coral skeletons and will consequently be more susceptible to even low intensity storms (Madin and Connolly 2006).

(d) (iv) *Extreme Weather Events*

Cyclones can cause substantial damage to coral reefs, seagrass meadows, mangrove forests and other coastal ecosystems (Gardner *et al.* 2005). Current global patterns of tropical cyclones indicate an increase in severity, and associated destruction of ecological communities (Walker *et al.* 2008). In Australia, there were fewer cyclones during the period 1970 to 1997, however there was an increase in the severity of those cyclones during that period.

Projections indicate an increase in the intensity and associated destructive potential of cyclones, rather than the frequency (Walsh and Ryan 2000; Webster *et al.* 2005; GBRMPA 2009a and references cited within). There will also likely be increased intensity in both high rainfall events (and associated flooding) and droughts (GBRMPA 2009a and references cited within), all of which have potential to impact coral reefs, seagrass meadows, mangrove forests and other coastal ecosystems.

The 1-in-100-year storm tide event is projected to increase by 51 centimetres in Gladstone and 32 centimetres at Cape Clinton, under certain conditions (i.e. a 30 centimetre sea-level rise, 10 percent increase in cyclone intensity and frequency, and a 130 kilometre shift southwards in cyclone tracks) (DERM 2012).

(d) (v) *Projections for the Great Barrier Reef*

The pre-industrial concentration of atmospheric carbon dioxide was approximately 277 ppm and the current concentration is approximately 387 ppm. Carbon dioxide projections have not been developed for the GBR; however the following vulnerabilities have been predicted for different concentrations of atmospheric carbon dioxide

(GBRMPA 2009a and references cited within):

- at 400 ppm, the frequency of mass bleaching is likely to increase, leading to the dominance of relatively thermally tolerant species. Acidification is expected to be affecting the growth of coral species and coralline algae;
- at 450 ppm, severe mass bleaching is predicted to occur annually with 34 percent of reefs on the GBR above the critical threshold for bleaching. Ocean acidification is likely to further affect the growth of most calcifying organisms, with reefs increasingly dominated by non-calcareous macro-algae and other non-calcifying organisms. Islands and coastal habitats are likely to be experiencing rising sea levels;
- at 500 ppm, there is likely to be reduced density and diversity of corals, with flow-on effects to other species reliant on coral reef habitats (especially fish). Marine mammals and seagrasses are likely to be affected by the flow-on effects of increasing sea temperatures; and
- at 550 ppm, critical limits for coral bleaching would be reached for 65 percent of reefs on the GBR. Coral reef habitats are expected to erode rapidly.

Increasing ocean acidification is likely to impact calcareous forms of macroalgae such as Halimeda *sp.* and cause shifts in community composition of plankton. The following management responses have been employed to help mitigate the threats of climate change on the GBR:

- the GBRMPA Zoning Plan ensures all of the habitat types in the GBR are adequately protected. By preserving a portion of each habitat type in a network of protected areas, plants, corals and animals are protected, and connectivity between habitats is maintained;
- the GBRMPA is also working to reduce pressure on the reef from declining water quality through the Reef Water Quality Protection Plan. The aim is to develop on-ground initiatives that help decrease water pollutants from entering the reef. The latest results for marine water quality can be found in the Annual Marine Monitoring Report 2006;
- the Coral Bleaching Response Plan has improved the ability to predict bleaching risk, to detect early warning signs of major coral bleaching events, and involves the community in monitoring the health of the reef, and raises awareness about bleaching; and
- Keppel Bay reefs are being used to trial management responses to climate change. "No Anchoring Areas" are being trialled as a measure to increase the resilience of reefs against the impacts of climate change (and other disturbances such as flooding). Four sites have been selected for the "No Anchoring Areas" trial: Barren Island, Humpy Island and both Big Peninsula and Monkey Beach reef on Great Keppel Island. In addition, the peak Queensland marine aquarium fishing industry body (Pro-Vision) also instigated a voluntary moratorium on the commercial take of

certain anemonefish and anemone species, following the 2006 bleaching event; as a pro-active measure to increase the resilience of reef ecosystems and aid recovery. A monitoring program, linked to BleachWatch, is also being undertaken to provide information on ecosystem condition health at sites regularly visited by commercial aquarium fishermen (GBRMPA 2011).

(d) (vi) *Potential Impacts Associated with the Development and Climate Change*

Seagrass meadow and coral reef communities in the immediate vicinity of the proposed marina and (possibly) the ocean outfall are likely to be impacted by the proposed development. The water quality and mangroves communities of Putney Creek are likely to be positively impacted in the longer term, as may the faunal communities of the marina given the additional physical habitat (hard surfaces) for sessile and mobile epibenthic fauna (e.g. algae, corals, sponges, ascidians and gastropods) and mobile fauna (e.g. fish, sharks and marine turtles seeking refuge and / or food).

The direct impacts (i.e. removal of habitat due to dredging and placement of infrastructure) of the proposed development are likely to have a minor impact on the resilience of flora and fauna compared to other disturbances such as climate change. However the potential cumulative impacts of the proposed development on these species and ecosystem functioning, associated with climate change, are likely to be negligible at the time scale predicted for many climate change impacts (i.e. 30 to 50 years). For example:

- more extreme rainfall and flooding of the Fitzroy River has the potential to completely smother significant areas of seagrass and cause large areas of corals to bleach (due to stress associated with high turbidity and inputs of freshwater and potential contaminants) at regular intervals for the foreseeable future (thereby also impacting recovery), whereas a relatively small area of seagrass will be lost to the marina in the short term, and an even smaller area of seagrass may be smothered by modified sedimentation patterns in the medium term;
- more extreme cyclones have the potential to physically destroy seagrass meadows and coral reefs (particularly where weakened by ocean acidification) and mangroves forests at regular intervals for the foreseeable future (thereby also impacting recovery), whereas a relatively small area of seagrass and even smaller area of coral will be lost to the marina in the short term, and an even smaller area of seagrass may be smothered by modified sedimentation patterns in the medium term (no major negative impact to mangroves predicted in association with the development);
- rising sea temperature and increased ocean acidification have the potential to increase coral bleaching and erode calcium carbonate reef structures, whereas a relatively small area of coral will be lost to the marina in the short term with no major impact associated with the development predicted to occur in the medium to long term; and

- increased ocean acidification is likely to affect calcareous algal and plankton communities with flow-on effects to predators such as herbivorous fishes and planktivorous vertebrates (e.g. manta rays), whereas the development is unlikely to have a major negative impact on algal or plankton communities in the medium to long term (the marina has the potential to change the diversity of plankton communities as discussed in **Appendix E** and will provide more hard substrate for algal growth).

The marina, and to a lesser extent the ocean wet weather outfall (if at all), may have a minor impact on the resilience and recovery of seagrass meadows and coral reefs in the short term. However there are unlikely to be any cumulative impacts associated with the development and climate change in the medium to long term, given the comparative severity and time scale of climate change impacts, particularly where communities are severely impacted by climate change (e.g. seagrass meadows almost completely smothered by successive flooding of the Fitzroy River).

That is, the magnitude of impact associated with the development will be far less than those impacts predicted to occur as a result of climate change; however any chronic impacts will influence the resilience of ecosystems and will need to be assessed through a rigorous and insightful EMP, with the outcomes used to re-assess management of the development on an on-going basis. Potential chronic issues include marina barriers (e.g. breakwall and marina precinct) that will require protection in the long-term future as sea levels rise, and landward migration of mangrove habitats.

Reefs of the Keppel Group have recently demonstrated resilience to bleaching and strong recovery following severe bleaching (Diaz-Pulido *et al.* 2009). Coral reefs of the Region have been repeatedly affected by bleaching with substantial declines in coral coverage observed in 1998, 2002 and 200610; in January 2006, 100 percent of corals in Keppel Bay were bleached with approximately 40 percent mortality by May 2006 (GBRMPA 2007; Weeks *et al.* 2008). Rapid recovery has been documented (e.g. Diaz-Pulido *et al.* 2009; Johnson *et al.* 2010), and some reefs in southern Keppel Bay (Humpy, Middle, Halfway and Pumpkin islands, and the reef surrounding Passage and Outer rocks) have been described as coral 'refuges' due to high diversity and connectivity to sites with lower diversity and coral cover (Jones *et al.* 2011). The development is unlikely to impact on these areas of reef. Reopening Putney Creek has the potential to enhance the landward extent of mangrove and saltmarsh communities (via enhanced tidal flushing) and reduce the corresponding downstream extent of freshwater communities, in association with predicted sea level rise. However, Putney Creek is an ephemeral system that is dry for most of the year and the impact of a relatively slow ecological shift (in terms of ephemeral freshwater faunal communities being able to shift upstream in response to increasing salinities) is likely to be minimal. The ecological benefit of improved tidal flushing, water quality and mangrove ecosystem functioning is considered to be greater than any minor impact to ephemeral freshwater communities.

(e) Impacts on Orderly and Proper Management of the GBRMP

The Project may impact both positively and negatively on the orderly and proper management of GBRMP, the Keppel Group of Islands and the coast.

Positive impacts of the Project on the management of the GBRMP include:

- the construction of the marina could allow designated and safe berthing facilities for natural resource management agencies to undertake works including: surveys, research, liaison, policy development, and oil spill response training;
- the construction of the marina could also potentially reduce the number of vessels anchoring/mooring in areas of sensitive benthic habitat, reducing coral damage;
- the construction of the Project could potentially decrease the impact on the Whitsundays if southern vessel movements divert to the Keppel Group of islands;
- the Island could allow for the storage of equipment and facilities for the care and management of surrounding national park islands; and
- the cooperative management between island staff, researchers, natural resource management staff and Traditional Owners could allow for an increased amount of environmental reporting for both the terrestrial and marine environments.

Negative impacts of the Project on the management of the GBRMP include:

- an increased number of research permit applications due to the construction of the Research Centre;
- an increased number of tourism permit applications due to the increase of tourism trade in the area;
- an increased number of government agency vessel patrols including Queensland Parks and Wildlife Service, Queensland Police and Queensland Boating and Fisheries due to the increased recreational use of the region (refer to **Chapter 4**); and
- an increased amount of agency development assessment including ongoing monitoring and compliance post construction.

Note that the Project is outside the permitted whale watching areas so this tourism activity would only require limited public education and no permit management. The Keppel Group of islands is also outside the designated shipping channel so no interference with commercial shipping vessels and recreational vessels will occur.

The majority of the Keppel Group are National Park Islands with the exception of Great Keppel Island, Pumpkin Island (recently leased to XXXX Gold) and several identified rocks. Impacts as a result of the Project on these National Park Islands are possible but the focus of the Project is to retain visitor focus and therefore all potential impact on Great Keppel Island. If however visitor numbers to these national parks islands does increase possible impacts could include:

- increased requirement for toilet, shower and camping facilities;
- increased requirement for picnic facilities;
- increased requirement for track maintenance; and
- increased requirement for pest management and monitoring.

3.4.3.3 Placement of Marine Infrastructure During Construction

(a) Loss of Marine Habitat

(a) (i) *Unvegetated Soft Sediment*

Construction and dredging of the marina will results in the direct loss of approximately 20.08 hectares of unvegetated soft sediment, and the associated macrobenthos.

(a) (ii) *Seagrass and Macroalgae*

Construction of the marina will result in the direct loss of patches of seagrass within an area of approximately 9.60 hectares. These patches cover less than 10 percent of the of seabed; the cover within the patches ranges from <five percent to 15 percent. A total area of less than 0.96 hectares of seagrass will be lost.

Installation of the submarine cables along the marina breakwall will remove an additional 0.004 hectares of seagrass (calculation is approximate, based on a one metre wide installation corridor through an area of 0.04 hectares that contains seagrass patches covering less than 10 percent). A hydrographic survey was undertaken to inform route alignment, and avoid sensitive ecological communities including seagrass meadows.

These calculations are based on the maximum extent of seagrass distribution recorded during this study (the pre-wet season survey in November 2010), and consequently the calculated loss is likely to over-estimate the loss averaged over time. This is equivalent to less than 0.1 percent of the seagrass recorded in the Central Queensland Region (Mackay to Gladstone), or less than 0.0002 percent of the seagrass in the GBRMP.

(a) (iii) *Seagrass as Habitat for Fauna*

Seagrasses provide shelter and refuge for resident and transient adult and juvenile finfish, crustaceans and cephalopods. Many of these species are of commercial and recreational importance, and others are the preferred foods of these species. While juvenile abundance of many fish and crustacean species is commonly higher in seagrass habitats than over bare sand or mud, there are significant differences in abundance between seagrass beds. Some sites have consistently higher recruitment, while other sites may only periodically or temporarily have higher abundances. This may be due to the structural complexity of the seagrass beds; location of the seagrass beds with respect to currents and the dispersal of larvae; and natural fluctuations (patchiness) in population sizes.

Loss of seagrass has the potential to affect species of conservation significance, as seagrass provides an important food source for several important species, e.g. marine turtles, dugong and syngnathids. Given that the meadows within and adjacent to the proposed marina are sparse and patchy, and typical of the region, the potential loss is unlikely to have a measurable ecological impact beyond the marina footprint.

(a) (iv) *Mangroves*

Mainland connection of the submarine cables along the current proposed alignment may remove up to 0.04 hectares (based on a 2.5 metres wide installation corridor) of mangrove forest. This is less than 9.7 x 10-7 percent of the mangroves in the Central Queensland Coast Bioregion.

There are several gaps in the forest (up to 67 metres wide) and removal of mangroves will not be required where the alignment is modified to extend through one of the gaps.

(a) (v) *Coral Communities*

A small coral colony directly adjacent to the marina footprint may be lost as it is relatively close to the marina breakwall. The closest coral community to the marina is Passage Rocks. The community is located 400 metres from the Island and is approximately 4.5 hectares in size. Passage Rocks is known for having high species richness, despite its relative small size and high turbidity. This community is prone to strong tidal and wind driven currents which connects the area to other sites making it a potential source of coral propagules during mass annual spawning. Passage Rocks also supports populations of sea snake species such as the Olive sea snake Aipysurus laevis and the Turtle-head sea snake Emydocephalus annulatu. This has been identified as an important location for these species as they maintain small home ranges, and if subject to extinction are likely to re-establish by dispersal due to their isolation from other local populations (refer **Appendix W**). A total of 32 species of coral communities have been identified in the GBRMP with many of these species found in the Keppel Islands and Swain Reefs.

(a) (vi) *Rocky Intertidal Communities*

Approximately 0.98 hectares of intertidal rocky shore will be lost as a result of the construction of the marina.

(b) Gain of Habitat

(b) (i) *Artificial Structures as Habitat within the Marina Basin*

Construction of the proposed marina will result in a mosaic of habitats associated with breakwalls, pontoons, piles and other intertidal and subtidal structures, together with moored vessels. The hard surfaces of these structures will provide substrate for many species of algae, hard and soft corals, sponges, ascidians and a variety of other invertebrates. The wastewater outfall will also provide a recruitment surface for a variety of benthic flora and fauna. In turn, this sessile benthic community may provide shelter and food for a variety of fishes and other fauna. The structures associated with the proposed development will also provide a high degree of shade, which is important in attracting many fish species.

The waters of the marina basin are likely to have relatively low ecological value, as the waters are likely to be too deep to support substantial floral communities. The soft sediment community will likely be similarly depauperate to those recorded in the proposed footprint (dominated by polychaete worms). Habitat, and consequently ecological value, could be enhanced with the addition of fish-friendly structures. DERM's Fisheries Guidelines for Fish-Friendly Structures describe a number of artificial structures that may enhance fish habitat. These opportunities will be considered at the detailed design stage.

(b) (ii) *Mangroves of Putney Creek*

Reopening the Putney Creek mouth would change the flood regime with the potential to positively impact water and sediment quality. Improved water and sediment quality would facilitate improved condition of the mangrove and saltmarsh communities in Putney Creek, which are currently in relatively poor condition and provide relatively poor habitat for fauna compared to forests with better flushing and hence water and sediment quality (e.g. Leeke's Creek and Kinka Beach). The fisheries habitat values of the creek are expected to significantly improve.

(b) (iii) *Increased Turbidity and Sediment Deposition*

Dredge plume modelling by Water Technology (2011) shows the likely dredge plume to be generally confined to the marina footprint. The dredge plume may extend beyond the marina basin on occasion for short periods of time.

Outside the marina footprint, communities are unlikely to be substantially affected by any temporary reduction in light intensity, given that these seagrasses currently inhabit inshore coastal waters with variable turbidity and light penetration, and are capable of recovery following flood-related turbidity and sedimentation (as discussed in **Appendix E**). Given the very limited cover of seagrass in the vicinity of the marina, and the short duration of any predicted increase in suspended solid concentration, the ecological consequences of predicted seagrass damage / loss is likely to be negligible, even in a local context.

Outside of the marina, silt may settle over a very small area of seagrass to the south of the marina (up to approximately one hectare). Species with small growth forms (*H. uninervis* and *H. ovalis*) are likely to be more affected than those with a larger growth form (*H. spinulosa* and *S. isoetifolium*). Given the essentially permanent nature of the predicted deposition, *H. uninervis* and *H. ovalis* are unlikely to survive substantial deposition, however these species are likely to rapidly recolonise the area.

The coral communities in the vicinity of the proposed marina are likely to be largely unaffected by increased suspended solid concentration and sediment deposition given the physiological tolerances that are characteristic of corals growing in inshore waters subject to variable turbidity and light penetration. The small coral outcrop directly adjacent to the marina footprint would likely be impacted to a greater extent than the corals of Putney Point, as they are relatively close to the marina breakwall. Any impacts of dredging on these nearby coral communities are likely to be temporary and reversible.

Whilst the proposed dredging may impact the soft sediment invertebrate communities within the dredge plume, any impact will be temporary and reversible. The effect of increased suspended solids concentration and sediment deposition on fish communities of the likely dredge plume dispersal area is likely to be of negligible ecological consequence (unlikely to influence migratory behaviour or health). However any site attached species in the vicinity of the marina footprint are likely to be impacted if their preferred habitat type is also impacted by or lost to the marina.

(b) (iv) *Spills of Hydrocarbons and other Contaminants*

A moderate spill of hydrocarbons or other contaminants at the marina may severely impact the local marine ecosystem. Best-practice vessel management and marina site management will minimise the risk of contaminant spillage. Where the spill is a 'once-off', recovery is likely. The Proponent's environmental manager will conduct daily inspection during construction and weekly audits of the marina during operation. As noted in the EMP spill and recovery equipment will be made available in the marina.

(b) (v) *Nutrient Enrichment*

Nutrient enrichment of marine environments as a result of the dredging plume during construction of the marina is likely to be low, based on sediment sampling undertaken in accordance with the National Assessment Guidelines for Dredging. Modest enhancement of primary production is likely, but it is considered unlikely that any detrimental effects will be manifest. These minor impacts will be of a temporary and reversible nature.

The proposed marina will include a sewage pump out facility which will reduce the amount of nutrient discharge in the local area.

(b) (vi) *Waste and Litter*

Litter and waste associated with construction of the marina has the potential to contribute to the degradation of water quality and may pose a direct hazard to marine fauna. Best practice site management can be expected to result in a negligible amount of litter escaping to the marine environment.

(b) (vii) *Acid Sulfate or Potential Acid Sulfate Sediment*

Levels of acid sulfate and potential acid sulfate soils are likely to be low based on sediment sampling undertaken in accordance with the National Assessment Guidelines for Dredging.

Further detailed mitigation refer to **Table 3.59**.

TABLE 3.59 SUMMARY OF POTENTIAL IMPACTS ON FRESHWATER ECOSYSTEMS

Design	Construction	Operation	Potential Impact	Mitigation Measure	Monitoring	Significance of Impact (Unmitigated)	Significance of Residual (Mitigated Impact)
•	•	•	boat strike.	• 'go slow' zones • Resort Tours Management Plan as part of the EMP • report of any boat strikes or standings to management and relevant agency	• undertaken by agencies	Marine turtles (15) **High**	Marine turtles (10) **Medium**
						Dugongs (15) **High**	Dugongs (10) **Medium**
						Dolphins (5) **Medium**	Dolphins (5) **Medium**
						Whales (5) **Medium**	Whales (5) **Medium**
•		•	damage or depletion associated with resort tours.	• Resort Tours Management Plan as part of the EMP	• an annual (pre-wet) coral monitoring program would provide the opportunity to assess the severity of predicted impacts and inform management of potential issues, including operational EMPs and remediation	Mangroves (4) **Low**	Mangroves (2) **Low**
						Seagrass (4) **Low**	Seagrass (2) **Low**
						Coral reef (10) **Medium**	Coral reef (9) **Medium**
						Mobile biota (6) **Medium**	Mobile biota (4) **Low**
						Listed species (8) **Medium**	Listed species (6) **Medium**

(c) Direct Marine Fauna Impact Mitigation

Current 'best practice' assessment offer significant opportunities to minimise the impacts associated with the operation of the proposed development. Development and adherence to a Flora and Fauna Management Plan as part of the EMP, offers significant opportunity to mitigate impacts associated with boat strike and resort tours, including the following instructions to operators, contractors, employees and guests:

- 'go slow' areas and staying alert for dugong and marine turtles in shallow waters, particularly over seagrass meadows;
- be particularly alert for marine turtles during the mating season (typically September and October), and implement strict controls to ensure turtles are not disturbed during this season;
- be particularly alert for whales and their calves during the migration season (typically June to October), and do not disturb; noting that there is an increasing rate of humpback whales migrating along the east of Australia;
- adhere to any boating restrictions;
- be particularly alert when approaching shorelines, beaches and reef edges;
- proceed slowly and choose carefully where to come ashore or anchor;
- take care when transferring fuel to minimise the risk of spillages; re-fuel onshore or at the marina;
- carry enough chain and line for the depth of anchoring;
- check the area before anchoring for coral or other sensitive ecological communities; anchor in sand or mud away from corals;
- use the appropriate type of anchor for the sediment;
- motor in the direction of the anchor when retrieving anchors;
- all resort tours (water and land based) to be adequately supervised;
- all beginner snorkelers and divers to practise buoyancy control away from coral or other wildlife;
- avoid stepping on coral or other wildlife;
- observe but do not touch coral or other wildlife (noting they may be dangerous);
- if tourists pick up something, living or dead, instructed or guided to return it to the same position;
- tourists instructed to not block, chase, ride or grab wildlife;
- marked trails for guests and visitors will be developed and reef walks will be supervised; if there is no marked trail, use obvious routes and / or follow sand channels;
- do not approach closely or shine lights on turtles leaving the water or moving up the beach;
- do not shine lights directly on the turtle during nest-digging or egg-laying;
- reduce vessel speed to minimise the risk of collision in areas where marine turtles, dugongs, whales and dolphins are sighted; stay at least 100 metres from whales
- adhere to fisheries regulations, e.g. bag limits and no take species;
- report incidents to the Marine Animals Hotline (1300 360 898); and
- marine vessels to use the sewage pump-out facility at the marina.

3.4.4 Listed Threatened Flora and Fauna Species and Ecological Communities

3.4.4.1 Description and Values

As detailed in by CEPLA (2011, **Appendix AB**) and in **Section 3.3.2** and **Section 3.3.3**, ecological surveys have assessed flora and fauna and the potential impacts on these values. Generally, the methodology remains the same for listed species and ecological communities; however, further scrutiny was applied where additional guidelines and condition classes have been published by SEWPaC.

(a) ***Threatened Ecological Communities***

The EPBC listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community was mapped where it met the key diagnostic characteristics and the condition thresholds as defined by the Threatened Species Scientific Committee (2008). **Figure 3.53** maps the spatial extent of Littoral Rainforest and Coastal Vine Thickets. Three areas on the Island, located outside the development footprint, were found to meet SEWPaC's (2008) definition for the threatened ecological community. The biodiversity value of the Littoral Rainforest and Coastal Vine thickets of Eastern Australia lie in their ability to provide habitat for over 70 threatened plants and animals and provide a buffering capacity against coastal erosion and wind damage. Their conservation value is due to their highly fragmented, low integrity meaning the long term survival of the community is under threat if not managed.

Table 3.60 describes the representation of all of the known broad ecological community groups of GKI as they known on a local, regional, state and national level.

Figure 3.53 CEPLA MAP OF EPBC COMMUNITIES

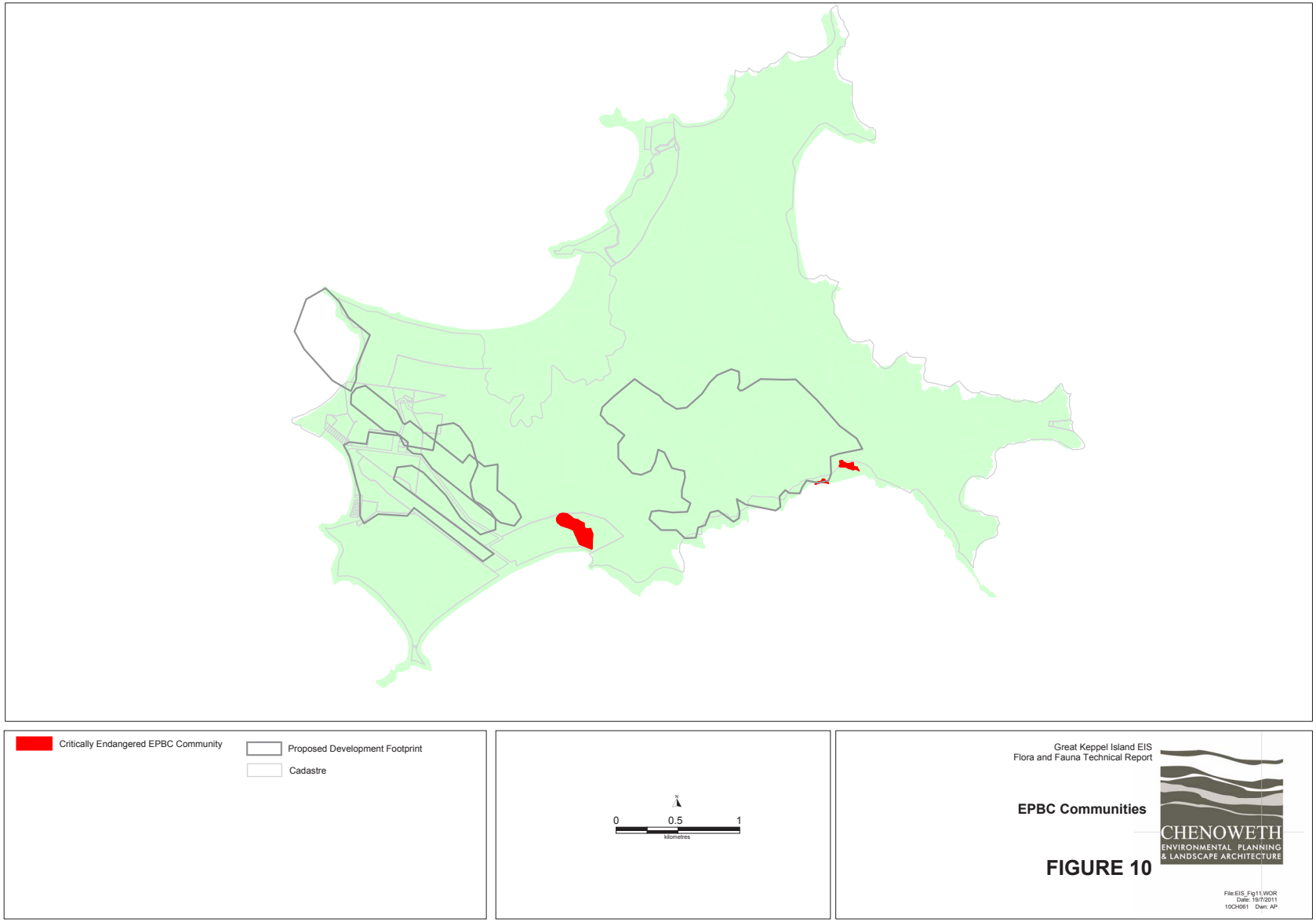


TABLE 3.60 NATIONAL, STATE, REGIONAL AND LOCAL REPRESENTATION OF THE BROAD VEGETATION GROUPS OF GKI (CONTINUED)

Regional Ecosystem	Regional Ecosystem Conservation Status	Broad Vegetation Group (BVG)	BVG Description (DERM, 2011)	Area (ha) GKI (as mapped by CEPLA)	Extent of RE within Protected Estate (in Qld) (DERM 2009)	Remnant representation within State *	Remnant representation in Bioregion (regional) Central Queensland Coast *	Remnant representation within Subregion (local) Byfield*	Representation in GBRMP Islands*	EPBC Communities (National) (Threatened Species Scientific Committee, 2008afi)
8.2.2	Of Concern	3b	Evergreen to semideciduous, notophyll to microphyll vine forest/ thicket on beach ridges and coastal dunes, occasionally *Araucaria cunninghamii microphyll* vine forest on dunes. Pisonia grandis on coral cays. (land zone 2).	3.94	**Medium**	51,483.35; (0.008%)	2,087.38; (0.19%)	34.05; (11.57%)	1,402.08; (0.3%)	3.94ha on GKI compared with total area in QLD 16,135ha and total area Australia of 18,000ha.
8.11.3a	Least Concern	9d	Moist to dry open-forest to woodland dominated by *Eucalyptus portuensis, Corymbia intermedia* or *E. reducta* +/- *Syncarpia glomulifera* +/- *E. cloeziana* on ranges. (Can occur on land zones 2, 3, 8, 11, and 12).	101.49	**Medium**	51,8432.27; (0.02%)	191,028; (0.05%)	64,404.65; (0.16%)	1,434.07; (7.1%)	N/A

TABLE 3.60 NATIONAL, STATE, REGIONAL AND LOCAL REPRESENTATION OF THE BROAD VEGETATION GROUPS OF GKI (CONTINUED)

Regional Ecosystem	Regional Ecosystem Conservation Status	Broad Vegetation Group (BVG)	BVG Description (DERM, 2011)	Area (ha) GKI (as mapped by CEPLA)	Extent of RE within Protected Estate (in Qld) (DERM 2009)	Remnant representation within State *	Remnant representation in Bioregion (regional) Central Queensland Coast *	Remnant representation within Subregion (local) Byfield*	Representation in GBRMP Islands*	EPBC Communities (National) (Threatened Species Scientific Committee, 2008afi)
8.12.14 x2c	Least Concern	9c	Open-forests of *Corymbia clarksoniana* (or C. *intermedia* or C. *novoguinensis*), C. *tessellaris* ± *Eucalyptus tereticornis* predominantly on coastal ranges, Other frequent treespecies include *Eucalyptus drepanophylla, E. pellita, E. brassiana* and *Lophostemon suaveolens.* (Can occur on land zones 2, 3, 5, 8, 11 and 12).	84.69	**High**	294,650.9; (0.03%)	65,829.62; (0.13%)	9,807.08; (0.86%)	11,602.52; (0.73%)	A small portion (0.86ha) of the 8.12.14x2c could be regarded as the EPBC community
8.2.8a	Least Concern	9e	Open-forests, woodlands and open-woodlands dominated by *Corymbia clarksoniana* (or C. *novoguinensis* or C. *intermedia* or C. *polycarpa*) frequently with *Erythrophleum chlorostachys* or *Eucalyptus platyphylla* predominantly on coastal sandplains and alluvia. (land zones 2, 3, 5).	145.33	**High**	1,280,075.21; (0.01%)	66,880.55; (0.22%)	13,169.2; (10.6%)	1,400.33; (10.4%)	N/A

TABLE 3.60 NATIONAL, STATE, REGIONAL AND LOCAL REPRESENTATION OF THE BROAD VEGETATION GROUPS OF GKI (CONTINUED)

Regional Ecosystem	Regional Ecosystem Conservation Status	Broad Vegetation Group (BVG)	BVG Description (DERM, 2011)	Area (ha) GKI (as mapped by CEPLA)	Extent of RE within Protected Estate (in Qld) (DERM 2009)	Remnant representation within State *	Remnant representation in Bioregion (regional) Central Queensland Coast *	Remnant representation within Subregion (local) Byfield*	Representation in GBRMP Islands*	EPBC Communities (National) (Threatened Species Scientific Committee, 2008afi)
8.11.8a	Least Concern	10b	Moist open-forests to woodlands dominated by *Corymbia citriodora*. Can occur on land zones 5, 10, 11, and 12.	423.34	**Low**	1108218.72; (0.04%)	195,137.9; (0.22%)	12603.98; (3.36%)	616.02; (68.72%)	N/A
8.11.8b	Least Concern	13d	Woodlands dominated by *Eucalyptus moluccana* (or E. *microcarpa*) on a range of substrates. (land zone 3, 11, 12).	14.03	**Low**	272,778.47; (0.005%)	4,515.26; (0.31%)	1,255.74; (1.12%)	14.03; (100%)	N/A
8.2.7e	Of Concern	22a	Open-forests and woodlands dominated by *Melaleuca quinquenervia* in seasonally inundated lowland coastal areas and swamps. (land zones 2, 3).	11.7	**High**	80,592.91; (0.01%)	3,152.33; (0.37%)	173.41; (6.75%)	101.77; (11.5%)	N/A
8.2.7b	Of Concern	22b	Open-forests and low openforests dominated by *Melaleuca spp.* (M. *saligna*, M. *leucadendra,* M. *clarksonii* or M. *arcana*) in seasonally inundated swamps. (land zones 2, 3).	14.98	**High**	240,327.13; (0.01%)	5,255.93; (0.29%)	761.81; (2%)	42.43; (35.31%)	N/A

TABLE 3.60 NATIONAL, STATE, REGIONAL AND LOCAL REPRESENTATION OF THE BROAD VEGETATION GROUPS OF GKI (CONTINUED)

Regional Ecosystem	Regional Ecosystem Conservation Status	Broad Vegetation Group (BVG)	BVG Description (DERM, 2011)	Area (ha) GKI (as mapped by CEPLA)	Extent of RE within Protected Estate (in Qld) (DERM 2009)	Remnant representation within State *	Remnant representation in Bioregion (regional) Central Queensland Coast *	Remnant representation within Subregion (local) Byfield*	Representation in GBRMP Islands*	EPBC Communities (National) (Threatened Species Scientific Committee, 2008afi)
8.2.1	Of Concern	28a	Complex of open-shrubland to closed-shrubland, grassland, low woodland and open-forest, on strand and foredunes. Includes pure stands of *Casuarina equisetifolia.* (land zone 2).	117.89	**High**	182,931.56; (0.06%)	771.15; (15.29%)	237.57; (49.6%)	1,465.77; (8%)	N/A
8.11.10	Of Concern	28e	Low open-forest to woodlands dominated by *Lophostemon suaveolens* (or L. *confertus*) or *Syncarpia glomulifera* frequently with *Allocasuarina spp.* on rocky hill slopes. (land zones 3, 5, 11, 12).	258.69	**High**	105,594.34; (0.24%)	51,819.15; (0.5%)	2,023.51; (12.78%)	16,477.6; (1.6%)	N/A

TABLE 3.60 NATIONAL, STATE, REGIONAL AND LOCAL REPRESENTATION OF THE BROAD VEGETATION GROUPS OF GKI (CONTINUED)

Regional Ecosystem	Regional Ecosystem Conservation Status	Broad Vegetation Group (BVG)	BVG Description (DERM, 2011)	Area (ha) GKI (as mapped by CEPLA)	Extent of RE within Protected Estate (in Qld) (DERM 2009)	Remnant representation within State *	Remnant representation in Bioregion (regional) Central Queensland Coast *	Remnant representation within Subregion (local) Byfield*	Representation in GBRMP Islands*	EPBC Communities (National) (Threatened Species Scientific Committee, 2008afi)
8.11.9a	Of Concern	32b	Closed-tussock grasslands and open-woodlands on undulating clay plains and upland areas. Dominant species include Heteropogon triticeus or Themeda arguens or Sarga plumosum or Imperata cylindrica or Mnesithea rottboellioides/ Arundinella setosa. With areas of open-woodland dominated by tree species such as Corymbia papuana / Terminalia spp. / Acacia ditricha/ Piliostigma malabaricum. (land zones 3, 5, 8, 9, 12).	71.32	**High**	54,646.62; (0.13%)	5,224.75; (1.37%)	584.40; (12.2%)	5,308.41; (1.3%)	N/A
8.1.1	Least Concern	35a	Closed-forests and low closed-forests dominated by mangroves. (land zone 1)	26.75	**High**	476,403.03; (0.006%)	41,113.76; (0.07%)	78.71; (34%)	4,011.83; (0.7%)	N/A

TABLE 3.60 NATIONAL, STATE, REGIONAL AND LOCAL REPRESENTATION OF THE BROAD VEGETATION GROUPS OF GKI (CONTINUED)

Regional Ecosystem	Regional Ecosystem Conservation Status	Broad Vegetation Group (BVG)	BVG Description (DERM, 2011)	Area (ha) GKI (as mapped by CEPLA)	Extent of RE within Protected Estate (in Qld) (DERM 2009)	Remnant representation within State *	Remnant representation in Bioregion (regional) Central Queensland Coast *	Remnant representation within Subregion (local) Byfield*	Representation in GBRMP Islands*	EPBC Communities (National) (Threatened Species Scientific Committee, 2008afi)
8.1.2	Least Concern	35b	Bare saltpans ± areas of Halosarcia spp. sparseforbland and/or Xerochloa imberbis or Sporobolus virginicus tussock grassland. (land zone 1).	32.02	**High**	651,233.99; (0.005%)	14,523.21; (0.22%)	38.02; (84.21%)	661.16; (4.8%)	N/A

(ii) Threatened Flora

Threatened species with potential to occur on the Island based on review of existing databases, including the EPBC protected matters search, were targeted during field work. No flora species scheduled under the EPBC Act were identified as known or likely to occur on the Island.

(iii) Threatened Fauna

Searches for threatened species followed EPBC Guidelines (SEWPaC, 2010) where the likelihood of occurrence was regarded as 'Possible' to 'Known'. Database searches identified only two species regarded as threatened fauna under the EPBC Act including the endangered Southern Giant-Petrel (*Macronectes giganteus*) and vulnerable Kermadec Petrel (western) (*Pterodroma neglecta*). The likelihood of occurrence of these species was regarded as 'Unlikely'. No fauna species scheduled under the EPBC Act were identified as known or likely to occur on the Island.

3.4.4.2 Potential Impacts, Risk Assessment and Mitigation

A risk assessment of potential impacts for each phase of the Project has been undertaken. There will be no direct impacts on the EPBC community as a result of the Project, nor any impacts on threatened species. Possible indirect impacts on the Littoral Rainforest and Coastal Vine Thickets community are described in **Table 3.61**.

TABLE 3.61 POTENTIAL INDIRECT IMPACTS ON LITTORAL RAINFOREST AND COASTAL VINE THICKETS

Impact	Prediction of impact	Mitigation Measures	Significance of Impact (unmitigated) (aggregate score)	Significance of Impact (mitigated) (aggregate score)
Changes to hydrological regimes, particularly impacting wetland associations.	Potential to permanently affect some vegetation immediately surrounding drainage lines. Adequate management of drainage from development to the north of Clam Bay and Long Beach will ensure there are no impacts on the community.	• Refer **Table 3.34 Section 3.3.3.2 (c)** Mitigation measure e).	**(10) Medium**	**(4) Low**
Uncontrolled public access to remnant vegetation.	Uncontrolled access vegetation communities have the potential to introduce weeds and cause erosion. The impact during operation will be limited to small areas and likely reversible. Adequate pedestrian control to Clam Bay will mean there will be no or managed access to the community.	• Refer **Table 3.34 Section 3.3.3.2 (c)** Mitigation measure h).	**(8) Medium**	**(4) Low**
Invasion of transformer weeds.	Invasion of introduced plants may lead to structural changes or smothering (Threatened Species Scientific Committee, 2008). Adequate weed control should prevent transformer weeds from invading the community.	• Refer **Table 3.34 Section 3.3.3.2 (c)** Mitigation measures d) and g).	**(12) High**	**(3) Low**
Inappropriate burning regimes.	Inappropriate burning regimes have the potential to affect the integrity of vegetation communities and lead to opening of the forest canopy and increase potential for weed invasion and species change (DEWHA, 2009). Adequate bushfire management will mean there is a low chance of this having any significant impact.	• Refer **Table 3.34 Section 3.3.3.2 (c)** Mitigation measure i).	**(12) High**	**(4) Low**

TABLE 3.61 POTENTIAL INDIRECT IMPACTS ON LITTORAL RAINFOREST AND COASTAL VINE THICKETS (CONTINUED)

Impact	Prediction of impact	Mitigation Measures	Significance of Impact (unmitigated) (aggregate score)	Significance of Impact (mitigated) (aggregate score)
Grazing/browsing by feral animals (introduction and/or lack of management of existing pest animals, e.g., goats).	May lead to a change in species composition due to vegetation removal, soil compaction and acceleration of weed invasion. Adequate feral animal control (goats) in conjunction with adequate weed management means that the threat to this community is minimised.	• Refer **Table 3.34 Section 3.3.3.2 (c)** Mitigation measures f) and g).	**(9) Medium**	**(3) Low**

Section 3.3.2.2 (C) includes mitigation measures that will prevent potential impacts of the GKI Revitalisation Plan on the threatened Littoral Rainforest and Coastal Vine Thickets community.

3.4.5 Listed Migratory and Marine Species

3.4.5.1 Description and Values

Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. Many migratory species listed under the international conventions and agreements of Australia are protected under the EPBC Act.

International conventions and agreements that also impact migratory species include:

(a) Japan-Australia Migratory Bird Agreement (JAMBA):

JAMBA is an agreement between the government of Australia and the government of Japan for the protection of migratory birds in danger of extinction, and the management and protection of their supporting habitats (SEWPaC 2012a).

JAMBA recognises that many species of birds migrate between Japan and Australia seasonally and these species are in danger of extinction (SEWPaC 2012a). Measures taken by the Governments to protect them include prohibiting the take of migratory birds and their eggs, exceptions include scientific research and hunting for traditional purposes (SEWPaC 2012a). The agreement also encourages the exchange of data and publications regarding research on migratory birds (SEWPaC 2012a).

(b) China-Australia Migratory Bird Agreement (CAMBA):

CAMBA is an agreement between the government of Australia and the government of the People's Republic of China for the protection of migratory birds and their environment (SEWPaC 2012b).

CAMBA recognises many species of birds are known to migrate between Australia and the People's Republic of China. (SEWPaC 2012). Birds play an important role in the natural environment, are important natural resources and are of great value to the scientific, economic and cultural community (SEWPaC 2012b). Measures taken by each government to protect migratory bird species include prohibiting the take of migratory birds and their eggs, exceptions include scientific research and hunting for traditional purposes (SEWPaC 2012b). The agreement also encourages the exchange of data and publications regarding research on migratory birds (SEWPaC 2012b).

(c) Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA):

ROKAMBA is an agreement between the government of Australia and the government of the Republic of Korea on the protection of migratory birds (SEWPaC 2012c).

ROKAMBA recognises the many species of birds migrate between Australia and the Republic of Korea and there is international concern for the protection of migratory birds (SEWPaC 2012c). The agreement acknowledges the importance birds play in the natural environment (SEWPaC 2012c). Both governments have taken measures to manage and protect migratory birds, birds in danger of extinction and also for the effective management and protection of their environments (SEWPaC 2012c). Such measures include prohibiting the taking of migratory birds and their eggs, exceptions include scientific research and hunting for traditional purposes (SEWPaC 2012c). The agreement also encourages the exchange of data and publications regarding research on migratory birds (SEWPaC 2012c).

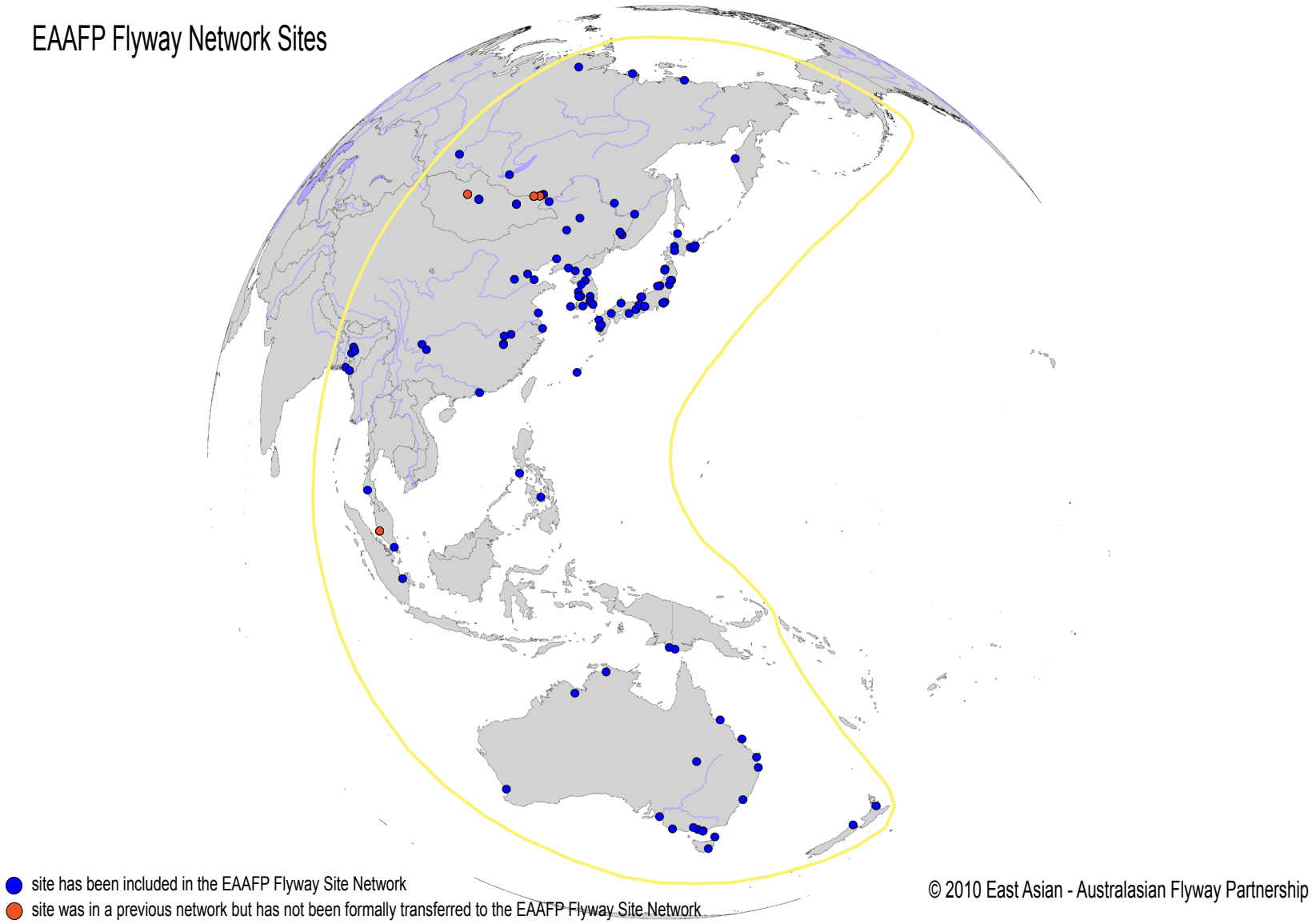
(d) Bonn Convention

The Convention on the Conservation of Migratory Species of Wild Animals (known as the CMS or Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species (CMS, 2012).

The Bonn Convention is an intergovernmental treaty under the United Nations Environment Program (UNEP) which was concerned with the conservation of wildlife and habitats on a global scale (CMS, 2012). This is the only global convention specialising in the conservation of migratory species, migration routes and their habitats (CMS, 2012). Migratory species threatened with extinction are listed on Appendix I of the Convention and migratory species that need or would significantly benefit from international co-operation are listed in Appendix II of the Convention (CMS, 2012).

All of these agreements assist in protecting the habitats that make up the East Asian–Australasian Flyway (refer **Figure 3.54**), which is one of eight flyways in the world. The East Asian–Australasian Shorebird Reserve Network is an international chain of wetlands recognised for their importance to shorebirds. The network ensures there are safe and convenient stopover points for shorebirds to rest and feed along their migration pathways (DERM, 2010).

Figure 3.54 EAST AUSTRALIAN FLYWAY



An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

The following sub-sections have regard to the following EPBC listed species groupings and identifies potential impacts and mitigation measures for:

- migratory terrestrial, wetland or marine bird species; and
- marine species.

(e) Terrestrial, Wetland or Marine birds

Fourteen species are regarded as migratory terrestrial, wetland or marine birds for the purpose of the EPBC Act (refer **Table 3.63**). None of the nationally significant species have any particular social, economic significance; nor do they have any special conservation or biodiversity value. While Aboriginal groups did have strong links with the native flora and fauna and some of these links may still be important today, no specific species of cultural significance have been identified at this time. Consultation with the Traditional Owners will be important during the lifetime of the Project.

Assessment of the habitats on the Island supporting these and other fauna species indicates that none can be considered 'unique' as all types of habitat are adequately represented elsewhere, either on the mainland or on other continental islands of the GBR (refer **Table 3.16** of **Section 3.3.2.1 (B) (i)**).

Application of the definition of 'important habitat' (DEWHA, 2009) indicates that are no 'important habitats' for migratory birds on the Island. Despite the absence of 'important habitat', the vegetation associations of the Island nonetheless provide potential nesting, resting, breeding and/or foraging opportunities for listed migratory terrestrial, wetland or marine bird species. The habitat preferences of species that are known or are likely to occur on the Island are detailed in **Appendix AB**.

(f) Marine Species

Twenty one marine species listed as 'migratory' are considered moderately or highly likely to use habitats in the Project area (refer **Table 3.63**).

(g) Marine Reptiles

Five of Australia's six species of marine turtles occur in the study area (**Table 3.62**). This includes resident populations of flatback (*Natator depressus*) and green (Chelonia mydas) turtles, and occasional occurrence of loggerhead (*Caretta caretta*) hawksbill (*Eretmochelys imbricata*) and olive Ridley (*Lepidochelys olivacea*) turtles. Marine turtles are protected under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Queensland Nature Conservation (Wildlife) Regulation 2006* (NCWR).

The number of marine turtle strandings (sick, injured or dead individuals) recorded in the Region (along the Queensland coast in latitudinal block 23) from 1999 to 2004 is presented in **Table 3.62**. Each year, more green turtle strandings were reported than for any other species (QPWS 1999; 2000; 2001; 2003; 2004).

TABLE 3.62 NUMBER OF MARINE TURTLE STRANDINGS IN THE REGION FROM 1999 TO 2004

Species	Common Name	2004	2003	2002	2001	2000	1999	1998
Caretta caretta	loggerhead turtle	0	4	4	2	2	1	2
Chelonia mydas	green turtle	43	57	34	20	25	27	14
Eretmochelys imbricata	hawksbill turtle	7	3	2	0	7	1	2
Natator depressus	flatback turtle	2	2	2	1	0	1	0
Lepidochelys olivacea	olive ridley turtle	1	0	0	0	0	0	0
Unidentified turtle	–	0	5	4	1	2	1	0

(g) (i) *Flatback Turtle*

The flatback turtle (*Natator depressus*) is listed under the 'vulnerable', 'migratory' and 'marine' schedule of the EPBC Act and under the 'vulnerable' schedule of the NCWR. Internationally, it is listed under the Convention on Migratory Species (CMS) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and as 'data deficient' on the International Union for Conservation of Nature (IUCN) Red List.

The flatback turtle tends to forage in shallow continental shelf waters with soft substrates, feeding on a variety of soft-bodied animals, including soft corals, sea pens, sea cucumbers and jellyfish (Limpus 2007). Catch records from trawlers (as by-catch) indicate that the flatback turtle also feeds in turbid, shallow (depth of 10 metres to 40 metres) inshore waters (Robins 1995).

Unlike other turtles, the flatback lacks an oceanic phase and remains in the surface waters of the continental shelf throughout its life. Little is known about their foraging habits and habitat, although juvenile and adult turtles seem to occupy similar habitats and both forage on soft-bodied (mostly benthic) organisms (Limpus *et al.* 1994).

In eastern Queensland, flatback turtles nest between Bundaberg in the south to the Torres Strait in the north. The main nesting sites in the southern GBR are:

- Curtis Island;
- Peak Island;
- Facing Island;
- Hummock Hill Island; and
- Wild Duck Islands (Limpus 1971; Limpus *et al.* 1983).

Peak Island beaches are one of the most important nesting areas on Australia's east coast. The beaches of Curtis, Facing and Hummock Hill Islands are key nesting areas for the flatback turtle and are identified nationally as medium density rookeries (Limpus *et al*. 2006). There is minor nesting at Mon Repos and in the Mackay Region, and scattered aperiodic nesting along the mainland and on inshore islands between Townsville and the Torres Strait (Limpus *et al.* 1994).

Nesting activity is greatest between late November and early December ceasing sometime in late January. Hatchlings typically emerge from nests from early December to late March, with peak hatching in February (Limpus 2007).

The flatback turtle is likely to be relatively common in the study area. It is likely to use the area for foraging, given the dominant soft-sediment habitat, and also for nesting (or traversing during the nesting season) as it is close to several rookeries (Limpus 2008b).

(g) (ii) *Green Turtle*

The green turtle (*Chelonia mydas*) is listed under the 'vulnerable', 'marine' and 'migratory' schedules of the EPBC Act and under the 'vulnerable' schedule of the NCWR. Internationally, it is listed under the CMS and the CITES and as 'endangered' on the IUCN Red List.

The green turtle feeds extensively on seagrass, particularly *Halophila ovalis*, *Halophila spinulosa* and *Halodule uninervis*, and is commonly found in association with seagrass meadows. It also feeds on algae and propagules of the grey mangrove (Avicennia marina) and algae (GBRMPA 2007). The long life-span of green turtles (35 to 50 years to sexual maturity) and fidelity to feeding grounds means that green turtles rely on the seagrass meadows (Couper 1998), and consequently their survival can be threatened if seagrass meadows are diminished.

Regionally, the southern GBR provides key nesting and inter-nesting areas for the green turtle. Including:

- Northwest Island;
- Wreck Island;
- Hoskyn Island;
- Tryon Island;
- Heron Island;
- Lady Musgrave Island;
- Masthead Island;
- Erskine Island;
- Fairfax Island;
- North Reef Island; and
- Wilson Island (Limpus *et al.* 2006).

Green turtles mate in October, with eggs laid between October and March. Green and loggerhead turtles migrate to breed, but tend to maintain small home range feeding areas (within approximately 10 to 15 kilometres of coastline). Turtle movements within foraging grounds are likely to be related to food availability and environmental factors such as the tide cycle (as they can only feed in intertidal areas when the water depth is between 0.5 and one metre) (Bell 2003).

The green turtle is likely to be relatively common in the study area. It may use the area for feeding (although given the patchy and spare nature of the meadows this species is unlikely to reply on those meadows for feeding) and also nesting (or traversing during the nesting season) as it is close to several rookeries.

(g) (iii) *Loggerhead Turtle*

The loggerhead turtle (*Caretta caretta*) is listed under the 'endangered', 'marine' and 'migratory' schedules of the EPBC Act and under the 'endangered' schedule of the NCWR. Internationally, it is listed under the CMS and the CITES and as 'endangered' on the IUCN Red List.

The loggerhead turtle has a diverse diet including bivalves, gastropods, molluscs, crabs and jellyfish from a wide range of intertidal and subtidal habitats, including coral and rocky reefs, seagrass meadows, and unvegetated sand or mud areas (Limpus 2008b). As is the case with the green turtle, the loggerhead turtle tends to maintain small home ranges within their foraging grounds (within approximately 10 to 15 kilometres of coastline). Loggerhead turtles can be found in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia (Limpus *et al.* 1992; Prince 1994; Limpus 1995).

The east coast population of loggerhead turtles has been sharply declined, with an estimated loss of 50 to 80 percent of its annual nesting population from the mid-1970s to 1990. Furthermore, continued loss of a few hundred individuals annually may threaten the survival of the species on the east coast (Limpus and Reimer 1994).

Three major nesting areas in Queensland include:

- the Capricorn Bunker Island Groups, especially Wreck, Tryon and Erskine Islands;
- Mon Repos and adjacent beaches of the Woongarra Coast and Wreck Rock Beach; and
- the islands of the Swain Reefs, especially Pryce Island and Frigate, Bylund, Thomas and Bacchi cays.

While nesting is concentrated in Southern Queensland on the east coast, and from Shark Bay to the North West Cape on the west coast, foraging areas are more widely distributed (Limpus 2008a).

The loggerhead turtle may feed in, or traverse, the study area.

(g) (iv) *Hawksbill Turtle*

The hawksbill (*Eretmochelys imbricata*) turtle is listed under the 'vulnerable', 'migratory' and 'marine' schedules of the EPBC Act and under the 'vulnerable' schedule of the NCWR. Internationally, it is listed under the CMS and the CITES and as 'critically endangered' by the IUCN Red List.

Hawksbills breed in the northern GBR and the Torres Strait and are heavily reliant on reef and rocky habitats, where it forages mainly on sponges but also seagrass, algae, squid, gastropods and jellyfish.

The study area is highly unlikely to support nesting populations although some hawksbill turtles may feed over the reef and rocky habitat of the area.

(g) (v) *Olive Ridley Turtle*

The olive Ridley (*Lepidochelys olivacea*) is listed under the 'endangered', 'migratory' and 'marine' schedules of the EPBC Act and under the 'endangered' schedule of the NCWR. Internationally, it is listed under the CMS and the CITES and as 'vulnerable' under the IUCN Red List.

The olive Ridley appears to forage in benthic and pelagic habitats (Musick and Limpus 1997), for mostly gastropods and bivalves (Conway 1994). It is most commonly found in waters with a depth of 11 to 40 metres (Robins 1995) but has also been reported in water more than 100 metres deep (Hughes 1974). No large rookeries of olive Ridley turtle have been recorded in Australia (DERM 2011a).

The olive Ridley turtle is highly unlikely to nest in the study area but may feed in, or traverse, the study area.

(g) (vi) *Seasnakes*

Seasnakes are listed under the 'marine' schedule of the EPBC Act, and are consequently protected within Commonwealth Marine waters such as the GBRMP. Seasnakes inhabit a range of habitats, including sandy bottom habitats, reef habitats and pelagic habitats (*Pelamis sp.* only) (Stokes 2004). Seasnakes inhabit the study area; the olive (*Aipysurus laevis*) and stokes (*Astrotia stokesii*) seasnake are relatively abundant at Passage Rocks and Middle Island (Lynch 2000; GBRMPA 2007).

3.4.5.2 Potential Impacts, Risk Assessment and Mitigation Measures

(a) Terrestrial, Wetland or Marine birds

Potential impacts of loss of habitat are discussed in **Section 3.3.3.2 (B)(i)**. Other potential direct and indirect impacts on listed migratory terrestrial, wetland and marine birds are tabulated in **Table 3.64**.

(b) Marine Species

Potential direct and indirect impacts on listed marine species including dugongs and turtles are tabulated in **Table 3.65**.

(b) (i) *Noise Impacts*

The presence of the marina will lead to an increase in the use of recreational vessels around GKI, inevitably resulting in more frequent interactions between boating traffic and megafauna. Megafauna may respond to boating disturbance by altering their behaviour (e.g. changing swimming direction or reducing time spent resting (Hodgson and Marsh 2007). Long-term effects of boat traffic include displacement of fauna to deeper waters, where less food resources may be located. Importantly, the waters off GKI are not considered to support significant feeding grounds (seagrass meadows) for dugong or green turtles, and substantial coral-dominated habitat (feeding grounds for loggerhead and hawksbill turtles) are relatively distant from the proposed marina. The risk of collision between boats and marine fauna is reduced when vessels operate at slow and consistent speeds (Hazel *et al.* 2007; Hodgson and Marsh 2007). As such, the enforcement of speed limits around the marina area will be key to reducing the disturbance of marine megafauna.

(b) (ii) *Boat Strike*

During 1999 and 2000, boat strike was the primary cause of human-associated mortality of marine turtles in Queensland, accounting for up to 60 percent of deaths. Green turtles are especially at risk because of their habit of basking at the surface of the water (GBRMPA 2005). During 2001 and 2002, boat strike was also a major concern for dugongs (QPWS 2004b). Dugongs may be seriously injured when struck by high-sped boat hulls, including fractures and internal injuries. Propeller cuts can lacerate organs killing the animal outright, or lead to serious infection or disability that may lead to death (GBRMPA 2005). More recent data suggests that 'go slow' zones are reducing the incident of boat strike in areas with relatively high boat traffic and relatively large marine turtle and dugong populations, i.e. the Great Sandy Straits and Moreton Bay (QPWS 2004b; 2007). An increased number of high-speed boats in the Project area would increase the risk of boat strike in areas frequented by turtles and dugongs. In the Project area, dugongs and marine turtles are relatively uncommon and seagrass meadows are relatively sparse and patchy, compared to regions such as the Great Sandy Straits and Moreton Bay; hence boat strike is considered manageable where 'go slow' zones are introduced over shallow water likely to have increased high-speed boat traffic. The risk of boat strike associated with wildlife tours is considered manageable where a Resort Tours Management Plan as part of the EMP is developed and adhered to, with all activities undertaken in accordance with current best practice including GBRMPA's Best Environmental Practices for dugong watching (GBRMPA 2011a).

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS

Species	**Status**	**Habitat Use on GKI** (Recorded and Likely)	**Prediction of impact**	**Mitigation Measures**	**Significance of Impact** (unmitigated) (aggregate score)*	**Significance of Impact** (Mitigated (aggregate score)*
Esacus neglectus Beach Stone Curlew	Mar (EPBC) V (NCA)	Species uses intertidal mudflats, sandflats, river mouths. Recorded in Leeke's Estuary (incorporating regional ecosystems 8.1.1, 8.1.2 and 8.2.1) and Putney Beach.	This species is sensitive to human disturbance and loss of habitat. The Project will not directly impact Leeke's Estuary; however indirect and ongoing impacts to Putney Beach are anticipated from the adjacent Marine Services Precinct and airstrip. Adequate sediment control and maintenance of hydrological regimes will mean the indirect impact on Leeke's Estuary will be minor or negligible. Indirect and ongoing impacts from increased human recreation in and around the wetland areas may cause disturbance to roosting and breeding. Indirect impacts from human disturbance can be mitigated with adequate pedestrian control (e.g., well defined track network) and a no pet policy will not introduce any additional impacts. Whilst the impact on Beach Stone Curlew is not entirely predictable, it is likely to be minor given the marina occupies two percent of the total coastline of the Island and the Putney Creek marine vegetation community occupies only 2.8 percent of this total habitat type on the Island. Although there may be some impact on the species, within the context of available habitat on the Island and throughout its range it is considered to be minor.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures b), e) and h).	**(8) Medium**	**(2) Low**

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS (CONTINUED)

Species	Status	**Habitat Use on GKI** (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (unmitigated) (aggregate score)*	Significance of Impact (Mitigated (aggregate score)*
Meropsornatus Rainbow Bee-eater	M, Mar (EPBC)	This species is abundant and is likely to use a wide range of habitats on the Island including disturbed environments.	As the rainbow bee eaters are migratory and use a wide variety of habitats on the Island, direct impacts of habitat loss are likely to be negligible. SEWPaC (2011) identifies an indirect threat to rainbow bee-eaters is the Cane Toad as this species feeds on the eggs and usurp nesting burrows. No cane toads were observed on the Island during the EIS. Strict and appropriate hygiene protocols applied to vehicles/materials entering the Island should prevent the introduction of pests and therefore the impact would be nullified. Diligent inspections will be necessary	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measure i).	**(15) High**	**(3) Low** Short term impact. Adequate practices during construction will ensure there is little to no impacts associated with trenching, tree clearing or earthworks.
Burhinusgrallarius Bush Stone Curlew	M (EPBC)	Resident on the Island as recorded during both wet and dry season surveys in high numbers. Wide range of habitat throughout the Island including in areas of existing development.	Direct impacts on breeding of this species may be caused by removal of ground habitat complexity (i.e., fallen logs/ branches), which are a key requirement for successful breeding (DEH, 2005). Indirect impacts from habitat fragmentation and development are likely to be low for this species with adequate management of retained natural environments, as it is a large bird and capable of moving through disturbed areas.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures a), d) and h).	**(6) Medium**	**(2) Low**

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS (CONTINUED)

Species	Status	**Habitat Use on GKI** (Recorded and Likely)	Prediction of impact	Mitigation Measures	**Significance of Impact** (unmitigated) (aggregate score)*	**Significance of Impact** (Mitigated (aggregate score)*
Haliaeestusleucogaster White-bellied Sea Eagle	M, Mar (EPBC)	Forage over the sea and require breeding territories close to water and mainly tall open forest or woodland (DEWHA, 2010). Population of the Island likely to be low due to high mobility and use of large areas.	The main direct threats to White-bellied sea eagles are clearing of habitat and development especially near nesting habitats. Eagles may desert nests and young if exposed to human activity near the nest (SEWPaC, 2011). No nests were recorded on the Island within the study area. Therefore impacts on this species are likely to be minimal.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures h) and k).	**(12) High**	**(3) Low**
Monarcha melanopis Black-faced Monarch	M, Mar (EPBC)	Resident in the north of its range, migrant arriving in September and returning north in March (Birds Australia, 2010) Uses rainforest, coastal scrub, Eucalypt woodlands and wet gullies (birds Australia, 2010).	The clearing of vegetation will result in a minor direct impact of habitat availability for this species within its range. With adequate management of retained natural environments no significant impact is expected.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures a), d) and h).	**(6) Medium**	**(2) Low**

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS (CONTINUED)

Species	Status	**Habitat Use on GKI** (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (unmitigated) (aggregate score)*	Significance of Impact (Mitigated (aggregate score)*
Monarchatrivirgatus Spectacled Monarch	M, Mar (EPBC)	Resident to approximately Rockhampton then migratory further south (Birds Australia, 2010). May be migratory on the Island. Prefers thick understorey vegetation, wet gullies and mangroves (Birds Australia, 2010).	The clearing of vegetation will result in a minor direct impact of habitat availability for this species within its range. With adequate management of retained natural environments no significant impact is expected.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures a), d) and h).	**(6) Medium**	**(2) Low**
Myiagra inquieta Leaden Flycatcher	M (EPBC)	Likely migratory, abundant in September South-eastern populations move north during winter (Birds Australia, 2010), and common on the Island in dry season months. Uses habitats across much of the Island.	The clearing of vegetation will result in a minor direct impact of habitat availability for this species within its range. With adequate management of retained natural environments no significant impact is expected.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures a), d) and h).	**(6) Medium**	**(2) Low**

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS (CONTINUED)

Species	Status	**Habitat Use on GKI** (Recorded and Likely)	Prediction of impact	Mitigation Measures	**Significance of Impact** (unmitigated) (aggregate score)*	**Significance of Impact** (Mitigated (aggregate score)*
Myiagra rubecula Restless Flycatcher	M (EPBC)	Migrate north in winter to Northern Queensland and Papua New Guinea. Breed in the south in spring (Birds Australia, 2010).	The clearing of vegetation will result in a minor direct impact of habitat availability for this species within its range. With adequate management of retained natural environments no significant impact is expected.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures a), d) and h).	**(6) Medium**	**(2) Low**
Vanellus miles Masked Lapwing	M (EPBC)	Sighted in a range of habitats from beach front, eucalypt associations to disturbed environments.	The clearing of vegetation will result in a minor direct impact of habitat availability for this species within its range. With adequate management of retained natural environments no significant impact is expected.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures a), d), h) and k).	**(8) Medium**	**(2) Low**
Numenius Madagascarie-nsis Eastern Curlew	M, Mar (EPBC) NT (NCA)	The species does not breed in Australia. The Leeke's Estuary is the only part of the Island where this species was recorded in this study.	Occasional human disturbance can disrupt feeding and roosting. Eastern Curlews may take off if approached within 100 metres 250 metres (SEWPaC, 2011), therefore human disturbance may impact this birds' migratory fitness. Adequate pedestrian control (e.g., well defined track network) and a "no pet policy" will also reduce potential impacts. Adequate sediment control and maintenance of hydrological regimes will mean the indirect impact on Leeke's Estuary will be minor or negligible.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures e) and h).	**(7) Medium**	**(2) Low**

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS (CONTINUED)

Species	Status	**Habitat Use on GKI** (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (unmitigated) (aggregate score)*	Significance of Impact (Mitigated (aggregate score)*
Numenius phaeopus Whimbrel	M, Mar (EPBC)	The species does not breed in Australia. Mangroves are important as roosting habitat and Leeke's Estuary the only part of the Island where this species was recorded in this study.	Leeke's Estuary is not to be directly impacted by the development. Indirect impacts may occur from increase human activity within or around the wetland. Adequate pedestrian control (e.g., well defined track network) and a "no pet policy" will also reduce potential impacts. Adequate sediment control and maintenance of hydrological regimes will mean the indirect impact on Leeke's Estuary will be minor or negligible.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures e) and h).	**(7) Medium**	**(2) Low**
Falco cenchroides Nankeen Kestrel	M, Mar (EPBC)	Recorded from Leeke's Beach, Putney Beach and Resort Precinct (Black and Houston, 2011). Nankeen Kestrel's have a broad habitat requirement (Birds Australia, 2011).	The clearing of vegetation will result in a minor direct impact of habitat availability for this species within its range. With adequate management of retained natural environments no significant impact is expected. Leeke's Estuary is not to be directly impacted by the development. Indirect impacts may occur from increase human activity within or around the wetland. Adequate pedestrian control (e.g., well defined track network) and a no pet policy will also reduce impacts.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures d), e) and h).	**(6) Medium**	**(2) Low**

TABLE 3.63 POTENTIAL IMPACTS ON LISTED MIGRATORY TERRESTRIAL, WETLAND AND MARINE BIRDS (CONTINUED)

Species	Status	**Habitat Use on GKI** (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (unmitigated) (aggregate score)*	Significance of Impact (Mitigated (aggregate score)*
Thalasseus bengalensis Lesser Crested Tern	M, Mar (EPBC)	This species has been recorded from Leeke's Estuary (Black and Houston, 2011) and generally uses a variety of habitat types (DERM, 2011).	Leeke's Estuary is not to be directly impacted by the development. Indirect impacts may occur from increase human activity within or around the wetland. Adequate pedestrian control (e.g., well defined track network) and a "no pet policy" will also reduce potential impacts. Adequate sediment control and maintenance of hydrological regimes will mean the indirect impact on Leeke's Estuary will be minor or negligible.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures e) and h).	**(7) Medium**	**(2) Low**
Tringa brevipes Grey-tailed Tattler	M, Mar (EPBC)	This species has been recorded from Leeke's Estuary (Black and Houston, 2010) on the Island and also in high numbers at Shoalwater Bay and Broad Sound within the CQC bioregion.	Leeke's Estuary is not to be directly impacted by the development. Indirect impacts may occur from increase human activity within or around the wetland. Adequate pedestrian control (e.g., well defined track network) and a "no pet policy" will also reduce potential impacts. Adequate sediment control and maintenance of hydrological regimes will mean the indirect impact on Leeke's Estuary will be minor or negligible.	• Refer **Table 3.33 Section 3.3.3.2 (c)** Mitigation measures e) and h).	**(7) Medium**	**(2) Low**

** Note that, where referring to more than one mitigation measure, significance of impact scores (unmitigated and mitigated) – are mean scores of identified impacts rounded to the nearest whole number.*

(c) Marine Species

There will be no direct impacts of the Project on any of the listed migratory marine species. Potential indirect impacts are identified in **Table 3.65:**

TABLE 3.64 POTENTIAL IMPACTS ON LISTED MARINE MIGRATORY SPECIES CONSIDERED MODERATELY OR HIGHLY LIKELY TO USE HABITATS IN THE PROJECT AREA

Species	Status	Habitat Use on GKI (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (Unmitigated)	Significance of Impact (Mitigated)
Dugong dugon Dugong	M, Mar (EPBC)	Dugongs prefer shallow and protected areas with seagrass meadows, however they can be highly migratory due to their search for suitable seagrass or warmer waters (Marsh *et al.* 2002) and are known to travel several hundreds of kilometres. While there is little scientific data on dugong within the Project area, and none were sighted during the EIS studies (refer to **Appendix W**) dugong may occur in the Project area on occasion.	• Loss of marine habitat. • Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(10) Medium**	**(4) Low**
Balaeno pteraedeni Bryde's Whale	M, Cet (EPBC)	Bryde's whales are considered to be a fairly opportunistic feeders, readily consuming whatever shoaling prey is available (SEWPaC 2011). The Project area is unlikely to provide important habitat for Bryde's whales (SEWPaC 2011), however they may traverse open waters in the vicinity of the Project. None were sighted during the EIS studies (refer to **Appendix W**).	• Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(8) Medium**	**(2) Low**

TABLE 3.64 POTENTIAL IMPACTS ON LISTED MARINE MIGRATORY SPECIES CONSIDERED MODERATELY OR HIGHLY LIKELY TO USE HABITATS IN THE PROJECT AREA (CONTINUED)

Species	Status	Habitat Use on GKI (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (Unmitigated)	Significance of Impact (Mitigated)
Megapteranova eangliae Humpback Whale	M, Cet, V (EPBC)	Humpback whales make an annual migration from Antarctica to Australian coastal waters. While the Project area is not recorded as an important area for humpback whales (SEWPaC 2011), they may occur in open waters offshore of the Project area during their annual migration. None were sighted during the EIS studies (refer to **Appendix W**).	• Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(8) Medium**	**(2) Low**
Orcaella heinsohni Australian Snubfin Dolphin and *Orcaell abrevirostris* Irrawaddy Dolphin	M, Cet, (EPBC)	The Australian snubfin dolphin is Australia's only endemic dolphin and was described as a separate species from the Irrawaddy dolphin (*Orcaell abrevirostris*) in 2005. Although little is known about the ecology of the Australian snubfin dolphin, they appear to be opportunistic-generalist feeders, taking food from the bottom and water column within coastal and estuarine waters. They inhabit shallow waters within 10 kilometres of the coast and 20 kilometres of a river mouth. The Project area is unlikely to provide important habitat for the Australian snubfin dolphin and none were sighted during the EIS studies (refer to **Appendix W**), however, they occur in the nearby waters of the Fitzroy River mouth.	• Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(8) Medium**	**(2) Low**

TABLE 3.64 POTENTIAL IMPACTS ON LISTED MARINE MIGRATORY SPECIES CONSIDERED MODERATELY OR HIGHLY LIKELY TO USE HABITATS IN THE PROJECT AREA (CONTINUED)

Species	Status	Habitat Use on GKI (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (Unmitigated)	Significance of Impact (Mitigated)
Sousa chinensis Indo-Pacific Humpback Dolphin	M, Cet, (EPBC)	The Indo-Pacific humpback dolphin is an opportunist-generalist feeder. It consumes a wide variety of coastal and estuarine fishes, but also reef, littoral and demersal fishes, and some cephalopods and crustaceans. The Indo-Pacific humpback dolphin generally eats fish associated with mangrove habitats and is consequently affected by disturbances to these habitats (Parra 2005). The Indo-Pacific humpback dolphin is likely to occur in the Project area.	• Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(8) Medium**	**(2) Low**
Carettacaretta Loggerhead Turtle	M, Mar, End (EPBC)	The loggerhead turtle has a diverse diet including bivalves, gastropods, molluscs, crabs and jellyfish from a wide range of intertidal and subtidal habitats, including coral and rocky reefs, seagrass meadows, and unvegetated sand or mud areas (Limpus 2008b). Nesting is concentrated in southern Queensland on the east coast, and from Shark Bay to the North West Cape on the west coast, foraging areas are more widely distributed (Limpus 2008a). The loggerhead turtle may feed in, or traverse, the Project area.	• Loss of marine habitat. • Artificial lighting. • Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(10) Medium**	**(4) Low**

TABLE 3.64 POTENTIAL IMPACTS ON LISTED MARINE MIGRATORY SPECIES CONSIDERED MODERATELY OR HIGHLY LIKELY TO USE HABITATS IN THE PROJECT AREA (CONTINUED)

Species	Status	Habitat Use on GKI (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (Unmitigated)	Significance of Impact (Mitigated)
Cheloniamydas Green Turtle	M, Mar, V (EPBC)	The green turtle feeds extensively on seagrass, particularly *Halophila ovalis, Halophila spinulosa* and *Halodule uninervis,* and is commonly found in association with seagrass meadows. The green turtle is likely to be relatively common in the Project area. It may use the area for feeding (although given the patchy and spare nature of the meadows this species is unlikely to rely on those meadows for feeding) and also nesting (or traversing during the nesting season) as it is close to several rookeries.	• Loss of marine habitat. • Artificial lighting. • Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(10) Medium**	**(4) Low**
Eretmochelys-imbricata Hawksbill Turtle	M, Mar, V (EPBC)	The hawksbill turtle breeds in the northern GBR and the Torres Strait and is heavily reliant on reef and rocky habitats, where it forages mainly on sponges as well as seagrass, algae, squid, gastropods and jellyfish. The Project area is highly unlikely to support nesting populations although some hawksbill turtles may feed over the reef and rocky habitat of the area. None were sighted during the EIS studies (refer to **Appendix W**).	• Loss of marine habitat. • Artificial lighting. • Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(10) Medium**	**(4) Low**

TABLE 3.64 POTENTIAL IMPACTS ON LISTED MARINE MIGRATORY SPECIES CONSIDERED MODERATELY OR HIGHLY LIKELY TO USE HABITATS IN THE PROJECT AREA (CONTINUED)

Species	Status	Habitat Use on GKI (Recorded and Likely)	Prediction of impact	Mitigation Measures	Significance of Impact (Unmitigated)	Significance of Impact (Mitigated)
Lepidochely-solivacea Olive Ridley Turtle	M, Mar, End (EPBC)	Olive Ridley turtle appears to forage in benthic and pelagic habitats (Musick and Limpus 1997), for mostly gastropods and bivalves (Conway 1994). The Olive Ridley turtle is highly unlikely to nest in the Project area but may feed in, or traverse, the Project area.	• Loss of marine habitat. • Artificial lighting. • Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(10) Medium**	**(4) Low**
Natatordepressus Flatback Turtle	M, Mar, V (EPBC)	The Flatback Turtle tends to forage in shallow continental shelf waters with soft substrates, feeding on a variety of soft-bodied animals, including soft corals, sea pens, sea cucumbers and jellyfish (Limpus 2007). In eastern Queensland, Flatback Turtles nest between Bundaberg in the south to the Torres Strait in the north. Nesting activity is greatest between late November and early December ceasing sometime in late January (Limpus 2007). The Flatback Turtle is likely to be relatively common in the Project area. It is likely to use the area for foraging, given the dominant soft-sediment habitat, and also for nesting (or traversing during the nesting season) as it is close to several rookeries (Limpus 2008b).	• Loss of marine habitat. • Artificial lighting. • Human activity. • Waste and litter. • Spills of hydrocarbons and other contaminants. • Increased turbidity and sediment deposition.	Refer **Table 3.48 Section 3.3.4.10** for corresponding mitigation measures.	**(10) Medium**	**(4) Low**

NOTES:

- ***Loss of Marine Habitat***

  Loss of seagrass has the potential to affect listed migratory species, as seagrass provides an important food source for several important species, e.g., marine turtles and dugong.

  The sparse nature of the seagrass around the Island makes it unlikely habitat for species of legislative significance, such as dugongs (*Dugong dugon*). Given that the meadows within and adjacent to the proposed marina are sparse and patchy, and typical of the Region, the potential loss from marina development is unlikely to impact on migratory species. Nevertheless, seagrass distribution is dynamic and sensitive to siltation. Dredging will be monitored with respect to nearby seagrasses, in order to reduce the risk of impacts on feeding areas for dugongs and turtles.

- ***Increased Turbidity and Sediment Deposition***

  The effect of increased suspended solid concentrations in the water column, and sediment deposition, during construction of the Project (including, marina, wastewater wet weather outfall and submarine cables) is likely to be minimal on these species, primarily because they are mobile and tend to avoid unfavourable environments. While some marine vertebrates will avoid areas of high turbidity, these waters may also attract a range of fishes, particularly juveniles, as such waters provide a greater degree of protection from predators (Blaber and Blaber 1980).

  Toxicants may also be released from sediment. Depending upon the nature and extent of this release, impacts could range from morbidity and the reduction of reproductive capacity of some species, through to outright mortality of animals. These impacts are considered highly unlikely given assessments of the sediments to be dredged within the marina were found to be below the *National Assessment Guidelines for Dredging* (NAGD) Screening Levels (DEWHA 2009). Turbidity plumes will be monitored and appropriate controls put in place to reduce any such impacts.

- ***Spills of Hydrocarbons and Other Contaminants***

  A moderate spill of hydrocarbon, or other contaminant, from a vessel during construction or marina operation, may impact marine vertebrates. While there is a moderate risk of this occurring (most likely during refuelling), environmental and marina management plans will be implemented to reduce this risk. Also, given that mobile organisms tend to avoid unfavourable environments, the likelihood of impacts on listed migratory marine species is low.

- ***Waste and Litter***

  Litter and waste associated with construction and marine operation will have the potential to contribute to the degradation of water quality and may pose a direct hazard to marine fauna, for example, by turtles ingesting plastic bags. Site management, signage and awareness programs for visitors and boat-users will minimise the amount of litter escaping to the marine environment, and associated risks to listed marine migratory species.

- ***Artificial Lighting***

  The construction and operation of the marina will increase the illumination of the Putney Beach area at night, and operation of the Project may increase the illumination of Fisherman's Beach. Increased illumination has the potential to impact nesting turtles and hatchlings (Lutcavage *et al.* 1997; DERM 2009).

  The Island is not a significant turtle rookery, but some of the beaches are used for turtle nesting. Most of the nesting recorded on the Island has been on beaches remote from the existing and proposed development, and most of the lighting associated with the Project (apart from the marina) will be well away from beaches. Nesting turtles very rarely nest on Putney or Fisherman's Beaches. No turtles were recorded nesting on Fisherman's Beach and four (of 29) turtles were recorded nesting on Putney Beach during the EIS. Over the period 2005 to 2009, only four turtle nesting activities have reported for Putney Beach. Turtles do not rely on Putney or Fisherman's beaches for nesting.

  Nevertheless, 'light leakage' to seaward will be minimised by shoreline setback buffers for buildings and foreshore vegetation at Fisherman's Beach, and by selection, height and location of appropriate lighting at the detailed design stage. At Putney Beach, the marina lighting and vessel lighting will be designed and/or operated to minimise light spillage particularly during turtle nesting season. No significant regional impact on turtle nesting or hatching success is expected.

- ***Human Activity***

  Construction of the Project (i.e., marina, wastewater wet weather outfall and / or submarine cables) is likely to result in increased noise and activity. This may temporarily disturb fauna such as dolphins, dugongs and turtles, and they may move away from the area. However, this is likely to be a short-term response, and they are likely to return once construction is completed.

Increases in human activity on turtle nesting beaches such as Leeke's Beach, may interrupt nesting marine turtles. However most of the people visiting the Island will be resort guests and residents amenable to visitor management programs including signage, education and awareness material. Given that the Island is not a significant turtle-nesting rookery frc environment has concluded that, disturbance by humans is unlikely to have a significant impact on turtle populations within the Region.

The presence of the marina will lead to an increase in the use of recreational vessels around the Island, inevitably resulting in more frequent boat strikes and other interactions between boating traffic and megafauna. Megafauna may respond to boating disturbance by altering their behaviour (e.g., changing swimming direction or reducing time spent resting) (Hodgson and Marsh 2007). Long-term effects of boat traffic include displacement of fauna to deeper waters, where less food resources may be located. The waters off the Island are not considered to support significant feeding grounds (seagrass meadows) for dugong or green turtles. Substantial coral-dominated habitat (feeding grounds for loggerhead and hawksbill turtles) are relatively distant from the proposed marina. The risk of collision between boats and marine fauna is reduced when vessels operate at slow and consistent speeds (Hazel *et al.* 2007; Hodgson and Marsh 2007). As such, the enforcement of speed limits around the marina area will be key to reducing the disturbance of migratory marine megafauna.

3.4.6 Commonwealth Marine Area

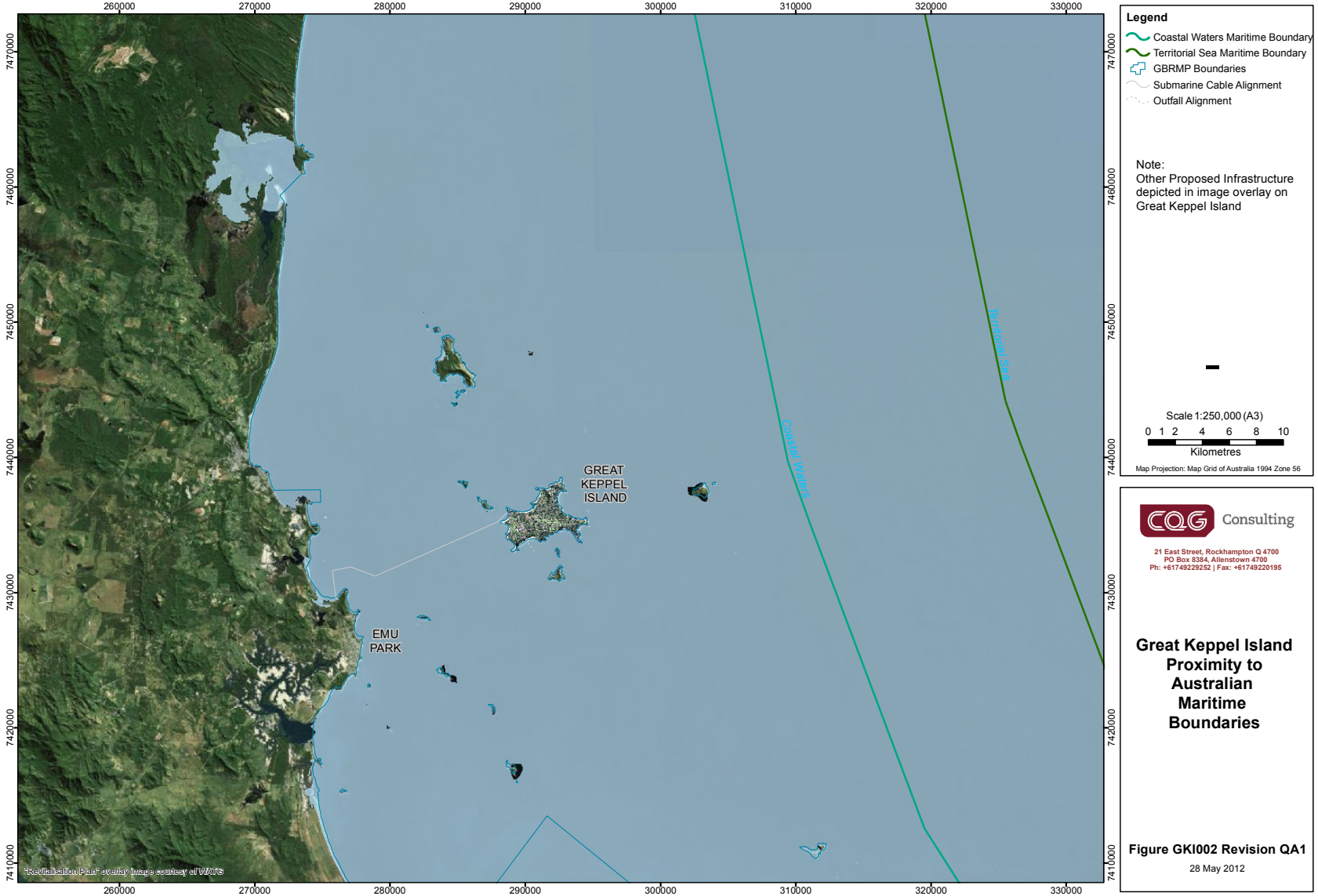
The Commonwealth Marine Area (CMA) is designated as any part of the sea, including the waters, seabed and airspace within Australia's exclusive economic zone and or over the continental shelf of Australia, that is not State or Northern Territory waters. The CMA stretches from three to 200 nautical miles from the coast including islands.

3.4.6.1 Impact

As identified in **Figure 3.55** the CMA is more than three nautical miles from the coast of the Island due to the proximity of Barren Island, so the entire Project, including the submarine cable is not within CMA. It is therefore anticipated that the Project will have no direct impact on the CMA.

There is however potential that the development of the marina and resort may have an indirect positive impact on the CMA directly to the east by reducing recreational boating traffic. Anecdotal conversations with Yacht club members have identified that sailors from Sydney, Brisbane and Bundaberg did not identify the Keppel Group as a destination of importance due to the lack of mania and resort facilities. Yachts tend to travel to the Capricorn Bunkers and onto the Whitsundays through the CMA to the east of GKI, if this Project is realised, vessels and recreational yachting may be diverted into waters within the three nm limit, reducing impact on the CMA.

Figure 3.55 AUSTRALIAN MARITIME BOUNDARIES



3.4.7 Summary

MNES addressed in **Section 3.4** includes World Heritage Areas and National Heritage Places, GBRMP, listed threatened flora and fauna communities, listed migratory and marine species and Commonwealth Marine Areas. World Heritage Values of the GBRWHA are iconic. Their importance was highlighted by UNESCO's recent monitoring mission to assess the state of the GBR. These important values have been addressed by detailed investigation of the terrestrial and marine environments of the Island and its surrounds, by a constraints-based approach to project planning, risk assessments and mitigation measures to avoid or reduce potential impacts.

GKI is a 1,308 hectare continental island within the GBRWHA, and many of the MNES are associated with its World Heritage status. Unlike other islands in the Keppel Group of islands, the Island is not a national park, and it has a history of grazing use and is an established node of tourist resort development.

The World Heritage Values include the scenery of the Island and surrounding waters, fringing coral reefs and associated reef-building processes, habitat for migratory species (birds and marine fauna), and flora and fauna typical of continental islands which add to the biodiversity of the GBRWHA. Most of these features are outside the Project area, or associated with the waters and land-water interface.

The land based project area of approximately 941 hectares, comprising 72 percent of the Island, is proposed for development (GKI Revitalisation Plan), comprising two terrestrial development precincts with a combined area of approximately 350 hectares, plus the offshore Marine Services Precinct of approximately 31.5 hectares and a submarine cable and pipe connection to Kinka Beach on the mainland. Within the Fisherman's Beach and Clam Bay Precincts, the total area of development impacts will be approximately 203 hectares (15 percent of the Island), but this includes areas already developed as the existing resort and airstrip, areas previously disturbed by grazing, and earthworks which will be revegetated. The total infrastructure footprint (including buildings, roads, airstrip and associated services) will comprise, in total, approximately 46 hectares (3.5 percent of the Island) and approximately 38 hectares of golf course open space (2.9 percent of the Island). The proposed marina at Putney Point will occupy approximately 2.33 percent of the Island's coastline and comprise a marina footprint of 20.8 hectares. Most of the land based Project area (575 hectares or 65 percent) will be an Environmental Protection Precinct, effectively protecting approximately 44 percent of the Island.

The World Heritage Values associated with geomorphology and associated processes (terrestrial and marine) are not at risk from the Project. There are no wetlands of international importance, and no terrestrial species of flora or fauna which are listed as threatened. The EPBC-listed "Littoral Rainforest and Coastal Vine Thickets of Eastern Australia" does occur on the Island, but outside the proposed development footprint area and will not be directly impacted. The locally important habitat area associated with Leeke's Estuary will be protected and buffered, as will all the coastline apart from the proposed marina.

A number of migratory and listed marine species have been recorded or are likely to use the Island and surrounding waters, but there are no 'important habitats' for migratory birds (as defined by DEWHA 2009) nor is the Island a significant turtle rookery.

The GKI Revitalisation Plan, with a small development footprint limited to areas of lower environmental significance and higher tolerance of disturbance, and with mitigation measures as proposed, has overall a low risk of causing detrimental impacts on listed species, communities, geomorphological processes or ecology of the Island.

In terms of World Heritage aesthetic values (including the 'existence value' of the Island as a relatively undeveloped place close to and within view of the Capricorn Coast), the constraint-based approach to project planning has ensured the protection of the OUV and that most of the Project will be screened from view and separated into several discrete precincts. One of these is already developed as the existing resort and airstrip, and the proposed Fisherman's Beach Precinct development will be no more visible from the mainland than at present (and in respect to the existing hillside units, will be less visible). The main visual impact will be associated with the proposed marina which, although its location and building height will ensure it is partly-screened by Putney Point, Sand Spit and Middle Island, the built form and night-time lighting will be visible from within an arc of offshore view. All built form will be low-rise (two to three-storey maximum storeys), set back from the shoreline and landscaped, such that other visual impacts are of a minor nature.

In terms of the GBRMP the Island demonstrates a range of social and cultural values that will be altered by the Project in terms of utilisation and management however the significance is in keeping with the objectives of the GBRMP Act.

The CMA are indirectly impacted by the Project and will likely have a positive impact if any on this area.

The environmental impact studies summarised in this section indicate that the GKI Revitalisation Plan is unlikely to cause degradation of World Heritage or National Heritage values, or significantly affect other MNES. The few environmental impacts which could potentially occur are low risk and capable of being mitigated, managed or offset.