Enhanced management of Ramsar site wetlands within the Great Sandy Strait catchments

Queensland Government

Queensland Wetlands Program

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The Queensland Department of National Parks, Sport and Racing

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1 Introduction

In this report we outline the findings from an inventory of instream structures conducted in the Great Sandy Strait Ramsar site and five declared Fish Habitat Areas (FHA): Fraser Island, Susan River, Maaroom, Kauri Creek and Tin Can Inlet for the project, 'Enhanced management of Ramsar site wetlands in Great Sandy Strait catchments'. The project was managed and conducted in 2012 by the *then* Fisheries Queensland business area, within the *then* Department of Agriculture, Forestry and Fisheries (DAFF). The project was funded by the Australian Government as part of the Queensland Wetlands Program (QWP).

Fish depend on access to a wide range of habitats for their survival. Coastal wetlands are dynamic ecosystems that are vital habitats for fish. Wetland habitats provide fish with food, shelter that helps protect fish from predation and are also important as breeding and nursery areas (Blaber, 1997). A number of fish species move between wetland habitats to breed and complete their life cycles. Maintaining connection between wetland habitats and access to a diverse mosaic of healthy fish habitats is critical to sustaining those fish populations important to Queensland's commercial, recreational and traditional fisheries (Meynecke et al., 2008).

To meet the demands of expanding residential, industrial and agricultural development, a range of instream structures exist throughout freshwater, estuarine and marine fish habitats. Instream structures such as floodgates, levee banks, jetties, pontoons, boat ramps, revetments, moorings and road crossings, can impact fish habitats by modifying flow regimes and causing permanent physical disturbances that result in direct habitat loss or fragmentation (Burns, 2001; Adams, 2002). Other structures may form complete or partial barriers that prevent, disrupt or severely limit important migrations and movements of fish and other aquatic species within these areas (Fairfull & Witheridge, 2003). Impacts of instream structures can lead to inability of fish to complete life cycles, population declines of key fish species, reduced distributions of certain species and degraded fish habitats for fish communities. All these have detrimental effects on Queensland's commercial, recreational and traditional fisheries.

Project Objectives

The purpose of the project was to employ the framework and inventory guidelines (NPRSR, 2014), developed previously to conduct an inventory and data storage of structures that impact on fish habitats and movement of fish and other aquatic species in the Great Sandy Strait Ramsar

site. The project area included five declared FHAs, the Great Sandy Marine Park and Great Sandy National Park. The project was developed and managed to meet the following main objectives:

1. to conduct an inventory of instream structures within the Great Sandy Strait Ramsar site.

2. to conduct workshops for the transfer of knowledge and to determine appropriate management actions to agreed priority structures with key stakeholders (including Burnett Mary Regional Group (BMRG), Oceanwatch and Local Government) at Hervey Bay, Maryborough and Tin Can Bay, within Natural Resource Management investment Plans and Council work programs.

3. to enhance the FishBarriers VQ (Version Queensland) digital menu system used to collect data, inventory guidelines and Decision Support System protocol.

The Queensland Wetlands Program (QWP) has conducted mapping and inventory projects for wetlands in Queensland to classify and document the extent of these systems in the state. This essential step is required for effective wetlands management for Ramsar sites, high conservation value aquatic ecosystems (HCVAE) and Marine Protected Areas (MPAs), including declared FHAs.

The base wetlands mapping conducted through the QWP (EPA 2005) identified a number of larger structures, e.g. bridges, impoundments, through interpretation of aerial photography and incorporated this information as part of the classification of those wetlands. Many smaller but often more numerous structures, which collectively have equal or greater impacts on wetland function and value relative to the larger structures, are not detected by this process.

This project fulfils a critical step in improving the quality and coverage of the QWP database in corroborating and extending the current wetlands mapping and inventory data through conducting detailed on-ground surveys in a consistent manner, ensuring data accuracy and currency. The project also contributes data to both the mapping and classification project and the broader wetland inventory database for Queensland.

Prioritising remedial actions in partnerships with regional Natural Resource Management (NRM) agencies and other key stakeholders, e.g. local government, NRM groups, traditional owners, will

follow the application of the management considerations for structures identified in this project. Potential remedial actions for strategic priorities include modification or removal of structures options in alignment with NRM investment strategies and local government work programs.

Previous Work

The Project implements a framework and guidelines developed by Fisheries Queensland in 2008–09 ('Targeted collection of inventory data for wetlands fish barriers in the Great Barrier Reef catchment') (Lawrence et al. 2009). The NPRSR 'Guidelines for conducting an inventory of instream structures in coastal Queensland' (NPRSR, 2014) were developed based on trials in the Great Barrier Reef lagoon, including two declared FHAs: Trinity Inlet declared FHA near Cairns and Hinchinbrook declared FHA near Ingham. A second project, undertaken in 2010–11, applied the framework and guidelines to conduct instream structure inventories the Ramsar sites of Bowling Green Bay, Townsville and Shoalwater and Corio Bays, Rockhampton and the declared FHAs within these sites.

The current project, also funded by Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) as part of the QWP, employs the framework and guidelines, developed in the pilot project and refined in the second project, to yield specific inventories and identify priority structures impacting on wetland condition and fish habitats within the Great Sandy Strait Ramsar site and the five declared FHAs in that part of the coast.

The guidelines consist of an inventory protocol that describes how to identify structure locations and assess structure impacts, as well as a response protocol including a Decision Support System for the prioritisation of structures for management response actions. The inventory protocol is based on the use of the Fish Barriers menu system, an Arcpad application originally developed by New South Wales Department of Primary Industries (NSW DPI), to collect field data.

The guidelines build on previous NSW DPI and Fisheries Queensland work aimed at prioritising fish passage barriers in a number of New South Wales and Queensland catchments (Stockwell et al., 2008; NSW DPI, 2006; Stewart & Marsden, 2006). Essentially the guidelines were developed to encompass the range of other non-barrier structures that exist in estuarine areas of coastal Queensland in addition to establishing a specific protocol for use in targeted protected areas.

The guidelines provide both government (State agencies and local governments) and non-government organisations (e.g. Natural Resource Management bodies) with the capacity to undertake similar inventory work and/or deliver on the RAP priorities.

Ramsar Wetlands

There are 65 Ramsar sites throughout Australia and five of these sites are found in Queensland (Figure 1). The four coastal Queensland sites incorporate declared FHAs—Bowling Green Bay near Townsville, North Queensland, Shoalwater and Corio Bays north of Yeppoon, Central Queensland, the Great Sandy Strait on the Cooloola Coast, and Moreton Bay, Brisbane, South East Queensland.

Ramsar wetlands are designated as internationally important in The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, Iran, 1971)—called the 'Ramsar Convention'—is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the 'wise use', or sustainable use, of all of the wetlands in their territories. The aim of which is to prevent further worldwide loss of wetlands and conserve existing wetlands through wise use and management based on the principles of ecologically sustainable development (ESD). The responsibility for the management of Ramsar wetlands includes wetland site managers and the State and Australian governments, working in partnership. As a matter of national significance, Ramsar wetlands are regulated under the Environmental Protection & Biodiversity Conservation (EPBC) Act 1999.

The Great Sandy Strait Ramsar wetland site includes Great Sandy Strait, Tin Can Bay, Tin Can Inlet, parts of Fraser Island to the east, and the mainland. The Ramsar wetland has a total area of 93,160ha (including water channels and open water). The site is a sand passage estuary between the mainland and the World Heritage listed Fraser Island. Fraser Island has formed sufficiently close to the mainland to block the flow of a substantial river system, creating a double-ended estuary with a dynamic, though relatively stable, pattern of mangrove communities, sand banks and mud islands.

Great Sandy Strait contains the largest area of tidal swamps within the South East Queensland bioregion, consisting of intertidal sand and mud flats, extended seagrass beds, mangrove forests, salt flats and saltmarshes, often contiguous with freshwater paperbark wetlands and coastal wallum swamps. The mangrove communities, with more than 10 species within the Strait, represent a transition between tropical (39) and subtropical (7) species. Rare freshwater patterned fens have also been identified.

The coastal wetlands of Great Sandy Strait are of international significance for migratory birds, with 18 species listed under international migratory bird conservation agreements, recorded. The Strait is also utilised by a number of turtle species, dugong and humpback whales. Threatened fish such as oxleyan pygmy perch and honey blue-eye inhabit the mainland and Fraser Island.

Great Sandy Strait Ramsar wetland holds significant cultural heritage values for local Indigenous groups. Evidence of occupation in the area dates back 5500 years and middens are frequently found in the site. The Ramsar wetland is currently highly valued for commercial fishing and recreational fishing, boating and tourism related activities. The Great Sandy Region (GSR) was the subject of the GSR Management Plan (1994) which highlighted the need for coordinated management.

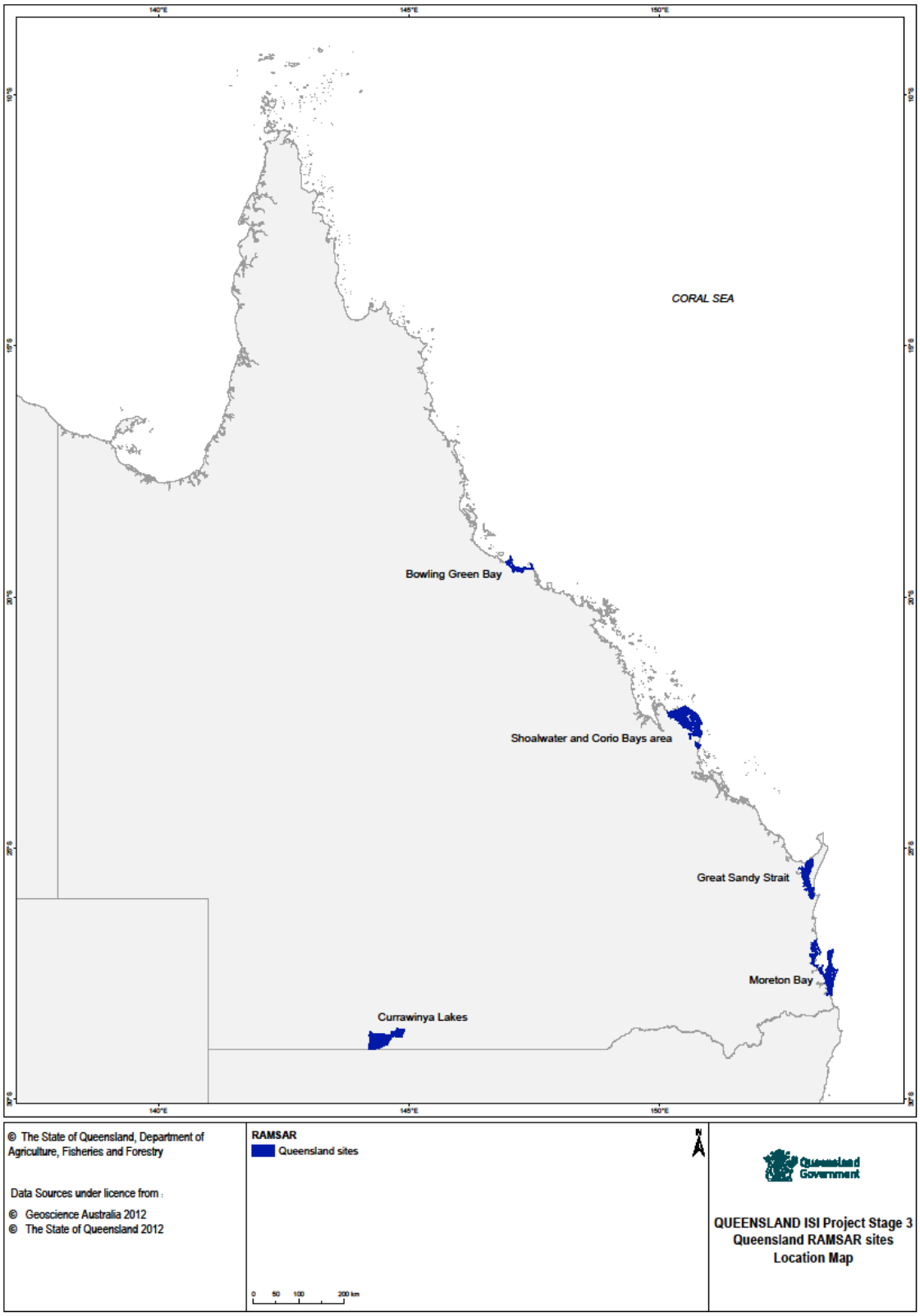

Figure 1 Map of Queensland showing locations of Ramsar sites

The draft Ecological Character Description (ECD) describes and records the ecological character of a Ramsar site and includes the process, components and ecosystem services which together make up the features of the site and their threats. The ECD assists decision makers to determine whether an action has, will have, or is likely to have, a significant impact on a Ramsar wetland. Information within an ECD should be updated every six years. The aim of the ECD is to provide a baseline description of ecological character of the wetland at the time of listing, and against which potential changes in the ecological character of the Ramsar wetland can be determined. Ideally the ECD should occur at the time of listing, however, the ECDs recently undertaken for Queensland Ramsar sites have been undertaken several years after the listing as the process for undertaking ECDs has only recently been developed (Department of the Environment, Water, Heritage and the Arts 2008).

Urban development and the modification of natural wetlands systems present potential threats to the ecological character of Ramsar wetlands, through marine plant/terrestrial vegetation removal and subsequent introduction of weed species and hydrological changes. In addition, linear infrastructure without appropriate culverts interrupts natural surface water and groundwater flow paths. With population rises and associated development activities in the coastal zone continue to increase, the impacts that urban encroachment and changing surrounding land uses pose to the values of Ramsar wetlands are likely to intensify.

Baseline information on existing infrastructure within and adjacent to Ramsar sites is critical to the assessment of future development impacts on Ramsar values. Collection of this information is not only important within the boundaries of the Ramsar site, but changes in the uses of adjacent lands will have impacts on the values within the site and should be monitored. In identifying and assessing the impacts of instream structures on Ramsar wetlands and recording wetlands inventory information, structure inventory project data supplements the ECD and forms a baseline against which to measure future impacts.

The Declared Fish Habitat Area Network

The declared Fish Habitat Area Network was established by the Queensland Government in the late 1960s in response to development pressures in the coastal zone (McKinnon et al., 2002). These statutory marine protected areas safeguard fish habitats and fish stocks along the Queensland coast that sustain the commercial, recreational and traditional fisheries from development. While protecting natural fish habitats (e.g. vegetation, sand bars, rocky

headlands) from alteration and degradation from development impacts, declared FHAs allow for natural processes and community uses, including: community access; boating; and commercial, recreational and traditional fishing.

The extent and nature of development activities that occur within the declared FHA network are regulated under the Fisheries Act 1994 and its Fisheries Regulation 2008, supported by policies and guidelines. Despite the statutory framework that underpins the management of declared FHAs, development impacts do occur and remain in these marine protected areas. In particular the legality of some structures within declared FHA boundaries is often uncertain and the impacts of these structures can continue to be detrimental to the health and value of key fish habitats within the declared FHA Network.

The pilot, second Instream Structure Inventory (ISI) project and current project support the first three years of a five year Fisheries Queensland inventory program to audit instream structures in selected marine protected areas (Ramsar and declared FHAs) in coastal Queensland. The program aligns with the Fish Habitat Area (FHA) Network Strategy (2009–14) that includes active management and response to unlawful activities to prevent the degradation of individual declared FHAs and the declared FHA Network. The program also links to the 2012 declared Fish Habitat Area Network Assessment report (DAFF, 2012) that highlights the status and management requirements of individual declared FHAs within the network.

Unauthorised structures include: those constructed or installed before FHA declaration and therefore not subject to the development assessment process; structures constructed in such a way that breaches the conditions of a fisheries development approval; or structures installed since FHA declaration without an approval.

A number of management responses may address the impacts of individual structures, including raising community awareness of ecological values, removal of structures and rehabilitation of disturbed sites, or development of a strategic approach to manage unauthorised structures. Comprehensive baseline information on the location and impacts of structures throughout the declared FHA network is essential to inform the determination of appropriate management responses to structures identified as potential problems.

Project Reference Group

A project reference group was established to provide local input and knowledge for project delivery and to ensure linkages with related projects. The reference group met on several occasions during the term of the project with representation from the following agencies and organisations: Department of Environment and Resource Management (DERM), BMRG, Oceanwatch, WetlandCare Australia, Fraser Coast Regional Council (FRRC), Gympie Regional Council (GRC), Department of Transport and Main Roads (DTMR) and the Butchulla People. A list of project reference group members is included in Appendix A.

Project Area

The project area included the Great Sandy Strait Ramsar site and five FHAs, declared as Fraser Island (19 November 1983), Susan River (10 May 1986), Maaroom (22 January 1976), Kauri Creek (22 January 1976) and Tin Can Inlet (22 Janaury 1976); and some adjacent areas (Figure 2). The project area also included parts of Poona National Park, Great Sandy Marine Park and Great Sandy National Park.

The Wide Bay Training Area (WTBA) is located immediately adjacent to and south-west of the GSS Ramsar site and partly fell within the project area. A number of structures within the WBTA were mapped and inventoried as part of the project. Given the nature of activities conducted by the Department of Defence within WBTA, a summary of data collected in this area is provided in a supplement to the final report. The supplement will be used for reporting purposes and any impacts relating to structures will be followed up with the Department of Defence. The project results presented in this report do not include data from the WBTA. These are the subject of a separate report.

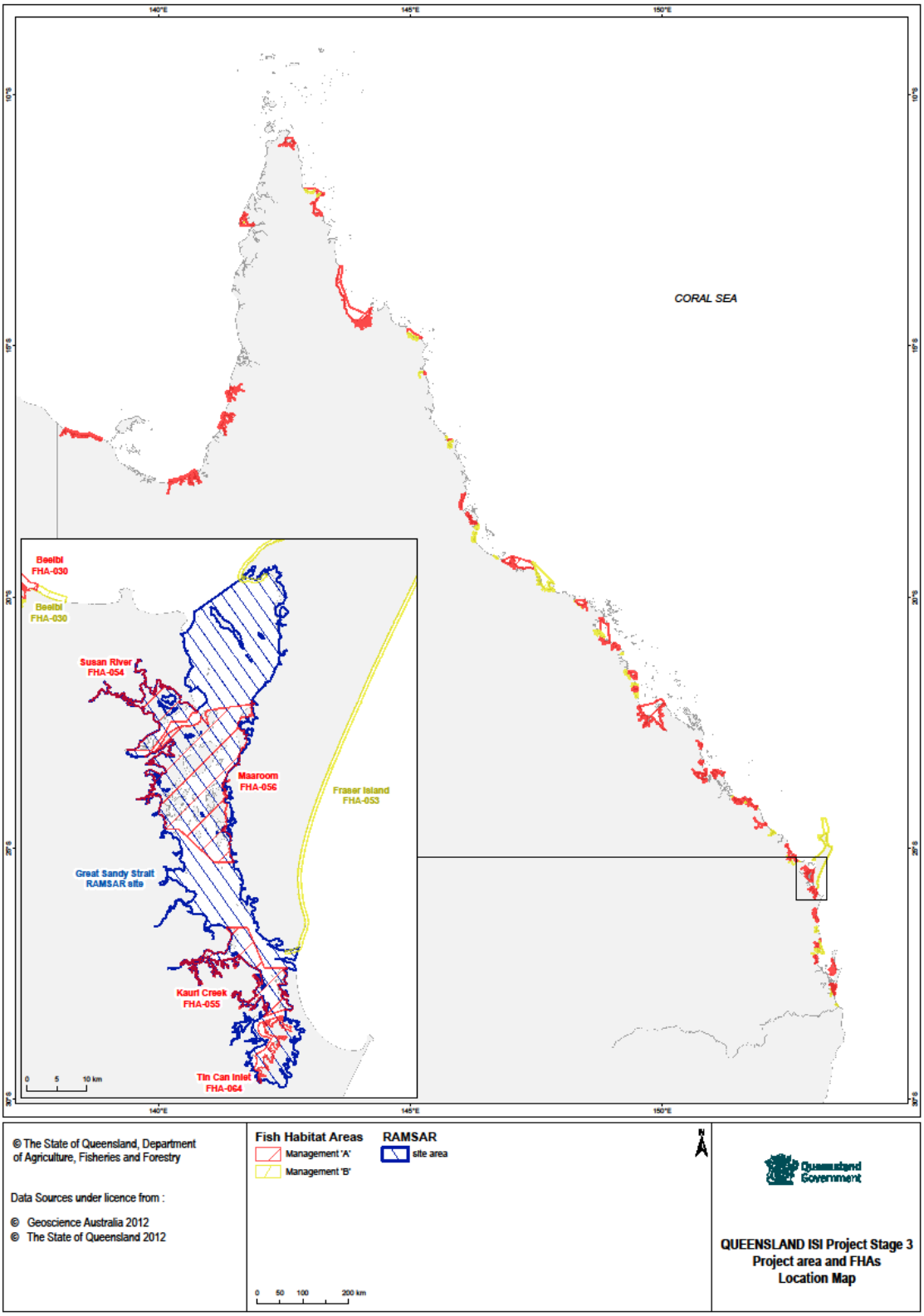

Figure 2 Location of GSS Ramsar project area within the declrared FHA network.

2 Project methods

Project Methods

Methods used in the project include an inventory protocol for structure identification and data collection and a response protocol for scoring and prioritisation of structures. Detailed information on project methodology can be found in the guidelines, available on the NPRSR website (www.nprsr.qld.gov.au).

Part 1: Inventory protocol

Structure identification: desktop assessment

All available geographic information system (GIS) data layers (watercourses, wetlands, vegetation, infrastructure, waterholes and bores, land tenure) and existing approvals information (fisheries development approvals, Department of Transport and Main Roads boat ramps, prescribed tidal works, Section 86 approvals) were compiled for the project area. This information was laid over base layers consisting of the Digital Cadastral Data Base (DCDB), topographic maps, declared FHA mapping, and the QWP wetlands mapping and imagery to identify the locations of known structures. Preliminary data relating to the location of potential biopassage remediation sites, collected as part of the Caring for our Country Biopassage project (Berghuis, 2012) was used to identify and assist the prioritisation of barrier sites. Queensland Parks and Wildlife Service (DNPRSR) supplied bridge location data on Fraser Island.

ArcGIS (Mapping and spatial analysis program developed by ESRI) was used to compile data layers and create project maps. First an overview map of the GSS project area was created. The overview map, consisting of the project area and a buffer area, was used to determine the project area boundaries. A 1:5000 grid was then overlaid on the project area map to form the key map for individual 4-grid maps (Figure 3). The project area was divided into three broad sections in order to collect field data.

This enabled fieldwork progress to be monitored. Each grid square was numbered consecutively for ease of reference. Individual maps were subsequently created for each numbered grid square and used for field navigation. An example of an individual 4-grid map for Bunya Creek and Susan River area is shown in Figure 4.

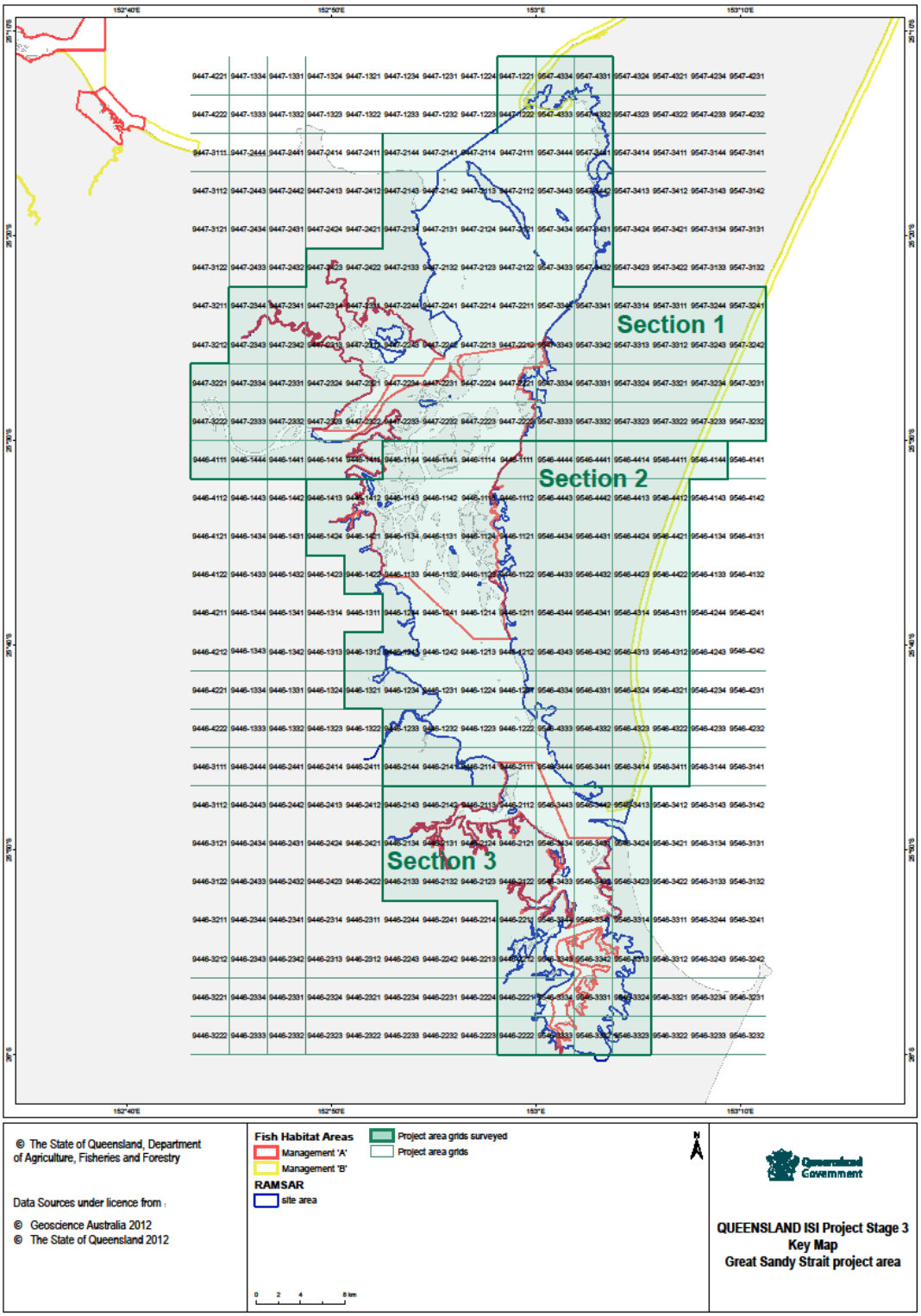

Figure 3 Key map for Great Sandy Strait project area

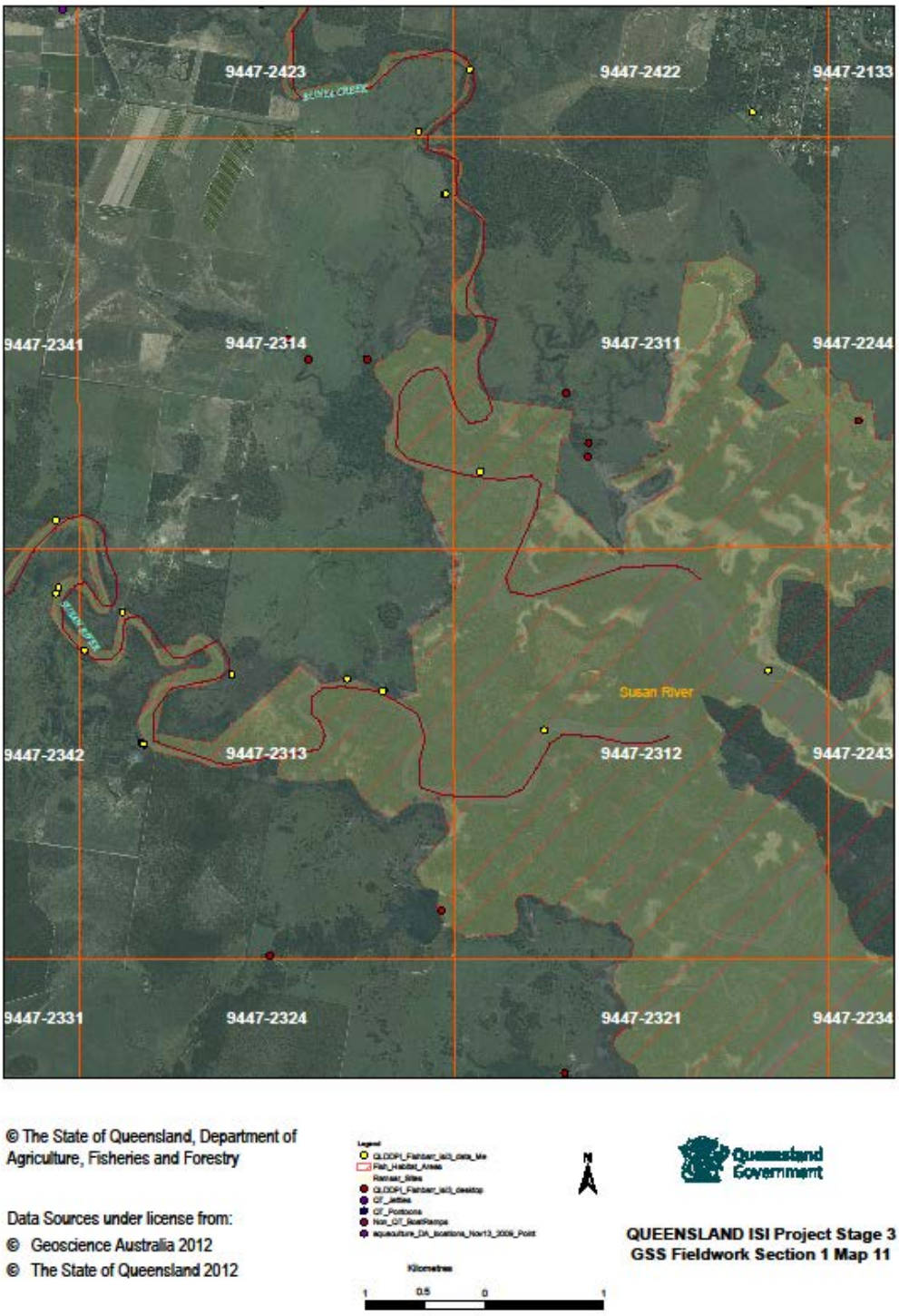

Figure 4 – Example of an individual field map

Structure identifcication: field assessment

Inventory data was collected in July, August and October 2011, using a TDS Nomad, personal digital assistant (PDA) with an in-built GPS. The PDA was uploaded with Arcpad (V.8[SP4]), GIS data layers, project area maps, and the FishBarriers VQ menu system, a modified version of the original menu system (FishBarriers V.4) developed by NSW DPI (2006).

The methods of data collection used in each project sector are outlined in Table 1. Aerial surveys were conducted in May and October 2011, using a Bell 206 Jet Ranger helicopter at approx. 500 feet, to identify structures that were difficult to detect using satellite imagery and where on-ground access was known to be an issue. Aerial photography (digital ortho-rectified aerial photography for Hervey Bay 2010 [spatial resolution to 10cm]), Satellite Spot 5 Imagery (Qld Zones 55 & 56—2009; to 2.5m resolution) and Google Maps Imagery were also used. Aerial surveys allowed the location of known structures to be confirmed and assisted with identifying access points for on-ground navigation and field assessments.

Table 1 Methods of data collection used in different sectors of the project area

Project area sector	Methods of data collection					
	Aerial survey	Boat-based and on-ground surveys	Aerial photography	Satellite Spot 5 Imagery	Google Maps Imagery	Stakeholder consultation
GSS Ramsar site; Susan River, Maaroom, Kauri Creek and Tin Can Inlet FHAs	●	●	●	●	●	●
Private land	●		●	●	●	●
Wide Bay Training Area (Western half)	●	●		●		●
Fraser Island FHA	●			●	●	●

Ground-truthing/on-ground inspection of these structures would be an important follow-up step where management response actions in relation to these structures are proposed. Wherever

possible, field assessments were conducted at low tide to allow the greatest visibility and assessment of structures.

Using the FishBarriers VQ menu system, data was collected on the following broad categories: general; spatial location; site details; non-barrier type; barrier type; barrier details; fish passage details; habitat; vegetation; threats (or impacts); location; and ownership. Information and a full list of data attributes regarding the application of the FishBarriers VQ menu system are contained in the guidelines (NPRSR, 2014).

Part 2: Response protocol

Scoring of structures

To identify management priorities, structures were scored based on a number of fish habitat values and impact criteria, as per the guidelines (NPRSR, 2014). Individual structures were given a score for each criterion. These were then added together to derive a total fish habitat value score and a total impact score. A high fish habitat value score indicates a structure located in an area of high fish habitat value, while a low score refers to a structure located in relatively poor quality fish habitat. The fish habitat value criteria for both non-barriers and barriers are listed in Table 2.

Table 2 Fish habitat value criteria and scoring system

Criterion	Description	Score
1. Waterway class	Inshore coastal waters/tidal inlet/main stream/lowland lagoon*	10
	Major tributary of main stream direct to sea/small lowland lagoon**	8
	Minor tributary of main stream/large low-order tributary direct to sea***	4
	Minor, low order tributary****	0
2. Habitat class	High fisheries significance plants dominant (mangroves, seagrass, saltmarsh)	10
	Known to previously support high fisheries significance plants	8
	Other tidal fish habitats (naturally bare/unvegetated dominant)	5
	Low significance fisheries plants (non-tidal, terrestrial plants, trees, grasses) dominant	2
3. Habitat condition	Pristine, 100% natural forest	10
	Low disturbance, <25% of waterway degraded	8
	Moderate disturbance, 25–50% of waterway degraded	6
	High disturbance, 51–75% of waterway degraded	4
	Very high disturbance, >75% of waterway degraded	0
	Total habitat value score/30	/30

*e.g. Great Sandy Strait, Mary River, Susan River (northern GSS)

**e.g. Big Tuan Creek, Snapper Creek, Maaroom Creek (southern GSS)

*** e.g.Mullen Creek, Black Swan Creek (southern GSS)

****e.g. Middle Creek (Cairns)

The impact criteria for non-barriers are listed in Table 3. A high impact score refers to a structure with a relatively high level of impact on fish habitats, while a structure with a relatively low impact on fish habitats would result in a low impact score.

Table 3 Impact criteria and scoring system to prioritise non-barriers

Criterion	Description	Score
1. Structure type	Fill, slab—obvious changes to wave and sand patterns	20
	Fill, slab—possible changes to sand and wave patterns	18
	Stabilisation structures—vertical/concrete face; unlikely habitat	16
	Rubbish/wreckage—no fish/epibiota observed/unlikely habitat	15
	Rubbish/wreckage—fish/epibiota observed/likely habitat	13
	Stabilisation structures—rubble/rock; providing some fish habitat	12
	Moorings—traditional block system	10
	Pile-supported—shading; inhibiting marine plant growth	8
	Pile-supported—adequate light penetration	6
	Mooring posts	6
	Discharge/pipe—no/inadequate scour protection	5
	Formed natural surface ramp	4
	Discharge/pipe—with scour protection	3
	Moorings—environmentally friendly	3
2. Footprint area (from structure)	>250m² (provide estimate)	10
	101–25 m²	8
	51–100m²	6
	11–50m²	4
	0–10m²	1
2. Disturbance area (outside footprint)	>250m² (provide estimate)	10
	101–250m²	8
	51–100m²	6
	11–50m²	4
	0–10m²	1
	Total impact score/40	/40

Similarly, barrier structures that have a high impact on fish passage are given a high impact score compared to those structures with a low impact score. The impact criteria for prioritising barries are listed in Table 4.

Table 4 Impact criteria and scoring system to prioritise barriers

Criterion	Description	Score
1. Structure type	Tidal barrage—no further scoring	20
	Large dam or weir (e.g. across whole river valley >3m high)	13
	Tidal bund wall or levee	12
	Tidal floodgate passively managed	11
	Medium dam or weir (1.5—3m high) or culvert <60% of waterway width	11
	Small dam or weir (e.g. across waterway; <1.5m high)	10
	Culvert crossing >60% of waterway width	8
	Causeway/ford	7
	Tidal floodgates actively managed	5
	Bridge or fish-friendly structure (e.g. incorporates fishway)—no further scoring	2
2. Barrier impact (select one of a, b, c, d, e or f)	a) Dams and weirs	
	Headloss/invert level >100mm	6
	Headloss/invert level <100mm	0
	b) Tidal bund walls or levee banks	
	No evidence of tidal flow through (barrier at most times)	6
	Evidence of some tidal flow through (partial barrier)	0
	c) Floodgates	
	Evidence of tidal flow through	6
	No evidence of tidal flow through	0
	d) Culvert crossings	
	Culvert length >6m	2
	Culverts length <6m	0
	Individual culvert width >600mm	2
	Individual culvert width <600mm	0
	Culverts raised from bed level or evidence of scouring	2
	Culverts at bed level	0
	e) Causeways	
	Drop on downstream side	3
	No drop on downstream side	0
	Incorporates pipes with length <6m	3
	Doesn't incorporate pipes or incorporates pipes with length >6m	0
	f) Fords	
	Evidence of increased water velocities across the structure (e.g. scouring)	6
	No evidence of increased water velocities across the structure	0
	Total impact score/20	/20

The ranges of habitat value and impact scores, derived by addition of these two scores, for both non-barriers and barriers, is given in Table 5.

Table 5 The range of habitat value and impact scores for non-barrier and barriers

	Non-barriers	Barriers
Habitat value score (Criterion 1 + 2 + 3)	0–30	0–30
Impact score (Criterion 1 + 2)	0–40	0–20

Prioritisation matrix

Each structure was assigned a position in a prioritisation matrix, based on its habitat value and fish-friendly scores (conceptual matrix presented in Figure 5). The matrix locates structures across the four main quarters:

- high impact structures in high value habitat (Quarter 1)
- high impact structures in low value habitat (Quarter 2)
- low impact structures in low value habitat (Quarter 3)
- low impact structures in high value habitat (Quarter 4).

Identification of structures in terms of their location within a specific matrix quarter allowed priorities to be developed for each project area. Structures identified in Quarter 1 were considered as being of highest priority for management response. These structures had relatively high impacts on fish habitats and were located in relatively high value habitat. Separate matrices were developed for barriers and non-barriers in the project area.

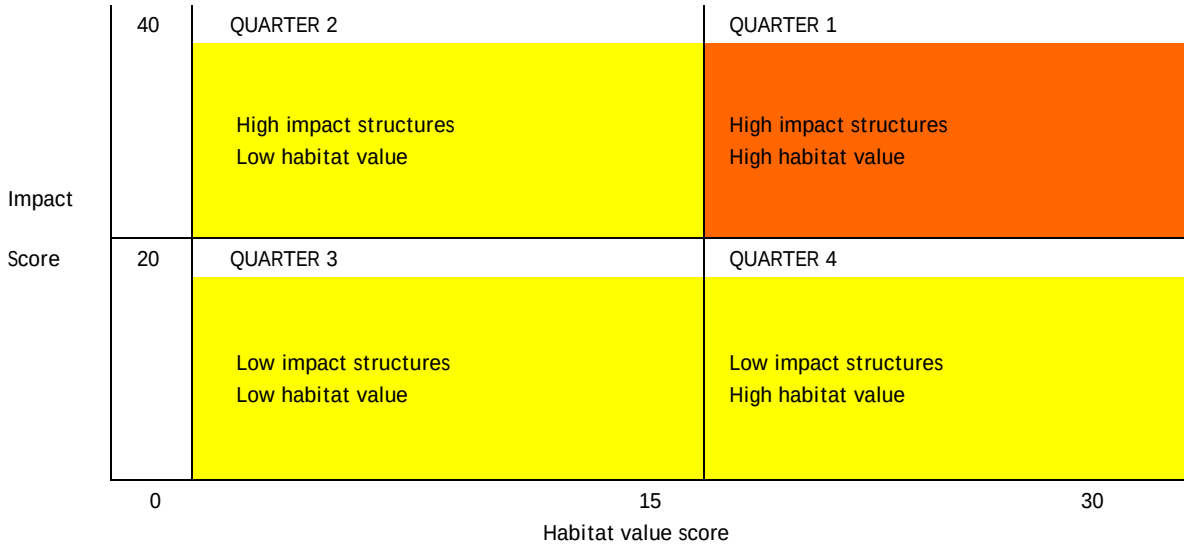

Figure 5 Prioritisation conceptul matrix

Response Action Plan (RAP)

A Response Action Plan (RAP) that identifies priority structures and recommends management response actions was developed for the GSS. The RAP is an internal QPWS document used to inform protected areas management and NRM planning decisions. The priority structures include all those non-barriers and barriers that were assessed to have relatively high impacts to fish habitats and were also in ecologically high habitat value areas (near pristine habitats) as described in the prioritisation matrix (Quarter 1).

Two types of management recommendations are specific to the RAP:

- general recommendations that apply broadly across a structure category
- specific recommendations that apply to an individual structure.

The selected management responses vary depending on the type of structure and nature of its impacts. Management responses are not restricted to but may include:

- further investigation/assessment of impacts
- developing strategic approaches to identified management actions

- decommissioning informal/unauthorised structures
- restricting access to informal/unauthorised structures
- raising awareness of ecological values
- removal of structures and rehabilitation of the site.

Local stakeholder consultation

Local stakeholder consultation and inventory training to transfer skills and knowledge took place via workshops with relevant stakeholders in the project area. Three workshops were held in Hervey Bay and Maryborough. Workshop participants included representatives from BMRG, OceanWatch and WetlandCare Australia, FCRC, GRC, the Department of Defence (DoD), DSEWPaC, DERM, and Traditional Owners. The workshops included training in the inventory and response protocols, discussion of inventory results and development of a draft RAP including recommended response actions for priority structures.

Separate presentations on the project were made to full Council meetings of the Fraser Coast Regional Council and the Gympie Regional Council.

Project Results and Discussion

A summary of inventory results for the Great Sandy Strait project area is outlined below. The results and the RAP for the Wide Bay Training Area (WBTA) are included within a supplement to this report. The supplement will have restricted circulation within State and Federal Government agencies to meet project reporting requirements and for WBTA wetlands management purposes.

Figure 6 shows coverage of project area in terms of the grids completed within the inventory. Yellow shaded grids have been completed; the two grids in blue were partially completed but lie outside Ramsar and declared FHA boundaries, and the purple shaded grids have not been assessed. Red dots show mapped structures; blue dots show location of DNPRSR bridge data on Fraser island.

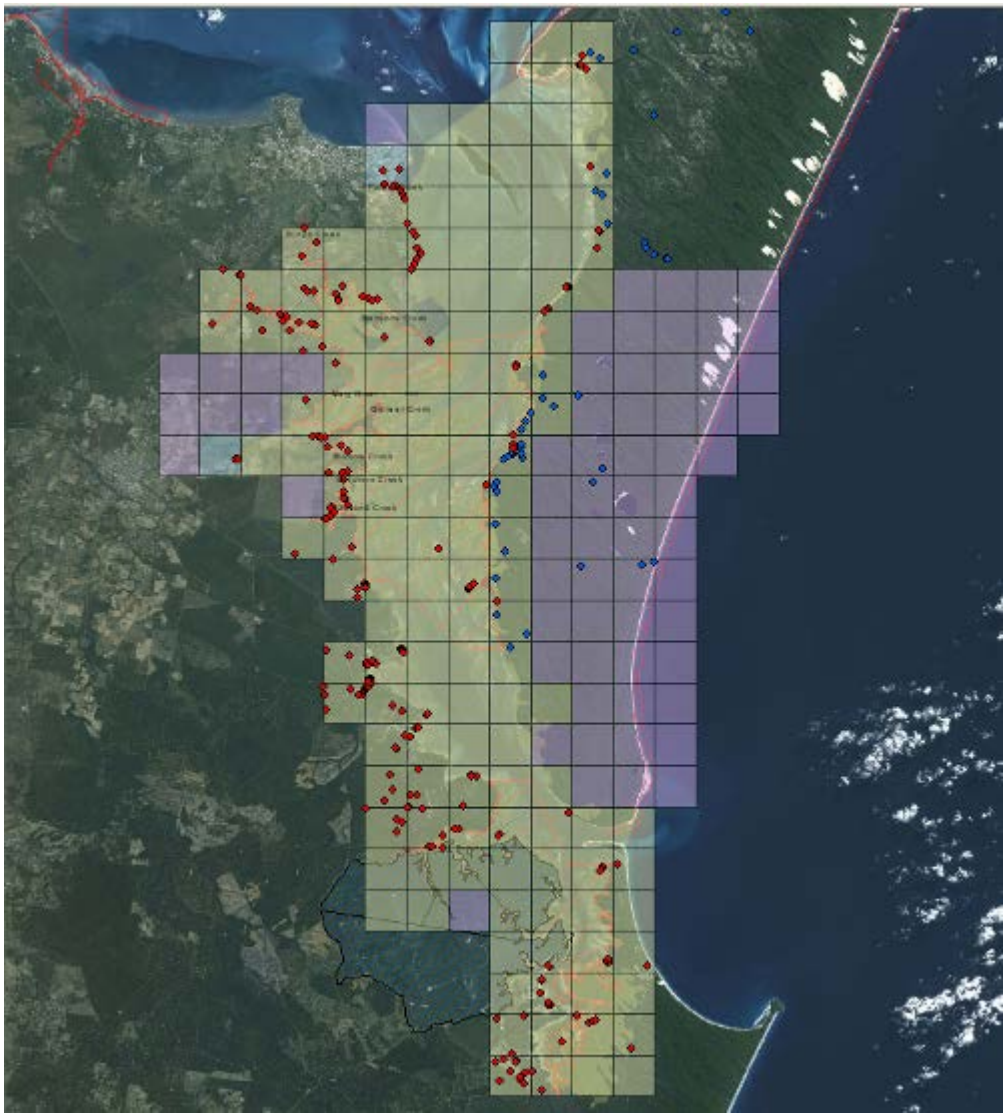

Figure 6 Extent of inventory conducted: yellow grids (completed); blue grids (2)(partially completed); purple grids (not assessed). Red dots show mapped structures; blue dots show the DNPRSR bridge data for Fraser Island

The project identified a number of non-barrier and barrier structure types and these are displayed in Table 6. The name of each different structure type was abbreviated to a two-letter code.

Table 6 List of identified structure types and abbreviated codes

Non-barriers		Barriers
Fill and slab: AC Access Channel BR Boat Ramp MA Marina SW Slipway Stabilisation: RE Revetment Rubbish/Wreckage: DM Dumped Material DV Derelict Vessel Pile supported: FP Fishing Platform JE Jetty PX Pontoon fixed PF Pontoon floating VD Viewing deck	Moorings: MO Mooring Pipe intake/oulet: PI Pipe Drains: DR Drain Other non-barriers: ON Other non-barrier	SX Stream crossings: Bridges Causeways Culverts Fords WD Weir/Dam

Project area coverage

The maps in Figures 9 and 10 show the coverage of the project area, with the location of the site for each structure recorded. The total project area, as indicated by the project area grid, encompassed the Ramsar site, five declared FHAs and some adjacent areas (Fig 8). The entire Ramsar site and five declared FHAs were inventoried, in addition to some adjacent areas.

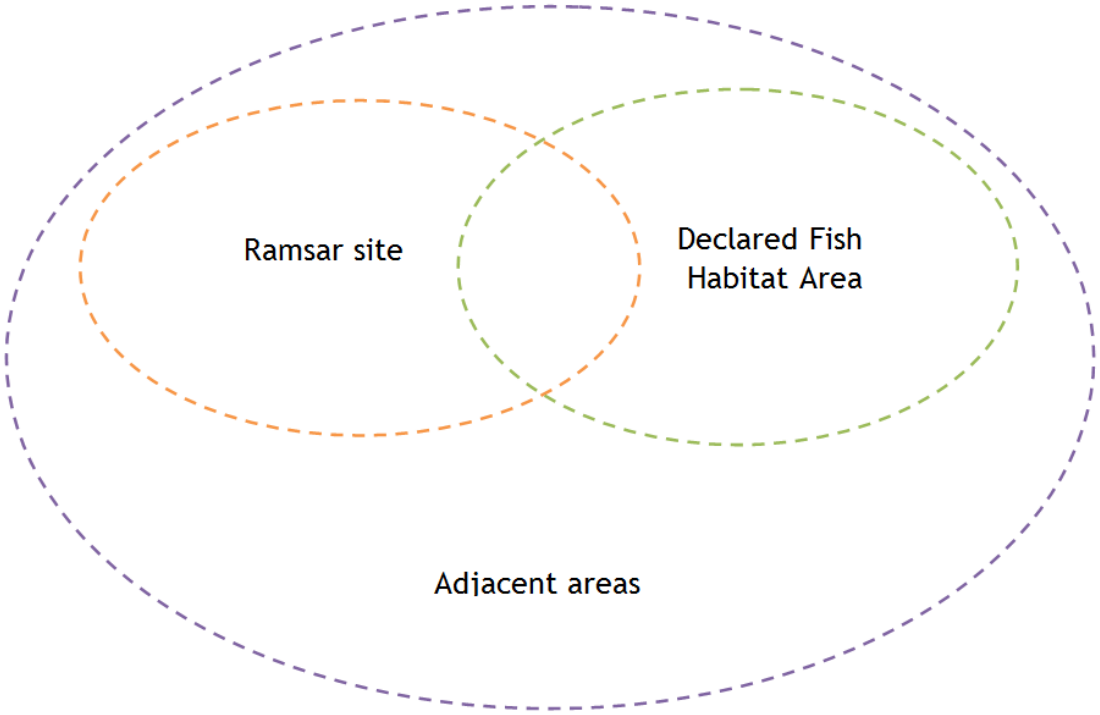

Figure 7 Total project area encompassed the Ramsar site, Declared Fish Habitat Areas and some adjacent areas.

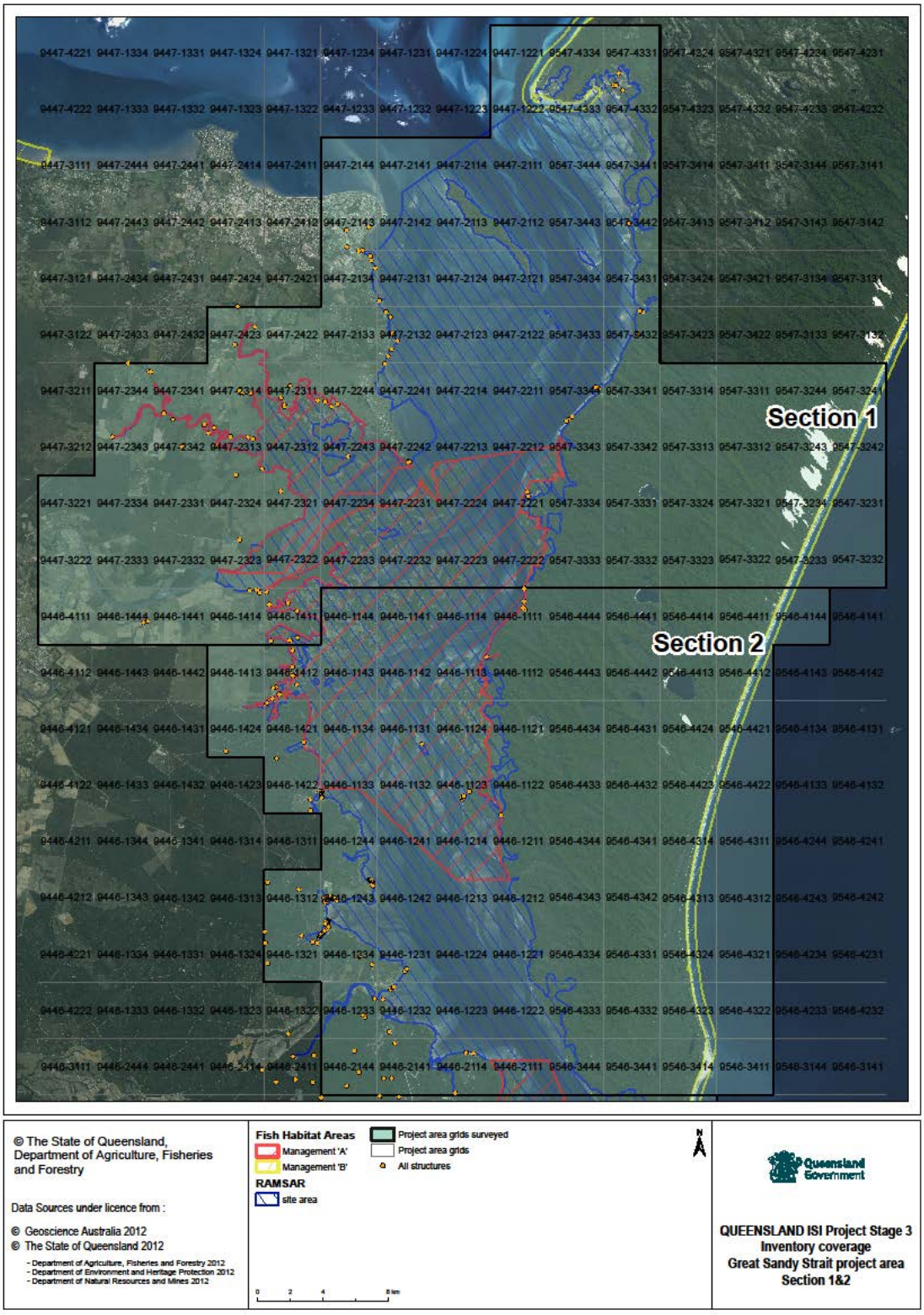

Figure 8 Inventory coverage of the GSS project area (Sections 1 and 2), showing location of each structure

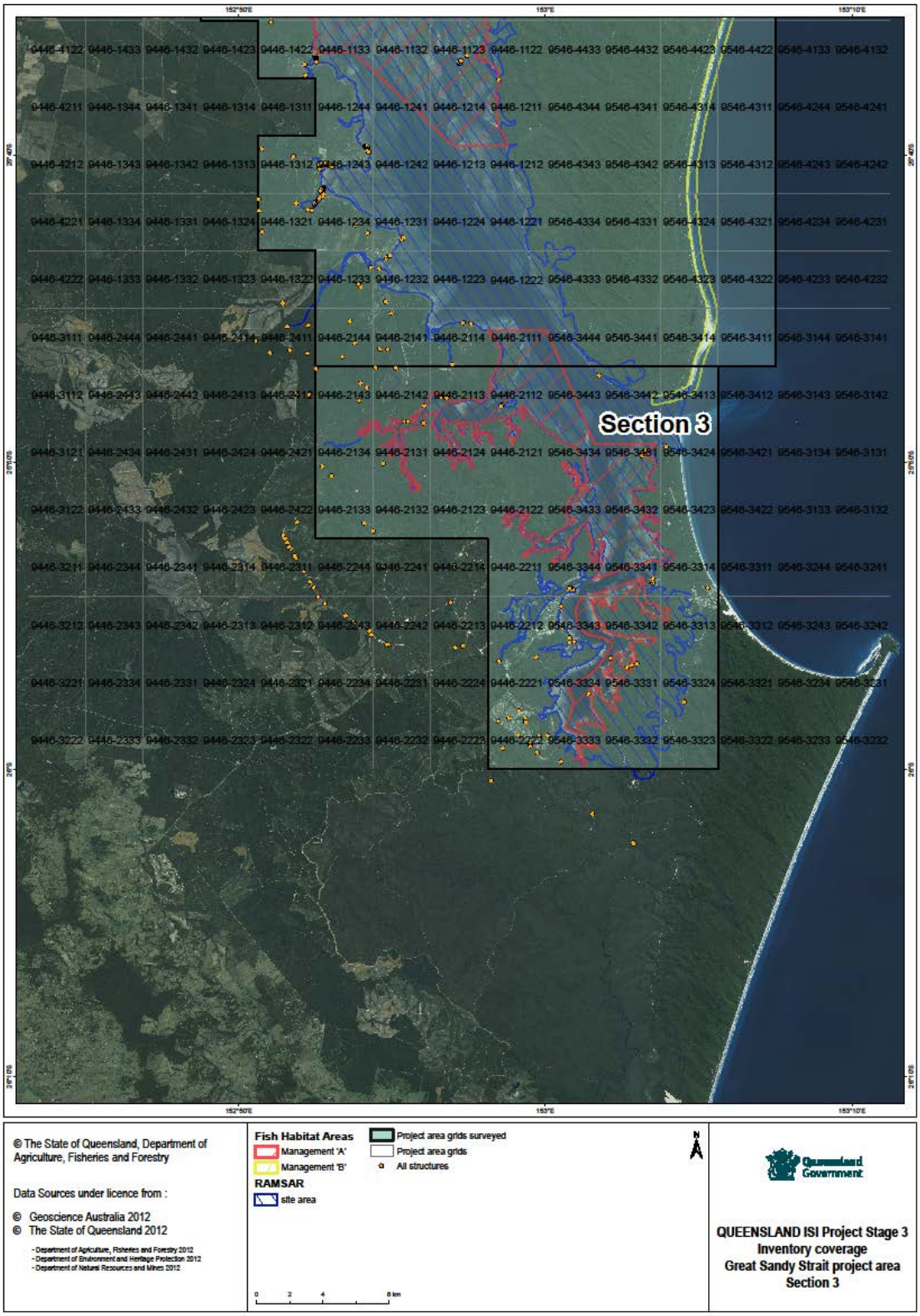

Figure 9 Inventory coverage of the GSS project area (Southern Section 2 and Section 3), showing location of each structure

Summary of structures identified

A total of 380 structures (Table 7) including 268 non-barriers and 112 barriers, were identified in the GSS project area. Of these, 193 structures were located within Ramsar boundaries (180 non-barriers; 13 barriers) and 66 (57 non-barriers; 9 barriers) across four of the five declared FHAs (Susan River—11; Maaroom—41; Kauri Creek—10; Tin Can Inlet—4; Fraser Island—0). A number of structures are located in a site that has both Ramsar site and a declared FHA status.

Table 7. Total number of structures by type in the GSS project area (Total project area includes the Ramsar site, declared FHAs and some adjacent areas outside the Ramsar and declared FHAs).

	Structure type	Total—Ramsar	Total—dec. FHAs	Total—project area
NON-BARRIERS	Access channel	0	0	1
	Boat ramp	37	17	67
	Derelict vessel	2	2	4
	Drain	0	0	6
	Dumped material	3	1	4
	Fishing platform	3	3	5
	Jetty	24	10	29
	Marina	0	0	1
	Mooring	60	5	60
	Other non-barrier	5	2	7
	Pipe intake/outlet	5	0	8
	Pontoon (fixed)	7	5	11
	Pontoon (floating)	11	3	21
	Revetment	20	8	40
	Slipway	1	0	1
	Viewing deck	2	1	3
	Total non-barriers	**180**	**57**	**268**
BARRIERS	Weir/dam	5	5	14
	Culvert crossing	0	1	20(11[1]*)
	Causeway	4	1	14(3*)
	Ford	0	0	16(4*)
	Bridge	3	1	38[2]**
	Stream crossing—Unknown	1	1	10
	Total barriers	**13**	**9**	**112**
TOTAL STRUCTURES		**193**	**66**	**380**

[1] *18 of the structures were identified during surveys by the Fisheries Queensland fishway team as part of the 'Great Sandy Straits Biopassage Project': 11 culvert crossings, 3 causeways and 4 fords.

[2] ** 8 of these bridge structures were identified during surveys by the Fisheries Queensland fishway team as part of the 'Great Sandy Straits Biopassage Project' and 29 are sourced from QPWS 2009 bridge data.

The total number of structures listed for the project area includes those within the Ramsar site and declared FHAs and adjacent areas. Maps with Insets for the recored structures are provided in Appendix B.

Structures in the GSS Ramsar site

A total of 180 non-barriers and 13 barriers were located in the Ramsar site. Structure types are in Table 7. These structures form 51% of the total for the project area and include structures that are common to those recorded in the declared FHAs.

Structures in the FHAs

There were 57 non-barriers and nine barriers located across four of the five declared FHAs. A breakdown of the number of structures within each declared FHA is provided in Table 8. These structures form 17% of the total for the project area and may include structures that are common to those recorded in the GSS Ramsar site.

Although the declared Fraser Island FHA was not surveyed via on-ground inspections, no structures were identified in the declared Fraser Island FHA. This finding was based on an aerial survey of the northern part of Fraser Island and on discussions with local stakeholders.

The largest number of non-barriers (39) occurs in the declared Maaroom FHA and the majority of these are boat ramps, revetments and jetties for private use. The declared Susan River FHA has the largest concentration of barriers (five). These are all weir structures that occur either on unallocated state land, adjacent freehold properties, or on freehold land with farming land use.

The number and types of structures located in the declared FHA local network are indicative of development proliferation in the region. This information will be incorporated within the declared FHA reporting framework developed by DAFF and be used to assess the status of existing declared FHAs to identify and prioritise future FHA management.

Table 8 Total number of structures by type in the declared Fish Habitat Areas

	Structure type	Declared Fish Habitat Area				
		Susan River	Maaroom	Kauri Creek	Tin Can Inlet	Fraser Island
NON-BARRIERS	Access channel					
	Boat ramp	2	11	4		
	Derelict vessel		2			
	Drain					
	Dumped material	1				
	Fishing platform	2	1			
	Jetty		8	1	1	
	Marina					
	Mooring		1	4		
	Other non-barrier			1	1	
	Pipe intake/outlet					
	Pontoon (fixed)		5			
	Pontoon (floating)	1	2			
	Revetment		8			
	Slipway					
	Viewing deck		1			
	Total non-barriers	**6**	**39**	**10**	**2**	**0**
BARRIERS	Weir/dam	5				
	Culvert crossing					
	Causeway		1		1	
	Ford					
	Bridge				1	
	Stream crossing—Unknown		1			
	Total barriers	**5**	**2**	**0**	**2**	**0**
TOTAL STRUCTURES		11	41	10	4	0

Structures recorded but not included in the prioritisation process

A number of structures within the GSS project area were excluded from either the assessment component of the survey or from the prioritisation process for the reasons outlined below.

Non-barriers

Snapper Creek

A number of structures within a 1.2km section (Figure 9—grid references 9546–3344; 9446–2211) of the southern bank of Snapper Creek, Tin Can Bay were not individually assessed as part of the project. The section lies outside the Ramsar site and declared FHA boundaries. It was noted during fieldwork that there are a variety of instream structures (e.g. pontoons, jetties, slipways, marina etc.) located at this site in support of commercial marine industry.

The following three structures in this area were assessed: the public boat ramp, small fishing platform and pontoon at Barnacles Café, Tin Can Bay. These are indicative of the type and nature of structures along this section of Creek. The impacts from these structures are historical and time constraints did not allow a comprehensive survey to be undertaken. As such, the three structures that were assessed were not included in the prioritisation (although these do form part of the project dataset).

Barriers

Twenty-seven barrier structures mapped as part of the project were not ground-truthed. These structures are a mix of weirs (13) and stream crossings (14). The weirs are mostly located on freehold land in the northern half of the GSS and were unable to be accessed during the course of the project. These structures were mapped using satellite and aerial imagery and aerial photography. Some further detail on these structures is outlined in project results.

On Fraser Island there are 29 hardwood bridge structures in the project area (mapped by QPWS). These fall along the western coast of Fraser Island. These were not ground-truthed as part of project survey but may warrant further investigation. One of the structures falls within the Ramsar boundaries (Figure 8, project grid reference 9446–1211; QPWS reference 'Toowara Creek').

Other issues identified

Sites of cattle and vehicle access/disturbance

Ten sites were identified during fieldwork where marine plants and tidal areas had been disturbed by either vehicle access or cattle. These sites, and a short description of each, are listed in the Response Action Plan (RAP). Four of the sites are at the locations of existing instream structures. The remaining six, although potentially having a relatively high impact for fish habitats, do not occur in association with the location of instream structures. None of the sites have been included in the prioritisation, however, they have been identified as part of the survey and may be considered for future rehabilatation and access management, e.g. fencing or similar access control measures.

Other prioritisation studies

Two other projects involving identification of structures impacting on biopassage ran concurrently with the current project.

The aim of the Biopassage Assessment of the Great Sandy Strait (White, 2012) was to build on the earlier Burnett Mary Regional Biopass Strategy (Stockwell et al., 2008), to prioritise potential barriers to facilitate biopassage and address the documented threat of a loss of connectivity to the Great Sandy Strait Ramsar site, specifically within the Cooloola Coast and Mary Estuary subcatchments.

The purpose of the Great Sandy Strait Biopassage Remediation Project (Berghuis, 2012) was to identify and remediate at least three biopassage barriers on streams in the Great Sandy Region.

While the scoring of structures and prioritisation critera differed between projects, significant similarity in sites being assessed allowed for pooling of resources. Data was shared amongst the three projects and for consistency the same final dataset was used by each project prioritisation.

In addition to assessing structures that may impact on biopassage, the current project included mapping and assessment of other coastal infrastructure that can have a range of impacts on fish habitats and hydrological processes, e.g. revetments, boat ramps, pontoons, moorings.

Prioritisation of structures—Response Action Plan

A total of 53 structures were located in Quarter 1 (high impact structures in areas of high value habitat) following the prioritisation process. Of these, 44 were non-barriers and these structures consisted of examples from the categories of fill/slab/dredging (30), stabilisation (9), rubbish/wreckage (3) and other non-barrier structures (2). The remainder, 9 structures, were barriers with 1 weir/dam and 8 stream crossings identified. These 53 structures form the basis of the RAP. A list of the structures and prioritisation scores for Quarters 1–4 is provided in Appendix C.

Due to its dynamic nature, it was decided to maintain the RAP as a stand alone, internal document separate from the final report. The RAP requires regular review, as the identified issues and management recommendations are to be addressed as funding and resources become available. This will depend on current agency priorities and their status is likely to change frequently. Further structures may also be added, subject to their meeting the criteria for inclusion. Agencies that may be involved in the delivery of RAP recommendations include Queensland Parks and Wildlife Service (QPWS), Fisheries Queensland and the Queensland Boating and Fisheries Patrol (DAFF), Department of Environment and Heritage Protection, Department of Transport and Main Roads (DTMR), Burnett Mary Regional Group (BMRG), Fraser Coast Regional Council (FCRC), Gympie Regional Council (GRC), Maritime Safety Queensland (MSQ), Oceanwatch and WetlandCare Australia.

Non-barriers

Out of the total 268 non-barrier structures, 265 were prioritised. The three structures that were not prioritised fell within the section of Snapper Creek that was excluded from the survey. The total number of priroitised structures that fell into Quarter 1 from the matrix was 44 non-barriers. Details of these are provided in the RAP.

Barriers

Out of the 112 total barriers mapped as part of the project, 60 were prioritised. Scoring of the 60 structures against habitat value and impact criteria and application of the prioritisation matrix resulted in identification of 9 priority barriers for the GSS project area. Appendix C contains the non-barrier and barrier prioritisation matrices respectively. Maps of the locations of priority structures are contained in this Appendix. The RAP for the GSS includes prioritisation matrices and recommended response actions for priority structures.

The 52 that weren't prioritised consisted of:

- 13 weirs in the northern GSS—4 of the weirs (structure IDs) are within the GSS Ramsar site and Susan River declared FHA—near MARY033WD (see Table 1, Appendix C).
- 39 stream crossings, 29 were the bridge crossings provided by QPWS; 10 were stream crossings mapped using using satellite and aerial imagery and aerial photography, but not ground-truthed due to access issues. Given that no on-ground inspection was undertaken they were unable to be asssessed and prioritised. One of the stream crossings (structure ID) is in the GSS Ramsar and Maaroom FHA.

Conclusions and future directions

The key outcomes of the Great Sandy Strait Ramsar site project are:

greater awareness across local government, state agencies and community groups, with responsiblities and interest in the Great Sandy Strait, of the values and functions of the Ramsar site and the declared FHAs, noting that the numerous structures currently located within the Great Sandy Strait study area do have impacts on these values and functions

- extensive inventory of some 380 structures of non-barriers and barriers and development of the RAP to address 53 priority structures through further site investigation and review of proposed management recommendations
- training of local stakeholder to transfer skills and knowledge via three workshops at Hervey Bay and Maryborough. Workshop participants included representatives from BMRG, OceanWatch and WetlandCare Australia, Fraser Coast Regional Council, Gympie Regional Council, the Department of Defence, DSEWPaC, DERM, and Traditional Owners
- formal presentations on the project findings to full Council meetings of the Fraser Coast Regional Council and the Gympie Regional Council.

This project is the third project within the five-year Fisheries Queensland inventory program to audit instream structures in selected declared FHAs in coastal Queensland. Additional inventory work will see completion of Years 4 and 5 of the program. The program delivers the Fisheries Queensland declared Fish Habitat Area Network Strategy 2009–2014 action to 'actively manage and respond to unlawful activities to prevent the degradation of individual declared FHAs and the declared FHA Network'.

The inventory provides an important base-line in documenting the type, number and location of the instream structures. Based on an approach that is both practical and systematic, the inventory gives an evaulation and measure of the existing level of coastal development and its impacts, approved and unapproved, in the Great Sandy Strait study area.

The inventory also provides an assessment of the awareness of local stakeholders of the Ramsar site and declared FHA values and functions and of the understanding of the approval requirements for instream structures and the level of compliance.

Implementation of the RAP in collaboration with local stakeholders in delivering appropriate management responses to the 53 priority non-barriers and barriers will address many of the impacts identified and documented. Long-term benefits are for the ecological character of the Great Sandy Strait Ramsar site, the five declared FHAs, Great Sandy Marine Park and other protected areas in the Great Sandy Strait study area.

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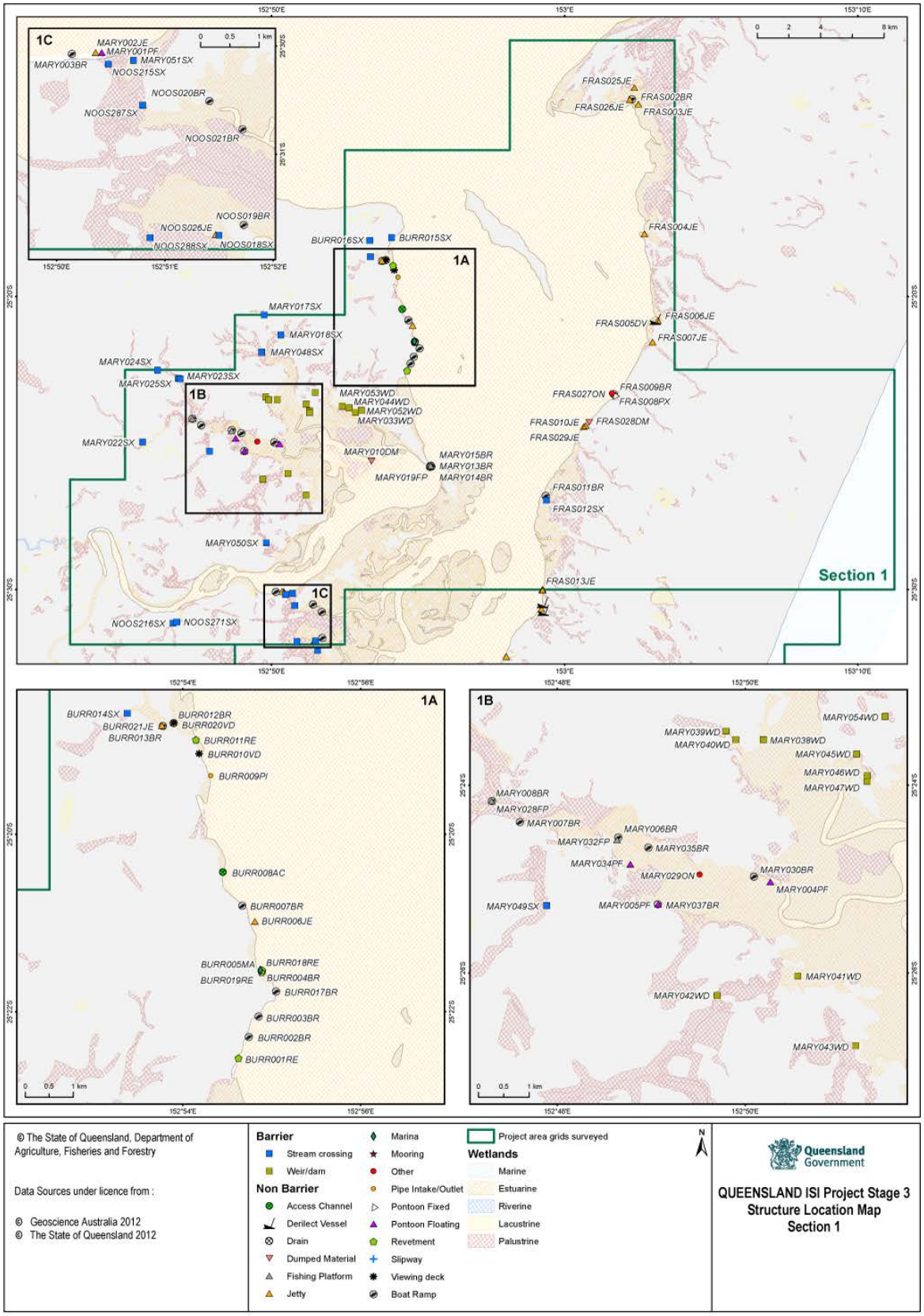
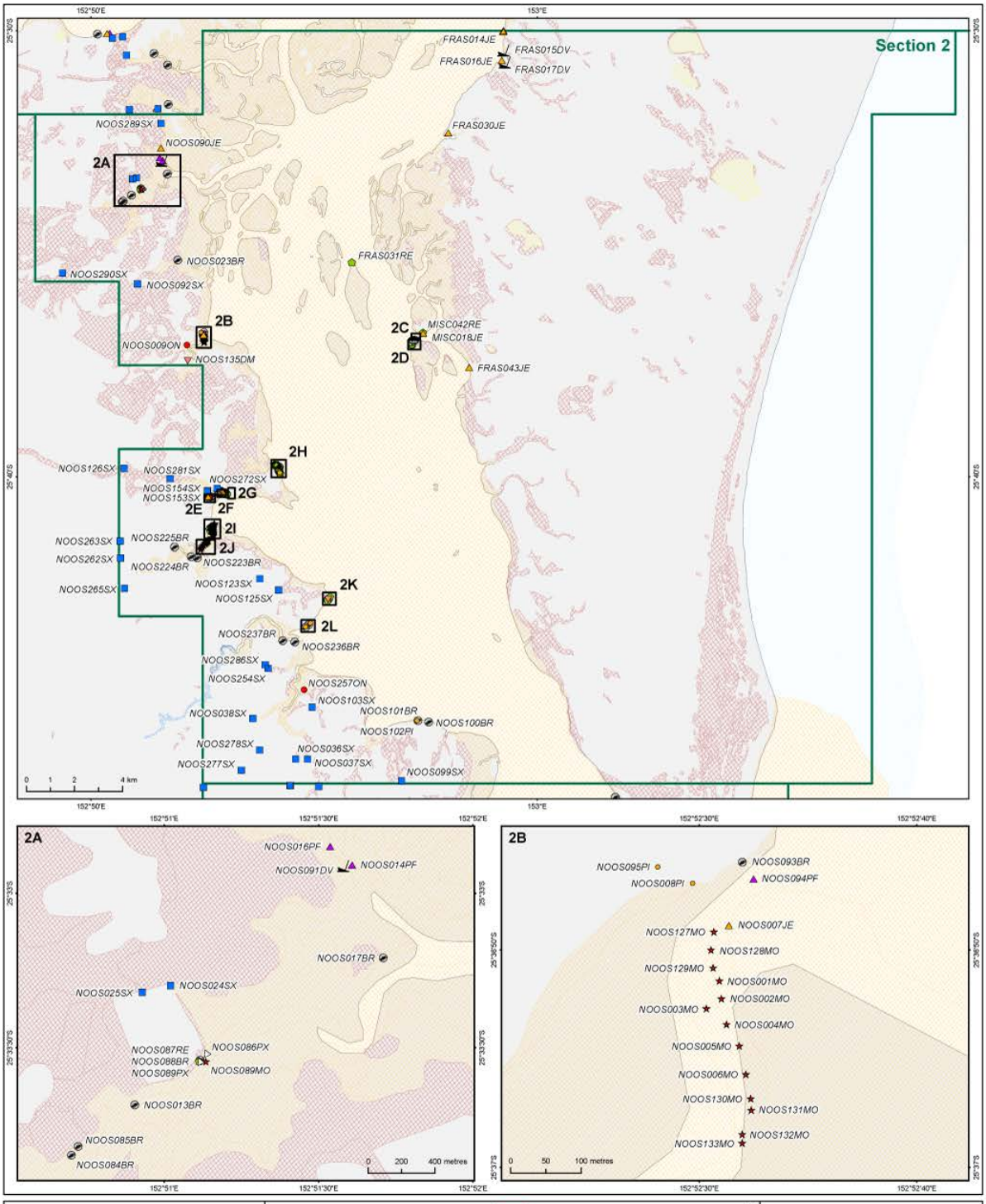
Appendix A—Project reference group

Project Reference Group Members

Name	Organisation
Malcolm Burns	Traditional Owner, Butchulla people
Greg Ingham	General Manager Works, Eastern Division Gympie Regional
Amy Gosley	Environmental Planning Officer, Gympie Regional Council Council
Mary-Alice Swan	Great Sandy Straits and Biopassage Project Manager, BMRG
Daniel Clifton	Senior Ranger, Great Sandy Marine Park, QPWS, DERM
Sherry O'Brien	Senior Project Officer, WetlandCare (Bundaberg)
Adam Gosling	Regional Coordinator, WetlandCare (Ballina)
Jamie Bunt	Principal Officer, Coastal Management, Fraser Coast Regional Council
John McLennan	Senior Development Engineer, Fraser Coast Regional Council
Luke Jackson	Senior Environmental Officer, Wide Bay/Burnett Region, DTMR
Andrew Berghuis	Senior Fisheries Biologist (Fishway), Fisheries Qld, DAFF
Chris Lupton	Senior Fisheries Technical Officer, Fisheries Qld, DAFF
Dawn Couchman	Senior Fisheries Scientist, Fisheries Qld, DAFF
John Beumer	Principal Scientist, Fisheries Qld, DAFF
Mary Chang (nee Lawrence)	Fisheries Scientist, Fisheries Queensland, DAFF

4 Appendix B. Maps (6) with Insets all structures, types and locations

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NOOS006MO
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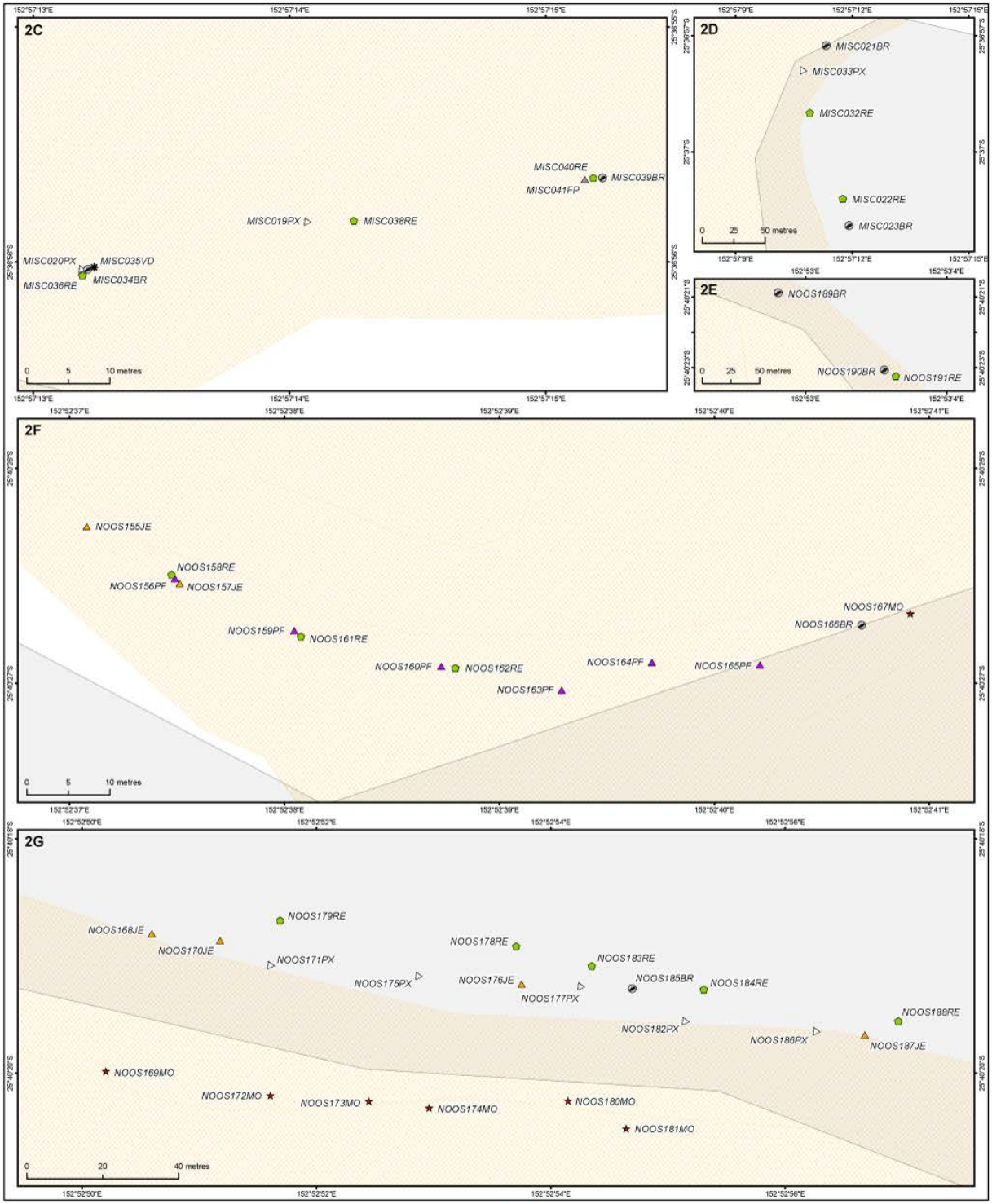
Data Sources under licence from
© Geoscience Australia 2012
© The State of Queensland 2012
Barrier
Stream crossing
Weir/dam
Non Barrier
Access Channel
Derilect Vessel
Drain
Dumped Material
Fishing Platform
Jetty
Marina
Mooring
Other
Pipe Intake/Outlet
Pontoon Fixed
Pontoon Floating
Revetment
Slipway
Viewing deck
Boat Ramp
Project area grids surveyed
Wetlands
Marine
Estuarine
Riverine
Lacustrine
Palustrine
N
Queensland Government
QUEENSLAND ISI Project Stage 3
Structure Locations
Section 2



Barrier
- Stream crossing
- Weir/dam

Non Barrier
- Access Channel
- Derilect Vessel
- Drain
- Dumped Material
- Fishing Platform
- Jetty
- Marina
- Mooring
- Other
- Pipe Intake/Outlet
- Pontoon Fixed
- Pontoon Floating
- Revetment
- Slipway
- Viewing deck
- Boat Ramp

Project area grids surveyed

Wetlands
- Marine
- Estuarine
- Riverine
- Lacustrine
- Palustrine

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Queensland Government

QUEENSLAND ISI Project Stage 3
Structure Locations
Section 2i


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0 25 50 metres
2L
NOOS116PI
NOOS115PI
NOOS114BR
NOOS112PI
NOOS104BR
0 25 50 metres
2J
NOOS234MO
NOOS233MO
NOOS232MO
NOOS231MO
NOOS230MO
NOOS229MO
NOOS228MO
NOOS227MO
NOOS226MO
0 50 100 metres
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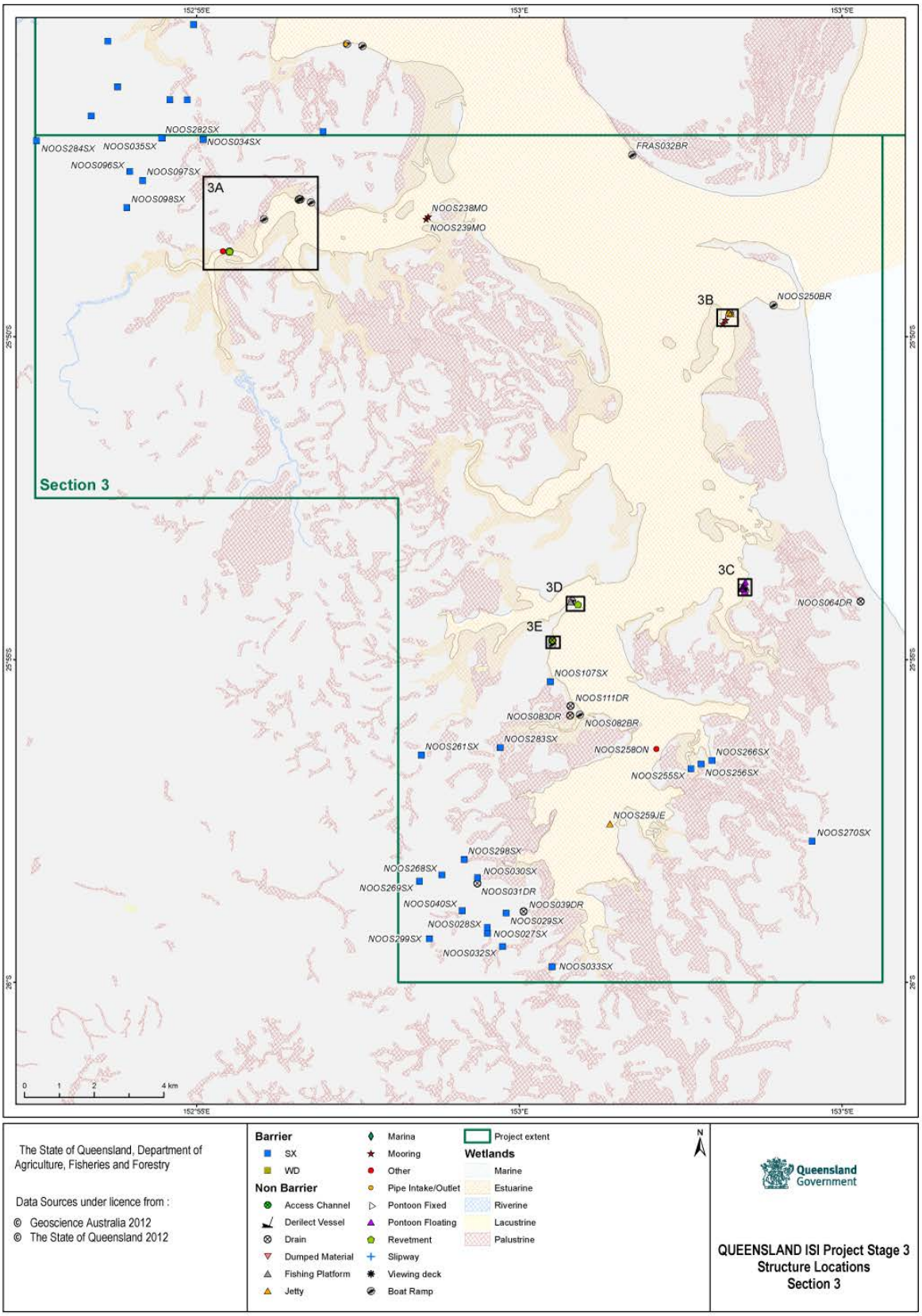
Barrier
Stream crossing
Weir/dam
Non Barrier
Access Channel
Derilect Vessel
Drain
Dumped Material
Fishing Platform
Jetty
Marina
Mooring
Other
Pipe Intake/Outlet
Pontoon Fixed
Pontoon Floating
Revetment
Slipway
Viewing deck
Boat Ramp
Project area grids surveyed
Wetlands
Marine
Estuarine
Riverine
Lacustrine
Palustrine
N
Queensland Government
QUEENSLAND ISI Project Stage 3
Structure Locations
Section 2ii


152°55'E
153°E
153°5'E
25°55'S
26°S
NOOS282SX
NOOS284SX
NOOS035SX
NOOS034SX
NOOS096SX
NOOS097SX
NOOS098SX
3A
NOOS238MO
NOOS239MO
FRAS032BR
3B
NOOS250BR
Section 3
3C
3D
3E
NOOS064DR
NOOS107SX
NOOS111DR
NOOS083DR
NOOS082BR
NOOS261SX
NOOS283SX
NOOS258ON
NOOS266SX
NOOS255SX
NOOS256SX
NOOS259JE
NOOS270SX
NOOS298SX
NOOS268SX
NOOS030SX
NOOS269SX
NOOS031DR
NOOS040SX
NOOS039DR
NOOS028SX
NOOS029SX
NOOS299SX
NOOS027SX
NOOS032SX
NOOS033SX
0 1 2 4 km
The State of Queensland, Department of Agriculture, Fisheries and Forestry
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Barrier
SX
WD
Non Barrier
Access Channel
Derilect Vessel
Drain
Dumped Material
Fishing Platform
Jetty
Marina
Mooring
Other
Pipe Intake/Outlet
Pontoon Fixed
Pontoon Floating
Revetment
Slipway
Viewing deck
Boat Ramp
Project extent
Wetlands
Marine
Estuarine
Riverine
Lacustrine
Palustrine
N
Queensland Government
QUEENSLAND ISI Project Stage 3
Structure Locations
Section 3


3A
NOOS242BR
NOOS241BR
NOOS243BR
NOOS240BR
NOOS244BR
NOOS246BR
NOOS248ON
NOOS247RE
0 0.5 1 km
3B
NOOS067JE
NOOS066BR
NOOS065JE
NOOS251MO
NOOS252MO
0 50 100 metres
3C
NOOS077PF
NOOS075PF
NOOS076PF
NOOS074PF
NOOS073BR
NOOS072PF
NOOS071PF
NOOS068RE
NOOS069BR
NOOS070PF
0 25 50 metres
3D
NOOS091BR
NOOS109PF
NOOS110FP
NOOS108RE
0 50 100 metres
3E
NOOS081DR
NOOS080RE
NOOS079BR
0 25 50 metres
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Barrier
SX
WD
Non Barrier
Access Channel
Derilect Vessel
Drain
Dumped Material
Fishing Platform
Jetty
Marina
Mooring
Other
Pipe Intake/Outlet
Pontoon Fixed
Pontoon Floating
Revetment
Slipway
Viewing deck
Boat Ramp
Project_Extents
Wetlands
Marine
Estuarine
Riverine
Lacustrine
Palustrine
N
Queensland Government
QUEENSLAND ISI Project Stage 3
Structure Locations
Section 3(i)

5 Appendix C. Q1, Q2, Q3, Q4 structures

Table 1 Structures from **Quarter 1** of the prioritisation matrix: high impact structures in low value habitat

Structure ID	Structure type	Structure Description	Habitat value	Impact score
Non-barriers				
BURR005MA	Fill/slab, dredging	Mini marina	20	31
BURR008AC		Access Channel	26	36
NOOS212SW		Slipway	22	25
BURR006JE		Jetty	26	29
BURR010VD		Viewing deck	26	25
BURR002BR		Boat ramp	26	27
BURR003BR		Boat ramp	26	25
BURR004BR		Boat ramp	23	23
MISC023BR		Boat ramp	23	23
NOOS020BR		Boat ramp	26	23
NOOS069BR		Boat ramp	23	27
NOOS114BR		Boat ramp	23	25
NOOS142BR		Boat ramp	23	25
BURR013BR		Boat ramp	18	23
NOOS066BR		Boat ramp	23	27
MARY003BR		Boat ramp	20	27
MARY013BR		Boat ramp	18	29
MARY014BR		Boat ramp	26	27
MARY015BR		Boat ramp	26	27
NOOS082BR		Boat ramp	23	29
NOOS093BR		Boat ramp	26	29
NOOS100BR		Boat ramp	23	25
NOOS101BR		Boat ramp	23	27
NOOS104BR		Boat ramp	23	29
NOOS213BR		Boat ramp	22	27

Structure ID	Structure type	Structure Description	Habitat value	Impact score
NOOS240BR		Boat ramp	25	23
NOOS073BR		Boat ramp	23	27
FRAS009BR		Boat ramp	23	29
FRAS011BR		Boat ramp	22	23
FRAS032BR		Boat ramp	23	25
FRAS031RE	Stabilisation	Revetment	28	23
BURR019RE		Revetment	23	21
MISC032RE		Revetment	23	23
NOOS137RE		Revetment	23	21
NOOS138RE		Revetment	23	21
NOOS139RE		Revetment	23	21
NOOS151RE		Revetment	23	21
NOOS068RE		Revetment	23	36
NOOS122RE		Revegetation project	28	23
FRAS005DV	Rubbish/wreckage	Derelict vessel	24	22
FRAS015DV		Derelict vessel	23	22
FRAS017DV		Derelict vessel	22	22
FRAS027ON	Other non-barriers	Breakwater	23	24
NOOS009ON		Dredging & filling	24	31
Barriers				
MARY033WD	Weir/dam	Weir	16	16
FRAS012SX	Stream crossings	Causeway	28	13
NOOS018SX		Causeway	24	13
NOOS024SX		Causeway	26	13
NOOS025SX		Causeway	26	13
NOOS256SX		Causeway	24	13
NOOS266SX		Causeway	20	13
NOOS215SX		Pipe culvert	18	13
NOOS272SX		Pipe culvert	20	13

Table 2 Structures from **Quarter 2** of the prioritisation matrix: high impact structures in low value habitat

Structure ID	Structure type	Structure Description	Habitat value	Impact score
Non-barriers				
BURR012BR	Fill/slab, dredging	Boat ramp	15	23
NOOS190BR		Boat ramp	15	25
NOOS178RE	Stabilisation	Revetment	15	21
NOOS184RE		Revetment	15	21
NOOS188RE		Revetment	15	21
NOOS191RE		Revetment	15	23
Barriers				
BURR014SX	Stream crossings	Pipe Culvert	12	12
BURR016SX		Pipe Culvert	2	13
MARY017SX		Pipe Culvert	10	15
NOOS028SX		Box Culvert	14	15
NOOS032SX		Pipe Culvert	12	15
NOOS040SX		Pipe Culvert	10	12
NOOS099SX		Pipe Culvert	14	15
NOOS107SX		Box Culvert	14	12
NOOS126SX		Box Culvert	12	12
NOOS265SX		Box Culvert	8	13
NOOS268SX		Box Culvert	6	13
NOOS269SX		Pipe Culvert	6	13
NOOS270SX		Pipe Culvert	12	15
NOOS277SX		Pipe Culvert	14	13
NOOS284SX		Causeway	12	17
NOOS035SX		Causeway	10	13
NOOS038SX		Causeway	14	15
NOOS029SX		Ford	14	13
NOOS030SX		Ford	10	13
NOOS033SX		Ford	14	13
NOOS034SX		Ford	12	13

Table 3 Structures from **Quarter 3** of the prioritisation matrix: low impact structures in low value habitat

Structure ID	Structure type	Structure Description	Habitat value	Impact score
Non-barriers				
NOOS166BR	Fill/slab, dredging	Boat ramp	15	20
NOOS185BR		Boat ramp	15	20
NOOS189BR		Boat ramp	15	6
NOOS031DR	Drains	Drain	10	5
NOOS039DR		Drain	2	16
NOOS064DR		Drain	6	12
NOOS176JE		Jetty	15	13
NOOS187JE		Jetty	15	13
NOOS167MO	Moorings	Mooring	15	8
NOOS169MO		Mooring	15	12
NOOS172MO		Mooring	15	8
NOOS173MO		Mooring	15	11
NOOS174MO		Mooring	15	11
NOOS180MO		Mooring	15	8
NOOS181MO		Mooring	15	11
NOOS177PX	Pile supported	Pontoon (fixed)	15	10
NOOS182PX		Pontoon (fixed)	15	13
NOOS186PX		Pontoon (fixed)	15	13
NOOS179RE	Stabilisation	Revetment	15	18
NOOS183RE		Revetment	15	18
Barriers				
NOOS216SX	Stream crossings	Pipe Culvert	10	10
NOOS262SX		Pipe Culvert	10	10
BURR015SX		Causeway	10	10
MARY018SX		Causeway	14	10
MARY023SX		Causeway	14	10
MARY025SX		Causeway	14	10
NOOS027SX		Ford	14	7
NOOS096SX		Ford	6	7
NOOS097SX		Ford	10	7
NOOS098SX		Ford	10	7
NOOS103SX		Ford	12	7
NOOS123SX		Ford	6	7
NOOS125SX		Ford	8	7
NOOS254SX		Ford	14	7
NOOS281SX		Ford	12	7
NOOS282SX		Ford	12	7
NOOS286SX		Ford	14	7
MARY024SX		Bridge	14	2
NOOS036SX		Bridge	10	2
NOOS037SX		Bridge	12	2
NOOS278SX		Bridge	14	2

Table 4 structures from Quarter 4 of the prioritisation matrix: low impact structures in high value habitat

Structure ID	Structure type	Structure Description	Habitat value	Impact score
Non-barriers				
BURR007BR	Fill/slab, dredging	Boat ramp	26	9
BURR017BR		Boat ramp	23	9
FRAS002BR		Boat ramp	22	15
MARY006BR		Boat ramp	26	9
MARY007BR		Boat ramp	26	9
MARY008BR		Boat ramp	26	9
MARY030BR		Boat ramp	26	6
MARY035BR		Boat ramp	26	6
MARY037BR		Boat ramp	26	20
MISC021BR		Boat ramp	23	10
MISC034BR		Boat ramp	23	10
MISC039BR		Boat ramp	23	10
NOOS013BR		Boat ramp	26	16
NOOS017BR		Boat ramp	26	18
NOOS019BR		Boat ramp	28	14
NOOS021BR		Boat ramp	26	12
NOOS023BR		Boat ramp	20	15
NOOS079BR		Boat ramp	23	11
NOOS084BR		Boat ramp	21	14
NOOS085BR		Boat ramp	21	6
NOOS088BR		Boat ramp	26	20
NOOS119BR		Boat ramp	23	20
NOOS144BR		Boat ramp	23	20
NOOS146BR		Boat ramp	23	20
NOOS148BR		Boat ramp	23	20
NOOS223BR		Boat ramp	22	18
NOOS224BR		Boat ramp	19	6
NOOS225BR		Boat ramp	19	9
NOOS236BR		Boat ramp	19	18
NOOS237BR		Boat ramp	19	6
NOOS241BR		Boat ramp	25	9
NOOS242BR		Boat ramp	25	9
NOOS243BR		Boat ramp	25	6
NOOS244BR		Boat ramp	25	9
NOOS246BR		Boat ramp	25	9
NOOS250BR		Boat ramp	23	9
NOOS091DV	Rubbish/wreckage	Derelict vessel	26	20
NOOS081DR	Drains	Drain	28	7
NOOS083DR		Drain	20	5
NOOS111DR		Drain	28	7
FRAS028DM		Dumped material	23	17
MARY010DM		Dumped material	26	20
NOOS121DM		Dumped material	23	15

Structure ID	Structure type	Structure Description	Habitat value	Impact score
NOOS135DM		Dumped material	26	15
MARY019FP		Fishing platform	26	19
MARY028FP		Fishing platform	26	10
MARY032FP		Fishing platform	26	10
MISC041FP		Fishing platform	23	8
BURR021JE	Pile supported	Jetty	20	13
FRAS003JE		Jetty	22	17
FRAS004JE		Jetty	24	15
FRAS006JE		Jetty	24	17
FRAS007JE		Jetty	24	13
FRAS010JE		Jetty	23	15
FRAS013JE		Jetty	23	13
FRAS014JE		Jetty	23	13
FRAS016JE		Jetty	24	17
FRAS025JE		Jetty	24	13
FRAS026JE		Jetty	24	10
FRAS029JE		Jetty	23	10
FRAS030JE		Jetty	24	10
FRAS043JE		Jetty	23	13
MARY002JE		Jetty	20	13
MISC018JE		Jetty	26	13
NOOS007JE		Jetty	26	10
NOOS026JE		Jetty	24	8
NOOS065JE		Jetty	28	11
NOOS067JE		Jetty	23	15
NOOS090JE		Jetty	26	16
NOOS155JE		Jetty	20	10
NOOS157JE		Jetty	20	8
NOOS168JE		Jetty	18	13
NOOS170JE		Jetty	20	13
NOOS259JE		Jetty	26	14
NOOS001MO	Moorings	Mooring	21	15
NOOS002MO		Mooring	21	15
NOOS003MO		Mooring	21	15
NOOS004MO		Mooring	21	15
NOOS005MO		Mooring	21	15
NOOS006MO		Mooring	21	15
NOOS089MO		Mooring	21	15
NOOS127MO		Mooring	21	14
NOOS128MO		Mooring	21	15
NOOS129MO		Mooring	21	15
NOOS130MO		Mooring	21	15
NOOS131MO		Mooring	21	15
NOOS132MO		Mooring	21	15
NOOS133MO		Mooring	21	15
NOOS192MO		Mooring	19	15
NOOS193MO		Mooring	19	15

Structure ID	Structure type	Structure Description	Habitat value	Impact score
NOOS194MO		Mooring	19	15
NOOS195MO		Mooring	19	15
NOOS196MO		Mooring	19	15
NOOS197MO		Mooring	19	15
NOOS198MO		Mooring	19	15
NOOS199MO		Mooring	19	15
NOOS200MO		Mooring	19	15
NOOS201MO		Mooring	19	15
NOOS202MO		Mooring	19	15
NOOS203MO		Mooring	19	15
NOOS204MO		Mooring	19	15
NOOS205MO		Mooring	19	15
NOOS206MO		Mooring	19	15
NOOS207MO		Mooring	19	15
NOOS208MO		Mooring	19	15
NOOS209MO		Mooring	19	15
NOOS210MO		Mooring	19	15
NOOS211MO		Mooring	19	15
NOOS217MO		Mooring	19	15
NOOS218MO		Mooring	19	15
NOOS219MO		Mooring	19	15
NOOS220MO		Mooring	19	15
NOOS221MO		Mooring	19	15
NOOS222MO		Mooring	19	15
NOOS226MO		Mooring	19	15
NOOS227MO		Mooring	19	15
NOOS228MO		Mooring	19	15
NOOS229MO		Mooring	19	15
NOOS230MO		Mooring	19	15
NOOS231MO		Mooring	19	15
NOOS232MO		Mooring	19	15
NOOS233MO		Mooring	19	15
NOOS234MO		Mooring	19	15
NOOS238MO		Mooring	25	15
NOOS239MO		Mooring	25	15
NOOS251MO		Mooring	23	15
NOOS252MO		Mooring	23	15
MARY029ON	Other non-barriers	Other non-barrier	26	8
NOOS235ON		Other non-barrier	24	17
NOOS248ON		Other non-barrier	28	13
NOOS258ON		Other non-barrier	23	8
BURR009PI	Pipe intake/outlet	Pipe intake/outlet	28	18
NOOS008PI		Pipe intake/outlet	26	10
NOOS095PI		Pipe intake/outlet	26	2
NOOS102PI		Pipe intake/outlet	20	10
NOOS112PI		Pipe intake/outlet	22	17
NOOS115PI		Pipe intake/outlet	23	7

Structure ID	Structure type	Structure Description	Habitat value	Impact score
NOOS116PI		Pipe intake/outlet	23	7
NOOS152PI		Pipe intake/outlet	23	5
FRAS008PX		Pontoon (fixed)	23	19
MISC019PX		Pontoon (fixed)	23	10
MISC020PX		Pontoon (fixed)	23	13
MISC033PX		Pontoon (fixed)	23	10
NOOS086PX		Pontoon (fixed)	26	10
NOOS089PX		Pontoon (fixed)	26	10
NOOS171PX		Pontoon (fixed)	20	13
NOOS175PX		Pontoon (fixed)	20	13
MARY001PF		Pontoon (floating)	20	13
MARY004PF		Pontoon (floating)	26	16
MARY005PF		Pontoon (floating)	26	11
MARY034PF		Pontoon (floating)	26	11
NOOS014PF		Pontoon (floating)	26	18
NOOS016PF		Pontoon (floating)	26	18
NOOS070PF		Pontoon (floating)	23	13
NOOS071PF		Pontoon (floating)	23	11
NOOS072PF		Pontoon (floating)	23	11
NOOS074PF		Pontoon (floating)	23	13
NOOS075PF		Pontoon (floating)	23	13
NOOS076PF		Pontoon (floating)	23	13
NOOS077PF		Pontoon (floating)	23	13
NOOS094PF		Pontoon (floating)	26	15
NOOS156PF		Pontoon (floating)	20	10
NOOS159PF		Pontoon (floating)	20	13
NOOS160PF		Pontoon (floating)	18	13
NOOS163PF		Pontoon (floating)	18	13
NOOS164PF		Pontoon (floating)	18	10
NOOS165PF		Pontoon (floating)	20	15
BURR001RE		Revetment	23	17
BURR011RE		Revetment	23	17
BURR018RE		Revetment	23	17
MISC022RE		Revetment	23	17
MISC036RE		Revetment	23	18
MISC038RE		Revetment	23	14
MISC040RE		Revetment	23	17
MISC042RE		Revetment	23	18
NOOS080RE		Revetment	28	19
NOOS087RE		Revetment	26	18
NOOS108RE		Revetment	23	19
NOOS120RE		Revetment	23	18
NOOS136RE		Revetment	23	17
NOOS140RE		Revetment	23	18
NOOS141RE		Revetment	23	17
NOOS143RE		Revetment	23	17
NOOS145RE		Revetment	23	17
NOOS147RE		Revetment	23	20

Structure ID	Structure type	Structure Description	Habitat value	Impact score
NOOS149RE		Revetment	23	17
NOOS150RE		Revetment	23	17
NOOS158RE		Revetment	18	14
NOOS161RE		Revetment	18	14
NOOS162RE		Revetment	18	14
NOOS214RE		Revetment	24	19
NOOS247RE		Revetment	25	17
NOOS260RE		Revetment	22	17
BURR020VD		Viewing deck	18	13
MISC035VD		Viewing deck	23	10
Barriers				
NOOS261SX	Stream crossings	Pipe Culvert	20	10
NOOS271SX		Pipe Culvert	18	9
NOOS283SX		Causeway	16	10
NOOS092SX		Ford	16	7
MARY022SX		Bridge	18	2
NOOS153SX		Bridge	20	2
NOOS154SX		Bridge	20	2
NOOS255SX		Bridge	24	2
NOOS263SX		Bridge	16	2