WATERWAYS AND MARINE PLANT ASSESSMENT

Lot 123 on SR687

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Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
V1.0	Waterway determination report DRAFT	K. McKenzie M. Davis	M. Davis	M. Davis	19 Mar. 21
V2.0	Waterway and Marine Plant review to address SARA comments	M. Davis	M. Davis	M. Davis	7 Apr. 21

Approval for issue

Megan Davis		7 April 2021

Prepared by:

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1 INTRODUCTION

RPS Australia East Pty Ltd (RPS) has been engaged by Graben Pty Ltd to undertake a waterway determination following advice received from the Department of Agriculture and Fisheries (DAF) through the State Assessment Referral Agency (SARA) in regards to an amber mapped waterway on a land parcel described as Lot 123 on SR687, hereafter referred to as 'the site' (**Figure 1**).

DAF has advised that while all care is taken to ensure accuracy of the spatial data layer *Queensland Waterways for Waterway Barrier Works*, anomalies due to dynamic site conditions and the scale of mapping may still occur, and where the fitness of the data layer in representing the on the ground characteristics of the site is in question, the burden for ensuring the appropriate determination of a waterway at the site rests solely with the user (proponent).

The following document provides supporting evidence to assist SARA with accurate assessment of determination of the waterways in question.

In addition, a marine plant survey was undertaken during the inspections to assess the likely extent of marine plants across the site, and calculate the potential for impact due to the proposed site layout.

Figure 1 Mapped Amber waterway (yellow line) and mapped canal (red line) (source: QLD Globe, 2021)

2 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The site is currently used for sugar cane production and has been under production since at least the 1960's.

It is likely that the waterways have been changed from the natural form to reduce saline intrusion into the site and redirect stormwater away from production areas.

We note that a range of different forms of development for the subject site are being considered, including but not limited to:

- A Wave Park;
- Ancillary facilities including a freshwater swimming lagoon;
- A hotel complex, comprising circa 160 room short-term accommodation units:
- A village precinct, comprising shops, food and drink outlets;
- A self-contained housing precinct.

3 WATERWAY DETERMINATION ASSESSMENT

In accordance with the physical and hydrological attributes defined in the factsheet *What is a Waterway?* Following two site inspections undertaken on 22 January 2021 (wet season survey) and 18 December 2020 (dry season survey) the evidence collected indicates that the amber mapped waterway shown in **Figure 1** above **does not have** the following features for the entire length of the mapped waterway:

- Defined bed and banks;
- An extended, if non-permanent, period of flow;
- Flow adequacy; or
- Fish habitat at, or upstream of the site.

It is noted, however, that the mapped canal is the most significant waterway observed on the site which was observed to have marine plants along the majority of the banks with flow observed during the wet season and fish and crabs observed during both assessments within the tidal influenced section of the canal. It appears that the historical mapped waterway has been diverted around the cane fields and now follows the flow of the mapped canal. The proposed development layout will retain the canal.

Please find photographic evidence that the amber waterway does not have the defining features of a waterway in **Plates 1 to Plate 2 below.**

Plate 1 Drainage swale observed along lower section of Mapped Amber Waterway during wet season

Plate 2 Drainage swale observed along section of Mapped Amber Waterway during wet season

3.1 Topography

The site is located on low lying coastal plains (<1.0 AHD) (**Figure 2**) and comprises undifferentiated coastal plain deposits: sand, muddy sand and minor mud.

The estimated gradient of the waterways in question are found in **Table 1**.

3.2 Waterway characteristics

Table 1 Waterway characteristics

Waterway	Slope	Length	Width	Bank height
Amber waterway	1- 2m	600	1-2m	0 - 0.2m
Canal	2- 4m	1000m	2-4m	0.2 – 1m

3.3 Waterway flow adequacy

Table 2 Waterway flow adequacy

Waterway	Depth	Frequency	Duration during flow events
Amber waterway	0m – 0.1m	Ponded during wet	During event flow is likely, ponded other times
Canal	0m to 1m	Flows throughout wet season and interacts with tide in lower 300m	Upper fresh section flows during wet season and is ponded during dry season.

IMPORTANT NOTE

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All lots, areas and dimensions are approximate only, Subject to relevant studies, Survey, Engineering and Government approvals.
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DNRM AERIAL PHOTOGRAPHY.
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Photography publish date:Sep 2019.
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DNRM LiDAR.
The contours shown on this plan have been derived from DNRM LiDAR data. Captured 2010
Vertical data: Spatial Accuracy: 0.15m @ 67 % CI
Horizontal Data: Spatial Accuracy: 0.45m @ 67 % CI
Notes on Expected Accuracy:
Values shown represent standard error (68% confidence level or 1 sigma), in meters. Accuracy estimates for terrain modelling refer to the terrain on hard flat surface unobstructed by vegetation or overhanging features. Ground definition in vegetated terrain may contain localised areas with systematic errors or outliers which fall outside this accuracy estimate.

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Contour Interval: 0.25m
Contour Index 1.0m

5
AP13754

Mowbray River

ESPLANADE

14
USL8610

3
USL8610

123
SR687
40.22 ha

TEMPORARILY CLOSED ROAD

ESPLANADE

Mowbray River

CAPTAIN COOK HIGHWAY

46
USL8612

Mowbray River

121
RP749352

CAPTAIN COOK HIGHWAY

TEMPORARILY CLOSED ROAD

TEMPORARILY CLOSED ROAD

120
SR351

127
SR763

Figure 2 SITE PLAN - PORT DOUGLAS WAVE PARK

LOT 123 SR687 MOWBRAY

PRELIMINARY - FOR DISCUSSION PURPOSES ONLY

0 20 40 60 80 100 200

Scale: 1:2000 @ A1

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Datum: MGA 2020 Z55 | **Date:** 17/11/2020 | **Drawing:** PR148361-1 A

3.4 Flow modelling and flood data

The Mowbray River gauging station (109003A) is located approximately 3km upstream from the waterways in question. The full period of record for the Mowbray River gauging station is from 1990 to 1995.

Figure 3 and **Figure 4** below show the reoccurrence interval of water level and watercourse discharge values. The reoccurrence interval is an estimate of the likelihood of an event such as a flood occurring. Points represent one of the largest events per year.

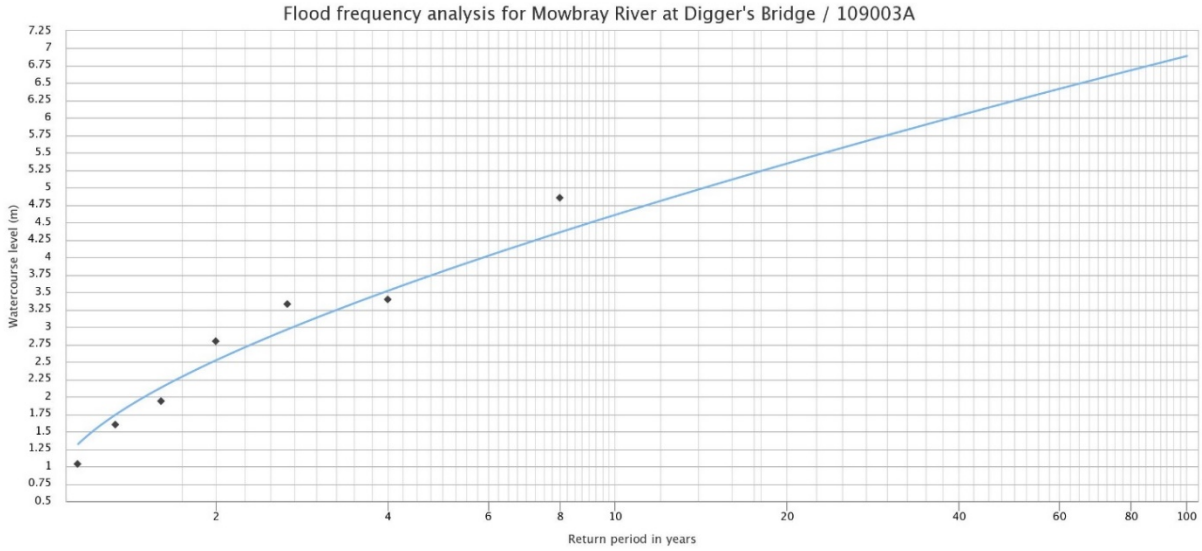


Figure 3 Flood frequency analysis (watercourse level vs return period) Source: http://www.bom.gov.au/waterdata/

According to **Figure 3**, the water level value corresponding to an 8-year return period event for the Mowbray River is approximately equal to 4.86 meters (the largest event on record).

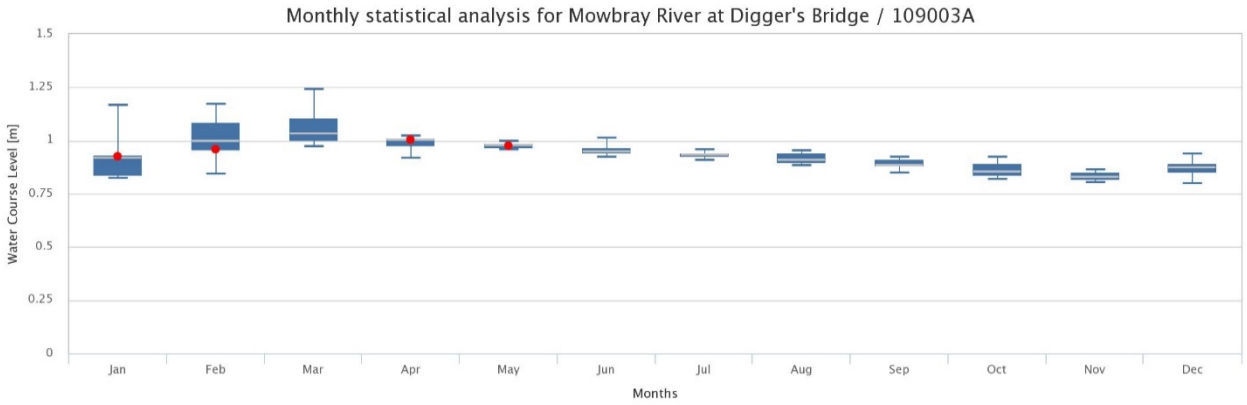


Figure 4 Monthly statistical analysis for Mowbray River (water course level) (source: http://www.bom.gov.au/waterdata/)

Monthly mean statistics for water course level (m) are plotted in **Figure 4**. **Figure 4** shows the highest water course levels recorded in the Mowbray River for the period of record were during March (where Q1 = 1.002m, Median = 1.032m and Q3 = 1.24m).

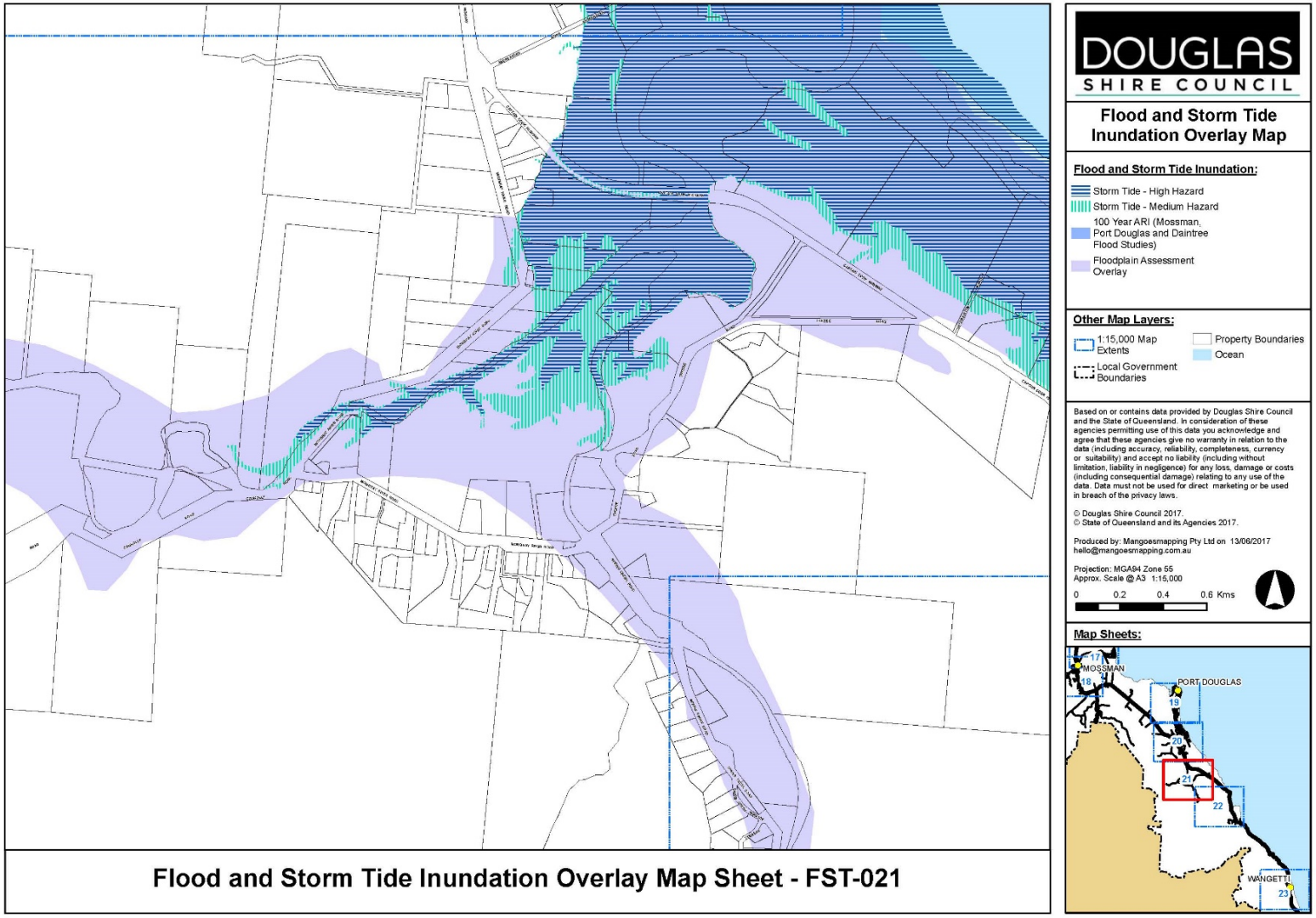


Figure 5 Flood and storm tide inundation overlay map (source: douglas.qld.gov.au, 2021)

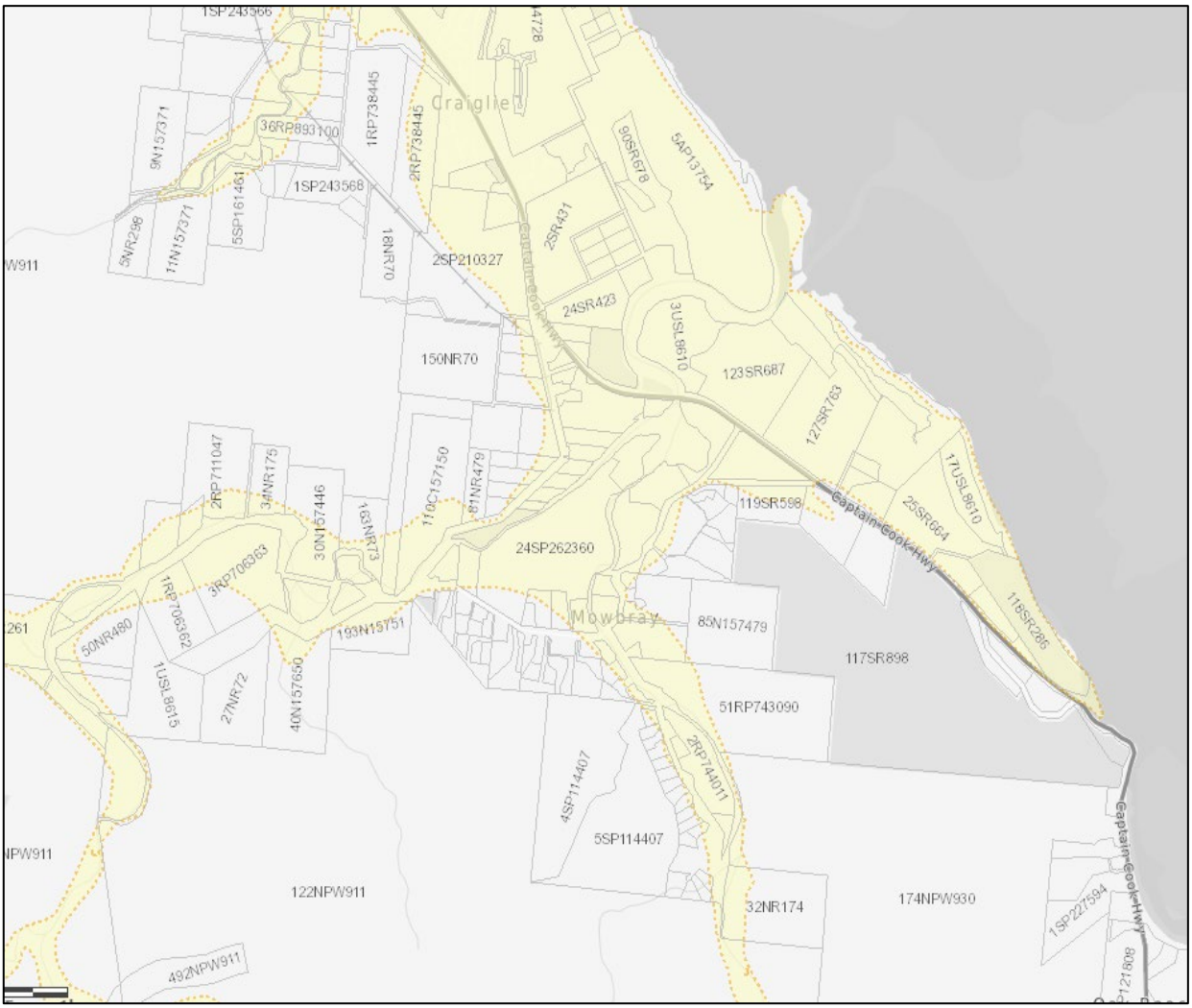
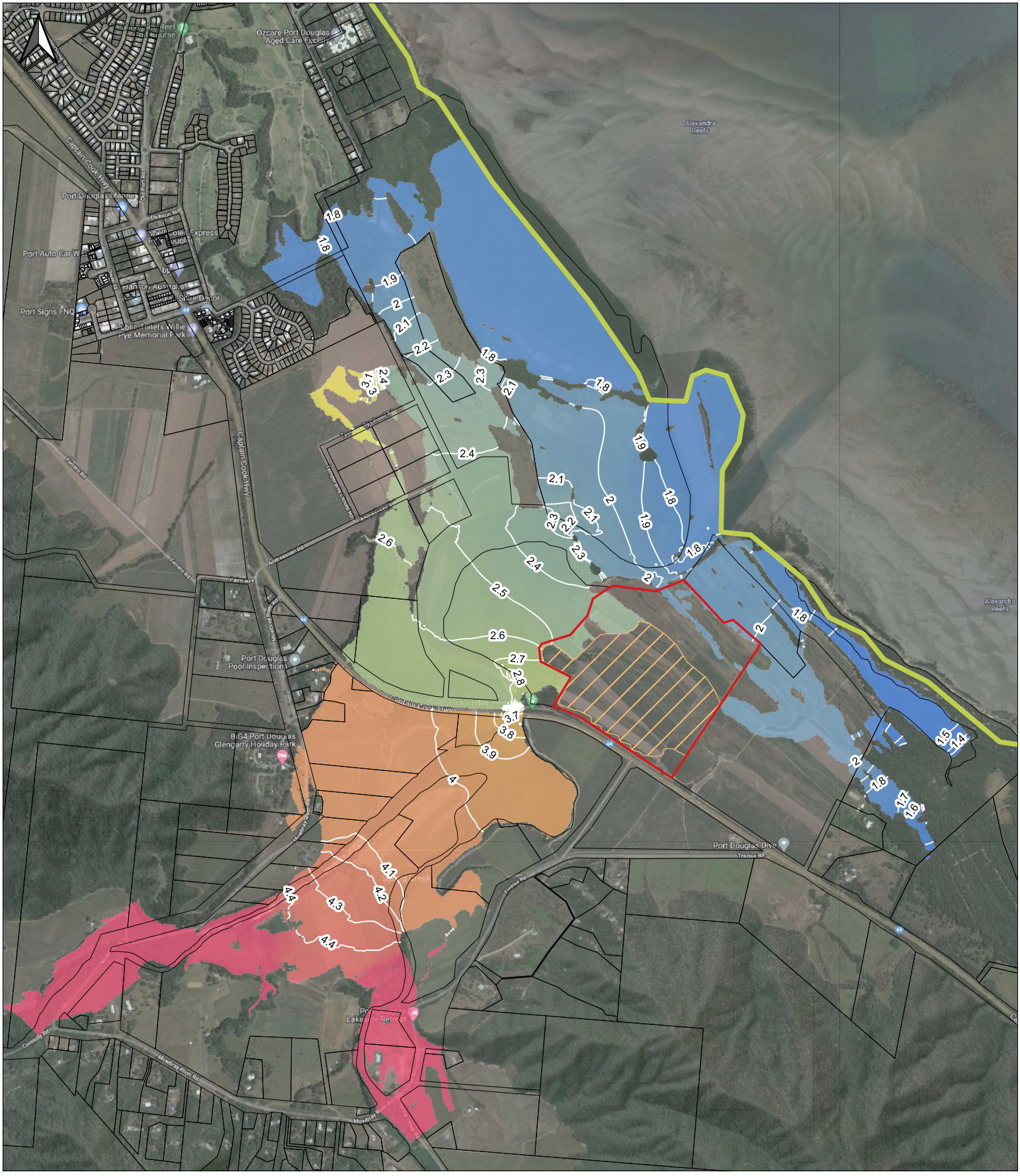


Figure 6 Queensland floodplain assessment overlay (source: SPP interactive mapping system, 2021)

The site is mapped as storm tide – high hazard by Douglas Shire Council (**Figure 5)**, and flood hazard area – level 1 by the State Planning policy (**Figure 6**).

JBP Scientists and Engineers have prepared 1% AEP flood modelling for the site, the levels of which are shown in **Figure 7** below.



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477 Boundary Street
Spring Hill
QLD 4004

Scale

0 400 800 m

Date
12/03/2021

Legend

- Coastline
- Site
- Earthwork

Water Level (mAHD)

- 1.6
- 2.4
- 3.2
- 4
- 4.8

Title

Figure 7 1%AEP Peak Water Level

Project

2021s0206 - Mowbray River - Wave Park FRA

Client

Hunt Design

3.5 Waterway Habitat

The amber waterway was observed to have limited habitat features with the drainage swale vegetation regularly slashed by the cane farmer and likely pesticides used for observed weeds. Native reeds were observed during the wet season within the lower section of the area as it is low lying with ponded water. Upper sections were under cane production.

The canal was observed to have muddy substrate with numerous mangrove species present, at the section that is tidally influenced, refer to **Plate 3** below. Brackish species observed for almost the entirety of the length of the canal on Lot 123 on SR687. Small crabs and small fish observed within the tidal section of the canal (Sample Locations 1 to 3).

Plate 3 Mangroves inhabiting lower canal subject to tidal influence

3.6 Catchment

The site forms part of the Mossman drainage basin which spans an area of 473km^2, 16 km^2 of which is comprised of estuarine wetlands (DES, 2013). The catchment comprises two major river systems, the Mossman and Mowbray rivers, as well as number of small drainage lines from the ranges to the coast. Rainfall averages 2109mm a year which results in discharges to the Great Barrier Reef (GBR) of approximately 505gl each year (Reef plan, 2021).

Most of the catchment is mapped nature conservation land; however, along the foot of the mountain ranges has been developed for sugar cane and urban land uses. The section of the Mowbray River adjacent to the site is mapped as Great Barrier Reef World Heritage area (**Figure 8**) and Estuarine Conservation Zone (**Figure 9**).

Figure 8 GBR world heritage area (green) (Source: Wetland*Maps*, 2021)

Figure 9 Estuarine conservation zone (dark yellow) (Source: Wetland*Maps*, 2021)

3.7 Connectivity

Figure 10 Hydrological connectivity of the pre-clear landscape to the GBR

(Source: Wetland*Maps*, 2021)

Figure 10 shows the hydrological connectivity of the site to the Great Barrier Reef. Most of the site (including the Amber waterway) is mapped as intermittently connected (light purple), where the canal waterway is mapped as very frequently connected (dark blue).

3.8 Fish passage

It is unlikely that the mapped Amber waterway provides adequate fish passage due to the following factors:

- Instream barriers;
  - Lack of water flow/depth (**Plates 1** to **2)**.
  - Poor water quality conditions (**Table 3**).
  - Sediment deposition has changed the habitat and structure resulting in the habitat becoming unpassable for aquatic species for most of the year.
- Intermittent connectivity of waterways.

The canal waterway was observed to have numerous fish present during the wet season survey and is likely to provide fish passage during the wet season. Dry season, the waterway was observed to contain ponded areas of poor quality water and is unlikely to provide fish passage.

Plate 4 Canal crossing during dry season

Plate 5 Canal crossing during wet season

The proposed crossing will be retained for the bikeway which is shown in the images above as a bed level crossing. No upgrade to the crossing is proposed.

The other crossing of mapped tidal area is within the central area of the site which has an existing culvert, refer to **Plate 6** below. Again, this will be retained as it currently.

Plate 6 Mapped Tidal Waterway Culvert Crossing

3.9 Water Quality

In accordance with the national framework and *Environmental Protection (Water) Policy 2009* (EPP (Water)) (EPP Water), the Daintree and Mossman River Basins Environmental Values and Water Quality Objectives provides local water quality guidelines for the Mowbray River. The most conservative of these values was utilised as a guideline.

The water quality analytes that exceeded guideline values are presented in **Table 3** and sampling locations are shown in **Figure 10**. Laboratory certificates are presented in **Appendix A**.

Table 3 Water quality of mapped waterways

	Date Sampled	pH	Conductivity	Ammonia N	Nitrate / Nitrite	Total Kjeldahl Nitrogen	Total Nitrogen	Total Phosphorus
Units		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L
Mowbray River Water Quality Objectives		**6.0-8.0**		**<0.01**	**<0.03**		**<0.24**	**<0.01**
Sample 1 (Mowbray)	22 Jan	7.7	14,000	0.04	0.10	0.51	0.61	0.06
Sample 1	17 Dec	7.9	54,000	0.006	0.042	0.21	0.25	<0.02

Canal

Sample 2	22 Jan	7.4	3,300	0.20	0.42	1.6	2.0	0.36
Sample 2	17 Dec	7.9	54,000	0.029	0.034	0.52	0.55	0.03
Sample 3	22 Jan	7.4	730	0.14	0.55	1.4	1.9	0.26
Sample 3	17 Dec	8.1	52,000	0.013	0.027	1.1	1.1	0.09
Sample 4	22 Jan	7.3	230	0.09	0.27	1.4	1.6	0.27
Sample 4	17 Dec	7.7	570	0.27	0.029	4.1	4.0	1.3
Sample 5	22 Jan	7.2	110	0.03	0.041	0.95	0.99	0.09
Sample 6	22 Jan	7.3	59	<0.01	<0.005	0.25	0.25	<0.02

Note: Exceedances highlighted in yellow

The surface water sampled contains concentrations of Ammonia, Nitrate/Nitrite, total Nitrogen and total Phosphorous which are above applicable guideline levels. It is noted that the concentration of nutrients was observed to be more elevated during the dry season when the waters were not flowing but ponding. The canal waters were observed to be much higher in salinity during the dry season as the tidal influence was more produced, particularly in the lower sections of the canal (Sample locations 2 and 3).

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Photography publish date:Sep 2019.
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Mowbray River
Esplanade
Captain Cook Highway
Captain Cook Highway
Mowbray River
Mowbray River
Esplanade
TEMPORARILY CLOSED ROAD
TEMPORARILY CLOSED ROAD

Sample 1
Sample 2
Sample 3
Sample 4
Sample 5
Sample 6

Marine Plant Impact Area

123
SR687
40.22 ha

3
USL8610

14
USL8610

46
USL8612

121
RP749352

120
SR351

127
SR763

Legend

- Water Sample Location
- Marine Plants
- Marine Plant Offset Area
- *Regulated Vegetation Management*
- Category B - Remnant
- Category C - High Value Regrowth
- Category R - Reef Regrowth Watercourse
- Water

Port Douglas Wave Park
Figure 10 Vegetation Mapping & Water Sample Locations Lot 123 SR687, Mowbray

0 40 80 120 160 200 400

PRELIMINARY - FOR DISCUSSION PURPOSES ONLY

Datum: MGA2020 Z55 | **Scale:** 1:4000 @ A3 | **Date:** 18-3-2021 | **Drawing:** PR148361-2a

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4 MARINE PLANT SURVEY

On 17 December 2020, Megan Davis, RPS Group and Dr Fanie Venter inspected the site to assess the vegetation on the site including the extent of marine plants and observed weeds across the area.

Table 4 below includes the species observed within the canal and mapped tidal areas and **Plates 7** to **9** show the observed marine plants.

Table 4 Marine Plant Species Observed

Genus	Species	Family	Growth form
Acrostichum	*aureum*	Pteridaceae	Fern
Aegiceras	*corniculatum*	Primulaceae	Shrub
Allophylus	*cobbe*	Sapindaceae	Shrub
Avicennia	*marina*	Acanthaceae	Tree
Bruguiera	*gymnorhiza*	Rhizophoraceae	Tree
Ceriops	*tagal*	Rhizophoraceae	Tree
Colubrina	*asiatica*	Rhamnaceae	Shrub
Crinum	*asiaticum* ssp. *pedunculatum*	Amaryllidaceae	Lily
Excoecaria	*agallocha*	Euphorbiaceae	Tree
Gahnia	*aspera*	Cyperaceae	Sedge
Hibiscus	*tiliaceus*	Malvaceae	Tree
Lumnitzera	*littorea*	Combretaceae	Tree
Osbornia	*octodonta*	Myrtaceae	Tree
Trianthema	*portulacastrum*	Aizoaceae	Herb
Volkameria	*inermis*	Lamiaceae	Shrub
Xylocarpus	*granatum*	Meliaceae	Tree
Xylocarpus	*moluccensis*	Meliaceae	Tree

Plate 7 Marine Plants Observed within Tidal Section of Canal

Plate 8 Node of Mangroves extending into Farming Area To Be Removed

Plate 9 *Acrostichum aureum* (Mangrove Fern)

A plan mapping the extent of marine plants is available in **Appendix B**.

It shows that based on the current layout approximately 0.1965ha of marine plants will be impacted.

The notional offset area is 0.786 ha based on the Department of Environment Science Offset Calculator or a financial offset of $29,475.00, refer to **Appendix C**.

Given the proposed vegetation rehabilitation across the site it may be possible to provide an on ground offset area instead of paying the notional financial offset.

The footprint of the proposed development has been sited to avoid marine plants where feasible, and offset where not. The proposed offset areas are provided **Appendix D** which demonstrates that the proposed offset area is substantially above the notional offset required in the DES Offset Calculator demonstrating not just the mitigation but net ecological improvement for marine plant habitat across the site.

5 DISCUSSION AND CONCLUSION

Two site inspections (wet season and dry season) and a desktop assessment were undertaken to determine the accuracy of the waterway mapping and to locate marine plants likely to be impacted within the site. The results indicate the following:

- The site is currently used for sugar cane farming and has been extensively modified. Water samples indicate poor water quality not conducive to aquatic life, particularly during the dry season for the canal but water quality was observed to improve in the wet season.
- The man-made canal is likely to constitute a waterway and is the most significant waterway on the site which has been avoided by the proposed development.
- The amber mapped waterway is a partially a drainage swale between and within cane cropping areas and does not constitute a waterway given the lack of flow even during the wet season, and undefined bed or banks.
- The site is low lying and prone to flooding in January, February, and March. No connectivity was observed for upstream of the mapped Amber waterway, however, the canal appeared to be connected and flowing during the wet season.
- A waterway intrudes into the site that includes marine plants which is likely to be impacted as a result of the proposed site layout which has been substantially offset as a result of the proposed rehabilitation.

The evidence collected from the site investigations and desktop assessment therefore indicates that the amber mapped waterway in **Figure 1** does not have the physical and hydrological attributes required to be defined as a waterway, however, the canal mapping may need to be amended to indicate it is a mapped waterway which has adequate flow to sustain fish habitat at, or upstream of the site.

The design of the site has been modified to avoid the canal which is the most substantial waterway on the site, and marine plants within this waterway have been avoided. The proposed marine plant removal area of 0.1965ha will be substantially offset with the proposed rehabilitation of 15 hectares of the site with approximately 4 hectares of wetland area designed to offset the marine plant impacts.

6 REFERENCES

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Daintree and Mossman River Basins Environmental Values and Water Quality Objectives - Environmental Protection (Water) Policy 2009 (2014).

Department of Environment and Science, Queensland (2013) Mossman River drainage sub-basin — facts and maps, Wetland*Info* website, accessed 1 February 2021. Available at: https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/sub-basin-mossman-river/

Department of Environment and Science, Queensland (2021) Mossman catchment water quality targets, accessed 3 February 2021. Available at: <https://www.reefplan.qld.gov.au/__data/assets/pdf_file/0019/46063/catchment-targets-wet-tropics-mossman.pdf>

Douglas Shire Council (2021) Flood and Storm Tide Inundation Overlay Map, accessed 3 February 2021. Available at https://douglas.qld.gov.au/development/schemes-masterplans/douglas-shire-planning-scheme/mapping/.

Queensland Globe, Queensland Government, 2021.

Queensland Spatial, Queensland Government, 2021.

State Planning Policy Interactive Mapping System, Queensland Government, 2021.

Appendix A Laboratory Analysis

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Megan Davis	Manager	Anthony Nilsson
Client	RPS AUSTRALIA EAST PTY LTD	Laboratory	SGS Cairns Environmental
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Project	**PR148361**	SGS Reference	**CE150012 R0**
Order Number	(Not specified)	Date Received	18 Dec 2020
Samples	4	Date Reported	07 Jan 2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146/19038)

SIGNATORIES

Anthony NILSSON
Operations Manager

Jon Dicker
Manager Northern QLD

Maristela GANZAN
Quality Coordinator

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE150012.001 Water 17 Dec 2020 Sample 1	CE150012.002 Water 17 Dec 2020 Sample 2	CE150012.003 Water 17 Dec 2020 Sample 3	CE150012.004 Water 17 Dec 2020 Sample 4
pH in water Method: AN101 Tested: 18/12/2020						
pH**	pH Units	-	**7.9**	**7.9**	**8.1**	**7.7**
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 18/12/2020						
Conductivity @ 25 C	µS/cm	5	**54000**	**54000**	**52000**	**570**
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 24/12/2020						
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.042**	**0.034**	**0.027**	**0.029**
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 23/12/2020						
Total Kjeldahl Nitrogen	mg/L	0.05	**0.21**	**0.52**	**1.1**	**4.0**
Total Nitrogen (calc)	mg/L	0.05	**0.25**	**0.55**	**1.1**	**4.1**
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 23/12/2020						
Total Phosphorus (Kjeldahl Digestion) as P	mg/L	0.02	<0.02	**0.03**	**0.09**	**1.3**
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 6/1/2021						
Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.006**	**0.029**	**0.013**	**0.27**

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB085438	mg/L	0.005	<0.005	0 - 3%	87%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB085169	µS/cm	5	<5	0 - 2%	98 - 100%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB085297	mg/L	0.005	<0.005	4%	97 - 98%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB085169	pH Units	-	5.7 - 8.1	0 - 4%	100 - 101%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB085273	mg/L	0.05	<0.05	1 - 9%	90 - 92%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion) as P	LB085273	mg/L	0.02	<0.02	2%	99%

METHOD	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour . The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
***	Indicates that both * and ** apply.	NVL	Not Validated

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Megan Davis	Manager	Anthony Nilsson
Client	RPS AUSTRALIA EAST PTY LTD	Laboratory	SGS Cairns Environmental
Address	PO BOX 1559 FORTITUDE VALLEY QLD 4006	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4031 1336	Telephone	+61 07 4035 5111
Facsimile	(Not specified)	Facsimile	+61 07 4035 5122
Email	Megan.Davis@rpsgroup.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**PR148361 - PD Wave Park**	SGS Reference	**CE150628 R0**
Order Number	(Not specified)	Date Received	01 Feb 2021
Samples	6	Date Reported	09 Feb 2021

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146/19038)

SIGNATORIES

Alyson BERGAMO
Senior Laboratory Technician

Anthony NILSSON
Operations Manager

Jon Dicker
Manager Northern QLD

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE150628.001 Water 22 Jan 2021 Sample 1	CE150628.002 Water 22 Jan 2021 Sample 2	CE150628.003 Water 22 Jan 2021 Sample 3	CE150628.004 Water 22 Jan 2021 Sample 4
pH in water Method: AN101 Tested: 1/2/2021						
pH**	pH Units	0.1	**7.7**	**7.4**	**7.4**	**7.3**
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 1/2/2021						
Conductivity @ 25 C	µS/cm	5	**14000**	**3300**	**730**	**230**
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 8/2/2021						
Ammonia Nitrogen, NH3 as N	mg/L	0.01	**0.04**	**0.20**	**0.14**	**0.09**
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 4/2/2021						
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.10**	**0.42**	**0.55**	**0.27**
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 3/2/2021						
Total Kjeldahl Nitrogen	mg/L	0.05	**0.51**	**1.6**	**1.4**	**1.4**
Total Nitrogen (calc)	mg/L	0.05	**0.61**	**2.0**	**1.9**	**1.6**
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 3/2/2021						
Total Phosphorus (Kjeldahl Digestion) as P	mg/L	0.02	**0.06**	**0.36**	**0.26**	**0.27**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE150628.005 Water 22 Jan 2021 Sample 5	CE150628.006 Water 22 Jan 2021 Sample 6
pH in water Method: AN101 Tested: 1/2/2021				
pH**	pH Units	0.1	**7.2**	**7.3**
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 1/2/2021				
Conductivity @ 25 C	µS/cm	5	**110**	**59**
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 8/2/2021				
Ammonia Nitrogen, NH3 as N	mg/L	0.01	**0.03**	<0.01
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 4/2/2021				
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.041**	<0.005
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 3/2/2021				
Total Kjeldahl Nitrogen	mg/L	0.05	**0.95**	**0.25**
Total Nitrogen (calc)	mg/L	0.05	**0.99**	**0.25**
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 3/2/2021				
Total Phosphorus (Kjeldahl Digestion) as P	mg/L	0.02	**0.09**	<0.02

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB086576	mg/L	0.01	<0.01	0%	NA

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB086342	µS/cm	5	<5	1%	99%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB086450	mg/L	0.005	<0.005	0 - 2%	109 - 112%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB086342	pH Units	0.1	6.9	0%	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB086418	mg/L	0.05	<0.05	2 - 9%	86 - 88%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion) as P	LB086418	mg/L	0.02	<0.02	0 - 8%	98 - 99%

METHOD	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
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FOOTNOTES

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		QFL	QC result is below the lower tolerance
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Solid samples expressed on a dry weight basis.

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Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

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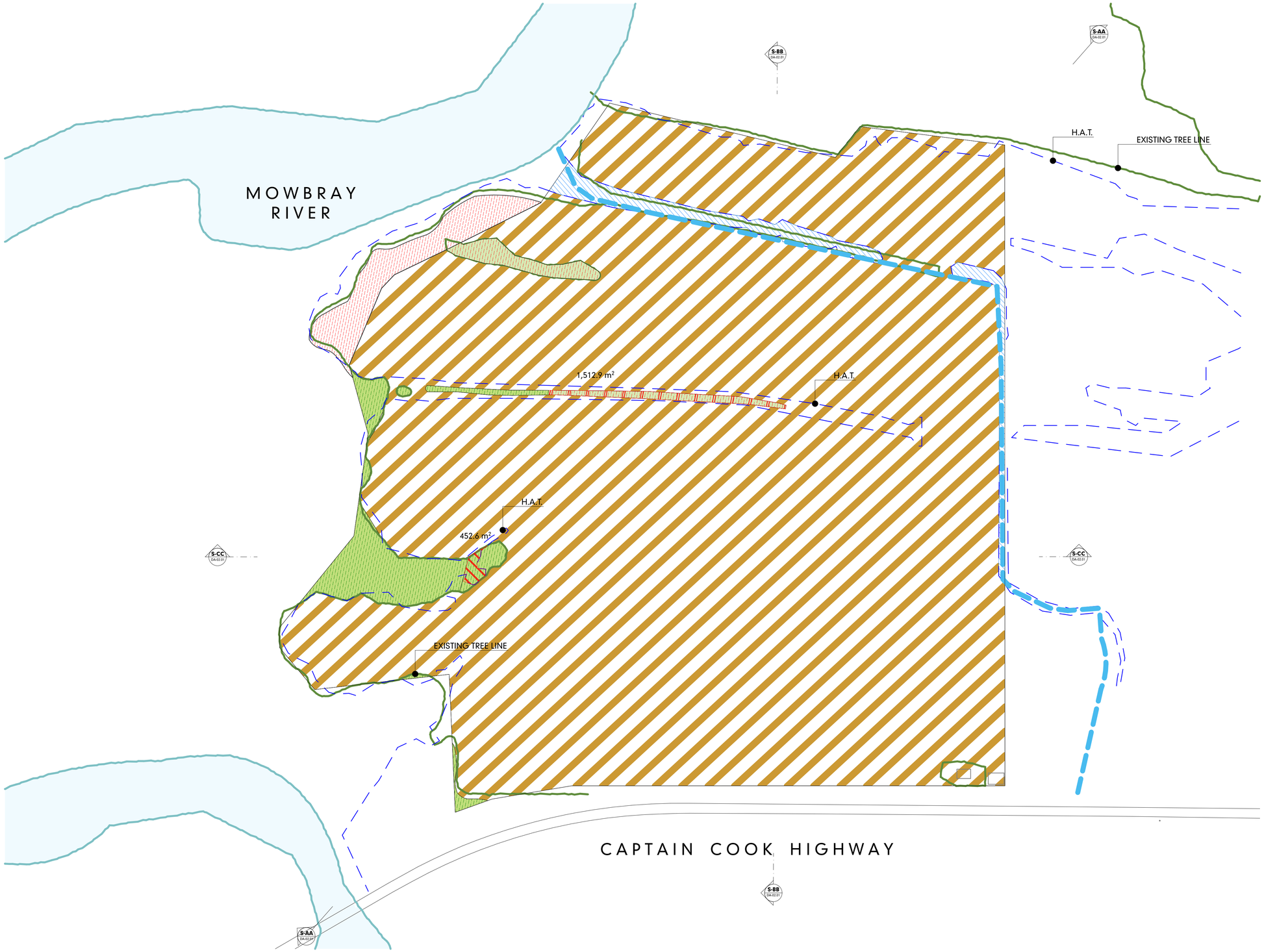
Appendix B Marine Plant Mapping



EXISTING SITE **A**
SCALE1:2000

100 EXISTING SITE		
TYPE	AREA	FILL
CANAL	7,750	
CANE CROP	379,135	
EXISTING	10,222	
TO BE CLEARED	5,026	
	402,132 m²	

EXISTING SITE **100**
SCALE1:1

HAT - HIGHEST ASTRONOMICAL TIDE

PORT DOUGLAS SURF PARK PRELIMINARY ISSUE

DA-01.4

DEVELOPMENT APPLICATION
FOR : GRABEN PTY LTD
5640 CAPTAIN COOK HIGHWAY
CRAIGLEE, QLD, AUST

MASTER PLAN DIAGRAMS
EXISTING SITE PLAN

N

PROJECT NO. **WAVE001**
STATUS **PRELIMINARY**
REVISION NO.
DATE **#Transmittal Set Date (of last Change)**

HUNT DESIGN
www.huntdesign.com.au
architect@huntdesign.com.au
ABN: 90514257527
PO BOX 170, QLD 4877
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Appendix C Offset Calculator

From: no-reply@des.qld.gov.au
To: Megan Davis
Subject: Environmental offsets calculator results - Financial settlement offset calculator
Date: Thursday, 8 April 2021 11:32:38 AM
Attachments: data.csv

Environmental offsets calculator results - Financial settlement offset calculator

Payment details

Non-protected area cost

On ground cost	$23,580.00
Landholder incentive payment	$0.00
Administrative cost	$5,895.00
Total non-protected area cost	$29,475.00

Protected area cost

Total protected area cost	$0.00

Total cost

Grand total	$29,475.00

Total offset area: 0.786 ha

Section 1

Bioregion
Inshore (non-remote)
Subregion
Wet Tropic Coast
Impact area
0.1965 ha
Notional offset area
0.786 ha
Distinct matter area 1.1

Impact area: 0.1965 ha
Notional offset area: 0.786 ha

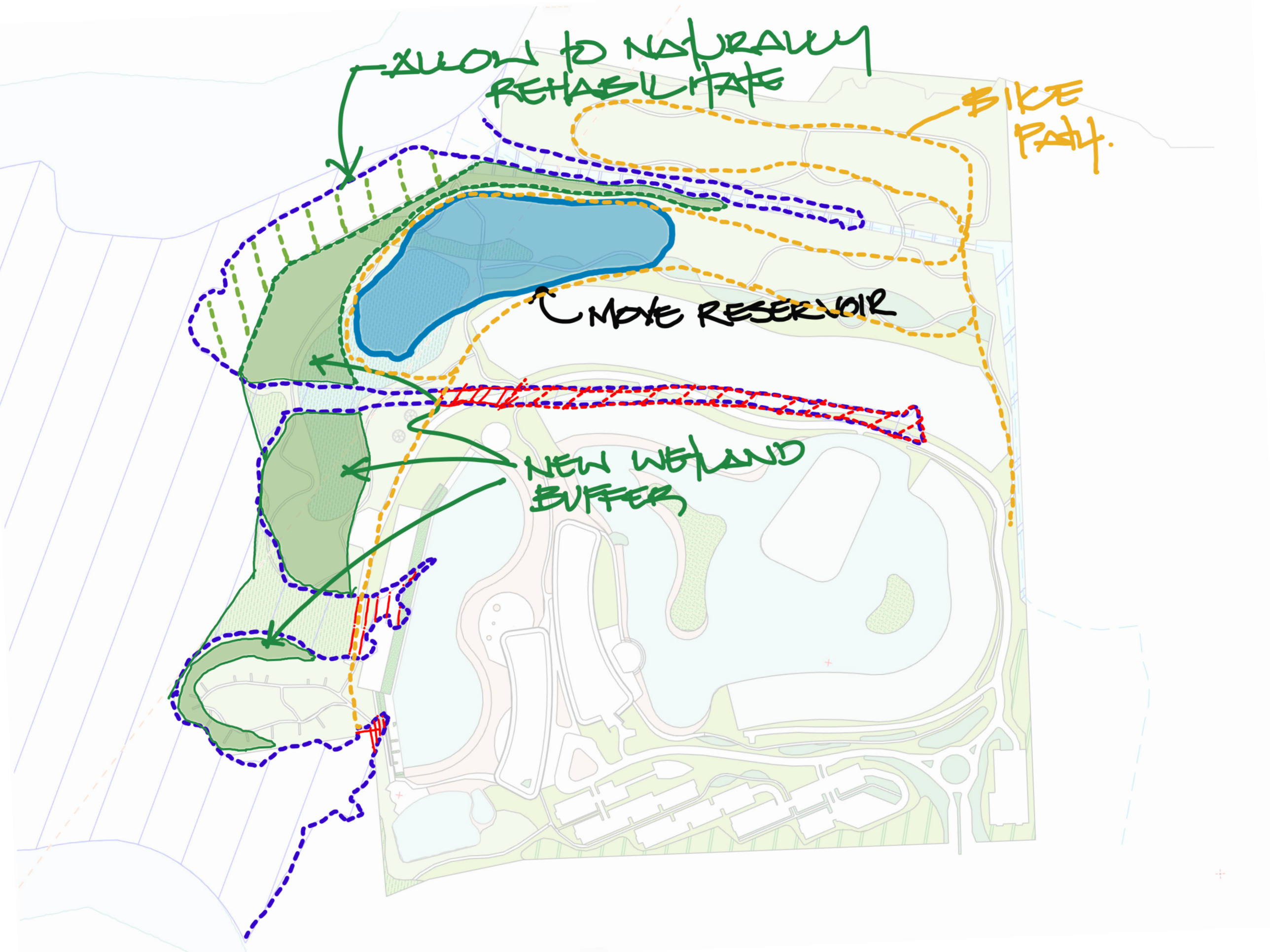
Matter groups:

- 1.1.1: Marine plants

Sections, areas and matter groups used in calculations

Section	Bioregion / Marine (and waterways) zone	Subregion / Marine bioregion	Local government area (LGA)	Distinct matter area (DMA)	DMA impact area (ha)	DMA notional offset area (ha)	Matter group
1	Inshore (non-remote)	Wet Tropic Coast		1.1	0.1965	0.786	1.1.1 Marine plants

Appendix D Indicative Marine Plant Rehabilitation Area


ALLOW TO NATURALLY REHABILITATE
BIKE PATH.
MOVE RESERVOIR
NEW WETLAND BUFFER