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Gooseponds Log Hotel Feasibility Study

Final Report

January 2016
Trent Power

Catchment Solutions

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Information contained in this document is provided as general advice only. For application to specific circumstances, professional advice should be sought.

Catchment Solutions has taken all reasonable steps to ensure the information contained in this document is accurate at the time of publication. Readers should ensure that they make appropriate enquires to determine whether new information is available on the particular subject matter.

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Introduction

Project Background

Gooseponds are a series of modified lagoons situated on Janes Creek in the lower Pioneer Catchment, Mackay (Figure 1). Five lagoons make up the complex, all of which are surrounded by residential areas and receive inflows from agricultural land in the upper catchment. In total the lagoons cover an area of 11 hectares, with considerable variation in the size and shape of each lagoon. As with most waterways in developed areas, habitat conditions are impacted by the removal of riparian zones, reductions in in-stream habitat complexity and increased nutrient load from urban and agricultural runoff. The result of these impacts is a eutrophic system that promotes excessive growth of algae and aquatic vegetation and support the proliferation of pest fish.

In 2014 a population of *Oreochromis mossambicus* (refer to herein as tilapia) were discovered in the lower lagoon. Subsequent discussions with stakeholders and consultation with regulatory agencies formulated an integrated management plan to reduce the risk of spread to other catchments in the region and limit the impact tilapia pose on native fish communities in the Gooesponds. The management plan consisted of three components: 1) a predatory control trial, to investigate whether stocked and wild predatory fish could reduce the number of tilapia, 2) an education and awareness campaign, to inform the public of the threat tilapia and other pest fish pose to our waterways, and 3) habitat improvement works, to increase resource availability and build resilience of our native fish.

This report details the assessment of potential habitat improvement works and the feasibility of undertaking the preferred improvement option.

Figure 1. Location and site names of lagoons within the Gooseponds complex. Base image – Qglobe, Google Earth.

Habitat Improvement Options

During initial and follow-up discussions about habitat improvement works several potential options were identified, including: riparian restoration, reducing nutrient and sediment runoff, improving connectivity within the waterway and increasing in-stream habitat complexity. It was identified that considerable work was already underway by the local council and resource management and community groups to restore riparian zones and reduce runoff within the Gooseponds catchment. Similarly, an extensive fishway project undertaken in 2002 saw the installation of five fishways in the Gooseponds, providing a high level of connectivity between the lagoons (Marsden et al 2003). It was therefore decided that increasing in-stream habitat complexity was the preferred improvement option.

Fish Species Criteria

The Gooseponds supports over 20 species of native freshwater species, ranging in size from fish less than 30 mm in length up to large barramundi that can exceed 1000 mm (Power 2015). Ideally, habitat types within the lagoons would support the preferences of all of these species. Currently there is an abundance of weed beds, riffle zones, open water and literal vegetation. Habitat that is less abundant or not present includes: rock bars, undercut banks and large woody debris. Increasing these types of habitat would benefit a number of species including predatory barramundi and mangrove jack that may put added pressure on tilapia and other pest fish.

In-stream habitat options

Options Considered

A number of in-stream habitat options were considered for the Gooseponds. These are outlined in Table 11.

Table 1. In-stream habitat options considered

TYPE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Rock bars/rip-raps	Rock wall, bar or stack constructed adjacent or perpendicular to the bank. Various sized rocks add roughness and complexity to finished structure (i.e. hollows and peaks) Size and layout is tailored to the site.	Long service life (100 yrs +). Suites a wide variety of species. Simple construction. Materials are relatively low cost (subject to rock source).	Site locations are limited to reach of excavator. Source of rock may be distant from site – cost consideration. Construction needs to be well supervised. Increased site disturbance during construction.

TYPE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Crib wall/lunker	Consists of a series of cells built into the bank of lagoon to emulate undercut banks. Construction materials consist of hardwood posts or concrete pillars. Generally installed along banks devoid of trees.	Long service life (25-50 yrs). Suites a wide variety of fish species. Cells can be constructed off site.	Sedimentation / debris issues following a flood or high flow event. Construction needs to be well supervised. Increased site disturbance during construction. Source of logs may be distant from site – cost consideration. WHS consideration – deep water (> 1 m) at edge of bank
			
Engineered log jam	Pile driven logs, interlocked that emulate large woody debris. Construction materials consist of hardwood logs sometimes fixed with cable and bolts. Generally installed along banks devoid of trees.	Long service life (25-50 yrs). Suites a wide variety of fish species. Provides bank stabilisation. Has been used elsewhere throughout Australia with excellent results.	Sedimentation / debris issues following a flood or high flow event. Construction needs to be well supervised Source of logs may be distant from site – cost consideration. Increased site disturbance during construction. Needs to be constructed on site.
			

TYPE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Log hotel	Modular stacks of interlocked posts that emulate large woody debris Construction materials consist of hardwood logs sometimes fixed with bolts and rods to a concrete base. Installed bankside or in open water.	Long service life (25-50 yrs). Suites a wide variety of fish species. Can be constructed offsite. Low site disturbance during installation. Has been used elsewhere throughout Australia with excellent results.	Sedimentation / debris issues following a flood or high flow event. Source of logs may be distant from site – cost consideration. Open water installations require clear access for a large crane.

Options Assessment Matrix

An assessment matrix has been developed for comparing the relative merits of the potential in-stream habitat improvement as a guide to recommending a preferred option (Table 2).

The scoring is subjective and has been a result of input from the design team (Trent Power and Matthew Moore).

Based on this assessment the rock walls/rip-raps received the highest overall scores, while the log hotels produced the best cost-benefit score. Either would be a viable option for improving habitat complexity in the Gooseponds. Crib wall/lunkers have been used successfully at other locations within the region (Power 2015, Ferguson and O'Brien 2009), however it was determined that these structures would not be as well suited for use in the Gooseponds. Several rock walls are currently in place throughout the lagoons complex, to add to the diversity of habitat types it was decided that the installation of log hotels were the preferred option for habitat improvement works.

Concept designs were drafted to use for identifying construction and installation limitations and to gain approvals and permits.

Table 2. Options assessment matrix.

All scores rated from 1 (very low) to 5 (very high) **CRITERIA**		**Rock wall/rip-rap**	**Crib wall/lunker**	**Engineered Log Jam**	**Log Hotel**
	Weighting	Score	Score	Score	Score
FUNCTIONALITY					
Habitat suitability for target species					
Small fish	5	4	4	4	4
Large fish	5	5	5	5	5
Pest fish	5	4	4	2	2
Habitat suitability for secondary species					
Birds	2	4	2	3	3
Insects	4	4	4	4	4
Crustaceans	3	4	3	4	4
Sub-total for Functionality		101	94	89	89
OPERATION					
Ease of maintenance	4	4	2	2	2
Sediment accumulation	5	3	4	1	1
Debris	5	2	2	4	3
Sub-total for Operation		41	38	33	28
ENVIRONMENT					
Footprint	3	4	4	4	4
Aesthetics	5	3	3	2	4
Sub-total for Environment		27	27	22	32
RISK					
Public access / Safety	4	4	2	2	5
Vandalism	3	4	3	3	5
Constructability	3	4	3	3	5
Sub-total for Risk		40	26	26	50
Total Overall Score		209	185	170	199
Capital Cost*		$25,000	$25,000	$22,000	$20,000
Cost-Benefit Score		$120	$135	$129	$101

* Estimated capital cost per site, excluding approval and permit fees

Permits and Approvals

Local Government Approval

The Gooseponds Lagoons are spread across several parkland reserves all under the management of Mackay Regional Council (MRC). Approval from the council was required for the installation of log hotels in the Gooseponds. The Strategic Planning Department requested flood modelling to be undertaken for the proposed structures to ensure there would be no adverse impacts on the intensity or duration of flooding during high flow events. Flood modelling was completed by WRM using the existing Gooseponds Catchment model, supplementary bathymetry data collected by the Department of Natural Resources and concept designs produced by Catchment Solutions. A copy of the WRM report is included in Appendix 1.

The results of flood modelling demonstrated that the proposed log hotel installations would have insignificant impact on the flood conditions during 1 in 5 and 1 in 100 year events. Based on these findings endorsement for the installation of the log hotels was provided by MRC. A copy of the letter of support from MRC is provided in Appendix 2.

Riverine Protection Exemption Permit

As referenced within Schedule 2 of the 'Riverine protection permit exemption requirements', Reef Catchments Limited (RCL) is a; 'Community group undertaking work for the purposes of natural resource management, catchment management or landcare'. RCL is therefore an approved entity that meets the requirements to be exempted from the Riverine Protection Permit. In addition, 'contractors, subcontractors and other agents engaged by any of the approved entities may also use the exemption requirements', as stated on page 1 of the 'Riverine protection permit exemption requirements'.

Coastal Management Area

Consultation with DGLIP, under delegation of the chief executive, has found operational work associated with the installation of small habitat improvement structures would have an insignificant impact on coastal management. This claim is supported by the findings of flood modelling completed as part of this feasibility study. It is anticipated that operational works associated with the proposed log hotel installations satisfy the requirements of excluded work in Schedule 26 of the SPA 2009.

Structural Designs

To ensure that proposed log hotels designs were suitable for the flow conditions experienced during 1 in 100 year flood events, a structural engineer was engaged to develop detailed designs and specifications. Utilising data produced by flood models it was identified that the maximum velocity experienced at the proposed installation locations ranged between 0.25 and 1.21 m/s. To ensure a level of redundancy was factored into the log hotels, the structural designs have been developed to withstand a maximum velocity of 1.5 m/s. A copy of the RPEQ certified detailed designs for the Gooseponds log hotels is provided in Appendix 3.

Cost Estimation

Based on the detailed designs a cost estimation for the construction and installation of the log hotels has been provided in Table 3. Estimations are based on a single site (four sites have been approved by MRC) with a configuration of five log hotel modules constructed to a height of 1.2 m. Costs given are indicative only and may change prior to construction. Additional costs that are not anticipated but may be incurred include: permit and approval fees, traffic and pedestrian management during installation, site access preparation for heavy vehicles and ongoing maintenance costs. These costs have not been included in the figures below.

Table 3. Cost Estimate (ex GST) – Construction and installation of log hotels

Task	Item Total ($)
Project Management	**2,400**
Project coordination and administration	2,400
Log Hotel Construction	**11,000**
Materials	5,000
Fabrication	6,000
Log Hotel Installation	**3,950**
Supervision	1,200
Vehicle	150
Consumables	100
Crane hire	2,500
Reporting	**800**
Construction report	800
Total	**18,150**

Conclusion

Based on the outcomes of this study, the installation of log hotels, in accordance with the locations, configuration and structural specifications listed in the detailed designs, are a feasible option for improving in-stream habitat conditions within the Gooseponds Lagoons.

Recommendations

- Funding for this feasibility study were provided by the project – *Preventing the Spread of Tilapia in Southern Great Barrier Reef Catchments.* Further funding for the construction and installation of the log hotels is beyond the scope of this project and alternative funding sources need to be secured to carry out on-ground works.
- To assess the utilisation of the log hotels by native and pest fish pre and post construction monitoring should be undertaken. Ongoing monitoring is also recommended to determine the long term changes in population and community structure resulting from the installation of the log hotels
- Utilisation of the structural designs should be considered for in-stream habitat improvement projects at locations with similar flow conditions. Considerable cost savings may be achieved, allowing further on-ground to be undertaken.
- With the considerable environmental improvement work being undertaken in the Gooseponds and its centralised location, would make the lagoons an excellent demonstration reach. The production of extension material and installation of interpretative signage will help raise public awareness of threats to our waterways such as pest fish, habitat degradation and urban/agricultural runoff.

References

Ferguson, M. and O'Brien, A. 2009. *Lunkers and Large Woody Debris (LWD) Installation for Jungle Perch and Other Species Enhancement*. Final report prepared for Envirofund. Department of Environment, Economic Development and Innovation, Mackay.

Marsden, T., Thorncraft, G. and McGill, D. 2003. *Gooseponds Creek Fish Passage Project*. Report for Mackay and Whitsundays Natural Resource Management Group. Department of Primary Industries and Fisheries, Mackay

Power, T. 2015. *Investigation into the distribution of tilapia in the lower Pioneer Catchment.* Report prepared for Reef Catchments and Mackay Regional Council. Catchments Solutions, Mackay.

Power, T. 2015. *Effects on fish communities of Owens Creek bank stabilisation and habitat improvement works – Engineered log jams.* Final report prepared for Pioneer Catchment Land Care. Catchment Solutions, Mackay.

Appendix 1 – Flood impact assessment of proposed log hotels in Gooseponds Creek – WRM Report

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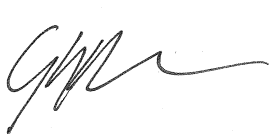
Flood impact assessment of proposed log hotels in Goosepond Creek

Catchment Solutions Pty Ltd

0500-11-B1, 13 November 2015

For and on behalf of WRM Water & Environment Pty Ltd
Level 9, 135 Wickham Tce, Spring Hill
PO Box 10703 Brisbane Adelaide St Qld 4000
Tel 07 3225 0200



Greg Roads
Director

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1 Introduction

1.1 OVERVIEW

It is proposed to construct one or more 'log hotels' at a total of four possible locations along Goospond Creek. These locations are referred to in this report as Location 1DS, 2, 5A and 5B and are shown on Figure 1.1. WRM Water & Environment (WRM) has been requested by Catchment Solutions Pty Ltd (Catchment Solutions) to assess the impact of the proposed log hotels on peak flood levels along Goospond Creek in the vicinity of the proposed log hotels. This report describes the methodology and results of this assessment.

1.2 METHOD OF ASSESSMENT

WRM previously prepared a flood study of Goosepond Creek and the Pioneer River (WRM, 2012) for Mackay Regional Council (MRC). A TUFLOW two dimensional hydrodynamic model (WBM, 2010) of the Pioneer River and Goosepond Creek (referred to as the Goosepond Creek model in this report) was developed using a 20 m grid cell size.

The grid size in the Goosepond Creek model was found to be too coarse to assess the impact of the proposed log hotels. To overcome this, part of the Goosepond Creek model was reconfigured using a 5 m grid. The four possible log hotel locations are included within the 5 m grid area. The updated model was then used to estimate design flood levels along Goosepond Creek in the vicinity of the proposed log hotels for the 18% (1 in 5) and 1% (1 in 100) Annual Exceedance Probability (AEP) design events. The updated model was also used to estimate design peak flood velocities for the 18% (1 in 5) and 1% (1 in 100) AEP design events at the four possible log hotel locations.

The results were used to assess the impact of the proposed log hotels on flood levels in the surrounding areas for the 18% (1 in 5) and 1% (1 in 100) AEP design events.

1.3 PROPOSED LOG HOTELS

Figure 1.1 shows the four possible locations of the proposed log hotels. Figure 1.2 shows a conceptual design of the log hotel units. Each log hotel unit will have a footprint of approximately 12.5 m x 2.5 m with its length oriented along the general direction of flow. The log hotels will be constructed up to a maximum height of 2 m above the existing creek bed (as advised by Catchment Solutions).

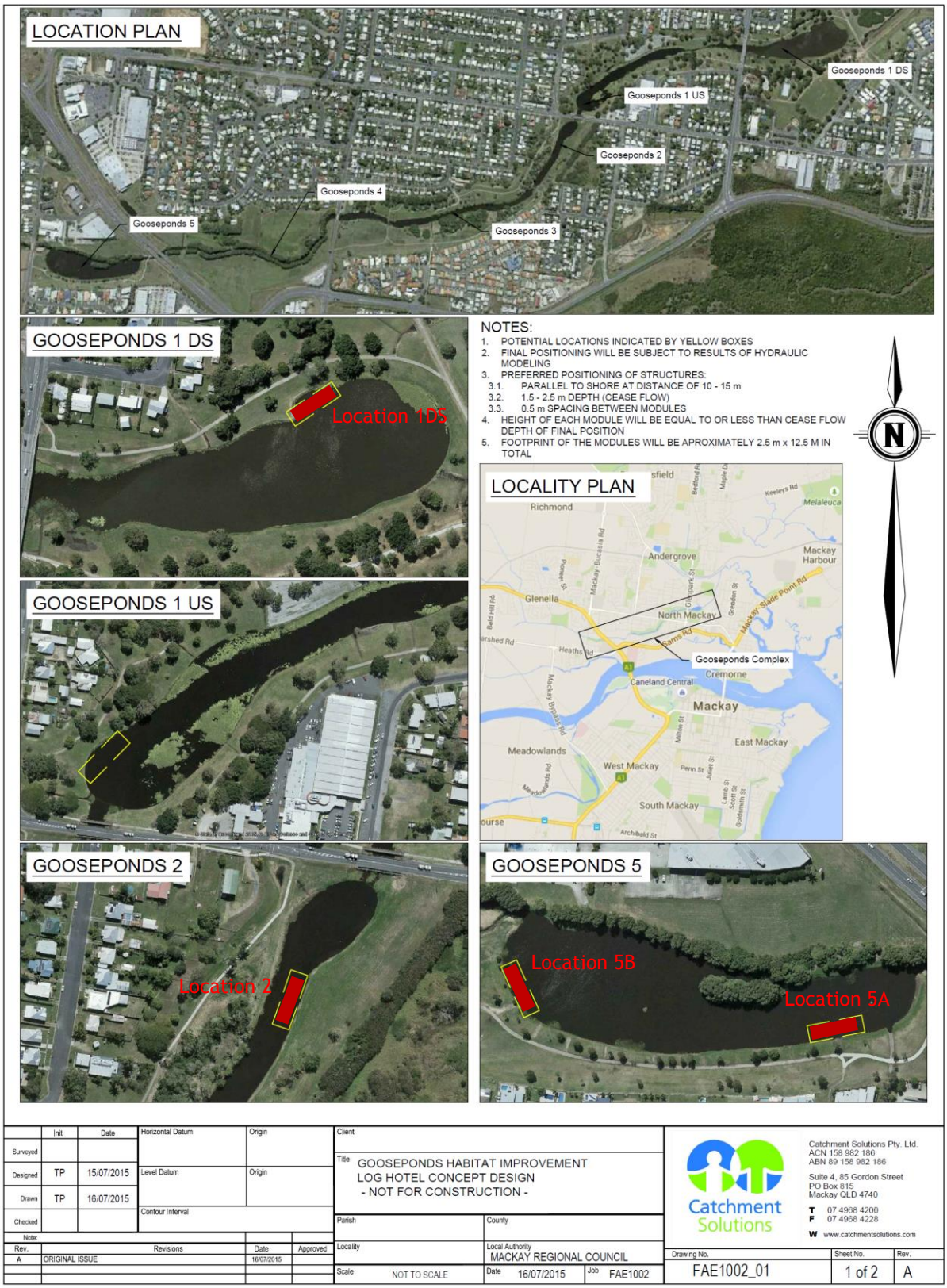

Figure 1.1 – Possible locations of the proposed log hotels

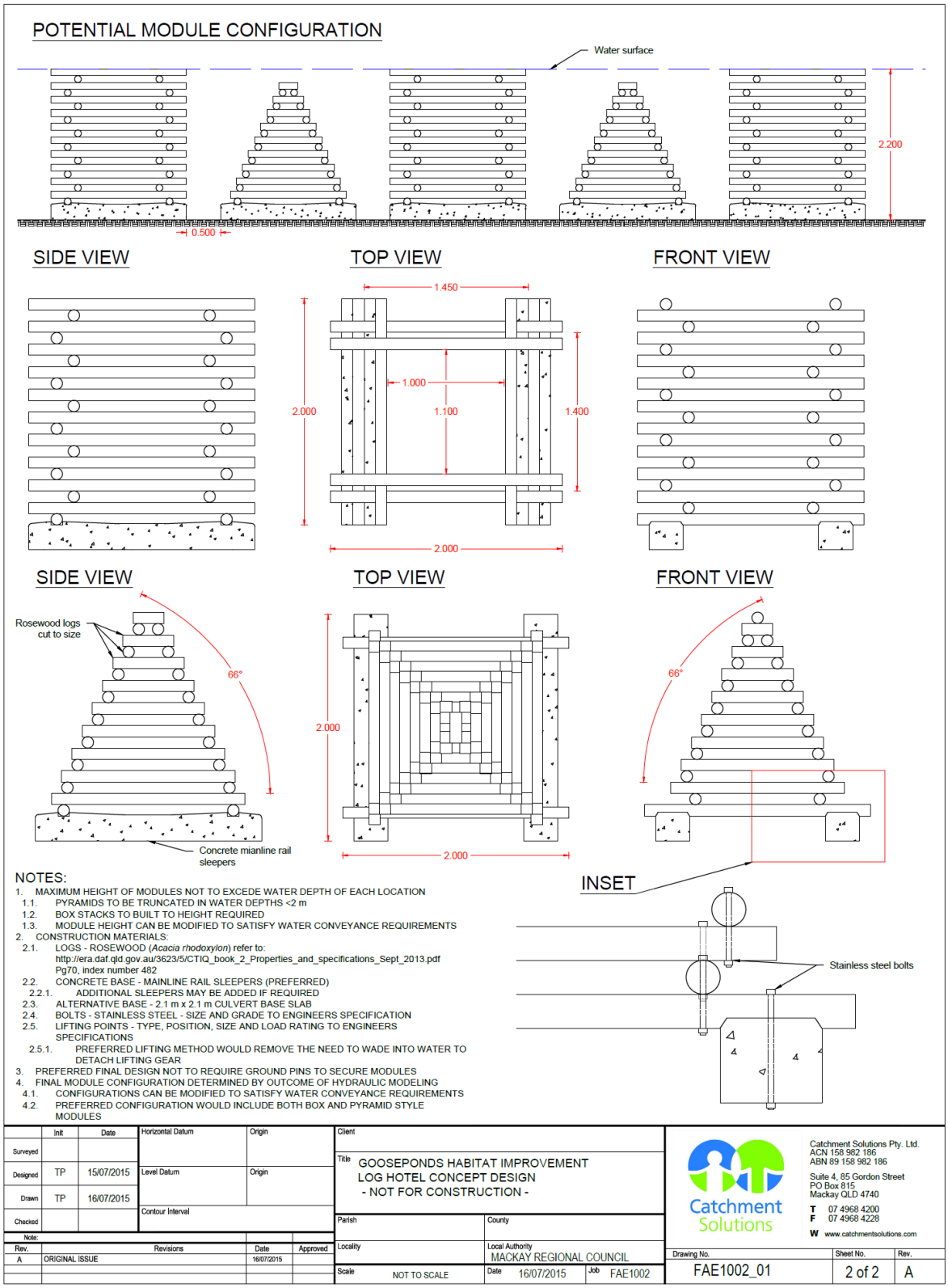

Figure 1.2 – Conceptual design of the log hotel units

2 Hydraulic modelling

2.1 OVERVIEW

The updated Goosepond Creek TUFLOW model used to estimate flood levels along Goospond Creek for the 18% (1 in 5) and 1% (1 in 100) AEP design events under existing conditions (without the log hotels) and developed conditions (with the log hotels). The model was also used to estimate design peak flood velocities for the 18% (1 in 5) and 1% (1 in 100) AEP design events at the four possible log hotel locations.

2.2 MODEL CONFIGURATION

The model topography of the lagoon containing locations 5A and 5B were updated using bathymetry data provided by Catchment Solutions on 16 September 2015.

In the developed conditions TUFLOW model, the log hotels were incorporated at Locations 1DS, 2, 5A and 5B as partial blockages referred to as '2D layered flow constrictions'. Under this configuration, a 100% blockage was applied to the grid cells at the four log hotel locations up to a height of 2 m above the creek bed, and zero blockage for elevations above 2 m.

2.3 MODEL RESULTS

Table 2.1 shows the design peak flood levels and velocities at the four possible log hotel locations for the 18% (1 in 5) and 1% (1 in 100) AEP design events.

The 18% (1 in 5) and 1% (1 in 100) AEP peak flood levels for existing and developed conditions estimated by the TUFLOW model were compared to assess for any increases in flood levels due to construction of the proposed log hotels.

Figure 2.1 and Figure 2.2 show the impacts of the proposed log hotels on peak flood levels for the 18% (1 in 5) and 1% (1 in 100) AEP design events respectively. The results show that there are no predicted increases in peak flood levels in the vicinity of the proposed log hotels for the 18% (1 in 5) and 1% (1 in 100) AEP design events, except for a very small localised increase of less than 0.02 m immediately upstream of Location 2 for the 1% (1 in 100) AEP design event.

Table 2.1 – Predicted peak flood levels and velocities at the four possible log hotel locations

Location	Peak flood level (mAHD)		Peak flood velocity (m/s)	
	18% (1 in 5) AEP	1% (1 in 100) AEP	18% (1 in 5) AEP	1% (1 in 100) AEP
Location 1 DS	5.28	5.93	0.10	0.25
Location 2	5.93	6.51	0.68	1.21
Location 5A	7.55	8.32	0.38	0.67
Location 5B	7.56	8.34	0.15	0.38

Figure 2.1 – Predicted 18% (1 in 5) AEP flood level impacts along Goosepond Creek in the vicinity of the proposed log hotels

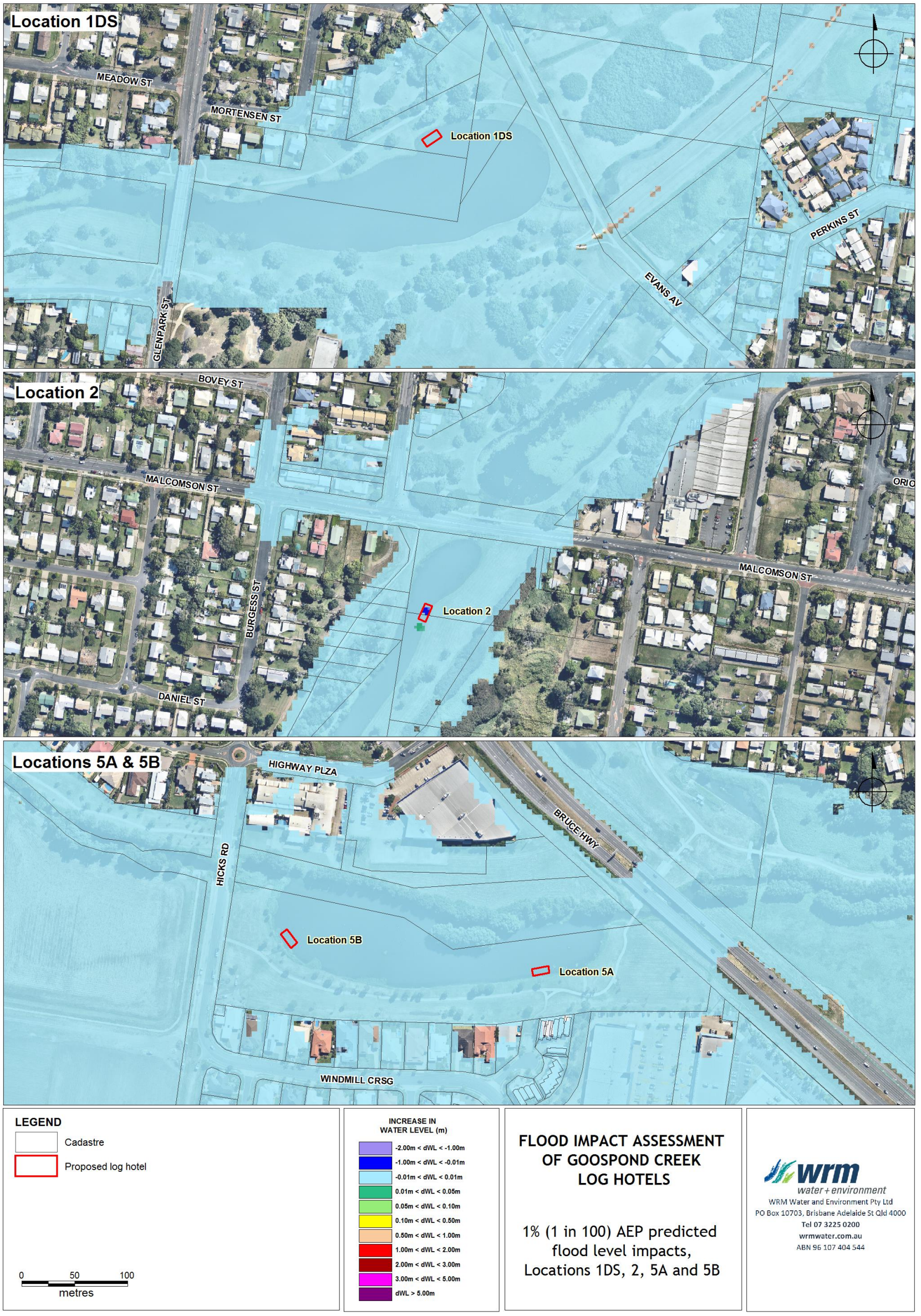

Figure 2.2 – Predicted 1% (1 in 100) AEP flood level impacts along Goosepond Creek in the vicinity of the proposed log hotels

3 References

WRM, 2012 *'Goosepond Creek (Including Pioneer River) Flood Study'* Report prepared for Mackay Regional Council by WRM Water & Environment Pty Ltd, October 2012.

Appendix 2 – Mackay Regional Council letter of endorsement for the installation of log hotels in Gooseponds Lagoons

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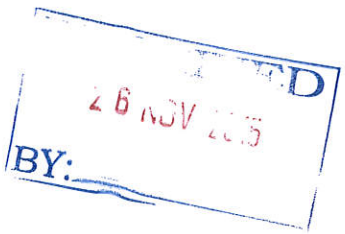
23 November 2015



Catchment Solutions Pty Ltd
Suite 4, 85 Gordon Street
Mackay QLD 4740

Attention: Trent Power
(email via tpower@catchmentsolutions.com.au)

Flood impact assessment and letter of support for proposed log hotels in Goosepond Creek

Dear Trent,

Thank you for the provision of the flood impact assessment for the proposed log hotels in Goosepond Creek (WRM November 2015).

The report identifies "*that there are no predicted increases in peak flood levels in the vicinity of the proposed log hotels for the 18% (1 in 5 annual chance) and 1% (1 in 100 annual chance) AEP design events, except for a very small localised increase of less than 0.02 m immediately upstream of Location 2 for the 1% AEP design event*".

Council supports the installation of the log hotels in Goosepond Creek and wishes Catchments Solutions well in implementing the project.

Please contact Robyn Birkett if you have any queries or require further information.

Yours sincerely,

Peter Owen

Manager – Parks, Environment & Sustainability

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Phone **1300 MACKAY** (1300 622 529)
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ABN 56 240 712 069

Appendix 3 – Gooseponds habitat improvement – Log hotel detailed designs

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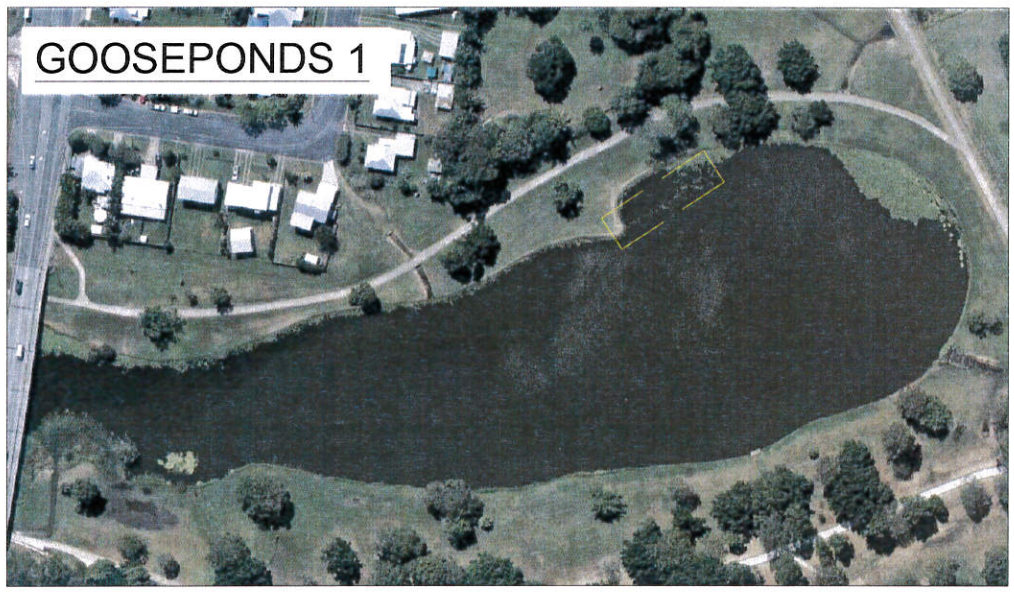
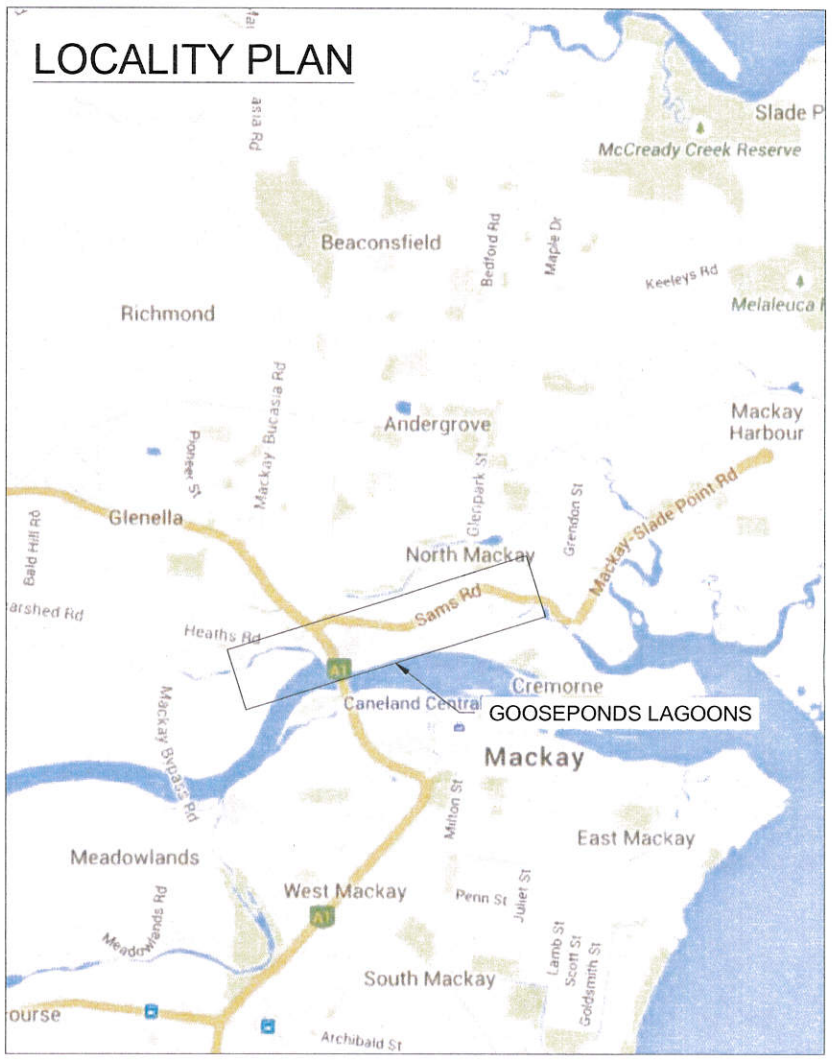
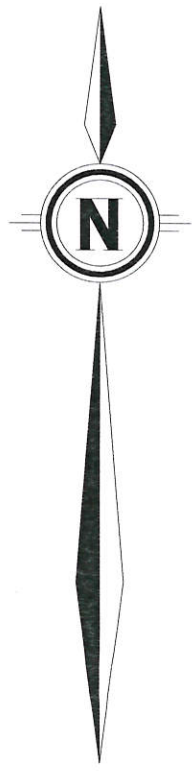
LOCATION PLAN

GOOSEPONDS 1



LOCALITY PLAN



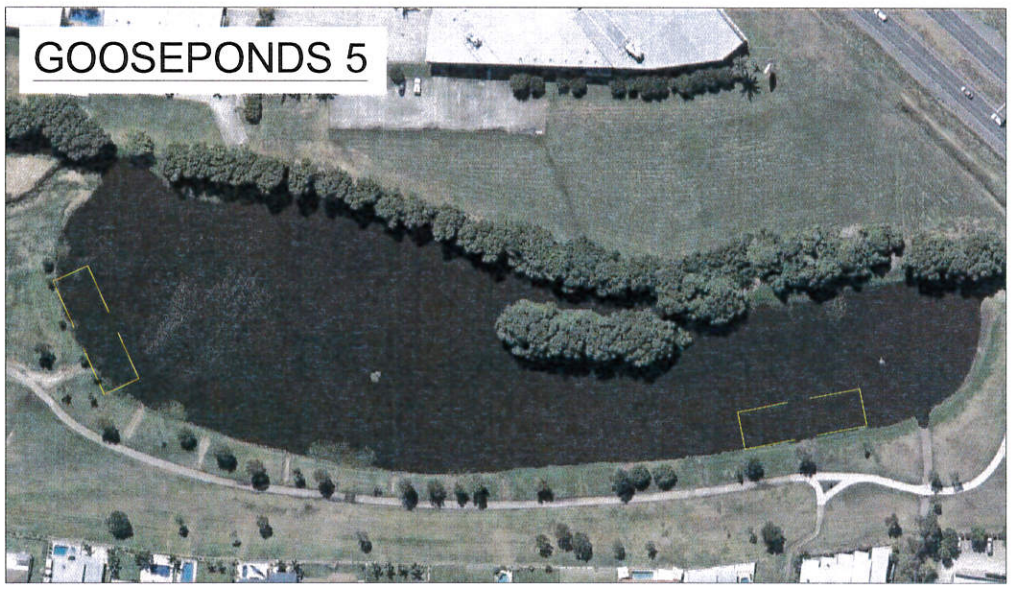


NOTES:

1. INSTALLATION LOCATIONS INDICATED BY YELLOW BOXES IN ACCORDANCE WITH HYDRAULIC MODELING refer to: *Flood impact assessment of proposed log hotels in Gooseponds Creek*, WRM Report of Catchment Solutions
2. POSITIONING OF STRUCTURES:
   - 2.1. PARALLEL TO SHORE AT DISTANCE OF 10 - 15 m
   - 2.2. 1.5 - 2.5 m DEPTH (CEASE FLOW)
   - 2.3. 0.5 - 1.0 m SPACING BETWEEN MODULES
3. MAXIMUM OF 5 MODULES TO BE INSTALLED AT EACH LOCATION
4. FOOTPRINT OF THE TOTAL INSTALLATION SHALL BE NO GREATER THAN 3.0 m x 15.0 m IN TOTAL
5. CONSIDERATION TO BE GIVEN FOR HEAVY VEHICLE ACCESS TO INSTALLATION LOCATIONS
   - 5.1. GOOSEPONDS 1 - FOOTPATH, TREES, PEDESTRIANS
   - 5.2. GOOSEPONDS 2 - CLEAR ACCESS
   - 5.3. GOOSEPONDS 5 - FOOTPATH, TREES, PEDESTRIANS
   - 5.4. HEAVY VEHICLES TO FOLLOW MACKAY REGIONAL COUNCIL PROCEDURES FOR ENTERING PUBLIC PARKS

GOOSEPONDS 2

GOOSEPONDS 5



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Surveyed				
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Drawn	TP	27/01/2016		
Checked	CS	28/01/2016	RPEQ 4883	

Note:

Rev.	Revisions	Date	Approved
A	ORIGINAL ISSUE - CONCEPT DESIGN	16/07/2015	
B	ORIGINAL ISSUE - DETAILED DESIGN	28/01/2016	CS

Client: REEF CATCHMENTS LIMITED

Title: GOOSEPONDS HABITAT IMPROVEMENT
LOG HOTEL DETAILED DESIGN - LOCATION PLAN

Parish: BASSET	County: CARLISLE
Locality:	Local Authority: MACKAY REGIONAL COUNCIL
Scale: NOT TO SCALE	Date: 28/01/2016 Job: FAE1002

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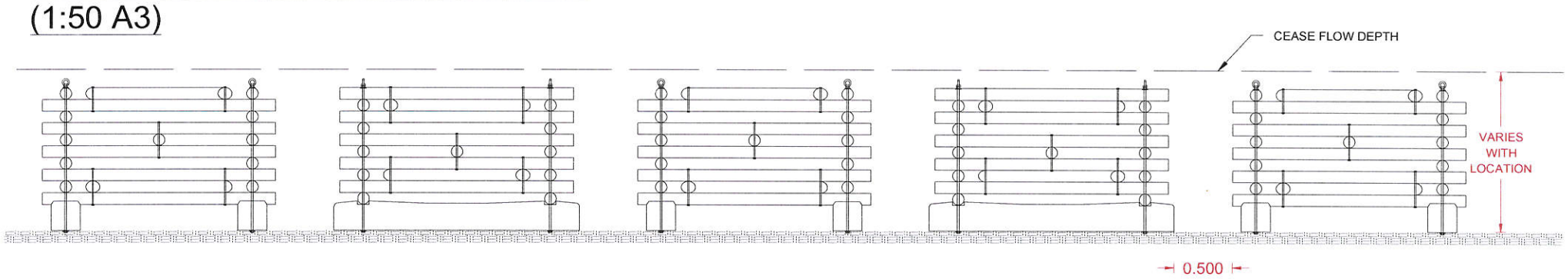
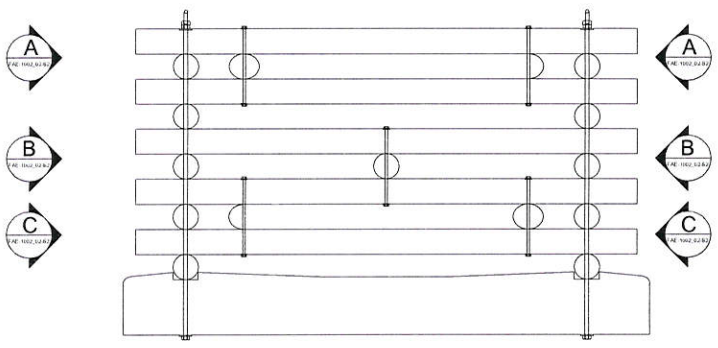
Drawing No.	Sheet No.	Rev.
FAE1002_02	1 of 2	B

TYPICAL MODULE CONFIGURATION (1:50 A3)

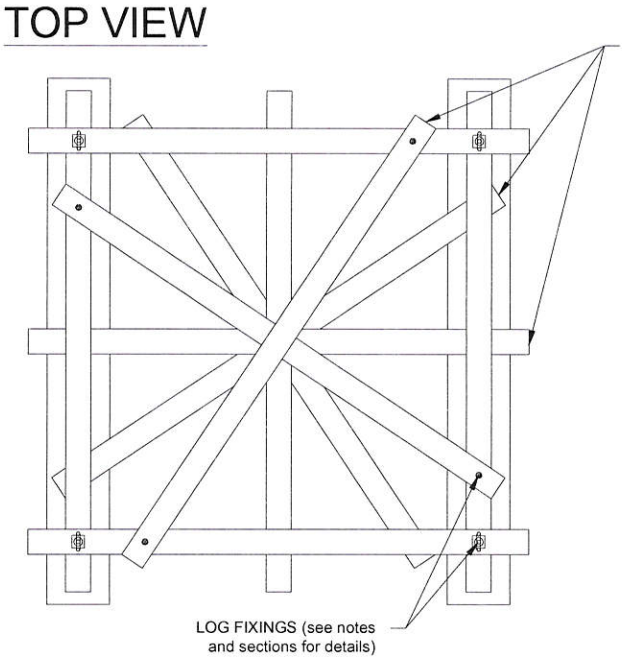


TYPICAL VIEWS (1:30 A3)

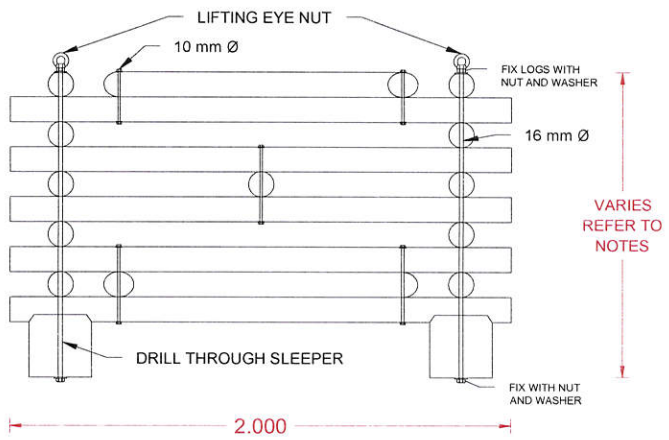
SIDE VIEW



TOP VIEW

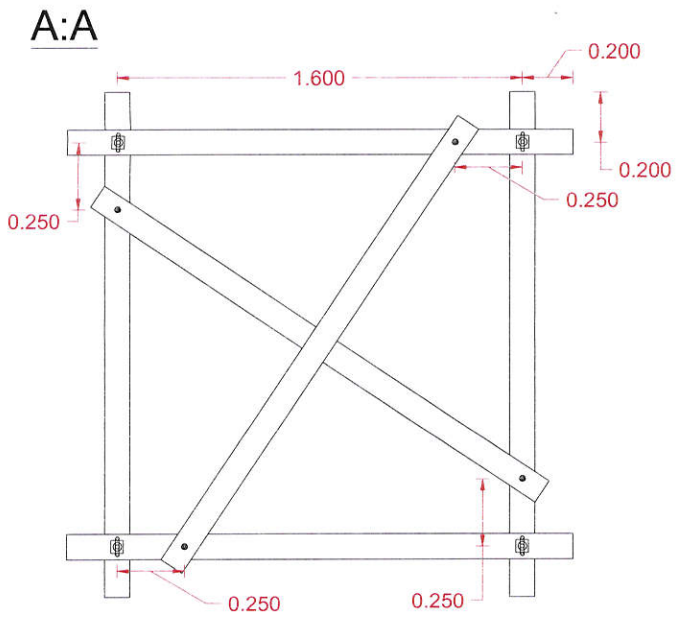


FRONT VIEW

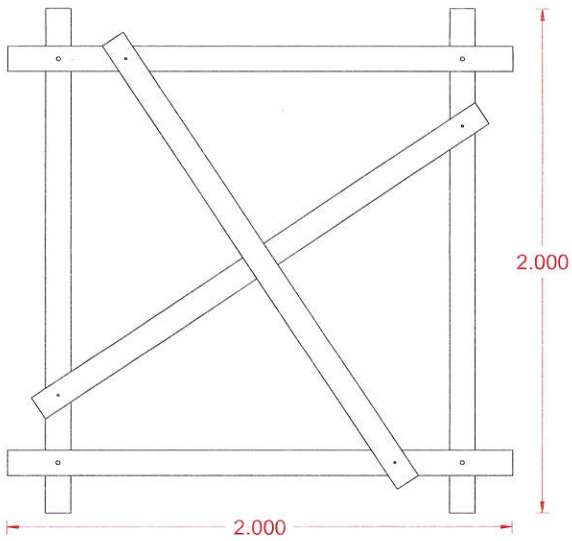


TYPICAL SECTIONS (1:30 A3)

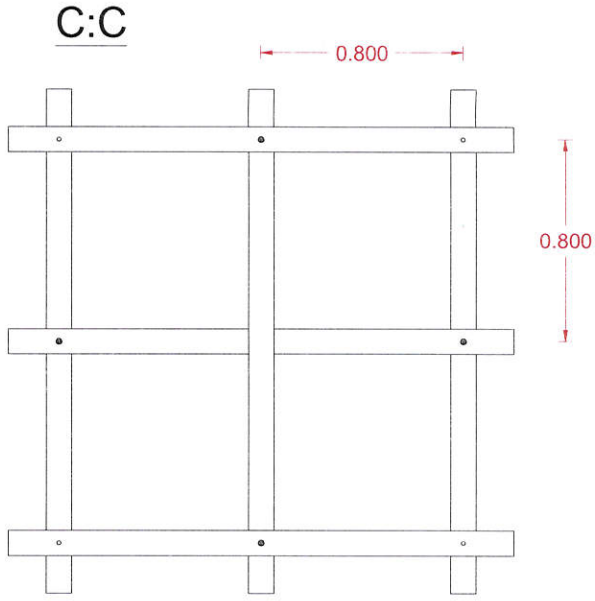
A:A



B:B



C:C



NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE
2. MAXIMUM HEIGHT OF MODULES NOT TO EXCEED 2.0 m OR CEASE FLOW DEPTH AT LOCATIONS < 2.0 m AT CEASE FLOW
3. CONSTRUCTION MATERIALS:
   - 3.1. LOGS SHALL BE ROSEWOOD (*Acacia rhodoxylon*) refer to: *http://era.daf.qld.gov.au/3623/5/CTIQ_book_2_Properties_and_specifications_Sept_2013.pdf Pg70, index number 482*
     - 3.1.1. LOGS >100 mm Ø SHALL BE NOTCHED TO MAINTAIN CONSISTENT SPACING
     - 3.1.2. LOGS <100 mm Ø SHALL BE PACKED WITH NYLON WASHERS TO MAINTAIN CONSISTENT SPACING
   - 3.2. CONCRETE BASE SHALL BE MAINLINE RAIL SLEEPERS
     - 3.2.1. min weight 275 kg
   - 3.3. FIXINGS SHALL BE 316 STAINLESS STEEL
     - 3.3.1. 16 mm Ø ROD (cut to size) FOR CORNER FIXING, WASHER 50 x 50 x 5 mm, NUT 16 mm Ø STRUCTURAL
     - 3.3.2. 10 mm Ø x 350 mm BOLTS FOR CROSS MEMBER FIXING, WASHER 25 mm, NUT 10 mm Ø STRUCTURAL
   - 3.4. LIFTING POINTS - THREADED CONNECT EYE NUT
     - 3.4.1. 16 mm Ø, 320 Kn LIFTING CAPACITY
4. LIFTING AND PLACEMENT:
   - 4.1. LIFTING MACHINERY AND PROCEDURES SHALL BE IN ACCORDANCE WITH *AS2550-2011 Australian Standard Cranes, hoists and winches - Safe use*

MATERIAL QUANTITIES (per module)

DESCRIPTION	QUANTITY
LOGS	46 / m (vertical)
SLEEPER	2
16 mm Ø ROD	4 lengths cut to size
16 mm Ø NUT	8
16 mm Ø WASHER	8
16 mm Ø EYE NUT	4
10 mm Ø BOLT	12 / m (vertical)
10 mm Ø NUT	12 / m (vertical)
10 mm WASHER	24 / m (vertical)

	Init	Date
Surveyed		
Designed	CS	21/01/2016
Drawn	TP	27/01/2016
Checked	CS	28/01/2016

Horizontal Datum | Origin
Level Datum | Origin
RPEQ 4883

Note:

Rev.	Revisions	Date	Approved
A	ORIGINAL ISSUE - CONCEPT DESIGN	16/07/2015	
B	ORIGINAL ISSUE - DETAILED DESIGN	28/01/2016	CS

Client: REEF CATCHMENTS LIMITED

Title: GOOSEPONDS HABITAT IMPROVEMENT
LOG HOTEL DETAILED DESIGN - LOCATION PLAN

Parish: BASSET
County: CARLISLE
Locality: NORTH MACKAY
Local Authority: MACKAY REGIONAL COUNCIL
Scale: NOT TO SCALE
Date: 28/01/2016
Job: FAE1002

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Drawing No.	Sheet No.	Rev.
FAE1002_02	2 of 2	B

Notes:

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CATCHMENT SOLUTIONS

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