



LINDEMAN GREAT BARRIER REEF RESORT PROJECT

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX Q - FLOOD STUDY

Addendum: This EIS was initially prepared assuming that the safe harbour was to be part of the Lindeman Great Barrier Reef Resort Project. With the commencement of the Great Barrier Reef Marine Park Authority's (GBRMPA) Dredging Coral Reef Habitat Policy (2016), further impacts on Great Barrier Reef coral reef habitats from yet more bleaching, and the recent impacts from Tropical Cyclone Debbie, the proponent no longer seeks assessment and approval to construct a safe harbour at Lindeman Island. Instead the proponent seeks assessment and approval for upgrades to the existing jetty and additional moorings in sheltered locations around the island to enable the resort's marine craft to obtain safe shelter under a range of wind and wave conditions. Accordingly, remaining references to, and images of, a safe harbour on various figures and maps in the EIS are no longer current.

Lindeman Island

Flood Study

HRP15078



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Table of Contents

1	Introduction	1
2	Gap Creek Dam	2
2.1	General Information	2
2.2	Catchment Details	2
2.2.1	Existing Dam	2
2.2.2	Proposed Dam	3
2.3	Dam Description	3
3	Flood Assessment	5
3.1	Data	5
3.2	Hydrology	5
3.2.1	Catchment Areas	5
3.2.2	Model Validation	6
3.2.3	Results	7
3.3	Hydraulics	7
3.3.1	General	7
3.3.2	Geometry	7
3.3.3	Boundaries	7
3.3.4	Roughness	8
3.3.5	Structures	8
3.4	Results	8
3.4.1	Existing Conditions	8
3.4.2	Developed Case	8
4	Dam Break Analysis	9
4.1	Background	9
4.2	Previous Reporting	9
4.3	Dam Failure Scenarios	10
4.4	Sunny Day Failure	10
4.4.1	General	10
4.4.2	Existing Conditions	11
4.4.3	Proposed Redevelopment	11
4.5	Dam Failure during a Flood	12
4.5.1	General	12
4.5.2	Existing Conditions	13
4.5.3	Proposed Redevelopment	13
4.5.4	Proposed Redevelopment with Mitigation Measures	13
4.6	Summary	13
5	Conclusion	14

Tables

Table 2-1	Gap Creek Dam Details	2
Table 2-2	Dam Characteristics	3
Table 2-3	Spillway Details	4
Table 3-1	WBNM Subcatchments	6
Table 4-1	Dam Break Parameters – Sunny Day Failure	11
Table 4-2	Dam Break Parameters – Dam Crest Failure	12

Figures

Figure 1	Existing Catchment Plan
Figure 2	Proposed Catchment Plan
Figure 3	Existing Topography
Figure 4	Proposed Topography
Figure 5	TUFLOW Model Layout
Figure 6	Land Use Areas
Figure 7	Existing Dam Extent
Figure 8	Proposed Dam Extent

Appendices

Appendix A	Flood Model Results
Appendix B	Masterplan Layout
Appendix C	Survey & Topographic Data
Appendix D	Dam Failure Impact Assessment Report
Appendix E	Proposed Dam Extension

1 Introduction

It is proposed to redevelop the existing Lindeman Island Resort into a world class integrated tourist resort with a spa, tourist villas and safe harbour. The Masterplan for the redevelopment is shown in Appendix B.

The redevelopment includes a substantial expansion to existing infrastructure, including an increase in water supply requirements. It is therefore proposed to extend the existing water supply dam in the middle of the island to increase its capacity and catchment area. The proposed extended dam will have a capacity of 207ML to the full supply level.

A number of minor ephemeral waterways are located in and around the site of the proposed redevelopment. The redevelopment therefore needs to be cognisant of the runoff in these waterways during periods of heavy rainfall.

Consequently, Cardno was commissioned by White Horse Australia (WHA) to complete a flood assessment for the Lindeman Island Resort, including a revised Dam Failure Impact Assessment for Gap Creek Dam (which provides the resort's water supply).

2 Gap Creek Dam

2.1 General Information

The Gap Creek Dam is an earth fill dam located approximately 320 m northwest of the resort. The dam is used for water supply purposes. It is proposed to increase the size of the dam as part of the expansion of Lindeman Island Resort. The increased storage capacity is needed to fulfil the increase in water supply demands associated with the expansion of the resort.

General information about the existing dam is contained in Table 2-1.

Table 2-1 Gap Creek Dam Details

Name of Dam	Gap Creek Dam (No. 654)
Dam Owner	White Horse Australia
Contact Details	PO Box 2628, Southport BC, QLD 4215 Mobile: 0408 581 883 Phone: 07 5591 2020
Status	Existing Proposed extension of dam to increase catchment area and volume available for water supply to Lindeman Island Resort
Property Description	Lot 2 on CP858366
Latitude	20°27'15" S
Longitude	142°09'02" E
Reference No.	DAM/130/000(0654)
Available Topographic data	2009 LiDAR Detailed ground survey of dam carried out in 2015
Watercourse and AMTD	Gap Creek, AMTD 0.5 km

2.2 Catchment Details

2.2.1 Existing Dam

The existing catchments defined in the study area are shown in Figure 1. The total catchment area of Gap Creek Dam is approximate 43 hectares. The slope of the catchment in its upper reaches is approximately 45%. Survey and topographic data of the island is contained in Appendix C, and the existing topography is shown in Figure 3

The creek is mostly narrow and contained within well-defined banks. Downstream of the dam, Gap Creek opens up into the relatively flat area in the vicinity of the existing golf course, before discharging to a steep sloping gully which outlets into the ocean.

The majority of the catchment comprises very dense vegetation. There are some areas of open grass, in particular the existing golf course. There are no impervious areas in the catchment which discharge to the dam.

Within the golf course, there is a small culvert which conveys low flows to the steep gully (which outlets into the ocean). This culvert has not been included in the flood modelling of the site as the small diameter of the culvert could easily become blocked during a flood event.

A ridge is located between two fairways in the existing golf course. This ridge forms the watershed between the Gap Creek catchment and the catchment which discharges to the south towards the existing resort. However, in a dam-break scenario, the sudden release of a large volume of water from the dam has the potential to overtop this ridge, allowing flow to discharge towards the resort area. For this reason, a dam break analysis was carried out to determine whether the height or extent of this ridge needed to be increased.

2.2.2 Proposed Dam

The proposed extension to the dam (as shown in Figure 4) will increase the catchment area contributing to the dam. However, all of the runoff from the additional catchment area will not be able to be diverted into the dam due to environmental restrictions on works in this area (refer Drawings in Appendix E).

During small rainfall events, a new waterway will direct flow contained in the main channel of the creek to the extension of the dam. During medium to large rainfall events, some of the runoff from the additional catchment will be directed to the dam, but the remainder will continue in a southerly direction along the existing floodplain.

The existing and proposed dam extents are provided in Figures 7 and 8 respectively.

2.3 Dam Description

Details of the existing and proposed dams are shown in Table 2-2.

Table 2-2 Dam Characteristics

Parameter	Units	Existing Dam	Proposed Dam
Type of Dam		Earth fill with riprap protection on upstream and downstream sides	Earth fill with riprap protection on upstream and downstream sides
Elevation at Base of Embankment	m AHD	48.5	48.5
Length	m	170	170
Crest Elevation	m AHD	51.33	51.33
Crest Width	m	3	3
Purpose of Storage		supply water for domestic and industrial use to the nearby resort	supply water for domestic and industrial use to the nearby resort
Dam Capacity to FSL	ML	199.6	207.3
Dam Capacity to DCL	ML	279.75	192.9
Dam Surface Area at FSL	ha	5.85	6.25

Details of the spillway outflow from Gap Creek Dam are shown in Table 2-3. The spillway is not affected by the proposed change in the dam catchment.

Table 2-3 Spillway Details

Parameter	Units	Value
Spillway description		Unlined channel with a steel lip control structure
Spillway Crest Length	m	8.48
Spillway Level Below Dam Crest	m	1.4
Spillway Capacity (Dam Crest Flood)	m ³ /s	24

3 Flood Assessment

3.1 Data

A variety of data was collected to contribute to the hydrologic and hydraulic models used to complete the flood modelling for Lindeman Island. This included:

- Topography
 - Lidar data was used to form the existing topography. The Lidar was captured in 2009 as part of the Tropical Coast Lidar capture project.
 - Detailed survey of the existing dam
 - Design TIN of the proposed extension to the dam
- Aerial images
- IFD data as available from the Bureau of Meteorology
- Dam stage storage relationship derived from detailed survey information
- DNRM dam break spread sheet

3.2 Hydrology

3.2.1 Catchment Areas

The hydrologic analysis for Lindeman Island was carried out using WBNM. The catchments contributing to flow into the dam and Lindeman Island resort extend over the south-western part of Lindeman Island. The WBNM catchment plan is shown in Figure 1.

The runoff from the eastern part of the study area generally flows in a southerly or westerly direction to the existing airplane runway and staff accommodation areas. The waterway then has its confluence with the outflow from Gap Creek Dam, near the golf course. The combined flow then discharges to the western coast of the island.

Small catchment areas discharge runoff to the southern coastline of the island.

Temporal patterns and rainfall intensities for Lindeman Island were determined in accordance with Australian Rainfall and Runoff (AR&R).

A rainfall on grid TUFLOW model was initially developed for the study area to determine the key flow paths on the island, especially in the flatter areas in the tableland at the top of the island. The rainfall on grid model was also used to confirm catchment boundaries and inflow points.

The total size of the catchment in the study area is approximately 189 hectares. The percentage impervious for each subcatchment was determined based on aerial photography and site inspection.

The catchment details are shown in Table 3-1.

Table 3-1 WBNM Subcatchments

Catchment ID	Area (ha)	% Impervious
A	23.38	0
B	13.9	0
C	8.09	0
D	8.11	0
E	11.9	0
F	6.54	0
G	24.9	10
H	10.33	2
I	9.21	0
J	18.19	0
K	17.22	0
East	6.52	2
Resort1	5.13	10
Resort2	1.58	5
Dam	19.29	30
Marina	4.29	2
Total	188.58	4.93

3.2.2 Model Validation

As there is no stream gauge on the island, the WBNM model was validated based on a peak flow estimate calculated using the Rational Method.

A Rational Method calculation was undertaken at the bottom of subcatchment I. Further downstream in the catchment, the minimal slope, dam and geographical features such as the airport runway and golf course provide a lot of storage. Therefore, it was considered more appropriate to conduct a Rational Method check further up in the catchment.

Parameters used for the Rational Method were chosen in accordance with the Queensland Urban Drainage Manual (QUDM). Time of concentration was determined using the Bransby-Williams equation.

The WBNM lag parameter adopted in the model was 1.30, which is within the normally accepted bounds for this parameter. The Rational Method was completed for the 1% Annual Exceedance Probability (AEP) flows. The details and results of this final Rational Method validation are shown below:

- Catchment Area = 43.8 ha
- Stream Length = 1,100 metres
- Average Catchment Slope = 7.5%
- Time of Concentration = 30 minutes
- Coefficient of Runoff (1% AEP event) = 0.84
- 1% AEP Rainfall Intensity = 177 mm/h
- Rational Method Discharge = 18.1 m³/s
- WBNM Model Discharge = 19.2 m³/s

The WBNM model peak discharge agrees well with the estimate obtained using the Rational Method. Therefore, it was considered that the WBNM model was acceptable.

3.2.3 Results

The 1% AEP event was analysed for a range of storm durations to determine the range of critical durations throughout the catchment. Due to the variety of conditions over the catchment, including steep upper catchments and flat inland catchments, the critical duration varies throughout the study area.

Hydrographs were exported from the WBNM model for use in the TUFLOW model, for the existing and post development cases.

3.3 Hydraulics

3.3.1 General

Lindeman Island was modelled using TUFLOW (version 2013-12-AE). It is a two-dimensional model with one-dimensional culverts and pipes included.

3.3.2 Geometry

Aerial laser survey of Lindeman Island was used to provide the existing topography in the study area. This data was supplemented by the detailed survey of Gap Creek Dam. A grid size of 2 metres was used in the model.

For the developed case, design TINs of the proposed dam extension and revised runway were included in the model.

3.3.3 Boundaries

A constant tail water level at the ocean outlets of 2.66 mAHD (equal to Highest Astronomical Tide, or HAT) was adopted. Due to the large difference in elevation between the ground levels in the study area and the tide level, the tailwater level boundary did not affect the calculated flood levels.

The WBNM derived local hydrographs were applied locally towards the downstream end of each subcatchment.

3.3.4 Roughness

The Manning's n values adopted in the model were based on site inspection and aerial photography. The adopted values were as follows.

- Rural areas, golf course 0.05
- Lakes 0.03
- Residential areas 0.20
- Vegetated Areas 0.08
- Runway 0.015

A roughness map is provided in Figure 6. The base roughness used for the model was for vegetated areas (0.08). Therefore any area not given a roughness value in Figure 6 was assigned the value 0.08.

3.3.5 Structures

Some 1D gully pits, culverts and pipes were included in the modelling in and around the existing Lindeman Island Resort. There is an existing drainage network around the existing buildings in order to convey flow out to the ocean.

The structure locations are shown on the TUFLOW model layout in Figure 5.

The details of these structures are shown on the plans provided in Appendix C.

3.4 Results

3.4.1 Existing Conditions

The existing case 1% AEP flood levels and depths are presented in Figures A1.1 and A1.2 respectively.

The results show that the flood flow is conveyed in the steep valley which discharges towards the existing resort. At the downstream end of this valley, the flow is diverted to an underground pipe drainage network. However, some overflow occurs during the 1% AEP event, causing flooding to some existing buildings. Thus, the detailed design of the future stormwater drainage system in this area will need to take this into account so that all future buildings are immune to flooding in the 1% AEP event.

3.4.2 Developed Case

The developed case 1% AEP flood levels and depths are presented in Figures A1.3 and A1.4 respectively.

The results are similar to those discussed in Section 3.4.1 above.

There is also flooding in the vicinity of some of the proposed buildings. The buildings that could be affected are the aircraft hangers, and a small part of the tourist villa district located east of the runway. These issues will need to be addressed during the detailed design of the site.

In summary, the results of the flood model indicate that some stormwater drainage upgrades will be required as part of the proposed redevelopment of the Lindeman Island Resort.

4 Dam Break Analysis

4.1 Background

As the proposed expansion of Lindeman Island Resort involves a substantial increase in the number of lodgings, it is necessary to revisit the dam failure impact assessment associated with Lindeman Island's water supply dam, Gap Creek Dam. It is also proposed to increase the storage capacity of the dam by extending the dam. The existing and proposed dam extents are shown in Figures 7 and 8 respectively.

The catchment contributing to Gap Creek Dam are relatively small, limiting the amount of flow running off into the dam during rainfall events. As shown by the results in Section 3, runoff from the Gap Creek Dam catchment the 1% AEP flood event discharges to the ocean outfall to the west of the island. However, in a dam break scenario, the discharge from the dam may be too large to be conveyed to the western ocean outfall, resulting in flow overtopping the existing ridgeline in the golf course and discharging through the resort area to the ocean on the southern side of the island.

Consequently, a dam break analysis was carried out to determine if any mitigation measures were required as part of the proposed redevelopment to control the flow during such an event.

The dam failure impact assessment (FIA) was conducted in accordance with the Queensland Government's Department of Energy and Water Supply's *Guidelines for Failure Impact Assessment of Water Dams*, 2012.

According to the guidelines, an FIA isn't automatically required for this dam.

An FIA is required if the height and storage criteria specified in the Water Act 2000 are exceeded. These criteria specify that an FIA is required if the dam currently, or after construction will be:

- more than eight metres in height with a storage capacity of more than 500 ML; or
- more than eight metres in height with a storage capacity of more than 250 ML and a catchment area that is more than three times its maximum surface area at full supply level.

These criteria do not apply to the Gap Creek Dam. However, as an FIA has been prepared for the dam in the past, and it is proposed to extend the current dam, it was considered appropriate to complete an FIA for the proposed redevelopment of Lindeman Island.

4.2 Previous Reporting

A dam failure impact assessment for the Gap Creek Dam was carried out previously by MRG Water Consulting Pty Ltd. A copy of the Dam Failure Impact Assessment Report (2013) is contained in Appendix D.

A stage one and two Preliminary Flood Impact Analysis was undertaken by the Department of Natural Resources and Water in 2004. This assessment included RORB and MIKE11 modelling, the files from which were provided to MRG to complete the full assessment. Some of the file were missing however and so were not used.

In 2013, it was found that there were inaccuracies in the breach hydrograph used dating possibly back to the initial assessments conducted by the Department of Energy and Water Supply. The inaccuracies were traced back to the dam storage curve, batter slopes of the embankment and the catchment hydrology. The original estimates calculated an approximate peak discharge of 390 m³/s for a Dam Crest Failure event. The revised breach hydrography had a peak of 220 m³/s.

Due to this reduction in the peak flow calculation, the 2013 report found that the dam break flow did not overtop the existing ridge in the golf course.

However, a review of this report has found some further areas for methodology improvement. The previous reporting did not include a coincident flood event downstream of the dam for the Dam Crest Failure event. Some levels used also seem to be approximately 2 metres different to recent survey data.

As it is proposed to significantly expand the resort, a comprehensive assessment was undertaken to ensure the increased population of the island are safe during a dam failure event.

4.3 Dam Failure Scenarios

The TUFLOW model developed for the flood assessment (refer Section 3) assessed the impact of dam failure scenarios for both the existing and proposed conditions. The model was also used to determine what, if any, mitigation measures were required to ensure the dam is not a referable dam and does not provide a population at risk in the event of a failure.

Both Sunny Day Failure (SDF) of the dam and a Dam Crest Failure (DCF) (i.e. dam failure due to overtopping of the dam embankment during a flood event) were considered. In order to determine if the dam is referable, it is necessary to calculate the number of people potentially at risk should a dam failure occur. As a sunny day failure occurs with no coincident flooding, every person at risk due to the dam failure flood is considered a person at risk. In a dam failure during a flood, only those people who would not have already been at risk due to the coincident flooding are counted as population at risk.

The dam break parameters were calculated using DNRM's breaching spreadsheet. The breaching spreadsheet also calculates a dam breach hydrograph. This hydrograph can then be used directly as an inflow into a hydraulic model directly downstream of the dam breach location in order to simulate a breach flood. However, this method produced a less conservative flood level than directly modelling the dam failure within the TUFLOW model (using a variable z-shape function). The breach shape and time to develop can be calculated using the breaching spreadsheet, and the failure can be triggered to start based on time or water levels within the TUFLOW model.

The TUFLOW method was adopted as initial sensitivity testing showed higher water levels being produced by this method, and it was therefore deemed the more conservative option.

4.4 Sunny Day Failure

4.4.1 General

A sunny day failure describes a dam failure that occurs at full supply level without any concurrent flood event. In this scenario, since there is no simultaneous flood event, nobody would be at risk of flooding if the dam did not break. Therefore, any persons at risk due to the dam break flood contribute towards population at risk calculations to determine if the dam is referable.

The dam break parameters were calculated using DNRM's breaching spreadsheet. The parameters used for the sunny day failure event are shown in Table 4-1.

Table 4-1 Dam Break Parameters – Sunny Day Failure

Parameter	Units	Value
EL Spillway	m (RL)	51.33
Width Spillway	m	8.48
EL Embankment	m (RL)	52.7
Centreline EL of Initial Pipe	m (RL)	51.3
Coefficient of spillway discharge		1.6
EL Base of Breach	m (RL)	43
Breach side slope	1H: x V	5.5
Time step	minutes	1
Volume of Water Lost	ML	200
Upstream Batter Slope	1H: x V	0.588
Downstream Batter Slope	1H: x V	0.667
Crest Width	m	3
B/d Ratio		0.87
B/d Ratio		1.72

4.4.2 Existing Conditions

The existing case sunny day failure is a failure of the dam in its existing condition, starting with the dam at its full supply level.

The peak flood levels and depths due to the existing case sunny day failure case are presented in Figure A2.1 and Figure A2.2 respectively.

The flood extent does not break out of the Gap Creek valley into the resort area. Hence, there are no persons at risk from a sunny day dam failure under existing conditions.

4.4.3 Proposed Redevelopment

The peak flood levels and depths due to the sunny day failure with the proposed dam arrangement are presented in Figure A2.3 and Figure A2.4 respectively.

Similar to existing conditions, the flood extent does not break out of the Gap Creek valley into the resort area. Hence, there are no persons at risk from a sunny day dam failure under developed conditions.

4.5 Dam Failure during a Flood

4.5.1 General

A dam failure event during a flood occurs due to overtopping or piping failure of the dam wall during a large flood event. It is assumed the dam fails with the water level at the crest of the embankment or at the probable maximum flood level if the dam does not overtop.

As per the *Guidelines for Failure Impact Assessment of Water Dams*, the relevant flood event is a PMF event in the catchments upstream of the dam and a coincident 1% AEP flood event in the other catchments.

The dam break parameters were calculated using DNRM's breaching spreadsheet. The parameters used for dam failure during a flood event are provided below in Table 4-2.

Table 4-2 Dam Break Parameters – Dam Crest Failure

Parameter	Units	Value
EL Spillway	m (RL)	51.33
Width Spillway	m	8.48
EL Embankment	m (RL)	52.7
Centreline EL of Initial Pipe	m (RL)	52.7
Coefficient of spillway discharge		170
EL Base of Breach	m (RL)	1.6
Breach side slope	1H: x V	43
Time step	minutes	6
Volume of Water Lost	ML	1
Upstream Batter Slope	1H: x V	0.588
Downstream Batter Slope	1H: x V	0.667
Crest Width	m	3
B/d Ratio		0.84
B/d Ratio		1.66

4.5.2 Existing Conditions

As discussed above, the relevant flood event is a PMF event in the catchments upstream of the dam and a coincident 1% AEP flood event in the other catchments.

Because the proposed dam case has different upstream catchments (due to the proposed diversion), these catchments were also modelled with PMF input for the existing case. This is both a conservative and consistent approach, and allows like for like comparison between cases.

The peak flood levels and depths due to the existing dam crest failure case are presented in Figure A3.1 and Figure A3.2 respectively.

The results show that the dam break flood is not contained within the Gap Creek valley, but overflows the existing ridge and discharges towards the resort area.

Left unmitigated, there is potential for there to be persons at risk during this type of dam failure event.

4.5.3 Proposed Redevelopment

The peak flood levels and depths due to the developed scenario dam crest failure case are presented in Figure A3.3 and Figure A3.4 respectively.

The results are similar to the existing case results, and show that the flow breaches the existing ridge and discharges towards the resort area.

4.5.4 Proposed Redevelopment with Mitigation Measures

As discussed in Section 4.5.3, the existing ridge line is overtopped during the dam failure event. The ridge is overtopped by a maximum depth of approximately 350 mm. It is therefore proposed to increase the height of this ridge (through minor earthworks) by 500 mm.

The peak flood levels and depths due to the developed scenario dam crest failure case with the mitigation measure in place are presented in Figure A4.3 and Figure A4.4 respectively.

These results show that the increased level of the ridge is sufficient to exclude the floodwaters from entering the resort area.

4.6 Summary

Detailed hydraulic modelling of the Gap Creek Dam determined:

- a sunny day failure would not cause inundation of the main resort area; and
- a dam crest failure event has the potential to cause floodwaters to discharge through the resort area. Consequently, it is recommended that the elevation of the existing ridge be raised 500 mm to protect the resort area and divert the flow to the western coastline.

5 Conclusion

It is proposed to redevelop the existing Lindeman Island Resort into a world class integrated tourist resort with a spa, tourist villas and safe harbour. As part of the redevelopment, it is proposed to extend the existing water supply dam in the middle of the island to increase its capacity and catchment area.

Detailed hydrologic and hydraulic modelling was carried out to determine:

- the flood levels within the proposed redevelopment areas; and
- the impact due to a dam failure.

The results of the analysis showed that:

- the 1% AEP flood event in the Gap Creek catchment can be safely conveyed to the ocean outfall on the western coastline;
- additional stormwater drainage works will be required to convey the runoff through the resort area to the southern coastline;
- a sunny day failure would not create or increase the population at risk; and
- a dam crest failure has the potential to increase the population at risk, thus it is recommended that the elevation of the existing earth bund be raised through earthworks by 500 mm.

Flood Study

FIGURES

- Figure 1 Existing Catchment Plan
- Figure 2 Proposed Catchment Plan
- Figure 3 Existing Topography
- Figure 4 Proposed Topography
- Figure 5 TUFLOW Model Layout
- Figure 6 Land Use Areas
- Figure 7 Existing Dam Extent
- Figure 8 Proposed Dam Extent



Scale: 1:7,500



LEGEND

- Catchment Boundaries
- Flow Paths

Figure 1
Lindeman Island
Existing Catchment Plan

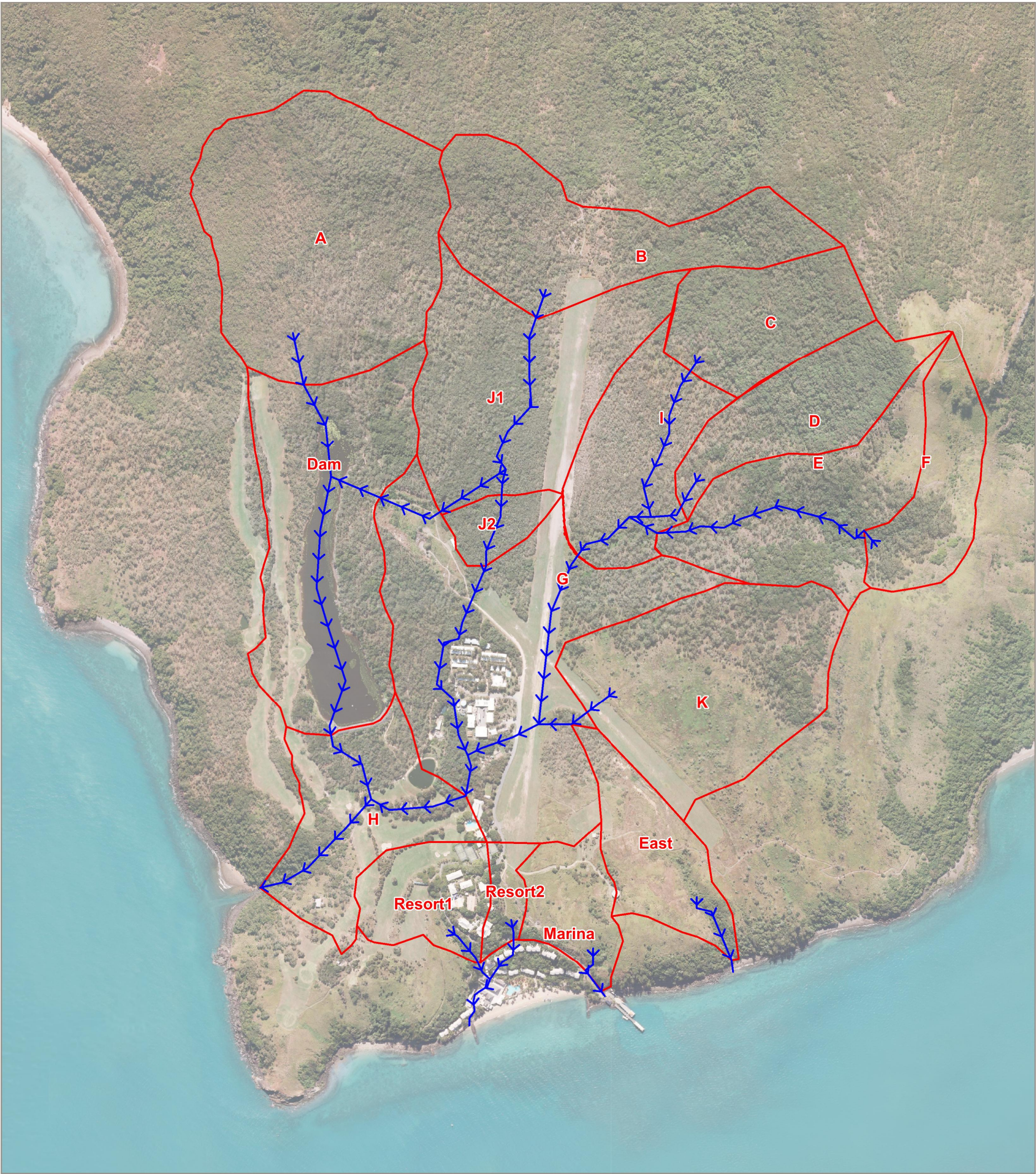
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LEGEND

- Catchment Boundaries
- Flow Paths

Figure 2
Lindeman Island
Proposed Catchment Plan

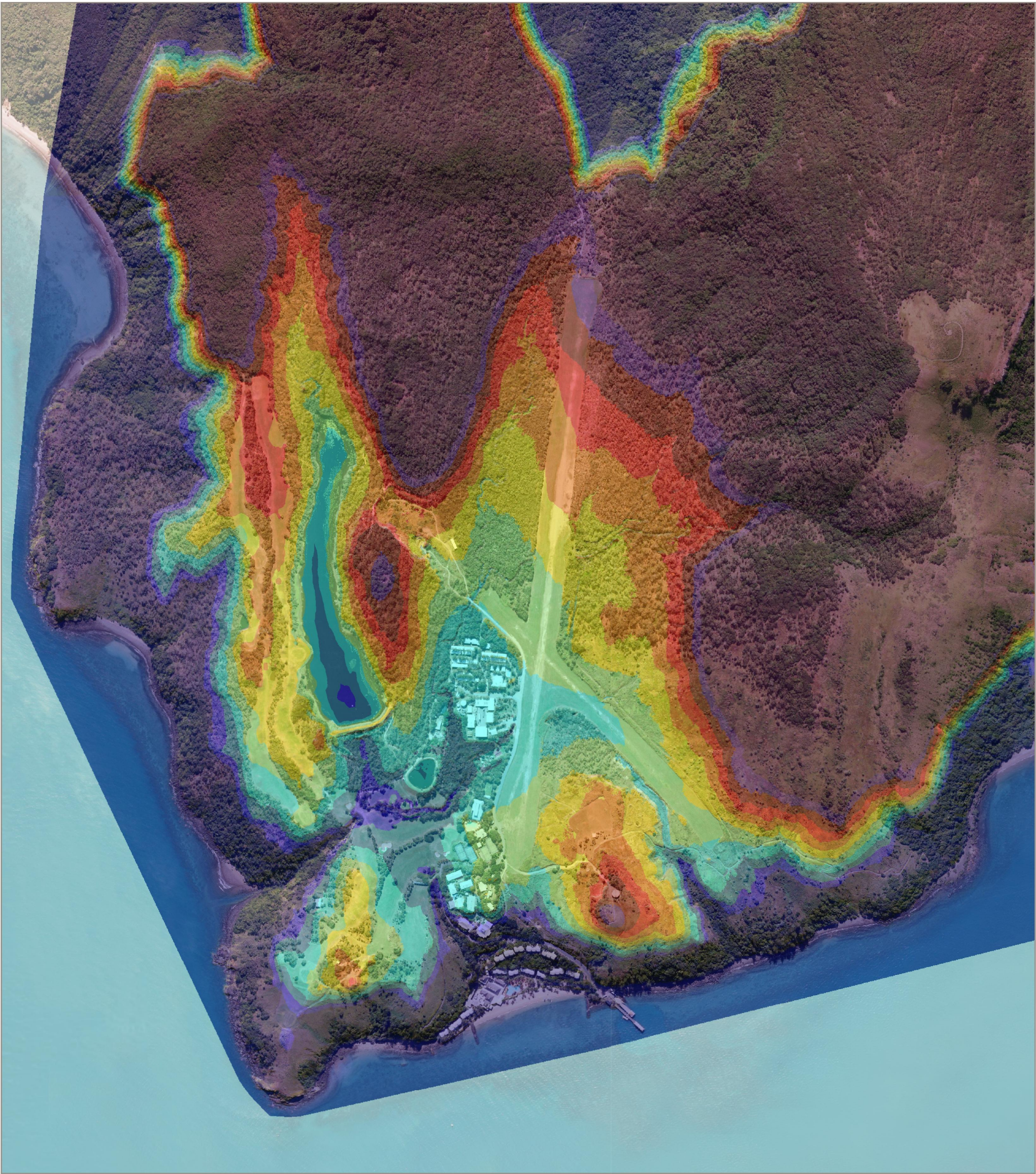
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Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Topography (m AHD)

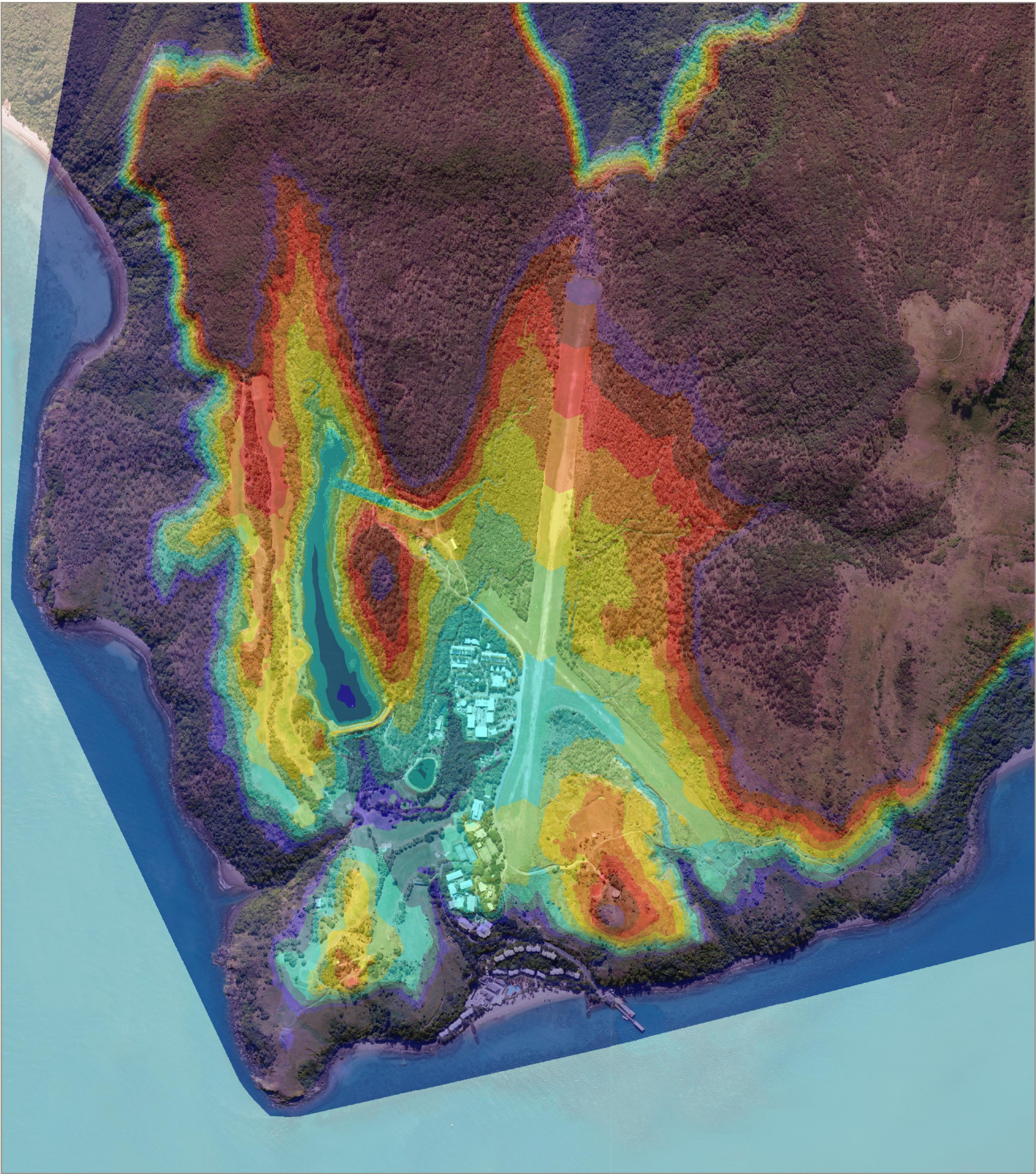
	< 40		55.00 to 58
	40 to 43		58 to 61
	43 to 46		61 to 64
	46 to 49		64 to 67
	49 to 52		>67
	52 to 55		

Figure 3

Lindeman Island

Existing Topography





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Topography (m AHD)

	< 40		55.00 to 58
	40 to 43		58 to 61
	43 to 46		61 to 64
	46 to 49		64 to 67
	49 to 52		>67
	52 to 55		

Figure 4

Lindeman Island

Proposed Topography





Scale: 1:7,500



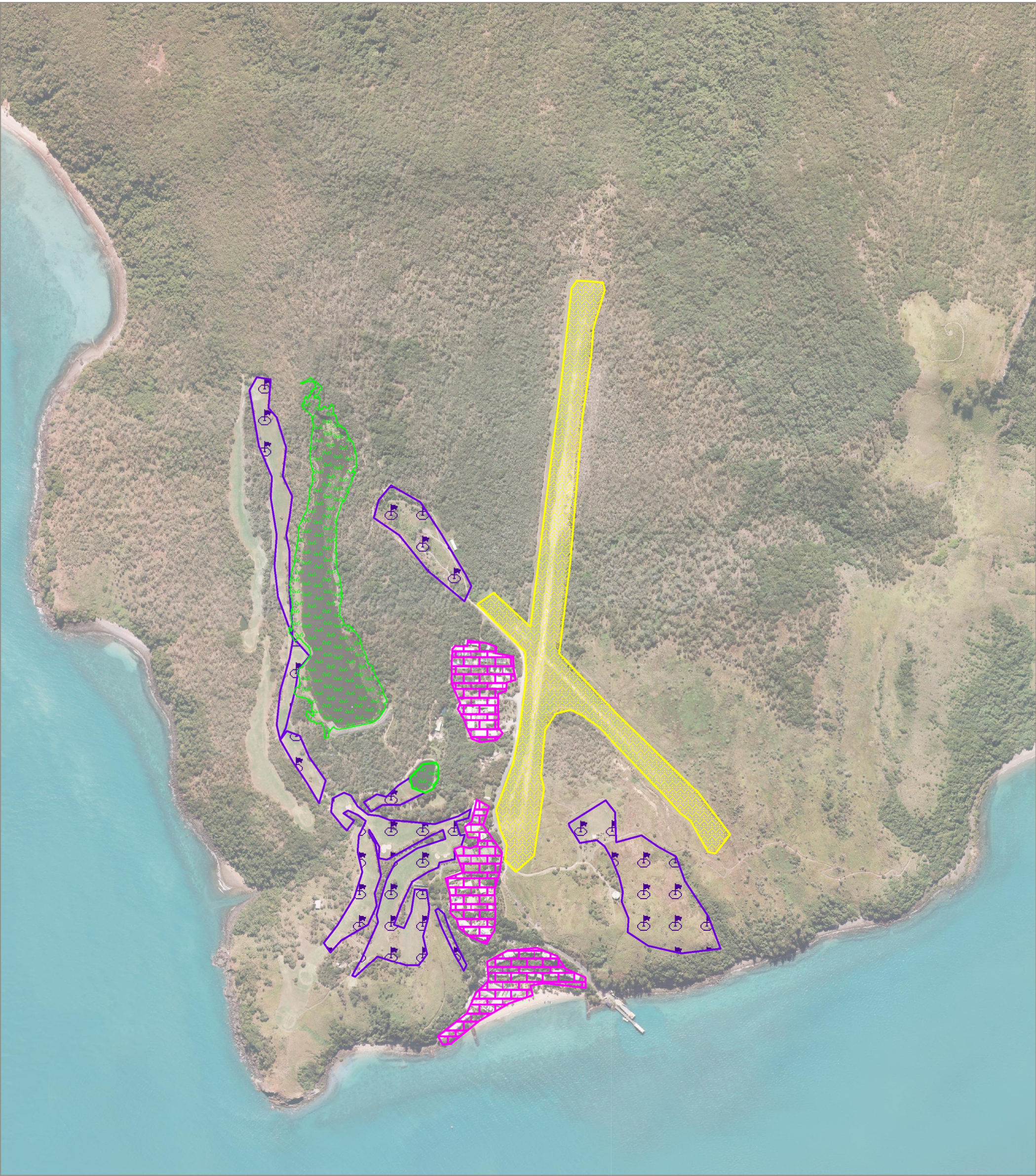
SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

- Culverts Line
- Downstream Boundary Location
- Inflow
- Model Extent

Figure 5
Lindeman Island
TUFLOW Model Layout





Scale: 1:7,500



SHEET | A3
Project No: | HRP15078
Date: | 17/03/2016
Revision Number: | 2
Designed by: | ZD
Client Name: | White Horse

LEGEND

- Lakes - 0.03
- Residential Areas
- Runway - 0.015
- Rural Areas, Golf

Figure 6



Scale: 1:7,500



LEGEND

 Dam Extent

Figure 7

Lindeman Island

Existing Dam Extent

SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse



Cardno (QLD) Pty Ltd | ABN 57 051 074 992
Level 11, North Tower, 515 St Pauls Terrace
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Scale: 1:7,500



LEGEND

-  Dam Extent
-  Mitigation Bund Location

Figure 8
Lindeman Island
Proposed Dam Extent

SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
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Client Name: White Horse



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Flood Study

APPENDIX A

FLOOD MODEL RESULTS



Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

< 40	55.00 to 58
40 to 43	58 to 61
43 to 46	61 to 64
46 to 49	64 to 67
49 to 52	>67
52 to 55	

Figure A1.1

Lindeman Island

Existing 1% AEP
Water Level





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Depth (m)	
	< 0.2
	0.2 to 0.4
	0.4 to 0.6
	0.6 to 0.8
	0.8 to 1.0
	1.0 to 1.2
	1.2 to 1.4
	1.4 to 1.6
	1.6 to 1.8
	1.8 to 2.0
	>2.0

Figure A1.2

Lindeman Island

Existing 1% AEP
Depth





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

< 40	55.00 to 58
40 to 43	58 to 61
43 to 46	61 to 64
46 to 49	64 to 67
49 to 52	>67
52 to 55	

Figure A1.3

Lindeman Island

Proposed 1% AEP
Water Level





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Depth (m)	
< 0.2	1.2 to 1.4
0.2 to 0.4	1.4 to 1.6
0.4 to 0.6	1.6 to 1.8
0.6 to 0.8	1.8 to 2.0
0.8 to 1.0	>2.0
1.0 to 1.2	

Figure A1.4

Lindeman Island

Proposed 1% AEP
Depth





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

	< 40		55.00 to 58
	40 to 43		58 to 61
	43 to 46		61 to 64
	46 to 49		64 to 67
	49 to 52		>67
	52 to 55		

Figure A2.1

Lindeman Island

Existing Case
Sunny Day Failure
Water Level





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Depth (m)	
< 0.2	1.2 to 1.4
0.2 to 0.4	1.4 to 1.6
0.4 to 0.6	1.6 to 1.8
0.6 to 0.8	1.8 to 2.0
0.8 to 1.0	>2.0
1.0 to 1.2	

Figure A2.2

Lindeman Island

Existing Case
Sunny Day Failure
Depth





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

< 40	55.00 to 58
40 to 43	58 to 61
43 to 46	61 to 64
46 to 49	64 to 67
49 to 52	>67
52 to 55	

Figure A2.3

Lindeman Island

Proposed Case
Sunny Day Failure
Water Level





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

< 40	55.00 to 58
40 to 43	58 to 61
43 to 46	61 to 64
46 to 49	64 to 67
49 to 52	>67
52 to 55	

Figure A2.4

Lindeman Island

Proposed Case
Sunny Day Failure
Depth





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

< 40	55.00 to 58
40 to 43	58 to 61
43 to 46	61 to 64
46 to 49	64 to 67
49 to 52	>67
52 to 55	

Figure A3.1

Lindeman Island

**Existing Dam Failure
During a Flood
Water Level**





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Depth (m)	
	< 0.2
	0.2 to 0.4
	0.4 to 0.6
	0.6 to 0.8
	0.8 to 1.0
	1.0 to 1.2
	1.2 to 1.4
	1.4 to 1.6
	1.6 to 1.8
	1.8 to 2.0
	>2.0

Figure A3.2

Lindeman Island

Existing Dam Failure
During a Flood
Depth





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

	< 40		55.00 to 58
	40 to 43		58 to 61
	43 to 46		61 to 64
	46 to 49		64 to 67
	49 to 52		>67
	52 to 55		

Figure A3.3

Lindeman Island

Proposed Dam Failure
During a Flood
Water Level





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Depth (m)	
< 0.2	1.2 to 1.4
0.2 to 0.4	1.4 to 1.6
0.4 to 0.6	1.6 to 1.8
0.6 to 0.8	1.8 to 2.0
0.8 to 1.0	>2.0
1.0 to 1.2	

Figure A3.4

Lindeman Island

**Proposed Dam Failure
During a Flood
Depth**





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

	< 40		55.00 to 58
	40 to 43		58 to 61
	43 to 46		61 to 64
	46 to 49		64 to 67
	49 to 52		>67
	52 to 55		

Figure A4.1

Lindeman Island

**Existing Mitigated
Dam Failure During a Flood
Water Level**





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

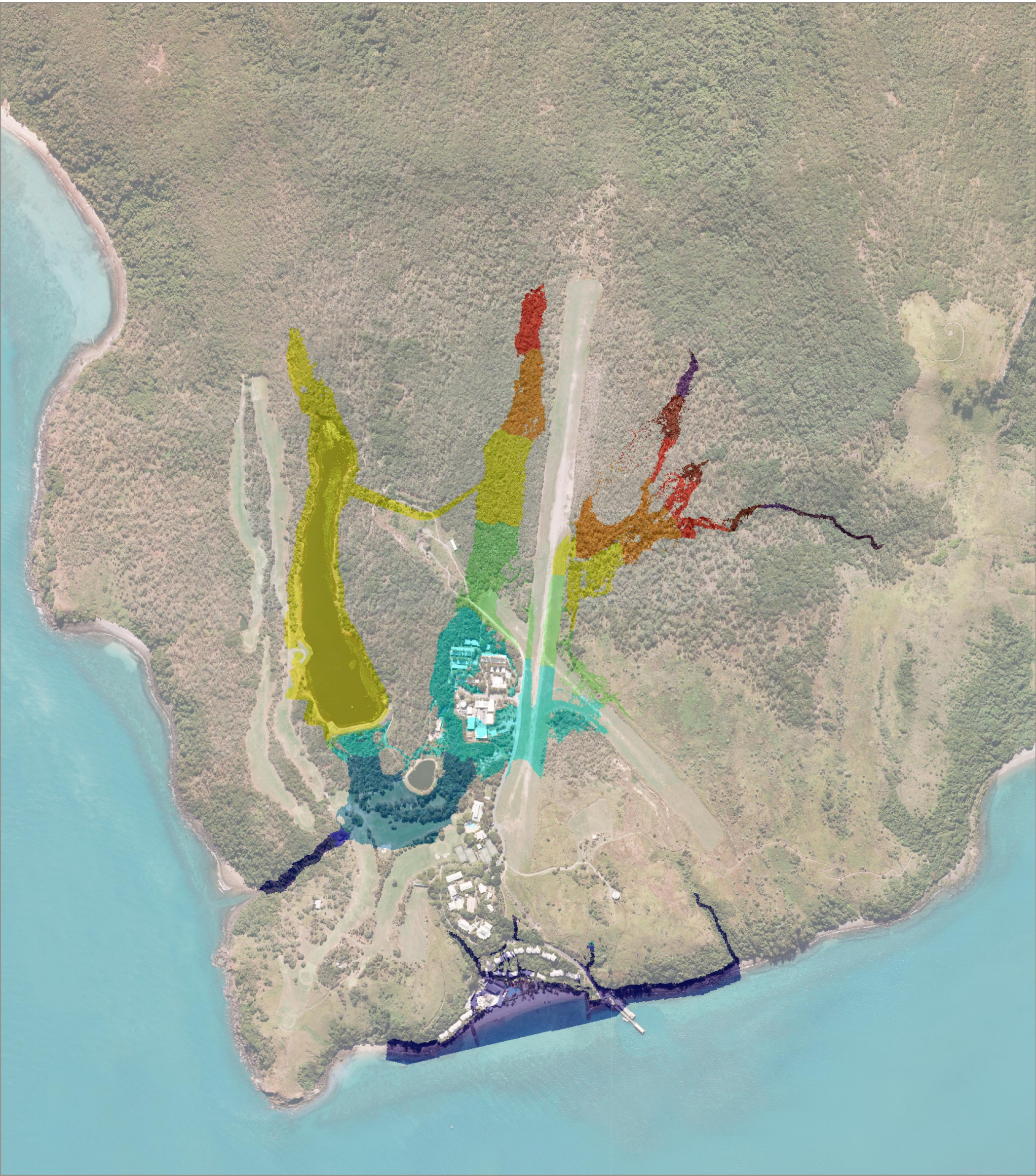
Depth (m)	
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	0.2 to 0.4
	0.4 to 0.6
	0.6 to 0.8
	0.8 to 1.0
	1.0 to 1.2
	1.2 to 1.4
	1.4 to 1.6
	1.6 to 1.8
	1.8 to 2.0
	>2.0

Figure A4.2

Lindeman Island

Existing Mitigated
Dam Failure During a Flood
Depth





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Water Level (m AHD)

< 40	55.00 to 58
40 to 43	58 to 61
43 to 46	61 to 64
46 to 49	64 to 67
49 to 52	>67
52 to 55	

Figure A4.3

Lindeman Island

Proposed Mitigated
Dam Failure During a Flood
Water Level





Scale: 1:7,500



SHEET A3
Project No: HRP15078
Date: 17/03/2016
Revision Number: 2
Designed by: ZD
Client Name: White Horse

LEGEND

Depth (m)	
< 0.2	1.2 to 1.4
0.2 to 0.4	1.4 to 1.6
0.4 to 0.6	1.6 to 1.8
0.6 to 0.8	1.8 to 2.0
0.8 to 1.0	>2.0
1.0 to 1.2	

Figure A4.4

Lindeman Island

Proposed Mitigated
Dam Failure During a Flood
Depth



Flood Study

APPENDIX B

MASTERPLAN LAYOUT



KEY PLAN

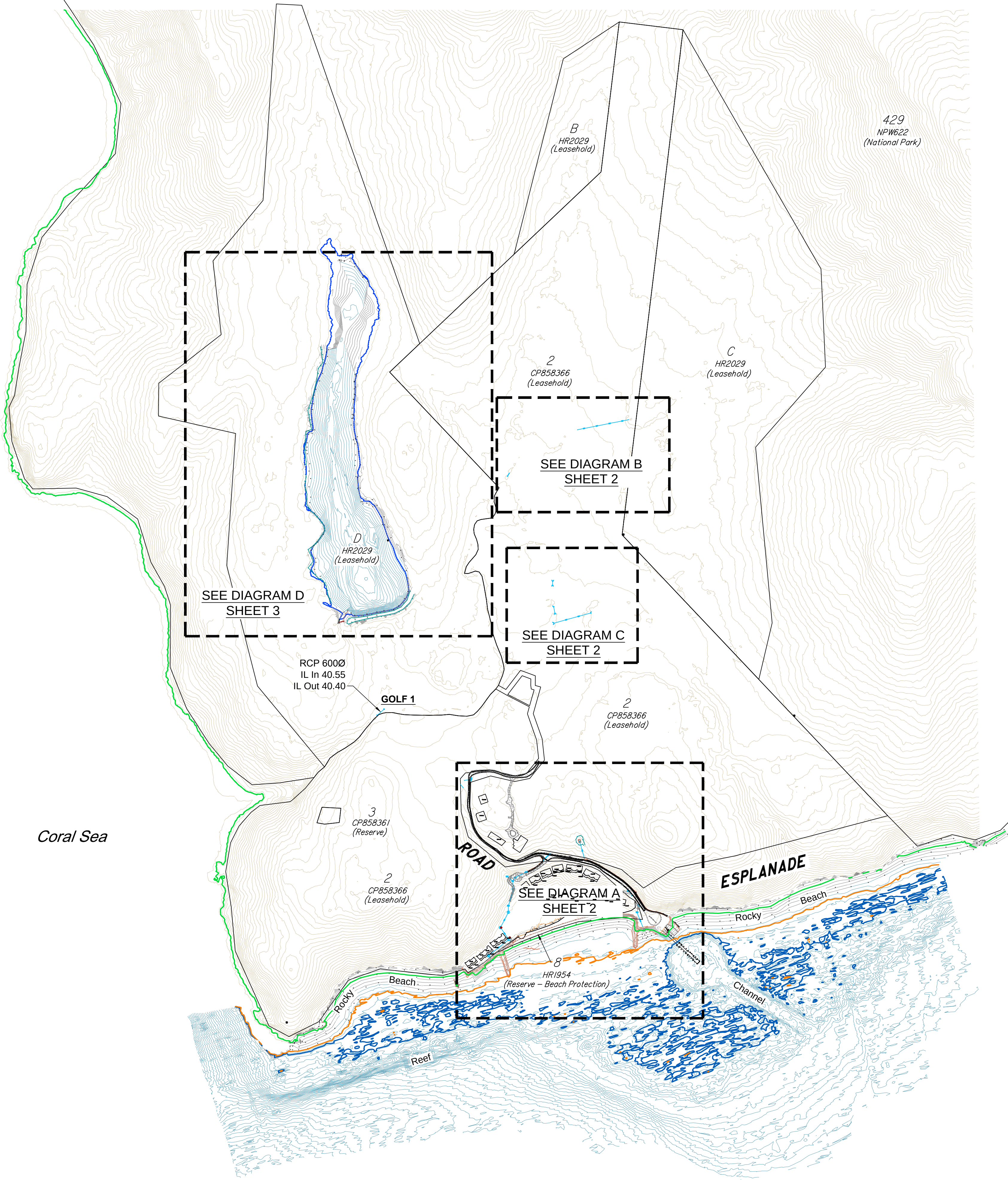
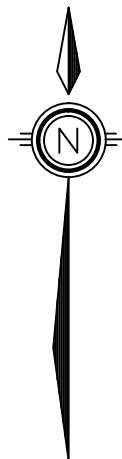


Flood Study

APPENDIX C

SURVEY & TOPOGRAPHIC DATA

LINDEMAN ISLAND



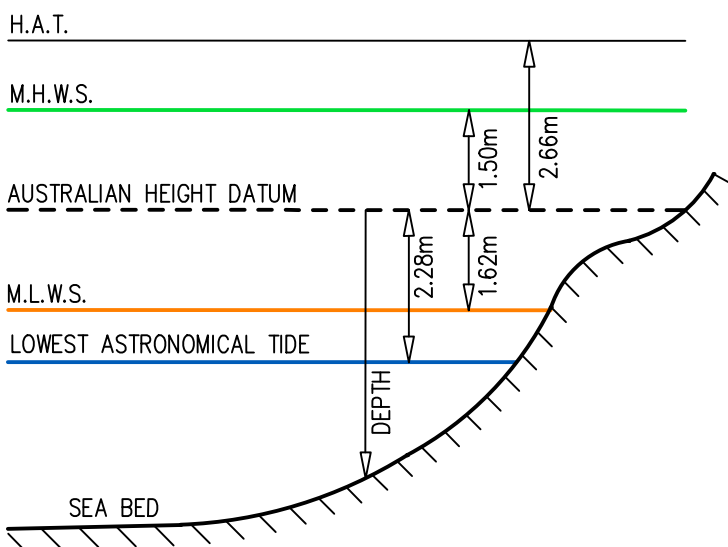
LEGEND

- ▲ TEMPORARY BENCH MARK
- ≡ GULLY GRATE
- ⊙ STORMWATER MANHOLE
- ⊙ SEWER MANHOLE
- 2₁ DEPTH BELOW AHD
- M.H.W.S. LINE
- M.L.W.S. LINE
- L.A.T. LINE
- TOE TOE BOTTOM OF BANK
- TOP OF BANK
- CHANGE OF GRADE
- SW STORMWATER LINE
- S SEWER LINE
- 19.00 SURVEY CONTOUR LINE (0.5m INTERVAL)
- 1.20 HYDRO SURVEY CONTOUR LINE (0.5m INTERVAL)
- 30.00 LIDAR CONTOUR LINE (2m INTERVAL)
- DRAINAGE FLOW LINE
- EXISTING BUILDING
- EDGE OF PAVERS
- EDGE OF BITUMEN
- EDGE OF CONCRETE

Scale 1:4000 - Lengths are in Metres.

50 0 50 100 150 200 250 300 350 400 450 500 550

DATUM DIAGRAM



DATUM INFORMATION

Origin of Coordinates PSM 102646
(Vide GNSS Survey) E 712903.830
N 7736372.824
RL= 1.977m
Location: Top of Barge Ramp

IMPORTANT NOTE:

This drawing is based on or contains data provided by the Department of Environment and Resource Management, Queensland 2007 which gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

NOTES

- LIDAR data has been lowered 0.27m to suit survey data.
- Cadastral boundaries shown are obtained from existing DCDB. These boundaries have not been verified and are approximate only.

CONTOUR & DETAIL SURVEY

PROJECT: Lindeman Island Redevelopment
LOCATION: Lindeman Island, Whitsundays
Real Property Description: Lot 2 on CP858366

CLIENT: Eastview Pty Ltd

Parish: Shaw
County: Herbert
Local Authority: Mackay Regional

Horiz. Datum: MGA Zone 55
Vert. Datum: AHD (See Table)
Contour Interval: 0.5m

VISION SURVEYS QUEENSLAND
Airlie Beach | Mackay | Townsville | Rockhampton | Moranbah
07 4846 3761 07 4961 0768 07 4721 0410 07 4927 1744 07 4941 9069
Email: admin@visionsurveysqld.com.au

Scale: 1:4000 @ A1
Drawing No: 15165-CD1
Drawn: AD
Sheet: 1 of 3
Surveyor: CH
Revision: A

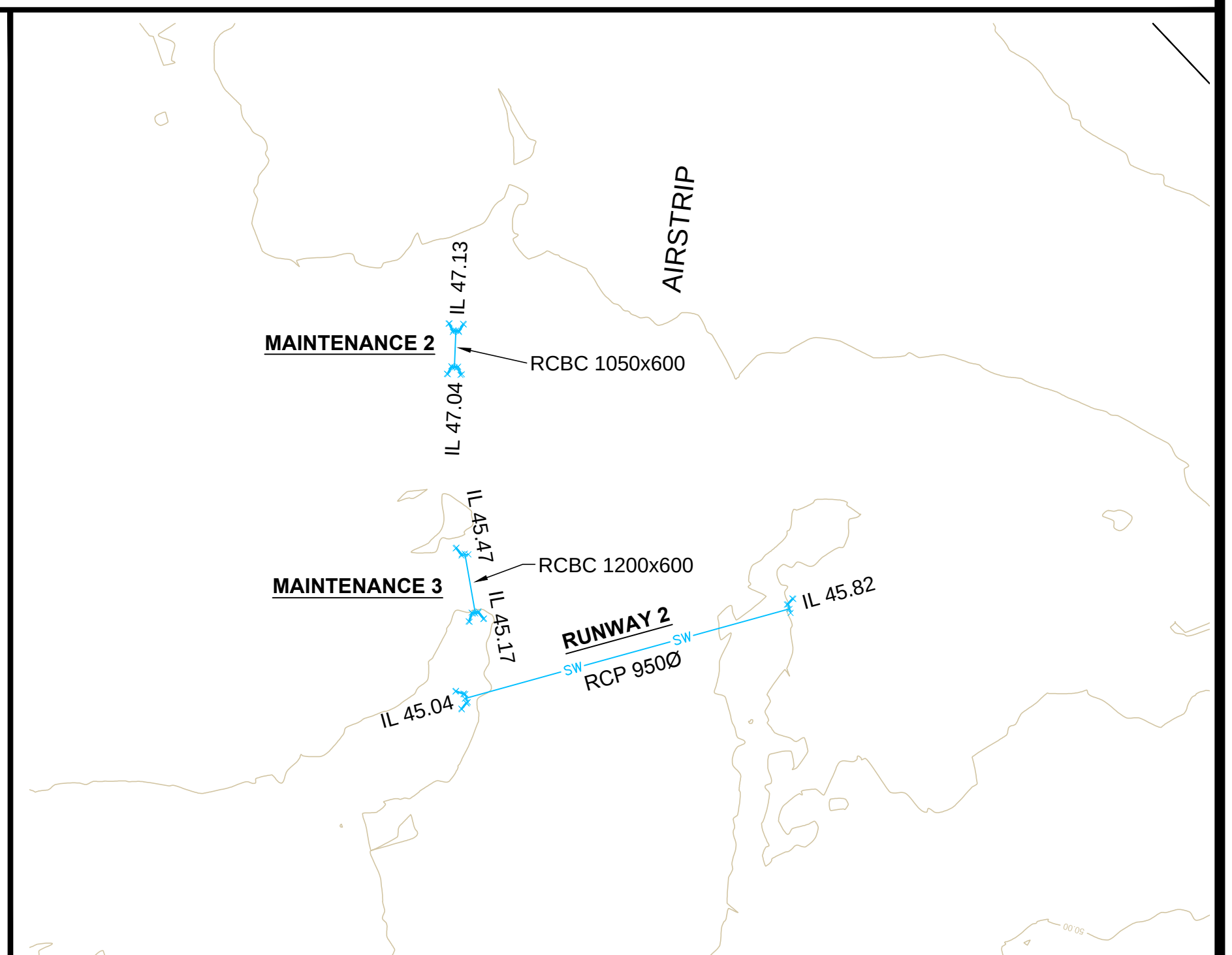
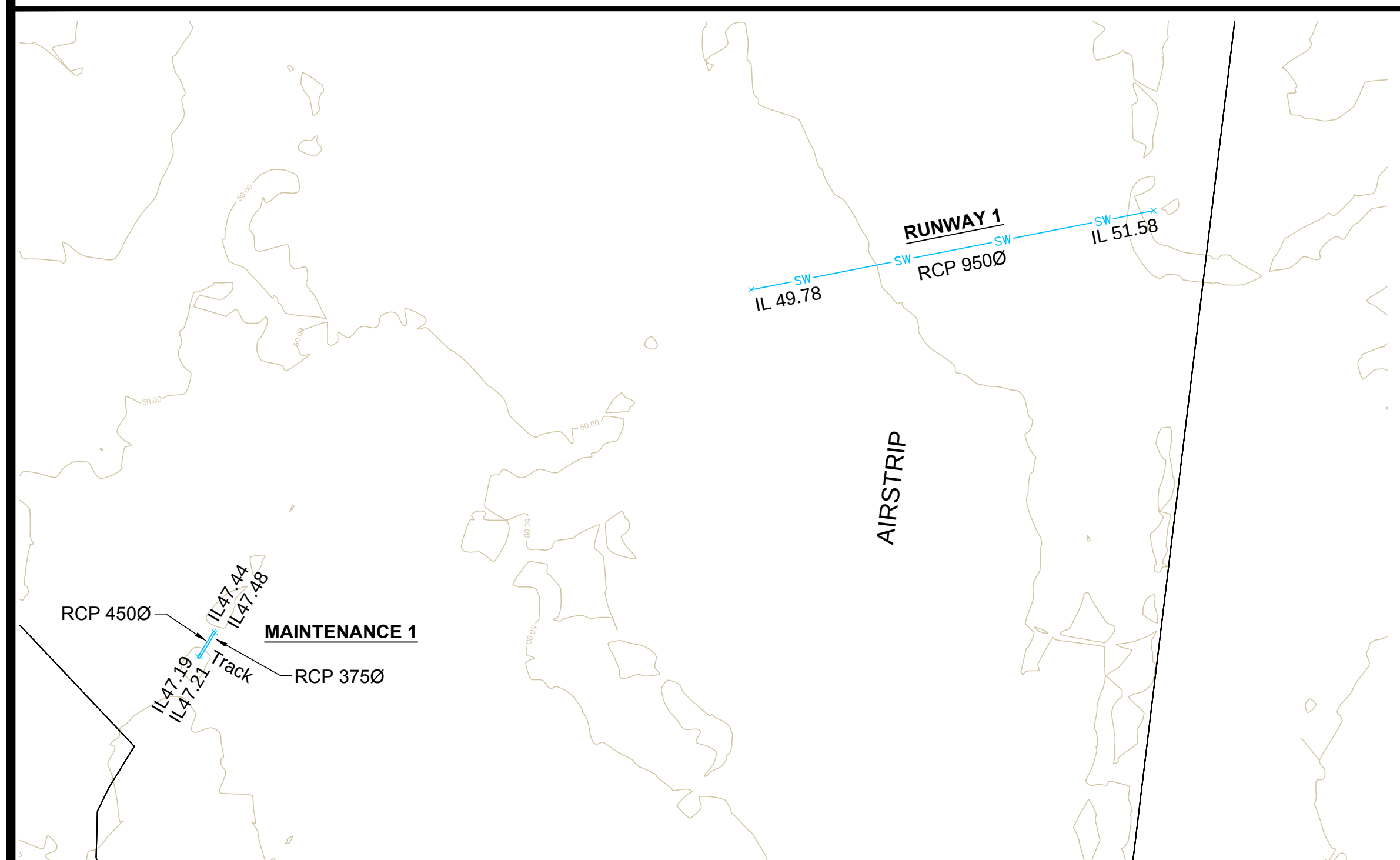
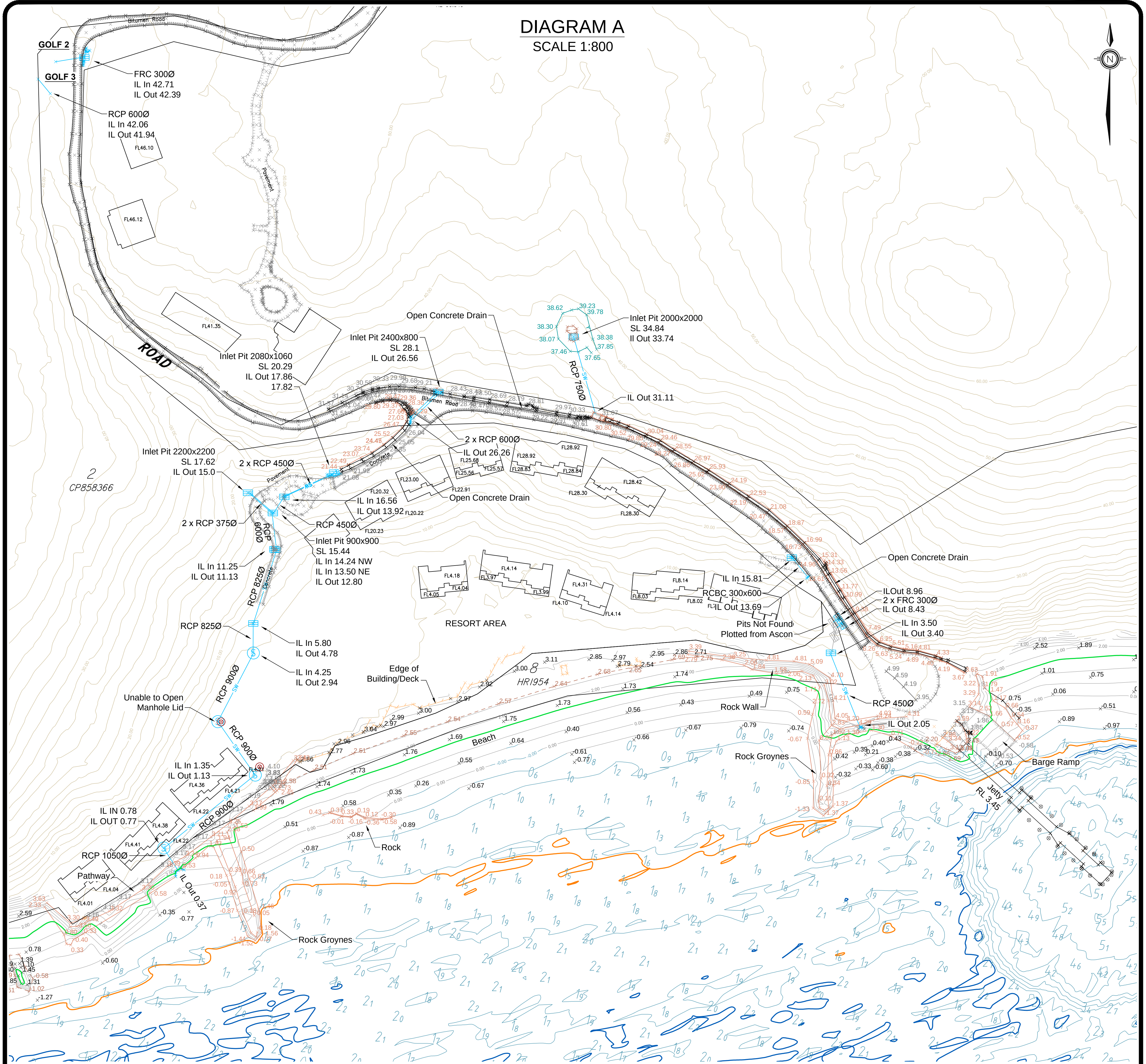


DIAGRAM C

SCALE 1:1000

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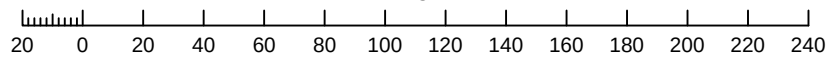


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 - b. RPS Australia East Pty Ltd relying on information provided to it by the Client or a Third Party where the information is incorrect, incomplete, inaccurate, out-of-date or unreasonable;
 - c. Any inaccuracies or other errors in the information or data supplied from a Third Party;
 - d. RPS Australia East Pty Ltd relying on surface indicators that are incorrect or inaccurate;
 - e. The Client or any Third Party not verifying information in this plan where recommended by RPS Australia East Pty Ltd;
 - f. Loss of this plan with any local authority against the recommendation of RPS Australia East Pty Ltd;
 - g. Inaccuracy, reliability, suitability or completeness of any approximations or estimates made or referred to by RPS Australia East Pty Ltd in this plan.
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- Cadastral boundaries are obtained by title dimensions and/or digitising from existing cadastral maps and/or DCDB. These boundaries have not been verified and are approximate only.
- Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of buried underground services and detailed locations of all services.
- For reasons of plan presentation, not all of the information can be shown on this plan. Please refer to the accompanying digital data file for survey information and attributes.
- The contours shown on this plan are [taken from topographic map(orthophoto map)] and are suitable only for the purposes of preliminary feasibility only. The accuracy of the contours has not been verified and no statement should be placed upon such contours for any purpose other than preliminary feasibility.
- Contour Interval: 0.25m

Scale 1:2500 - Lengths are in Metres.



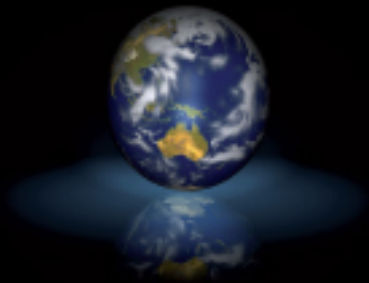
PRELIMINARY

[illegible]

Flood Study

APPENDIX D

DAM FAILURE IMPACT ASSESSMENT REPORT



MRG
WATER CONSULTING PTY LTD

DAM FAILURE IMPACT ASSESSMENT REPORT

GAP CREEK DAM, LINDEMAN ISLAND, QUEENSLAND

August 2013



Report Name	Date	Revision No.
Dam Failure Impact Assessment Report for Gap Creek Dam, Lindeman Island, Queensland	3 March 2009	1203/Rev 1
Dam Failure Impact Assessment Report for Gap Creek Dam, Lindeman Island, Queensland	6 November 2012	1203/Rev 2
Dam Failure Impact Assessment Report for Gap Creek Dam, Lindeman Island, Queensland	27 August 2013	1203/Rev 3

Project Engineer:

Mark Gibson
BE Civil, MIE Aust, RPEQ 6722
Director
E mark@mrgwater.com.au
M 0418 569 362



1.0 EXECUTIVE SUMMARY

MRG Water Consulting Pty Ltd (MRG) was commissioned by White Horse Australia (WHA) to complete a revised Dam Failure Impact Assessment of the dam located on Gap Creek, Lindeman Island.

The earth fill dam is located approximately 320 m northwest of the resort and is used to supply water for domestic and industrial use to it.

The dam has a capacity of 190 ML to spillway level and measures 9 m in height, from the base of the embankment to the spillway invert.

Detailed hydraulic modeling has predicted that the resort reception facilities building and accommodation will not be affected by a dam failure as water will not escape from the Gap Creek catchment.

The completed modelling indicates that the dam will no longer be referable under the *Water Act 2000*.



2.0 GENERAL INFORMATION

Gap Creek Dam is located on the southern side of Lindeman Island, some 500 m northwest of Lindeman Island Resort, as shown on Figure 1. The main role of the dam is to supply water for domestic and industrial use to the nearby resort. Table 1.0 gives some general information about the dam.

Table 1.0 General Information

Name of Dam	Gap Creek Dam (No. 654)
Dam Owner	White Horse Australia
Contact Details	PO Box 2628, Southport BC, Qld 4215 Mobile: 0408581883 Phone: 07-55912020
Status	Existing - completed in 1988
Property Description	Lot 2 on CP858366
Latitude	20° 27' 15" S
Longitude	142° 09' 02" E
Reference No.	DAM/130/000(0654)
Available Topographic Data	1:100,000 NR&M topographic maps with 20 m contour intervals and ± 10 m vertical accuracy. Detailed Survey by Whitsunday Surveys immediately downstream of the dam, 1:500, Drawing number 13669S01, (Appendix A)
Available Aerial Photographs	Google Earth Images 2009
Watercourse and AMTD	Gap Creek, AMTD 0.4 km.

3.0 CATCHMENT DETAILS

The total catchment area of Gap Creek is approximately 45 hectares. Gap Creek has a narrow, well defined streambed with steep slopes that opens in one location (the Golf Course) to a relatively flat area, before resuming its course down a very steep rocky cliff face. The slopes in the catchment range from 0.5 % to 45%, with an average slope of around 5%-10%.

The majority of the catchment (80%) has dense vegetation, with some areas of open grass (15%) and rocky cliff face (1%). The total impervious area within the catchment is less than 4%.

The region immediately downstream of the dam embankment and the spillway channel are covered by very dense brush and trees. Dense growth characterises the streambed of Gap Creek for most of its length.



Figure 1 – Aerial View of Lindeman Island, Queensland



Some 140 m downstream of the dam the creek passes through a golf course. At this location, the low flow of the creek flows through a small culvert for some 20 m. The culvert is circular, 1 m diameter and can easily be obstructed by debris during a flood event. As such, this analysis assumes the pipe is blocked and water flows across the golf course above.

During a flood event, the floodwater spread into the golf course towards the resort. A ridge runs between the Gap Creek valley and the resort located on the southern side of the island. This ridge separates the runoff from the resort area from the Gap Creek valley under normal rainfall events. If this ridge was overtopped in a dam failure scenario, the floodwater would continue along a drain that runs directly towards the reception area of the resort.

A low-level pedestrian bridge provides access over Gap Creek just downstream of the location where the creek exits the culvert. At this location the streambed is well defined but quite shallow. However, the wide embankment just upstream of the bridge acts as a hydraulic control.

4.0 DAM DESCRIPTION

Tables 4.0, 4.1 and 4.2 give further information about the dam's dimensions, spillway and storage capacity.

Table 4.0 - Dam Description

Parameter	Units	Value
Type of Dam		Earth fill with riprap protection on upstream and downstream sides
Elevation at Base of Embankment	m AHD	44.5
Length	m	170
Crest Elevation	m AHD	55.0
Crest Width	m	3.0
Purpose of Storage		supply water for domestic and industrial use to the nearby resort
Dam Capacity to FSL	ML	190
Dam Capacity to DCL	ML	270
Dam Surface Area at FSL	Ha	6.58



Table 4.1 - Spillway Description

Parameter	Units	Value
Spillway description		Unlined channel with a steel lip control structure
Spillway Crest Length	m	7
Spillway Level Below Dam Crest	m	1.7
Spillway Capacity (Dam Crest Flood)	m ³ /s	24
Available Spillway Flow Data		None available

Table 4.2 - Stage / Storage Parameters

Water Level (m AHD)	Volume (ML)	Notes
44.5	0	Base of Embankment Wall
53.5	200	Spillway level
55.0	270	Embankment crest level

The Department of Natural Resources and Water supplied previous RORB and MIKE11 modelling data files from modelling that was undertaken by them during the Stage 1 and 2 Preliminary Flood Impact Analysis which they undertook in 2004. The electronic data was not able to be used due to a few files being unable to be located.

On 2 August 2013, MRG Water Consulting Pty Ltd was contacted by email by Mr Rhys James, an engineer, in the Department of Energy and Water Supply. Mr James explained that,

The review [of the previous flood impact assessments] found inaccuracies in the breach hydrograph which date back as far as the original Sunwater assessments. Errors found in the original breach calculations were traced back to the dam storage curve, batter slopes of the embankment and the catchment hydrology. The original estimates calculated an approximate peak of 390m³/s for a Dam Crest Flood Failure (DCFF) event. A revised estimate suggests a peak breach discharge of 220m³/s is more likely which could have a significant reduction in downstream impacts. Further modelling with this revised breach estimate 'may' prove that there is no downstream impact from any dam failure scenarios. This would remove the Referable status of the dam without requiring earthworks.



If the modelling shows that the revised breach estimates do not impact the downstream PAR buildings a new revised FIA should be submitted with the appropriate information and findings. This report will need to be signed and certified by the responsible RPEQ engineer. It is important to note that the engineer receiving external information from DEWS still needs to check the validity of the information given and be satisfied that it is accurate. I have attached the breach spreadsheet that I have used to calculate the revised breach estimates.

MRG Water Consulting Pty Ltd has reviewed the new information regarding the dam storage curve and batter slopes and are satisfied that this information provides a better estimate of the performance of the dam during a breach. The new information has been incorporated into this revised report.

New survey data proved invaluable to the two dimensional hydraulic analysis undertaken. A copy of this surveyed area is found in Appendix A of this report. A three dimensional surface was created using the data which was used to undertake the 2D flood modelling.

Site visits were undertaken by Mark Gibson to Lindeman Island in May 2008 and August 2012. As part of these visits, Mark was able to walk over the areas to be modelled and investigate the impacts of dam failure on downstream buildings and residences.



5.0 METHODOLOGY - HYDRAULIC MODELLING - EXISTING

5.1. GENERAL

As discussed in Section 3.0 of this report, there is a possibility that during a dam failure event, water will overtop the low ridge of the golf course and divert to the south, flowing through the reception area to the ocean, instead of continuing southeast along Gap Creek. Figure 2 shows the possible directions of the flows.

To determine whether water would overtop the ridge, a TUFLOW hydraulic model was used. TUFLOW is a computer program for simulating depth-averaged, two and one-dimensional free-surface flows such as occurs from floods, tides and waves. TUFLOW stands for Two-Dimensional Unsteady FLOW. TUFLOW is specifically orientated towards establishing flow patterns in coastal waters, estuaries, rivers, floodplains and urban areas where the flow patterns are essentially 2D in nature and cannot or would be awkward to represent using a 1D network model.

5.2. MODEL VERSION

The model was constructed on the latest version of the TUFLOW software (version 2012-05-AA-iSP). The model used a 1m grid to ensure an accurate assessment of the topography.

5.3. SURVEY DATA

The survey data used in the 2d hydraulic modelling was the detailed survey undertaken by Whitsunday Surveys immediately downstream of the dam, 1:500, Drawing Number 13669S01, (Appendix A).

5.4. MANNINGS ROUGHNESS

The Mannings 'n' values varied across the site. The Mannings 'n' was set using the 2009 aerial photography. The default Mannings 'n' across the site was set at 0.03, (short grass on the golf course) and then varied in accordance with Figure 4 and the following list:

- Very Dense vegetation – 0.15
- Short Grass - 0.03 (default value)
- Rocky Terrain and Shrubs – 0.08 (default value)
- Medium Density vegetation – 0.10
- Foot Bridge – 0.2

It should be noted that the footbridge located across Gap Creek was included in the hydraulic model as a high Manning's 'n' value of 0.2. This was found to more accurately portray the high blockage effect of the handrails by debris.

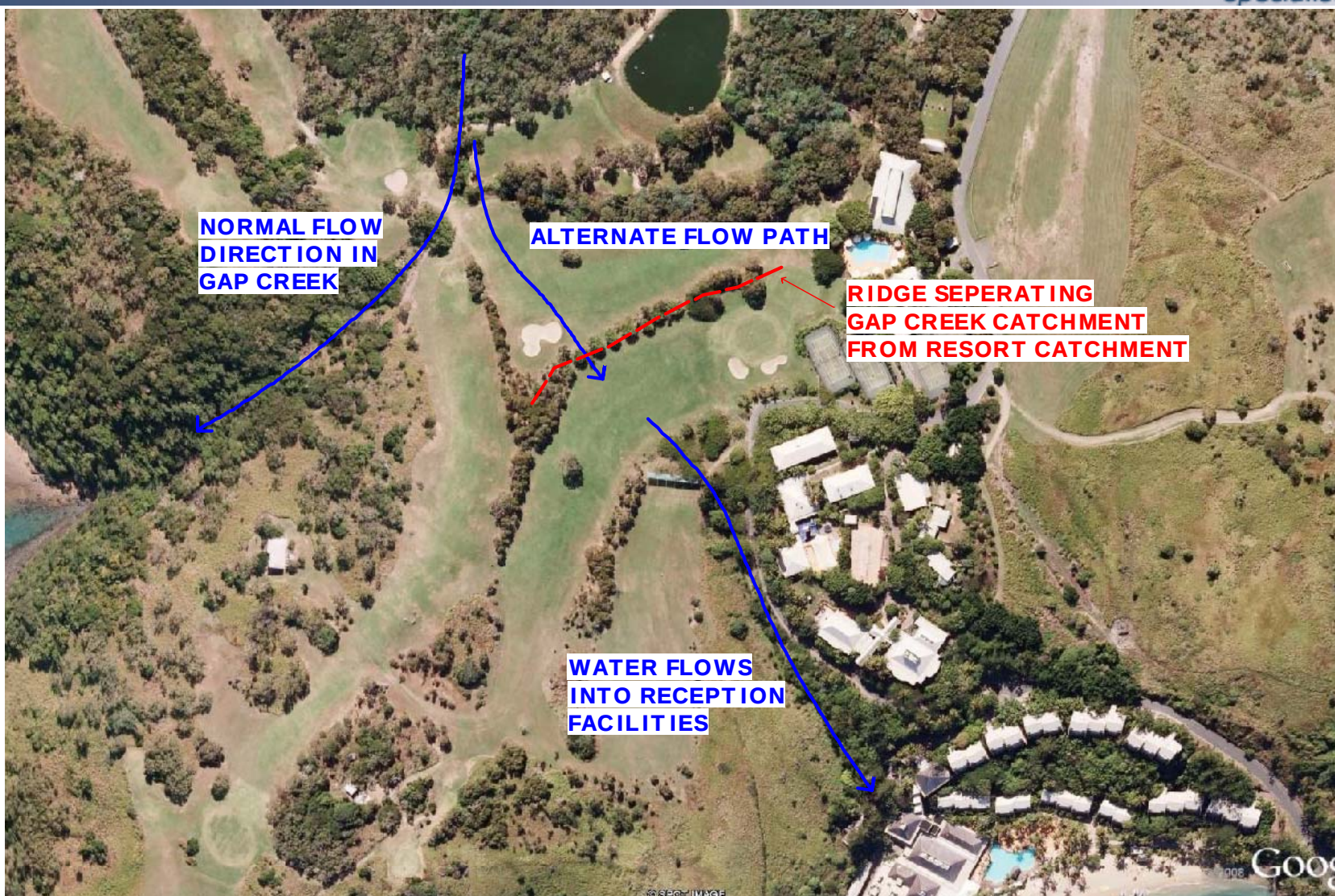


Figure 2 – Possible Flow Directions in Dam Break Scenarios, Not to measurable scale.



Figure 3 – Mannings Roughness Values, (Default 0.035), Scale 1:2000 @ A4



5.5. PIPES/CULVERTS

The 1 m diameter culvert which is located in the golf course was not included in the hydraulic model. It is expected that the culvert will be affected by debris and allow very little of the flow through it. It is expected that less than 1% of the water would pass through the culvert and therefore the culvert was not included in the hydraulic model. Thus the hydraulic model is slightly conservative.

5.6. BOUNDARY CONDITIONS

The 3 boundary conditions in this model were represented by:

- An inflow boundary where discharge hydrographs enter the TUFLOW hydraulic model: and
- Two outflow boundaries where water can exit the model.

Figure 4 shows the locations and length of the boundaries of the TUFLOW model.

5.7. DAM FAILURE SCENARIOS

The TUFLOW model assessed the impact of two dam failure scenarios; (1) A Sunny Day failure of the dam (SDF) and (2) A dam failure due to overtopping of the dam embankment during a flood event, (Dam Crest Failure, DCF).

As discussed previously, the inflow hydrographs calculated by the DNRW could not be used so SDF and DCF hydrographs were calculated using the DNRW Dam Breach Routing Spreadsheet. Tables 5.1 and 5.2 show the parameters used in the spreadsheet and Figures 5a and 5b shows the inflow hydrographs for each failure event.



Figure 5 – Location of TUFLOW Boundaries – Scale 1:2000 @ A4



Table 5.1 - Adopted Dam Breach Routing Spreadsheet Parameters - SDF

Parameter	Units	Value
EL Spillway	m (RL)	53.5
Width Spillway	m	7
EL Embankment	m (RL)	55
Centreline EL of Initial Pipe	m (RL)	53.5
Coefficient of spillway discharge		1.6
EL Base of Breach	m (RL)	44.5
Breach side slope	1H: x V	4
Time step	minutes	1
Volume of Water Lost	ML	190
Upstream Batter Slope	1H: x V	0.588
Downstream Batter Slope	1H: x V	0.667
Crest Width	m	3
B/d Ratio		0.68
B/d Ratio		3.85

Table 5.2 - Adopted Dam Breach Routing Spreadsheet Parameters - DCF

Parameter	Units	Value
EL Spillway	m (RL)	53.5
Width Spillway	m	7
EL Embankment	m (RL)	55
EL failure	m (RL)	55.01
Length of Embankment	m	170
Coefficient of spillway discharge		1.6
EL Base of Breach	m (RL)	44.5
Breach side slope	1H: x V	3.5
Time step	minutes	1
Upstream Batter Slope	1H: x V	0.588
Downstream Batter Slope	1H: x V	0.667
Crest Width	m	3
B/d Ratio		0.94
B/d Ratio		2.54

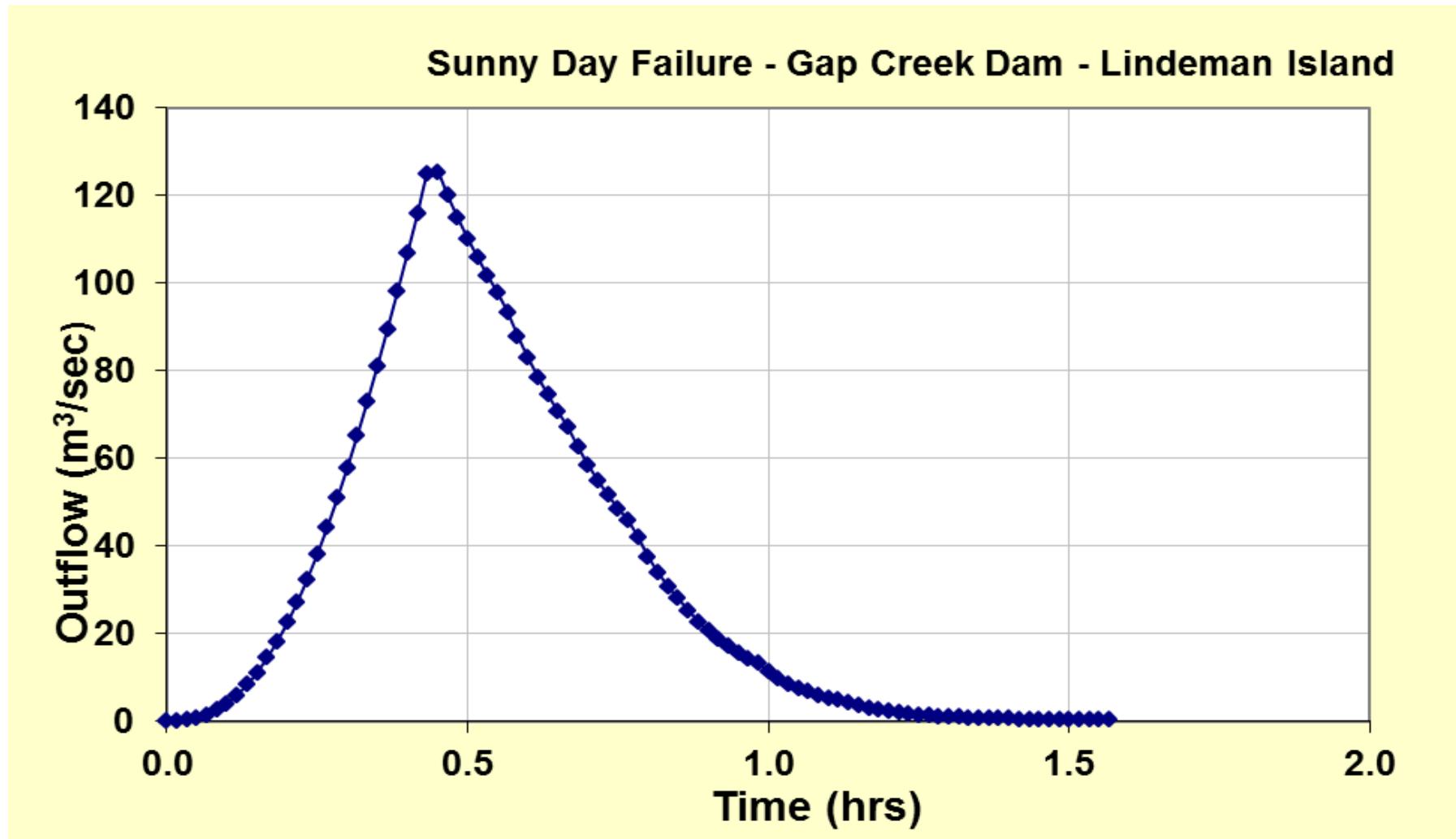


Figure 5a – Inflow Hydrographs for Dam Crest Failure (DCF) Scenario



Flood Failure - Gap Creek Dam - Lindeman Island

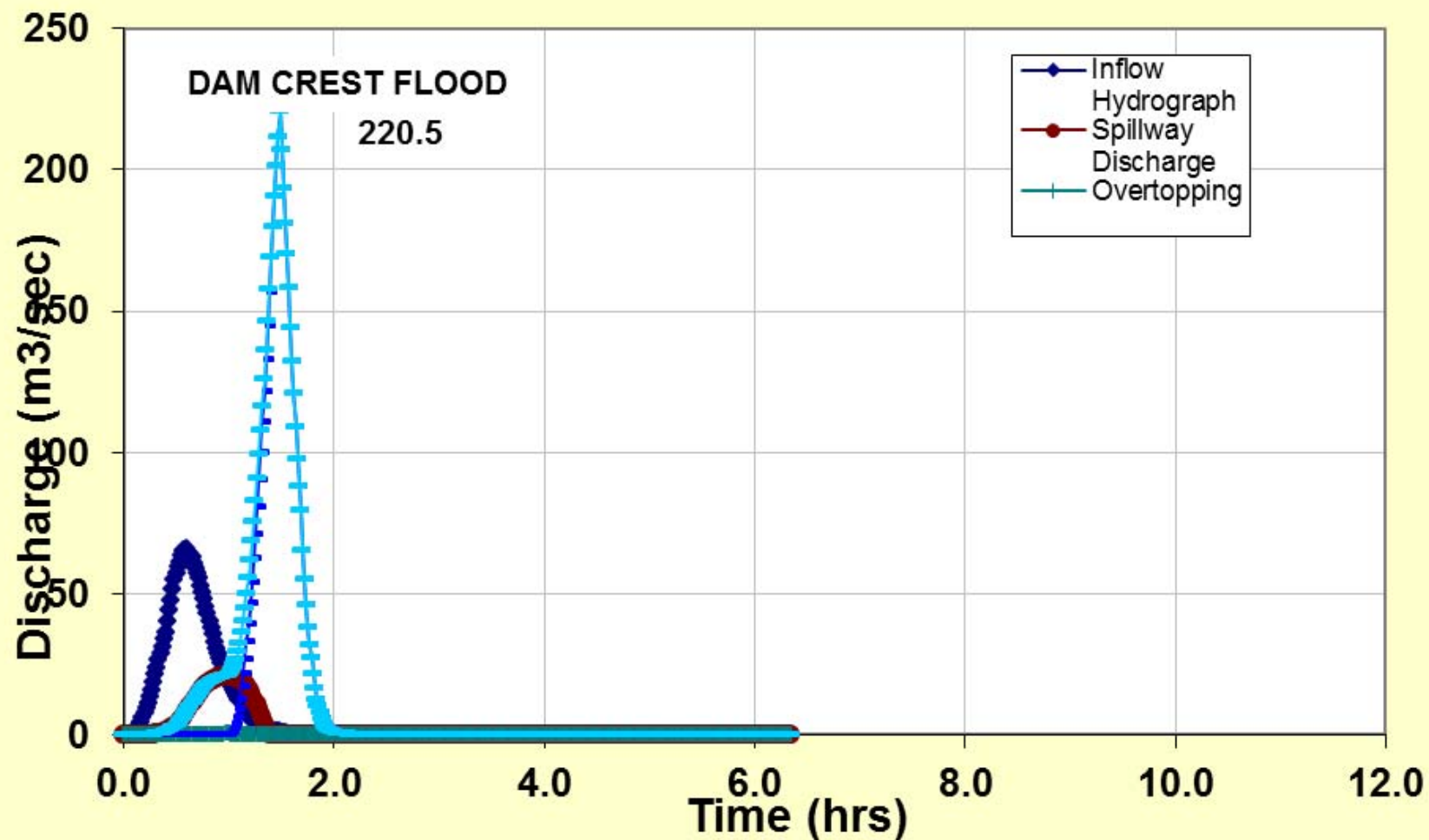


Figure 5b – Inflow Hydrographs for Sunny Day Failure (SDF) Scenario



5.8. RESULTS

The two scenarios discussed in Section 5.7 were run. The following observations can be made about each scenario.

Scenario 1 (SDF) - It was found that during the SDF event the ridge separating the resort from the Gap Creek catchment was not overtopped. Therefore the water ponded in the golf course area until it could flow down to the ocean. Figure 6 shows the maximum water levels across the golf course. This occurred 29 minutes 45 seconds after the beginning of the simulation.

Scenario 2 (DCF) - It was found that during the DCF event the ridge separating the resort from the Gap Creek catchment was not overtopped. Therefore the water ponded in the golf course area until it could flow down to the ocean. Figure 7 shows the maximum water levels across the golf course. This occurred 1 hour 30 minutes after the beginning of the simulation.

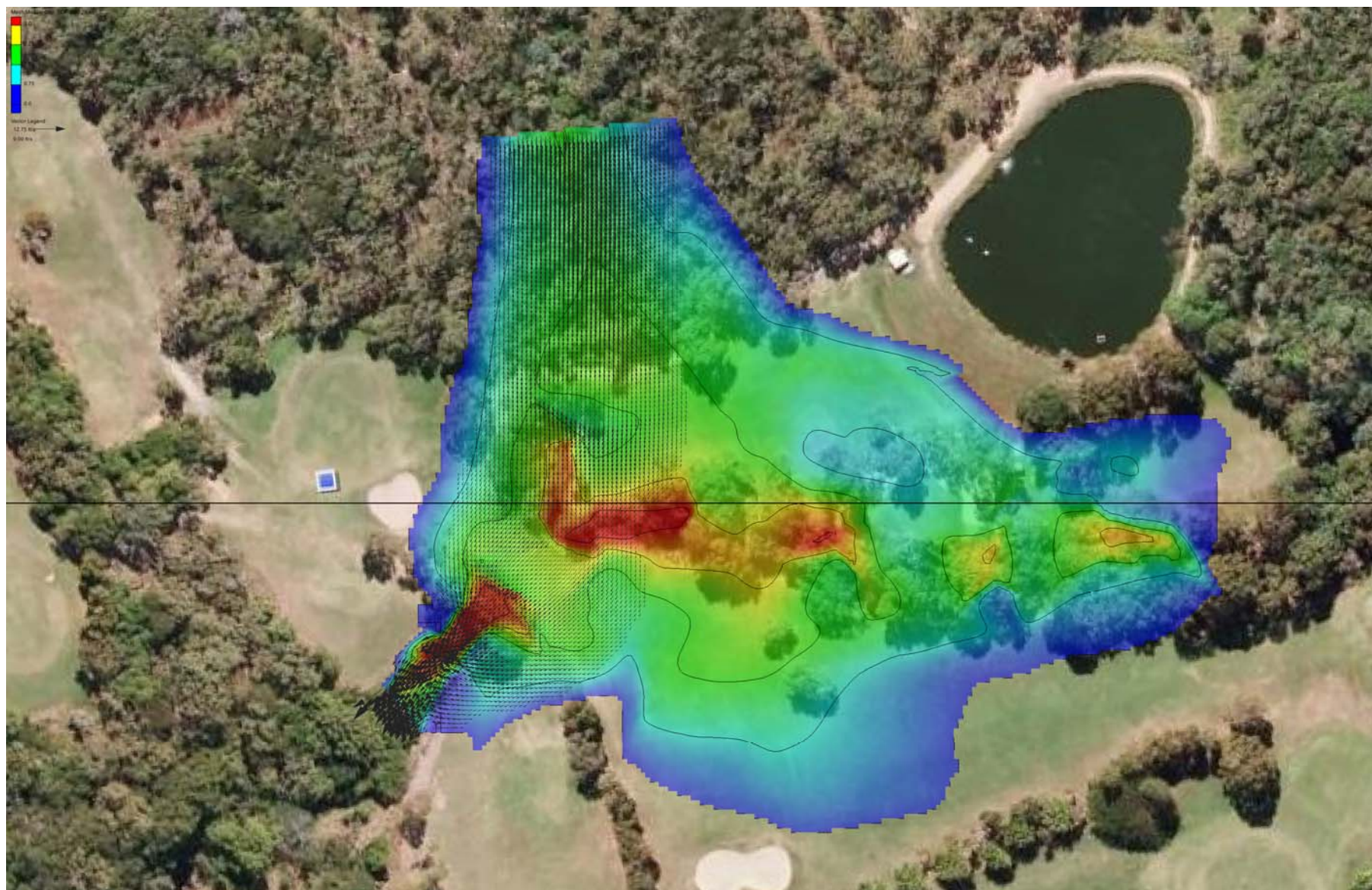


Figure 6 – Maximum Water Depths – SDF, (Not to Measurable Scale)

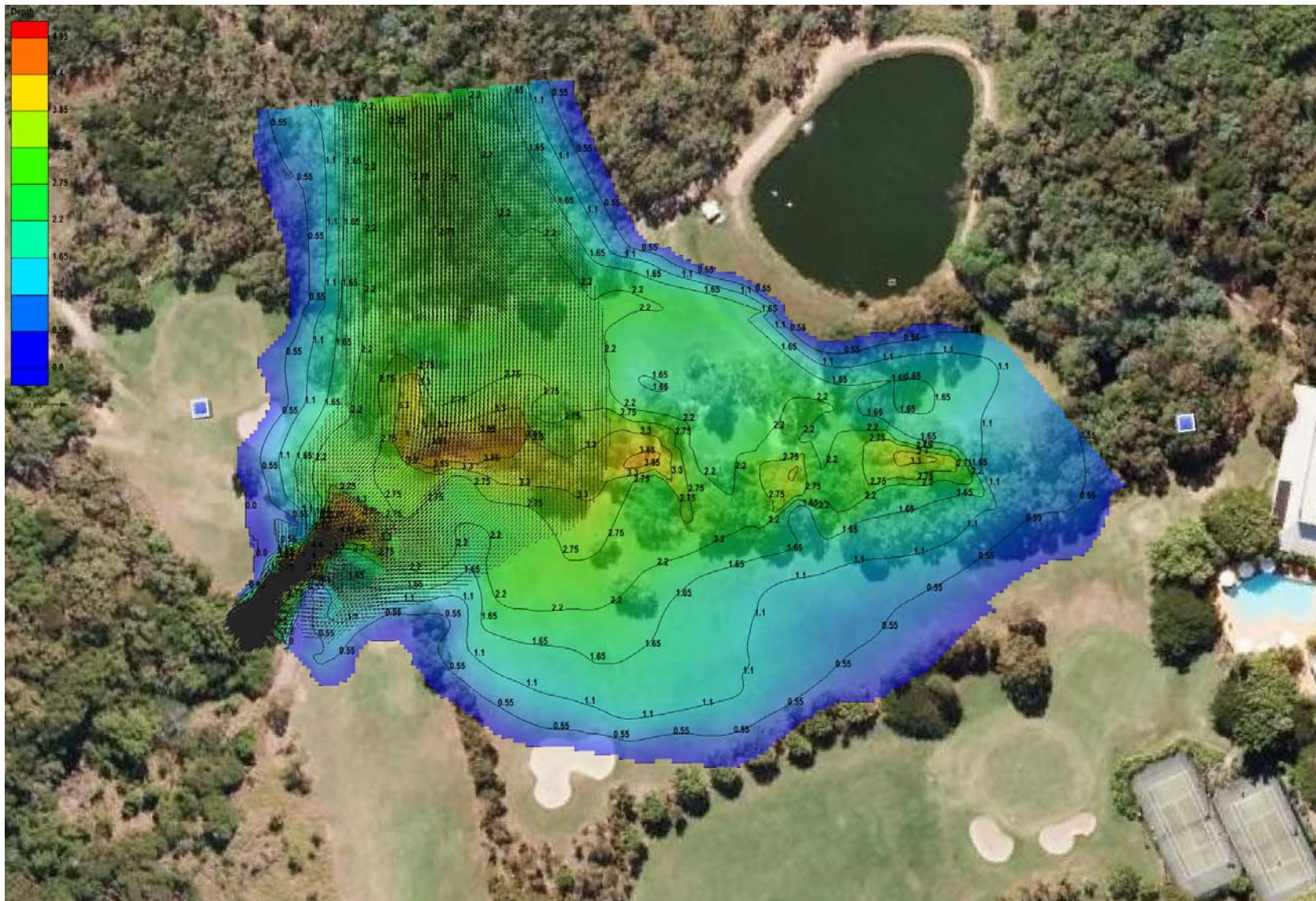


Figure 7 – Maximum Water Depths – DCF, (Not to Measurable Scale)



6.0 CONCLUSION

This dam failure assessment has been prepared in accordance with the Guidelines for Failure Impact Assessment of Water Dams, (DNRW, April 2002) and is not based on information that the I know is false or misleading.

I certify that I am not the owner, an employee of the owner, the operator, or an employee of the operator of the dam being assessed.

I consider that the detailed hydraulic modeling is best practice and accurate enough to show that the current dam does not pose a risk to the resort facilities.

I further certify that the dam should not be referable.

I am satisfied that my detailed inspection of the site has assisted the assumptions made in the modeling to justify the reports findings.

Mark Gibson
BE Civil, Grad Cert (IWM), MIE Aust, RPEQ 6722
Director
E mark@mrgwater.com.au
M 0418 569 362



LIST OF APPENDICES

APPENDIX A – Survey Plans



APPENDIX A

Survey Plans



Whitsunday Surveys
ACN 010 882 210

SURVEYORS
TOWN PLANNERS
Developing Opportunities

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MACKAY Ph: (07) 4951 2911
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Client:
CLUB MED
LINDEMAN ISLAND

Project:
DAM FAILURE
IMPACT ASSESSMENT

Title:
DETAIL SURVEY OF PART
OF LINDEMAN ISLAND

Scale: 1:500 (A1 Size)
Locality: LINDEMAN IS
Local Authority: MACKAY C.C.

Revisions:			
No.	By	Date	Description
A	DV	01/09	Original Issue
B			
C			
D			
E			
F			

Notes:

Vert. Datum	AHD
Origin	OPM 102646
Origin Level	1.965
Contour Interval	0.1
Horz. Azimuth	MGA ZONE 55
Coord. Datum	GDA94
Origin	PM102646

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Drawn	DV	
Approved		

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Drawing Number:

13669S01

Revision
A



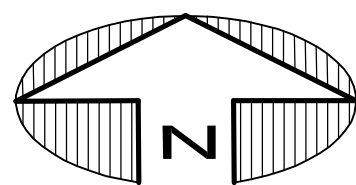
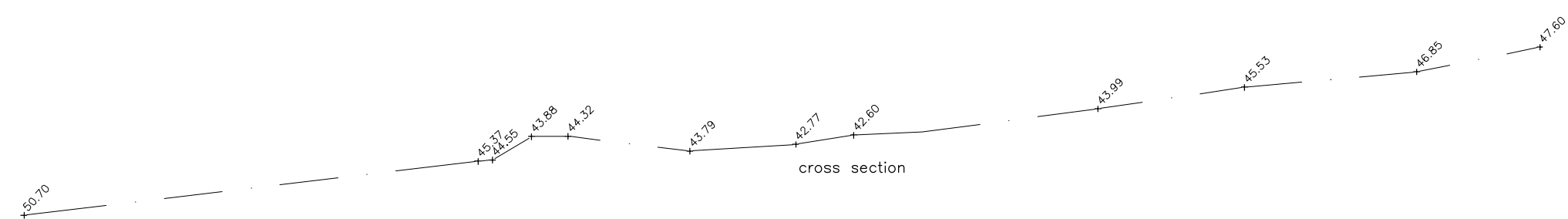


photo id point
centre of sprinkler cover



D
HR2029

THIS DIGITAL DRAWING ALSO CONTAINS:

1. GOOGLE AERIAL PHOTO – see layer “googlephoto”
2. 3D TRIANGLE FACES – see layer “triangles”
3. 3D POINTS – see layer “points”
4. 3D LINES – see layer “lines”

The title boundaries as shown hereon were not marked at the time of survey and have been determined by plan dimensions only and not by field survey.

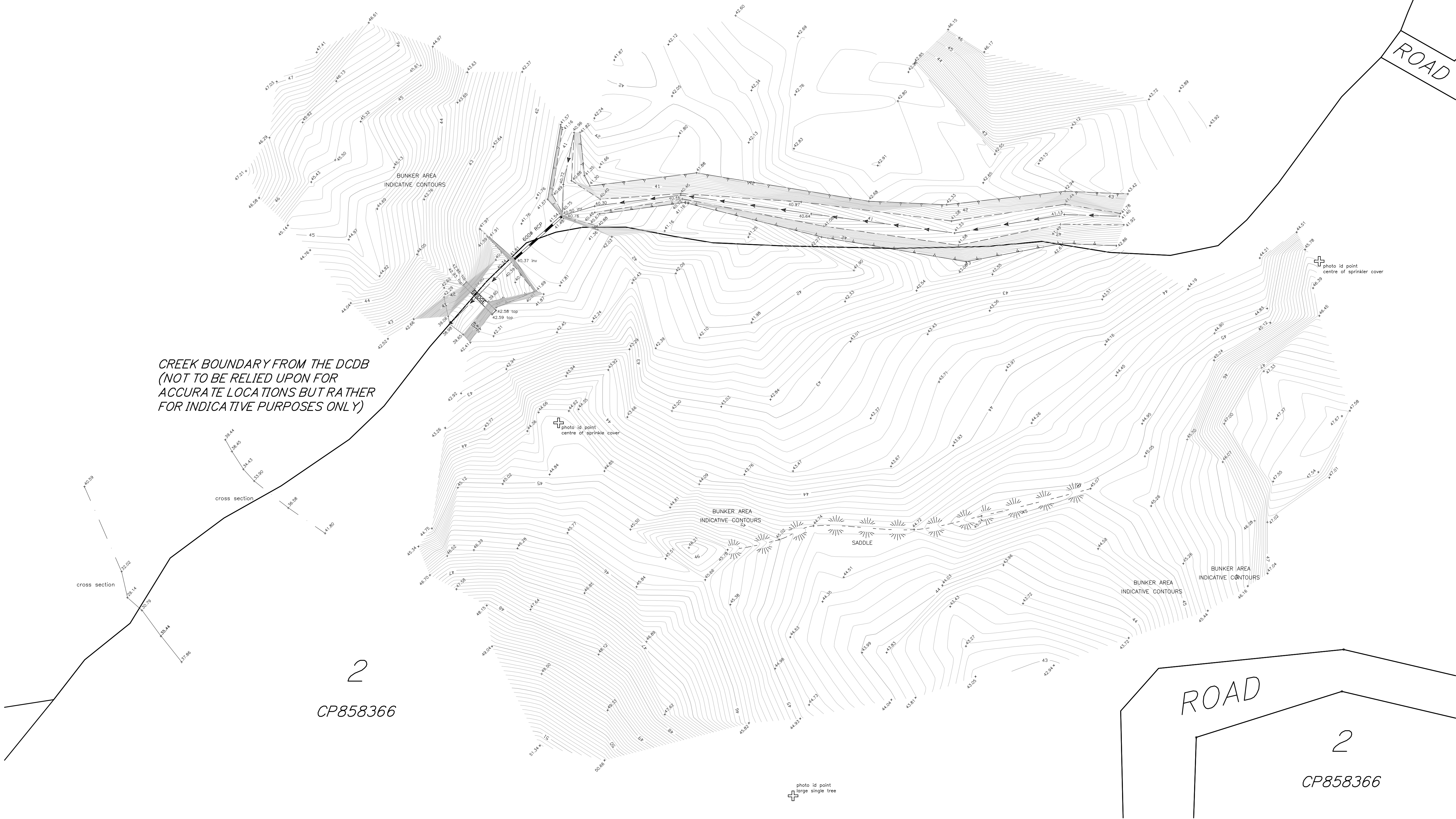
Services shown hereon have been located where possible by field survey. If not able to be so located, services have been plotted from the records of relevant authorities where available and have been noted accordingly on this plan. Where such records either do not exist or are inadequate, a notation has been made hereon.

Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.

This plan may not be photocopied unless this note is included.

CREEK BOUNDARY FROM THE DCDB
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ACCURATE LOCATIONS BUT RATHER
FOR INDICATIVE PURPOSES ONLY)

CREEK BOUNDARY FROM THE DCDB
(NOT TO BE RELIED UPON FOR
ACCURATE LOCATIONS BUT RATHER
FOR INDICATIVE PURPOSES ONLY)



ROAD

ROAD

WS
GROUP

Whitsunday Surveys
ACN 010 882 210

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TOWN PLANNERS

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WHITSUNDAY

email: wsgroup@wsgroup.com.au
web site: www.wsgroup.com.au

Client:

CLUB MED
LINDEMAN ISLAND

Project:

DAM FAILURE
IMPACT ASSESSMENT

Title:

DETAIL SURVEY OF PART
OF LINDEMAN ISLAND

Scale: 1:500 (A1 Size)

Locality: LINDEMAN IS

Local Authority: MACKAY C.C.

Revisions:

No.	By	Date	Description
A	DV	01/09	Original Issue
B			
C			
D			
E			
F			

Notes:

Vert. Datum AHD
Origin OPM 102646
Origin Level 1.965

Contour Interval 0.1

Horz. Azimuth MGA ZONE 55

Coord. Datum GDA94
Origin PM102646

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Drawn DV

Approved

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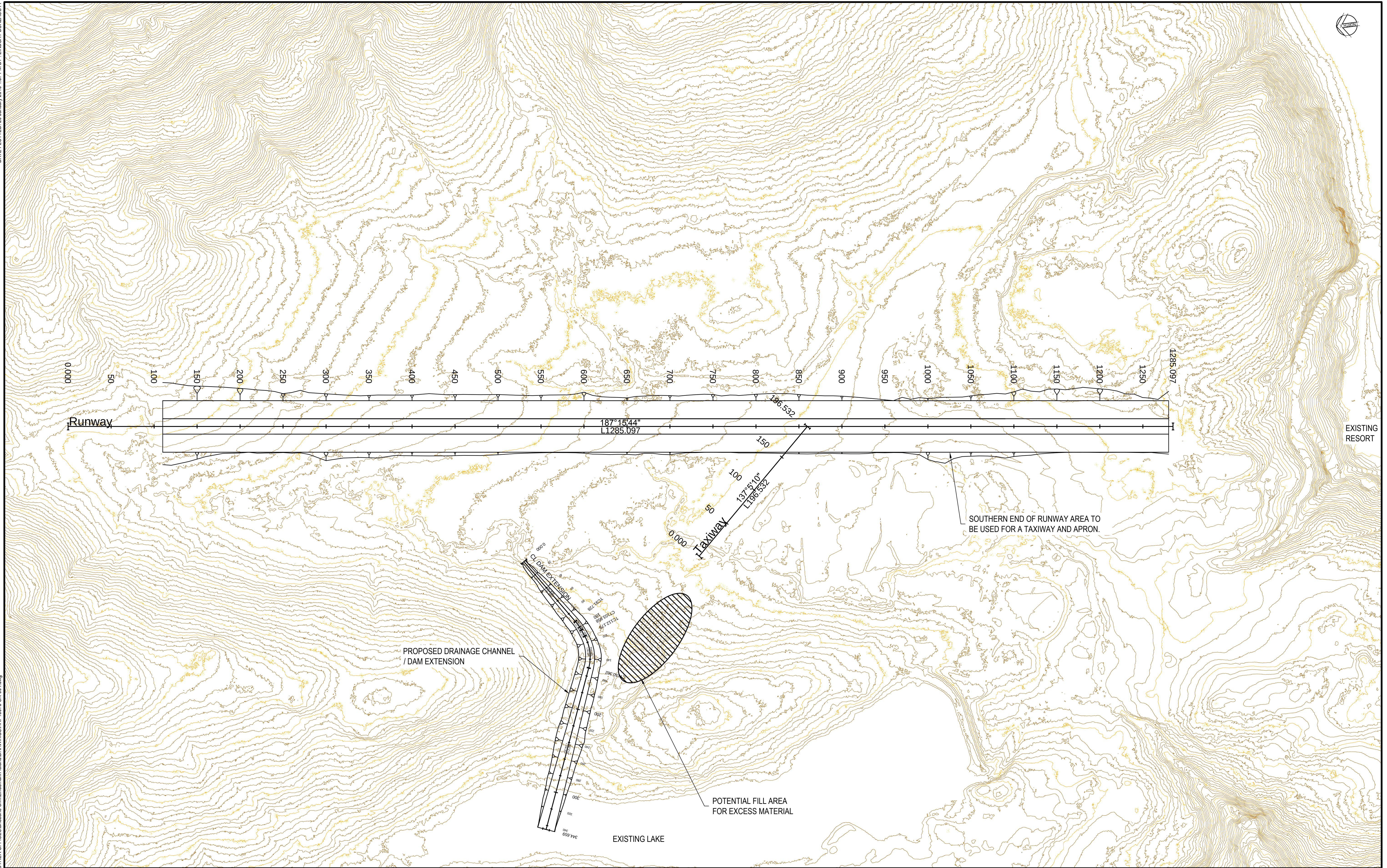
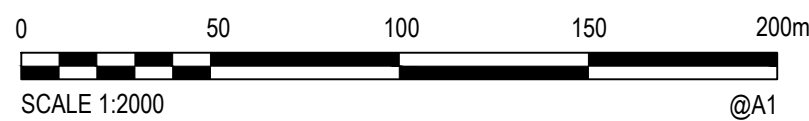
13669S01

Revision
A

Flood Study

APPENDIX E

PROPOSED DAM EXTENSION

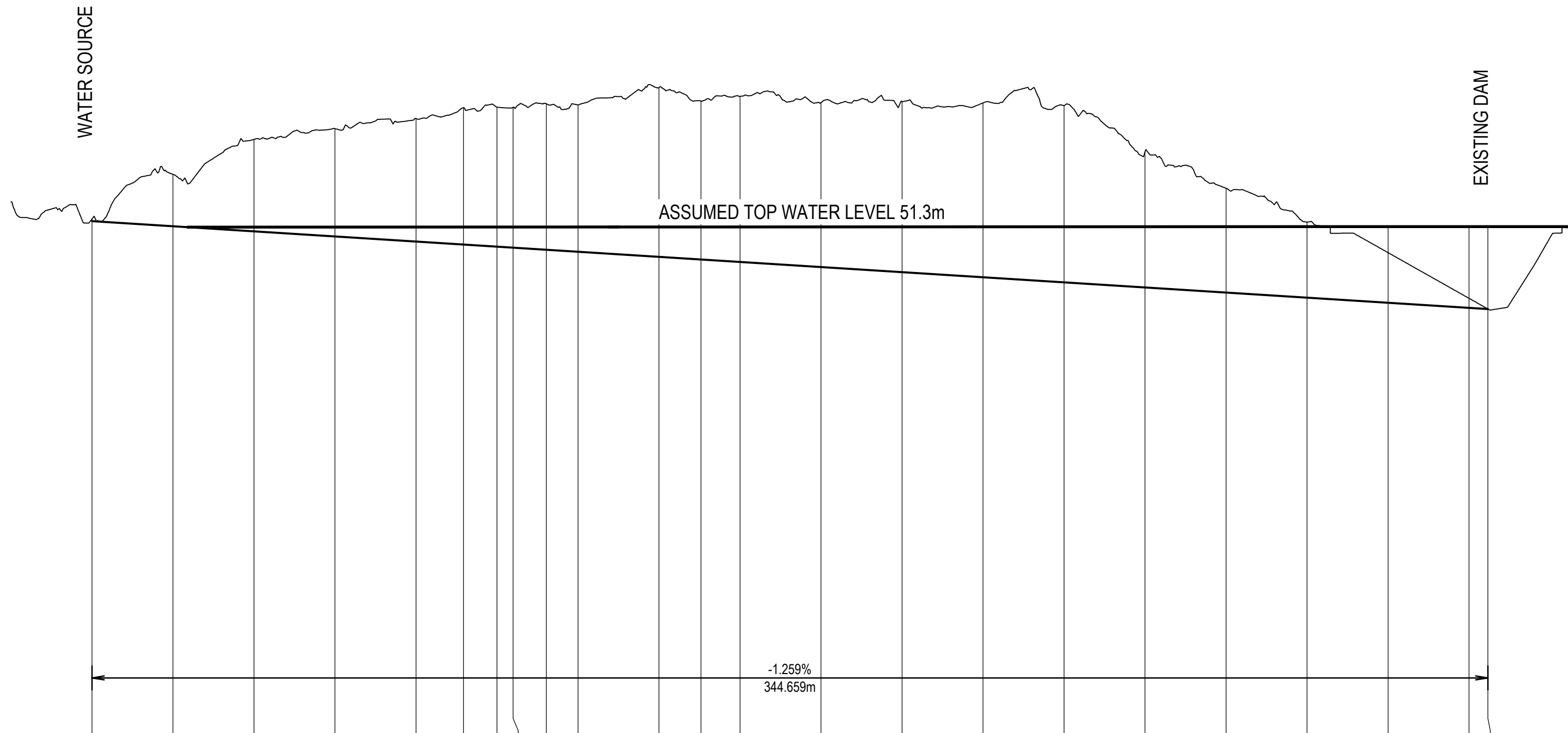
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Drawn L.A.B.	Date 6/01/2016	Client WHITE HORSE AUSTRALIA				
Checked	Date	Project LINDEMAN ISLAND, GREAT BARRIER REEF RESORT AND SPA	Status FOR INFORMATION ONLY NOT TO BE USED FOR CONSTRUCTION PURPOSES			
Designed L.A.B.	Date 6/01/2016		Datum AHD	Coordinates GDA94	Scale 1:2000	
Verified	Date		Size A1			
Approved		Title PRELIMINARY RUNWAY DESIGN CODE 1B RUNWAY	Drawing Number HRP15078-SK-004		Revision 2	

DATE PLOTTED: 20 January 2016 5:22 PM BY : LINDSAY BURZACOTT



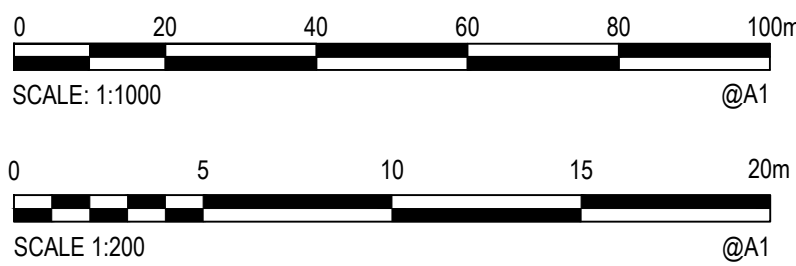
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VERT. CURVE RADIUS (m)
VERT. GEOMETRY GRADE (%)
VERT. GEOMETRY LENGTH(m)
DATUM RL 26.000

HORZ. CURVE LENGTH (m) HORZ. CURVE RADIUS (m)																								
VOLUMES	CUT	-66	-175	-151	-69	-70	-180	-301	-300	-99	-162	-183	-77	-104	-96	-50	-126	-116	-0					
	FILL	-16	-7	-12	-21	-23	-21	0	0	-15	-3	-9	-11	0	0	-32	-28	-151	-232					
EXISTING SURFACE LEVELS DRAIN CENTRELINE		51.674	53.880	55.606	56.139	56.640	57.175	57.198	57.188	57.367	57.312	58.172	57.499	57.735	57.426	57.473	57.408	57.285	54.993	53.197	51.526	50.011	47.754	47.227
CUT / FILL DEPTH TO EXISTING SURFACE		-0.108	-2.567	-4.545	-5.329	-6.082	-6.764	-6.891	-6.932	-7.214	-7.257	-8.369	-7.826	-8.183	-8.126	-8.425	-8.612	-8.741	-6.700	-5.156	-3.737	-2.474	-0.468	0.000
DESIGN LEVELS DRAIN CENTRELINE		51.565	51.314	51.062	50.810	50.558	50.411	50.307	50.257	50.153	50.055	49.803	49.673	49.551	49.300	49.048	48.796	48.544	48.293	48.041	47.789	47.538	47.286	47.227
CONTROL LINE CHAINAGE DRAIN CENTRELINE		0.000	20.000	40.000	60.000	80.000	91.728	100.000	103.958	112.179	120.000	140.000	150.362	160.000	180.000	200.000	220.000	240.000	260.000	280.000	300.000	320.000	340.000	344.659

CL DAM EXTENSION
SCALE: H 1:1000
V 1:200

XREF's: pot.LS DAM EXTEND 01
CAD File: N:\Projects\01 PROJECTS - OTHER OFFICES\Brisbane Civil\Indemman Island\DRAWINGS\HRP15078-SK-005.dwg

REVISION IN PROGRESS



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Checked	Date	Project LINDEMAN ISLAND, GREAT BARRIER REEF RESORT AND SPA
Designed L.A.B.	Date 20/01/2016	Status PRELIMINARY NOT TO BE USED FOR CONSTRUCTION PURPOSES
Verified	Date	Datum AHD
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