Technical Paper

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Flooding Impact Assessment

A part of BMT in Energy and Environment

North Byron Parklands Flood Impact Assessment

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July 2010

North Byron Parklands Flood Impact Assessment

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Prepared For:	Billinudgel Property Trust
Prepared By:	BMT WBM Pty Ltd (Member of the BMT group of companies)

DOCUMENT CONTROL SHEET

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Title :	North Byron Parklands Flood Impact Assessment
Author :	Carrie Dearnley
Synopsis :	Flood Impact Assessment for the North Byron Parklands development

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1 INTRODUCTION

1.1 Project Overview

The North Byron Parklands site is proposed to be developed as a purpose-built cultural event site. The site will be used for a limited number of occasions each year for a range of small and large events. This report investigates flood risk within the site and considers the flooding impacts of onsite road development. The assessment has been undertaken in light of the following flooding related development approval requirements:

1. Clause 24 of Byron Shire Council's Local Environmental Plan, 1988 – for which a key criterion is that the development does not increase the level of flooding on other land in the vicinity.

2. Director-General's Environmental Assessment Requirement (DGR) 6.5

   Provide an assessment of any flood risks on site (for the full range of floods including events greater than the design flood, up to probable maximum flood; and from coastal inundation, catchment based flooding or a combination of the two) and having consideration of any of the relevant provisions of the NSW Floodplain Development Manual 2005. The assessment should determine: The flood hazard in the area; address the impact of flooding on the proposed development, address the impact of the development (including filling) on the flood behaviour of the site and adjacent lands; address adequate egress and safety in a flood event.

3. Director-General's Environmental Assessment Requirement 6.6

   Assess the potential impacts of an increase in the rainfall intensity on the flood regime of the site and adjacent lands with consideration of 'Practical Consideration of Climate Change – flood plain Risk Management Guideline (DECC, October 2007)'.

Note that 'adequate egress and safety in a flood event', as required by the DGR 6.5, is considered in a separate report[1].

1.2 Site Description

The project site, encompassing the lots provided in Table 1-1 below, is located on the eastern side of the Pacific Highway in the north east corner of Byron Shire, NSW. The site locality is shown in Figure 1-1.

[1] North Byron Parklands Flood Evacuation Assessment, BMT WBM, July 2010

Table 1-1 Project Lots

Lot/DP Description	Area [ha]
Lot 403 and Part Lots 402,404 DP 755687	104.71
Lot 1 DP 1145020	2.47
Part Lot 46 DP 755687	8.43
Part Lot 10 DP 875112	4.29
Part Lot 2 DP848618	8.9
Part Lot 30 DP880376	9.89
Part Lot 102 DP1001878	15.17
Part Lot 12 DP848618	2.05
Total	**155.91**

The site is composed of four major zones: DECC nature reserve extensions, habitat areas, managed parklands and non-habitat areas, which will be used for events and conferences.

There will be some development to the site including the construction of a conference centre, cultural centre and sewerage treatment plant, as well as the development of a major access (spine) road and other minor road works.

1.3 Topography and Drainage

Hydrologically, the site is split into two sections, divided by the east-west alignment of Jones Road. To the north of Jones Road are the proposed main entertainment area and camping grounds as well as developments such as the conference centre. The majority of the northern area is within the Crabbes Creek floodplain, which itself is part of the Mooball Creek catchment. To the south of Jones Road is a proposed car parking area, check in and bus drop off zone. This southern area is located on the Billinudgel and Yelgun Creek floodplain, which is a tributary of Marshalls Creek.

There are three sets of culverts at the eastern site boundary, passing under the Pacific highway and Tweed Valley Way. These culverts, including sizing information, are identified in Figure 1-2.

Legend:

The Site

Extents of Application Area

0km 1km 2km

Date 25.02.10
Author DTI
Reference 09-120

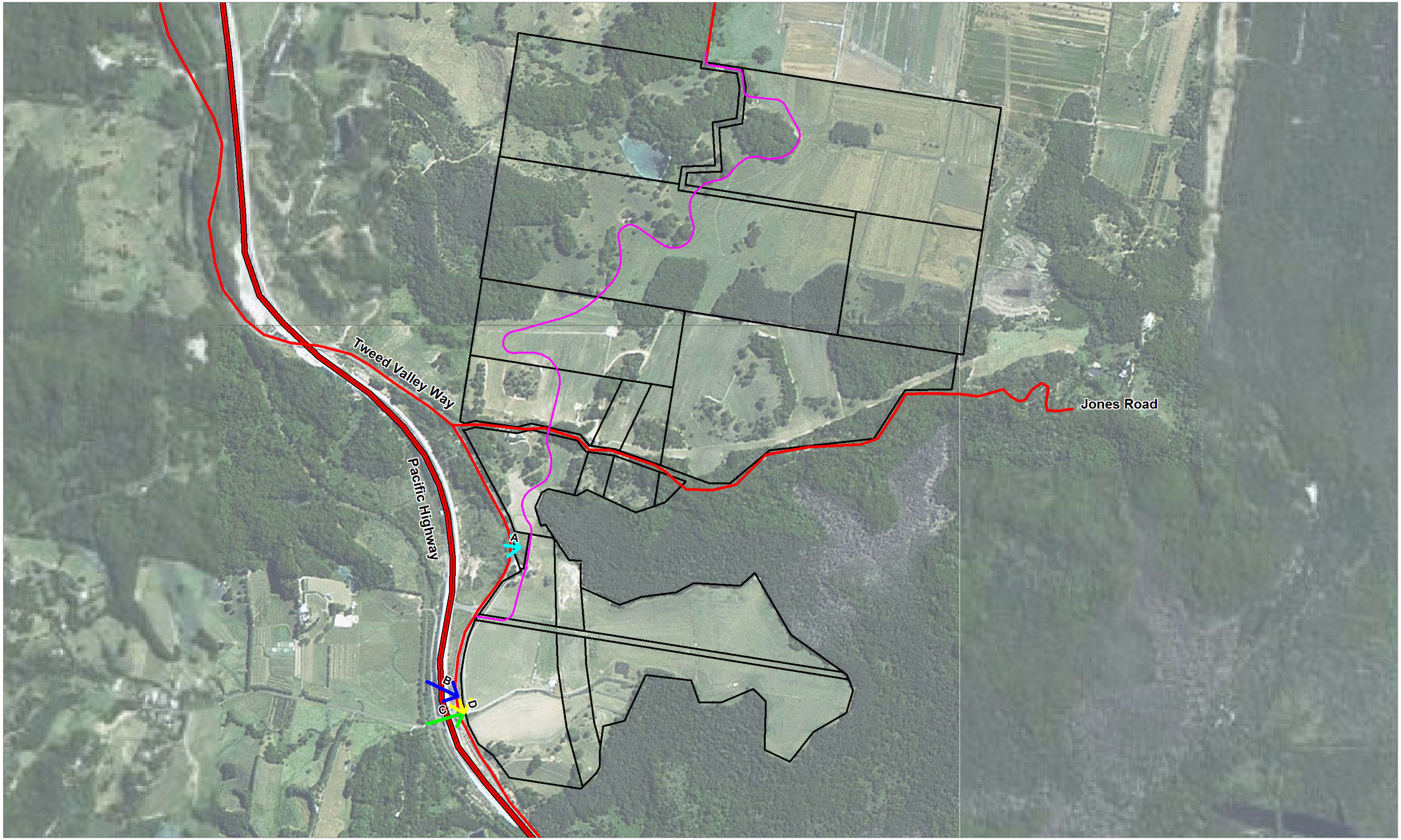
IMPORTANT NOTE |
Cadastral information is subject to survey. The alignment of the aerial photography and vectoral overlays is approximate only.

Sources | Aerial Photography: Google (2010) |

Prepared by
design team Ink
landscape architecture | urban design

Illustration | **1.5**
Site Locality

North Byron Parklands| Tweed Valley Way & Jones Road



LEGEND

Local Roads

Pacific Highway

Site Boundary

Spine Road

Culvert bank 'A'
2 x 1.2m diameter

Culvert bank 'B'
2 x 1.8m diameter

Culvert bank 'C'
3 x 3.6m wide x 1.8m high

Culvert bank 'D'
1 x 1.8m diameter

Title:

North Byron Shire Parklands: Site Layout

Figure:

Figure 1-2

Rev:

A

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2 STUDY METHODOLOGY

2.1 General Approach

An integrated two-dimensional/one-dimensional (2D/1D) hydrodynamic flood model of the site was used to characterise the existing flood conditions on site and to assess flood impacts due to the proposed development. The flood model comprises hydrological and hydraulic models. Hydrological models are used to estimate the quantity and rate of runoff during a particular rainfall event. These values are then used as a direct input into the hydraulic model, which is used to simulate the mechanisms of flow along water courses and across floodplains.

Across both the northern and southern parts of the site, the model is based on a 30m by 30m grid. This grid resolution is insufficient to accurately define sub-grid scale flood behaviour; however, it is sufficient to determine the rate of rise, peak flood levels and velocities, and the broader flood behaviour of the site. The road network has been represented in the model as one grid cell wide (30m). However in reality the roads are less than 10m wide. Thus flood storage capacity is slightly underestimated in some locations, which may result in an overestimate of flood levels.

2.2 Hydrological Modelling

To estimate the quantity and rate of runoff within the catchment, the runoff-routing software package, RAFTS, was used. This model produced hydrographs for individual subcatchments.

For the 100 year Annual Recurrence Interval (ARI) design event, a number of rainfall durations between 30 minutes and 48 hours were modelled. The 12 hour and 24 hour events resulted in the highest flood levels, with the 12 hour storm dominant across most of the site. Hence, this assessment has been undertaken using the peak levels from the 12 hour and 24 hour storm events.

All modelled flood events have been run for both of these durations, and an 'envelope' of the results has been mapped. This envelope of results is referred to as a 'combined event'.

2.3 Hydraulic Modelling

Hydraulic modelling for the site was undertaken using the TUFLOW hydrodynamic flood model of the Mooball and Marshalls Creeks. This model has been developed by BMT WBM for both Tweed and Byron Shire Councils[2]. The 2D/1D model has been calibrated to the June 2005 flood event and verified against the 1974 and 1987 flood events.

[2] Tweed-Byron Coastal Creeks Flood Study, BMT WBM, March 2010

3 EXISTING (PRE-DEVELOPMENT) FLOOD BEHAVIOUR

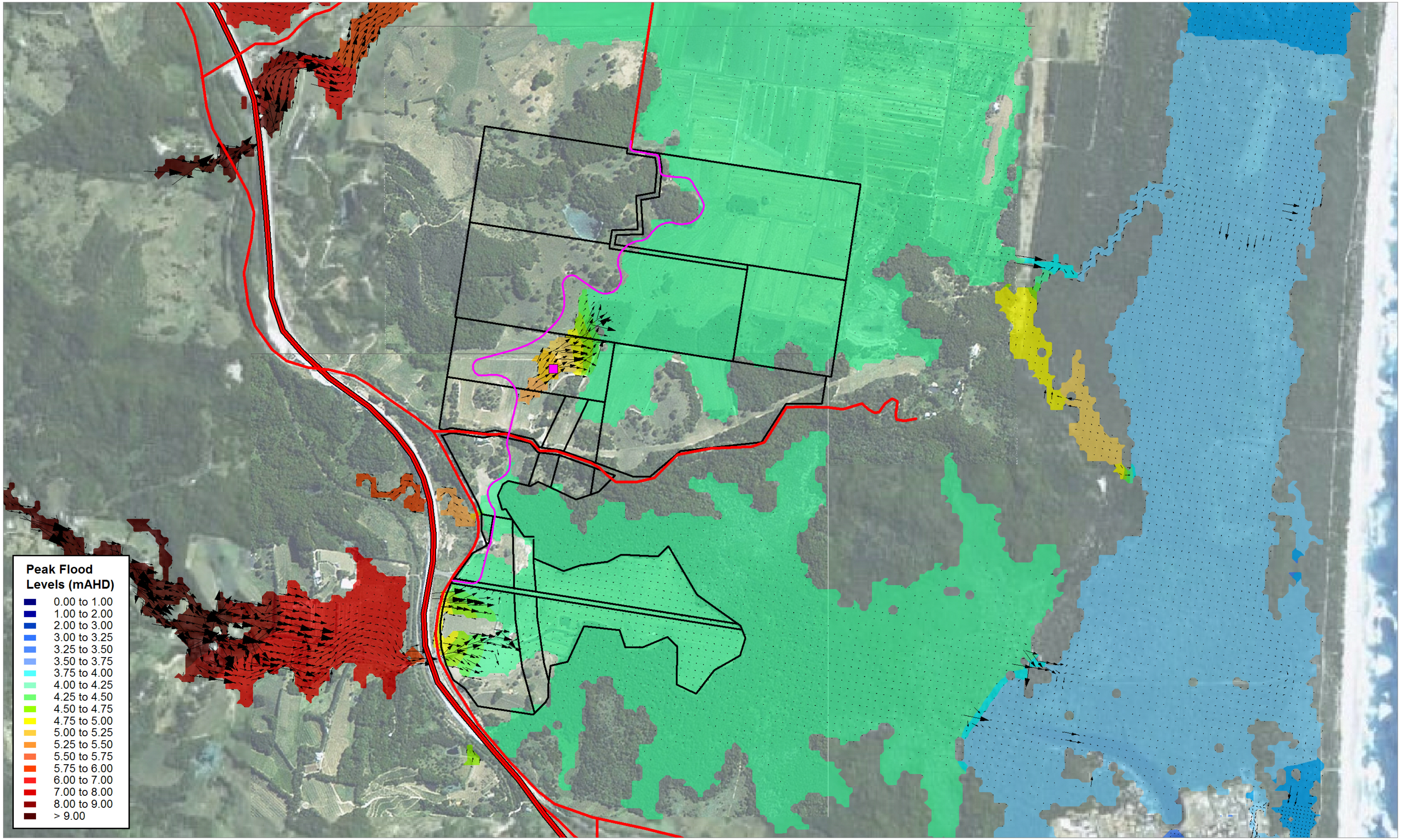
The project site is affected by both local catchment flow and flooding from the broader catchment. Due to the fast onset of local flooding, this type of flooding is most likely to enforce constraints on the use of the site.

Flooding across the northern part of the site is dominated by flooding within Crabbes Creek backing up onto the site.

The southern part of the site is located on the floodplain for Billinudgel and Yelgun creeks and has different flooding characteristics than the northern site. Flooding is dominated by water breaking out of these watercourses and entering the floodplain. The catchments of Billinudgel and Yelgun creeks upstream of the site are approximately 4.5km^2 and 0.5km^2, respectively. The response time of the southern catchment is significantly shorter than that of the Crabbes Creek catchment to the north.

The southern part of the site is also affected by flow entering via culverts under the Pacific Highway and Tweed Valley Way, as described in section 1.3. In the existing case, the flow from culvert bank B exceeds the capacity of culvert bank D, which is immediately downstream. This causes water to back up and travel northward in an existing cane drain, which runs parallel to Tweed Valley Way.

The 100 year ARI event for the combined 12 and 24 hour event has been modelled for the existing flood conditions, shown in Figure 3-1.



LEGEND

Local Roads

Pacific Highway

Site Boundary

Local inflow for regional model
(some flow will exist upstream of this point)

Velocity direction and magnitude

Spine Road

Title:

North Byron Shire Parklands: Undeveloped Site
100yr ARI Combined Event - Peak Flood Levels

Figure:
Figure 3-1

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B

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4 PROPOSED DEVELOPMENTS

4.1 Overview

There are two major forms of development on site: buildings, such as the conference centre, and road raising.

A spine road is proposed for the site. The design levels for the spine road are shown in Appendix B. The road, which is generally 250mm to 300mm above existing ground level, will connect the main entrance and traverse the site from south to north. Most traffic movement, including emergency evacuation, will be on this road. Additional access roads on the site, referred to in this report as 'event laneways', will be raised 100mm above existing ground level.

Additional resolution will be required in the hydrological model upstream of the spine road in the northern part of the site to size culverts in this area. This additional hydrologic modelling will be completed as part of the detailed design.

4.2 Modelling Methodology

The spine road and event laneways were included in the existing flood model to assess flood impacts due to the development. Flood impacts were determined by comparing the peak flood envelope of the developed case with the undeveloped case for the 100 year ARI event. A full range of flood events from 5 year ARI up to Probable Maximum Flood (PMF) were modelled in order to assess flood risk on the site.

Event laneways were included by raising the roads 100mm above ground level. Design levels for the spine road were included in the hydraulic model. Flow under the roads through proposed culverts that connect drains within the site have not been considered. This initial modelling therefore under predicts flow capacity across the spine road. As such, upstream impacts of the proposed spine road are overstated, and therefore conservative. Note that culverts under the road should be incorporated into the final design in order to maintain conveyance of flow though the drains. Following this initial development modelling, off site impacts were checked to ensure that there are no increases to flood levels on other land in the vicinity of the site.

Due to the scale and configuration of the hydrological model, the location of local inflow in the northern part of the site (marked with a small pink square on Figure 3-1) is downstream of the event laneways. Therefore it was not possible to model impacts at this location, and no mitigation measures have been designed. Culverts under the spine road in the northern part of the site will be designed as part of the detailed design process. Providing these culverts are sufficiently sized for local drainage flows, there will be no additional flood impacts.

5 DEVELOPED FLOOD BEHAVIOUR

5.1 Flood Levels and Depths

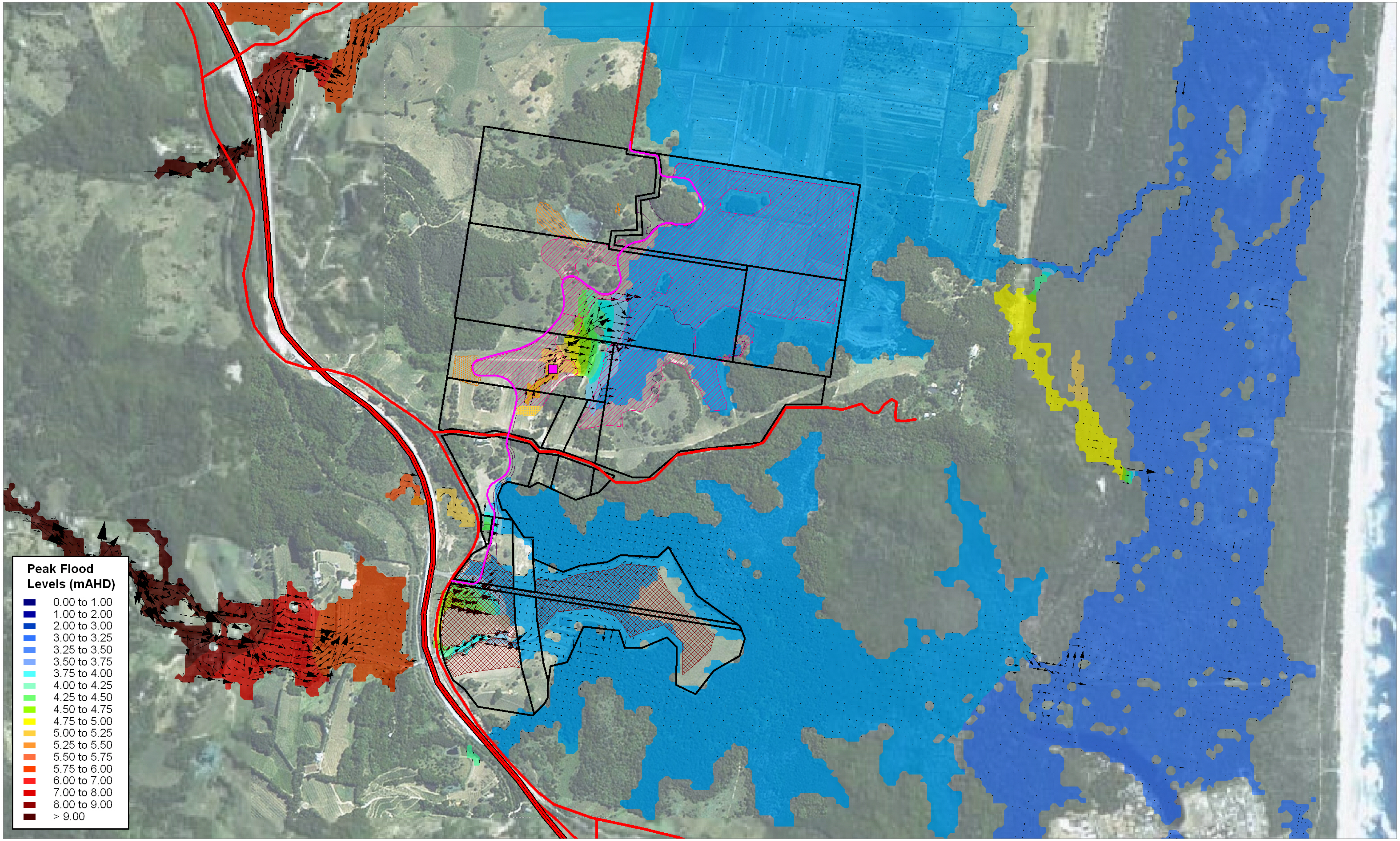
Flood behaviour has been modelled for the site, including proposed developments (as discussed in Section 4.2) to investigate flood risk and determine the impact that the development will have on flood levels. Modelled flood levels for the developed site are presented in Figure 5-1 to Figure 5-5 and flood depths in Figure 5-6 to Figure 5-10.

The results show the spine road to be inundated at two locations south of Jones road for all modelled events – in the vicinity of the main entrance and bus entry/exit and in the vicinity of culvert bank A.

The model does not present a true reflection of flood risk to the spine road in the vicinity of culvert bank A, particularly for small flood events, as the model does not include any culverts under the road. The proposed design specifies pipe culverts to be provided where roads cross drains. The flood immunity of the spine road in the vicinity of culvert A will depend on the culvert capacity under the road. Here, if the design road level is higher than the existing 100 year flood level (3.7mAHD) and the capacity of the proposed culvert is equivalent to culvert bank A (2m x 1.2m), the spine road should remain flood immune up to the 100 year ARI event.

The car parking area in the southern part of the site is inundated for the 5 year ARI event, and is thus located on flood prone land.

Much of the event area in the northern part of the site is also on flood prone land, being inundated for the 5 year ARI event. The model results indicate that the cultural centre administration area is flood immune. Due to the scale and configuration of the hydrological model, as discussed in section 4.2, flood risk in the northern area to the west of the spine road is not captured in the model. As such, it is not possible to determine the flood immunity of the resource centre area from the hydraulic model results. The centre is located in the upper part of the catchment, and may be liable to local storm water run-off. The floor level and drainage for the resource centre will be designed as part of the detailed design process. The conference centre is located on high ground, and is therefore flood immune.



LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)
- Velocity direction and magnitude

Title:

North Byron Shire Parklands: Developed Site
5yr ARI Combined Event - Peak Flood Levels

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Approx. Scale

Figure: **Figure 5-1**

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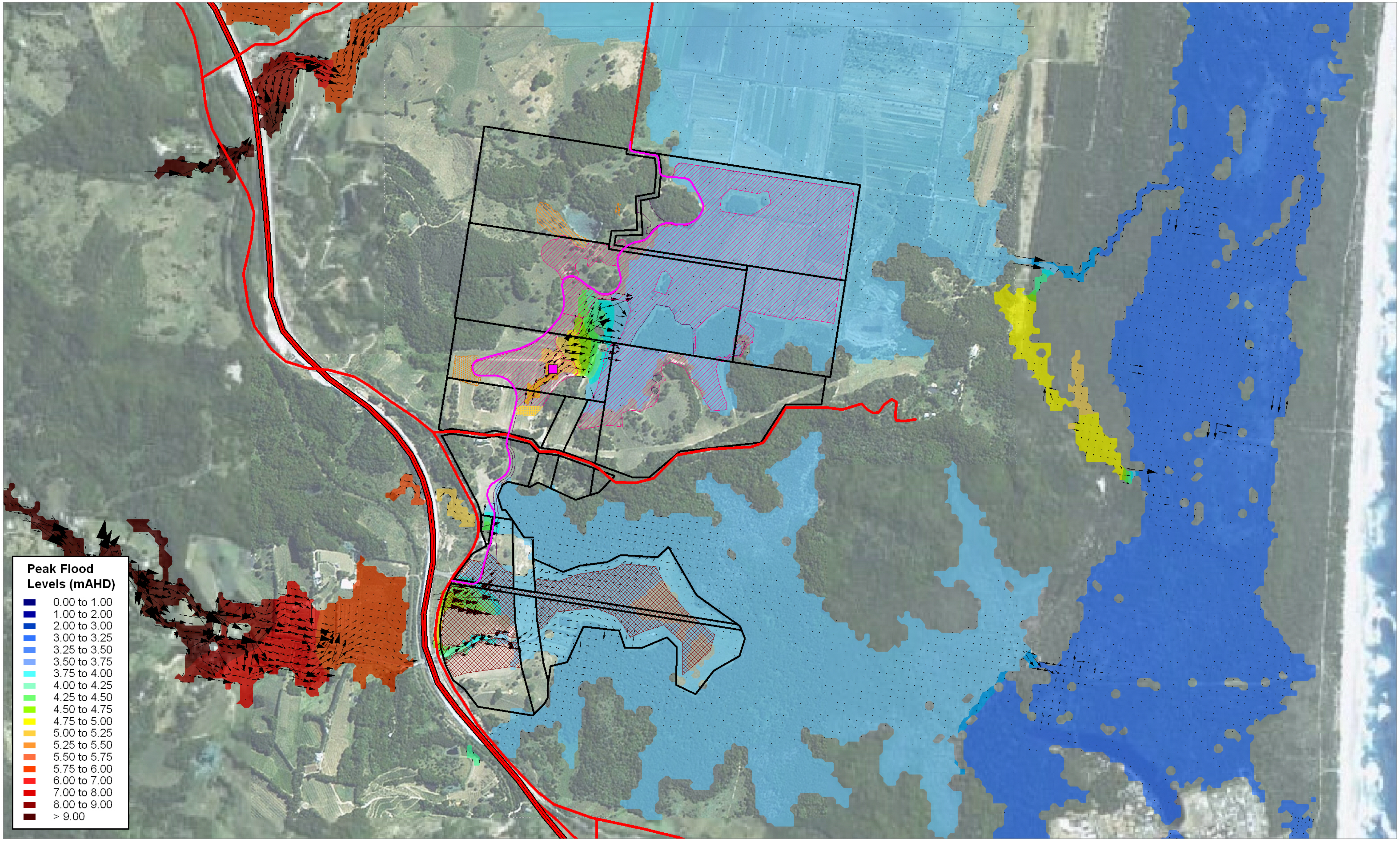

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)
- Velocity direction and magnitude

Title:

North Byron Shire Parklands: Developed Site 10yr ARI Combined Event - Peak Flood Levels

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Figure:
Figure 5-2

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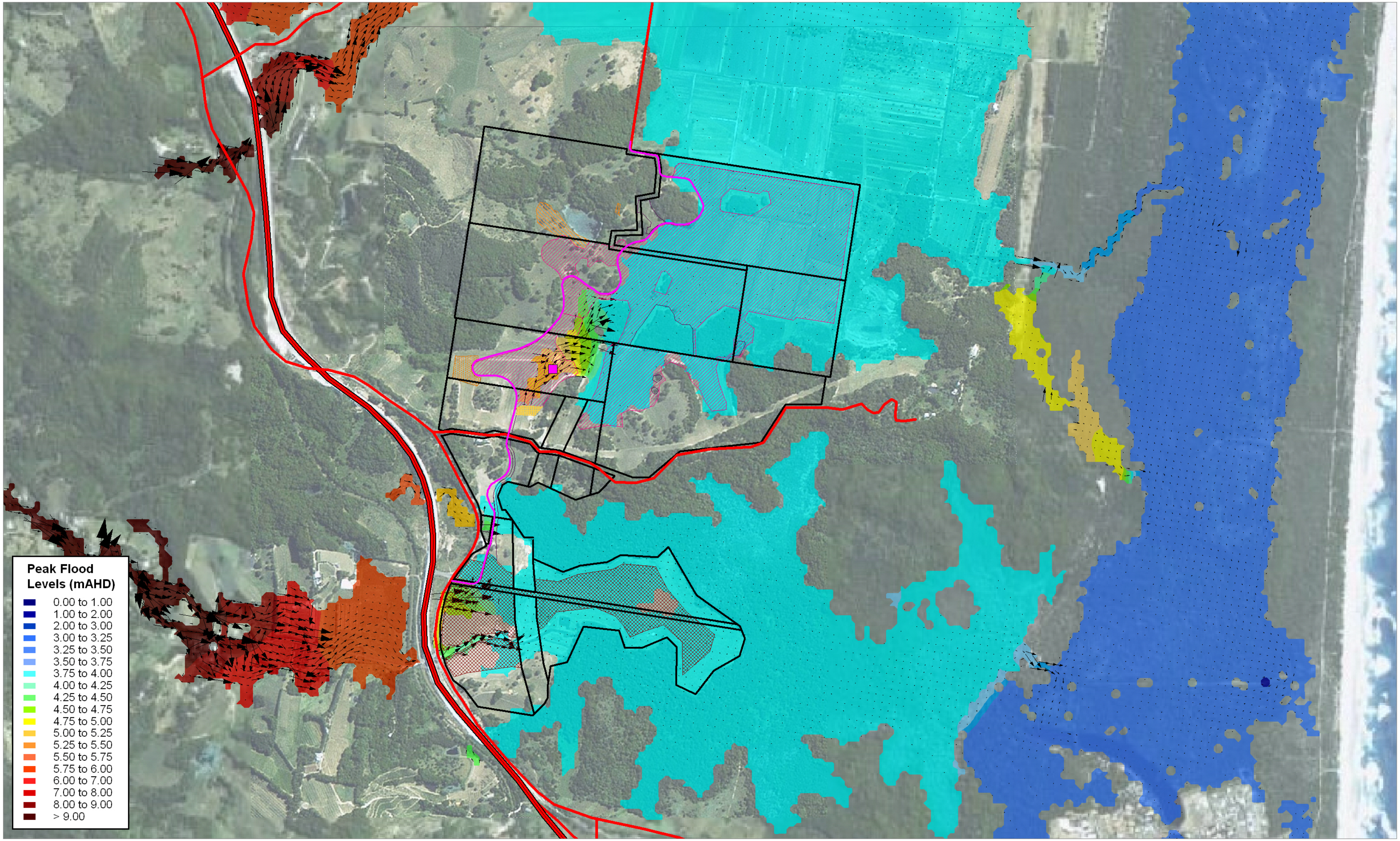

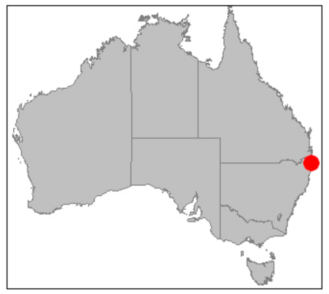

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)
- Velocity direction and magnitude

Title:

North Byron Shire Parklands: Developed Site
50yr ARI Combined Event - Peak Flood Levels

Figure: **Figure 5-3**

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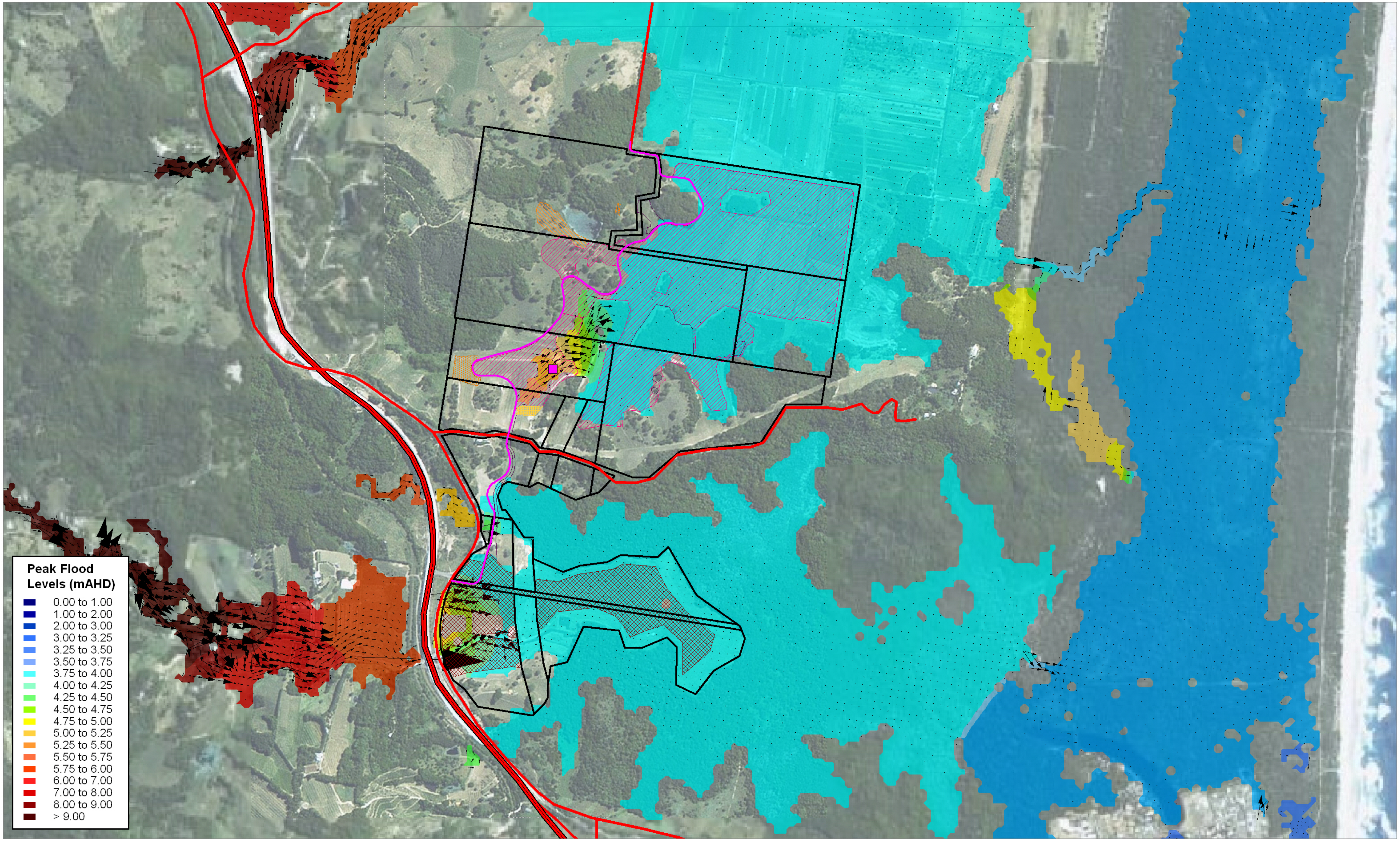

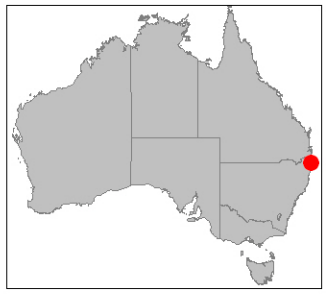

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)
- Velocity direction and magnitude

Title:

North Byron Shire Parklands: Developed Site
100yr ARI Combined Event - Peak Flood Levels

Figure: **Figure 5-4**

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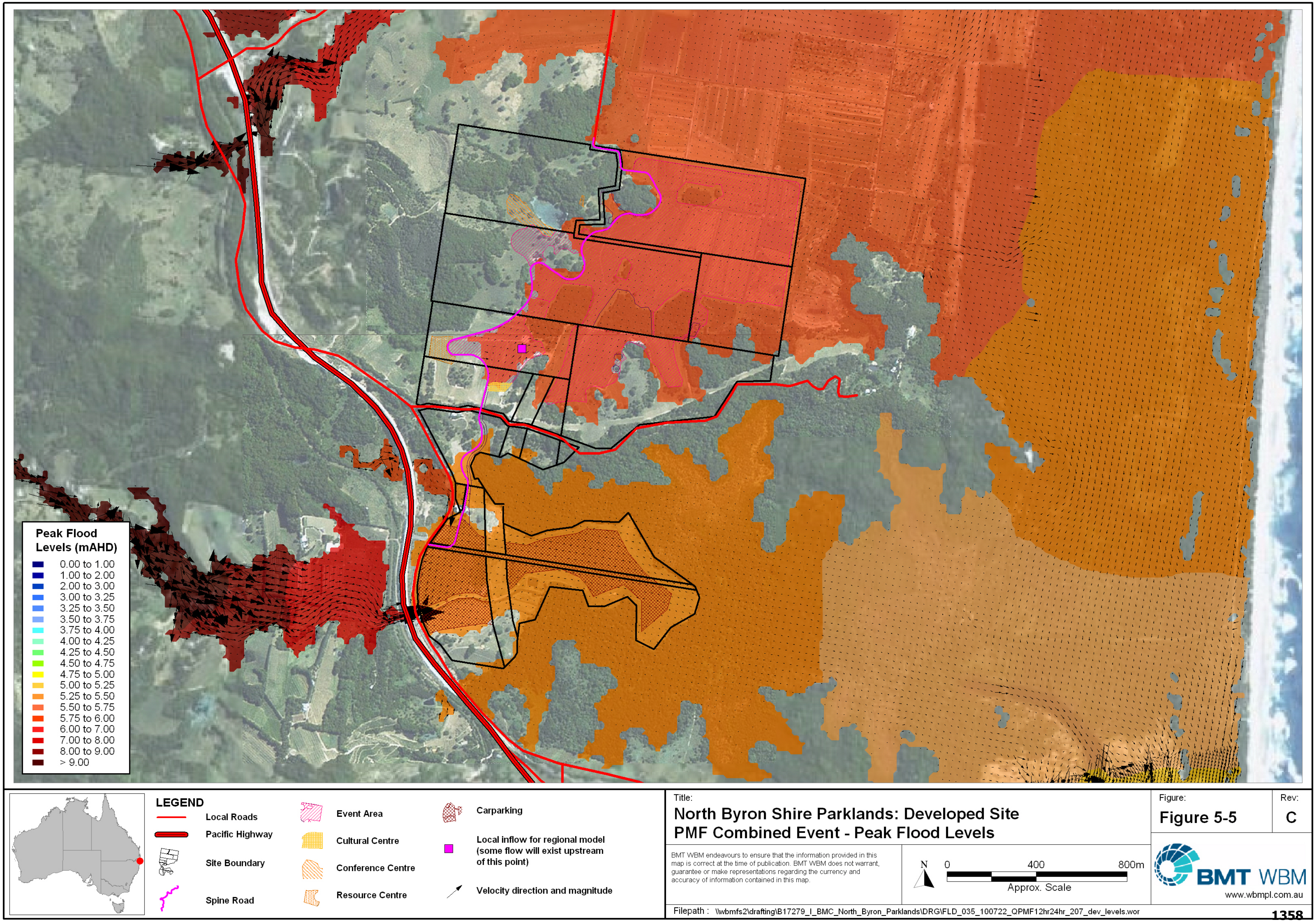

Title:

North Byron Shire Parklands: Developed Site PMF Combined Event - Peak Flood Levels

Figure: **Figure 5-5**

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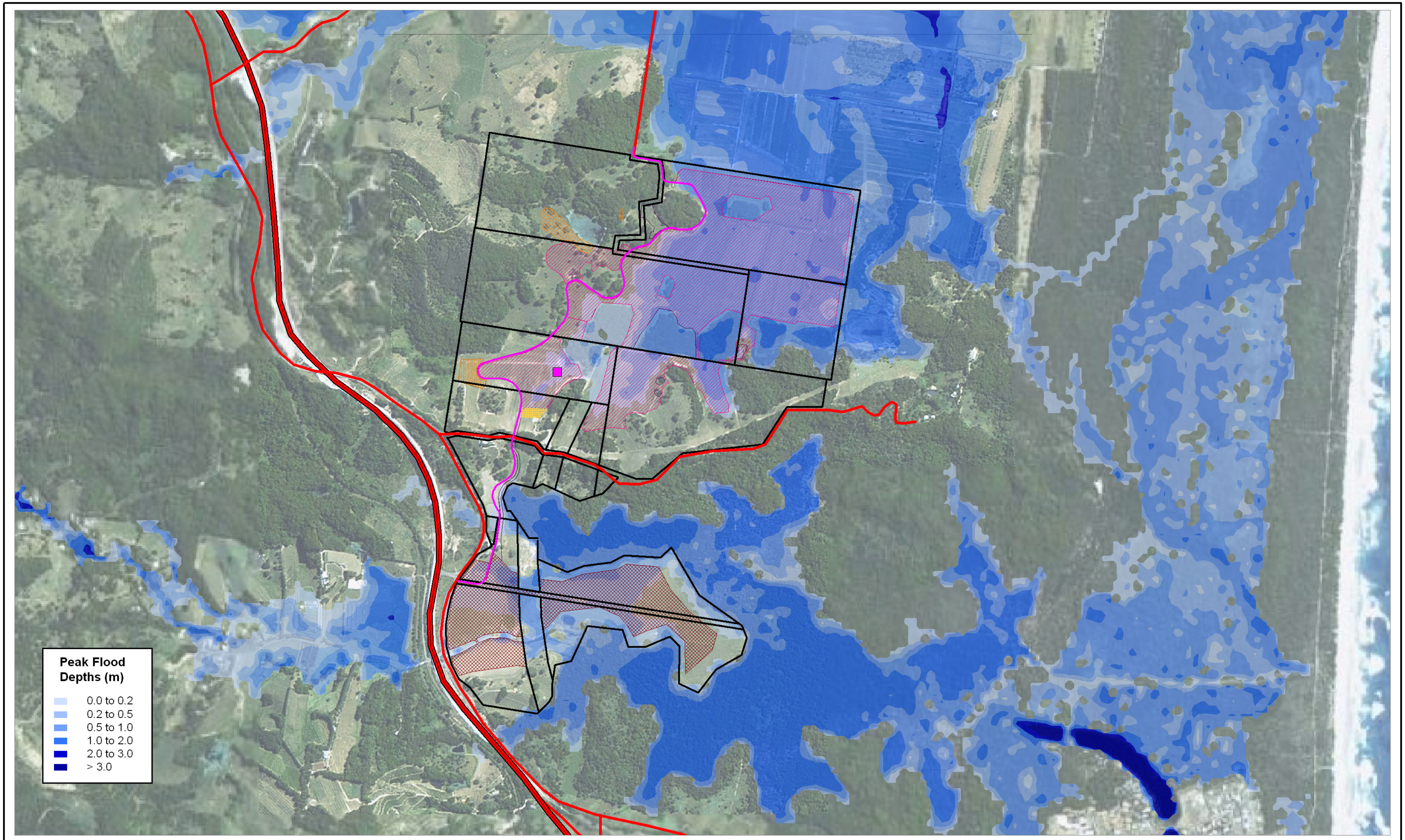

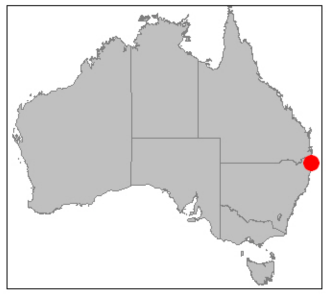

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)

Title:

North Byron Shire Parklands: Developed Site 5yr ARI Combined Event - Peak Flood Depths

N 0 400 800m
Approx. Scale

Figure: Figure 5-6

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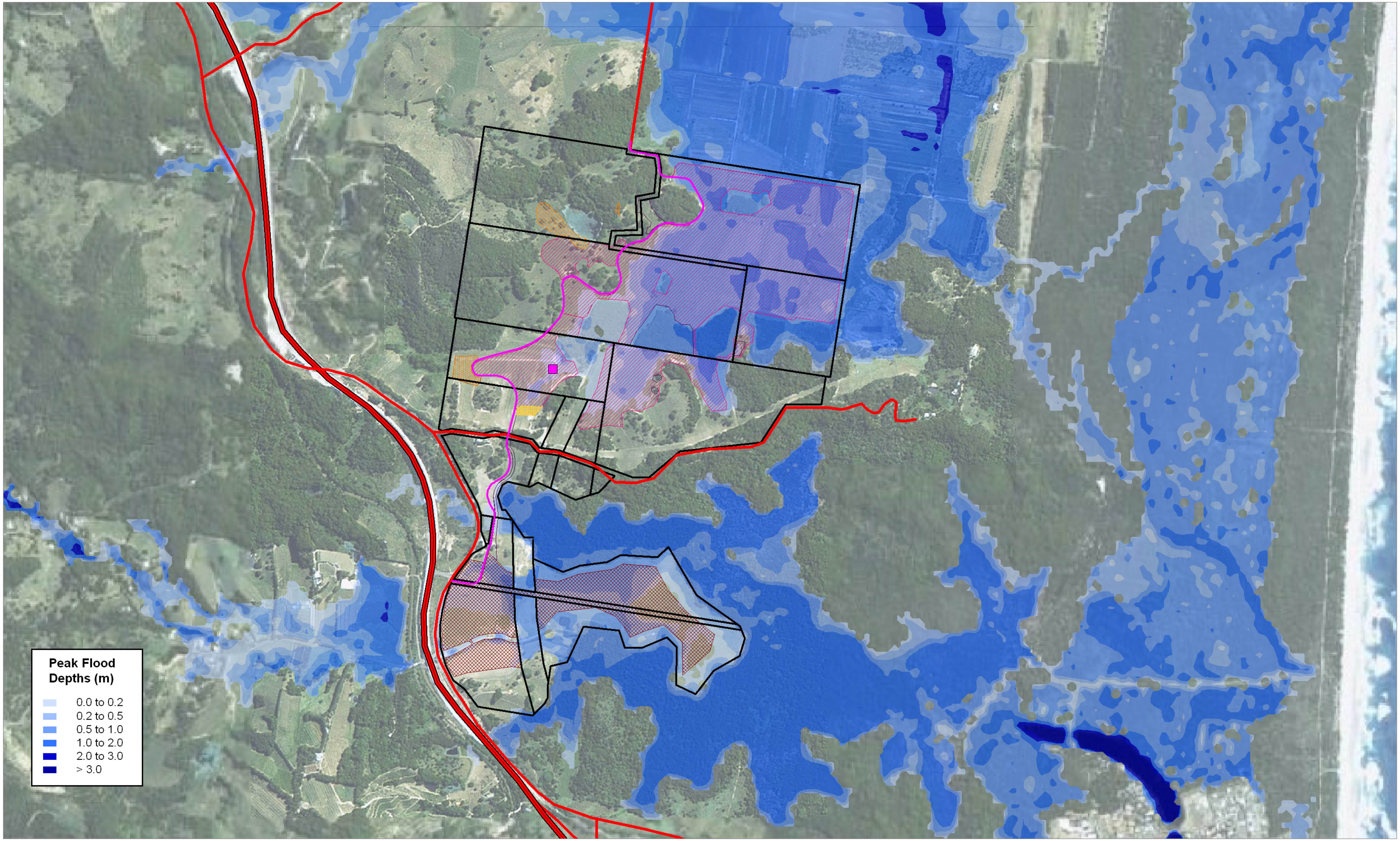

LEGEND

Local Roads
Pacific Highway
Site Boundary
Spine Road
Event Area
Cultural Centre
Conference Centre
Resource Centre
Carparking
Local inflow for regional model (some flow will exist upstream of this point)

Title:

North Byron Shire Parklands: Developed Site
10yr ARI Combined Event - Peak Flood Depths

Figure: **Figure 5-7**

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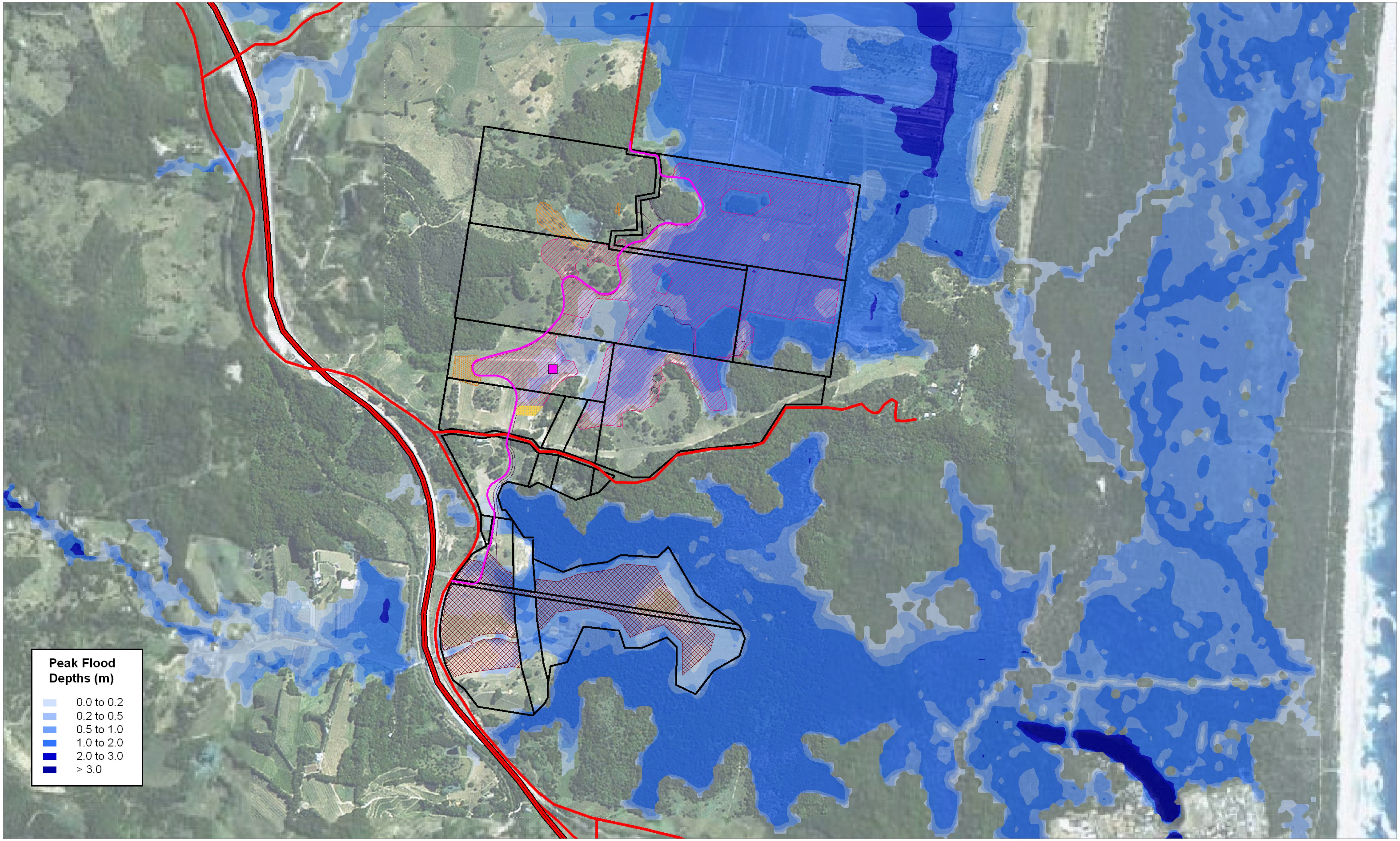

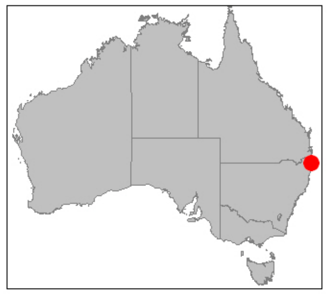

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)

Title:

North Byron Shire Parklands: Developed Site
50yr ARI Combined Event - Peak Flood Depths

Figure: **Figure 5-8**

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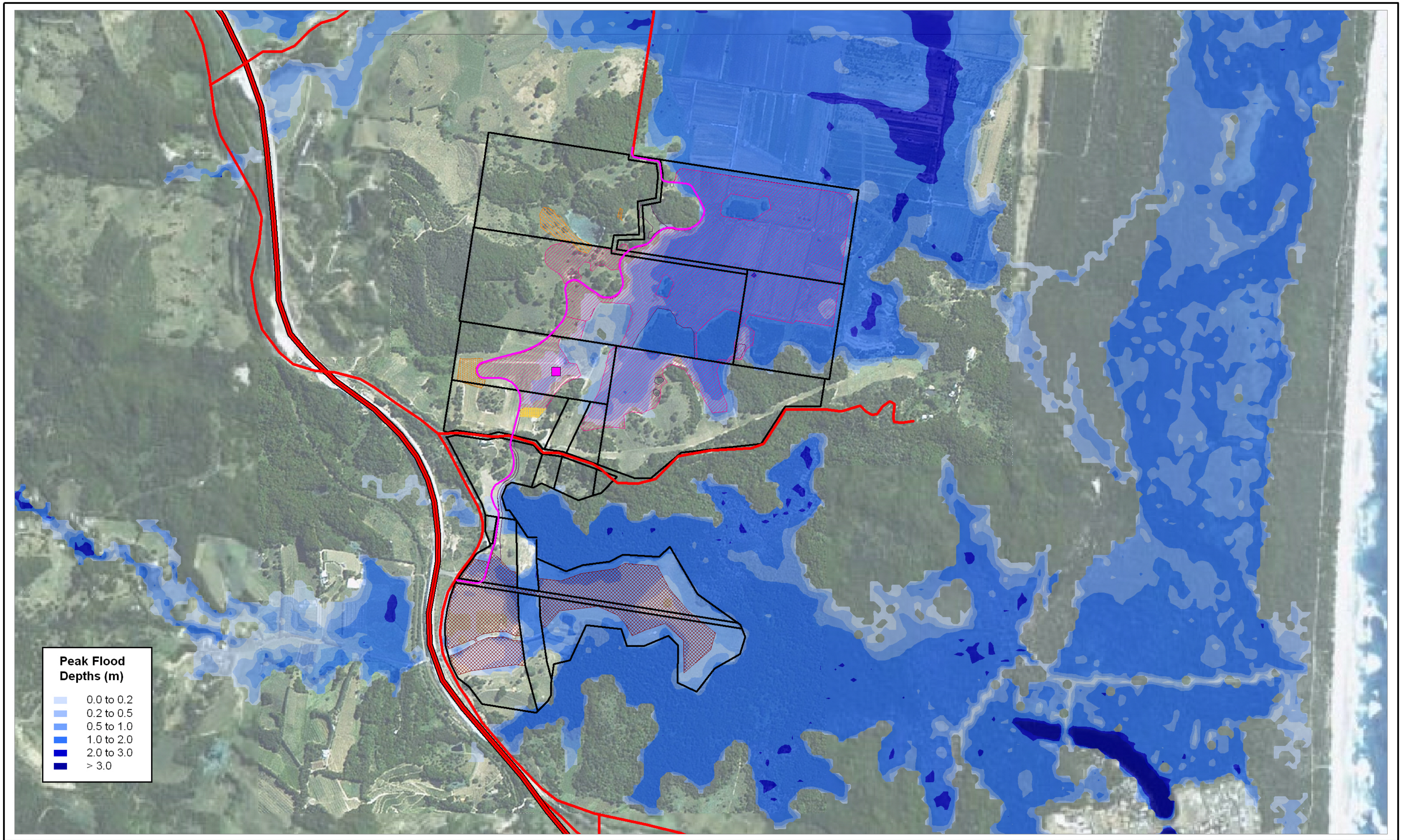

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)

Title:

North Byron Shire Parklands: Developed Site
100yr ARI Combined Event - Peak Flood Depths

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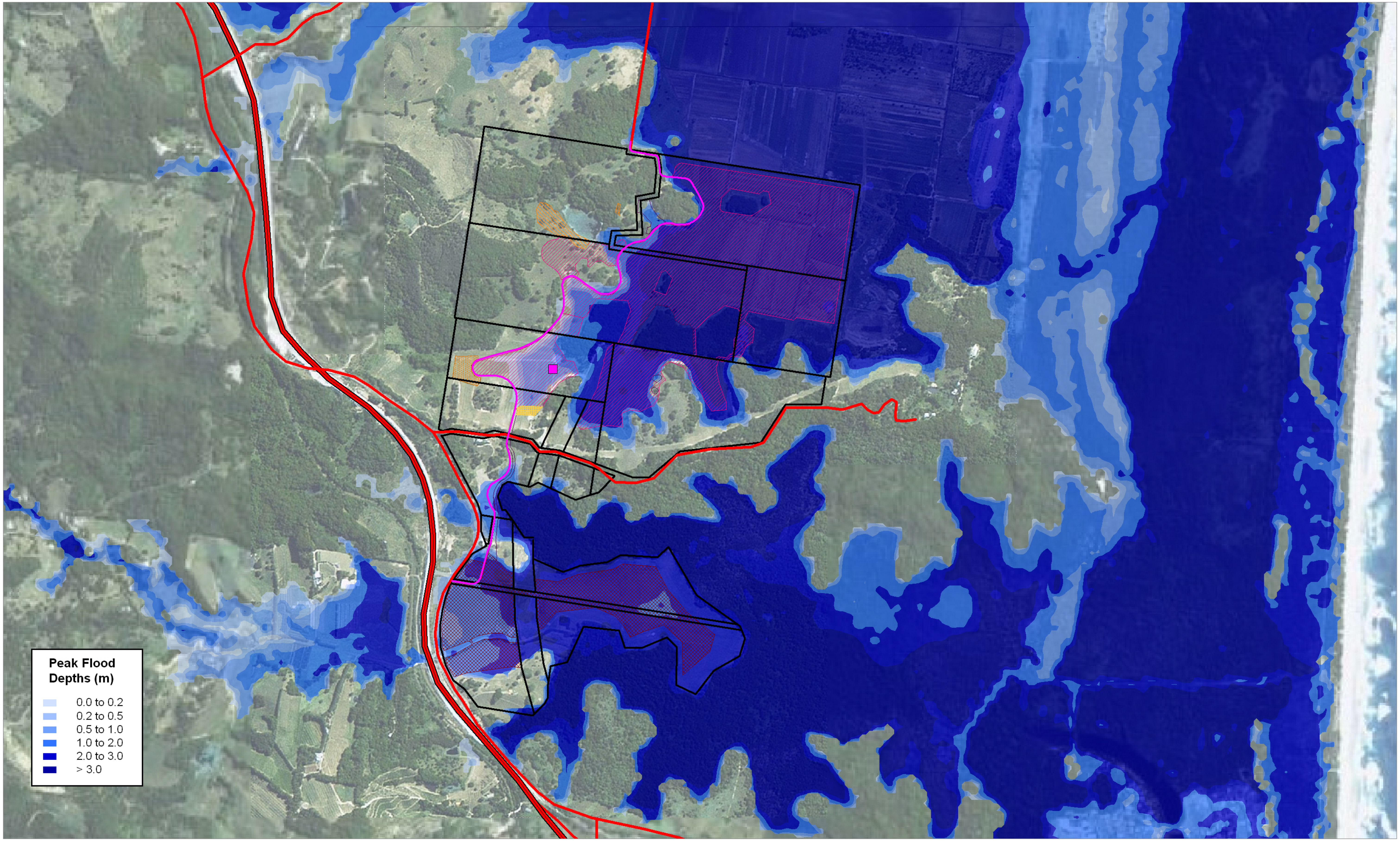

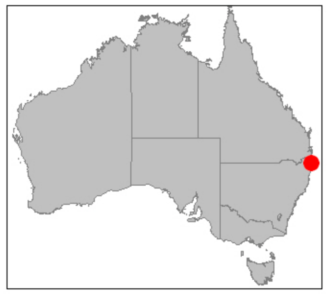

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)

Title:

North Byron Shire Parklands: Developed Site
PMF Combined Event - Peak Flood Depths

Figure:
Figure 5-10

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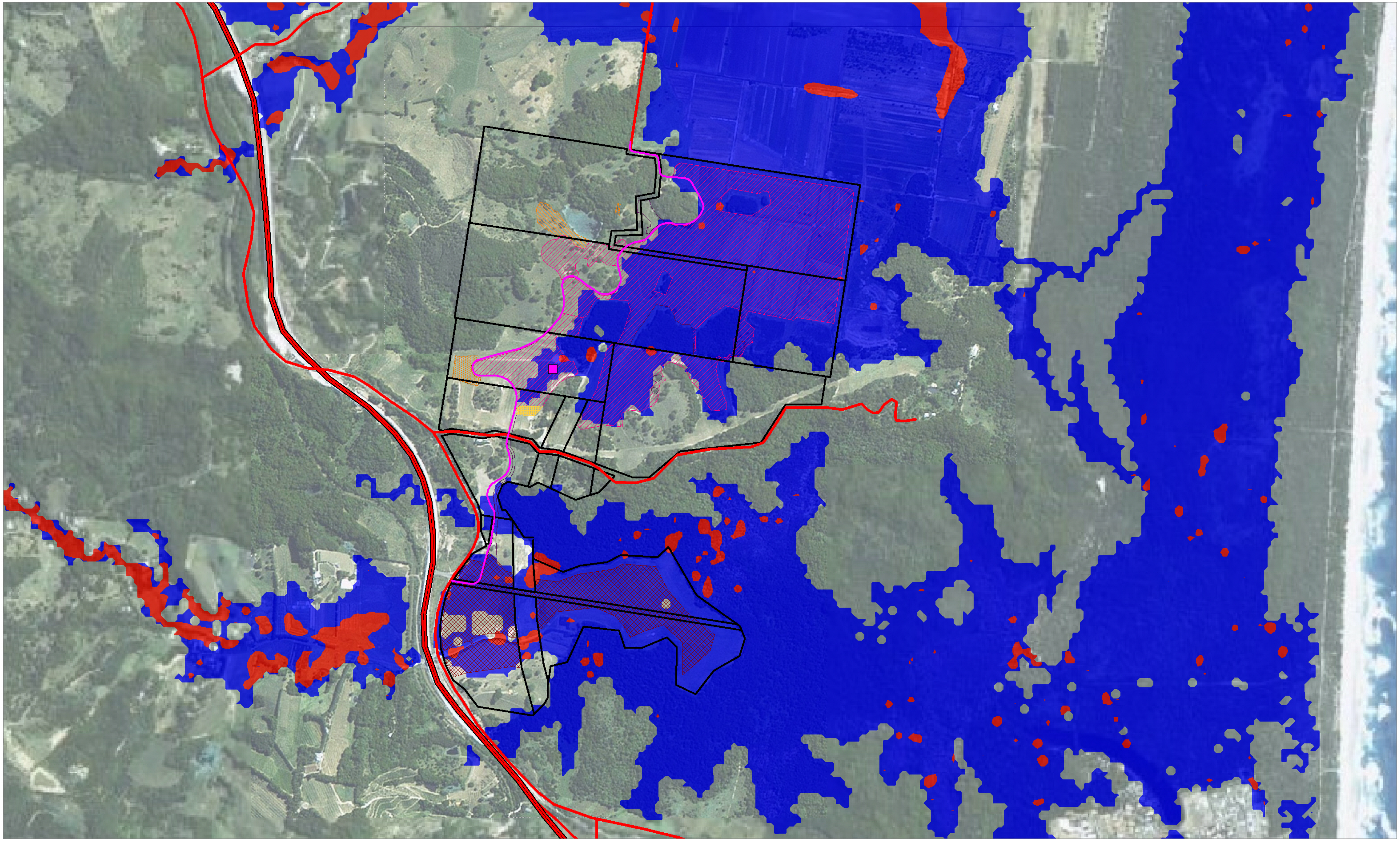
5.2 Flood Hazard

The modelled flood hazard for the 100 year ARI event, highlighting areas where the product of flow velocity and flood depth is high, has been mapped in Figure 5-11. Areas of fast flowing and/or deep water are categorised as 'high hazard'. Most of the site is categorised as 'low hazard', with a few localised areas of 'high hazard'. The flood hazard along the spine road and on the site is generally low for the 100 year ARI event. Smaller flood events will result in reduced flood hazard. It is recommended that care be taken during flood evacuation to avoid areas of fast flowing and/or deep water.



LEGEND

Local Roads	Event Area
Pacific Highway	Cultural Centre
Site Boundary	Conference Centre
Spine Road	Resource Centre
Carparking	
Local inflow for regional model (some flow will exist upstream of this point)	
v x d < 0.3 Low Flood Flow	
v x d < 0.3 High Flood Flow	

Title:

North Byron Shire Parklands: Developed Site
100yr ARI Combined Event - Flood Hazard

Figure: **Figure 5-11**

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N 0 400 800m
Approx. Scale

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5.3 Flood Impacts

Flood impacts have been assessed to determine areas where flood levels change as a result of the proposed on-site development. The only on-site development in the floodplain that is likely to impact on flood levels is the proposed road raising. The road raising is generally 250mm to 300mm above existing ground level for the spine road, and 100mm for the event laneways. The affect of this road raising on flood levels is discussed below. Due to the inherent uncertainty in the flood modelling process, it is not possible to predict impacts of less than 5mm. Thus regions of 'nil impact' in Figure 5-12 and Figure 5-13 are mapped where the difference between the developed and existing model results is less than 5mm.

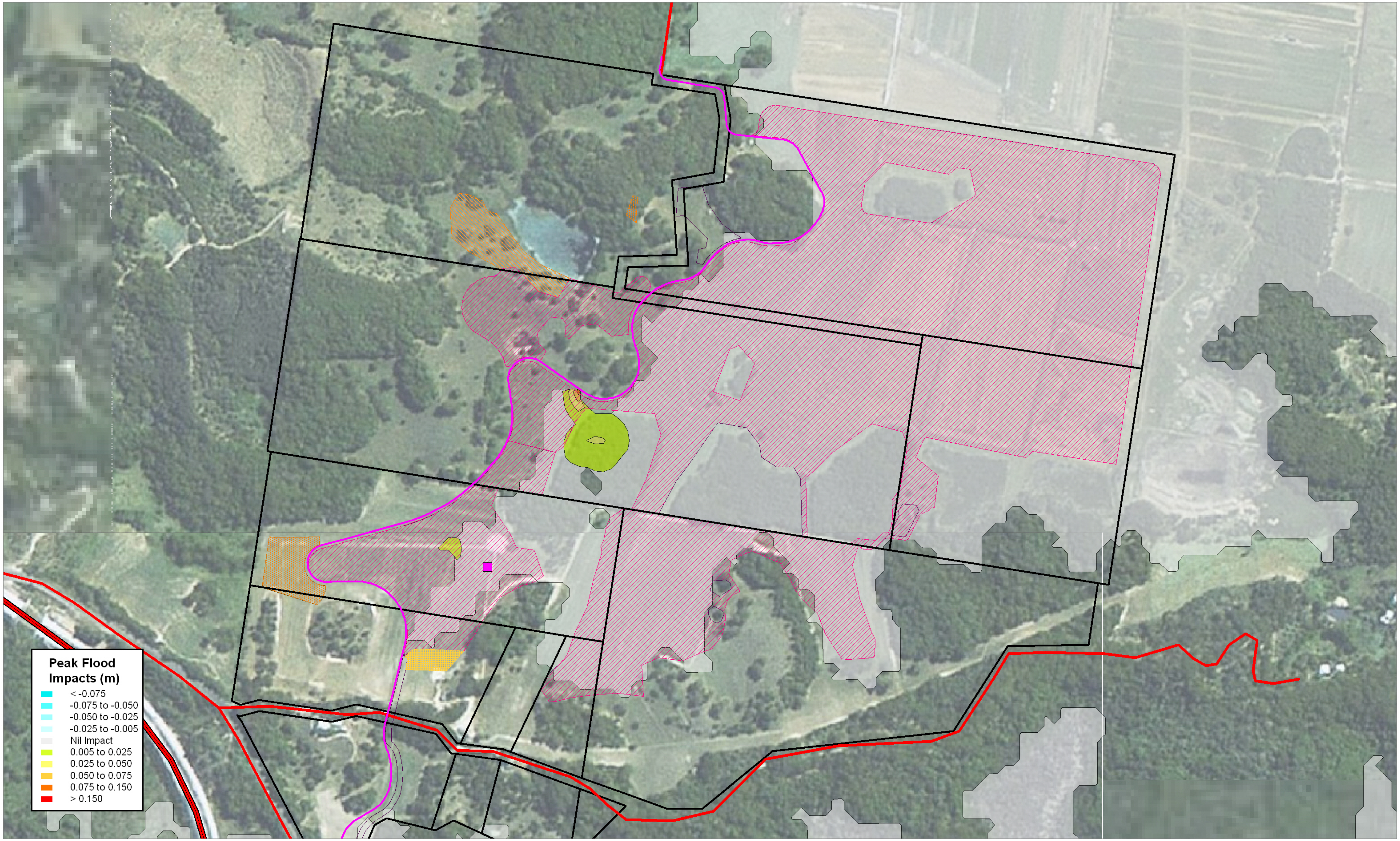
Impacts from the spine road in the northern part of the site are not assessable in the current flood model, however will be dealt with during detailed design, as outlined in section 4.2

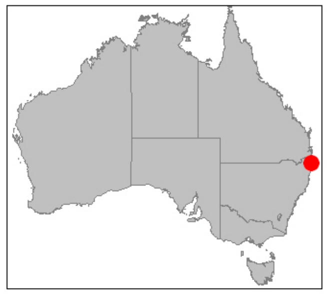
Impacts from the spine road in the southern part of the site are notable, but restricted to within the site perimeter. These are mostly restricted to the eastern day-patrons car park, where impacts are up to 250 mm.

The area where the proposed spine road has the most potential to cause off-site impacts is where the road crosses a drain downstream of culvert bank A. The on-site impact in this unused part of the site is up to 550mm (between the spine road and Tweed Valley Way). Flow through culvert bank A travels 50m along a drain for before reaching the spine road. The model does not include a culvert under the spine road. Water therefore backs up behind the road before overtopping it, hence the notable on-site impact. This modelling approach is conservative, and it is recommended that a culvert under the spine road is constructed along this drain, thereby providing a pathway for flow entering the site from culvert bank A to reach the wider floodplain without having to overtop the spine road.

The event laneways will result in only minor topological changes to the site and have very little impact on the flood levels on site.

There are no measurable flood impacts off-site.





LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)

NOTE: DUE TO THE INHERENT UNCERTAINTY IN THE FLOOD MODELLING PROCESS, IT IS NOT POSSIBLE TO PREDICT IMPACTS TO A RESOLUTION FINER THAN 5MM.

Title:

North Byron Shire Parklands: Developed Site (North)
100yr ARI Combined Event - Peak Flood Impacts

N 0 125 250m
Approx. Scale

Figure: **Figure 5-12**

Rev: **C**

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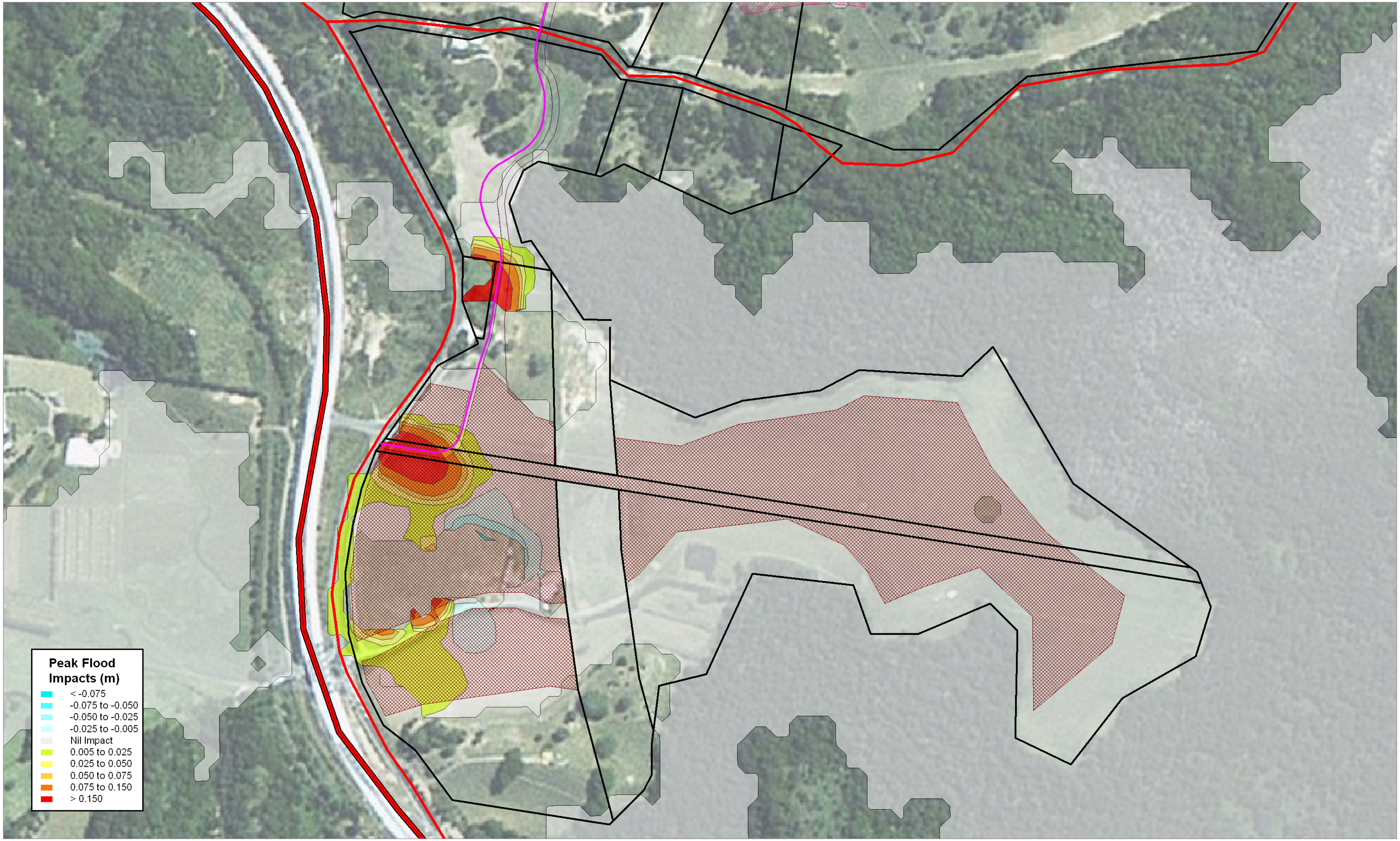
Filepath : I:\B17279_I_BMC_North_Byron_Parklands\DRG\FLD_030_100719_Q10012hr24hr_207_dev_impacts.wor



LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking

NOTE: DUE TO THE INHERENT UNCERTAINTY IN THE FLOOD MODELLING PROCESS, IT IS NOT POSSIBLE TO PREDICT IMPACTS TO A RESOLUTION FINER THAN 5MM.

Title:

North Byron Shire Parklands: Developed Site (South)
100yr ARI Combined Event - Peak Flood Impacts

Figure: **Figure 5-13**

Rev: **C**

N 0 400 800m
Approx. Scale

BMT WBM
www.wbmpl.com.au

Filepath : I:\B17279_I_BMC_North_Byron_Parklands\DRG\FLD_030_100719_Q10012hr24hr_207_dev_impacts.wor

5.4 Climate Change Assessment

'Medium' and 'high' climate change events for the 100 year model have been simulated for the developed site as per the DECCW guidelines[3] below. These levels are mapped in Figure 5-14 and Figure 5-15.

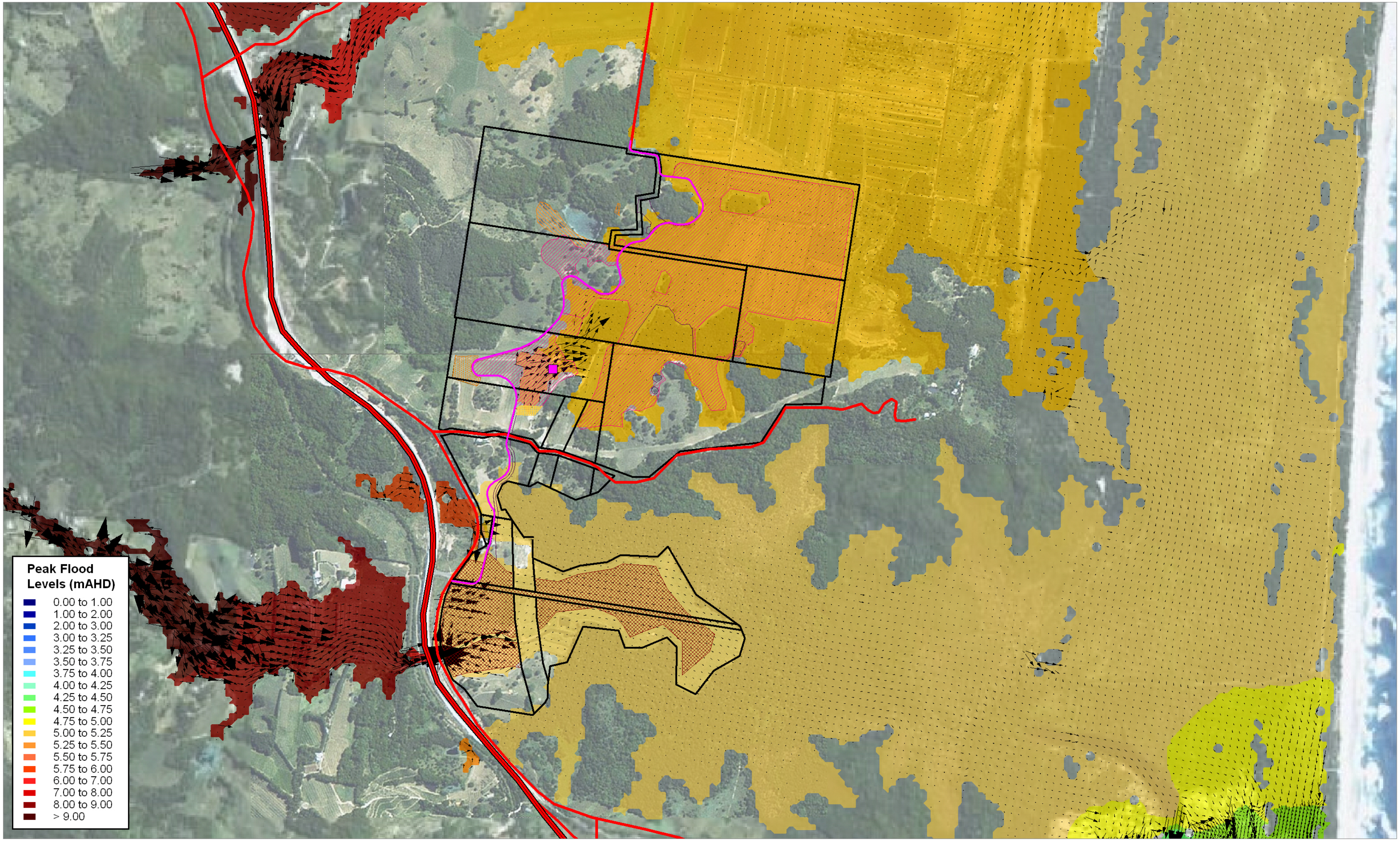
Medium increase = 20% increase in rainfall intensity + 55cm sea level rise

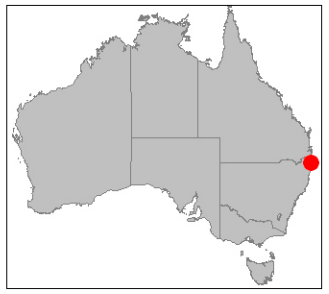
High increase = 30% increase in rainfall intensity + 91cm sea level rise

As a result of these increases, on-site levels in the vicinity of the car park area have generally risen by 1.15m for the medium scenario and 1.29m for the high scenario. In the vicinity of the event area, levels have generally risen by 1.46m for the medium scenario and 1.62m for the high scenario. Water levels in the vicinity of the resource centre have increased by 0.18m for the medium scenario and 0.20m for the high scenario.

The spatial extent of the flooding in the vicinity of the site does not change significantly. The flood mechanism through the site has not changed.

[3] Practical Considerations of Climate Change – Floodplain Risk Management Guideline (DECCW, October 2007)





LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)
- Velocity direction and magnitude

Title:

100 year ARI Combined Event Levels: Developed Site (Medium Climate Change)

Figure: **Figure 5-14**

Rev: **C**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N 0 400 800m
Approx. Scale

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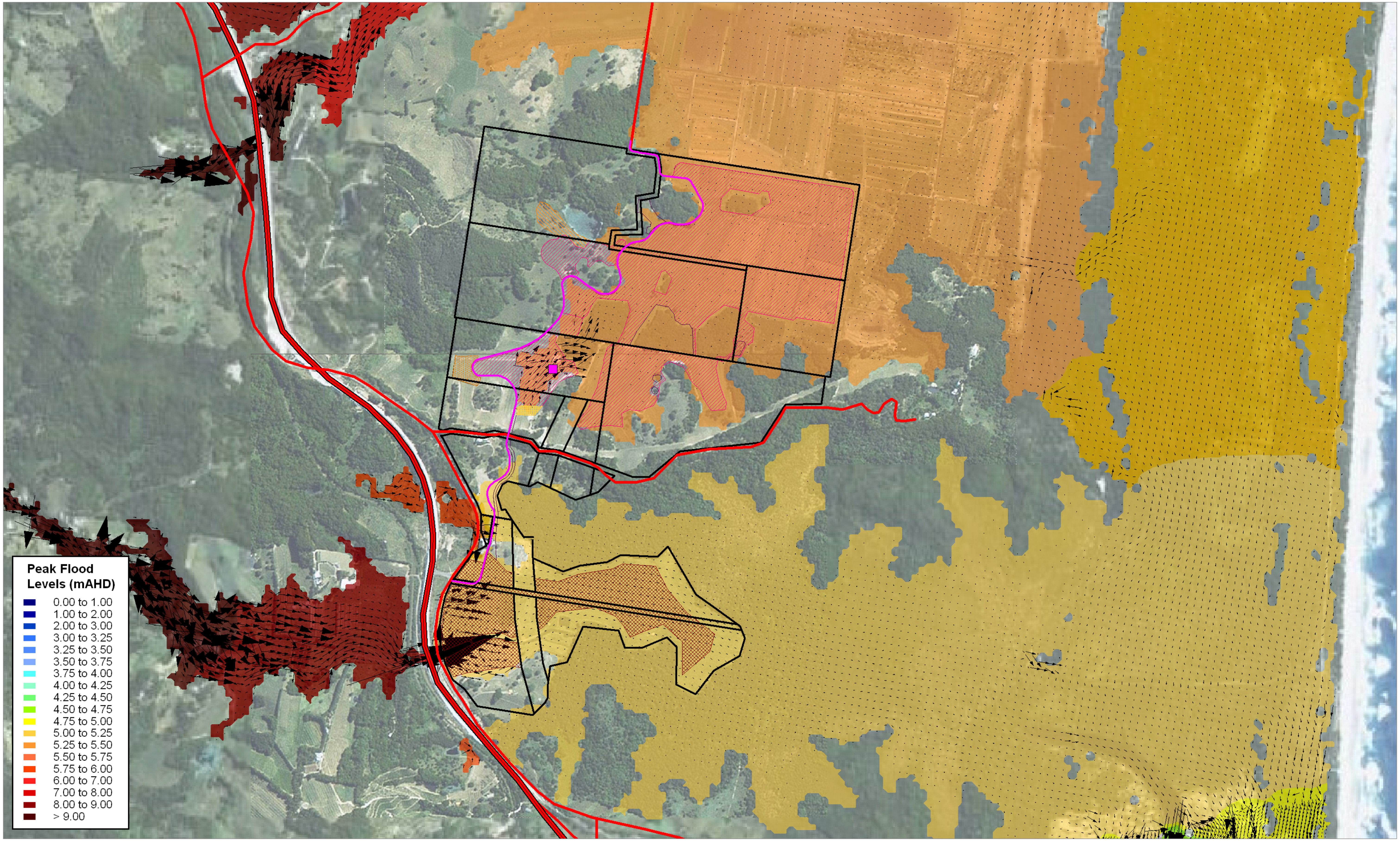

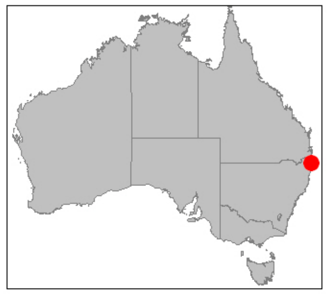

LEGEND

- Local Roads
- Pacific Highway
- Site Boundary
- Spine Road
- Event Area
- Cultural Centre
- Conference Centre
- Resource Centre
- Carparking
- Local inflow for regional model (some flow will exist upstream of this point)
- Velocity direction and magnitude

Title:

100 year ARI Combined Event Levels: Developed Site (High Climate Change)

Figure: **Figure 5-15**

Rev: **C**

N 0 400 800m
Approx. Scale

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Filepath : \\wbmfs2\drafting\B17279_I_BMC_North_Byron_Parklands\DRG\FLD_037_100722_Q10012hr24hr_CChigh_207_dev_levels.wor

6 CONCLUSIONS

The spine road and laneways proposed in the North Byron Parklands site have been modelled in order to investigate flood risk on the developed site and the impact on flood levels caused by the proposed development. Flood levels, depths and hazard have been assessed, as well as increased flood risk due to rising sea levels and increased rainfall intensity as a result of climate change.

The modelling methodology is conservative with regard to impacts upstream of the spine road, as culverts under the spine road have not been considered in the analysis. However, it is recommended that culverts under the spine road are included in the final design, particularly for the drain at culvert bank A, to maintain drainage of regular flows into the wider floodplain.

The results show that the car parking area and event area are on flood prone land, and two locations along the spine road are overtopped in all modelled events. Proposed buildings are not shown to be on flood prone land. The development of the spine road causes significant flood impact at some locations within the site perimeter (although impacts are overstated due to model setup), but no adverse off site impacts.

APPENDIX A: DRAFT FLOOD PROOFING CODE

The Draft Flood Proofing Code provided in the Development Control Plan 2002 has been reproduced here to highlight the type of information and conditions required for buildings on flood liable land.

Note that the design flood level (DFL) refers to the level of the 1% AEP flood.

Construction Methods and Materials
Construction methods and materials are graded into four classes according to their resistance to floodwaters.

Suitable - the materials or products which are relatively unaffected by submersion and unmitigated flood exposure and are the best available for the particular application.

Mild effects - where the most suitable materials or products are unavailable or economic considerations prohibit their use, these materials or products are considered the next best choice to minimise the damage caused by flooding.

Marked effects - as for "2nd preference" but considered to be more liable to damage under flood conditions.

Sever effects - the materials or products listed here are seriously affected by floodwaters and in general have to be replaced if submerged.

Electrical and Mechanical Equipment
For dwellings constructed on flood liable land, the electrical and mechanical materials, equipment and installation must conform to the following requirements.

Main power supply - Subject to the approval of the relevant power authority, the incoming main commercial power service equipment, including all metering equipment is to be located above the DFL. Means are to be available to easily disconnect the dwelling from the main power supply.

Wiring - all wiring, power outlets, switches, etc., must, to the maximum extent possible, be located above the DFL. All electrical wiring installed below the DFL must be suitable for continuous submergence in water and must contain no fibrous components. Only submersible-type splices are to be used below the DFL. All conduits located below the DFL are to be so installed that they will be self-draining if subjected to flooding.

Equipment - All equipment installed below or partially below the DFL must be capable of disconnection by a single plug and socket assembly.

Reconnection - Must any electrical device and/or part of the wiring be flooded it must be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.

Heating and Air Conditioning Systems

Heating and air conditioning systems must, to the maximum extent possible, be installed in areas and space of the house above the DFL. When this is not feasible every precaution must be taken to minimise the damage caused by submersion according to the following guidelines.

Fuel - Heating systems using gas or oil as a fuel must have a manually operated valve located in the fuel supply line to enable fuel cut-off.

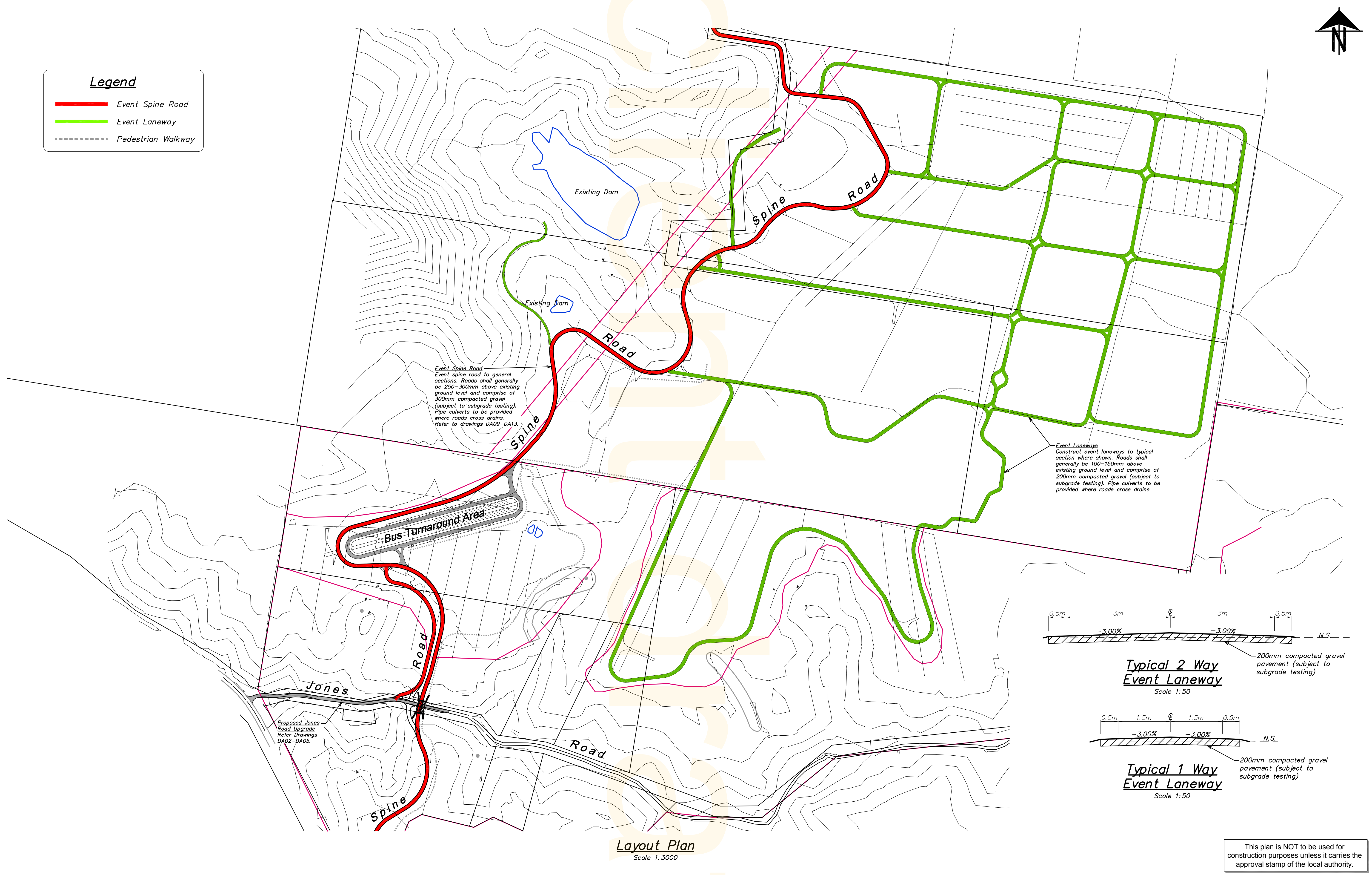
Installation - The heating equipment and fuel storage tanks must be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks must be vented to an elevation of 600 millimetres above the DFL.

Ducting - All ductwork located below the DFL must be provided with openings for drainage and cleaning. Self draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the DFL, the ductwork must be protected by a closure assembly operated from above DFL.

Component	Order of Preference			
	Suitable	Mild Effects	Marked Effects	Severe Effects
Floor and Sub-floor Structure	- concrete slab-on-ground monolith construction note: clay filling is not permitted beneath slab-on-ground construction, which could be inundated - suspension reinforced concrete slab	- timber floor (T&G boarding, marine plywood) full epoxy sealed joints	- timber floor (T&G boarding, marine plywood) with ends only epoxy sealed on joints and provision of side clearance for board swelling	- timber close to ground surrounding base - timber flooring with ceilings or soffit linings - timber flooring with seal on top only
Floor Covering	- clay tiles - concrete, precast or in situ - concrete tiles - epoxy, formed-in-place - mastic flooring, formed-in-place - rubber sheets or tiles with chemical-set adhesives - silicone floors formed-in-place - vinyl sheets or tiles with chemicalset adhesives - ceramic tiles, fixed with mortar or chemical set adhesive - asphalt tiles, fixed with water resistant adhesive	- cement/bitumenous formedin-place - cement/latex formed-in-place - rubber tiles, with chemicalset adhesive - terrazzo - vinyl tile with chemical-set adhesive - vinyl-asbestos tiles asphaltic adhesives - loose rugs - ceramic tiles with acid and alkali-resistant grout	- asphalt tiles with asphaltic adhesives - loose fit nylon or acrylic carpet with closed cell rubber underlay	- carpeting, glue-down type or fixed with smooth edge on jute felts - chipboard (particle board) - cork - linoleum - PVA emulsion cements - vinyl sheets or tiles coated on cork or wood backings - fibre matting (sea- grass matting)
Wall Structure (up to DFL)	- solid brickwork, blockwork, reinforced, concrete or mass concrete	- two skins of brickwork or blockwork with inspection openings	- brick or blockwork veneer construction with inspection openings	- inaccessible cavities - large window openings
Roof Structure (where DFL is above the ceiling)	- reinforced concrete construction - galvanised metal construction	- timber trusses with galvanised fittings	- traditional timber roof construction	- inaccessible flat roof construction - ungalvanised steelwork eg. lintels, arch bars, tie rods, beams, etc. unsecured roof tiles
Doors	- solid panel with water proof adhesives - flush door with marine ply	flush panel or single panel with marine plywood and water proof adhesive	- fly-wire doors -standard timber frame	- hollow core ply with PVA adhesives and honeycomb paper core

	filled with closed cell foam - painted metal construction - aluminium or galvanised steel frame	- T&G lines door, framed ledged and braced - painted steel - timber frame fully epoxy sealed before assembly		
Wall and Ceiling Linings	- asbestos-cement board - brick, face or glazed - clay tile glazed in waterproof mortar - concrete - concrete block - steel and waterproof applications - stone, natural solid or veneer, waterproof ground - glass blocks - glass - plastic sheeting or wall with waterproof adhesive	- brick, common - plastic wall tiles - metals, non ferrous - rubber mouldings and trim - wood, solid or exterior grade plywood fully sealed	- chipboard exterior grade - hardboard exterior grade - wood, solid (boards or timber) with allowance for swelling - wood, plywood exterior grade - fibrous plaster board	- chipboard - fibreboard panels - mineral fibreboard - paperboard - plaster-board, gypsum plaster - wall coverings (paper, burlap cloth types) - wood, standard plywood strawboard
Insulation	- foam or closed cell types	- reflective insulation	- bat or blanket types	- open cell fibre types
Windows	- aluminium frame with stainless steel or brass rollers	- epoxy sealed timber waterproof glues with stainless steel or brass fittings - galvanised or painted steel		- timber with PVA glues mild steel fittings
Nails, Bolts, Hinges and Fittings	- brass, nylon or stainless steel - removable pin hinges	- galvanised steel - aluminium		- mild steel

APPENDIX B: NORTH BYRON PARKLANDS ROAD DESIGN



This plan is NOT to be used for construction purposes unless it carries the approval stamp of the local authority.

Issue	Date	Amendment	App'd
A	18.6.10	At-grade spine road amended	TJC

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Road Hierarchy Plan and General Site Layout

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Design: RB	Scale at A1: As Shown	Date: May 2010	
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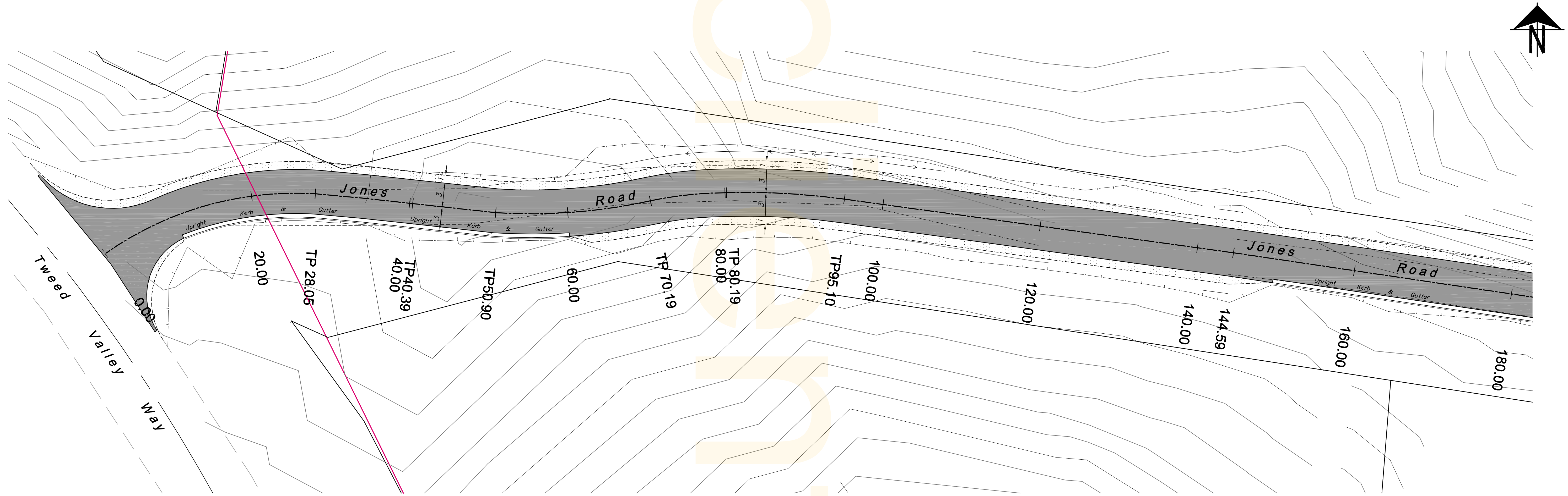
Approved	Ccad file: 6883-DA-1.dwg		
Job No.: 6883	Dwg. No.: DA01	Issue: A	



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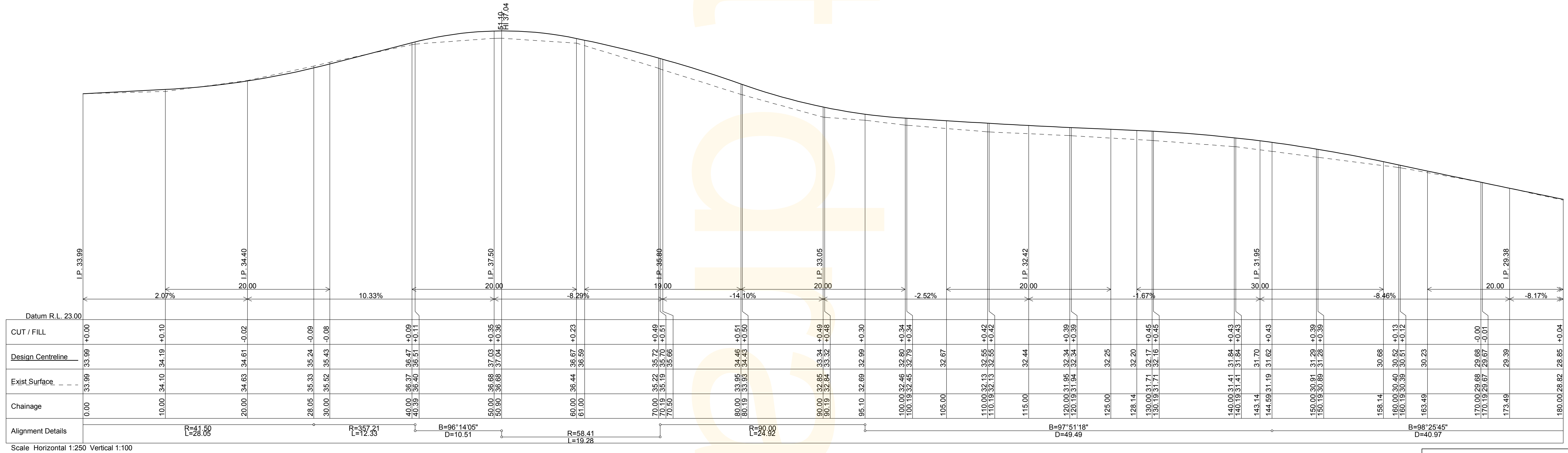

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Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Jones Road Plan and Long Section Ch0-180

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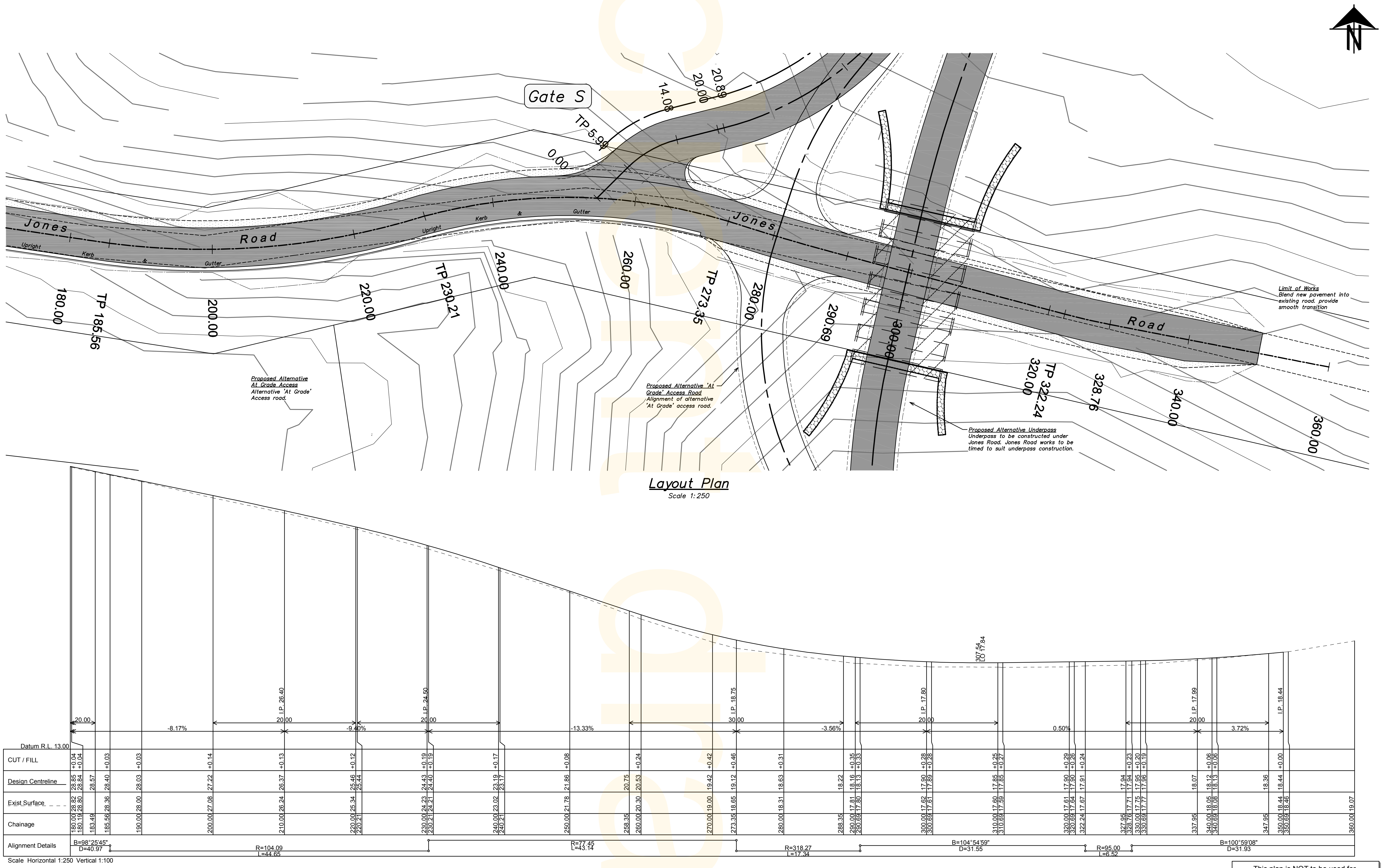

Layout Plan

Scale 1:250

Scale Horizontal 1:250 Vertical 1:100

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Issue	Date	Amendment	App'd
A	18.6.10	At-grade spine road amended	TJC

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Jones Road Plan and Long Section Ch180-360

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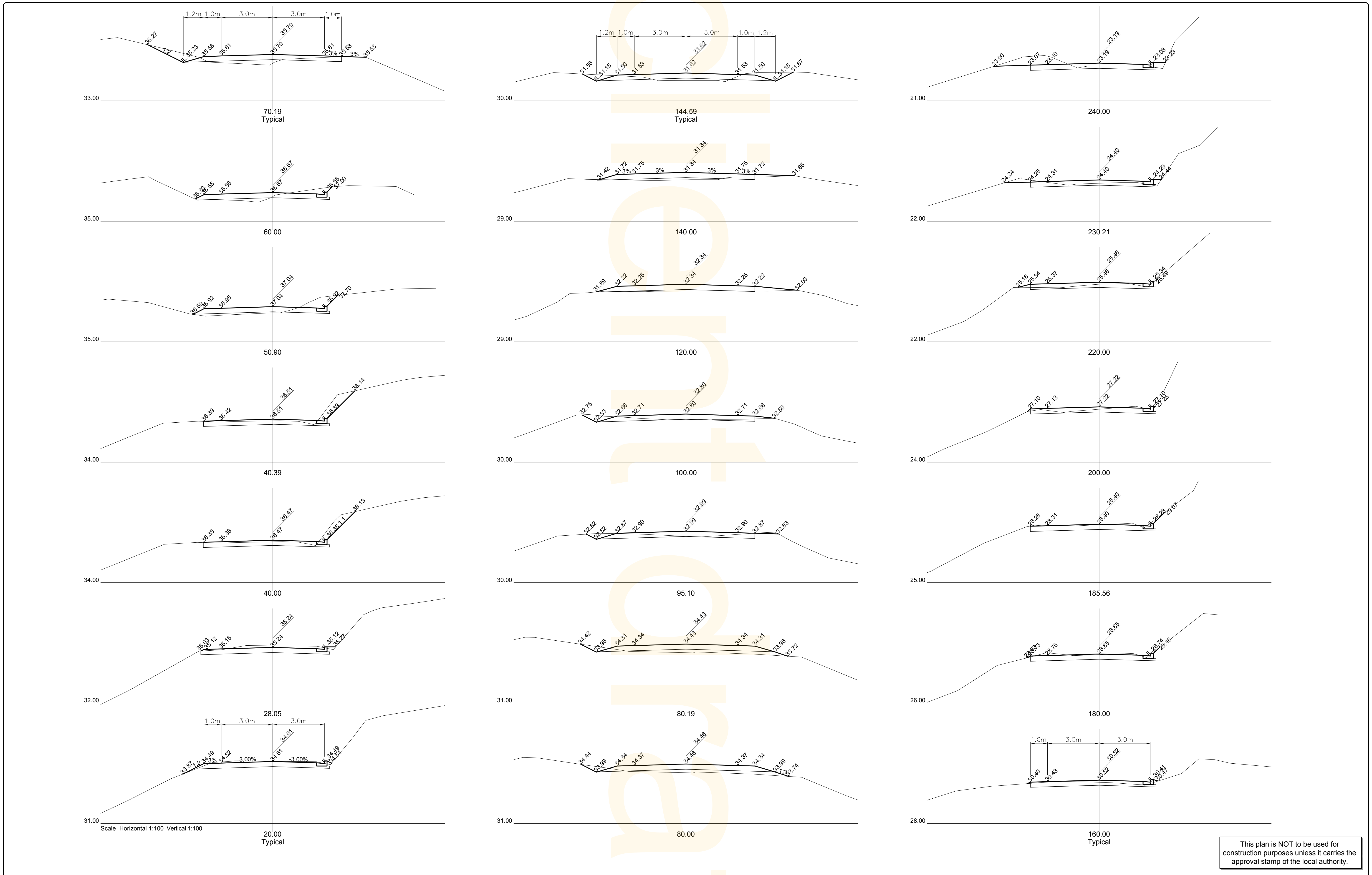
Issue	A		



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Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Jones Road Cross
Sections Ch 0-240

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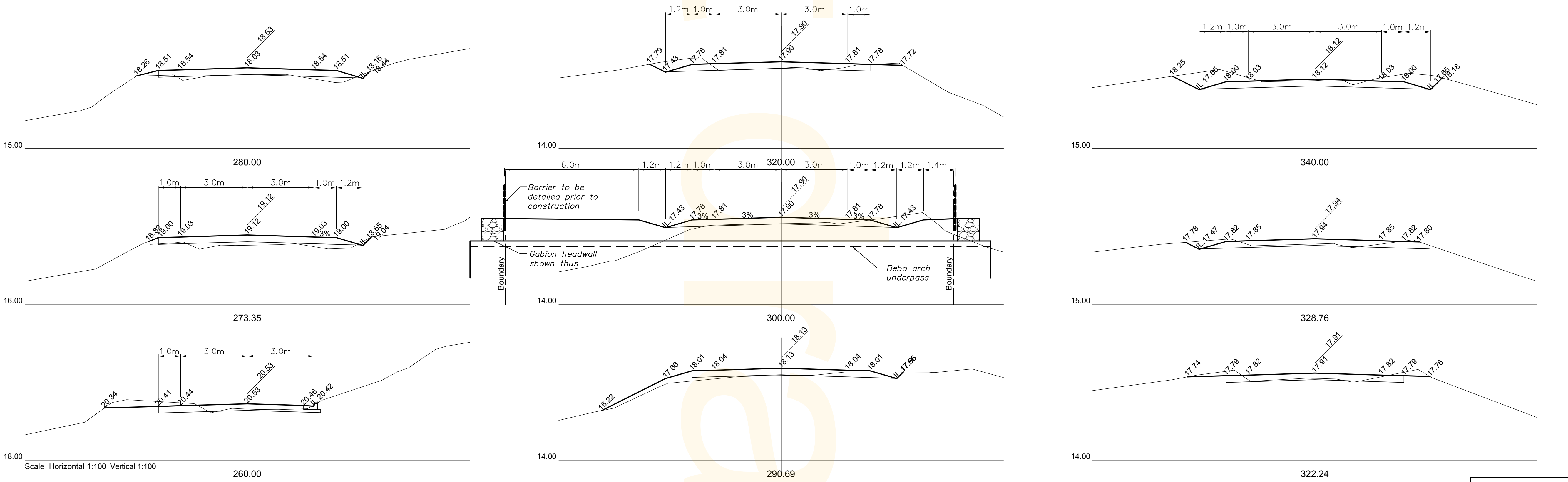

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Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Jones Road Cross Sections Ch 260-340

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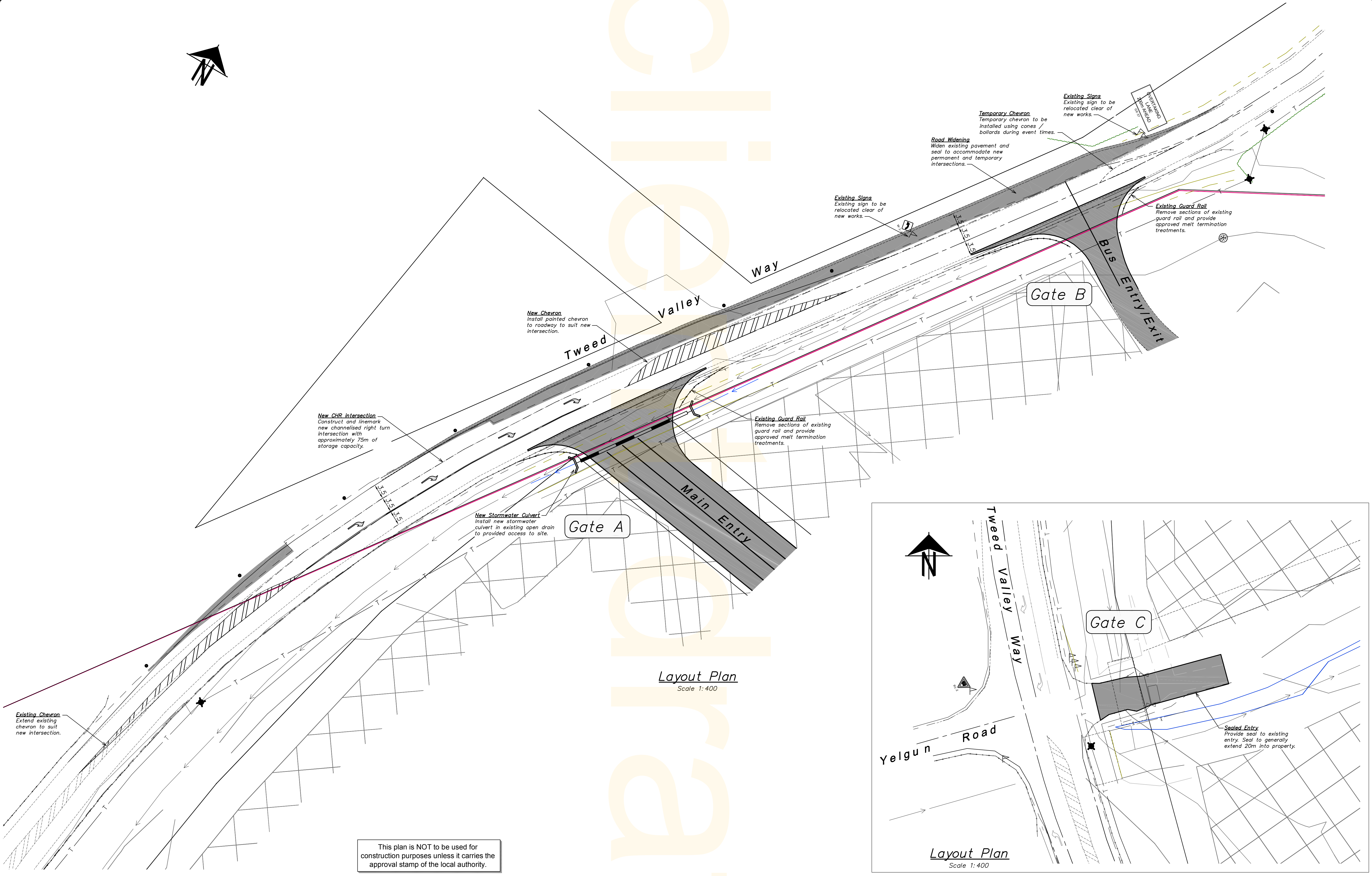

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Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Tweed Valley Way
Intersections

Do not scale drawing. Use written dimensions only

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Approved		Ccad file 6883-DA-1.dwg	
Job No. 6883		Dwg. No. DA06	Issue

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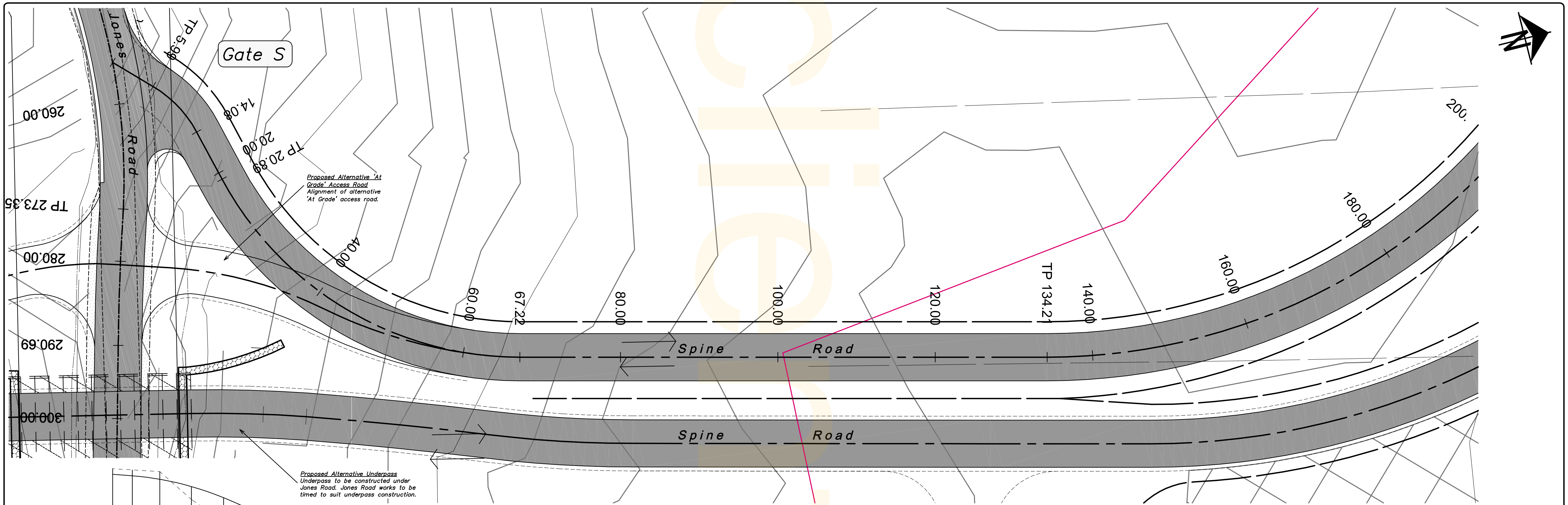

Layout Plan
Scale 1:250

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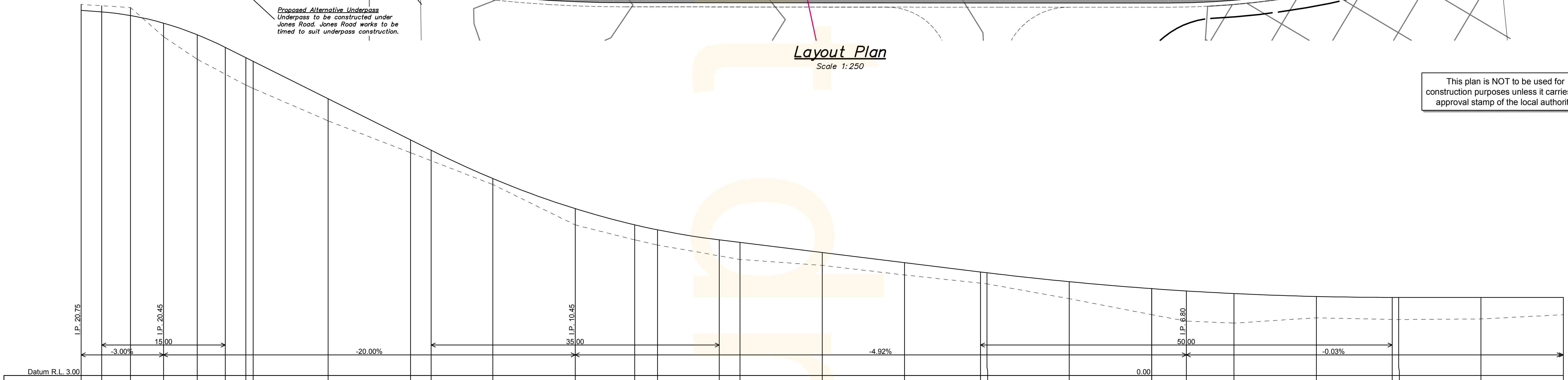

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40.00	14.45	13.83
42.50	13.95	
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100.00	8.48	7.88
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110.00	7.99	7.45
120.00	7.56	6.73
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130.00	7.22	5.95
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Scale Horizontal 1:250 Vertical 1:100

0 100 Table of millimetres 200 300 400 500 600 700 780

Issue	Date	Amendment	App'd
A	18.6.10	At-grade spine road amended	TJC

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road 'Drop In' Plan and Long Section Ch. 0-180

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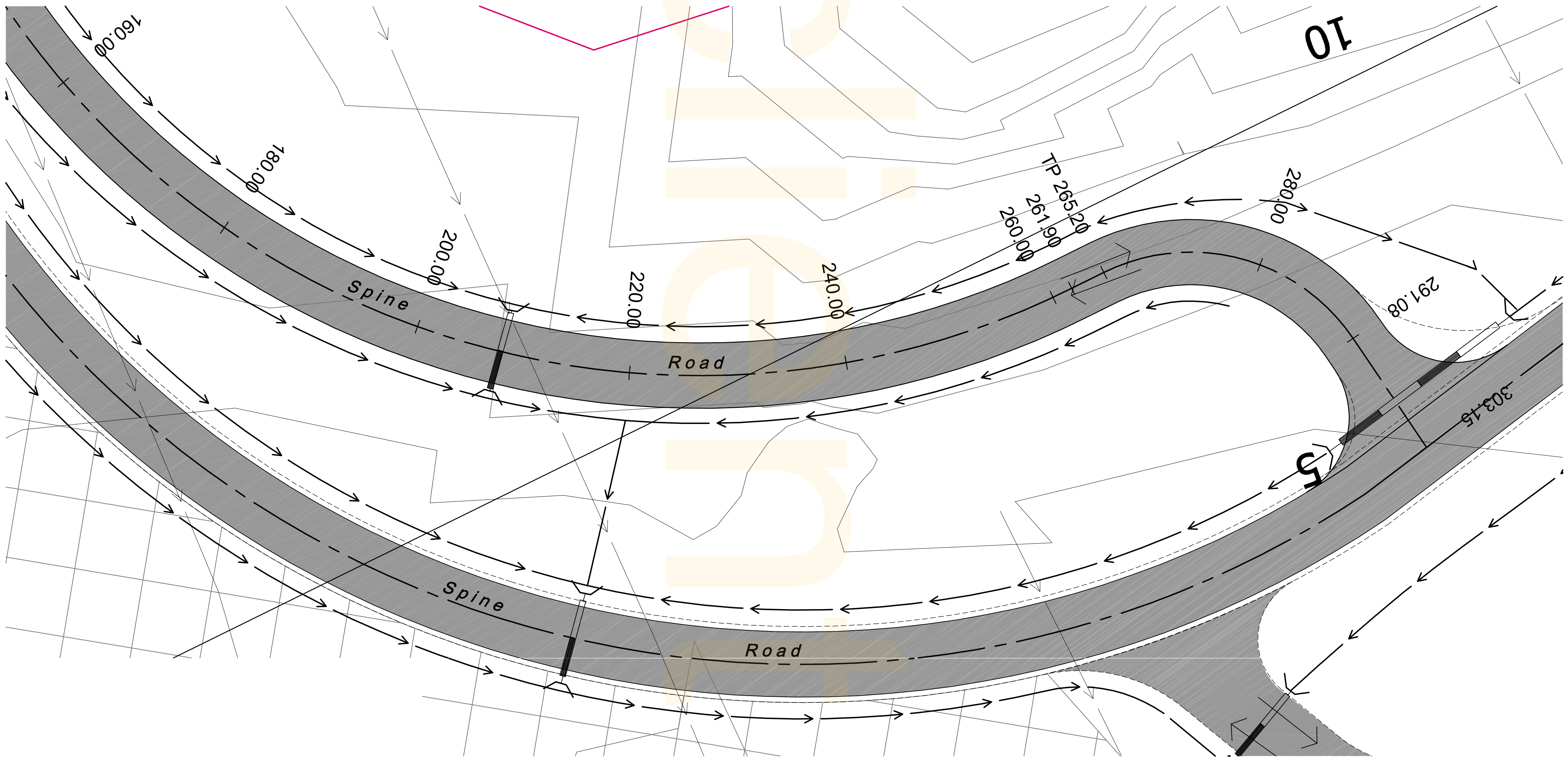
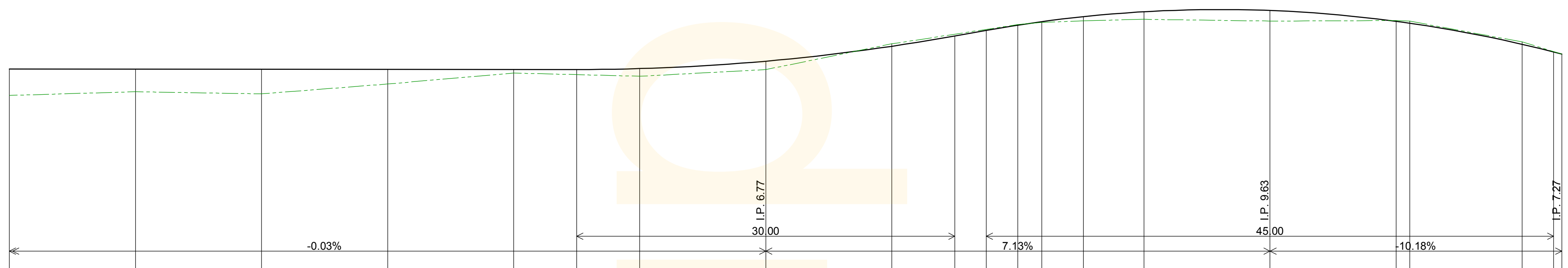
Approved:	Ccad file: 6883-DA-1.dwg		
Job No.: 6883	Dwg. No.: DA07	Issue: A	



Layout Plan
Scale 1:250



Datum R.L. 0.00

Chainage	DESIGN	NATURAL
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190.00	6.79	6.07
200.00	6.78	6.00
210.00	6.78	6.31
220.00	6.78	6.66
225.00	6.78	
230.00	6.80	6.56
240.00	7.04	6.77
250.00	7.52	7.59
255.00	7.84	
257.50	8.02	
260.00	8.19	8.21
261.90	8.30	8.27
265.20	8.46	8.33
270.00	8.61	8.37
280.00	8.65	8.32
290.00	8.31	8.33
291.08	8.25	8.31
300.00	7.58	7.65
302.50	7.34	
303.15	7.27	7.27

Alignment Details: R=77.00 L=127.69; B=279°10'01" D=3.30; R=18.00 L=25.88; B=1°32'31" D=12.07

Scale Horizontal 1:250 Vertical 1:100

This plan is NOT to be used for construction purposes unless it carries the approval stamp of the local authority.

Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road 'Drop In' Plan and Long Section Ch. 180-303

ARDILL PAYNE & PARTNERS
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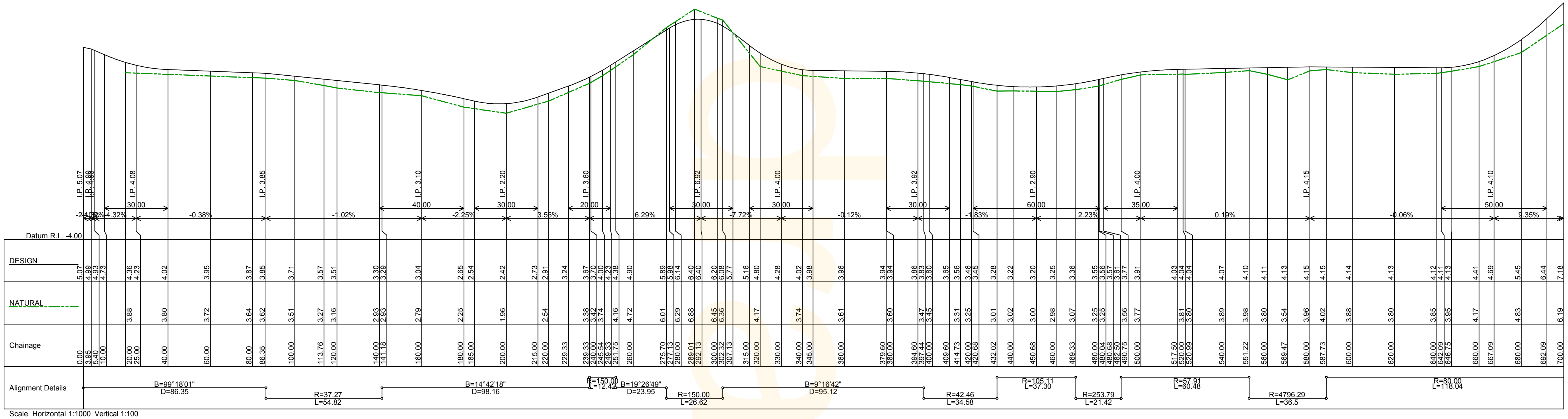
Website: www.ardillpayne.com.au

Design	RB	Scale at A1	As Shown	Date	May 2010
Drawn	RB	Datum	AHD		
Checked		Acad file	6883-DA.dwg		
Approved		Ccad file	6883-DA-1.dwg		
Job No.	6883	Dwg. No.	DA08	Issue	

S:\01 Jobs\6800-6899\6883 Splendour in the Grass Part 3A\05 Drawings\01 Civil\01 Current\01 DA Plans for 3A Approval\6883-DA.dwg, 17/06/2010 3:25:24 PM

Layout Plan
Scale 1:1000



Issue	Date	Amendment	App'd
A	18.6.10	At-grade spine road amended	TJC

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road
Plan and Long Section
Ch. 0-700

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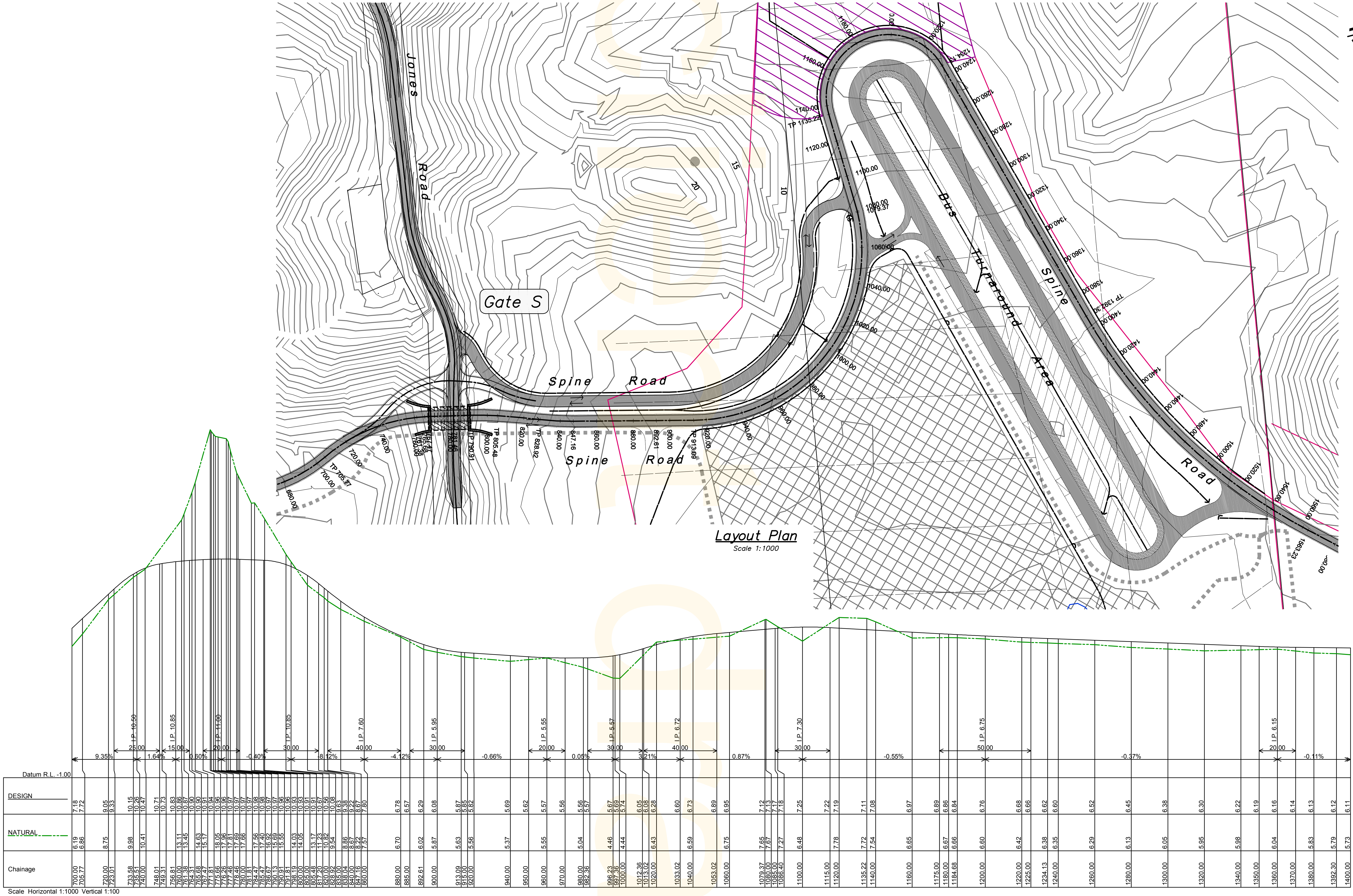
Website: www.ardillpayne.com.au

Design	RB	Scale at A1	As Shown
Date	May 2010	Drawn	RB
Datum	AHD	Checked	
Acad file	6883-DA.dwg	Approved	
Ccad file	6883-DA-1.dwg	Job No.	6883
Dwg. No.	DA09	Issue	A



Issue	Date	Amendment	App'd
A	18.6.10	At-grade spine road amended	TJC

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road
Plan and Long Section
Ch. 700-1400

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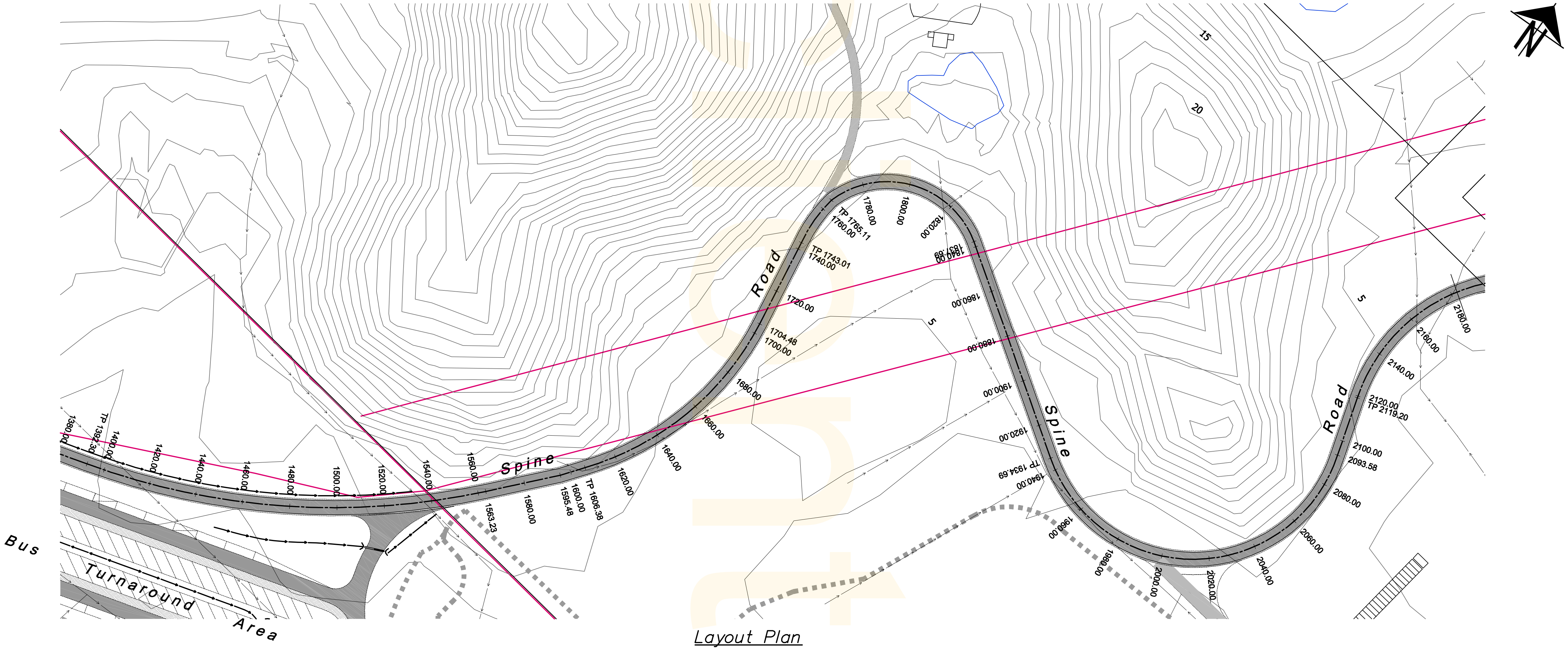
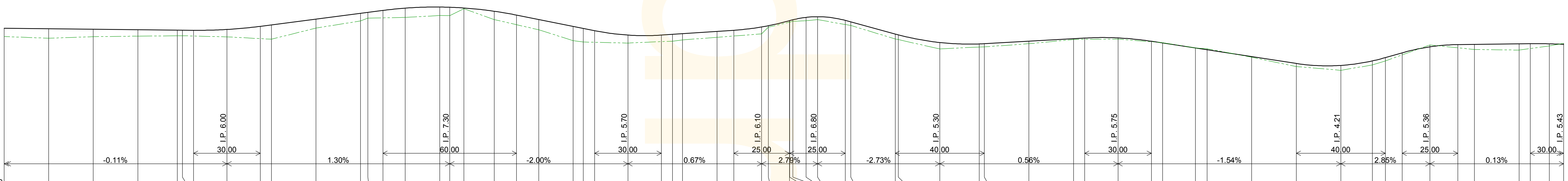
Website: www.ardillpayne.com.au

Design	RB	Scale at A1	As Shown	Date	May 2010
Drawn	RB	Datum	AHD		
Checked		Acad file	6883-DA.dwg		
Approved		Ccad file	6883-DA-1.dwg		
Job No.	6883	Dwg. No.	DA10	Issue	A



Layout Plan

Scale 1:1000



Datum R.L. -1.00

Chainage	DESIGN	NATURAL
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1420.00	6.09	5.66
1440.00	6.06	5.73
1460.00	6.04	5.75
1477.76	6.02	5.77
1480.00	6.02	5.77
1485.00	6.02	
1500.00	6.05	5.72
1515.00	6.20	
1520.00	6.26	5.62
1540.00	6.52	6.12
1560.00	6.78	6.44
1563.23	6.82	6.56
1570.00	6.91	
1580.00	7.01	6.59
1595.48	7.06	6.68
1600.00	7.05	6.68
1606.38	7.02	6.99
1620.00	6.87	6.50
1630.00	6.70	
1640.00	6.50	6.04
1655.43	6.19	5.55
1660.00	6.10	5.49
1665.00	6.00	
1680.00	5.80	5.44
1695.00	5.80	
1700.00	5.83	5.53
1704.48	5.86	5.58
1720.00	5.97	5.70
1727.50	6.02	
1740.00	6.17	5.85
1743.01	6.22	6.15
1752.50	6.45	
1752.61	6.45	
1754.06	6.49	6.42
1760.00	6.60	6.44
1765.11	6.63	6.50
1777.61	6.46	
1780.00	6.39	6.23
1800.00	5.85	5.63
1801.40	5.81	5.59
1820.00	5.46	5.18
1837.69	5.40	5.26
1840.00	5.41	5.27
1860.00	5.52	5.41
1880.00	5.64	5.60
1885.00	5.67	
1900.00	5.67	5.62
1915.00	5.52	
1920.00	5.44	5.46
1934.69	5.22	5.22
1940.00	5.14	5.19
1960.00	4.83	4.80
1980.00	4.52	4.38
2000.00	4.43	4.21
2014.14	4.64	4.45
2020.00	4.78	4.64
2027.50	5.00	
2040.00	5.27	5.36
2052.50	5.37	
2060.00	5.38	5.15
2080.00	5.41	5.12
2085.00	5.41	
2093.58	5.41	5.31
2100.00	5.38	5.43

Scale Horizontal 1:1000 Vertical 1:100

100 Table of millimetres

Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road
Plan and Long Section
Ch. 1400-2100

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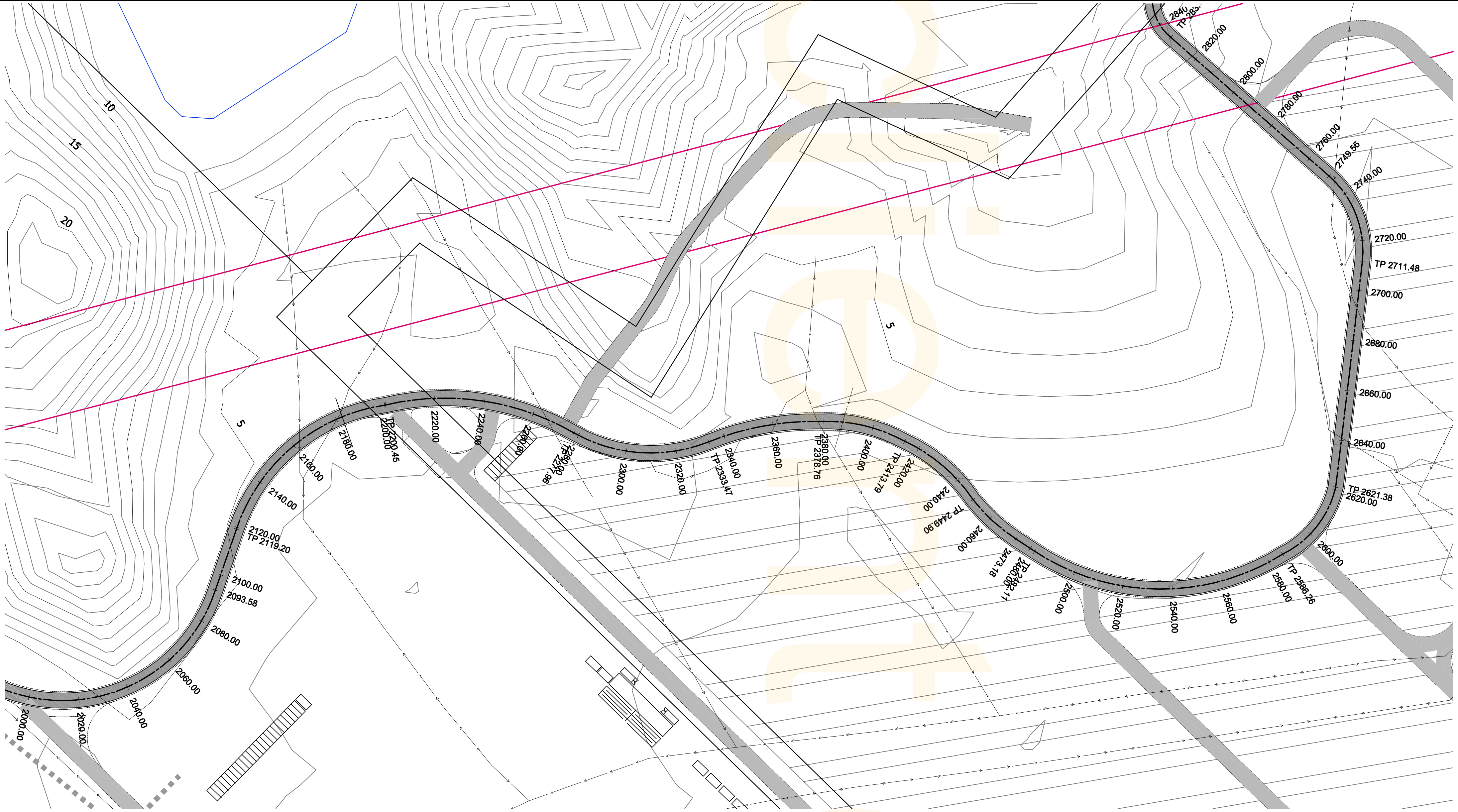
Design RB	Scale at A1 As Shown	Date May 2010	
Drawn RB	Datum AHD		
Checked	Acad file 6883-DA.dwg		
Approved	Ccad file 6883-DA-1.dwg		
Job No. 6883	Dwg. No. DA11	Issue	

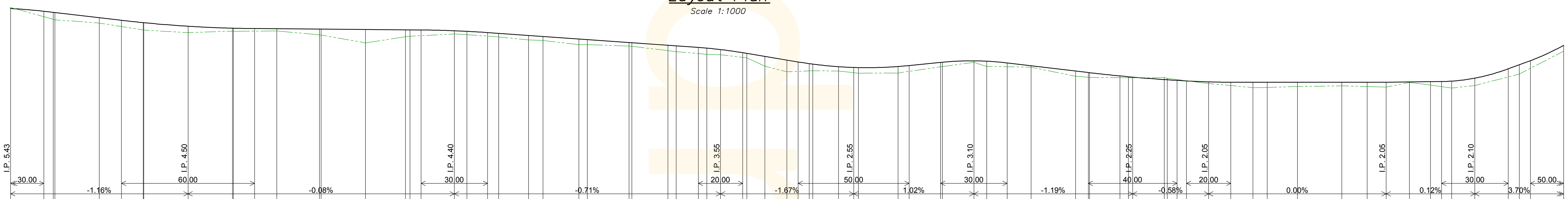
S:\01 Jobs\6800-6899\6883 Splendour in the Grass Part 3A\05 Drawings\01 Civil\01 Current\01 DA Plans for 3A Approval\6883-DA.dwg, 17/06/2010 3:26:02 PM



Layout Plan

Scale 1:1000

This plan is NOT to be used for construction purposes unless it carries the approval stamp of the local authority.



Datum R.L. -4.00

Chainage	DESIGN	NATURAL
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2119.20	5.21	4.89
2120.00	5.20	4.87
2140.00	4.97	4.73
2150.00	4.85	
2159.82	4.74	4.41
2160.00	4.74	4.41
2180.00	4.58	4.29
2200.00	4.49	4.36
2200.45	4.49	4.36
2210.00	4.48	
2220.00	4.47	4.37
2239.21	4.45	4.19
2240.00	4.45	4.19
2260.00	4.43	3.83
2277.96	4.42	4.10
2280.00	4.42	4.13
2285.00	4.41	
2300.00	4.38	4.23
2305.72	4.35	4.20
2315.00	4.29	
2320.00	4.26	4.10
2333.47	4.16	3.96
2340.00	4.12	3.93
2356.12	4.00	3.75
2360.00	3.98	3.75
2378.76	3.84	3.68
2380.00	3.83	3.67
2396.27	3.72	3.48
2400.00	3.69	3.43
2410.00	3.62	
2413.79	3.59	3.31
2420.00	3.53	3.29
2430.00	3.38	
2431.84	3.35	3.15
2440.00	3.22	2.78
2449.90	3.05	2.52
2455.00	2.97	
2460.00	2.89	2.56
2461.54	2.87	2.57
2473.18	2.75	2.55
2480.00	2.72	2.48
2482.11	2.71	2.46
2500.00	2.76	2.47
2505.00	2.80	
2519.18	2.95	
2520.00	2.96	2.76
2534.18	3.02	2.95
2540.00	3.00	2.76
2549.18	2.92	
2560.00	2.79	2.73
2580.00	2.56	2.32
2585.75	2.49	
2586.26	2.48	2.27
2600.00	2.33	2.25
2603.82	2.30	2.25
2605.75	2.28	
2620.00	2.17	2.26
2621.38	2.16	2.23
2625.75	2.13	
2630.00	2.11	
2640.00	2.06	1.99
2650.00	2.05	
2660.00	2.05	1.81
2666.43	2.05	1.81
2680.00	2.05	1.85
2700.00	2.05	1.89
2711.48	2.05	1.86
2720.00	2.05	1.83
2730.52	2.06	2.04
2740.00	2.08	1.92
2745.00	2.08	
2749.56	2.10	1.79
2760.00	2.23	1.90
2775.00	2.66	
2780.00	2.84	2.42
2785.00	3.02	
2800.00	3.72	3.45

Scale Horizontal 1:1000 Vertical 1:100

100 Table of millimetres

Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road
Plan and Long Section
Ch. 2100-2800

ARDILL PAYNE & PARTNERS
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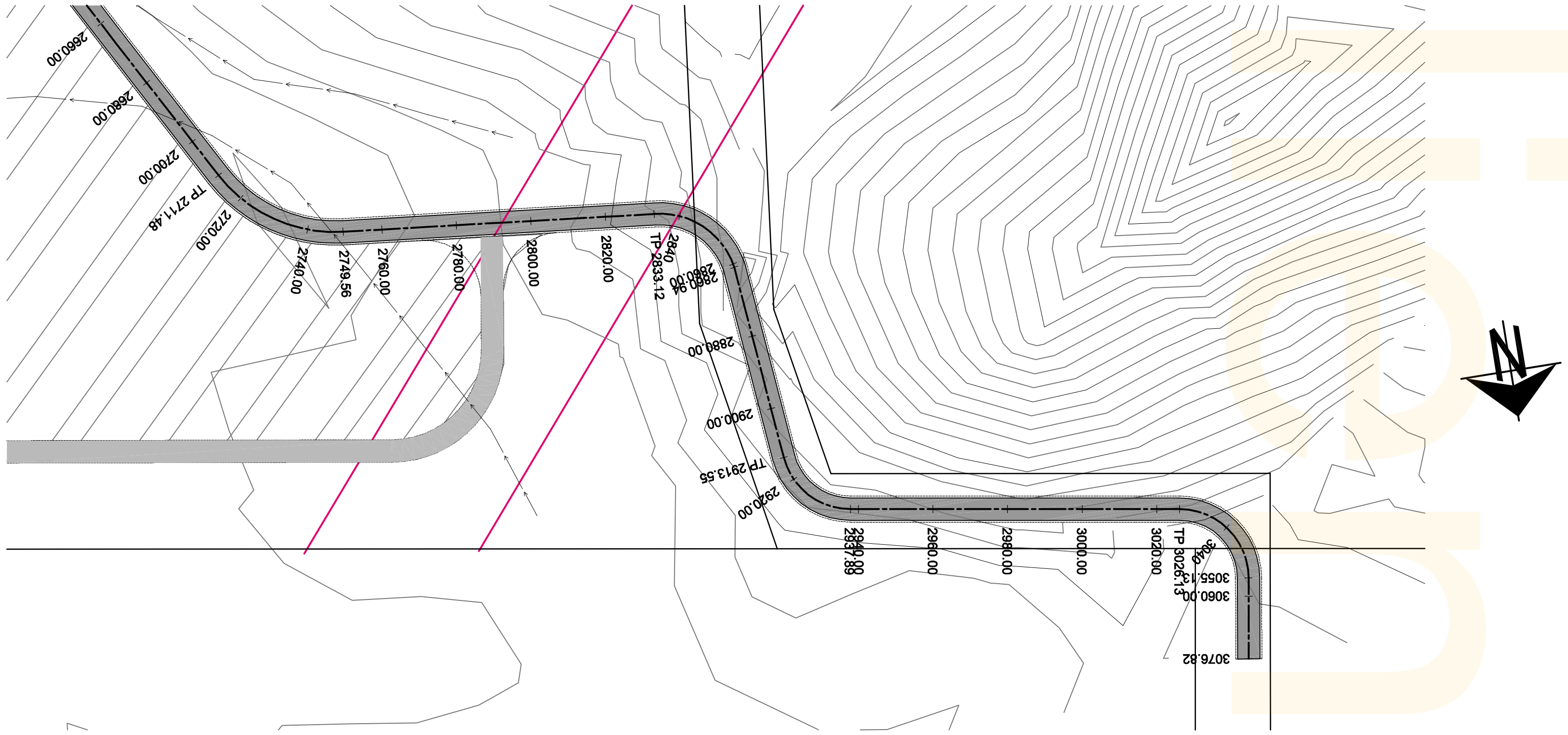
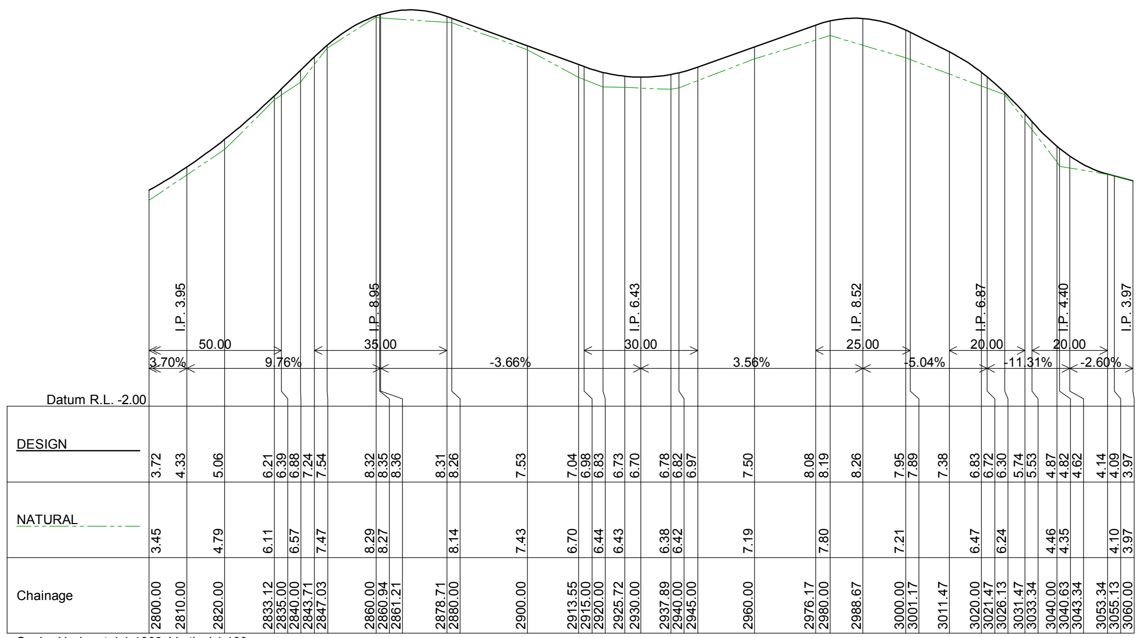
Design	RB	Scale at A1	As Shown	Date	May 2010
Drawn	RB	Datum	AHD		
Checked		Acad file	6883-DA.dwg		
Approved		Ccad file	6883-DA-1.dwg		
Job No.	6883	Dwg. No.	DA12	Issue	

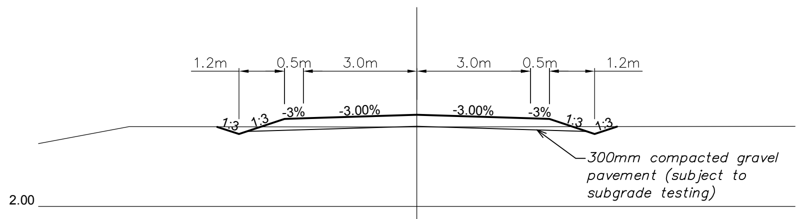


Layout Plan

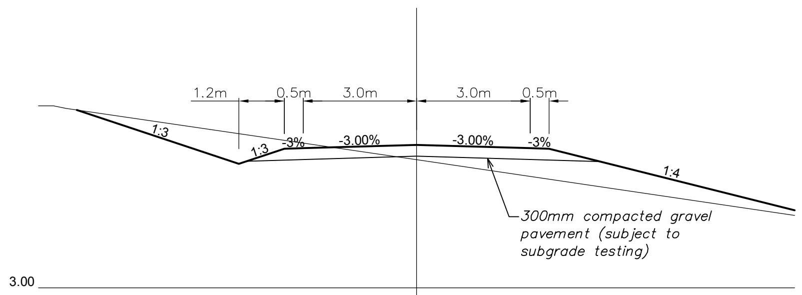
Scale 1:1000



Scale Horizontal 1:1000 Vertical 1:100



Typical Section Through Flat Ground



Typical Section through Side Sloped Ground

Typical Road Sections

Scale 1:100

This plan is NOT to be used for construction purposes unless it carries the approval stamp of the local authority.

Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road
Plan and Long Section
Ch. 2800-3060

ARDILL PAYNE & PARTNERS
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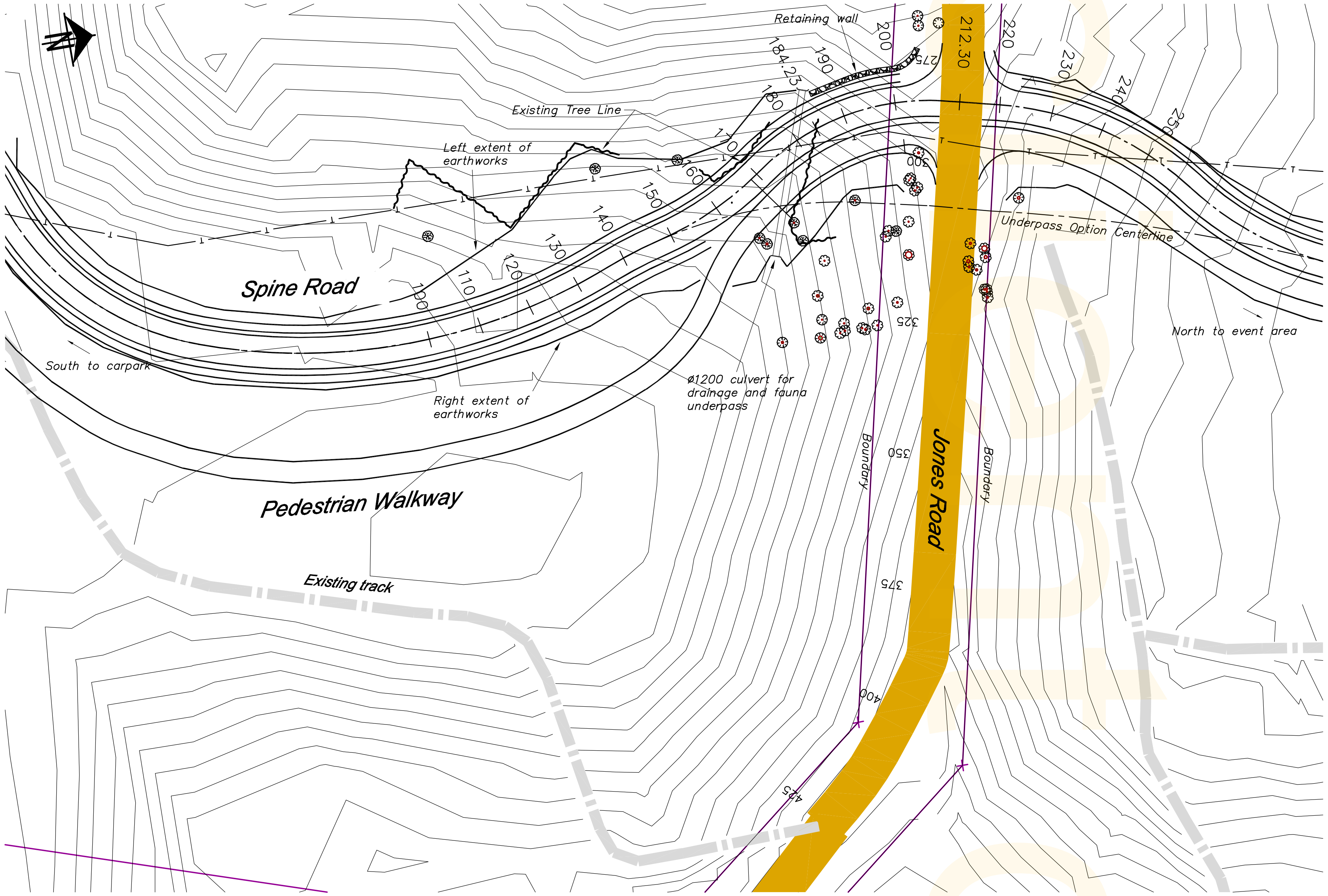
Design RB	Scale at A1 As Shown	Date May 2010	
Drawn RB	Datum AHD		
Checked	Acad file 6883-DA.dwg		
Approved	Ccad file 6883-DA-1.dwg		
Job No. 6883	Dwg. No. DA13	Issue	

S:\01 Jobs\6800-6899\6883 Splendour in the Grass Part 3A\05 Drawings\01 Civil\01 Current\01 DA Plans for 3A Approval\6883-DA.dwg, 17/06/2010 3:26:34 PM



Plan
Scale 1:500

Notes

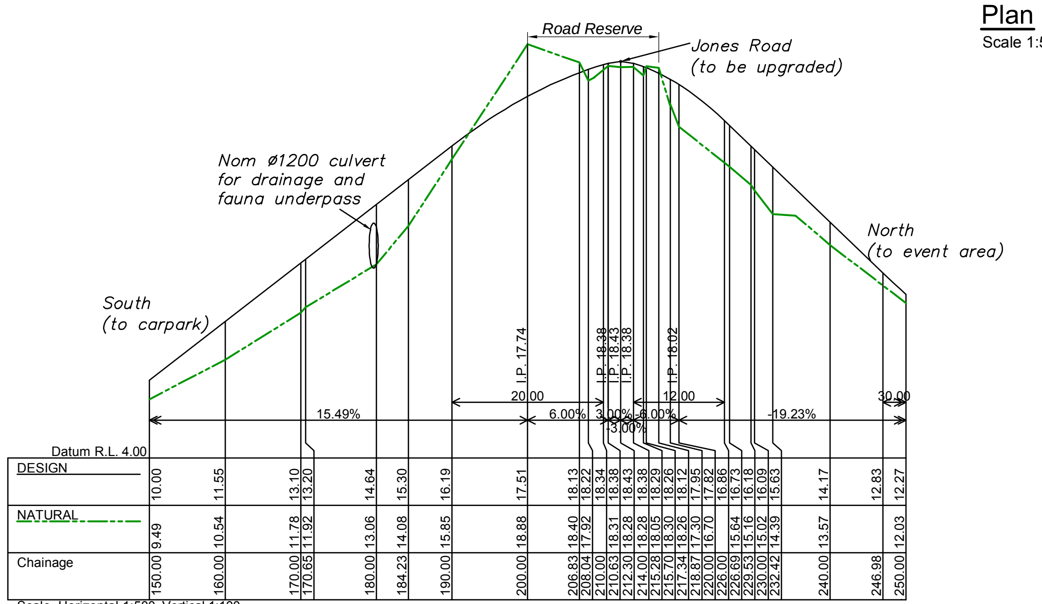
Natural surface contours are computer interpolated from Surveyors electronic field data.

Notwithstanding the limits of earthworks shown on the drawings, the actual limits shall be confirmed on site by the Contractor.

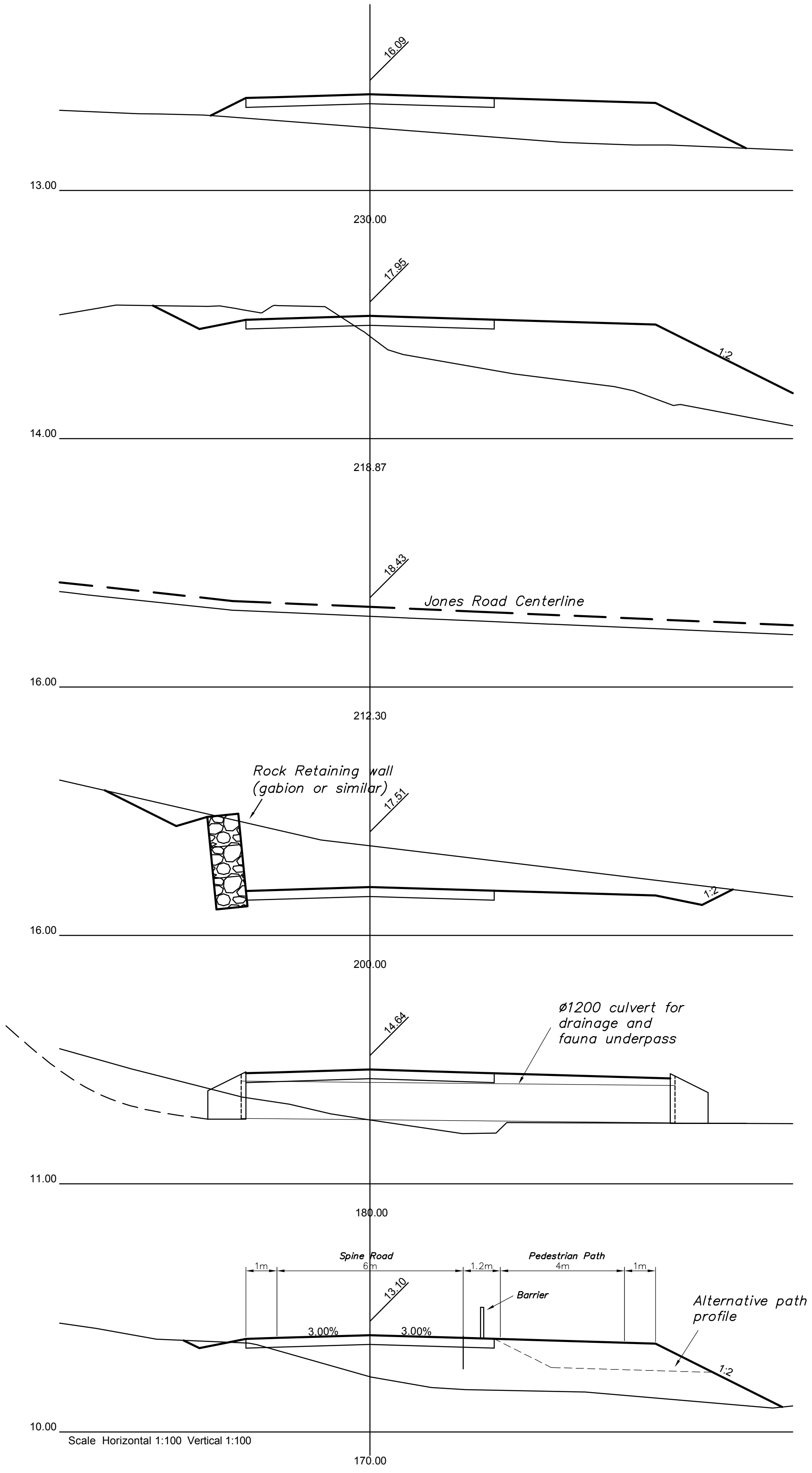
Prior to commencement of construction, the Contractor shall ascertain the location and level of existing services to his satisfaction. Services shown on plans are taken from Surveyors field notes only and may not necessarily indicate all services within the works area.

Notwithstanding the extent of the works shown on the drawings the Contractor shall undertake all necessary construction required to enable finished works to comply with the intent of the drawings and the requirements of the local authorities subdivision code.

These drawings are diagrammatic only and are intended to indicate design in accordance with the relevant Australian Standards. They do not relieve the Contractor from his responsibility to comply with these requirements, even if drawings are approved by the local authority.



Longitudinal Section



Cross Sections

Issue	Date	Amendment	App'd

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Spine Road At-Grade
Alternative Route

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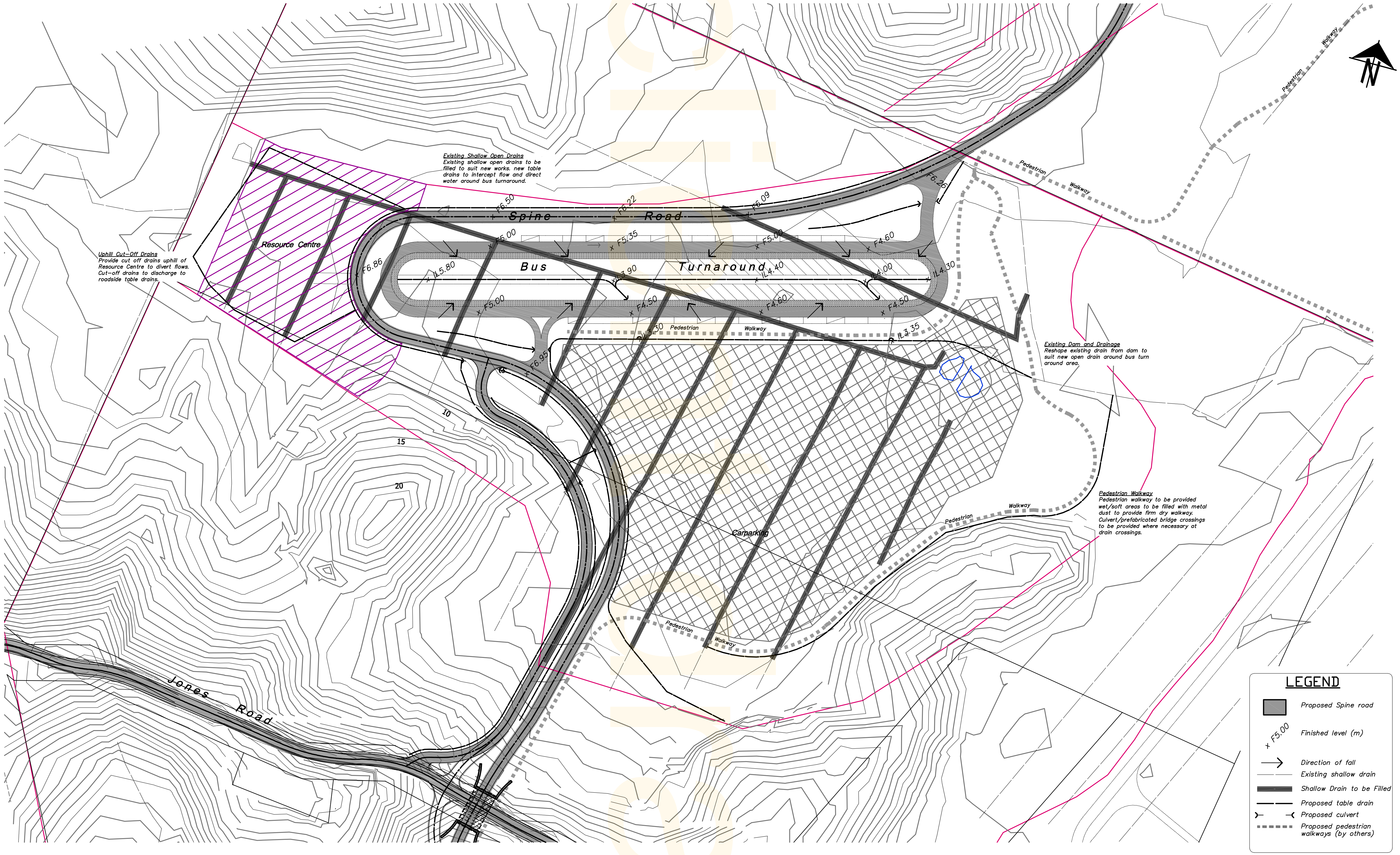
Design	TC	Scale at A1	as shown
Drawn	TC	Datum	AHD
Date	June 2010	Filename	6883 SpineRd at grade
Checked		Approved	
Job No.	6883	Dwg. No.	DA15
		Issue	



This plan is NOT to be used for construction purposes unless it carries the approval stamp of the local authority.

Issue	Date	Amendment	App'd
A	18.6.10	At-grade spine road amended	TJC

Client: Billinudgel Property Trust

Project: North Byron Parklands
Tweed Valley Way & Jones Road
Wooyung

Title: Bus Turnaround and Car Parking Area

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e-mail:info@ardillpayne.com.au
Website: www.ardillpayne.com.au

Design: RB	Scale at A1: As Shown	Date: May 2010	
Drawn: RB	Datum: AHD		
Checked	Acad file: 6883-DA.dwg		
Approved	Ccad file: 6883-DA-1.dwg		
Job No.: 6883	Dwg. No.: DA14	Issue: A	

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