# IRON GATES RESIDENTIAL DEVELOPMENT

## Revised

Engineering Services and Civil Infrastructure Report

23 JULY 2019

# GOLDCORAL PTY LTD
# IRON GATES RESIDENTIAL DEVELOPMENT

## Revised
Engineering Services and Civil Infrastructure Report


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## REVISIONS

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| 01 | 22/09/2014 | Draft Issue | DC | BL |
| 02 | 28/09/2014 | Draft Issue | DC | BL |
| 03 | 03/10/2014 | DA Issue | DC | BL |
| 04 | 21/07/2015 | Amended to address Richmond Valley Council RFI | BF | BL |
| 05 | 15/10/2015 | Amended to include Changes to Road Cross Section | BF | BL |
| 06 | 10/05/2016 | Amended to Include RFI Response | DC | BL |
| 07 | 1/11/2018 | Revised Report | GD | GD |
| 08 | 23/07/2019 | Final RFI Response | LP | GD |

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# REVISION 08

This Report was revised on 23rd July 2019 in order to Consolidate the Engineering Services Report and to include all amendments to the Report and include the additional details outlined in the response to RVC's recent Information Request dated 2nd February 2019. Below is a list of amendments and additions made to this report and the general engineering documents.

- Figure 1.1 was amended to incorporate consistent aerial images of the site.
- Section 3.2 was amended to include revised cut/fill earthworks volumes and provide clarity on expected haulage route and earthworks construction.
- Section 4 has been amended for slight changes to presentation and description of road design. Reference has been made to the separately prepared traffic engineering report.
- Section 6 has been amended for changes in presentation of outcomes of the BMT WBM OSD assessment letter.
- Section 9.1 has been amended to include a 40% duplex loading and reference to the Arcadis Water Network Capacity Assessment (Appendix G), which analyses the impact of the development on the Evans Head Water Network and shows no additional issues are caused by the development.
- Section 9.2 has been amended to include a 40% duplex loading and reference to the Arcadis Sewer Network Capacity Assessment (Appendix H), which analyses the capacity of the existing Evans Head sewer network and the future planning strategy to cater for the Iron Gates development.
- Section 9.3 has been amended to include new servicing connection locations for electrical and telecommunications reticulation.
- Section 10 has been added to address the development's flood emergency response strategy and discuss the impacts of regional flooding on the development and wider Evans Head region.
- Section 11 has been amended to include revised recommendation and outcomes of the prepared engineering material and summarise the new findings of this report.
- The Civil Engineering Drawings in Appendix A include the amendments to engineering components in accord with latest lot layout for the 184 Lot subdivision (Appendix F).
- Additional Reports have been prepared, collated and added to this report, including:
    - A Water Network Capacity Assessment in Appendix G.
    - A Sewer Network Capacity Assessment in Appendix H.
    - A Traffic Assessment Report in Appendix I.
    - The Arcadis Stage 1 Preliminary Contamination Report in Appendix J.
    - An Acid Sulphate Investigation and Soil Management Plan in Appendix K.
    - A Dewatering Management Plan in Appendix L.
    - A letter of supply for Electrical and Telecommunication in Appendix M.
    - A Site Analysis Plan and Design Response Plan in Appendix N.

# 1 INTRODUCTION

Arcadis has been engaged by Goldcoral Pty Ltd to prepare a revised Engineering Services and Civil Infrastructure Report for a Development Application for a total of 184 lots including 175 residential lots subdivision know as *Iron Gates,* located approximately 2km west of Evans Head.

The development involves the construction of 175 residential lots, with a minimum size of 600m$^2$, associated civil infrastructure such as internal roads, stormwater drainage, sewer and potable water services are also proposed. This revised report is to accompany an amendment to DA2015/0096 for the Iron Gates Residential Subdivision. This revised report deals with the engineering services and civil infrastructure component of the development and the engineering planning issues associated with the development application.

## 1.1 SITE DESCRIPTION

The subject site is known as *Iron Gates* and is surrounded by protected vegetation areas on the northern and eastern boundaries and the Evans River on the western and southern boundaries. The site is located over the following allotments:

- Lot 163 DP 831052, Lots 276 and 277 DP 755624, Crown Road Reserve between Lots 163 DP 831052 and Lot 276 DP 755724, Crown Foreshore Reserve and Iron Gates Drive, Evans Head NSW.

The main access to the site is via Iron Gates Drive to the east. Evans River is located directly to the south of the site. A site locality plan is shown in Figure 1-1 below.


Figure 1-1 Site Locality

The site has previously been developed with existing roads, sewer, stormwater and water infrastructure located on the site. The condition of the existing infrastructure on site is unknown however, where applicable testing will be undertaken to determine existing condition prior to Construction Certificate. The site was previously cleared in the mid 1990's however it has since been naturally vegetated.

## 1.2 LOT TOPOGRAPHY

The site features grades ranging from 0.5% to 11%. The eastern portion of the site is very flat and features very minimal grades of approximately 0.5%. This portion of the site features two (2) man made channels running from north to south to help facilitate flows to Evans River. A ridge is located on the western side of the site with an elevation of 22m AHD. Steep grades of approximately 11% are located in this area as the ridge flattens out to the east.

## 1.3 TOTAL AREA OF LAND

The total residential area of the site is approximately 18 ha.

## 1.4 PROPOSED DEVELOPMENT

The Iron Gates Development Proposal includes One Hundred and Eighty Four (184) Lot Subdivision including:

- One Hundred and Seventy Five (175) Residential Lots;
- Three (3) Residue Lots
- Four (4) Public Reserves
- One (1) Drainage Reserve
- One (1) Sewer Pump Station Lot
- Upgrading of Iron Gates Drive
- Demolition of Existing Structures Onsite
- Subdivision Work including road works, drainage, water supply, sewerage, landscaping and embellishment work and street tree planting

The proposed development is to feature 175 residential allotments. Allowances have been made in accordance with the North Coast Regional Plan 2036 in the Equivalent Tenement loadings for 40% of these to be duplex lots i.e. townhouses or other semi-attached dwellings. Duplex lots may not eventuate but is considered a conservative assessment of the site. The proposed development will utilise as much of the existing infrastructure as possible, including roads, stormwater, sewer and water infrastructure, pending on adequacy testing. Where necessary, existing infrastructure will be upgraded to ensure that it meets the standards of RVC and Northern Rivers Local Government (NRLG). Future infrastructure will be provided as an extension to the existing infrastructure and will be integrated into the previous existing design.

# 2 REFERENCE DOCUMENTS

This report should be read in conjunction with the following documents:

- Arcadis Engineering Drawings;
- Northern Rivers Local Government – Guidelines for Development and Subdivision of Land- January 2006;
- Northern Rivers Local Government – Development Construction Specification – Quality System Requirements – August 2013;
- NSW MUSIC Modelling Guidelines - August 2010;
- Evans Head Future Sewage Strategy Report – May 2010;

# 3 EARTHWORKS AND GRADING

## 3.1 SITE GRADING

Site grading has largely been dictated by existing ground levels, minimum and maximum road grades and drainage requirements.

Existing roads have been maintained at existing levels with allotments raised where necessary to comply with 100 year ARI flood levels.

All lots have been designed to achieve FFL above Flood Planning Levels of 3.6m. This assumes a minimum Earthworks level of 3.3m and a 300mm house slab.

## 3.2 EARTHWORKS QUANTITIES

The Iron Gates earthworks design estimates that earthwork volumes will not be balanced and fill will be imported. Table 3-1 below presents a summary of the estimated earthworks quantities and assume no compaction factors, road boxing or topsoil striping.

**Table 3-1 Summary of Estimated Earthworks Quantities**

| Total Cut Volume (m3) | Total Fill Volume (m³) | Balance Volume (m³) |
|---|---|---|
| 130,103 | 194,672 | 64,569 |

All imported fill will be sourced from local quarries with the truck haulage route nominated as being Woodburn-Evans Head Road, Woodburn Street, Wattle Street and Iron Gates Drive. The imported material will consist generally of sand fill as well as RMS specification road base and aggregates. It is expected that the earthworks activities will occur over a 16 week period and all fill will be placed in accordance with AS3798 under level 1 supervision, with all unsuitable material removed from the site.

## 3.3 RETAINING WALLS

In areas that have significant grade or level difference, retaining walls may be used. It is proposed that either a concrete sleeper or reinforced block walls will be used.

Roads adjacent to the environmental zone have been assessed and where required retaining walls may be provided. In these situations, the safety of both pedestrians and vehicles are considered paramount. Assessments have been undertaken and the use of a ‘W’ Beam guard rail will be used to minimise the risk of errant vehicles. Walls greater than, 1.0m will include a “2 rail” handrail system for pedestrian safety.

Due to a significant level difference between the proposed subdivision and the environmental zone west of Proposed Road 6 a 6.25m retain wall is proposed. The wall will be structurally designed as part of the Construction Certificate design.

Refer also to “Response to Information Request dated 11/05/2016 Items 1 & 2”

1. Section 3.2; The 6.25 metre retaining wall is considered visually excessive. Council requires a stepped embankment be provided. Please provide a revised design detail for this request.

Arcadis understands that the proposed wall could be considered visually excessive however in order to minimize the visual impact and use the wall as a feature, the development is proposing to create a green wall.

Figure 1 to 3 below show an example of the proposed treatment.

*Figure 2- Retaining Wall without Vegetation*

*Figure 3- Example 1 of Green Wall*

*Figure 4- Example 2 of Green Wall*

The open web construction and use of free draining material eliminates two common causes of failure in retaining walls — namely build-up of hydrostatic pressure and the destructive pressure of tree root systems.

The high quality precast concrete components provide for long-term durability and will not rot or warp.

Concrete crib walls are specifically designed to allow speed and ease of construction for minimum cost and require little or no maintenance. The standard, quality components allow for the most economical solutions for various wall heights.

A Concrib crib wall can be planted with flowers, shrubs, or creepers, using the spaces in the face of the wall. This allows the wall to blend in with any existing or proposed environment. Is it possible that we could "green" the wall with a variety of plants suitable for the Richmond Birdwing Butterfly.

To promote the Richmond Birdwing Butterfly the following plants are suggested:

> *Adult Richmond Birdwing butterflies will feed on nectar from flowers of many native plants, including native frangipani (Hymenosporum flavum), pavetta (Pavetta australiensis), black bean (Castanospermum australe) and lilly pillies (Syzygium species), as well as several exotic flowers, e.g. buddleia, pentas, honeysuckle, bougainvillea, impatiens and hibiscus. They prefer white and red blooms to other colours.*
>
> *The caterpillars (or larvae) only feed naturally on two species of vines – the lowland Richmond birdwing vine (Pararistolochia praevenosa) and the mountain aristolochia (Pararistolochia laheyana).*

These plants are proposed to be cultivated across the wall facing in order to assist in recovery of the breeding habitats for the butterfly.

Refer to Planit Drawing Iron Gates Cribb Wall Landscape Details. (attached).

2. To be noted: Plan C140 Rev 04. Ch 0 to 110 - MC1004 has a narrowing of the pavement to lessen the impact on environmental grounds with barriers and an elevated pedestrian platform. Plan C122 indicates retaining walls up to 1.5m with a pedestrian walkway on the side. -The width will need to be 2.5m wide to comply with cycleway standards and suitable balustrading to elevated walkways.

   Arcadis has amended Plan C140 to show a 2.5m wide pedestrian walkway to comply with Council's cycleway standards. Suitable balustrading will be provided with details provided during Construction Certificate Application.

# 4 ROADS

Vehicle access is currently provided via 1.2km of road known as Iron Gates Drive, located west of Evans Head. Iron Gates Drive has a rural residential cross section with a 2 lane sealed carriageway of 6.0m and shoulders of 0.5m-1.0m and a concrete footpath on the southern side. This road connects the existing Wattle Street in Evans Head to the proposed residential subdivision located at the western end of the road.

Pedestrian access will be provided as standard in the estate's road reserves in accordance with RVC policy. It is understood that all footpaths and bikeways must be designed in compliance with Council standards and be approved for construction prior to construction works.

## 4.1 INTERNAL ROADS

### 4.1.1 DESIGN VEHICLE

The design vehicle used in geometry checks for the internal roads is a 9.9m garbage truck with a 12.5m single unit vehicle (truck/bus) used to check all roundabouts. Fire trails have been checked based on a fire tank 7.8m long and 2.4m wide.

Design turning paths were used to determine where local increases in pavement width were required to ensure that the design vehicle could negotiate turns and bends without striking or mounting the kerb.

Where necessary, 'No Stopping' signs will be provided to ensure that required turning areas are free of parked vehicles.

### 4.1.2 ROAD GEOMETRY AND WIDTH

Road geometry design has generally been undertaken in accordance with Northern Rivers Local Government's (NRLG) Development and Subdivision of Land, 2006'.

The table and notes below in figure 4-1 are an extract from this document.

GEOMETRIC ROAD DESIGN

Table D.1.5 Characteristics of Roads in Residential Subdivision Road Networks

| Road Type | Maximum Traffic Volume (vpd) [1] | Maximum Speed [2] (km/h) | Carriageway Width (m)[3][10] Min | Parking Provisions Within Road Reserve | Kerbing [4] | Footpath Requirement [15] minimum | Bicycle path Requirement | Verge Width (m) minimum (each side) | Minimum Road Reserve Width (m) |
|---|---|---|---|---|---|---|---|---|---|
| Access Street | 100 | 40 | 6 | Carriageway | Mountable | No | No | 3 | 14 |
| Local Street | 2000 | 50 | 7-9 | Carriageway | Mountable | Network Dependent | Network Dependent | 3.5 | 15-17 |
| Collector Street | 3000 | 50 | 11 | Carriageway | Mountable | One side [16] | Network Dependent | 3.5 | 18 |
| Distributor Road | 3000+ | 60 | 13 | Carriageway | Upright | One Side | Network Dependent | 3.5 | 20 |

NOTES:

1. For single dwelling allotments apply traffic generation rate of 10 vehicles per day (vpd)/allotment (equivalent to approximately one vehicle per hour (vph) in the peak hour) unless a lower rate can be demonstrated. Lower rates can be applied to multi-unit dwellings based on locally derived rates.
2. See Clauses D1.09 and D1.11 on designing for specific operating speeds.
3. Widening required at bends to allow for wider vehicle paths (using AUSTROADS Turning Templates).
4. Where kerbing is not required a flush pavement edge treatment can be used. Maximum carriageway widths required if barrier kerbing used.
5. Requires:
   (i) Provision for widening to 5.0m if necessary in the future.
   (ii) Verge parking as noted with scope for additional spaces.
6. Minimum width required to provide for pedestrians, services, drainage, landscape and preservation of existing trees. Add additional width on one side for future widening of carriageway to 5.0m if required. For two lane carriageway design, no provision for widening required.

Figure 4-1 Geometric Road Design – NRLG Development & Subdivision of Land

There are 2 types of roads proposed for the Iron Gates Residential Subdivision. Details of the roads are presented in Table 4-1 and are generally consistent with the works in Council's LGA.

**Table 4-1 Summary of Road Type Characteristics**

| Road Name | Road Type | Pavement Width |
|---|---|---|
| Proposed Road 1 | Local Street* | 11.0 (CH0-320)<br>9.0 (CH320+) |
| Proposed Road 2 | Local Street* | 9.0 |
| Proposed Road 3 | Local Street | 9.0 |
| Proposed Road 4 | Local Street | 9.0 |
| Proposed Road 5 | Collector Road* | 7.0 (CH20 – 140)<br>11.0 (0-20; 140+) |
| Proposed Road 6 | Local Street | 9.0 |
| Proposed Road 7 | Local Street * | 9.0 |
| Proposed Road 8 | Local Street | 9.0 |
| Proposed Road 9 | Local Street | 9.0 |
| Proposed Road 10 | Local Street | 9.0 |
| Proposed Road 11 | Local Street | 9.0 |

*The table above shows the predominant dimensions. These may vary slightly from what has been shown. Park Edge roads have reduced verge width.

A section of the Proposed Road 5 between chainage 20 and 140 has been designed with a reduced verge and pavement width to minimise impacts on the environmentally protected areas to the north and south of the road. The adopted cross-section shown on Drawing C140-AA007094-07 in Appendix A, shows two 3.5m lanes without the additional 2m parking zones on each side of the road. Safety barriers (guard rails) have been adopted on both sides of the road to help in minimizing the total width. No verge is proposed on the northern edge of the road. Along the southern edge a 2.5m wide elevated platform will be provided as a pedestrian connection between the wider sections of the road.

All roads will be provided with mountable layback kerb and channel along both edges.

The exception to the above is for "Park Edge" roads that run adjacent to either open space or environmental areas. In this instance a "barrier" style kerb and gutter will be used along with a reduced verge width. This verge width may vary depending on the requirements for paths and guard rail as mentioned above. The typical road cross sections within the current Development Approval package show these details.

Refer also "Response to Information Request dated 11/05/2016 Items 3". Inserted below.

3 To be noted: Plan C140 Rev 04. Ch 0 to 110 - MC1004 has a narrowing of the pavement to lessen the impact on environmental grounds with barriers and an elevated pedestrian platform. Plan C122 indicates retaining walls up to 1.5m with a pedestrian walkway on the side. -The width will need to be 2.5m wide to comply with cycleway standards and suitable balustrading to elevated walkways.

Arcadis has amended Plan C140 to show a 2.5m wide pedestrian walkway to comply with Council's cycleway standards. Suitable balustrading will be provided with details provided during Construction Certificate Application.

## 4.1.3 ROAD GRADING

Roads have been graded to ensure that parameters as presented in NRLG's 'Development and Subdivision of Land, 2006' are met. Table 4-2 presents minimum, maximum and typical road grades proposed for Iron Gates Residential Subdivision.

**Table 4-2 Summary of Minimum and Maximum Road Grades Used**

| Road Type | Minimum Road Grade | Maximum Road Grade |
|---|---|---|
| Local Street | 0.5% | 16.0% |
| Collector Street | 0.5% | 5.5% |
| Fire Trail | 0.5% | 2.5% |

All roads have generally been designed with 3% cross fall.

## 4.1.4 ROAD PAVEMENT

Preliminary flexible road pavement designs have been prepared based on assumed subgrade CBR of 3.0% and presented in the design drawings. These designs are indicative only and subject to detail design and actual subgrade testing.

Table 4-3 below presents a summary of design criteria and overall pavement thickness for the site:

**Table 4-3 Summary of Design Criteria for Pavement Thickness**

| | Local Access | Local Road | Collector Road |
|---|---|---|---|
| ESA # | $3x10^5$ | $3x10^5$ | $1x10^6$ |
| Assumed CBR | 3.0% | 3.0% | 3.0% |
| Asphaltic Concrete (AC 10) | 50 mm* | 50 mm* | 50 mm* |
| Base | 150 mm | 150 mm | 150 mm |
| Sub Base | 150 mm | 250 mm | 360 mm |
| Total Pavement Thickness | 350 mm | 450 mm | 560 mm |

*2x25mm AC-10 – 2nd layer postponed until the majority of houses are constructed and occupied.

# ESA extracted from section D2.04 Design Traffic of the Northern Rivers' Development Design Specification D2, Pavement Design

## 4.1.5 FOOTPATH

Footpaths will be provided generally in accordance with NRLG's standard drawing R07. Shared paths for collector roads are intended to be provided at the time of construction. All footpaths within local roads are proposed to be postponed until the majority of the houses are constructed and occupied.

## 4.2 EXTERNAL ROADS - IRON GATES DRIVE

As Iron Gates Drive has been constructed approximately 20 years ago and the original design information is not easily available, the road has been assessed via a recent topographic survey to determine the original design intent. The assessment has been split into Horizontal Alignment, Vertical Grades, Design Speed, Cross Section, Pavement and Pedestrian Facilities.

In order to determine if the existing road would comply with current standards the design has been compared to the current Northern Rivers Local Government Guidelines for Development and Subdivision of Land and AUSTROADS.

### 4.2.1 HORIZONTAL ALIGNMENT

The existing road has been surveyed and imported into the 12D modelling software. From there an alignment was produced to create a best fit to the existing surveyed centreline.

The horizontal alignment consists of a series of straights and horizontal curves. The radii of these existing curves were noted to vary from R150m to R1750m. The R150 occurs at the southern end of Iron Gates Drive joining to an existing roundabout within the future development.

### 4.2.2 VERTICAL ALIGNMENT

The existing road vertical alignment has been assessed by matching a design alignment to the surveyed centreline as closely as possible. The longitudinal grades of the existing pavement have been determined to vary between 0.35% to 2.1% (approximately). The grading technique used consists of a series of crests and four sags to combat the original flat terrain.

A long section has been provided within Appendix E.

### 4.2.3 CROSS SECTION AND PAVEMENT

The existing cross section has been assessed based on the existing topographic survey. The assessment shows the existing section represents a Rural Residential profile in accordance with the D1.27 Carriageways section of the Geometric Road Design Aus-Spec for Northern Rivers – Local Government, Table T1.27. This table nominates 6m seal with 1m shoulders for rural roadways up to 500AADT and for rural residential roads. The existing profile consists of a pavement width of approximately 6m at 3% cross fall with varying verge widths consistent with the guidelines. It should be noted that in some areas the road does not have the full 1m shoulder as required within T1.27.

Figure 4-2, an extract from Northern Rivers Local Government Guidelines for Development, shows 7.5m seal and 1.5m shoulders for major roads over 1000 AADT. Iron Gates Drive will need to be classified as a Rural Major Road (over 1000AADT with $2 \times 10^6$ design ESAs) based on the proposed residential population.

D1.27 CARRIAGEWAYS

1. Carriageway widths for rural roads should generally be as follows:

**Table T 1.27 – Carriageway and seal widths for rural roads**

| Local Government Area | Minor no through road up to 150 AADT | Minor road up to 1000 AADT | Major road over 1000 AADT | Rural Residential |
|---|---|---|---|---|
| Ballina<br>Byron<br>Kyogle<br>Richmond Valley<br>Clarence Valley | 6m seal<br>0.5m shoulders | 150 – 500 AADT<br>6m seal<br>1m shoulders<br>500 – 1000 AADT<br>7m seal<br>1.0m shoulders | 7.5m seal<br>1.5m shoulders | 6m seal<br>1m shoulders |
| Lismore | See City of Lismore Development Control Plan No. 28 - Subdivision | | | |

2. Carriageway width to existing road shall generally be in accordance with Table T1.27 but shall be assessed on merit for individual applications for a reduced standard at the discretion of the Director of Engineering Services or delegated officer

**Figure 4-2 NRLG Road Carriageway widths**

The guidelines also state that carriageway width to an existing road shall generally be in accordance with Table T1.27 but shall be assessed on merit for individual applications for a reduced standard at the discretion of the Director of Engineering Services or delegated officer.

On areas of horizontal curves, super elevation has been provided to a maximum of 5% cross fall. Two typical road cross sections have been detailed within the Engineering Plans in Appendix E.

## 4.2.4 PEDESTRIAN FACILITIES

The existing road has a 2m wide concrete footpath on the southern side running the full length of the road. A duplication of this path has not been considered.

## 4.2.5 DESIGN SPEED

Based on the above, the current road geometry and future amendments, the design speed has been determined to be 70km/hr which incorporates a minimum horizontal radii of 200m with 5% super elevation. It should be noted that the radius 150m at the connection the existing roundabout is used to slow driver speeds as they approach the roundabout.

Both the vertical grading and horizontal alignment provide sufficient stopping sight distance for a 70m/hr design speed. It is recommended that the signed speed for Iron Gates Drive to be 60km/hr.

## 4.2.6 IRON GATES DRIVE COMPLIANCE

Arcadis has reviewed the cross section of the existing Iron Gates Drive in relation to the Northern Rivers Geometric Road Design in particular section D1.27 which reads "Carriageway width to existing road shall generally be in accordance with Table T1.27, but shall be assessed on merit for individual applications for a reduced standard at the discretion of the Director of Engineering services or delegated office".

The existing road profile, which include a 6m sealed carriageway and 1m of shoulders, is insufficient to comply with current bushfire management regulations and standards and therefore must be upgraded prior to the issue of a Subdivision Certificate. An upgrade is proposed to be undertaken with the internal construction works to widen the pavement to an 8m full width carriageway seal and 1m of shoulders to comply with both bushfire management requirements and section D1.27 of the Geometric Road Design Aus-Spec for Northern Rivers – Local Government.

In support of the reduced width application we note that this proposed access road is a section of 60km/h low speed rural road, with low truck volume and is arguably supported by Austroads Table 4.3 Urban Arterial roads width, which shows lanes varying from 3.0 to 3.5 for use in low speed roads with low truck volumes. Additional information and support for the proposed width increase is included in the TTM traffic engineering report.

Table 4-4 below shows the predicted traffic volumes resulting from the proposed development. The existing Iron Gates Drive road construction has capacity for approximately 30% of the entire development, and should be upgraded prior to 30% occupancy (or 50% without any duplex construction).

**Table 4-4 Predicted Iron Gates Drive Traffic Volume**

| Number of House constructions | Annual Average Daily Traffic * |
|---|---|
| 175 | 1685# |

*Based on calculations described in TTM traffic report

# Includes 40% duplex allowance

Based on 1685 Average Annual Daily Traffic, Iron Gates Drive should be classed Rural road with over 1000 AADT and therefore 2 x $10^6$ design ESA's and a prime and 2 coat flush seal is required in line with AUS-PEC#1.

### 4.2.7 PROPERTY ACCESS ROAD – FIRE TRAIL

A fire trail will be provided along the eastern boundary of the development to the rear of lots, to ensure that vehicle access is provided to the full perimeter of the development. All perimeter roads and the fire trail will be suitably fitted with water supply infrastructure (mains and hydrants) for use by emergency services. For further information, reference should be made to the Arcadis engineering drawings and Bushfire Management Plan prepared by Bushfire Risk.

# 5 ROAD STORMWATER DRAINAGE WORKS

## 5.1 EXISTING STORMWATER DRAINAGE CHARACTERISTICS

The existing site consists of multiple catchments and features an extensive stormwater drainage network that has been inoperative since its construction in the mid 1990's. The network consists of multiple stormwater reticulation pipes ranging in size from Ø375mm at upstream locations to Ø825mm at downstream outlets. The drainage configuration also makes use of open drainage channels collecting stormwater from the various drainage systems to direct stormwater south of the project site towards Evans River.

## 5.2 PROPOSED STORMWATER DRAINAGE INFRASTRUCTURE

As part of the proposed works the existing open drainage channel along the eastern boundary of proposed lots 1 to 21 will be filled. In addition to the filling of the open channel the proposed road layout and levels has precluded the utilization of any existing drainage infrastructure.

### 5.2.1 DRAINAGE DESIGN STANDARDS

The proposed road stormwater drainage network has been designed to comply with the Northern Rivers Local Government Handbook of Stormwater Drainage Design – D5-Stormater Drainage Design.

The proposed system will safely convey major and minor flows to the Evans River. Design rainfall intensities have been adopted from Council's Guidelines as follows:

- Minor system - Urban Residential - 5 years ARI
- Major System – 100 year ARI

Stormwater pits have been positioned to suit the proposed road geometry and generally maintain a maximum flow width of 2.5m from face of kerb during the minor design storm event (5 year ARI).

All overland flow paths are designed to cater for the 100 year ARI storm event by maintaining a velocity-depth product of 0.4 or less and maximum flow depth equal or less than 200mm.

### 5.2.2 HYDRAULICS CALCULATION

The preliminary hydraulic calculation was conducted using PC_DRAIN software using the Rational Method to generate flows.

The model represents all catchments collected via a pit and pipe network designed to cater for the minor flows with considerations to major design storms. All areas are gravity drained with overland flow in excess of pipe capacity safely directed to Evans River.

On grade pits have been assumed to be 10% blocked whilst sag pits have been assumed to be 20% blocked. Field inlets have been assumed with 50% blockage. Minimum lintel size is 2.4m in sags.

MHWS water level have been used as the initial level for the hydraulic grade line calculations with Ku losses being calculated depending on diameter, flows and pipe angles.

150mm Freeboard has been generally maintained to top of grate levels for the design storm in accordance with Council guidelines.

The preliminary pipe diameter is presented in the engineering drawings Appendix A.

### 5.2.3 OVERLAND FLOW CHECK

Generally overland flow in excess of pipe capacity will be contained within the road corridor and will comply with Councils flood safety design criteria. In a single location (Proposed Road 10) flows in excess of pipe capacity will be conveyed overland through a dedicated open space between lots 108, 104, 118 and 103.

Based on the preliminary stormwater assessment approximately 0.23 m3/s will travel south at the previously discussed location with maximum 0.08m depth and 0.04 vxd.

# 6 ON SITE DETENTION

Due to the proximity of the development to the river mouth an investigation was conducted by BMT WBM to show that in this case, the application of detention devices would not achieve the desirable effects of stormwater flow mitigation, rather worsening flows overall in the regional catchment if flows from the development were detained.

As discussed in the NSW Floodplain Development Manual, consideration must be given on a merit based approach in such circumstances where the use of OSD may counterproductive, and in turn a traditional rapid disposal method is more applicable, where stormwater is discharged readily from developed areas in the lower portion of regional catchments. The WBM Study concluded that "by directly discharging runoff into the river, the water can be drained from the Evans River system with the receding tide. Most runoff will then be drained prior to the larger, regional flows passing through the Evans River, either from Upper Evans River catchment runoff or from Richmond River overflow. Therefore, BMT WBM recommends against using OSD to delay the release of floodwaters from the proposed development site."

Based on the WBM BMT study the site will not provide OSD. The full study is included in Appendix C.

# 7 WATER QUALITY

Water quality areas on the Site have been modelled and designed in accordance with the 'Draft NSW MUSIC Modelling Guidelines'- WBM BMT August 2010 and the Richmond Valley Development Control Plan 2012 – Section I9: Water Sensitive Urban Design. Accordingly, the objectives of this element are to:

- Protect the values and quality of receiving waters for human (commercial, recreational, aesthetic, public health) and ecological purposes.
- Promote and implement stormwater quality source control.
- Implement appropriate and safe stormwater quality devices for the target pollutant and site conditions.

Applicable water quality performance targets are provided within the Richmond Valley Development Control Plan 2012 – Section I9.4.3 and are detailed in Table 7-1 below:

**Table 7-1 Stormwater Quality Targets Extract**

| Contaminant | Target |
|---|---|
| Coarse Sediment - 0.1 to 0.5mm (Total Suspended Solids) | 80% |
| Total Phosphorus | 45% |
| Total Nitrogen | 45% |
| Litter (Gross Pollutants) | 70% |

## 7.1 SOURCE NODE INPUT DATA

Water quality assessment has been undertaken using MUSIC computer software (Version 6.1.0). Catchments have been estimated from CAD base drawings assuming road areas as 70% impervious (based on CoGC standard road sections considering verge and footpath) and allotment areas being comprised of 70% roof area and 30% ground area, of which 30% of this ground area has been considered to be impervious.

The site has been delineated into three primary catchments, illustrated on the engineering drawings included in Appendix A for reference.

- Catchment A – The northern portion of the site discharging towards the northern boundary;
- Catchment B – The area of the site located to the north-east of the central ecological zone discharging towards the Evans River; and
- Catchment C – The south-western area of the site, split into three sub-catchments each discharging to a segment of bio-retention before discharging towards the Evans River.

A summary of the modelled MUSIC source nodes and their assumed imperviousness has been provided in Table 7-2 below:

**Table 7-2 Summary of Source Node Imperviousness**

| Source Node | MUSIC Source Node | Imperviousness (%) | Area (ha) |
|---|---|---|---|
| A-Roof Source Node | Residential Roof | 100 | 0.661 |
| A-Road Source Node | Residential Road | 70 | 0.595 |
| A-Ground Source Node | Residential Ground | 30 | 0.284 |
| B-Roof Source Node | Residential Roof | 100 | 3.530 |
| B-Road Source Node | Residential Road | 70 | 2.209 |
| B-Ground Source Node | Residential Ground | 30 | 1.513 |
| B-Road Bypass Source Node | Residential Road | 70 | 0.374 |
| C1-Roof Source Node | Residential Roof | 100 | 0.471 |
| C1-Road Source Node | Residential Road | 70 | 1.057 |
| C1-Ground Source Node | Residential Ground | 30 | 0.202 |
| C2-Roof Source Node | Residential Roof | 100 | 2.273 |
| C2-Road Source Node | Residential Road | 70 | 3.707 |
| C2-Ground Source Node | Residential Ground | 30 | 0.974 |
| C3-Roof Source Node | Residential Roof | 100 | 0.903 |
| C3-Road Source Node | Residential Road | 70 | 0.760 |
| C3-Ground Source Node | Residential Ground | 30 | 0.387 |

## 7.2 TREATMENT SYSTEMS INPUT DATA

### 7.2.1 BIO-RETENTION AREAS

The bio-retention areas have been designed specifically in accordance with Water by Design Bio-Retention Technical Design Guidelines (2014). A saturated zone has been implemented in the bio-retention basin within catchment B improving the denitrification process and allowing for additional moisture storage for plant sustenance. The remaining proposed bio-retention basins have been designed without submerged zones. General parameters for the bio-retention areas have been modelled as per the tables below:

**Table 7-3 Summary of Proposed Bio-retention Properties**

| Parameter | Value | | | |
|---|---|---|---|---|
| | Bio B | Bio C1 | Bio C2 | Bio C3 |
| Surface Area ($m^2$) | 95 | 80 | 225 | 200 |
| Filter Area ($m^2$) | 80 | 75 | 210 | 180 |
| Extended Detention Depth (m) | 0.3 | 0.3 | 0.3 | 0.3 |
| Filter Media Depth (m) | 0.4 | 0.4 | 0.4 | 0.4 |
| Weir Width (m) | 4 | 4 | 4 | 4 |
| Submerged Zone with Carbon | Yes | No | No | No |

**Table 7-4 Summary of Proposed Bio-retention Dimensions**

| Parameter | Value |
|---|---|
| | All Bio-Retention Basins |
| Hydraulic Conductivity | 200mm/hr |
| Orthophosphate Content | 40mg/kg |
| TN Content of Filter Media | 400mg/kg |
| Base Lined? | Yes |
| Vegetation Properties | Vegetated with effective nutrient removal plants |

### 7.2.2 GROSS POLLUTANT TRAPS

The gross pollutant traps included in the treatment train have been designed as per the Draft MUSIC Modelling Guidelines for New South Wales (August 2010 issue). Four GPTs have been proposed for the site, to be used as pre-treatment devices before discharge into secondary treatment devices (bio-retention basins). The minimum performance criteria have been adopted, stated below:

**Table 7-5 GPT Treatment Not Inputs Extract (Adopted from Alison et al 1998)**

| Parameter | Value | |
|---|---|---|
| | Input (mg/L) | Output (mg/L) |
| Total Suspended Solids (TSS) | 0 | 0 |
| | 75 | 75 |
| | 1000 | 350 |
| Total Phosphorus (TP) | 0.00 | 0.00 |
| | 0.50 | 0.50 |
| | 1.00 | 0.85 |
| Total Nitrogen (TN) | 0.0 | 0.0 |
| | 0.5 | 0.5 |
| | 5.0 | 4.3 |
| Gross Pollutants | 0 | 0 |
| | 15 | 1.5 |

## 7.2.3 INFILTRATION PITS

Due to existing soil conditions comprising high infiltration rates (refer to Appendix D for geotechnical investigation results), infiltration pit systems have been introduced into the treatment train in Catchments A & B to supplement the proposed bio-retention and swale systems. Individual infiltration pits are proposed on a per lot basis to allow for further treatment of roof areas (modelled as lumped infiltration system for lumped roof catchment areas).

The proposed infiltration pits have been designed as per the Draft MUSIC Modelling Guidelines for New South Wales (August 2010 issue) with exfiltration rates confirmed from geotechnical investigations. Additionally, these infiltration pits have been designed to provide sufficient capacity to store inflow for a 1 in 3 month Average Recurrence Interval storm event with emptying time of less than 24 hours (approximately 2.5m3 storage for 150m2 of roof area with fill at 30mm nominal particle size).

It should be noted that lots generally drain to the front of lot towards the adjacent road reserve. These infiltration systems are not proposed in lieu of inter allotment drainage, with their sole purpose being to act as stormwater quality treatment devices. All flows in excess of infiltration capacity will be directed to the road reserve where inter allotment drainage is not proposed. General parameters for the infiltration pits have been modelled as per Table 7-6 below:

**Table 7-6 Summary of Proposed Infiltration Pit Parameters**

| Parameter | Catchment A | Catchment B |
|---|---|---|
| Total Surface Area ($m^2$) | 73 | 389 |
| Total Filter Area ($m^2$) | 73 | 389 |
| Total Unlined Filter Media Perimeter (m) | 34.2 | 79 |
| Surface Area per Lot ($m^2$) | 4.86 | |
| Filter Area per Lot ($m^2$) | 4.86 | |
| Unlined Filter Media Perimeter per Lot (m) | 8.82 | |
| Extended Detention Depth (m) | 1 | |
| Infiltration Media Depth (m) | 0.4 | |
| Exfiltration Rate (mm/hr) | 180 (Geotechnical Investigations revealed generally higher values but minimum hydraulic conductivity conservatively adopted) | |
| Evaporative Loss | 0% of PET | |

A typical drainage strategy is represented in Figure 7-1 below:

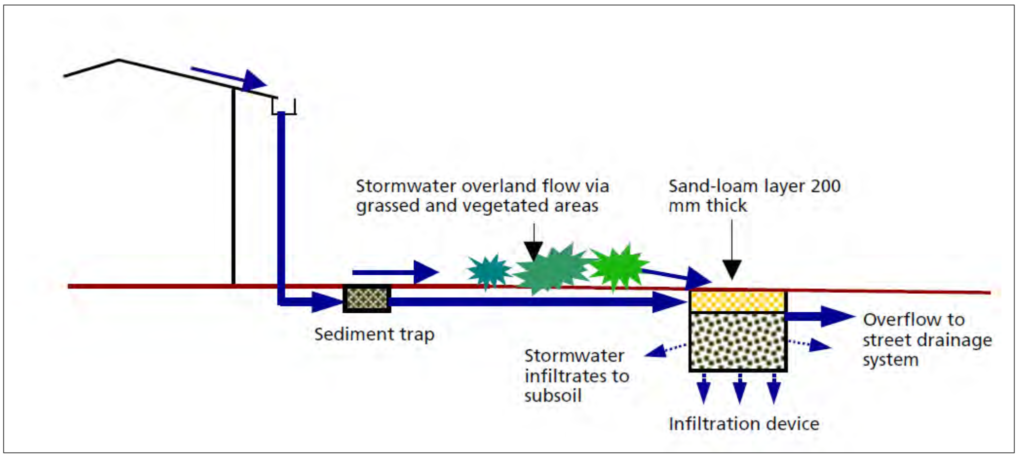



**Figure 7-1 Typical Drainage Strategy**

Refer also to “Response to Information Request dated 11/05/2016 Item 5”

5 Section 7.2.3 Infiltration pits are 1m deep and almost 5m². Council has concerns;

What are the risks to a saturated sub base for the roads?
To avoid any risks of saturating road sub-base, all roads will be provided with subsurface drainage in accordance with The Northern River Council Specs.

Impact to/from driveways?
Driveways will be coordinated during detailed design to avoid clashes with drainage system.

How is overflow from the pits to be managed without causing nuisance stormwater flows to adjoining land owners. Council preference is for the overflow to be discharged to street kerb or via Internal Allotment Drainage (IAD).

Flows will be captured and conveyed to the infiltration system, with overflow being directed to the street kerb system. Refer figures 4 and 5 below shows a typical infiltration system details. It should also be noted that all proposed lots typically fall to the road with no inter allotment needed.

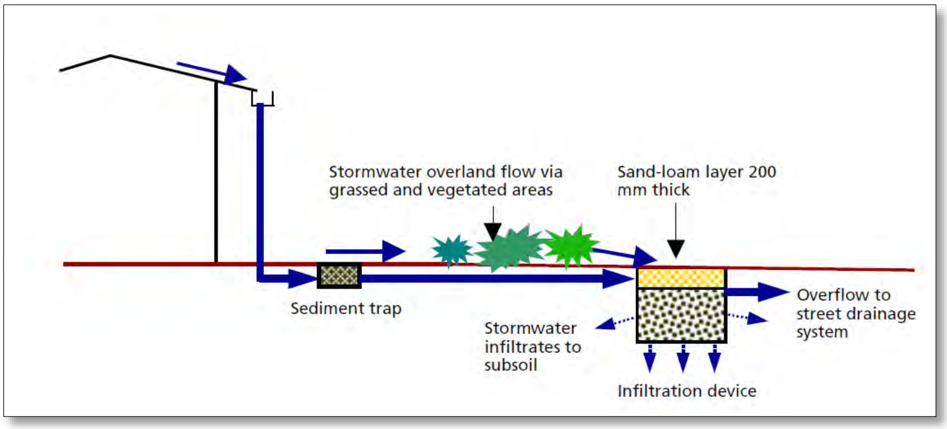



Figure 2- Typical Infiltration Strategy

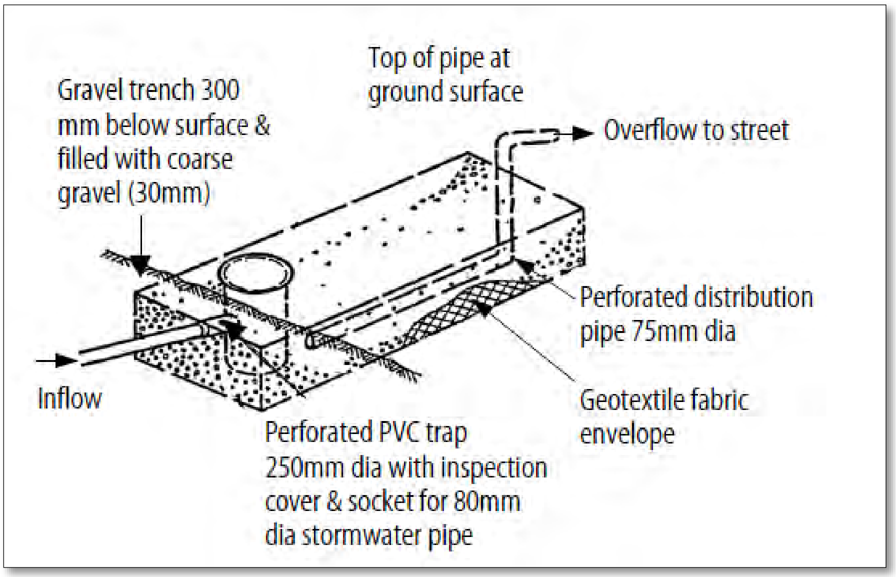


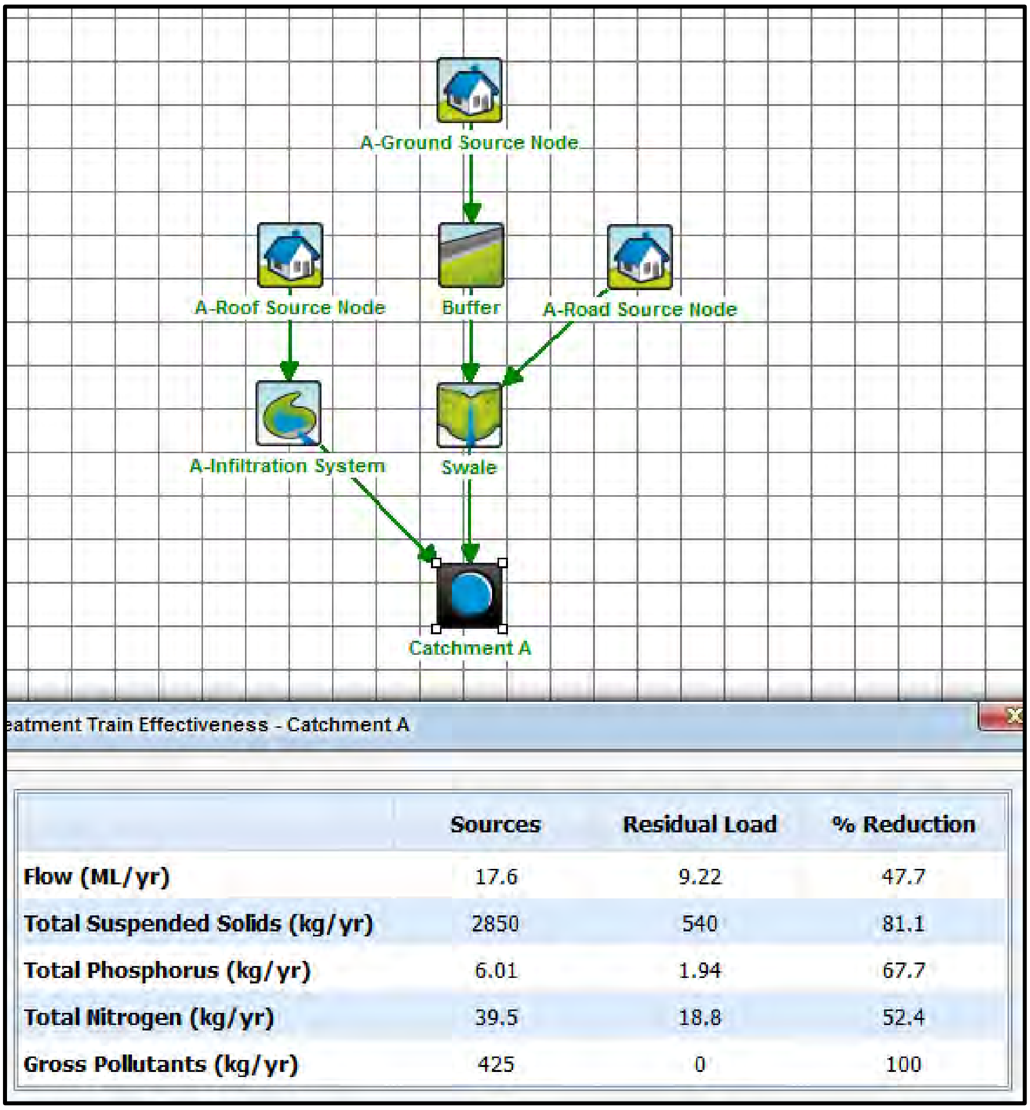

Figure 3- Infiltration System Details

- How are the pits be protected from future owners constructing over the pits or reducing the effectiveness of the pit. An easement on tittle may be an appropriate method to protect this infrastructure.

An easement for Stormwater will be provided over each device. This will be detailed during the detailed design phase of the project.

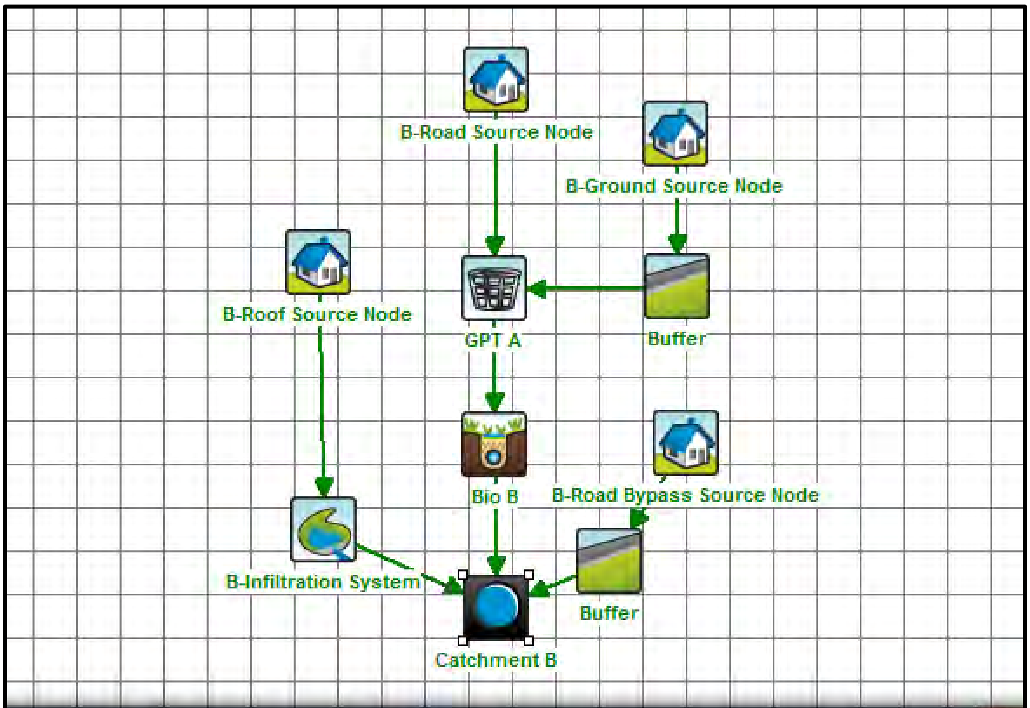
## 7.3 MUSIC MODELLING RESULTS

The developed site has been modelled in accordance with the sub-catchment regime to ensure each catchment meets pollutant reduction objectives as presented in Figure 7-4, Figure 7-5 and Figure 7-4 below.




| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| Flow (ML/yr) | 17.6 | 9.22 | 47.7 |
| Total Suspended Solids (kg/yr) | 2850 | 540 | 81.1 |
| Total Phosphorus (kg/yr) | 6.01 | 1.94 | 67.7 |
| Total Nitrogen (kg/yr) | 39.5 | 18.8 | 52.4 |
| Gross Pollutants (kg/yr) | 425 | 0 | 100 |

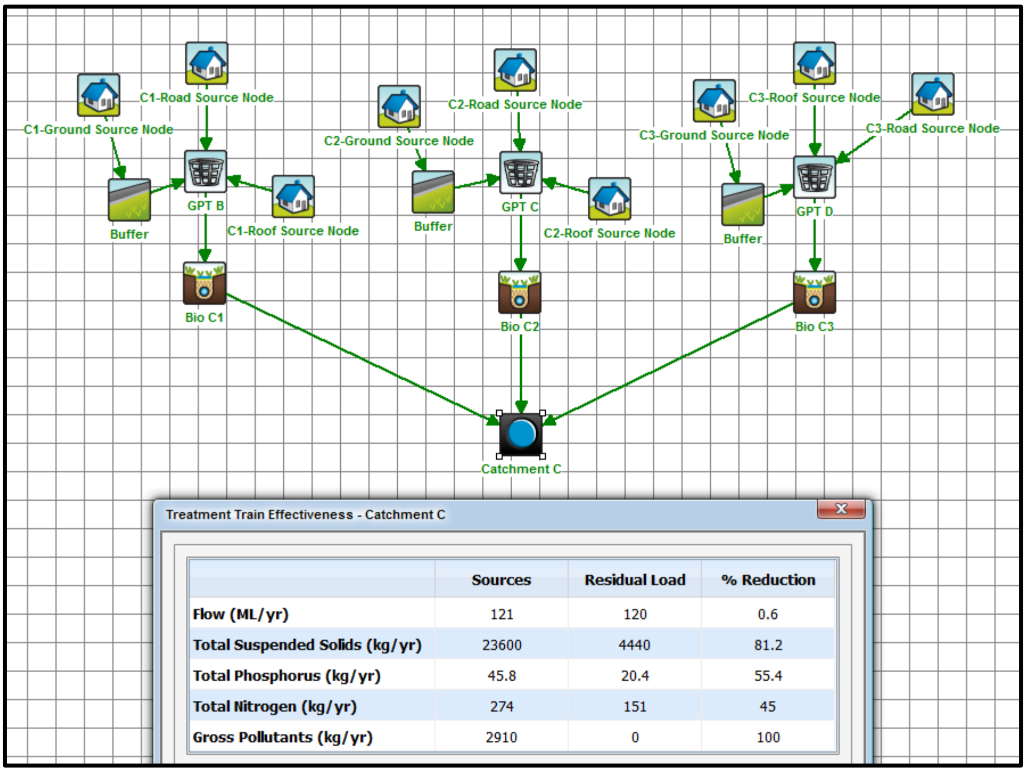
Figure 7-4 Catchment A MUSIC Layout and Pollutant Reduction Results




eatment Train Effectiveness - Catchment B

| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| **Flow (ML/yr)** | 87.9 | 45.1 | 48.7 |
| **Total Suspended Solids (kg/yr)** | 13500 | 2690 | 80.1 |
| **Total Phosphorus (kg/yr)** | 28.2 | 11.4 | 59.5 |
| **Total Nitrogen (kg/yr)** | 197 | 70.6 | 64.2 |
| **Gross Pollutants (kg/yr)** | 2120 | 94.7 | 95.5 |

**Figure 7-5 Catchment B MUSIC Layout and Pollutant Reduction Results**




| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| Flow (ML/yr) | 121 | 120 | 0.6 |
| Total Suspended Solids (kg/yr) | 23600 | 4440 | 81.2 |
| Total Phosphorus (kg/yr) | 45.8 | 20.4 | 55.4 |
| Total Nitrogen (kg/yr) | 274 | 151 | 45 |
| Gross Pollutants (kg/yr) | 2910 | 0 | 100 |

**Figure 7-6 Catchment C MUSIC Layout and Pollutant Reduction Results**

# 8 SEDIMENT AND EROSION CONTROL

Erosion and sediment control will be installed and maintained in accordance with NRLG's requirements and Landcom's Managing Urban Stormwater, Soils and Construction ('Blue Book').

# 9 PROPOSED UTILITY SERVICES PROVISION

## 9.1 POTABLE WATER

### 9.1.1 EXISTING WATER SUPPLY INFRASTRUCTURE

The site features an existing water reticulation system located within the verge of the existing road network. This reticulation features pipes ranging from Ø100mm to Ø300mm designed to service a previous lot layout.

Connection to the project site is currently through the Ø300mm main located within the Iron Gates Drive road reserve which runs along the length of Iron Gates Drive – Wattle Street before turning through Mangrove Street and connecting to the existing Ø250mm AC main located within the eastern verge of Elm Street.

### 9.1.2 PROPOSED WATER SUPPLY INFRASTRUCTURE

Connection for the proposed development to the RVC water supply network will be provided via a connection to the existing Ø300mm main located south-east of the project site within the Iron Gates Drive reserve. Again, it is proposed to maximise utilisation of the existing network however the adequacy of the current water reticulation is to be determined to ensure compliance with RVC standards. The internal potable water network shall be the subject of detailed design during the Construction Certification phase of the project.

### 9.1.3 PROJECTED DEVELOPMENT LOADINGS

#### Network Loadings

The development has been assessed under two loading cases in order to better determine the anticipated impact it will have on the surrounding network. These cases are the:

- **Planned Demand** – A demand assigned to the site via discussions with Richmond Valley Council based on the Evans Head Future Sewage Strategy report;
- **Actual Demand** – The calculated demand for the property based on proposed architect plans and conversion rates from the 'AUS-SPEC#1 Development and Design Manual'.

In accordance with the 'AUS-SPEC#1 Development and Design Manual'; section D11.06, Table 9-1 and Table 9-2 below show the calculations of Equivalent Persons (EPs) derived from both discussions with Richmond Valley Council and what is actually proposed on site.

**Table 9-1 RVC Planned Demand as per Pre-Lodgement Meeting Minutes**

| Category | Conversion Rate (EP/ET) | Planned Demand (ET) | Planned Demand (EP)* |
|---|---|---|---|
| RVC Current Water Allowance | 3.2 | **100** | **320** |

*3.2EP/ET – AUS-SPEC#1 Development and Design Manual D11.06

There are 175 lots proposed on site. 105 of these are assumed to have a loading of 1ET (3.2EP) per lot as per the RVC Development Guidelines. The other 70 have been assumed to be dual occupancy and have an applied loading of 2ET (6.4EP) per lot

**Table 9-2 Proposed Development Loadings**

| Category | Units (No.) | Demand Rate (ET/unit) | Proposed Demand (ET) | Conversion Rate (EP/ET) | Proposed Demand (EP)* |
|---|---|---|---|---|---|
| Standard Single Dwelling Unit | 105 | 1 | 105 | 3.2 | **336** |
| Standard Dual Dwelling Unit | 70 | 2 | 140 | 3.2 | **448** |
| | | **Total** | **245** | | **784** |

*3.2EP/ET – AUS-SPEC#1 Development and Design Manual D11.06

The difference in EPs between what has been planned and what is proposed is therefore **464 EPs**.

There is a difference between the current planned case as per Council's Local Area Plan and the developed case equivalent tenement calculations of 464 EP. A detailed assessment of the impact of increased loadings on the surrounding water infrastructure have been undertaken in the 'F0001-10027302-AAR' prepared by Arcadis and included in Appendix G.

## 9.1.4 INTERNAL WATER NETWORK

The developer shall, as part of the development works, construct an internal water reticulation service for the proposed development in accordance with the relevant building code requirements.

A water network design will be undertaken by a qualified hydraulic engineer for the proposed development to determine adequate levels of services for all internal firefighting flows and services demands.

## 9.1.5 CAPACITY OF EXISTING EXTERNAL WATER

A Water Network Capacity Assessment has been undertaken to determine the effects of the development on the surrounding water infrastructure. The assessment prepared by Arcadis in Appendix G indicates that once fully developed and in-use, the Iron Gates development will have no additional impact on the Evans head potable water network. This is true for both standard and fire flow events.

## 9.2 SEWER

### 9.2.1 EXISTING SEWERAGE INFRASTRUCTURE

The project site currently possesses a sewerage reticulation network dating back to a previous development attempt, consisting of Ø225mm mains cumulating at the south-east corner of the project site where a pump station is located. This station is equipped with a dual rising main configuration consisting of two Ø100mm rising mains, one which was to be used to cater for the first stage of the previous Development Application and a second to service future developments.

These rising mains are located within the Iron Gates Drive road reserve and follow Iron Gates Drive through Wattle Street and Mangrove Street to an existing Ø150mm gravity main.

### 9.2.2 PROPOSED SEWERAGE SUPPLY INFRASTRUCTURE

Connection for the proposed development to the RVC sewerage network will be provided via a sewerage reticulation network internal to the project site subject to a detailed sewer network capacity assessment ensuring adequate capacities are provided to service the development. Connection to the existing DN 100 rising main is to occur from the existing south-eastern pump station, to be pumped along Iron Gates Drive to the connection point in Mangrove Street. This connection point will be confirmed during detailed design with further discussion with RVC engineers.

Refer also to "Response to Information Request dated 11/05/2016 Items 4"

4 Section 9.2.2; please explain what is the comparison between the original ET loading that was the input for the dual rising main, and the proposed ET loading now by the proposed subdivision. Council needs to ensure the existing infrastructure is suitably sized for the proposed development.

The report entitled Iron Gates Residential Development Engineering Services and Civil Infrastructure Rev 06 dated 10/05/2016 has been amended to make allowance for the existing lots, currently connected to the DN150 gravity sewer in Mangrove Street upstream of the existing EHPS-02 pump station. Please refer to attached sewer calculations and Section 9 of the report.

### 9.2.3 PROJECTED DEVELOPMENT LOADINGS

#### Network Loadings

The development has been assessed under two loading cases in order to better determine the anticipated impact it will have on the surrounding network. These cases are the:

- **Planned Demand** – A demand assigned to the site via discussions with Richmond Valley Council based on the Evans Head Future Sewage Strategy report;
- **Actual Demand** – The calculated demand for the property based on proposed architect plans and conversion rates from the 'AUS-SPEC#1 Development and Design Manual'.

In accordance with the ‘AUS-SPEC#1 Development and Design Manual’; section D12.06, Table 9-3 and Table 9-4 below show the calculations of Equivalent Persons (EPs) derived from both discussions with Richmond Valley Council and what is actually proposed on site. For the sewer EP calculations, the EP/ET conversion rate is taken from the GHD report which forms the basis for RVC’s future sewer planning strategy.

**Table 9-3 RVC Planned Demand as per Pre-Lodgement Meeting Minutes**

| Category | Conversion Rate (EP/ET) | Planned Demand (ET) | Planned Demand (EP)* |
|---|---|---|---|
| RVC Current Sewer Allowance | 2.3 | 100 | 230 |

*2.3EP/ET – GHD (2010) Sewer Planning Report

There are 175 lots proposed on site. 105 of these are assumed to have a loading of 1ET (3.2EP) per lot as per the RVC Development Guidelines. The other 70 have been assumed to be dual occupancy and have an applied loading of 2ET (6.4EP) per lot

**Table 9-4 Proposed Development Loadings**

| Category | Units (No.) | Demand Rate (ET/unit) | Proposed Demand (ET) | Conversion Rate (EP/ET) | Proposed Demand (EP)* |
|---|---|---|---|---|---|
| Standard Single Dwelling Unit | 105 | 1 | 105 | 2.3 | **241.5** |
| Standard Dual Dwelling Unit | 70 | 2 | 140 | 2.3 | **322** |
| | | **Total** | **245** | | **563.5** |

*2.3EP/ET – GHD (2010) Sewer Planning Report

The difference in EPs between what has been planned and what is proposed is therefore **333.5 EPs**.

## 9.2.4 CAPACITY OF EXISTING EXTERNAL SEWER

Due to the proposed loads imposed on the existing external sewerage network a preliminary assessment has been undertaken to determine whether it has sufficient capacity. A report prepared by GHD in May 2010 titled “*Review of Evans Head Sewerage Augmentation Strategy”* includes an assessment of various augmentation strategies in order to upgrade the existing Richmond Valley Council sewerage system to cater for future development.

After discussions with RVC engineers, Arcadis undertook detailed calculations using the general strategy adopted by RVC to cater for future development in the sewer network to determine whether sufficient capacity was for the Iron Gates development. These calculations and a discussion on the findings are found in the Arcadis Sewer Network Capacity Assessment in Appendix H. The assessment found that sufficient capacity was available in the Evans Head pump station 2 (EHPS-02) catchment, with no augmentations to the RVC future sewer planning strategy required.

A brief assessment of the 150mm diameter sewer gravity main in Mangrove Street that serves as the SRM connection point has been undertaken to ensure that it has sufficient capacity to cater for the additional flows from the Iron Gates development.

Currently there are approximately 60 Lots within the catchment connected to the DN 150 gravity sewer upstream of the EHPS-02. The DN 150 gravity pipe will have some capacity to accept flows from the Iron Gates estate, with the Sewer Network Capacity Assessment prepared by Arcadis indicating that the Iron Gates development has a total developed flow of 9.29L/s. The capacity of the 150mm diameter pipe at minimum grade is 11.35L/s. A detailed assessment of this pipe's capacity will be undertaken during Construction Certificate stage.

## 9.3 ELECTRICAL AND TELECOMMUNICATIONS SERVICES

The existing site is not equipped with electrical reticulation infrastructure however 'Essential Energy' Dial Before You Dig (DBYD) results have revealed the presence of an underground or earth wire structure within the south-western corner of the project site. Two electrical poles have also been located within the site in alignment with a service track to the north of the site. It is understood that the proposed development must incorporate an internal low-voltage electricity supply to all facilities within the development in order to comply with relevant legislation. Connection to electrical reticulation is proposed via infrastructure within Iron Gates Drive with ultimate connection in Wattle Street within Evans Head. Refer to Preferred Energy electrical consultants Electrical and Telecommunications Supply Availability in Appendix M for further detail and Appendix B for DBYD results.

Telecommunication services have been identified in the immediate surroundings of the site, with an underground telecommunication network being situated within the project site. This network is not connected to any working infrastructure and is therefore not live at this stage. Two elevated cable joints are also identified in the adjacent lot towards the west (Lot 163 DP831052), connecting to an elevated cable joint in Blue Pool Road. Telecommunications connection for the site will be made through new infrastructure through a design and submit process with NBN as outlined in the Electrical and Telecommunications Supply Availability in Appendix M.

Connection from the proposed development to the above-mentioned services will be undertaken by a specialist consultant and will form part of the future Construction Certification applications and approval processes through the relevant service providers.

A Level 3 Energy Accredited Service Provider will undertake the design and documentation of the electrical reticulation network. Street lighting will be installed in accordance with Authority standards and in accordance with the relevant conditions of approval and supporting consultant reports.

## 9.4 GAS

No allowance has been made to supply the development with reticulated gas. This will be subject to future agreement between the developer and local gas suppliers.

## 9.5 TESTING OF EXISTING INFRASTRUCTURE

There are areas of the development where it is proposed to utilise existing infrastructure constructed as part of a previous development design. Where this is proposed the infrastructure will be tested to ensure that it is of an appropriate quality as per the RVC Guidelines.

Water

- Pressure testing to detect leakage and defects in the pipeline including joints, thrust and anchor blocks.
- Disinfect all water mains in accordance with the specification in WSA 03 Part 4, section 13.

Sewer

- Compressed air testing of gravitation sewers;
- Ovality testing using a Council approved proving tool. Ovality should comply with the requirements specified in Chapter 402.40 – Initial Test of Gravitation Sewers of the Richmond Valley Council Construction Manual.
- Leakage test of maintenance holes. Tests should comply with Chapter 402.41 – Initial Test of Maintenance Holes of the Richmond Valley Council Construction Manual.
- Hydrostatic testing. Tests should comply with Chapter 402.45 – Hydrostatic testing of gravity mains of the Richmond Valley Council Construction Manual.
- Pressure testing of rising mains. Tests should comply with Chapter 402.47 – Testing of Rising Mains of the Richmond Valley Council Construction Manual.
- Visual inspection via CCTV cameras. Tests should comply with Chapter 402.65 – What is to be inspected of the Richmond Valley Council Construction Manual.

Stormwater

- Visual inspection via CCTV cameras. Tests should comply with Chapter 402.65 – What is to be inspected of the Richmond Valley Council Construction Manual.

# 10 FLOOD EMERGENCY MANAGEMENT

The proposed developed features 175 residential allotments, with all internal road areas and lot areas constructed above the current 1 in 100 year flood level. Permanent residents and visitors can move freely around the site during flood events up to the 1 in 100 year regional flood. The proposed development is connected to the Evans Head town centre by a single road, being Iron Gates Drive. Iron Gates drive is susceptible to current day 1 in 100 year flooding, with the lowest point inundated by approximately 400mm for 5 hours. It should be noted that this flooding is low velocity back water, and would be considered trafficable if required by emergency vehicles.

The proposed strategy for flood emergency management by residents and visitors will be ‘stay in place’ rather than an evacuation. Under this strategy, site occupants will be encouraged to remain within their homes for the duration of flooding, with medical emergencies to be dealt with by the emergency services. Considering the potential of emergency vehicles to travel through water inundating roads (with low velocity) and the duration of inundation being 5 hours, the development is not considered to be isolated during an emergency event. Residents will stay in place, in their homes, where emergency vehicles can access the site.

In the future sea level rise modelling for a 1 in 100 year flood of the Evans River, Iron Gates Drive will be inundated for a maximum of 9 hours and to a depth of 1.3m. No residential allotments on site will be beneath the 100 year flood level with sea level rise. The development is considered to be no more isolated than the town of Evans Head itself, given the flooding potential of roads leading out of Evans Head, including the currently under construction motorway upgrade. If this height of sea level rise is reached in the future, all medical emergencies in the Evans Head region must be dealt with through aerial evacuation.

# 11 CONCLUSION

This report has discussed the engineering aspects of the development of the proposed Iron Gates residential estate.

The proposed development is to feature 175 residential allotments that are proposed to utilise as much of the existing infrastructure as possible, including roads, stormwater, sewer and water infrastructure.

This report has demonstrated that the proposed development can be adequately provided with all necessary engineering services, including sewer, water, stormwater drainage, electrical and telecommunication infrastructure. It is assumed that the other existing services which are located within the vicinity of the site can accommodate the proposed development's needs.

A summary of the existing and proposed stormwater drainage infrastructure on site has been presented. The provision of on-site stormwater detention has been shown to be detrimental in the case of this development based on the BMT WBM study identifying a rapid disposal method to be more efficient in the release of flood waters.

To service the development with potable water a single water connection point is proposed to the 300mm diameter potable water main in the Iron Gates Drive verge adjacent to the site, connecting to the existing Ø250mm AC main. A Water Network Capacity Assessment has been undertaken to determine the effects of the development on the surrounding water infrastructure. The assessment prepared by Arcadis in Appendix G indicates that once fully developed and in-use, the Iron Gates development will have no additional impact on the Evans head potable water network. This is true for both standard and fire flow events.

The proposed connection to the RVC sewerage network for the proposed development will be via the dual 100mm diameter rising main adjacent to the project site within the southern verge of Iron Gates Drive, connecting to the existing Ø150mm gravity main. After discussions with RVC engineers, Arcadis undertook detailed calculations using the general strategy adopted by RVC to cater for future development in the sewer network to determine whether sufficient capacity was for the Iron Gates development. These calculations and a discussion on the findings are found in the Arcadis Sewer Network Capacity Assessment in Appendix H. The assessment found that sufficient capacity was available in the Evans Head pump station 2 (EHPS-02) catchment, with no augmentations to the RVC future sewer planning strategy required.

Electrical and telecommunication services shall be provided to the development through connection points through Iron Gates Drive and Wattle Street, from the Evans Head town centre. Electrical and telecommunications supply has been planned for by the relevant service authorities and will be subject to the development Construction Certificate applications. Additional engineering issues such as road access and earthworks have also been presented within the report.

It is anticipated that there will not be any detrimental effects of the proposed development on surrounding properties and that it is possible for all engineering services to be catered for.

# APPENDIX A

## ENGINEERING DRAWINGS

# RESIDENTIAL DEVELOPMENT LOT 277 IRON GATES ROAD EVANS HEAD

## DEVELOPMENT APPLICATION

## RICHMOND VALLEY COUNCIL

### DRAWING SCHEDULE

GENERAL

| | |
|---|---|
| C100 | DRAWING SCHEDULE AND LOCALITY PLAN |
| C101 | GENERAL NOTES |
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LOCALITY PLAN
1 : 10000

LEVELS & GRID

ORIGIN PM 83272
LEVELS to AHD
(AUSTRALIAN HEIGHT DATUM)
GRID to GDA94

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| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
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100mm on Original

Scale

0 100 200 400 600 800 1000m

1 : 10000

Surveyor

ROBERT A HARRIES
SURVEYOR

Architect

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Client

GOLDCORAL PTY LTD

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FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

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Original Issue Signatures

Drawn A. CARDEÑO

Designed A. MAGONDACAN

Project Manager L. PRIZEMAN

Original Size A1

Height Datum AHD

Grid GRID

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Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

DRAWING SCHEDULE AND
LOCALITY PLAN


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| Drawing No. | Project No. | Issue |
|---|---|---|
| C100 | AA007094 | 06 |

## GENERAL NOTE:

ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH RVC COUNCIL DESIGN GUIDELINES & WORKS SPECIFICATION.
WHERE DISCREPANCIES OCCUR THE MORE STRINGENT SPECIFICATION WILL TAKE PRECEDENCE.

## SITEWORKS NOTES

1. CONTRACTOR MUST VERIFY ALL DIMENSIONS AND EXISTING LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORK. ANY DISCREPANCIES TO BE REPORTED TO HYDER CONSULTING.
2. MAKE SMOOTH CONNECTION WITH EXISTING WORKS.
3. ALL TRENCH BACKFILL MATERIAL SHALL BE COMPACTED TO THE SAME DENSITY AS THE ADJACENT MATERIAL.
4. SEWER, POTABLE WATER AND RECYCLED WATERMAINS BACKFILL TO BE IN ACCORDANCE WITH WSA03-2002-2.2, WAT-1201, WAT-1202, WAT-1203 AND WAT-1204-V.
   ALL OTHER SERVICE TRENCHES UNDER VEHICULAR PAVEMENTS SHALL BE BACKFILLED WITH SAND TO 300mm ABOVE PIPE. WHERE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH TO UNDERSIDE OF PAVEMENT WITH SAND OR APPROVED GRANULAR MATERIAL COMPACTED IN 150mm LAYERS TO MINIMUM 98% MODIFIED MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1.
   (OR A DENSITY INDEX OF NOT LESS THAN 70)
5. PROVIDE 10mm WIDE EXPANSION JOINTS BETWEEN BUILDINGS AND ALL CONCRETE OR UNIT PAVEMENTS.
6. ASPHALTIC CONCRETE SHALL CONFORM TO R.T.A. SPECIFICATION R116.
7. ALL BASECOURSE MATERIAL SHALL BE IGNEOUS ROCK QUARRIED MATERIAL TO COMPLY WITH R.T.A. FORM 3051 (UNBOUND), R.T.A. FORM 3052 (BOUND) COMPACTED TO MINIMUM 98% MODIFIED DENSITY IN ACCORDANCE WITH AS 1289 5.2.1
   FREQUENCY OF COMPACTION TESTING SHALL NOT BE LESS THAN 1 TEST PER $50m^3$ OF BASECOURSE MATERIAL PLACED.
8. ALL SUB-BASE COURSE MATERIAL SHALL BE IGNEOUS ROCK QUARRIED MATERIAL TO COMPLY WITH R.T.A. FORM 3051, 3051.1 AND COMPACTED TO MINIMUM 98% MODIFIED DENSITY IN ACCORDANCE WITH A.S 1289 5.2.1
   FREQUENCY OF COMPACTION TESTING SHALL NOT BE LESS THAN 1 TEST PER $50m^3$ OF SUB-BASE COURSE MATERIAL PLACED.
9. AS AN ALTERNATIVE TO THE USE OF IGNEOUS ROCK AS A SUB-BASE MATERIAL IN (9) A CERTIFIED RECYCLED CONCRETE MATERIAL COMPLYING WITH R.T.A. FORM 3051 AND 3051.1 WILL BE CONSIDERED. SUBJECT TO MATERIAL SAMPLES AND APPROPRIATE CERTIFICATIONS BEING PROVIDED TO THE SATISFACTION OF HYDER CONSULTING AND RCV COUNCIL SPEC.
10. SHOULD THE CONTRACTOR WISH TO USE A RECYCLED PRODUCT THIS SHALL BE CLEARLY INDICATED IN THEIR TENDER AND THE PRICE DIFFERENCE BETWEEN AN IGNEOUS PRODUCT AND A RECYCLED PRODUCT SHALL BE CLEARLY INDICATED.
11. WHERE NOTED ON THE DRAWINGS THAT WORKS ARE TO BE CARRIED BY OTHERS, (eg. ADJUSTMENT OF SERVICES), THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CO-ORDINATION OF THESE WORKS.
12. ALL FOOT PATHS AND CYLCEWAYS TO BE IN ACCORDANCE WITH RVC STD DRAWING R-07

## GENERAL NOTES

1. ALL WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH COUNCIL'S STANDARDS AND SPECIFICATIONS AND/OR AS DIRECTED BY THE ENGINEER.
2. THE CONTRACTOR SHALL LOCATE AND LEVEL ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND SHALL MAKE ALL NECESSARY ARRANGEMENTS WITH THE RELEVANT AUTHORITY TO RELOCATE OR ADJUST AS REQUIRED. ALL COSTS TO BE BORNE BY THE APPLICANT, (NOT AT COUNCIL'S EXPENSE)
3. THE CONTRACTOR SHALL NOT ENTER UPON OR DO ANY WORK WITHIN ADJACENT LANDS WITHOUT PRIOR WRITTEN PERMISSION OF THE LAND OWNER.
4. SURVEY MARKS SHOWN THUS ◘ SHALL BE MAINTAINED AT ALL TIMES. WHERE RETENTION IS NOT POSSIBLE THE ENGINEER SHALL BE NOTIFIED AND CONSENT RECEIVED PRIOR TO THEIR REMOVAL OR RELOCATION.
5. ALL NEW WORKS SHALL MAKE SMOOTH JUNCTION WITH EXISTING CONDITIONS.
6. SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED PRIOR TO SOIL DISTURBANCE IN KEEPING WITH THE "MANAGING STORMWATER MANUAL", 2004 BY LANDCOM AND TO COUNCIL'S SOIL EROSION AND SEDIMENT CONTROL POLICY.
7. ALL LAND DISTURBED BY EARTHWORKS SHALL BE HYDROMULCHED, OR SIMILARLY TREATED TO ESTABLISH GRASS COVER. SEED MIXTURES ARE TO BE APPROVED BY COUNCIL PRIOR TO SPRAYING. ALL GRASSED AREAS SHALL BE REGULARLY WATERED AND MAINTAINED UNTIL EXPIRATION OF THE MAINTENANCE PERIOD.
8. THE CONTRACTOR SHALL MAINTAIN DUST CONTROL THROUGHOUT THE DURATION OF THE PROJECT.
9. ALL PITS DEEPER THAN 1.2m SHALL HAVE STEP IRONS PROVIDED IN ACCORDANCE WITH COUNCIL'S STANDARDS.
10. ALL DRAINAGE LINES THROUGH LOTS SHALL BE CONTAINED WITHIN THEIR EASEMENTS AND CONFORM WITH COUNCIL'S STANDARDS.
11. SUBSOIL DRAINS SHALL BE CONSTRUCTED TO THE SATISFACTION OF THE COUNCIL.
12. INTERALLOTMENT DRAINAGE LINES SHALL HAVE A MINIMUM 300mm COVER AND DESIRABLE MINIMUM GRADE OF 1%.
13. MINIMUM 50mm THICK TOPSOIL SHALL BE SPREAD ON ALL FOOTPATHS, BERMS, BATTERS AND SITE REGRADING AREAS. EXCESS TOPSOIL SHALL BE DISPOSED OF AS DIRECTED BY THE ENGINEER.
14. THE CONTRACTOR SHALL PROVIDE MINIMUM 48 HOURS NOTICE TO THE ENGINEER FOR ALL INSPECTIONS.
15. THE CONTRACTOR SHALL MAINTAIN SERVICES AND ALL WEATHER ACCESS AT ALL TIMES TO THE ADJOINING PROPERTIES.
16. THE CONTRACTOR SHALL UNDERTAKE TRAFFIC CONTROL MEASURES TO ENGINEER'S AND RCV COUNCIL SATISFACTION AND SHALL DISPLAY APPROPRIATE WARNING SIGNS THROUGHOUT THE DURATION OF CONSTRUCTION.
17. ALL NATURAL SURFACE DATA HAS BEEN DETERMINED BY TERRAIN MODELLING. ALL CONSTRUCTION SITE WORKS MUST BE CARRIED OUT USING THE BENCH MARKS NOTED ON THIS DRAWING.
18. 100 YEAR FLOW PATHS TO BE FORMED AT TIME OF CONSTRUCTION.

## STRUCTURAL INSPECTIONS

1. STRUCTURAL INSPECTIONS ARE REQUIRED FOR STRUCTURES WHERE NOTED ON PLANS OR REQUIRED BY COUNCIL.
2. 48 HOURS NOTICE IS REQUIRED FOR ALL INSPECTIONS.

## CONCRETE NOTES

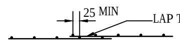
1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS 3600 CURRENT EDITION WITH AMENDMENTS, EXCEPT WHERE VARIED BY THE CONTRACT DOCUMENTS.
2. CONCRETE QUALITY
   ALL REQUIREMENTS OF THE CURRENT ACSE CONCRETE SPECIFICATION DOCUMENT 1 SHALL APPLY TO THE FORMWORK, REINFORCEMENT AND CONCRETE UNLESS NOTED OTHERWISE.

| ELEMENT | AS 3600 F'c MPa AT 28 DAYS | SPECIFIED SLUMP | NOMINAL AGG. SIZE |
|---|---|---|---|
| VEHICULAR BASE | 32 | 60 | 20 |
| KERBS, PATHS, AND PITS | 20 | 80 | 20 |
| RETAINING WALLS | 20 | 80 | 20 |

   - CEMENT TYPE SHALL BE (ACSE SPECIFICATION) TYPE SL
   - PROJECT CONTROL TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS 1379.
3. NO ADMIXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED IN WRITING BY HYDER CONSULTING.
4. CLEAR CONCRETE COVER TO ALL REINFORCEMENT FOR DURABILITY SHALL BE 40mm TOP AND 70mm FOR EXTERNAL EDGES UNLESS NOTED OTHERWISE.
5. ALL REINFORCEMENT SHALL BE FIRMLY SUPPORTED ON MILD STEEL PLASTIC TIPPED CHAIRS, PLASTIC CHAIRS OR CONCRETE CHAIRS AT NOT GREATER THAN 1m CENTRES BOTH WAYS. BARS SHALL BE TIED AT ALTERNATE INTERSECTIONS.
6. THE FINISHED CONCRETE SHALL BE A DENSE HOMOGENEOUS MASS, COMPLETELY FILLING THE FORMWORK, THOROUGHLY EMBEDDING THE REINFORCEMENT AND FREE OF STONE POCKETS. ALL CONCRETE INCLUDING SLABS ON GROUND AND FOOTINGS SHALL BE COMPACTED AND CURED IN ACCORDANCE WITH R.T.A. SPECIFICATION R83.
7. REINFORCEMENT SYMBOLS:
   N DENOTES GRADE 450 N BARS TO AS 4671 GRADE N
   R DENOTES 230 R HOT ROLLED PLAIN BARS TO AS 4671
   SL DENOTES HARD-DRAWN WIRE REINFORCING FABRIC TO AS 4671

   NUMBER OF BARS IN GROUP — BAR GRADE AND TYPE
   17 N 20 250
   NOMINAL BAR SIZE IN mm — SPACING IN mm

   THE FIGURE FOLLOWING THE FABRIC SYMBOL SL IS THE REFERENCE NUMBER FOR FABRIC TO AS 4671.
8. FABRIC SHALL BE LAPPED IN ACCORDANCE WITH THE FOLLOWING DETAIL:




## STORMWATER DRAINAGE NOTES

1. STORMWATER DESIGN CRITERIA:
   (A) AVERAGE RECURRENCE INTERVAL:
   ROAD DRAINAGE
   5 YEARS ARI MINOR STORM EVENT
   100 YEARS ARI MAJOR STORM EVENT
   INTER ALLOTMENT DRAINAGE
   5 YEARS ARI STORM EVENT
2. PIPES 375 DIA. AND LARGER TO BE REINFORCED CONCRETE CLASS '2' APPROVED SPIGOT AND SOCKET WITH RUBBER RING JOINTS. U.N.O.
3. PIPES TO BE INSTALLED TO TYPE HS1 SUPPORT IN ACCORDANCE WITH AS 3725 (1989) IN ALL CASES BACKFILL TRENCH WITH SAND TO 300mm ABOVE PIPE. WHERE PIPE IS UNDER PAVEMENTS BACKFILL REMAINDER OF TRENCH TO UNDERSIDE OF PAVEMENT WITH SAND OR APPROVED GRANULAR MATERIAL COMPACTED IN 150mm LAYERS TO MINIMUM 98% MODIFIED. MAXIMUM DRY DENSITY IN ACCORDANCE WITH AS 1289 5.2.1. (OR A DENSITY INDEX OF NOT LESS THAN 70)
4. ALL INTERNAL WORKS WITHIN PROPERTY BOUNDARIES ARE TO COMPLY WITH THE REQUIREMENTS OF AS 3500 3.1 (1998) AND AS/NZS 3500 3.2 (1998).
5. PRECAST PITS MAY BE USED SUBJECT TO APPROVAL BY HYDER CONSULTING.
6. WHERE SUBSOIL DRAINS PASS UNDER FLOOR SLABS AND VEHICULAR PAVEMENTS, UNSLOTTED uPVC SEWER GRADE PIPE IS TO BE USED.
7. CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT APPROVAL.
8. GRATES AND COVERS SHALL CONFORM TO BCC REQUIREMENTS AND AS3996
9. AT ALL TIMES DURING CONSTRUCTION OF STORMWATER PITS, ADEQUATE SAFETY PROCEDURES SHALL BE TAKEN TO ENSURE AGAINST THE POSSIBILITY OF PERSONNEL FALLING DOWN PITS.
10. ALL EXISTING STORMWATER DRAINAGE LINES AND PITS THAT ARE TO REMAIN ARE TO BE INSPECTED AND CLEANED. DURING THIS PROCESS ANY PART OF THE STORMWATER DRAINAGE SYSTEM THAT WARRANTS REPAIR SHALL BE REPORTED TO THE SUPERINTENDENT/ENGINEER FOR FURTHER DIRECTIONS.
11. CCTV ALL PIPES AFTER CONSTRUCTION AND PRIOR TO PRACTICAL COMPLETION.
12. PIPES ARE DESIGNED FOR OPERATIONAL TRAFFIC LOADS ONLY. APPROPRIATE MEASURES SHOULD BE TAKEN TO PROTECT PIPES DURING CONSTRUCTION.

## BULK EARTHWORKS NOTES

1. ORIGIN OF LEVELS: REFER SURVEY NOTES
2. STRIP ALL TOPSOIL/ORGANIC MATERIAL (50mm NOMINAL) FROM CONSTRUCTION AREA AND REMOVE FROM SITE OR STOCK PILE AS DIRECTED BY SUPERINTENDENT.
3. EXCAVATED MATERIAL TO BE USED AS STRUCTURAL FILL PROVIDED THE PLACEMENT MOISTURE CONTENT OF THE MATERIAL IS +/- 2% OF THE OPTIMUM MOISTURE CONTENT.
4. COMPACT FILL AREAS AND SUBGRADE TO NOT LESS THAN:

| LOCATION | MINIMUM DRY DENSITY (AS 1289 E 5.1.1.) |
|---|---|
| UNDER BUILDING SLABS ON GROUND | 95% STD |
| UNDER ROADS, FOOTWAYS AND CARPARKS | 98% STD |
| LANDSCAPED AREAS UNLESS NOTED OTHERWISE | 95% STD |

5. BEFORE PLACING FILL, PROOF ROLL EXPOSED SUBGRADE WITH AN 12 TONNE (MIN) DEADWEIGHT SMOOTH DRUM VIBRATORY ROLLER TO DETECT THEN REMOVE SOFT SPOTS (AREAS WITH MORE THAN 2mm MOVEMENT UNDER ROLLER).
6. FREQUENCY OF COMPACTION TESTING SHALL BE NOT LESS THAN :-
   (A) 1 TEST PER $200m^3$ OF FILL PLACED PER 200 LAYER OF FILL.
   (B) 3 TESTS PER LAYER
   (C) 1 TEST PER $1000m^2$ OF EXPOSED SUBGRADE
   TESTING SHALL BE "LEVEL 1" TESTING IN ACCORDANCE WITH AS 3798 (1996).
7. FILLING TO BE PLACED AND COMPACTED IN MAXIMUM 250mm LAYERS
8. NO FILLING SHALL TAKE PLACE TO EXPOSED SUBGRADE UNTIL THE AREA HAS BEEN PROOF ROLLED IN THE PRESENCE OF THE GEOTECHNICAL ENGINEER AND APPROVAL GIVEN IN WRITING THAT FILLING CAN PROCEED.
9. WHERE GROUNDWATER DISCHARGE OCCURS IN BULK EXCAVATIONS OR CUT FACES, SUBSOIL DRAINAGE SHALL BE INSTALLED IN ACCORDANCE WITH THE SITE SUPERINTENDENT / GEOTECH INSTRUCTIONS TO DIRECT DISCHARGE WATER TO THE NEAREST STORMWATER / SEDIMENTATION CONTROL DEVICE. THE SUBSOIL DRAINAGE MUST BE INSTALLED AS SOON AS PRACTICALLY POSSIBLE AFTER EXCAVATION. SUBSOIL DRAINAGE SHALL ALSO BE INSTALLED AT LOW POINTS IN THE FINISHED EARTHWORK PROFILE IN ACCORDANCE WITH THE SITE SUPERINTENDENT / GEOTECH'S INSTRUCTIONS.
10. ENSURE TEMPORARY DIVERSION CHANNELS ARE CONSTRUCTED AROUND STOCKPILED MATERIALS AND DISTURBED AREAS GENERALLY AS DETAILED.
11. THE CONTRACTOR SHALL ALLOW FOR AND COORDINATE ALL MONITORING AND MAINTENANCE REQUIREMENTS IN RELATION TO SOIL AND GROUNDWATER CONDITIONS DURING CONSTRUCTION.

## SUBSOIL DRAINAGE NOTES:

1. SUBSOILS DRAINAGE TO BE IN ACCORDANCE WITH RVC COUNCIL SPECIFICATIONS.
2. SUBSOIL DRAINAGE LINES TO BE CONSTRUCTED UNDER ALL KERB AND GUTTER EXCEPT WHERE LONGITUDINAL ROAD DRAINAGE IS PROVIDED.
3. CLEANOUT TO BE PROVIDED IN ACCORDANCE WITH RCV COUNCIL SPECIFICATIONS.
4. EXTRA SUBSOIL DRAINS ARE TO BE PROVIDED WHERE SHOWN ON THE SITE WORKS AND DRAINAGE PLAN.

## PROPOSED SERVICES NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH:- SERVICE AUTHORITY DRAWINGS AND SPECIFICATIONS
2. THE CONTRACTOR SHALL ATTEND, MANAGE & SUPERVISE THE PROVISION OF PUBLIC UTILITY SERVICES TO THE WORKS GENERALLY AS INDICATED ON THE SERVICES PLANS, NOTING THAT PRIOR & DURING CONSTRUCTION THE PUBLIC UTILITY AUTHORITIES WILL FINALISE THEIR DOCUMENTATION TO CONSTRUCTION ISSUE STANDARD. THE FOLLOWING GENERAL ARRANGEMENTS SHALL APPLY IN RESPECT OF EACH PUBLIC UTILITY SERVICE.

   CONDUIT ROAD CROSSING

   THE CIVIL CONTRACTOR SHALL ALLOW IN THEIR PRICE FOR CONDUIT CROSSINGS UNDER THE PROPOSED ROADS AS SHOWN ON THE "SERVICES PLAN".
3. THE CIVIL CONTRACTOR (TRENCH PROVIDER) IS TO ARRANGE ON SITE MEETING WITH ALL SERVICE AUTHORITIES PRIOR TO THE INSTALLATION OF CONDUITS.
4. THE CIVIL CONTRACTOR TO CO-ORDINATE INSTALLATION OF ELECTRICITY, GAS AND TELECOMMUNICATION SERVICES.
5. ELECTRICITY, GAS AND TELECOMMUNICATION SERVICES ARE TO BE LAID FOLLOWING THE INSTALLATION OF STORMWATER, SEWER AND WATER SERVICES AND KERB AND GUTTER.
6. ALL UTILITY AUTHORITY REPRESENTATIVES TO INSPECT ROAD CROSSINGS PRIOR TO SEALING.
7. ALL ELECTRICAL ROAD CROSSINGS TO BE CLASS 6 (ORANGE) uPVC CONDUITS.
8. ALL GAS ROAD CROSSINGS TO BE uPVC GREY SEWER GRADE CONDUITS.

10. ALL STREET POLES TO BE POSITIONED 350mm FROM BOUNDARY TO CENTRELINE OF POLE. CONTRACTOR TO ALLOW TO EXCAVATE AND BACKFILL TRENCH GENERALLY IN ACCORDANCE WITH NOTE 2.
11. WHERE FOOTPATHS ARE TO BE CONSTRUCTED, ALL SERVICE PIT COVERS AND MARKERS ARE TO BE LAID WHOLLY WITHIN THE CONCRETE FOOTPATH. CONTACT SUPERINTENDENT SHOULD DIFFICULTIES ARISE.
12. ELECTRICITY CONDUITS ARE SHOWN FOR CLARITY HOWEVER, CABLES MAY BE DIRECTLY BURIED. APPROVAL BY ENERGY AUSTRALIA REQUIRED.
13. SERVICES MARKERS ARE TO BE PLACED ON THE KERB & GUTTER AT ALL ROAD CROSSING POINTS, ON BOTH SIDES OF THE ROAD.
14. ALL SERVICE PIT COVERS TO BE INSTALLED FLUSH WITH PROPOSED VERGE LEVELS AND GRADES.

## TELSTRA - DUTY OF CARE NOTE

TELSTRA'S PLANS SHOW ONLY THE PRESENCE OF CABLES AND PLANT. THEY ONLY SHOW THEIR POSITION RELATIVE TO ROAD BOUNDARIES, PROPERTY FENCES ETC. AT THE TIME OF INSTALLATION AND TELSTRA DOES NOT WARRANT OR HOLD OUT THAT SUCH PLANS ARE ACCURATE THEREAFTER DUE TO CHANGES THAT MAY OCCUR OVER TIME.
DO NOT ASSUME DEPTH OR ALIGNMENT OF CABLES OR PLANT AS THESE VARY SIGNIFICANTLY.
THE CONTRACTOR HAS A DUTY OF CARE WHEN EXCAVATING NEAR TELSTRA CABLES AND PLANT. BEFORE USING MACHINE EXCAVATORS TELSTRA PLANT MUST FIRST BE PHYSICALLY EXPOSED BY SOFT DIG POTHOLING TO IDENTIFY IT'S LOCATION TELSTRA WILL SEEK COMPENSATION FOR DAMAGES CAUSED TO IT'S PROPERTY AND LOSSES CAUSED TO TELSTRA AND IT'S CUSTOMERS.

## EXISTING UNDERGROUND SERVICES NOTES

THE LOCATIONS OF UNDERGROUND SERVICES SHOWN IN THIS SET OF DRAWINGS HAVE BEEN PLOTTED FROM SURVEY INFORMATION AND SERVICE AUTHORITY INFORMATION.THE SERVICE INFORMATION HAS BEEN PREPARED ONLY TO SHOW THE APPROXIMATE POSITIONS OF ANY KNOWN SERVICES AND MAY NOT BE AS CONSTRUCTED OR ACCURATE.
HYDER CONSULTING CAN NOT GUARANTEE THAT THE SERVICES INFORMATION SHOWN ON THESE DRAWINGS ACCURATELY INDICATES THE PRESENCE OR ABSENCE OF SERVICES OR THEIR LOCATION AND WILL ACCEPT NO LIABILITY FOR INACCURACIES IN THE SERVICES INFORMATION SHOWN FROM ANY CAUSE WHATSOEVER.

CONTRACTORS SHALL TAKE DUE CARE WHEN EXCAVATING ONSITE INCLUDING HAND EXCAVATION WHERE NECESSARY.

CONTRACTORS ARE TO CONTACT THE RELEVANT SERVICE AUTHORITY PRIOR TO COMMENCEMENT OF EXCAVATION WORKS.

CONTRACTORS ARE TO UNDERTAKE A SERVICES SEARCH, PRIOR TO COMMENCEMENT OF WORKS ON SITE. SEARCH RESULTS ARE TO BE KEPT ON SITE AT ALL TIMES.

## TRAFFIC CONTROL NOTES

1. A TRAFFIC CONTROL PLAN IS TO BE PREPARED AND LODGED WITH COUNCIL BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION

| Issue | Description | By | Ckd | RPEQ | Date |
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| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
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100mm on Original

Scale

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

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Approved
R.P.E.Q No :

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|---|---|---|
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
GENERAL NOTES

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| Drawing No. | Project No. | Issue |
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| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

0 50 100 150 200m

1 : 2000

Surveyor

ROBERT A HARRIES
SURVEYOR

Architect

Filename C102-AA007094-gcd-00-GeneralArrangementLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

Scales 1 : 2000

Original Issue Signatures

Drawn A. CARDEÑO

Original Size A1

Designed A. MAGONDACAN

Height Datum AHD

Project Manager L. PRIZEMAN

Grid GRID

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Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

GENERAL ARRANGEMENT
LAYOUT PLAN


ARCADIS
Arcadis Australia Pacific Pty Limited
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Brisbane QLD 4000
ABN 76 104 485 289

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Fax No: +61 7 3337 0055
www.arcadis.com


Drawing No. C102 — Project No. AA007094 — Issue 05

100mm on Original

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FOR CONTINUATION REFER DWG C106

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale
0 10 20 40 60 80 100m
1 : 1000

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C105-AA007094-gcd-00-ExistingFeaturesSurveyPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 1000 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
EXISTING FEATURES
SURVEY PLAN
SHEET 1 OF 2

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www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C105 | AA007094 | 05 |

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| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

0 10 20 40 60 80 100m

1 : 1000

Surveyor

ROBERT A HARRIES
SURVEYOR

Architect

Filename C105-AA007094-gcd-00-ExistingFeaturesSurveyPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 1000 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

EXISTING FEATURES
SURVEY PLAN
SHEET 2 OF 2


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Tel No: +61 7 3337 0000
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www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C106 | AA007094 | 05 |

100mm on Original

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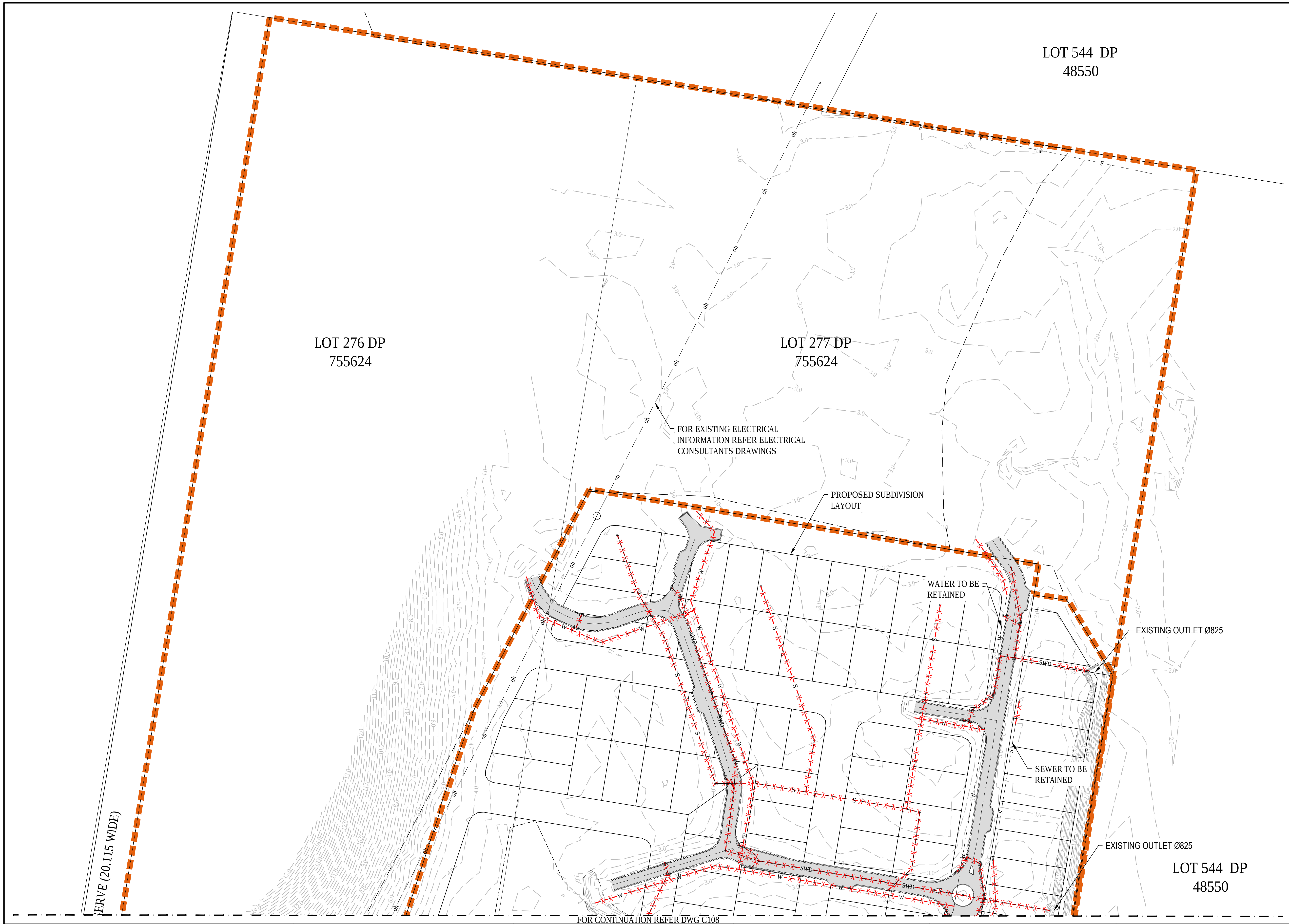


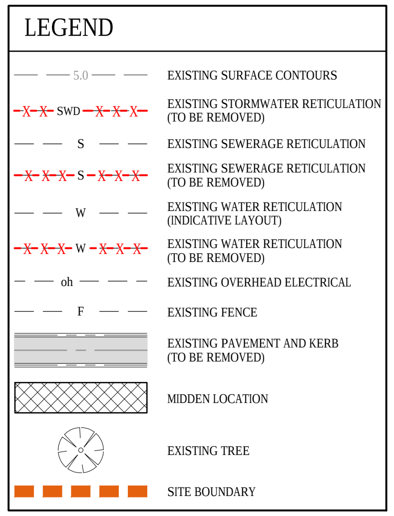


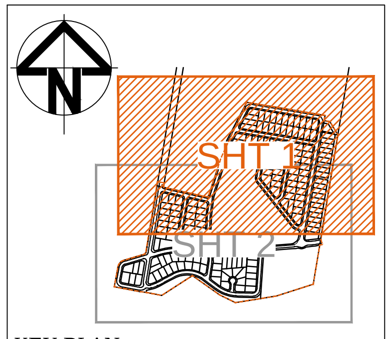

KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

100mm on Original

Scale
0 20 40 60 80 100m
1 : 1000

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C107-AA007094-gcd-00-DemolitionLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 1000 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
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Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
DEMOLITION LAYOUT
PLAN SHEET 1 OF 2

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| Drawing No. | Project No. | Issue |
|---|---|---|
| C107 | AA007094 | 03 |

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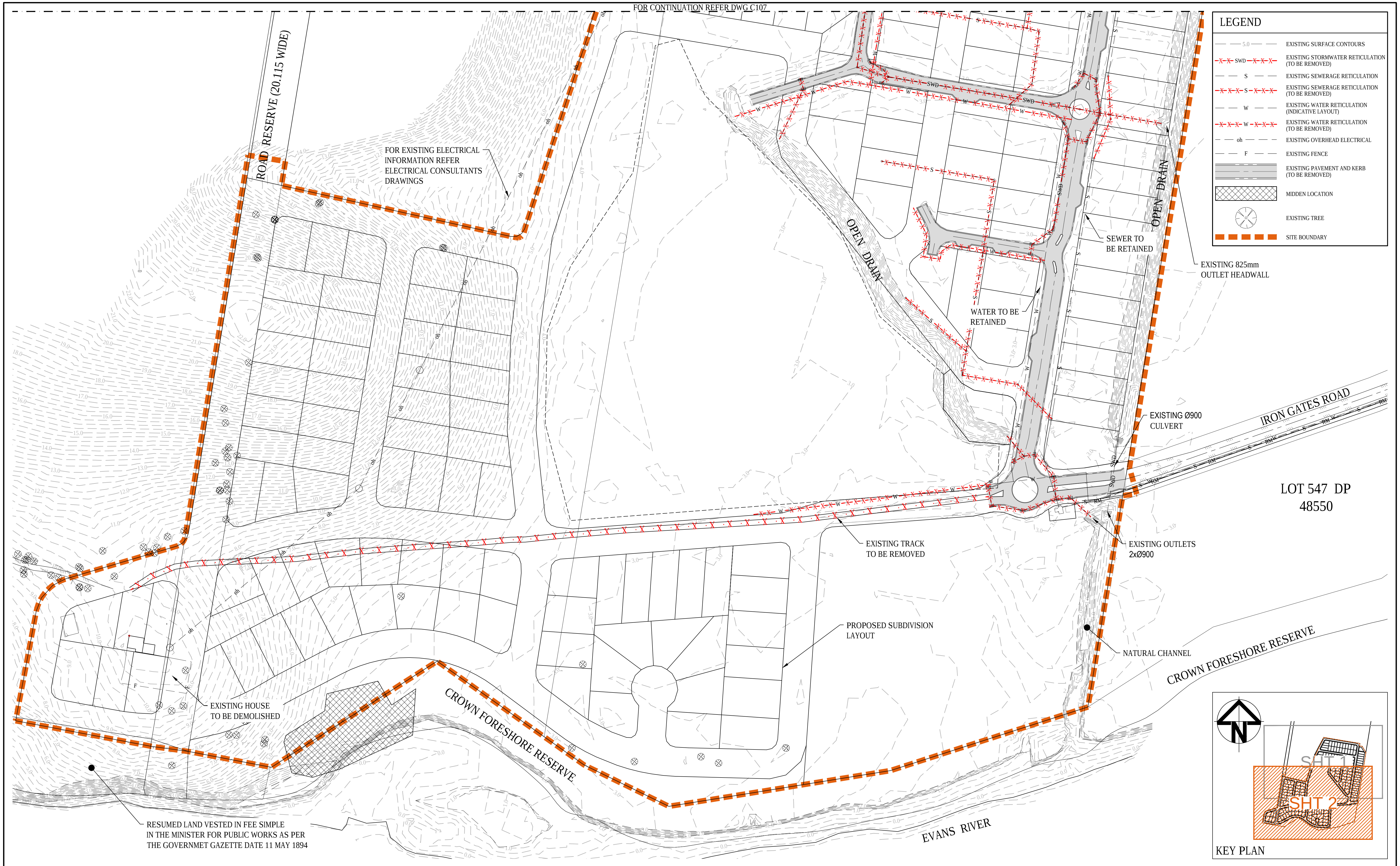


| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale
0 20 40 60 80 100m
1 : 1000

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C107-AA007094-gcd-00-DemolitionLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 1000 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
DEMOLITION LAYOUT PLAN
SHEET 2 OF 2

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| Drawing No. | Project No. | Issue |
|---|---|---|
| C108 | AA007094 | 03 |

100mm on Original

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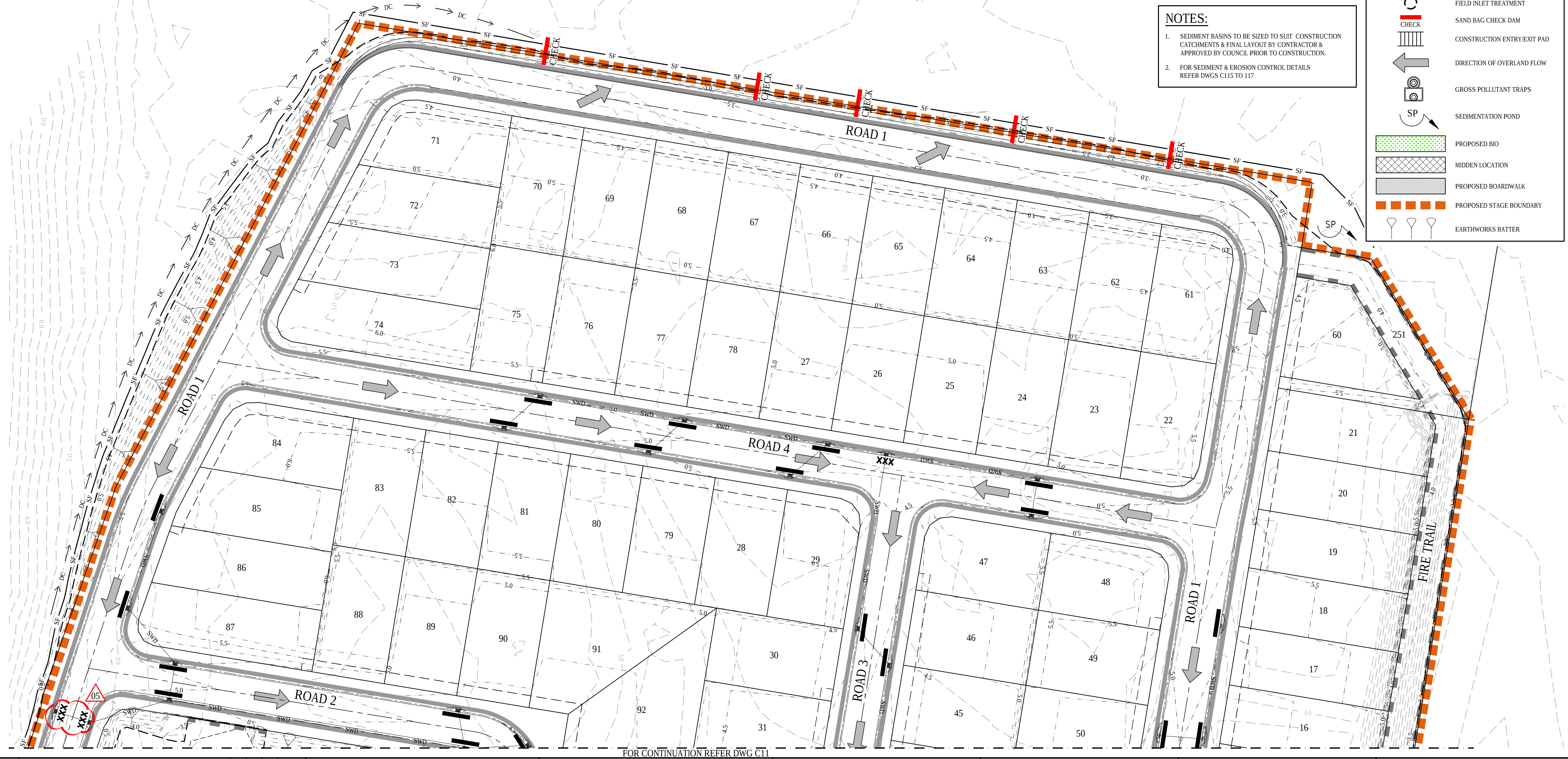


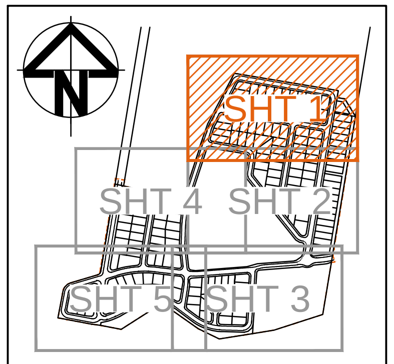


KEY PLAN

## NOTES:

1. SEDIMENT BASINS TO BE SIZED TO SUIT CONSTRUCTION CATCHMENTS & FINAL LAYOUT BY CONTRACTOR & APPROVED BY COUNCIL PRIOR TO CONSTRUCTION.
2. FOR SEDIMENT & EROSION CONTROL DETAILS REFER DWGS C115 TO 117

## LEGEND:

- PROPOSED SURFACE CONTOURS
- EXISTING SURFACE CONTOURS
- EARTHWORKS EXTENTS
- PROTECTED VEGETATION LINE
- PROPOSED STORMWATER DRAINAGE (SWD)
- PROPOSED RETAINING WALL
- 1m WIDE TURF BEHIND KERB
- SILT FENCE (SF)
- DIVERSION CHANNEL (DC)
- CATCH DRAIN
- GULLY TREATMENT ON GRADE
- SAG GULLY TREATMENT (XXX)
- FIELD INLET TREATMENT
- SAND BAG CHECK DAM (CHECK)
- CONSTRUCTION ENTRY/EXIT PAD
- DIRECTION OF OVERLAND FLOW
- GROSS POLLUTANT TRAPS
- SEDIMENTATION POND (SP)
- PROPOSED BIO
- MIDDEN LOCATION
- PROPOSED BOARDWALK
- PROPOSED STAGE BOUNDARY
- EARTHWORKS BATTER

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C110-AA007094-gcd-00-SedimentAndErosionControlPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales 1 : 500
Original Issue Signatures
Drawn A. CARDEÑO
Original Size A1
Designed A. MAGONDACAN
Height Datum AHD
Project Manager L. PRIZEMAN
Grid GRID
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Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
SEDIMENT & EROSION
CONTROL PLAN
SHEET 1 OF 5

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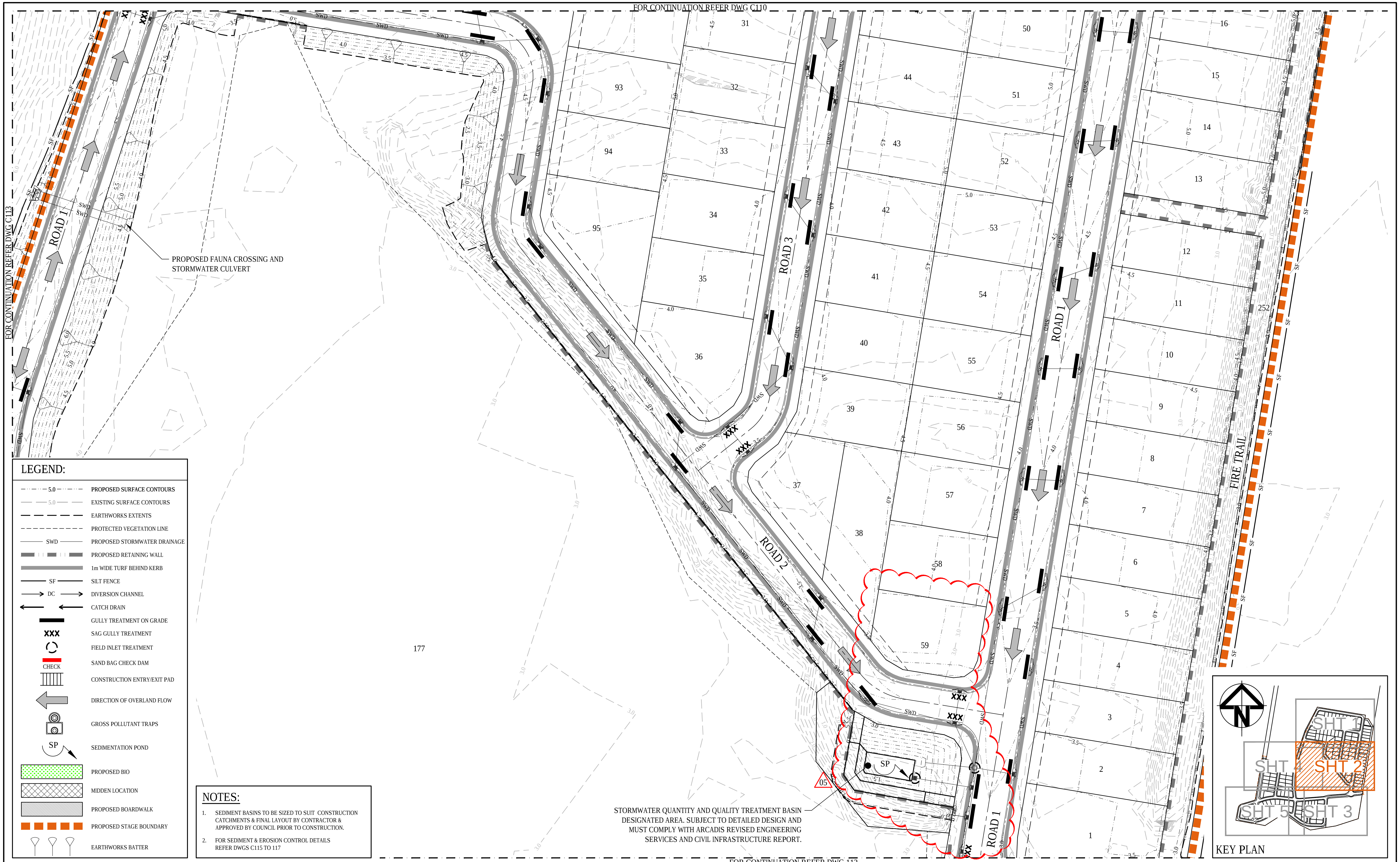
Drawing No. C110 — Project No. AA007094 — Issue 05




## LEGEND:

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| SWD | PROPOSED STORMWATER DRAINAGE |
| | PROPOSED RETAINING WALL |
| | 1m WIDE TURF BEHIND KERB |
| SF | SILT FENCE |
| DC | DIVERSION CHANNEL |
| | CATCH DRAIN |
| | GULLY TREATMENT ON GRADE |
| XXX | SAG GULLY TREATMENT |
| | FIELD INLET TREATMENT |
| CHECK | SAND BAG CHECK DAM |
| | CONSTRUCTION ENTRY/EXIT PAD |
| | DIRECTION OF OVERLAND FLOW |
| | GROSS POLLUTANT TRAPS |
| SP | SEDIMENTATION POND |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | PROPOSED STAGE BOUNDARY |
| | EARTHWORKS BATTER |

## NOTES:

1. SEDIMENT BASINS TO BE SIZED TO SUIT CONSTRUCTION CATCHMENTS & FINAL LAYOUT BY CONTRACTOR & APPROVED BY COUNCIL PRIOR TO CONSTRUCTION.
2. FOR SEDIMENT & EROSION CONTROL DETAILS REFER DWGS C115 TO 117

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| Scales | 1 : 500 | Original Issue Signatures |
|---|---|---|
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
SEDIMENT & EROSION CONTROL PLAN
SHEET 2 OF 5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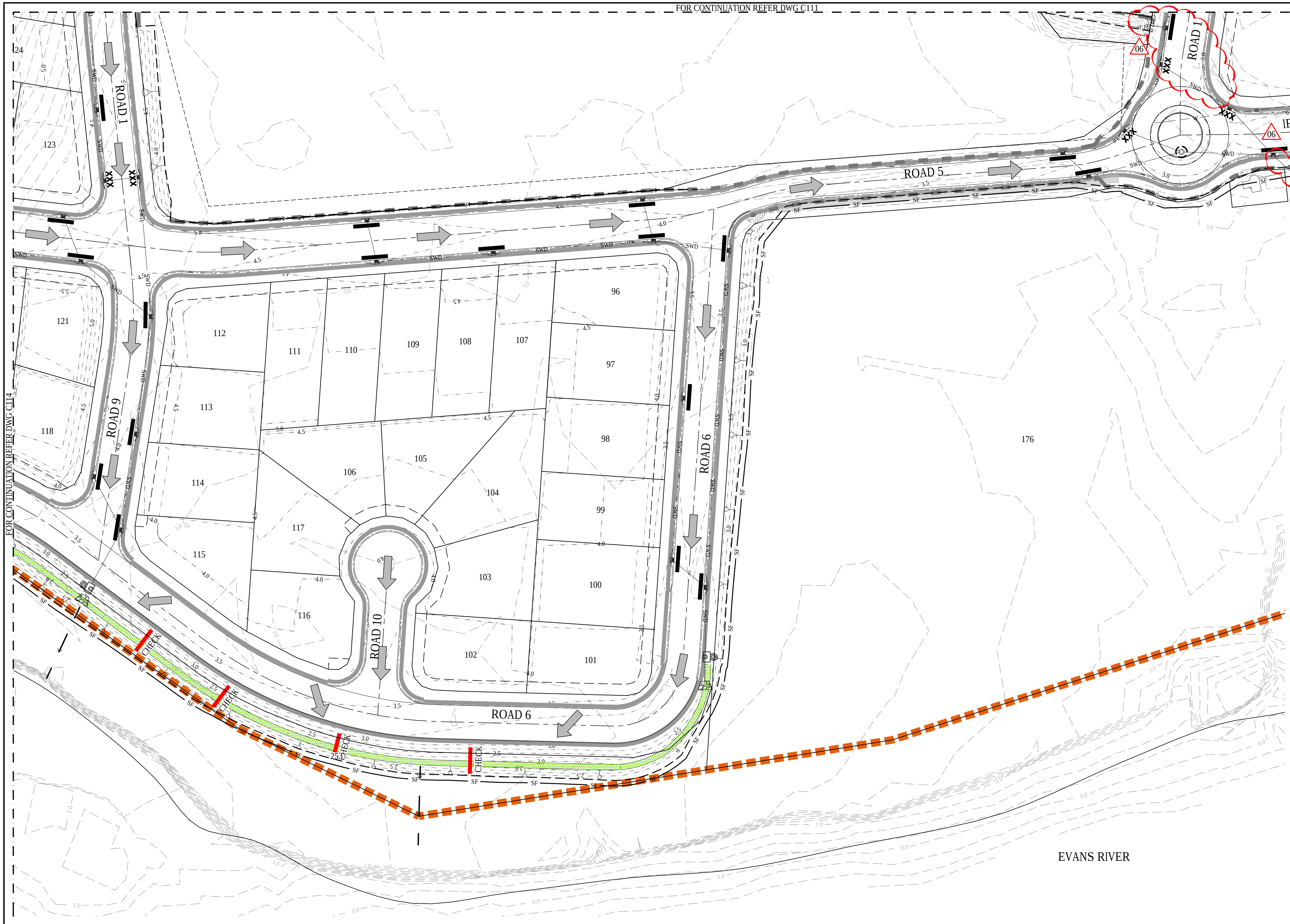
Fax No: +61 7 3337 0055
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C111 | AA007094 | 05 |

Filename C110-AA007094-gcd-00-SedimentAndErosionControlPlan.dwg

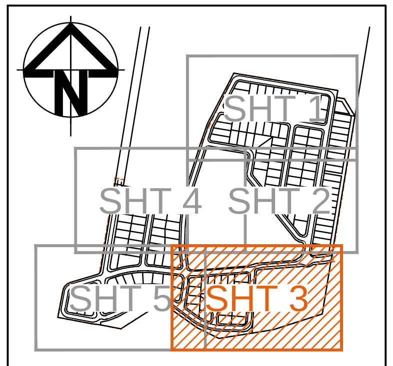



## LEGEND:

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| SWD | PROPOSED STORMWATER DRAINAGE |
| | PROPOSED RETAINING WALL |
| | 1m WIDE TURF BEHIND KERB |
| SF | SILT FENCE |
| DC | DIVERSION CHANNEL |
| | CATCH DRAIN |
| | GULLY TREATMENT ON GRADE |
| XXX | SAG GULLY TREATMENT |
| | FIELD INLET TREATMENT |
| CHECK | SAND BAG CHECK DAM |
| | CONSTRUCTION ENTRY/EXIT PAD |
| | DIRECTION OF OVERLAND FLOW |
| | GROSS POLLUTANT TRAPS |
| SP | SEDIMENTATION POND |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | PROPOSED STAGE BOUNDARY |
| | EARTHWORKS BATTER |

## NOTES:

1. SEDIMENT BASINS TO BE SIZED TO SUIT CONSTRUCTION CATCHMENTS & FINAL LAYOUT BY CONTRACTOR & APPROVED BY COUNCIL PRIOR TO CONSTRUCTION.
2. FOR SEDIMENT & EROSION CONTROL DETAILS REFER DWGS C115 TO 117




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
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| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 04 | MC1004 SECTION AMENDED | | | BD | 14.10.15 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale: 0 10 20 30 40 50m — 1 : 500

Surveyor: ROBERT A HARRIES SURVEYOR

Architect:

Filename: C110-AA007094-gcd-00-SedimentAndErosionControlPlan.dwg

Client: GOLDCORAL PTY LTD

Status: FOR APPROVAL CONSTRUCTION SUBJECT TO APPROVAL

Approved — R.P.E.Q No :

Scales: 1 : 500 — Original Issue Signatures

Original Size: A1 — Drawn: A. CARDEÑO — Designed: A. MAGONDACAN

Height Datum: AHD — Project Manager: L. PRIZEMAN

Grid: GRID



Project: RESIDENTIAL DEVELOPMENT LOT 277 IRON GATES ROAD EVANS HEAD

Title: SEDIMENT & EROSION CONTROL PLAN SHEET 3 OF 5

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www.arcadis.com

| Drawing No. | Project No. | Issue |
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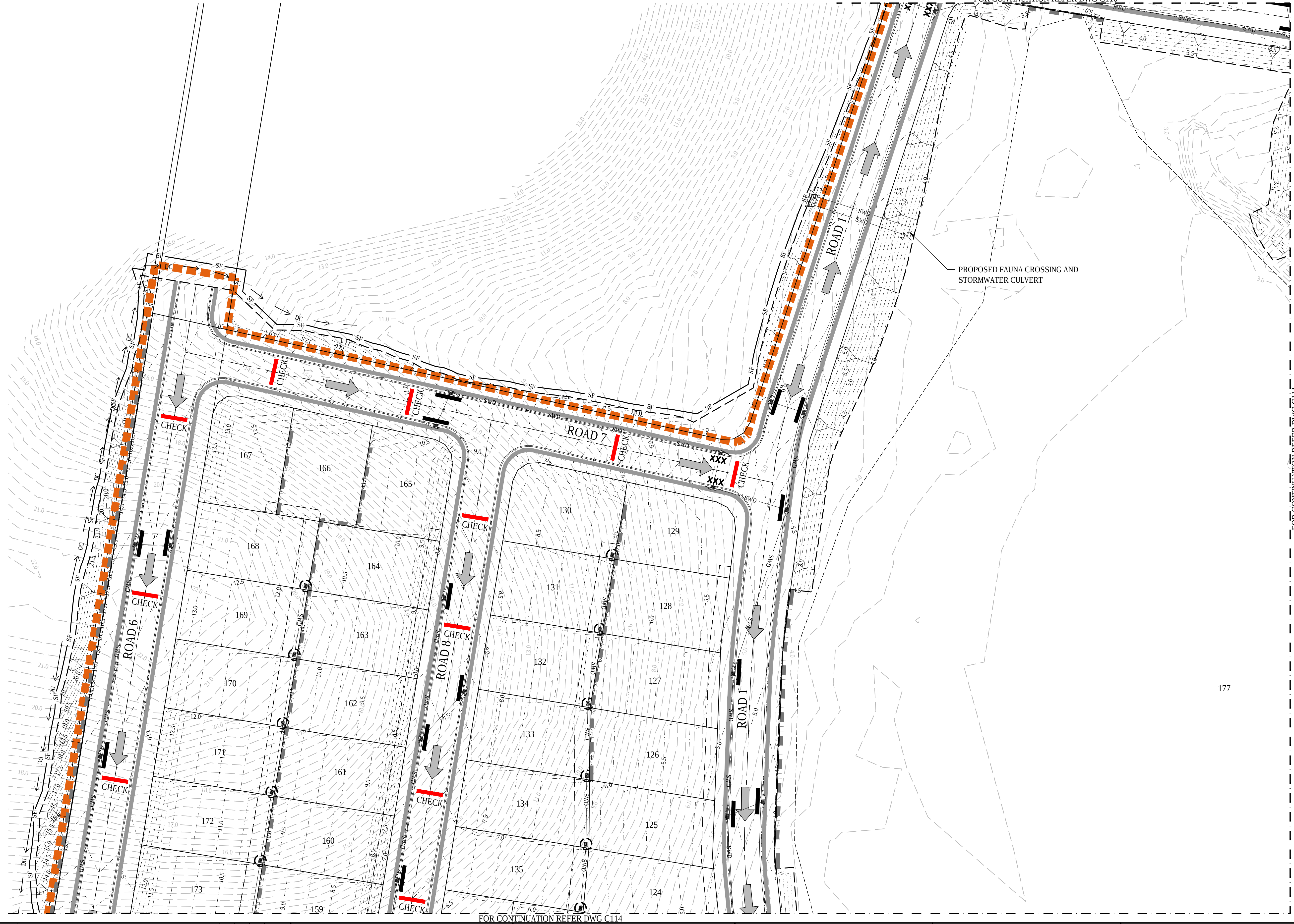
| C112 | AA007094 | 06 |

FOR CONTINUATION REFER DWG C110




FOR CONTINUATION REFER DWG C111

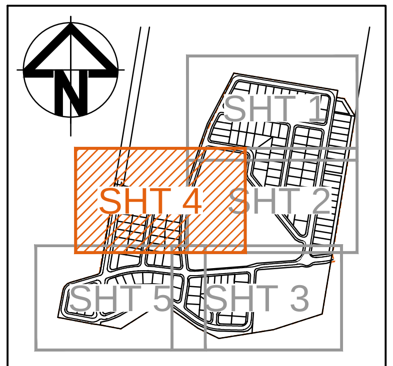
FOR CONTINUATION REFER DWG C114

## LEGEND:

- PROPOSED SURFACE CONTOURS
- EXISTING SURFACE CONTOURS
- EARTHWORKS EXTENTS
- PROTECTED VEGETATION LINE
- PROPOSED STORMWATER DRAINAGE
- PROPOSED RETAINING WALL
- 1m WIDE TURF BEHIND KERB
- SILT FENCE
- DIVERSION CHANNEL
- CATCH DRAIN
- GULLY TREATMENT ON GRADE
- SAG GULLY TREATMENT
- FIELD INLET TREATMENT
- SAND BAG CHECK DAM
- CONSTRUCTION ENTRY/EXIT PAD
- DIRECTION OF OVERLAND FLOW
- GROSS POLLUTANT TRAPS
- SEDIMENTATION POND
- PROPOSED BIO
- MIDDEN LOCATION
- PROPOSED BOARDWALK
- PROPOSED STAGE BOUNDARY
- EARTHWORKS BATTER

## NOTES:

1. SEDIMENT BASINS TO BE SIZED TO SUIT CONSTRUCTION CATCHMENTS & FINAL LAYOUT BY CONTRACTOR & APPROVED BY COUNCIL PRIOR TO CONSTRUCTION.
2. FOR SEDIMENT & EROSION CONTROL DETAILS REFER DWGS C115 TO 117




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

0 10 20 30 40 50m

1 : 500

Surveyor

ROBERT A HARRIES SURVEYOR

Architect

Filename C110-AA007094-gcd-00-SedimentAndErosionControlPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

SEDIMENT & EROSION CONTROL PLAN
SHEET 4 OF 5

ARCADIS

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Level 5, 120 Edward Street
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ABN 76 104 485 289

Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C113 | AA007094 | 05 |

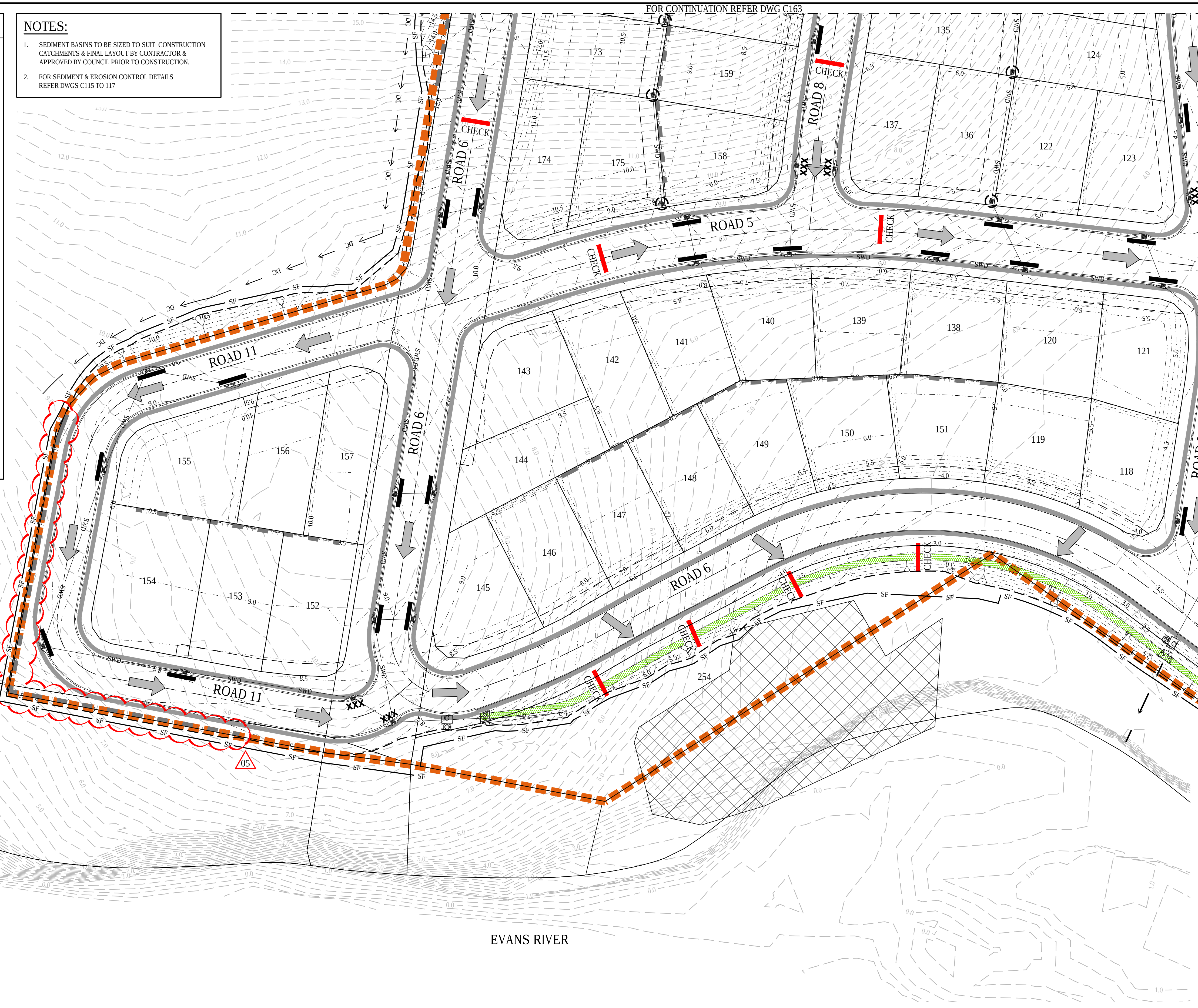
## LEGEND:

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| SWD | PROPOSED STORMWATER DRAINAGE |
| | PROPOSED RETAINING WALL |
| | 1m WIDE TURF BEHIND KERB |
| SF | SILT FENCE |
| DC | DIVERSION CHANNEL |
| | CATCH DRAIN |
| | GULLY TREATMENT ON GRADE |
| XXX | SAG GULLY TREATMENT |
| | FIELD INLET TREATMENT |
| CHECK | SAND BAG CHECK DAM |
| | CONSTRUCTION ENTRY/EXIT PAD |
| | DIRECTION OF OVERLAND FLOW |
| | GROSS POLLUTANT TRAPS |
| SP | SEDIMENTATION POND |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | PROPOSED STAGE BOUNDARY |
| | EARTHWORKS BATTER |

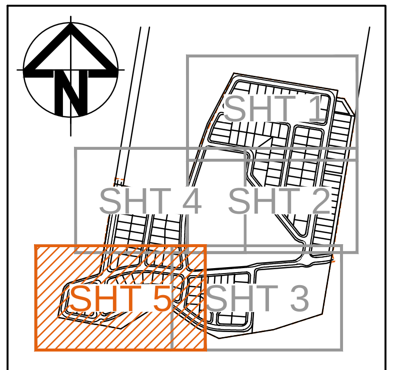
## NOTES:

1. SEDIMENT BASINS TO BE SIZED TO SUIT CONSTRUCTION CATCHMENTS & FINAL LAYOUT BY CONTRACTOR & APPROVED BY COUNCIL PRIOR TO CONSTRUCTION.
2. FOR SEDIMENT & EROSION CONTROL DETAILS REFER DWGS C115 TO 117

FOR CONTINUATION REFER DWG C163




FOR CONTINUATION REFER DWG C162




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

0 10 20 30 40 50m

1 : 500

Surveyor

ROBERT A HARRIES SURVEYOR

Architect

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Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

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| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

SEDIMENT & EROSION CONTROL PLAN
SHEET 5 OF 5

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| Drawing No. | Project No. | Issue |
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| C114 | AA007094 | 05 |

## GENERAL

1. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE INSPECTION, MAINTENANCE AND TESTING OF ALL DRAINAGE, EROSION AND SEDIMENT CONTROL MEASURES ARE UNDERTAKEN ON SITE.
2. ALL DRAINAGE, EROSION AND SEDIMENT CONTROL MEASURES MUST BE APPLIED AND MAINTAINED IN ACCORDANCE WITH THE LATEST INTERNATIONAL EROSION CONTROL ASSOCIATION (IECA) AUSTRALASIA BEST PRACTICE EROSION AND SEDIMENT CONTROL (BPESC) DOCUMENT.
3. REFER TO APPROVED PLANS FOR LOCATION, EXTENT, AND CONSTRUCTION DETAILS. IF THERE ARE QUESTIONS OR PROBLEMS WITH THE LOCATION, EXTENT, OR METHOD OF INSTALLATION, CONTACT THE ENGINEER OR RESPONSIBLE ON-SITE OFFICER FOR ASSISTANCE.
4. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MUST BE IMPLEMENTED AND A REVISED EROSION AND SEDIMENT CONTROL PLAN (ESCP) MUST BE SUBMITTED FOR APPROVAL IN THE EVENT THAT SITE CONDITIONS CHANGE SIGNIFICANTLY FROM THOSE CONSIDERED WITHIN THIS ESCP.
5. IN CIRCUMSTANCES WHERE IT IS CONSIDERED NECESSARY TO PREPARE AN AMENDED EROSION AND SEDIMENT CONTROL PLAN (ESCP), AND WHERE THE DELIVERY OF SUCH AN AMENDED ESCP IS NOT IMMINENT, THEN ALL NECESSARY NEW OR MODIFIED EROSION AND SEDIMENT CONTROL WORKS MUST BE IN ACCORDANCE WITH THE LATEST VERSION OF THE IECA BPESC DOCUMENT. UPON APPROVAL OF THE AMENDED ESCP, ALL WORKS MUST BE IMPLEMENTED IN ACCORDANCE WITH THE AMENDED PLAN.
6. WHERE THERE IS A HIGH PROBABILITY THAT SERIOUS OR MATERIAL ENVIRONMENTAL HARM MAY OCCUR AS A RESULT OF SEDIMENT LEAVING THE SITE, APPROPRIATE ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MUST BE IMPLEMENTED SUCH THAT ALL REASONABLE AND PRACTICABLE MEASURES ARE BEING TAKEN TO PREVENT OR MINIMISE SUCH HARM. ONLY THOSE WORKS NECESSARY TO MINIMISE OR PREVENT ENVIRONMENTAL HARM SHALL BE CONDUCTED ON-SITE PRIOR TO APPROVAL OF THE AMENDED EROSION AND SEDIMENT CONTROL PLAN (ESCP).
7. AT ALL TIMES THE CONTRACTOR SHALL MONITOR THE PREVAILING WEATHER CONDITIONS AND PROTECT ANY DOWNSTREAM CONSTRUCTION OR RECEIVING ENVIRONMENTS.
8. WORKS SHALL BE COMPLETED ON SITE GENERALLY IN ACCORDANCE WITH THE FOLLOWING SCHEDULE:
   (i) PRE CONSTRUCTION - CONSTRUCT SILT FENCES PRIOR TO PRE-START MEETING, WHICH WILL PROTECT EXISTING DOWNSTREAM PROPERTIES, PARKS OR ROAD RESERVES FROM SEDIMENTATION AND EROSION.
   (ii) CLEARING AND BULK EARTHWORKS - CONSTRUCT AND MAINTAIN SILT FENCES WHICH CONTROL SEDIMENTATION AND EROSION DURING CLEARING AND BULK EARTHWORKS. ALL DISTURBED AREAS TO BE EITHER GRASS SEEDED OR TURFED, AS SPECIFIED, AS SOON AS POSSIBLE OR WITHIN 7 DAYS OF FINAL TRIMMING OF EARTHWORKS.
   (iii) MAINTENANCE PERIOD - CONSTRUCT AND MAINTAIN SILT MANAGEMENT CONTROLS WHICH CONTROL SEDIMENTATION AND EROSION PRIOR TO THE ESTABLISHMENT OF GRASS COVER AND REHABILITATION. PROVIDE GRASS FILTER STRIPS IN LOCATIONS AS SHOWN ON EROSION AND SEDIMENT CONTROL PLANS.
9. EROSION AND SEDIMENT CONTROL PROTECTION MEASURES SHALL BE MAINTAINED BY THE CONTRACTOR THROUGHOUT THE CONTRACT.

## RECOMMENDED IMPLEMENTATION SEQUENCE

1 ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND FUNCTIONAL PRIOR TO WORKS COMMENCING AND IN THE FOLLOWING SEQUENCE:
   a. CONSTRUCT TEMPORARY STABILISED SITE ACCESS
   b. PROVIDE INLET PROTECTION TO STORMWATER INLETS AND GULLIES ON ALL ROADS ADJOIN THE SITE.
   c. CONSTRUCT BARRIER FENCING AROUND RESTRICTED 'NO-GO' ZONES OF THE RETAINED VEGETATION AND AREAS NOT TO BE DISTURBED AND AREAS WHICH REMAIN UN-WORKED.
   d. INSTALL ALL TEMPORARY SEDIMENT FENCES
   e. CONSTRUCT DIVERSION BANKS AS NECESSARY (PARALLEL TO CONTOURS) TO DIVERT RUNOFF FROM DISTURBED AREAS INTO THE SEDIMENT PONDS/BASINS
   f. WORK AREAS TO BE DELINEATED BY BARRIER FENCING AND DIVERSION CHANNEL UPSLOPE AND SEDIMENT FENCING DOWNSLOPE.
   g. MAINTAIN EXISTING SEDIMENT PONDS/BASINS AS LONG AS PRACTICALLY POSSIBLE
   h. STABILISE ALL DISTURBED AREAS ASAP AND PROGRESSIVELY AS WORKS ARE COMPLETED.
   i. TEMPORARY STABILISATION TO BE DONE USING MULCHING, HYDROMULCHING, HYDROSEEDING OR DIRECT SEEDING TO GIVE A 70% COVERAGE OF GROUND SURFACE WITHIN 14 DAYS OF WORKS COMPLETING (EVEN IF WORKS MAY CONTINUE LATER)

2 EROSION AND SEDIMENT CONTROL PROTECTION MEASURES MAY NEED TO BE REVISED AND UPDATED TO REFLECT THE SITE CONDITIONS AND PROGRESSION OF THE WORKS, I.E. MEASURES INCLUDING SEDIMENT FENCES SHOULD BE MOVED AND REINSTATED AS WORKS PROGRESS.

## SITE MANAGEMENT

1. ALL OFFICE FACILITIES AND OPERATIONAL ACTIVITIES MUST BE LOCATED SUCH THAT ANY LIQUID EFFLUENT (E.G. PROCESS WATER, WASH-DOWN WATER, EFFLUENT FROM EQUIPMENT CLEANING, OR PLANT WATERING), CAN BE TOTALLY CONTAINED AND TREATED WITHIN THE SITE.
2. THE CONSTRUCTION SCHEDULE MUST AIM TO MINIMISE THE DURATION THAT ANY AND ALL AREAS OF SOIL ARE EXPOSED TO THE EROSIVE EFFECTS OF WIND, RAIN AND SURFACE WATER.
3. LAND-DISTURBING ACTIVITIES MUST BE UNDERTAKEN IN ACCORDANCE WITH THE ESCP AND ASSOCIATED DEVELOPMENT CONDITIONS.
4. LAND-DISTURBING ACTIVITIES MUST BE UNDERTAKEN IN SUCH A MANNER THAT ALLOWS ALL REASONABLE AND PRACTICABLE MEASURES TO BE UNDERTAKEN TO:
   (i) ALLOW STORMWATER TO PASS THROUGH THE SITE IN A CONTROLLED MANNER AND AT NON-EROSIVE FLOW VELOCITIES UP TO THE SPECIFIED DESIGN STORM DISCHARGE;
   (ii) MINIMISE SOIL EROSION RESULTING FROM RAIN, WATER FLOW AND/OR WIND;
   (iii) MINIMISE ADVERSE EFFECTS OF SEDIMENT RUNOFF, INCLUDING SAFETY ISSUES;
   (iv) PREVENT, OR AT LEAST MINIMISE, ENVIRONMENTAL HARM RESULTING FROM WORK-RELATED SOIL EROSION AND SEDIMENT RUNOFF;
   (v) ENSURE THAT THE VALUE AND USE OF LAND/PROPERTIES ADJACENT TO THE DEVELOPMENT (INCLUDING ROADS) ARE NOT DIMINISHED AS A RESULT OF THE ADOPTED ESC MEASURES.
5. ALL EROSION AND SEDIMENT CONTROL MEASURES MUST CONFORM TO THE STANDARDS AND SPECIFICATIONS CONTAINED IN:
   (i) THE DEVELOPMENT APPROVAL CONDITION ISSUED BY THE RELEVANT REGULATORY AUTHORITY; AND
   (ii) THE APPROVED ESCP AND SUPPORTING DOCUMENTATION; OR
   (iii) THE LATEST VERSION OF THE IECA BPESC DOCUMENT, IF THE STANDARDS AND SPECIFICATIONS ARE NOT CONTAINED IN THE APPROVED ESCP.
6. ANY WORKS THAT MAY CAUSE SIGNIFICANT SOIL DISTURBANCE AND ARE ANCILLARY TO ANY ACTIVITY FOR WHICH REGULATORY BODY APPROVAL IS REQUIRED, MUST NOT COMMENCE BEFORE THE ISSUE OF THAT APPROVAL.
7. ADDITIONAL AND/OR ALTERNATIVE ESC MEASURES MUST BE IMPLEMENTED IN THE EVENT THAT SITE INSPECTIONS, THE SITE'S MONITORING AND MAINTENANCE PROGRAM, OR THE REGULATORY AUTHORITY, IDENTIFIES THAT UNACCEPTABLE OFF-SITE SEDIMENTATION IS OCCURRING AS A RESULT OF THE WORK ACTIVITIES.
8. LAND-DISTURBING ACTIVITIES MUST NOT CAUSE UNNECESSARY SOIL DISTURBANCE IF AN ALTERNATIVE CONSTRUCTION PROCESS IS AVAILABLE THAT ACHIEVES THE SAME OR EQUIVALENT OUTCOMES AT AN EQUIVALENT COST.
9. SEDIMENT (INCLUDING CLAY, SILT, SAND, GRAVEL, SOIL, MUD, CEMENT AND CERAMIC WASTE) DEPOSITED OFF THE SITE AS A DIRECT RESULT OF AN ON-SITE ACTIVITY, MUST BE COLLECTED AND THE AREA APPROPRIATELY CLEANED/REHABILITATED AS SOON AS REASONABLE AND PRACTICABLE, AND IN A MANNER THAT GIVES APPROPRIATE CONSIDERATION TO THE SAFETY AND ENVIRONMENTAL RISKS ASSOCIATED WITH THE SEDIMENT DEPOSITION.
10. WHEREVER REASONABLE AND PRACTICABLE, BRICK, TILE AND MASONRY CUTTING MUST BE CARRIED OUT ON A PERVIOUS SURFACE, SUCH AS GRASS, OR OPEN SOIL, OR IN SUCH A MANNER THAT ALL SEDIMENT-LADEN RUNOFF IS PREVENTED FROM DISCHARGING INTO A GUTTER, DRAIN, OR WATER BODY.
11. ADEQUATE WASTE COLLECTION BINS MUST BE PROVIDED ON-SITE AND MAINTAINED SUCH THAT POTENTIAL AND ACTUAL ENVIRONMENTAL HARM RESULTING FROM SUCH MATERIAL WASTE IS MINIMISED.
12. CONCRETE WASTE AND CHEMICAL PRODUCTS, INCLUDING PETROLEUM AND OIL-BASED PRODUCTS, MUST BE PREVENTED FROM ENTERING AN INTERNAL WATER BODY, OR AN EXTERNAL DRAIN, STORMWATER SYSTEM, OR WATER BODY.
13. ALL FLAMMABLE AND COMBUSTIBLE LIQUIDS, INCLUDING ALL LIQUID CHEMICALS IF SUCH CHEMICALS COULD POTENTIALLY BE WASHED OR DISCHARGED FROM THE SITE, ARE STORED AND HANDLED ON-SITE IN ACCORDANCE WITH RELEVANT STANDARDS SUCH AS AS1940 THE STORAGE AND HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS.
14. TRENCHES NOT LOCATED WITHIN ROADWAYS MUST BE BACKFILLED, CAPPED WITH TOPSOIL, AND COMPACTED TO A LEVEL AT LEAST 75mm ABOVE ADJOINING GROUND LEVEL AND APPROPRIATELY STABILISED.
15. ALL STORMWATER, SEWER LINE AND OTHER SERVICE TRENCHES, NOT LOCATED WITHIN ROADWAYS, MUST BE MULCHED AND SEEDED, OR OTHERWISE APPROPRIATELY STABILISED WITHIN 7 DAYS AFTER BACKFILL.
16. NO MORE THAN 150m OF A STORMWATER, SEWER LINE OR OTHER SERVICE TRENCH MUST TO BE OPEN AT ANY ONE TIME.
17. SITE SPOIL MUST BE LAWFULLY DISPOSED OF IN A MANNER THAT DOES NOT RESULT IN ONGOING SOIL EROSION OR ENVIRONMENTAL HARM.
18. ALL FILL MATERIAL PLACED ON SITE MUST COMPRISE ONLY NATURAL EARTH AND ROCK, AND IS TO BE FREE OF CONTAMINANTS, BE FREE DRAINING, AND BE COMPACTED IN LAYERS NOT EXCEEDING 300mm TO 95% STANDARD RELATIVE DRY DENSITY IN ACCORDANCE WITH AS1289.
19. FOOT AND VEHICULAR TRAFFIC WILL BE RESTRICTED IN RECENTLY STABILISED AREAS INCLUDING THOSE HYDROSEEDED, TURFED OR GRASS SEEDED.
20. TEMPORARY SITE STABILISATION PROCEDURES MUST COMMENCE AT LEAST 30 DAYS PRIOR TO THE NOMINATED SITE SHUTDOWN DATE. AT LEAST 70% STABLE COVER OF ALL UNSTABLE AND/OR DISTURBED SOIL SURFACES MUST BE ACHIEVED PRIOR TO SHUTDOWN. THE STABILISATION WORKS MUST NOT RELY UPON THE LONGEVITY OF NON-VEGETATED EROSION CONTROL BLANKETS, OR TEMPORARY SOIL BINDERS.
21. IF BIO-RETENTION FILTER MEDIA IS INSTALLED PRIOR TO 80% OF THE UPSTREAM CATCHMENT BEING FULLY DEVELOPED, THE FILTER MEDIA SHALL BE PROTECTED WITH A LAYER OF GEOFABRIC WITH TURF ON TOP.

## LAND CLEARING

1. LAND CLEARING MUST BE DELAYED AS LONG AS PRACTICABLE AND MUST BE UNDERTAKEN IN CONJUNCTION WITH DEVELOPMENT OF EACH STAGE OF WORKS, UNLESS OTHERWISE APPROVED BY SUPERINTENDENT.
2. ALL REASONABLE AND PRACTICABLE EFFORTS MUST BE TAKEN TO DELAY THE REMOVAL OF, OR DISTURBANCE TO, EXISTING GROUND COVER (ORGANIC OR INORGANIC) PRIOR TO LAND-DISTURBING ACTIVITIES.
6. BULK TREE CLEARING MUST OCCUR IN A MANNER THAT MINIMISES DISTURBANCE TO EXISTING GROUND COVER (ORGANIC OR INORGANIC).
7. BULK TREE CLEARING AND GRUBBING OF THE SITE MUST BE IMMEDIATELY FOLLOWED BY SPECIFIED TEMPORARY STABILISATION MEASURES (E.G. TEMPORARY GRASSING, OR MULCHING) PRIOR TO COMMENCEMENT OF EACH STAGE OF CONSTRUCTION WORKS.
8. DISTURBANCE TO NATURAL WATERCOURSES (INCLUDING BED AND BANKS) AND THEIR ASSOCIATED RIPARIAN ZONES MUST BE LIMITED TO THE MINIMUM PRACTICABLE.
9. NO LAND CLEARING SHALL BE UNDERTAKEN UNLESS PRECEDED BY THE INSTALLATION OF ADEQUATE DRAINAGE AND SEDIMENT CONTROL MEASURES, UNLESS SUCH CLEARING IS REQUIRED FOR THE PURPOSE OF INSTALLING SUCH MEASURES, IN WHICH CASE, ONLY THE MINIMUM CLEARING REQUIRED TO INSTALL SUCH MEASURES SHALL OCCUR.
10. LAND CLEARING MUST BE LIMITED TO 5M FROM THE EDGE OF PROPOSED CONSTRUCTED WORKS, 2M OF ESSENTIAL CONSTRUCTION TRAFFIC ROUTES, AND A TOTAL OF 10M WIDTH FOR CONSTRUCTION ACCESS, UNLESS OTHERWISE APPROVED BY SUPERINTENDENT.
11. PRIOR TO LAND CLEARING, AREAS OF PROTECTED VEGETATION, AND SIGNIFICANT AREAS OF RETAINED VEGETATION MUST BE CLEARLY IDENTIFIED (E.G. WITH HIGH-VISIBILITY TAPE, OR LIGHT FENCING) FOR THE PURPOSES OF MINIMISING THE RISK OF UNNECESSARY LAND CLEARING.
12. ALL REASONABLE AND PRACTICABLE MEASURES MUST BE TAKEN TO MINIMISE THE REMOVAL OF, OR DISTURBANCE TO, THOSE TREES, SHRUBS AND GROUND COVERS (ORGANIC OR INORGANIC) THAT ARE INTENDED TO BE RETAINED.
13. ALL LAND CLEARING MUST BE IN ACCORDANCE WITH THE FEDERAL, STATE AND LOCAL GOVERNMENT VEGETATION PROTECTION/PRESERVATION REQUIREMENTS AND/OR POLICIES.
14. LAND CLEARING IS LIMITED TO THE MINIMUM PRACTICABLE DURING THOSE PERIODS WHEN SOIL EROSION DUE TO WIND, RAIN OR SURFACE WATER IS POSSIBLE.
15. LAND CLEARING MUST NOT EXTEND BEYOND THAT NECESSARY TO PROVIDE UP TO EIGHT (8) WEEKS OF SITE ACTIVITY DURING THOSE MONTHS WHEN THE ACTUAL OR AVERAGE RAINFALL IS LESS THAN 45mm, SIX (6) IF BETWEEN 45 AND 100mm, FOUR (4) WEEKS IF BETWEEN 100 AND 225mm, AND TWO (2) WEEKS IF GREATER THAN 225mm.
16. NATIVE SITE VEGETATION REQUIRED AND APPROVED FOR CLEARING SHOULD BE MULCHED AND STOCKPILED FOR LATER USE IN LANDSCAPING, STABILISATION AND/OR SITE REHABILITATION WORKS.

## SITE ACCESS

1. PRIOR TO THE COMMENCEMENT OF SITE WORKS, THE LOCATION OF THE SITE ACCESS POINT(S) MUST BE VERIFIED WITH THE RELEVANT REGULATORY AUTHORITY.
2. SITE ACCESS MUST BE RESTRICTED TO THE MINIMUM PRACTICAL NUMBER OF LOCATIONS.
3. SITE EXIT POINTS MUST BE APPROPRIATELY MANAGED TO MINIMISE THE RISK OF SEDIMENT BEING TRACKED ONTO SEALED, PUBLIC ROADWAYS.
5. INSTALL SEDIMENT FENCING AND/OR BARRIER FENCING TO CONFINE INGRESS TO AND EGRESS FROM THE SITE TO STABILISED ACCESS POINTS ONLY.
4. STORMWATER RUNOFF FROM ACCESS ROADS AND STABILISED ENTRY/EXIT POINTS MUST DRAIN TO AN APPROPRIATE SEDIMENT CONTROL DEVICE.

CONSTRUCTION EXIT - ROCK PAD

MATERIALS:

1. ROCK: WELL GRADED, HARD, ANGULAR, EROSION RESISTANT ROCK, NOMINAL DIAMETER OF 50 TO 75mm (SMALL DISTURBANCES) OR 100 TO 150mm (LARGE DISTURBANCES). ALL REASONABLE MEASURES MUST BE TAKEN TO OBTAIN ROCK OF NEAR UNIFORM SIZE.
2. FOOTPATH STABILISING AGGREGATE: 25 TO 50mm GRAVEL OR AGGREGATE.
3. GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE -PUNCHED, NON-WOVEN FILTER CLOTH ('BIDIM' A24 OR EQUIVALENT).

INSTALLATION:

1. CLEAR THE LOCATION OF THE ROCK PAD, REMOVING STUMPS, ROOTS AND OTHER VEGETATION TO PROVIDE A FIRM FOUNDATION SO THAT THE ROCK IS NOT PRESSED INTO SOFT GROUND. CLEAR SUFFICIENT WIDTH TO ALLOW PASSAGE OF LARGE VEHICLES, BUT CLEAR ONLY THAT NECESSARY FOR THE EXIT. DO NOT CLEAR ADJACENT AREAS UNTIL THE REQUIRED EROSION AND SEDIMENT CONTROL DEVICES ARE IN PLACE.
2. IF THE EXPOSED SOIL IS SOFT, PLASTIC OR CLAYEY, PLACE A SUB-BASE OF CRUSHED ROCK OR A LAYER OF HEAVY-DUTY FILTER CLOTH TO PROVIDE A FIRM FOUNDATION.
3. PLACE THE ROCK PAD FORMING A MINIMUM 200mm THICK LAYER OF CLEAN, OPEN-VOID ROCK.
4. IF THE ASSOCIATED CONSTRUCTION SITE IS UP-SLOPE OF THE ROCKPAD, THUS CAUSING STORMWATER RUNOFF TO FLOW TOWARD THE ROCK PAD, THEN FORM A MINIMUM 300mm HIGH FLOW CONTROL BERM ACROSS THE ROCK PAD TO DIVERT SUCH RUNOFF TO A SUITABLE SEDIMENT TRAP.
5. THE LENGTH OF THE ROCK PAD SHOULD BE AT LEAST 15m WHERE PRACTICABLE, AND AS WIDE AS THE FULL WIDTH OF THE ENTRY OR EXIT AND AT LEAST 3m. THE ROCK PAD SHOULD COMMENCE AT THE EDGE OF THE OFF-SITE SEALED ROAD OR PAVEMENT.
6. FLARE THE END THE ROCK PAD WHERE IT MEETS THE PAVEMENT SO THAT THE WHEELS OF TURNING VEHICLES DO NOT TRAVEL OVER UNPROTECTED SOIL.
7. IF THE FOOTPATH IS OPEN TO PEDESTRIAN MOVEMENT, THEN COVER THE COARSE ROCK WITH FINE AGGREGATE OR GRAVEL, OR OTHERWISE TAKE WHATEVER MEASURES ARE NEEDED TO MAKE THE AREA SAFE.

## SOIL AND STOCKPILE MANAGEMENT

1. TOPSOIL SHALL BE STRIPPED AND STOCKPILED FOR LATER USE ONSITE.
2. ALL REASONABLE AND PRACTICABLE MEASURES MUST BE TAKEN TO OBTAIN THE MAXIMUM BENEFIT FROM EXISTING TOPSOIL, INCLUDING:
   (i) WHERE THE PROPOSED AREA OF SOIL DISTURBANCE DOES NOT EXCEED 2500m², AND THE TOPSOIL DOES NOT CONTAIN UNDESIRABLE WEED SEED, THE TOP 100mm OF SOIL LOCATED WITHIN AREAS OF PROPOSED SOIL DISTURBANCE (INCLUDING STOCKPILE AREAS) MUST BE STRIPPED AND STOCKPILED SEPARATELY FROM THE REMAINING SOIL.
   (ii) WHERE THE PROPOSED AREA OF SOIL DISTURBANCE EXCEEDS 2500m², AND THE TOPSOIL DOES NOT CONTAIN UNDESIRABLE WEED SEED, THE TOP 50mm OF SOIL MUST BE STRIPPED AND STOCKPILED SEPARATELY FROM THE REMAINING TOPSOIL, AND SPREAD AS A FINAL SURFACE SOIL.
   (iii) IN AREAS WHERE THE TOPSOIL CONTAINS UNDESIRABLE WEED SEED, THE AFFECTED SOIL MUST BE SUITABLY BURIED OR REMOVED FROM THE SITE.
3. STOCKPILES OF ERODABLE MATERIAL THAT HAS THE POTENTIAL TO CAUSE ENVIRONMENTAL HARM IF DISPLACED, MUST BE:
   (i) APPROPRIATELY PROTECTED FROM WIND, RAIN, CONCENTRATED SURFACE FLOW AND EXCESSIVE UP-SLOPE STORMWATER SURFACE FLOWS.
   (ii) LOCATED AT LEAST 2M (PREFERABLY 5M) FROM ANY HAZARDOUS AREA, RETAINED VEGETATION, ROADS AND CONCENTRATED WATER FLOW.
   (iii) LOCATED UP-SLOPE OF AN APPROPRIATE SEDIMENT CONTROL SYSTEM.
   (iv) PROVIDED WITH AN APPROPRIATE PROTECTIVE COVER (SYNTHETIC, MULCH OR VEGETATIVE) IF THE MATERIALS ARE LIKELY TO BE STOCKPILED FOR MORE THAN 28 DAYS.
   (v) PROVIDED WITH AN APPROPRIATE PROTECTIVE COVER (SYNTHETIC, MULCH OR VEGETATIVE) IF THE MATERIALS ARE LIKELY TO BE STOCKPILED FOR MORE THAN 10 DAYS DURING THOSE MONTHS THAT HAVE A HIGH EROSION RISK.
   (vi) PROVIDED WITH AN APPROPRIATE PROTECTIVE COVER (SYNTHETIC, MULCH OR VEGETATIVE) IF THE MATERIALS ARE LIKELY TO BE STOCKPILED FOR MORE THAN 5 DAYS DURING THOSE MONTHS THAT HAVE AN EXTREME EROSION RISK.
4. A SUITABLE FLOW DIVERSION SYSTEM MUST BE ESTABLISHED IMMEDIATELY UP-SLOPE OF A STOCKPILE OF ERODABLE MATERIAL THAT HAS THE POTENTIAL TO CAUSE ENVIRONMENTAL HARM IF DISPLACED, IF THE UP-SLOPE CATCHMENT AREA DRAINING TO THE STOCKPILE EXCEEDS 1500m².

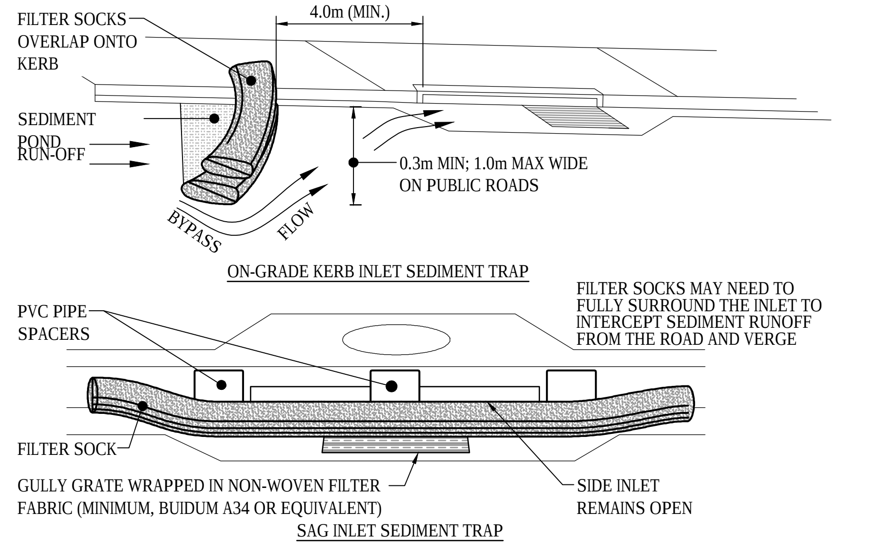
## FILTER SOCKS-CONCENTRATED FLOW

MATERIALS:

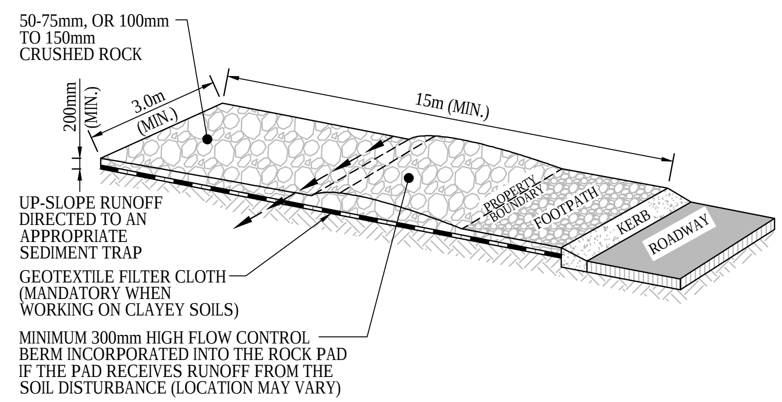
1. SOCKS: MINIMUM Ø200mm SYNTHETIC OR BIODEGRADABLE TUBES MANUFACTURED FROM NON-WOVEN OR COMPOSITE FABRIC SUITABLE FOR THE "FILTRATION" OF COURSE SEDIMENT.
2. FILL MATERIALS: STRAW, CANE MULCH, COMPOSTED MATERIAL (AS4454), COARSE SAND, OR CLEAN AGGREGATE

INSTALLATION:

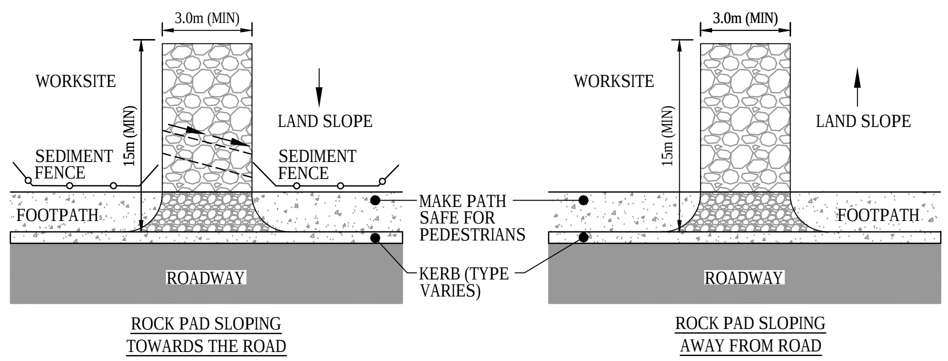
1. ENSURE THE SOCKS ARE PLACED INDIVIDUALLY OR COLLECTIVELY (AS A SINGLE SEDIMENT TRAP) SUCH THAT:
   i) LEAKAGE AROUND OR UNDER THE SOCKS IS MINIMISED;
   ii) ADJOINING SOCKS ARE TIGHTLY BUTTED OR OVERLAPPED AT LEAST 450mm.
   iii) THE SURFACE AREA OF POTENTIAL WATER PONDING UP-SLOPE OF EACH SEDIMENT TRAP IS MAXIMISED.
   iv) TO THE MAXIMUM DEGREE PRACTICAL, ALL SEDIMENT-LADEN WATER WILL PASS THROUGH THE FORMED POND BEFORE FLOWING OVER THE DOWN-SLOPE END OF THE SEDIMENT TRAP.



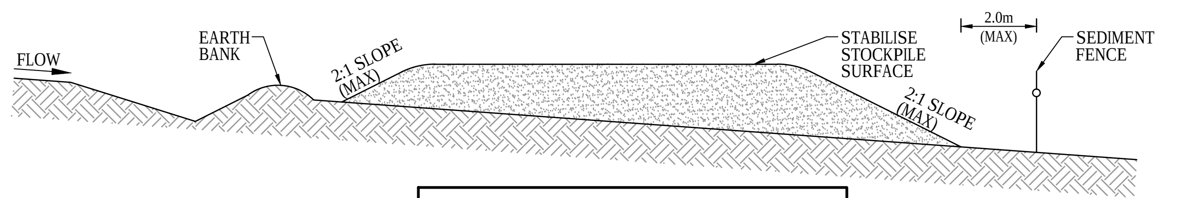

FILTER SOCKS - CONCENTRATED FLOWS




ROCK ENTRY/EXIT PAD FOR CONSTRUCTION SITES




CONSTRUCTION EXIT - ROCK PAD
(CONSTRUCTION SITES ONLY)




TYPICAL STOCKPILE CONFIGURATION

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 04 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 03 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

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Client
GOLDCORAL PTY LTD

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| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
SEDIMENT & EROSION
CONTROL DETAILS
SHEET 1 OF 3


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100mm on Original

## DRAINAGE CONTROL

1. WHEREVER REASONABLE AND PRACTICABLE, STORMWATER RUNOFF ENTERING THE SITE FROM EXTERNAL AREAS, AND NON-SEDIMENT LADEN (CLEAN) STORMWATER RUNOFF ENTERING A WORK AREA OR AREA OF SOIL DISTURBANCE, MUST BE DIVERTED AROUND OR THROUGH THAT AREA IN A MANNER THAT MINIMISES SOIL EROSION AND THE CONTAMINATION OF THAT WATER FOR ALL DISCHARGES UP TO THE SPECIFIED DESIGN STORM DISCHARGE.
2. DURING THE CONSTRUCTION PERIOD, ALL REASONABLE AND PRACTICABLE MEASURES MUST BE IMPLEMENTED TO CONTROL FLOW VELOCITIES IN SUCH A MANNER THAT PREVENTS SOIL EROSION ALONG DRAINAGE PATHS AND AT THE ENTRANCE AND EXIT OF ALL DRAINS AND DRAINAGE PIPES DURING ALL STORMS UP TO THE RELEVANT DESIGN STORM DISCHARGE.
3. TO THE MAXIMUM DEGREE REASONABLE AND PRACTICABLE, ALL WATERS DISCHARGED DURING THE CONSTRUCTION PHASE MUST DISCHARGE ONTO STABLE LAND, IN A NON-EROSIVE MANNER, AND AT A LEGAL POINT OF DISCHARGE.
4. DURING THE CONSTRUCTION PERIOD, ROOF WATER MUST BE MANAGED IN A MANNER THAT MINIMISES SOIL EROSION THROUGHOUT THE SITE, AND SITE WETNESS WITHIN ACTIVE WORK AREAS.

## DIVERSION CHANNELS AND CATCH DRAINS

1. CLEAR THE LOCATION FOR THE CHANNEL, CLEARING ONLY WHAT IS NEEDED TO PROVIDE ACCESS FOR PERSONNEL AND CONSTRUCTION EQUIPMENT.
2. REMOVE ROOTS, STUMPS, AND OTHER DEBRIS AND DISPOSE OF THEM PROPERLY. DO NOT USE DEBRIS TO BUILD ANY ASSOCIATED EMBANKMENTS.
3. EXCAVATE THE CHANNEL TO THE SPECIFIED SHAPE, ELEVATION AND GRADIENT (1% MIN). THE SIDES OF THE CHANNEL SHOULD BE NO STEEPER THAN A 2:1 (H:V) IF CONSTRUCTED IN EARTH, UNLESS SPECIFICALLY DIRECTED WITHIN THE APPROVED PLANS.
4. STABILISE THE CHANNEL AND BANKS IMMEDIATELY UNLESS IT WILL OPERATE FOR LESS THAN 30 DAYS. IN EITHER CASE, TEMPORARY EROSION PROTECTION (MATTING, ROCK, TURF, ETC.) WILL BE REQUIRED AS SPECIFIED WITHIN THE APPROVED PLANS OR AS DIRECTED.
5. IF THE CHANNEL IS CUT INTO A DISPERSIVE (SODIC) SOIL, THE EXPOSED DISPERSIVE SOIL MUST BE COVERED AND MAINTAINED WITH A MINIMUM 200mm THICK LAYER OF NON-DISPERSIVE SOIL PRIOR TO PLACEMENT OF EROSION PROTECTION MEASURES.
6. ENSURE THE CHANNEL DISCHARGES TO A STABLE AREA SUCH THAT SOIL EROSION WILL BE PREVENTED. SPECIFICALLY, ENSURE THE DRAIN DOES NOT DISCHARGE TO AN UNSTABLE FILL SLOPE.

## EROSION CONTROL

1. THE APPLICATION OF LIQUID-BASED DUST SUPPRESSION MEASURES MUST ENSURE THAT SEDIMENT-LADEN RUNOFF RESULTING FROM SUCH MEASURES DOES NOT CREATE A TRAFFIC OR ENVIRONMENTAL HAZARD.
2. ALL TEMPORARY EARTH BANKS, FLOW DIVERSION SYSTEMS, AND EMBANKMENTS ASSOCIATED WITH CONSTRUCTED SEDIMENT BASINS MUST BE MACHINE-COMPACTED, SEEDED AND MULCHED FOR THE PURPOSE OF ESTABLISHING A TEMPORARY VEGETATIVE COVER WITHIN 10 DAYS AFTER GRADING.
3. UNPROTECTED SLOPE LENGTHS MUST NOT EXCEED 80M, OR AN EQUIVALENT VERTICAL FALL OF 3M.
4. THE CONSTRUCTION AND STABILISATION OF EARTH BATTERS STEEPER THAN 6:1 (H:V) MUST BE STAGED SUCH THAT NO MORE THAN 3 VERTICAL-METRES OF ANY BATTER IS EXPOSED TO RAINFALL AT ANY INSTANT.
5. SYNTHETIC REINFORCED EROSION CONTROL MATS AND BLANKETS MUST NOT BE PLACED WITHIN, OR ADJACENT TO, RIPARIAN ZONES AND WATERCOURSES IF SUCH MATERIALS ARE LIKELY TO CAUSE ENVIRONMENTAL HARM TO WILDLIFE OR WILDLIFE HABITATS.
6. A MINIMUM 60% GROUND COVER MUST BE ACHIEVED ON ALL NON-COMPLETED EARTHWORKS EXPOSED TO ACCELERATED SOIL EROSION IF FURTHER CONSTRUCTION ACTIVITIES OR SOIL DISTURBANCES ARE LIKELY TO BE SUSPENDED FOR MORE THAN 30 DAYS DURING THOSE MONTHS WHEN THE EXPECTED RAINFALL IS LESS THAN 30mm; MINIMUM 70% COVER WITHIN 30 DAYS IF BETWEEN 30 AND 45mm; MINIMUM 70% COVER WITHIN 20 DAYS IF BETWEEN 45 AND 100mm; MINIMUM 75% COVER WITHIN 10 DAYS IF BETWEEN 100 AND 225mm; AND MINIMUM 80% COVER WITHIN 5 DAYS IF GREATER THAN 225mm. (ALTERNATIVE TO ABOVE)

### EROSION CONTROL MAT LINING

1. EROSION CONTROL MATS MUST BE STORED AWAY FROM DIRECT SUNLIGHT OR COVERED WITH ULTRAVIOLET PROTECTIVE SHEETING UNTIL THE SITE IS READY FOR THEIR INSTALLATION.
2. VEHICLES AND CONSTRUCTION EQUIPMENT MUST NOT BE PERMITTED TO MANEUVER OVER THE MATTING UNLESS IT HAS BEEN COVERED WITH A LAYER OF SOIL OR GRAVEL AT LEAST 150mm THICK.
3. IF THE CHANNEL IS TO BE GRASSED, PREPARE A SMOOTH SEED BED OF APPROXIMATELY 75mm OF TOPSOIL, SEED, FERTILISE, WATER AND RAKE TO REMOVE ANY REMAINING SURFACE IRREGULARITIES.
4. EXCAVATE A 300mm DEEP BY 150mm WIDE ANCHOR TRENCH ALONG THE FULL WIDTH OF THE UPSTREAM END OF THE AREA TO BE TREATED.
5. AT LEAST 300mm OF THE MAT MUST BE ANCHORED INTO THE TRENCH WITH THE ROLL OF MATTING RESTING ON THE GROUND UP-SLOPE OF THE TRENCH.
6. WHEN SPREADING THE MATS, AVOID STRETCHING THE FABRIC. THE MATS SHOULD REMAIN IN GOOD CONTACT WITH THE SOIL.
7. THE INSTALLATION PROCEDURE MUST ENSURE THAT THE MAT ACHIEVES AND RETAINS GOOD CONTACT WITH THE SOIL.
8. DAMAGED MATTING MUST BE REPAIRED OR REPLACED.

### TURF LINED

1. TURF SHOULD BE USED WITHIN 12 HOURS OF DELIVERY, OTHERWISE ENSURE THE TURF IS STORED IN CONDITIONS APPROPRIATE FOR THE WEATHER CONDITIONS (e.g. A SHADED AREA).
2. MOISTENING THE TURF AFTER IT IS UNROLLED WILL HELP MAINTAIN ITS VIABILITY.
3. TURF SHOULD BE LAID ON A MINIMUM 75mm BED OF ADEQUATELY FERTILISED TOPSOIL. RAKE THE SOIL SURFACE TO BREAK THE CRUST JUST BEFORE LAYING THE TURF.
4. DURING THE WARMER MONTHS, LIGHTLY IRRIGATE THE SOIL IMMEDIATELY BEFORE LAYING THE TURF.
5. ENSURE THE TURF IS NOT LAID ON GRAVEL, HEAVILY COMPACTED SOILS, OR SOILS THAT HAVE BEEN RECENTLY TREATED WITH HERBICIDES.
6. ENSURE THE TURF EXTENDS UP THE SIDES OF THE DRAIN AT LEAST 100mm ABOVE THE ELEVATION OF THE CHANNEL INVERT, OR AT LEAST TO A SUFFICIENT ELEVATION TO FULLY CONTAIN EXPECTED CHANNEL FLOW.
7. ON CHANNEL GRADIENTS OF 3:1(H:V) OR STEEPER, OR IN SITUATIONS WHERE HIGH FLOW VELOCITIES (i.e. VELOCITY >1.5m/s) ARE LIKELY WITHIN THE FIRST TWO WEEK FOLLOWING PLACEMENT, SECURE THE INDIVIDUAL TURF STRIPS WITH WOODEN OR PLASTIC PEGS.
8. ENSURE THAT INTIMATE CONTACT IS ACHIEVED AND MAINTAINED BETWEEN THE TURF AND THE SOIL SUCH THAT SEEPAGE FLOW BENEATH THE TURF IS AVOIDED.
9. WATER UNTIL THE SOIL IS WET 100mm BELOW THE TURF. THEREAFTER, WATERING SHOULD BE SUFFICIENT TO MAINTAIN AND PROMOTE HEALTHY GROWTH.

### ROCK-LINED

1. ALL ROCK MUST BE HARD, WEATHER RESISTANT, AND DURABLE AGAINST DISINTEGRATION UNDER CONDITIONS TO BE MET IN HANDLING, PLACEMENT AND OPERATION.
2. ALL ROCK MUST HAVE ITS GREATEST DIMENSION NOT GREATER THAN 3 TIMES ITS LEAST DIMENSIONS.
3. THE ROCK USED IN FORMATION OF THE DRAIN MUST BE EVENLY GRADED WITH 50% BY WEIGHT LARGER THAN THE SPECIFIED NOMINAL ROCK SIZE AND HAVE SUFFICIENT SMALL ROCK TO FILL THE VOIDS BETWEEN THE LARGER ROCK. DIRT, FINES, AND SMALLER ROCK MUST NOT EXCEED 5% BY WEIGHT.
4. THE DIAMETER OF THE LARGEST ROCK SIZE SHOULD BE NO LARGER THAN 1.5 TIMES THE NOMINAL ROCK SIZE. SPECIFIC GRAVITY TO BE AT LEAST 2.5.
5. FILTER CLOTH GEOTEXTILE FABRIC: HEAVY-DUTY, NEEDLE-PUNCHED, NON-WOVEN FILTER CLOTH, MINIMUM 'BIDIM' A24 OR EQUIVALENT.
6. PRIOR TO PLACEMENT, ALL ROCKS MUST BE VISUALLY CHECKED FOR SIZE, ELONGATION, CRACKS, DETERIORATION AND OTHER VISIBLE DEFECTS. THE DEGREE AND THOROUGHNESS OF SUCH CHECKING MUST BE APPROPRIATE FOR THE POTENTIAL CONSEQUENCES ASSOCIATED WITH FAILURE OF THE STRUCTURE OR PURPOSE FOR WHICH THE MATERIAL WILL BE USED.
7. IF A FILTER CLOTH UNDERLAY IS SPECIFIED, PLACE THE FILTER FABRIC DIRECTLY ON THE PREPARED FOUNDATION. IF MORE THAN ONE SHEET OF FILTER CLOTH IS REQUIRED OVER THE AREA, OVERLAP THE EDGE OF EACH SHEET AT LEAST 300mm, AND SECURE ANCHOR PINS AT MINIMUM 1M SPACING ALONG THE OVERLAP.
8. ENSURE THE FILTER CLOTH IS PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION OF THE FABRIC AND THE ROCK. REPAIR ANY DAMAGE BY REMOVING THE ROCK AND REPLACING WITH ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA OVERLAPPING THE EXISTING FABRIC A MINIMUM OF 300mm.
9. PLACEMENT OF ROCK SHOULD FOLLOW IMMEDIATELY AFTER PLACEMENT OF THE FILTER LAYER. PLACE ROCK SO THAT IT FORMS A DENSE, WELL-GRADED MASS OF ROCK WITH A MINIMUM OF VOIDS.
10. PLACE ROCK LINING TO THE EXTENT AND DEPTH INDICATED WITHIN THE APPROVED PLANS.
11. ENSURE THE ROCK IS PLACED IN AN APPROPRIATE MANNER TO AVOID DISPLACING UNDERLYING MATERIALS OR PLACING UNDUE IMPACT FORCE ON THE BEDDING MATERIALS.
12. ENSURE THE ROCK IS PLACED WITH A MINIMUM THICKNESS OF 1.5 TIMES THE NOMINAL ROCK SIZE (D50).
13. ENSURE MATERIALS THAT ARE D50 AND LARGER ARE POSITIONED FLUSH WITH THE TOP SURFACE WITH FACES AND SHAPES MATCHED TO MINIMISE VOIDS.
14. ENSURE PROJECTIONS ABOVE OR DEPRESSIONS UNDER THE SPECIFIED TOP SURFACE ARE LESS THAN 20% OF THE ROCK LAYER THICKNESS. THE AVERAGE SURFACE PLANE OF THE FINISHED ROCK IS DEFINED AS THE PLANE WHERE 50% OF THE TOPS OF ROCKS WOULD CONTACT.
15. ENSURE THE COMPLETED CHANNEL HAS SUFFICIENT DEPTH (AS SPECIFIED FOR THE TYPE OF CHANNEL) MEASURED FROM THE CHANNEL INVERT (AVERAGE SURFACE PLANE ALONG CHANNEL INVERT) TO THE TOP OF THE EMBANKMENT. THE AVERAGE SURFACE PLANE OF THE FINISHED ROCK IS DEFINED AS THE PLANE WHERE 50% OF THE TOPS OF ROCKS WOULD CONTACT.
16. TO THE MAXIMUM DEGREE PRACTICABLE, THE MATERIAL BETWEEN LARGER ROCK MUST NOT BE LOOSE OR EASILY DISPLACED BY THE EXPECTED FLOW.
17. AFTER PLACEMENT OF THE ROCK LINING, ENSURE THE DRAIN HAS A CONSTANT FALL IN THE DESIRED DIRECTION FREE OF OBSTRUCTIONS.

## CHECK DAMS

1. CHECK DAMS CAN BE BUILT WITH VARIOUS MATERIALS INCLUDING ROCKS AND SANDBAGS.

### MATERIALS:

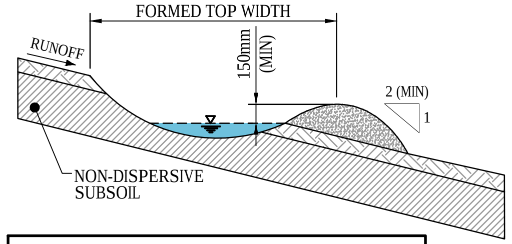
1. ROCK: 150 TO 300mm EQUIVALENT DIAMETER HARD EROSION RESISTANT ROCK.
2. RECYCLED CONCRETE: 150 TO 300mm EQUIVALENT DIAMETER FREE FROM FINES AND CEMENT DUST.
3. SANDBAGS: GEOTEXTILE BAGS (WOVEN SYNTHETIC, OR NON-WOVEN BIODEGRADABLE) FILLED WITH CLEAN COARSE SAND, CLEAN AGGREGATE, OR COMPOST.

### INSTALLATION:

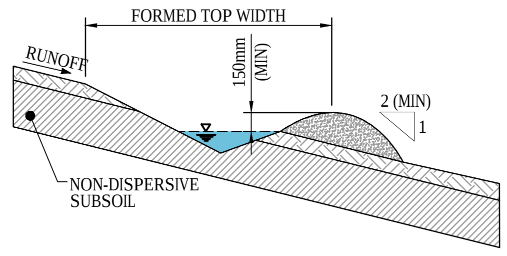
1. PRIOR TO PLACEMENT OF THE SEDIMENT TRAP, ENSURE THE DRAINAGE CHANNEL IS DEEP ENOUGH TO PREVENT WATER BEING UNSAFELY DIVERTED OUT OF THE DRAIN ONCE THE CHECK DAMS ARE INSTALLED.
2. LOCATE EACH CHECK DAM SEDIMENT TRAP AS DIRECTED WITHIN THE APPROVED PLANS, OR OTHERWISE AT SUCH A SPACING TO ACHIEVE THE REQUIRED SEDIMENT TRAPPING OUTCOMES. REFER DETAIL.
3. PLACE EACH CHECK DAM SEDIMENT TRAP TO THE LINES AND PROFILE SHOWN IN THE APPROVED PLAN OR AS DIRECTED BY THE SITE SUPERVISOR.

## LEVEL SPREADER INSTALLATION:

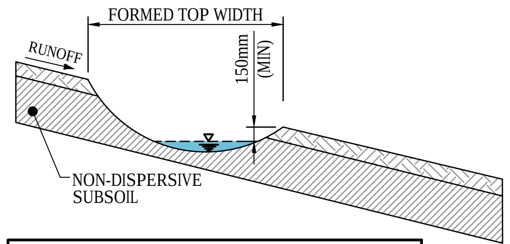
1. THE OUTLET SILL OF THE SPREADER SHOULD BE PROTECTED WITH EROSION CONTROL MATTING TO PREVENT EROSION DURING THE ESTABLISHMENT OF VEGETATION. THE MATTING SHOULD BE A MINIMUM OF 1200mm WIDE EXTENDING AT LEAST 300mm UPSTREAM OF THE EDGE OF THE OUTLET CREST AND BURIED AT LEAST 150mm IN A VERTICAL TRENCH. THE DOWNSTREAM EDGE SHOULD BE SECURELY HELD IN PLACE WITH CLOSELY SPACED HEAVY-DUTY WIRE STAPLES AT LEAST 150mm LONG.
2. ENSURE THAT THE OUTLET SILL (CREST) IS LEVEL FOR THE SPECIFIED LENGTH.
3. IMMEDIATELY AFTER CONSTRUCTION, TURF, OR SEED AND MULCH WHERE APPROPRIATE, THE LEVEL SPREADER.




TYPE A - PARABOLIC CATCH DRAIN WITH DOWN-SLOPE BANK



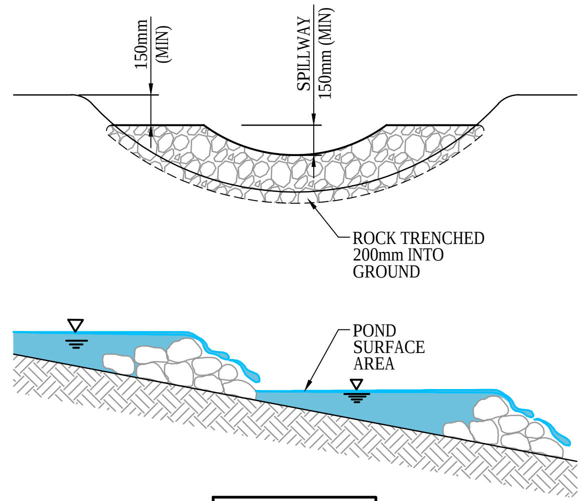

TYPE B - TRIANGULAR V-DRAIN CATCH DRAIN WITH DOWN-SLOPE BANK



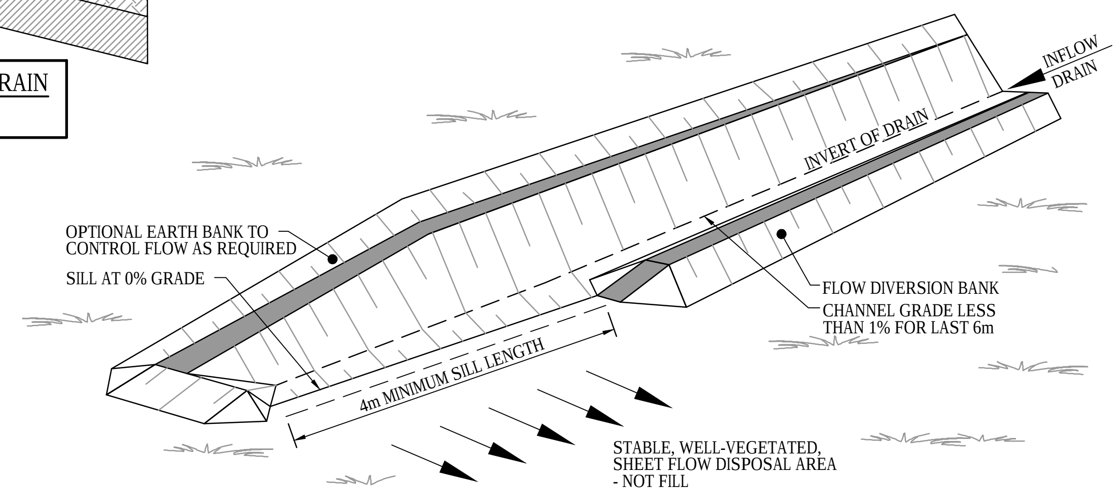

TYPE C - PARABOLIC CATCH DRAIN WITHOUT BANK

| CONSTRUCTED DIMENSIONS OF PARABOLIC CATCH DRAINS | | |
|---|---|---|
| DRAIN TYPE | FORMED WIDTH WITH OR WITHOUT BANK | FORMED DEPTH WIDTH OR WITHOUT BANK |
| TYPE-A | 1.6m | 0.30m |
| TYPE-B | 2.4m | 0.45m |
| TYPE-C | 3.6m | 0.65m |

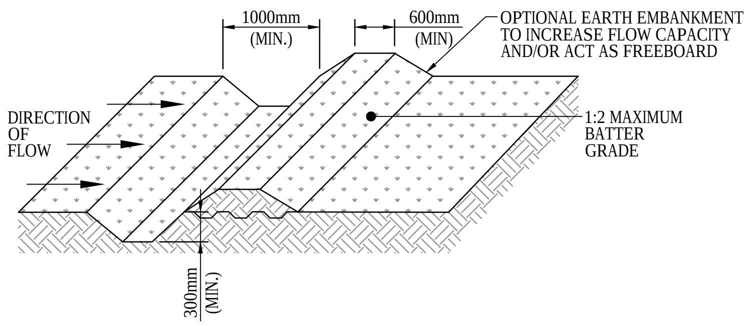
| CONSTRUCTED DIMENSIONS OF TRIANGULAR V-DRAINS | | |
|---|---|---|
| DRAIN TYPE | FORMED WIDTH WITH OR WITHOUT BANK | FORMED DEPTH WIDTH OR WITHOUT BANK |
| TYPE-AV | 2.0m | 0.30m |
| TYPE-BV | 2.7m | 0.45m |
| TYPE-CV | 3.9m | 0.65m |



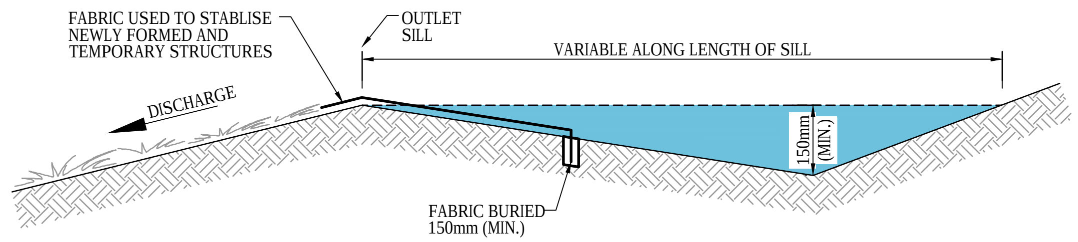

CHECK DAMS




TYPICAL LAYOUT OF LEVEL SPREADER




DIVERSION CHANNEL




TYPICAL PROFILE OF THE OUTLET WEIR

LEVEL SPREADER

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 04 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 03 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C115-AA007094-gcd-00-SedimentAndErosionControlDetails.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| Scales | N.T.S | Original Issue Signatures |
|---|---|---|
| | | Drawn B. MONROYO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
SEDIMENT & EROSION
CONTROL DETAILS
SHEET 2 OF 3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| Drawing No. | Project No. | Issue |
|---|---|---|
| C116 | AA007094 | 04 |

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## SEDIMENT CONTROL

1. OPTIMUM BENEFIT MUST BE MADE OF EVERY OPPORTUNITY TO TRAP SEDIMENT WITHIN THE WORK SITE, AND AS CLOSE AS PRACTICABLE TO ITS SOURCE.
2. SEDIMENT TRAPS MUST BE INSTALLED AND OPERATED TO BOTH COLLECT AND RETAIN SEDIMENT.
3. THE POTENTIAL SAFETY RISK OF A PROPOSED SEDIMENT TRAP TO SITE WORKERS AND THE PUBLIC MUST BE GIVEN APPROPRIATE CONSIDERATION, ESPECIALLY THOSE DEVICES LOCATED WITHIN PUBLICLY ACCESSIBLE AREAS.
4. ALL REASONABLE AND PRACTICABLE MEASURES MUST BE TAKEN TO PREVENT, OR AT LEAST MINIMISE, THE RELEASE OF SEDIMENT FROM THE SITE.
5. SUITABLE ALL-WEATHER MAINTENANCE ACCESS MUST BE PROVIDED TO ALL SEDIMENT CONTROL DEVICES.

## SEDIMENT FENCE

1. SEDIMENT FENCE TO BE INSTALLED ALONG A LINE OF CONSTANT GROUND ELEVATION WHEREVER PRACTICAL.
2. BOTH ENDS OF THE SEDIMENT FENCE TO EXTEND UP THE SLOPE AT LEAST 1m.
3. SUPPORT POST TO BE SPACED A MAXIMUM 2m UNLESS THE FENCE IS SUPPORTED BY A TOP WIRE OR MESH BACKING, IN WHICH CASE 3m MAXIMUM SPACING.
4. FENCE 'RETURNS' SHALL BE INSTALLED AT MAXIMUM 20m SPACING IF FENCE IS INSTALLED ALONG THE CONTOUR, OTHERWISE 5 TO 10m MAXIMUM SPACING DEPENDING ON SLOPE.
5. MINIMUM 4 STAPLES OR TIE WIRES PER STAKE.

MATERIALS:

1. FABRIC: POLYPROPYLENE, POLYAMIDE, NYLON, POLYESTER, OR POLYETHYLENE WOVEN OR NON-WOVEN FABRIC, AT LEAST 700mm IN WIDTH AND A MINIMUM UNIT WEIGHT OF 140GSM. ALL FABRICS TO CONTAIN ULTRAVIOLET INHIBITORS AND STABILISERS TO PROVIDE A MINIMUM OF 6 MONTHS OF USEABLE CONSTRUCTION LIFE (ULTRAVIOLET STABILITY EXCEEDING 70%).
2. FABRIC REINFORCEMENTS: WIRE OR STEEL MESH MINIMUM 14-GAUGE WITH A MAXIMUM MESH SPACING OF 200mm.
3. SUPPORT POSTS/STAKES: 1500mm² (MIN.) HARDWOOD, 2500mm² (MIN.) SOFTWOOD, OR 1.5kg/m (MIN) STEEL STAR PICKETS SUITABLE FOR ATTACHING FABRIC.

INSTALLATION OF A SPILL-THROUGH WEIR:

1. LOCATE THE SPILL-THROUGH WEIR SUCH THAT THE WEIR CREST WILL BE LOWER THAN THE GROUND LEVEL AT EACH END OF THE FENCE.
2. ENSURE THE CREST OF THE SPILL-THROUGH WEIR IS AT LEAST 300mm ABOVE THE GROUND ELEVATION.
3. SECURELY TIE A HORIZONTAL CROSS MEMBER (WEIR) TO THE SUPPORT POSTS/STAKES EACH SIDE OF THE WEIR. CUT THE FABRIC DOWN THE SIDE OF EACH POST AND FOLD THE FABRIC OVER THE CROSS MEMBER AND APPROPRIATELY SECURE THE FABRIC.
4. INSTALL A SUITABLE SPLASH PAD AND/OR CHUTE IMMEDIATELY DOWN-SLOPE OF THE SPILL-THROUGH WEIR TO CONTROL SOIL EROSION AND APPROPRIATELY DISCHARGE THE CONCENTRATED FLOW PASSING OVER THE WEIR.

INSTALLATION FABRIC DROP INLET PROTECTION:

1. ENSURE THAT THE INSTALLATION OF THE SEDIMENT TRAP WILL NOT CAUSE UNDESIRABLE SAFETY OR FLOODING ISSUES.
2. WHERE POSSIBLE, EXCAVATE A 200x200mm TRENCH AROUND THE INLET STRUCTURE.
3. SPACE STAKES EVENLY AROUND THE PERIMETER OF THE STORMWATER INLET AT A MAXIMUM 1m SPACING AND SECURELY DRIVE THEM INTO THE GROUND.
4. WHERE NECESSARY, INSTALL A HORIZONTAL SPILL-THROUGH WEIR TO LIMIT THE MAXIMUM HEIGHT WATER PONDING AROUND THE STRUCTURE.
5. ENSURE THE MAXIMUM POND HEIGHT WILL NOT CAUSE A SAFETY HAZARD, INCLUDING UNDESIRABLE FLOODING OF AN ADJACENT PROPERTY OR ROADWAY. WHEREVER PRACTICAL, THE SPILL-THROUGH WEIR SHOULD BE AT LEAST 300mm ABOVE GROUND LEVEL.
6. IF A SPILL THROUGH WEIR IS NOT INSTALLED, THEN FRAME THE TOP OF THE STAKES WITH HORIZONTAL CROSS MEMBERS.
7. CUT FABRIC FROM A CONTINUOUS ROLL TO ELIMINATE JOINTS.
8. PLACE THE BOTTOM 300mm OF FABRIC IN THE EXCAVATED TRENCH
9. SECURELY FASTEN THE FABRIC TO THE STAKES AND CROSS MEMBERS AT THE FABRIC JOINT, OVERLAP THE FABRIC TO THE NEXT STAKE.
10. BACKFILL THE TRENCH WITH AT LEAST 200mm OF AGGREGATE OR COMPACTED SOIL. IF A TRENCH CANNOT BE EXCAVATED, LAY THE BOTTOM 300mm OF FABRIC EVENLY ON THE GROUND SURFACE AND COVER WITH A 300mm LAYER OF AGGREGATE, NOT EARTH OR SOIL.
11. WHERE REQUIRED, INSTALL A FLOW CONTROL BUND TO MAINTAIN THE SPECIFIED POOL DEPTH AND CONTROL THE MOVEMENT OF WATER.
12. TAKE ALL NECESSARY MEASURES TO MINIMISE THE SAFETY RISK CAUSED BY THE STRUCTURE AND TO PREVENT UNSAFE ENTRY INTO THE STORMWATER INLET.

## SEDIMENT BASIN

1. REMOVE ALL VEGETATION AND TOPSOIL FROM UNDER THE DAM WALL AND FROM WITHIN THE STORAGE AREA.
2. PREPARE THE SITE UNDER THE EMBANKMENT BY RIPPING AT LEAST 100mm TO HELP BOND COMPACTED FILL TO THE EXISTING SUBSTRATE.
3. FOR EARTH EMBANKMENT MATERIAL TYPE AND COMPACTION REFER TO DTMR SPECIFICATION MRTS04 SECTION14.2.6 - WATER RETAINING EMBANKMENTS.
4. CONSTRUCT EMERGENCY SPILLWAY.
5. INSTALL MARKER POST SHOWING MAXIMUM STORAGE AND SETTLING ZONE VOLUMES.
6. AS-CONSTRUCTED PLANS MUST BE PREPARED FOR ALL CONSTRUCTED SEDIMENT BASINS AND ASSOCIATED EMERGENCY SPILLWAYS. SUCH PLANS MUST APPROPRIATELY VERIFY THE BASIN'S DIMENSIONS, LEVELS AND VOLUMES, AND MUST BE SUBMITTED TO THE RELEVANT REGULATORY AUTHORITY WITHIN 14 CALENDAR DAYS OF THE CONSTRUCTION OF EACH BASIN.
7. BASINS SHOULD BE APPROPRIATELY FENCED AND MARKED BY WARNING SIGNS IF UNSUPERVISED PUBLIC ACCESS IS LIKELY AND PUBLIC SAFETY IS AT RISK.

## SITE MONITORING AND MAINTENANCE

1. ALL DRAINAGE, EROSION AND SEDIMENT CONTROL MEASURES MUST BE INSPECTED:
   (i) AT LEAST DAILY (WHEN WORK IS OCCURRING ON-SITE);
   (ii) AT LEAST WEEKLY (WHEN WORK IS NOT OCCURRING ON-SITE);
   (iii) WITHIN 24 HOURS OF EXPECTED RAINFALL; AND
   (iv) WITHIN 18 HOURS OF A RAINFALL EVENT OF SUFFICIENT INTENSITY AND DURATION TO CAUSE RUNOFF ON-SITE).
2. INSPECTION SHALL BE CONDUCTED IN LINE WITH THE FOLLOWING AS A MINIMUM:
   i) RECORD TYPE OF DEVICE/CONTROL MEASURE BEING INSPECTED AND ITS LOCATION;
   ii) RECORD THE CONDITION OF EACH DEVICE/CONTROL MEASURE BEING INSPECTED;
   iii) RECORD MAINTENANCE REQUIREMENTS FOR EACH DEVICE/CONTROL MEASURE BEING INSPECTED;
   iv) RECORD SEDIMENT VOLUMES REMOVED FROM EACH DEVICE/CONTROL MEASURE BEING INSPECTED;
   v) RECORD DETAILS OF SEDIMENT BASIN TREATMENT, FLOCCULENT DOSAGE AND CLEANOUTS;
   vi) RECORD SEDIMENT DISPOSAL PROCEDURES AND LOCATION;
3. ALL DRAINAGE, EROSION AND SEDIMENT CONTROL MEASURES MUST BE MAINTAINED IN PROPER WORKING ORDER AT ALL TIMES DURING THEIR OPERATIONAL LIVES.
4. SEDIMENT CONTROL DEVICES MUST BE DE-SILTED AND MADE FULLY OPERATIONAL AS SOON AS REASONABLE AND PRACTICABLE AFTER A SEDIMENT-PRODUCING EVENT, WHETHER NATURAL OR ARTIFICIAL, IF THE DEVICE'S SEDIMENT RETENTION CAPACITY FALLS BELOW 75% OF ITS DESIGN RETENTION CAPACITY. DE-SILT SEDIMENT TRAP IF THE SEDIMENT LEVEL EXCEEDS 1/3 OF THE CREST HEIGHT.
5. MATERIALS, WHETHER LIQUID OR SOLID, REMOVED FROM SEDIMENT CONTROL DEVICES DURING MAINTENANCE OR DECOMMISSIONING, MUST BE DISPOSED OF IN A MANNER THAT DOES NOT CAUSE ONGOING SOIL EROSION OR ENVIRONMENTAL HARM.
7. ALL WATER QUALITY DATA, INCLUDING DATES OF RAINFALL, DATES OF TESTING, TESTING RESULTS AND DATES OF WATER RELEASE, MUST BE KEPT IN AN ON-SITE REGISTER. THE REGISTER IS TO BE MAINTAINED UP TO DATE FOR THE DURATION OF THE APPROVED WORKS AND BE AVAILABLE ON-SITE FOR INSPECTION BY THE RELEVANT REGULATORY AUTHORITY ON REQUEST.
8. AT NOMINATED INSTREAM WATER MONITORING SITES, A MINIMUM OF 3 WATER SAMPLES MUST BE TAKEN AND ANALYSED, AND THE AVERAGE RESULT USED TO DETERMINE QUALITY.
9. ALL ENVIRONMENTALLY RELEVANT INCIDENTS MUST BE RECORDED IN A FIELD LOG THAT MUST REMAIN ACCESSIBLE TO ALL RELEVANT REGULATORY AUTHORITIES.
10. WASHING/FLUSHING OF SEALED ROADWAYS MUST ONLY OCCUR WHERE SWEEPING HAS FAILED TO REMOVE SUFFICIENT SEDIMENT AND THERE IS A COMPELLING NEED TO REMOVE THE REMAINING SEDIMENT (E.G. FOR SAFETY REASONS). IN SUCH CIRCUMSTANCES, ALL REASONABLE AND PRACTICABLE SEDIMENT CONTROL MEASURES MUST BE USED TO PREVENT, OR AT LEAST MINIMISE, THE RELEASE OF SEDIMENT INTO RECEIVING WATERS. ONLY THOSE MEASURES THAT WILL NOT CAUSE SAFETY AND PROPERTY FLOODING ISSUES SHALL BE EMPLOYED. SEDIMENT REMOVED FROM ROADWAYS MUST BE DISPOSED OF IN A LAWFUL MANNER THAT DOES NOT CAUSE ONGOING SOIL EROSION OR ENVIRONMENTAL HARM.
11. ALL SEEDING, HYDROSEEDING AND TURFING REQUIRES REGULAR WATERING UNTIL EFFECTIVE COVER IS ESTABLISHED AND PLANTS ARE GROWING VIGOROUSLY. WATERING SHOULD DEPEND ON WEATHER AND SOIL CONDITIONS. WATERING SHOULD START IMMEDIATELY AFTER PLANTING AND SHOULD COMPLY WITH THE FOLLOWING AS A MINIMUM:
   i) WEEK 1 — 3 WATERINGS PER WEEK
   ii) WEEK 2-6 — 2 WATERINGS PER WEEK
   iii) WEEK 7-12 — 1 WATERING PER WEEK
11. MAINTENANCE MOWING OF ALL ROAD SHOULDERS, TABLE DRAINS, BATTERS AND OTHER SURFACES LIKELY TO EXPERIENCE ACCELERATED SOIL EROSION MUST AIM TO LEAVE THE GRASS LENGTH NO SHORTER THAN 50mm WHERE REASONABLE AND PRACTICABLE.
12. MAINTENANCE MOWING MUST BE DONE IN A MANNER THAT WILL NOT DAMAGE THE PROFILE OF FORMED, SOFT EDGES, SUCH AS THE CREST OF EARTH EMBANKMENTS.

SEDIMENT BASIN

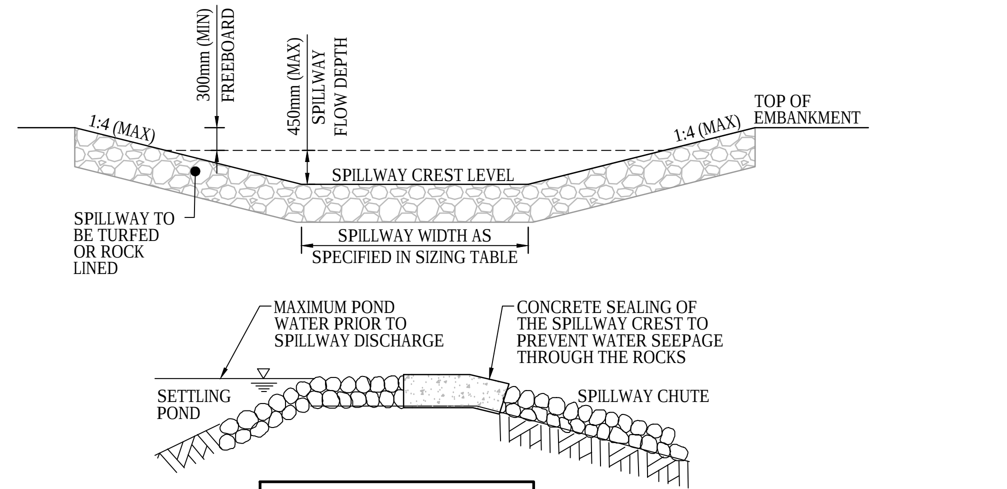
1. CONSTRUCTED SEDIMENT BASINS MUST BE MAINTAINED AND FULLY OPERATIONAL THROUGHOUT THE CONSTRUCTION PERIOD AND UNTIL EACH BASIN'S CATCHMENT AREA ACHIEVES 80% GROUND COVER ON ALL SOIL SURFACES.
2. SETTLED SEDIMENT MUST BE REMOVED FROM SEDIMENT BASINS WHEN THE VOLUME OF THE SEDIMENT EXCEEDS THE DESIGNATED SEDIMENT STORAGE VOLUME, OR THE DESIGN MAXIMUM SEDIMENT STORAGE ELEVATION.
3. SEDIMENT BASIN WATER QUALITY SAMPLES MUST BE TAKEN AT A DEPTH NO GREATER THAN 200mm ABOVE THE LEVEL OF SETTLED SEDIMENT BY A SUITABLY QUALIFIED PERSON. WATER TESTING TO BE UNDERTAKEN USING EITHER A HANDHELD PH/TURBIDITY METER OR SAMPLES COLLECTED FOR LABORATORY TESTING PRIOR TO BASIN DEWATERING. ALL LABORATORY TESTING TO BE UNDERTAKEN BY A NATA ACCREDITED LABORATORY.
4. ALL WATER PUMPED FROM THE SEDIMENT BASIN SHALL BE TESTED FOR ENVIRONMENTAL COMPLIANCE AGAINST THE RELEASE CRITERIA IN THE TABLE BELOW (AS A MINIMUM), UNLESS ALTERNATIVE (MORE STRINGENT) STANDARDS ARE SPECIFIED BY THE LOCAL AUTHORITY PRIOR TO RELEASE.

| PARAMETER | RELEASE CRITERIA |
|---|---|
| SUSPENDED SOLIDS | 50mg/l MAX |
| pH | WITHIN RANGE 6.5-8.5 |
| VISUAL AMENITY | NO VISUAL PLUME |

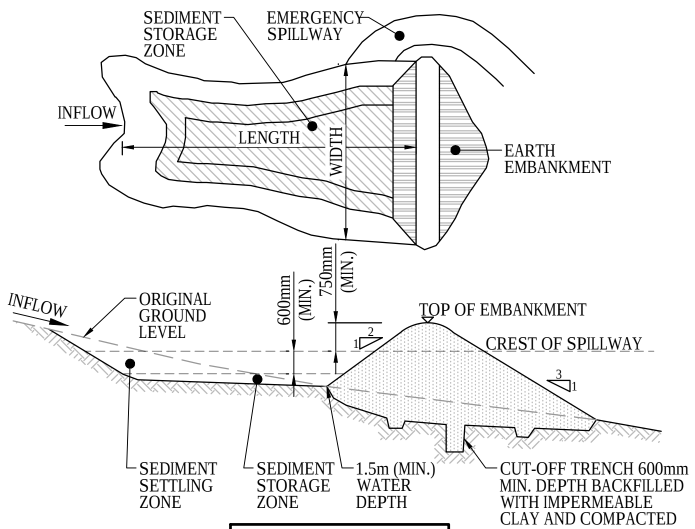
5. THE SEDIMENT BASIN SHALL BE TREATED BY FLOCCULATION AFTER ALL RAINFALL EVENTS (> 5mm) USING GYPSUM OR ALUM. MANUAL DOSAGE OF BASIN SHALL BE UNDERTAKEN USING A MINIMUM RATE OF 32kg/100m³ FOR GYPSUM AND 1.5-8kg/100m³ FOR ALUM. HIGHER DOSAGE MAY BE REQUIRED DEPENDING ON SOIL TYPE AND APPLICATION TECHNIQUE. ALUM SHALL NOT BE USED WHERE THE CATCHMENT DISCHARGES DIRECTLY TO A WATERWAY.
6. THE CHOSEN FLOCCULENT SHALL BE SPREAD EVENLY OVER THE BASIN SURFACE AREA. THE BASIN WILL REQUIRE A PUMP SYSTEM TO SPRAY SLURRY OF FLOCCULANTS OVER SURFACE AT AN ANGLE OF 10°-20°.
7. THE TREATED BASIN SHALL BE DEWATERED WITH A PUMP SYSTEM WITH A FLOATING INLET TO ENSURE SETTLED SEDIMENT IS NOT ENTRAINED AND DISCHARGED. BASIN DEWATERING SHALL OCCUR WITHIN 5 DAYS FROM CONCLUSION OF RAINFALL EVENT.

## SITE REHABILITATION

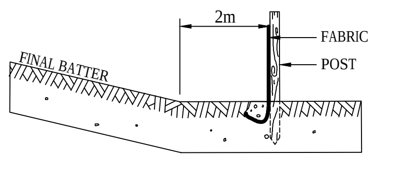
1. ALL DISTURBED AREAS IDENTIFIED AS VERY LOW, LOW, MEDIUM, HIGH, OR EXTREME EROSION RISK MUST BE SUITABLY STABILISED WITHIN 60, 30, 20, 10 OR 5 DAYS RESPECTIVELY, OR PRIOR TO ANTICIPATED RAINFALL, WHICHEVER IS THE GREATER, FROM THE DAY THAT SOIL DISTURBANCES ON THE AREA HAVE BEEN FINALISED.
2. THE TYPE OF GROUND COVER APPLIED TO COMPLETED EARTHWORKS SHOULD BE COMPATIBLE WITH THE ANTICIPATED LONG-TERM LAND USE, ENVIRONMENTAL RISK, AND SITE REHABILITATION MEASURES.
3. UNLESS OTHERWISE DIRECTED BY SUPERINTENDENT OR WHERE DIRECTED BY THE APPROVED REVEGETATION PLAN, TOPSOIL MUST BE PLACED AT A MINIMUM DEPTH OF 75mm ON SLOPES 4:1 (H:V) OR FLATTER, AND 50mm ON SLOPES STEEPER THAN 4:1.
4. THE PH LEVEL (SOIL:WATER 1:5) OF TOPSOIL MUST BE ADEQUATE TO ENABLE ESTABLISHMENT AND GROWTH OF THE SPECIFIED VEGETATION.
5. SOIL AMELIORANTS MUST BE ADDED TO THE SOIL IN ACCORDANCE WITH THE APPROVED LANDSCAPE/REVEGETATION PLANS AND/OR SOIL ANALYSIS.
6. SOIL DENSITY/COMPACTION MUST BE ADJUSTED PRIOR TO SEEDING/PLANTING IN ACCORDANCE WITH THE RELEVANT SPECIFICATIONS, SOIL REPORT AND/OR APPROPRIATE REFERENCE PLANS.
7. ALL UNSTABLE OR DISTURBED SOIL SURFACES MUST BE ADEQUATELY STABILISED AGAINST EROSION (MINIMUM 80%) PRIOR TO COMMENCEMENT OF USE, OR SURVEY PLAN ENDORSEMENT.
8. ALL TEMPORARY DRAINAGE, EROSION AND SEDIMENT CONTROL MEASURES MUST BE REMOVED AFTER ACHIEVING A SATISFACTORY "OFF-MAINTENANCE INSPECTION" BY THE RELEVANT REGULATORY AUTHORITY.
9. DISPOSE OF ANY COLLECTED SEDIMENT OR FILL IN A LAWFUL MANNER THAT DOES NOT CAUSE ONGOING SOIL EROSION OR ENVIRONMENTAL HARM.
10. IMMEDIATELY PRIOR TO THE CONSTRUCTION OF THE PERMANENT STORMWATER TREATMENT DEVICE, APPROPRIATE FLOW BYPASS CONDITIONS MUST BE ESTABLISHED TO PREVENT SEDIMENT-LADEN WATER ENTERING THE DEVICE.
11. IMMEDIATELY FOLLOWING THE CONSTRUCTION OF THE FILTER MEDIA OF THE PERMANENT STORMWATER TREATMENT DEVICE, THE FILTER MEDIA MUST BE COVERED BY HEAVY-DUTY FILTER CLOTH (MINIMUM BIDUM A44 OR EQUIVALENT) AND A MINIMUM 200mm LAYER OF EARTH OR SACRIFICIAL FILTER MEDIA. SUCH EARTH AND FILTER CLOTH MUST NOT BE REMOVED FROM THE DEVICE UNTIL SUITABLE SURFACE CONDITIONS BEING ACHIEVED WITHIN THE BASIN'S CATCHMENT AREA.
12. IMMEDIATELY FOLLOWING THE CONSTRUCTION OF THE PERMANENT STORMWATER TREATMENT DEVICE AN APPROPRIATE TYPE 2 SEDIMENT TRAP MUST BE INSTALLED IN A MANNER TO PREVENT SEDIMENT INTRUSION INTO THE DEVICE.
13. THE MINIMUM SEDIMENT CONTROL STANDARD FOR THE PROTECTION OF THE PERMANENT STORMWATER TREATMENT DEVICE DURING THE CONSTRUCTION AND MAINTENANCE PHASES IS A TYPE 2 SEDIMENT TRAP. (ALTERNATIVE TO ABOVE)
14. PLANT ESTABLISHMENT WITHIN THE PERMANENT STORMWATER TREATMENT DEVICE MUST BE DELAYED UNTIL SEDIMENT INTRUSION INTO THE DEVICE IS SUITABLY UNDER CONTROL.
15. UPON SUITABLE CONDITIONS BEING ACHIEVED WITHIN THE BASIN'S CATCHMENT AREA, THE OPERATIONAL FEATURES OF THE PERMANENT STORMWATER TREATMENT SYSTEM MUST BE MADE FULLY OPERATIONAL (I.E. MAINTENANCE AND/OR RECONSTRUCTION AS REQUIRED).
16. THE PERMANENT STORMWATER TREATMENT FEATURES OF THE REHABILITATED BASIN MUST NOT BE MADE OPERATIONAL UNTIL ALL UP-SLOPE SITE STABILISATION MEASURES HAVE BEEN IMPLEMENTED AND ARE APPROPRIATELY WORKING TO CONTROL SOIL EROSION AND SEDIMENT RUNOFF IN ACCORDANCE WITH THE SPECIFIED ESC STANDARD. (ALTERNATIVE TO ABOVE).



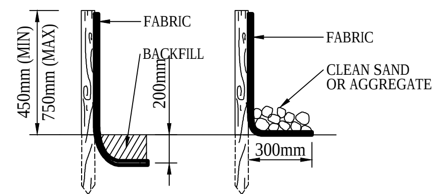

EMERGENCY SPILLWAY



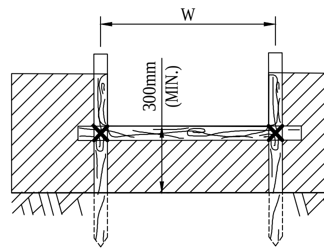

SEDIMENT BASIN



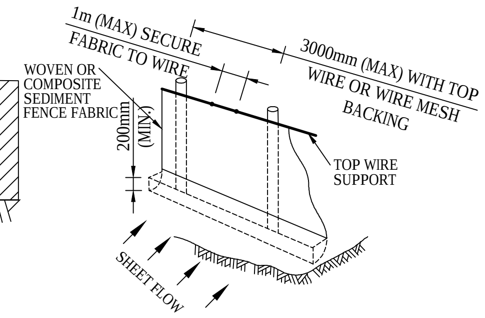

LOCATION OF FENCE RELATIVE TO BASE OF SLOPE



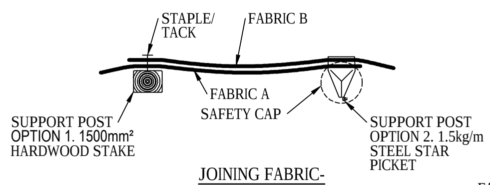

ANCHORING BASE OF FABRIC



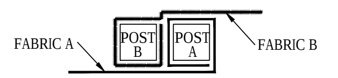

SPILL THROUGH WEIR




INSTALLATION WITH TOP WIRE SUPPORT

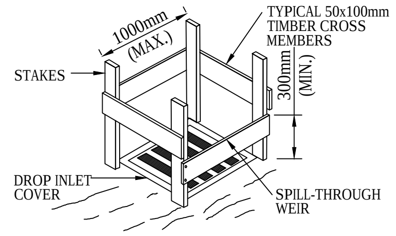



JOINING FABRIC- METHOD 2

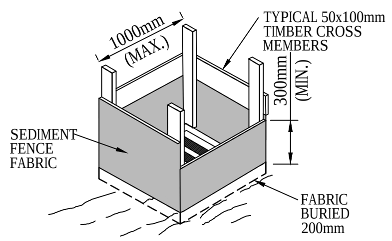



FABRIC TO FOLD AROUND EACH STAKE ONE FULL TURN. STAKE B TO BE DRIVEN TIGHTLY AGAINST STAKE A. THE TOPS OF BOTH STAKES TO BE SECURED WITH WIRE.

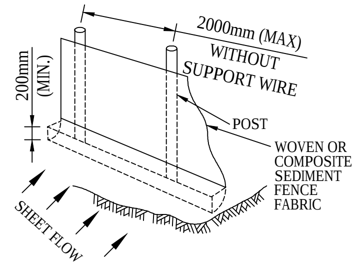
JOINING FABRIC - METHOD 1




DETAILS OF SUPPORT FRAME WITH SPILL-THROUGH WEIR

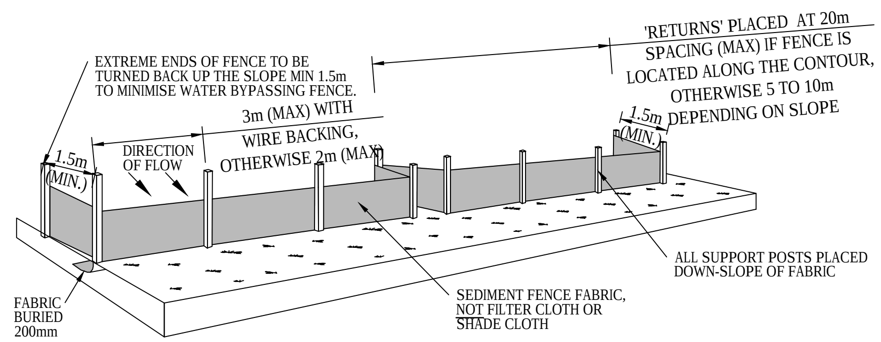



FABRIC DROP INLET PROTECTION WITH SPILL-THROUGH WEIR




INSTALLATION WITHOUT BACKING SUPPORT

FABRIC DROP INLET PROTECTION




INSTALLATION OF SEDIMENT FENCE

SEDIMENT FENCE

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 04 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 03 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

Surveyor: ROBERT A HARRIES SURVEYOR

Architect

Filename C115-AA007094-gcd-00-SedimentAndErosionControlDetails.dwg

Client: GOLDCORAL PTY LTD

Status: FOR APPROVAL CONSTRUCTION SUBJECT TO APPROVAL

Approved — R.P.E.Q No :

Scales: N.T.S — Original Issue Signatures

Drawn: B. MONROYO

Designed: A. MAGONDACAN

Original Size: A1

Height Datum: AHD — Project Manager: L. PRIZEMAN

Grid: GRID — © Copyright reserved

Project: RESIDENTIAL DEVELOPMENT LOT 277 IRON GATES ROAD EVANS HEAD

Title: SEDIMENT & EROSION CONTROL DETAILS SHEET 3 OF 3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| Drawing No. | Project No. | Issue |
|---|---|---|
| C117 | AA007094 | 04 |

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FOR CONTINUATION REFER DWG C121

## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS BATTER |
| | EARTHWORKS AREA OF FILL |
| | EARTHWORKS AREA OF CUT |
| 14.25 | BUILDING PAD |
| | NOMINAL KERB LINE |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| | MIDDEN LOCATION |
| | PROPOSED RETAINING WALL (MAX 1.5m) |
| | STAGE BOUNDARY |

## BULK EARTHWORKS VOLUMES

| | |
|---|---|
| CUT | $-130,103m^3$ |
| FILL | $194,672m^3$ |
| BALANCE | 64,569 IMPORT |

05

NOTE: NO COMPACTION FACTORS, BOXING OR STRIPPING HAVE BEEN APPLIED TO THE ABOVE VOLUMES.

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

0 10 20 30 40 50m

1 : 500

Surveyor

ROBERT A HARRIES
SURVEYOR

Architect

Filename C120-AA007094-gcd-00-BulkEarthworksCut&FillLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

BULK EARTHWORKS CUT
& FILL LAYOUT PLAN
SHEET 1 OF 5

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| Drawing No. | Project No. | Issue |
|---|---|---|
| C120 | AA007094 | 05 |

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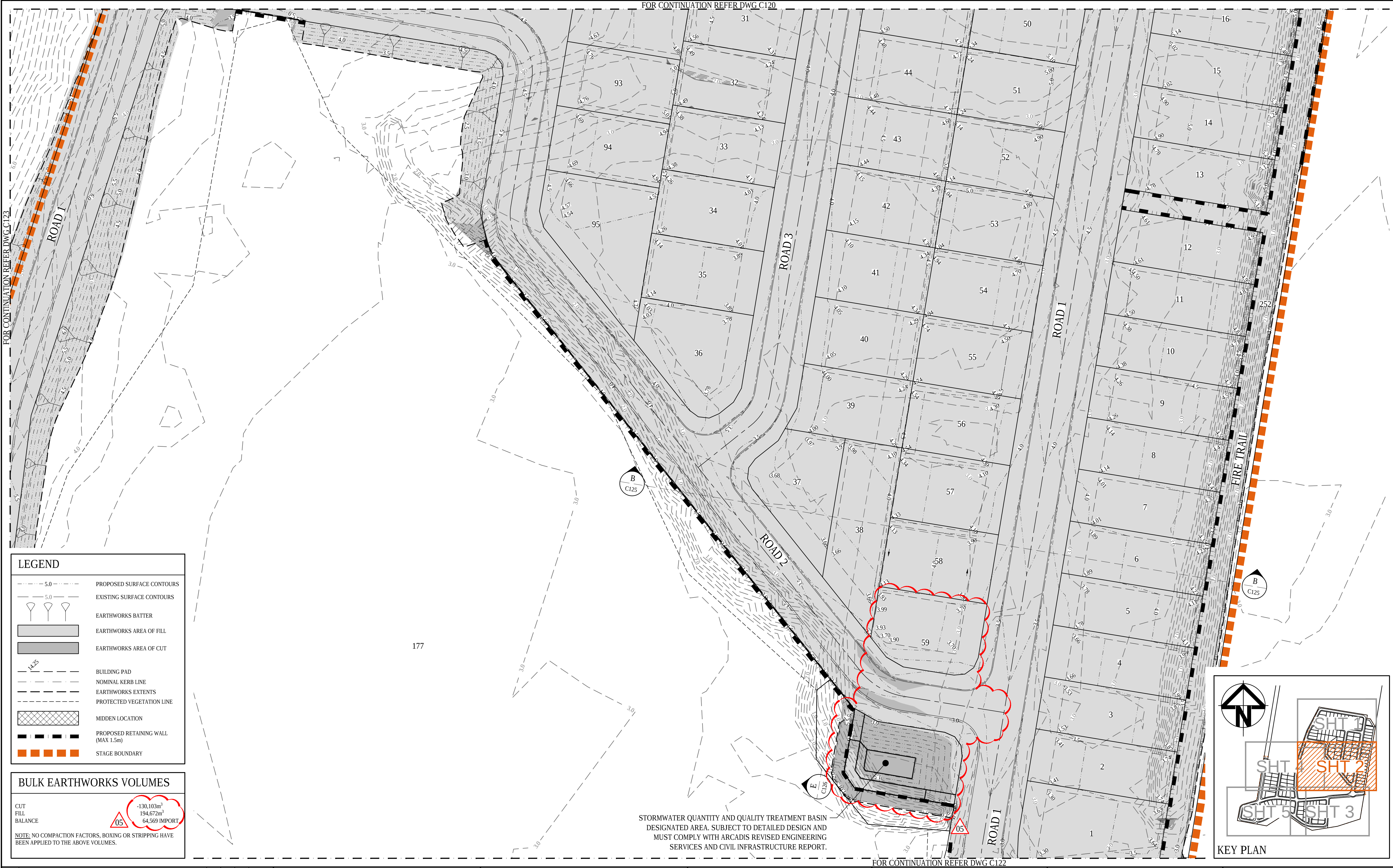


## LEGEND

| | |
|---|---|
| — 5.0 — | PROPOSED SURFACE CONTOURS |
| — 5.0 — | EXISTING SURFACE CONTOURS |
| | EARTHWORKS BATTER |
| | EARTHWORKS AREA OF FILL |
| | EARTHWORKS AREA OF CUT |
| 14.25 | BUILDING PAD |
| | NOMINAL KERB LINE |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| | MIDDEN LOCATION |
| | PROPOSED RETAINING WALL (MAX 1.5m) |
| | STAGE BOUNDARY |

## BULK EARTHWORKS VOLUMES

| | |
|---|---|
| CUT | $-130,103m^3$ |
| FILL | $194,672m^3$ |
| BALANCE | 64,569 IMPORT |

05

NOTE: NO COMPACTION FACTORS, BOXING OR STRIPPING HAVE BEEN APPLIED TO THE ABOVE VOLUMES.

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

0 10 20 30 40 50m

1 : 500

Surveyor

ROBERT A HARRIES SURVEYOR

Architect

Filename C120-AA007094-gcd-00-BulkEarthworksCut&FillLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

BULK EARTHWORKS CUT & FILL LAYOUT PLAN
SHEET 2 OF 5

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| Drawing No. | Project No. | Issue |
|---|---|---|
| C121 | AA007094 | 05 |

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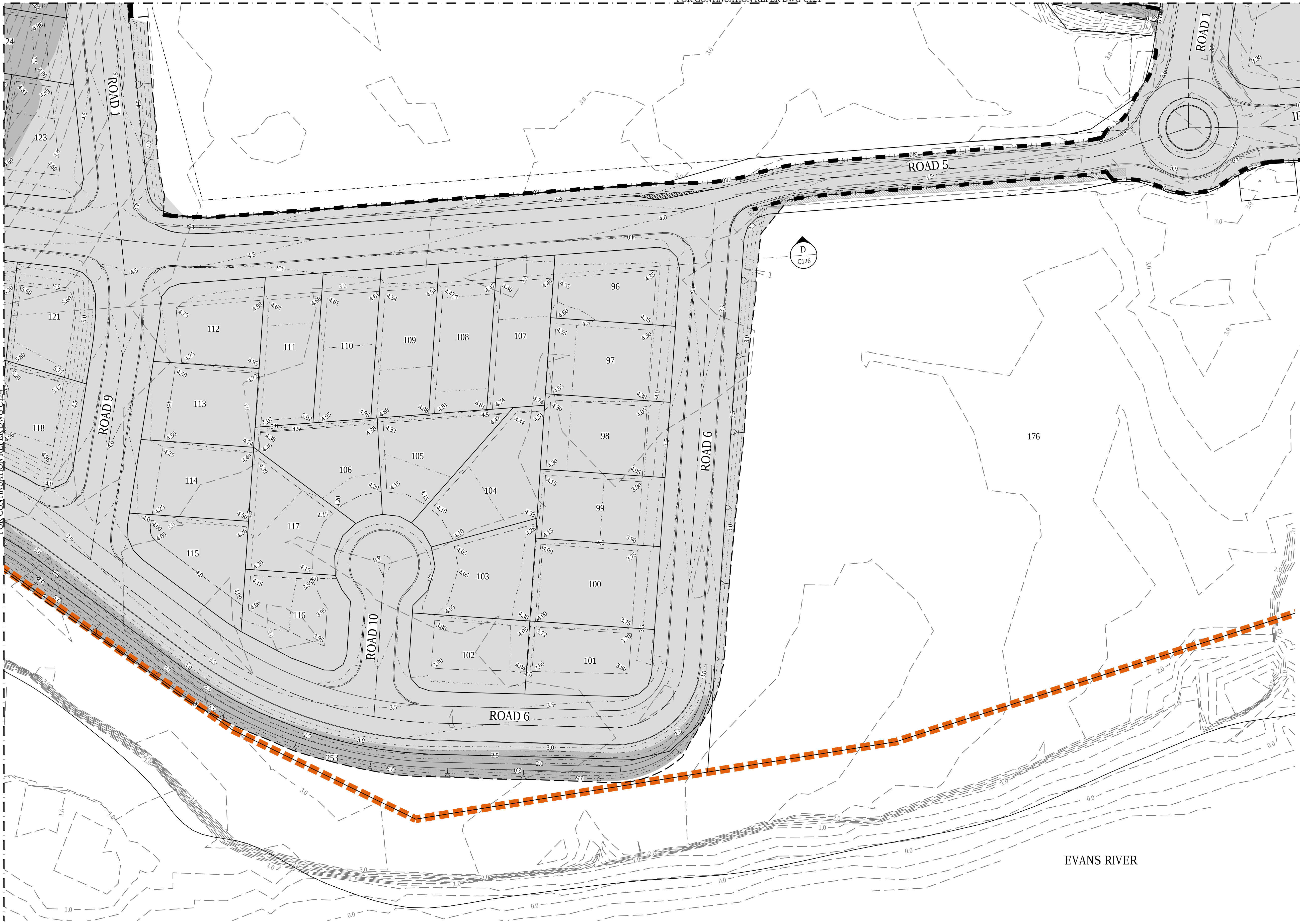
FOR CONTINUATION REFER DWG C121

FOR CONTINUATION REFER DWG C124




## LEGEND

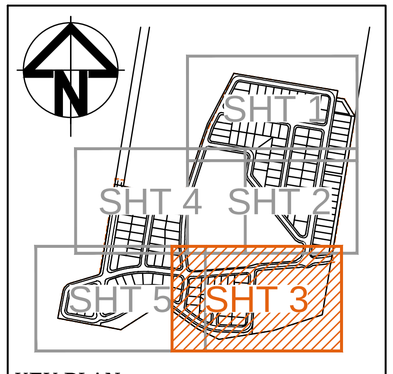
| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS BATTER |
| | EARTHWORKS AREA OF FILL |
| | EARTHWORKS AREA OF CUT |
| 14.25 | BUILDING PAD |
| | NOMINAL KERB LINE |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| | MIDDEN LOCATION |
| | PROPOSED RETAINING WALL (MAX 1.5m) |
| | STAGE BOUNDARY |

## BULK EARTHWORKS VOLUMES

| | |
|---|---|
| CUT | $-130{,}103m^3$ |
| FILL | $194{,}672m^3$ |
| BALANCE | 64,569 IMPORT |

06

NOTE: NO COMPACTION FACTORS, BOXING OR STRIPPING HAVE BEEN APPLIED TO THE ABOVE VOLUMES.




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 04 | MC1004 SECTION AMENDED | | | BD | 14.10.15 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

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1 : 500

Surveyor

ROBERT A HARRIES SURVEYOR

Architect

Filename C120-AA007094-gcd-00-BulkEarthworksCut&FillLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

BULK EARTHWORKS CUT & FILL LAYOUT PLAN
SHEET 3 OF 5


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| Drawing No. | Project No. | Issue |
|---|---|---|
| C122 | AA007094 | 06 |

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FOR CONTINUATION REFER DWG 120


FOR CONTINUATION REFER DWG C121

FOR CONTINUATION REFER DWG 124

## LEGEND

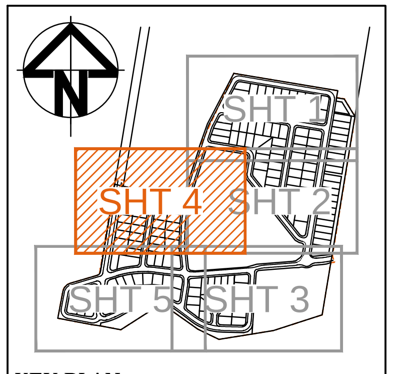
| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS BATTER |
| | EARTHWORKS AREA OF FILL |
| | EARTHWORKS AREA OF CUT |
| 14.25 | BUILDING PAD |
| | NOMINAL KERB LINE |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| | MIDDEN LOCATION |
| | PROPOSED RETAINING WALL (MAX 1.5m) |
| | STAGE BOUNDARY |

## BULK EARTHWORKS VOLUMES

| | |
|---|---|
| CUT | -130,103m³ |
| FILL | 194,672m³ |
| BALANCE | 64,569 IMPORT |

05

NOTE: NO COMPACTION FACTORS, BOXING OR STRIPPING HAVE BEEN APPLIED TO THE ABOVE VOLUMES.




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C120-AA007094-gcd-00-BulkEarthworksCut&FillLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
BULK EARTHWORKS CUT & FILL LAYOUT PLAN
SHEET 4 OF 5

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C123 | AA007094 | 05 |

100mm on Original

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## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | EARTHWORKS BATTER |
| | EARTHWORKS AREA OF FILL |
| | EARTHWORKS AREA OF CUT |
| 14.25 | BUILDING PAD |
| | NOMINAL KERB LINE |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| | MIDDEN LOCATION |
| | PROPOSED RETAINING WALL (MAX 1.5m) |
| | STAGE BOUNDARY |

## BULK EARTHWORKS VOLUMES

| | |
|---|---|
| CUT | $-130,103m^3$ |
| FILL | $194,672m^3$ |
| BALANCE | 64,569 IMPORT |

05

NOTE: NO COMPACTION FACTORS, BOXING OR STRIPPING HAVE BEEN APPLIED TO THE ABOVE VOLUMES.


| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C120-AA007094-gcd-00-BulkEarthworksCut&FillLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
BULK EARTHWORKS CUT
& FILL LAYOUT PLAN
SHEET 5 OF 5


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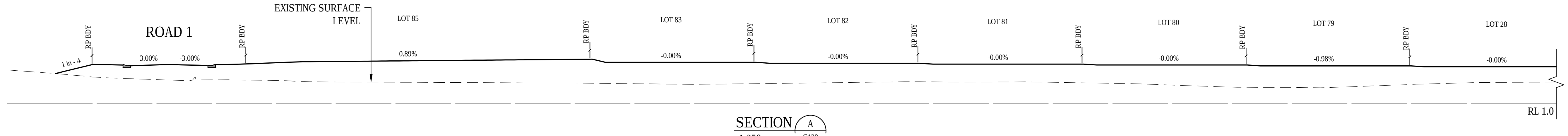
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C124 | AA007094 | 05 |

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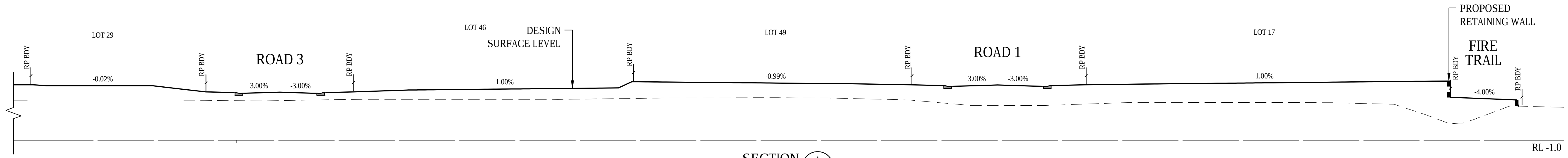


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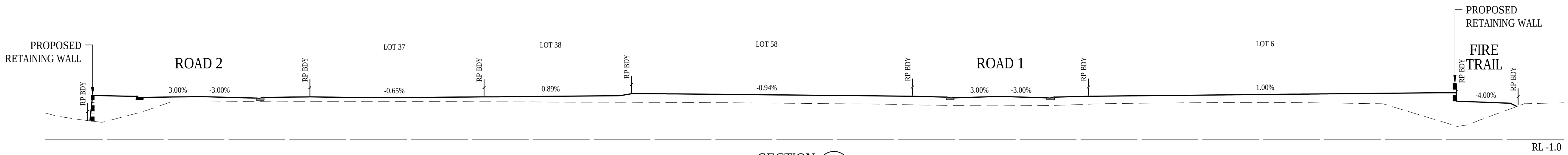


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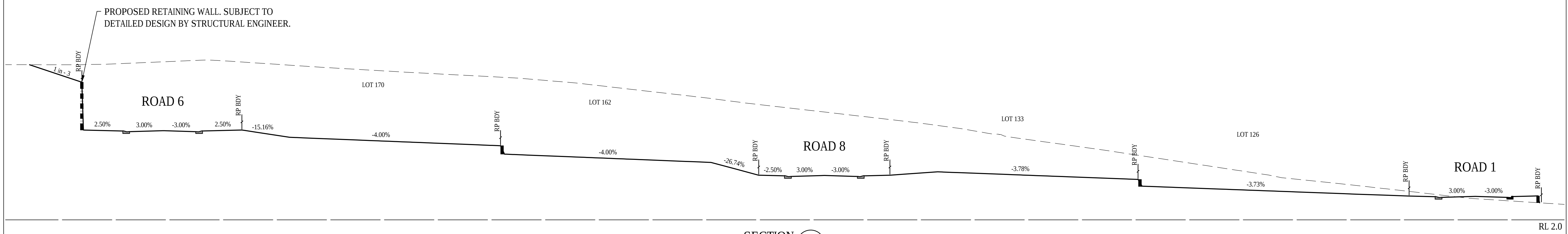


SECTION C C123
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| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale
0 5 10 15 20 25m
1 : 250

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C125-AA007094-gcd-00-BulkEarthworksCut&FillSections.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 250 | Original Issue Signatures |
| | | Drawn B. MONROYO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
BULK EARTHWORKS
CUT & FILL SECTIONS
SHEET 1 OF 2

ARCADIS

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ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C125 | AA007094 | 03 |

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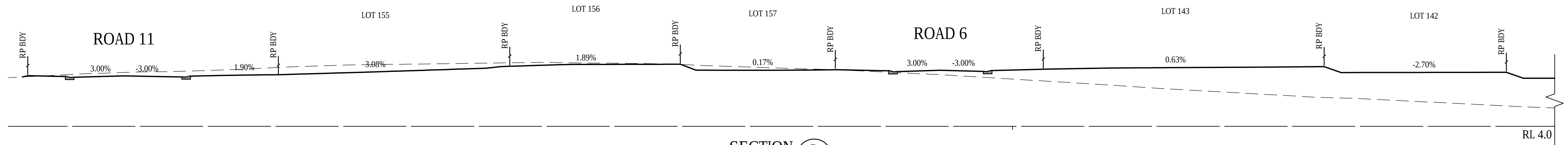
100mm on Original




SECTION D C124
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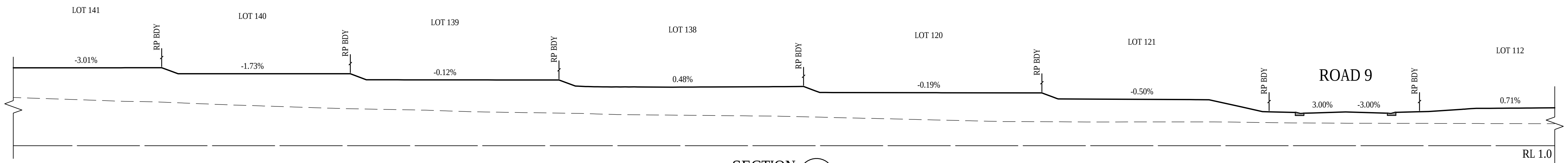


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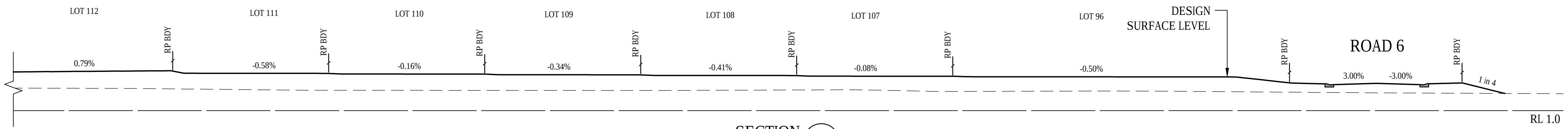


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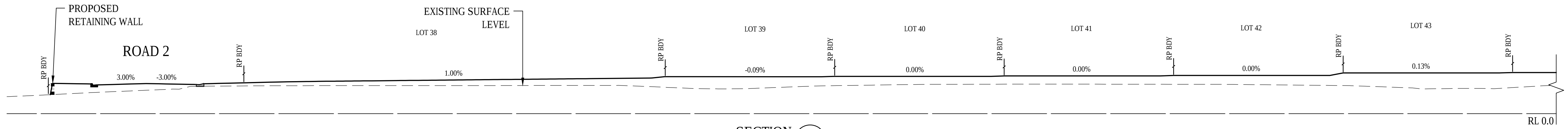


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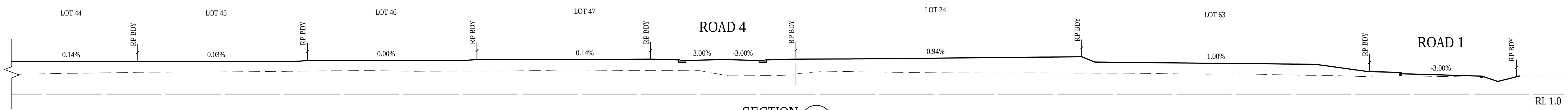


SECTION E C121
1:250

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale
0 5 10 15 20 25m
1 : 250

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C125-AA007094-gcd-00-BulkEarthworksCut&FillSections.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 250 | Original Issue Signatures |
| | | Drawn B. MONROYO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
BULK EARTHWORKS
CUT & FILL SECTIONS
SHEET 2 OF 2

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Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C126 | AA007094 | 03 |

100mm on Original

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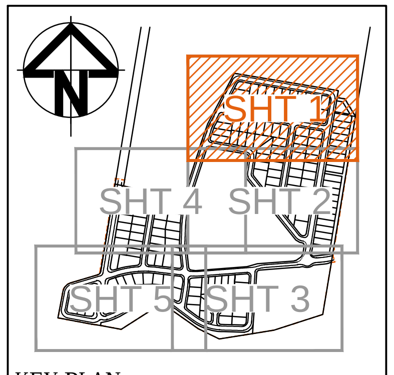


KEY PLAN

## LEGEND

- PROPOSED SURFACE CONTOURS
- EXISTING SURFACE CONTOURS
- PROPOSED MOUNTABLE KERB / LAYBACK KERB
- PROPOSED BARRIER KERB & CHANNEL
- PROPOSED BARRIER KERB
- PROPOSED EDGE RESTRAINT
- EARTHWORKS EXTENTS
- PROTECTED VEGETATION LINE
- PROPOSED STORMWATER DRAINAGE
- PROPOSED SEWERAGE RETICULATION
- PROPOSED WATER RETICULATION
- EXISTING SEWERAGE RETICULATION
- EXISTING WATER RETICULATION
- INDICATES LOT WITH SEEPAGE PIT (REFER NOTE)
- PROPOSED RETAINING WALL
- PROPOSED PAVEMENT
- PROPOSED BIO
- MIDDEN LOCATION
- PROPOSED BOARDWALK
- STAGE BOUNDARY

## NOTE:

- SEEPAGE PIT TO BE LOCATED IN LOT FRONTAGE ADJACENT TO SEWER LINE. AN EASEMENT FOR STORMWATER WILL BE PROVIDED OVER EACH DEVICE

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 04 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 03 | ISSUE FOR DEVELOPMENT APPROVAL / PAVEMENT HATCH ADDED | | | ND | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C130-AA007094-gcd-00-RoadworksAndDrainageLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROADWORKS & DRAINAGE LAYOUT PLAN
SHEET 1 OF 5

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289

Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C130 | AA007094 | 06 |

100mm on Original

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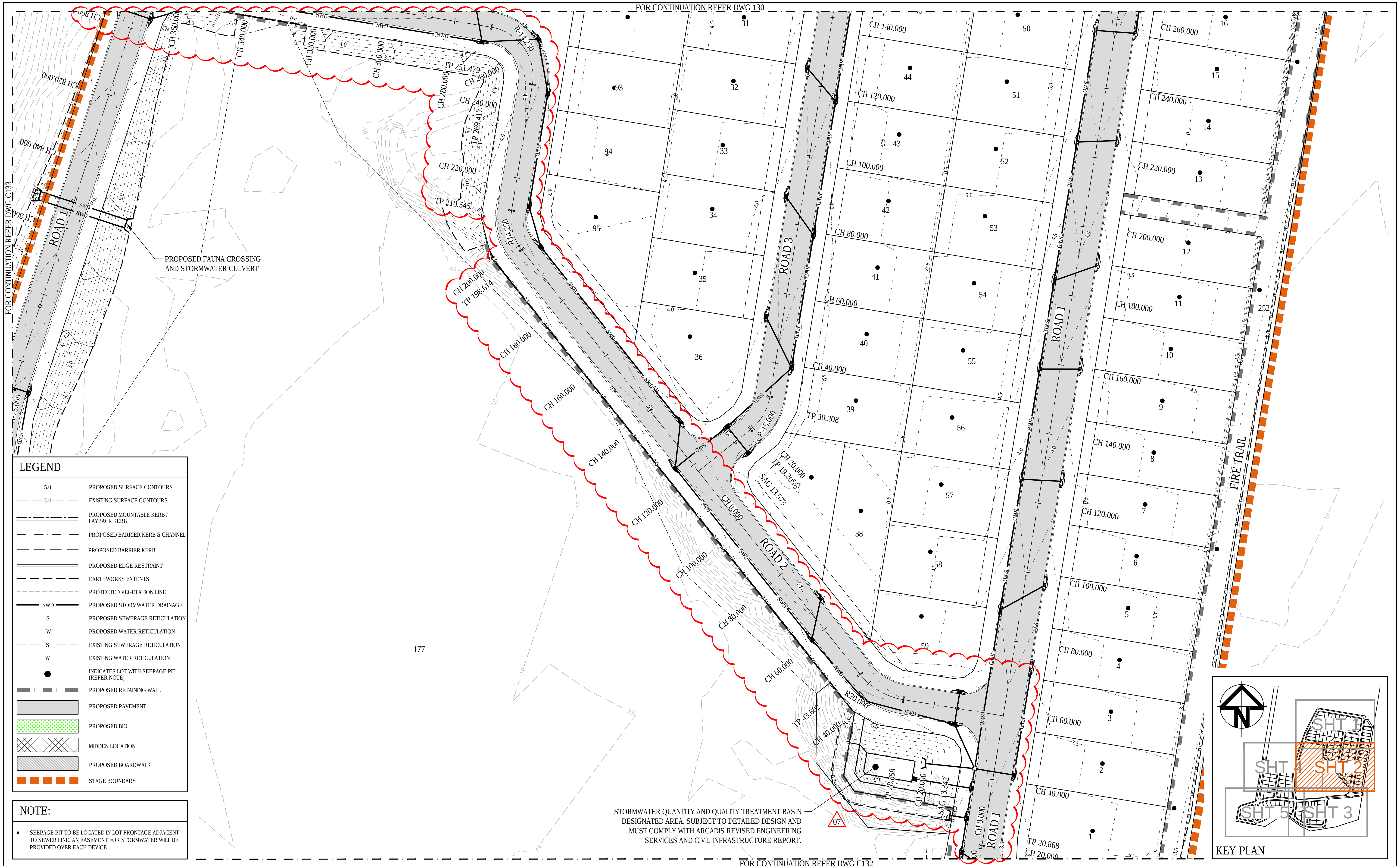



## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | PROPOSED MOUNTABLE KERB / LAYBACK KERB |
| | PROPOSED BARRIER KERB & CHANNEL |
| | PROPOSED BARRIER KERB |
| | PROPOSED EDGE RESTRAINT |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| SWD | PROPOSED STORMWATER DRAINAGE |
| S | PROPOSED SEWERAGE RETICULATION |
| W | PROPOSED WATER RETICULATION |
| S | EXISTING SEWERAGE RETICULATION |
| W | EXISTING WATER RETICULATION |
| ● | INDICATES LOT WITH SEEPAGE PIT (REFER NOTE) |
| | PROPOSED RETAINING WALL |
| | PROPOSED PAVEMENT |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | STAGE BOUNDARY |

## NOTE:

- SEEPAGE PIT TO BE LOCATED IN LOT FRONTAGE ADJACENT TO SEWER LINE. AN EASEMENT FOR STORMWATER WILL BE PROVIDED OVER EACH DEVICE

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 07 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 06 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 05 | DRAINAGE AND FAUNA CROSSING ADDED | | BD | | 14.10.15 |
| 04 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | BD | | 13.07.15 |
| 03 | ISSUE FOR DEVELOPMENT APPROVAL / PAVEMENT HATCH ADDED | | ND | | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | BD | | 03.10.14 |
| 01 | ORIGINAL ISSUE | | BD | | 18.06.14 |

Scale: 0 10 20 30 40 50m — 1 : 500

Surveyor: ROBERT A HARRIES SURVEYOR

Architect:

Client: GOLDCORAL PTY LTD

Status: FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved — R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

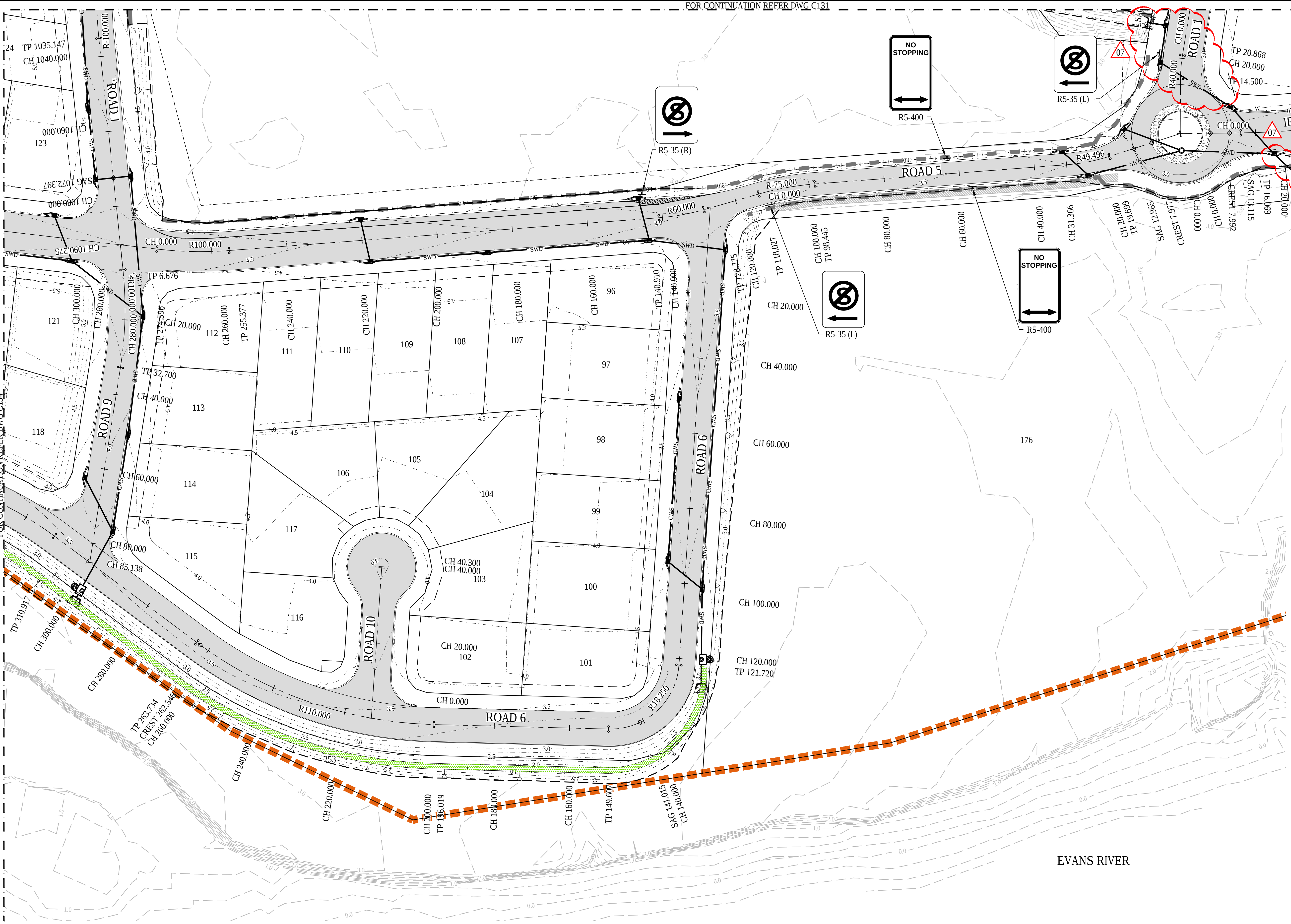
Project: RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title: ROADWORKS & DRAINAGE LAYOUT PLAN
SHEET 2 OF 5

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

Drawing No. C131 — Project No. AA007094 — Issue 07

Filename C130-AA007094-gcd-00-RoadworksAndDrainageLayoutPlan.dwg

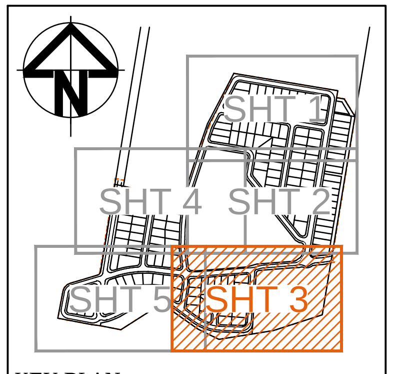



LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | PROPOSED MOUNTABLE KERB / LAYBACK KERB |
| | PROPOSED BARRIER KERB & CHANNEL |
| | PROPOSED BARRIER KERB |
| | PROPOSED EDGE RESTRAINT |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| SWD | PROPOSED STORMWATER DRAINAGE |
| S | PROPOSED SEWERAGE RETICULATION |
| W | PROPOSED WATER RETICULATION |
| S | EXISTING SEWERAGE RETICULATION |
| W | EXISTING WATER RETICULATION |
| ● | INDICATES LOT WITH SEEPAGE PIT (REFER NOTE) |
| | PROPOSED RETAINING WALL |
| | PROPOSED PAVEMENT |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | STAGE BOUNDARY |

NOTE:

- SEEPAGE PIT TO BE LOCATED IN LOT FRONTAGE ADJACENT TO SEWER LINE. AN EASEMENT FOR STORMWATER WILL BE PROVIDED OVER EACH DEVICE




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 07 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 06 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 05 | MC1004 SECTION AMENDED / BOARDWALK ADDED | | | BD | 15.10.15 |
| 04 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 03 | ISSUE FOR DEVELOPMENT APPROVAL / PAVEMENT HATCH ADDED | | | ND | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

0 10 20 30 40 50m

1 : 500

Surveyor

ROBERT A HARRIES SURVEYOR

Architect

Filename C130-AA007094-gcd-00-RoadworksAndDrainageLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

ROADWORKS & DRAINAGE LAYOUT PLAN
SHEET 3 OF 5

ARCADIS


Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289

Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C132 | AA007094 | 07 |

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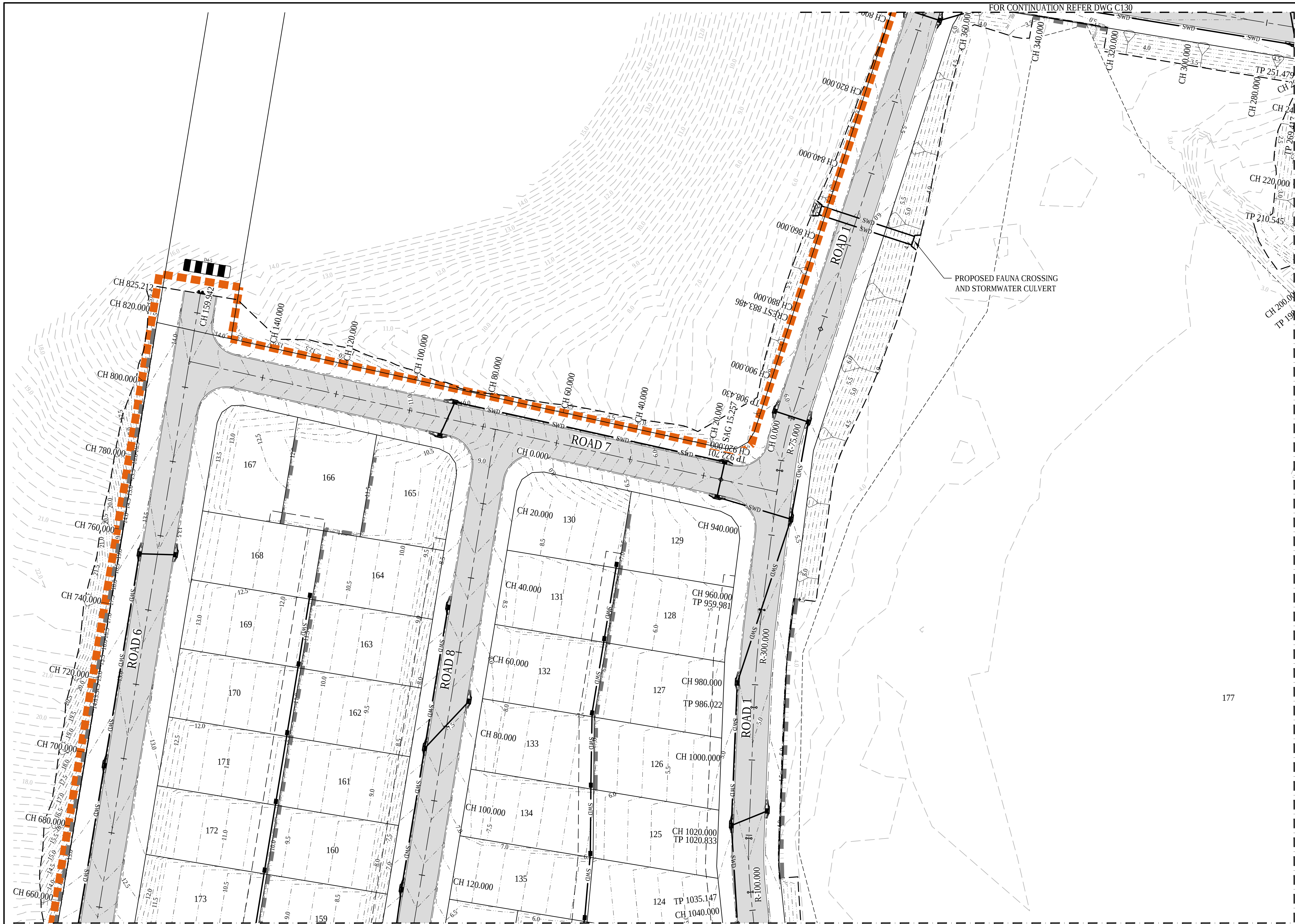
FOR CONTINUATION REFER DWG C130




FOR CONTINUATION REFER DWG C131

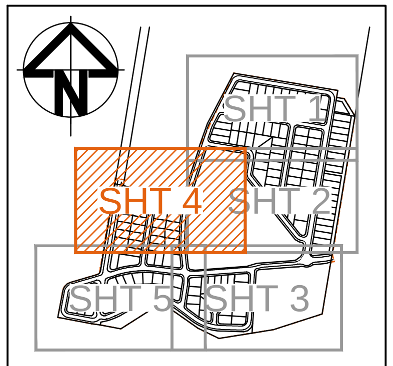
FOR CONTINUATION REFER DWG C134

## LEGEND

- PROPOSED SURFACE CONTOURS
- EXISTING SURFACE CONTOURS
- PROPOSED MOUNTABLE KERB / LAYBACK KERB
- PROPOSED BARRIER KERB & CHANNEL
- PROPOSED BARRIER KERB
- PROPOSED EDGE RESTRAINT
- EARTHWORKS EXTENTS
- PROTECTED VEGETATION LINE
- PROPOSED STORMWATER DRAINAGE
- PROPOSED SEWERAGE RETICULATION
- PROPOSED WATER RETICULATION
- EXISTING SEWERAGE RETICULATION
- EXISTING WATER RETICULATION
- INDICATES LOT WITH SEEPAGE PIT (REFER NOTE)
- PROPOSED RETAINING WALL
- PROPOSED PAVEMENT
- PROPOSED BIO
- MIDDEN LOCATION
- PROPOSED BOARDWALK
- STAGE BOUNDARY

## NOTE:

- SEEPAGE PIT TO BE LOCATED IN LOT FRONTAGE ADJACENT TO SEWER LINE. AN EASEMENT FOR STORMWATER WILL BE PROVIDED OVER EACH DEVICE




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 07 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 06 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 05 | DRAINAGE AND FAUNA CROSSING ADDED | | | BD | 15.10.15 |
| 04 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 03 | ISSUE FOR DEVELOPMENT APPROVAL / PAVEMENT HATCH ADDED | | | ND | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C130-AA007094-gcd-00-RoadworksAndDrainageLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROADWORKS &
DRAINAGE LAYOUT PLAN
SHEET 4 OF 5

ARCADIS
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Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | | Project No. | | Issue |
|---|---|---|---|---|
| C133 | — | AA007094 | — | 07 |


## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| | PROPOSED MOUNTABLE KERB / LAYBACK KERB |
| | PROPOSED BARRIER KERB & CHANNEL |
| | PROPOSED BARRIER KERB |
| | PROPOSED EDGE RESTRAINT |
| | EARTHWORKS EXTENTS |
| | PROTECTED VEGETATION LINE |
| SWD | PROPOSED STORMWATER DRAINAGE |
| S | PROPOSED SEWERAGE RETICULATION |
| W | PROPOSED WATER RETICULATION |
| S | EXISTING SEWERAGE RETICULATION |
| W | EXISTING WATER RETICULATION |
| ● | INDICATES LOT WITH SEEPAGE PIT (REFER NOTE) |
| | PROPOSED RETAINING WALL |
| | PROPOSED PAVEMENT |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | STAGE BOUNDARY |

## NOTE:

- SEEPAGE PIT TO BE LOCATED IN LOT FRONTAGE ADJACENT TO SEWER LINE. AN EASEMENT FOR STORMWATER WILL BE PROVIDED OVER EACH DEVICE

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 04 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 03 | ISSUE FOR DEVELOPMENT APPROVAL / PAVEMENT HATCH ADDED | | | ND | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C130-AA007094-gcd-00-RoadworksAndDrainageLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROADWORKS & DRAINAGE LAYOUT PLAN
SHEET 5 OF 5

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C134 | AA007094 | 06 |

100mm on Original

C:\Users\nfaz3463\Desktop\Iron Gates\D-Final\c130-AA007094-gcd-00-RoadworksAndDrainageLayoutPlan.dwg 23/Jul/2019 12:37 PM V1

## CATCHMENT TABLE

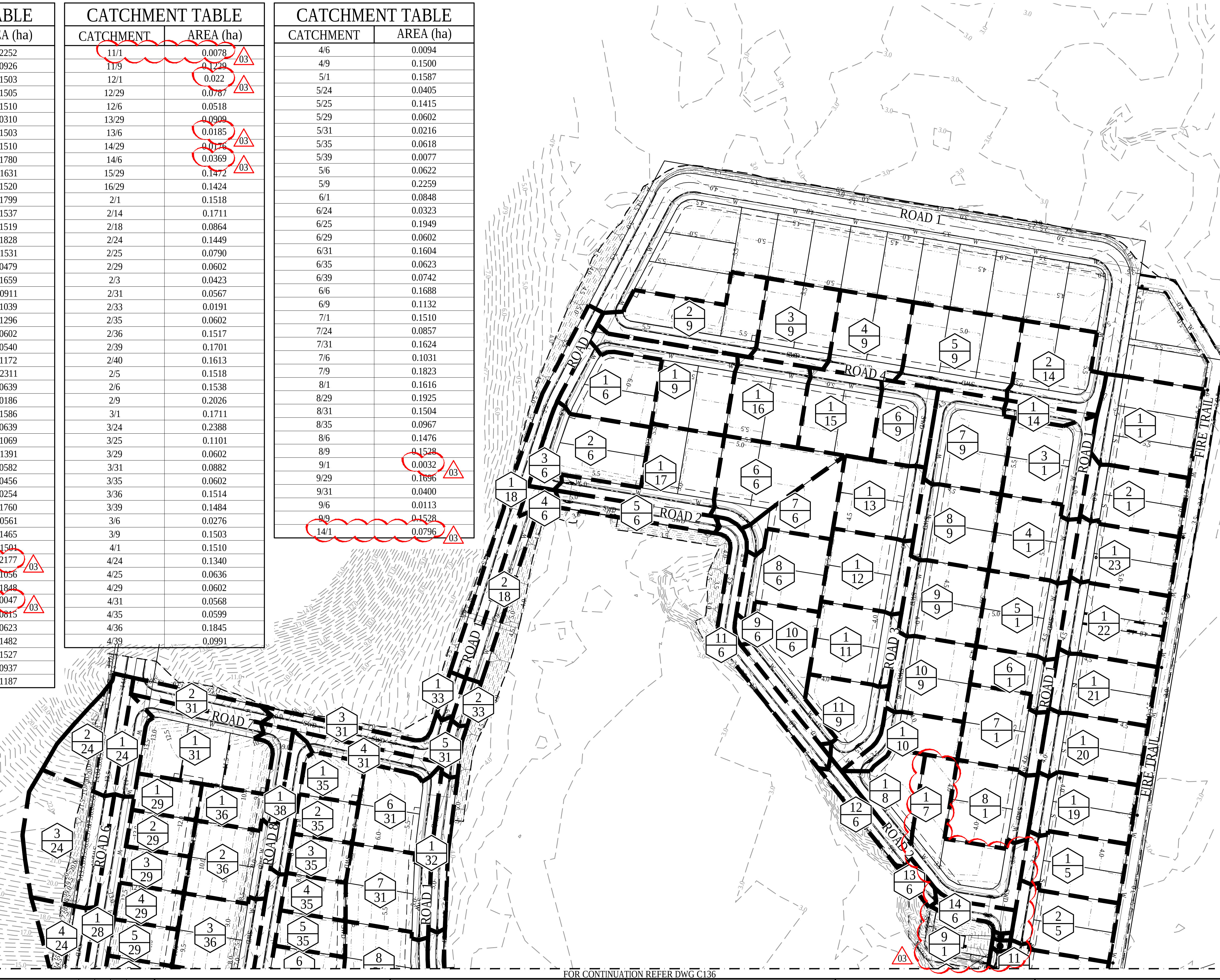
| CATCHMENT | AREA (ha) |
|---|---|
| 1/1 | 0.2252 |
| 1/10 | 0.0926 |
| 1/11 | 0.1503 |
| 1/12 | 0.1505 |
| 1/13 | 0.1510 |
| 1/14 | 0.0310 |
| 1/15 | 0.1503 |
| 1/16 | 0.1510 |
| 1/17 | 0.1780 |
| 1/18 | 0.1631 |
| 1/19 | 0.1520 |
| 1/2 | 0.1799 |
| 1/20 | 0.1537 |
| 1/21 | 0.1519 |
| 1/22 | 0.1828 |
| 1/23 | 0.1531 |
| 1/24 | 0.0479 |
| 1/25 | 0.1659 |
| 1/26 | 0.0911 |
| 1/27 | 0.1039 |
| 1/28 | 0.1296 |
| 1/29 | 0.0602 |
| 1/3 | 0.0540 |
| 1/30 | 0.1172 |
| 1/31 | 0.2311 |
| 1/32 | 0.0639 |
| 1/33 | 0.0186 |
| 1/34 | 0.1586 |
| 1/35 | 0.0639 |
| 1/36 | 0.1069 |
| 1/37 | 0.1391 |
| 1/38 | 0.0582 |
| 1/39 | 0.0456 |
| 1/4 | 0.0254 |
| 1/40 | 0.1760 |
| 1/41 | 0.0561 |
| 1/5 | 0.1465 |
| 1/6 | 0.1501 |
| 1/7 | 0.2177 |
| 1/8 | 0.1056 |
| 1/9 | 0.1848 |
| 10/1 | 0.0047 |
| 10/29 | 0.0815 |
| 10/31 | 0.0623 |
| 10/6 | 0.1482 |
| 10/9 | 0.1527 |
| 11/29 | 0.0937 |
| 11/6 | 0.1187 |

## CATCHMENT TABLE

| CATCHMENT | AREA (ha) |
|---|---|
| 11/1 | 0.0078 |
| 11/9 | 0.1229 |
| 12/1 | 0.022 |
| 12/29 | 0.0787 |
| 12/6 | 0.0518 |
| 13/29 | 0.0909 |
| 13/6 | 0.0185 |
| 14/29 | 0.0176 |
| 14/6 | 0.0369 |
| 15/29 | 0.1472 |
| 16/29 | 0.1424 |
| 2/1 | 0.1518 |
| 2/14 | 0.1711 |
| 2/18 | 0.0864 |
| 2/24 | 0.1449 |
| 2/25 | 0.0790 |
| 2/29 | 0.0602 |
| 2/3 | 0.0423 |
| 2/31 | 0.0567 |
| 2/33 | 0.0191 |
| 2/35 | 0.0602 |
| 2/36 | 0.1517 |
| 2/39 | 0.1701 |
| 2/40 | 0.1613 |
| 2/5 | 0.1518 |
| 2/6 | 0.1538 |
| 2/9 | 0.2026 |
| 3/1 | 0.1711 |
| 3/24 | 0.2388 |
| 3/25 | 0.1101 |
| 3/29 | 0.0602 |
| 3/31 | 0.0882 |
| 3/35 | 0.0602 |
| 3/36 | 0.1514 |
| 3/39 | 0.1484 |
| 3/6 | 0.0276 |
| 3/9 | 0.1503 |
| 4/1 | 0.1510 |
| 4/24 | 0.1340 |
| 4/25 | 0.0636 |
| 4/29 | 0.0602 |
| 4/31 | 0.0568 |
| 4/35 | 0.0599 |
| 4/36 | 0.1845 |
| 4/39 | 0.0991 |

## CATCHMENT TABLE

| CATCHMENT | AREA (ha) |
|---|---|
| 4/6 | 0.0094 |
| 4/9 | 0.1500 |
| 5/1 | 0.1587 |
| 5/24 | 0.0405 |
| 5/25 | 0.1415 |
| 5/29 | 0.0602 |
| 5/31 | 0.0216 |
| 5/35 | 0.0618 |
| 5/39 | 0.0077 |
| 5/6 | 0.0622 |
| 5/9 | 0.2259 |
| 6/1 | 0.0848 |
| 6/24 | 0.0323 |
| 6/25 | 0.1949 |
| 6/29 | 0.0602 |
| 6/31 | 0.1604 |
| 6/35 | 0.0623 |
| 6/39 | 0.0742 |
| 6/6 | 0.1688 |
| 6/9 | 0.1132 |
| 7/1 | 0.1510 |
| 7/24 | 0.0857 |
| 7/31 | 0.1624 |
| 7/6 | 0.1031 |
| 7/9 | 0.1823 |
| 8/1 | 0.1616 |
| 8/29 | 0.1925 |
| 8/31 | 0.1504 |
| 8/35 | 0.0967 |
| 8/6 | 0.1476 |
| 8/9 | 0.1528 |
| 9/1 | 0.0032 |
| 9/29 | 0.1696 |
| 9/31 | 0.0400 |
| 9/6 | 0.0113 |
| 9/9 | 0.1528 |
| 14/1 | 0.0796 |

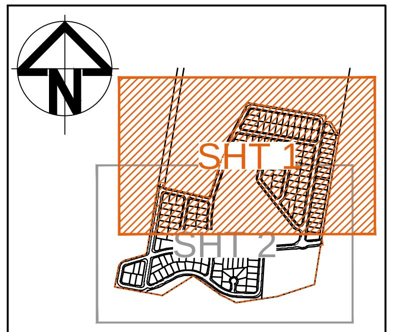



FOR CONTINUATION REFER DWG C136

## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| SWD | PROPOSED STORMWATER DRAINAGE |
| | PROPOSED CATCHMENT BOUNDARY |
| X/X | CATCHMENT NUMBER |

KEY PLAN




| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale: 0 20 40 60 80 100m — 1 : 1000

Surveyor: ROBERT A HARRIES SURVEYOR

Architect

Filename C135-AA007094-gcd-00-StormWaterCatchmentLayoutPlan.dwg

Client: GOLDCORAL PTY LTD

Status: FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved — R.P.E.Q No :

Scales: 1 : 1000 — Original Issue Signatures
Drawn: B. MONROYO
Original Size: A1 — Designed: R. MACAS
Height Datum: AHD — Project Manager: L. PRIZEMAN
Grid: GRID — © Copyright reserved

Project: RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title: STORMWATER CATCHMENT
LAYOUT PLAN SHEET 1 OF 2

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www.arcadis.com

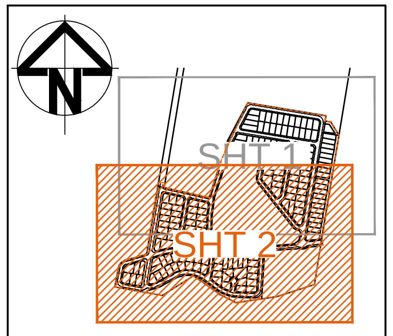
Drawing No. C135 — Project No. AA007094 — Issue 03


## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| SWD | PROPOSED STORMWATER DRAINAGE |
| | PROPOSED CATCHMENT BOUNDARY |
| X/X | CATCHMENT NUMBER |

## NOTE

REFER TO DWG C135 FOR CATCHMENT AREAS.




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale

0 20 40 60 80 100m

1 : 1000

Surveyor

ROBERT A HARRIES
SURVEYOR

Architect

Filename C135-AA007094-gcd-00-StormWaterCatchmentLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 1000 | Original Issue Signatures |
| Original Size | A1 | Drawn B. MONROYO |
| | | Designed R. MACAS |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

STORMWATER CATCHMENT
LAYOUT PLAN SHEET 2 OF 2

ARCADIS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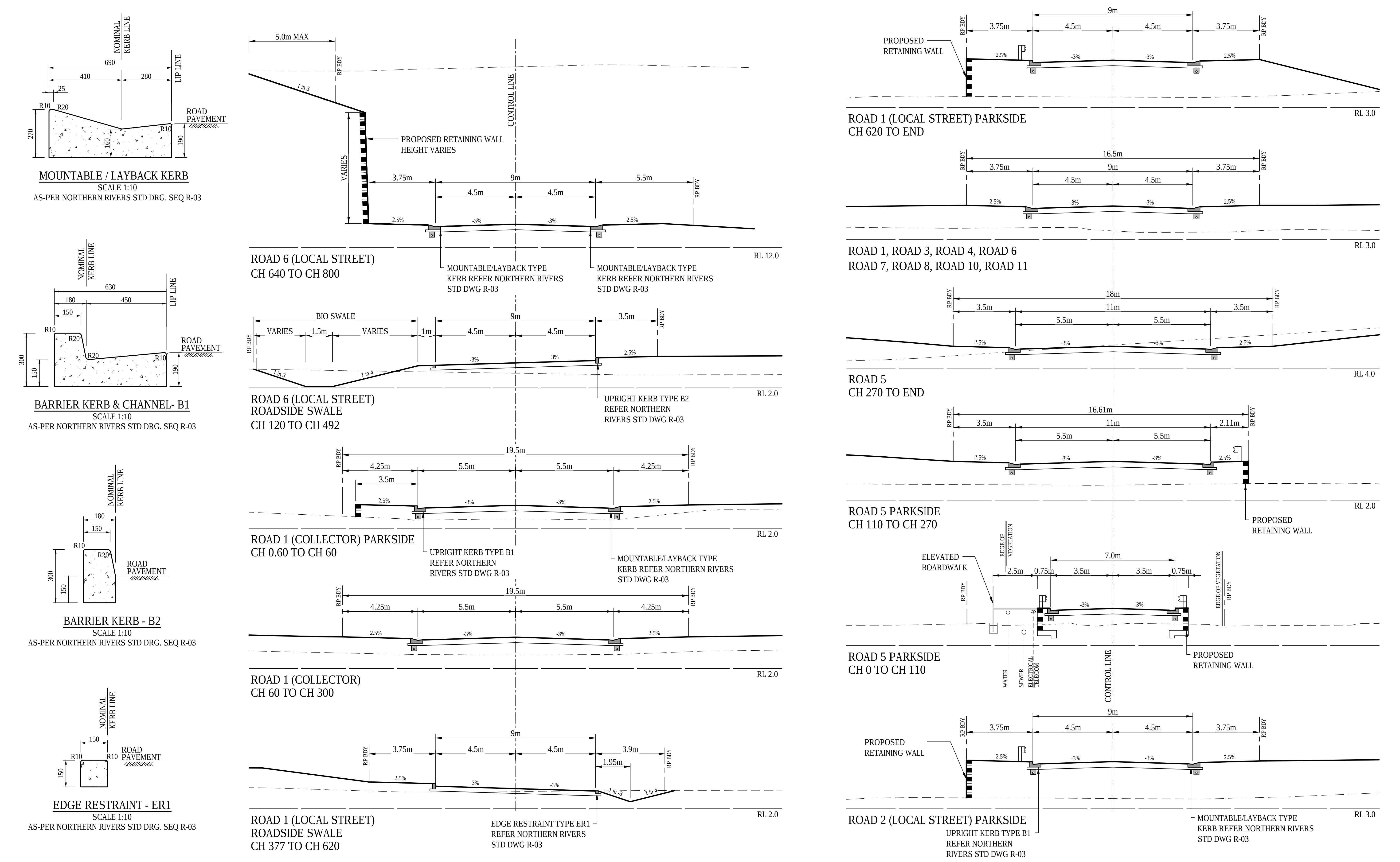
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C136 | AA007094 | 03 |

100mm on Original




| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 07 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 06 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 05 | ISSUE FOR RFI RESPONSE | | | BD | 04.04.16 |
| 04 | MC1004 SECTION AMENDED | | | BD | 14.10.15 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale
1 : 10
1 : 100

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C140-AA007094-gcd-00-TypicalRoadCrossSections.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales AS SHOWN
Original Issue Signatures
Drawn A. CARDEÑO
Designed A. MAGONDACAN
Project Manager L. PRIZEMAN
Original Size A1
Height Datum AHD
Grid GRID



Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
TYPICAL ROAD CROSS SECTIONS

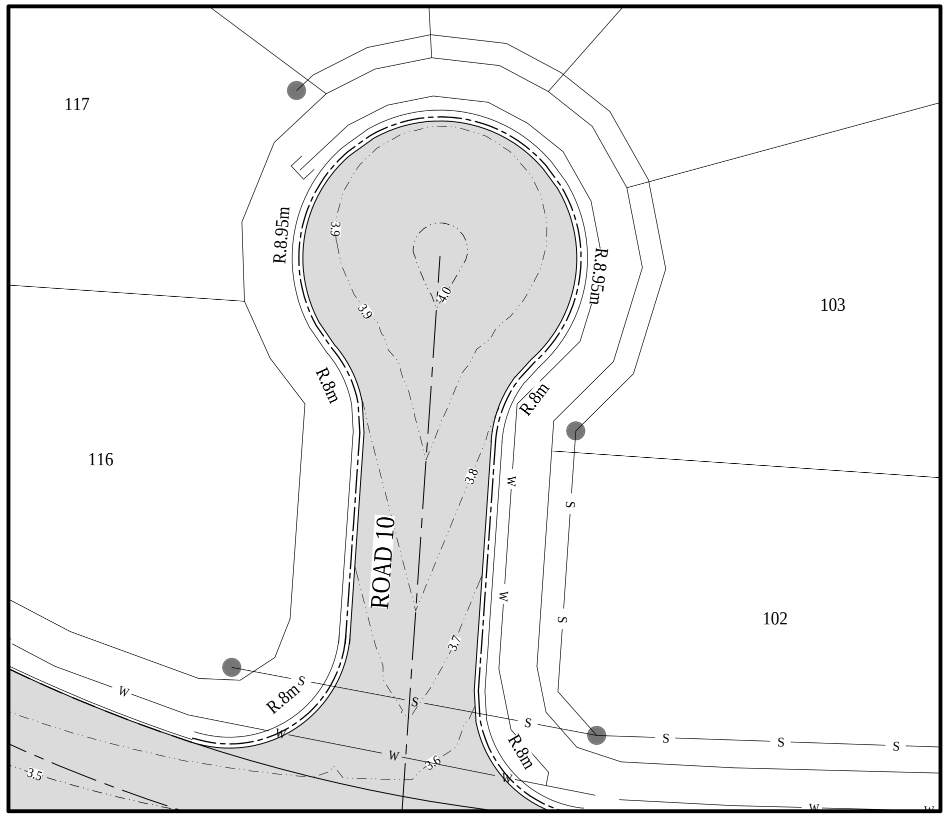
ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

Drawing No. C140 — Project No. AA007094 — Issue 07

LEGEND

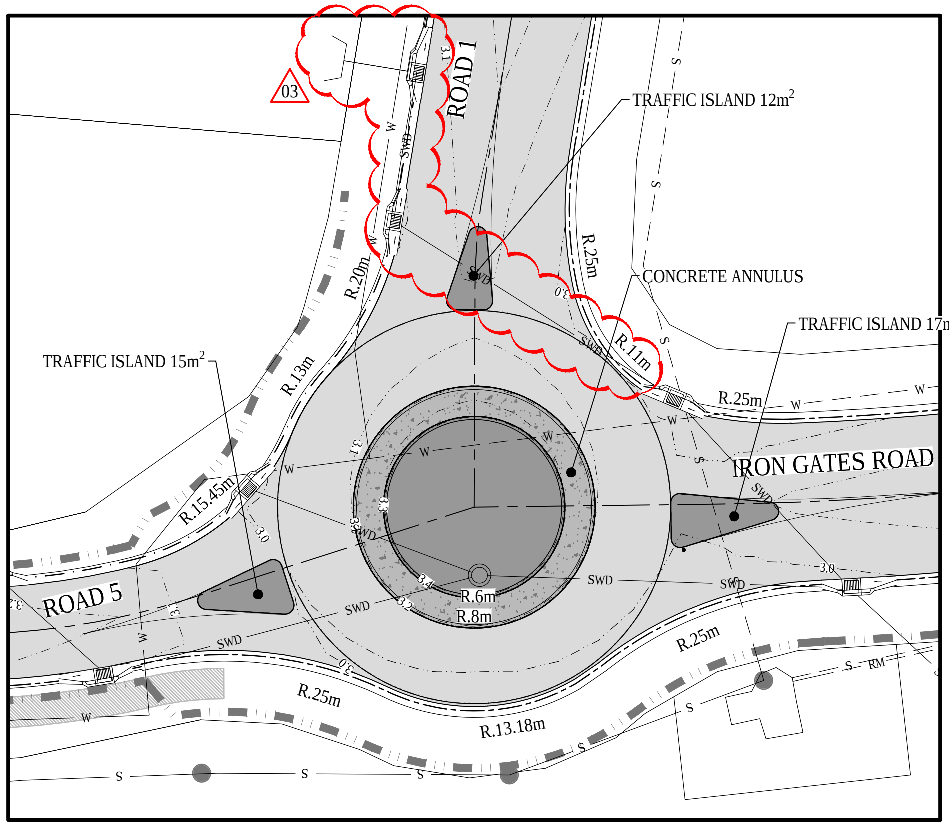
- 5.0 PROPOSED SURFACE CONTOURS
- 5.0 EXISTING SURFACE CONTOURS
- PROPOSED LAYBACK KERB
- PROPOSED CONCRETE ANNULUS
- PROPOSED BOARDWALK
- PROPOSED RETAINING WALL

N




ROAD 10 - CULDESAC DETAIL

SCALE 1 : 250




ROUNDABOUT DETAIL

SCALE 1 : 250

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

100mm on Original

Scale: 0 5 10 15 20 25m — 1 : 250

Surveyor: ROBERT A HARRIES SURVEYOR

Architect

Filename: C145-AA007094-gcd-00-IntersectionDetails.dwg

Client: GOLDCORAL PTY LTD

Status: FOR APPROVAL CONSTRUCTION SUBJECT TO APPROVAL

Approved — R.P.E.Q No :

Scales: 1: 250 — Original Issue Signatures

Drawn: A. CARDEÑO

Original Size: A1 — Designed: A. MAGONDACAN

Height Datum: AHD — Project Manager: L. PRIZEMAN

Grid: GRID — 

Project: RESIDENTIAL DEVELOPMENT LOT 277 IRON GATES ROAD EVANS HEAD

Title: INTERSECTION DETAILS

ARCADIS
Arcadis Australia Pacific Pty Limited
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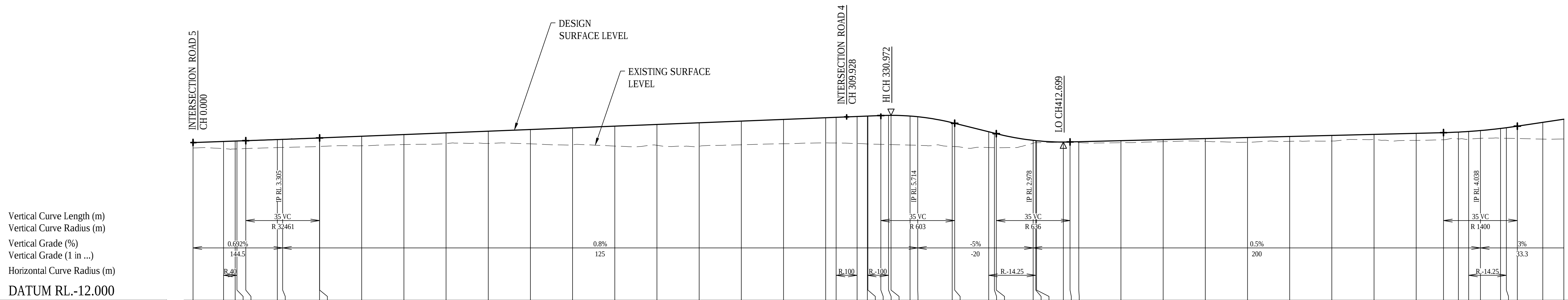
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

Drawing No. C145 — Project No. AA007094 — Issue 03




| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 0.000 | 3.011 | | 4.364 | 2.488 | 0.523 |
| 14.500 | 3.111 | | 4.481 | 2.434 | 0.677 |
| 20.000 | 3.149 | 2.998 | 4.844 | 2.403 | 0.747 |
| 20.868 | 3.155 | 3.004 | 4.902 | 2.409 | 0.746 |
| 25.032 | 3.184 | 3.033 | 3.028 | 2.440 | 0.745 |
| 40.000 | 3.291 | | 3.135 | 2.531 | 0.760 |
| 42.532 | 3.310 | | 3.154 | 2.545 | 0.765 |
| 60.000 | 3.445 | 3.289 | 3.289 | 2.635 | 0.810 |
| 60.032 | 3.445 | 3.289 | 3.289 | 2.635 | 0.810 |
| 80.000 | 3.605 | 3.449 | 3.449 | 2.701 | 0.904 |
| 100.000 | 3.765 | 3.609 | 3.609 | 2.818 | 0.947 |
| 120.000 | 3.925 | 3.769 | 3.769 | 2.911 | 1.015 |
| 140.000 | 4.085 | 3.929 | 3.929 | 2.930 | 1.155 |
| 160.000 | 4.245 | 4.089 | 4.089 | 2.887 | 1.358 |
| 180.000 | 4.405 | 4.249 | 4.249 | 2.790 | 1.615 |
| 200.000 | 4.565 | 4.409 | 4.409 | 2.671 | 1.894 |
| 220.000 | 4.725 | 4.569 | 4.569 | 2.748 | 1.977 |
| 240.000 | 4.885 | 4.729 | 4.729 | 2.649 | 2.236 |
| 260.000 | 5.045 | 4.889 | 4.889 | 2.799 | 2.246 |
| 280.000 | 5.205 | 5.049 | 5.049 | 2.891 | 2.315 |
| 300.000 | 5.365 | 5.211 | 5.209 | 2.971 | 2.394 |
| 304.939 | 5.405 | 5.257 | 5.248 | 2.970 | 2.435 |
| 314.906 | 5.484 | 5.350 | 5.338 | 2.914 | 2.570 |
| 319.773 | 5.523 | 5.395 | 5.386 | 2.873 | 2.651 |
| 320.000 | 5.525 | 5.397 | 5.389 | 2.873 | 2.653 |
| 326.144 | 5.574 | 5.448 | 5.446 | 2.838 | 2.736 |
| 329.780 | 5.592 | 5.466 | 5.466 | 2.816 | 2.776 |
| 330.972 | 5.594 | 5.467 | 5.467 | 2.811 | 2.783 |
| 340.000 | 5.526 | 5.399 | 5.399 | 2.768 | 2.758 |
| 343.644 | 5.461 | 5.333 | 5.333 | 2.745 | 2.716 |
| 360.000 | 4.895 | 4.823 | 4.769 | 2.636 | 2.259 |
| 361.144 | 4.839 | 4.780 | 4.713 | 2.625 | 2.214 |
| 377.285 | 4.032 | 4.167 | 3.906 | 2.535 | 1.497 |
| 380.000 | 3.897 | 4.042 | 3.762 | 2.524 | 1.372 |
| 380.880 | 3.852 | 4.001 | 3.717 | 2.510 | 1.343 |
| 398.380 | 3.218 | 3.359 | 3.083 | 2.944 | 0.275 |
| 399.612 | 3.192 | 3.327 | 3.057 | 2.990 | 0.201 |
| 400.000 | 3.184 | 3.316 | 3.049 | 2.992 | 0.192 |
| 412.699 | 3.057 | 3.192 | 2.922 | 3.034 | 0.023 |
| 415.880 | 3.065 | 3.200 | 2.930 | 3.034 | 0.031 |
| 420.000 | 3.086 | 3.221 | 2.951 | 3.001 | 0.084 |
| 440.000 | 3.186 | 3.321 | 3.051 | 2.991 | 0.195 |
| 460.000 | 3.286 | 3.421 | 3.151 | 3.090 | 0.196 |
| 480.000 | 3.386 | 3.521 | 3.251 | 3.129 | 0.256 |
| 500.000 | 3.486 | 3.621 | 3.351 | 3.033 | 0.452 |
| 520.000 | 3.586 | 3.721 | 3.451 | 3.125 | 0.461 |
| 540.000 | 3.686 | 3.821 | 3.551 | 3.151 | 0.535 |
| 560.000 | 3.786 | 3.921 | 3.651 | 3.303 | 0.483 |
| 580.000 | 3.886 | 4.021 | 3.751 | 3.217 | 0.669 |
| 592.946 | 3.950 | 4.085 | 3.815 | 3.277 | 0.673 |
| 600.000 | 4.003 | 4.138 | 3.868 | 3.353 | 0.650 |
| 604.884 | 4.061 | 4.198 | 3.926 | 3.330 | 0.731 |
| 610.446 | 4.147 | 4.301 | 4.012 | 3.413 | 0.734 |
| 620.000 | 4.347 | 4.494 | 4.212 | 3.422 | 0.925 |
| 622.755 | 4.417 | 4.553 | 4.282 | 3.414 | 1.003 |
| 627.946 | 4.563 | 4.630 | 4.436 | 3.392 | 1.171 |
| 640.000 | 4.924 | 4.853 | 4.798 | 3.336 | 1.589 |
| 650.000 | 5.224 | 5.098 | 5.098 | 3.348 | 1.877 |

## ROAD 1 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| Scales | AS SHOWN | Original Issue Signatures |
|---|---|---|
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 1 LONGITUDINAL SECTION - SHEET 1 OF 2

ARCADIS
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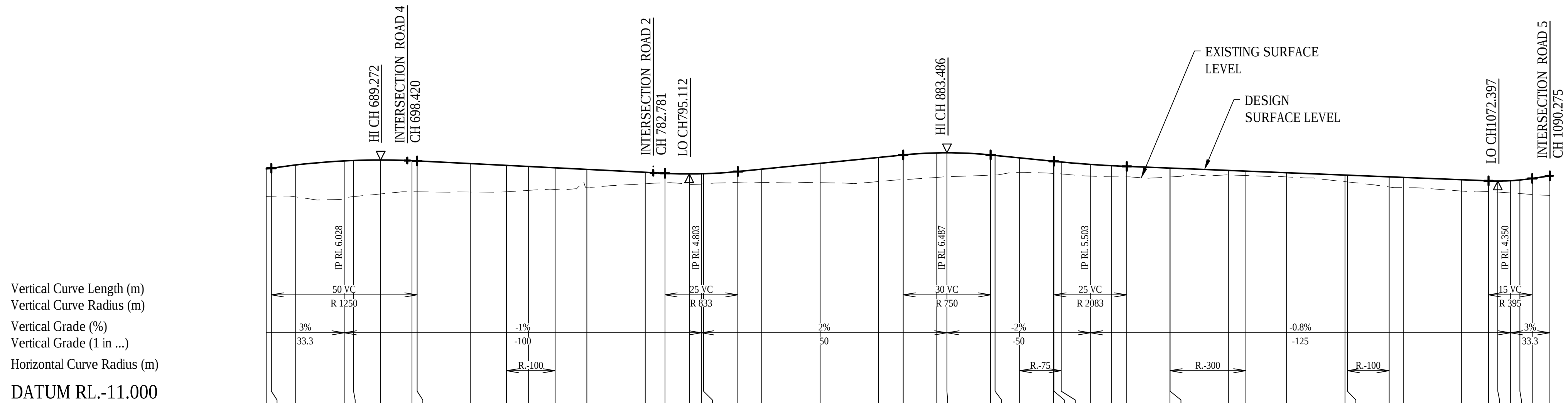
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C150 | AA007094 | 05 |




DATUM RL.-11.000

| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 650.000 | 5.224 | 5.098 | 5.098 | 3.348 | 1.877 |
| 651.771 | 5.278 | 5.151 | 5.151 | 3.354 | 1.923 |
| 660.000 | 5.497 | 5.371 | 5.371 | 3.316 | 2.181 |
| 676.771 | 5.778 | 5.651 | 5.651 | 3.195 | 2.582 |
| 680.000 | 5.806 | 5.679 | 5.679 | 3.331 | 2.475 |
| 689.272 | 5.840 | 5.713 | 5.713 | 3.516 | 2.324 |
| 700.000 | 5.794 | 5.667 | 5.667 | 3.660 | 2.134 |
| 701.771 | 5.778 | 5.651 | 5.651 | 3.657 | 2.121 |
| 720.000 | 5.595 | 5.469 | 5.469 | 3.646 | 1.950 |
| 732.450 | 5.471 | 5.344 | 5.344 | 3.658 | 1.813 |
| 740.000 | 5.395 | 5.269 | 5.269 | 3.760 | 1.635 |
| 749.106 | 5.304 | 5.178 | 5.178 | 3.820 | 1.484 |
| 760.000 | 5.195 | 5.069 | 5.069 | 3.977 | 1.218 |
| 780.000 | 4.995 | | 4.869 | 4.213 | 0.782 |
| 786.779 | 4.928 | | 4.801 | 4.277 | 0.650 |
| 795.112 | 4.886 | 4.764 | 4.759 | 4.183 | 0.703 |
| 799.279 | 4.896 | 4.775 | 4.770 | 4.189 | 0.707 |
| 800.000 | 4.900 | 4.779 | 4.774 | 4.208 | 0.692 |
| 811.779 | 5.053 | 4.931 | 4.926 | 4.314 | 0.738 |
| 820.000 | 5.217 | 5.095 | 5.090 | 4.313 | 0.904 |
| 840.000 | 5.617 | 5.495 | 5.490 | 4.287 | 1.329 |
| 860.000 | 6.017 | 5.895 | 5.890 | 4.366 | 1.651 |
| 868.486 | 6.187 | 6.065 | 6.060 | 4.491 | 1.695 |
| 880.000 | 6.329 | 6.207 | 6.202 | 4.646 | 1.683 |
| 883.486 | 6.337 | 6.215 | 6.210 | 4.699 | 1.638 |
| 898.486 | 6.187 | 6.065 | 6.060 | 4.799 | 1.388 |
| 900.000 | 6.156 | 6.035 | 6.030 | 4.809 | 1.347 |
| 908.430 | 5.988 | 5.866 | 5.861 | 4.999 | 0.989 |
| 920.000 | 5.756 | 5.635 | 5.630 | 4.922 | 0.834 |
| 920.165 | 5.753 | 5.632 | 5.626 | 4.920 | 0.833 |
| 922.701 | 5.704 | 5.582 | 5.577 | 4.889 | 0.815 |
| 932.665 | 5.541 | 5.419 | 5.414 | 4.735 | 0.806 |
| 940.000 | 5.451 | 5.329 | 5.324 | 4.691 | 0.759 |
| 945.165 | 5.403 | 5.282 | 5.276 | 4.684 | 0.719 |
| 959.981 | 5.285 | 5.163 | 5.158 | 4.678 | 0.607 |
| 960.000 | 5.284 | 5.163 | 5.158 | 4.678 | 0.606 |
| 980.000 | 5.124 | 5.003 | 4.998 | 4.821 | 0.304 |
| 986.022 | 5.076 | 4.955 | 4.950 | 4.780 | 0.296 |
| 1000.000 | 4.964 | 4.843 | 4.838 | 4.684 | 0.281 |
| 1020.000 | 4.804 | 4.683 | 4.678 | 4.354 | 0.450 |
| 1020.833 | 4.798 | 4.676 | 4.671 | 4.337 | 0.461 |
| 1035.147 | 4.683 | 4.562 | 4.557 | 3.994 | 0.689 |
| 1040.000 | 4.644 | 4.523 | 4.518 | 3.946 | 0.698 |
| 1060.000 | 4.484 | 4.363 | 4.358 | 3.718 | 0.767 |
| 1069.239 | 4.410 | 4.289 | 4.284 | 3.674 | 0.736 |
| 1072.397 | 4.398 | 4.276 | 4.271 | 3.643 | 0.755 |
| 1076.739 | 4.422 | 4.301 | | 3.583 | 0.839 |
| 1080.000 | 4.471 | | | 3.538 | 0.933 |
| 1084.239 | 4.576 | | | 3.479 | 1.096 |
| 1090.275 | 4.757 | | | 3.420 | 1.337 |

## ROAD 1 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales AS SHOWN
Original Issue Signatures
Drawn A. CARDEÑO
Designed A. MAGONDACAN
Original Size A1
Height Datum AHD
Project Manager L. PRIZEMAN
Grid GRID

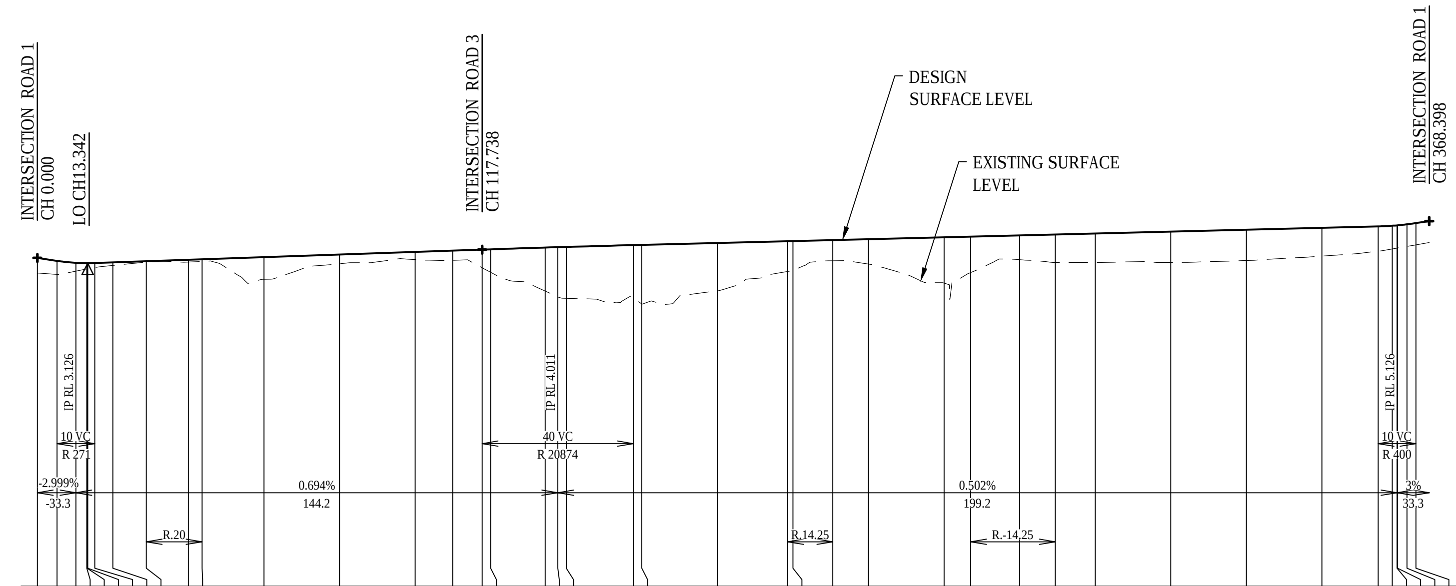

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 1 LONGITUDINAL SECTION - SHEET 2 OF 2

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C151 | AA007094 | 05 |

05




Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-14.000

| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 0.000 | 3.433 | | | 2.621 | 0.811 |
| 5.220 | 3.276 | | | 2.560 | 0.716 |
| 10.220 | 3.172 | | | 2.735 | 0.438 |
| 13.077 | 3.154 | | | 2.851 | 0.303 |
| 13.192 | 3.154 | 3.033 | | 2.855 | 0.299 |
| 13.342 | 3.154 | 3.033 | 3.028 | 2.861 | 0.294 |
| 15.220 | 3.161 | 3.039 | 3.034 | 2.926 | 0.235 |
| 20.000 | 3.194 | 3.073 | 3.067 | 3.033 | 0.161 |
| 28.858 | 3.255 | 3.134 | 3.129 | 3.204 | 0.052 |
| 40.000 | 3.333 | 3.211 | 3.206 | 3.212 | 0.121 |
| 43.602 | 3.358 | 3.236 | 3.231 | 3.247 | 0.111 |
| 60.000 | 3.471 | 3.350 | 3.345 | 2.304 | 1.168 |
| 80.000 | 3.610 | 3.489 | 3.484 | 3.125 | 0.485 |
| 100.000 | 3.749 | 3.627 | 3.622 | 3.341 | 0.408 |
| 109.977 | 3.818 | 3.697 | 3.692 | 3.308 | 0.511 |
| 117.756 | 3.872 | 3.751 | 3.746 | 2.912 | 0.960 |
| 120.000 | 3.888 | 3.766 | 3.761 | 2.669 | 1.219 |
| 134.417 | 3.981 | 3.860 | 3.854 | 1.678 | 2.303 |
| 137.756 | 4.001 | 3.880 | 3.875 | 1.370 | 2.631 |
| 140.000 | 4.015 | 3.893 | 3.888 | 1.294 | 2.721 |
| 157.756 | 4.111 | 3.990 | 3.985 | 1.307 | 2.804 |
| 160.000 | 4.122 | 4.001 | 3.996 | 0.999 | 3.124 |
| 180.000 | 4.223 | 4.101 | 4.096 | 1.690 | 2.533 |
| 198.614 | 4.316 | 4.195 | 4.190 | 2.712 | 1.604 |
| 200.000 | 4.323 | 4.202 | 4.197 | 2.774 | 1.549 |
| 210.545 | 4.376 | 4.255 | 4.250 | 3.284 | 1.092 |
| 220.000 | 4.424 | 4.302 | 4.297 | 3.108 | 1.316 |
| 240.000 | 4.524 | 4.403 | 4.397 | 2.094 | 2.430 |
| 247.020 | 4.559 | 4.438 | 4.433 | 2.655 | 1.904 |
| 260.000 | 4.624 | 4.503 | 4.498 | 3.343 | 1.281 |
| 269.417 | 4.672 | 4.550 | 4.545 | 3.188 | 1.484 |
| 280.000 | 4.725 | 4.603 | 4.598 | 3.186 | 1.539 |
| 300.000 | 4.825 | 4.704 | 4.699 | 3.191 | 1.635 |
| 320.000 | 4.926 | 4.804 | 4.799 | 3.298 | 1.628 |
| 340.000 | 5.026 | 4.905 | 4.899 | 3.527 | 1.499 |
| 354.878 | 5.101 | 4.979 | | 3.790 | 1.310 |
| 358.606 | 5.137 | | | 3.905 | 1.232 |
| 359.878 | 5.157 | | | 3.950 | 1.207 |
| 360.000 | 5.159 | | | 3.954 | 1.205 |
| 362.525 | 5.212 | | | 4.042 | 1.170 |
| 364.878 | 5.276 | | | 4.125 | 1.151 |

ROAD 2 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

0 20 40 60 80 100m

1 : 1000

0 5 10 15 20m

1 : 200

Surveyor

ROBERT A HARRIES
SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client

GOLDCORAL PTY LTD

Status

FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

Scales AS SHOWN

Original Issue Signatures

Drawn A. CARDEÑO

Designed A. MAGONDACAN

Project Manager L. PRIZEMAN

Original Size A1

Height Datum AHD

Grid GRID

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Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

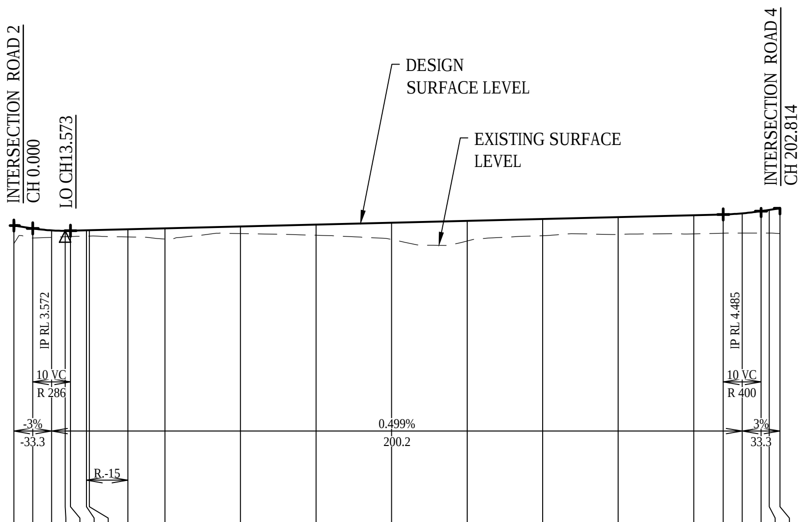
ROAD 2 LONGITUDINAL SECTION


ARCADIS

Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289

Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C152 | AA007094 | 05 |



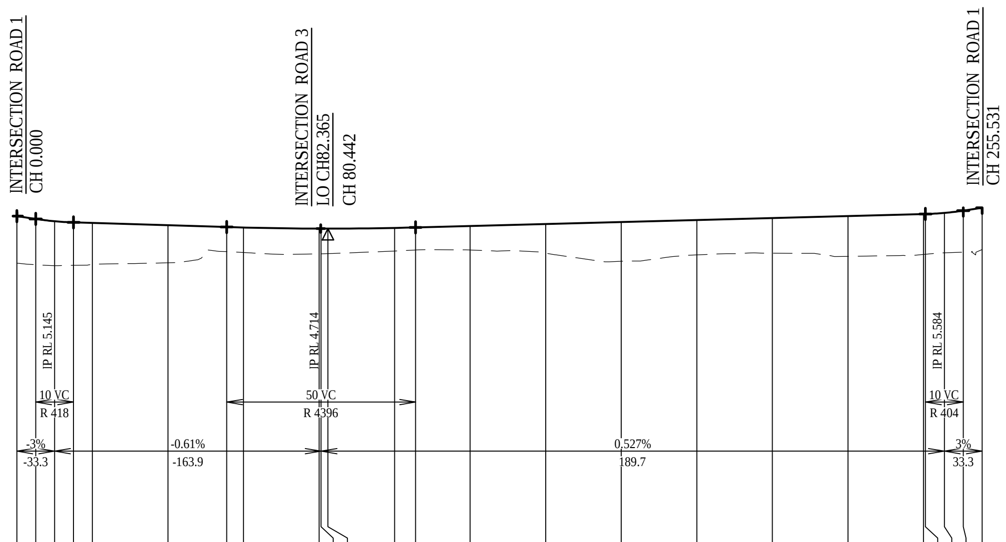

Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-12.000

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN LEVELS ON ROAD CENTRELINE | 3.872 | 3.722 | 3.616 | 3.593 | 3.597 | 3.618 | 3.622 | 3.673 | 3.722 | 3.822 | 3.922 | 4.021 | 4.121 | 4.221 | 4.321 | 4.421 | 4.460 | 4.516 | 4.635 | 4.701 | 4.785 |
| DESIGN LIP OF KERB (LHS) | | | | 3.467 | 3.470 | 3.491 | 3.495 | 3.546 | 3.595 | 3.695 | 3.795 | 3.895 | 3.995 | 4.095 | 4.195 | 4.294 | 4.333 | | | | |
| DESIGN LIP OF KERB (RHS) | | | | 3.467 | 3.470 | 3.491 | 3.495 | 3.546 | 3.595 | 3.695 | 3.795 | 3.895 | 3.995 | 4.095 | 4.195 | 4.294 | 4.333 | | | | |
| EXISTING SURFACE ON ROAD CENTRELINE | 2.914 | 3.210 | 3.250 | 3.278 | 3.289 | 3.312 | 3.315 | 3.269 | 3.156 | 3.449 | 3.359 | 3.135 | 3.054 | 3.334 | 3.398 | 3.428 | 3.466 | 3.476 | 3.474 | 3.473 | 3.452 |
| CUT / FILL DEPTH | 0.958 | 0.512 | 0.366 | 0.315 | 0.308 | 0.306 | 0.307 | 0.403 | 0.566 | 0.372 | 0.563 | 0.886 | 1.068 | 0.887 | 0.923 | 0.993 | 0.994 | 1.040 | 1.161 | 1.227 | 1.333 |
| PEGGED CHAINAGE | 0.000 | 5.000 | 10.000 | 13.573 | 15.000 | 19.205 | 20.000 | 30.208 | 40.000 | 60.000 | 80.000 | 100.000 | 120.000 | 140.000 | 160.000 | 180.000 | 187.814 | 192.814 | 197.814 | 200.000 | 202.814 |

## ROAD 3 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL




Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-12.000

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN LEVELS ON ROAD CENTRELINE | 5.445 | 5.295 | 5.175 | 5.114 | 5.084 | 4.962 | 4.867 | 4.842 | 4.786 | 4.785 | 4.785 | 4.820 | 4.846 | 4.922 | 5.028 | 5.133 | 5.239 | 5.344 | 5.450 | 5.555 | 5.558 | 5.615 | 5.734 | 5.884 |
| DESIGN LIP OF KERB (LHS) | | | | 4.982 | 4.952 | 4.831 | 4.738 | 4.713 | 4.659 | 4.659 | 4.658 | 4.694 | 4.720 | 4.796 | 4.902 | 5.007 | 5.113 | 5.218 | 5.324 | 5.429 | 5.432 | 5.491 | | |
| DESIGN LIP OF KERB (RHS) | | | | 4.982 | 4.952 | 4.831 | 4.738 | 4.713 | 4.659 | 4.659 | 4.658 | 4.694 | 4.720 | 4.796 | 4.902 | 5.007 | 5.113 | 5.218 | 5.324 | | | | | |
| EXISTING SURFACE ON ROAD CENTRELINE | 2.953 | 2.873 | 2.819 | 2.842 | 2.885 | 2.975 | 3.564 | 3.521 | 3.450 | 3.452 | 3.460 | 3.598 | 3.649 | 3.652 | 3.485 | 3.059 | 3.394 | 3.481 | 3.317 | 3.416 | 3.425 | 3.505 | 3.532 | 3.663 |
| CUT / FILL DEPTH | 2.492 | 2.422 | 2.355 | 2.273 | 2.198 | 1.986 | 1.303 | 1.321 | 1.336 | 1.333 | 1.325 | 1.223 | 1.197 | 1.270 | 1.543 | 2.074 | 1.845 | 1.863 | 2.133 | 2.139 | 2.132 | 2.110 | 2.202 | 2.222 |
| PEGGED CHAINAGE | 0.000 | 5.000 | 10.000 | 15.000 | 20.000 | 40.000 | 55.542 | 60.000 | 80.000 | 80.542 | 82.365 | 100.000 | 105.542 | 120.000 | 140.000 | 160.000 | 180.000 | 200.000 | 220.000 | 240.000 | 240.523 | 245.523 | 250.523 | 255.531 |

## ROAD 4 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 04 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

100mm on Original

Scale

0 20 40 60 80 100m
1 : 1000

0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

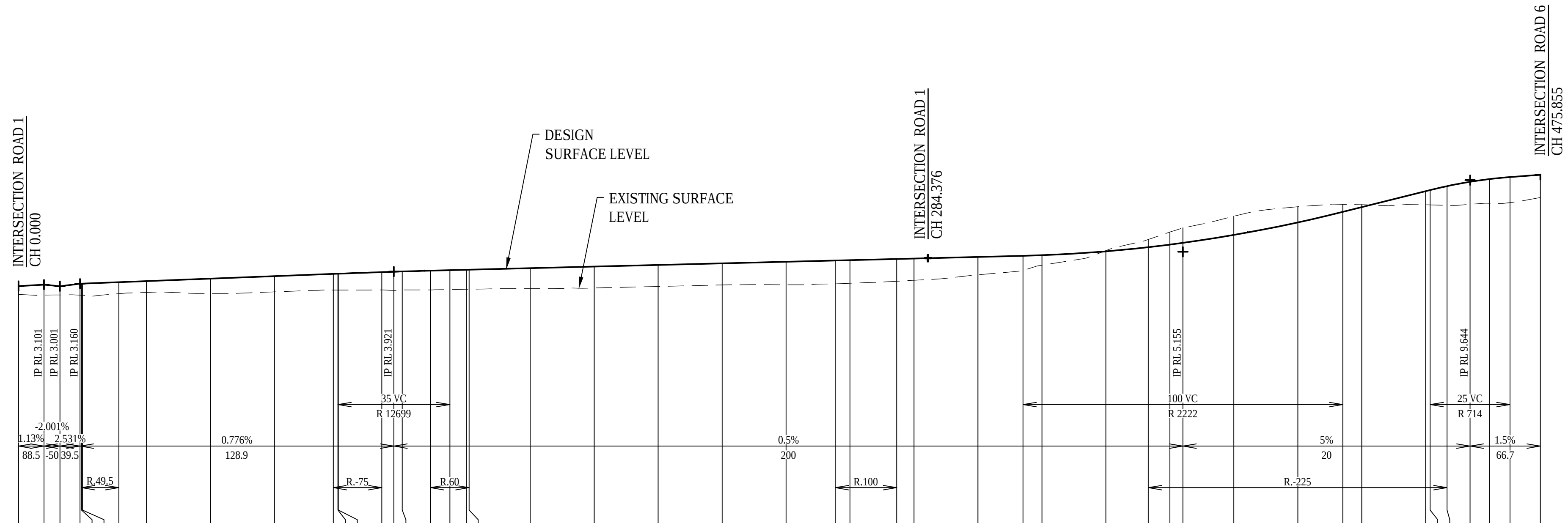
| | | | |
|---|---|---|---|
| Scales | AS SHOWN | Original Issue Signatures | |
| | | Drawn A. CARDEÑO | |
| Original Size | A1 | Designed A. MAGONDACAN | |
| Height Datum | AHD | Project Manager L. PRIZEMAN | |
| Grid | GRID | © Copyright reserved | |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 3 & 4 LONGITUDINAL
SECTIONS

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C153 | AA007094 | 06 |




Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-12.000

| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 0.000 | 3.011 | | | 2.488 | 0.523 |
| 7.977 | 3.101 | | | 2.447 | 0.654 |
| 12.965 | 3.001 | | | 2.461 | 0.541 |
| 19.243 | 3.160 | | | 2.449 | 0.711 |
| 19.699 | 3.164 | | | 2.445 | 0.719 |
| 20.000 | 3.166 | | | 2.442 | 0.724 |
| 31.366 | 3.254 | 3.163 | 3.163 | 2.535 | 0.719 |
| 40.000 | 3.321 | 3.230 | 3.230 | 2.618 | 0.704 |
| 60.000 | 3.476 | 3.385 | 3.385 | 2.551 | 0.926 |
| 80.000 | 3.632 | 3.540 | 3.540 | 2.648 | 0.983 |
| 98.445 | 3.775 | 3.683 | 3.683 | 2.762 | 1.013 |
| 99.866 | 3.786 | 3.694 | 3.694 | 2.762 | 1.024 |
| 100.000 | 3.787 | 3.695 | 3.695 | 2.762 | 1.025 |
| 113.602 | 3.885 | 3.793 | 3.793 | 2.771 | 1.113 |
| 117.366 | 3.909 | 3.818 | 3.818 | 2.741 | 1.169 |
| 120.000 | 3.926 | 3.834 | 3.834 | 2.771 | 1.155 |
| 128.775 | 3.977 | 3.860 | 3.859 | 2.774 | 1.203 |
| 134.866 | 4.009 | 3.857 | 3.866 | 2.793 | 1.216 |
| 140.000 | 4.035 | 3.878 | 3.883 | 2.810 | 1.224 |
| 140.910 | 4.039 | 3.883 | 3.888 | 2.814 | 1.225 |
| 160.000 | 4.135 | 3.978 | 3.983 | 2.865 | 1.270 |
| 180.000 | 4.235 | 4.078 | 4.083 | 2.894 | 1.341 |
| 200.000 | 4.335 | 4.178 | 4.183 | 2.988 | 1.347 |
| 220.000 | 4.435 | 4.278 | 4.283 | 3.081 | 1.353 |
| 240.000 | 4.535 | 4.378 | 4.383 | 3.096 | 1.439 |
| 255.377 | 4.612 | 4.455 | 4.460 | 3.152 | 1.459 |
| 260.000 | 4.635 | 4.478 | 4.483 | 3.187 | 1.448 |
| 274.596 | 4.708 | 4.551 | 4.556 | 3.316 | 1.392 |
| 280.000 | 4.735 | 4.578 | 4.583 | 3.373 | 1.361 |
| 300.000 | 4.835 | 4.678 | 4.678 | 3.714 | 1.120 |
| 314.085 | 4.905 | 4.749 | 4.749 | 3.991 | 0.914 |
| 320.000 | 4.943 | 4.786 | 4.786 | 4.318 | 0.624 |
| 340.000 | 5.186 | 5.029 | 5.029 | 5.231 | -0.045 |
| 353.254 | 5.446 | 5.290 | 5.290 | 5.929 | -0.483 |
| 360.000 | 5.609 | 5.452 | 5.452 | 6.392 | -0.783 |
| 364.085 | 5.718 | 5.561 | 5.561 | 6.655 | -0.937 |
| 380.000 | 6.212 | 6.056 | 6.056 | 7.384 | -1.172 |
| 400.000 | 6.996 | 6.839 | 6.839 | 7.981 | -0.986 |
| 414.085 | 7.655 | 7.499 | 7.499 | 8.131 | -0.475 |
| 420.000 | 7.951 | 7.794 | 7.794 | 8.105 | -0.154 |
| 440.000 | 8.951 | 8.794 | 8.794 | 8.100 | 0.851 |
| 441.365 | 9.019 | 8.863 | 8.863 | 8.093 | 0.926 |
| 446.681 | 9.265 | 9.109 | 9.109 | 8.063 | 1.202 |
| 453.865 | 9.535 | 9.378 | 9.378 | 8.125 | 1.410 |
| 460.000 | 9.708 | 9.552 | | 8.192 | 1.516 |
| 466.365 | 9.832 | 9.677 | | 8.236 | 1.595 |
| 475.855 | 9.974 | | | 8.550 | 1.424 |

ROAD 5 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 04 | MC1004 SECTION AMENDED | | | BD | 14.10.15 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales: AS SHOWN
Original Size: A1
Height Datum: AHD
Grid: GRID

Original Issue Signatures
Drawn: A. CARDEÑO
Designed: A. MAGONDACAN
Project Manager: L. PRIZEMAN



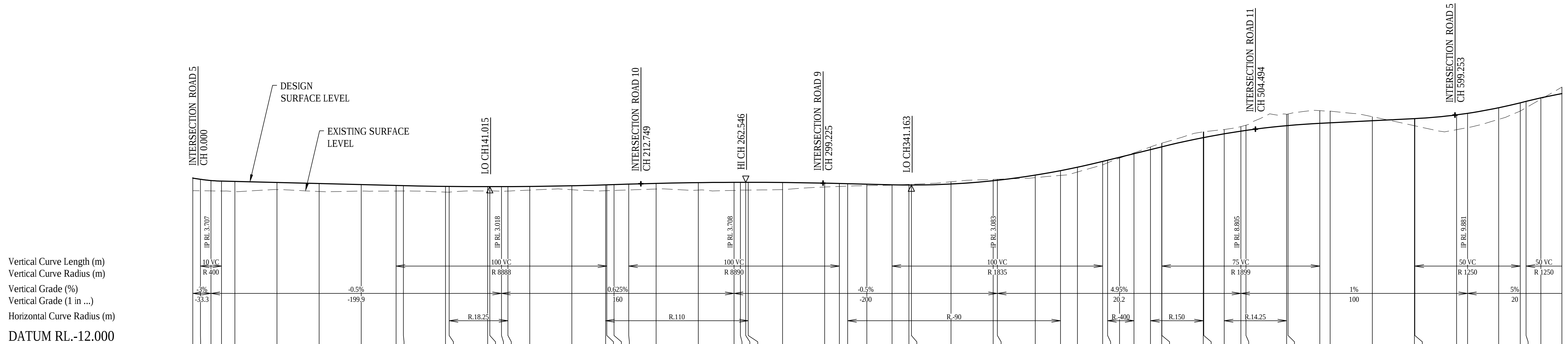
Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 5 LONGITUDINAL SECTION

ARCADIS

Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C154 | AA007094 | 06 |




| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 0.000 | 3.967 | 11.540 | | 2.774 | 1.193 |
| 3.646 | 3.857 | 11.377 | | 2.766 | 1.092 |
| 8.646 | 3.739 | 3.613 | | 2.754 | 0.985 |
| 13.646 | 3.682 | 3.556 | | 2.744 | 0.939 |
| 20.000 | 3.651 | 3.524 | 3.524 | 2.678 | 0.972 |
| 40.000 | 3.551 | 3.424 | 3.424 | 2.869 | 0.681 |
| 60.000 | 3.451 | 3.324 | 3.324 | 2.695 | 0.756 |
| 80.000 | 3.351 | 3.224 | 3.224 | 2.732 | 0.618 |
| 96.557 | 3.268 | 3.141 | 3.141 | 2.738 | 0.529 |
| 100.000 | 3.251 | 3.125 | 3.125 | 2.742 | 0.509 |
| 120.000 | 3.181 | 3.055 | 3.055 | 2.641 | 0.540 |
| 121.720 | 3.177 | 3.051 | 3.051 | 2.629 | 0.549 |
| 140.000 | 3.157 | 3.022 | 3.292 | 2.745 | 0.412 |
| 141.015 | 3.157 | 3.022 | 3.292 | 2.746 | 0.411 |
| 146.557 | 3.158 | 3.023 | 3.293 | 2.724 | 0.434 |
| 149.607 | 3.161 | 3.026 | 3.296 | 2.738 | 0.422 |
| 160.000 | 3.177 | 3.042 | 3.312 | 2.827 | 0.349 |
| 180.000 | 3.242 | 3.107 | 3.377 | 2.861 | 0.381 |
| 196.019 | 3.327 | 3.192 | 3.462 | 2.770 | 0.557 |
| 196.557 | 3.330 | 3.195 | 3.465 | 2.774 | 0.556 |
| 200.000 | 3.352 | 3.217 | 3.487 | 2.797 | 0.554 |
| 206.995 | 3.395 | 3.260 | 3.530 | 2.845 | 0.550 |
| 220.000 | 3.467 | 3.332 | 3.602 | 2.933 | 0.534 |
| 240.000 | 3.540 | 3.405 | 3.675 | 2.830 | 0.710 |
| 256.995 | 3.567 | 3.432 | 3.702 | 2.795 | 0.772 |
| 260.000 | 3.568 | 3.433 | 3.703 | 2.828 | 0.741 |
| 262.546 | 3.569 | 3.434 | 3.704 | 2.827 | 0.742 |
| 263.734 | 3.569 | 3.434 | 3.704 | 2.827 | 0.742 |
| 280.000 | 3.552 | 3.417 | 3.687 | 2.874 | 0.678 |
| 300.000 | 3.490 | 3.355 | 3.625 | 3.120 | 0.369 |
| 306.995 | 3.458 | 3.323 | 3.593 | 3.179 | 0.279 |
| 310.917 | 3.438 | 3.303 | 3.573 | 3.211 | 0.227 |
| 320.000 | 3.393 | 3.258 | 3.528 | 3.252 | 0.141 |
| 331.989 | 3.333 | 3.198 | 3.468 | 3.304 | 0.028 |
| 340.000 | 3.310 | 3.175 | 3.445 | 3.376 | -0.066 |
| 341.163 | 3.310 | 3.175 | 3.445 | 3.386 | -0.076 |
| 360.000 | 3.407 | 3.272 | 3.542 | 3.618 | -0.212 |
| 380.000 | 3.721 | 3.586 | 3.856 | 3.846 | -0.125 |
| 381.989 | 3.764 | 3.629 | 3.899 | 3.860 | -0.096 |
| 400.000 | 4.253 | 4.118 | 4.388 | 4.016 | 0.237 |
| 411.958 | 4.676 | 4.541 | 4.811 | 4.224 | 0.452 |
| 420.000 | 5.003 | 4.868 | 5.138 | 4.548 | 0.455 |
| 431.989 | 5.558 | 5.423 | 5.693 | 5.235 | 0.322 |
| 434.319 | 5.673 | 5.538 | 5.808 | 5.426 | 0.247 |
| 440.000 | 5.954 | 5.819 | 6.089 | 5.870 | 0.084 |
| 446.867 | 6.294 | 6.159 | 6.429 | 6.368 | -0.074 |
| 454.697 | 6.682 | 6.547 | 6.817 | 6.932 | -0.250 |
| 460.000 | 6.944 | 6.809 | 7.079 | 7.288 | -0.344 |
| 460.085 | 6.949 | 6.814 | 7.084 | 7.293 | -0.344 |
| 479.738 | 7.820 | 7.685 | 7.826 | 8.368 | -0.548 |
| 480.000 | 7.830 | 7.695 | 7.833 | 8.377 | -0.547 |
| 489.673 | 8.183 | 8.048 | 8.067 | 8.591 | -0.409 |
| 497.585 | 8.434 | 8.308 | 8.308 | 8.862 | -0.428 |
| 500.000 | 8.505 | 8.378 | 8.378 | 8.999 | -0.495 |
| 519.315 | 8.957 | 8.830 | 8.830 | 10.042 | -1.085 |
| 520.000 | 8.969 | 8.842 | 8.842 | 10.065 | -1.096 |
| 535.085 | 9.180 | 9.053 | 9.053 | 10.386 | -1.206 |
| 540.000 | 9.229 | 9.102 | 9.102 | 10.341 | -1.112 |
| 560.000 | 9.429 | 9.302 | 9.302 | 9.807 | -0.379 |
| 580.000 | 9.629 | 9.502 | 9.502 | 8.952 | 0.676 |
| 580.218 | 9.631 | 9.504 | 9.504 | 8.943 | 0.688 |
| 600.000 | 9.985 | 9.859 | 9.859 | 8.578 | 1.407 |
| 605.218 | 10.131 | 10.005 | 10.005 | 8.773 | 1.358 |
| 620.000 | 10.662 | 10.535 | 10.535 | 9.559 | 1.103 |
| 630.218 | 11.131 | 11.004 | 11.004 | 10.347 | 0.784 |
| 633.004 | 11.270 | 11.144 | 11.144 | 10.668 | 0.603 |
| 640.000 | 11.601 | 11.474 | 11.474 | 11.473 | 0.128 |
| 650.000 | 12.005 | 11.878 | 11.878 | 12.629 | -0.624 |

## ROAD 6 LONGITUDINAL SECTION

SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales AS SHOWN
Original Issue Signatures
Drawn A. CARDEÑO
Designed A. MAGONDACAN
Original Size A1
Height Datum AHD
Project Manager L. PRIZEMAN
Grid GRID



Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 6 LONGITUDINAL SECTION

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
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Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
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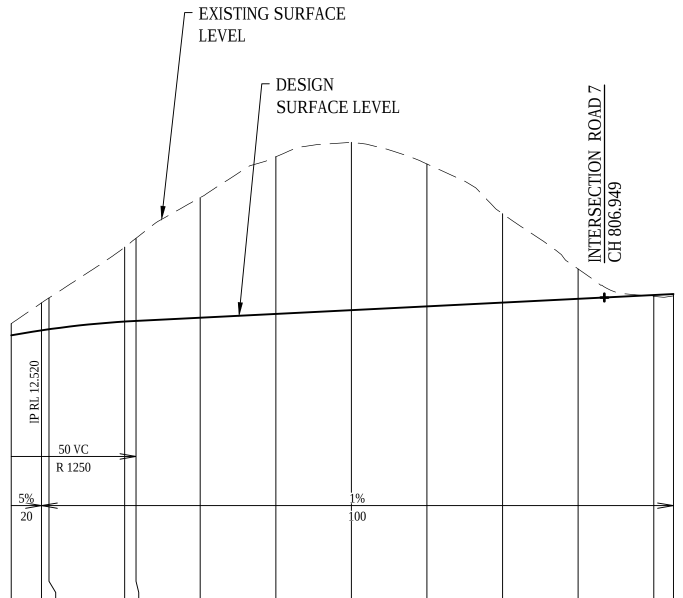
Drawing No. C155 — Project No. AA007094 — Issue 05

100mm on Original

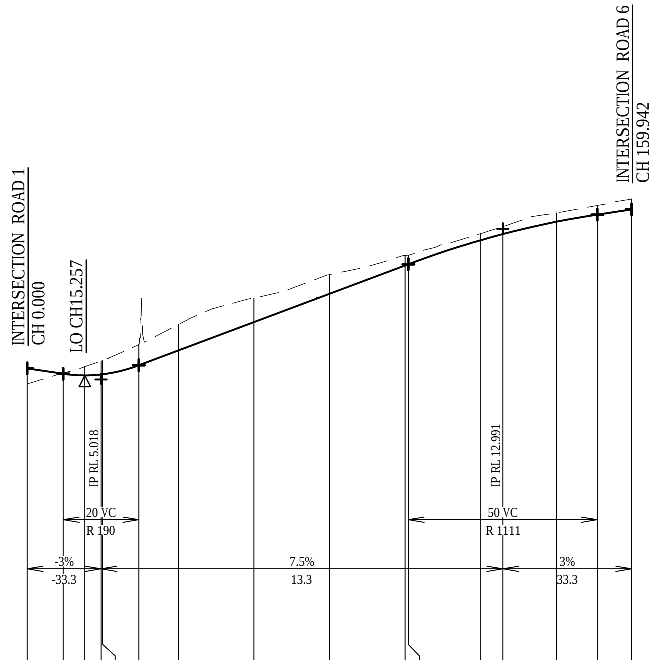



Vertical Curve Length (m): 50 VC
Vertical Curve Radius (m): R 1250
Vertical Grade (%): 5% | 1%
Vertical Grade (1 in ...): 20 | 100
Horizontal Curve Radius (m)

DATUM RL.-2.000

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN LEVELS ON ROAD CENTRELINE | 12.005 | 12.270 | 12.329 | 12.737 | 12.770 | 12.940 | 13.140 | 13.340 | 13.540 | 13.740 | 13.940 | 14.140 | 14.192 |
| DESIGN LIP OF KERB (LHS) | 11.878 | 12.144 | 12.202 | 12.610 | 12.644 | 12.814 | 13.014 | 13.214 | 13.414 | 13.614 | 13.814 | 14.014 | 14.066 |
| DESIGN LIP OF KERB (RHS) | 11.878 | 12.144 | 12.202 | 12.610 | 12.644 | 12.814 | 13.014 | 13.214 | 13.414 | 13.614 | 13.814 | 14.014 | 14.066 |
| EXISTING SURFACE ON ROAD CENTRELINE | 12.629 | 13.727 | 13.991 | 16.670 | 17.141 | 19.294 | 21.455 | 22.215 | 21.074 | 18.444 | 15.521 | 14.069 | 14.103 |
| CUT / FILL DEPTH | -0.624 | -1.456 | -1.662 | -3.933 | -4.371 | -6.354 | -8.315 | -8.875 | -7.534 | -4.704 | -1.581 | 0.071 | 0.090 |
| PEGGED CHAINAGE | 650.000 | 658.004 | 660.000 | 680.000 | 683.004 | 700.000 | 720.000 | 740.000 | 760.000 | 780.000 | 800.000 | 820.000 | 825.212 |

ROAD 6 LONGITUDINAL SECTION
SCALE 1:200 VERTICAL
1:1000 HORIZONTAL




Vertical Curve Length (m): 20 VC | 50 VC
Vertical Curve Radius (m): R 190 | R 1111
Vertical Grade (%): -3% | 7.5% | 3%
Vertical Grade (1 in ...): -33.3 | 13.3 | 33.3
Horizontal Curve Radius (m)

DATUM RL.-10.000

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN LEVELS ON ROAD CENTRELINE | 5.604 | 5.318 | 5.232 | 5.281 | 5.291 | 5.768 | 6.552 | 8.052 | 9.552 | 11.052 | 11.116 | 12.387 | 12.710 | 13.362 | 13.741 | 14.014 |
| DESIGN LIP OF KERB (LHS) | | | 5.106 | 5.156 | 5.165 | 5.641 | 6.426 | 7.926 | 9.426 | 10.926 | 10.989 | 12.261 | 12.583 | 13.236 | | |
| DESIGN LIP OF KERB (RHS) | | | 5.106 | 5.156 | 5.165 | 5.641 | 6.426 | 7.926 | 9.426 | 10.926 | 10.989 | 12.261 | 12.583 | 13.236 | | |
| EXISTING SURFACE ON ROAD CENTRELINE | 4.783 | 5.351 | 5.693 | 5.996 | 6.029 | 6.895 | 7.923 | 9.327 | 10.567 | 11.578 | 11.594 | 12.737 | 13.099 | 13.829 | 14.220 | 14.565 |
| CUT / FILL DEPTH | 0.821 | -0.033 | -0.461 | -0.716 | -0.737 | -1.127 | -1.371 | -1.275 | -1.014 | -0.526 | -0.478 | -0.349 | -0.389 | -0.466 | -0.479 | -0.551 |
| PEGGED CHAINAGE | 0.000 | 9.543 | 15.257 | 19.543 | 20.000 | 29.543 | 40.000 | 60.000 | 80.000 | 100.000 | 100.847 | 120.000 | 125.847 | 140.000 | 150.847 | 159.942 |

ROAD 7 LONGITUDINAL SECTION
SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 04 | ISSUE FOR RFI RESPONSE | | | NF | 04.04.16 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor: ROBERT A HARRIES SURVEYOR

Architect

Filename: C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client: GOLDCORAL PTY LTD

Status: FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved — R.P.E.Q No :

Scales: AS SHOWN — Original Issue Signatures

Drawn: A. CARDEÑO

Original Size: A1 — Designed: A. MAGONDACAN

Height Datum: AHD — Project Manager: L. PRIZEMAN

Grid: GRID — © Copyright reserved

Project: RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title: ROAD 6 & 7 LONGITUDINAL SECTIONS

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Drawing No. C156 — Project No. AA007094 — Issue 06

100mm on Original

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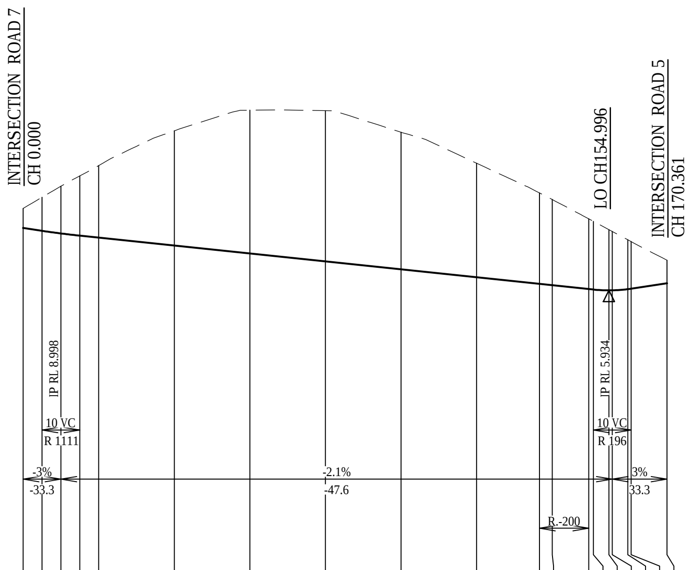
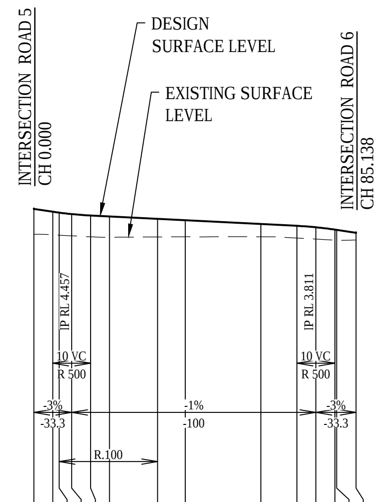



Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-9.000

| DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH | PEGGED CHAINAGE |
|---|---|---|---|---|---|
| 9.298 | | | 10.335 | -1.037 | 0.000 |
| 9.148 | | | 10.924 | -1.776 | 5.001 |
| 9.009 | | | 11.508 | -2.498 | 10.001 |
| 8.893 | 8.766 | 8.766 | 12.056 | -3.163 | 15.001 |
| 8.788 | 8.661 | 8.661 | 12.603 | -3.815 | 20.000 |
| 8.368 | 8.241 | 8.241 | 14.444 | -6.077 | 40.000 |
| 7.948 | 7.821 | 7.821 | 15.537 | -7.589 | 60.000 |
| 7.528 | 7.401 | 7.401 | 15.510 | -7.983 | 80.000 |
| 7.108 | 6.981 | 6.981 | 14.370 | -7.262 | 100.000 |
| 6.688 | 6.561 | 6.561 | 12.729 | -6.042 | 120.000 |
| 6.339 | 6.212 | 6.212 | 11.157 | -4.818 | 136.616 |
| 6.268 | 6.141 | 6.141 | 10.806 | -4.538 | 140.000 |
| 6.064 | 5.938 | 5.938 | 9.781 | -3.717 | 149.675 |
| 6.039 | 5.913 | 5.913 | 9.652 | -3.613 | 150.878 |
| 5.996 | 5.869 | 5.869 | 9.210 | -3.214 | 154.996 |
| 5.998 | 5.871 | 5.871 | 9.115 | -3.117 | 155.878 |
| 6.060 | | | 8.673 | -2.613 | 160.000 |
| 6.084 | | | 8.578 | -2.494 | 160.878 |
| 6.369 | | | 7.595 | -1.226 | 170.361 |

ROAD 8 LONGITUDINAL SECTION
SCALE 1:200 VERTICAL
1:1000 HORIZONTAL




Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-11.000

| DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH | PEGGED CHAINAGE |
|---|---|---|---|---|---|
| 4.757 | | | 3.420 | 1.337 | 0.000 |
| 4.607 | | | 3.387 | 1.220 | 5.000 |
| 4.559 | | | 3.369 | 1.190 | 6.676 |
| 4.482 | | | 3.333 | 1.148 | 10.000 |
| 4.407 | 4.280 | 4.280 | 3.281 | 1.126 | 15.000 |
| 4.357 | 4.230 | 4.230 | 3.256 | 1.101 | 20.000 |
| 4.230 | 4.103 | 4.103 | 3.275 | 0.955 | 32.700 |
| 4.157 | 4.030 | 4.030 | 3.286 | 0.871 | 40.000 |
| 3.957 | 3.830 | 3.830 | 3.283 | 0.673 | 60.000 |
| 3.861 | 3.735 | | 3.217 | 0.645 | 69.531 |
| 3.786 | 3.659 | | 3.161 | 0.625 | 74.531 |
| 3.661 | | | 3.105 | 0.556 | 79.531 |
| 3.647 | | | 3.100 | 0.548 | 80.000 |
| 3.493 | | | 3.114 | 0.379 | 85.138 |

ROAD 9 LONGITUDINAL SECTION
SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 04 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 03 | ISSUE FOR RFI RESPONSE | BF | | BD | 26.11.18 |
| 02 | ISSUE FOR RFI RESPONSE | | | NF | 04.04.16 |
| 01 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales AS SHOWN
Original Issue Signatures
Drawn A. CARDEÑO
Original Size A1
Designed A. MAGONDACAN
Height Datum AHD
Project Manager L. PRIZEMAN
Grid GRID
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Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 8 & 9 LONGITUDINAL SECTIONS


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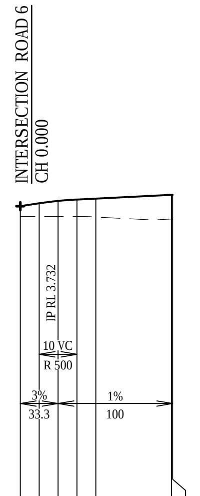
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C157 | AA007094 | 04 |

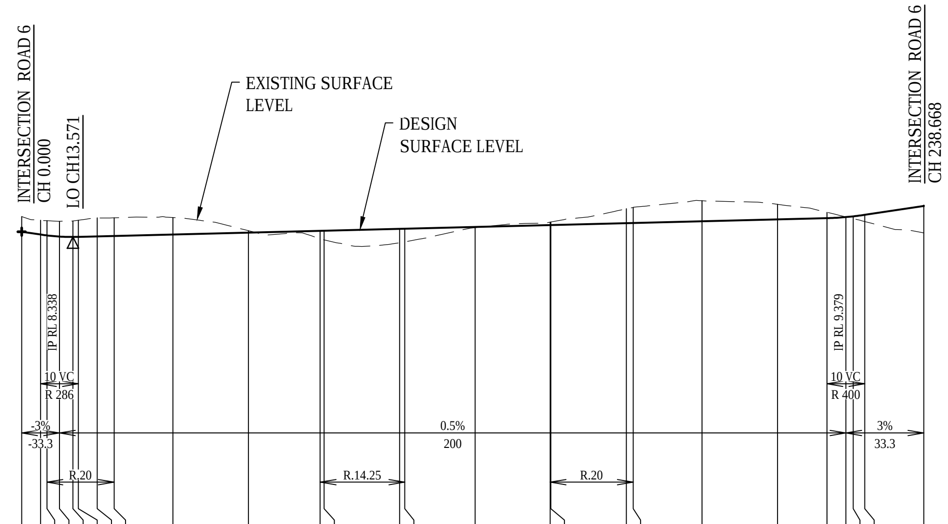



Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-12.000

| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 0.000 | 3.432 | | | 2.884 | 0.548 |
| 5.000 | 3.582 | | | 2.881 | 0.700 |
| 10.000 | 3.707 | | | 2.878 | 0.828 |
| 15.000 | 3.782 | 3.655 | 3.655 | 2.878 | 0.904 |
| 20.000 | 3.832 | 3.705 | 3.705 | 2.854 | 0.977 |
| 40.000 | 4.032 | | | 2.747 | 1.284 |
| 40.300 | 4.035 | | | 2.750 | 1.285 |

ROAD 10 LONGITUDINAL SECTION
SCALE 1:200 VERTICAL
1:1000 HORIZONTAL




Vertical Curve Length (m)
Vertical Curve Radius (m)
Vertical Grade (%)
Vertical Grade (1 in ...)
Horizontal Curve Radius (m)

DATUM RL.-7.000

| PEGGED CHAINAGE | DESIGN LEVELS ON ROAD CENTRELINE | DESIGN LIP OF KERB (LHS) | DESIGN LIP OF KERB (RHS) | EXISTING SURFACE ON ROAD CENTRELINE | CUT / FILL DEPTH |
|---|---|---|---|---|---|
| 0.000 | 8.639 | 8.983 | | 9.439 | -0.800 |
| 5.000 | 8.489 | 8.958 | | 9.243 | -0.754 |
| 6.686 | 8.443 | 8.951 | | 9.218 | -0.775 |
| 10.000 | 8.382 | 8.256 | | 9.188 | -0.806 |
| 13.571 | 8.360 | 8.233 | | 9.206 | -0.846 |
| 15.000 | 8.363 | 8.237 | | 9.239 | -0.875 |
| 20.000 | 8.388 | 8.262 | 8.262 | 9.367 | -0.979 |
| 24.475 | 8.411 | 8.284 | 8.284 | 9.370 | -0.959 |
| 40.000 | 8.488 | 8.362 | 8.362 | 9.386 | -0.897 |
| 60.000 | 8.588 | 8.462 | 8.462 | 8.689 | -0.100 |
| 78.983 | 8.683 | 8.557 | 8.557 | 8.269 | 0.415 |
| 80.000 | 8.688 | 8.562 | 8.562 | 8.206 | 0.483 |
| 100.000 | 8.788 | 8.662 | 8.662 | 8.053 | 0.736 |
| 101.376 | 8.795 | 8.669 | 8.669 | 8.102 | 0.694 |
| 120.000 | 8.888 | 8.762 | 8.762 | 8.853 | 0.036 |
| 139.834 | 8.988 | 8.861 | 8.861 | 9.142 | -0.154 |
| 140.000 | 8.988 | 8.862 | 8.862 | 9.147 | -0.159 |
| 160.000 | 9.088 | 8.962 | 8.962 | 9.851 | -0.763 |
| 161.810 | 9.098 | 8.971 | 8.971 | 9.925 | -0.827 |
| 180.000 | 9.188 | 9.062 | 9.062 | 10.275 | -1.087 |
| 200.000 | 9.288 | 9.162 | 9.162 | 10.084 | -0.795 |
| 213.053 | 9.354 | 9.227 | 9.227 | 9.663 | -0.309 |
| 218.053 | 9.410 | 9.283 | 9.283 | 9.421 | -0.011 |
| 220.000 | 9.449 | 9.322 | | 9.327 | 0.122 |
| 223.053 | 9.529 | 9.402 | | 9.177 | 0.351 |
| 238.668 | 9.997 | | | 8.579 | 1.418 |

ROAD 11 LONGITUDINAL SECTION
SCALE 1:200 VERTICAL
1:1000 HORIZONTAL

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 03 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 02 | ISSUE FOR RFI RESPONSE | BF | | | 26.11.18 |
| 01 | ISSUE FOR RFI RESPONSE | | | NF | 04.04.16 |

Scale
0 20 40 60 80 100m
1 : 1000
0 5 10 15 20m
1 : 200

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C150-AA007094-gcd-00-MC1000RoadLongitudinalSection.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| Scales | AS SHOWN | Original Issue Signatures |
|---|---|---|
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
ROAD 10 & 11 LONGITUDINAL SECTIONS

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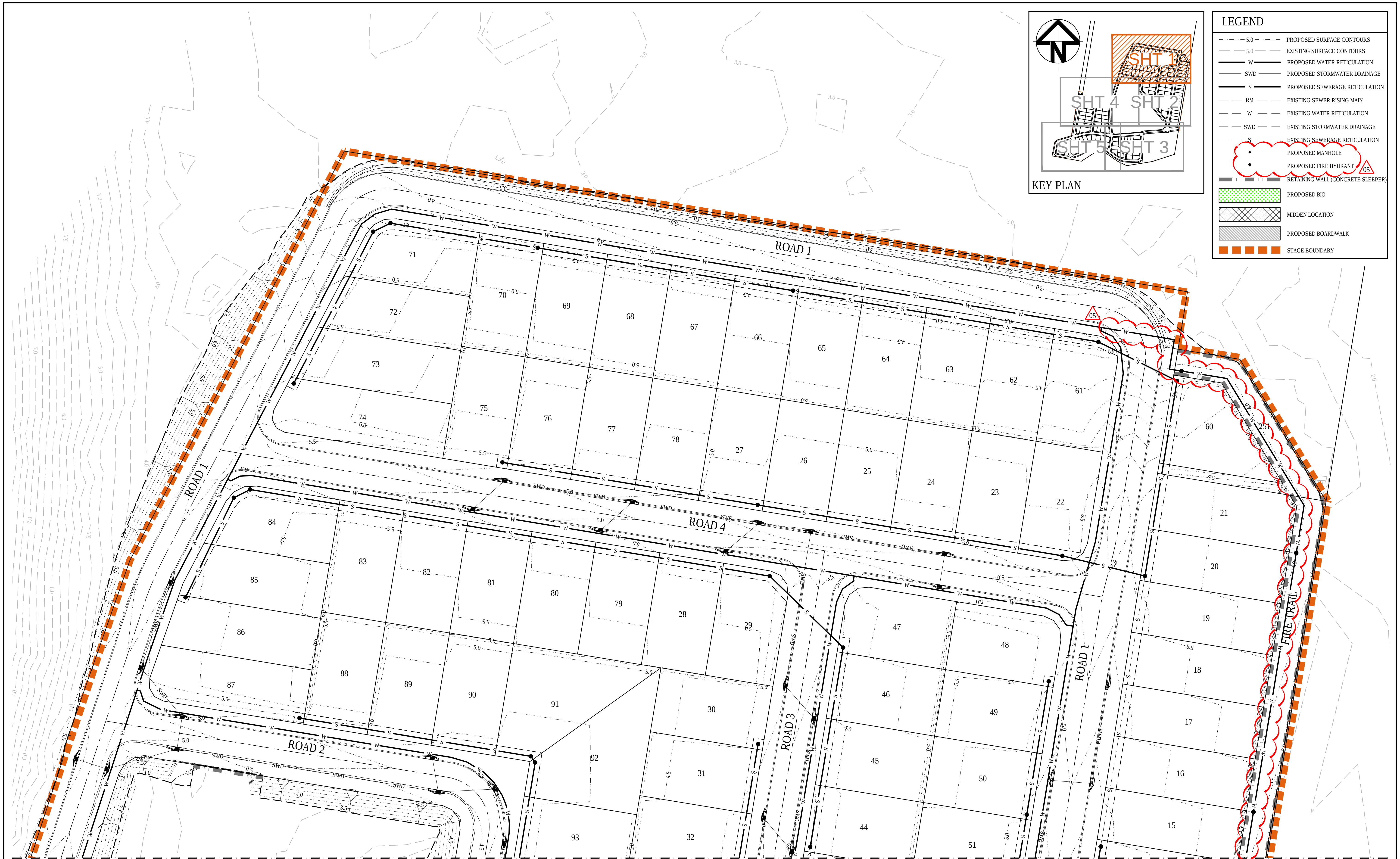
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C158 | AA007094 | 03 |

100mm on Original




FOR CONTINUATION REFER DWG C161

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C160-AA007094-gcd-00-CombinedServicesLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales 1 : 500
Original Issue Signatures
Drawn A. CARDEÑO
Original Size A1
Designed J. PECSON
Height Datum AHD
Project Manager L. PRIZEMAN
Grid GRID
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Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
COMBINED SERVICES LAYOUT
PLAN SHEET 1 OF 5

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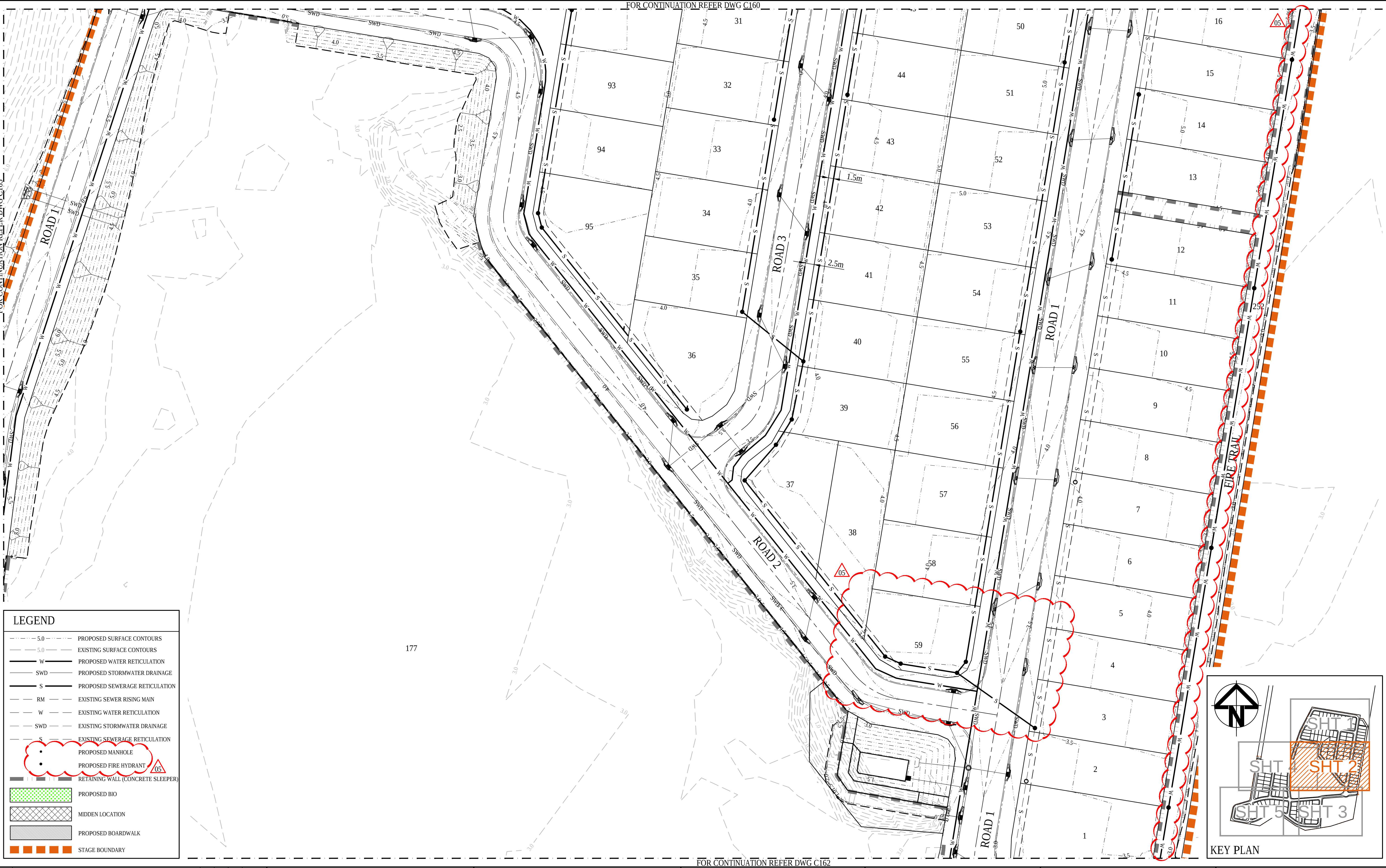
| Drawing No. | Project No. | Issue |
|---|---|---|
| C160 | AA007094 | 05 |

100mm on Original

C:\Users\nfaz3463\Desktop\Iron Gates\D-Final\c160-AA007094-gcd-00-CombinedServicesLayoutPlan.dwg 23/Jul/2019 12:43 PM V1

FOR CONTINUATION REFER DWG C160

FOR CONTINUATION REFER DWG C162




## LEGEND

| | |
|---|---|
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| W | PROPOSED WATER RETICULATION |
| SWD | PROPOSED STORMWATER DRAINAGE |
| S | PROPOSED SEWERAGE RETICULATION |
| RM | EXISTING SEWER RISING MAIN |
| W | EXISTING WATER RETICULATION |
| SWD | EXISTING STORMWATER DRAINAGE |
| S | EXISTING SEWERAGE RETICULATION |
| • | PROPOSED MANHOLE |
| • | PROPOSED FIRE HYDRANT 05 |
| | RETAINING WALL (CONCRETE SLEEPER) |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | STAGE BOUNDARY |

FOR CONTINUATION REFER DWG C162

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C160-AA007094-gcd-00-CombinedServicesLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed J. PECSON |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
COMBINED SERVICES LAYOUT
PLAN SHEET 2 OF 5

ARCADIS
Arcadis Australia Pacific Pty Limited
Level 5, 120 Edward Street
Brisbane QLD 4000
ABN 76 104 485 289
Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| C161 | AA007094 | 05 |

100mm on Original

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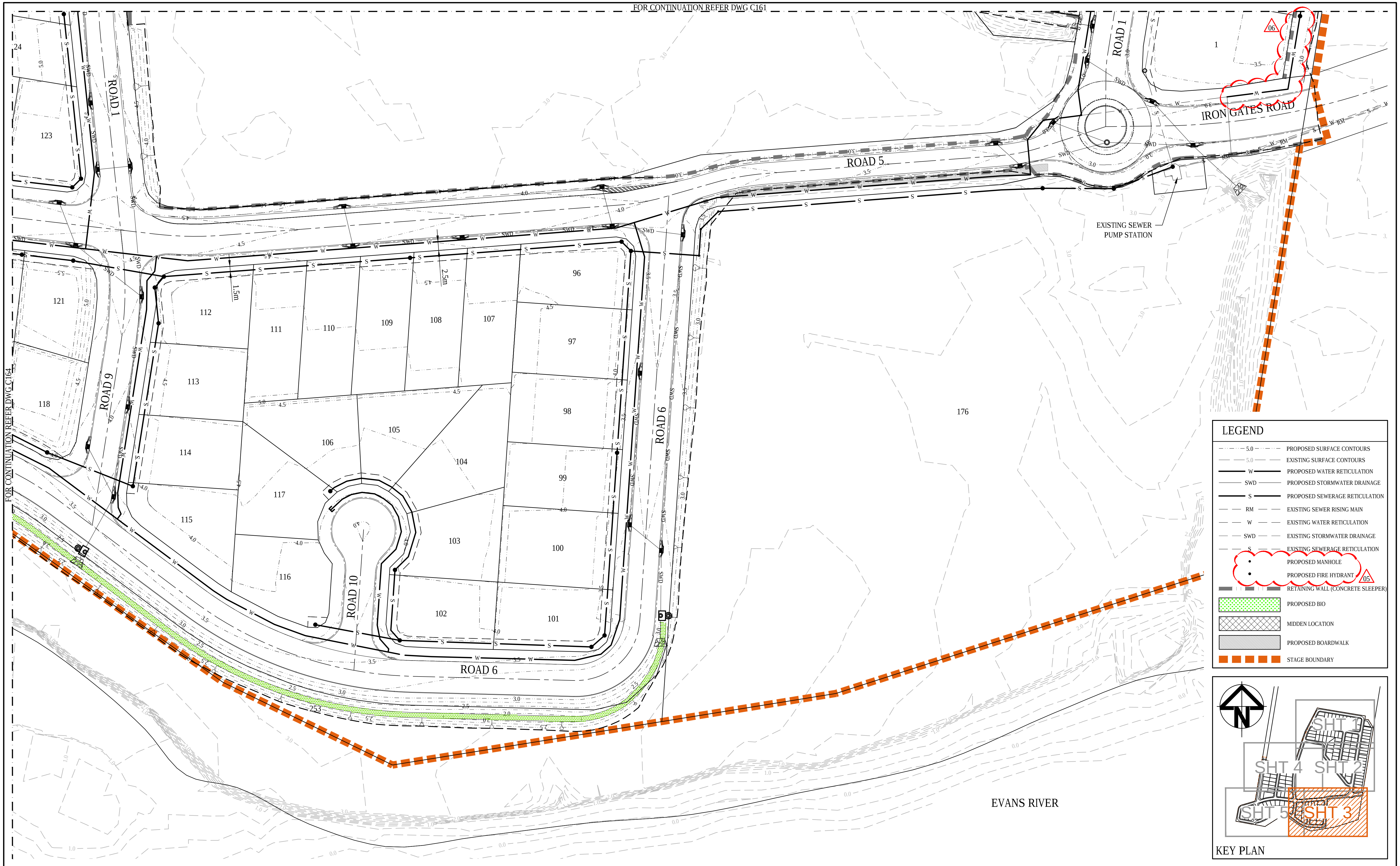


| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 06 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 05 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 04 | MC1004 SECTION AMENDED | | | BD | 14.10.15 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Filename C160-AA007094-gcd-00-CombinedServicesLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

Scales 1 : 500 | Original Issue Signatures
Drawn A. CARDEÑO
Original Size A1 | Designed J. PECSON
Height Datum AHD | Project Manager L. PRIZEMAN
Grid GRID | © Copyright reserved

Project
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LOT 277 IRON GATES ROAD
EVANS HEAD

Title
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PLAN SHEET 3 OF 5

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Drawing No. C162 — Project No. AA007094 — Issue 06

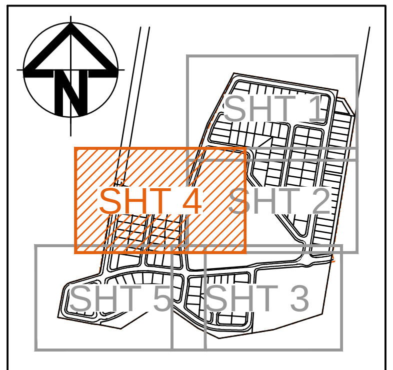
FOR CONTINUATION REFER DWG C160


FOR CONTINUATION REFER DWG C161

FOR CONTINUATION REFER DWG C164

## LEGEND

| | |
| --- | --- |
| 5.0 | PROPOSED SURFACE CONTOURS |
| 5.0 | EXISTING SURFACE CONTOURS |
| W | PROPOSED WATER RETICULATION |
| SWD | PROPOSED STORMWATER DRAINAGE |
| S | PROPOSED SEWERAGE RETICULATION |
| RM | EXISTING SEWER RISING MAIN |
| W | EXISTING WATER RETICULATION |
| SWD | EXISTING STORMWATER DRAINAGE |
| S | EXISTING SEWERAGE RETICULATION |
| | PROPOSED MANHOLE |
| | PROPOSED FIRE HYDRANT 05 |
| | RETAINING WALL (CONCRETE SLEEPER) |
| | PROPOSED BIO |
| | MIDDEN LOCATION |
| | PROPOSED BOARDWALK |
| | STAGE BOUNDARY |




KEY PLAN

| Issue | Description | By | Ckd | RPEQ | Date |
| --- | --- | --- | --- | --- | --- |
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale
0 10 20 30 40 50m
1 : 500

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename C160-AA007094-gcd-00-CombinedServicesLayoutPlan.dwg

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| | | |
| --- | --- | --- |
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed J. PECSON |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

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EVANS HEAD

Title
COMBINED SERVICES LAYOUT
PLAN SHEET 4 OF 5

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ABN 76 104 485 289
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Fax No: +61 7 3337 0055
www.arcadis.com

| Drawing No. | Project No. | Issue |
| --- | --- | --- |
| C163 | AA007094 | 05 |

100mm on Original

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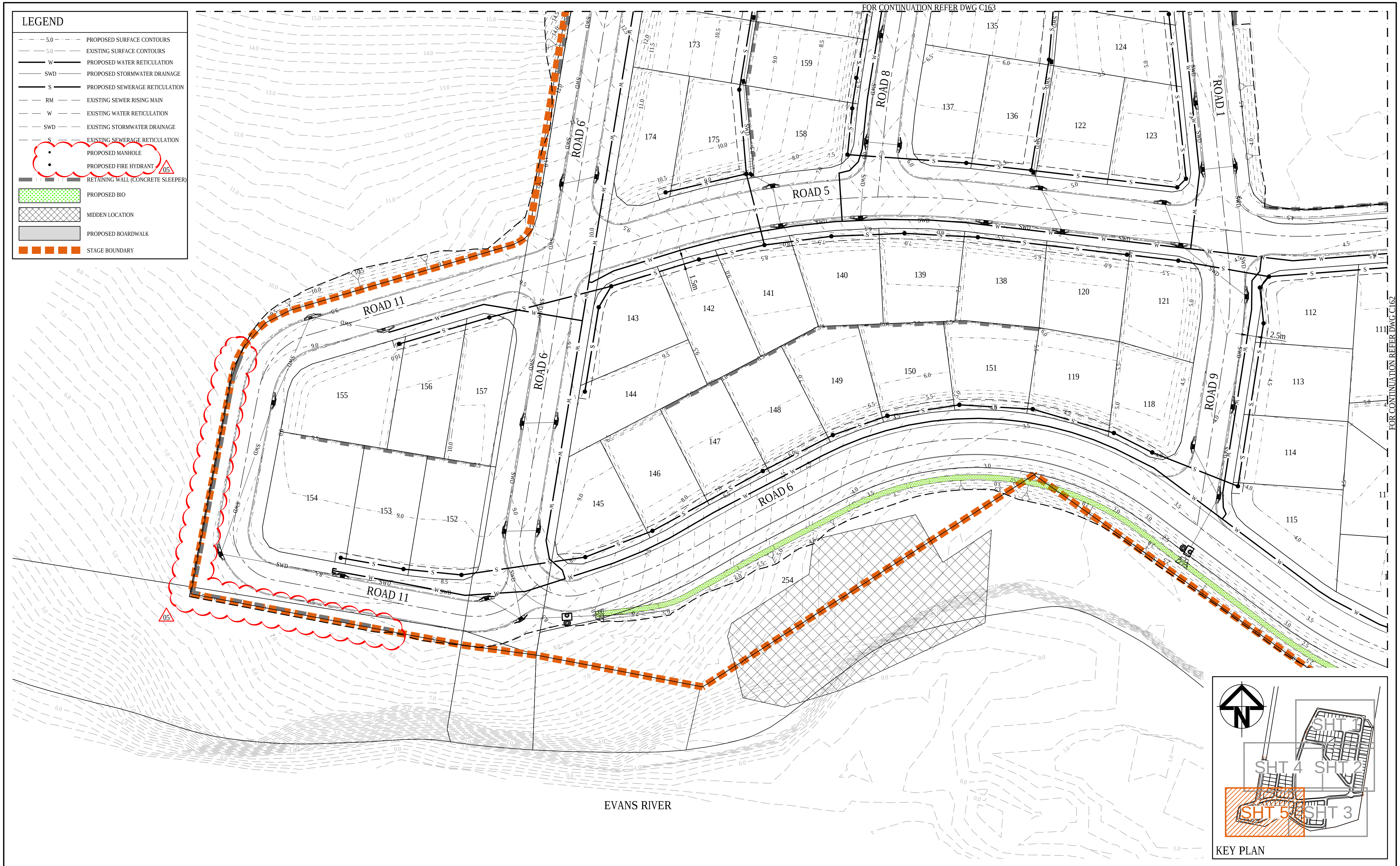


| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 05 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 04 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 03 | RE-ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |
| 02 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 03.10.14 |
| 01 | ORIGINAL ISSUE | | | BD | 18.06.14 |

Scale

0 10 20 30 40 50m

1 : 500

Surveyor

ROBERT A HARRIES SURVEYOR

Architect

Filename C160-AA007094-gcd-00-CombinedServicesLayoutPlan.dwg

Client

GOLDCORAL PTY LTD

Status

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CONSTRUCTION SUBJECT TO APPROVAL

Approved

R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1 : 500 | Original Issue Signatures |
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed J. PECSON |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
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Project

RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title

COMBINED SERVICES LAYOUT
PLAN SHEET 5 OF 5

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| Drawing No. | Project No. | Issue |
|---|---|---|
| C164 | AA007094 | 05 |

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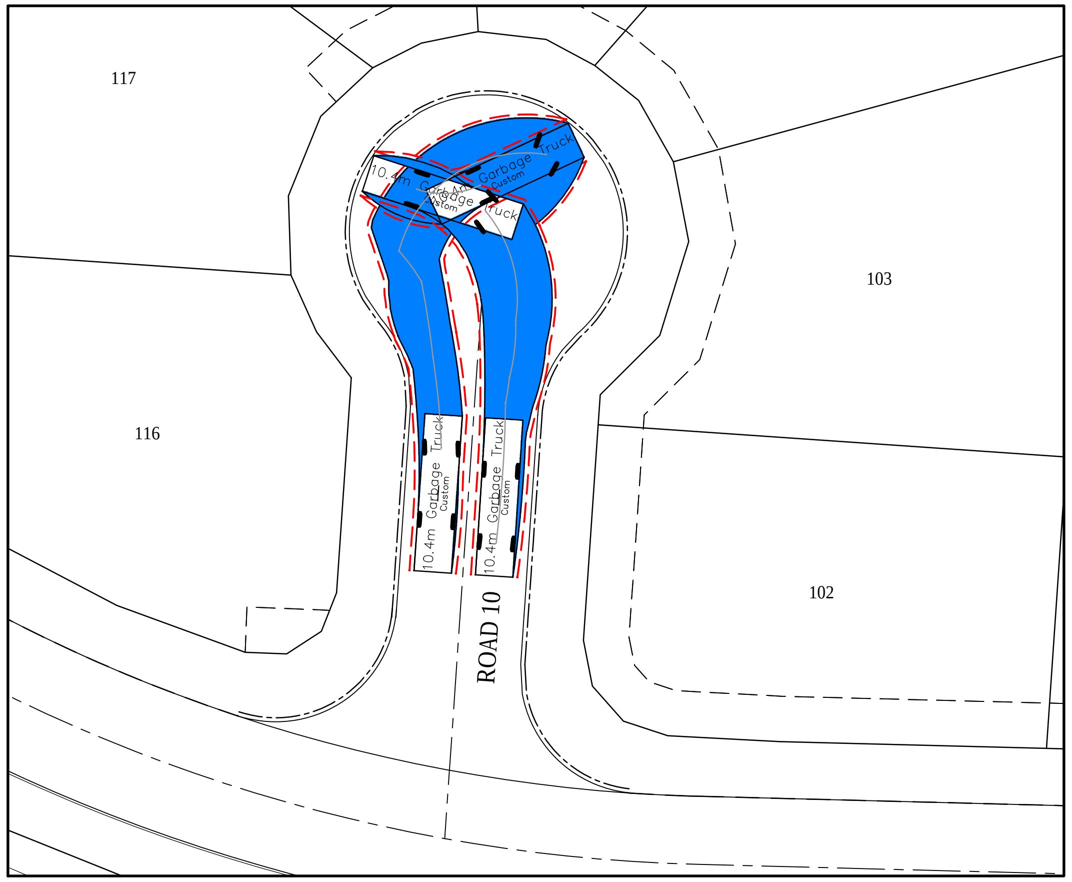
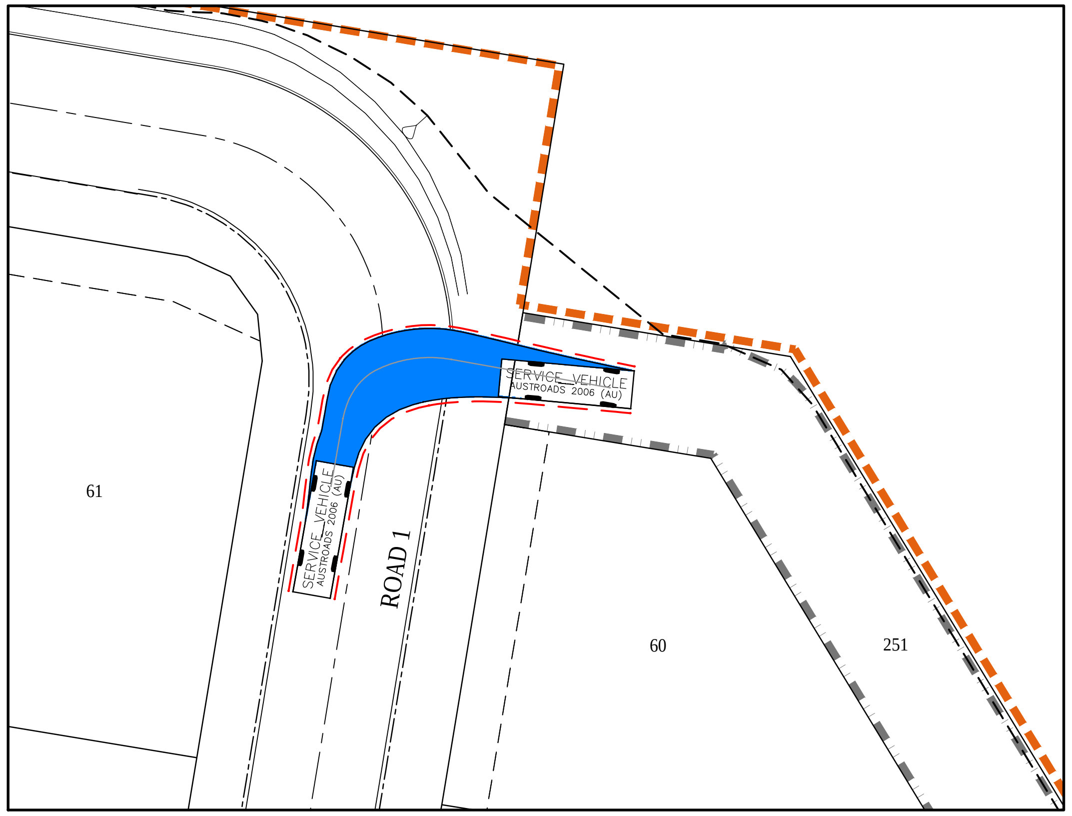
## LEGEND

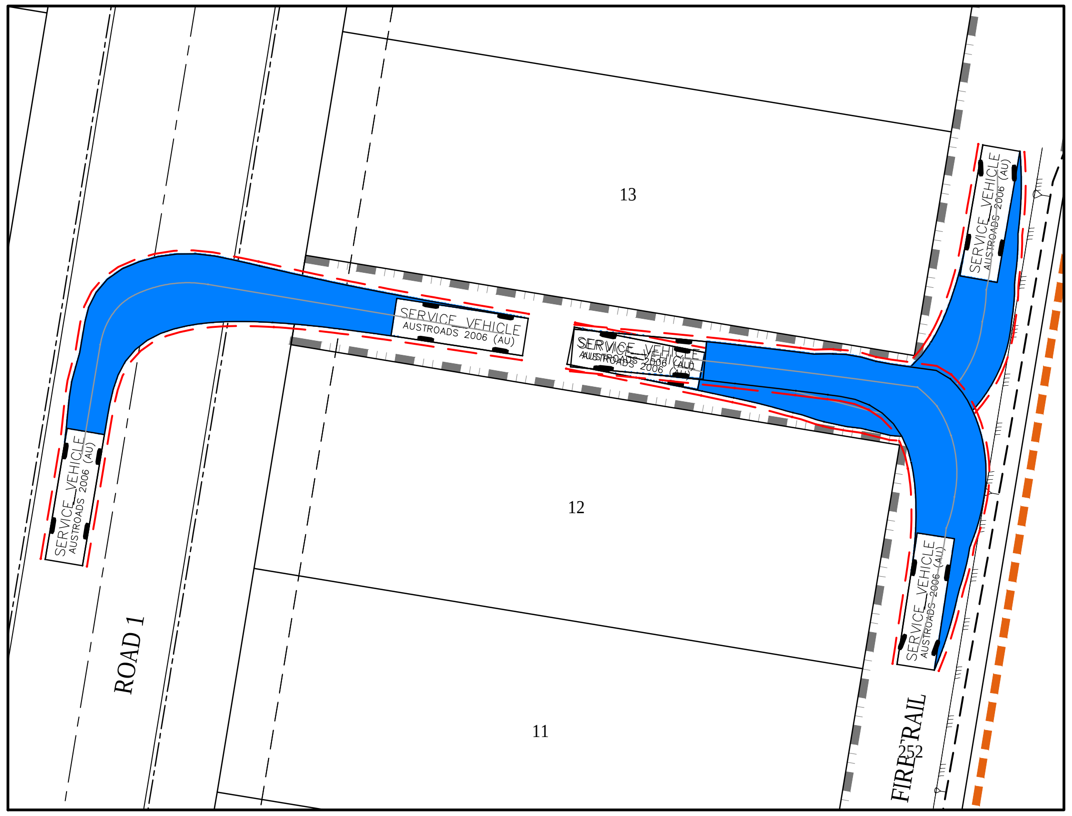
- DENOTES 300mm BODY CLEARANCE
- DENOTES VEHICLE BODY
- DENOTES VEHICLE BODY ENVELOPE
- PROPOSED RETAINING WALL
- STAGE BOUNDARY



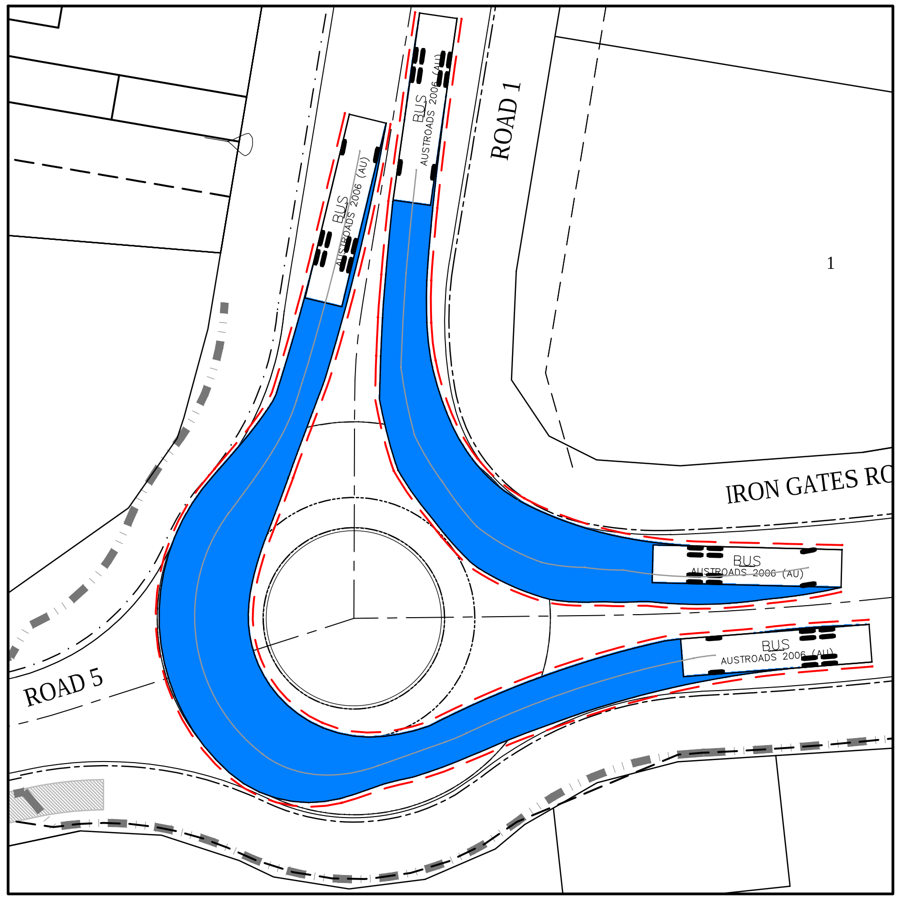

GARBAGE TRUCK TURNING MOVEMENT MC1010
SCALE 1 : 250



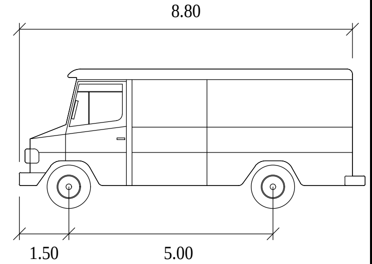

SERVICE VEHICLE TURNING MOVEMENT MC1000 AND FIRETRAIL
SCALE 1 : 250




SERVICE VEHICLE TURNING MOVEMENT MC1000 AND FIRETRAIL
SCALE 1 : 250

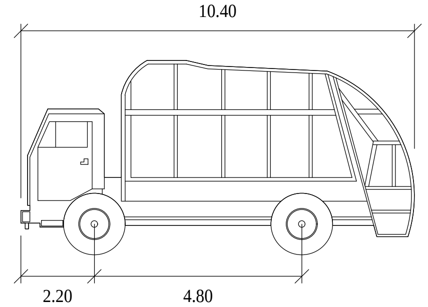



12.5m BUS TURNING MOVEMENT
SCALE 1 : 250



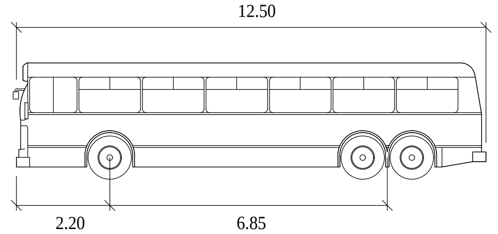

| BUS | | METERS |
|---|---|---|
| WIDTH | : | 2.50 |
| TRACK | : | 2.50 |
| LOCK TO LOCK TIME | : | 6.0 |
| STEERING ANGLE | : | 38.7 |

SERVICE VEHICLE DETAILS
NTS




| BUS | | METERS |
|---|---|---|
| WIDTH | : | 2.48 |
| TRACK | : | 2.48 |
| LOCK TO LOCK TIME | : | 6.0 |
| STEERING ANGLE | : | 33.5 |

10.4m GARBAGE TRUCK DETAILS
NTS




| BUS | | METERS |
|---|---|---|
| WIDTH | : | 2.50 |
| TRACK | : | 2.50 |
| LOCK TO LOCK TIME | : | 6.0 |
| STEERING ANGLE | : | 36.6 |

12.5m BUS DETAILS
NTS

| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 04 | ISSUE FOR RFI RESPONSE | RR | | | 18.07.19 |
| 03 | ISSUE FOR RFI RESPONSE | AC | | | 26.11.18 |
| 02 | AMENDED AS PER COUNCIL RFI | | | ANC | 10.07.15 |
| 01 | ISSUE FOR DEVELOPMENT APPROVAL | | | BD | 13.07.15 |

Scale
0 5 10 15 20 25m
1 : 250

Surveyor
ROBERT A HARRIES SURVEYOR

Architect

Client
GOLDCORAL PTY LTD

Status
FOR APPROVAL
CONSTRUCTION SUBJECT TO APPROVAL

Approved
R.P.E.Q No :

| Scales | 1: 250 | Original Issue Signatures |
|---|---|---|
| | | Drawn A. CARDEÑO |
| Original Size | A1 | Designed A. MAGONDACAN |
| Height Datum | AHD | Project Manager L. PRIZEMAN |
| Grid | GRID | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
IRON GATES ROAD VEHICLE
SWEPT PATH ANALYSIS


ARCADIS
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Tel No: +61 7 3337 0000
Fax No: +61 7 3337 0055
www.arcadis.com


| Drawing No. | Project No. | Issue |
|---|---|---|
| C170 | AA007094 | 04 |

100mm on Original

Filename C170-AA007094-gcd-00-IronGatesRoadVehicleSweptPathAnalysis.dwg

# APPENDIX B

## DIAL BEFORE YOU DIG SEARCH RESULTS

Job No 8032706

Phone: 1100
**www.1100.com.au**

## Caller Details

| | | | | | |
|---|---|---|---|---|---|
| **Contact:** | Mr Mike Cazeres | **Caller Id:** | 1280753 | **Phone:** | 07 5503 4886 |
| **Company:** | Not Supplied | **Mobile:** | 0410 101 179 | **Fax:** | Not Supplied |
| **Address:** | Level 7 Premion Place Queen Street Southport QLD 4215 | **Email:** | mike.cazeres@hyderconsulting.com | | |

## Dig Site and Enquiry Details

**WARNING:** The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.


**User Reference:** AA007094

**Working on Behalf of:**
Private

| **Enquiry Date:** | **Start Date:** | **End Date:** |
|---|---|---|
| 24/06/2014 | 26/06/2014 | 30/06/2014 |

**Address:**
Iron Gates Road
Iron Gates NSW 2473

**Job Purpose:** Excavation
**Onsite Activity:** Mechanical Excavation
**Location of Workplace:** Private Property
**Location in Road:** Not Supplied

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
- Should the scope of works change, or plan validity dates expire, you must submit a new enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

**Notes/Description of Works:**
Not Supplied

## Your Responsibilities and Duty of Care

- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at **www.1100.com.au**
- **For more information on safe excavation practices, visit www.1100.com.au**

## Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.
** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.
# Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

| Seq. No. | Authority Name | Phone | Status |
|---|---|---|---|
| 40148856 | Essential Energy | 132391 | NOTIFIED |
| 40148855 | Richmond Valley | 0266600300 | NOTIFIED |
| 40148857 | Telstra NSW, North | 1800653935 | NOTIFIED |

END OF UTILITIES LIST

## LEGEND

**Exchange**
(major cable present)

**Footway access chamber**
(can vary from 1-lid to 12-lid)

**Roadway access chamber**

or

**Pillar/cabinet**
(above the ground / free standing)

**Above ground complex equipment housing** (eg RIM)
Please Note: This equipment is powered by 240V electricity.

PT **Public telephone**
Please Note: This equipment is powered by 240V electricity.

**Direct buried cable**

**Cable jointing pit**
(number indicating pit type)

**Buried cable jointing pit**
(number indicating pit type)

**Elevated cable joint**
(above ground joint on buried cable)

**Cable loop** (direct buried)

**Telstra Plant in shared utility trench**

**Aerial Cable**
(above ground)

**Aerial Cable**
(attached to joint use pole e.g. power)

SMOF **Optical fibre cable direct buried**

or or or

**Single to multiple round conduit**
Configurations 1, 2, 4, 9 respectively

P100 (Attached text denotes conduit type and size)

or or

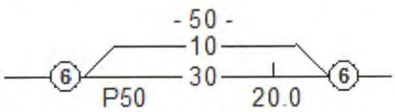
**Multiple square conduit**
Configurations 2, 4, 6 respectively

E85 (Attached text denotes conduit type and size)

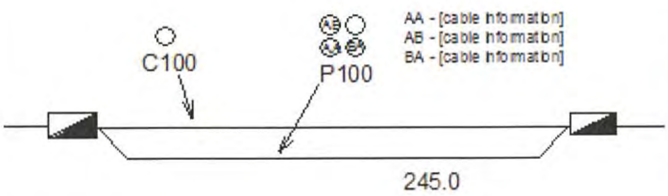
**Some examples of conduit type and size:**
A - Asbestos cement, P - PVC / plastic, C - Concrete, GI - Galvanised iron, E - Earthenware.
Conduit sizes *nominally* range from 20mm to 100mm.

| | |
|---|---|
| P50 | 50mm PVC conduit |
| P100 | 100mm PVC conduit |
| A100 | 100mm asbestos cement conduit |
| E 85 | 85mm square earthenware conduit |

## Some examples of how to read Telstra plans:




One 50mm PVC conduit (P50) containing a 50-pair and a 10-pair cable between two 6-pits, 20.0m apart, with a direct buried 30-pair cable along the same route.




Two separate conduit runs between two footway access chambers (manholes) 245m apart. A nest of four 100mm PVC conduits (P100) containing assorted cables in three ducts (one being empty) and one empty 100mm concrete duct (C100) along the same route.

**WARNING:** Telstra's plans show only the presence of cables and plant. They only show their position relative to road boundaries, property fences etc. at the time of installation and Telstra does not warrant or hold out that such plans are accurate thereafter due to changes that may occur over time.
DO NOT ASSUME DEPTH OR ALIGNMENT of cables or plant as these vary significantly.
The customer has a DUTY OF CARE when excavating near Telstra cables and plant. Before using machine excavators TELSTRA PLANT MUST FIRST BE PHYSICALLY EXPOSED BY SOFT DIG (potholing) to identify its location.
Telstra will seek compensation for damages caused to its property and losses caused to Telstra and its customers.


Overhead wires not shown LOOK UP & LIVE!

## LEGEND

- LV Underground Cable
- HV Underground Cable
- Underground Pipe
- Underground Earth or Wires
- Ground Substation
- Pole
- Cubicle
- Pit
- Proposed Construction
- Critical* Underground Cable
- Critical* Zone Substation

* Critical Assets: Contact Essential Energy on 13 23 91

THE INFORMATION ON THIS MAP MAY NOT BE ACCURATE.
If details are incorrect, please notify Essential Energy on 13 23 91 (or fax 1800 354 636)

ISSUE DATE: 24/06/2014

You must resubmit your request if you have not started work within 4 weeks of the 'Issue Date' above

A4 SCALE: 1:7111

essential energy

Job Number: 8032706 Sequence number: 40148856 Job location: Iron Gates Road, Iron Gates Map Centre: 153° 24' 51.8", -29° 7' 17.8"

# APPENDIX C

## BMT WBM FLOOD REPORT AND OSD STUDY

A part of BMT in Energy and Environment

BMT WBM

# Evans River Flood Study - Final Report

Reference: R.B20500.001.03.Final_Report.docx
Date: November 2014

# Evans River Flood Study - Final Report

| | |
|---|---|
| Prepared for: | Richmond River County Council |
| Prepared by: | BMT WBM Pty Ltd (Member of the BMT group of companies) |

***Offices***

*Brisbane*
*Denver*
*London*
*Mackay*
*Melbourne*
*Newcastle*
*Perth*
*Sydney*
*Vancouver*

# Document Control Sheet

| BMT WBM Pty Ltd<br>Level 8, 200 Creek Street<br>Brisbane Qld 4000<br>Australia<br>PO Box 203, Spring Hill 4004<br><br>Tel: +61 7 3831 6744<br>Fax: + 61 7 3832 3627<br><br>ABN 54 010 830 421<br><br>www.bmtwbm.com.au | **Document:** | R.B20500.001.03.Final_Report.docx |
|---|---|---|
| | **Title:** | **Evans River Flood Study - Final Report** |
| | **Project Manager:** | Barry Rodgers |
| | **Author:** | Barry Rodgers, Melissa Hovey, Ben Caddis |
| | **Client:** | Richmond River County Council |
| | **Client Contact:** | Michael Wood |
| | **Client Reference:** | |
| **Synopsis:** | **Evans River Flood Study** | |

**REVISION/CHECKING HISTORY**

| Revision Number | Date | Checked by | | Issued by | |
|---|---|---|---|---|---|
| 0 | 12/12/2013 | BMC | | BR | |
| 1 | 14/03/2013 | BMC | | BR | |
| 2 | 11/06/2014 | BMC | | BR | |
| 3 | 19/11/2014 | BMC | | BR | |

**DISTRIBUTION**

| Destination | Revision | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Richmond River County Council | PDF | PDF | PDF | PDF | | | | | | | |
| BMT WBM File | PDF | PDF | PDF | PDF | | | | | | | |
| BMT WBM Library | PDF | PDF | PDF | PDF | | | | | | | |

# Executive Summary

The Evans River is located within the Richmond Valley Council (RVC) local government area in the Northern Rivers region of NSW. Relative to the neighbouring Richmond River catchment (6,900km2), the Evans River has a small catchment (90km$^2$). However, the floodplains of the Richmond and Evans Rivers are linked, and during floods the Evans River receives floodwater from the Richmond. The Evans River provides a shorter flowpath for floodwaters to drain from the Mid-Richmond basin to the Pacific Ocean at Evans Head, hence is a critical part of the Richmond River system. In the late 1800's, the connectivity between the Richmond and Evans Rivers was formalised through construction of the Tuckombil Canal. Following two major events in the 1950's, the Tuckombil Canal was enlarged to its current form. A weir at the upstream end of the Tuckombil Canal prevents the more saline waters of the Evans River from entering Rocky Mouth Creek and the Richmond River. The Tuckombil Canal and associated weir have been a continued source of disagreement amongst the community as flood mitigation is balanced against prevention of tidal intrusion. The current fixed concrete weir structure has been demonstrated to provide a fair balance. Richmond River County Council (RRCC) is the floodplain management authority responsible for the Evans River catchment, working closely with RVC and the NSW Office of Environment and Heritage. Management of the Tuckombil Canal weir is the responsibility of RRCC.

Evans Head is the only town within the Evans River catchment and much of the town is high enough not be directly affected by flood events on the Evans River. However, to date, no study has been produced which has determined and mapped the flood risk along the entire length of the Evans River.

As part of this study, hydrologic and hydraulic modelling of the Evans River has been undertaken which has included development of a high resolution two-dimensional hydraulic flood model extending from Rocky Mouth Creek to the ocean. The hydraulic model incorporates LiDAR aerial survey captured by the NSW Department of Land and Property Information in 2010. The terrestrial survey has been merged with bathymetric data of the Evans River and Tuckombil Canal channels. Survey of key levees collected by RRCC in 2010 has also been included.

Inflows to the hydraulic model have been derived from the Richmond River flood model developed as part of the Richmond River Flood Mapping Study (BMT WBM, 2010) and since modified as part of other recent flood investigations on the Richmond River. The Richmond River flood model (hydrologic and hydraulic models) have previously been jointly calibrated and verified against various historical flood events. As such, a full calibration of the Evans River model has not been required. The two historical events of March 1974 and May 2009 have been used for verification of model performance. The model verification has shown that the model performs well in estimating the timing and peak flood levels and that the model is fit-for-purpose for use in defining design flood behaviour (i.e. levels, depths, velocities and hazard).

The 20, 50, 100, and 500 year ARI design flood events have been modelled and mapped along with the probable maximum flood (PMF). The Evans River hydraulic model uses a downstream time varying ocean boundary with a peak level of 2.0m AHD in the 100 year ARI event, which accounts for storm surge.

Modelling has shown that the upper parts of the Evans River catchment near the Tuckombil Canal are subject to extensive flooding. At Evans Head the overall risk to the community is low. However, some low lying parts of Evans Head such as the Silver Sands Caravan Park and parts of South Evans Head (including the harbour, Ocean Drive and Bundjalung Road) are at risk during major flood events (i.e. the 100 year ARI or greater).

A climate change assessment accounting for the effects of a 10% increase in rainfall intensity and a 0.9m increase in sea level has shown significant increases in flood levels in Evans Head. However, the overall extent of inundation is largely unchanged with much of the town remaining above the predicted 100 year ARI future flood level.

An additional assessment has been undertaken on local flood events caused by short, intense rainfall over the Evans River catchment (i.e. events with no flood inflows from the Richmond River). The assessment showed that, except for the uppermost headwaters, the predicted flood levels will be lower than those for when the Richmond River overflows into the catchment. The modelled design events which include the Richmond River inflows have therefore been selected for mapping the maximum flood extents.

A further assessment has been undertaken on travel times of a major (100 year ARI) Richmond River flood passing through the Evans River system. The analysis has showed that it takes approximately 5 hours for the peak to travel from the Tuckombil Weir to the ocean.

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# Abbreviations

| | |
|---|---|
| **1D / 2D** | One dimensional / two dimensional |
| **AHD** | Australian Height Datum |
| **ARI** | Average Recurrence Interval |
| **ARR** | Australian Rainfall and Runoff (IEAust, 1987) |
| **BoM** | Bureau of Meteorology |
| **BSC** | Ballina Shire Council |
| **DECCW** | Department of Environment, Climate Change and Heritage (now OEH) |
| **DEM** | Digital Elevation Model |
| **DNR** | Department of Natural Resources |
| **GIS** | Geographical Information System |
| **OEH** | NSW Office of Environment and Heritage |
| **LiDAR** | Light Detection and Ranging (aerial survey technique) |
| **km** | Kilometre |
| **MHL** | Manly Hydraulics Laboratory |
| **m** | Metre |
| **m/s** | Metres per second |
| **m AHD** | Elevation in metres relative to the Australian Height Datum |
| **NOW** | NSW Office of Water |
| **NPWS** | National Parks and Wildlife Service |
| **RRCC** | Richmond River County Council |
| **RVC** | Richmond Valley Council |
| **WBNM** | Watershed Network Bounded Model hydrologic modelling software |

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# 1 Introduction

## 1.1 Background

Evans River is located within the administrative area of Richmond Valley Council (RVC) and extends from the Tuckombil Canal in the west to the Pacific Ocean in the east. Relative to the neighbouring Richmond River catchment (6,900km$^2$), the Evans River has a small catchment (90km$^2$). Following the construction of the Tuckombil Canal in 1895 the catchment was linked to the much larger catchment of the Richmond River from which it receives flow during flood events on the Richmond River. Figure 1-1 shows the Evans River catchment and Figure 1-2 shows the topography of the catchment.

RRCC commissioned BMT WBM to undertake a flood study for Evans River which considers both flooding from local runoff generated within the Evans River catchment and flooding from the regional inflows which enter the catchment from the Richmond River. The purpose of the study is to use hydrologic and hydraulic modelling to quantify and map the flood risk with the Evans River, with a particular focus on the only main township within the catchment at Evans Head.

## 1.2 Study Objectives

The objectives for this study are to:

- Develop and calibrate a hydraulic model of the Evans River;
- Use the hydraulic model to define existing flood risk for design events ranging from a 20 year average recurrence interval (ARI) event to the probable maximum flood (PMF);
- Identify approximate travel times of the riverine flood along the Evans River;
- Identify any specific access issues to property during flood events;
- Identify any drainage infrastructure which may be undersized and cause flooding issues; and
- Assess the likely implications to flood risk under a future (2100) climate by considering sea level rise.

It is intended that Richmond Valley Council will incorporate the flood risk mapping into their Development Control Plans, as well as making the information publically available through the Richmond Valley interactive flood mapping website.

## 1.3 Past Investigations

There has been a range of studies undertaken of the Evans River, Richmond River and the Tuckombil Canal which connects the two. A brief summary of the more recent studies is listed below.

**Coastal Zone Management Plan: Evans Head Coastline and Evans River Estuary (2013)**

Completed by Hydrosphere Consulting in 2013 and subsequently adopted by Council in June 2013, the study provides a ten year strategic plan to implement key actions which achieve objectives for management of the Evans Head coastline and estuary. The objectives seek to balance long term utilisation of the coastline and estuary with its conservation.

**Evans Head Coastline Hazard and Estuarine Water Level Definition Study (2012)**

The study for Richmond Valley Council prepared by Worley Parsons updated a previous study completed in 2004 and defined coastline hazard lines for the existing climate as well as 2050 and 2100 climate scenarios. The study developed a 2D hydraulic model of the lower Evans River to determine the 100 year ARI flood level.

**Richmond River Flood Mapping Study (2010)**

This study undertaken for Richmond Valley Council by BMT WBM defined flooding behaviour for the lower Richmond River from Casino to Broadwater including the Wilsons River from Lismore and the lower Bungawalbin Creek. A dynamically linked 1D/2D hydraulic model was developed with the Evans River and floodplain represented as 1D elements. The inclusion of the Evans River was to allow for flows to leave the Richmond River and it was not explicitly part of the mapping study. Therefore the study did not present flood maps of the Evans River.

**Climate Change Assessment for the Tuckombil Barrage (2008)**

This study was undertaken by BMT WBM for Richmond River County Council to determine the water levels at the Tuckombil Barrage during a standard spring tide, and during the same tide including a 400mm increase to mean sea levels due to climate change. No local rainfall or storm surge was included in the modelling.

**Tuckombil Canal Management Structure - Review of Gate Alternative (2007)**

GHD prepared a report for Richmond River County Council which reviewed international best practice with regard to gate technologies and assessed two gate options. The gate options were compared on a cost basis with the re-installation of an inflatable dam.

**Tuckombil Barrage Flood Affect Assessment (2005)**

This study was prepared by WBM Oceanics to present the findings from investigations into the flood affect of different weir heights at the Tuckombil Barrage. The modelling used for this study was the first 2D model of the Mid-Richmond area.

## 1.4 Structure of this Report

The remainder of this report is structured as follows:

- Section 2 provides an overview of the study area and historical flood risk.
- Section 3 documents the data collection and review process.
- Section 4 describes the development of the models including methodology, key inputs and assumptions.
- Section 5 details the verification of the hydraulic model against historic events.
- Section 6 describes the design event modelling and provides the design mapping output.
- Section 7 lists the key conclusions made from this study.

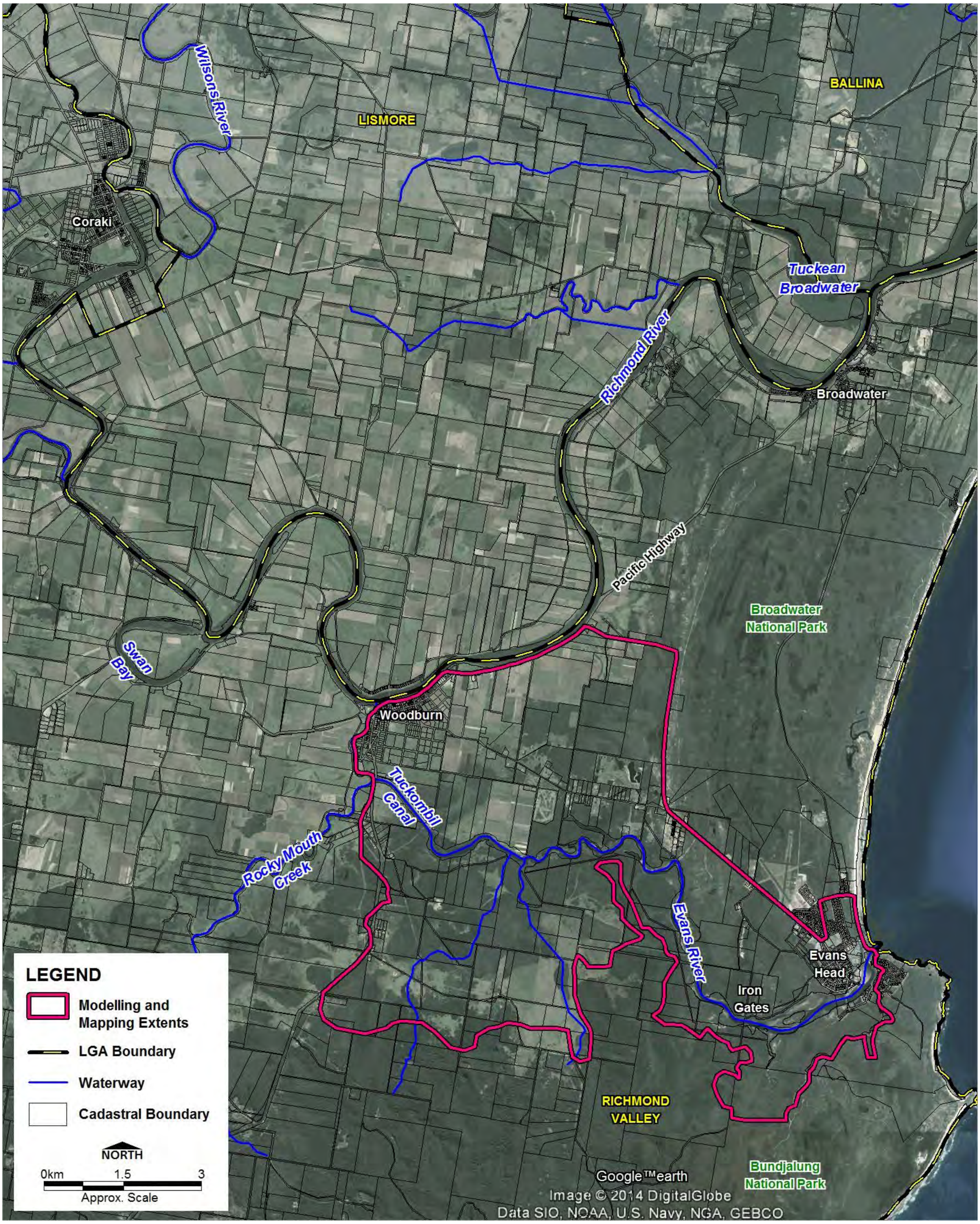


**Figure 1-1 Locality Plan – Aerial Photograph**

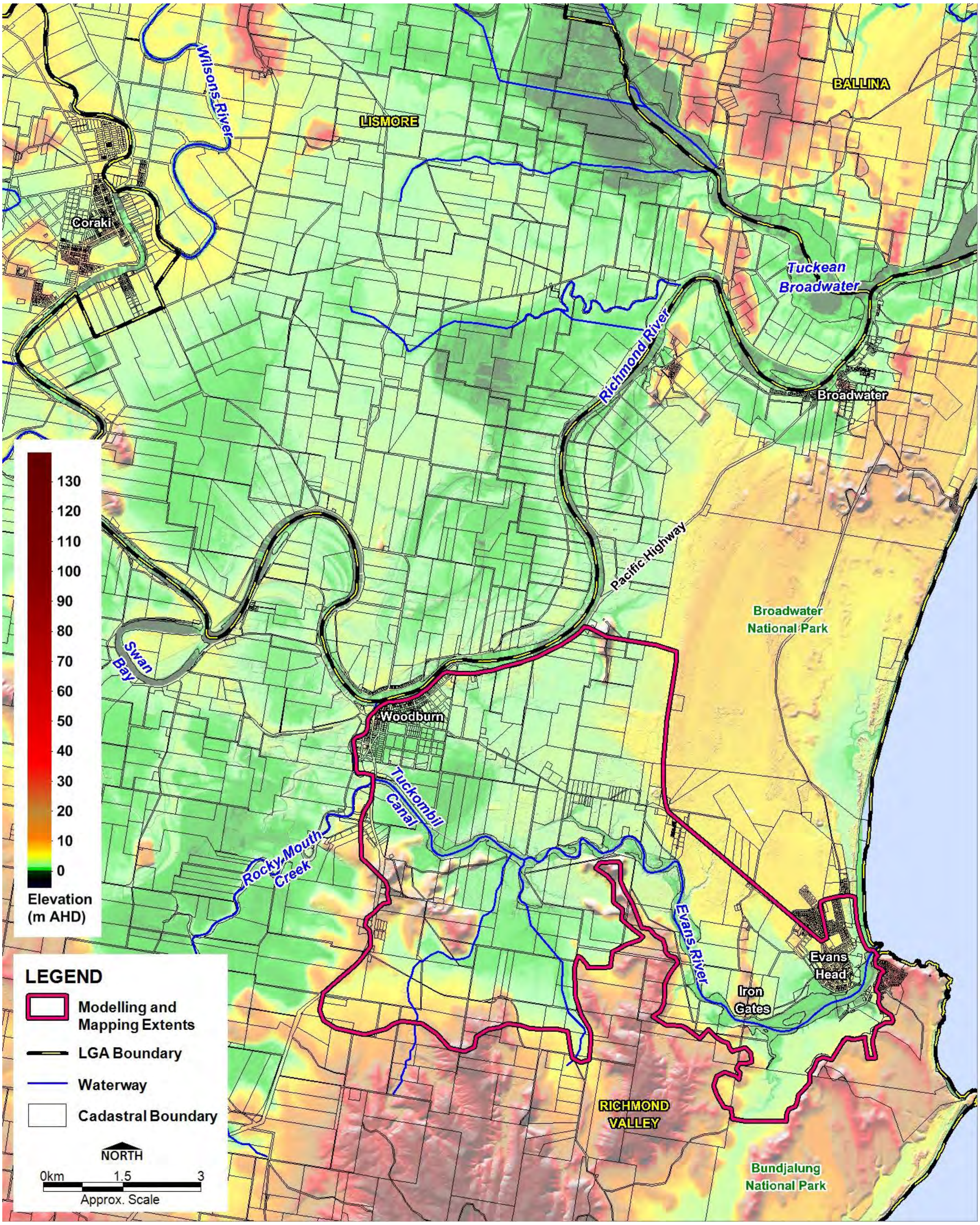


**Figure 1-2 Locality Plan – Topography**

# 2 Study Area

## 2.1 Catchment Description

Located between the towns of Woodburn and Evans Head, the Evans River drains a local catchment of approximately 90km$^2$. The exact extent of the catchment is difficult to define, since the floodplain in the upper reaches of the Evans River is shared with the Richmond River with no clear catchment divide. During moderate to major flood events, the Evans River receives flows from the Richmond River via defined waterways and overland flow. Refer to Figure 2-1 for study area. The Evans River catchment is entirely within the Richmond Valley local government area.

In 1895, the connectivity between the Richmond River and the Evans River was formalised through construction of the Tuckombil Canal. The canal is 1.5km long, connecting the upstream end of the Evans River to Rocky Mouth Creek, two kilometres upstream of the confluence with the Richmond River at Woodburn. A concrete weir separates Rocky Mouth Creek from the more saline waters of the Tuckombil Canal and Evans River. From the weir (Figure 2-2) to the river mouth at Evans Head (Figure 2-3), the Evans River system is 15km long.

The Tuckombil Canal was excavated for flood mitigation purposes following significant flooding on the Richmond River in the 1890's. Prior to the creation of the canal the Evans River drained a local catchment area and only received flows from the much larger Richmond catchment during major flood events. The canal was deepened and widened in 1965 to its present dimensions. The deepening necessitated the construction of the weir. Since 2001 this barrier has been formed by a concrete weir with crest elevation of 0.94m AHD. Previous manifestations include inflatable fabridams and a steel sheet piling coffer dam.

The Evans River drains the hills in and around Bundjalung National Park, on the southern side of the river. On the northern side, the topography is flatter with the river draining parts of the Broadwater National Park.

The only town within the Evans River catchment is Evans Head, with a population of approximately 3,000, located at the outlet of Evans River into the ocean. As such it is the principal town at risk to flooding from the Evans River and the ocean.

Two bridges cross the Evans River; one is the Pacific Highway crossing at the upstream end of the Tuckombil Canal (Figure 2-2) and the other is the Evans Head, Elm Street Bridge (Figure 2-4)

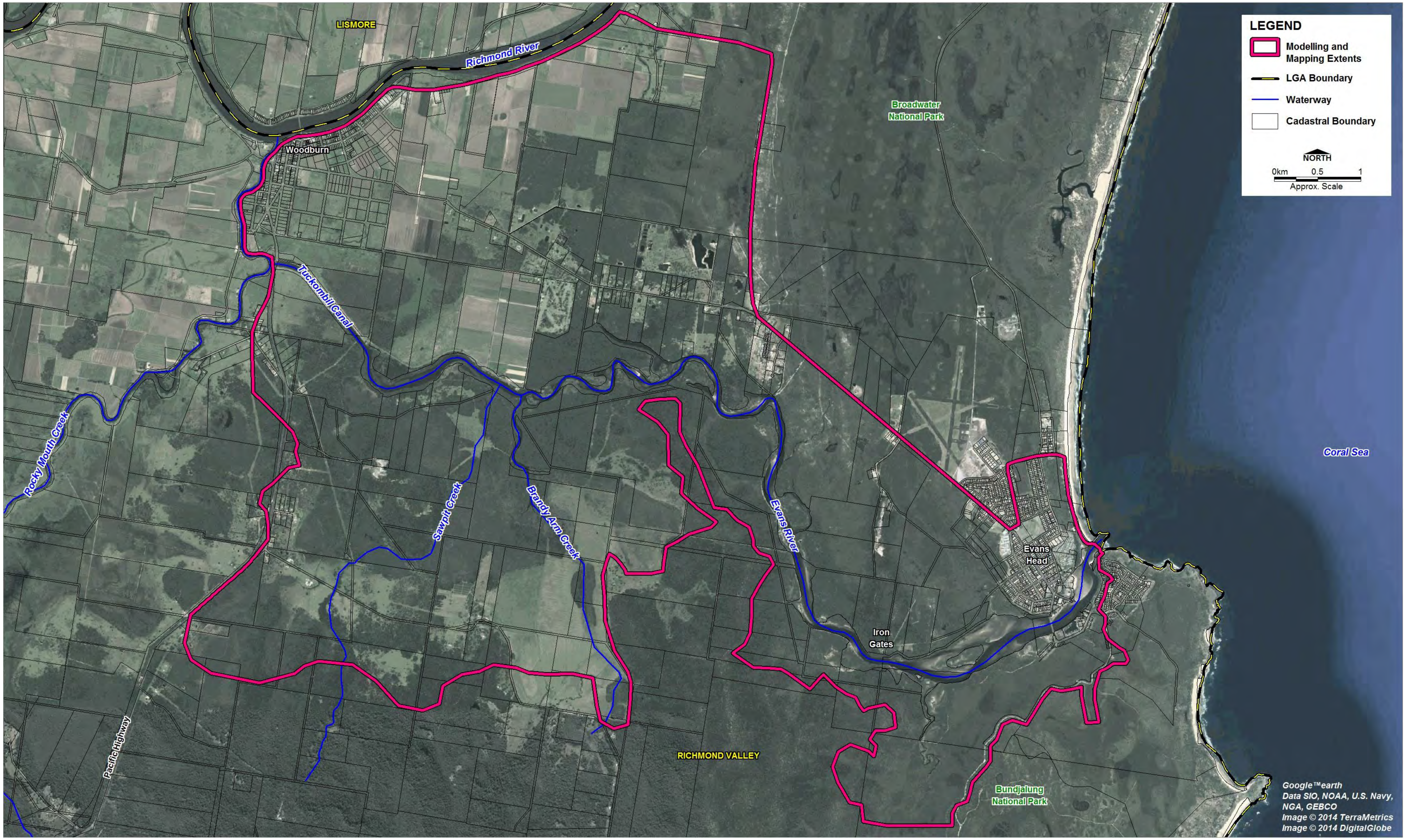


Figure 2-1 Study Area

**Figure 2-2 Tuckombil Canal Weir and Pacific Highway Bridge (Tuckombil Canal in the foreground, Rocky Mouth Creek in the background)**

**Figure 2-3 Evans River Mouth at Evans Head**

**Figure 2-4 Elm Street Bridge at Evans Head**

## 2.2 Flood Mechanisms and History

There are three potential sources of flooding along the Evans River:

- Local catchment runoff – high intensity, short duration rainfall has the potential to cause localised flooding in the Evans Head urban area, as well as across agricultural land. This type of flooding is typically of short duration, and will occur as waters drain into the Evans River, rather than flows breaking out from the Evans River.
- Storm surge – due to the close proximity to the ocean, large storm surges caused by tropical cyclones or low pressure systems can result in flooding of the low lying areas.
- Richmond River overflow – as floodwaters in the Richmond River and Rocky Mouth Creek cause overtopping of the Tuckombil Canal weir, flood levels in the Evans River will rise as a result. Overflow from the Richmond River poses the greatest flood risk to most of the Evans River catchment.

Most flood events will involve more than one of these sources of flooding. The relative timing of each source is an important factor dictating the magnitude of the ensuing flood. For example, local catchment runoff will drain from the river before the Richmond River flood, however, should the Richmond River flood occur simultaneously with a high tide or the peak of a storm surge, a large flood could result.

Historically, significant flood events on the Evans River are dominated by large events on the Richmond River overtopping the Tuckombil Canal weir and entering the Evans River. In addition to the flows within the Tuckombil Canal, moderate to major floods in the Richmond River will overtop the banks of the river, inundating the low lying floodplain and subsequently draining to the Evans River. Significant events have occurred in 1954 and 1974. The 1974 flood was noted as being particularly severe as it occurred during high spring tides.

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# 3 Data Collation and Review

## 3.1 Aerial Photography

Various sources of aerial photography have been used for coverage of the entire Evans River catchment. All imagery used has been captured between 2007 and present. Aerial photography has been provided by Richmond Valley Council and Richmond River County Council. Where required, Microsoft Bing and Google Earth imagery has also been used.

The available imagery has been used for identification of land use and ground roughness for hydraulic modelling, and for presentation of flood maps.

## 3.2 Topographic Survey

### 3.2.1 Aerial Survey

The previous *Richmond River Flood Mapping Study (RRFMS) (BMT WBM, 2010)* used a compilation of aerial survey datasets for generation of a topography mosaic. The RRFMS dataset was assessed for accuracy against recent survey captured across the Mid-Richmond and Evans River areas. The most reliable and accurate datasets were then merged into a single digital elevation model (DEM). The resulting DEM used for the Evans River flood modelling incorporates:

- Photogrammetry captured in 2007 for the RRFMS; and
- LiDAR survey captured in 2010 by the NSW Department of Land and Property Information.

Refer to Figure 3-1 for the DEM of the study area.

### 3.2.2 Ground Survey

Ground survey across the study area has previously been collected for:

- Mid-Richmond Flood Study (WBM, 1998); and
- Richmond River County Council levee survey (2010).

The survey typically comprises spot heights along hydraulic controls, such as road embankment and levees. Available ground survey is shown in Figure 3-2 Bathymetric Survey

Bathymetric survey of the estuarine extents of the Richmond River and Evans River systems was captured in 2004 as part of the NSW Department of Natural Resources' (DNR) Estuary Management Program. The survey was provided for this project by the NSW Office of Environment and Heritage (OEH). Refer to Figure 3-2 for extents of bathymetric survey.

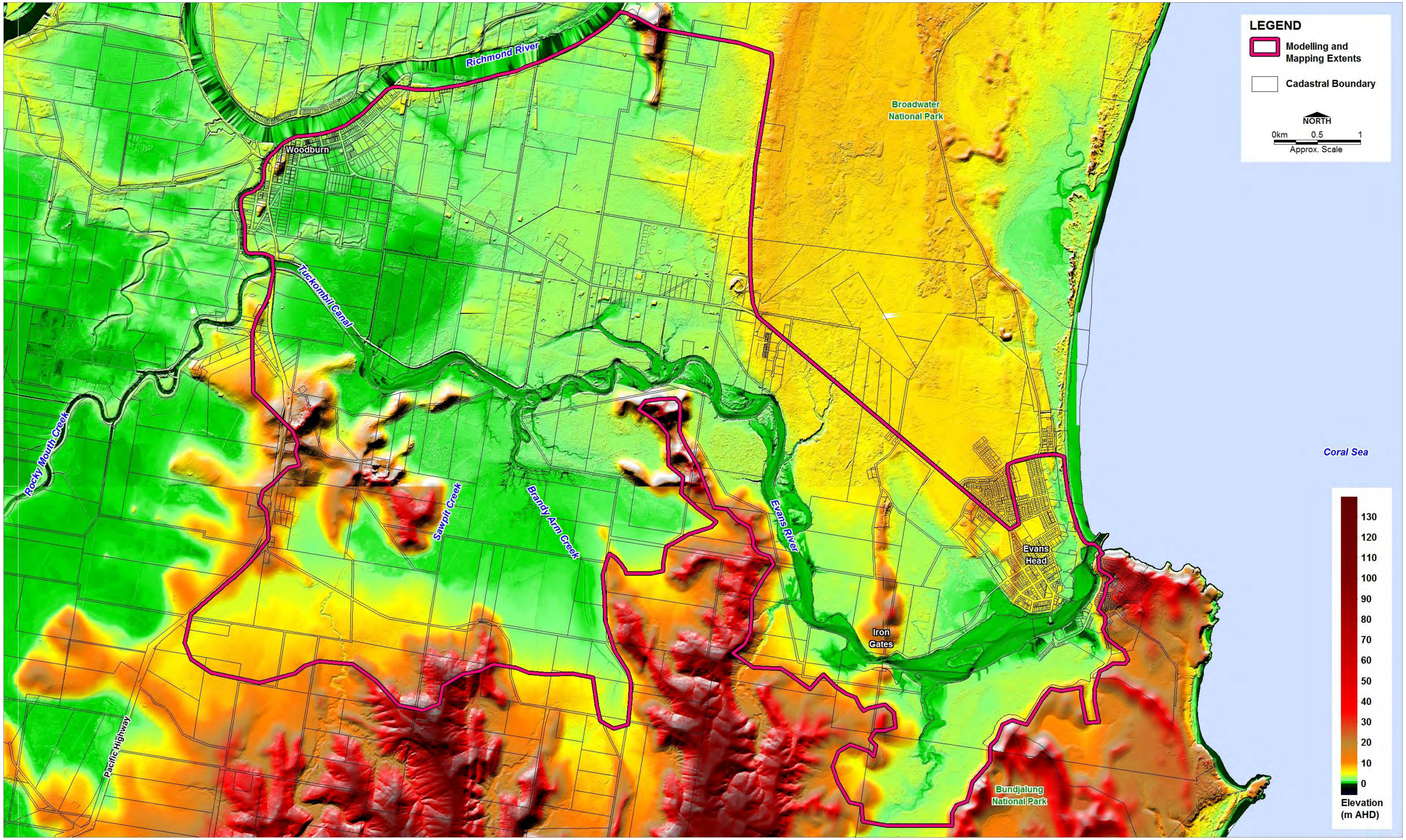


**Figure 3-1 Digital Elevation Model**


Figure 3-2 Additional Topographic Data

## 3.3 Historic Flood Levels

There have been numerous floods that have occurred in the area, including:

- February 1954;
- March 1974;
- January 2008; and
- May 2009.

Extensive field data collection occurred during the January 2008 and May 2009 flood events, as part of the *Richmond River Flood Mapping Study (BMT WBM, 2010)*. However no flood levels were recorded in the Evans River catchment.

There are a limited number of historic flood levels available for the 1974 event. These are located in the floodplain of the upper Evans River with none at Evans Head. Refer to Figure 3-3 for the locations.

## 3.4 Rainfall, Stream Flow and Tidal Data

The following data have been collated for this study:

- Daily, hourly and continuous (5 minute or 6 minute pluviographic) rainfall records were sourced from the Bureau of Meteorology (BoM), NSW Office of Water and Manly Hydraulic Laboratory (MHL) for the wider catchment.
- River level data sourced from MHL for the Irongates and Fishermans Co-op gauges for the May 2009 flood event (see Figure 3-3 for locations). No gauged data was available within the Evans River catchment for the March 1974 event.
- Tidal data sourced from MHL for the May 2009 event. Tidal data for the March 1974 event was used in accordance with the *Mid-Richmond Flood Study (WBM, 1999)*. The tide levels used for that study are based on recordings at Coffs Harbour with an additional 300mm added to account for storm surge.

## 3.5 Structures

The following key structures have the potential to affect flood behaviour along the Evans River:

- Elm Street Bridge – the Evans Head Bridge links South Evans Head to Evans Head and was constructed in 1961.
- Tuckombil Canal and Weir – the Tuckombil Canal was originally excavated in 1895 between Rocky Mouth Creek and the Evans River. The canal was intended to provide flood relief to the Mid-Richmond area, allowing floodwaters to drain to the ocean via the Evans River, while preventing tidal exchange. The canal was excavated to its current form in 1965, which included a fabridam at the upstream end. This fabridam was replaced in 2001 by a fixed concrete weir with a level of 0.94m AHD.

In addition, there are numerous other smaller levees that divert floodwater within the floodplain.

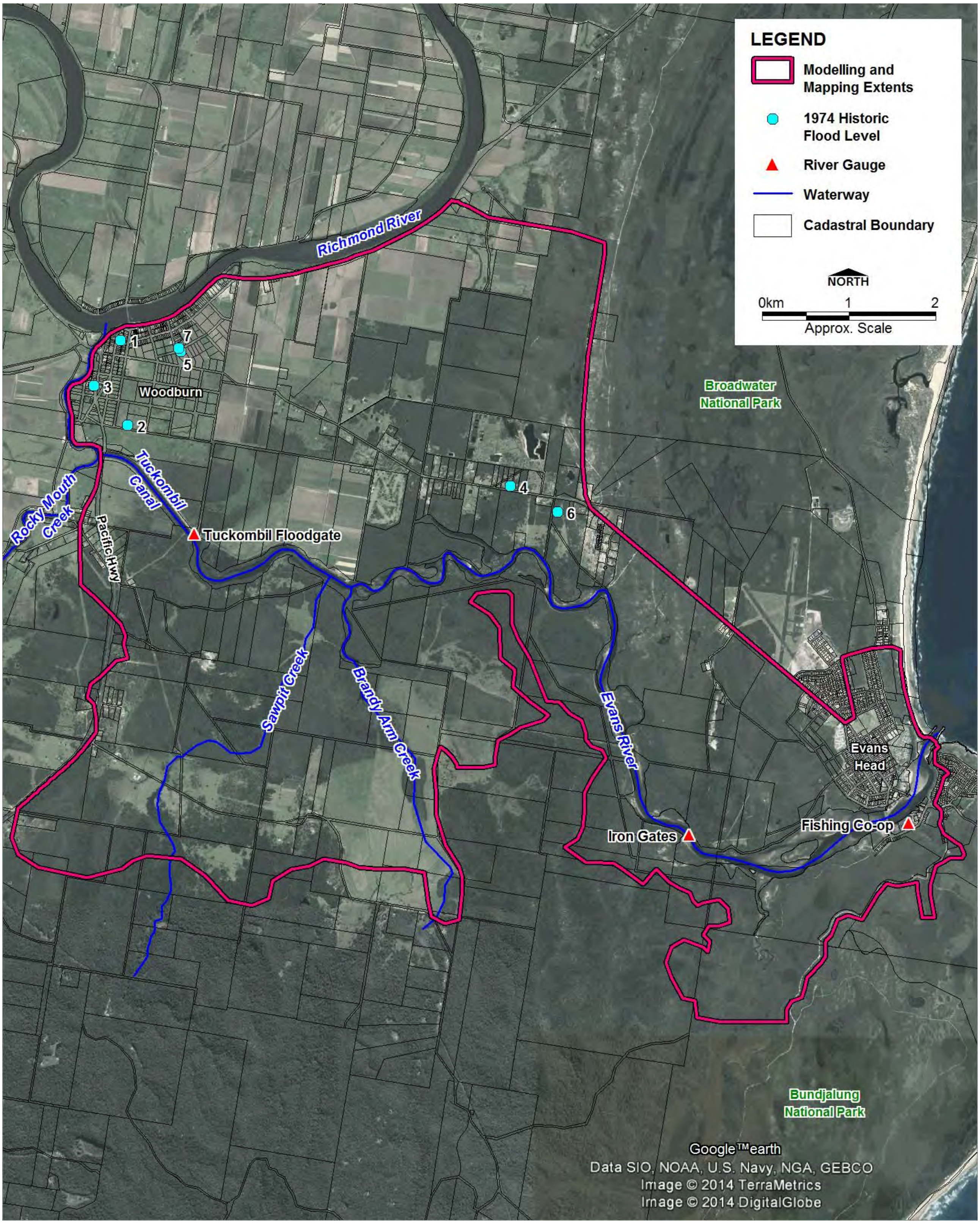


**Figure 3-3 Evans River Gauges and Historic Flood Levels**

# 4 Model Development

## 4.1 Background

Development of a flood model typically involves two key components. Firstly, a hydrologic model is developed to estimate the amount of runoff during a given storm event. Historical or design rainfall are applied to the hydrologic model, which uses algorithms to convert the rainfall to runoff, and route the runoff through the catchment. These runoff-routing models are simplistic representations of the catchment, generally requiring minimal geographical input data.

Secondly, a hydraulic model is developed to simulate the passage of this runoff through the catchment. Inflow hydrographs, estimated using the hydrologic modelling, are applied at the upstream ends of waterways and floodplains. Rainfall over the hydraulic model area is applied directly to the cells of the hydraulic model. Hydraulic models are generally more complex and data intensive.

The development of each model is described in more detail in the following sections.

## 4.2 Hydrologic Model

The hydrologic models developed during the *Richmond River Flood Mapping Study (BMT WBM, 2010)* covered the entire Richmond and Evans River systems. These models use the WBNM modelling platform. Since publication of the RRFMS, these models have undergone extensive revision. The updated models have been used to feed inflows into the updated Richmond River flood model, which has been used to determine inter-catchment flow from the Richmond River to the Evans River catchment. In total 16 sub-catchments are used to represent the Evans River local catchment area. These sub-catchments, together with surrounding sub-catchments that drain to the Richmond River are shown in Figure 4-1.

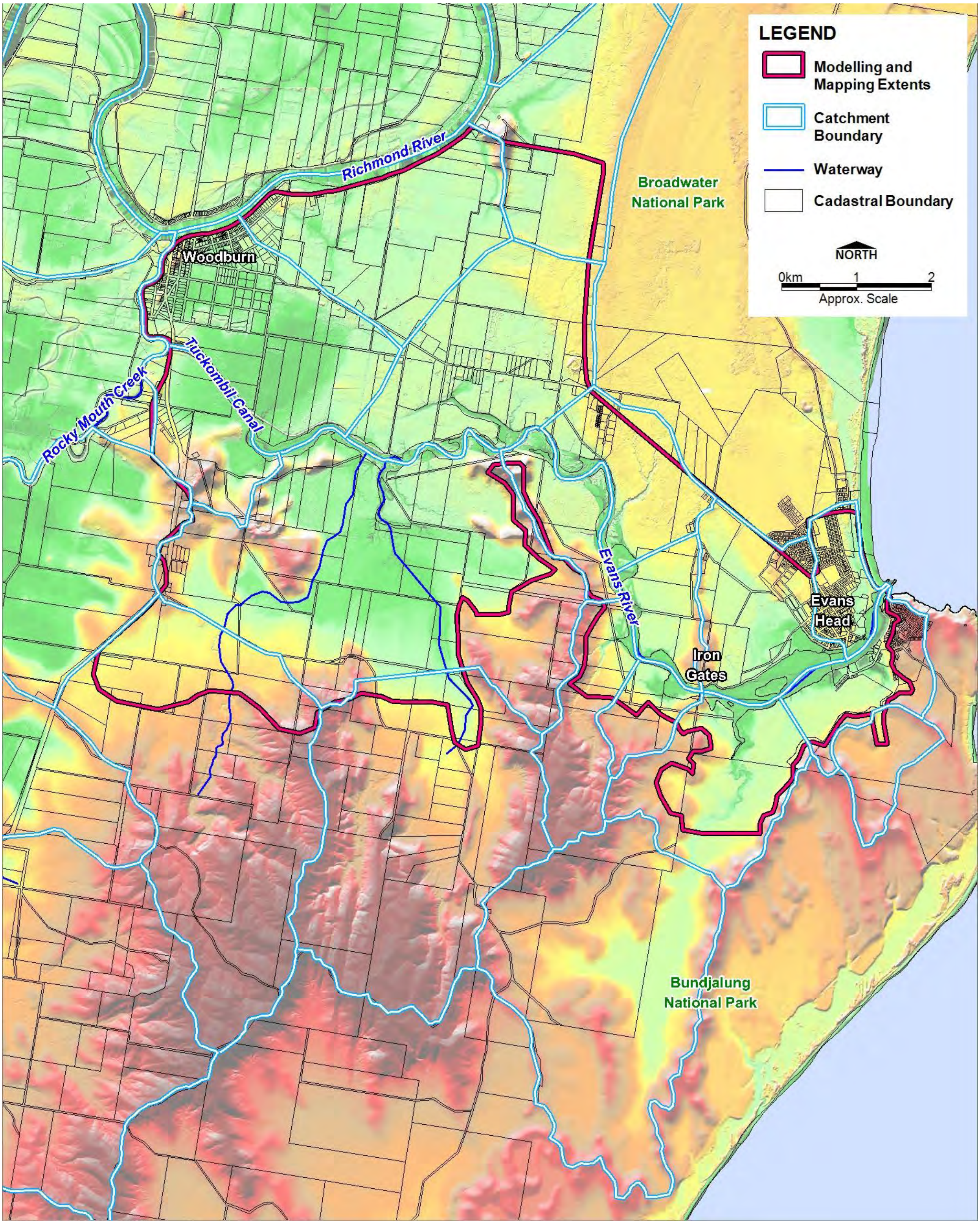


Figure 4-1 Catchment Hydrology

## 4.3 Hydraulic Model

### 4.3.1 Previous Models

There are numerous hydraulic models of the area currently available.

The RRFMS study in 2010 represented the most comprehensive hydraulic modelling of the Richmond River to date. It consisted of a 1D/2D dynamically linked TUFLOW model. The model included the Evans River as a 1D/2D linked model downstream to Doonbah, beyond which it was solely a 1D model.

Two studies were since undertaken which made separate modifications to the RRFMS model in the vicinity of Evans River:

- In 2012, the original RRFMS model was enhanced as part of the Iron Gates flood impact assessment. This study increased the 1D/2D model extent to the mouth of the Evans River. This included updates to the terrain within the model extension, and mapped the current land uses.
- In 2013, the original RRFMS was updated with the 2010 LiDAR and levee survey as part of the Roads and Maritime Services study for the Pacific Highway Upgrade. The model extents were not increased and the majority of the Evans River remained as a 1D only section of the model.

### 4.3.2 Evans River Model

As part of this Evans River Flood Study a new model was created of the Evans River. The model extends from the Tuckombil Canal down to the ocean at Evans Head. TUFLOW software was used and the relatively fine scale 10m grid resolution of the model enabled a purely 2D model to be developed.

The model relies upon extraction of water level data from the RRFMS flood model which are then applied as inflows to the Tuckombil Canal and along the adjoining floodplain.

Figure 4-2 shows the extent of the Evans River Model developed for this study.

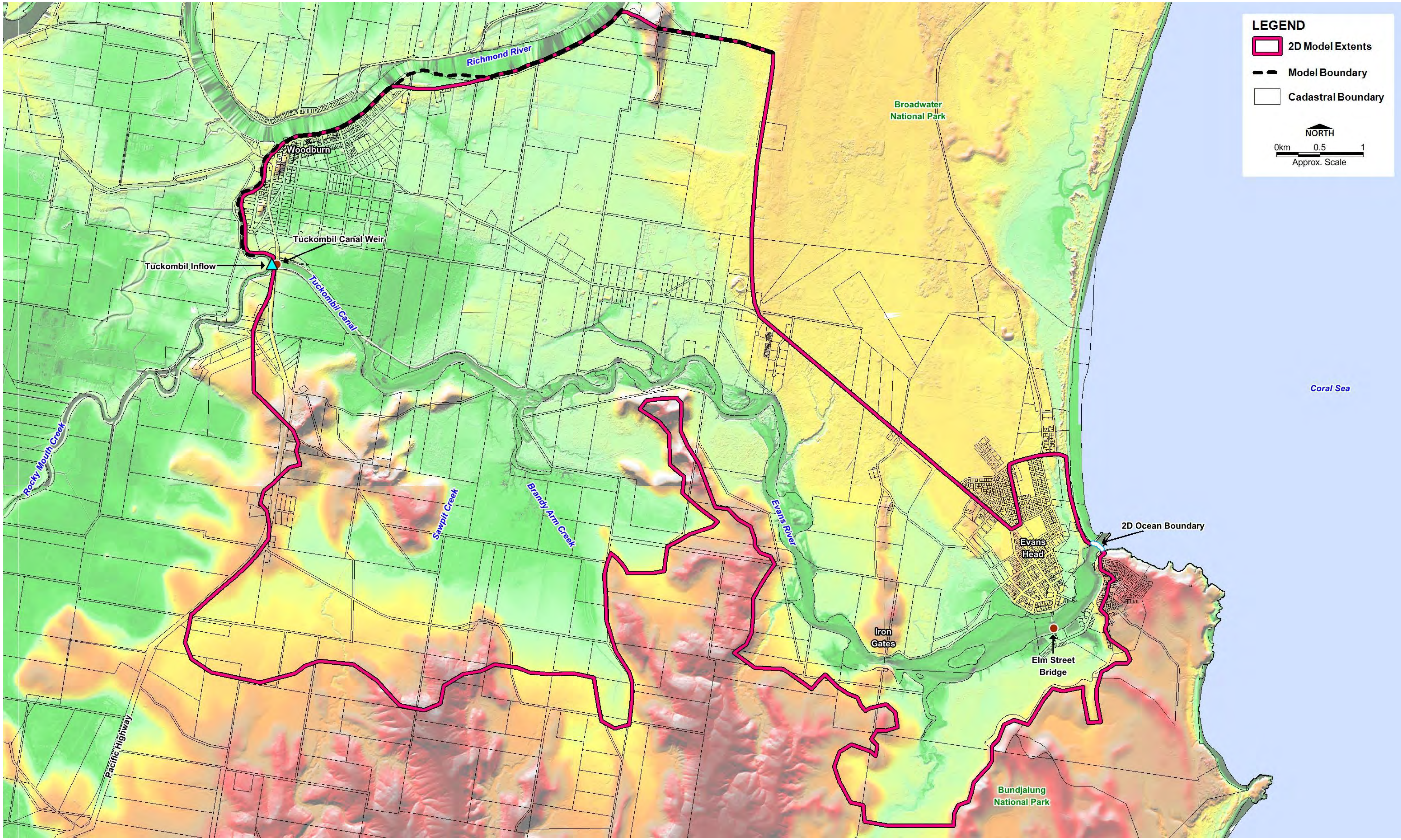


Figure 4-2 Hydraulic Model Layout

#### 4.3.2.1 Model Geometry

The base topography of the model is derived from 1m horizontal resolution 2010 LiDAR data which represents the latest aerial survey data available. The base data has been supplemented with bathymetric survey data of Evans River collected in 2004. The grid resolution of the model is 10m.

Additional modifications to represent raised levees, road embankments and minor drainage channels have been included as follows:

- 2013 ground survey data of the northern bank of the Tuckombil Canal extending from the Pacific Highway to 3.5km downstream and then inland for 1.2km alongside the Golf Club.
- Ground survey data of levees and roads, undertaken by Michel Surveys for RRCC in 1998/1999.
- Levee crest elevations along the southern bank of the Richmond River extending from Rocky Mouth Creek to the north eastern extent of the Evans River model. These elevations have been extracted from the 2010 LiDAR.
- Levee crest elevations along both banks of the Evans River extracted from the 2010 LiDAR.
- Minor drainage channels in the area surrounding Woodburn extracted from the 2010 LiDAR.

Locations of levees and drainage features are included in Figure 3-2. Where levee datasets overlap then preference has been given to ground survey data.

#### 4.3.2.2 Modelled Structures

Two major structures located within the Evans River model have been included as follows:

- Elm Street Bridge at Evans Head (Figure 2-4) – No survey elevations were available for the 130m span road bridge and adjacent footbridge. However, bridge obvert elevations have been estimated to range from 3.5m AHD near the bank to 4m AHD at the centre.
- The Tuckombil Canal Weir (Figure 2-2) has been included in the model with a fixed elevation of 0.94mAHD representing the current weir height.

#### 4.3.2.3 Landuse Mapping

Ground surface roughness can have a significant influence on the flow of water. Ground roughness is represented in the model by assigning Manning’s ‘n’ values for different land uses. Land use was determined from aerial photography along with on-site ground truthing.

Values of Manning’s ‘n’ for different land uses were selected based on industry accepted values and are shown in Table 4-1.

Table 4-1 Manning's 'n' Roughness Values

| Ground Cover | Manning's 'n' Value |
|---|---|
| Pasture | 0.05 |
| Cultivated fields | 0.06 |
| Sugar Cane | 0.15 |
| Maintained Grass | 0.035 |
| Sparse Vegetation, Top of Banks | 0.09 |
| Medium Density / In-Creek Vegetation | 0.10 |
| Dense Vegetation | 0.12 |
| Sandy Areas, Low Vegetation | 0.07 |
| Sandy River Bed | 0.025 |
| River Bed | 0.040 |
| Rough River Bed | 0.06 |
| Stony River Bed | 0.07 |
| Roads | 0.025 |
| Urban and Commercial Blocks | 1.00 |
| Sparse Urban Blocks | 0.20 |

#### *4.3.2.4 Model Boundaries*

The upstream boundary to the Evans River model extends from alongside eastern bank of Rocky Mouth Creek and the southern bank of the Richmond River (see Figure 4-2). The boundary has been schematised in the model as a time varying water level boundary. Time series data of water levels were extracted from the RRFMS model and applied to the Evans River model.

A study of elevated ocean water levels (i.e. from cyclones and east-coast tropical lows) was carried out for the Richmond River entrance (Lawson & Treloar, 1994). The study considered the probability of elevated ocean water levels due to low pressure systems and wave forces.

Extended investigations of that study in 1995 produced a set of water level hydrographs over the duration of a flood event for various probabilities of recurrence. These hydrographs were used in the hydraulic model to simulate the effects on flooding in the Richmond River floodplain of elevated and varying ocean water levels. The storm tide peak was timed to coincide with the local rainfall peak which is approximately three days before the Richmond River flood peak at Broadwater.

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# 5 Model Calibration and Verification

The Richmond River has been subject to a number of flood events. Floodwater originating from the Richmond River is the dominant cause of flooding to the Evans River catchment.

The Richmond River flood model developed by BMT WBM for RRCC was calibrated as part of the original study to the May 2009 flood event with further verification undertaken for the March 1974 January 2008, and February 1954 events. It is beyond the scope of this study to revisit the calibration of the Richmond River model. However, the Evans River model, which has been developed for this study, requires additional validation to ensure confidence in the performance of the model.

Two verification events have been run through the Evans River model:

- March 1974; and
- May 2009.

The 1974 event was selected as this was particularly severe in coastal regions due to it occurring during a high spring tide cycle. Historic flood levels were also available in the upper Evans River catchment. The 2009 event was selected due to the availability of gauged river levels to aid comparison.

## 5.1 March 1974 Flood

### 5.1.1 Event Description

The March 1974 event occurred due to Tropical Cyclone Zoe, which crossed the coast at Coolangatta. Two main bursts of rainfall occurred across the Richmond Valley during the 9/10 and 12/13 March. The main concentration of rain fell across the Wilsons River, with totals for the six day period commencing 9 March exceeding 950mm along the Tweed-Wilsons catchment boundary. Heavy rainfall occurred along the eastern part of the Richmond River catchment, with Woodburn and Broadwater receiving over 750mm during the same six day period.

### 5.1.2 Model Setup

Inflows entering the Evans River model from the Richmond River were extracted from the Richmond model for the March 1974 event. Outputs from the Richmond River hydrology models covering the Evans River catchment were applied as local inflows to the Evans River model. Rainfall applied in the hydrology models was derived from an analysis of 39 daily and pluviograph stations across the Richmond River catchment.

The original fabridam on the Tuckombil Canal was in place during the 1974 event but has since been replaced by a concrete weir. To replicate the behaviour of the March 1974 event, the weir was removed from the Evans River hydraulic model to represent the deflated fabridam.

### 5.1.3 Verification Results

Table 5-1 presents the results of the 1974 verification. Locations of historic flood levels are shown in Figure 3-3.

**Table 5-1 March 1974 Verification Results**

| ID | Recorded Flood Level (mAHD) | Modelled Flood Level (mAHD) | Difference (m) |
|---|---|---|---|
| 1 | 4.16 | 4.11 | -0.05 |
| 2 | 4.3 | 4.13 | -0.17 |
| 3 | 4.08 | 4.19 | 0.11 |
| 4 | 3.75 | 3.96 | 0.21 |
| 5 | 4.06 | 4.10 | 0.04 |
| 6 | 3.77 | 3.88 | 0.11 |
| 7 | 4.42 | 4.10 | -0.32 |

From Table 5-1 it can be seen that the model provides a reasonable fit to recorded flood levels.

No gauges of recorded river levels were available for comparison with the model output.

## 5.2 May 2009 Flood

### 5.2.1 Event Description

Between 20 and 22 May 2009, heavy rainfall fell across the Richmond River catchment as a result of an east coast low pressure system moving southwards from South East Queensland. The most intense rainfall occurred across the Wilsons River catchment, with a band of less intense rainfall extending southwest across the Bungawalbin Creek catchment.

### 5.2.2 Model Setup

The recorded water level hydrograph at Tuckombil Bridge was used to generate inflows to the Evans River model for the May 2009 event. Outputs from the Richmond River hydrology models covering the Evans River catchment were applied as local inflows to the Evans River model. Rainfall applied in the hydrology models was derived from an analysis of 61 daily and pluviograph stations across the Richmond River catchment.

No catchment specific changes were made to the hydraulic model for the May 2009 event. The Tuckombil weir was left at its current elevation of 0.94mAHD.

### 5.2.3 Verification Results

Time series flood level information was available for two gauges during the May 2009 event; Iron Gates and the Fishermans Co-op. Gauge locations are shown in Figure 3-3. Recorded flood levels are plotted against modelled flood levels for the Iron Gates and Fishermans Co-op gauges in Figure 5-1 and Figure 5-2 respectively.

It can be seen that the model performs well with respect to timing and provides a good match to peak flood levels with only minor overestimations. These peak levels are driven by the tide. However it is also evident that the model is overestimating the non-tidal component of the flood levels. This is apparent from the model not capturing the lower portion of each tidal cycle. This is caused by an overstatement of flow entering the catchment from upstream. Local inflows from the Evans River catchment will only play a minor role so it is likely that the higher than expected flows are entering the catchment from the Richmond River.

BMT WBMs experience of modelling in the Richmond River suggests that considerable uncertainty is associated with flows from the Bungawalbin catchment. It was found that a significantly improved calibration could be achieved using the recorded water level hydrograph for the 2009 event at Tuckombil Highway gauge as an upstream boundary to the Evans River model. However as these data have not been subject to quality assurance checking by Manly Hydraulics Lab, they have not been made available for use in the study.

As the Evans River model performs well in determining peak levels then it is considered suitable for the purposes of this assessment which is with regard to deriving flood planning levels. However it is recommended that the verification of the Evans River model is revisited if any significant updates occur to the Richmond River model.

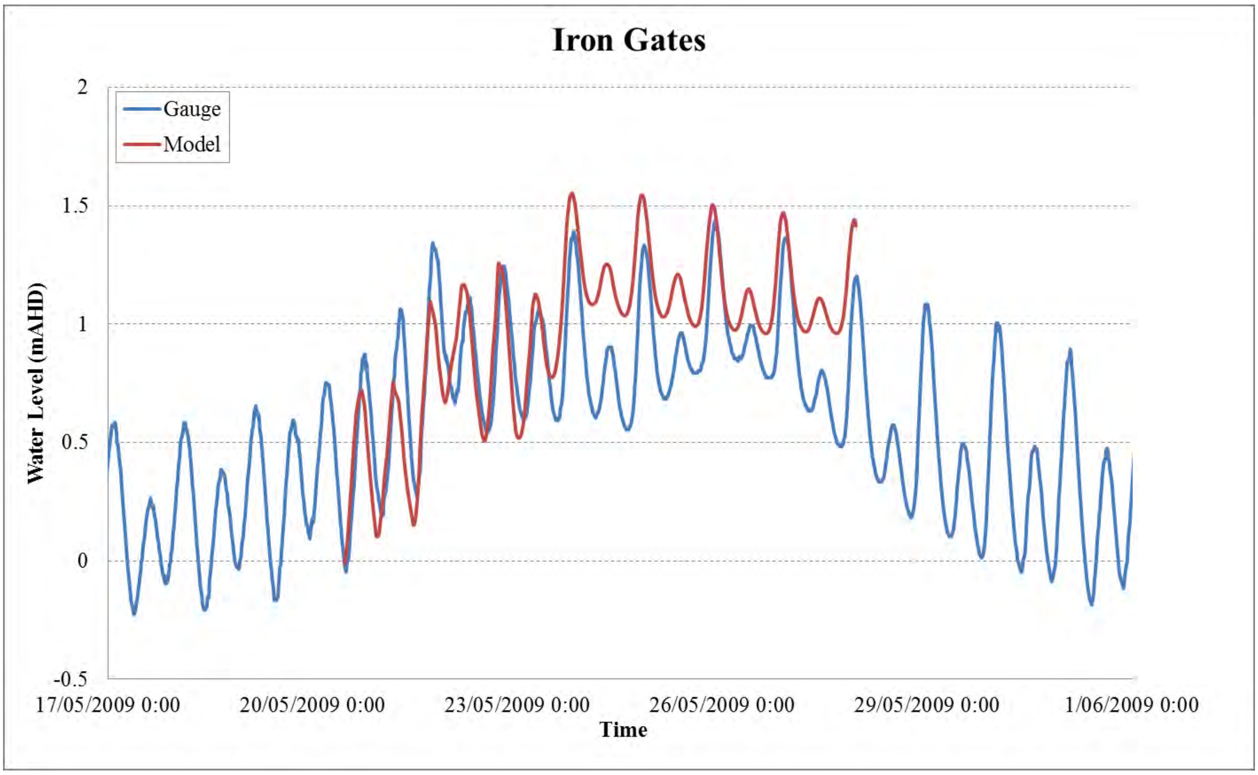


**Figure 5-1 May 2009 Recorded vs Modelled Flood Levels (Irongates)**

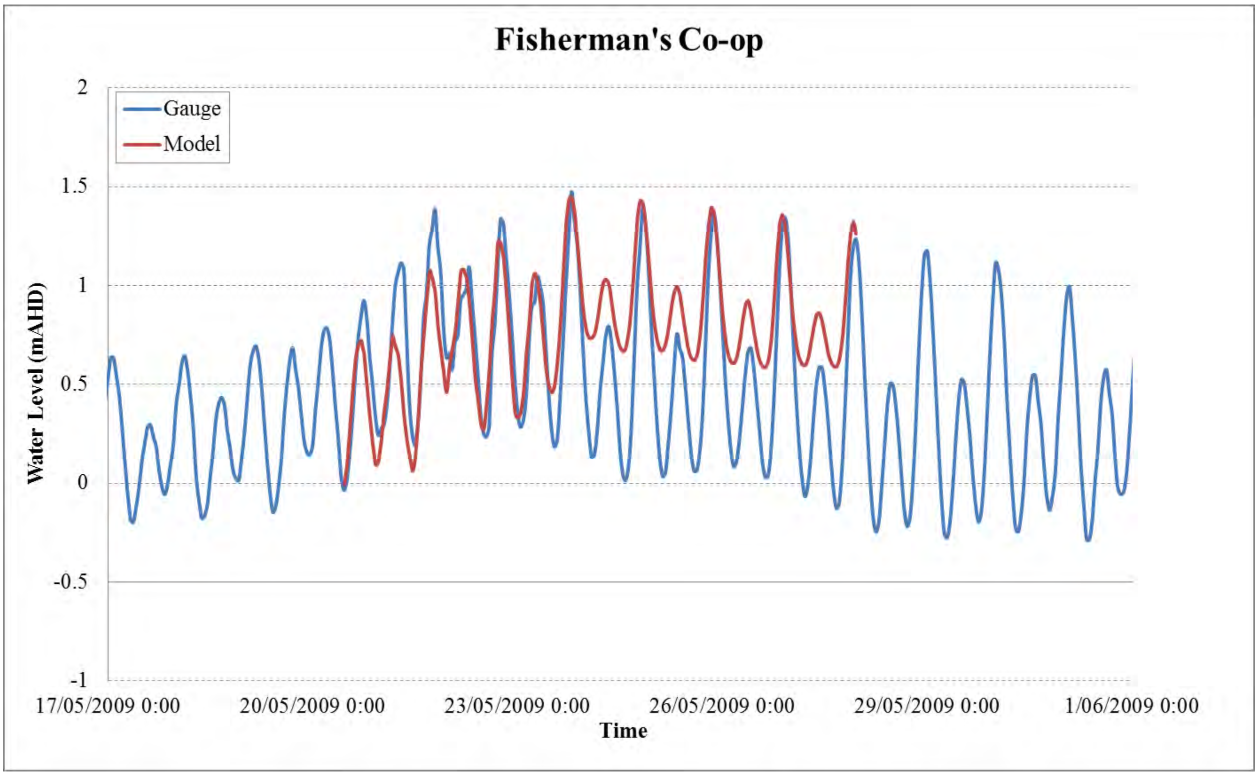


Figure 5-2 May 2009 Recorded vs Modelled Flood Levels (Fishermans Co-op)

# 6 Design Event Modelling

## 6.1 Introduction

Design floods are hypothetical floods used for planning and floodplain management purposes. They are based on having a probability of occurrence specified either as:

- Average Recurrence Interval (ARI) expressed in years; or
- Annual Exceedance Probability (AEP) expressed as a percentage.

With the imminent release of the revised Australian Rainfall and Runoff guideline, the industry is standardising and favouring the AEP terminology. However for this study, the ARI terminology has been used for consistency with previous studies in the Richmond River area and familiarity of terminology amongst stakeholders. A definition of ARI and the AEP equivalents are listed in Table 6-1. The 20, 50, 100, 500 year ARI events and the Probable Maximum Flood have been assessed in this study.

**Table 6-1 Terminology Used for Design Floods**

| Category | ARI | AEP[1] | Description |
|---|---|---|---|
| Small Frequent Floods | 5 years | 20% | A hypothetical flood or combination of floods which is likely to have a 20% chance of occurring in any one year or is likely occur once every 5 years on average. |
| Medium to Large Floods | 20 years | 5% | A hypothetical flood or combination of floods which is likely to have a 5% chance of occurring in any one year or is likely occur once every 20 years on average. |
| | 50 years | 2% | A hypothetical flood or combination of floods which is likely to have a 2% chance of occurring in any one year or is likely occur once every 50 years on average. |
| | 100 years | 1% | A hypothetical flood or combination of floods which is likely to have a 1% chance of occurring in any one year or is likely occur once every 100 years on average. |
| Rare to Extreme Floods | 500 years | 0.2% | A hypothetical flood or combination of floods which is likely to have a 0.2% chance of occurring in any one year or is likely occur once every 500 years on average. |
| | Probable Maximum Flood | | A hypothetical flood or combination of floods which represent a theoretical 'worst case' scenario. It is only used for special purposes where a high factor of safety is recommended, or in consideration of floodplain planning (e.g. evacuation and isolation of communities). |

[1] The AEPs listed are approximations of the corresponding ARI for ease of reference. For example, a 100 year ARI = 1% AEP, however a 5 year ARI = 18.13% AEP.

## 6.2 Sources of Flooding

Flooding within the Evans River catchment can originate from three major sources:

- Richmond River flood: spillage of Richmond River flows into the Evans River catchment via the Tuckombil Canal and/or overtopping of the Richmond River and Rocky Mouth Creek embankments;
- Local catchment flood: localised rainfall swelling local creeks and floodplains such as Sawpit Creek, Brandy Arm Creek and local drainage channels within Evans Head; and
- Ocean storm surge: elevated ocean levels caused by low depressions (barometric setup), strong onshore winds (wind setup) and storm wave conditions (wave setup). The peak ocean elevated levels were determined to be 1.6, 1.8 and 2.0 for the 5, 20 and 100 year ARI events respectively.

The design flood modelling undertaken for this study accounts for all three sources of flooding.

## 6.3 Design Event Hydrology

### 6.3.1 Design Rainfall

Intensity-Frequency-Duration (IFD) relationships are used to determine the average rainfall intensity for a given storm duration and average recurrence interval. The procedure outlined in Australian Rainfall and Runoff (AR&R) (IEAust, 1987) for calculating an IFD relationship for a point location involves interrogation of point rainfall parameters from six isopleth maps. The six values are supplemented by three geographical parameters. Average rainfall intensity can then be calculated for storm durations ranging from 5 minutes to 72 hours, and for ARIs of 1, 2, 5, 10, 20, 50 and 100 years.

Since IFD parameters relate to a point location, application to a large catchment has its limitations. The preferred approach is to assess a series of IFD parameters, each representing a different part of the catchment. Use of GIS mapping has enabled the parameters to be quickly inspected from digital isopleth maps. Hence, deriving a series of IFD parameters is a relatively quick procedure. The following points outline the approach that has been adopted within the *Richmond River Flood Mapping Study (BMT WBM, 2010)* and subsequently adopted for use with this study:

(1) The Richmond River catchment has been sub-divided into 26 regions, the boundaries of which align with the hydrological model sub-catchment boundaries. The regions generally take consideration of known areas of varying intensity rainfall and topographical features. For example, the steep sub-catchments of the Wilsons River have been assigned a different region than the lower floodplains around Ballina.

(2) IFD parameters were derived for each of the 26 regions as follows:

  (a) Maximum parameter within region;

  (b) Average parameter across region; and

  (c) Parameters at centroid of region.

(3) The resulting sets of IFD parameters were compared for specific locations against those specified in the *Northern Rivers Local Government Handbook of Stormwater Drainage Design* (2006). In general, the IFD parameters calculated using approaches (b) and (c), were lower than the values specified in the handbook. The parameters calculated using approach (a) were higher or consistent with the handbook values. This translates to higher than or consistent rainfall intensities to those used throughout the region for stormwater infrastructure design. Therefore, these higher IFD parameters were adopted for use.

IFD parameters for the Alstonville region have been replaced by the revised parameters issued by the BoM during the *Ballina Floodplain Management Study* (WBM, 1997). The reason for the revision was to account for the occurrence of several storm events with greater than 100 year ARI rainfall intensity since issue of AR&R in 1987. The revised set of parameters results in higher rainfall intensity than otherwise calculated.

For the Mid Richmond River the 72 hour duration resulted in the greatest flows. As the Richmond River floods also dominate the Evans River catchment then the 72 hour duration event also resulted in the greater flows on the Evans River.

### 6.3.2 PMP Estimation

The probable maximum precipitation (PMP) is defined as '*the greatest depth of precipitation for a given duration meteorologically possible for a given storm area at a particular location at a particular time of year'* (WMO, 1986). The PMP is used to estimate the probable maximum flood (PMF), representing an extreme flood that can be expected to occur on average once every 10,000 to 1,000,000 years, depending on the catchment.

The two methods recommended for calculation of the PMP along the East Coast of Australia are:

- Generalised Short Duration Method (GSDM); and
- Generalised Tropical Storm Method Revised (GTSMR).

As the name implies, the GSDM is used for short duration events on catchments up to 1,000km$^2$. More applicable to the 7,000km$^2$ Richmond River catchment is the GTSMR, which is recommended for event durations up to 120 hours.

Presented in Table 6-2, are the total PMP rainfall depths for the Richmond River. Also shown in Table 6-2 are the rainfall depths for the 20, 50, 100 and 500 year ARI events for comparison. The depths shown have not been spatially factored; therefore, represent an average depth across the catchment.

**Table 6-2 Comparison of Design Rainfall Depths**

| Event Duration | Richmond River Average Design Rainfall Depth* (mm) | | | | |
|---|---|---|---|---|---|
| | 20 year | 50 year | 100 year | 500 year | PMP |
| 24 hour | 240 | 286 | 322 | - | 840 |
| 36 hour | 284 | 339 | 382 | - | 990 |
| 48 hour | 318 | 381 | 430 | 548 | 1,120 |
| 72 hour | 366 | 440 | 498 | 651 | 1,360 |
| 96 hour | - | - | - | - | 1,550 |
| 120 hour | - | - | - | - | 1,630 |

* depths presented are un-factored, based on catchment average

### 6.3.3 Design Rainfall Losses

Values applied for initial and continuing losses are 20mm and 2.0mm/hr respectively. These values are in accordance with AR&R and have been used for all design events.

### 6.3.4 Design Ocean Boundary

As discussed in Section 4.3.2.4 design ocean boundaries have been applied so that the peak coincides with the peak of the design rainfall event. Figure 6-1 shows the 100 year ARI downstream boundary applied in the model where a peak ocean level of 2.0m AHD is used.

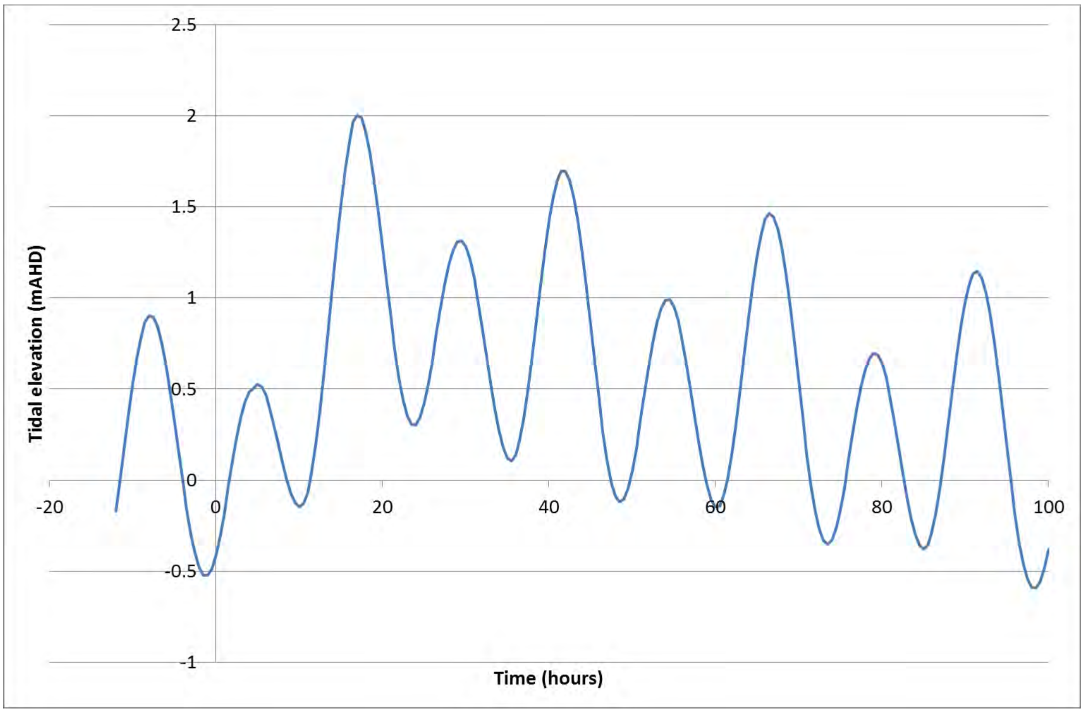


**Figure 6-1 100 year ARI Downstream Boundary**

## 6.4 Design Flood Mapping

The interpretation of maps within this report should be done with an appreciation of any limitations with their accuracy. Whilst the points below highlight these limitations, it is important to note that the results presented provide a current prediction of design flood behaviour:

- Recognition that no two floods behave in exactly the same manner;
- Design floods are a ‘best estimate’ of an average flood for their probability of occurrence; and
- Approximations and assumptions are made in the modelling and mapping process as discussed throughout this report.

### 6.4.1 100 Year ARI Design Flood

Figure 6-2 to Figure 6-5 present maps showing peak 100 year ARI flood levels, depths, velocities and hazard respectively. Figure 6-6 presents a map of peak 100 year ARI flood levels focussed on the Evans Head area. Figure 6-6 also includes the coastal hazard beach regression planning line for the year 2100 as derived by Hydrosphere Consulting.

It can be seen from the Figures that flooding is extensive across the upper part of the Evans River catchment with the extent narrowing towards the natural constriction in the terrain at Iron Gates. Flood elevations in this upper floodplain typically range between 4.5 and 5.7m AHD. At Iron Gates the flood elevation decreases to approximately 2.5m AHD.

The 100 year peak velocity map shows the main locations where floodwater spills into the upper Evans river floodplain from the Richmond River. As the Richmond River nears its peak level these inflow locations largely merge into a continuous inflow.

The natural constriction at Iron Gates limits the width of the flood extent to around 90m and this in turn creates some of the highest flood velocities within the catchment at around 4m/s. Additional information on floodplain constrictions is provided in Section 6.6.2.

At Evans Head the flood elevations along the river typically range between 2.0m AHD and 2.3m AHD. The majority of the town is located at elevations sufficient to be above the 100 year ARI flood levels. Low lying parts of the town are affected and these are:

- Bundjalung Road and the harbour at South Evans Head; and
- The Silver Sands Holiday Park within Evans Head.

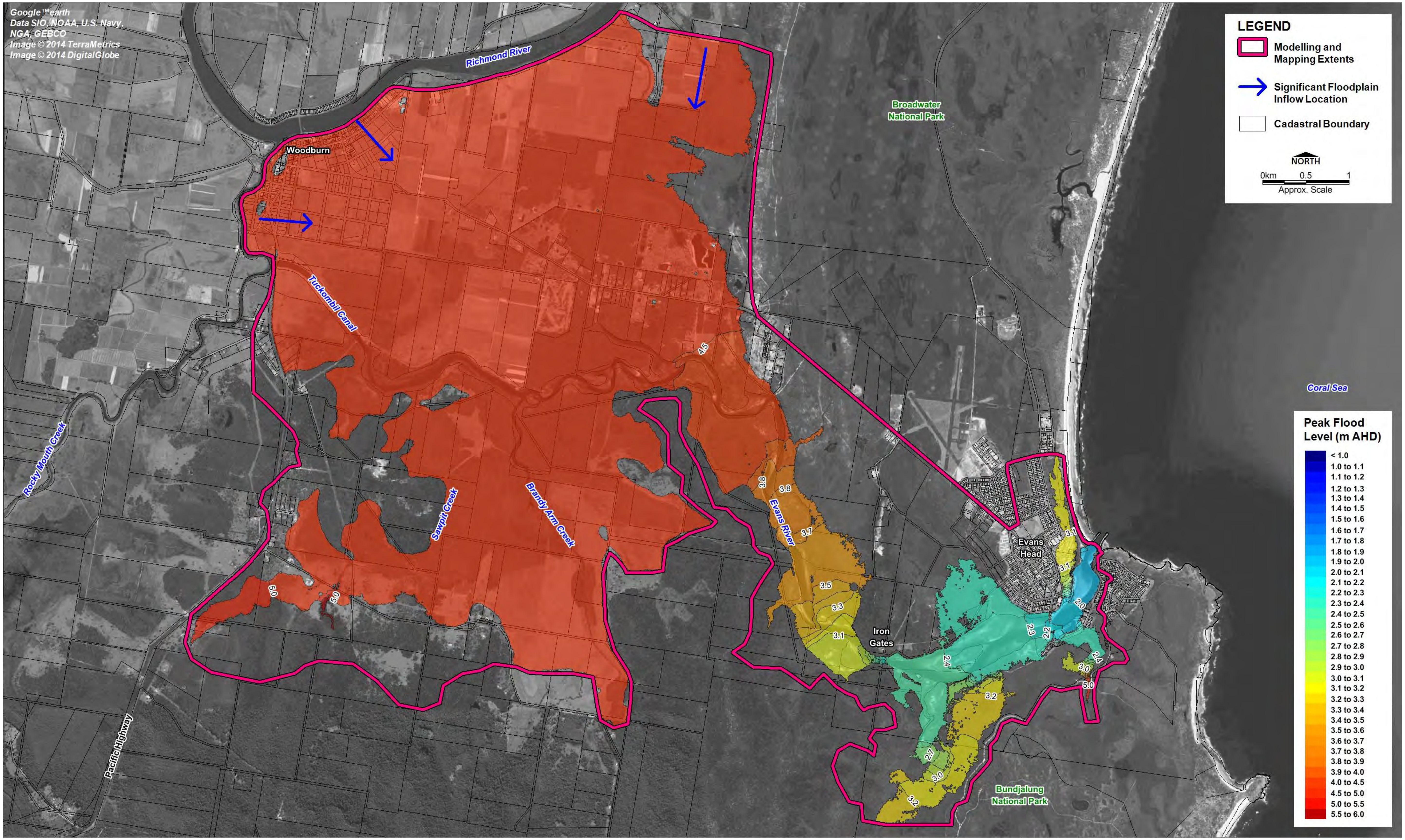


**Figure 6-2 100 year ARI Flood Levels**

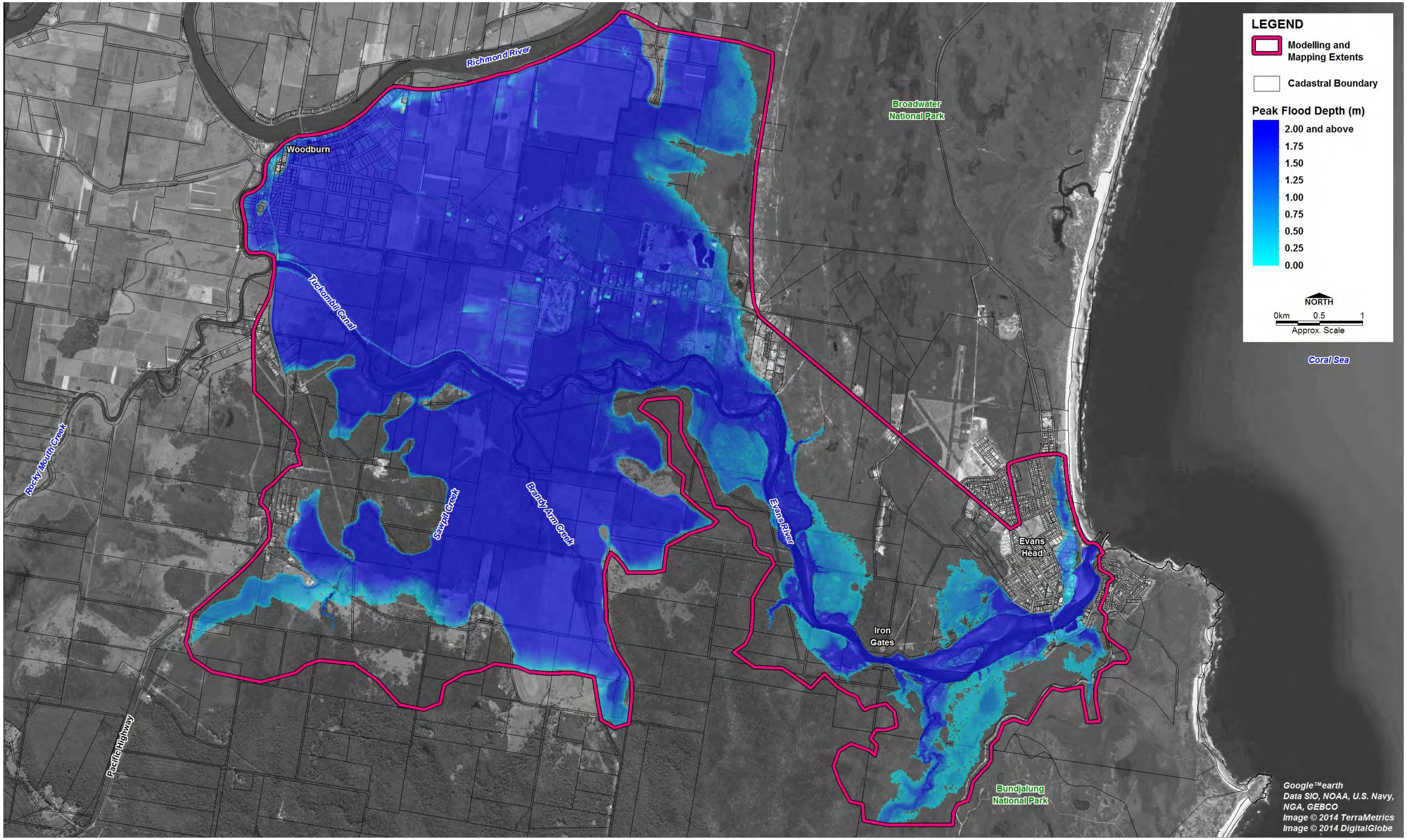


**Figure 6-3 100 year ARI Flood Depth**

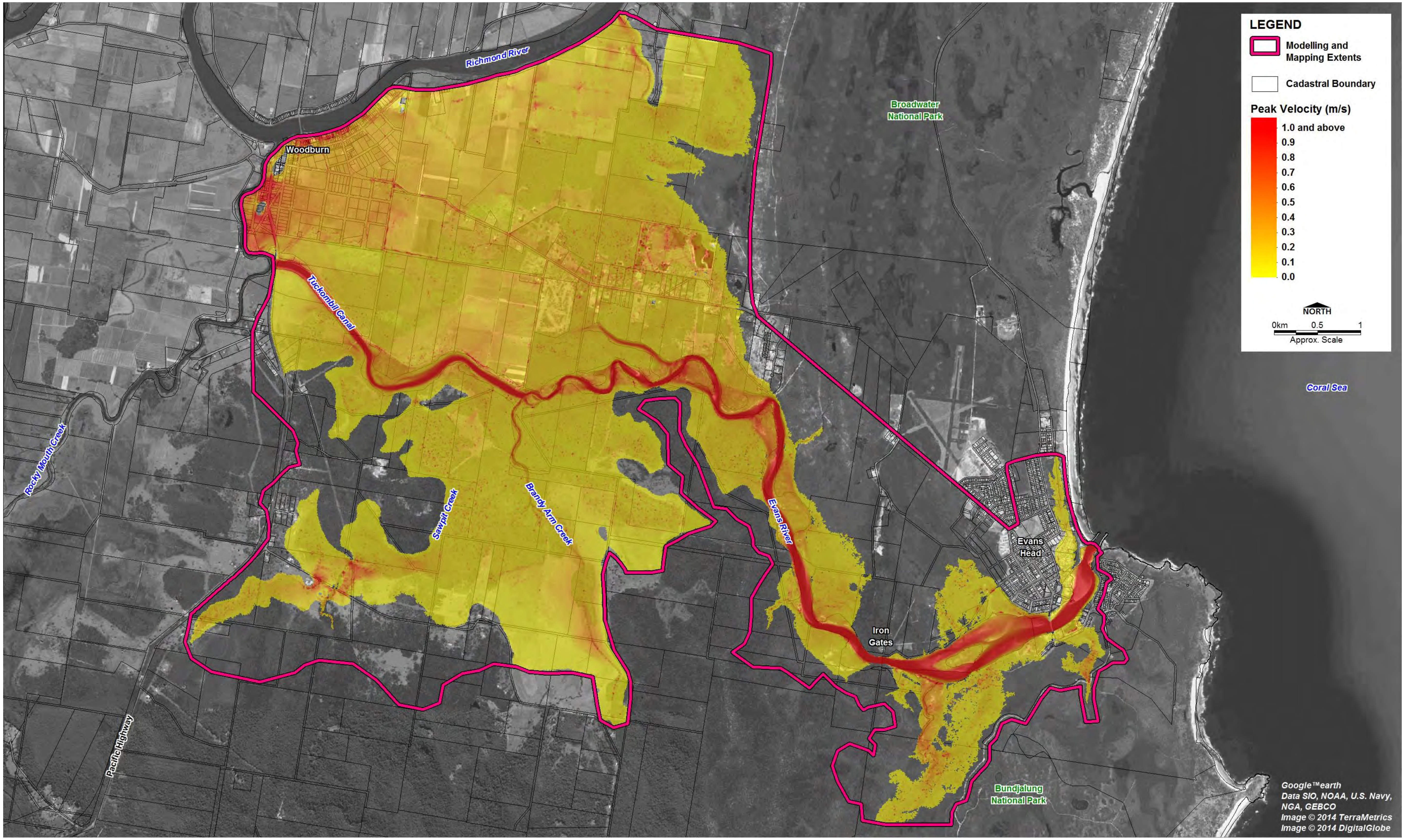


Figure 6-4 100 year Flood Velocity

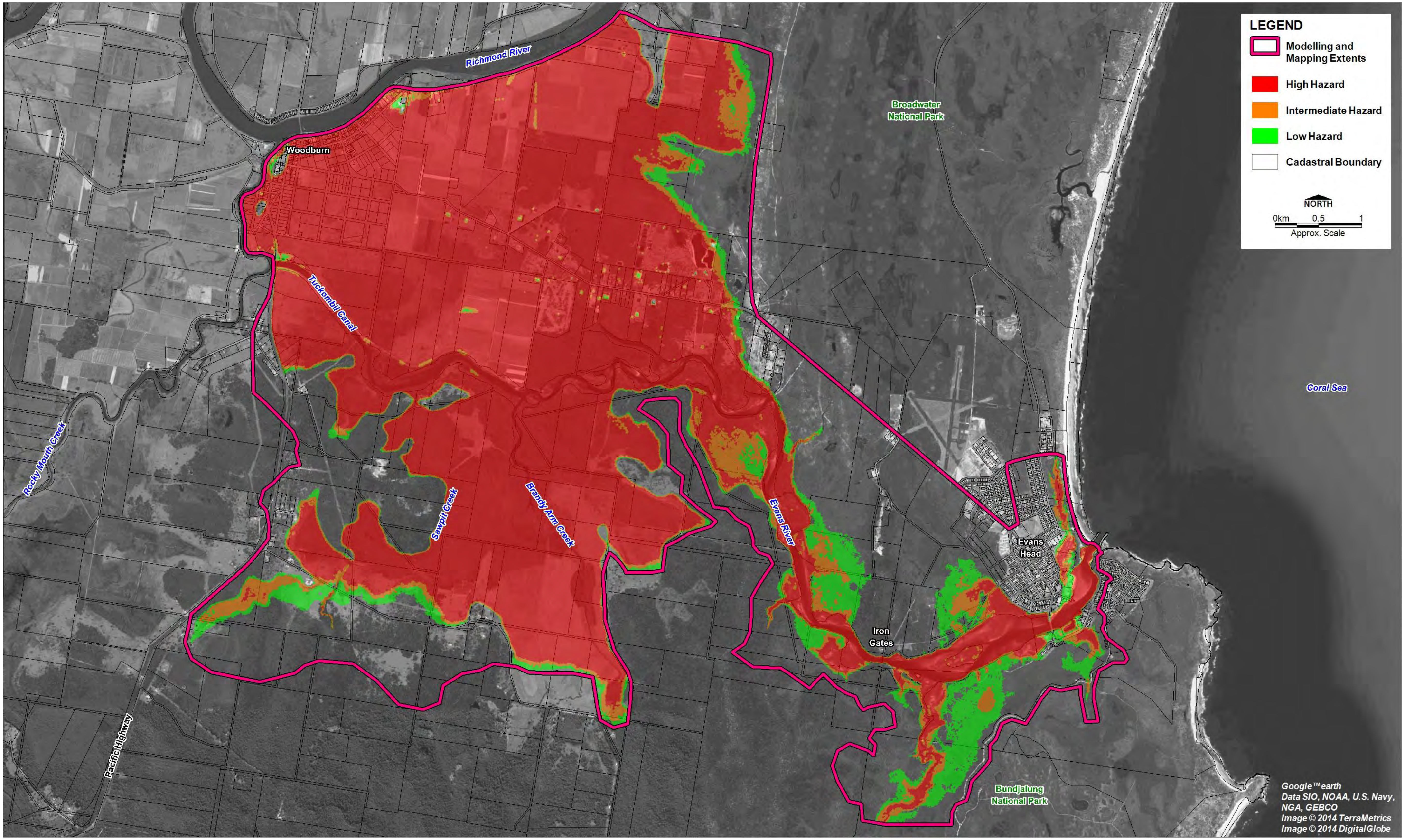


**Figure 6-5 100 year ARI Flood Hazard**

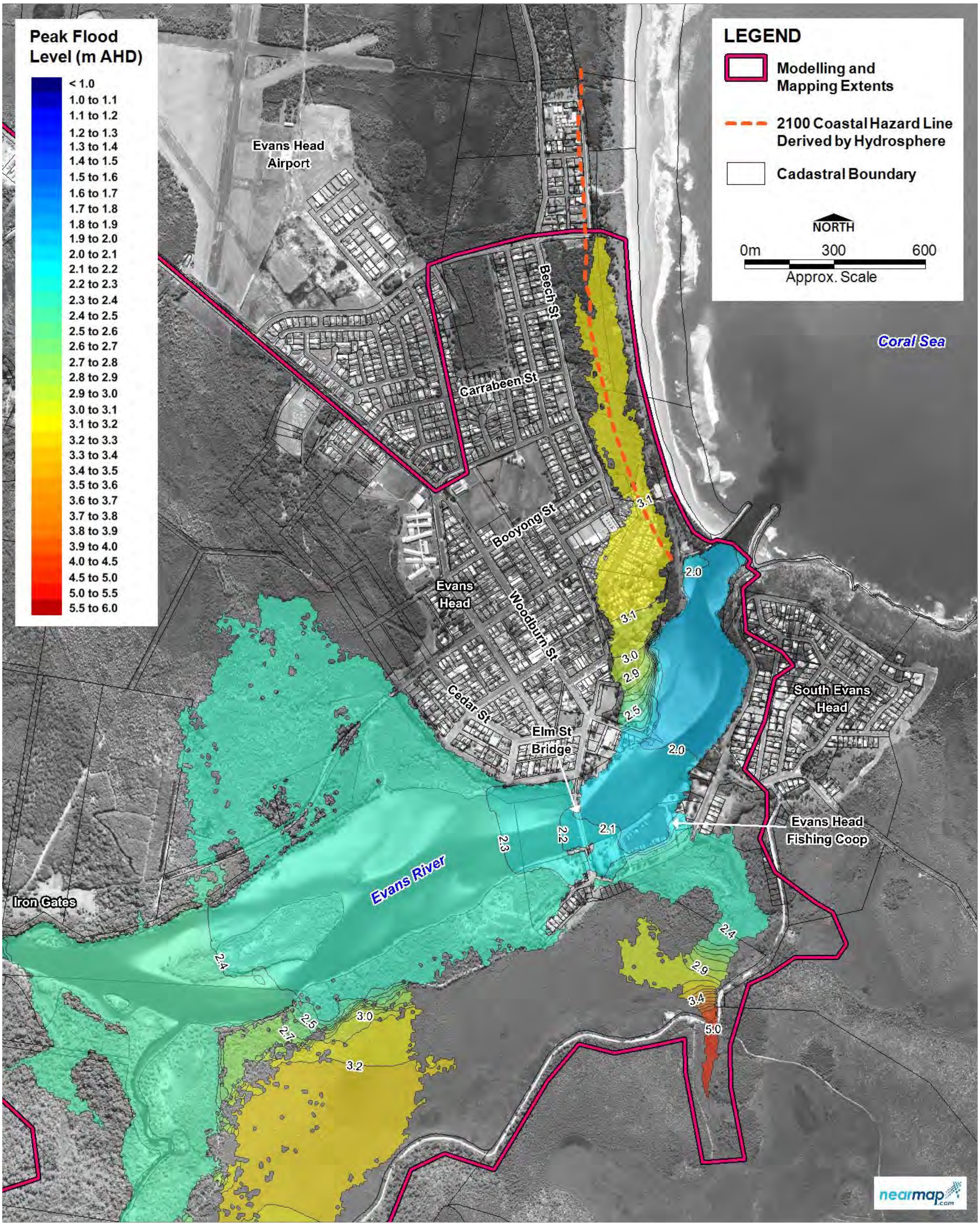


Figure 6-6 100 year ARI Flood Levels (Evans Head)

### 6.4.2 20 year ARI Flood

Figure 6-7 and Figure 6-8 present the 20 year ARI peak flood levels for the Evans River and Evans Head respectively. Flood levels vary between 3.5m AHD and 4.0m AHD in the upper Evans River floodplain. This causes inundation of a significant extent of floodplain. Within Evans Head the Silver Sands Holiday Park is inundated along with the area surrounding the harbour in South Evans Head. All other areas within Evans Head are raised above the flood levels.

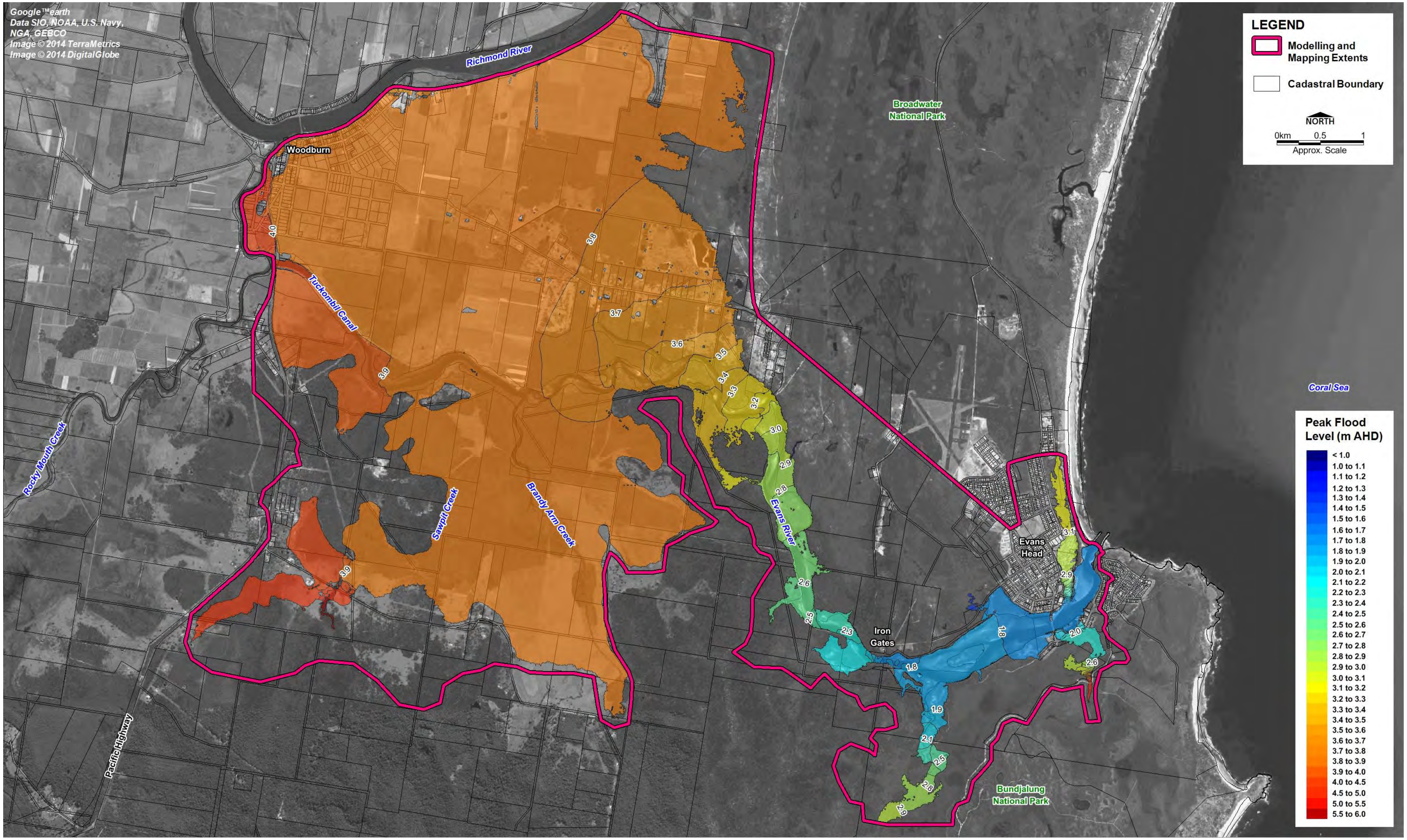


Figure 6-7 20 year ARI Flood Levels

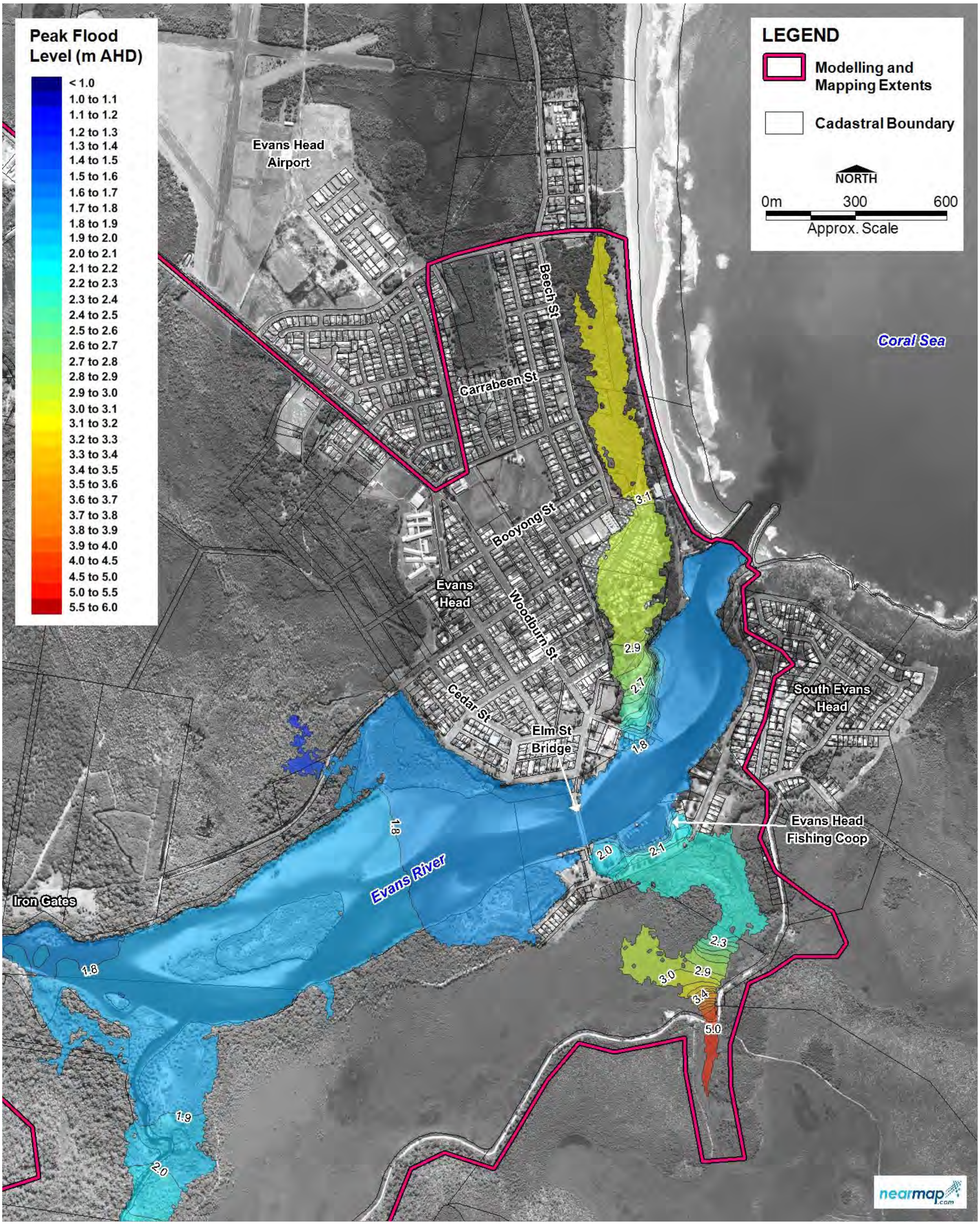


Figure 6-8 20 year ARI Flood Levels (Evans Head)

### 6.4.3 50 year ARI Flood

Figure 6-9 and Figure 6-10 present the 50 year ARI peak flood levels for the Evans River and Evans Head respectively. Flood levels vary between 4.0m AHD and 4.2m AHD in the upper Evans River floodplain. This causes inundation of a significant extent of floodplain. Within Evans Head the extent of inundation is broadly similar to the 20 year ARI event with the Silver Sands Holiday Park inundated along with the area surrounding the harbour in South Evans Head. All other areas within Evans Head are raised above the flood levels.

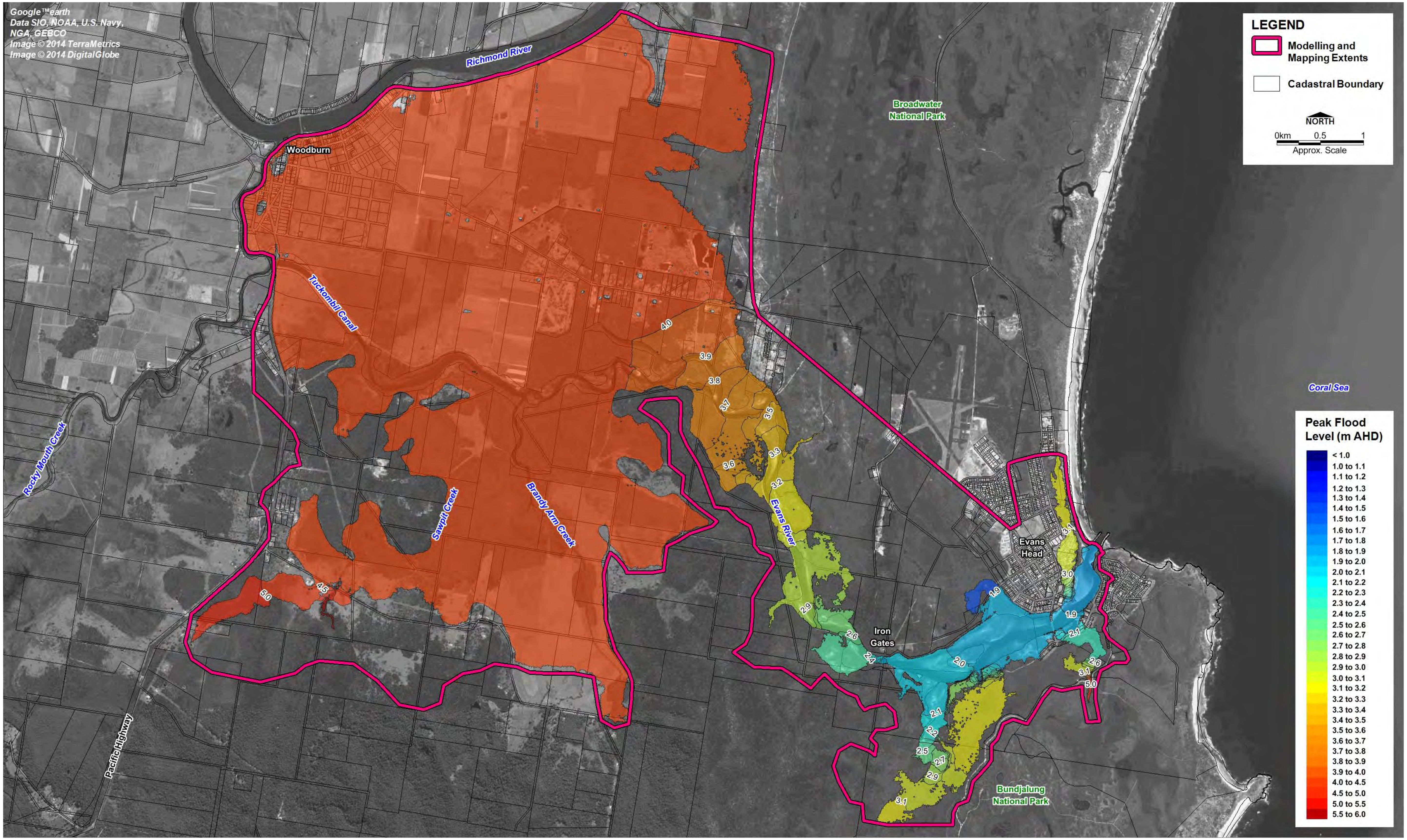


**Figure 6-9 50 year ARI Flood Levels**

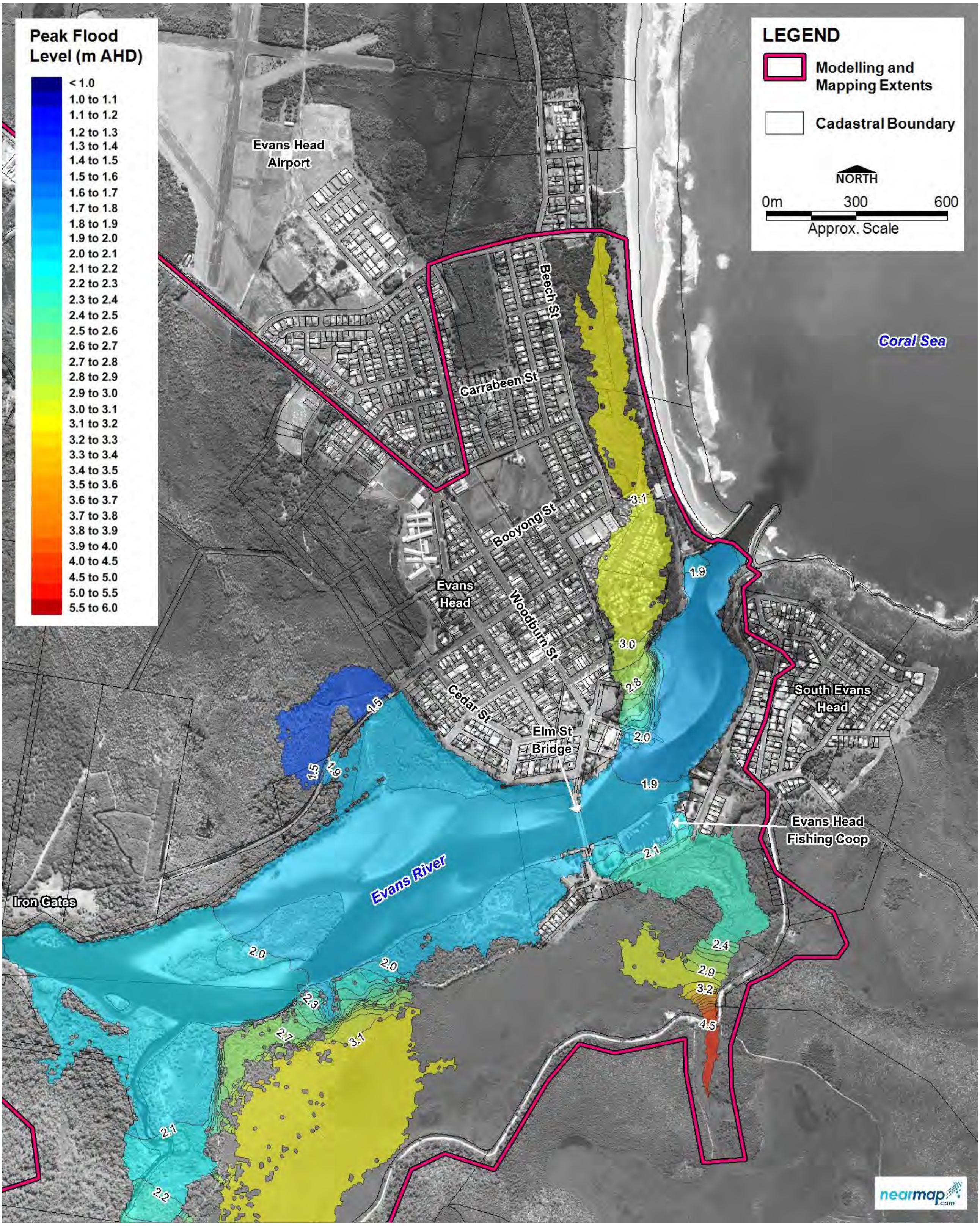


Figure 6-10 50 year ARI Flood Levels (Evans Head)

### 6.4.4 500 year ARI Flood

Figure 6-11 and Figure 6-12 present the 50 year ARI peak flood levels for the Evans River and Evans Head respectively. Flood levels vary between 5.5m AHD and 5.6m AHD in the upper Evans River floodplain. This causes inundation of a significant extent of floodplain. Within Evans Head the extent of inundation is broadly similar to the 100 year ARI event with the Silver Sands Holiday Park inundated. However the extent of inundation within South Evans Head has increased to include much of Bundjalung Road and Ocean Drive alongside the harbour being inundated. All other areas within Evans Head are raised above the flood levels

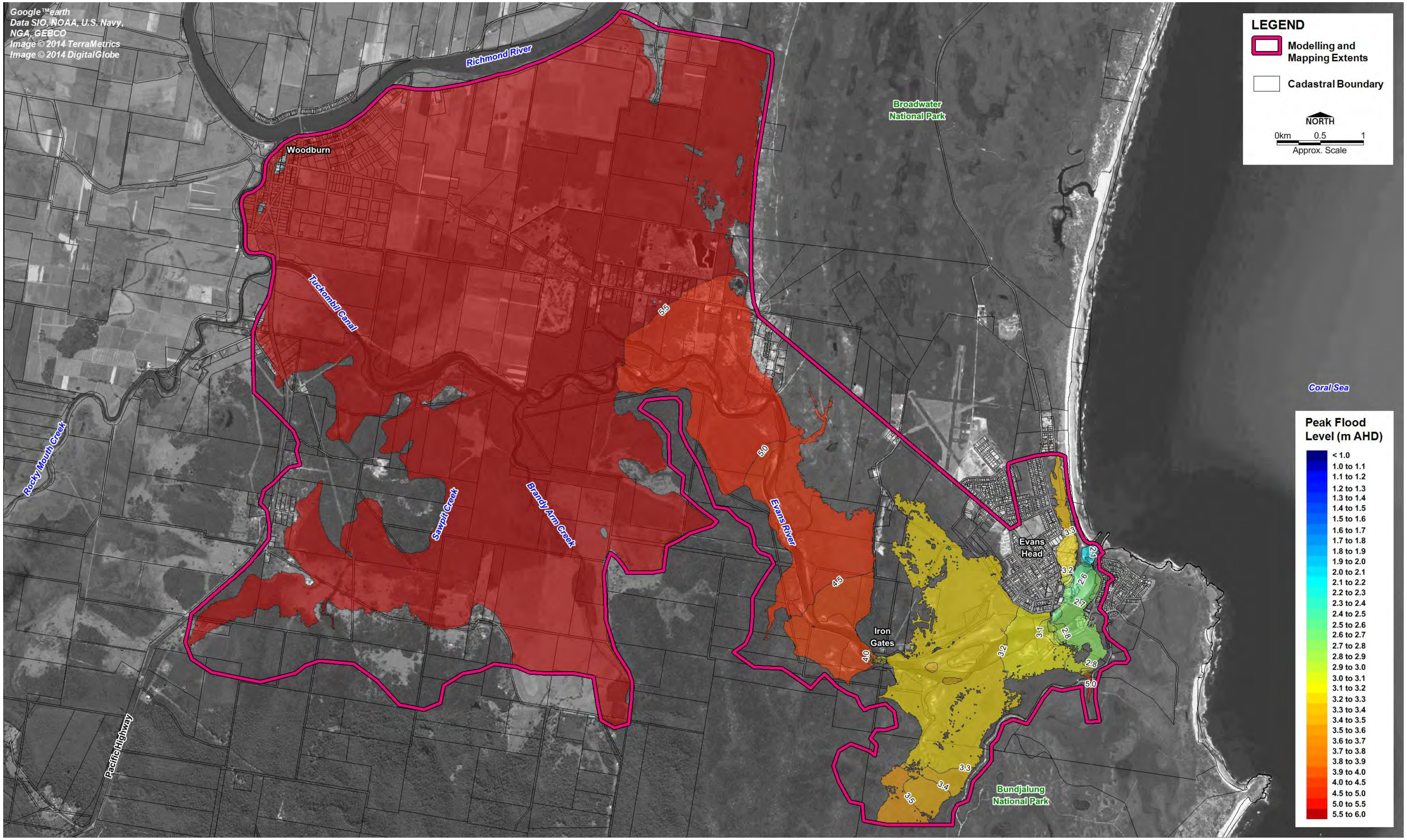


**Figure 6-11 500 year ARI Flood Levels**

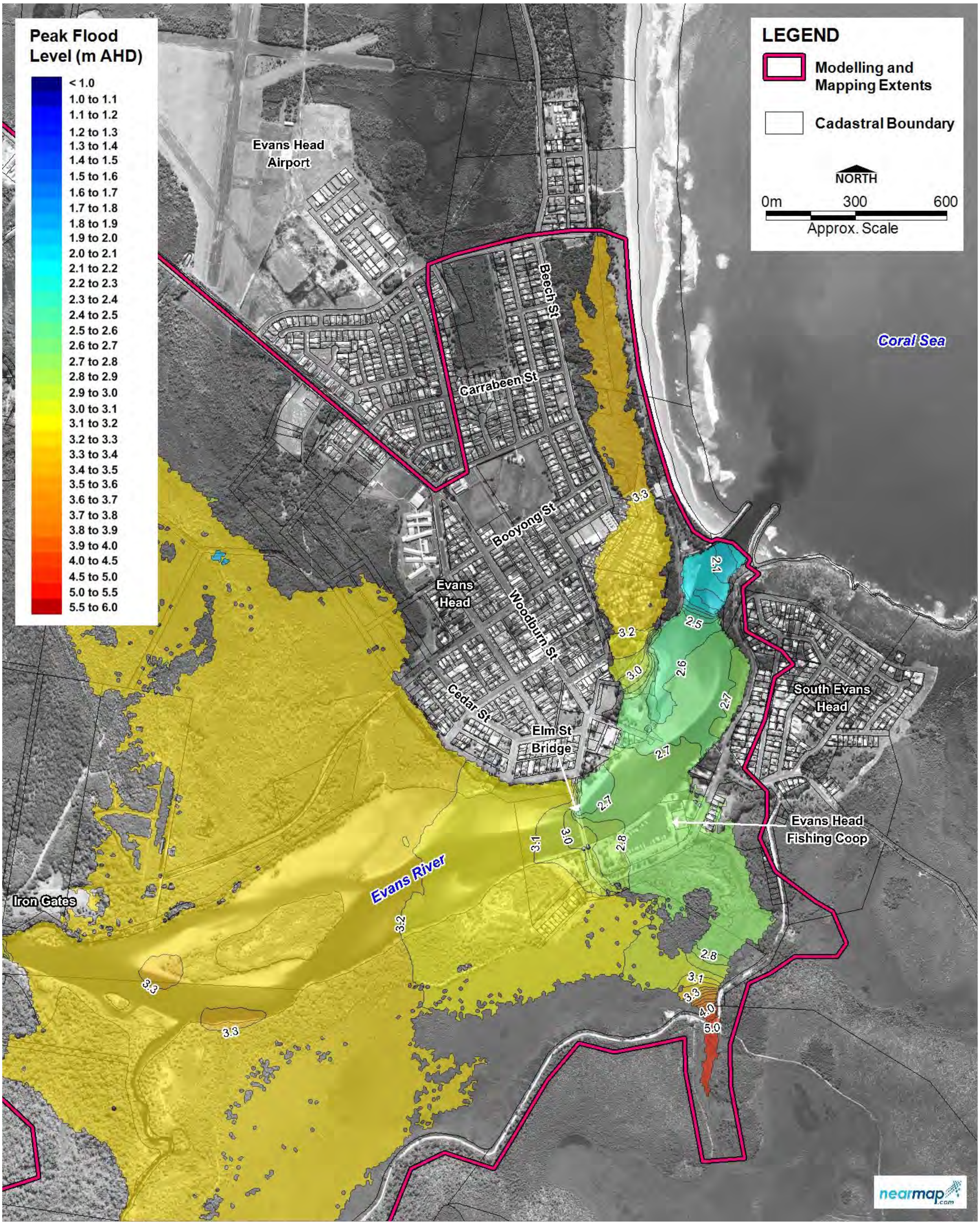


Figure 6-12 500 year ARI Flood Levels (Evans Head)

### 6.4.5 Probable Maximum Flood

The Probable Maximum Flood (PMF) inflow to the Evans River from the Richmond River is so great that it exceeds the scale of the model and results in exaggerated flood levels. It was clear, however, that the majority of the Evans River catchment, including Evans Head would be inundated during a PMF event. Figure 6-13 shows potentially PMF affected flood prone land based on the topography. It should be noted that this map is not based on hydraulic model output but has instead been informed by the findings form the hydraulic modelling.

The map, whilst conservative, does reflect the extreme nature of the event.

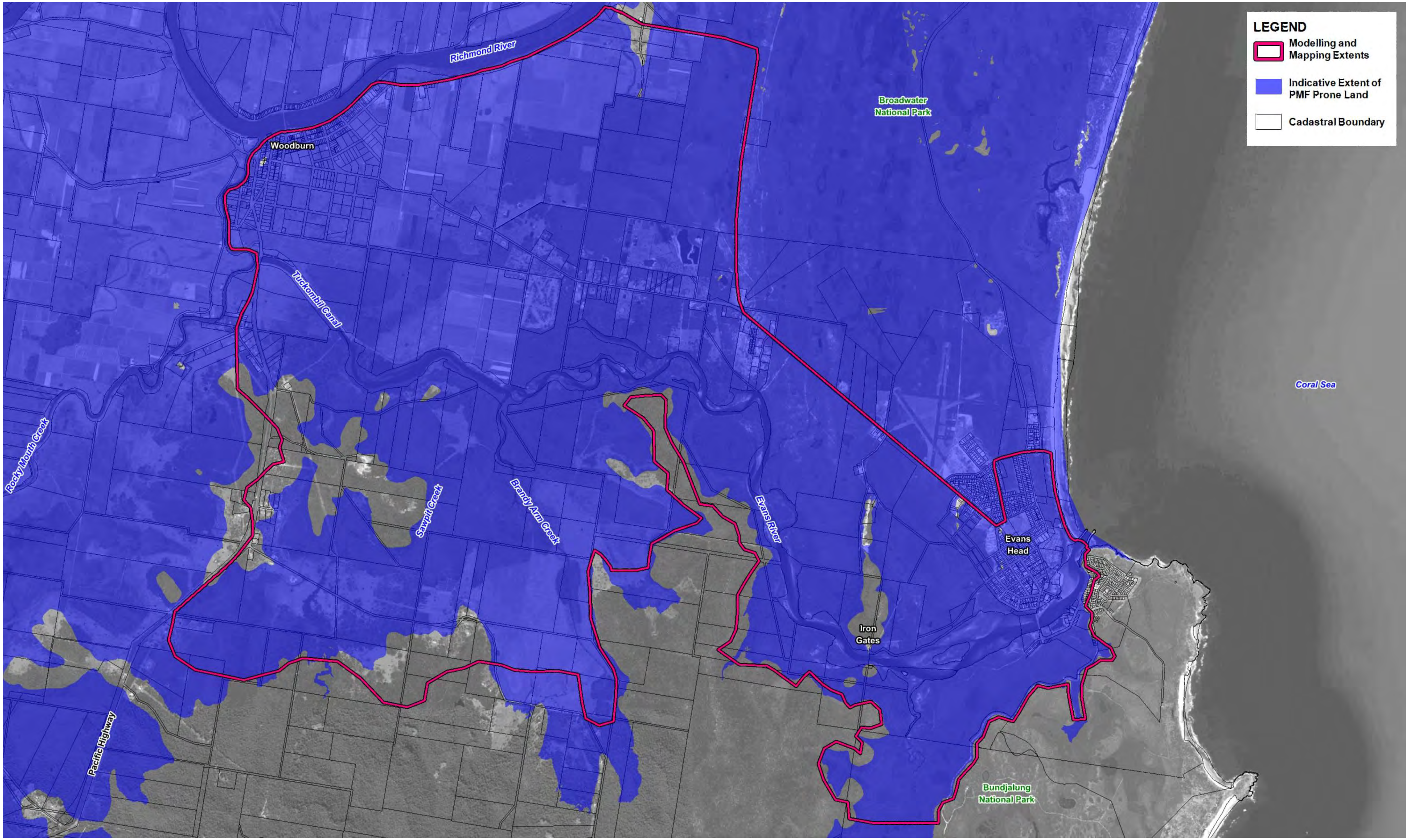


Figure 6-13 Indicative Extent showing PMF Flood Prone Land

## 6.5 Climate Change Assessment

A climate change sensitivity assessment has been undertaken on the 100 year ARI event by applying a 10% increase in rainfall intensity and a 0.9m rise in sea level. These values are currently used by RVC and are derived from the following New South Wales government guidelines and policy:

- Floodplain Risk Management Guideline: Practical Consideration of Climate Change (DECC, 2007); and
- NSW Sea Level Rise Policy Statement (DECCW, 2009).

While the NSW Government has since abandoned the Sea Level Rise Policy and no longer prescribes state-wide sea level rise projections, Council has not undertaken any scientific investigations of its own and have maintained the 0.9m benchmark used in the 2009 policy. A 10% increase to rainfall intensity has also been adopted.

Additional climate change sensitivity assessments were undertaken for the 20, 50 and 500 year ARI events but these only included the 0.9m sea level rise and not the additional 10% rainfall intensity increase. This was due to the dominance of the tidal component over the riverine component in determining the peak flood levels at Evans Head.

Figure 6-14 presents the peak flood levels for the 100 year ARI event under a future climate. Figure 6-15 shows the same data but presented for Evans Head. It can be seen that peak flood levels increase at Evans Head by approximately the same increase applied in the sea level (0.9m). The majority of Evans Head remains at a sufficient elevation to be located above this future 100 year ARI flood level. A notable exception is for areas in South Evans Head near the harbour, Ocean Drive and Bundjalung Road which are now subject to greater inundation.

Figure 6-16 to Figure 6-18 present peak flood levels in Evans Head for the 20, 50 and 500 year ARI events respectively.

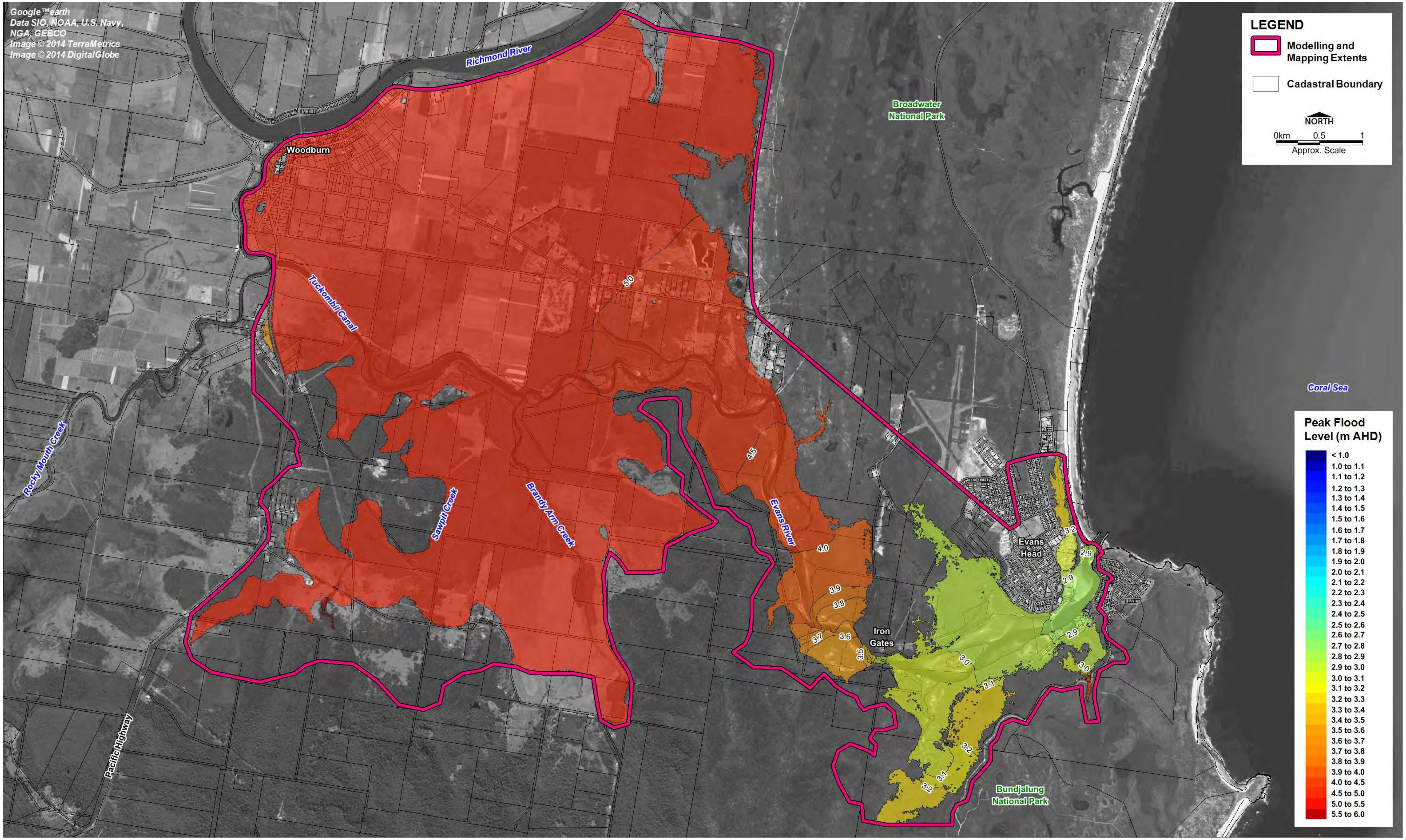


Figure 6-14 100 year ARI Levels Climate Change Assessment

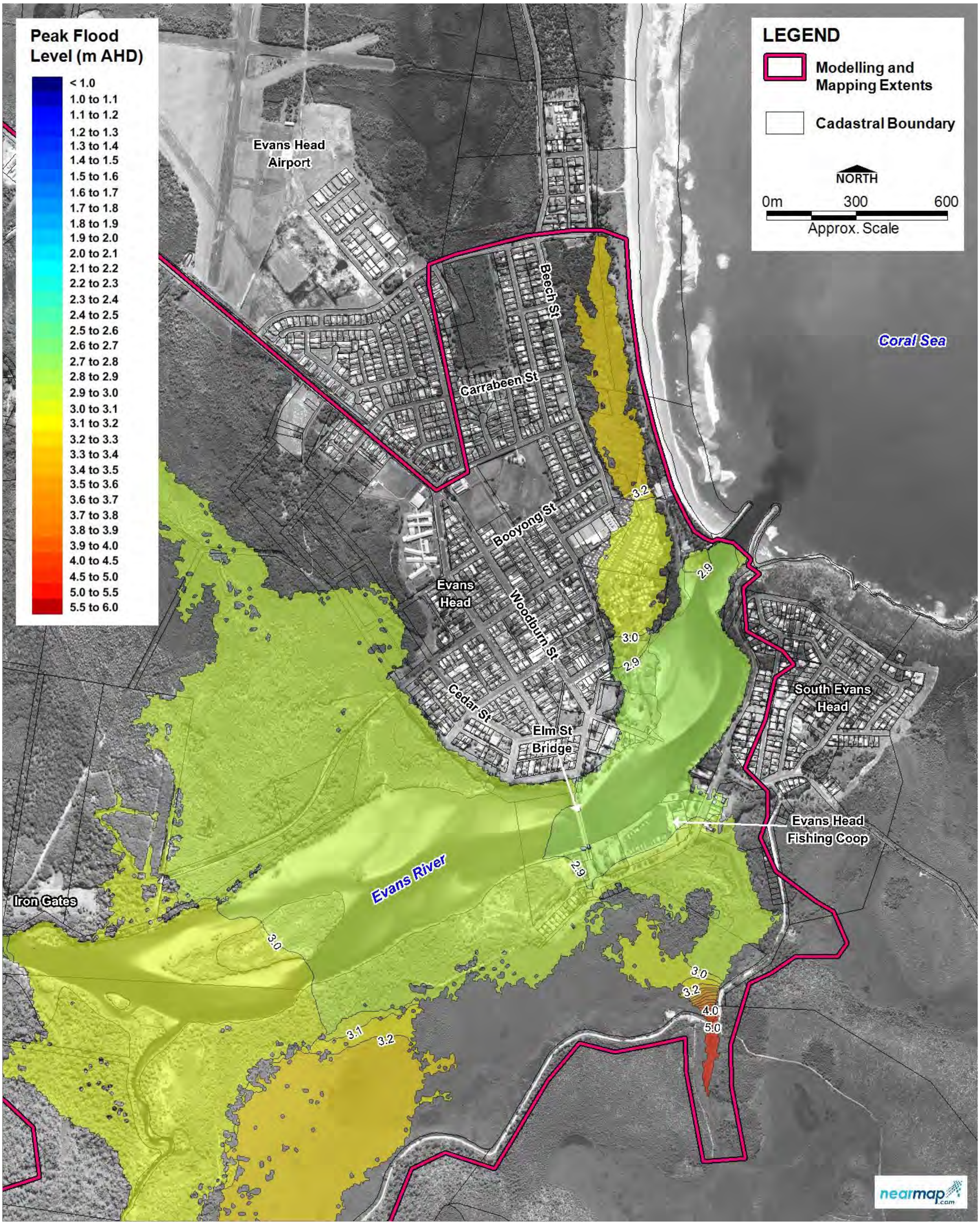


Figure 6-15 100 year ARI Levels Climate Change Assessment – Evans Head

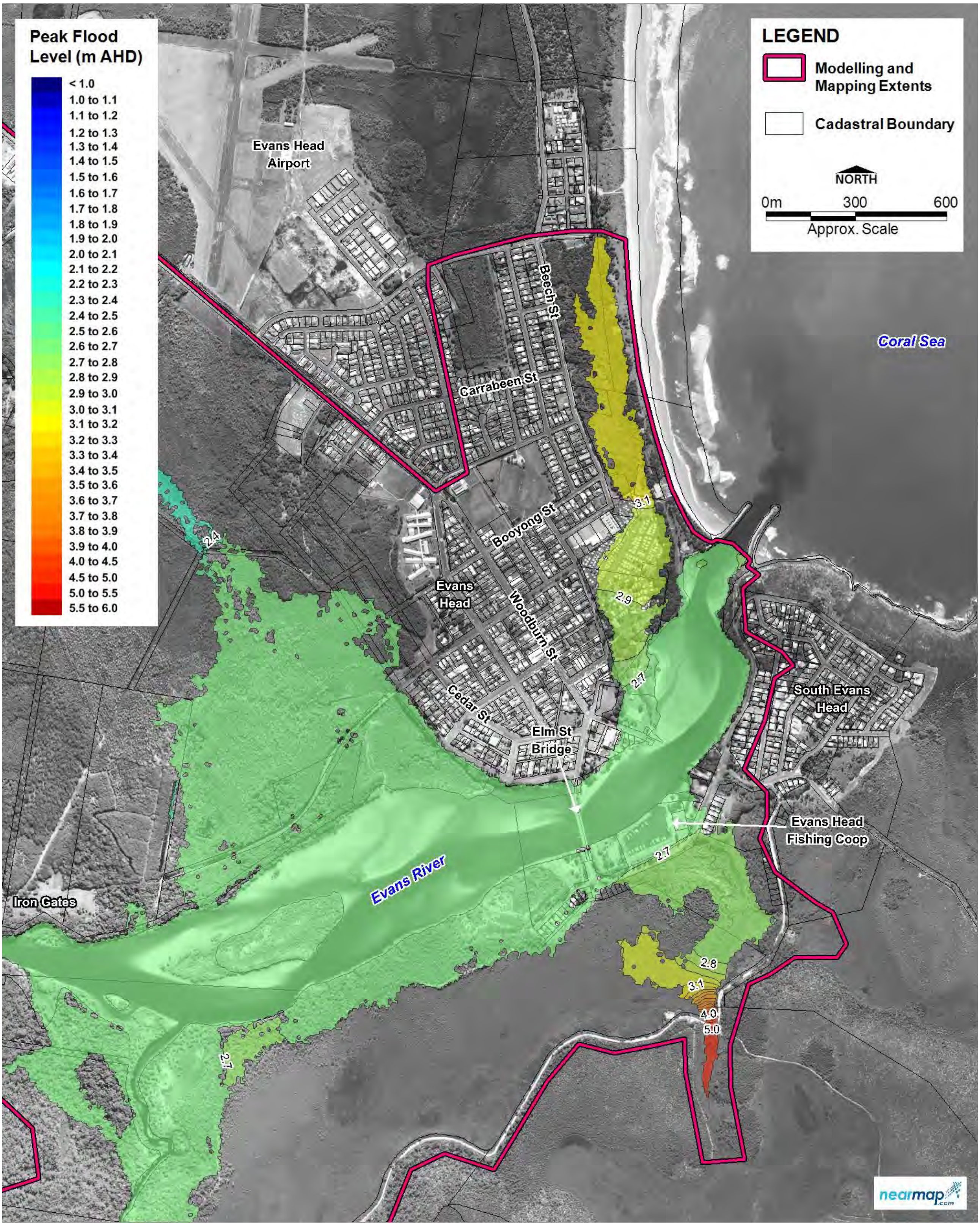


Figure 6-16 20 year ARI Levels Climate Change Assessment – Evans Head

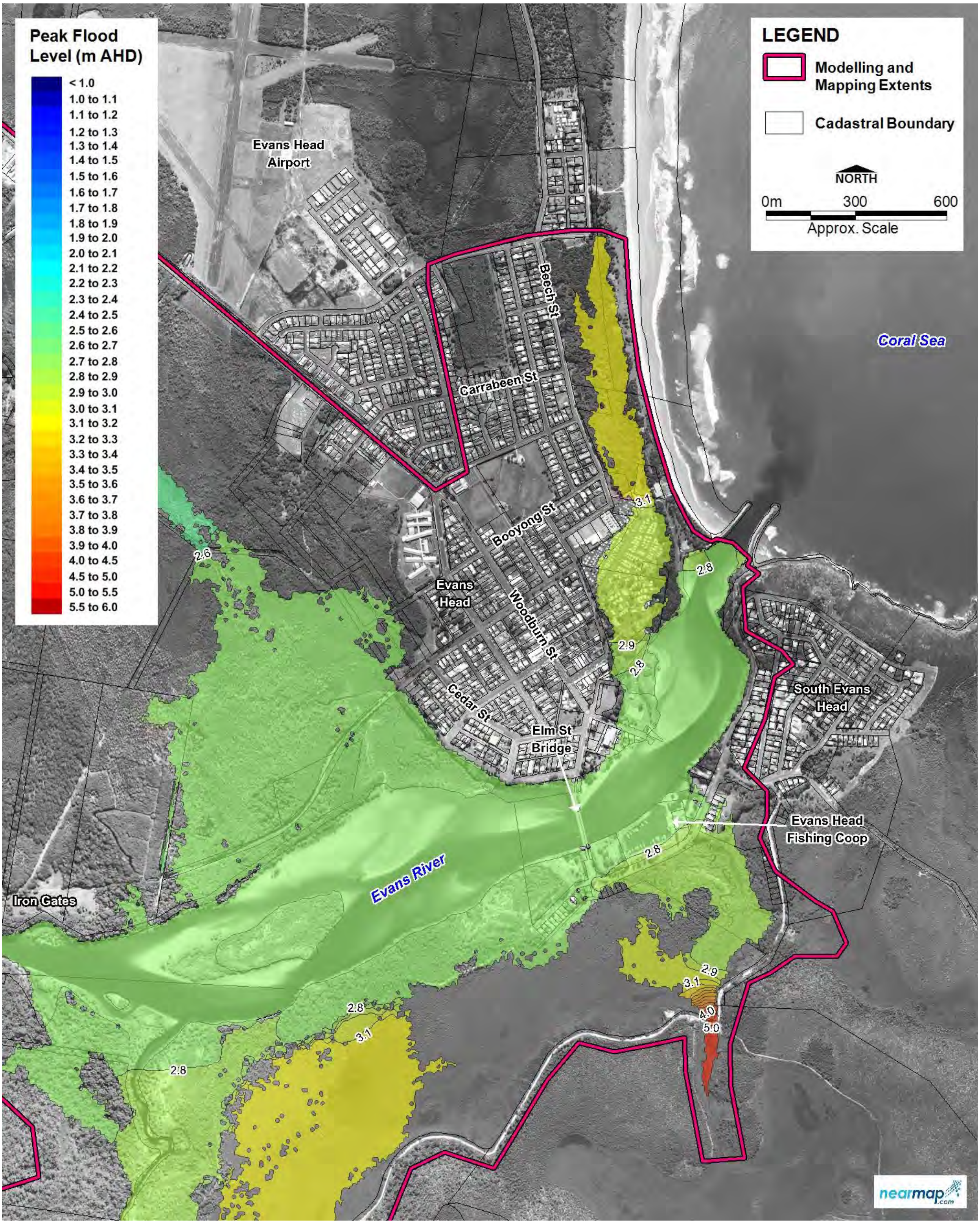


Figure 6-17 50 year ARI Levels Climate Change Assessment – Evans Head

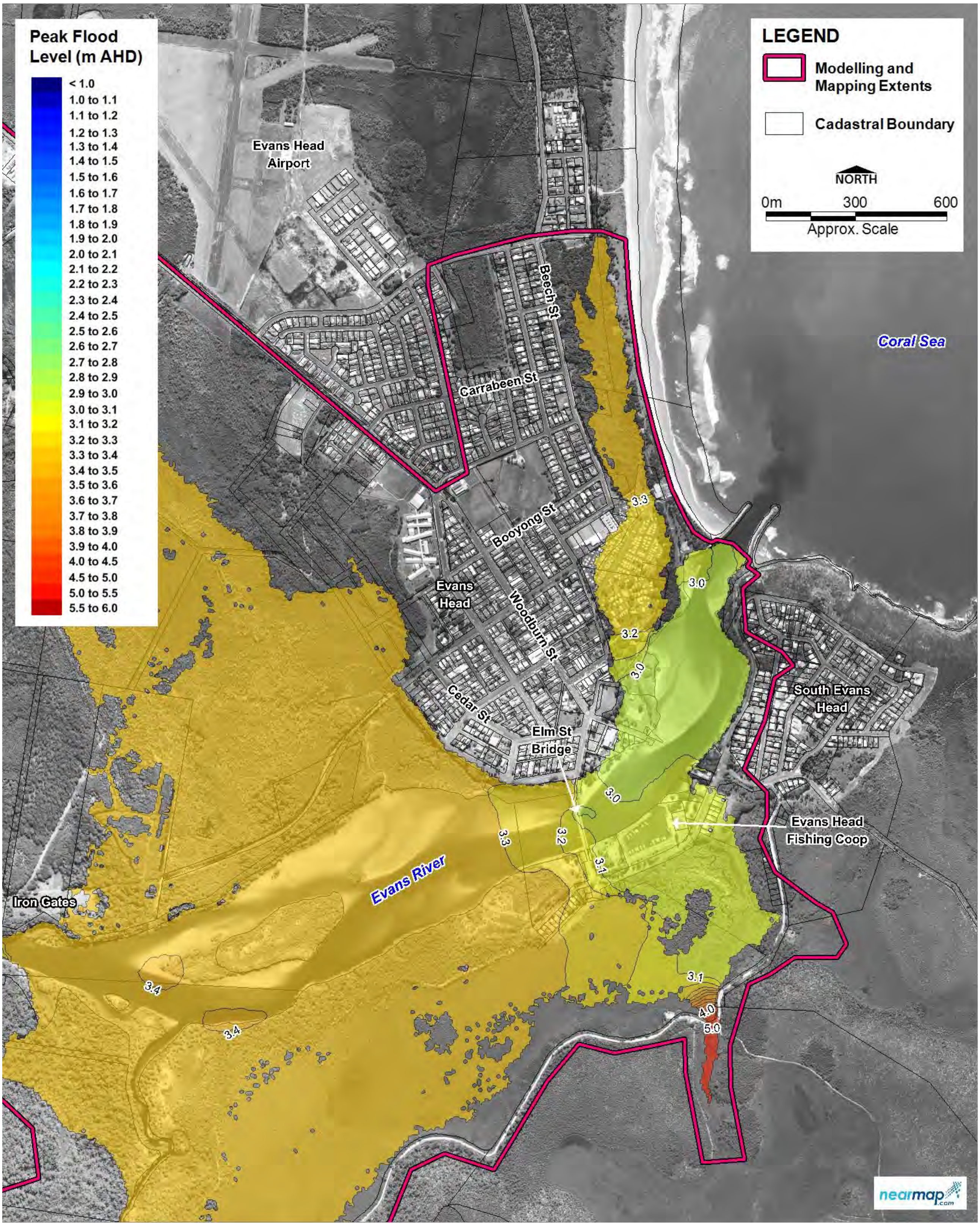


Figure 6-18 500 year ARI Levels Climate Change Assessment – Evans Head

## 6.6 Additional Assessments

### 6.6.1 Travel Time Assessment

In order to assess the travel time of the peak flood as it passes along Evans River it was necessary to remove the time varying tidal boundary component and replace it with a static boundary level set to 0m AHD. In this way the signal of the flood wave was clearly distinguishable at the downstream end of the model where the tidal signal dominates. A map showing the resulting 100 year ARI peak levels along with indicative travel times along the Evans River is presented in Figure 6-20. It can be seen that total travel time from the Tuckombil Weir to Evans Head is approximately 5 hours. It should be noted that flooding at Evans Head will only occur on the high tides, with flood waters subsiding during the low tide, before rising again with the next high tide. Therefore, the 5 hour travel time of the flood from the Tuckombil Weir will actually depend upon the tide at the time of the flood.

### 6.6.2 Floodplain Constrictions

A long section plot of the 100 year ARI flood event without the tidal component is presented in Figure 6-19. The tidal component was removed so that the plot clearly shows the influence of any floodplain constrictions on the propagation of the riverine flood. It can be seen from Figure 6-19 that two major constrictions are present which affect peak flood levels during riverine flood events; Iron Gates and the Breakwater. By comparison Elm Street Bridge is a relatively minor constriction.

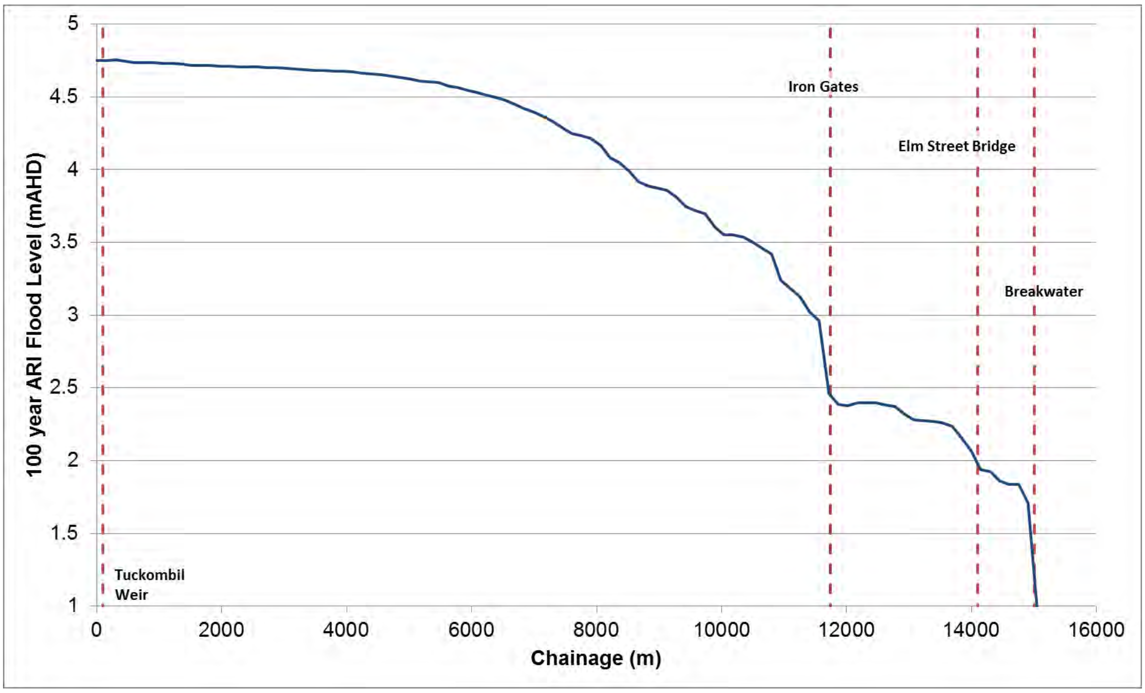


Figure 6-19 100 year ARI Long Section Plot

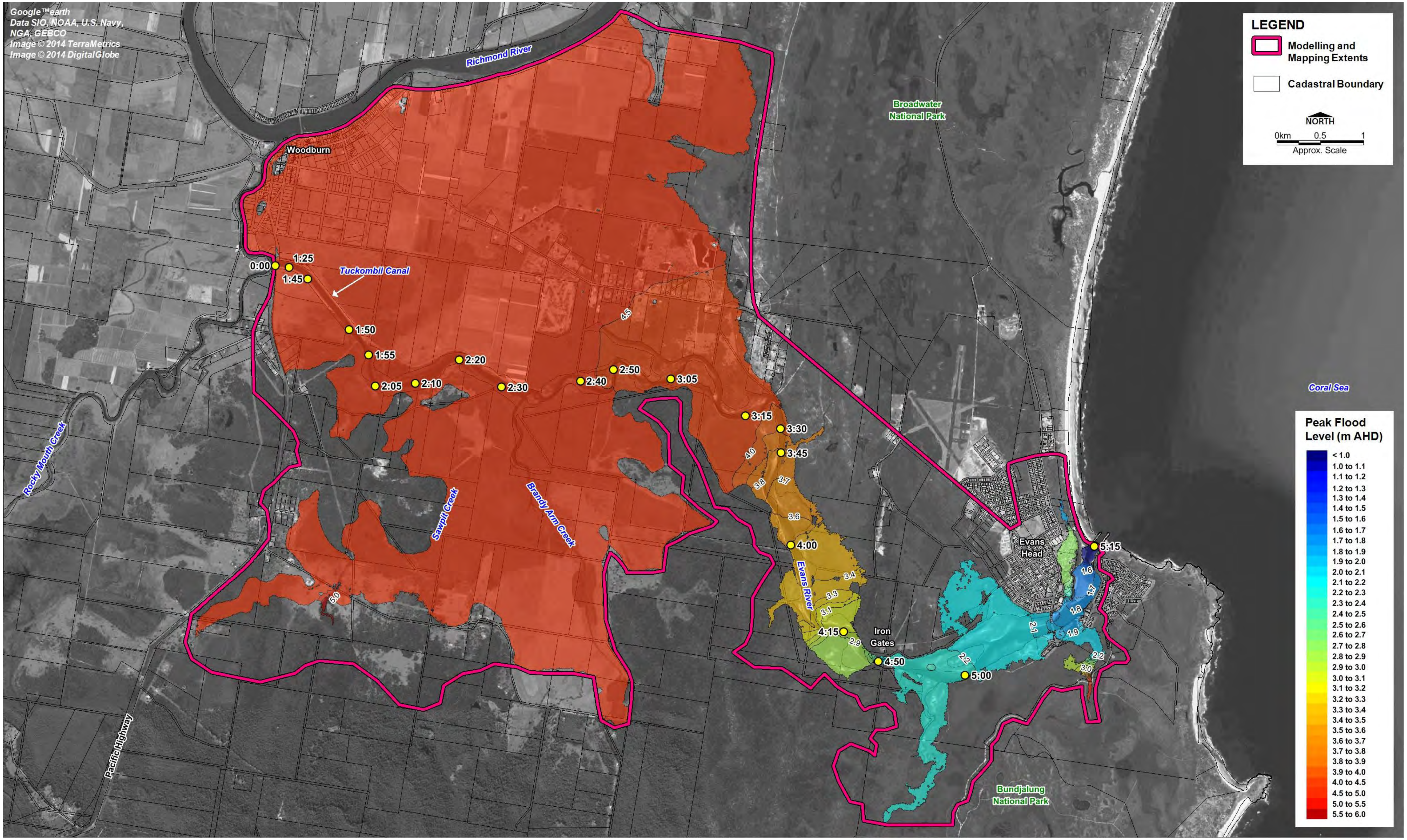


**Figure 6-20 100 year Approximate Travel Times along the Evans River**

### 6.6.3 Local Runoff Event

A 100 year ARI local runoff event was assessed to determine whether a short, intense burst of rainfall could, in places, result in higher flood levels than the modelled design events. This local event was modelled with a particular focus on the unnamed drainage channel within Evans Head that flows through the holiday park. A king tide event was simulated to occurred at the same time as a 100 year ARI 3 hour storm event. At all places except for the headwaters of tributaries joining Evans River, it was predicted that peak flood levels were lower than for the design events used in this study (100 year ARI, 72 hour storm). For these reasons a map of the local flood event has not been prepared.

### 6.6.4 Sensitivity of Tuckombil Weir Elevation

The Tuckombil weir is set to a fixed elevation of 0.94m AHD. A sensitivity assessment was undertaken to assess the impact on drainage times (upstream of the weir) if the weir was lowered by 0.2m to an elevation of 0.74m AHD. The RRFMS model was used for this assessment as the upstream boundary of the Evans River model was too close to the weir to permit a valid sensitivity assessment in that model.

Figure 6-21 shows the effect of changing the weir elevation on drainage times for the 20 year ARI event. The hydrograph is plotted at Rocky Mouth Creek immediately upstream of Tuckombil Canal. It can be seen that the changes in flood level and therefore drainage times are negligible and that during flood events the 0.2m height change in the weir level is insignificant.

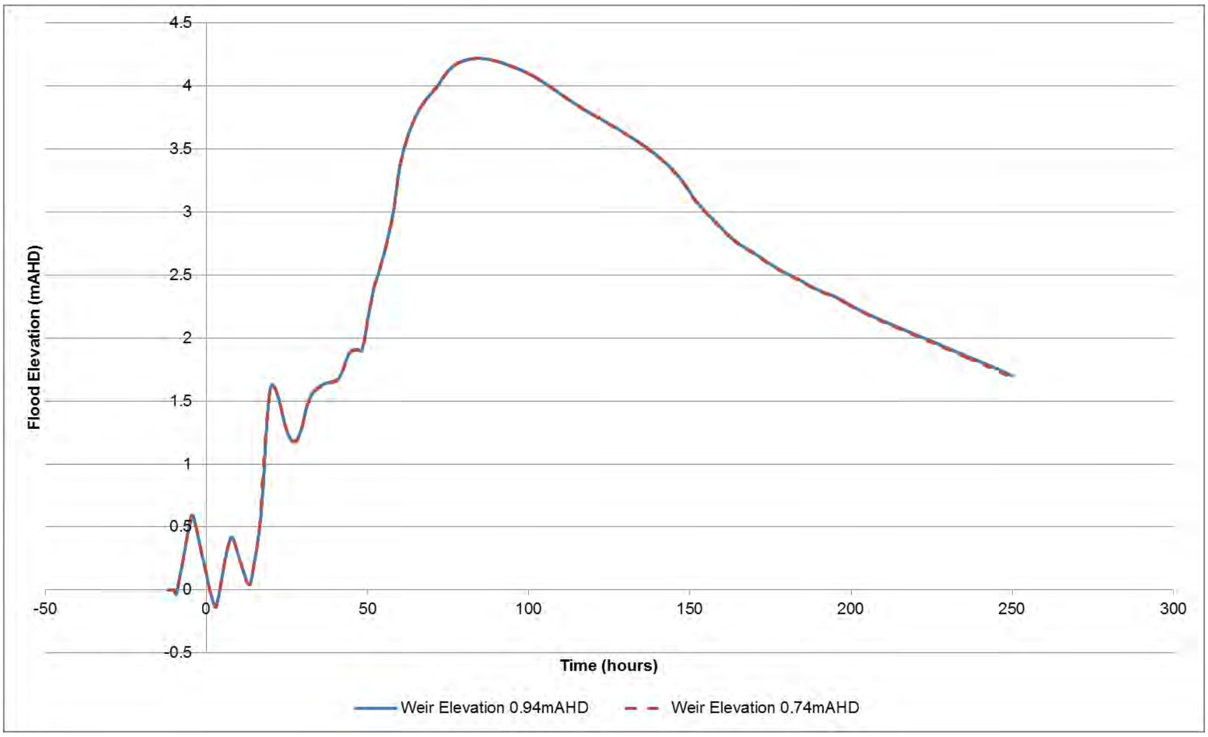


**Figure 6-21 Evans River Sensitivity to Weir Height (20 year ARI)**

# 7 Conclusions

The following key conclusions have been made from this study:

- The dominant source of flooding to the upper Evans River (Tuckombil area) is from overflows from the Richmond River.
- At Evans Head the main flood risk is from storm surge. However, much of Evans Head is at elevations sufficient to be above the 100 year ARI storm surge level.
- Peak 100 year ARI flood elevations at Evans Head typically range between 2.0m AHD and 2.3m AHD.
- Silver Sands Holiday Park within Evans Head and low lying parts of South Evans Head along Ocean Drive and Bundjalung Road are at risk from flooding in a 100 year ARI event.
- A climate change assessment was undertaken with a 10% increase in rainfall intensity and a 0.9m rise in sea level. This showed that whilst flood depths increased significantly in the Evans River, the overall 100 year ARI flood extent within Evans Head did not notably change with the exception of some additional inundation along Ocean Drive and Bundjalung Road.
- A local, short duration, high intensity rainfall event across the Evans River does not result in higher flood levels than for when a Richmond River event passes through the Evans River catchment.
- The approximate travel time of a significant flood peak (100 year ARI event) between the Tuckombil Weir and Evans Head is around 5 hours.
- A sensitivity assessment of lowering the Tuckombil Weir level from 0.94m AHD to 0.74m AHD showed that the change in elevation was insignificant on the flooding response of the river for the 20 year ARI event.

# Appendix A Model and Results Files

The supplied DVD contains TUFLOW model files and max asc grid result files for the 20, 50, 100 and 500 year ARI design flood events. Climate change models and results are also included.

| | |
|---|---|
| BMT WBM Bangalow | 6/20 Byron Street, Bangalow 2479<br>Tel +61 2 6687 0466 Fax +61 2 66870422<br>Email bmtwbm@bmtwbm.com.au<br>Web www.bmtwbm.com.au |
| BMT WBM Brisbane | Level 8, 200 Creek Street, Brisbane 4000<br>PO Box 203, Spring Hill QLD 4004<br>Tel +61 7 3831 6744 Fax +61 7 3832 3627<br>Email bmtwbm@bmtwbm.com.au<br>Web www.bmtwbm.com.au |
| BMT WBM Denver | 8200 S. Akron Street, #B120<br>Centennial, Denver Colorado 80112 USA<br>Tel +1 303 792 9814 Fax +1 303 792 9742<br>Email denver@bmtwbm.com<br>Web www.bmtwbm.com |
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| BMT WBM Mackay | Suite 1, 138 Wood Street, Mackay 4740<br>PO Box 4447, Mackay QLD 4740<br>Tel +61 7 4953 5144 Fax +61 7 4953 5132<br>Email mackay@bmtwbm.com.au<br>Web www.bmtwbm.com.au |
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Our Ref: : L.B19079.012_Iron_Gates.docx

22 August 2014

Gold Coral Pty Ltd
c/o Planit Consulting
Level 2, 11-13 Pearl Street
Kingscliff
NSW 2487

Attention: Adam Smith

Dear Adam

**RE: ASSESSMENT OF LOCAL RUNOFF FOR THE IRON GATES DEVELOPMENT**

This letter has been prepared at the request of Planit Consulting, acting on behalf of Gold Coral Pty Ltd, to assess the impact of runoff from the proposed Iron Gates development site. The main focus of this assessment is whether on-site detention of runoff is required to protect downstream properties.

## Background of Flood Modelling

In 2010, BMT WBM prepared the *Richmond River Flood Mapping Study* (RRFMS) for Richmond Valley Council and Richmond River County Council. A major component of that study was the preparation of regional hydrologic and hydraulic models. In 2012, on behalf of the Ingles Group, BMT WBM extended the RRFMS flood model down the Evans River to the river mouth at Evans Head. The purpose of that assessment was to assess the flood risk for the Iron Gates development as well as any potential flood impact. In 2014, BMT WBM prepared the *Evans River Flood Study* (ERFS) for Richmond River County Council. For that study, a new flood model of the Evans River was prepared, incorporating more recent topographic survey than used in the RRFMS. The new Evans River model was higher resolution than any previous modelling, and represented the Evans River system using a two-dimensional grid[1].

Peak flood levels adjacent to the Iron Gates development site are consistent between the 2012 flood assessment and the recent Evans River Flood Study. Peak 100 year ARI flood levels are shown in Table 1, together with the corresponding climate change scenario flood levels.

**Table 1 100 year ARI flood levels at the Iron Gates site**

| | 100 Year ARI Flood Level | 100 Year ARI Flood Level including Climate Change |
|---|---|---|
| **Iron Gates Flood Assessment (2012)** | 2.5m AHD | 3.0m AHD |
| **Evans River Flood Study (2014)** | 2.5m AHD | 3.1m AHD |

[1] The RRFMS flood model used a 1D representation of the Evans River past Iron Gates, whereas the 2012 Iron Gates Flood Assessment model used an integrated 1D/2D approach.

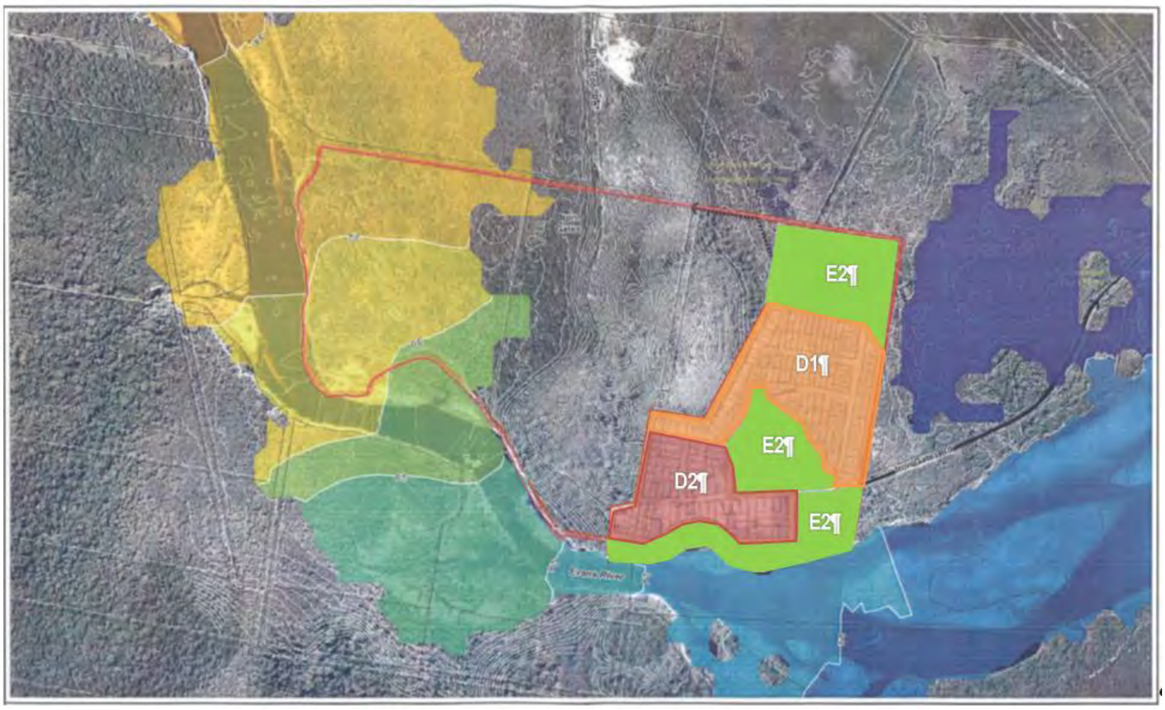


**Figure 1 Proposed Iron Gates development site**

Of relevance to this assessment, the following conclusions are listed in the ERFS report (ref. R.B2500.001.02.Main_Report):

- *At Evans Head the main flood risk is from storm surge. However, much of Evans Head is at elevations sufficient to be above the 100 year ARI storm surge level.*
- *A climate change assessment was undertaken with a 10% increase in rainfall intensity and a 0.9m rise in sea level. This showed that whilst flood depths increased significantly in the Evans River, the overall 100 year ARI flood extent within Evans Head did not notably change with the exception of some additional inundation along Ocean Drive and Bundjalung Road.*
- *A local, short duration, high intensity rainfall event across the Evans River does not result in higher flood levels than for when a Richmond River event passes through the Evans River catchment.*
- *The approximate travel time of a significant flood peak (100 year ARI event) between the Tuckombil Weir and Evans Head is around 5 hours.*

For this assessment, three flood / runoff scenarios are discussed:

- Regional flooding from the Richmond River;
- Evans River catchment flooding; and
- Storm surge.

**Regional Flooding from the Richmond River**

During significant flood events, floodwaters in the Richmond River and Rocky Mouth Creek overtop the Tuckombil Canal and enter the Evans River. This mechanism of flooding poses the greatest risk to the Evans River catchment, in terms of peak flood levels and flows. Typically, the response time of the Richmond River at the Tuckombil Canal is greater than 2 days, meaning that flooding in the Mid-Richmond area will typically occur days after the main rainfall. The critical duration assessment of the Richmond River also shows the highest flood levels at the Tuckombil Canal to be the 72 hour design event. As shown during previous studies, whilst these floods pose the greatest risk to the Evans River catchment, peak 100 year ARI flood levels are still below the ground elevation of the development site.

Shown in Figure 1 is the flood hydrograph (flood level vs time) in the Evans River adjacent to the site, resulting from a 100 year ARI 72 hour duration Richmond River Flood (blue line). The hydrograph shows the peak occurring at 91 hours simulation time, with a smaller peak occurring on the high tide the day before at 67 hours simulation time. The local runoff from the sub-catchment incorporating the Iron Gates development is shown as the red line. The primary point of interest from this figure is the correlation between the two time series. As runoff from the local catchments enters the Evans River, there is a series of minor rises in river level. The peaks shown at 5, 17, 29, 42, 55 hours simulation time, are actually a result of the storm surge, rather than the local runoff. However, the magnitude of the peaks is determined by the volume of water in the system due to local runoff. This can be seen by looking at the low tides between these peaks, where the peak flood level remains above 0.6m AHD following the start of the storm. The local runoff is generally drained with each falling tide, always resulting in the low tide flood level being below 1.0m AHD.

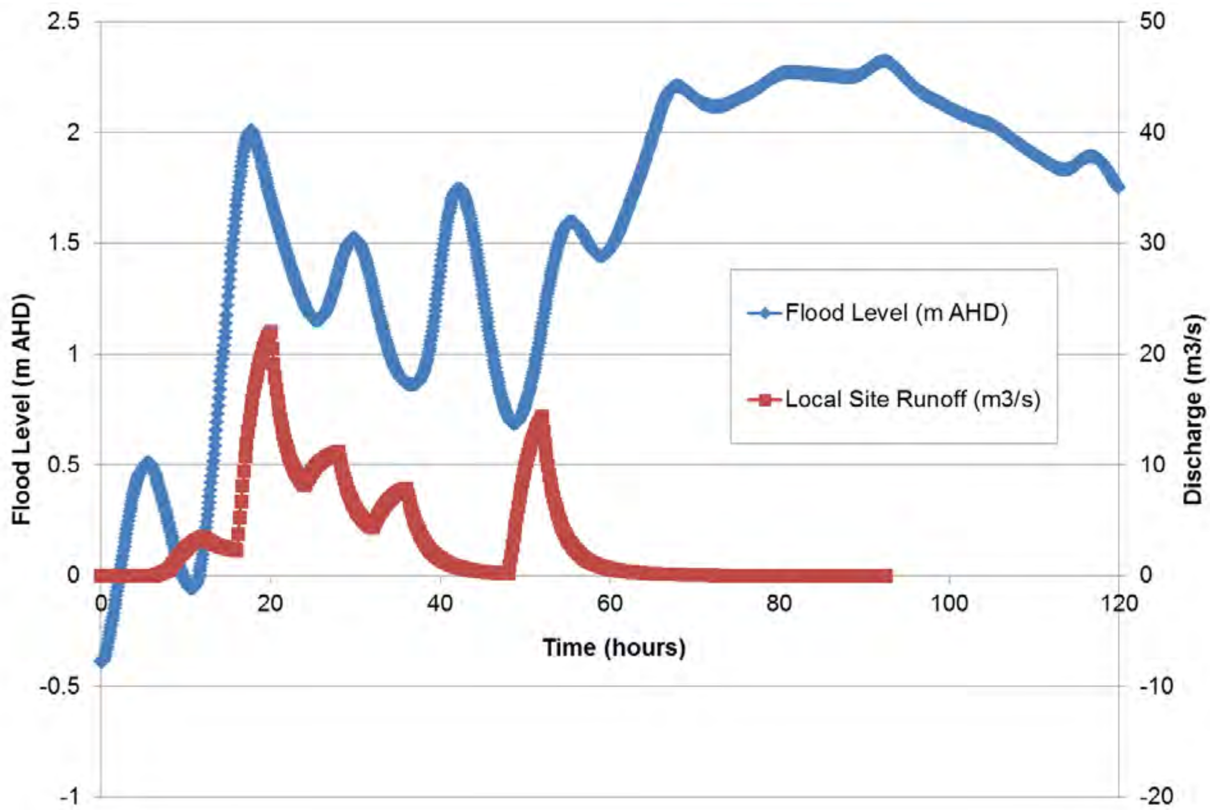


**Figure 2 Richmond River and Local Catchment runoff timing**

Following the local catchment runoff, the Tuckombil Canal overtops and the Richmond River flood flushes through the Evans River system. This can be seen on Figure 1 by the major flood levels occurring after 60 hours simulation time. During the Richmond River flush, flood levels remain above 1.5m for nearly 3 days. During this time, whilst the tide is having an influence on the discharge from the system, it is not having a significant effect on flood levels.

In order to minimise the peak flood levels, it is important to allow as much of the local runoff to drain from the Evans River system prior to the Richmond River flood flushing through.

**Evans River Catchment Flooding**

Flooding from the Evans River catchment follows the same trend, albeit on shorter timescale and with lower flood levels. The local catchment runoff enters the Evans River and drains with the next receding tide. This is then followed by the Upper Evans River catchment runoff flowing along the Evans River through the Iron Gates.

**Storm Surge Flooding**

Storm surge has been incorporated into the various modelling simulations undertaken for all flood assessments on the Evans River. Storm surge in isolation from rainfall does not pose a risk to the development site. The various simulations undertaken have included storm surge both with and without an allowance for sea level rise. The presence of storm surge at the tidal boundary does not influence the relative timings of the local catchment runoff, Evans River catchment runoff and the Richmond River runoff.

**Development Scenarios**

The following development scenarios have been considered in terms of their effect on peak flows in the Evans River.

- Entire site development – Catchments D1 and D2 considered to be fully developed without detention basins and environmental areas E2, undeveloped
- Partial site development – Catchment D2 to detain flows to pre-development peak; Catchments D1 developed without detention basin and environmental areas E2 undeveloped.

The WBNM hydrologic model has been updated to include these development scenarios. The outcome from the assessment is that whilst there is an increase in local runoff from the development, in the context of the broader river system, these changes are not noticeable. The fully developed site results in a change to the local sub-catchment (draining western half of Evans Head and the low land to the east of the Iron Gates Ridge) of less than 5%. In terms of the Evans River catchment, this change is less than 0.3% of the area.

This minor change has no influence on peak discharge rates and peak flood levels in the Evans River.

**Concluding Remarks**

The use of on-site detention (OSD) to mitigate post development peak discharge to pre-development rates is well considered best management practice. However, in some scenarios, the application of OSD is counter-productive. In such cases, consideration must be given on a merit based approach, as recommended in the NSW Floodplain Development Manual.

The Iron Gates development is a good example for not using OSD to manage discharge rates. The proximity of the development to the river mouth means that the traditional ‘rapid disposal’ method is more applicable. By directly discharging runoff into the river, the water can be drained from the Evans River system with the receding tide. Most runoff will then be drained prior to the larger, regional flows passing through the Evans River, either from Upper Evans River catchment runoff or from Richmond River overflow.

Therefore, BMT WBM recommends against using OSD to delay the release of floodwaters from the proposed development site.

Should you wish to discuss the contents of this letter or require any additional information, please call the undersigned on 07 3831 6744.

**BMT WBM Pty Ltd**

**Ben Caddis**

**Associate**
**Senior Flood Engineer**

# APPENDIX D

## GEOTECHNICAL INVESTIGATION RESULTS

Geotech INVESTIGATIONS PTY LTD

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Our Ref: JW:jw: GI 2039-a
2 June 2015

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PO Box 3441
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P1**

| | | |
|---|---|---|
| Location | N: 6778265 E: 540560 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, grey brown<br>0.5 m (SP) SAND: Fine sand, dry, pale grey<br>2.2 m (SP) SAND: Fine sand, wet, pale grey<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 2.2 m BSL | |
| Field Test Results | $K_{sat}$ = 13.7 m/day = 572 mm/hr | K = 1.6 x $10^{-4}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P2**

| | | |
|---|---|---|
| Location | N: 6778474 E: 540581 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, grey brown<br>0.5 m (SP) SAND: Fine sand, moist, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, moist, dark brown<br>1.6 m (SP) SAND: Trace silt, fine sand, moist, dark grey<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | Not identified | |
| Field Test Results | $K_{sat}$ = 89.5 m/day = 3728 mm/hr | K = 1 x $10^{-3}$ m/s |
| Test Hole Depth | 0.6 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P3**

| | | |
|---|---|---|
| Location | N: 6778597 E: 540503 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: With silt, fine sand, moist, grey<br>0.3 m (SM) Silty SAND: Fine sand, moist, dark brown<br>0.6 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.6 m BSL | |
| Field Test Results | $K_{sat}$ = 16.8 m/day = 698 mm/hr | K = 1.9 x $10^{-4}$ m/s |
| Test Hole Depth | 0.17 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P4**

| | | |
|---|---|---|
| Location | N: 6778425 E: 540493 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine to medium sand, moist, dark brown<br>0.7 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.7 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>2.0 m (SP) SAND: Trace silt, fine sand, wet, grey brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 1.7 m BSL | |
| Field Test Results | $K_{sat}$ = 27.0 m/day = 1128 mm/hr | K = 3.1 x $10^{-4}$ m/s |
| Test Hole Depth | 0.77 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P5**

| | | |
|---|---|---|
| Location | N: 6778333 E: 540483 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, dark brown<br>0.6 m (SP) SAND: Trace silt, fine sand, dry, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, moist to wet, pale grey<br>2.4 m (SP) SAND: Trace silt, fine sand, wet, grey brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 1.5 m BSL | |
| Field Test Results | $K_{sat}$ = 4.2 m/day = 176 mm/hr | K = 4.9 x $10^{-5}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P6**

| | | |
|---|---|---|
| Location | N: 6778091 E: 540285 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, dark grey<br>0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>0.8 m (SM) Silty SAND: Fine sand, moist, dark orange brown<br>1.2 m (SM) Silty SAND: Fine sand, moist, grey brown mottled orange brown<br>2.7 m (SM) Silty SAND: Fine sand, wet, grey brown mottled orange brown<br>T.D. 3 m | |
| Water Table | 2.7 m BSL | |
| Field Test Results | $K_{sat}$ = 2.2 m/day = 91 mm/hr | K = 2.5 x $10^{-5}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'well drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P7**

| | | |
|---|---|---|
| Location | N: 6778447 E: 540402 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: With silt, fine to medium sand, moist, grey brown<br>0.2 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>0.7 m (SM) Silty SAND: Trace clay, fine sand, wet, orange brown<br>1.1 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.7 m BSL | |
| Field Test Results | $K_{sat}$ = 7.2 m/day = 300 mm/hr | K = 8.3 x $10^{-5}$ m/s |
| Test Hole Depth | 0.87 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P8**

| | | |
|---|---|---|
| Location | N: 6778560 E: 540397 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: Trace silt, fine sand, moist, brown<br>0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.2 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>1.4 m (SM) Silty SAND: Fine sand, wet, dark brown<br>1.9 m (SP) SAND: Trace silt, fine sand, wet, dark grey / brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.6 m BSL | |
| Field Test Results | $K_{sat}$ = 2.6 m/day = 109 mm/hr | K = 3.0 x $10^{-5}$ m/s |
| Test Hole Depth | 0.07 m BSL | |
| Indicative Drainage Class | 'well drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P9**

| | | |
|---|---|---|
| Location | N: 6778502 E: 540329 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine to medium sand, moist, dark grey<br>0.5 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.8 m (SM) Silty SAND: With clay, fine sand, wet, dark brown<br>2.0 m (SM) Silty SAND: Fine sand, wet, dark brown mottled orange brown<br>2.5 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.5 m BSL | |
| Field Test Results | $K_{sat}$ = 18.6 m/day = 775 mm/hr | K = 2.2 x $10^{-4}$ m/s |
| Test Hole Depth | 0.07 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

# PLAN OF SUBDIVISION

IRON GATES, EVANS HEAD

| LOT | AREA | LOT | AREA | LOT | AREA |
|---|---|---|---|---|---|
| 01 | 958.54m² | 74 | 601.67m² | 147 | 623.04m² |
| 02 | 609.58m² | 75 | 602.27m² | 148 | 623.04m² |
| 03 | 610.02m² | 76 | 602.86m² | 149 | 623.04m² |
| 04 | 610.48m² | 77 | 611.90m² | 150 | 623.04m² |
| 05 | 610.80m² | 78 | 601.02m² | 151 | 623.04m² |
| 06 | 611.13m² | 79 | 645.62m² | 152 | 701.77m² |
| 07 | 611.45m² | 80 | 642.13m² | 153 | 703.42m² |
| 08 | 611.78m² | 81 | 602.42m² | 154 | 611.15m² |
| 09 | 612.10m² | 82 | 602.31m² | 155 | 611.15m² |
| 10 | 612.43m² | 83 | 602.20m² | 156 | 611.15m² |
| 11 | 612.75m² | 84 | 854.34m² | 157 | 611.15m² |
| 12 | 612.98m² | 85 | 854.15m² | 158 | 611.15m² |
| 13 | 611.49m² | 86 | 601.23m² | 159 | 611.29m² |
| 14 | 613.85m² | 87 | 601.27m² | 160 | 720.75m² |
| 15 | 614.18m² | 88 | 951.69m² | 161 | 753.34m² |
| 16 | 614.50m² | 89 | 794.12m² | 162 | 633.95m² |
| 17 | 614.82m² | 90 | 601.19m² | 163 | 602.77m² |
| 18 | 615.14m² | 91 | 601.15m² | 164 | 707.28m² |
| 19 | 615.47m² | 92 | 601.11m² | 165 | 649.98m² |
| 20 | 615.80m² | 93 | 601.06m² | 166 | 661.66m² |
| 21 | 653.44m² | 94 | 601.03m² | 167 | 686.92m² |
| 22 | 639.06m² | 95 | 600.07m² | 168 | 640.98m² |
| 23 | 600.87m² | 96 | 665.25m² | 169 | 621.28m² |
| 24 | 601.48m² | 97 | 617.23m² | 170 | 845.54m² |
| 25 | 601.78m² | 98 | 605.72m² | 171 | 829.97m² |
| 26 | 602.07m² | 99 | 609.16m² | 172 | 600.73m² |
| 27 | 602.37m² | 100 | 613.10m² | 173 | 600.73m² |
| 28 | 602.67m² | 101 | 606.61m² | 174 | 601.88m² |
| 29 | 602.97m² | 102 | 600.24m² | 175 | 600.94m² |
| 30 | 603.27m² | 103 | 600.05m² | 176 | 618.69m² |
| 31 | 603.56m² | 104 | 603.86m² | | |
| 32 | 603.87m² | 105 | 606.12m² | | |
| 33 | 611.56m² | 106 | 604.88m² | | |
| 34 | 602.69m² | 107 | 644.68m² | | |
| 35 | 687.98m² | 108 | 604.83m² | | |
| 36 | 744.04m² | 109 | 603.24m² | | |
| 37 | 601.47m² | 110 | 608.18m² | | |
| 38 | 601.47m² | 111 | 606.58m² | | |
| 39 | 601.47m² | 112 | 608.28m² | | |
| 40 | 601.47m² | 113 | 736.06m² | | |
| 41 | 601.47m² | 114 | 720.51m² | | |
| 42 | 601.47m² | 115 | 1029.27m² | | |
| 43 | 601.47m² | 116 | 602.49m² | | |
| 44 | 601.47m² | 117 | 609.57m² | | |
| 45 | 601.47m² | 118 | 607.83m² | | |
| 46 | 601.84m² | 119 | 651.61m² | | |
| 47 | 600.97m² | 120 | 603.93m² | | |
| 48 | 602.78m² | 121 | 603.27m² | | |
| 49 | 601.06m² | 122 | 604.77m² | | |
| 50 | 600.70m² | 123 | 613.74m² | | |
| 51 | 604.45m² | 124 | 602.29m² | | |
| 52 | 604.30m² | 125 | 628.60m² | | |
| 53 | 604.17m² | 126 | 603.18m² | | |
| 54 | 604.11m² | 127 | 690.16m² | | |
| 55 | 603.12m² | 128 | 601.05m² | | |
| 56 | 601.74m² | 129 | 606.82m² | | |
| 57 | 600.79m² | 130 | 632.34m² | | |
| 58 | 833.34m² | 131 | 609.67m² | | |
| 59 | 783.87m² | 132 | 606.00m² | | |
| 60 | 674.25m² | 133 | 601.02m² | | |
| 61 | 612.30m² | 134 | 600.03m² | | |
| 62 | 605.75m² | 135 | 600.92m² | | |
| 63 | 604.82m² | 136 | 600.85m² | | |
| 64 | 603.90m² | 137 | 600.91m² | | |
| 65 | 602.98m² | 138 | 639.85m² | | |
| 66 | 602.05m² | 139 | 655.96m² | | |
| 67 | 601.13m² | 140 | 795.02m² | | |
| 68 | 600.20m² | 141 | 897.95m² | | |
| 69 | 603.67m² | 142 | 603.25m² | | |
| 70 | 620.23m² | 143 | 636.28m² | | |
| 71 | 603.10m² | 144 | 722.96m² | | |
| 72 | 600.46m² | 145 | 620.19m² | | |
| 73 | 601.06m² | 146 | 623.04m² | | |


PLANIT CONSULTING

**PROJECT TITLE:** IRON GATES DEVELOPMENT, EVANS HEAD

**DRAWING TITLE:** PLAN OF SUBDIVISION - OPTION 7

**BASE PROVIDED BY:** N/A

**CLIENT:** GOLD CORAL

| NO | DATE | REVISION | BY |
|---|---|---|---|
| - | - | - | - |

**SCALE:** 1/1500 @ A1

**DESIGN:** PLANIT CONSULTING

**DRAWN:** ZP

**DATE:** 03/2015

**CHECKED:** AS

**DRAWING NO:** IRONGATES_PLNOFSUB_01

**NORTH POINT:**

**SHEET NO:** 01 OF 01


Level 1 2247 Gold Coast Hwy
Nobby Beach
PO Box 206 QLD 4218
Telephone: 07 5526 1500
Fax: 07 5526 1502
Email: admin@planitconsulting.com.au

# APPENDIX E

## ADDITIONAL RFI – RESPONSE 11/05/2016

Graeme Ingles
Gold Coral c/- Ingles Group Pty Ltd
Po Box 558
Surfers Paradise QLD 4271

Arcadis Australia Pacific Pty Ltd
Level 7, Premion Place
Cnr Queen & High Streets
PO Box 1653
SOUTHPORT QLD 4215
Tel No: +61 7 5532 3933
Fax No: +61 7 5591 4778
arcadis.com

11/05/2016

**Iron Gates Residential Subdivision – Response to Richmond Valley Council Request for Further Information**

**A0002-AA007094-AAL-01**

Dear Graeme

We refer to the Information Request issued by Richmond Valley Council and the Office of Environment & Heritage for the abovementioned development on 1st of March 2016 reference DA2015/096 –SMc:SL and our subsequent fee. In accordance with our approved scope of works, this is our response (in orange font) to the request for information items (in black font) for your inclusion in the collated response to Council.

1. Section 3.2; The 6.25 metre retaining wall is considered visually excessive. Council requires a stepped embankment be provided. Please provide a revised design detail for this request.

   Arcadis understands that the proposed wall could be considered visually excessive however in order to minimize the visual impact and use the wall as a feature, the development is proposing to create a green wall.

   Figure 1 to 3 below show an example of the proposed treatment.

*Figure 1- Retaining Wall without Vegetation*

*Figure 2- Example 1 of Green Wall*

*Figure 3- Example 2 of Green Wall*

The open web construction and use of free draining material eliminates two common causes of failure in retaining walls — namely build-up of hydrostatic pressure and the destructive pressure of tree root systems.

The high quality precast concrete components provide for long-term durability and will not rot or warp.

Concrete crib walls are specifically designed to allow speed and ease of construction for minimum cost and require little or no maintenance. The standard, quality components allow for the most economical solutions for various wall heights.

A Concrib crib wall can be planted with flowers, shrubs, or creepers, using the spaces in the face of the wall. This allows the wall to blend in with any existing or proposed environment. Is it possible that we could “green” the wall with a variety of plants suitable for the Richmond Birdwing Butterfly.

To promote the Richmond Birdwing Butterfly the following plants are suggested:

> *Adult Richmond Birdwing butterflies will feed on nectar from flowers of many native plants, including native frangipani (Hymenosporum flavum), pavetta (Pavetta australiensis), black bean (Castanospermum australe) and lilly pillies (Syzygium species), as well as several exotic flowers, e.g. buddleia, pentas, honeysuckle, bougainvillea, impatiens and hibiscus. They prefer white and red blooms to other colours.*
>
> *The caterpillars (or larvae) only feed naturally on two species of vines – the lowland Richmond birdwing vine (Pararistolochia praevenosa) and the mountain aristolochia (Pararistolochia laheyana).*

These plants are proposed to be cultivated across the wall facing in order to assist in recovery of the breeding habitats for the butterfly.

Refer to Planit Drawing Iron Gates Cribb Wall Landscape Details. (attached).

2. To be noted: Plan C140 Rev 04. Ch 0 to 110 - MC1004 has a narrowing of the pavement to lessen the impact on environmental grounds with barriers and an elevated pedestrian platform. Plan C122 indicates retaining walls up to 1.5m with a pedestrian walkway on the side. -The width will need to be 2.5m wide to comply with cycleway standards and suitable balustrading to elevated walkways.

   Arcadis has amended Plan C140 to show a 2.5m wide pedestrian walkway to comply with Council’s cycleway standards. Suitable balustrading will be provided with details provided during Construction Certificate Application.

3. Section 4.2.6 At the latter stages of the development, where traffic volumes may exceed 500 AADT". Council has assessed the following traffic movements; 176 lots x say 6 movements per day = 1.056 vpd. The 1,056 is much greater than the standard that the road has been assessed at which is only 500vpd. Council request the road designs be reassessed to account for 1,056 vpd.

   The report entitled Iron Gates Residential Development Engineering Services and Civil Infrastructure Rev 06 dated 10/05/2016 has been amended to include discussion about Iron Gates Road estimated traffic volumes, proposed upgrade and timing. The existing road profile, which include a 6m and 1m shoulder, is able to support Stage 1 and a large portion of Stage 2 traffic when an upgrade is proposed to widen the pavement to an 8m full width seal. Refer Section 4.2.6 of the report for further details.

4. Section 9.2.2; please explain what is the comparison between the original ET loading that was the input for the dual rising main, and the proposed ET loading now by the proposed subdivision. Council needs to ensure the existing infrastructure is suitably sized for the proposed development.

   The report entitled Iron Gates Residential Development Engineering Services and Civil Infrastructure Rev 06 dated 10/05/2016 has been amended to make allowance for the existing lots, currently connected to the DN150 gravity sewer in Mangrove Street upstream of the existing EHPS-02 pump station. Please refer to attached sewer calculations and Section 9 of the report.

5. Section 7.2.3 Infiltration pits are 1m deep and almost 5m$^2$ . Council has concerns;
   - What are the risks to a saturated sub base for the roads?

   To avoid any risks of saturating road sub-base, all roads will be provided with subsurface drainage in accordance with The Northern River Council Specs.

   - Impact to/from driveways?

   Driveways will be coordinated during detailed design to avoid clashes with drainage system.

   - How is overflow from the pits to be managed without causing nuisance stormwater flows to adjoining land owners. Council preference is for the overflow to be discharged to street kerb or via Internal Allotment Drainage (IAD).

   Flows will be captured and conveyed to the infiltration system, with overflow being directed to the street kerb system. Refer figures 4 and 5 below shows a typical infiltration system details. It should also be noted that all proposed lots typically fall to the road with no inter allotment needed.

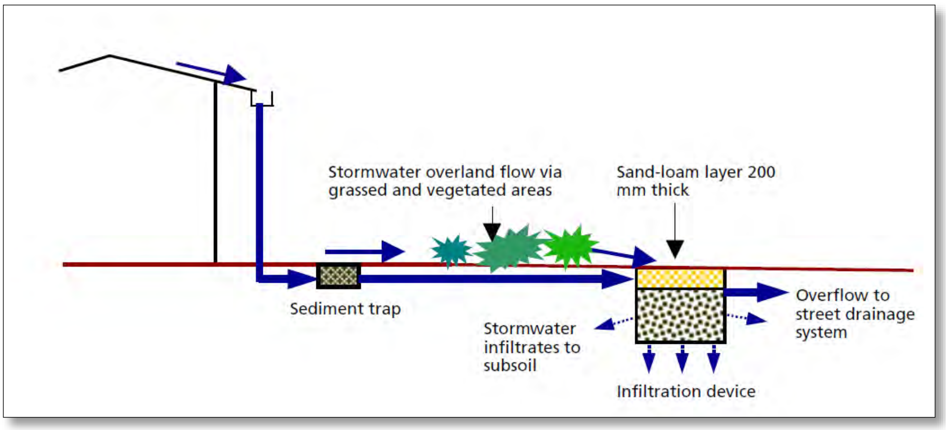



Figure 4- Typical Infiltration Strategy

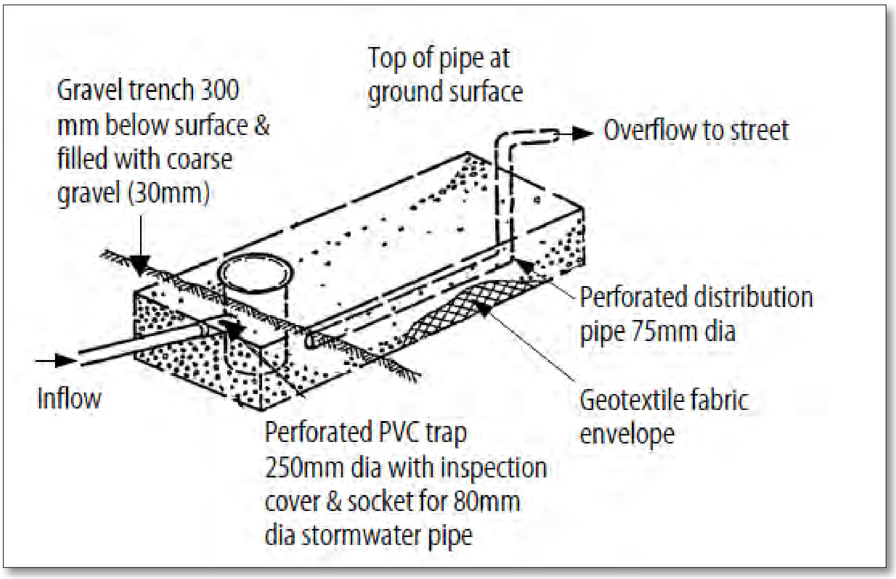



Figure 5- Infiltration System Details

- How are the pits be protected from future owners constructing over the pits or reducing the effectiveness of the pit. An easement on tittle may be an appropriate method to protect this infrastructure.

An easement for Stormwater will be provided over each device. This will be detailed during the detailed design phase of the project.

Yours sincerely

Darlan Castro
Senior Engineers
(07) 5503 4822

Enc. Planit Cribb Wall Landscape Details
Sewer Calculations
Iron Gates Residential Development Engineering
Services and Civil Infrastructure Rev 06 dated
10/05/2016

CC. Gold Coral Pty Ltd
CC. Planit Consulting

# APPENDIX F

## AMENDED SUBDIVSION PLANS

## Lot Table

| Lot | Area |
|---|---|
| 1 | 969 $m^2$ |
| 2 | 612 $m^2$ |
| 3 | 612 $m^2$ |
| 4 | 612 $m^2$ |
| 5 | 612 $m^2$ |
| 6 | 612 $m^2$ |
| 7 | 612 $m^2$ |
| 8 | 612 $m^2$ |
| 9 | 612 $m^2$ |
| 10 | 612 $m^2$ |
| 11 | 612 $m^2$ |
| 12 | 612 $m^2$ |
| 13 | 612 $m^2$ |
| 14 | 612 $m^2$ |
| 15 | 612 $m^2$ |
| 16 | 612 $m^2$ |
| 17 | 612 $m^2$ |
| 18 | 612 $m^2$ |
| 19 | 612 $m^2$ |
| 20 | 612 $m^2$ |
| 21 | 649 $m^2$ |
| 22 | 615 $m^2$ |
| 23 | 600 $m^2$ |
| 24 | 600 $m^2$ |
| 25 | 600 $m^2$ |
| 26 | 600 $m^2$ |
| 27 | 600 $m^2$ |
| 28 | 600 $m^2$ |
| 29 | 627 $m^2$ |
| 30 | 600 $m^2$ |
| 31 | 600 $m^2$ |
| 32 | 600 $m^2$ |
| 33 | 600 $m^2$ |
| 34 | 600 $m^2$ |
| 35 | 600 $m^2$ |
| 36 | 788 $m^2$ |
| 37 | 674 $m^2$ |
| 38 | 775 $m^2$ |
| 39 | 612 $m^2$ |
| 40 | 604 $m^2$ |
| 41 | 604 $m^2$ |
| 42 | 604 $m^2$ |
| 43 | 604 $m^2$ |
| 44 | 604 $m^2$ |
| 45 | 604 $m^2$ |
| 46 | 604 $m^2$ |
| 47 | 609 $m^2$ |
| 48 | 605 $m^2$ |
| 49 | 600 $m^2$ |
| 50 | 600 $m^2$ |
| 51 | 600 $m^2$ |
| 52 | 600 $m^2$ |
| 53 | 600 $m^2$ |
| 54 | 600 $m^2$ |
| 55 | 600 $m^2$ |
| 56 | 600 $m^2$ |
| 57 | 623 $m^2$ |
| 58 | 623 $m^2$ |
| 59 | 633 $m^2$ |
| 60 | 632 $m^2$ |
| 61 | 618 $m^2$ |
| 62 | 604 $m^2$ |
| 63 | 604 $m^2$ |
| 64 | 605 $m^2$ |
| 65 | 606 $m^2$ |
| 66 | 606 $m^2$ |
| 67 | 607 $m^2$ |
| 68 | 607 $m^2$ |
| 69 | 608 $m^2$ |
| 70 | 609 $m^2$ |

## Lot Table

| Lot | Area |
|---|---|
| 71 | 607 $m^2$ |
| 72 | 608 $m^2$ |
| 73 | 682 $m^2$ |
| 74 | 766 $m^2$ |
| 75 | 600 $m^2$ |
| 76 | 600 $m^2$ |
| 77 | 600 $m^2$ |
| 78 | 600 $m^2$ |
| 79 | 600 $m^2$ |
| 80 | 601 $m^2$ |
| 81 | 601 $m^2$ |
| 82 | 601 $m^2$ |
| 83 | 601 $m^2$ |
| 84 | 608 $m^2$ |
| 85 | 614 $m^2$ |
| 86 | 634 $m^2$ |
| 87 | 696 $m^2$ |
| 88 | 602 $m^2$ |
| 89 | 602 $m^2$ |
| 90 | 602 $m^2$ |
| 91 | 859 $m^2$ |
| 92 | 856 $m^2$ |
| 93 | 603 $m^2$ |
| 94 | 603 $m^2$ |
| 95 | 954 $m^2$ |
| 96 | 616 $m^2$ |
| 97 | 663 $m^2$ |
| 98 | 657 $m^2$ |
| 99 | 602 $m^2$ |
| 100 | 723 $m^2$ |
| 101 | 605 $m^2$ |
| 102 | 609 $m^2$ |
| 103 | 620 $m^2$ |
| 104 | 714 $m^2$ |
| 105 | 602 $m^2$ |
| 106 | 604 $m^2$ |
| 107 | 602 $m^2$ |
| 108 | 602 $m^2$ |
| 109 | 602 $m^2$ |
| 110 | 602 $m^2$ |
| 111 | 601 $m^2$ |
| 112 | 600 $m^2$ |
| 113 | 600 $m^2$ |
| 114 | 600 $m^2$ |
| 115 | 608 $m^2$ |
| 116 | 601 $m^2$ |
| 117 | 602 $m^2$ |
| 118 | 600 $m^2$ |
| 119 | 601 $m^2$ |
| 120 | 600 $m^2$ |
| 121 | 600 $m^2$ |
| 122 | 647 $m^2$ |
| 123 | 619 $m^2$ |
| 124 | 603 $m^2$ |
| 125 | 600 $m^2$ |
| 126 | 646 $m^2$ |
| 127 | 661 $m^2$ |
| 128 | 626 $m^2$ |
| 129 | 600 $m^2$ |
| 130 | 639 $m^2$ |
| 131 | 602 $m^2$ |
| 132 | 602 $m^2$ |
| 133 | 600 $m^2$ |
| 134 | 618 $m^2$ |
| 135 | 623 $m^2$ |
| 136 | 604 $m^2$ |
| 137 | 602 $m^2$ |
| 138 | 600 $m^2$ |
| 139 | 600 $m^2$ |
| 140 | 600 $m^2$ |

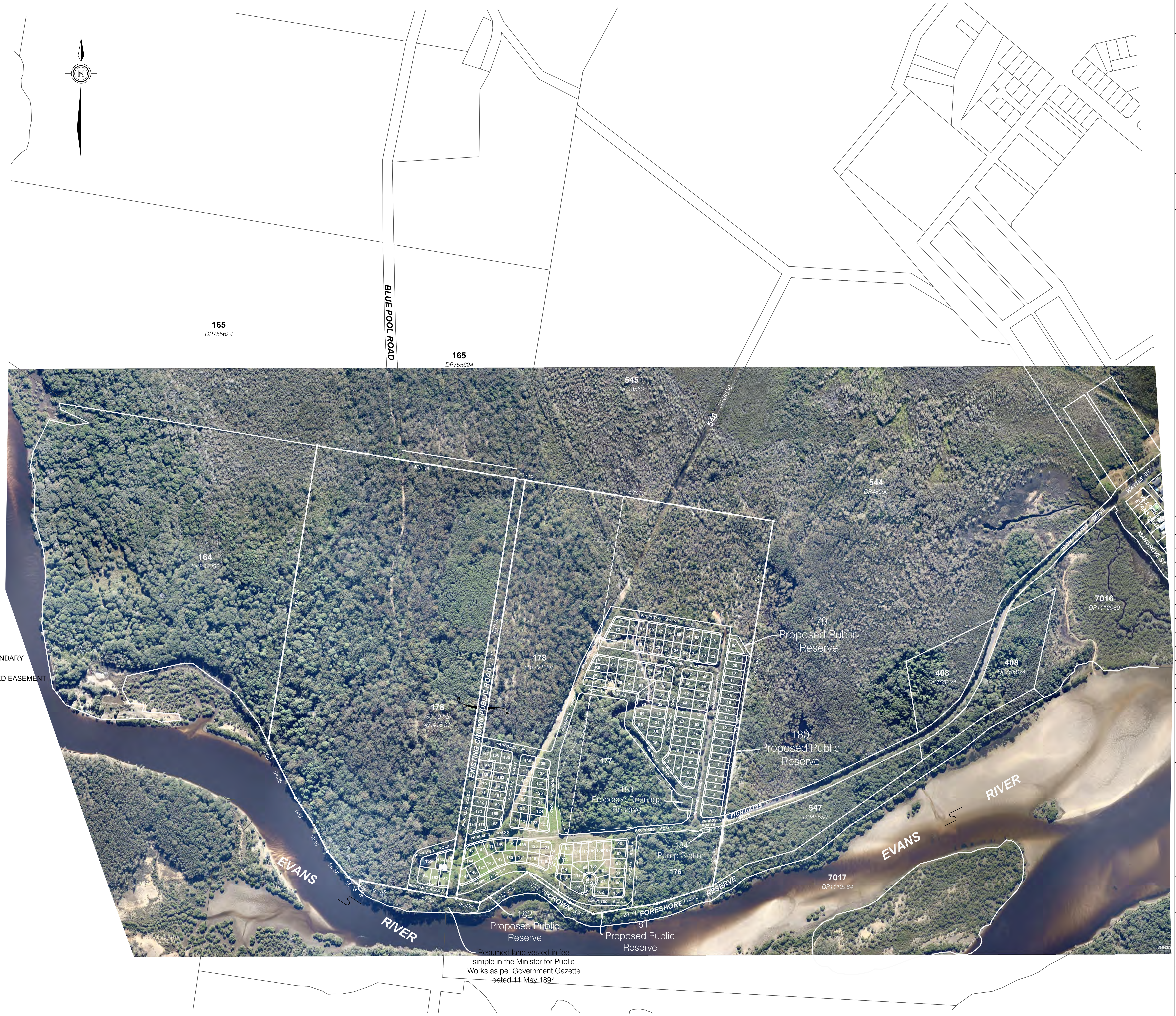
## Lot Table

| Lot | Area |
|---|---|
| 141 | 600 $m^2$ |
| 142 | 600 $m^2$ |
| 143 | 605 $m^2$ |
| 144 | 600 $m^2$ |
| 145 | 600 $m^2$ |
| 146 | 601 $m^2$ |
| 147 | 600 $m^2$ |
| 148 | 600 $m^2$ |
| 149 | 601 $m^2$ |
| 150 | 601 $m^2$ |
| 151 | 600 $m^2$ |
| 152 | 665 $m^2$ |
| 153 | 629 $m^2$ |
| 154 | 834 $m^2$ |
| 155 | 765 $m^2$ |
| 156 | 603 $m^2$ |
| 157 | 627 $m^2$ |
| 158 | 644 $m^2$ |
| 159 | 601 $m^2$ |
| 160 | 601 $m^2$ |
| 161 | 601 $m^2$ |
| 162 | 601 $m^2$ |
| 163 | 601 $m^2$ |
| 164 | 601 $m^2$ |
| 165 | 600 $m^2$ |
| 166 | 601 $m^2$ |
| 167 | 602 $m^2$ |
| 168 | 602 $m^2$ |
| 169 | 602 $m^2$ |
| 170 | 602 $m^2$ |
| 171 | 602 $m^2$ |
| 172 | 602 $m^2$ |
| 173 | 602 $m^2$ |
| 174 | 614 $m^2$ |
| 175 | 600 $m^2$ |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |

LEGEND:

SITE BOUNDARY

PROPOSED EASEMENT




CLIENT

# GOLDCORAL PTY LTD

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

(i) This plan was prepared for the purpose and exclusive use of THE INGLES GROUP to accompany an application to RICHMOND VALLEY for approval to reconfigure the land described in this plan and is not to be used for any other purpose or by any other person or corporation. LandPartners Pty Ltd accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention of the terms of this clause or clauses (ii) or (iii) hereof.

(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

Aerial Photography sourced from Nearmap 13-3-2019.
Date of photography - 03/07/2012

| LOTS | TOTAL AREA |
|---|---|
| Residential Lots (175) | 16.884ha |
| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

40m 0 80 200m

SCALE 1:4000 @ A1


LANDPARTNERS
built environment consultants

Brisbane Office
Level 1 - CDOP6
18 Little Cribb Street,
Milton Qld 4064
PO Box 1399
Milton Qld 4064

p: (07) 3842 1000
f: (07) 3842 1001
e: info@landpartners.com.au
w: www.landpartners.com.au


| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16-COPY |

| | | | |
|---|---|---|---|
| DRAWN | CGW | DATE | 27/06/2019 |
| CHECKED | CMJ | DATE | 27/06/2019 |
| APPROVED | CGW | DATE | 27/06/2019 |

PLAN NUMBER BRJD6396.100-013 SHEET 1 OF 2 REV H CGW

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

| Lot Table | |
|---|---|
| Lot | Area |
| 1 | 969 m² |
| 2 | 612 m² |
| 3 | 612 m² |
| 4 | 612 m² |
| 5 | 612 m² |
| 6 | 612 m² |
| 7 | 612 m² |
| 8 | 612 m² |
| 9 | 612 m² |
| 10 | 612 m² |
| 11 | 612 m² |
| 12 | 612 m² |
| 13 | 612 m² |
| 14 | 612 m² |
| 15 | 612 m² |
| 16 | 612 m² |
| 17 | 612 m² |
| 18 | 612 m² |
| 19 | 612 m² |
| 20 | 612 m² |
| 21 | 649 m² |
| 22 | 615 m² |
| 23 | 600 m² |
| 24 | 600 m² |
| 25 | 600 m² |
| 26 | 600 m² |
| 27 | 600 m² |
| 28 | 600 m² |
| 29 | 627 m² |
| 30 | 600 m² |
| 31 | 600 m² |
| 32 | 600 m² |
| 33 | 600 m² |
| 34 | 600 m² |
| 35 | 600 m² |
| 36 | 788 m² |
| 37 | 674 m² |
| 38 | 775 m² |
| 39 | 612 m² |
| 40 | 604 m² |
| 41 | 604 m² |
| 42 | 604 m² |
| 43 | 604 m² |
| 44 | 604 m² |
| 45 | 604 m² |
| 46 | 604 m² |
| 47 | 609 m² |
| 48 | 605 m² |
| 49 | 600 m² |
| 50 | 600 m² |
| 51 | 600 m² |
| 52 | 600 m² |
| 53 | 600 m² |
| 54 | 600 m² |
| 55 | 600 m² |
| 56 | 600 m² |
| 57 | 623 m² |
| 58 | 623 m² |
| 59 | 633 m² |
| 60 | 632 m² |
| 61 | 618 m² |
| 62 | 604 m² |
| 63 | 604 m² |
| 64 | 605 m² |
| 65 | 606 m² |
| 66 | 606 m² |
| 67 | 607 m² |
| 68 | 607 m² |
| 69 | 608 m² |
| 70 | 609 m² |

| Lot Table | |
|---|---|
| Lot | Area |
| 71 | 607 m² |
| 72 | 608 m² |
| 73 | 682 m² |
| 74 | 766 m² |
| 75 | 600 m² |
| 76 | 600 m² |
| 77 | 600 m² |
| 78 | 600 m² |
| 79 | 600 m² |
| 80 | 601 m² |
| 81 | 601 m² |
| 82 | 601 m² |
| 83 | 601 m² |
| 84 | 608 m² |
| 85 | 614 m² |
| 86 | 634 m² |
| 87 | 696 m² |
| 88 | 602 m² |
| 89 | 602 m² |
| 90 | 602 m² |
| 91 | 859 m² |
| 92 | 856 m² |
| 93 | 603 m² |
| 94 | 603 m² |
| 95 | 954 m² |
| 96 | 616 m² |
| 97 | 663 m² |
| 98 | 657 m² |
| 99 | 602 m² |
| 100 | 723 m² |
| 101 | 605 m² |
| 102 | 609 m² |
| 103 | 620 m² |
| 104 | 714 m² |
| 105 | 602 m² |
| 106 | 604 m² |
| 107 | 602 m² |
| 108 | 602 m² |
| 109 | 602 m² |
| 110 | 602 m² |
| 111 | 601 m² |
| 112 | 600 m² |
| 113 | 600 m² |
| 114 | 600 m² |
| 115 | 608 m² |
| 116 | 601 m² |
| 117 | 602 m² |
| 118 | 600 m² |
| 119 | 601 m² |
| 120 | 600 m² |
| 121 | 600 m² |
| 122 | 647 m² |
| 123 | 619 m² |
| 124 | 603 m² |
| 125 | 600 m² |
| 126 | 646 m² |
| 127 | 661 m² |
| 128 | 626 m² |
| 129 | 600 m² |
| 130 | 639 m² |
| 131 | 602 m² |
| 132 | 602 m² |
| 133 | 600 m² |
| 134 | 618 m² |
| 135 | 623 m² |
| 136 | 604 m² |
| 137 | 602 m² |
| 138 | 600 m² |
| 139 | 600 m² |
| 140 | 600 m² |

| Lot Table | |
|---|---|
| Lot | Area |
| 141 | 600 m² |
| 142 | 600 m² |
| 143 | 605 m² |
| 144 | 600 m² |
| 145 | 600 m² |
| 146 | 601 m² |
| 147 | 600 m² |
| 148 | 600 m² |
| 149 | 601 m² |
| 150 | 601 m² |
| 151 | 600 m² |
| 152 | 665 m² |
| 153 | 629 m² |
| 154 | 834 m² |
| 155 | 765 m² |
| 156 | 603 m² |
| 157 | 627 m² |
| 158 | 644 m² |
| 159 | 601 m² |
| 160 | 601 m² |
| 161 | 601 m² |
| 162 | 601 m² |
| 163 | 601 m² |
| 164 | 601 m² |
| 165 | 600 m² |
| 166 | 601 m² |
| 167 | 602 m² |
| 168 | 602 m² |
| 169 | 602 m² |
| 170 | 602 m² |
| 171 | 602 m² |
| 172 | 602 m² |
| 173 | 602 m² |
| 174 | 614 m² |
| 175 | 600 m² |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |


CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

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Aerial Photography sourced from Nearmap 13-3-2019.
Date of photography - 03/07/2012

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| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR
0 5 10 20 30 50 80m
SCALE 1:1250 @ A1

LANDPARTNERS built environment consultants

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f: (07) 3842 1001
e: info@landpartners.com.au
w: www.landpartners.com.au

ISO 9001 Quality Management

| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16-COPY |
| DRAWN CGW | DATE 27/06/2019 |
| CHECKED CMJ | DATE 27/06/2019 |
| APPROVED CGW | DATE 27/06/2019 |
| PLAN NUMBER SHEET 2 OF 2 BRJD6396.100-013 | REV H |

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

## Lot Table

| Lot | Area |
|---|---|
| 1 | 969 $m^2$ |
| 2 | 612 $m^2$ |
| 3 | 612 $m^2$ |
| 4 | 612 $m^2$ |
| 5 | 612 $m^2$ |
| 6 | 612 $m^2$ |
| 7 | 612 $m^2$ |
| 8 | 612 $m^2$ |
| 9 | 612 $m^2$ |
| 10 | 612 $m^2$ |
| 11 | 612 $m^2$ |
| 12 | 612 $m^2$ |
| 13 | 612 $m^2$ |
| 14 | 612 $m^2$ |
| 15 | 612 $m^2$ |
| 16 | 612 $m^2$ |
| 17 | 612 $m^2$ |
| 18 | 612 $m^2$ |
| 19 | 612 $m^2$ |
| 20 | 612 $m^2$ |
| 21 | 649 $m^2$ |
| 22 | 615 $m^2$ |
| 23 | 600 $m^2$ |
| 24 | 600 $m^2$ |
| 25 | 600 $m^2$ |
| 26 | 600 $m^2$ |
| 27 | 600 $m^2$ |
| 28 | 600 $m^2$ |
| 29 | 627 $m^2$ |
| 30 | 600 $m^2$ |
| 31 | 600 $m^2$ |
| 32 | 600 $m^2$ |
| 33 | 600 $m^2$ |
| 34 | 600 $m^2$ |
| 35 | 600 $m^2$ |
| 36 | 788 $m^2$ |
| 37 | 674 $m^2$ |
| 38 | 775 $m^2$ |
| 39 | 612 $m^2$ |
| 40 | 604 $m^2$ |
| 41 | 604 $m^2$ |
| 42 | 604 $m^2$ |
| 43 | 604 $m^2$ |
| 44 | 604 $m^2$ |
| 45 | 604 $m^2$ |
| 46 | 604 $m^2$ |
| 47 | 609 $m^2$ |
| 48 | 605 $m^2$ |
| 49 | 600 $m^2$ |
| 50 | 600 $m^2$ |
| 51 | 600 $m^2$ |
| 52 | 600 $m^2$ |
| 53 | 600 $m^2$ |
| 54 | 600 $m^2$ |
| 55 | 600 $m^2$ |
| 56 | 600 $m^2$ |
| 57 | 623 $m^2$ |
| 58 | 623 $m^2$ |
| 59 | 633 $m^2$ |
| 60 | 632 $m^2$ |
| 61 | 618 $m^2$ |
| 62 | 604 $m^2$ |
| 63 | 604 $m^2$ |
| 64 | 605 $m^2$ |
| 65 | 606 $m^2$ |
| 66 | 606 $m^2$ |
| 67 | 607 $m^2$ |
| 68 | 607 $m^2$ |
| 69 | 608 $m^2$ |
| 70 | 609 $m^2$ |

## Lot Table

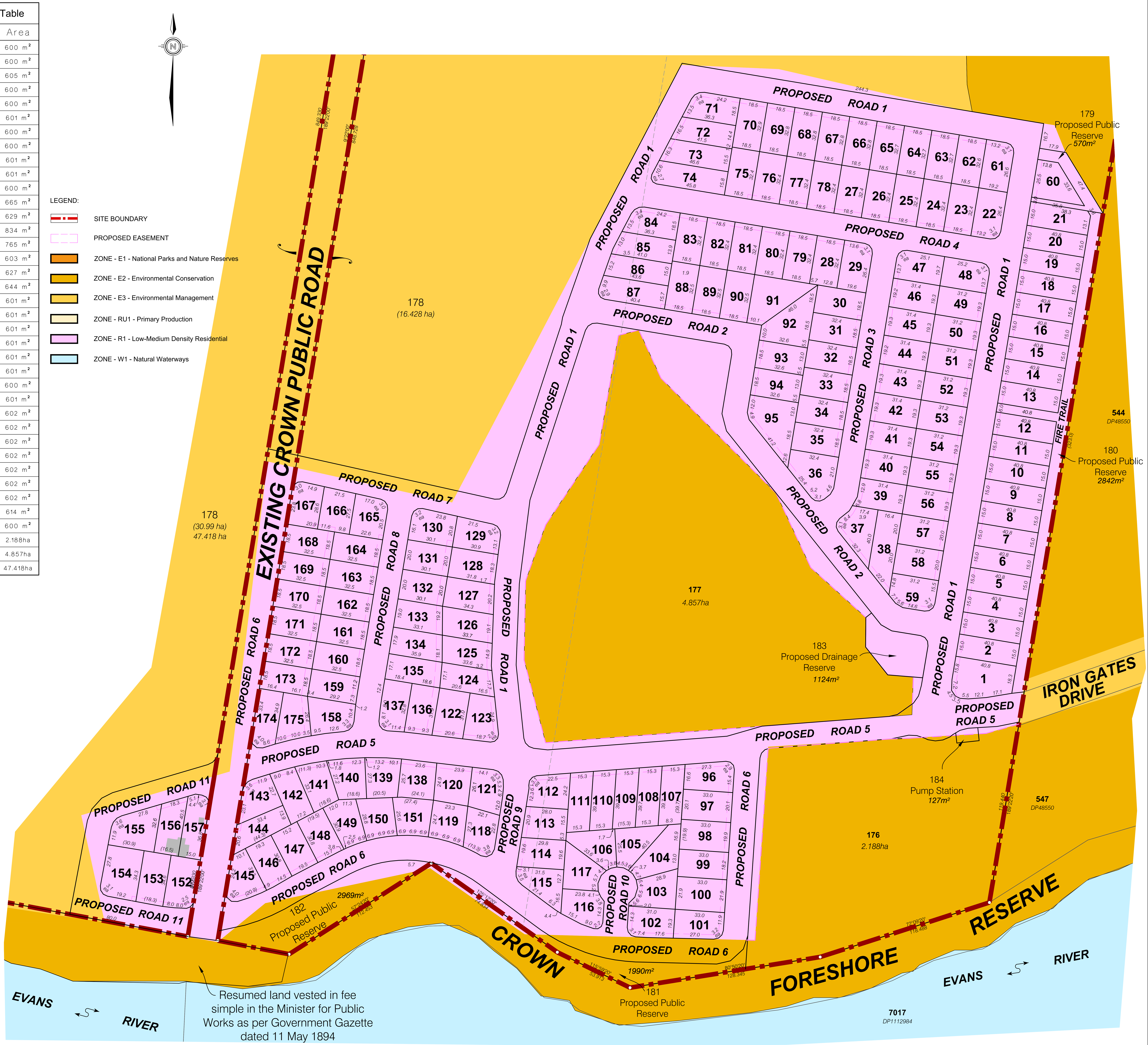
| Lot | Area |
|---|---|
| 71 | 607 $m^2$ |
| 72 | 608 $m^2$ |
| 73 | 682 $m^2$ |
| 74 | 766 $m^2$ |
| 75 | 600 $m^2$ |
| 76 | 600 $m^2$ |
| 77 | 600 $m^2$ |
| 78 | 600 $m^2$ |
| 79 | 600 $m^2$ |
| 80 | 601 $m^2$ |
| 81 | 601 $m^2$ |
| 82 | 601 $m^2$ |
| 83 | 601 $m^2$ |
| 84 | 608 $m^2$ |
| 85 | 614 $m^2$ |
| 86 | 634 $m^2$ |
| 87 | 696 $m^2$ |
| 88 | 602 $m^2$ |
| 89 | 602 $m^2$ |
| 90 | 602 $m^2$ |
| 91 | 859 $m^2$ |
| 92 | 856 $m^2$ |
| 93 | 603 $m^2$ |
| 94 | 603 $m^2$ |
| 95 | 954 $m^2$ |
| 96 | 616 $m^2$ |
| 97 | 663 $m^2$ |
| 98 | 657 $m^2$ |
| 99 | 602 $m^2$ |
| 100 | 723 $m^2$ |
| 101 | 605 $m^2$ |
| 102 | 609 $m^2$ |
| 103 | 620 $m^2$ |
| 104 | 714 $m^2$ |
| 105 | 602 $m^2$ |
| 106 | 604 $m^2$ |
| 107 | 602 $m^2$ |
| 108 | 602 $m^2$ |
| 109 | 602 $m^2$ |
| 110 | 602 $m^2$ |
| 111 | 601 $m^2$ |
| 112 | 600 $m^2$ |
| 113 | 600 $m^2$ |
| 114 | 600 $m^2$ |
| 115 | 608 $m^2$ |
| 116 | 601 $m^2$ |
| 117 | 602 $m^2$ |
| 118 | 600 $m^2$ |
| 119 | 601 $m^2$ |
| 120 | 600 $m^2$ |
| 121 | 600 $m^2$ |
| 122 | 647 $m^2$ |
| 123 | 619 $m^2$ |
| 124 | 603 $m^2$ |
| 125 | 600 $m^2$ |
| 126 | 646 $m^2$ |
| 127 | 661 $m^2$ |
| 128 | 626 $m^2$ |
| 129 | 600 $m^2$ |
| 130 | 639 $m^2$ |
| 131 | 602 $m^2$ |
| 132 | 602 $m^2$ |
| 133 | 600 $m^2$ |
| 134 | 618 $m^2$ |
| 135 | 623 $m^2$ |
| 136 | 604 $m^2$ |
| 137 | 602 $m^2$ |
| 138 | 600 $m^2$ |
| 139 | 600 $m^2$ |
| 140 | 600 $m^2$ |

## Lot Table

| Lot | Area |
|---|---|
| 141 | 600 $m^2$ |
| 142 | 600 $m^2$ |
| 143 | 605 $m^2$ |
| 144 | 600 $m^2$ |
| 145 | 600 $m^2$ |
| 146 | 601 $m^2$ |
| 147 | 600 $m^2$ |
| 148 | 600 $m^2$ |
| 149 | 601 $m^2$ |
| 150 | 601 $m^2$ |
| 151 | 600 $m^2$ |
| 152 | 665 $m^2$ |
| 153 | 629 $m^2$ |
| 154 | 834 $m^2$ |
| 155 | 765 $m^2$ |
| 156 | 603 $m^2$ |
| 157 | 627 $m^2$ |
| 158 | 644 $m^2$ |
| 159 | 601 $m^2$ |
| 160 | 601 $m^2$ |
| 161 | 601 $m^2$ |
| 162 | 601 $m^2$ |
| 163 | 601 $m^2$ |
| 164 | 601 $m^2$ |
| 165 | 600 $m^2$ |
| 166 | 601 $m^2$ |
| 167 | 602 $m^2$ |
| 168 | 602 $m^2$ |
| 169 | 602 $m^2$ |
| 170 | 602 $m^2$ |
| 171 | 602 $m^2$ |
| 172 | 602 $m^2$ |
| 173 | 602 $m^2$ |
| 174 | 614 $m^2$ |
| 175 | 600 $m^2$ |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |

LEGEND:

- SITE BOUNDARY
- PROPOSED EASEMENT
- ZONE - E1 - National Parks and Nature Reserves
- ZONE - E2 - Environmental Conservation
- ZONE - E3 - Environmental Management
- ZONE - RU1 - Primary Production
- ZONE - R1 - Low-Medium Density Residential
- ZONE - W1 - Natural Waterways




NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

(i) This plan was prepared for the purpose and exclusive use of THE INGLES GROUP to accompany an application to RICHMOND VALLEY for approval to reconfigure the land described in this plan and is not to be used for any other purpose or by any other person or corporation. LandPartners Pty Ltd accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention of the terms of this clause or clauses (ii) or (iii) hereof.

(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

| LOTS | TOTAL AREA |
|---|---|
| Residential Lots (175) | 16.884ha |
| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

0 5 10 20 30 50 80m

SCALE 1:1250 @ A1


LANDPARTNERS
built environment consultants

**Brisbane Office**
Level 1 - CDOP6
18 Little Cribb Street,
Milton Qld 4064
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f: (07) 3842 1001
e: info@landpartners.com.au
w: www.landpartners.com.au


bsi. ISO 9001 Quality Management
ISO 9001: FS 535063

| | | | |
|---|---|---|---|
| LEVEL DATUM | AHD | | |
| LEVEL ORIGIN | - | | |
| CONTOUR INTERVAL | - | | |
| COMPUTER FILE | BRJD6396-100-33-16 | | |
| DRAWN | CGW | DATE | 27/06/2019 |
| CHECKED | CMJ | DATE | 27/06/2019 |
| APPROVED | CGW | DATE | 27/06/2019 |
| PLAN NUMBER | SHEET 2 OF 2 BRJD6396.100-014 | REV | O |

CGW

| Lot Table | |
|---|---|
| Lot | Area |
| 1 | 969 m² |
| 2 | 612 m² |
| 3 | 612 m² |
| 4 | 612 m² |
| 5 | 612 m² |
| 6 | 612 m² |
| 7 | 612 m² |
| 8 | 612 m² |
| 9 | 612 m² |
| 10 | 612 m² |
| 11 | 612 m² |
| 12 | 612 m² |
| 13 | 612 m² |
| 14 | 612 m² |
| 15 | 612 m² |
| 16 | 612 m² |
| 17 | 612 m² |
| 18 | 612 m² |
| 19 | 612 m² |
| 20 | 612 m² |
| 21 | 649 m² |
| 22 | 615 m² |
| 23 | 600 m² |
| 24 | 600 m² |
| 25 | 600 m² |
| 26 | 600 m² |
| 27 | 600 m² |
| 28 | 600 m² |
| 29 | 627 m² |
| 30 | 600 m² |
| 31 | 600 m² |
| 32 | 600 m² |
| 33 | 600 m² |
| 34 | 600 m² |
| 35 | 600 m² |
| 36 | 788 m² |
| 37 | 674 m² |
| 38 | 775 m² |
| 39 | 612 m² |
| 40 | 604 m² |
| 41 | 604 m² |
| 42 | 604 m² |
| 43 | 604 m² |
| 44 | 604 m² |
| 45 | 604 m² |
| 46 | 604 m² |
| 47 | 609 m² |
| 48 | 605 m² |
| 49 | 600 m² |
| 50 | 600 m² |
| 51 | 600 m² |
| 52 | 600 m² |
| 53 | 600 m² |
| 54 | 600 m² |
| 55 | 600 m² |
| 56 | 600 m² |
| 57 | 623 m² |
| 58 | 623 m² |
| 59 | 633 m² |
| 60 | 632 m² |
| 61 | 618 m² |
| 62 | 604 m² |
| 63 | 604 m² |
| 64 | 605 m² |
| 65 | 606 m² |
| 66 | 606 m² |
| 67 | 607 m² |
| 68 | 607 m² |
| 69 | 608 m² |
| 70 | 609 m² |

| Lot Table | |
|---|---|
| Lot | Area |
| 71 | 607 m² |
| 72 | 608 m² |
| 73 | 682 m² |
| 74 | 766 m² |
| 75 | 600 m² |
| 76 | 600 m² |
| 77 | 600 m² |
| 78 | 600 m² |
| 79 | 600 m² |
| 80 | 601 m² |
| 81 | 601 m² |
| 82 | 601 m² |
| 83 | 601 m² |
| 84 | 608 m² |
| 85 | 614 m² |
| 86 | 634 m² |
| 87 | 696 m² |
| 88 | 602 m² |
| 89 | 602 m² |
| 90 | 602 m² |
| 91 | 859 m² |
| 92 | 856 m² |
| 93 | 603 m² |
| 94 | 603 m² |
| 95 | 954 m² |
| 96 | 616 m² |
| 97 | 663 m² |
| 98 | 657 m² |
| 99 | 602 m² |
| 100 | 723 m² |
| 101 | 605 m² |
| 102 | 609 m² |
| 103 | 620 m² |
| 104 | 714 m² |
| 105 | 602 m² |
| 106 | 604 m² |
| 107 | 602 m² |
| 108 | 602 m² |
| 109 | 602 m² |
| 110 | 602 m² |
| 111 | 601 m² |
| 112 | 600 m² |
| 113 | 600 m² |
| 114 | 600 m² |
| 115 | 608 m² |
| 116 | 601 m² |
| 117 | 602 m² |
| 118 | 600 m² |
| 119 | 601 m² |
| 120 | 600 m² |
| 121 | 600 m² |
| 122 | 647 m² |
| 123 | 619 m² |
| 124 | 603 m² |
| 125 | 600 m² |
| 126 | 646 m² |
| 127 | 661 m² |
| 128 | 626 m² |
| 129 | 600 m² |
| 130 | 639 m² |
| 131 | 602 m² |
| 132 | 602 m² |
| 133 | 600 m² |
| 134 | 618 m² |
| 135 | 623 m² |
| 136 | 604 m² |
| 137 | 602 m² |
| 138 | 600 m² |
| 139 | 600 m² |
| 140 | 600 m² |

| Lot Table | |
|---|---|
| Lot | Area |
| 141 | 600 m² |
| 142 | 600 m² |
| 143 | 605 m² |
| 144 | 600 m² |
| 145 | 600 m² |
| 146 | 601 m² |
| 147 | 600 m² |
| 148 | 600 m² |
| 149 | 601 m² |
| 150 | 601 m² |
| 151 | 600 m² |
| 152 | 665 m² |
| 153 | 629 m² |
| 154 | 834 m² |
| 155 | 765 m² |
| 156 | 603 m² |
| 157 | 627 m² |
| 158 | 644 m² |
| 159 | 601 m² |
| 160 | 601 m² |
| 161 | 601 m² |
| 162 | 601 m² |
| 163 | 601 m² |
| 164 | 601 m² |
| 165 | 600 m² |
| 166 | 601 m² |
| 167 | 602 m² |
| 168 | 602 m² |
| 169 | 602 m² |
| 170 | 602 m² |
| 171 | 602 m² |
| 172 | 602 m² |
| 173 | 602 m² |
| 174 | 614 m² |
| 175 | 600 m² |
| 176 | 2.188ha |
| 177 | 4.857ha |
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LEGEND:

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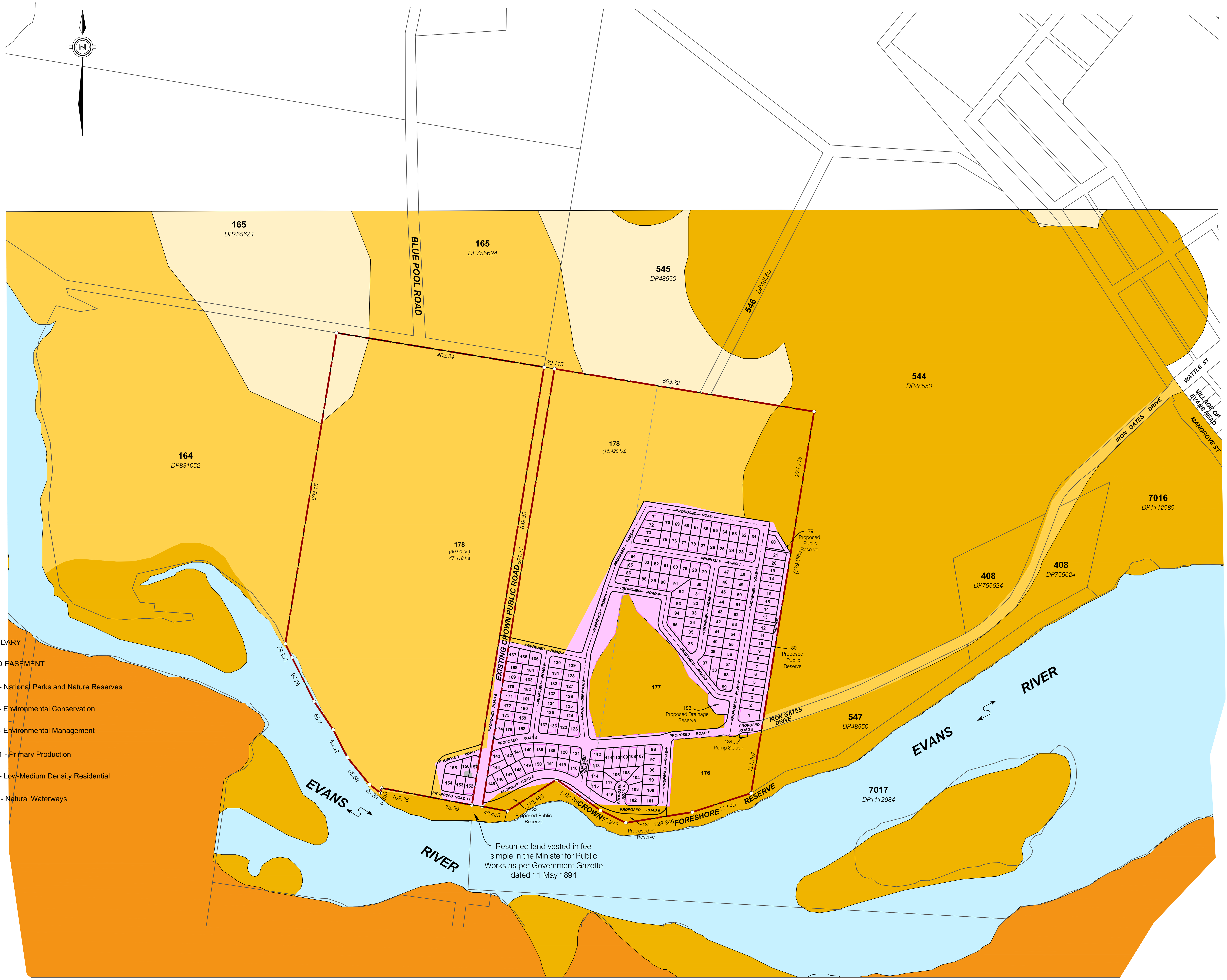


CLIENT

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PROJECT

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| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

40m 0 80 200m

SCALE 1:4000 @ A1


LANDPARTNERS built environment consultants

Brisbane Office
Level 1 - CDOP6
18 Little Cribb Street,
Milton Qld 4064
PO Box 1399
Milton Qld 4064

p: (07) 3842 1000
f: (07) 3842 1001
e: info@landpartners.com.au
w: www.landpartners.com.au


| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16 |
| DRAWN CGW | DATE 27/06/2019 |
| CHECKED CMJ | DATE 27/06/2019 |
| APPROVED CGW | DATE 27/06/2019 |
| PLAN NUMBER BRJD6396.100-014 | SHEET 1 OF 2 |
| REV | O |

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

| Lot Table | |
|---|---|
| Lot | Area |
| 1 | 969 $m^2$ |
| 2 | 612 $m^2$ |
| 3 | 612 $m^2$ |
| 4 | 612 $m^2$ |
| 5 | 612 $m^2$ |
| 6 | 612 $m^2$ |
| 7 | 612 $m^2$ |
| 8 | 612 $m^2$ |
| 9 | 612 $m^2$ |
| 10 | 612 $m^2$ |
| 11 | 612 $m^2$ |
| 12 | 612 $m^2$ |
| 13 | 612 $m^2$ |
| 14 | 612 $m^2$ |
| 15 | 612 $m^2$ |
| 16 | 612 $m^2$ |
| 17 | 612 $m^2$ |
| 18 | 612 $m^2$ |
| 19 | 612 $m^2$ |
| 20 | 612 $m^2$ |
| 21 | 649 $m^2$ |
| 22 | 615 $m^2$ |
| 23 | 600 $m^2$ |
| 24 | 600 $m^2$ |
| 25 | 600 $m^2$ |
| 26 | 600 $m^2$ |
| 27 | 600 $m^2$ |
| 28 | 600 $m^2$ |
| 29 | 627 $m^2$ |
| 30 | 600 $m^2$ |
| 31 | 600 $m^2$ |
| 32 | 600 $m^2$ |
| 33 | 600 $m^2$ |
| 34 | 600 $m^2$ |
| 35 | 600 $m^2$ |
| 36 | 788 $m^2$ |
| 37 | 674 $m^2$ |
| 38 | 775 $m^2$ |
| 39 | 612 $m^2$ |
| 40 | 604 $m^2$ |
| 41 | 604 $m^2$ |
| 42 | 604 $m^2$ |
| 43 | 604 $m^2$ |
| 44 | 604 $m^2$ |
| 45 | 604 $m^2$ |
| 46 | 604 $m^2$ |
| 47 | 609 $m^2$ |
| 48 | 605 $m^2$ |
| 49 | 600 $m^2$ |
| 50 | 600 $m^2$ |
| 51 | 600 $m^2$ |
| 52 | 600 $m^2$ |
| 53 | 600 $m^2$ |
| 54 | 600 $m^2$ |
| 55 | 600 $m^2$ |
| 56 | 600 $m^2$ |
| 57 | 623 $m^2$ |
| 58 | 623 $m^2$ |
| 59 | 633 $m^2$ |
| 60 | 632 $m^2$ |
| 61 | 618 $m^2$ |
| 62 | 604 $m^2$ |
| 63 | 604 $m^2$ |
| 64 | 605 $m^2$ |
| 65 | 606 $m^2$ |
| 66 | 606 $m^2$ |
| 67 | 607 $m^2$ |
| 68 | 607 $m^2$ |
| 69 | 608 $m^2$ |
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| Lot Table | |
|---|---|
| Lot | Area |
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| 78 | 600 $m^2$ |
| 79 | 600 $m^2$ |
| 80 | 601 $m^2$ |
| 81 | 601 $m^2$ |
| 82 | 601 $m^2$ |
| 83 | 601 $m^2$ |
| 84 | 608 $m^2$ |
| 85 | 614 $m^2$ |
| 86 | 634 $m^2$ |
| 87 | 696 $m^2$ |
| 88 | 602 $m^2$ |
| 89 | 602 $m^2$ |
| 90 | 602 $m^2$ |
| 91 | 859 $m^2$ |
| 92 | 856 $m^2$ |
| 93 | 603 $m^2$ |
| 94 | 603 $m^2$ |
| 95 | 954 $m^2$ |
| 96 | 616 $m^2$ |
| 97 | 663 $m^2$ |
| 98 | 657 $m^2$ |
| 99 | 602 $m^2$ |
| 100 | 723 $m^2$ |
| 101 | 605 $m^2$ |
| 102 | 609 $m^2$ |
| 103 | 620 $m^2$ |
| 104 | 714 $m^2$ |
| 105 | 602 $m^2$ |
| 106 | 604 $m^2$ |
| 107 | 602 $m^2$ |
| 108 | 602 $m^2$ |
| 109 | 602 $m^2$ |
| 110 | 602 $m^2$ |
| 111 | 601 $m^2$ |
| 112 | 600 $m^2$ |
| 113 | 600 $m^2$ |
| 114 | 600 $m^2$ |
| 115 | 608 $m^2$ |
| 116 | 601 $m^2$ |
| 117 | 602 $m^2$ |
| 118 | 600 $m^2$ |
| 119 | 601 $m^2$ |
| 120 | 600 $m^2$ |
| 121 | 600 $m^2$ |
| 122 | 647 $m^2$ |
| 123 | 619 $m^2$ |
| 124 | 603 $m^2$ |
| 125 | 600 $m^2$ |
| 126 | 646 $m^2$ |
| 127 | 661 $m^2$ |
| 128 | 626 $m^2$ |
| 129 | 600 $m^2$ |
| 130 | 639 $m^2$ |
| 131 | 602 $m^2$ |
| 132 | 602 $m^2$ |
| 133 | 600 $m^2$ |
| 134 | 618 $m^2$ |
| 135 | 623 $m^2$ |
| 136 | 604 $m^2$ |
| 137 | 602 $m^2$ |
| 138 | 600 $m^2$ |
| 139 | 600 $m^2$ |
| 140 | 600 $m^2$ |

| Lot Table | |
|---|---|
| Lot | Area |
| 141 | 600 $m^2$ |
| 142 | 600 $m^2$ |
| 143 | 605 $m^2$ |
| 144 | 600 $m^2$ |
| 145 | 600 $m^2$ |
| 146 | 601 $m^2$ |
| 147 | 600 $m^2$ |
| 148 | 600 $m^2$ |
| 149 | 601 $m^2$ |
| 150 | 601 $m^2$ |
| 151 | 600 $m^2$ |
| 152 | 665 $m^2$ |
| 153 | 629 $m^2$ |
| 154 | 834 $m^2$ |
| 155 | 765 $m^2$ |
| 156 | 603 $m^2$ |
| 157 | 627 $m^2$ |
| 158 | 644 $m^2$ |
| 159 | 601 $m^2$ |
| 160 | 601 $m^2$ |
| 161 | 601 $m^2$ |
| 162 | 601 $m^2$ |
| 163 | 601 $m^2$ |
| 164 | 601 $m^2$ |
| 165 | 600 $m^2$ |
| 166 | 601 $m^2$ |
| 167 | 602 $m^2$ |
| 168 | 602 $m^2$ |
| 169 | 602 $m^2$ |
| 170 | 602 $m^2$ |
| 171 | 602 $m^2$ |
| 172 | 602 $m^2$ |
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| 176 | 2.188ha |
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LEGEND:

SITE BOUNDARY

PROPOSED EASEMENT


CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

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(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

| LOTS | TOTAL AREA |
|---|---|
| Residential Lots (175) | 16.884ha |
| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

40m 0 80 200m

SCALE 1:4000 @ A1


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Milton Qld 4064

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f: (07) 3842 1001
e: info@landpartners.com.au
w: www.landpartners.com.au


| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16 |
| DRAWN CGW | DATE 27/06/2019 |
| CHECKED CMJ | DATE 27/06/2019 |
| APPROVED CGW | DATE 27/06/2019 |
| PLAN NUMBER BRJD6396.100-015 | SHEET 1 OF 2 |
| REV | M |

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

Last saved by COLIN.WALTERS on 28/6/2019 at 10:17:54 AM

Lot Table

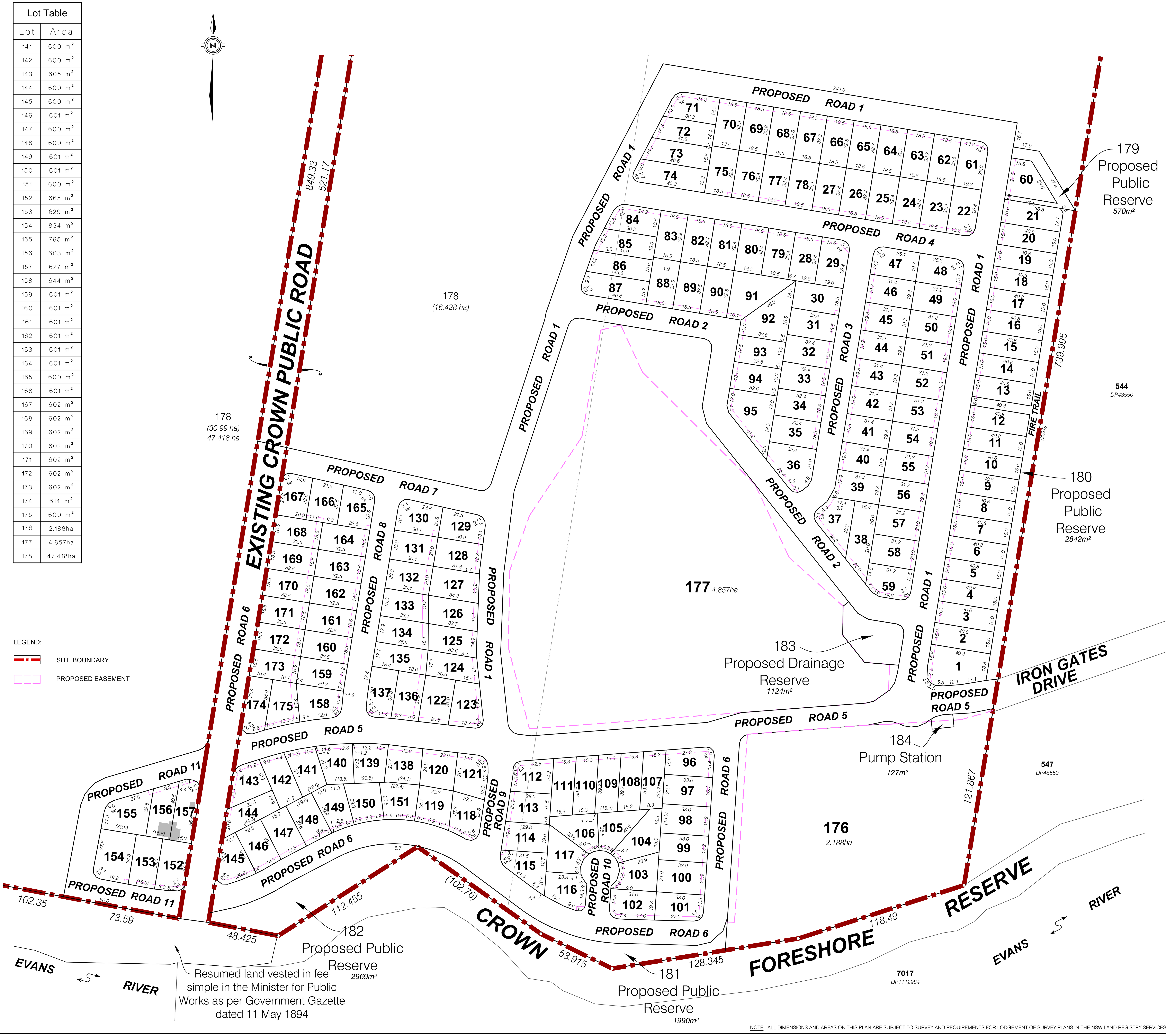
| Lot | Area |
|---|---|
| 1 | 969 m² |
| 2 | 612 m² |
| 3 | 612 m² |
| 4 | 612 m² |
| 5 | 612 m² |
| 6 | 612 m² |
| 7 | 612 m² |
| 8 | 612 m² |
| 9 | 612 m² |
| 10 | 612 m² |
| 11 | 612 m² |
| 12 | 612 m² |
| 13 | 612 m² |
| 14 | 612 m² |
| 15 | 612 m² |
| 16 | 612 m² |
| 17 | 612 m² |
| 18 | 612 m² |
| 19 | 612 m² |
| 20 | 612 m² |
| 21 | 649 m² |
| 22 | 615 m² |
| 23 | 600 m² |
| 24 | 600 m² |
| 25 | 600 m² |
| 26 | 600 m² |
| 27 | 600 m² |
| 28 | 600 m² |
| 29 | 627 m² |
| 30 | 600 m² |
| 31 | 600 m² |
| 32 | 600 m² |
| 33 | 600 m² |
| 34 | 600 m² |
| 35 | 600 m² |
| 36 | 788 m² |
| 37 | 674 m² |
| 38 | 775 m² |
| 39 | 612 m² |
| 40 | 604 m² |
| 41 | 604 m² |
| 42 | 604 m² |
| 43 | 604 m² |
| 44 | 604 m² |
| 45 | 604 m² |
| 46 | 604 m² |
| 47 | 609 m² |
| 48 | 605 m² |
| 49 | 600 m² |
| 50 | 600 m² |
| 51 | 600 m² |
| 52 | 600 m² |
| 53 | 600 m² |
| 54 | 600 m² |
| 55 | 600 m² |
| 56 | 600 m² |
| 57 | 623 m² |
| 58 | 623 m² |
| 59 | 633 m² |
| 60 | 632 m² |
| 61 | 618 m² |
| 62 | 604 m² |
| 63 | 604 m² |
| 64 | 605 m² |
| 65 | 606 m² |
| 66 | 606 m² |
| 67 | 607 m² |
| 68 | 607 m² |
| 69 | 608 m² |
| 70 | 609 m² |

Lot Table

| Lot | Area |
|---|---|
| 71 | 607 m² |
| 72 | 608 m² |
| 73 | 682 m² |
| 74 | 766 m² |
| 75 | 600 m² |
| 76 | 600 m² |
| 77 | 600 m² |
| 78 | 600 m² |
| 79 | 600 m² |
| 80 | 601 m² |
| 81 | 601 m² |
| 82 | 601 m² |
| 83 | 601 m² |
| 84 | 608 m² |
| 85 | 614 m² |
| 86 | 634 m² |
| 87 | 696 m² |
| 88 | 602 m² |
| 89 | 602 m² |
| 90 | 602 m² |
| 91 | 859 m² |
| 92 | 856 m² |
| 93 | 603 m² |
| 94 | 603 m² |
| 95 | 954 m² |
| 96 | 616 m² |
| 97 | 663 m² |
| 98 | 657 m² |
| 99 | 602 m² |
| 100 | 723 m² |
| 101 | 605 m² |
| 102 | 609 m² |
| 103 | 620 m² |
| 104 | 714 m² |
| 105 | 602 m² |
| 106 | 604 m² |
| 107 | 602 m² |
| 108 | 602 m² |
| 109 | 602 m² |
| 110 | 602 m² |
| 111 | 601 m² |
| 112 | 600 m² |
| 113 | 600 m² |
| 114 | 600 m² |
| 115 | 608 m² |
| 116 | 601 m² |
| 117 | 602 m² |
| 118 | 600 m² |
| 119 | 601 m² |
| 120 | 600 m² |
| 121 | 600 m² |
| 122 | 647 m² |
| 123 | 619 m² |
| 124 | 603 m² |
| 125 | 600 m² |
| 126 | 646 m² |
| 127 | 661 m² |
| 128 | 626 m² |
| 129 | 600 m² |
| 130 | 639 m² |
| 131 | 602 m² |
| 132 | 602 m² |
| 133 | 600 m² |
| 134 | 618 m² |
| 135 | 623 m² |
| 136 | 604 m² |
| 137 | 602 m² |
| 138 | 600 m² |
| 139 | 600 m² |
| 140 | 600 m² |

Lot Table

| Lot | Area |
|---|---|
| 141 | 600 m² |
| 142 | 600 m² |
| 143 | 605 m² |
| 144 | 600 m² |
| 145 | 600 m² |
| 146 | 601 m² |
| 147 | 600 m² |
| 148 | 600 m² |
| 149 | 601 m² |
| 150 | 601 m² |
| 151 | 600 m² |
| 152 | 665 m² |
| 153 | 629 m² |
| 154 | 834 m² |
| 155 | 765 m² |
| 156 | 603 m² |
| 157 | 627 m² |
| 158 | 644 m² |
| 159 | 601 m² |
| 160 | 601 m² |
| 161 | 601 m² |
| 162 | 601 m² |
| 163 | 601 m² |
| 164 | 601 m² |
| 165 | 600 m² |
| 166 | 601 m² |
| 167 | 602 m² |
| 168 | 602 m² |
| 169 | 602 m² |
| 170 | 602 m² |
| 171 | 602 m² |
| 172 | 602 m² |
| 173 | 602 m² |
| 174 | 614 m² |
| 175 | 600 m² |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |




CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

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| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

0 5 10 20 30 50 80m

SCALE 1:1250 @ A1


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e: info@landpartners.com.au
w: www.landpartners.com.au


bsi. ISO 9001 Quality Management
ISO 9001: FS 535063

| | | | |
|---|---|---|---|
| LEVEL DATUM | AHD | | |
| LEVEL ORIGIN | - | | |
| CONTOUR INTERVAL | - | | |
| COMPUTER FILE | BRJD6396-100-33-16 | | |
| DRAWN | CGW | DATE | 27/06/2019 |
| CHECKED | CMJ | DATE | 27/06/2019 |
| APPROVED | CGW | DATE | 27/06/2019 |
| PLAN NUMBER | SHEET 2 OF 2 BRJD6396.100-015 | REV | M |

CGW

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES


NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE DEPARTMENT.

CLIENT

# GOLDCORAL PTY LTD

PROJECT
PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY
RICHMOND VALLEY

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(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

| STAGE | No. OF LOTS | NEW ROAD | AREA OF PARK | TOTAL AREA |
|---|---|---|---|---|
| - | - | - | - | - |
| | | | | |
| | | | | |
| | | | | |
| TOTAL | | | | |

SCALE BAR
50m 0 50 100m

SCALE 1:2500 @ A3

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w: www.landpartners.com.au

bsi. ISO 9001 Quality Management

| | |
|---|---|
| LEVEL DATUM | NA |
| LEVEL ORIGIN | NA |
| CONTOUR INTERVAL | NA |

| | | | |
|---|---|---|---|
| DRAWN | CGW | DATE | 27/06/2019 |
| CHECKED | MEA | DATE | 27/06/2019 |
| APPROVED | CGW | DATE | 27/06/2019 |

UDN
BRJD6396-100-38-4
SHEET 1 OF 1
CGW

# APPENDIX G

## WATER NETWORK CAPACITY ASSESSMENT

MEMO

| | |
|---|---|
| **Date** | 18/04/2019 |
| **To** | Richmond Valley Council |
| **From** | Arcadis |
| **Author** | Oliver Purton |
| **Reviewer** | Lachlan Prizeman |
| | |
| **Reference** | F0002-10027302-AAR-01 - Water Network Memo |
| **Subject** | Evans Heads Water Network Capacity Assessment – Iron Gates Development |

## EXECUTIVE SUMMARY

The purpose of this memorandum to undertake an investigation into how the proposed Iron Gates development affects the surrounding Evan's Head potable water network, utilising the H2OMap water network models supplied by Richmond Valley Council. The proposed development's internal potable water network was not assessed and will be the subject of future detailed design to ensure minimum servicing to all allotments.

This Water Network Assessment Memorandum shows that the proposed development can be serviced by the existing potable water network. The model analysis indicates that the Iron Gates development, once fully developed and in-use, will have no additional impact on the Evans Head potable water network. This is true for both standard 'Peak Day Demand' and during a Fire Flow event. Issues within the Evans Head network are current and not exaggerated in any aspect from the proposed development.

## SITE LOCATION AND REFERENCE PLAN

The following reference plan is provided:

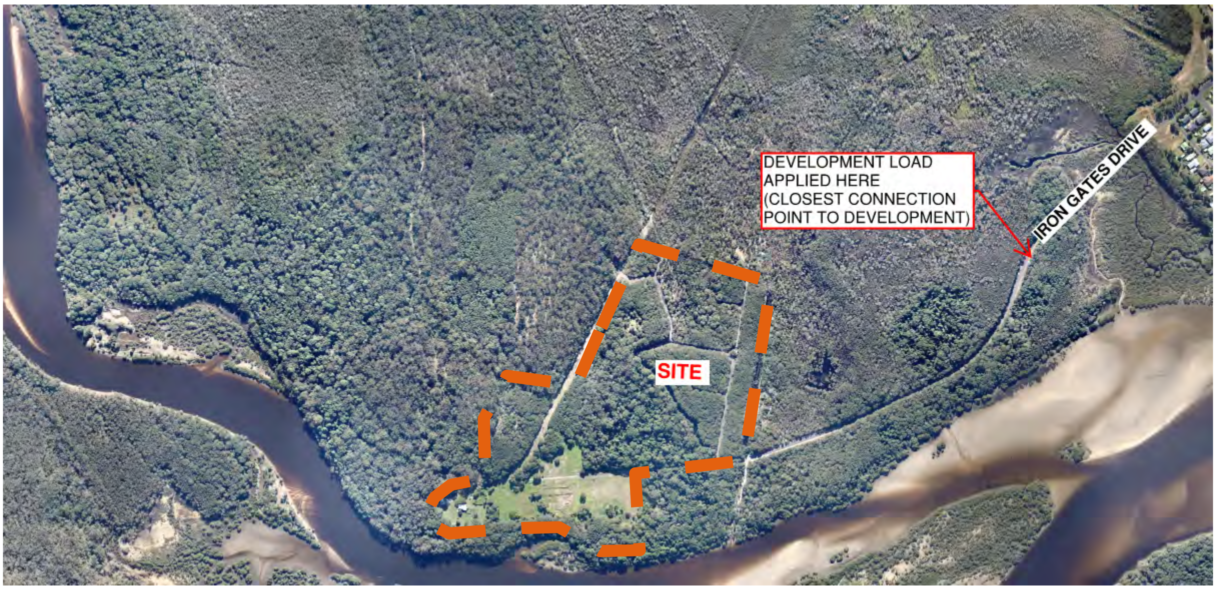


**Figure 1 – Reference Plan (Image courtesy of Nearmap)**

# PROPOSED DEVELOPMENT LOADING

For the purposes of this report, the development has been assessed under two loading cases to better determine the anticipated impact to be had on the surrounding network. These cases are as follows:

- **Existing Case** – The existing potable water network, excluding loads from the proposed development. The 'GHD, PDD with Rising Main' scenario was assessed, which analyses the 'Peak Day Demand' for the entire Evans Head network.
- **Developed Case** – The calculated demand for the Iron Gates development based on the latest development plans, applied to the network at Iron Gates Road. The 'GHD, PDD with Rising Main' scenario was again assessed to determine the impact on the network during the 'Peak Day Demand'.

The proposed development's load was applied to the model via 'RSF, Residential Single Family' loading pattern. This loading pattern was chosen as it best represents the proposed development and complies with the assumptions made in the model for the Evans Head network.

Table 1 below shows the proposed development's calculated Equivalent Tenements (ET).

**Table 1 Proposed Development Loadings**

| Category | Number of Lots | Conversion Rate | Proposed ET Loading |
|---|---|---|---|
| Single Detached Dwelling Lot | **105** | 1ET/lot | 105 |
| Duplex Dwelling Lot | **70** | 2ET/lot | 140 |
| | | **Total:** | **245** |

# MODELLING ASSUMPTIONS & METHODOLOGY

## ASSUMPTIONS

Richmond Valley Council supplied three H2OMap Water network models – 'High level zone ADD', 'New Zoning' and 'High level zone PDD' in March 2019. Upon inspection of the models, it was decided that the 'High level zone PDD' model would be used for the investigation, as it had generally lower minimum pressures which typically indicate the network is under greater loads. Therefore, the potable water supply network surrounding the proposed development site was modelled using the 'High level zone PDD' H2OMap Water model. These models each had four scenarios – 'BASE, Base Network Scenario', '2009_AD, Average Day Demand', '2009_PD, Peak Day Demand' and 'GHD, PDD with Rising Main'. The development demand has been applied in the 'GHD, PDD with Rising Main' scenario, as it was determined to be the most conservative scenario. The analysis was undertaken considering the following assumptions and design criteria (Note: All design criteria are in accordance with the 'New South Wales Development Design Specification D11 – Water Supply', the 'Water Services Association of Australia – Water Supply Code of Australia – Part 1: Planning and Design' and the 'AS3500.1:2018 Plumbing and Drainage Part 1: Water Services'):

- The site is located within the Evans Head zone;
- 3-day standard flow simulation with a minimum design pressure of 20m and a maximum design pressure of 78m.
- 3-day standard flow simulation with a maximum design velocity of 3m/s.
- 1-day fire flow simulation with a minimum design pressure of 11.8m and a maximum design pressure of 78m. Fire flow was applied from 5:30am to 9:30am, as this was determined to be when the peak demand in the network occurred.
- The development will be serviced from one connection point – junction 'MWH2142', and feeder pipe '51524', being the potable water main on Iron Gates Road.

- Demand has been applied using the ‘RSF, Residential Single Family’ loading pattern.
- Adopted the *North Coast Regional Plan 2036* target plan of 40% of dwellings to be duel occupancies for development site.

## METHODOLOGY

The proposed development was incorporated into the H2OMap Water model by applying the anticipated loads at the specified connection point of the model as per Table . The impact on the existing water supply network was assessed by verifying and comparing the standard flow pressure, fire flow pressure and pipe velocity against the abovementioned design criteria.

Summary tables are included below which specify the applied loadings in each of the modelled scenarios as a result of the development.

**Table 2 Load Application Table at Connection Junction MWH2142**

| Scenario | Existing Scenario (ET) | Loads to be Removed (ET) | Proposed Development Load (ET) | Load Net Increase (ET) |
|---|---|---|---|---|
| GHD, PDD with Rising Main | 0 | 0 | 245 | 245 |

### STANDARD FLOW PRESSURE

The standard flow scenario was assessed for the ‘GHD, PDD with Rising Main’ scenario in the existing and developed cases. In the developed case the development loads were applied to the specified connection point and the results were then compared to the results modelled in the existing case. The minimum and maximum pressures in the previously specified vicinity to the proposed development were assessed over a 72-hour period using a steady state simulation.

### PIPE VELOCITY

The standard flow scenario was assessed for the ‘GHD, PDD with Rising Main’ scenario for both the existing and developed cases to determine pipe velocities. In the developed case the additional loads were applied to the specified connection point and the results were then compared to the results modelled in the existing case. The minimum and maximum velocities domain in the proposed development were assessed over a 72-hour period using a steady state simulation.

### FIRE FLOW VELOCITY

The fire flow scenario was modelled using a fire flow simulation of 1 day by applying 11L/s fire flow demand for residential uses at the proposed connection point over a period of 4 hours. A duration of 4 hours is adopted to ensure the peak in the system is adequately captured when modelling. It is noted that site will likely only be approved for 11L/s for 2 hours unless another flow and duration is approved by Richmond Valley Council. The minimum fire flow pressures in the specified vicinity of the site were then assessed against the previously mentioned design criteria.

# RESULTS AND DISCUSSION

## EXISTING SYSTEM PERFORMANCE

### STANDARD FLOW PRESSURES

The H2OMap Water simulation results are displayed in Table . The minimum and maximum pressures at the connection point and within the modelled domain are presented.

**Table 3 Existing Standard Flow Pressures within Modelled Domain**

| Scenario | Connection Node (MWH2142) | | Min Pressure within Domain Pressure (m): Node | Max Pressure within Domain Pressure (m): Node | Number of Non-Compliant Min Pressures in Domain | Number of Non-Compliant Excess Pressures in Domain |
|---|---|---|---|---|---|---|
| | Min Pressure (m): | Max Pressure (m): | | | | |
| GHD, PDD with Rising Main | 33.57 | 43.24 | 3.50 (MWH2044) | 58.84 (MWH4156) | 61 | 0 |

The above existing case results indicate that the minimum pressures within the modelled domain are not in accordance with the DSS requirements. There are 61 minimum pressure non-compliances within the existing network. The minimum pressure found in the network was 3.50m at junction ‘MWH2044’. These results will be the basis of which the developed case is assessed against.

The maximum pressures within the existing network are in accordance with the DSS requirements.

It must be noted that these minimum pressure non-compliances were seen across all models and scenarios.

### STANDARD FLOW VELOCITIES

The H2OMap Water simulation results are displayed in Table 4. The maximum velocities within the modelled domain and the connecting pipe are presented below.

**Table 4 Existing Standard Flow Velocities within the Modelled Domain**

| Scenario | 51524 | Max Velocity within Domain Velocity (m/s): Node | DSS Compliant (YES/NO) | Number of Max Velocity Non-Compliances |
|---|---|---|---|---|
| | Max Velocity: (m/s) | | | |
| GHD, PDD with Rising Main | 0.01 | 3.12 (MWH149) | NO | 5 |

The above existing case results indicate maximum velocities within the modelled domain do not demonstrate compliance with the DSS. There are 5 max velocity non-compliances within the existing network.

The maximum velocity found in the network is 3.12m/s at ‘MWH149’. These results will be the basis of which the developed case is assessed against.

It must be noted that these max velocity non-compliances were seen across all models and scenarios.

## FIRE FLOW PRESSURE/ VELOCITY

The existing case fire flow simulations were run at the proposed development connection with a fire flow demand of 11L/s. The fire flow pressure and pipe velocity results are presented in Table 5 below.

**Table 5 Existing Fire Flow Pressure & Velocity within Modelled Domain**

| Scenario | Fire Flow Demand (L/s) | Connection Node (MWH2142) Min Residual Pressure (m): | Min Residual Pressure in Domain (m): Node | Max Velocity within Domain Velocity (m/s): Pipe | Number of Minimum Pressure Non-Compliances | Number of Max Velocity Non-Compliances |
|---|---|---|---|---|---|---|
| GHD, PDD with Rising Main | 11 | 33.40 | 3.52 (MWH2044) | 3.12 (MWH161) | 11 | 5 |

The fire flow simulations show the DSS of a minimum of 11.8m pressure is not achieved within the network for the assessed scenario with the specified fire loading.

The above existing fire flow case results indicate maximum velocities within the modelled domain do not demonstrate full compliance with DSS requirements for the assessed planning horizon.

The maximum velocity found in the assessed domain is 3.12m/s at 'MWH161'. The minimum residual pressure found in the assessed domain is 3.52m at 'MWH2044'.

These results will be the basis of which the developed case is assessed against.

# DEVELOPED SYSTEM PERFORMANCE

# DEVELOPED SYSTEM PERFORMANCE

## STANDARD FLOW PRESSURES

The H2OMap Water simulation results are displayed in Table 6. The minimum and maximum pressures within the modelled domain are presented.

**Table 6 Developed Standard Flow Pressures within Modelled Domain**

| Scenario | Connection Node (MWH2142) | | Min Pressure within Domain Pressure (m): Node (+/-) | Max Pressure within Domain Pressure (m): Node (+/-) | Number of Non-Compliant Min Pressures in Domain (+/-) | Number of Non-Compliant Excess Pressures in Domain (+/-) |
|---|---|---|---|---|---|---|
| | Min Pressure (m): (+/-) | Max Pressure (m): (+/-) | | | | |
| GHD, PDD with Rising Main | 31.38 (-2.19) | 42.79 (-0.45) | 3.50 (0) (MWH2044) | 58.84 (0) (MWH4156) | 61 (0) | 0 (0) |

The above developed case results indicate that the minimum pressures within the modelled domain are not in accordance with the DSS requirements. There are 61 minimum pressure non-compliances within the network. The minimum pressure found in the network was 3.50m at junction 'MWH2044'.

The maximum pressures within the network are in accordance with the DSS requirements.

However, it must be noted that the proposed development does not cause any additional non-compliances and only causes a minor diminishment in the surrounding water network.

## STANDARD FLOW VELOCITIES

The H2OMap Water simulation results are displayed in Table 7. The maximum velocities within the modelled domain and the connecting pipe are presented below.

**Table 7 Developed Standard Flow Velocities within the Modelled Domain**

| Scenario | 51524 | Max Velocity within Domain Velocity (m/s): Node | DSS Compliant (YES/NO) | Number of Additional Max Velocity Non-Compliances |
|---|---|---|---|---|
| | Max Velocity: (m/s) | | | |
| GHD, PDD with Rising Main | 0.01 (0) | 3.12 (MWH149) | NO | 5 (0) |

The above developed case results indicate maximum velocities within the modelled domain do not demonstrate compliance with the DSS.

The maximum velocity found in the assessed domain is 3.12m/s at 'MWH149'.

However, it must be noted that the proposed development does not cause any additional non-compliances within the network.

## FIRE FLOW PRESSURE/ VELOCITY

The existing case fire flow simulations were run at the proposed development connection with a fire flow demand of 11L/s. The fire flow pressure and pipe velocity results are presented in Table 8 below.

**Table 8 Developed Fire Flow Pressure & Velocity within Modelled Domain**

| Scenario | Fire Flow Demand (L/s) | Connection Node (MWH2142) Min Residual Pressure (m): (+/-) | Min Residual Pressure in Domain (m): Node (+/-) | Max Velocity within Domain Velocity (m/s): Pipe (+/-) | Number of Minimum Pressure Non-Compliances (+/-) | Number of Additional Max Velocity Non-Compliances (+/-) |
|---|---|---|---|---|---|---|
| GHD, PDD with Rising Main | 11 | 31.21 (-2.19) | 3.52 (0) (MWH2044) | 3.12 (0) (MWH149) | 11 (0) | 5 (0) |

The fire flow simulations show the DSS of a minimum of 11.8m pressure is not achieved within the network for the assessed scenario with the specified fire loading.

The above developed fire flow case results indicate maximum velocities within the modelled domain do not demonstrate compliance with the DSS for the assessed scenario.

The maximum velocity found in the assessed domain is 3.12m/s at 'MWH149'.

The minimum residual pressure found in the assessed domain is 3.52m at 'MWH2044'.

It must be noted that the proposed development does not cause any additional non-compliances within the network.

## CONCLUSION

This Water Network Assessment Memorandum shows that the proposed development can be serviced by the existing potable water network.

Upon the inclusion of the development, the assessment resulted in the following conclusions:

- **Standard Flow Pressure –** Some minimum pressures for both the existing and developed case do not comply with the DSS requirements for the assessed scenario. The proposed development does not cause any additional minimum pressure non-compliances within the network, any non-compliances are current and existing according to the model. The maximum pressure for both the existing and developed case comply with the DSS requirements for the assessed scenario.
- **Standard Flow Velocity –** There are max velocity non-compliances in both the existing and developed scenario. However, the proposed development does not cause any additional non-compliances.
- **Fire Flow –** For both the existing and developed cases, the DSS minimum of 11.8m pressure was not achieved for particular areas in the assessed scenario. There was multiple max velocity non-compliance in both the existing and developed scenarios. However, the proposed development does not cause any additional non-compliances in either low pressure or high velocity.

The above discussion and model analysis indicate that the Iron Gates development, once fully developed and in-use, will have no additional impact on the Evans Head potable water network. This is true for both standard 'Peak Day Demand' and during a Fire Flow event. Issues within the Evans Head network are current and not exaggerated in any aspect from the proposed development.

# APPENDIX H

## SEWER NETWORK CAPACITY ASSESEMENT

MEMO

| | |
|---|---|
| **Date** | 18/04/2019 |
| **To** | Richmond Valley Council |
| **From** | Arcadis |
| **Author** | Ashley Shepherd |
| **Reviewer** | Lachlan Prizeman |
| **Reference** | F0002-10027302-AAR-01 - Sewer Network Memo |
| **Subject** | Evans Heads Sewer Network Capacity Assessment – Iron Gates Development |

## EXECUTIVE SUMMARY

The purpose of this memorandum is to undertake an investigation into how the proposed Iron Gates development affects the surrounding Evan's Head sewer network, utilising the information supplied by Richmond Valley Council (RVC). Based on the information supplied in this document, council engineers will be able to satisfy themselves the DA achieves the relevant considerations of cl 6.2 of the RVLEP 2012.

This memorandum has found that the development flows (9.29L/s) are not exceeding the planned flows (9.4L/s). This is based off the investigation of Richmond Valley Council (RVC) sewerage planning report for Evans Head(*Evans Head Sewerage Augmentation Strategy* (22/153537/78398 R3), undertaken by GHD) and discussion with council regarding their system performance.

## SITE LOCATION AND REFERENCE PLAN

The following reference plan is provided:

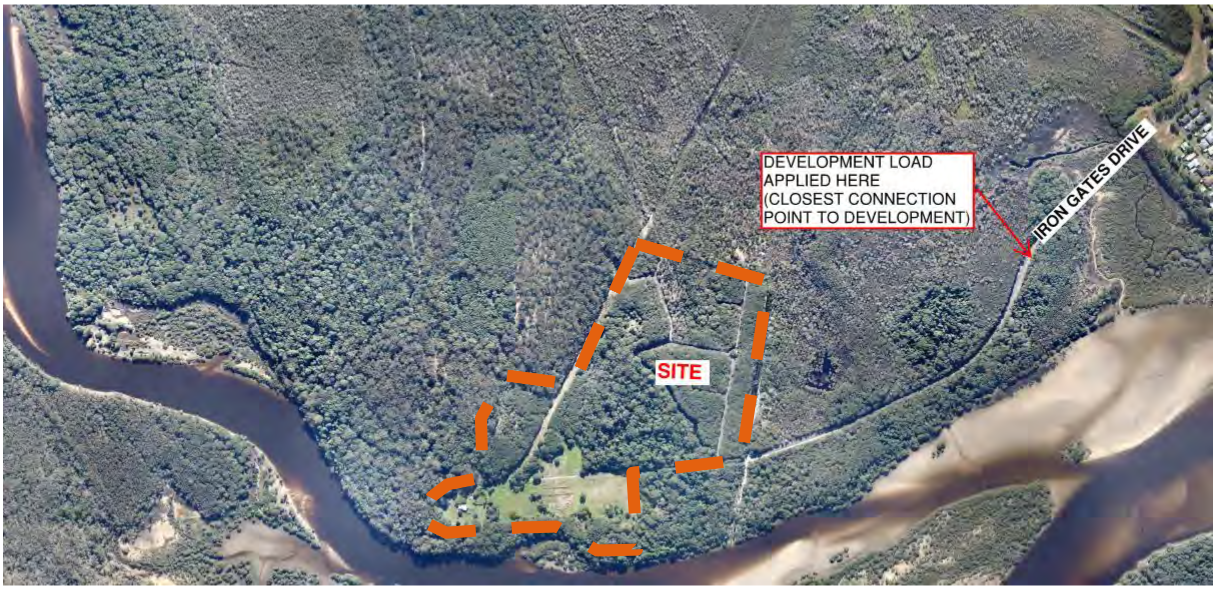


**Figure 1 – Reference Plan (Image courtesy of Nearmap)**

# SEWER NETWORK INFROMATION PROVIDED BY COUNCIL & ASSESSMENT ASSUMPTIONS

RVC's sewer planning strategy for the greater Evans Head Township is summarised in a report, *Review of Evans Head Sewerage Augmentation Strategy* (22/153537/78398 R3), undertaken by GHD in May 2010. This report summaries the existing network performance, future network performance and network augmentations to rectify any network non-compliances. GHD have put forward a number of options that council can utilise to augment their network to rectify these said non-compliances. Arcadis has used this report as a guide to assess the developments impact on the surrounding network. Some key points from this report are summarised below with advice from council;

- RVC confirmed that council has adopted the strategy summarised in Figure 7-7 of the GHD report for the Evans Head sewer network;
- Council have indicated that only the 2008 network upgrades have been undertaken in accordance with the GHD report. No further upgrades in the network have been undertaken.
- RVC strategy is based on an existing population of 3,659 persons for Evans Head;
- RVC strategy is based on an ultimate population forecast in 2050 of 6,101 persons for Evans Head;
- RVC strategy estimates 123ET (11.4L/s) for catchment 2 (Iron Gates connection catchment) in the ultimate;
- RVC strategy has allowed for 100ET (9.4L/s) from the Iron Gates Development;
- Proposed 2008 pump upgrade to pump station EHPS-02 has been completed which provides a flow of 20.8L/s; and
- 2.3 EP/ ET (Based of GHD Report).

Correspondence with RVC has provided the following input and assumptions to assist in the calculations for this memorandum;

- ADWF – 468 L/ET/day (Based on Draft Evans Head Sewer model and confirmed by council officer);
- PWWF – Design Standard stipulates 5 x ADWF, however, Council has noted that their sewer system is more like 7 x ADWF for a PWWF. Therefore, for this assessment 7 x ADWF has been adopted as PWWF; and

General assumptions made for the assessment are summarised below:

- Adopted the *North Coast Regional Plan 2036* target plan of 40% of dwellings to be duel occupancies for development site.

# PROPOSED DEVELOPMENT LOADING

For the purposes of this report, the development has been assessed under two loading cases to better determine the anticipated impact to be had on the surrounding network. These cases are as follows:

- **Existing Case** –Planned loads GHD and council Strategy Report;
- **Developed Case** – The calculated demand for the Iron Gates development based on the latest development plans.

Table 1 below shows the proposed development's calculated Equivalent Tenements (ET).

**Table 1 Existing/ Planned Load for the Site**

| Loading Type | Loading |
|---|---|
| Planned Load | 100ET |

Table 2 below shows the proposed development's calculated Equivalent Tenements (ET).

Table 2 Proposed Development Loadings

| Category | Number of Lots | Conversion Rate | Proposed ET Loading |
|---|---|---|---|
| Single Detached Dwelling Lot | **105** | 1ET/lot | 105 |
| Duplex Dwelling Lot | **70** | 2ET/lot | 140 |
| | | **Total:** | **245** |

## PROPSOED DEVELOPMENT FLOW CALCULAITON

Table 3 demonstrates the calculation of the average dry weather flow and peak wet weather flow from the development.

Table 3 Proposed Development Flows

| Parameter | Result |
|---|---|
| Proposed Development Load | 245ET |
| Average Dry Weather Flow (ADWF) | 1.33 L/s |
| Peak Wet Weather Flow (PWWF) | 9.29 L/s |

## PUMP STATION PS2 CATCHMENT

The above mentioned GHD report has estimated the catchment flows that enter PS2 are made up of two portions. The first portion is the existing development flows which have been estimated at 11.4L/s for PWWF. The secondary flow is from the proposed Iron Gates development which the report estimated to be 9.4L/s. This gives the pump station a total inflow of 20.8L/s. The pump upgrade to cater for this 20.8L/s has confirmed to have been implemented by council.

As seen in the above Table 3 the PWWF from the proposed development is lower than planned loading that GHD and Council have stipulated.

## WIDER SEWER NETWORK IMPLICATIONS

If the general strategy that council has adopted, Figure 7-7, of the GHD report is maintained and followed in its augmentation process, then the proposed development should not cause impact any impacts on the network. If the strategy is not followed, PS2 will still have capacity, however, downstream pump stations might begin to demonstrate non-compliances in the future if the estimated population grows as expected or at a higher rate. If the population remains stagnant there may be opportunity for council to delay augmentation which appears to what is happening as none of the 2014 upgrades have been undertaken. This will however require further studies.

# APPENDIX I

## TRAFFIC REPORT

17 July 2019
Our Ref: 19GCT0119
Council Reference: MCU/2019/127

Attention: Mr Graeme Ingles

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport 4215

Dear Graeme,

**RE: Iron Gates Development, Evans Heads – Residential Subdivision**

TTM Consulting Pty Ltd (TTM) has been engaged, as requested by Gold Coral Pty Ltd, to respond to Section 16.13 and 18.3 of the Richmond Valley Council's Information Request (ref: No.2015/0096, dated 2 February 2019).

TTM has undertaken a traffic study for the proposed 175 residential lot subdivision and prepared a traffic engineering assessment to form part of the revised Iron Gates residential subdivision development application in Evans Heads.

The aim of this assessment is to discuss the proposed access road capacity and impact on the local network.

## Introduction

The site is located along Iron Gates Drive, located approximately 2km west of Evans Head NSW. The property description of the development is Lot 163 DP 831052, Lots 276 and 277 DP 755624, Crown Road Reserve between Lots 163 DP 831052 and Lot 276 DP 755724, Crown Foreshore Reserve and Iron Gates Drive, Evans Head NSW.

The site is currently zoned for General Residential and Environmental Conservation uses according to the Richmond Valley Local Environmental Pan 2012 and is currently provided access from Iron Gates Drive.

## Development Description

The proposed development involves a One Hundred and Eighty Four (184) Lot Subdivision including:

- One Hundred and Seventy Five (175) Residential Lots;
- Three (3) Residue Lots
- Four (4) Public Reserves
- One (1) Drainage Reserve
- One (1) Sewer Pump Station Lot
- Upgrading of Iron Gates Drive
- Demolition of Existing Structures Onsite
- Subdivision Work including road works, drainage, water supply, sewerage, landscaping and embellishment work and street tree planting

## Section 16.13 – Roads and Traffic (Item 1)

*The traffic generating volumes of up to 500AADT represents 91 dwellings. The DA is for 175 residential allotments. The capacity of the existing road, classified as a rural or rural residential road, will be below standard after the construction of the 91st dwelling.*

Response

TTM has estimated the expected peak hour trip generation for the proposed development.

Roads and Maritime Services (RMS) 'Guide to Traffic Generating Developments Updated traffic surveys' (2013) recommends using specific generation rates, for planning purposes, for different development types. Application of these rates to the proposed development, results in the estimate of development site traffic generation, as shown in Table 1.

An in:out split of 20:80 for the morning peak period and 70:30 for the evening peak period has been assumed for the proposed residential dwellings.

TTM has been informed that the proposed development would consist of a mix of 105 residential lots and a maximum of 70 duplex allotments (140 total dwellings). TTM has undertaken the peak hour trip generation estimation based on the maximum dwelling yield across the site.

Table 1: Peak Hour Trip Generation

| Land Use | RMS / RTA Trip Rate | Extent | Trip Generation | In : Out Split | In : Out Trips |
|---|---|---|---|---|---|
| Morning Peak Hour | | | | | |
| Regional Area Dwelling | 0.78 trips per dwelling | 105 dwellings | 82 | 20 : 80 | 16 : 66 |
| Duplex (Medium Density) | 0.6 trips per dwelling | 70 duplexes (140 dwellings) | 84 | 20 : 80 | 17 : 67 |
| Total | | | | | 33 : 133 |
| Evening Peak Hour | | | | | |
| Regional Area Dwelling | 0.71 trips per dwelling | 105 dwellings | 75 | 70 : 30 | 53 : 22 |
| Duplex (Medium Density) | 0.6 trips per dwelling | 70 duplexes (140 dwellings) | 84 | 70 : 30 | 59 : 25 |
| Total | | | | | 112 : 47 |

Generally, the daily trips generated by residential developments is 10 times the peak hour trip generation. Based on the above, the proposed development is expected to generate 1,685 daily vehicle trips. All vehicular trips would access the site via Iron Gates Drive.

TTM have estimated the development traffic distribution and subsequent turning volumes through the Woodburn Street / Wattle Street intersection, as shown in Figure 1 and Figure 2. TTM notes that the estimated traffic would represent the worst case scenario through the Woodburn Street / Wattle Street intersection, as it is likely that some traffic would turn off onto Cypress Street or Cedar Street.


Figure 1: Estimated Development Traffic Distribution

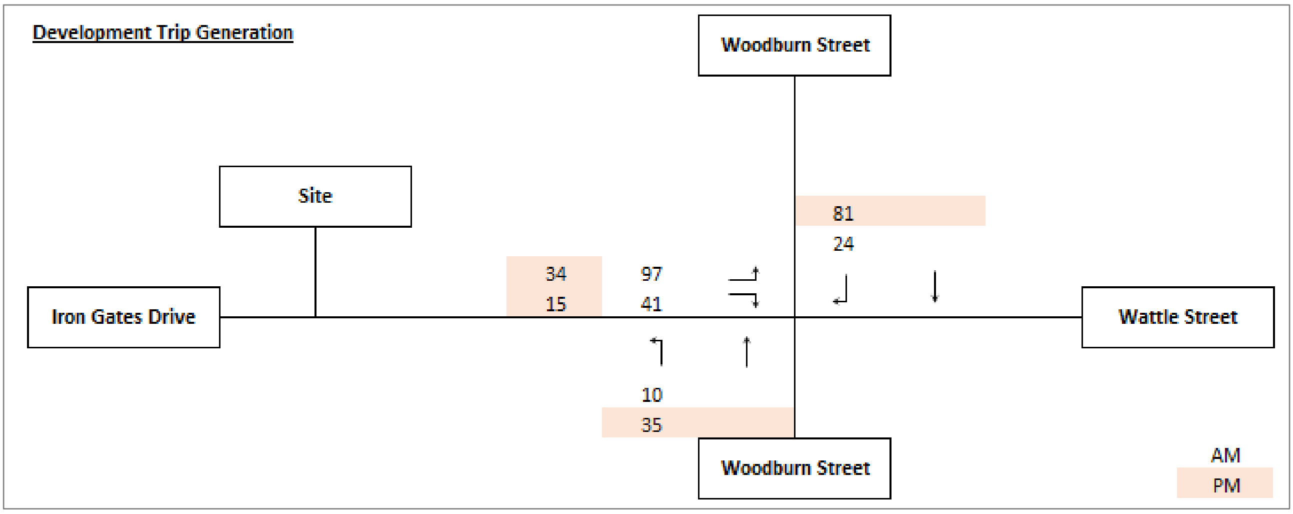


Figure 2: Estimated Turning Volumes – Woodburn Street / Wattle Street

The traffic generated by the proposed development would exceed the threshold of a minor up to 1,000 AADT (for rural roads), as per the NSW Development Design Specification – D1 Geometric Road Design. Table T 1.27 – Carriageway and seal width for rural roads outlines that 'major roads over 1,000 AADT' should be designed with a 7.5m seal and 1.5m shoulders. TTM notes that this design is for all rural roads with an AADT over 1,000 trips.

Table D.1.5 outlines that collector streets (ie maximum AADT 3,000) within a residential subdivision road network should be designed with a carriageway width of 11m. TTM understands that the 11m carriageway includes two 3.5m wide traffic lanes and two 2.0m wide parking lanes. TTM note that there is no demand for parking along Iron Gates Drive, therefore, parking lanes would not be required.

The proposed development is to be an urban subdivision in nature and is to form part of the Evans Head township. Iron Gates Drive is the road connecting the subdivision to the township and is between 1.0-1.5km long.

The nature of Iron Gates Drive is solely to provide connection to the subdivision, would not have a parking demand and does not direct provide vehicle accesses to new single dwellings, as shown in Figure 8. TTM would not consider the road to be solely rural or urban in nature.

It is proposed that improvements be made to Iron Gates Drive, to provide an 8.0m wide two-way carriageway including two 3.5m wide traffic lanes and a 0.5m wide sealed shoulders on either side.

TTM consider that the proposed carriageway is suitable. The use of Iron Gates Drive is to be for both urban and rural purposes; and, the proposed carriageway is to be a medium between the two standard designs. There is suitable carriageway width to accommodate the two-way traffic and there would be suitable area within the verge for broken down vehicles to pull over. Iron Gates Drive would also be a low speed environment with a low volume of heavy vehicle traffic.

## Section 16.13 – Roads and Traffic (Item 2)

*The weight of loads on the bridge is unknown and should be to ensure bushfire tenders can safely cross it and that it has the capacity to provide for the traffic generated by the DA, in particular the impact of transport haulage associated with the bulk earthworks.*

<u>Response</u>

TTM is unaware of any load limits associated with the bridge and there is no signage on the approach to identify limits below the national standard. It is assumed that the bridge was designed and constructed to the relevant design standards at the time of construction. TTM's experience would indicate that the load limit in this case would generally be 42.5t.

The bridge is currently constructed with a 6.2m wide carriageway and a 2.5m walkway (to be retained), including two 3m wide through lanes. 3m wide lanes are in accordance with Austroads Guide to Road Design.

The proposed Iron Gates Road would narrow from an 8m wide carriageway to the 6.2m wide bridge ie by reducing the through lane width and removing the shoulder. TTM considers that the existing bridge width to be suitable, as the provision would provide through lanes that are suitably wide to cater for two-way traffic movements and the pinch point (bridge) only is 18m long (ie 3 car lengths).

TTM recommends that Narrow Bridge (W4-1) signage be installed on both approaches to the bridge.

## Section 16.13 – Roads and Traffic (Item 3)

*The DA does not make any traffic impact assessment relating to the bulk earthworks, which are substantive, given the constraints and condition of Iron Gates Dr.*

*A traffic impact assessment in accordance with RMS guidelines is required to clearly:*

*• Establish the classification of the only link road between an existing township and a proposed 175 residential lot subdivision*

*• Identify the existing condition of Wattle St to and including the intersection of Woodburn St, there existing capacities and when and how these roads should be up-graded (if required) to relevant RVC standards*

*• Identify the existing condition of Iron Gates Dr, its existing capacity and when and how that should be up-graded to relevant RVC and regional standards, and*

*• Identify the existing condition of Iron Gates Dr, is existing capacity and when and how that should be up-graded to the relevant standards required by the NSW RFS.*

*Knowing what are and satisfying the relevant standards required by the NSW RFS for Iron Gates Dr is a key important issue and needs to be clearly documented in both the traffic impact assessment and bushfire threat assessment for the DA.*

Response

As outlined above, the proposed development would generate approximately 1,685 vpd and the proposed design of Iron Gates Road would be effectively to a Collector Standard (without parking lanes). The expected daily traffic along Iron Gates Road would be much lower than 3,000vpd, which is generally the threshold for a Collector Street. Therefore, TTM considers that Iron Gates Road should be classified as a collector street, which in turn would be classified as a Minor Road.

Development Traffic Impact Assessment

TTM have been provided AADT data from the Richmond Valley Council along Woodburn Street, as follows:

- 2007 – 3505 AADT
- 2017 – 4570 AADT

This increase in AADT between 2007 and 2017 corresponds to an average background traffic increase of 2.7% per annum.

TTM has then estimated the base traffic for a 2019 base year scenario to be an AADT of 4,820 vpd. It is estimated that this would correspond to volumes of 240 vehicles in each direction on Woodburn Street during peak hours (ie 10% of daily traffic during peak hours and a 50:50 split).

TTM have estimated the 2032 base case through traffic along Woodburn Street, by applying a compounding growth factor of 2.7% over 15 years), as shown in Figure 3.

The 2032 project case has then been derived from the addition of the development generated traffic, Figure 2, and the 2032 base case scenario, Figure 3. This is shown in Figure 4.

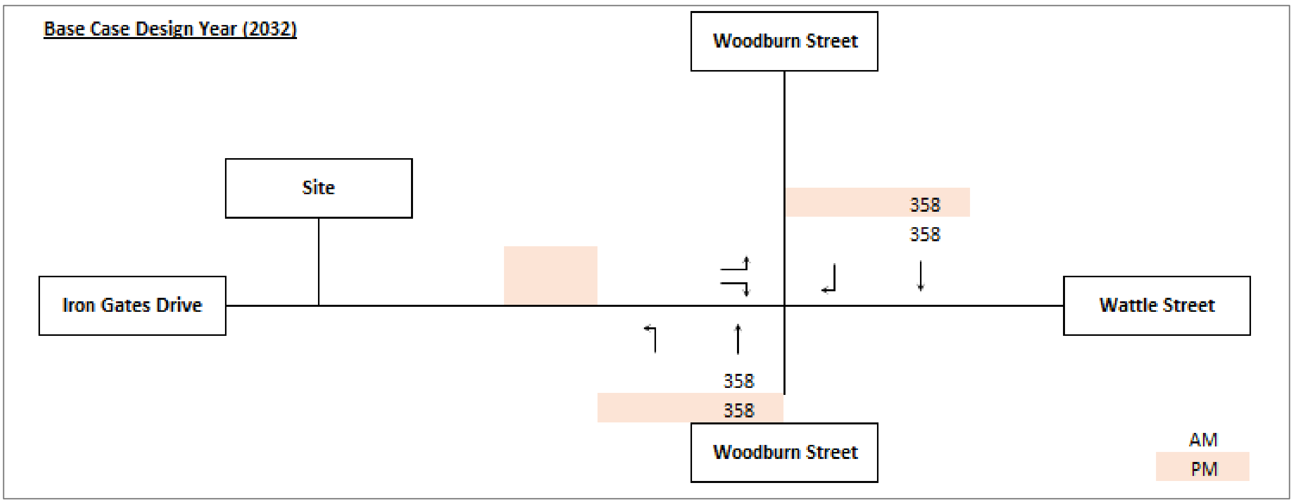


Figure 3: Estimated Local Traffic Movements for Development Generated Traffic 2032 Design Year

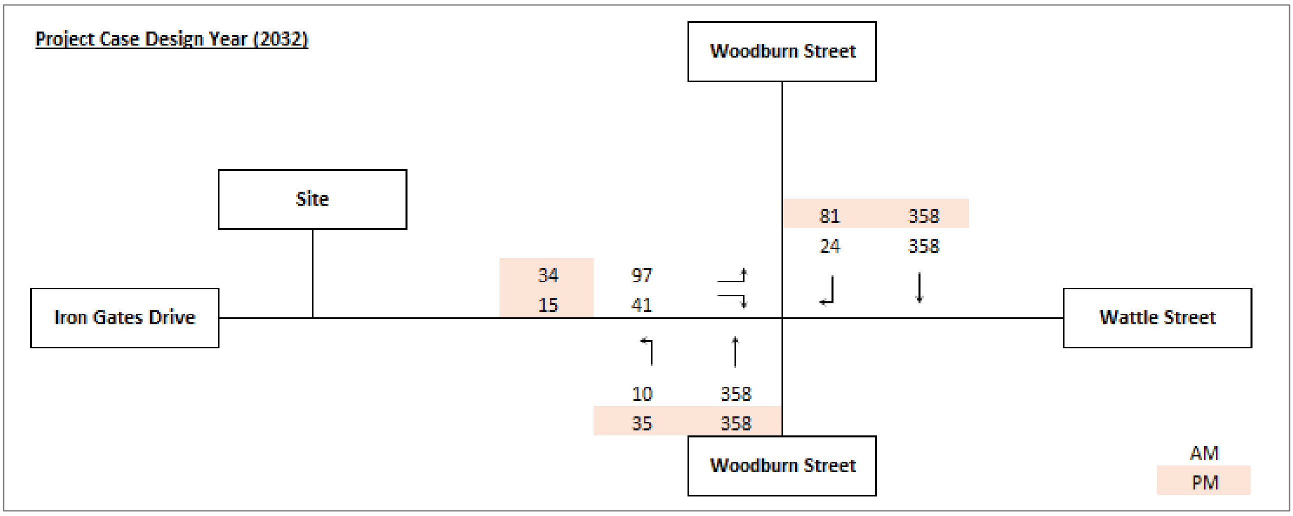


Figure 4: Estimated Local Traffic Movements for Development Generated Traffic 2032 Design Year

TTM have undertaken a turn warrant assessment for the future 2032 project case design year.

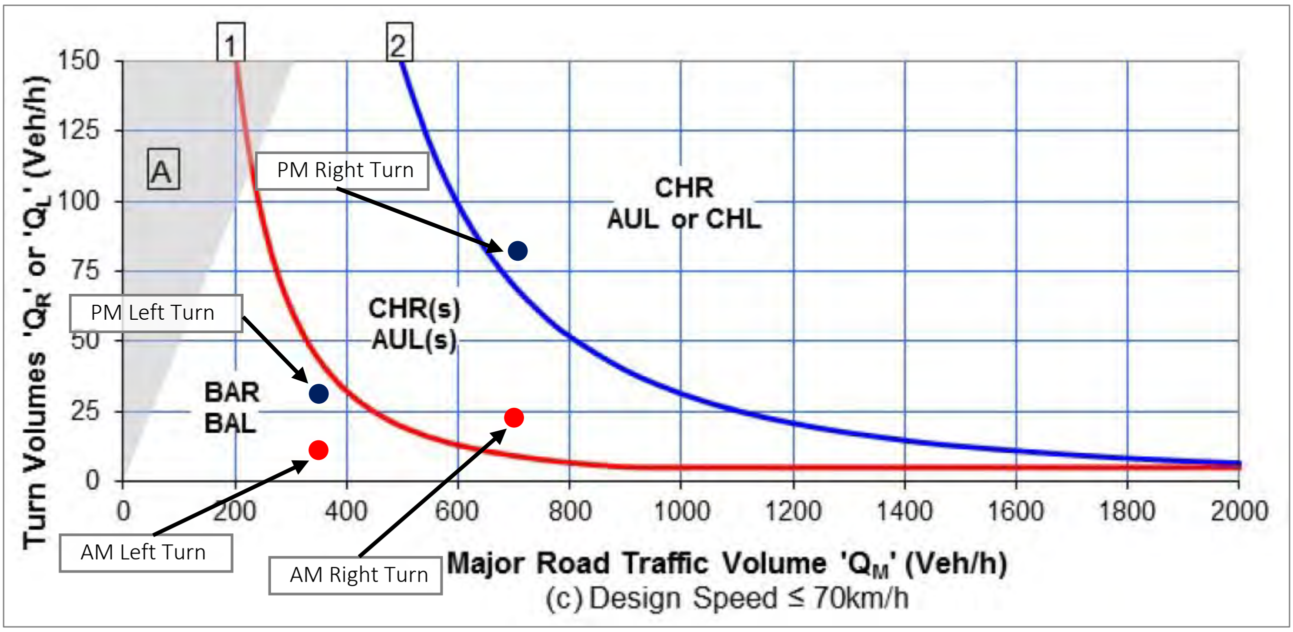


Figure 5: Woodburn Street / Wattle Street Intersection

As it is likely that there would be additional right turning traffic due to existing surrounding uses. TTM considers that a suitable right turn treatment would be a Channelised Right Turn (CHR).

TTM expect that there would be some additional left turning traffic, and a Short Auxiliary Left turn lane (AUL(S)) may be warranted. However, there are no left turning treatments around the Evans Head area, so the provision of such a turning treatment would not be consistent with the surrounding road network and would not meet driver's expectation. Therefore, TTM considers that a Basic Left turn (BAL) turning treatment would be suitable at the Woodburn Street / Wattle Street intersection.

TTM recommends that a CHR and a BAL turning treatment be incorporated into the design of the Woodburn Street / Wattle Street intersection. TTM has prepared a functional layout plan which demonstrates the recommended turning treatments, as shown enclosed. TTM expects that the turning treatments should be able to be completed with linemarking and recommends that it is implemented before the completion of the development.

Bulk Earthworks Traffic Impact Assessment

TTM has been informed by Arcadis that the bulk earthworks would have a duration of 16 weeks of import, 6 days per week for 9 hours per day, expecting 36 truck trips each way per day. This corresponds to a maximum average rate of 4 trucks in per hour and 4 trucks out.

TTM have also been informed that the deliveries would be made by Truck & Dogs (19m) using the Doonbah Quarry 5km west of Evans Head and utilise following route: Evans Head – Woodburn Road then via Wattle Street. So, all delivery traffic would be utilising the Woodburn Street / Wattle Street intersection.

TTM have estimated the turning movements associated with the bulk earthworks, as shown in Figure 6; and, TTM have conducted a turn warrant assessment as shown in Figure 7.

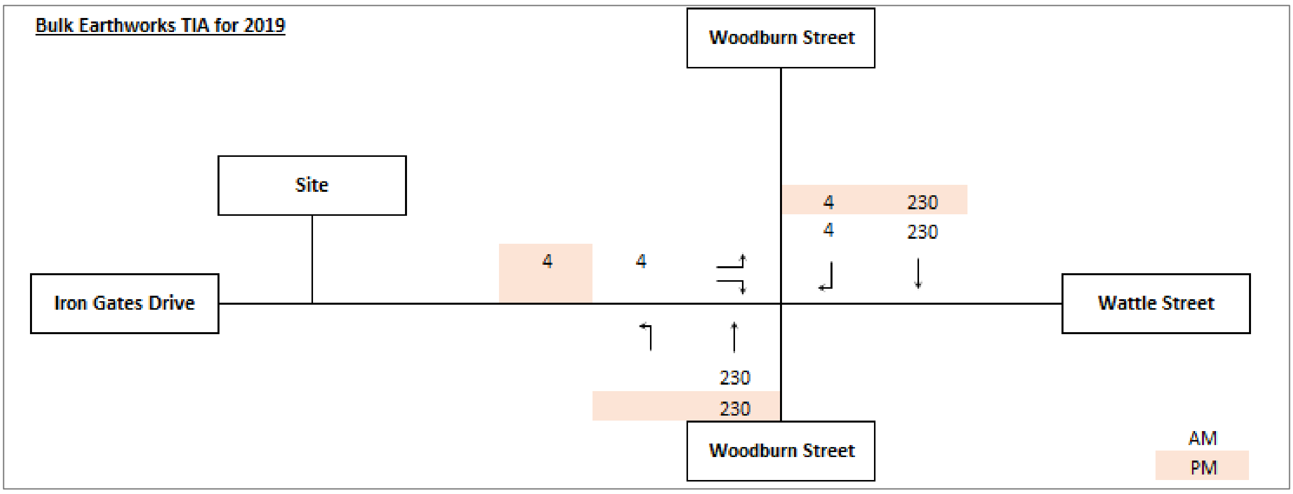


Figure 6: Woodburn Street / Wattle Street Intersection

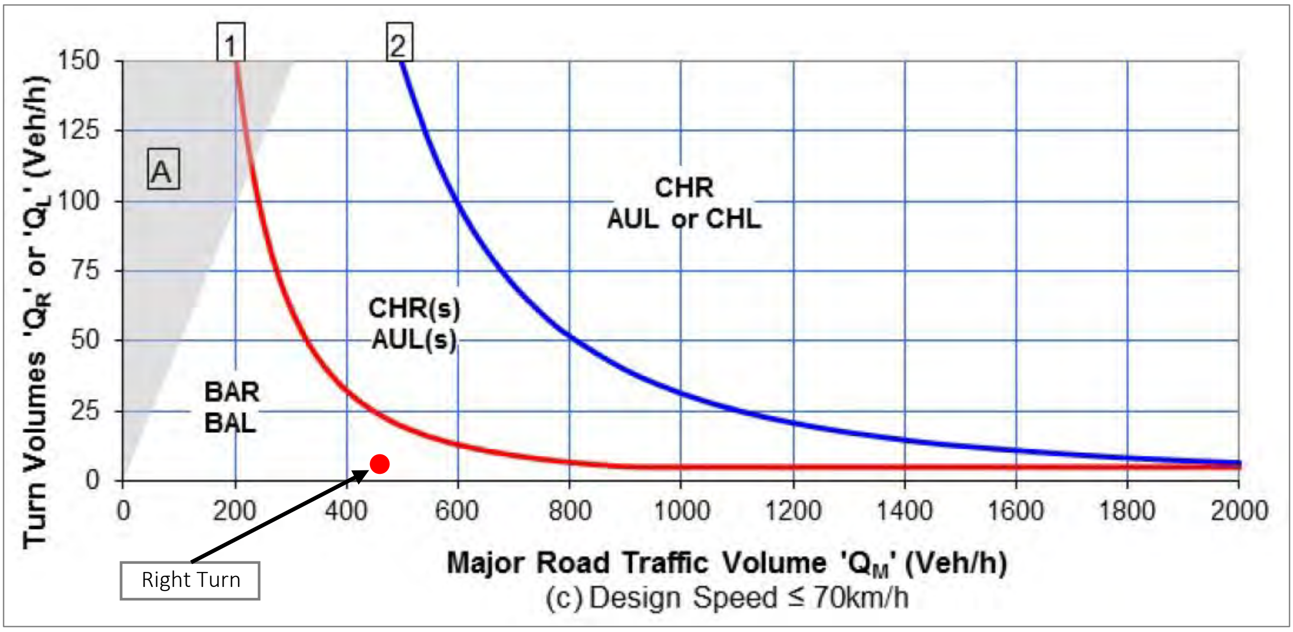


Figure 7: Woodburn Street / Wattle Street Intersection Bulk Earthworks Turn Warrant Assessment

TTM understands that there would be some additional right turning movements considering the surrounding area. However, considering temporary nature of the works and TTM considers that a basic right (BAR) turning treatment would be suitable to cater for the truck and dog delivery vehicles, as there would be no residential activity at this time.

TTM notes that Woodburn Street currently has a 22m wide carriageway, including two 11m wide through lanes (which include informal carparking). There is sufficient width for a through vehicle to pass a waiting right turning vehicle, which would effectively operate as a BAR treatment. Therefore, TTM consider the existing intersection design sufficient to cater for the traffic associated with the proposed bulk earthworks.

TTM have conducted a swept path assessment, which demonstrates that a 19m truck and dog can perform a right turn manoeuvre from Woodburn Street to Wattle Street and a left turn manoeuvre from Wattle Street to Woodburn Street, as shown enclosed. The two manoeuvres are clear of one-another, therefore, TTM consider the proposed intersection layout to be suitable.

<u>NSW RFS</u>

TTM has undertaken a swept path assessment of a firetruck negotiating the Woodburn Street / Wattle Street intersection, as shown enclosed. TTM understands that a firetruck would be able to access all required areas of the proposed development.

## Section 16.13 – Roads (Item 4)

*The report does not seem to have considered the design requirements for buses within the development and indicates that footpaths within the collector and local roads will not be constructed until the majority of houses are built and occupied.*

<u>Response</u>

TTM understands that there is currently a bus stop at Evans Head on Woodburn Street between Elm Street and School Lane, which is located over 1.5km from the proposed development.

TTM understand that there is currently no proposed bus route to the proposed development, however, in the future there is potential for a bus route to the development.

It is proposed that space for a future bus stop be provided along the proposed bus route through the site, as shown in Figure 8, along with the 3 options for bus stops to service the development. This would provide the development access to the future public transport network.

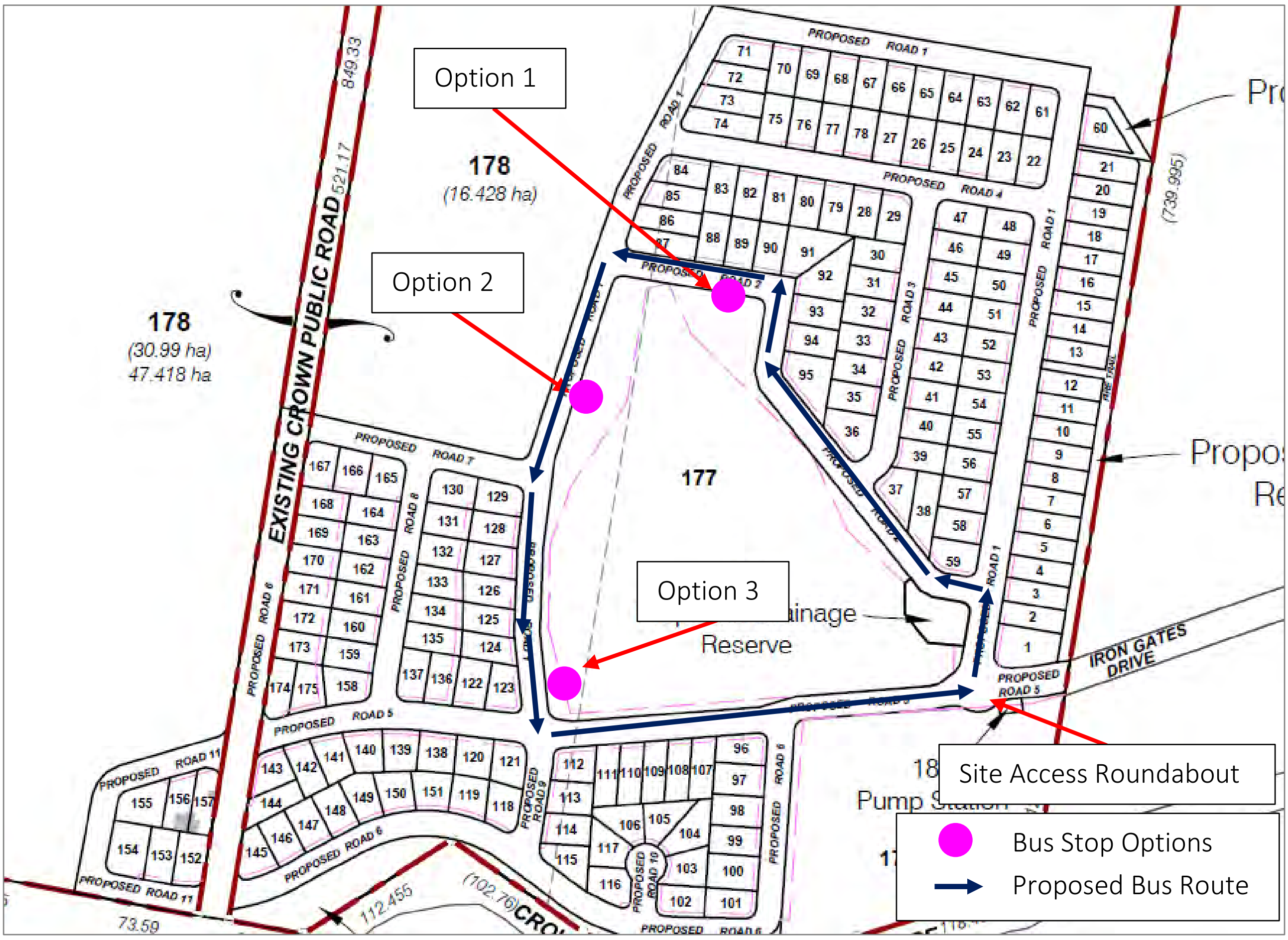


Figure 8: Development Plan – Proposed Bus Route

The site access roundabout (as shown in Figure 8) has been designed with a 34m diameter of road reserve. Assuming 4.25m wide verges, this would allow for a roundabout with a total diameter of 25.5m. This is a sufficient amount of space to design a roundabout that would be able to accommodate a 12.5m long rigid bus, in accordance with Austroads Guide to Road Design Part 4B: Roundabouts.

An example design of such a roundabout would be 6m central island radius, 2m wide mountable surface on the outer edge of the central island and 4.7m wide circulating carriageway widths, which would total to a total radius of 25.4m.

TTM also understand that bus swept paths have been undertaken by the project team that demonstrate that a bus can suitably negotiate the sites internal road network.

Therefore, TTM considers the proposed bus stop arrangements to be suitable to cater for the needs of the development.

## Section 16.13 – Iron Gates Drive Bridge (Item 5)

*The weight of loads limits on the bridge in Iron Gates Drive is unknown and should be, to ensure bushfire tenders can safely cross it and that it has the capacity to provide for the traffic generated by the DA, in particular the impact of transport haulage with the bulk earthworks.*

Response

This has been responded to in TTM's response in Item 2.

## Section 18.3 – SEPP – Infrastructure 2007 (Item 6)

*Access and infrastructure not resolved - insufficient information issues and considerations not resolved.*

Response

TTMs discussion in Item 1 indicates that the proposed Iron Gates Road cross-section is suitable to cater for the proposed development.

## Conclusions

Based on the assessment contained within this letter, it is considered that the proposed local road suitably designed to cater for the expected development traffic and there is to be suitable public transport infrastructure to cater for the needs of the local area.

Yours sincerely,

Brendan Baker

Project Consultant

TTM Consulting Pty Ltd

*Enclosed:* *Development Plans, Functional Layout Plan, Swept Path Assessment*

| Lot Table | |
|---|---|
| Lot | Area |
| 1 | 969 m² |
| 2 | 612 m² |
| 3 | 612 m² |
| 4 | 612 m² |
| 5 | 612 m² |
| 6 | 612 m² |
| 7 | 612 m² |
| 8 | 612 m² |
| 9 | 612 m² |
| 10 | 612 m² |
| 11 | 612 m² |
| 12 | 612 m² |
| 13 | 612 m² |
| 14 | 612 m² |
| 15 | 612 m² |
| 16 | 612 m² |
| 17 | 612 m² |
| 18 | 612 m² |
| 19 | 612 m² |
| 20 | 612 m² |
| 21 | 649 m² |
| 22 | 615 m² |
| 23 | 600 m² |
| 24 | 600 m² |
| 25 | 600 m² |
| 26 | 600 m² |
| 27 | 600 m² |
| 28 | 600 m² |
| 29 | 627 m² |
| 30 | 600 m² |
| 31 | 600 m² |
| 32 | 600 m² |
| 33 | 600 m² |
| 34 | 600 m² |
| 35 | 600 m² |
| 36 | 788 m² |
| 37 | 674 m² |
| 38 | 775 m² |
| 39 | 612 m² |
| 40 | 604 m² |
| 41 | 604 m² |
| 42 | 604 m² |
| 43 | 604 m² |
| 44 | 604 m² |
| 45 | 604 m² |
| 46 | 604 m² |
| 47 | 609 m² |
| 48 | 605 m² |
| 49 | 600 m² |
| 50 | 600 m² |
| 51 | 600 m² |
| 52 | 600 m² |
| 53 | 600 m² |
| 54 | 600 m² |
| 55 | 600 m² |
| 56 | 600 m² |
| 57 | 623 m² |
| 58 | 623 m² |
| 59 | 633 m² |
| 60 | 632 m² |
| 61 | 618 m² |
| 62 | 604 m² |
| 63 | 604 m² |
| 64 | 605 m² |
| 65 | 606 m² |
| 66 | 606 m² |
| 67 | 607 m² |
| 68 | 607 m² |
| 69 | 608 m² |
| 70 | 609 m² |

| Lot Table | |
|---|---|
| Lot | Area |
| 71 | 607 m² |
| 72 | 608 m² |
| 73 | 682 m² |
| 74 | 766 m² |
| 75 | 600 m² |
| 76 | 600 m² |
| 77 | 600 m² |
| 78 | 600 m² |
| 79 | 600 m² |
| 80 | 601 m² |
| 81 | 601 m² |
| 82 | 601 m² |
| 83 | 601 m² |
| 84 | 608 m² |
| 85 | 614 m² |
| 86 | 634 m² |
| 87 | 696 m² |
| 88 | 602 m² |
| 89 | 602 m² |
| 90 | 602 m² |
| 91 | 859 m² |
| 92 | 856 m² |
| 93 | 603 m² |
| 94 | 603 m² |
| 95 | 954 m² |
| 96 | 616 m² |
| 97 | 663 m² |
| 98 | 657 m² |
| 99 | 602 m² |
| 100 | 723 m² |
| 101 | 605 m² |
| 102 | 609 m² |
| 103 | 620 m² |
| 104 | 714 m² |
| 105 | 602 m² |
| 106 | 604 m² |
| 107 | 602 m² |
| 108 | 602 m² |
| 109 | 602 m² |
| 110 | 602 m² |
| 111 | 601 m² |
| 112 | 600 m² |
| 113 | 600 m² |
| 114 | 600 m² |
| 115 | 608 m² |
| 116 | 601 m² |
| 117 | 602 m² |
| 118 | 600 m² |
| 119 | 601 m² |
| 120 | 600 m² |
| 121 | 600 m² |
| 122 | 647 m² |
| 123 | 619 m² |
| 124 | 603 m² |
| 125 | 600 m² |
| 126 | 646 m² |
| 127 | 661 m² |
| 128 | 626 m² |
| 129 | 600 m² |
| 130 | 639 m² |
| 131 | 602 m² |
| 132 | 602 m² |
| 133 | 600 m² |
| 134 | 618 m² |
| 135 | 623 m² |
| 136 | 604 m² |
| 137 | 602 m² |
| 138 | 600 m² |
| 139 | 600 m² |
| 140 | 600 m² |

| Lot Table | |
|---|---|
| Lot | Area |
| 141 | 600 m² |
| 142 | 600 m² |
| 143 | 605 m² |
| 144 | 600 m² |
| 145 | 600 m² |
| 146 | 601 m² |
| 147 | 600 m² |
| 148 | 600 m² |
| 149 | 601 m² |
| 150 | 601 m² |
| 151 | 600 m² |
| 152 | 665 m² |
| 153 | 629 m² |
| 154 | 834 m² |
| 155 | 765 m² |
| 156 | 603 m² |
| 157 | 627 m² |
| 158 | 644 m² |
| 159 | 601 m² |
| 160 | 601 m² |
| 161 | 601 m² |
| 162 | 601 m² |
| 163 | 601 m² |
| 164 | 601 m² |
| 165 | 600 m² |
| 166 | 601 m² |
| 167 | 602 m² |
| 168 | 602 m² |
| 169 | 602 m² |
| 170 | 602 m² |
| 171 | 602 m² |
| 172 | 602 m² |
| 173 | 602 m² |
| 174 | 614 m² |
| 175 | 600 m² |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |

LEGEND:

SITE BOUNDARY

PROPOSED EASEMENT


NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

(i) This plan was prepared for the purpose and exclusive use of THE INGLES GROUP to accompany an application to RICHMOND VALLEY for approval to reconfigure the land described in this plan and is not to be used for any other purpose or by any other person or corporation. LandPartners Pty Ltd accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention of the terms of this clause or clauses (ii) or (iii) hereof.

(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

| LOTS | TOTAL AREA |
|---|---|
| Residential Lots (175) | 16.884ha |
| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

40m 0 80 200m

SCALE 1:4000 @ A1

LANDPARTNERS built environment consultants


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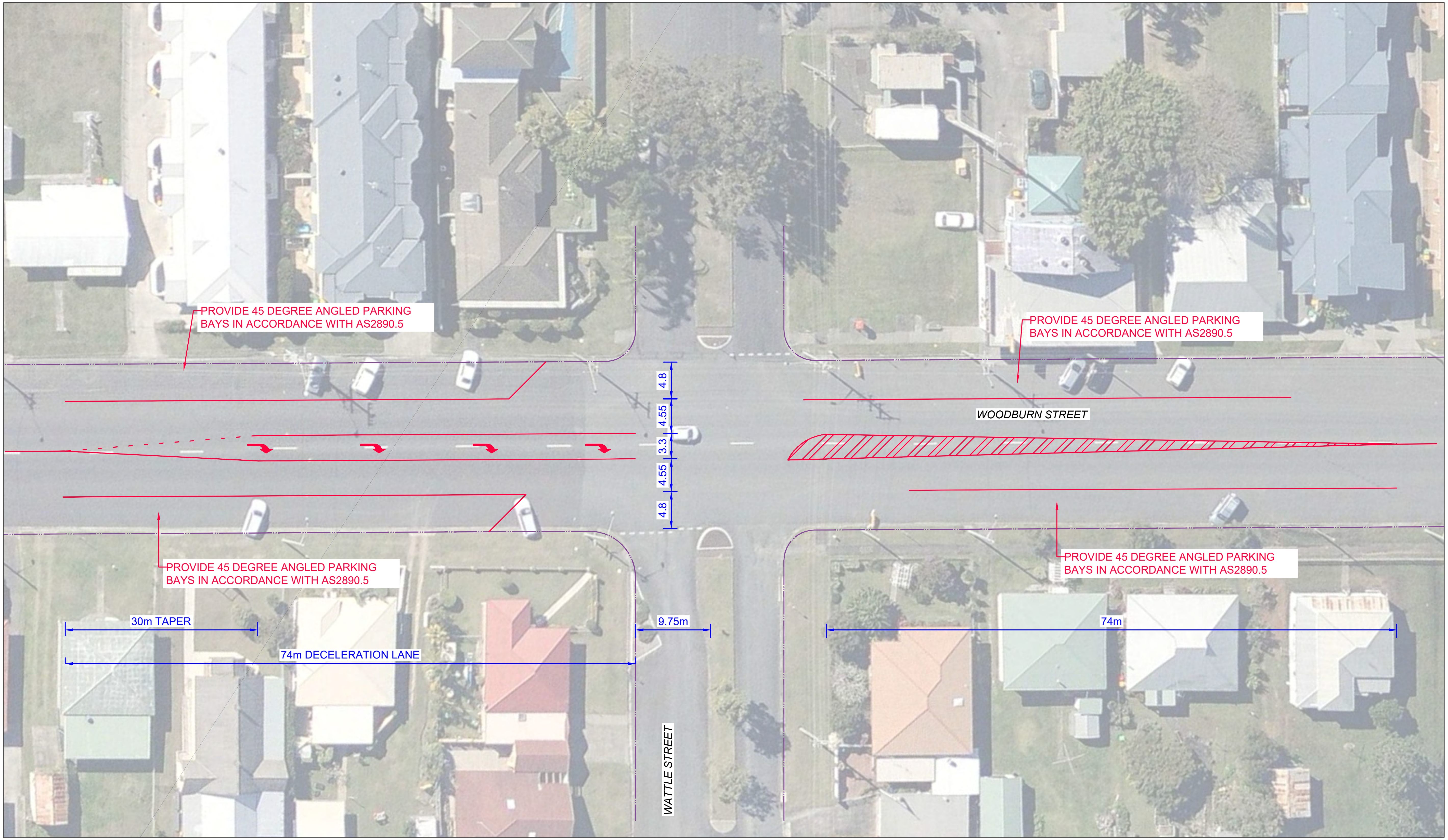
| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16 |
| DRAWN CGW | DATE 27/06/2019 |
| CHECKED CMJ | DATE 27/06/2019 |
| APPROVED CGW | DATE 27/06/2019 |
| PLAN NUMBER BRJD6396.100-015 | SHEET 1 OF 2 |
| REV | M |




**PRELIMINARY**

ISSUED FOR COMMENT ONLY

m:\synergy\projects\19gct\19gct0119 iron gates development\3 - plans\ttm\19 06 20 - chr(s) linemarking\19gct0119.dwg

| REV. | DATE | AMENDMENT DESCRIPTION | DRAWN | CHECKED | APPROVED |
|---|---|---|---|---|---|
| A | 05-07-19 | ORIGINAL ISSUE | LD | BB | BB |

SCALE 0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

NORTH

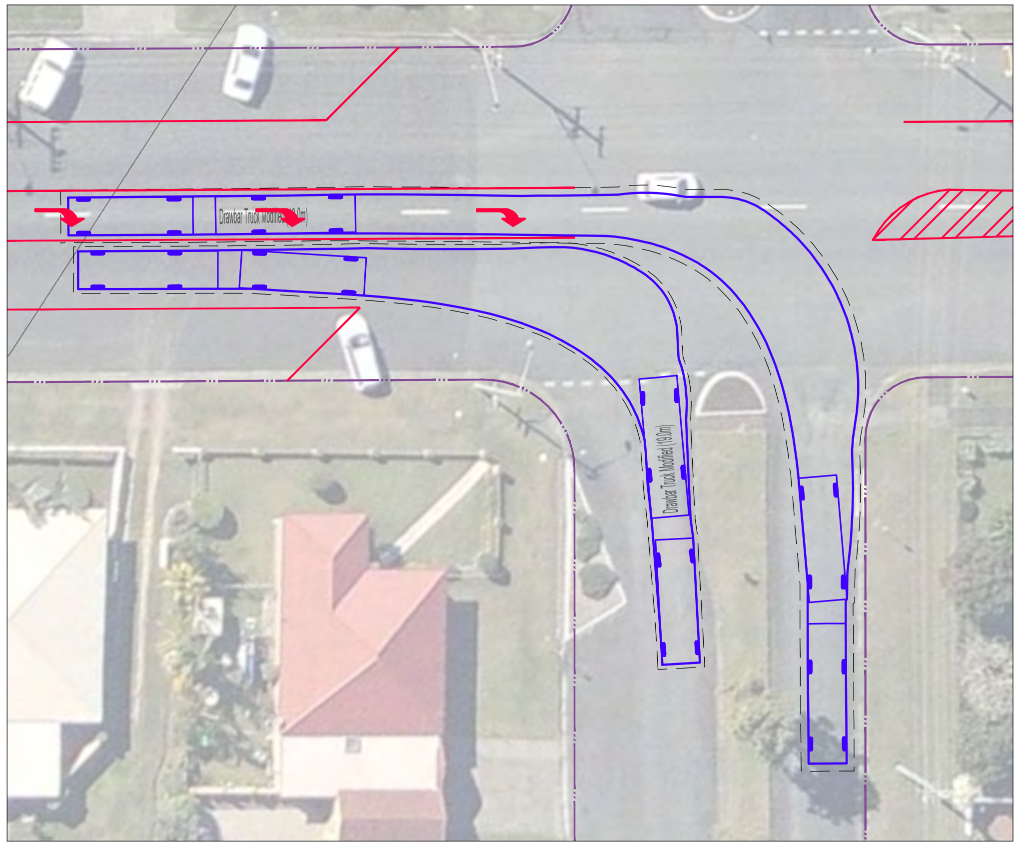
CLIENT: ARCADIS

TTM CONSULTING PTY LTD
ABN 65 010 868 621
41A Quay Street, Sanctuary Cove, QLD, 4212
P.O. BOX 930, Sanctuary Cove, QLD, 4212
T: (07) 5514 8000 F: (07) 5514 8144
E: ttmgc@ttmgroup.com.au W: www.ttmgroup.com.au

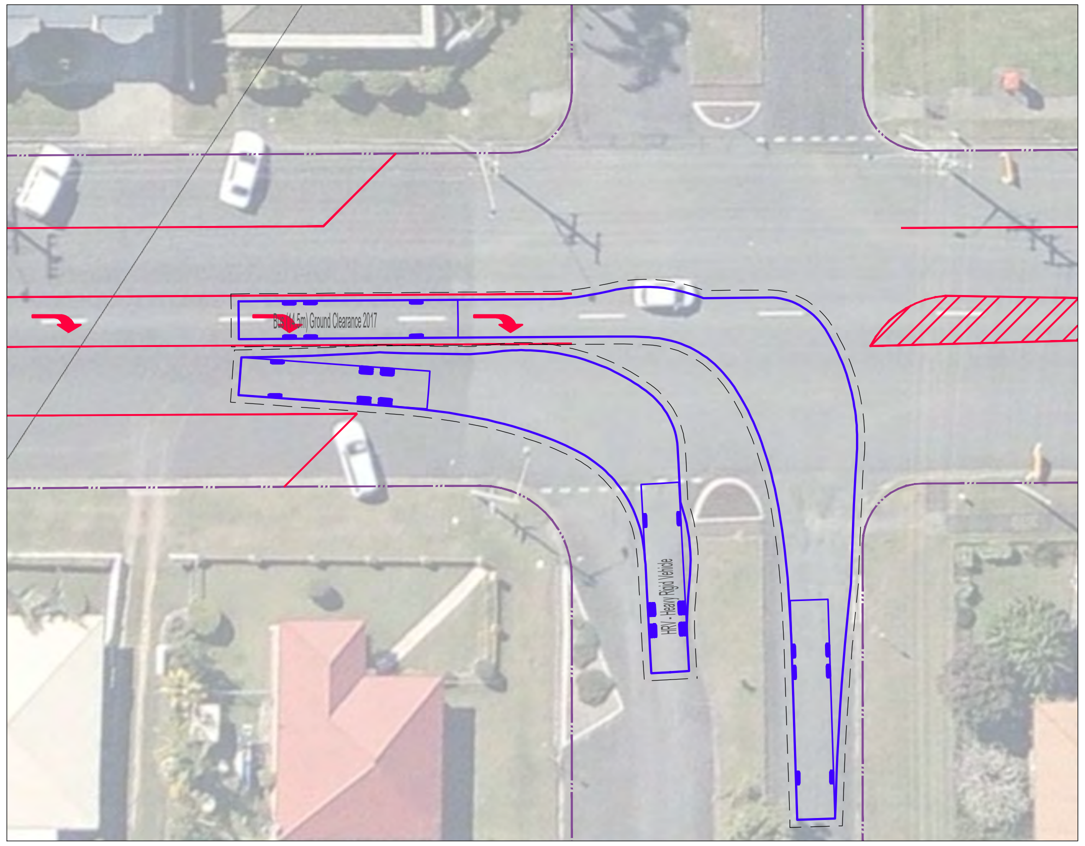
PROJECT: IRON GATES DEVEPMENT

DRAWING TITLE: **FUNCTIONAL LAYOUT WOODBURN STREET & WATTLE STREET**

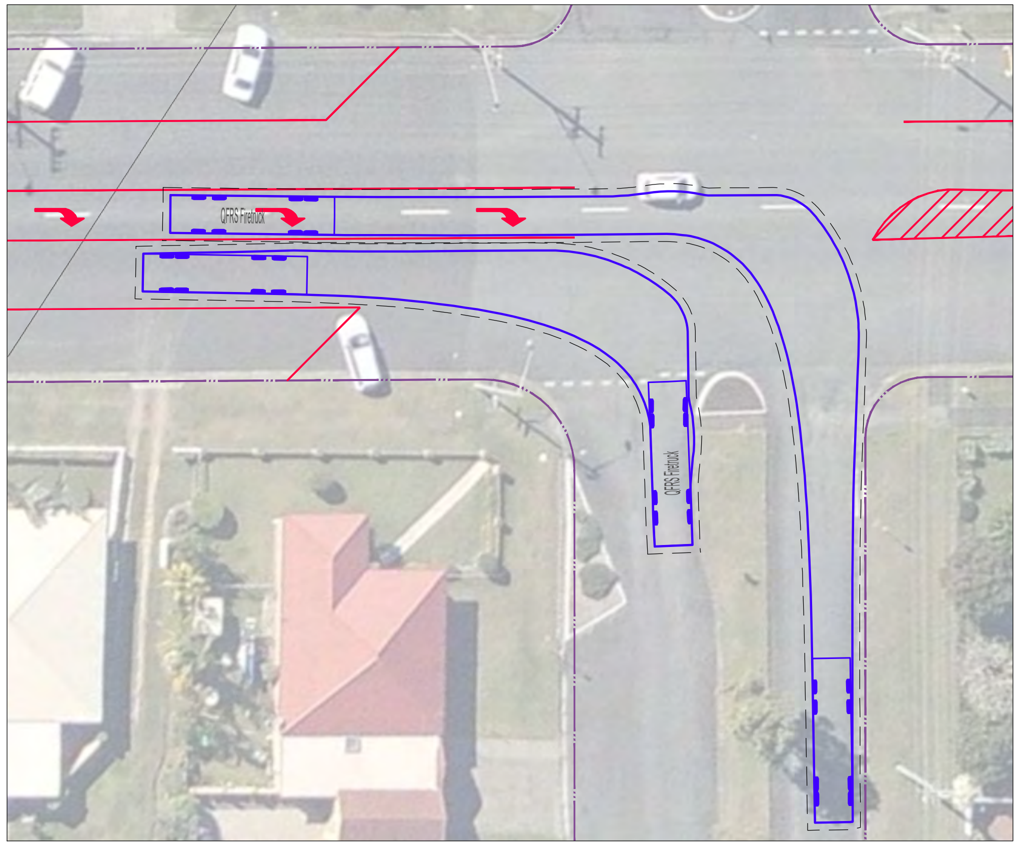
| PROJECT NUMBER | ORIGINAL SIZE |
|---|---|
| 19GCT0119 | A3 |
| DRAWING NUMBER | REVISION |
| 19GCT0119-01 | A |
| DATE | SHEET |
| 5 Jul 2019 | 1 OF 1 |



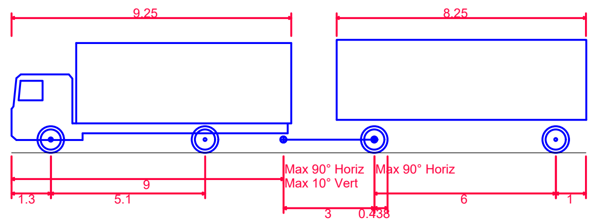

TRUCK AND DOG - ENTRY




14.5m BUS - ENTRY

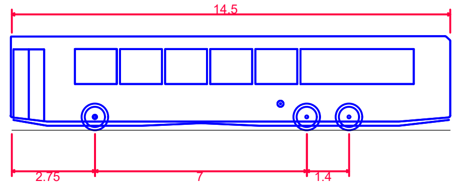



QFRS FIRE TRUCK - ENTRY



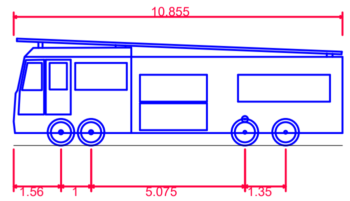

Drawbar Truck Modified (19.0m)

| | |
|---|---|
| Overall Length | 19.000m |
| Overall Width | 2.500m |
| Overall Body Height | 3.738m |
| Min Body Ground Clearance | 0.427m |
| Track Width | 2.500m |
| Lock-to-lock time | 6.00s |
| Curb to Curb Turning Radius | 9.600m |




Bus (14.5m) Ground Clearance 2017

| | |
|---|---|
| Overall Length | 14.500m |
| Overall Width | 2.500m |
| Overall Body Height | 3.102m |
| Min Body Ground Clearance | 0.150m |
| Track Width | 2.500m |
| Lock-to-lock time | 6.00s |
| Curb to Curb Turning Radius | 12.135m |




QFRS Firetruck

| | |
|---|---|
| Overall Length | 10.855m |
| Overall Width | 2.500m |
| Overall Body Height | 3.533m |
| Min Body Ground Clearance | 0.418m |
| Track Width | 2.500m |
| Lock-to-lock time | 4.00s |
| Curb to Curb Turning Radius | 11.500m |

**PRELIMINARY**
ISSUED FOR COMMENT ONLY

| REV. | DATE | AMENDMENT DESCRIPTION | DRAWN | CHECKED | APPROVED |
|---|---|---|---|---|---|
| A | 05-07-19 | ORIGINAL ISSUE | LD | BB | BB |

SCALE 0 2.5 5 7.5 10 12.5m
SCALE 1:250 AT ORIGINAL SIZE

NORTH

CLIENT: ARCADIS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PROJECT: **IRON GATES DEVEPMENT**

DRAWING TITLE: **SWEPT PATH ASSESSMENT**
**WOODBURN STREET & WATTLE STREET**

| PROJECT NUMBER | ORIGINAL SIZE |
|---|---|
| 19GCT0119 | A3 |
| DRAWING NUMBER | REVISION |
| 19GCT0119-02 | A |
| DATE | SHEET |
| 5 Jul 2019 | 1 OF 1 |

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# APPENDIX J

## STAGE 1 PRELIMINARY CONTAMINATION ASSESSMENT

# GOLDCORAL PTY LTD

# STAGE 1 PRELIMINARY CONTAMINATION ASSESSMENT

Iron Gates Development – Evans Head NSW

08 JULY 2019

# CONTACT

**SIMON GROTH**
**Principal Environmental Scientist**

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Arcadis
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Brisbane QLD 4000

# GOLDCORAL PTY LTD IRON GATES DEVELOPMENT – EVANS HEAD NSW

## STAGE 1 PRELIMINARY CONTAMINATION ASSESSMENT

| | |
|---|---|
| **Author** | Simon Groth |
| **Checker** | Gerard Dick |
| **Approver** | Simon Groth |
| **Report No** | 10027302 – PCA – R1 |
| **Date** | 2/07/2019 |
| **Revision Text** | 01 |



## REVISIONS

| Revision | Date | Description | Prepared by | Approved by |
|---|---|---|---|---|
| 0 | 28/08/14 | STAGE 1 PRELIMINARY CONTAMINATION ASSESSMENT | Simon Groth | Simon Groth |
| 1 | 02/07/19 | STAGE 1 PRELIMINARY CONTAMINATION ASSESSMENT | Simon Groth | Simon Groth |

# CONTENTS



# APPENDICES

# EXECUTIVE SUMMARY

Arcadis Consulting Pty Ltd (Arcadis) has been commissioned by Goldcoral Pty Ltd to undertake a Stage 1 Preliminary Contamination Assessment (PCA) of the proposed Iron Gates residential development, Evans Head.

The scope of this study was the "development area" as detailed in the locality plan provided below. The development site is located approximately 1.7 kilometres south-west of Evans Head township. This is the area that will be directly disturbed as a result of the construction required for the development. This includes bulk earthworks, road construction and ancillary activities such as stockpile and compound sites, utility installation and access requirements, and any alterations to intersections. The purpose of the investigation was to identify high risk activities with the potential to cause substantial contamination which may have occurred or are occurring within and adjacent to the development area. Such activities may require remediation or management through construction. The investigation was undertaken in accordance with the relevant Office of Environment and Heritage (OEH) guidelines and standard industry practice.

As part of the investigation, the following was undertaken:

- A desktop review of available aerial photographs, land title certificates, contaminated sites databases, groundwater, soil and geology databases and relevant available historical reports and documentation as required; and
- A visual, non-intrusive site inspection of the proposal area.

Based on information obtained from the desktop review, potential environmental issues at the site can be summarised as follows:

- During the 1970s and early 1980s sand mining activities took place. As a result, tailings dams may have concentrated monazite separated out as part of the mining process. Monazite tailing can be responsible for elevated radiation levels and potentially causes health risks.

A site inspection was undertaken on 22 May 2014. The site visit involved identifying activities or site features that may be associated with potential contamination being present. These locations were closely inspected and reference made to the concept plan of the development works proposed. Site inspection photographs are provided in Appendix 3. No contaminating activities or evidence of contamination was identified during the site inspection.

A subsequent Preliminary Radiation Site Assessment was also undertaken by Arcadis on 17 June 2014 (Provided in Appendix D). The site visit involved identifying activities or site features that may be associated with past sand mining activities being present in areas identified in historic aerial photographs. These locations were closely inspected and reference made to the concept plan of the development works proposed.

No contaminating activities or evidence of mineral sand staining was identified during the site inspection. Surface radiation levels were also monitored on the Iron Gates site in areas where previous sand mining activities were located are all equivalent to background levels displayed at the three off site background control locations. Surface radiation levels generally varied between 0.00 uSv/Hr to 0.3 uSv/Hr. Some discrete areas displayed levels of 0.4 and 0.5 uSv/Hr however these areas are still below Action Level Criteria for dwellings.

Based on the desktop reviews and site assessment undertaken, further surface radiation level monitoring should be undertaken in areas where earthworks more than 1 metre below current surface levels during construction to determine the presence/absence of contaminated materials in the form of radioactive residues associated with sand mining activities.

# 1 INTRODUCTION

## 1.1 Background

Arcadis Consulting Pty Ltd (Arcadis) has been commissioned by Goldcoral Pty Ltd to undertake a Stage 1 Preliminary Contamination Assessment (PCA) of the proposed Iron Gates residential development, Evans Head.

The purpose of this investigation was to identify any risks and constraints to the proposal through identification of areas of potentially contaminated land. This report has been produced as a requirement of the NSW Department of Planning Director General's Requirements under Section 75F of the Environmental Planning and Assessment Act 1979. This report specifically addresses SEPP 55 – Remediation of Land.

This assessment has been carried out in accordance with the relevant guidelines entitled "Contaminated Sites – Guidelines for Consultants Reporting on Contaminated Sites" and standard industry practices outlined by the NSW Office of Environment and Heritage (OEH).

This report will:

- Identify past and present potentially contaminating activities.
- Identify potential contamination sites.
- Discuss the site condition.
- Provide a preliminary assessment of potential site contamination.
- Assess the need for further investigations.

## 1.2 Site Identification

The scope of this study was the "development area" as detailed in the locality plan provided below. The development site is located approximately 1.7 kilometres south-west of Evans Head township. This is the area that will be directly disturbed as a result of the construction required for the development. This includes bulk earthworks, road construction and ancillary activities such as stockpile and compound sites, utility installation and access requirements, and any alterations to intersections. The location of the proposal is illustrated in Figure 1 (A detailed locality plan with development layout is provided in Appendix 1).


Figure 1: Site locality plan showing the development area

## 1.3 Objective

The objective of this contamination investigation was to identify potential risks associated with contamination based on past and present land uses in the study area and to identify areas that may require remediation or management through construction phases.

Carrying out the Stage 1 Preliminary Contaminated Assessment will provide the Goldcoral Pty Ltd with information on potential risks associated with contamination based on past and present land uses. The process will identify where there is a contamination risk that warrant additional intrusive investigations to characterise the presence and extent of any impact on the development area. The outcomes of this Stage 1 Preliminary Contaminated Assessment will inform management actions for ongoing protection of the environment and provide baseline information to monitor future change.

## 1.4 Scope of Works

To achieve the above outlined objectives the following scope of works was undertaken:

- Desktop review of site history information of the proposal site and adjoining sites to identify potential areas of environmental concern. Where available, this included review of the following information sources:
  - Historical titles.
  - Historical aerial photographs (from 1953 to present, where available).
  - Previous environmental reports for the site.
  - Licences and notices (i.e. water discharge licences, hazardous materials, trade waste etc.).
  - Groundwater bore database search.
  - Publicly available records comprising topographic, geological and hydrogeological maps.
  - Trade waste plans and EPA licence (where available).
- A site walkover by an Arcadis representative; which included:
  - Identification of current activities within the study area.
  - Identification of any chemical or fuel storage areas.
  - Identification of potential sources of contamination.
  - General review of current and/or previous operations within the area of impact.
  - Identification of the current uses of adjoining properties.
  - Checking the validity of publicly available information (as listed above).
  - General description of structures, storage facilities, disposal areas etc., within the study area.
  - Checking for signs of ground contamination that are visible on the ground surface.
  - Detailing waste disposal locations along the study area.
- Preparation of a Stage 1 Preliminary Contaminated Assessment Report for the proposal.

## 1.5 Limitations

The results of this assessment are based on the site inspection undertaken by Arcadis personnel and specialists from accessible areas, information provided by Goldcoral Pty Ltd and publically available background information. This assessment is limited strictly to identifying typical environmental conditions associated with the study area. All environmental and contaminated land work is subject to general limitations related to the heterogeneity of the natural environment, variability of contaminant distribution and constraints imposed by the investigation methods utilised. Arcadis has performed the services in a manner consistent with the level of care and expertise exercised by members of the environmental consulting profession. No warranties expressed or implied are made. All conclusions and recommendations are the professional opinions of the Arcadis personnel and specialists involved in the project, subject to the qualifications made above. While normal assessments of data reliability have been made, Arcadis assumes no responsibility or liability for errors in any data obtained from external sources, or developments resulting from situations outside the scope of this project.

Specifically, with regard to this report, it should be noted that the scope of works carried out herein is not intended to include sufficient information to enable completion of a statutory audit of the site, and as such does not include the following:

- Any intrusive soil/groundwater sampling and analysis.
- Sampling and analysis of any emissions to air, wastewater discharges or solid and liquid wastes.

Please ensure that these limitations are understood before utilising or basing decisions on the information presented in this report.

# 2 GEOLOGY AND HYDROLOGY

## 2.1 Geology

The Australian Stratigraphic Units Database describes the Evan Head area (Evans Head Coal Measure) as Thin- to thick-bedded, crossbedded, coarse-grained quartz to sublithic arenite, thinly-bedded grey siltstone, claystone, minor coal, as partings and very thin bands. The Evans Head area belongs to the Ipswich Basin Geological Province.

Basic geological mapping of the area indicates that the Evans Head headlands are comprised of different types of sediments. These are all very recent which geologically places them at Quaternary (or more specifically Pleistocene to Holocene aged) comprising mainly sands in the beach and dune systems and silts and clays around the river estuary. Many of the Holocene aged sediments contain potential acid sulfate soils, which are common in the region. Acid sulphate soils are covered in more detail in section 2.3 of this report.

## 2.2 Contaminated Land Search

A contaminated land search of the NSW EPA online contaminated land record was undertaken to identify contaminated sites in the area. Results of these searches are summarised below in Table 1.

**Table 1: contaminated Land search for Evans Head**

| Suburb/City | Site description and address | EPA initial assessment | EPA site management class |
|---|---|---|---|
| Evans Head | Bundjalung National Park<br>Gap Road | Unclassified | The EPA is awaiting further information to progress its initial assessment of this site. |
| Evans Head | Evans Head Aerodrome Memorial Airport Drive | Other Industry | Based on the information made available to the EPA to date, the contamination of this site is considered by the EPA to be not significant enough to warrant regulatory intervention under the *Contaminated Land Management Act 1997.* |
| Evans Head | Evans Head Residential subdivision<br>Bounded by Currajong, Woodburn, Carrabeen Streets and Tuckeroo Cres | Unclassified | Based on the information made available to the EPA to date, the contamination of this site is considered by the EPA to be not significant enough to warrant regulatory intervention under the Contaminated Land Management Act 1997. |

## 2.3 Surface Hydrology and Hydrogeology

The study area bounds Evans river to the south and has wetlands to the east of the site which drain toward the Evans River to the south. An online search of the Groundwater Bores (http: http://www.bom.gov.au/water/groundwater/explorer/map.shtml) was undertaken. Through this search it was found that the closest groundwater monitoring bores are located east of the development site located in the township of Evans Head. Figure 2 below shows the location of the surrounding groundwater bores.

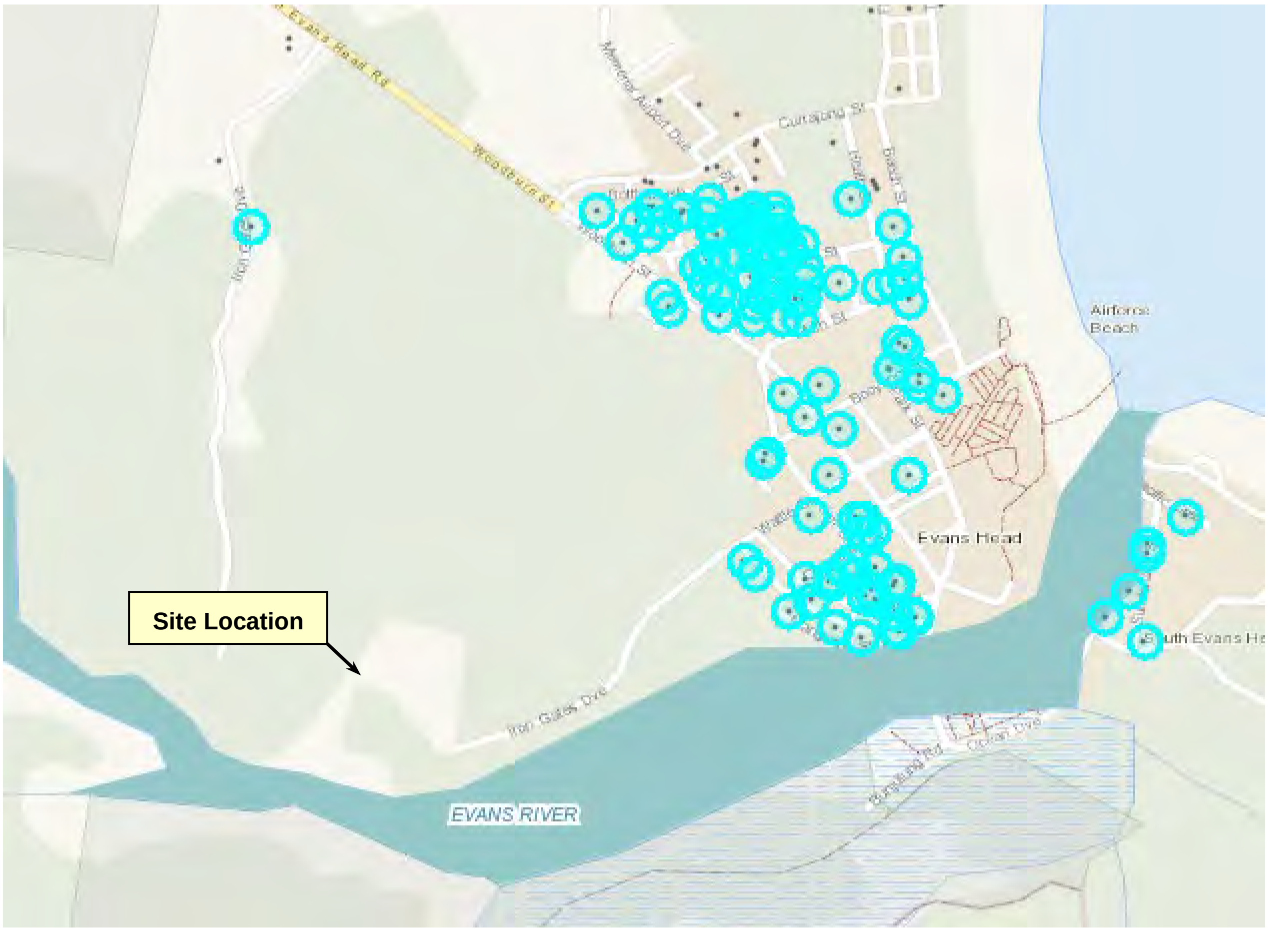


**Figure 2: Map outlining locations of groundwater bores (NSW NRAtlas 2011)**

Insufficient data was available for the local bores. As the elevation based on Australian Height Datum (AHD) was not provided for any of the bores the actual depth of the water table, and likelihood of there being a common groundwater system below the bores, could not be determined. Further investigation on the local aquifer depth, nature and contamination status of groundwater underneath the site was not completed during the preparation of this report.

## 2.4 Acid Sulphate Soils

Acid sulfate soils are acidic soil horizons or layers formed as a result of aeration of soil materials rich in iron sulphides (predominately pyrite - FeS2). Such characteristics are likely to be found in:

- Marine and estuarine sediments of the recent (Holocene) geological age.
- Soils usually not more than five metres above mean sea level.

- Marine or estuarine settings.
- Inland environments such as:
    - River and stream channels.
    - Lakes.
    - Wetlands.
    - Seepages overlying mineralized zones.
    - Disposal basins (Evaporation).
    - Billabongs.
    - Marshes.
    - Ground water systems.
    - Sports fields.

A search of the Australian Soil Resource Information System (ASRIS) National Acid Sulphate Soils (ASS) Risk Map was carried out for the study area. The results of this search revealed the site to be located largely within a Low Probability Area with Confidence Unknown.

An acid sulphate soil Investigation was undertaken on site by Coffey Partners International in 1995. The report stated that there was no acid sulphate or acid generating potential for the samples tested. An Acid Sulphate Investigation and Soil Management Plan (F0003-10027302) has been prepared by Arcadis summarising the works undertaken on-site to date with discussions on Council mapping and recommendations moving through construction.

# 3 SITE BACKGROUND AND HISTORICAL REVIEW

## 3.1 General Information

Goldcoral Pty Ltd propose to develop the Iron Gates site into a 175 lot residential development. The proposal is located approximately 1.7 kilometres south-west of Evans Head township. Figures 1 shows the proposal in relation to its local and regional context.

### Table 2: Site identification details

| Site Address: | Iron Gates Road, Iron Gates |
|---|---|
| Approximate Total Area of Impact | 18 Hectares |
| Postcode | 2473 |
| Lot and DP Numbers for site and adjacent lots | Lot 163 DP 831052, Lots 276 and 277 DP 755624, Crown Road Reserve between Lots 163 DP 831052 and Lot 276 DP 755724, Crown Foreshore Reserve and Iron Gates Drive, Evans Head NSW |
| Local Government Area | Richmond Valley Council |
| Current Site Zoning | Low Medium Residential |
| Current Site Use | Vacant Land |

## 3.2 Adjoining Land Use

Land use in the study area is characterised by surrounding undeveloped land zoned Non-Urban. The Proposal area is zoned under the Richmond Valley Council Local Environmental Plan (2012). This planning context is shown in Figure 3 below.

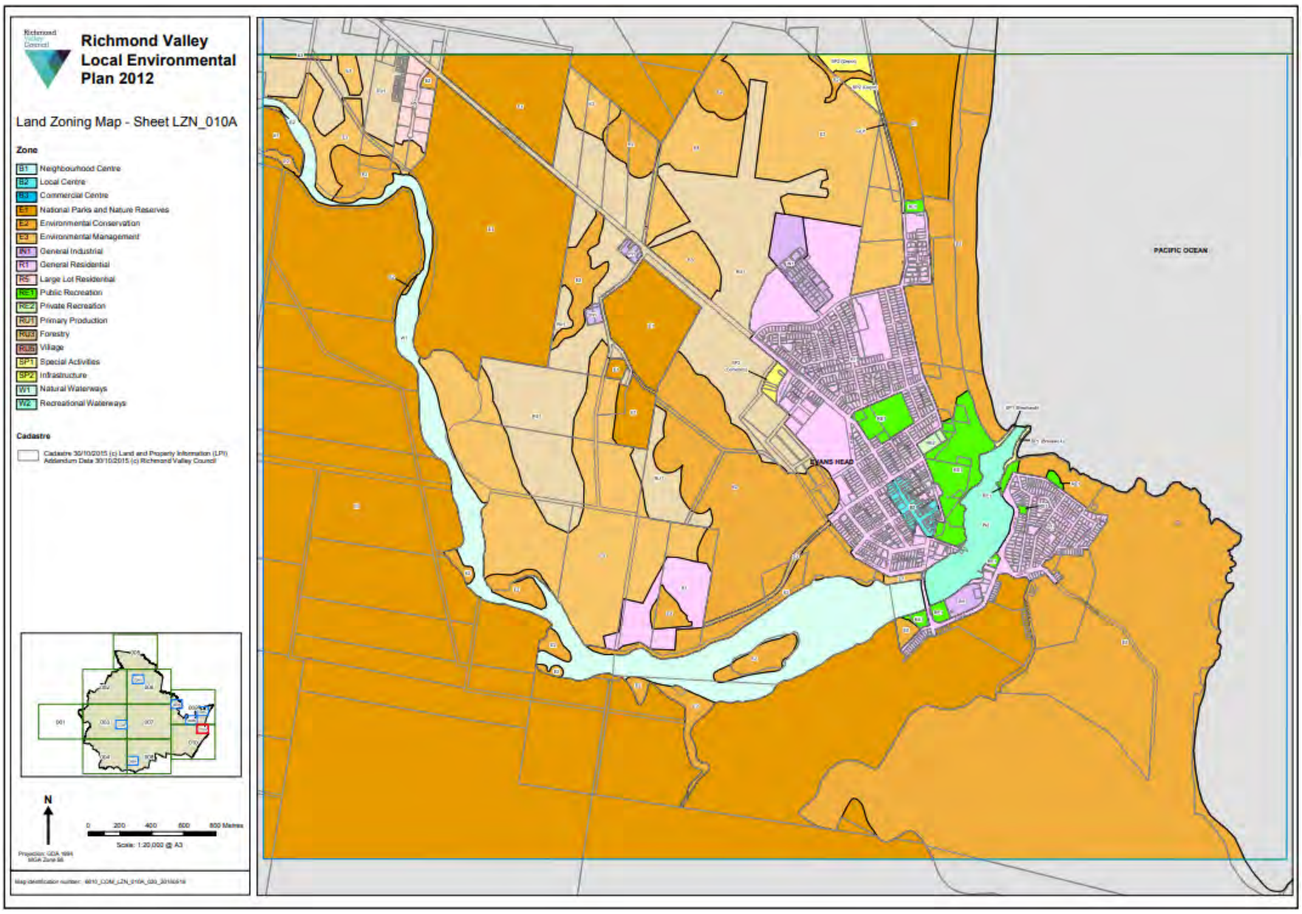


**Figure 3: Richmond Valley Council Local Environmental Plan for the study area**

## 3.3 Title Searches

Arcadis conducted a title search of "properties of interest" with the aim of tracing ownership details through a search of title records. The proposed Iron Gates development comprises of three separate properties. No historical potentially contaminating activities were identified by the historical title search.

## 3.4 Aerial Photography

Historical aerial photographs were obtained from the Land and Property Management Authority (LPMA). A review of the historical aerial photographs of the site is presented in the Table 1. Aerial photographs are presented in Appendix 2.

**Table 1: Review of historical aerial photographs**

| Year | Site History Details | Potential contamination Implications |
|---|---|---|
| 1953 | Sole Dwelling with surrounding cleared land for rural use. | |
| 1964 | Sole Dwelling with surrounding cleared land for rural use. | |
| 1971 | Sole Dwelling with surrounding cleared land for rural use.<br><br>Eastern portion and adjacent property to the Iron Gates property has evidence of substantial sand mining activities. | Potential sand mining residues with elevated radiation levels |

| Year | Site History Details | Potential contamination Implications |
|---|---|---|
| 1980 | Sole Dwelling with surrounding cleared land for rural use.<br><br>Sand mining activities seem to have down sized and revegetation of areas is evident. | Potential sand mining residues with elevated radiation levels |
| 1988 | Sole Dwelling with surrounding cleared land for rural use.<br><br>Sand mining activities have ceased. | |
| 1998 | Sole dwelling and cleared land and constructed roads associated with the Iron Gates development. | |
| 2001 | Sole dwelling and cleared land and constructed roads associated with the Iron Gates development. | |
| 2014 | Sole dwelling and cleared land and constructed roads associated with the Iron Gates development. | |

## 3.5 Summary of Site History

The information obtained from the site history review can be summarised as follows:

- Previous to 1971 the area was generally rural with a sole dwelling.
- There is evidence that sand mining activities were undertaken between 1965 and 1981
- Sand mining activities ceased before 1988.
- In 1996 the Iron Gates urban development was partially constructed.
- The site has remained unchanged since 1996.

## 3.6 Potential areas of Concerns

Based on information obtained from this site history review, it is evident that during the 1970s and early 1980s sand mining activities took place. As a result, tailings dams may have concentrated monazite and illminite separated out as part of the mining process. Monazite and illminite tailing can be responsible for elevated radiation levels and potentially causes health risks.

As a result of these findings a Preliminary Radiation Site Assessment was undertaken and comprised of:

- A preliminary site investigation, to establish whether radioactive sand residues from former mineral sand mining activities exists on the site; and

- If required, establishing the extent of soil contamination, and possible environmental, health and safety impairment risks, with a view to establishing a suitable remediation/management strategy.

The above assessment was carried out in accordance with NSW Government Department of Health – Radiation Branch publication, “No. 12 Clean-Up and Disposal of Radioactive Residues from Commercial Operations Involving Mineral Sands”.

# 4 SITE INSPECTION

A site inspection was undertaken by Arcadis Consulting on 22 May 2014 by Simon Groth of Arcadis Consulting. The site visit involved identifying activities or site features that may be associated with potential contamination being present. These locations were closely inspected and reference made to the concept plan of the development works proposed. Site inspection photographs are provided in Appendix 3. No contaminating activities or evidence of contamination was identified during the site inspection.

### Conditions at Site Boundary

There were no visible signs of contamination or staining identified during the site inspection.

### Presence of Dangerous goods, Wastes and Fill Material

No dangerous goods, wastes or fill material was identified as part of the site inspection.

### Odours

There were no odours encountered on site that may indicate land contamination.

### Condition of Buildings and Roads

There were no signs of contamination associated with any roads or structures on or around the site.

### Further Preliminary Radiation Site Assessment

A subsequent Preliminary Radiation Site Assessment was also undertaken by Arcadis on 17 June 2014 (Provided in Appendix D). The site visit involved identifying activities or site features that may be associated with past sand mining activities being present in areas identified in historic aerial photographs. These locations were closely inspected and reference made to the concept plan of the development works proposed.

No contaminating activities or evidence of mineral sand staining was identified during the site inspection.

A surface radiation survey of the development site was also undertaken using a calibrated HPI Cypher 5000 Digital Radiation Alert Monitor to measure surface gamma radiation levels and detect and locate any areas of elevated radiation levels.

The surface radiation levels monitored on the Iron Gates site in areas where previous sand mining activities were located are all equivalent to background levels displayed at the three off site background control locations. Surface radiation levels generally varied between 0.00 uSv/Hr to 0.3 uSv/Hr. Some discrete areas displayed levels of 0.4 and 0.5 uSv/Hr however these areas are still below Action Level Criteria for dwellings.

# 5 FURTHER INVESTIGATIONS

Based on the desktop reviews and site assessment undertaken, further surface radiation level monitoring should be undertaken in areas where works are more than 1 metre below current surface levels during construction to determine the presence/absence of contaminated materials in the form of radioactive residues associated with sand mining activities.

# 6 CONCLUSIONS AND RECOMMENDATIONS

Desktop studies revealed that eastern parts of the site and the property adjacent of the Iron Gates development was subject to sandmining activities during the 1970s and early 1980s. As a result there may be potential for the existence of sand mining residues with elevated radiation levels on site that may have been associated with tailings dams from rutile separation processes.

Site investigations were undertaken and surface radiation levels monitored on the Iron Gates site in areas where previous sand mining activities were located are all equivalent to background levels displayed at the three off site background control locations. Surface radiation levels generally varied between 0.00 uSv/Hr to 0.3 uSv/Hr. Some discrete areas displayed levels of 0.4 and 0.5 uSv/Hr however these areas are still below Action Level Criteria for dwellings.

It is recommended that further surface radiation level monitoring should be undertaken in areas where works are more than 1 metre below current surface levels during construction to determine the presence/absence of contaminated materials in the form of radioactive residues associated with sand mining activities so appropriate management strategies can developed if required.

.

# APPENDIX A PROPOSED DEVELOPEMENT

| Lot Table | |
|---|---|
| Lot | Area |
| 1 | 969 $m^2$ |
| 2 | 612 $m^2$ |
| 3 | 612 $m^2$ |
| 4 | 612 $m^2$ |
| 5 | 612 $m^2$ |
| 6 | 612 $m^2$ |
| 7 | 612 $m^2$ |
| 8 | 612 $m^2$ |
| 9 | 612 $m^2$ |
| 10 | 612 $m^2$ |
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| 26 | 600 $m^2$ |
| 27 | 600 $m^2$ |
| 28 | 600 $m^2$ |
| 29 | 627 $m^2$ |
| 30 | 600 $m^2$ |
| 31 | 600 $m^2$ |
| 32 | 600 $m^2$ |
| 33 | 600 $m^2$ |
| 34 | 600 $m^2$ |
| 35 | 600 $m^2$ |
| 36 | 788 $m^2$ |
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| 68 | 607 $m^2$ |
| 69 | 608 $m^2$ |
| 70 | 609 $m^2$ |

| Lot Table | |
|---|---|
| Lot | Area |
| 71 | 607 $m^2$ |
| 72 | 608 $m^2$ |
| 73 | 682 $m^2$ |
| 74 | 766 $m^2$ |
| 75 | 600 $m^2$ |
| 76 | 600 $m^2$ |
| 77 | 600 $m^2$ |
| 78 | 600 $m^2$ |
| 79 | 600 $m^2$ |
| 80 | 601 $m^2$ |
| 81 | 601 $m^2$ |
| 82 | 601 $m^2$ |
| 83 | 601 $m^2$ |
| 84 | 608 $m^2$ |
| 85 | 614 $m^2$ |
| 86 | 634 $m^2$ |
| 87 | 696 $m^2$ |
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| 90 | 602 $m^2$ |
| 91 | 859 $m^2$ |
| 92 | 856 $m^2$ |
| 93 | 603 $m^2$ |
| 94 | 603 $m^2$ |
| 95 | 954 $m^2$ |
| 96 | 616 $m^2$ |
| 97 | 663 $m^2$ |
| 98 | 657 $m^2$ |
| 99 | 602 $m^2$ |
| 100 | 723 $m^2$ |
| 101 | 605 $m^2$ |
| 102 | 609 $m^2$ |
| 103 | 620 $m^2$ |
| 104 | 714 $m^2$ |
| 105 | 602 $m^2$ |
| 106 | 604 $m^2$ |
| 107 | 602 $m^2$ |
| 108 | 602 $m^2$ |
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| 120 | 600 $m^2$ |
| 121 | 600 $m^2$ |
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| 125 | 600 $m^2$ |
| 126 | 646 $m^2$ |
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| 129 | 600 $m^2$ |
| 130 | 639 $m^2$ |
| 131 | 602 $m^2$ |
| 132 | 602 $m^2$ |
| 133 | 600 $m^2$ |
| 134 | 618 $m^2$ |
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| Lot Table | |
|---|---|
| Lot | Area |
| 141 | 600 $m^2$ |
| 142 | 600 $m^2$ |
| 143 | 605 $m^2$ |
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| 145 | 600 $m^2$ |
| 146 | 601 $m^2$ |
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| 150 | 601 $m^2$ |
| 151 | 600 $m^2$ |
| 152 | 665 $m^2$ |
| 153 | 629 $m^2$ |
| 154 | 834 $m^2$ |
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| 156 | 603 $m^2$ |
| 157 | 627 $m^2$ |
| 158 | 644 $m^2$ |
| 159 | 601 $m^2$ |
| 160 | 601 $m^2$ |
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| 168 | 602 $m^2$ |
| 169 | 602 $m^2$ |
| 170 | 602 $m^2$ |
| 171 | 602 $m^2$ |
| 172 | 602 $m^2$ |
| 173 | 602 $m^2$ |
| 174 | 614 $m^2$ |
| 175 | 600 $m^2$ |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |


CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

(i) This plan was prepared for the purpose and exclusive use of THE INGLES GROUP to accompany an application to RICHMOND VALLEY for approval to reconfigure the land described in this plan and is not to be used for any other purpose or by any other person or corporation. LandPartners Pty Ltd accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention of the terms of this clause or clauses (ii) or (iii) hereof.

(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

Aerial Photography sourced from Nearmap 13-3-2019.
Date of photography - 03/07/2012

| LOTS | TOTAL AREA |
|---|---|
| Residential Lots (175) | 16.884ha |
| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

0 5 10 20 30 50 80m

SCALE 1:1250 @ A1

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w: www.landpartners.com.au

| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16-COPY |
| DRAWN CGW | DATE 27/06/2019 |
| CHECKED CMJ | DATE 27/06/2019 |
| APPROVED CGW | DATE 27/06/2019 |
| PLAN NUMBER BRJD6396.100-013 | SHEET 2 OF 2 |
| REV | H |

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

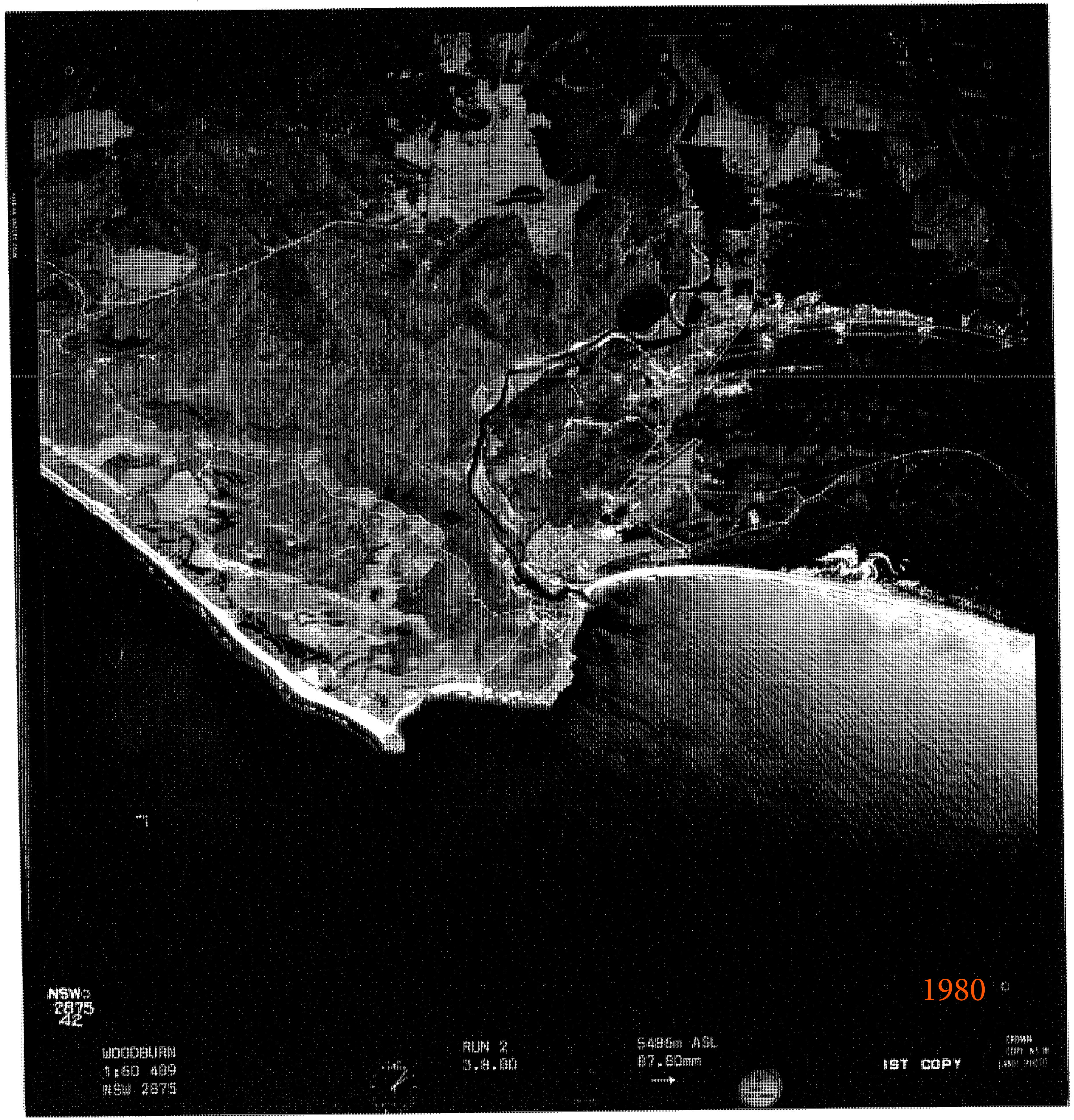
# APPENDIX B HISTORIC AERIAL PHOTOGRAPHS


1953
c. 1002. 5062
LANDSPH
WOODBURN RUN 3W NOV 53 152.21 MM 15100 →

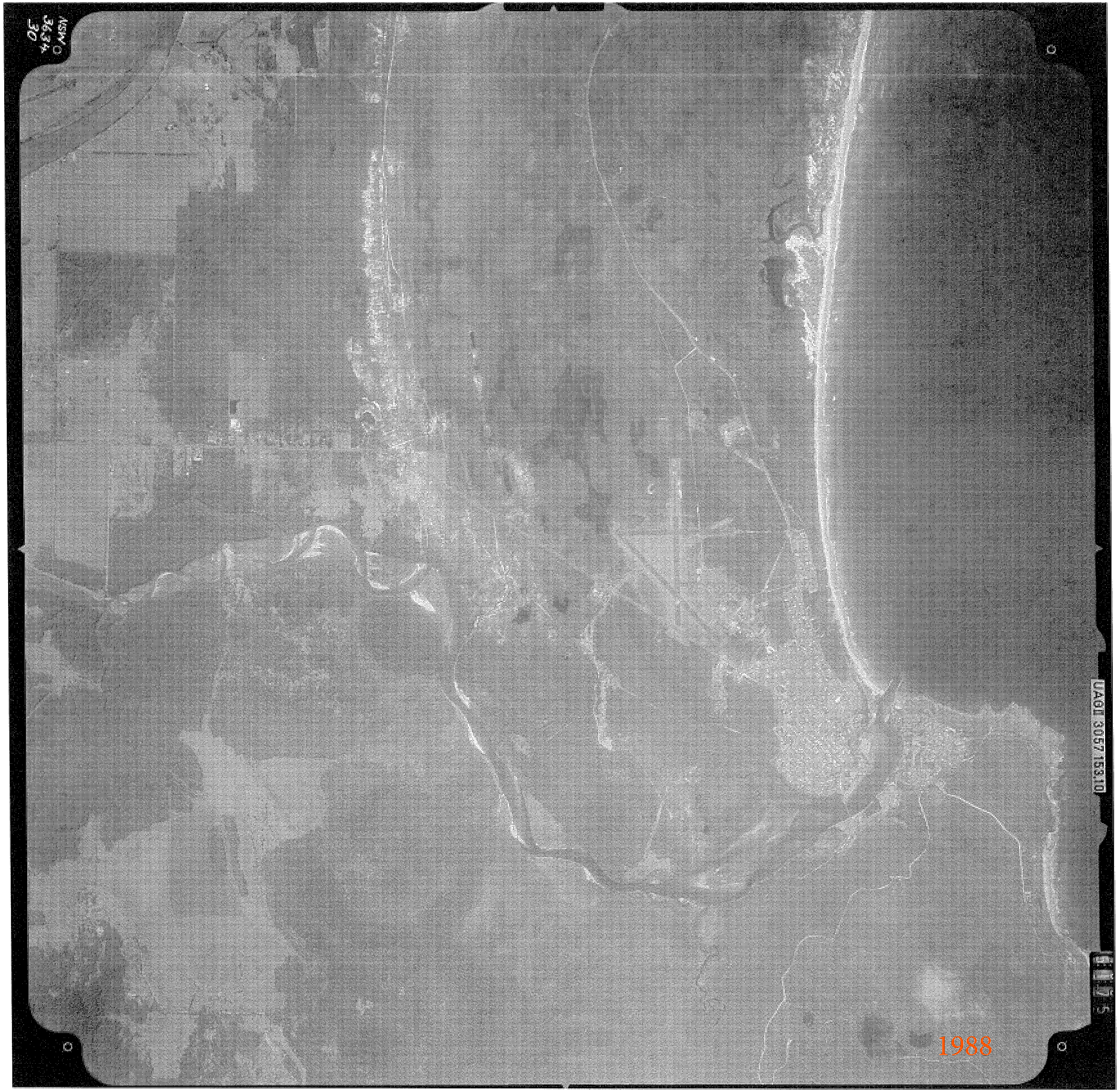

NSW
1220
5192
WOODBURN
NSW 1220
RUN 3W
JUNE '64
15,000' A.S.L.
114.44 M.M.
1964
CROWN
COPY N.S.W.
LANDS PHOTO


1971


1964


NSW
2875
42
1980
WOODBURN
1:60 489
NSW 2875
RUN 2
3.8.80
5486m ASL
87.80mm
1ST COPY


1980




20.8.88


1988


0022
2001
WOODBURN
1:50000 Approx. Scale
NSW4554 (M2232)
RUN 2
09-05-01
14-24
152.76 mm
© Land and Property Information
All Rights Reserved


2001


2014

# APPENDIX C SITE INSPECTION PHOTOGRAPHS

**Photographic Illustration 1**: Cleared area adjacent to Evans Creek with sole dwelling in the background.

**Photographic Illustration 2**: Open drain located on the eastern boundary of the site.

**Photographic Illustration 3**: Previously constructed road on the Iron Gates estate.

**Photographic Illustration 4**: Photograph of the North West portion of the Iron Gates property.

# APPENDIX D PRELIMINARY RADIATION SITE ASSESSMENT

# GOLDCORAL PTY LTD

# PRELIMINARY RADIATION SITE ASSESSMENT

## Iron Gates Development – Evans Head NSW

10 JULY 2019

# CONTACT

**SIMON GROTH**
**Principal Environmental Scientist**

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M 0411558974
E simon.groth@arcadis.com

Arcadis
Level 5/120 Edward Street
Brisbane QLD 4000

# GOLDCORAL PTY LTD
# IRON GATES DEVELOPMENT – EVANS HEAD NSW

## PRELIMINARY RADIATION SITE ASSESSMENT

| | |
|---|---|
| **Author** | Simon Groth |
| **Checker** | Gerard Dick |
| **Approver** | Simon Groth |
| **Report No** | F0006-10027302-01 |
| **Date** | 10/07/2019 |
| **Revision Text** | 01 |

This report has been prepared for Goldcoral Pty Ltd in accordance with the terms and conditions of appointment for Review Environmental Factors dated 16/1/12. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

## REVISIONS

| Revision | Date | Description | Prepared by | Approved by |
|---|---|---|---|---|
| 0 | 28/08/14 | PRELIMINARY RADIATION SITE ASSESSMENT | Simon Groth | Simon Groth |
| 1 | 10/07/19 | AMENDED TO ARCADIS LAYOUT | Simon Groth | Simon Groth |

# CONTENTS



# APPENDICES

# 1 INTRODUCTION

## 1.1 Background

Arcadis has been commissioned by Goldcoral Pty Ltd to undertake a Preliminary Radiation Site Assessment of the proposed Iron Gates residential development, Evans Head. This assessment comprises of:

- A preliminary site investigation, to establish whether radioactive sand residues from former mineral sand mining activities exists on the site; and
- If required, establishing the extent of soil contamination, and possible environmental, health and safety impairment risks, with a view to establishing a suitable remediation/management strategy.

The above will be carried out in accordance with NSW Government Department of Health – Radiation Branch publication, "No. 12 Clean-Up and Disposal of Radioactive Residues from Commercial Operations Involving Mineral Sands".

This report covers:

- The results of the on-site inspection and preliminary in-situ analysis, (to identify, likely areas of contamination, and prepare a sampling and analysis protocol);
- Recommendations for ongoing site management.

## 1.2 Site Identification

The scope of this study was the "development area" as detailed in the locality plan provided below. The development site is located approximately 1.7 kilometres south-west of Evans Head township. This is the area that will be directly disturbed as a result of the construction required for the development. This includes bulk earthworks, road construction and ancillary activities such as stockpile and compound sites, utility installation and access requirements, and any alterations to intersections. The location of the proposal is illustrated in Figure 1 (a detailed locality plan with development layout is provided in Appendix 1).


Figure 1: Site locality plan showing the development area

## 1.3 Objective

The objective of this contamination investigation was to identify potential risks associated with radioactive sand residues from past sand mining activities in the study area and to identify areas that may require remediation or management through construction phases.

Carrying out the Preliminary Radiation Site Assessment will provide the Goldcoral Pty Ltd with information on potential risks associated with contamination based on past sand mining operations adjacent to and on portions of the site. The process will identify where there is a contamination risk which warrants additional intrusive investigations aimed at characterising the presence and extent of any impact within the vicinity of the proposal. The outcomes of the assessment will inform management actions for ongoing protection of the environment and will provide baseline information to monitor future change.

## 1.4 Scope of Works

To achieve the above outlined objectives the following scope of works was undertaken:

- Desktop review of site history information of the proposal site and adjoining sites to identify potential areas of environmental concern. Where available, this included review of the following information sources:
  - Historical titles.
  - Historical aerial photographs (from 1953 to present, where available).
  - Previous environmental reports for the site.
- A site walkover by an Arcadis representative; which included:
  - Evidence of past sand mining activities.
  - Identification of sand mining residues or former tailings.
  - General review of previous operations within the area of impact.
  - Checking for signs of ground illminite or monozite that are visible on the ground surface.
  - A radiation survey recording surface radiation levels.
- Preparation of a Preliminary Radiation Site Assessment Report for the proposal.

## 1.5 Limitations

The findings in this report are based on a preliminary environmental desktop study described in the scope of works. Arcadis has performed the services in a manner consistent with the level of care and expertise exercised by members of the environmental consulting profession. No warranties, expressed or implied are made. Arcadis' assessment is limited strictly to identifying typical environmental conditions associated with the study area. All environmental and contaminated land/radiation survey work is subject to general limitations related to the heterogeneity of the natural environment, variability of contaminant distribution and constraints imposed by the investigation methods utilised.

The results of this assessment are based on the site inspection undertaken by Arcadis personnel from accessible areas, information provided by Goldcoral Pty Ltd and publically available background information. All conclusions and recommendations are the professional opinions of the Arcadis personnel involved in the project, subject to the qualifications made above. While normal assessments of data reliability have been made, Arcadis assumes no responsibility or liability for errors in any data obtained from external sources, or developments resulting from situations outside the scope of this project.

Specifically, with regard to this report, it should be noted that the scope of works carried out herein is not intended to include sufficient information to enable completion of a statutory audit of the site, and as such does not include the following:

Any intrusive soil/groundwater sampling and analysis.

Sampling and analysis of any emissions to air, wastewater discharges or solid and liquid wastes.

Please ensure that these limitations are understood before utilising, or basing decisions on the information presented in this report.

# 2 GEOLOGY AND HYDROLOGY

## 2.1 Geology

The Australian Stratigraphic Units Database describes the Evan Head area (Evans Head Coal Measure) as Thin- to thick-bedded, crossbedded, coarse-grained quartz to sublithic arenite, thinly-bedded grey siltstone, claystone, minor coal, as partings and very thin bands. The Evans Head area belongs to the Ipswich Basin Geological Province.

Basic geological mapping of the area indicates that the Evans Head headlands are comprised of different types of sediments. These are all very recent which geologically places them at Quaternary (or more specifically Pleistocene to Holocene aged) comprising mainly sands in the beach and dune systems and silts and clays around the river estuary. Many of the Holocene aged sediments contain potential acid sulfate soils, which are common in the region.

# 3 SITE BACKGROUND AND HISTORICAL REVIEW

## 3.1 General Information

Goldcoral Pty Ltd propose to develop the Iron Gates site into a 175 lot residential development. The proposal is located approximately 1.7 kilometres south-west of Evans Head township. Table 1 shows the proposal in relation to its local and regional context.

**Table 1: Site identification details**

| Site Address: | Iron Gates Road, Iron Gates |
|---|---|
| Approximate Total Area of Impact | 18 Hectares |
| Postcode | 2473 |
| Lot and DP Numbers for site and adjacent lots | 544/48550 | 547/48550 | 276/55624 | 277/755624 |
| Local Government Area | Richmond Valley Council |
| Current Site Zoning | Low Medium Residential |
| Current Site Use | Vacant Land |

## 3.2 Adjoining Land Uses

Land use in the study area is characterised by surrounding undeveloped land zoned Parcel Boundary.

## 3.3 Planning Context

### 3.3.1 Zoning

The Proposal area is zoned under the Richmond Valley Council Development Control Plan (DCP). This planning context is shown in Figure 2 below.

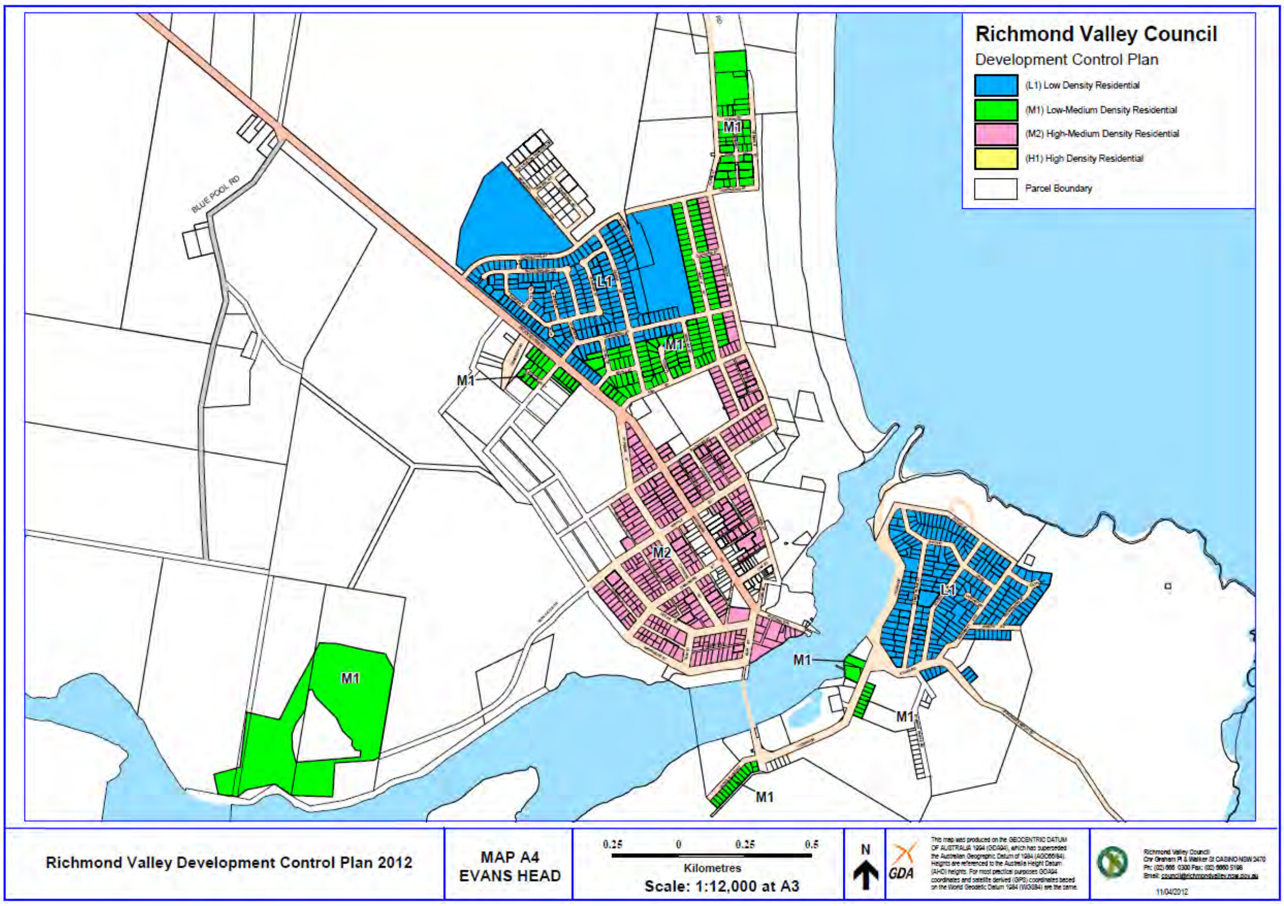


**Figure 1: Richmond Valley Council Development Control Plan for the study area**

## 3.4 Title Searches

Arcadis conducted a title search of "properties of interest" with the aim of tracing ownership details through a search of title records.  The proposed Iron Gates development comprises of three separate properties. Those properties that have been identified by aerial photography historic searches as having past activities that may have had the potential to contaminate the receiving environment. No historical potentially contaminating activities were identified by the historical title search.

## 3.5 Aerial Photograph Review

Historical aerial photographs were obtained from the Land and Property Management Authority (LPMA). A review of the historical aerial photographs of the site is presented in the Table 2. Aerial photographs are presented in Appendix 2.

**Table 1: Review of historical aerial photographs**

| Year | Site History Details | Potential contamination Implications |
|---|---|---|
| 1953 | Sole Dwelling with surrounding cleared land for rural use | |
| 1964 | Sole Dwelling with surrounding cleared land for rural use | |
| 1971 | Sole Dwelling with surrounding cleared land for rural use<br><br>Eastern portion and adjacent property to the Iron Gates property has evidence of substantial sand mining activities (Refer Figure 2) | <br><br>Potential sand mining residues with elevated radiation levels |
| 1980 | Sole Dwelling with surrounding cleared land for rural use<br><br>Sand mining activities seem to have down sized and revegetation of areas is evident | <br><br>Potential sand mining residues with elevated radiation levels |
| 1988 | Sole Dwelling with surrounding cleared land for rural use<br><br>Sand mining activities have ceased | |
| 1998 | Sole dwelling and cleared land and constructed roads associated with the Iron Gates development (Refer Figure 3) | |
| 2001 | Sole dwelling and cleared land and constructed roads associated with the Iron Gates development | |
| 2014 | Sole dwelling and cleared land and constructed roads associated with the Iron Gates development | |

## 3.6 Summary of Site History

The information obtained from the site history review can be summarised as follows:

- Previous to 1971 the area was generally rural with a sole dwelling.
- There is evidence that sand mining activities were undertaken between 1965 and 1981
- Sand mining activities ceased before 1988.
- In 1996 the Iron Gates urban development was constructed.
- The site has remained unchanged since 1996.

## 3.7 Potential Areas of Environmental Concern

Based on information obtained from this site history review, potential environmental issues at the site can be summarised as follows:

- During the 1970's and early 1980's sand mining activities took place. As a result tailings dams may have concentrated monazite separated out as part of the mining process. Monazite tailing can be responsible for elevated radiation levels and potentially causes health risks.

**Figure 3: Aerial photograph of Iron Gates Site in 1971 with sand mining activities evident on the eastern portion of the site and adjacent property**

**Figure 4: Aerial photograph of Iron Gates Site in 1998 with developed roads.**

# 4 RELEVANT REGULATIONS AND GUIDELINES

The NSW Department of Health - Radiation Branch has developed action level thresholds for the clean-up and disposal of radioactive residues from commercial operations involving mineral sands, and are presented below.

1. <u>Action Level Criteria</u>

1.1 For dwellings, schools (including playground), businesses, factories, etc. where occupancies by the same individuals occur regularly on a day by day basis, the remedial action level should be 0.7 $\mu Gy\ h^{-1}$ (or 70 $\mu R\ h^{-1}$) for all points at 1 metre above the area of concern on the property.

1.2 For other areas, where occupancies are for a few hours per week by the same individuals or by differing individuals and for garden areas, the remedial action level should be 1.0 $\mu Gy\ h^{-1}$ (100 $\mu R\ h^{-1}$) for all points at 1 metre above the lowest surface of the area.

1.3 For roads, paths, and other areas with intermittent occupancy, the remedial action level should be 2.5 $\mu Gy\ h^{-1}$ (250 $\mu R\ h^{-1}$) for all points at 1 metre above the surface of the areas.

1.4 All values quoted above should include a value for normal natural background of 0.1 $\mu Gy\ h^{-1}$ (10 $\mu R\ h^{-1}$).

# 5 SITE INSPECTION

A site inspection was on 17 June 2014 by Simon Groth of Arcadis. The site visit involved identifying activities or site features that may be associated with past sand mining activities being present in areas identified in historic aerial photographs. These locations were closely inspected and reference made to the concept plan of the development works proposed. Site inspection photographs are provided in Appendix 3. No contaminating activities or evidence of mineral sand staining was identified during the site inspection.

A surface radiation survey of the development site was also undertaken using a calibrated HPI Cypher 5000 Digital Radiation Alert Monitor to measure surface gamma radiation levels and detect and locate any areas of elevated radiation levels. The assessment was undertaken by walking transects of the site approximately 20-25 metres apart with the aid of a GPS device. Radiation levels were continuously monitored at all times whilst walking transects. Transects were recorded and plotted in Figure 5 below.

Radiation levels were also recorded at three off site locations to determine endemic background radiation levels for the Evans Head area. These locations are detailed in table 3.

**Table 2: Off-site locations to determine endemic background levels for the Evans Head area**

| Location Description | Distance from Iron Gates Site (km) | Radiation Measurement (microsievert/hour) |
|---|---|---|
| Cherry Street, Evans Head | 1.0 | 0.2 - 0.4 |
| Evans Head Rugby League Club | 1.8 | 0.2 – 0.35 |
| Evans Heads River K12 School | 1.6 | 0.2 – 0.385 |

**Figure 5: Surface radiation survey transects continuously monitored (in red) on the Iron Gates site.**

## Conditions at Site Boundary

There were no visible signs of mineral sand staining identified during the site inspection.

# 6 RESULTS

The surface radiation levels monitored on the Iron Gates site in areas where previous sand mining activities were located are all equivalent to background levels displayed at the three off site background control locations. Surface radiation levels generally varied between 0.00 uSv/Hr to 0.3 uSv/Hr. Some discrete areas displayed levels of 0.4 and 0.5 uSv/Hr however these areas are still below Action Level Criteria for dwellings.

It should be noted that while radiation dose rate unit results are quoted in uSv/Hr (microsieverts) and Action Level Criteria units are quoted in uGy/Hr (microgray) these units are identical for gamma radiation in this situation.

# 7 FURTHER INVESTIGATIONS

Based on the desktop reviews and site assessment undertaken, further surface radiation level monitoring should be undertaken in areas where works are more than 1 metre below current surface levels during construction to determine the presence/absence of contaminated materials in the form of radioactive residues associated with sand mining activities.

# 8 CONCLUSIONS AND RECOMMENDATIONS

Desktop studies revealed that eastern parts of the site and the property adjacent of the Iron Gates development was subject to sandmining activities during the 1970’s and early 1980’s. As a result there may have been potential for the existence of sand mining residues with elevated radiation levels on site that may have been associated with tailings dams from rutile separation processes.

Site investigations were undertaken and surface radiation levels monitored on the Iron Gates site in areas where previous sand mining activities were located are all equivalent to background levels displayed at the three off site background control locations. Surface radiation levels generally varied between 0.00 uSv/Hr to 0.3 uSv/Hr. Some discrete areas displayed levels of 0.4 and 0.5 uSv/Hr however these areas are still below Action Level Criteria for dwellings.

It is recommended that further surface radiation level monitoring should be undertaken in areas where works are more than 1 metre below current surface levels during construction to determine the presence/absence of contaminated materials in the form of radioactive residues associated with sand mining activities so appropriate management strategies can developed if required.

# APPENDIX A PROPOSED DEVELOPEMENT

| Lot Table | |
|---|---|
| Lot | Area |
| 1 | 969 $m^2$ |
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| 87 | 696 $m^2$ |
| 88 | 602 $m^2$ |
| 89 | 602 $m^2$ |
| 90 | 602 $m^2$ |
| 91 | 859 $m^2$ |
| 92 | 856 $m^2$ |
| 93 | 603 $m^2$ |
| 94 | 603 $m^2$ |
| 95 | 954 $m^2$ |
| 96 | 616 $m^2$ |
| 97 | 663 $m^2$ |
| 98 | 657 $m^2$ |
| 99 | 602 $m^2$ |
| 100 | 723 $m^2$ |
| 101 | 605 $m^2$ |
| 102 | 609 $m^2$ |
| 103 | 620 $m^2$ |
| 104 | 714 $m^2$ |
| 105 | 602 $m^2$ |
| 106 | 604 $m^2$ |
| 107 | 602 $m^2$ |
| 108 | 602 $m^2$ |
| 109 | 602 $m^2$ |
| 110 | 602 $m^2$ |
| 111 | 601 $m^2$ |
| 112 | 600 $m^2$ |
| 113 | 600 $m^2$ |
| 114 | 600 $m^2$ |
| 115 | 608 $m^2$ |
| 116 | 601 $m^2$ |
| 117 | 602 $m^2$ |
| 118 | 600 $m^2$ |
| 119 | 601 $m^2$ |
| 120 | 600 $m^2$ |
| 121 | 600 $m^2$ |
| 122 | 647 $m^2$ |
| 123 | 619 $m^2$ |
| 124 | 603 $m^2$ |
| 125 | 600 $m^2$ |
| 126 | 646 $m^2$ |
| 127 | 661 $m^2$ |
| 128 | 626 $m^2$ |
| 129 | 600 $m^2$ |
| 130 | 639 $m^2$ |
| 131 | 602 $m^2$ |
| 132 | 602 $m^2$ |
| 133 | 600 $m^2$ |
| 134 | 618 $m^2$ |
| 135 | 623 $m^2$ |
| 136 | 604 $m^2$ |
| 137 | 602 $m^2$ |
| 138 | 600 $m^2$ |
| 139 | 600 $m^2$ |
| 140 | 600 $m^2$ |

| Lot Table | |
|---|---|
| Lot | Area |
| 141 | 600 $m^2$ |
| 142 | 600 $m^2$ |
| 143 | 605 $m^2$ |
| 144 | 600 $m^2$ |
| 145 | 600 $m^2$ |
| 146 | 601 $m^2$ |
| 147 | 600 $m^2$ |
| 148 | 600 $m^2$ |
| 149 | 601 $m^2$ |
| 150 | 601 $m^2$ |
| 151 | 600 $m^2$ |
| 152 | 665 $m^2$ |
| 153 | 629 $m^2$ |
| 154 | 834 $m^2$ |
| 155 | 765 $m^2$ |
| 156 | 603 $m^2$ |
| 157 | 627 $m^2$ |
| 158 | 644 $m^2$ |
| 159 | 601 $m^2$ |
| 160 | 601 $m^2$ |
| 161 | 601 $m^2$ |
| 162 | 601 $m^2$ |
| 163 | 601 $m^2$ |
| 164 | 601 $m^2$ |
| 165 | 600 $m^2$ |
| 166 | 601 $m^2$ |
| 167 | 602 $m^2$ |
| 168 | 602 $m^2$ |
| 169 | 602 $m^2$ |
| 170 | 602 $m^2$ |
| 171 | 602 $m^2$ |
| 172 | 602 $m^2$ |
| 173 | 602 $m^2$ |
| 174 | 614 $m^2$ |
| 175 | 600 $m^2$ |
| 176 | 2.188ha |
| 177 | 4.857ha |
| 178 | 47.418ha |


Aerial Photography sourced from Nearmap 13-3-2019.
Date of photography - 03/07/2012

CLIENT

**GOLDCORAL PTY LTD**

PROJECT

PROPOSED SUBDIVISION OF LOTS 276 & 277 ON DP755624, LOT 163 ON DP831052, CROWN PUBLIC ROAD RESERVE (BETWEEN LOT 163 DP831052 AND LOT 276 DP755624) AND CROWN FORESHORE RESERVE (ADJACENT TO EVANS RIVER)

LOCAL AUTHORITY

RICHMOND VALLEY

NOTES

(i) This plan was prepared for the purpose and exclusive use of THE INGLES GROUP to accompany an application to RICHMOND VALLEY for approval to reconfigure the land described in this plan and is not to be used for any other purpose or by any other person or corporation. LandPartners Pty Ltd accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this plan in contravention of the terms of this clause or clauses (ii) or (iii) hereof.

(ii) The dimensions, areas, number of lots, size and location of improvements & flood information (if shown) are approximate only and may vary.

(iii) This plan may not be copied unless these notes are included.

| LOTS | TOTAL AREA |
|---|---|
| Residential Lots (175) | 16.884ha |
| Residue Lots (3) | 54.463ha |
| Public Reserves (4) | 0.8366ha |
| Drainage Reserve (1) | 0.1124ha |
| Pump station lot (1) | 0.0127ha |
| TOTAL | 72.309ha |

ADDITIONAL NOTES

SCALE BAR

0 5 10 20 30 50 80m

SCALE 1:1250 @ A1


LANDPARTNERS
built environment consultants
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e: info@landpartners.com.au
w: www.landpartners.com.au


| | |
|---|---|
| LEVEL DATUM | AHD |
| LEVEL ORIGIN | - |
| CONTOUR INTERVAL | - |
| COMPUTER FILE | BRJD6396-100-33-16-COPY |
| DRAWN CGW | DATE 27/06/2019 |
| CHECKED CMJ | DATE 27/06/2019 |
| APPROVED CGW | DATE 27/06/2019 |
| PLAN NUMBER BRJD6396.100-013 | SHEET 2 OF 2 |
| REV | H |

NOTE: ALL DIMENSIONS AND AREAS ON THIS PLAN ARE SUBJECT TO SURVEY AND REQUIREMENTS FOR LODGEMENT OF SURVEY PLANS IN THE NSW LAND REGISTRY SERVICES

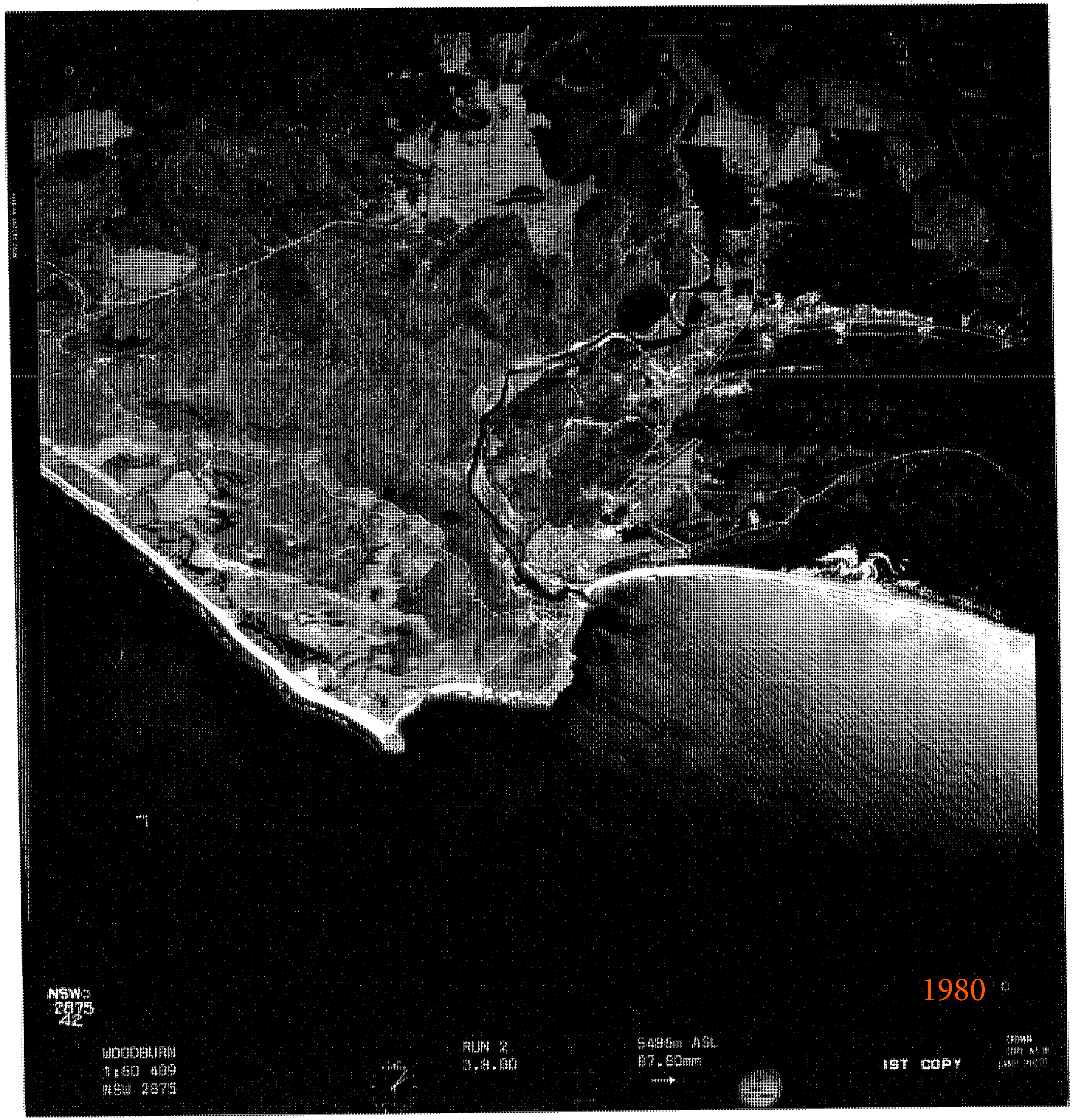
# APPENDIX B HISTORIC AERIAL PHOTOGRAPHS


1953
c. 1002. 5062
WOODBURN RUN 3W NOV 53 152.21 MM 15100
LANDSPH

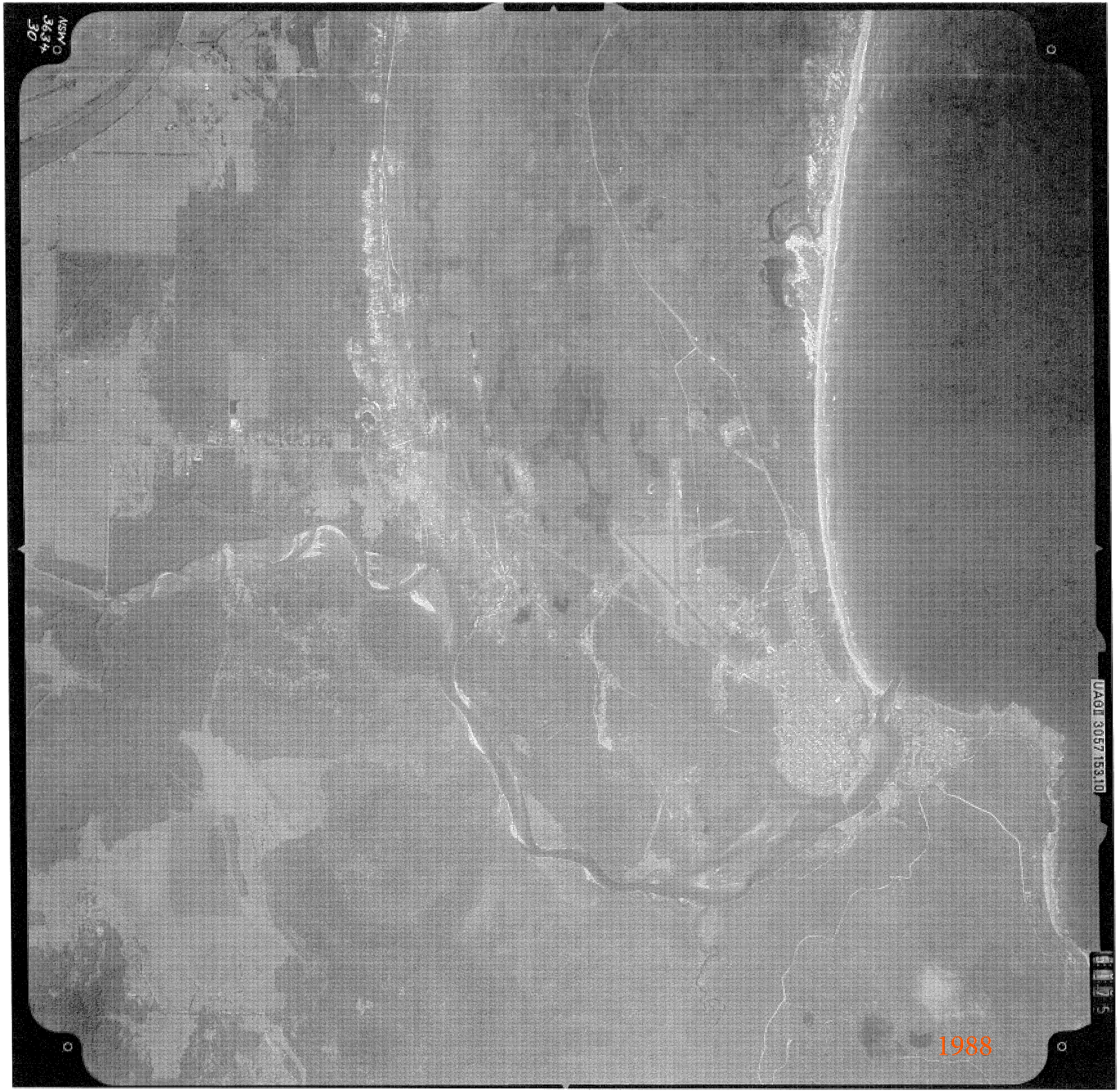

NSW
1220
5192
WOODBURN
NSW 1220
RUN 3W
JUNE '64
15,000' A.S.L.
114.44 M.M.
1964


1971


1964


NSW
2875
42
1980
WOODBURN
1:60 489
NSW 2875
RUN 2
3.8.80
5486m ASL
87.80mm
IST COPY


1980




20.8.88


1988

0022
2001
WOODBURN
1:50000 Approx. Scale
NSW4554 (M2232)
RUN 2
09-05-01
14-24
152.76 mm
© Land and Property Information
All Rights Reserved


2001


2014

# APPENDIX C SITE INSPECTION PHOTOGRAPHS

**Photographic Illustration 1**: Cleared area adjacent to Evans Creek with sole dwelling in the background.

**Photographic Illustration 2**: Open drain located on the eastern boundary of the site.

**Photographic Illustration 3**: Previously constructed road on the Iron Gates estate.

**Photographic Illustration 4**: Photograph of the North West portion of the Iron Gates property.

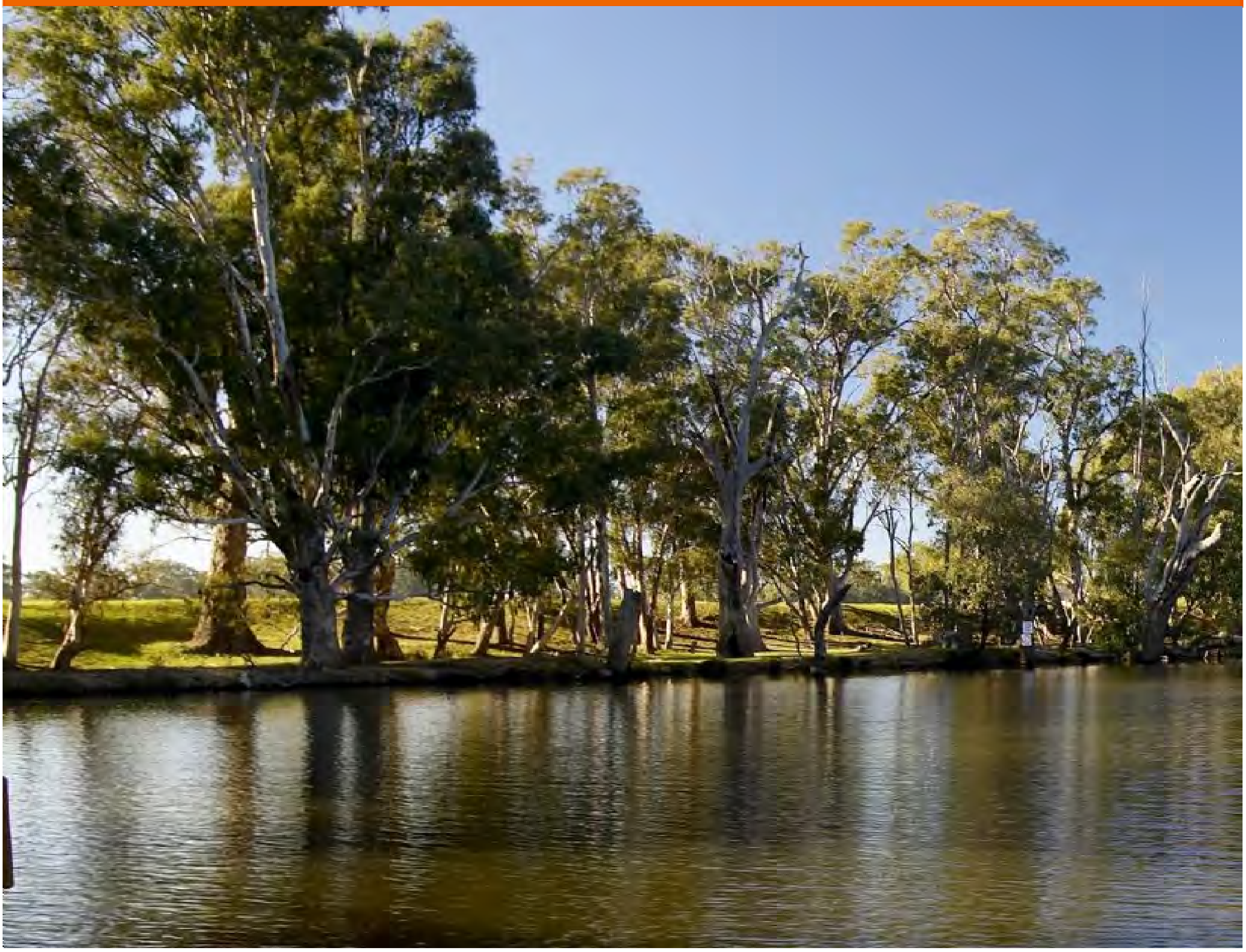
# APPENDIX K

## ACID SULPHATE INVESTIGATION AND SOIL MANAGEMENT PLAN

# IRON GATES RESIDENTIAL DEVELOPMENT

## Acid Sulfate Investigation and Soil Management Plan

08 JULY 2019



Incorporating

# GOLD CORAL PTY LTD
# IRON GATES RESIDENTIAL DEVELOPMENT

## Acid Sulfate Investigation and Soil Management Plan



| | | |
|---|---|---|
| **Author** | Gerard Dick | |
| **Checker** | Simon Groth | |
| **Approver** | Lachlan Prizeman | |





| | |
|---|---|
| **Report No** | F0003-10027302-AAR |
| **Date** | 8/07/2019 |
| **Revision** | 01 |



This report has been prepared for Gold Coral Pty Ltd in accordance with the terms and conditions of appointment for Vantage, Evans Head dated March 2019. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

## REVISIONS

| Revision | Date | Description | Prepared by | Approved by |
|---|---|---|---|---|
| 01 | 08/07/2019 | Issued for Approval | GD | LP |

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# APPENDICES

**APPENDIX A**

**GEOTECH INVESTIGATIONS (2015)**

**APPENDIX B**

**COFFEY PARTNERS INTERNATIONAL (1995)**

**APPENDIX C**

**DOUGLAS PARTNERS (1991)**

# 1 INTRODUCTION

## 1.1 General Background

An Acid Sulphate Investigation and Soil Management Plan (ASI&SMP) is proposed for the construction of the proposed Iron Gates Residential development.

The ASI&SMP relates specifically to the construction of lot filling and installation of the proposed Sewer and Stormwater services at or below the natural surface level.

Initial investigations undertaken by Coffey Partners International (1995) and Geotech Investigations (2015) included a number Groundwater and Soil investigations, including 21 boreholes, and laboratory testing, both Reports recording the absence of any Actual or Potential Acid Sulfate Soils. Copies of the site Investigation Reports including the laboratory testing results are attached to this Report in the appendices.

As construction involves substantial filling and minimal disturbance of the existing soils on the site and given the absence of AASS or PASS soils recordered in the initial investigations, an Acid Sulphate Management Plan is not considered necessary.

The development site is mapped as Class 3 and Class 5 – Class 3 soils require a preliminary investigation where works greater than 1.0 m below ground level are proposed. The proposed development construction includes excavation and construction of sewer and stormwater services expected to be at a maximum depth of 1.5m.

Acid sulfate soils are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres of adjacent class 1,2,3 or 4 land. Works in a class 5 area that are likely to lower the water table below 1 metre AHD on adjacent class 1, 2, 3 or 4 land will trigger the requirement for assessment and may require management.

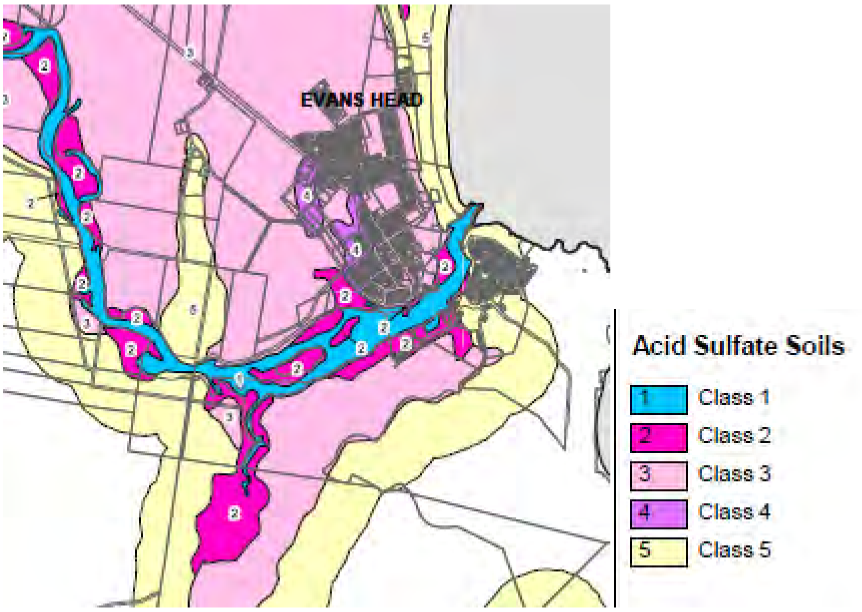


**Figure 1: Richmond Valley Council Acid Sulfate Soil Mapping**

This investigation and report is based on the Geotechnical, Groundwater and Acid Sulfate Assessment reports developed by Douglas Partners 1991; Coffey Geosciences Pty Ltd (Coffey) 1995; & Geotech Investigations Pty Ltd 2015 - with findings and results of laboratory testing forming the basis for this document herein.

The original site investigation carried out in 1991 by Douglas Partners included a report and laboratory testing of soil samples and identified:

The sandy soils were assessed for potential acid sulphate conditions. The completed laboratory tests indicate that at the sites indicated there is no evidence of (actual) acid sulphate material in any of the test pits. Further, field tests for pH decrease after oxidation in laboratory analysis for total sulphur (%) suggest that there are no potentially acid sulphate soils in any of the samples. These results should be representative of the survey area, according to Morse McVey & Associates. The soil analysis conclude that with respect to limitations imposed by the occurrence of acid sulphate materials, there is no reason why development should not proceed in this area. '

The Coffey Groundwater and Acid Sulfate Assessment 1995 also identified a general absence of Acid Sulfate Soils in the 23 borelog tests, this was confirmed by subsequent 5 laboratory testing results and are quoted in the extract below.

## 5.0 DISCUSSION

### 5.1 Acid Sulphate Soils

The field qualitative spot testing indicated a general absence or very low concentration of either ferrous monosulphide or pyrite in either the topsoil, sands above the water table or sands below the water table. This was confirmed by the laboratory testing which indicated nil acid sulphate potential and nil acid generating potential for all 5 samples submitted.

ANALYSIS OF SOIL SAMPLES
ACID SULPHATE POTENTIAL
IRON GATES ESTATE, EVANS HEAD
JOB NO. NR865/2

Date Collected: Not Specified
Date Received: 13.12.94
Date Analysed: 13.12.94 - 09.01.95

Sampled By: Client
Sampling Method: Not Specified

| SAMPLE REGD. NO. | ANALYSIS<br>S & B METHOD NO. | INITIAL pH (1:5)<br>G090. | pH AFTER $H_2O_2$ OXID'N<br>G090. | INITIAL $SO_4$<br>SC280.4 mg/kg | $SO_4$ AFTER OXID'N<br>SC280.4 mg/kg | PYRITE S<br>% | $CaCO_3$<br>SC015. % | ACID SULPHATE POTENTIAL SC120. * | ACID GENERATING POTENTIAL ** |
|---|---|---|---|---|---|---|---|---|---|
| 97297 | 50M 1.0 - 2.0 CB 944478 | 5.4 | 5.6 | 10. | 150. | <0.01 | <0.2 | NIL | NIL |
| 97298 | 150M 0.7 - 1.5 CB 944479 | 5.1 | 6.0 | 5. | 125. | <0.01 | <0.2 | NIL | NIL |
| 97299 | 250M 1.0 - 2.0 CB 944480 | 5.5 | 5.2 | <5. | 75. | <0.01 | <0.2 | NIL | NIL |
| 97300 | 350M 1.0 - 2.0 CB 944481 | 5.6 | 5.2 | <5. | 75. | <0.01 | <0.2 | NIL | NIL |
| 97301 | 465M 0.3 - 1.0 CB 944482 | 5.4 | 5.0 | 10. | 125. | <0.01 | <0.2 | NIL | NIL |

* Qualitative assessment based solely on % pyrite - not subject to NATA certification.
** Qualitative assessment based on % pyrite, % $CaCO_3$ and pH after oxidation - not subject to NATA certification.

This Laboratory is registered by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with its terms of registration. This document shall not be reproduced except in full.

SIMMONDS & BRISTOW PTY LTD

PER

## 1.2 Soil Management Plan - Environmental Objectives

As field and laboratory testing by Coffey has indicated low acid generating potential, not actual or potential acid sulfate soil (ASS), specific management measures are not considered necessary for ASS. However, some non sulphuric actual acidity may be present in soils on site, therefore a Site Specific Soil Management Plan and measures will be adopted to deal with "incidental" acid generation where base materials are excavated, drained or dewatered for periods of greater than 24 hours during construction.

The specific environmental objectives of this Site Specific Soil Management plan are to:

- To prevent acid leachate to groundwater resources;
- To prevent acidification of storm water; and
- To prevent acidification of adjacent surface waters.

## 1.3 Scope of work

Development of a Site Specific Soil Management plan (SMP) having regard to the following:

- New South Wales Acid Sulfate Soils, 2002;
- Review of results identified within the investigation being Coffey Partners International Pty Ltd (Coffey) Geotechnical and Acid Sulfate Assessment report – dated 12th January 1995; and
- Development of a site specific SMP in recognition of the Richmond Valley Local Environmental Plan 2012 – Clause 6.1 for submission and approval to council prior to the commencement of works onsite.

## 1.4 Site Description & Location

The proposed development is at the Vantage development at Evans Heads. The property description is Lot 276 DP 755624, Lot 277 DP 755624 and Lot 163 on DP831052. The site is bounded by the Evans River and adjoining SEPP 14 Wetlands at the Western end of Irongates road and lies opposite the Bundjalung National Park on the southern shores of the Evans River.

# 2 NEW SOUTH WALES LEGISLATION & REFERENCES

To following New South Wales Legislation and references were used in preparation for the development of this report:

- New South Wales Acid Sulfate Soils Manual ;
- Richmond Valley Local Environmental Plan 2012 – Clause 6.1 Acid Sulfate Soils, 2012;
- Instructions for the Treatment and Management of Acid Sulfate Soils, EPA 200; and
- QASSIT Guidelines.

# 3 SOIL MANAGEMENT PLAN

## 3.1 Sensitive Receivers

**Environmental Receivers**

The most sensitive environmental receiver is the surface water, which eventually flows to Evans River to then enter the South Pacific Ocean.

**Site Personnel**

Potential health impacts have been considered as a minor risk for site personnel working closely with excavation and filling activities. Appropriate personnel protective equipment (PPE) (gloves, safety glasses, hard hat, long sleeves and trousers) must be worn at all times.

**Surrounding Community and Stakeholders**

The surrounding land uses are predominantly residential sections of the Town of Evans Heads approximately 1.2km downstream from the site, Coastal SEPP Wetlands to the East of the site , and the Bundjalung National Park on the southern side of the Evans River.

## 3.2 Operational Controls

**Earthworks / Filling**

Prior to the placement of filling earthworks it is recommended that additional ASS testing be carried out to determine whether it is necessary for a guard layer of fine agricultural lime equivalent to 10kg lime per square meter per meter depth of fill be spread over fill areas prior to the placement of any imported fill or soils from the excavation. Liming of the surface of the fill at the rate of 5 kg per square meter and incorporating to a depth of 300 mm may also be recommended following site filling.

Should any potential acid soil (PAS) materials be excavated during construction exposure shall be minimised and contained in an adequately bunded containment area for treatment with lime as required.

Surface water infiltration to groundwater shall be prevented from passing through PAS. Where required lime material shall be placed to intercept infiltration.

Any acid leachate detected during excavation, and earthworks shall be treated by liming at required doses prior to disposal or use on site as engineered fill.

As the proposed development will affect soils below 5m AHD and involves either:

a) The excavation of 100m3 or more of soil or sediment; or

b) The filling of land involving 500m3 or more of material with an average depth of 0.5m or greater,

The following conditions in relation to acid sulphate soil investigation, management plan preparation and submission of documents to council must be complied with.

**Water Usage – construction management**

The use of potable water will not be available for use in activities associated with road and pavement construction, the compaction of fill material or dust suppression. The use of recycled water is encouraged, especially where other alternative sources do not exist. Where recycled water is proposed to be used:

c) The use of the recycled water must be in accordance with any requirements of a developed Recycled Water Safety Plan, which sets out the requirements for transport and use of recycled water;

d) The contractor must first complete a recycled water training course, in accordance with the Safety plan. Proof of completion of the training course will be by issue of a valid certification card;

e) The applicant can only contract to use a recycled water carrier who is accredited and certified by Richmond Valley Council. Accreditation requires current authorised agreement between the water carrier and Richmond Valley; and

f) The water carrier is only allowed to employ certified tanker operator/drivers, who have completed the recycled-water training course and hold a valid certification card.

**Dewatering**

Dewatering activities during site filling and trench excavations shall be undertaken in a controlled manner to prevent acid leachate to waterways, and in accordance with the approved Dewatering Management Plan

*Verification Testing*

Acid Sulphate Soil Assessments by Coffey Partners concluded that soils on site are not actual or potential acid sulphate soils. The results indicate non sulphuric actual acidity may be present within soils onsite and as such general duty of care requires the managing of proposed earthworks.

Verification testing must follow the performance criteria attained for soil that has been treated for neutralisation as stated in Soil Management Guidelines as follows:

1 The neutralising capacity of the treated soil must exceed the existing plus potential acidity of the soil; and

  - Post neutralisation, the soil pH is to be greater than 6.5; and
  - Excess neutralising agent should remain within the soil until all acid generation reactions are complete and the soil has no further capacity to generate acid.
  - The SPOCAS suite or “Chromium” suite is required for the verification testing at a rate of one test per 500 cubic metres.

2 If necessary all treatment of excavated soils shall be within a bunded area of the site filling area prior to final placement.

# 4 RESPONSIBILITIES

It will be the responsibility of the Site Project Engineer / Construction manager to ensure all site personnel are informed regarding the potential for PAS on site. All site personnel are expected to complete risk awareness training and or induction prior to arriving on site.

# 5 REPORTING & MONITORING

## 5.1 Performance Indicators

The pH of waters collected on-site shall be maintained between 6.5 and 8.5.

## 5.2 Monitoring

**Visual Monitoring**

At all times visual monitoring should be undertaken to check for signs of contamination, such as:

- Unexplained scalding, degradation or death of vegetation;
- Formation of the mineral jarosite and other acidic salts in exposed or excavated soils;
- Areas of green-blue or extremely clear water indicating high aluminium concentrations;
- A transition to, or an establishment of, a community dominated by acid tolerant species;
- Rust coloured deposits on plants and on the banks of drains; water bodies and watercourses indicating iron precipitates;
- Corrosion of concrete and/or steel structures in contact with soil or water; and
- Black to very coloured waters indicating de-oxygenation;
- Sulfurous smell (rotten egg gas).

**Water Quality Monitoring**

The water quality monitoring programme is to be undertaken by the principal consultant for pre-construction, during construction and post-construction activities. The principal consultant is responsible for performing and reporting on water quality in accordance with a Construction Site Based Management Plan (CSBMP) developed prior to construction.

Surface and stormwater runoff discharged from the site shall be monitored at discharge locations for pH, salinity, dissolved oxygen, suspended solids, temperature, iron, aluminium, total phosphorus and total nitrogen. All waters discharged are to meet the performance criteria and the environmental values and water quality objectives published within the ANZECC Water Quality Guidelines 2006.

Groundwater resources potentially affected by construction activities shall be monitored for pH, salinity, dissolved oxygen, temperature, iron, aluminium, total phosphorus and total nitrogen.

## 5.3 Corrective Actions

Non-conformance with this plan shall be documented and a corrective action request (CAR) issued. All CAR's shall be included in the non-conformance register.

Should a decline in water quality be observed, corrective action shall be undertaken in consultation with Council.

## 5.4 Reporting

The Contractor shall document any encounter of Potential and Actual ASS and report any such occurrence to the Proponent.

During construction, monthly reports are to be prepared on the water quality monitoring carried out. The reports are to include all test results and a summary of the findings for the period. The reports are to be submitted to council.

Quarterly water quality reports after completion of the development will be prepared and submitted to council for a six month period.

# APPENDIX A

## GEOTECH INVESTIGATIONS (2015)

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-a
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P1**

| | | |
|---|---|---|
| Location | N: 6778265 E: 540560 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, grey brown<br>0.5 m (SP) SAND: Fine sand, dry, pale grey<br>2.2 m (SP) SAND: Fine sand, wet, pale grey<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 2.2 m BSL | |
| Field Test Results | $K_{sat}$ = 13.7 m/day = 572 mm/hr | K = 1.6 x $10^{-4}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

DRILLING ENVIRONMENTAL GEOTECHNICAL

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
ACN 154555478

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DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-b
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P2**

| | | |
|---|---|---|
| Location | N: 6778474 E: 540581 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, grey brown<br>0.5 m (SP) SAND: Fine sand, moist, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, moist, dark brown<br>1.6 m (SP) SAND: Trace silt, fine sand, moist, dark grey<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | Not identified | |
| Field Test Results | $K_{sat}$ = 89.5 m/day = 3728 mm/hr | K = 1 x $10^{-3}$ m/s |
| Test Hole Depth | 0.6 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

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ACN 154555478

P 07 5523 3979
F 07 5523 3981
admin@geotechinvestigations.com

Our Ref: JW:jw: GI 2039-c
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P3**

| | | |
|---|---|---|
| Location | N: 6778597 E: 540503 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: With silt, fine sand, moist, grey<br>0.3 m (SM) Silty SAND: Fine sand, moist, dark brown<br>0.6 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.6 m BSL | |
| Field Test Results | $K_{sat}$ = 16.8 m/day = 698 mm/hr | K = 1.9 x $10^{-4}$ m/s |
| Test Hole Depth | 0.17 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

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ACN 154555478

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Our Ref: JW:jw: GI 2039-d
2 June 2015

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PO Box 3441
Australia Fair Southport QLD 4215

**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P4**

| | | |
|---|---|---|
| Location | N: 6778425 E: 540493 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine to medium sand, moist, dark brown<br>0.7 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.7 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>2.0 m (SP) SAND: Trace silt, fine sand, wet, grey brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 1.7 m BSL | |
| Field Test Results | $K_{sat}$ = 27.0 m/day = 1128 mm/hr | K = 3.1 x $10^{-4}$ m/s |
| Test Hole Depth | 0.77 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

Geotech INVESTIGATIONS PTY LTD

ABN 81154555478
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DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-e
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
Australia Fair Southport QLD 4215

**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P5**

| | | |
|---|---|---|
| Location | N: 6778333 E: 540483 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, dark brown<br>0.6 m (SP) SAND: Trace silt, fine sand, dry, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, moist to wet, pale grey<br>2.4 m (SP) SAND: Trace silt, fine sand, wet, grey brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 1.5 m BSL | |
| Field Test Results | $K_{sat}$ = 4.2 m/day = 176 mm/hr | K = 4.9 x $10^{-5}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
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DRILLING ENVIRONMENTAL GEOTECHNICAL

Our Ref: JW:jw: GI 2039-f
2 June 2015

Gold Coral Pty Ltd
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P6**

| | | |
|---|---|---|
| Location | N: 6778091 E: 540285 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, dark grey<br>0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>0.8 m (SM) Silty SAND: Fine sand, moist, dark orange brown<br>1.2 m (SM) Silty SAND: Fine sand, moist, grey brown mottled orange brown<br>2.7 m (SM) Silty SAND: Fine sand, wet, grey brown mottled orange brown<br>T.D. 3 m | |
| Water Table | 2.7 m BSL | |
| Field Test Results | $K_{sat}$ = 2.2 m/day = 91 mm/hr | K = 2.5 x $10^{-5}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'well drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

<u>**James Walle**</u> *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
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Our Ref: JW:jw: GI 2039-g
2 June 2015

Gold Coral Pty Ltd
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P7**

| | | |
|---|---|---|
| Location | N: 6778447 E: 540402 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: With silt, fine to medium sand, moist, grey brown<br>0.2 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>0.7 m (SM) Silty SAND: Trace clay, fine sand, wet, orange brown<br>1.1 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.7 m BSL | |
| Field Test Results | $K_{sat}$ = 7.2 m/day = 300 mm/hr | K = 8.3 x $10^{-5}$ m/s |
| Test Hole Depth | 0.87 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
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Our Ref: JW:jw: GI 2039-h
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P8**

| | | |
|---|---|---|
| Location | N: 6778560 E: 540397 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: Trace silt, fine sand, moist, brown<br>0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.2 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>1.4 m (SM) Silty SAND: Fine sand, wet, dark brown<br>1.9 m (SP) SAND: Trace silt, fine sand, wet, dark grey / brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.6 m BSL | |
| Field Test Results | $K_{sat}$ = 2.6 m/day = 109 mm/hr | K = 3.0 x $10^{-5}$ m/s |
| Test Hole Depth | 0.07 m BSL | |
| Indicative Drainage Class | 'well drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
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Our Ref: JW:jw: GI 2039-i
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P9**

| | | |
|---|---|---|
| Location | N: 6778502 E: 540329 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine to medium sand, moist, dark grey<br>0.5 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.8 m (SM) Silty SAND: With clay, fine sand, wet, dark brown<br>2.0 m (SM) Silty SAND: Fine sand, wet, dark brown mottled orange brown<br>2.5 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.5 m BSL | |
| Field Test Results | $K_{sat}$ = 18.6 m/day = 775 mm/hr | K = 2.2 x $10^{-4}$ m/s |
| Test Hole Depth | 0.07 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

# PLAN OF SUBDIVISION

IRON GATES, EVANS HEAD

| LOT | AREA | LOT | AREA | LOT | AREA |
|---|---|---|---|---|---|
| 01 | 958.54m² | 74 | 601.67m² | 147 | 623.04m² |
| 02 | 609.58m² | 75 | 602.27m² | 148 | 623.04m² |
| 03 | 610.02m² | 76 | 602.86m² | 149 | 623.04m² |
| 04 | 610.48m² | 77 | 611.90m² | 150 | 623.04m² |
| 05 | 610.80m² | 78 | 601.02m² | 151 | 623.04m² |
| 06 | 611.13m² | 79 | 645.62m² | 152 | 701.77m² |
| 07 | 611.45m² | 80 | 642.13m² | 153 | 703.42m² |
| 08 | 611.78m² | 81 | 602.42m² | 154 | 611.15m² |
| 09 | 612.10m² | 82 | 602.31m² | 155 | 611.15m² |
| 10 | 612.43m² | 83 | 602.20m² | 156 | 611.15m² |
| 11 | 612.75m² | 84 | 854.34m² | 157 | 611.15m² |
| 12 | 612.98m² | 85 | 854.15m² | 158 | 611.15m² |
| 13 | 611.49m² | 86 | 601.23m² | 159 | 611.29m² |
| 14 | 613.85m² | 87 | 601.27m² | 160 | 720.75m² |
| 15 | 614.18m² | 88 | 951.69m² | 161 | 753.34m² |
| 16 | 614.50m² | 89 | 794.12m² | 162 | 633.95m² |
| 17 | 614.82m² | 90 | 601.19m² | 163 | 602.77m² |
| 18 | 615.14m² | 91 | 601.15m² | 164 | 707.28m² |
| 19 | 615.47m² | 92 | 601.11m² | 165 | 649.98m² |
| 20 | 615.80m² | 93 | 601.06m² | 166 | 661.66m² |
| 21 | 653.44m² | 94 | 601.03m² | 167 | 686.92m² |
| 22 | 639.06m² | 95 | 600.07m² | 168 | 640.98m² |
| 23 | 600.87m² | 96 | 665.25m² | 169 | 621.28m² |
| 24 | 601.48m² | 97 | 617.23m² | 170 | 845.54m² |
| 25 | 601.78m² | 98 | 605.72m² | 171 | 829.97m² |
| 26 | 602.07m² | 99 | 609.16m² | 172 | 600.73m² |
| 27 | 602.37m² | 100 | 613.10m² | 173 | 600.73m² |
| 28 | 602.67m² | 101 | 606.61m² | 174 | 601.88m² |
| 29 | 602.97m² | 102 | 600.24m² | 175 | 600.94m² |
| 30 | 603.27m² | 103 | 600.05m² | 176 | 618.69m² |
| 31 | 603.56m² | 104 | 603.86m² | | |
| 32 | 603.87m² | 105 | 606.12m² | | |
| 33 | 611.56m² | 106 | 604.88m² | | |
| 34 | 602.69m² | 107 | 644.68m² | | |
| 35 | 687.98m² | 108 | 604.83m² | | |
| 36 | 744.04m² | 109 | 603.24m² | | |
| 37 | 601.47m² | 110 | 608.18m² | | |
| 38 | 601.47m² | 111 | 606.58m² | | |
| 39 | 601.47m² | 112 | 608.28m² | | |
| 40 | 601.47m² | 113 | 736.06m² | | |
| 41 | 601.47m² | 114 | 720.51m² | | |
| 42 | 601.47m² | 115 | 1029.27m² | | |
| 43 | 601.47m² | 116 | 602.49m² | | |
| 44 | 601.47m² | 117 | 609.57m² | | |
| 45 | 601.47m² | 118 | 607.83m² | | |
| 46 | 601.84m² | 119 | 651.61m² | | |
| 47 | 600.97m² | 120 | 603.93m² | | |
| 48 | 602.78m² | 121 | 603.27m² | | |
| 49 | 601.06m² | 122 | 604.77m² | | |
| 50 | 600.70m² | 123 | 613.74m² | | |
| 51 | 604.45m² | 124 | 602.29m² | | |
| 52 | 604.30m² | 125 | 628.60m² | | |
| 53 | 604.17m² | 126 | 603.18m² | | |
| 54 | 604.11m² | 127 | 690.16m² | | |
| 55 | 603.12m² | 128 | 601.05m² | | |
| 56 | 601.74m² | 129 | 606.82m² | | |
| 57 | 600.79m² | 130 | 632.34m² | | |
| 58 | 833.34m² | 131 | 609.67m² | | |
| 59 | 783.87m² | 132 | 606.00m² | | |
| 60 | 674.25m² | 133 | 601.02m² | | |
| 61 | 612.30m² | 134 | 600.03m² | | |
| 62 | 605.75m² | 135 | 600.92m² | | |
| 63 | 604.82m² | 136 | 600.85m² | | |
| 64 | 603.90m² | 137 | 600.91m² | | |
| 65 | 602.98m² | 138 | 639.85m² | | |
| 66 | 602.05m² | 139 | 655.96m² | | |
| 67 | 601.13m² | 140 | 795.02m² | | |
| 68 | 600.20m² | 141 | 897.95m² | | |
| 69 | 603.67m² | 142 | 603.25m² | | |
| 70 | 620.23m² | 143 | 636.28m² | | |
| 71 | 603.10m² | 144 | 722.96m² | | |
| 72 | 600.46m² | 145 | 620.19m² | | |
| 73 | 601.06m² | 146 | 623.04m² | | |


PLANIT CONSULTING

**PROJECT TITLE:** IRON GATES DEVELOPMENT, EVANS HEAD

**DRAWING TITLE:** PLAN OF SUBDIVISION - OPTION 7

**BASE PROVIDED BY:** N/A

**CLIENT:** GOLD CORAL

| NO | DATE | REVISION | BY |
|---|---|---|---|
| - | - | - | - |

**SCALE:** 1/1500 @ A1

**DESIGN:** PLANIT CONSULTING

**DRAWN:** ZP

**DATE:** 03/2015

**CHECKED:** AS

**DRAWING NO:** IRONGATES_PLNOFSUB_01

**NORTH POINT:**

**SHEET NO:** 01 OF 01


Level 1 2247 Gold Coast Hwy
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PO Box 206 QLD 4218
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# APPENDIX B

## COFFEY PARTNERS INTERNATIONAL (1995)

# Coffey Partners International Pty Ltd

A.C.N. 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources

COFFEY

530 Fairlawn Street
Nathan QLD 4111

PO Box 100
Salisbury QLD 4107
Australia

Fax (07) 274 4977
Telephone (07) 274 4411


Your Reference

Our Reference NR865/2-B GHD

Date 12th January, 1995

W P Brown & Partners Pty Ltd
PO Box 6527
UPPER MT GRAVATT QLD 4122

Attention: Mr Gary Spence

Dear Sir,

RE **IRON GATES ESTATE - STAGE 1A**
**INVESTIGATION OF PROPOSED OPEN DRAIN**

Please find enclosed our report on the geotechnical investigation for a proposed drain at the Iron Gates Estate. The investigation was carried out in general accordance with our proposal NRP294/17-A dated 21st November, 1994.

Should you have any queries regarding the contents of this report, please contact Geoff Drew or the undersigned at our Brisbane office.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

Philip Shaw

P.SHAW

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## 1.0 INTRODUCTION

It is proposed that an open drain be constructed adjoining the Iron Gates Estate Stage 1A development. Coffey Partners International Pty Ltd was commissioned verbally by Mr.Gary Spence of W.P.Brown & Partners Pty Ltd to perform an investigation of the subsurface conditions along the drain alignment. This report contains details of the field investigation and the laboratory chemical and geotechnical testing. Comment is provided on the impact of the proposed drain on a nearby wetland area and the possibility that acid sulphate soils will be exposed during excavation.

## 2.0 FIELD INVESTIGATION

A total of 9 holes was drilled using hand held (sand) auger equipment on 6th & 7th December, 1994. The holes were advanced to depths of 2m below the existing ground surface at 50m intervals along the alignment of Open Drain No.1, beginning at approximately ch.50m. Samples were taken for laboratory testing for acid sulphate soils and for particle size distribution analysis, and standing water levels (SWL) were measured.

Qualitative spot tests for the presence of either ferrous monosulphide or pyrite were performed at each drilling location in the surface layer and in the soils above and below the water table. Engineering logs of the boreholes along with explanation sheets describing the terms and symbols used are presented in Appendix A.

## 3.0 SITE DESCRIPTION

The site of the proposed drain is a generally flat sandy area with variable tree and grass cover. The ground surface along the alignment has a maximum elevation of about RL3.0m over most of the alignment and, at the end of the alignment, falls from an elevation of RL2.3m to the banks of the Evans River over a distance of 20m. The area comprises beach or coastal dune sands. The estate layout drawings show the proposed drain running from a point close to an area of wetlands directly to the Evans River.

The wetlands are swampy with large areas of surface water, thick weed growth and paperbark trees. Organic clays are reported to occur at approximately 300mm below the surface sands, but their thickness is not known. The topographic mapping of the area shows an elongated feature with a surface elevation a little below the RL2m contour trending south from the Open Space. Surface water within this depression may be either perched on the organic clay layer, or be a 'window' to the water table, or a combination of both in the case of a discontinuous organic clay layer.

## 4.0 LABORATORY TESTING

### 4.1 Acid Sulphate

The qualitative spot tests for the presence of acid sulphates all indicated nil to very low concentrations. Three samples from below the water table and two samples from above the water table were submitted for quantitative acid sulphate testing. Summary results of the laboratory testing are set out in Table 1 below, with laboratory test reports in Appendix C.

**TABLE 1**
Summary of Acid Sulphate Testing

| Chainage | Depth (m) | pH | | $SO_4$ (mg/kg) | |
|---|---|---|---|---|---|
| | | initial | after oxidation | initial | after oxidation |
| 50m | 1.0 - 2.0 | 5.4 | 5.6 | 10 | 150 |
| 100m | 0.7 - 1.5 | 5.1 | 6.0 | 5 | 125 |
| 250m | 1.0 - 2.0 | 5.5 | 5.2 | <5 | 75 |
| 350m | 1.0 - 2.0 | 5.6 | 5.2 | <5 | 75 |
| 465m | 0.3 -1.0 | 5.4 | 5.0 | 10 | 125 |

Note: Pyrite S concentrations all <0.01%. $CaCO_3$ concentrations all <0.2%.

### 4.2 Particle Size Distribution

Field description of the sands gives a grain size in the fine to medium grained range. Laboratory testing indicates less than 5% passing 0.075mm and 98% passing 0.425mm sieves. Laboratory test results can are reported in Appendix B. Coefficient of Uniformity is less than 2, indicating high porosity.

## 5.0 DISCUSSION

### 5.1 Acid Sulphate Soils

The field qualitative spot testing indicated a general absence or very low concentration of either ferrous monosulphide or pyrite in either the topsoil, sands above the water table or sands below the water table. This was confirmed by the laboratory testing which indicated nil acid sulphate potential and nil acid generating potential for all 5 samples submitted.

### 5.2 Groundwater Movement

On the basis of the SWLs measured during the field investigation, a gradient averaging about 1:200 currently exists towards the river from ch.250m with a negligible gradient from ch.250m to ch.465m and an apparent slight mounding at about ch.250m. The water table is of the order of 1m below ground surface over most of the proposed drain alignment so can be said to roughly follow the ground surface contours, as is to be expected under phreatic conditions. Standing water levels in BH1 and BH2 drilled in August 1994 were 0.6m below a ground surface level which is assessed at about RL2.3m from contours on supplied plans. This indicates that the water table beyond the end of the proposed drain is relatively constant at about RL 1.75m which corresponds to the inferred free water surface level in the wetlands.

An estimated permeability (K) of between $3x10^{-3}$cm/sec (2.5m/day) and $4.5x10^{-3}$cm/sec (4.0m/day) can be inferred from the particle size characteristics of the sands. Specific Yield is estimated at 0.33. With this permeability and gradient, a steady regional groundwater flow would already be established towards the river, the flow being maintained by both direct infiltration of rainwater and leakage of some surface water from the wetlands area. The proportion of the existing flow attributable to the wetlands source would depend on the permeability and thickness of the organic clay layers underlying the wetlands. Total throughflow rates would vary with water table fluctuations resulting from changes in the availability of recharge, especially that deriving from direct infiltration of rainfall.

Design drawings show that the open drain will be excavated to a depth of about 1m below the water table. The effect of this excavation will be a localised lowering of the water table due to the creation of a new line of discharge. Homogeneous fine grained unconfined aquifers of the type encountered here are known to exhibit delayed drainage with the result that the lowering of water table will be gradual and, in the short term, of limited extent. Long term expansion of the zone of influence of the drain is likely to occur only during long periods without recharge. Other factors such as evaporation and transpiration could then prove to be of greater importance to the wetlands than any induced drawdowns.

Estimations of drawdown at distances from the drain have been made using methods for estimating flow of groundwater to galleries (Huisman after Edelman). Assumptions made for these calculations are; 1 year (365 days) without recharge, instantaneous drawdown at the gallery of 1m, and aquifer thickness of 1.75m.

**TABLE 2**
**Distance-Drawdown Estimations**

| Distance from Drain Centreline (m) | Drawdown (m) at | |
|---|---|---|
| | K=3.8m/day | K=2.5m/day |
| 20 | 0.87 | 0.84 |
| 30 | 0.81 | 0.76 |
| 40 | 0.74 | 0.68 |
| 50 | 0.68 | 0.61 |
| 60 | 0.62 | 0.54 |
| 80 | 0.51 | 0.42 |
| 100 | 0.41 | 0.31 |

Significantly lower calculated drawdowns at distance from the drain are obtained by reducing the time without recharge (rainfall). Reducing the period without recharge to 100 days (3 months) results in drawdowns at 100m of 0.12m and 0.05m for permeabilities of 3.8 and 2.5m/day respectively.

The organic clay layer noted in the wetlands area was not present at a similar level along the proposed drain, so it can be inferred that it is specific to the wetland area. In this case, there is a high probability that the much lower permeability of the organic clay layer will tend to isolate the wetlands from the drawdowns induced by the drain excavation. Even if the isolating effect of the organic clays is less than expected it is likely that any loss of water to the proposed drain would be replaced by groundwater flow from other directions.

Any potential impact of the drain on the area could be reduced if it was possible to modify the overall estate drainage design to allow the invert level of the drain to be raised so that it is closer to the present water table. As the drawdowns were calculated on the basis of a 1m lowering of water level at the drain, proportional adjustments can be made for any alteration in the depth of excavation below the water table. Flow to the drain given the assumptions described above is estimated to be of the order of $0.04m^3$/day per metre length of excavation after 1 year without significant rainfall recharge.

Philip Shaw

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

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# IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks.

## A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration, the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations.

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report:

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed.

## SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts. Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events.

## MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

## A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

## GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

## GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

APPENDIX A

# APPENDIX A

# APPENDIX A

## ENGINEERING LOGS OF BOREHOLES

Coffey Partners International Pty Ltd
ACN 003 692 019

# descriptive terms soil and rock

COFFEY

Explanation Sheet 1

## SOIL DESCRIPTIONS

**Classification of Material** based on Unified Classification System (refer SAA Site Investigation Code AS1726–1975 Add. No. 1 Table D1).

**Moisture Condition** based on appearance of soil

- **dry** Looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through hands.
- **moist** Soil feels cool, darkened in colour; cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hands on remoulding.
- **wet** Soil feels cool, darkened in colour; cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.

**Consistency** based on unconfined compressive strength (Qu) (generally estimated or measured by hand penetrometer).

| term | very soft | soft | firm | stiff | very stiff | hard |
|---|---|---|---|---|---|---|
| Qu kPa | 25 | 50 | 100 | 200 | 400 | |

If soil crumbles on test without meaningful result, it is described as **friable**.

**Density Index** (generally estimated or based on penetrometer results).

| term | very loose | loose | medium dense | dense | very dense |
|---|---|---|---|---|---|
| density index $I_D$ % | 15 | 35 | 65 | 85 | |

## ROCK DESCRIPTIONS

**Weathering** based on visual assessment

| term | criterion |
|---|---|
| Fresh. | Rock substance unaffected by weathering. |
| Slightly Weathered. | Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance. |
| Moderately Weathered: | Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable. |
| Highly Weathered: | Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable. |
| Extremely Weathered: | Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident. |

**Strength** based on point load strength index, corrected to 50 mm diameter - Is(50) (refer I.S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1). (Generally estimated: x indicates test result).

| classification | extremely low | very low | low | medium | high | very high | extremely high |
|---|---|---|---|---|---|---|---|
| Is (50) MPa | 0.03 | 0.1 | 0.3 | 1 | 3 | 10 | |

The unconfined compressive strength is typically about 20 x $I_{S50}$ but the multiplier may range, for different rock types, from as low as 4 to as high as 30

**Defect Spacing**

| classification | extremely close | very close | close | medium | wide | very wide | extremely wide |
|---|---|---|---|---|---|---|---|
| spacing m | 0.03 | 0.1 | 0.3 | 1 | 3 | 10 | |

**Defect description** uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam (etc.) and character (roughness, extent, coating etc.).



A E C D E F G H J K L M N O P Q R S T U V W X Y Z

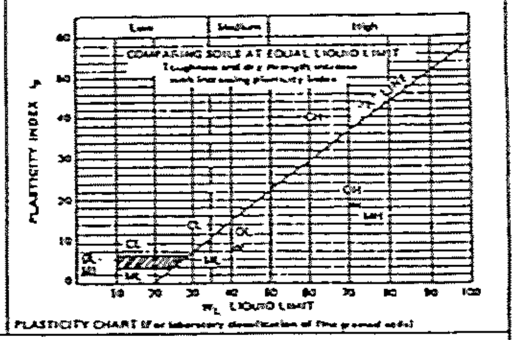
# SOIL CLASSIFICATION
## INCLUDING IDENTIFICATION AND DESCRIPTION

| FIELD IDENTIFICATION PROCEDURES [illegible] | | | | GROUP SYMBOLS | TYPICAL NAMES | INFORMATION REQUIRED FOR DESCRIBING SOILS | LABORATORY CLASSIFICATION CRITERIA |
|---|---|---|---|---|---|---|---|
| COARSE GRAINED SOILS (More than 50% of material less than 60 mm is larger than 0.06 mm) | GRAVELS (More than half of coarse fraction is larger than 2.0 mm) | CLEAN GRAVELS (Little or no fines) | Wide range in grain size and substantial amounts of all intermediate particle sizes | GW | Well graded gravels, gravel - sand mixtures, little or no fines. | SYMBOL Give typical name, indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and strength of the coarse grains. colour, amount, plasticity of fine component | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3 |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing | GP | Poorly graded gravels, gravel - sand mixtures little or no fines | | Not meeting all gradation requirements for GW |
| | | GRAVELS WITH FINES (Appreciable amount of fines) | Non plastic fines (for identification procedures see ML below) | GM | Silty gravels, poorly graded gravel - sand - silt mixtures | For undisturbed soils add information on moisture condition, degree of compaction, stratification, cementation, odour | Atterberg limits below "A" line or $I_p$ less than 4. / Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | Plastic fines (for identification procedures see CL below) | GC | Clayey gravels, poorly graded gravel - sand - clay mixtures | | Atterberg limits above "A" line with $I_p$ greater than 7 |
| | SANDS (More than half of coarse fraction is smaller than 2.0 mm) | CLEAN SANDS (Little or no fines) | Wide range in grain sizes and substantial amounts of all intermediate particle sizes | SW | Well graded sands, gravelly sands, little or no fines. | Give local or geologic name and/ other pertinent descriptive information. | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3 |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing | SP | Poorly graded sands, gravelly sands, little or no fines. | Example: SM - Gravelly Silty SAND coarse to fine, pale brown, about 20% strong angular gravel particles - 10 mm maximum size, rounded and sub angular sand, about 15% non plastic fines, moist, dense, alluvial sand | Not meeting all gradation requirements for SW |
| | | SANDS WITH FINES (Appreciable amount of fines) | Non plastic fines (for identification procedures see ML below) | SM | Silty sands, poorly graded sand - silt mixtures | | Atterberg limits below "A" line or $I_p$ less than 4 / Above "A" line with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols. |
| | | | Plastic fines (for identification procedures see CL below) | SC | Clayey sands, poorly graded sand - clay mixtures | | Atterberg limits above "A" line with $I_p$ greater than 7. |

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION

Determine percentages of gravel and sand from grain size curve. Depending on percentage smaller than 0.06 mm size coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols

| FINE GRAINED SOILS (More than 50% of material less than 60 mm is smaller than 0.06 mm) (The 0.06 mm particle is about the smallest particle visible to the naked eye) | IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 mm | DRY STRENGTH † | DILATANCY † | TOUGHNESS † | GROUP SYMBOLS | TYPICAL NAMES | INFORMATION REQUIRED FOR DESCRIBING SOILS |
|---|---|---|---|---|---|---|---|
| | SILTS AND CLAYS (Liquid limit less than 50) | None to Low | Quick to slow | None | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit. * | SYMBOL Give typical name, indicate degree and character of plasticity, colour, amount and size of coarse grains. |
| | | Medium to high | None to very slow | Medium | CL | Inorganic clays of low to medium plasticity, * gravelly clays, sandy clays, silty clays. | For undisturbed soils add information on moisture condition, consistency, structure, stratification, odour. |
| | | Low to medium | Slow | Low | OL | Organic silts and organic silt - clays of low to medium plasticity. * | |
| | SILTS AND CLAYS (Liquid limit greater than 50) | Low to medium | Slow to none | Low to medium | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit. | Give local or geologic name, and other pertinent descriptive information. |
| | | High to very high | None | High | CH | Inorganic clays of high plasticity. * | Example: |
| | | Medium to high | None to very slow | Low to medium | OH | Organic clays of high plasticity. * | CL - Sandy CLAY of low plasticity pale grey and brown; Sand fine to medium, trace of fine gravel, dry, firm, numerous vertical root holes; (FILL). |
| HIGHLY ORGANIC SOILS | Readily identified by colour, odour, spongy feel and frequently by fibrous texture. | | | | Pt | Peat and other highly organic soils. | |



PLASTICITY CHART (For laboratory classification of fine grained soils)

1. Boundary classifications - Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

* Low plasticity - Liquid Limit $w_L$ less than 35%. Medium plasticity - $w_L$ between 35% and 50%.

Adapted from A.S. 1726-1981 (App.D)

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

[illegible]

† TOUGHNESS (Consistency near plastic limit)

[illegible]

† DILATANCY (Reaction to shaking)

[illegible]

† DRY STRENGTH (Crushing characteristics)

[illegible]

COFFEY

Coffey Partners International

Consulting Engineers in the geotechnical sciences

SOIL CLASSIFICATION CHART

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

| borehole no. | HA1 |
|---|---|
| sheet | 1 of 1 |

office job no: NR065/2

| | | | |
|---|---|---|---|
| client: | V P, BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch 50m | checked by: | SHO. |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting: | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.33 approx. |
| hole diameter: | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SM | SILTY SAND: fine to medium grained, dark grey, with 15% silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | 0 | | | | SP | SAND: fine to medium grained, light grey, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | | 0 | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | | | | | W | | | |
| | | | | | | 2 | | | Borehole HA1 Terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
N not measured
O none observed
water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample,
N standard penetration test:
Nn SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A
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C
D
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F
G
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P
Q
R
S
T
U
V
W
X
Y
Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

office job no: NR865/2

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch.100m | checked by: | |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.62 Approx. |
| hole diameter | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | |
| | | | | D | | | SP | SAND: fine to medium grained, brown & light brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | | D | 1 | | SP | SAND: as above. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | W | | | |
| | | | | | 2 | | | Borehole HA2 terminated at 2.00 m | | | | |
| | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

**SUPPORT**
Nil no support
C casing
M mud

**PENETRATION**
1 2 3 4
little resistance
ranging to
very slow progress

**WATER**
not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
N* SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

| | | | |
|---|---|---|---|
| client: W.P. BROWN & PARTNERS PTY LTD | | office job no: | NR865/2 |
| principal: | | hole commenced: | 7.12.94 |
| project: IRON GATES ESTATE - STAGE 1A - EVANS HEAD | | hole completed: | 7.12.94 |
| borehole location: DRAIN No.1 - Approx.Ch 100m | | logged by: | AEL |
| | | checked by: | SHO |
| drill model and mounting: SAND AUGER | slope: -90 DEG | R.L.Surface: | 2.62 approx. |
| hole diameter: 80mm | bearing: | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | |
| | | | | D | | | | SP | SAND: fine to medium grained, brown & light brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | | D | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | | | 2 | | | Borehole HA2 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

**SUPPORT**
Nil no support M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nm SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

# engineering log - borehole

COFFEY

| borehole no: | HA3 |
|---|---|
| sheet | 1 of 1 |

office job no: N8065/2

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch.150m | checked by: | gro. |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting: | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.78 approx. |
| hole diameter | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SA | | C | | D | | | | SP | SAND fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | D | | 1 | | SP | SAND fine to medium grained, brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | | | 2 | | SP | SAND As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | | | | Borehole HA3 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
¥ not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bt bulk sample
E environmental sample
N standard penetration test;
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense


form GEO 2.2 rev. 3

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

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Coffey Partners International Pty. Ltd.
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA4

sheet 1 of 1

| | | | |
|---|---|---|---|
| client: | K.P. BROWN & PARTNERS PTY LTD | office job no: | NR065/2 |
| principal: | | hole commenced: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | hole completed: | 7.12.94 |
| borehole location: | DRAIN No.1 - Approx.Ch 200m | logged by: | AEL |
| | | checked by: | SAO |
| drill model and mounting: | SAND AUGER | slope: | -90 DEG |
| | | R.L.Surface: | 2.8 approx. |
| hole diameter: | 80mm | bearing: | |
| | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SA | | C | | D | | | | SM | SILTY SAND: fine to medium grained, dark grey-brown, with 15% silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | | | | | SP | SAND: fine to medium grained, light grey-brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | 1 | | | | W | | | |
| | | | | | | | | SP | SAND: as above. | | | | ACID SULPHATE TEST CLEAR |
| | | NIL | | | | 2 | | | Borehole HA4 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

**SUPPORT**
Nil no support M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured D none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nr SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



0587

Coffey Partners International Pty. Ltd.
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA5
sheet 1 of 1

office job no: NR065/2

| | | | |
|---|---|---|---|
| client | K P. BROWN & PARTNERS PTY LTD | hole commenced | 7.12.94 |
| principal: | | hole completed | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch 250m | checked by: | gWO |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting | SAND AUGER | slope: | -90 DEG | R.L.Surface | 2.97 approx. |
| hole diameter | 80mm | bearing: | | datum | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | | | | | SP | SAND: fine to medium grained, white, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ∇ | | | | | | | W | | | |
| | | | | D | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA5 Terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured
O none observed
water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no. HA6
sheet 1 of 1

office job no: NR065/2

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx. Ch 300m | checked by: | GAO. |
| drill model and mounting: | SAND AUGER | slope: -90 DEG | R.L. Surface: 2.83 approx |
| hole diameter: | 80mm | bearing: | datum: AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. m | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | |
| | | | | D | | | | SP | SAND: fine to medium grained, off-white, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | 1 | | | | | | | |
| | | | | D | | | | SP | SAND: as above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA6 Terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
- AS auger screwing*
- AD auger drilling*
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- *bit shown by suffix
- B blank bit
- V V bit
- T TC bit
- e.g. AD/T

**SUPPORT**
- NIL no support
- M mud
- C casing

**PENETRATION** 1 2 3 4
- little resistance ranging to very slow progress

**WATER**
- N not measured
- O none observed
- ▽ water level
- water outflow
- water inflow

**SAMPLES, TESTS, ETC**
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- N standard penetration test
- Nc SPT + sample recovered
- Nc SPT with solid cone
- VS vane shear
- PM pressuremeter
- DP dynamic penetrometer
- WS water sample
- PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense



A B C D E F G H . K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

# engineering log - borehole

COFFEY

| | |
|---|---|
| borehole no: | HA7 |
| sheet | 1 of 1 |
| office job no: | N0065/2 |

| | | | |
|---|---|---|---|
| client: | W P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch.350m | checked by: | GD. |
| drill model and mounting: | SAND AUGER | slope: | -90 DEG |
| R.L.Surface: | 2.73 approx. | datum: | AHD |
| hole diameter: | 80mm | bearing: | |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, grey & brown, with some silt fines. | M | MD | | |
| | | | | D | | | | SP | SAND: fine to medium grained, off-white, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | D | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | NIL | | | | | | | | | | | |
| | | | | | | 2 | | | Borehole HA7 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
NIL no support M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample 0mm
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

| borehole no: | HA9 |
|---|---|
| sheet | 1 of 1 |

| | | | |
|---|---|---|---|
| client: | W P. BROWN & PARTNERS PTY LTD | office job no: | N0865/2 |
| principal: | | hole commenced: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | hole completed: | 7.12.94 |
| borehole location: | DRAIN No.1 - Approx.Ch 465m | logged by: | AEL |
| | | checked by: | [illegible] |
| drill model and mounting: | SAND AUGER | slope: | -90 DEG |
| hole diameter: | 80mm | bearing: | |
| R.L. Surface: | 2.97 approx. | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, light brown & brown, with a trace of silt lines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | D | | | | SP | SAND: fine to medium grained, off-white, with a trace of silt lines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | 1 | | SP | SAND: As above. | W | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA9 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support M mud
C casing

**PENETRATION**
1 2 3 4 little resistance ranging to very slow progress

**WATER**
N not measured O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

# APPENDIX B

# APPENDIX B

## PARTICLE SIZE DISTRIBUTION

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Coffey Partners International Pty Ltd
A C N 003 692 019

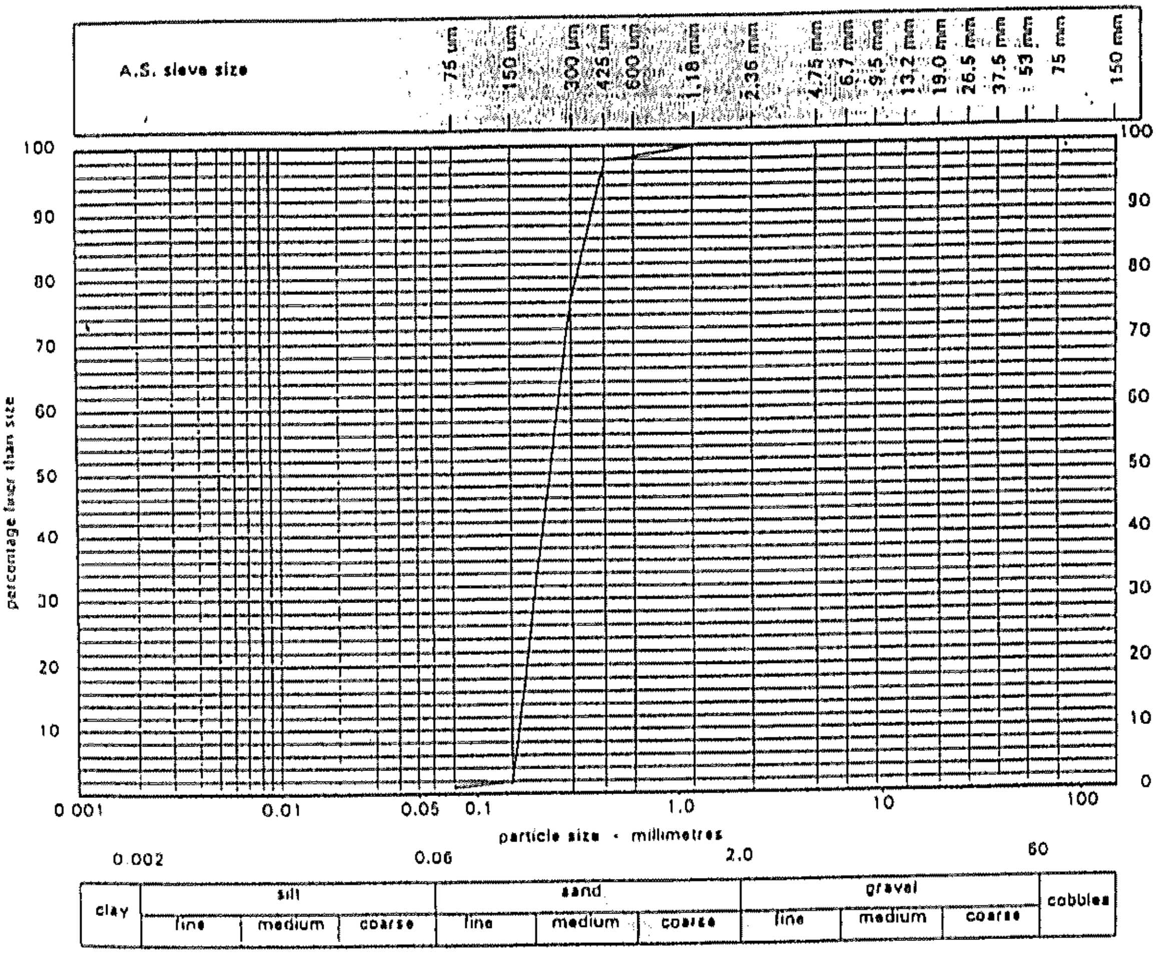
Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources
530 Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

COFFEY

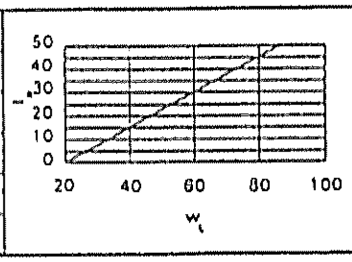
# particle size distribution

| | | | |
|---|---|---|---|
| client : | WP BROWN & PARTNERS | job no : | NR865/2 |
| principal : | | laboratory : | BRISBANE |
| project : | IRON GATES ESTATE | date : | 05/01/95 |
| location : | EVANS HEAD | test report : | CB95001.ENG |

sample identification : CB944483 Ch. 300m depth : 1.0 - 2.0m
test procedure : AS1289 C6.1




| | | |
|---|---|---|
| liquid limit | % | |
| plastic limit | % | |
| plasticity index | % | |
| linear shrinkage | % | |
| particle density | $t/m^3$ | |
| natural moisture | % | |




classification :



Authorised Signature
NATA Reg. No. 596

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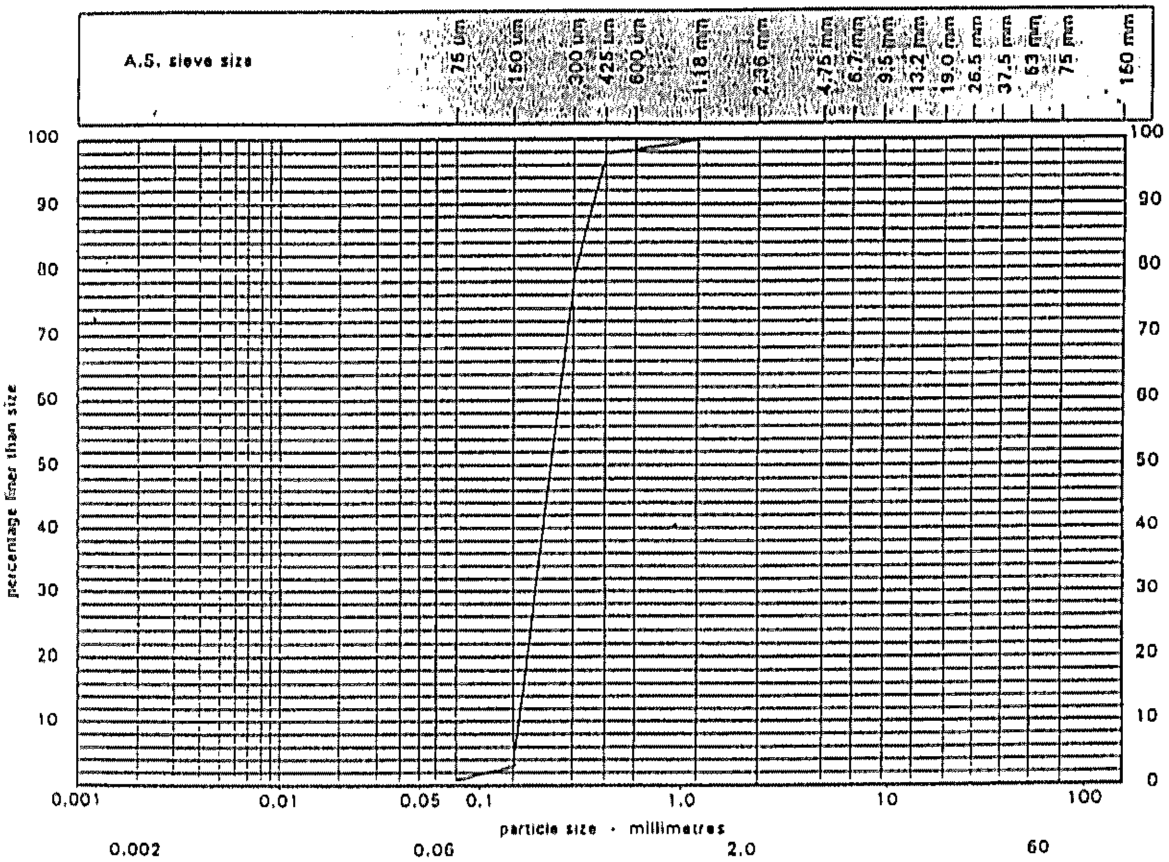
COFFEY

# particle size distribution

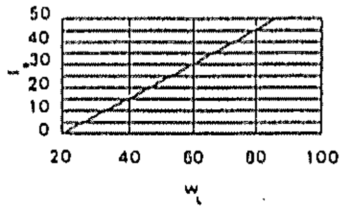
| | | | |
|---|---|---|---|
| client : | WP BROWN & PARTNERS | job no : | NR865/2 |
| principal : | | laboratory : | BRISBANE |
| project : | IRON GATES ESTATE | date : | 05/01/95 |
| location : | EVANS HEAD | test report : | CB95001.ENG |

sample identification : CB944484 Ch. 100m depth : 1.0 - 2.0m
test procedure : AS1289 C6.1




| clay | silt | | | sand | | | gravel | | | cobbles |
|---|---|---|---|---|---|---|---|---|---|---|
| | fine | medium | coarse | fine | medium | coarse | fine | medium | coarse | |

| | | |
|---|---|---|
| liquid limit | % | |
| plastic limit | % | |
| plasticity index | % | |
| linear shrinkage | % | |
| particle density | t/m³ | |
| natural moisture | % | |




classification :

NATA

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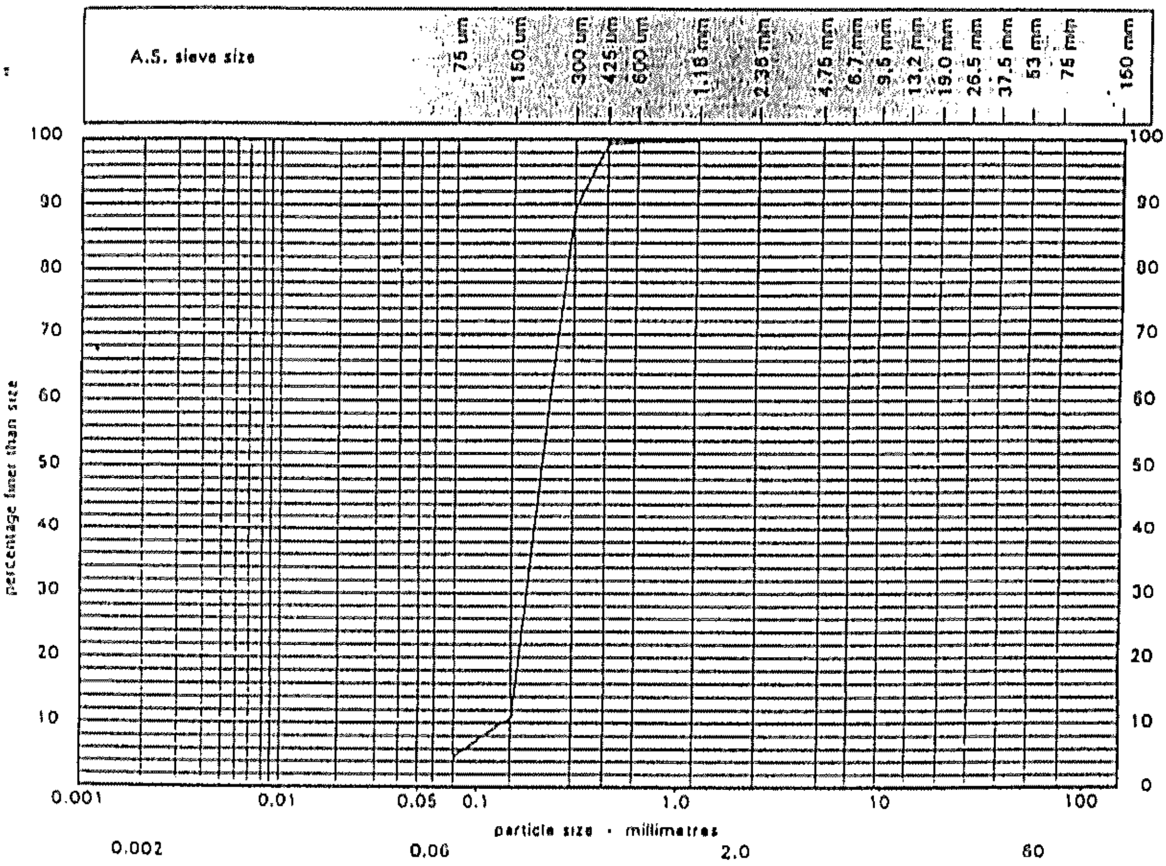
COFFEY

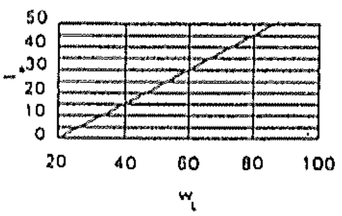
# particle size distribution

| | | | |
|---|---|---|---|
| client : | WP BROWN & PARTNERS | job no : | NR865/2 |
| principal : | | laboratory : | BRISBANE |
| project : | IRON GATES ESTATE | date : | 05/01/95 |
| location : | EVANS HEAD | test report : | CB95001.ENG |

sample identification : CB944485 Ch. 50m depth : 0.4 - 1.0m
test procedure : AS1289 C6.1




| | | | |
|---|---|---|---|
| liquid limit | % | | classification : |
| plastic limit | % | | |
| plasticity index | % | | |
| linear shrinkage | % | | |
| particle density | t/m³ | | |
| natural moisture | % | | |

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Authorised Signature
NATA Reg. No. 596

Howard
05 JAN 1995



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# APPENDIX C

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## APPENDIX C

## ACID SULPHATE TEST RESULTS

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SIMMONDS & BRISTOW PTY. LTD.
A.C.N. 010 252 418
WATER & ENVIRONMENTAL ANALYSTS & CONSULTANTS


DN:PR

Ref. No. 27130
11 January 1995

The Manager,
Coffey Partners International Pty Ltd,
PO Box 108,
Salisbury, Qld 4107

Attention: Mr Brian Booker

Dear Sir,

ANALYSIS OF SOIL SAMPLES
ORDER NO. B17724 - JOB NO. NR865/2

Five (5) samples were received for testing on 13 December 19994. The results of analysis are presented in the Table attached.

Please advise if you have any queries.

Yours faithfully,
SIMMONDS & BRISTOW PTY. LTD.

D K Nial

David Nial
Supervisor - Soils Laboratory

Encl.

COFFEYSWINE


Simmonds & Bristow Pty. Ltd.
30 Shottery Street, Yeronga.
Queensland. 4104. Australia.

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Environmental
Analysis &
Consultants

30 Shottery Street,
Yeronga, Queensland,
Australia, 4104.
Telephone: (07) 848 7699
Fax No.: (07) 892 3345

Ref. No. 27130
COFFEY & PARTNERS BRISBANE



# ANALYSIS OF SOIL SAMPLES
## ACID SULPHATE POTENTIAL
## IRON GATES ESTATE, EVANS HEAD
## JOB NO. NR865/2

Date Collected: Not Specified
Date Received: 13.12.94
Date Analysed: 13.12.94 - 09.01.95

Sampled By: Client
Sampling Method: Not Specified

| SAMPLE REGD. NO. | ANALYSIS<br>S & B METHOD NO. | INITIAL pH (1:5)<br>G090. | pH AFTER $H_2O_2$ OXID'N<br>G090. | INITIAL $SO_4$<br>SC280.4<br>mg/kg | $SO_4$ AFTER OXID'N<br>SC280.4<br>mg/kg | PYRITE S<br>% | $CaCO_3$<br>SC015.<br>% | ACID SULPHATE POTENTIAL<br>SC120.<br>* | ACID GENERATING POTENTIAL<br>** |
|---|---|---|---|---|---|---|---|---|---|
| 97297 | 50M 1.0 - 2.0 CB 944478 | 5.4 | 5.6 | 10. | 150. | <0.01 | <0.2 | NIL | NIL |
| 97298 | 150M 0.7 - 1.5 CB 944479 | 5.1 | 6.0 | 5. | 125. | <0.01 | <0.2 | NIL | NIL |
| 97299 | 250M 1.0 - 2.0 CB 944480 | 5.5 | 5.2 | <5. | 75. | <0.01 | <0.2 | NIL | NIL |
| 97300 | 350M 1.0 - 2.0 CB 944481 | 5.6 | 5.2 | <5. | 75. | <0.01 | <0.2 | NIL | NIL |
| 97301 | 465M 0.3 - 1.0 CB 944482 | 5.4 | 5.0 | 10. | 125. | <0.01 | <0.2 | NIL | NIL |

* Qualitative assessment based solely on % pyrite - not subject to NATA certification.
** Qualitative assessment based on % pyrite, % $CaCO_3$ and pH after oxidation - not subject to NATA certification.

NATA



SIMMONDS & BRISTOW PTY LTD

PER C. Cochrane ....................

COFFEYSBNE

A B C D E F G H . K L M N O P Q R S T U V W X Y Z

# APPENDIX C

## DOUGLAS PARTNERS (1991)

Land of slope generally greater than 25-33% presents severe limitations on housing development and are generally best left in a relatively undisturbed state. These lands can, however, be utilised as the back blocks of larger allotments, or, with appropriate geotechnical engineering measures in place, capable of supporting special kinds of development e.g. "pole houses" or multi -level development.

In summary, the terrain over the whole development area consists of central ridge running north-south and rising to a knob of approximately 30 metres above sea level, the ridge comprising approximately a quarter of the whole site area. Slopes running off this central ridge vary from as steep as 15-25% adjacent to the knob with gentler slopes encountered within the central part of the ridge and footslope areas.

## Aspect

Aspect is important as it modifies regional climate providing a local climate or a micro-climate. The most desirable aspect for residential living environments is a northerly aspect, and in particular a north-easterly aspect which attracts maximum sunlight and is protected from cold winter westerly winds, and is exposed to cooling summer breezes, the latter which would help to ease the effect of high humidity and high temperatures during summer periods.

Due to the north-south alignment of the central ridge which runs through the centre of the Iron Gates property, the generally flat to rolling topography encountered, the site is capable of enjoying the effects of cooling summer breezes and northerly aspect. The top of the central ridge enjoys some longer range views screened to some extent by existing vegetation. To the east of the central ridge lie lands with an easterly/northerly aspect, with lands to the west of the ridge enjoying a northerly/westerly aspect. Lower lying lands behind existing major vegetation stands would be sheltered from the effects of colder westerly winds. A similar situation applies in the case of the lands to the east of the central ridge system.

## Soils and Geology

The coastal landscapes supporting much of the heath land and dune vegetation around Evans Head is understood to have developed during the Quaternary period. These comprise older Pleistocene deposits which formed the undulating plains and swamps away from the coast. The Quaternary marine deposits comprise uniform coarse textured sands with minor accumulations of organic matter in the topsoil. An analysis of the sandy soils of the lower lying parts of the Iron Gates property was undertaken by Morse McVey & Associates, in association with D. J. Douglas & Partners Pty Ltd in 1991. Ten back-hoe pits, ranging in depth from 0.8m to 2.8m were dug and consistent results were obtained, both among the test pits themselves, and based on observations of exposed soil profiles along the river bank.

In general terms, the profile of the sandy soils found on the site consist of a shallow layer of sandy topsoil with organic matter, underlain by fine-to-medium-grained sand. One test pit showed a layer of 200mm thick sandy clay.

The sandy soils were assessed for potential acid sulphate conditions. The completed laboratory tests indicate that at the sites indicated there is no evidence of (actual) acid sulphate material in any of the test pits. Further, field tests for pH decrease after oxidation in laboratory analysis for total sulphur (%) suggest that there are no potentially acid sulphate soils in any of the samples. These results should be representative of the survey area, according to Morse McVey & Associates. The soil analysis conclude that with respect to limitations imposed by the occurrence of acid sulphate materials, there is no reason why development should not proceed in this area.

Sedimentary rocks of the Triassic Clarence-Morton Basin occur along the Iron Gates Road ridge. Soils associated with these areas are shallow podsols with a base geology of shales, sand stones and conglomerates. Quaternary alluvial deposits occur along the river, forming flood plains and terraces.

## 2.5 VEGETATION

### Overview, Past Disturbance of Site

The original vegetation pattern of the Iron Gates property has been affected by the previous history of land use of the site. Those areas which have been subject to significant clearing and/or site disturbance over the years may be summarised as follows:

- cleared land: found over much of the eastern part of the site adjoining the existing dwelling house on the property. This land has been cleared for decades and continued to be maintained in such a condition.
- Cleared and partly cleared hillside lands: comprising the larger proportion of the elevated hillside area lying to the north of the existing dwelling house and extending as far as the northern boundary of the site. These lands fall within a corridor of approximate width 150 metres. An additional area of cleared land occurs to the west of the main access track running into the property, situated to the west of the main hill.
- Disturbed heathland: previously subject to sand-mining activities, lying in the north-east corner of the property.

# APPENDIX L

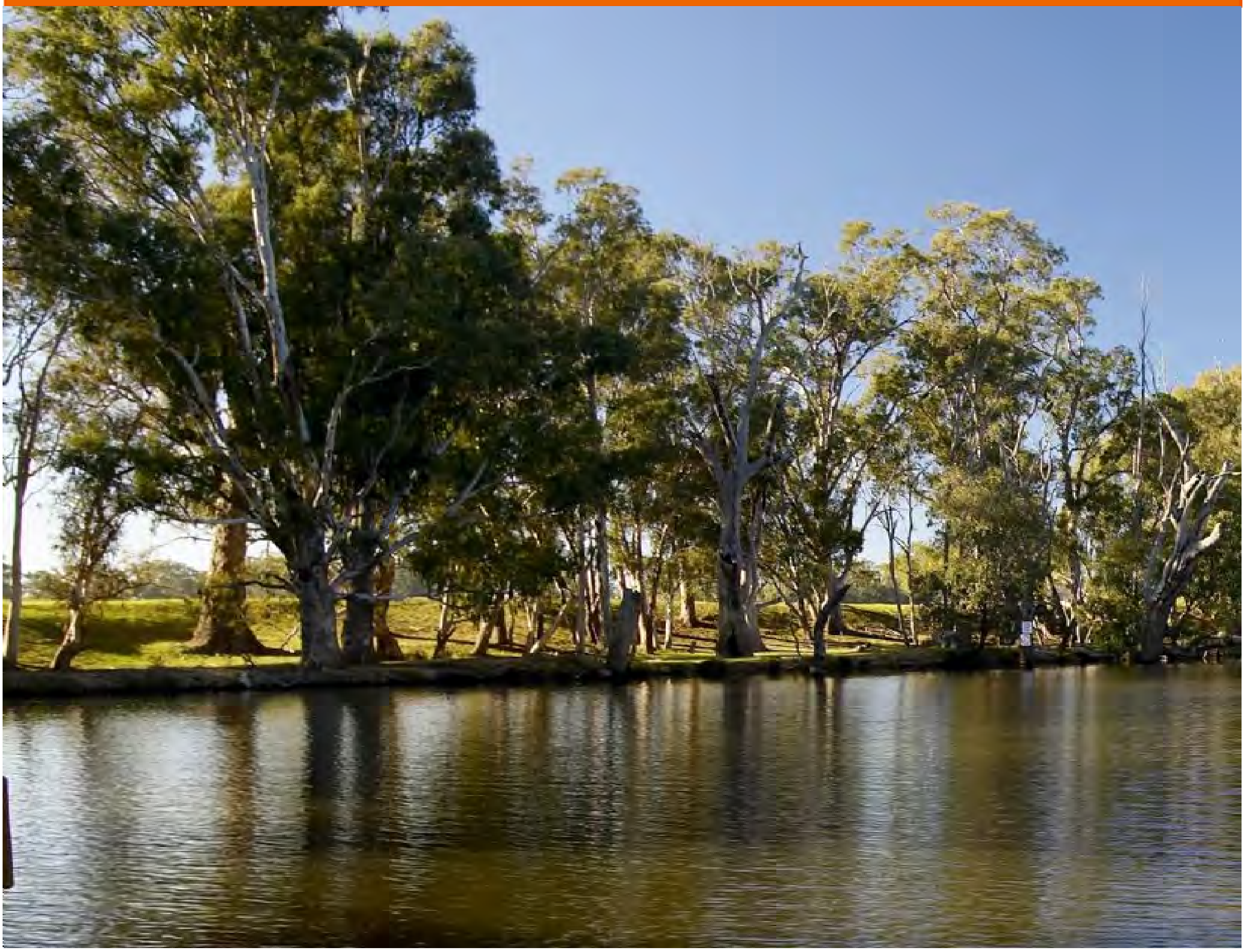
## DEWATERING MANAGEMENT PLAN

ARCADIS Design & Consultancy for natural and built assets

# IRON GATES RESIDENTIAL DEVELOPMENT

## Dewatering Management Plan

08 JULY 2019



Incorporating Hyder

# GOLDCORAL PTY LTD
# IRON GATES RESIDENTIAL DEVELOPMENT

## Dewatering Management Plan


| | |
|---|---|
| **Author** | Gerard Dick |
| **Checker** | Simon Groth |
| **Approver** | Lachlan Prizeman |



| | |
|---|---|
| **Report No** | F0004-10027302-AAR |
| **Date** | 8/07/2019 |
| **Revision** | 01 |




## REVISIONS

| Revision | Date | Description | Prepared by | Approved by |
|---|---|---|---|---|
| 01 | 08/07/2019 | Issued for Approval | GD | LP |

# CONTENTS

# APPENDICES

# 1 INTRODUCTION

A Dewatering Management Plan (DMP) is proposed for the construction of the proposed Iron Gates development at Evans Head.

The DMP relates specifically to the installation of the proposed Sewer and Stormwater services below the natural water table level. These are the only services expected to be below the existing water table. The deeper sewer and stormwater trench excavations are envisaged to be 1.0 to 2.0m below the lowest finished design levels. Other services are expected to be above the water table.

Initial investigations undertaken by Coffey Partners International and Geotech Investigations included a number Groundwater and Soil investigations including 21 boreholes recording the interception of the Water Table, copies of these investigations can be found attached in the appendices. The groundwater levels varied from RL 2.30m located at the north east corner of the Development to RL 1.87m at the south east corner of the development, approximately 130m from the Evans River. The water table gradient across the site appears to be consistent with the natural ground levels and the fall towards the Evans River. Groundwater was encountered in the boreholes at depths of between 0.5m and 1.5m below the existing ground level. Typically, the standing ground water level would be expected at RL 0.0 to 0.5m with fluctuations of ±0.5m under normal (non-flood) conditions. Rises in groundwater to RL 1.5m to 2.0m (AHD) have been recorded in the immediate area following heavy and prolonged rainfall periods (flood conditions).

Water table levels can be expected to vary with seasonal and climatic conditions. Current finished surface design levels require a minimum flood free level of 3.3m and this will provide additional fill over the existing surface levels of a minimum 1.0m up to 2.0m. This will provide 2.7m to 1.5 m fill depths to the water table and retain the majority of the sewer and stormwater constructions above the water table. This Dewatering Management Plan will provide for the construction of those deeper services.

# 2 DEWATERING METHOD

It is envisaged that the limit of the excavations will be retained with a system of trench shoring bedded into the underlying indurated sands. A series of spear and or internal well points will be used to lower the water table on the site to a minimum depth of 0.5m below proposed excavation level.

For the proposed development, for only construction of the deeper services, dewatering to approximately 2.0m below existing ground level, will be required. It is expected that dewatering will require only a short term drawdown to about 2.5m depth will be required to enable construction of the services and backfilling of the trenches.

Water collected from the proposed dewatering system shall be directed towards a holding tank or suitably lined sampling pit prior to discharge or re-charging into the existing groundwater table. The holding tank/pit will then be used to monitor/test waters followed by remediation of any waters which are below acceptable discharge quality guidelines.

Water quality criteria must be maintained to those presented as baseline conditions plus or minus 10%, prior to discharge, in accordance with the release criteria for the project. It is proposed to either discharge the extracted groundwater into the adjacent groundwater system or into the existing site drainage system.

Given the extent of the proposed excavation numerous points are available around the perimeter of the site. As the dewatering management requirements for the development will vary during the dewatering operation, it is expected a number of discharge points will be utilised for discharge or recharge of the existing water table. The natural drainage system along the eastern boundary discharges into Evans River approximately 100 to 150m south of the site and will not be used for discharge without strict compliance with the Water quality criteria.

# 3 DEWATERING EFFECTS

The trench spear pumping system is envisaged to penetrate into the water table sufficient to allow dewatering of the trench alignments. This will limit the dewatering required and minimise the time of construction allowing for the watertable return to its original level.

Controlled recharge pumping may also be undertaken from the drainage system, where required to maintain the water table levels across the adjoining sensitive wetlands and rainforest areas development. The spear or well point pumping systems required to maintain the dewatering whilst installation and backfilling is completed will be dependent upon the groundwater inflows from the trenches, and are envisaged to vary during the relatively short construction period.

The construction period is understood to be in the order of 2 months. Drawdown of the groundwater levels of not more than 1000mm has been calculated to be restricted to a distance of not more than three times the depth of the drawdown, i.e. approximately 25m beyond the dewatering points. Given the location of proposed services this will be well away from the site boundaries any short-term drawdown will be entirely within the site.

On the basis of the original acid sulfate investigations undertaken for the development, and as part of the water table investigations, no acid sulfate soils are present on site in the dewatering zone, and beyond the depth of the excavation and therefore no acid sulfate groundwater conditions will be generated and no acid sulfate soils will be exposed as a result of the dewatering operation.

The effects of drawdown of the water table are not expected to create any adverse environmental impacts and recharging will be not be required to be mandatory unless boundary monitoring bores indicate significant changes and provided all water discharged from site lies within the acceptable range outlined in the ANZECC Water Quality Guidelines, as appropriate.

If subsequent testing of the pH of the water is below the release criteria, the pH can be raised by treatment with hydrated lime or caustic soda or similar. If the DO is below the release criteria aeration of the water at discharge can be undertaken,or an in-line aeration system installed.

The turbidity and suspended solids can be controlled through the use of settling tanks, the addition of slaking agents, flocking agents, geofabric filters and socks and, if required silt curtains at the discharge point. Provided the pH is controlled, it is likely the Fe and Al concentrations will be within the required release criteria.

Noise emissions resulting from the dewatering systems shall comply with the relevant provisions of the Interim Construction Noise Guideline, Protection of the Environment Operations Act 1997. The machinery shall be equipped with high efficiency mufflers and noise attenuated enclosures installed around the pumps if considered necessary.

# 4 GROUNDWATER MONITORING

## 4.1 Background Monitoring

Prior to works commencing on site groundwater monitoring wells shall be installed within nominally 20m to 25m of the adjoining Wetlands and Rainforest boundaries where monitoring is to be undertaken. The location of the monitoring wells will be determined on site prior to the commencement of the installation of the dewatering system, to allow optimal positioning of the wells for access throughout the life of the project. A plan will be developed at this stage, identifying the location of the monitoring wells, dewatering construction, locations and discharge retention wall and pump locations.

Background monitoring of the groundwater shall be undertaken weekly for a minimum of 4 weeks prior to the commencement of dewatering on site. The results of the background monitoring will be used to determine the groundwater quality trigger values that will indicate the need for corrective action to be undertaken during the dewatering operation.

The wells will be monitored for groundwater levels, pH, DO, turbidity, conductivity, SS, EC, Fe and Al. As a general guideline a deviation of 10% from the established baseline criteria for two or more of the water quality parameters would be considered a trigger for corrective action, however this should be reassessed depending on the results and consistency of the background monitoring.

## 4.2 Monitoring During Construction

The following groundwater monitoring frequency shall be adopted during dewatering operations. Daily monitoring of groundwater levels in the boundary standpipes and pH for the first 2-3 weeks. Weekly sampling and testing for pH, DO, temperature, turbidity, conductivity, Fe and Al for the construction period where requiring dewatering. If the monitoring results prove consistent after the first month of monitoring, the sampling frequency could be reduced to fortnightly for the duration of the dewatering operation, subject to Richmond Valley Council approval. Additionally, twice weekly monitoring by visual assessment of the areas external to the site shall be undertaken to ensure no adverse impacts are occurring as a result of the dewatering.

# 5 DISCHARGE MONITORING

A discharge monitoring program shall be implemented to provide feedback on the effectiveness of the dewatering management strategy and provide early warning should environmental degradation begin. Monitoring will be carried out at the holding tank/pit immediately prior to release into the environment.

The following monitoring frequency is recommended during any dewatering operations:

- Daily - pH, Dissolved Oxygen (DO), Turbidity and Conductivity; and
- Weekly - As above plus Fe, Al, SS.

If the results of monitoring prove consistent, the frequency of monitoring could be reduced, subject to Richmond Valley Council approval.

Prior to release, the groundwater discharge shall meet the ANZECC Water Quality Guidelines for Fresh and Marine Waters (2000) as summarised in Table 5-1 below.

**Table 5-1 Water Quality Criteria**

| INDICATOR RELEASE CRITERIA | |
|---|---|
| ph | 7.0-8.4 |
| Dissolved Oxygen | >85% sat |
| Turbidity | 55 NTU |
| Suspended Soils | 20 (mg/e) |
| Pd (soluble) | 4.4 ug/L |
| Cu (soluble) | 1.3 ug/L |
| Cr (soluble) | 4.4 ug/L |
| Fe (soluble) | 1000 ug/L |
| Al (soluble | < 30 ug/L for pH < 6.5<br>< 300 ug/L for pH > 6.5 |

It is requirement that any proposed discharge water complies with the water quality criteria listed above.

# 6 RECOMMENDATIONS

Prior to commencement of dewatering operations on site the results of the background monitoring will be submitted to the Richmond Valley Council. A monthly dewatering report shall be prepared and submitted to Richmond Valley Council. The report shall include, as a minimum, details of the dewatering and retention method, water quality results, treatment required, status of the existing groundwater and any unforeseen issues. The DMP recommendations will be implemented by the Civil construction contractor for the proposed development. A NATA registered Geotechnical or Environmental Engineering shall be engaged by the Civil contractor to undertake the required background monitoring, and discharge monitoring during construction.

# APPENDIX A

## GEOTECH INVESTIGATIONS (2015)

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Our Ref: JW:jw: GI 2039-a
2 June 2015

Gold Coral Pty Ltd
PO Box 3441
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P1**

| | | |
|---|---|---|
| Location | N: 6778265 E: 540560 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, grey brown<br>0.5 m (SP) SAND: Fine sand, dry, pale grey<br>2.2 m (SP) SAND: Fine sand, wet, pale grey<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 2.2 m BSL | |
| Field Test Results | $K_{sat}$ = 13.7 m/day = 572 mm/hr | K = 1.6 x $10^{-4}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P2**

| | | |
|---|---|---|
| Location | N: 6778474 E: 540581 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, grey brown<br>0.5 m (SP) SAND: Fine sand, moist, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, moist, dark brown<br>1.6 m (SP) SAND: Trace silt, fine sand, moist, dark grey<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | Not identified | |
| Field Test Results | $K_{sat}$ = 89.5 m/day = 3728 mm/hr | K = 1 x $10^{-3}$ m/s |
| Test Hole Depth | 0.6 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P3**

| | | |
|---|---|---|
| Location | N: 6778597 E: 540503 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: With silt, fine sand, moist, grey<br>0.3 m (SM) Silty SAND: Fine sand, moist, dark brown<br>0.6 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.6 m BSL | |
| Field Test Results | $K_{sat}$ = 16.8 m/day = 698 mm/hr | K = 1.9 x $10^{-4}$ m/s |
| Test Hole Depth | 0.17 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P4**

| | | |
|---|---|---|
| Location | N: 6778425 E: 540493 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine to medium sand, moist, dark brown<br>0.7 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.7 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>2.0 m (SP) SAND: Trace silt, fine sand, wet, grey brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 1.7 m BSL | |
| Field Test Results | $K_{sat}$ = 27.0 m/day = 1128 mm/hr | K = 3.1 x $10^{-4}$ m/s |
| Test Hole Depth | 0.77 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P5**

| | | |
|---|---|---|
| Location | N: 6778333 E: 540483 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, dark brown<br>0.6 m (SP) SAND: Trace silt, fine sand, dry, pale grey<br>1.4 m (SP) SAND: Trace silt, fine sand, moist to wet, pale grey<br>2.4 m (SP) SAND: Trace silt, fine sand, wet, grey brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 1.5 m BSL | |
| Field Test Results | $K_{sat}$ = 4.2 m/day = 176 mm/hr | K = 4.9 x $10^{-5}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P6**

| | | |
|---|---|---|
| Location | N: 6778091 E: 540285 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine sand, moist, dark grey<br>0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>0.8 m (SM) Silty SAND: Fine sand, moist, dark orange brown<br>1.2 m (SM) Silty SAND: Fine sand, moist, grey brown mottled orange brown<br>2.7 m (SM) Silty SAND: Fine sand, wet, grey brown mottled orange brown<br>T.D. 3 m | |
| Water Table | 2.7 m BSL | |
| Field Test Results | $K_{sat}$ = 2.2 m/day = 91 mm/hr | K = 2.5 x $10^{-5}$ m/s |
| Test Hole Depth | 1.1 m BSL | |
| Indicative Drainage Class | 'well drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P7**

| | | |
|---|---|---|
| Location | N: 6778447 E: 540402 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: With silt, fine to medium sand, moist, grey brown<br>0.2 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>0.7 m (SM) Silty SAND: Trace clay, fine sand, wet, orange brown<br>1.1 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.7 m BSL | |
| Field Test Results | $K_{sat}$ = 7.2 m/day = 300 mm/hr | K = 8.3 x $10^{-5}$ m/s |
| Test Hole Depth | 0.87 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P8**

| | | |
|---|---|---|
| Location | N: 6778560 E: 540397 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SP) SAND: Trace silt, fine sand, moist, brown<br>0.4 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.2 m (SP) SAND: Trace silt, fine sand, wet, pale grey<br>1.4 m (SM) Silty SAND: Fine sand, wet, dark brown<br>1.9 m (SP) SAND: Trace silt, fine sand, wet, dark grey / brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.6 m BSL | |
| Field Test Results | $K_{sat}$ = 2.6 m/day = 109 mm/hr | K = 3.0 x $10^{-5}$ m/s |
| Test Hole Depth | 0.07 m BSL | |
| Indicative Drainage Class | 'well drained' | |

Notes: T.D. – Terminate depth of borehole BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
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**REPORT ON IN-SITU PERMEABILITY TESTING**
**IRON GATES DRIVE, EVANS HEAD**

**Test ID: Test P9**

| | | |
|---|---|---|
| Location | N: 6778502 E: 540329 | |
| Test Date | 25/05/2015 | |
| Soil Description | 0 m (SM) Silty SAND: Fine to medium sand, moist, dark grey<br>0.5 m (SP) SAND: Trace silt, fine sand, moist, pale grey<br>1.8 m (SM) Silty SAND: With clay, fine sand, wet, dark brown<br>2.0 m (SM) Silty SAND: Fine sand, wet, dark brown mottled orange brown<br>2.5 m (SP) SAND: Trace silt, fine sand, wet, dark brown<br>T.D. 3 m | |
| Water Table<br>(estimated based on drilling) | 0.5 m BSL | |
| Field Test Results | $K_{sat}$ = 18.6 m/day = 775 mm/hr | K = 2.2 x $10^{-4}$ m/s |
| Test Hole Depth | 0.07 m BSL | |
| Indicative Drainage Class | 'rapidly drained' | |

Notes: T.D. – Terminate depth of borehole; BSL – Below existing surface level
$K_{sat}$ – Saturated hydraulic conductivity; K – Permeability
Table 4.2A4 AS 1547 (On-site domestic wastewater management)

For and on behalf of
**Geotech Investigations Pty Ltd**

**James Walle** *RPEQ (15701), RPEng (Civil), B.Eng (Civil)*
Senior Geotechnical Engineer

| LOT | AREA | LOT | AREA | LOT | AREA |
|---|---|---|---|---|---|
| 01 | 958.54m² | 74 | 601.67m² | 147 | 623.04m² |
| 02 | 609.58m² | 75 | 602.27m² | 148 | 623.04m² |
| 03 | 610.02m² | 76 | 602.86m² | 149 | 623.04m² |
| 04 | 610.48m² | 77 | 611.90m² | 150 | 623.04m² |
| 05 | 610.80m² | 78 | 601.02m² | 151 | 623.04m² |
| 06 | 611.13m² | 79 | 645.62m² | 152 | 701.77m² |
| 07 | 611.45m² | 80 | 642.13m² | 153 | 703.42m² |
| 08 | 611.78m² | 81 | 602.42m² | 154 | 611.15m² |
| 09 | 612.10m² | 82 | 602.31m² | 155 | 611.15m² |
| 10 | 612.43m² | 83 | 602.20m² | 156 | 611.15m² |
| 11 | 612.75m² | 84 | 854.34m² | 157 | 611.15m² |
| 12 | 612.98m² | 85 | 854.15m² | 158 | 611.15m² |
| 13 | 611.49m² | 86 | 601.23m² | 159 | 611.29m² |
| 14 | 613.85m² | 87 | 601.27m² | 160 | 720.75m² |
| 15 | 614.18m² | 88 | 951.69m² | 161 | 753.34m² |
| 16 | 614.50m² | 89 | 794.12m² | 162 | 633.95m² |
| 17 | 614.82m² | 90 | 601.19m² | 163 | 602.77m² |
| 18 | 615.14m² | 91 | 601.15m² | 164 | 707.28m² |
| 19 | 615.47m² | 92 | 601.11m² | 165 | 649.98m² |
| 20 | 615.80m² | 93 | 601.06m² | 166 | 661.66m² |
| 21 | 653.44m² | 94 | 601.03m² | 167 | 686.92m² |
| 22 | 639.06m² | 95 | 600.07m² | 168 | 640.98m² |
| 23 | 600.87m² | 96 | 665.25m² | 169 | 621.28m² |
| 24 | 601.48m² | 97 | 617.23m² | 170 | 845.54m² |
| 25 | 601.78m² | 98 | 605.72m² | 171 | 829.97m² |
| 26 | 602.07m² | 99 | 609.16m² | 172 | 600.73m² |
| 27 | 602.37m² | 100 | 613.10m² | 173 | 600.73m² |
| 28 | 602.67m² | 101 | 606.61m² | 174 | 601.88m² |
| 29 | 602.97m² | 102 | 600.24m² | 175 | 600.94m² |
| 30 | 603.27m² | 103 | 600.05m² | 176 | 618.69m² |
| 31 | 603.56m² | 104 | 603.86m² | | |
| 32 | 603.87m² | 105 | 606.12m² | | |
| 33 | 611.56m² | 106 | 604.88m² | | |
| 34 | 602.69m² | 107 | 644.68m² | | |
| 35 | 687.98m² | 108 | 604.83m² | | |
| 36 | 744.04m² | 109 | 603.24m² | | |
| 37 | 601.47m² | 110 | 608.18m² | | |
| 38 | 601.47m² | 111 | 606.58m² | | |
| 39 | 601.47m² | 112 | 608.28m² | | |
| 40 | 601.47m² | 113 | 736.06m² | | |
| 41 | 601.47m² | 114 | 720.51m² | | |
| 42 | 601.47m² | 115 | 1029.27m² | | |
| 43 | 601.47m² | 116 | 602.49m² | | |
| 44 | 601.47m² | 117 | 609.57m² | | |
| 45 | 601.47m² | 118 | 607.83m² | | |
| 46 | 601.84m² | 119 | 651.61m² | | |
| 47 | 600.97m² | 120 | 603.93m² | | |
| 48 | 602.78m² | 121 | 603.27m² | | |
| 49 | 601.06m² | 122 | 604.77m² | | |
| 50 | 600.70m² | 123 | 613.74m² | | |
| 51 | 604.45m² | 124 | 602.29m² | | |
| 52 | 604.30m² | 125 | 628.60m² | | |
| 53 | 604.17m² | 126 | 603.18m² | | |
| 54 | 604.11m² | 127 | 690.16m² | | |
| 55 | 603.12m² | 128 | 601.05m² | | |
| 56 | 601.74m² | 129 | 606.82m² | | |
| 57 | 600.79m² | 130 | 632.34m² | | |
| 58 | 833.34m² | 131 | 609.67m² | | |
| 59 | 783.87m² | 132 | 606.00m² | | |
| 60 | 674.25m² | 133 | 601.02m² | | |
| 61 | 612.30m² | 134 | 600.03m² | | |
| 62 | 605.75m² | 135 | 600.92m² | | |
| 63 | 604.82m² | 136 | 600.85m² | | |
| 64 | 603.90m² | 137 | 600.91m² | | |
| 65 | 602.98m² | 138 | 639.85m² | | |
| 66 | 602.05m² | 139 | 655.96m² | | |
| 67 | 601.13m² | 140 | 795.02m² | | |
| 68 | 600.20m² | 141 | 897.95m² | | |
| 69 | 603.67m² | 142 | 603.25m² | | |
| 70 | 620.23m² | 143 | 636.28m² | | |
| 71 | 603.10m² | 144 | 722.96m² | | |
| 72 | 600.46m² | 145 | 620.19m² | | |
| 73 | 601.06m² | 146 | 623.04m² | | |


# PLAN OF SUBDIVISION

IRON GATES, EVANS HEAD

PLANIT CONSULTING

**PROJECT TITLE:** IRON GATES DEVELOPMENT, EVANS HEAD

**DRAWING TITLE:** PLAN OF SUBDIVISION - OPTION 7

**BASE PROVIDED BY:** N/A

**CLIENT:** GOLD CORAL

| NO | DATE | REVISION | BY |
|---|---|---|---|
| - | - | - | - |

**SCALE:** 1/1500 @ A1

**DESIGN:** PLANIT CONSULTING

**DRAWN:** ZP

**DATE:** 03/2015

**CHECKED:** AS

**DRAWING NO:** IRONGATES_PLNOFSUB_01

**NORTH POINT:**

**SHEET NO:** 01 OF 01

Level 1 2247 Gold Coast Hwy
Nobby Beach
PO Box 206 QLD 4218
Telephone: 07 5526 1500
Fax: 07 5526 1502
Email: admin@planitconsulting.com.au

# APPENDIX B

## COFFEY PARTNERS INTERNATIONAL (1995)

Coffey Partners International Pty Ltd
A.C.N. 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources

COFFEY

530 Fairlawn Street
Nathan QLD 4111

PO Box 100
Salisbury QLD 4107
Australia

Fax (07) 274 4977
Telephone (07) 274 4411

Your Reference
Our Reference NR865/2-B GHD
Date 12th January, 1995

W P Brown & Partners Pty Ltd
PO Box 6527
UPPER MT GRAVATT QLD 4122

Attention: Mr Gary Spence

Dear Sir,

RE IRON GATES ESTATE - STAGE 1A
INVESTIGATION OF PROPOSED OPEN DRAIN

Please find enclosed our report on the geotechnical investigation for a proposed drain at the Iron Gates Estate. The investigation was carried out in general accordance with our proposal NRP294/17-A dated 21st November, 1994.

Should you have any queries regarding the contents of this report, please contact Geoff Drew or the undersigned at our Brisbane office.

For and on behalf of
COFFEY PARTNERS INTERNATIONAL PTY LTD

Philip Shaw
P.SHAW



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

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A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

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## 1.0 INTRODUCTION

It is proposed that an open drain be constructed adjoining the Iron Gates Estate Stage 1A development. Coffey Partners International Pty Ltd was commissioned verbally by Mr.Gary Spence of W.P.Brown & Partners Pty Ltd to perform an investigation of the subsurface conditions along the drain alignment. This report contains details of the field investigation and the laboratory chemical and geotechnical testing. Comment is provided on the impact of the proposed drain on a nearby wetland area and the possibility that acid sulphate soils will be exposed during excavation.

## 2.0 FIELD INVESTIGATION

A total of 9 holes was drilled using hand held (sand) auger equipment on 6th & 7th December, 1994. The holes were advanced to depths of 2m below the existing ground surface at 50m intervals along the alignment of Open Drain No.1, beginning at approximately ch.50m. Samples were taken for laboratory testing for acid sulphate soils and for particle size distribution analysis, and standing water levels (SWL) were measured.

Qualitative spot tests for the presence of either ferrous monosulphide or pyrite were performed at each drilling location in the surface layer and in the soils above and below the water table. Engineering logs of the boreholes along with explanation sheets describing the terms and symbols used are presented in Appendix A.

## 3.0 SITE DESCRIPTION

The site of the proposed drain is a generally flat sandy area with variable tree and grass cover. The ground surface along the alignment has a maximum elevation of about RL3.0m over most of the alignment and, at the end of the alignment, falls from an elevation of RL2.3m to the banks of the Evans River over a distance of 20m. The area comprises beach or coastal dune sands. The estate layout drawings show the proposed drain running from a point close to an area of wetlands directly to the Evans River.

The wetlands are swampy with large areas of surface water, thick weed growth and paperbark trees. Organic clays are reported to occur at approximately 300mm below the surface sands, but their thickness is not known. The topographic mapping of the area shows an elongated feature with a surface elevation a little below the RL2m contour trending south from the Open Space. Surface water within this depression may be either perched on the organic clay layer, or be a 'window' to the water table, or a combination of both in the case of a discontinuous organic clay layer.

## 4.0 LABORATORY TESTING

### 4.1 Acid Sulphate

The qualitative spot tests for the presence of acid sulphates all indicated nil to very low concentrations. Three samples from below the water table and two samples from above the water table were submitted for quantitative acid sulphate testing. Summary results of the laboratory testing are set out in Table 1 below, with laboratory test reports in Appendix C.

**TABLE 1**
Summary of Acid Sulphate Testing

| Chainage | Depth (m) | pH | | $SO_4$ (mg/kg) | |
|---|---|---|---|---|---|
| | | initial | after oxidation | initial | after oxidation |
| 50m | 1.0 - 2.0 | 5.4 | 5.6 | 10 | 150 |
| 100m | 0.7 - 1.5 | 5.1 | 6.0 | 5 | 125 |
| 250m | 1.0 - 2.0 | 5.5 | 5.2 | <5 | 75 |
| 350m | 1.0 - 2.0 | 5.6 | 5.2 | <5 | 75 |
| 465m | 0.3 -1.0 | 5.4 | 5.0 | 10 | 125 |

Note: Pyrite S concentrations all <0.01%. $CaCO_3$ concentrations all <0.2%.

### 4.2 Particle Size Distribution

Field description of the sands gives a grain size in the fine to medium grained range. Laboratory testing indicates less than 5% passing 0.075mm and 98% passing 0.425mm sieves. Laboratory test results can are reported in Appendix B. Coefficient of Uniformity is less than 2, indicating high porosity.

## 5.0 DISCUSSION

### 5.1 Acid Sulphate Soils

The field qualitative spot testing indicated a general absence or very low concentration of either ferrous monosulphide or pyrite in either the topsoil, sands above the water table or sands below the water table. This was confirmed by the laboratory testing which indicated nil acid sulphate potential and nil acid generating potential for all 5 samples submitted.

### 5.2 Groundwater Movement

On the basis of the SWLs measured during the field investigation, a gradient averaging about 1:200 currently exists towards the river from ch.250m with a negligible gradient from ch.250m to ch.465m and an apparent slight mounding at about ch.250m. The water table is of the order of 1m below ground surface over most of the proposed drain alignment so can be said to roughly follow the ground surface contours, as is to be expected under phreatic conditions. Standing water levels in BH1 and BH2 drilled in August 1994 were 0.6m below a ground surface level which is assessed at about RL2.3m from contours on supplied plans. This indicates that the water table beyond the end of the proposed drain is relatively constant at about RL 1.75m which corresponds to the inferred free water surface level in the wetlands.

An estimated permeability (K) of between $3x10^{-3}$cm/sec (2.5m/day) and $4.5x10^{-3}$cm/sec (4.0m/day) can be inferred from the particle size characteristics of the sands. Specific Yield is estimated at 0.33. With this permeability and gradient, a steady regional groundwater flow would already be established towards the river, the flow being maintained by both direct infiltration of rainwater and leakage of some surface water from the wetlands area. ~~The proportion of the existing flow attributable to the wetlands source would depend on the permeability and thickness of the organic clay layers underlying the wetlands.~~ Total throughflow rates would vary with water table fluctuations resulting from changes in the availability of recharge, especially that deriving from direct infiltration of rainfall.

Design drawings show that the open drain will be excavated to a depth of about 1m below the water table. The effect of this excavation will be a localised lowering of the water table due to the creation of a new line of discharge. Homogeneous fine grained unconfined aquifers of the type encountered here are known to exhibit delayed drainage with the result that the lowering of water table will be gradual and, in the short term, of limited extent. Long term expansion of the zone of influence of the drain is likely to occur only during long periods without recharge. Other factors, such as evaporation and transpiration could then prove to be of greater importance to the wetlands than any induced drawdowns.

Estimations of drawdown at distances from the drain have been made using methods for estimating flow of groundwater to galleries (Huisman after Edelman). Assumptions made for these calculations are; 1 year (365 days) without recharge, instantaneous drawdown at the gallery of 1m, and aquifer thickness of 1.75m.

**TABLE 2**
**Distance-Drawdown Estimations**

| Distance from Drain Centreline (m) | Drawdown (m) at | |
|---|---|---|
| | K=3.8m/day | K=2.5m/day |
| 20 | 0.87 | 0.84 |
| 30 | 0.81 | 0.76 |
| 40 | 0.74 | 0.68 |
| 50 | 0.68 | 0.61 |
| 60 | 0.62 | 0.54 |
| 80 | 0.51 | 0.42 |
| 100 | 0.41 | 0.31 |

Significantly lower calculated drawdowns at distance from the drain are obtained by reducing the time without recharge (rainfall). Reducing the period without recharge to 100 days (3 months) results in drawdowns at 100m of 0.12m and 0.05m for permeabilities of 3.8 and 2.5m/day respectively.

The organic clay layer noted in the wetlands area was not present at a similar level along the proposed drain, so it can be inferred that it is specific to the wetland area. In this case, there is a high probability that the much lower permeability of the organic clay layer will tend to isolate the wetlands from the drawdowns induced by the drain excavation. Even if the isolating effect of the organic clays is less than expected it is likely that any loss of water to the proposed drain would be replaced by groundwater flow from other directions.

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Any potential impact of the drain on the area could be reduced if it was possible to modify the overall estate drainage design to allow the invert level of the drain to be raised so that it is closer to the present water table. As the drawdowns were calculated on the basis of a 1m lowering of water level at the drain, proportional adjustments can be made for any alteration in the depth of excavation below the water table. Flow to the drain given the assumptions described above is estimated to be of the order of $0.04m^3$/day per metre length of excavation after 1 year without significant rainfall recharge.

Philip Shaw

For and on behalf of

COFFEY PARTNERS INTERNATIONAL PTY LTD

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

# IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks

## A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration, the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one,
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed

## SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts. Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events

## MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

## A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

## GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

## GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

# APPENDIX A

# APPENDIX A

# APPENDIX A

## ENGINEERING LOGS OF BOREHOLES

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# descriptive terms soil and rock

COFFEY

Explanation Sheet 1

## SOIL DESCRIPTIONS

**Classification of Material** based on Unified Classification System (refer SAA Site Investigation Code AS1726—1975 Add. No. 1 Table D1).

**Moisture Condition** based on appearance of soil

- dry — Looks and feels dry; cohesive soils usually hard, powdery or friable, granular soils run freely through hands.
- moist — Soil feels cool, darkened in colour; cohesive soils usually weakened by moisture, granular soils tend to cohere, but one gets no free water on hands on remoulding.
- wet — Soil feels cool, darkened in colour; cohesive soils weakened, granular soils tend to cohere, free water collects on hands when remoulding.

**Consistency** based on unconfined compressive strength (Qu) (generally estimated or measured by hand penetrometer).

| term | very soft | soft | firm | stiff | very stiff | hard |
|---|---|---|---|---|---|---|
| Qu kPa | 25 | 50 | 100 | 200 | 400 | |

If soil crumbles on test without meaningful result, it is described as **friable**.

**Density Index** (generally estimated or based on penetrometer results).

| term | very loose | loose | medium dense | dense | very dense |
|---|---|---|---|---|---|
| density index $I_D$ % | 15 | 35 | 65 | 85 | |

## ROCK DESCRIPTIONS

**Weathering** based on visual assessment

| term | criterion |
|---|---|
| Fresh. | Rock substance unaffected by weathering. |
| Slightly Weathered. | Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance. |
| Moderately Weathered: | Rock substance affected by weathering to the extent that staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable. |
| Highly Weathered: | Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable. |
| Extremely Weathered: | Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident. |

**Strength** based on point load strength index, corrected to 50 mm diameter - Is(50) (refer I.S.R.M., Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1). (Generally estimated: x indicates test result).

| classification | extremely low | very low | low | medium | high | very high | extremely high |
|---|---|---|---|---|---|---|---|
| Is (50) MPa | 0.03 | 0.1 | 0.3 | 1 | 3 | 10 | |

The unconfined compressive strength is typically about 20 x $I_{S50}$ but the multiplier may range, for different rock types, from as low as 4 to as high as 30

**Defect Spacing**

| classification | extremely close | very close | close | medium | wide | very wide | extremely wide |
|---|---|---|---|---|---|---|---|
| spacing m | 0.03 | 0.1 | 0.3 | 1 | 3 | 10 | |

**Defect description** uses terms contained on AS1726 table D2 to describe nature of defect (fault, joint, crushed zone, clay seam (etc.) and character (roughness, extent, coating etc.).

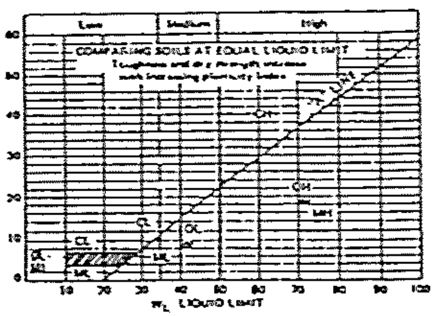


A B C D E F G H K L M N O P Q R S T U V W X Y Z

# SOIL CLASSIFICATION
## INCLUDING IDENTIFICATION AND DESCRIPTION

| FIELD IDENTIFICATION PROCEDURES | | | | GROUP SYMBOLS | TYPICAL NAMES | INFORMATION REQUIRED FOR DESCRIBING SOILS | LABORATORY CLASSIFICATION CRITERIA | |
|---|---|---|---|---|---|---|---|---|
| COARSE GRAINED SOILS | GRAVELS | CLEAN GRAVELS (Little or no fines) | Wide range in grain size and substantial amounts of all intermediate particle sizes | GW | Well graded gravels, gravel sand mixtures, little or no fines. | SYMBOL Give typical name, indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and strength of the coarse grains, colour, amount, plasticity of fine component | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3 | |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing | GP | Poorly graded gravels, gravel - sand mixtures little or no fines | | Not meeting all gradation requirements for GW | |
| | | GRAVELS WITH FINES | Non plastic fines (for identification procedures see ML below) | GM | Silty gravels, poorly graded gravel - sand - silt mixtures | For undisturbed soils add information on moisture condition, degree of compactness, stratification, cementation, odour | Atterberg limits below "A" line or $I_p$ less than 4. | Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols |
| | | | Plastic fines (for identification procedures see CL below) | GC | Clayey gravels, poorly graded gravel - sand - clay mixtures | | Atterberg limits above "A" line with $I_p$ greater than 7 | |
| | SANDS | CLEAN SANDS (Little or no fines) | Wide range in grain sizes and substantial amounts of all intermediate particle sizes | SW | Well graded sands, gravelly sands, little or no fines. | Give local or geologic name and/ other pertinent descriptive information. | $C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 & 3 | |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing | SP | Poorly graded sands, gravelly sands, little or no fines. | Example: SM - Gravelly Silty SAND coarse to fine, pale brown, about 20% strong angular gravel particles - 10 mm maximum size, rounded and sub angular sand, about 15% non plastic fines, moist, dense, alluvial sand | Not meeting all gradation requirements for SW | |
| | | SANDS WITH FINES | Non plastic fines (for identification procedures see ML below) | SM | Silty sands, poorly graded sand - silt mixtures | | Atterberg limits below "A" line or $I_p$ less than 4 | Above "A" line with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols. |
| | | | Plastic fines (for identification procedures see CL below) | SC | Clayey sands, poorly graded sand - clay mixtures | | Atterberg limits above "A" line with $I_p$ greater than 7. | |
| FINE GRAINED SOILS | IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 mm | | | | | | | |
| | | DRY STRENGTH † | DILATANCY † | TOUGHNESS † | | | | |
| | SILTS AND CLAYS Liquid limit less than 50 | None to Low | Quick to slow | None | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit. * | SYMBOL Give typical name, indicate degree and character of plasticity, colour, amount and size of coarse grains. | |
| | | Medium to high | None to very slow | Medium | CL | Inorganic clays of low to medium plasticity, * gravelly clays, sandy clays, silty clays. | For undisturbed soils add information on moisture condition, consistency, structure, stratification, odour. | |
| | | Low to medium | Slow | Low | OL | Organic silts and organic silt - clays of low to medium plasticity. * | | |
| | SILTS AND CLAYS Liquid limit greater than 50 | Low to medium | Slow to none | Low to medium | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit. | Give local or geologic name, and other pertinent descriptive information. | |
| | | High to very high | None | High | CH | Inorganic clays of high plasticity. * | Example: CL - Sandy CLAY of low plasticity pale grey and brown; Sand fine to medium, trace of fine gravel, dry, firm, numerous vertical root holes; (FILL). | |
| | | Medium to high | None to very slow | Low to medium | OH | Organic clays of high plasticity. * | | |
| HIGHLY ORGANIC SOILS | | Readily identified by colour, odour, spongy feel and frequently by fibrous texture. | | | Pt | Peat and other highly organic soils. | | |

USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION




PLASTICITY CHART (For laboratory classification of fine grained soils)

Adapted from A.S. 1726-1981 (App.D)

1. Boundary classifications - Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

* Low plasticity - Liquid Limit $w_L$ less than 35%. Medium plasticity - $w_L$ between 35% and 50%.

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

† TOUGHNESS (Consistency near plastic limit)

† DILATANCY (Reaction to shaking)

† DRY STRENGTH (Crushing characteristics)

COFFEY

Coffey Partners International

Consulting Engineers in the geotechnical sciences

SOIL CLASSIFICATION CHART

0583

A B C D E F G H J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no. HA1
sheet 1 of 1

office job no: NR065/2

| | | | |
|---|---|---|---|
| client: | V P, BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch 50m | checked by: | SHO. |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting: | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.33 approx. |
| hole diameter: | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SM | SILTY SAND: fine to medium grained, dark grey, with 15% silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | D | | | | SP | SAND: fine to medium grained, light grey, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | | D | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | | | 2 | | | Borehole HA1 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

METHOD
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

SUPPORT
Nil no support M mud
C casing

PENETRATION
1 2 3 4
little resistance ranging to very slow progress

WATER
N not measured D none observed
water level
water outflow
water inflow

SAMPLES, TESTS, ETC
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample,
N standard penetration test
Nn SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION
based on unified classification system

MOISTURE
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

CONSISTENCY/DENSITY INDEX
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

office job no: NR865/2

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE IA - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch.100m | checked by: | |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.62 Approx. |
| hole diameter | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | |
| | | | | D | | | | SP | SAND fine to medium grained, brown & light brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | | D | | 1 | | SP | SAND as above. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | | | 2 | | | Borehole HA2 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing
AD auger drilling
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
N* SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA2
sheet 1 of 1

office job no: NF665/2

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch 300m | checked by: | |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting: | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.62 approx. |
| hole diameter: | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt lines. | M | MD | | |
| | | | | D | | | | SP | SAND: fine to medium grained, brown & light brown, with a trace of silt lines. | | | | ACID SULPHATE TEST CLEAR |
| | | | | D | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | | | 2 | | | Borehole HA2 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nn SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

COFFEY

| borehole no: | HA3 |
|---|---|
| sheet | 1 of 1 |

# engineering log - borehole

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | office job no: | N0065/2 |
| principal: | | hole commenced: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | hole completed: | 7.12.94 |
| borehole location: | DRAIN No.1 - Approx. Ch. 150m | logged by: | AEL |
| | | checked by: | gwd. |
| drill model and mounting: | SAND AUGER | slope: -90 DEG | R.L. Surface: 2.78 approx. |
| hole diameter | 80mm | bearing: | datum: AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | D | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | D | | 1 | | SP | SAND: fine to medium grained, brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | | | | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA3 terminated at 2.00 m | | | | |

| METHOD | | SUPPORT | | SAMPLES, TESTS, ETC | | CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION | | CONSISTENCY/DENSITY INDEX | |
|---|---|---|---|---|---|---|---|---|---|
| AS | auger screwing* | Nil | no support | U | undisturbed sample (mm) | based on unified classification system | | VS | very soft |
| AD | auger drilling* | M | mud | D | disturbed sample | | | S | soft |
| RR | roller/tricone | C | casing | Bt | bulk sample | | | F | firm |
| W | washbore | PENETRATION 1 2 3 4 | little resistance ranging to very slow progress | E | environmental sample | | | St | stiff |
| CT | cable tool | | | N | standard penetration test | | | VSt | very stiff |
| HA | hand auger | | | Nc | SPT + sample recovered | MOISTURE | | H | hard |
| DT | diatube | WATER | | Nc | SPT with solid cone | D | dry | Fb | friable |
| *bit shown by suffix | | X | not measured 0 none observed | VS | vane shear | M | moist | VL | very loose |
| B | blank bit | ▽ | water level | PM | pressuremeter | W | wet | L | loose |
| V | V bit | | | DP | dynamic penetrometer | Wp | plastic limit | MD | medium dense |
| T | TC bit | ◁ | water outflow | WS | water sample | Wl | liquid limit | D | dense |
| e.g. | AD/T | ▷ | water inflow | Pz | piezometer | | | VD | very dense |



A E C D E F G H I J K L M N O P Q R S T U V W X Y Z

A
B
C
D
E
F
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U
V
W
X
Y
Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

COFFEY

borehole no: HA4
sheet 1 of 1

# engineering log - borehole

office job no: NR865/2

| | | | |
|---|---|---|---|
| client: | K.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch 200m | checked by: | GAO |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting: | SAND AUGER | slope: | -90 DEG | R.L.Surface: | 2.8 approx. |
| hole diameter: | 80mm | bearing: | | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SA | | C | | D | | | | SM | SILTY SAND: fine to medium grained, dark grey-brown, with 15% silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | | | | | SP | SAND: fine to medium grained, light grey-brown, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | 1 | | SP | SAND: As above. | W | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA4 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. ADT

**SUPPORT**
N nil no support
M mud
C casing

**PENETRATION** 1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nr SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense

Coffey Partners International Pty. Ltd.
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA5
sheet 1 of 1

| | | | |
|---|---|---|---|
| client | W.P. BROWN & PARTNERS PTY LTD | office job no: | NR065/2 |
| principal: | | hole commenced | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | hole completed | 7.12.94 |
| borehole location: | DRAIN No.1 - Approx.Ch 250m | logged by: | AEL |
| | | checked by: | gWO |

| | | | | | |
|---|---|---|---|---|---|
| drill model and mounting | SAND AUGER | slope: | -90 DEG | R.L.Surface | 2.97 approx. |
| hole diameter | 80mm | bearing: | | datum | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | | | | | SP | SAND: fine to medium grained, white, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | D | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA5 Terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
- AS auger screwing*
- AD auger drilling*
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- *bit shown by suffix
- B blank bit
- V V bit
- T TC bit
- e.g. AD/T

**SUPPORT**
- Nil no support
- M mud
- C casing

**PENETRATION**
1 2 3 4 little resistance ranging to very slow progress

**WATER**
- X not measured
- O none observed
- ▽ water level
- water outflow
- water inflow

**SAMPLES, TESTS, ETC**
- U undisturbed sample (mm)
- D disturbed sample
- Bs bulk sample
- E environmental sample
- N standard penetration test
- N* SPT + sample recovered
- Nc SPT with solid cone
- VS vane shear
- PM pressuremeter
- DP dynamic penetrometer
- WS water sample
- PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

| | |
|---|---|
| borehole no. | HA6 |
| sheet | 1 of 1 |
| office job no: | NR065/2 |

| | | | |
|---|---|---|---|
| client: | W.P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx. Ch 300m | checked by: | GAO. |
| drill model and mounting: | SAND AUGER | slope: -90 DEG | R.L. Surface: 2.83 approx |
| hole diameter: | 80mm | bearing: | datum: AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. m | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SA | | C | | | | | | SP | SAND fine to medium grained, dark grey-brown, with some silt fines. | M | MD | | |
| | | | | D | | | | SP | SAND fine to medium grained, off-white, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | 1 | | | | | | | |
| | | | | D | | | | SP | SAND as above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA6 Terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
N not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Nr SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty. Ltd.
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA7
sheet 1 of 1

office job no: N0065/2

| | | | |
|---|---|---|---|
| client: | W P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch.350m | checked by: | GD. |
| drill model and mounting: | SAND AUGER, slope: -90 DEG | R.L.Surface: | 2.73 approx. |
| hole diameter | 80mm, bearing: | datum: | AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, grey & brown, with some silt fines. | M | MD | | |
| | | | | 0 | | | | SP | SAND: fine to medium grained, off-white, with a trace of silt fines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ▽ | | | | | | | W | | | |
| | | | | 0 | | 1 | | SP | SAND: As above. | | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA7 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |
| | | | | | | 4 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
X not measured
O none observed
▽ water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample 4mm
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test
Ns SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



GBF 230

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Coffey Partners International Pty Ltd
ACN 003 692 019

# engineering log - borehole

COFFEY

borehole no: HA9
sheet 1 of 1

office job no: N0865/2

| | | | |
|---|---|---|---|
| client: | W P. BROWN & PARTNERS PTY LTD | hole commenced: | 7.12.94 |
| principal: | | hole completed: | 7.12.94 |
| project: | IRON GATES ESTATE - STAGE 1A - EVANS HEAD | logged by: | AEL |
| borehole location: | DRAIN No.1 - Approx.Ch 465m | checked by: | |
| drill model and mounting: | SAND AUGER | slope: -90 DEG | R.L.Surface: 2.97 approx. |
| hole diameter: | 80mm | bearing: | datum: AHD |

| method | penetration 1 2 3 4 | support | water | samples, tests, etc | R.L. | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components | moisture condition | consistency/density index | hand penetrometer kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HA | | C | | | | | | SP | SAND: fine to medium grained, light brown & brown, with a trace of silt lines. | M | MD | | ACID SULPHATE TEST CLEAR |
| | | | | D | | | | SP | SAND: fine to medium grained, off-white, with a trace of silt lines. | | | | ACID SULPHATE TEST CLEAR |
| | | | ∇ | | | 1 | | SP | SAND: As above. | W | | | ACID SULPHATE TEST CLEAR |
| | | | | | | 2 | | | Borehole HA9 terminated at 2.00 m | | | | |
| | | | | | | 3 | | | | | | | |

**METHOD**
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
*bit shown by suffix
B blank bit
V V bit
T TC bit
e.g. AD/T

**SUPPORT**
Nil no support
M mud
C casing

**PENETRATION**
1 2 3 4
little resistance ranging to very slow progress

**WATER**
N not measured
O none observed
water level
water outflow
water inflow

**SAMPLES, TESTS, ETC**
U undisturbed sample (mm)
D disturbed sample
Bs bulk sample
E environmental sample
N standard penetration test;
N* SPT + sample recovered
Nc SPT with solid cone
VS vane shear
PM pressuremeter
DP dynamic penetrometer
WS water sample
PZ piezometer

**CLASSIFICATION SYMBOLS AND SOIL DESCRIPTION**
based on unified classification system

**MOISTURE**
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

**CONSISTENCY/DENSITY INDEX**
VS very soft
S soft
F firm
St stiff
VSt very stiff
H hard
Fb friable
VL very loose
L loose
MD medium dense
D dense
VD very dense



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

APPENDIX B

# APPENDIX B

## PARTICLE SIZE DISTRIBUTION

Coffey Partners International Pty Ltd

A C N 003 692 019

**COFFEY**

Consulting Engineers, Managers and Scientists

Environment • Geotechnics • Mining • Water Resources

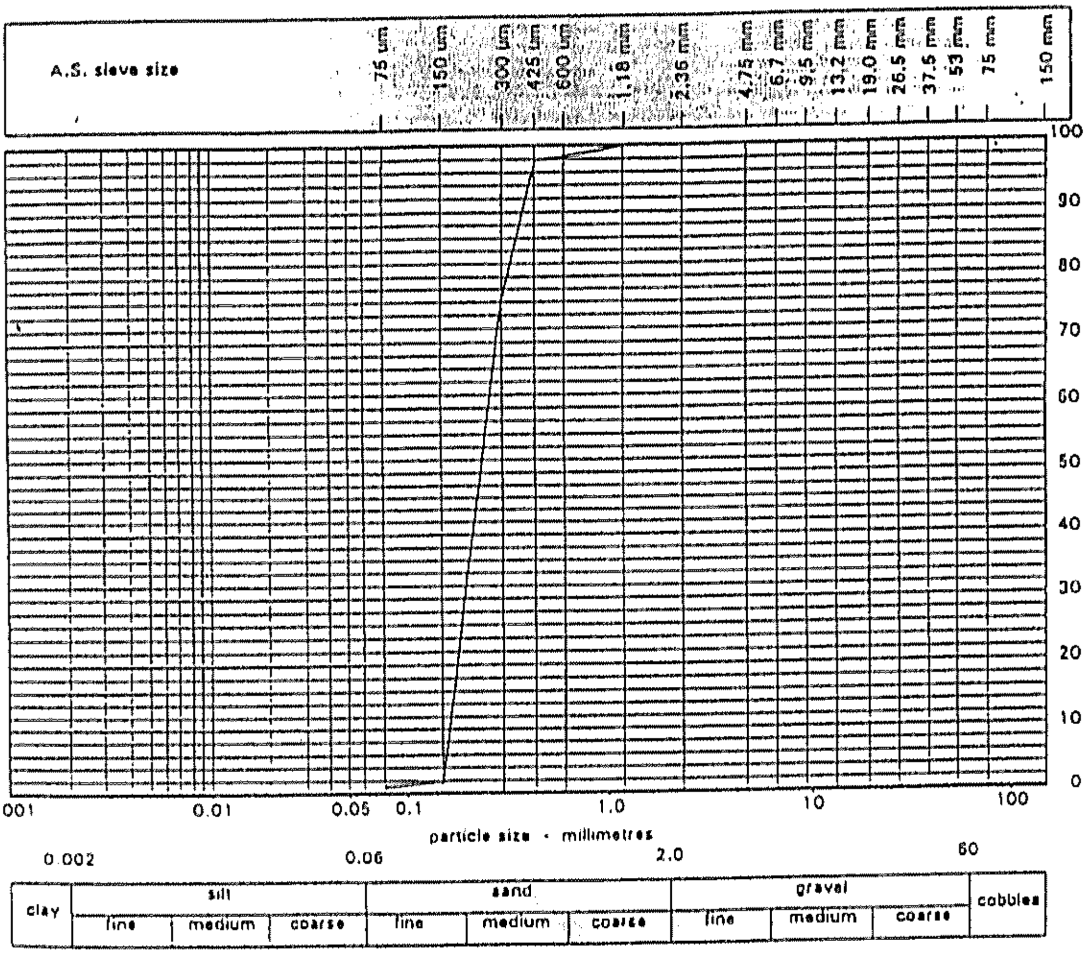
53B Fairlawn Street, Nathan, QLD, 4111, Ph: (07) 274 4411, Fax: (07) 274 4977

# particle size distribution

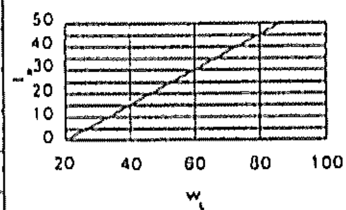
| | | | |
|---|---|---|---|
| client : | WP BROWN & PARTNERS | job no : | NR865/2 |
| principal : | | laboratory : | BRISBANE |
| project : | IRON GATES ESTATE | date : | 05/01/95 |
| location : | EVANS HEAD | test report : | CB95001.ENG |

sample identification : CB944483 Ch. 300m    depth : 1.0 - 2.0m

test procedure : AS1289 C6.1




| | | |
|---|---|---|
| liquid limit | % | |
| plastic limit | % | |
| plasticity index | % | |
| linear shrinkage | % | |
| particle density | t/m³ | |
| natural moisture | % | |




classification :

This laboratory is registered by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with the terms of registration. This document shall not be reproduced except in full without the prior approval of the laboratory.

Authorised Signature

NATA Reg. No. 596

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A.C.N. 003 692 019

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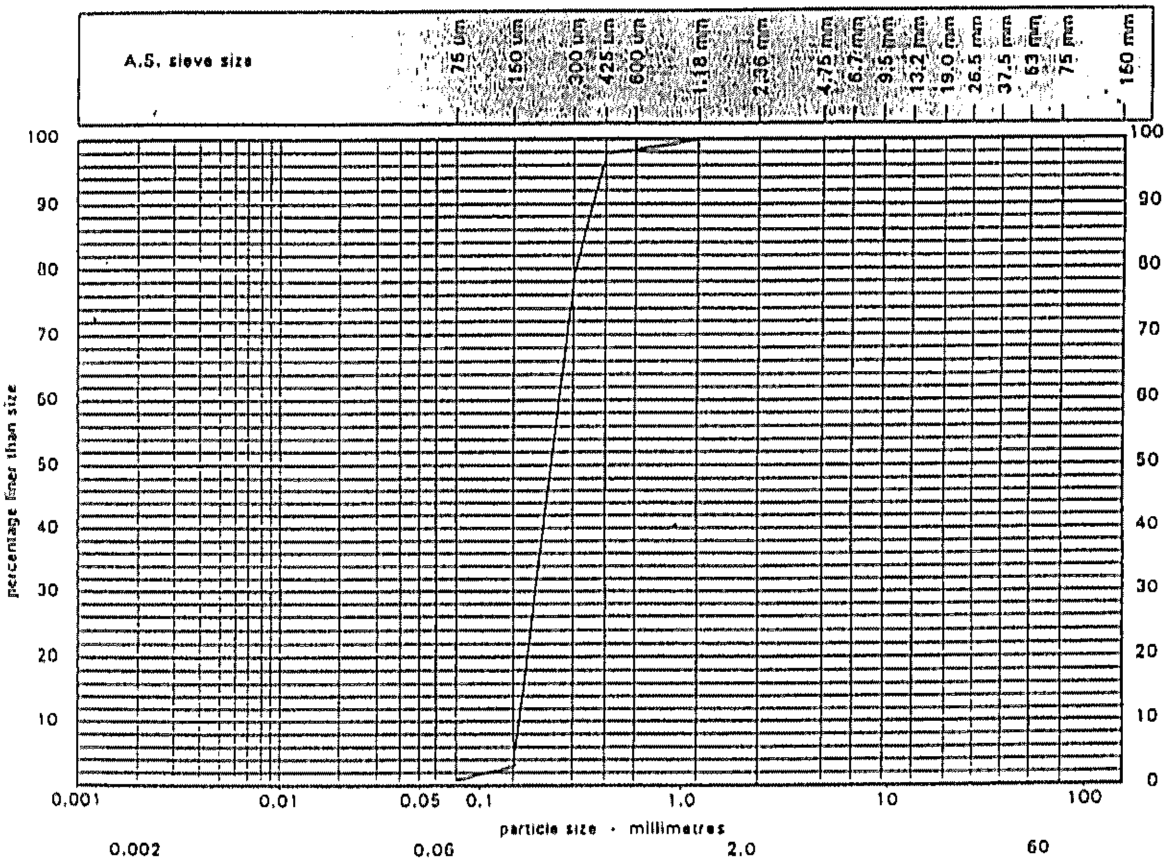
COFFEY

# particle size distribution

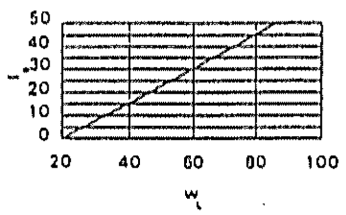
| | | | |
|---|---|---|---|
| client : | WP BROWN & PARTNERS | job no : | NR865/2 |
| principal : | | laboratory : | BRISBANE |
| project : | IRON GATES ESTATE | date : | 05/01/95 |
| location : | EVANS HEAD | test report : | CB95001.ENG |

sample identification : CB944484 Ch. 100m    depth : 1.0 - 2.0m
test procedure : AS1289 C6.1




| clay | silt | | | sand | | | gravel | | | cobbles |
|---|---|---|---|---|---|---|---|---|---|---|
| | fine | medium | coarse | fine | medium | coarse | fine | medium | coarse | |

| | | |
|---|---|---|
| liquid limit | % | |
| plastic limit | % | |
| plasticity index | % | |
| linear shrinkage | % | |
| particle density | t/m³ | |
| natural moisture | % | |




classification :



Authorised Signature
NATA Reg. No. 596



A B C D E F G H J K L M N O P Q R S T U V W X Y Z

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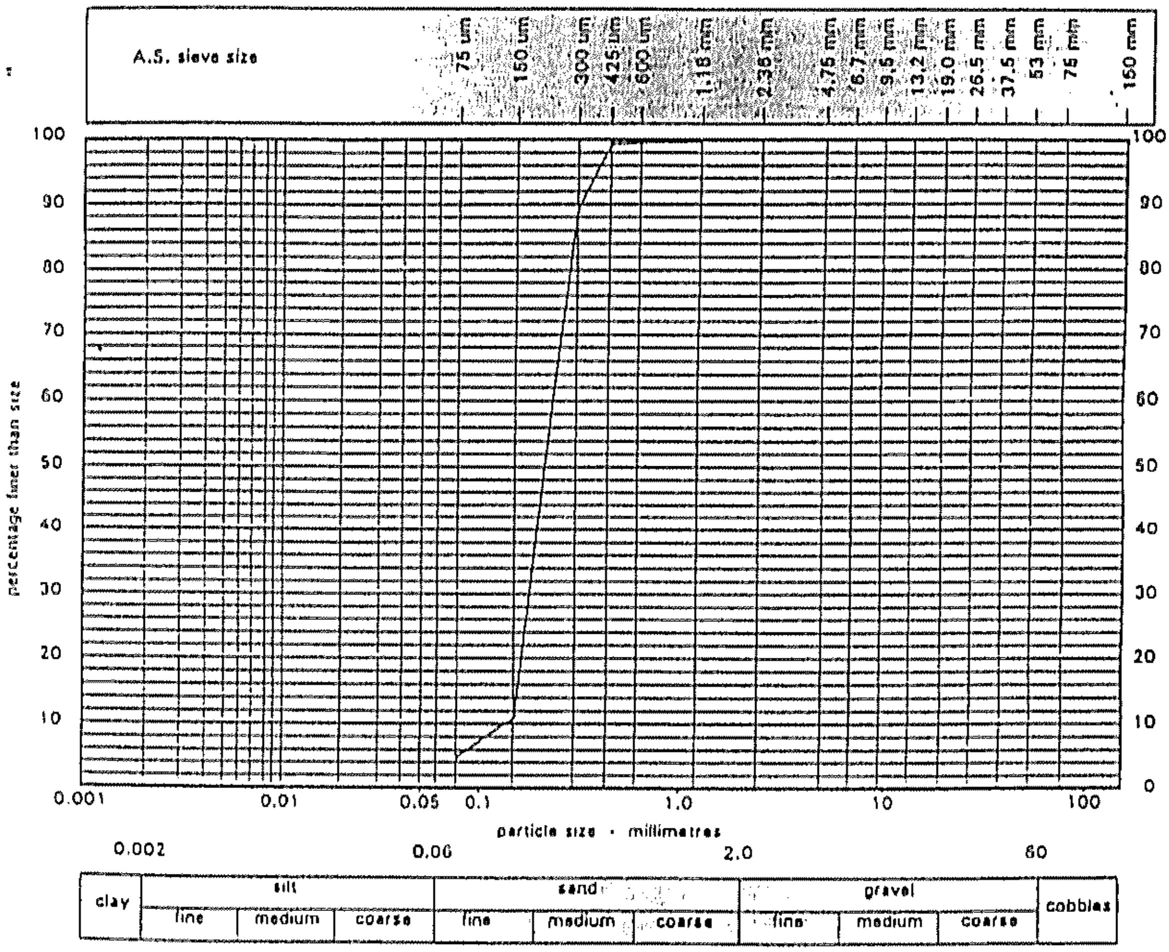
COFFEY

# particle size distribution

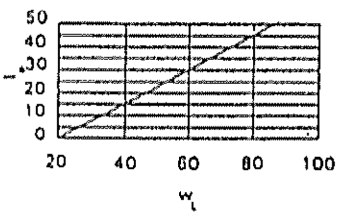
| | | | |
|---|---|---|---|
| client : | WP BROWN & PARTNERS | job no : | NR865/2 |
| principal : | | laboratory : | BRISBANE |
| project : | IRON GATES ESTATE | date : | 05/01/95 |
| location : | EVANS HEAD | test report : | CB95001.ENG |

sample identification : CB944485 Ch. 50m    depth : 0.4 - 1.0m

test procedure : AS1289 C6.1




| | | |
|---|---|---|
| liquid limit | % | |
| plastic limit | % | |
| plasticity index | % | |
| linear shrinkage | % | |
| particle density | $t/m^3$ | |
| natural moisture | % | |




classification :

NATA

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Authorised Signature
NATA Reg. No. 596

Howard

05 JAN 1995

# APPENDIX C

A
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## APPENDIX C

## ACID SULPHATE TEST RESULTS

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SIMMONDS & BRISTOW PTY. LTD.
A.C.N. 010 252 418
WATER & ENVIRONMENTAL ANALYSTS & CONSULTANTS

DN:PR

Ref. No. 27130
11 January 1995

The Manager,
Coffey Partners International Pty Ltd,
PO Box 108,
Salisbury, Qld 4107

Attention: Mr Brian Booker

Dear Sir,

ANALYSIS OF SOIL SAMPLES
ORDER NO. B17724 - JOB NO. NR865/2

Five (5) samples were received for testing on 13 December 19994. The results of analysis are presented in the Table attached.

Please advise if you have any queries.

Yours faithfully,
SIMMONDS & BRISTOW PTY. LTD.

D K Nial

David Nial
Supervisor - Soils Laboratory

Encl.

COFFEYSUINE

Simmonds & Bristow Pty. Ltd.
30 Shottery Street, Yeronga.
Queensland. 4104. Australia.

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Yeronga, Queensland,
Australia, 4104.
Telephone: (07) 848 7699
Fax No.: (07) 892 3345

Ref. No. 27130
COFFEY & PARTNERS BRISBANE

Sheet 1 of 1

# ANALYSIS OF SOIL SAMPLES
## ACID SULPHATE POTENTIAL
## IRON GATES ESTATE, EVANS HEAD
## JOB NO. NR865/2

Date Collected: Not Specified
Date Received: 13.12.94
Date Analysed: 13.12.94 - 09.01.95

Sampled By: Client
Sampling Method: Not Specified

| SAMPLE REGD. NO. | ANALYSIS<br>S & B METHOD NO. | INITIAL pH (1:5)<br>G090. | pH AFTER $H_2O_2$ OXID'N<br>G090. | INITIAL $SO_4$<br>SC280.4<br>mg/kg | $SO_4$ AFTER OXID'N<br>SC280.4<br>mg/kg | PYRITE S<br>% | $CaCO_3$<br>SC015.<br>% | ACID SULPHATE POTENTIAL<br>SC120.<br>* | ACID GENERATING POTENTIAL<br>** |
|---|---|---|---|---|---|---|---|---|---|
| 97297 | 50M 1.0 - 2.0 CB 944478 | 5.4 | 5.6 | 10. | 150. | <0.01 | <0.2 | NIL | NIL |
| 97298 | 150M 0.7 - 1.5 CB 944479 | 5.1 | 6.0 | 5. | 125. | <0.01 | <0.2 | NIL | NIL |
| 97299 | 250M 1.0 - 2.0 CB 944480 | 5.5 | 5.2 | <5. | 75. | <0.01 | <0.2 | NIL | NIL |
| 97300 | 350M 1.0 - 2.0 CB 944481 | 5.6 | 5.2 | <5. | 75. | <0.01 | <0.2 | NIL | NIL |
| 97301 | 465M 0.3 - 1.0 CB 944482 | 5.4 | 5.0 | 10. | 125. | <0.01 | <0.2 | NIL | NIL |

* Qualitative assessment based solely on % pyrite - not subject to NATA certification.
** Qualitative assessment based on % pyrite, % $CaCO_3$ and pH after oxidation - not subject to NATA certification.

NATA



SIMMONDS & BRISTOW PTY LTD

PER C. Cochrane ....................

COFFEYSBNE

# APPENDIX M

## ELECTRICAL AND COMMUNICATIONS SUPPLY AVAILABILITY

Preferred ENERGY Pty Ltd
electrical consultants

Energy by Design
A C N 089 041 896 A division of the
Don Family Trust ABN 33 839 164 100

12/07/19
The Technical Director
ARCADIS
Level 7 Premion Place,
Cnr Queen and High Streets
SOUTHPORT. QLD 4215
By email to: Gerard.dick@arcadis.com

Re: Electrical and Telecommunications Supply Availability

Dear Sir

I refer to your request to review the availability of electricity supply and communications infrastructure to the proposed 175 lots of the Iron Gates Development.
It will be necessary to construct new infrastructure within the development and within Iron Gates Drive to make connection available to the existing electricity and communications infrastructure within Wattle Street near the corner of Cherry Street.

Electricity Supply
When the development was planned for Construction previously the Electricity authority existing at the time was NorthPower. This authority has subsequently been merged and rebadged several times with the current network owner now known as Essential Energy. In September 1996 NorthPower made an offer to supply the development which is attached (File name EE Original 260996.pdf). I have confirmed with Essential Energy that the connection method proposed in 1996 is still appropriate and that supply would be available to the development from a connection point in Wattle Street. It should be noted that the construction of these works has been deregulated since 1996 and Essential Energy would not do the construction work but would supervise its design and installation. On completion of the works (by Authorised Contractors to an approved design) the assets would be gifted to Essential Energy and they would become responsible for the ongoing operation and maintenance of the assets. Essential Energy will not formalise this offer without an approved current DA. See EE Response 170519.pdf. Once the DA is approved EE will formalise the design requirements after receiving an application.

Communications Infrastructure
In a similar manner to Essential Energy NBN do not carry out works within the development but rely on the developer to arrange an authorised design and installation of pit and pipe infrastructure. This is then gifted to NBN prior to land registration. NBN require a contribution from the developer for each connection required as well as a contribution for lead in works to extend the NBN network to the boundary of the pit and pipe installed by the

developer. NBN have made an offer to the developer and is attached as NBN Offer 210817.pdf. This offer establishes an NBN Developer Reference number which is used for the design and construction of the pit and pipe and the contractual payments between the developer and NBN. The next step in this process is to do an NBN design and submit to NBN for Approval.

<u>Summary</u>

In terms of connection availability to the overall development I can confirm that technically nothing has changed since 1996 in terms of the connection points and supply availability. Since this time the administrative procedures, technical standards for the new equipment and mechanism for its installation has changed. None of these changes have affected the concept that supply will be available from both networks provided the necessary installation works are carried out by the developer.

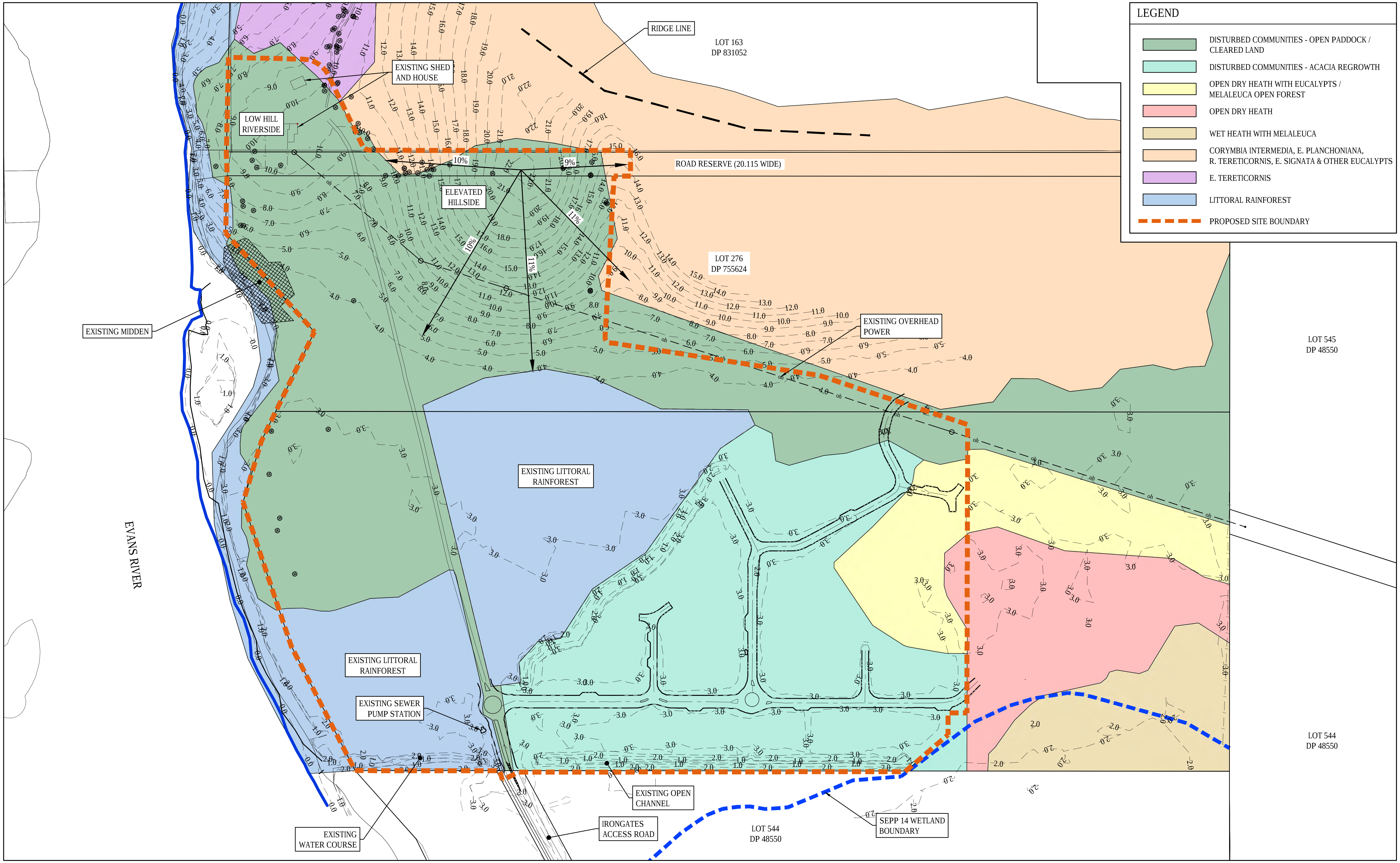
Yours Sincerely

Greg Don

Greg Don
B.Sc., B.E., M.B.A., M.I.E.
Director
Preferred Energy Pty Ltd
Level 3 ASP no 3479

# APPENDIX N

## SITE ANALYSIS & DESIGN RESPONSE PLANS




| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 01 | ORIGINAL ISSUE | NF | GD | | 17.07.19 |

Scale
0 15 30 60 90 120 150m
1 : 1500

Surveyor
ROBERT A HARRIES
SURVEYOR

Architect

Filename SiteAnalysisPlan2.dwg

Client
GOLDCORAL PTY LTD

Status
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Approved
R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1:1500 | Original Issue Signatures |
| | | Drawn N. FAHEY |
| Original Size | A1 | Designed G. DICK |
| Height Datum | AHD | Project Manager G. DICK |
| Grid | | © Copyright reserved |

Project
RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title
SITE ANALYSIS PLAN


ARCADIS
Arcadis Australia Pacific Pty Limited
P O Box, 1653
Southport QLD 4215
ABN 76 104 485 289
Tel No: +61 7 5532 3933
Fax No: +61 7 5591 4778
www.arcadis.com


Drawing No. #### — Project No. AA007094 — Issue 01

100mm on Original

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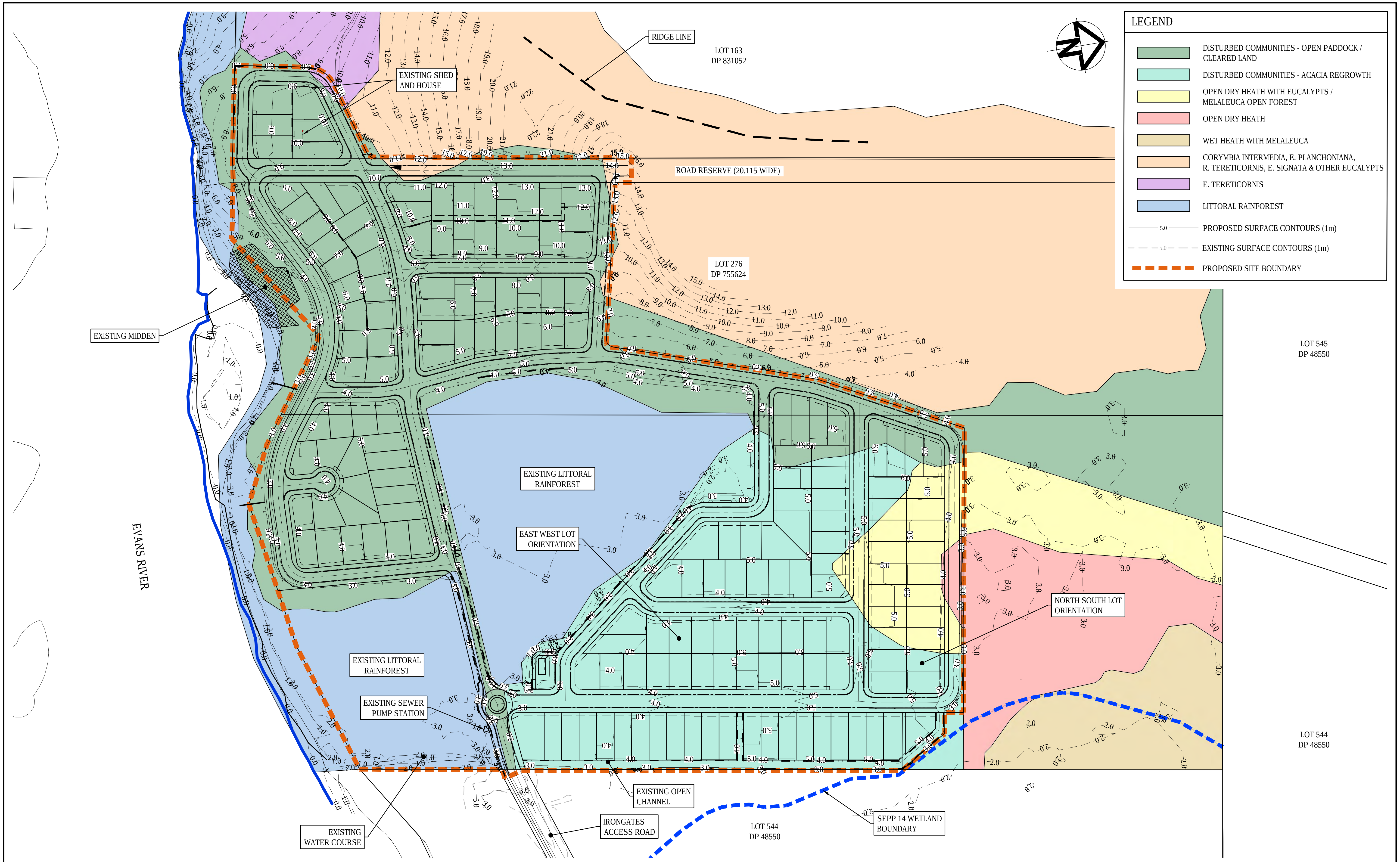


| Issue | Description | By | Ckd | RPEQ | Date |
|---|---|---|---|---|---|
| 01 | ORIGINAL ISSUE | NF | GD | | 17.07.19 |

Scale: 0 15 30 60 90 120 150m — 1 : 1500

Surveyor: ROBERT A HARRIES SURVEYOR

Architect:

Filename: DesignResponse.dwg

Client: GOLDCORAL PTY LTD

Status: PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Approved: R.P.E.Q No :

| | | |
|---|---|---|
| Scales | 1:1500 | Original Issue Signatures |
| | | Drawn: N. FAHEY |
| Original Size | A1 | Designed: G. DICK |
| Height Datum | AHD | Project Manager: G. DICK |
| Grid | | © Copyright reserved |

Project: RESIDENTIAL DEVELOPMENT
LOT 277 IRON GATES ROAD
EVANS HEAD

Title: DESIGN RESPONSE PLAN

ARCADIS

Arcadis Australia Pacific Pty Limited
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Southport QLD 4215
ABN 76 104 485 289
Tel No: +61 7 5532 3933
Fax No: +61 7 5591 4778
www.arcadis.com

| Drawing No. | Project No. | Issue |
|---|---|---|
| #### | AA007094 | 01 |

100mm on Original

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