**From:** Steve Connelly
**Sent:** Fri, 3 Jul 2020 16:26:55 +1000
**To:** Council Email
**Cc:** Ross Courtney;Daniel Hargreaves
**Subject:** PLANNING PROPOSAL for a propsed Highway Service Centre at Maclean.
**Attachments:** 200703 PP TO CVC RE MACLEAN HSC PROPOSAL REPORT pn id 1707.3198.pdf

hi

PLANNERS NORTH has been engaged by Hargreaves Property Group with respect to the preparation and lodgement of a Planning Proposal with Clarence Valley Council in regard to Lot 2, DP 634170 2 Schwonberg Street, Townsend.

The Hargreaves Property Group proposes to develop the Schwonberg Street property for the purposes of a contemporary Highway Service Centre. The proposal will include a 24-hour fuel shop and three restaurant tenancies with associated amenities. It is envisaged that the overall floor space of the development will be in the order of 900m$^2$. To facilitate the development of an amendment to the Council LEP is required. Please find attached our Planning Proposal. This LINK will give you access to the Technical Reports that support the Planning Proposal. On Monday we will dispatch to the Council the 3 hard copies of the documentation that you require.

Can you please arrange for an invoice to be prepared to cover the Pre Gateway Assessment - Initial Application for this project.

Should the Council require any additional information, please feel free to contact me at any time.

Regards

Steve Connelly

Partnership Principal

ABN 56 291 496 553

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m: 0419237982 | p: 1300 660 087 | w: www.plannersnorth.com.au

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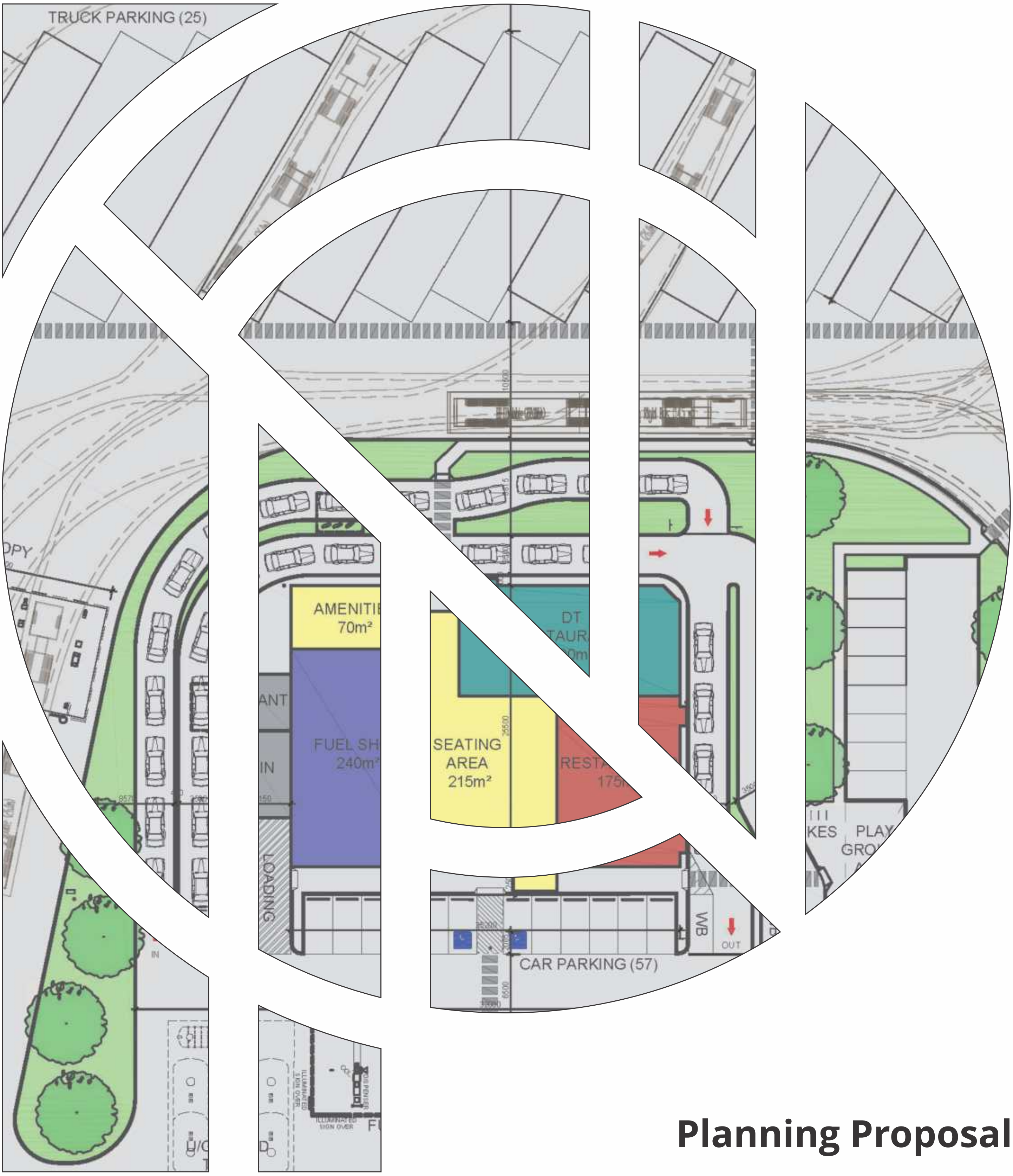



# Planning Proposal

## Maclean Highway Service Centre
## Lot 2 DP634170
## Schwonberg Street, Townsend

**PLANNERS NORTH**, July 2020

Document Set ID: 2124538
Version: 1, Version Date: 09/07/2020

## COMPLIANCE AND USAGE STATEMENT

This Planning Proposal has been prepared and submitted under Part 3 of the *Environmental Planning and Assessment Act 1979* by:

**Preparation**

| | |
|---|---|
| Name: | Stephen Connelly |
| Company: | PLANNERS NORTH |
| Address: | 6 Porter Street, Byron Bay, NSW, 2478 |
| Postal Address | P.O. Box 538, Lennox Head NSW 2478 |
| In respect of: | Lot 2, DP 634170, 2 Schwonberg Street, Townsend |

**Application**

| | |
|---|---|
| Proponent: | Hargreaves Property Group |
| Address: | C/ - PLANNERS NORTH<br>P.O. Box 538, Lennox Head NSW 2478 |
| Proposed zoning: | Amendment to Clarence Valley LEP 2011 to permit a Highway Service Centre |

**Certificate**

I certify that I have prepared the content of this Planning Proposal to the best of my knowledge:

- it is in accordance with the Act and Regulations, and
- it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

**Notice**

The plans to this document were prepared for the exclusive use of the proponent and are not to be used for any other purpose or by any other person or corporation. PLANNERS NORTH and Balanced Advice accepts no responsibility for any loss or damage suffered howsoever arising to any person or corporation who may use or rely on this document for purposes other than the proposed development.

Plans accompanying this document may not be reproduced, stored or transmitted in any form unless this note is included.

PLANNERS NORTH declares that it does not have, nor expects to have, a beneficial interest in the subject project. We do not have any reportable political donations within the meaning of Section 147(3) of the Act to declare and our clients have advised that they do not have political donations of a reportable nature.



Stephen Connelly RPIA (Fellow)
Partnership Principal

PLANNERS NORTH

ABN 56 291 496 553
6 Porter Street,
Byron Bay NSW 2481
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PIA Registered Planner Planning Institute Australia

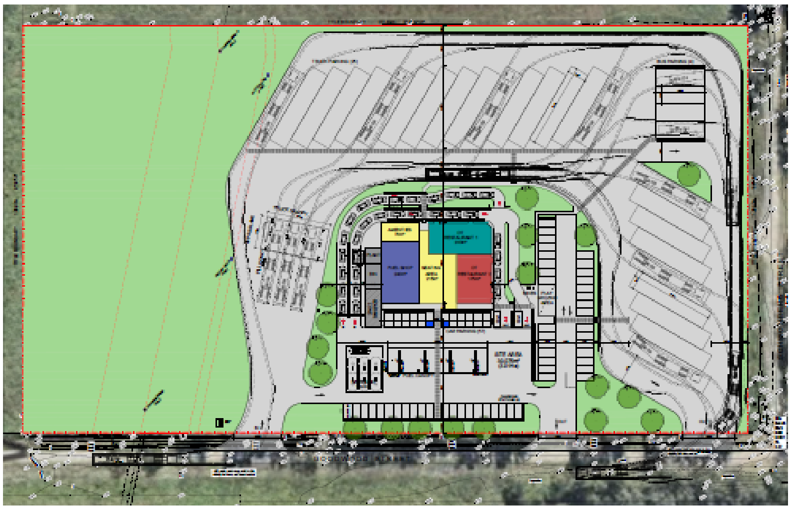
Ref: 1707.3198
**Date: July 2020**

# EXECUTIVE SUMMARY



PLANNERS NORTH has been engaged by Hargreaves Property Group with respect to the preparation and lodgement of a Planning Proposal with Clarence Valley Council in regard to land known in Real Property terms as Lot 2, DP 634170 and referred to as 2 Schwonberg Street, Townsend.

Highway Service Centres encourage drivers to "stop, revive, survive" and take breaks when they recognise the warning signs of fatigue, which contributes significantly to travel safety and efficiency. It is therefore very important that Highway Service Centres are provided at conveniently spaced centres along the route and close to bypassed towns so the economic benefits can remain with those centres.



*Concept plan illustrating the layout of the proposed Highway Service Centre.*

The Hargreaves Property Group proposes to develop the Schwonberg Street property for the purposes of a contemporary Highway Service Centre. The proposal will include a 24-hour fuel shop and three restaurant tenancies with associated amenities. It is envisaged that the overall floor space of the development will be in the order of 900m$^2$.

The premises will provide:

- 24 hours a day, 7 days a week operation;
- provide at least 25 heavy vehicle parking spaces;
- 4 parking spaces for recreational vehicles and coaches;
- 4 spaces for electric vehicle charging;
- a children's play area;
- tourist information;
- suitable toilets and other amenities free of obligation; and
- separate undercover fuel areas for heavy and light vehicles.

We submit that there is a legitimate need for the Maclean Highway Service Centre and the subject site is capable of development and use in a manner which mitigates potential adverse impacts consistent with:

- Good town planning practice and the constraints applying to the property;
- The guidance published by relevant departmental offices;
- Section 117 Directions issued by the Minister for Planning;
- The North Coast Regional Plan 2036;
- Relevant State Environmental Planning Policies; and
- The Community Strategic Plan published by Clarence Valley Council.

## TABLE OF CONTENTS



## LIST OF PLANS & PLATES

## LIST OF TABLES



## APPENDICES



## SUPPORTING DOCUMENTS BUNDLE

# 1 INTRODUCTION

*This section provides a brief introduction to the Planning Proposal, describes the structure of the report, and Technical advice relied upon for the purposes of the application.*

## 1.1 PREAMBLE

PLANNERS NORTH has been engaged by *Hargreaves Property Group* with respect to the preparation and lodgement of a Planning Proposal with Clarence Valley Council in regard to land described as Lot 2, DP 634170 and referred to as 2 Schwonberg Street, Townsend.

**Plan 1.1** illustrates the subject site in its local context. The below graphic shows the proposed service centre and rest area network from Tweed Heads through to Halfway Creek.


*Extract from RMS Highway Service Centres along the Pacific Highway Policy of Review 2014.*

The purpose of this Planning Proposal is to amend the current town planning controls that apply to the subject site. The intended outcome of the Planning Proposal is to permit the construction of a Highway Service Centre on the subject land.

Pursuant to the provisions of the Clarence Valley Local Environmental Plan 2011 (CVLEP11) a Highway Service Centre means:

*"a building or place used to provide refreshments and vehicle services to highway users. It may include any one or more of the following—*

*(a) a restaurant or cafe,*

*(b) take away food and drink premises,*

*(c) service stations and facilities for emergency vehicle towing and repairs,*

*(d) parking for vehicles,*

*(e) rest areas and public amenities."*

This Planning Proposal has been prepared in accordance with Section 3.33, of the Environmental Planning & Assessment Act 1979 (EP&A Act). As required by Section 3.33 this Planning Proposal includes the following:

a) a statement of the objectives or intended outcomes of the proposed instrument;

b) an explanation of the provisions that are to be included in the proposed instrument;

c) the justification for those objectives, outcomes and provision and the process for their implementation;

d) if maps are to be adopted by the proposed instrument; and

e) details of the community consultation that is to be undertaken before consideration is given to the making of the proposed instrument.

This Planning Proposal has also been prepared having regard to the Departmental publications "*A guide to preparing local* *environmental plans*" and "*A guide to preparing planning proposals*".

## 1.2 Structure of Report and its Scope

Section 2 of this report describes the physical characteristics of the subject land and its planning context. Section 3 describes the development potential of the subject land. A description of the proposed amendments to CVLEP11 is set out in Section 4. A brief outline in relation to the statutory and strategic planning context of the subject site is described at Section 5. Section 6 sets out a justification of the proposal having regard to the relevant strategic planning context. Section 7 contains brief concluding remarks.

**Annexure A** to this Planning Proposal contains the Council's Planning Proposal application form and landowner's consent.

This Planning Proposal should be read in conjunction with the **Supporting Documents Bundle** which accompany this application.

## 1.3 Specialist Technical Advice

For the purposes of researching the strategic characteristics of the subject site, specialist advice was sought from:

- *de Groot &* Benson – Engineering considerations;
- *Geo-Logix* – Contamination assessment;
- *Everick* - Archaeological considerations; and
- *Bitzios* Traffic Impact Assessment

## Further Information

Should Council or the Department require any additional information or wish to clarify any matter raised by this Planning Proposal please consult Steve Connelly.


Source: Openstreetmap website, viewed 4 March 2020

North

0 500m

1 : 20 000 @ A4

**Legend**

Subject site - Lot 2 DP634170

# Plan 2.1

## THE SITE

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1707.3198

## 2 SITE DESCRIPTION

*This section of the Planning Proposal describes the site in terms of the physical planning opportunities and constraints.*

### 2.1 Cadastral Description

The subject site (see **Plan 2.1**) is described in Real Property terms as Lot 2 DP 634170, 2 Schwonberg Street, Townsend, 2463, Parish of Taloumbi, County of Clarence. The site has an area of 3.007ha and is regular in shape with a 130m frontage to Schwonberg Street and 231.345m frontage to Goodwood Street.

The land is owned by Corbett Haulage Pty Ltd. The following restrictions on title apply:

- Easement for water supply – 3m wide, 6m wide and variable, affecting that part of the land designated "C" in DP 1202603; and
- Easement for overhead power line 30m wide and variable affecting that part of the land designated as "A" in DP 1202603.

### 2.2 Site Context

The subject site is located approximately 2.6 km (5 minutes driving) from Maclean Post Office. The property is 87km south of the new Ballina Highway Service Centre and 74km north of the Highway Service Centre located at Halfway Creek.

### 2.3 Access

All traffic will access the subject site from Goodwood Street, which has connectivity via the Pacific Highway. Schwonberg Street is an unsealed narrow road with limited connectivity to other local roads.

For traffic modelling purposes traffic data was sourced from the Pacific complete Woolgoolga to Ballina project team. SIDRA intersection modelling results show that average delays and the degree of saturation within the network will be minimal. The Level Of Service during peaks in all assessment scenarios indicate the scenarios, including an assessment over a 10-year design horizon is LOS A.

### 2.4 Utility Connections

Sewerage

The subject site is not currently serviced by Council's reticulated sewer. The proposed development will have its own sewerage pumping station and is proposed to pump sewerage via a new rising main about 1.5 kilometres north-west along Shwonburg Street to the Council's existing sewerage pumping station at the corner of Jubilee Street.

Water

The property has been serviced by reticulated town water historically via a 375 mm water main.

Power

The property has historically been serviced by overhead power with high voltage overhead lines crossing the western portion of the property in an easement. The provision of the installation of a new onsite transformer is proposed.

### 2.5 Flooding

The subject site is flood-prone. The floodplain in this area is protected by a levy formed by the old Pacific Highway and Causley Lane. The floodplain behind the levy drains via an open drain to Edwards Creeks, which discharges to the Clarence River via a set of floodgates. It is proposed to build the Highway Service Centre floor level 0.5m above the 1 in 100 flood event. Consistent with contemporary practice, the truck and car parking areas will be set at a lower level. The proposal will involve filling the floodplain and will have an impact on flooding by both obstruction and loss of floodplain storage. Engineering advice suggests the impact on a flood event of a 1 in 20 year ARI and greater will not be more than 5mm locally.

## 2.6 Archaeology

The site has been assessed in compliance with the *Code of Practice for Archaeological Investigations of Aboriginal objects in New South Wales (*DEECW2010). That assessment involved consultation with the Yaegal Traditional Owners Aboriginal Corporation (TOAC). Searches of applicable heritage registers, a review of ethnographic and historical sources relevant to the region and a review of previous archaeological work were also undertaken. From this analysis, a summary of the local and regional character of aboriginal land use and a predicted model was developed. Further, an archaeological survey with the representative of Yaegal TOAC is being carried out.

No aboriginal site or culturally significant sites occur within the subject's site. Having regard to the predictive model developed by the archaeologist, it is not considered the subject site has a high potential to contain aboriginal sites.

## 2.7 Acid Sulfate Soils

The whole of the subject's site is classified "Class 3". In this classification, consent is required for excavation more than 1 metre below the natural ground surface. Given the filling proposed to the land there is a low likelihood of disturbing, exposing or draining acid sulphate soils.

## 2.8 Bushfire Prone Land

The land is not mapped as being bushfire prone. To its south-east is a bushfire prone land vegetation buffer to some category 2 vegetation.

## 2.9 Land Contamination

The subject site has an historical use from sewerage treatment plant purposes. A remediation action plan was prepared for the land in February 2018. The key elements of the that plan involved a discharge of ponded water, excavation removal of bio solids, removal an asbestos waste stockpile, treatment of pond walls for potential acid sulphate soils and backfilling the pond walls.

This work was completed during the period April-February 2019. On 6th of June 2019 a Site Audit Statement was issued for the land.

## 2.10 Flora and Fauna

Prior to 1983 the land was utilised for grazing and agriculture. Between 1983 and 2010 the site was used as a Sewerage Treatment Plant. In 2010 the STP operation ceased and the site has been generally unused. All our background research indicates that there are no Flora and Fauna issues associated with development of the subject land.


Source: DP634170

North

0 50m

1 : 2000 @ A4

**Legend**

Subject site

Easement

Ⓐ Easement for transmission line 30 wide

Ⓒ Easement for water supply 3 wide

**Plan 2.1**

**THE SITE**

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1707.3198

# 3 DEVELOPMENT PROPOSAL

*This section of the submission outlines the development concept for the subject site.*

The Hargreaves Property Group propose to development the Schwonberg Street property for the purposes of a Highway Service Centre. The proposal will include a 24-hour fuel shop and three restaurant tenancies with associated amenities. It is envisaged that the overall floor space of the development will be in the order of 900m$^2$.

The premises will provide:

- 24 hours a day, 7 days a week operation;
- provide at least 25 heavy vehicle parking spaces;
- 4 parking spaces for recreational vehicles and coaches;
- 4 spaces for electric vehicle charging;
- a children's play area;
- tourist information;
- suitable toilets and other amenities free of obligation; and
- separate undercover fuel areas for heavy and light vehicles.

A concept sketch illustrating the character and nature of the intended use is set out at **Plan 3.1**.

Plan 3.1
Development Proposal

## AREA SCHEDULE:

| | |
|---|---|
| TOTAL SITE AREA - | 30,075m² (3.01Ha) |
| **TENANCY AREAS:** | |
| FUEL SHOP - | 240m² |
| D/T RESTAURANT 1 - | 200m² |
| D/T RESTAURANT 2 - | 175m² |
| SEATING AREA - | 215m² |
| AMENITIES - | 70m² |
| TOTAL AREA - | 900m² |
| CAR SPACES - | 57 cars |
| TRUCK SPACES - | 25 trucks |
| BUS SPACES - | 4 buses |
| BIKE SPACES - | 16 bikes |

ALL SITE BOUNDARY & AREAS ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY


| REV | AMENDMENT DETAILS | BY | DATE |
|---|---|---|---|
| P2 | PRELIMINARY ISSUE | KM | 17-06-20 |
| P1 | PRELIMINARY ISSUE | KM | 15-06-20 |

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RBP No. DP-AD1689




PROJECT
PROPOSED MIXED USE DEVELOPMENT

PROJECT ADDRESS
CNR OF GOODWOOD & SCHWONBERG STREET
MACLEAN
NSW 2463

DRAWING TITLE
CONCEPT SITE PLAN

CLIENT
HARGREAVES PROPERTY GROUP

| DATE | SCALE @ A1 | NORTH |
|---|---|---|
| JUN '20 | 1:500 | |
| DRAWN: JS | CHECKED: AB | |
| ISSUE: PRELIMINARY | | |

| PROJECT No. | DRAWING No. | REVISION No. | SHEET |
|---|---|---|---|
| 19097 | SK02 | P2 | 01 of 01 |

0m 5m 10m 15m 20m
1:500 @ A1 SIZE / 1:1000 @ A3 SIZE

# 4 PLANNING PROPOSAL

*This section describes the strategic background to the planning proposal and provides a suggested form in relation to the LEP amendments sought.*

## 4.1 Objectives

The primary objective of this Planning Proposal is to permit the development of a Highway Service Centre at Lot 2 DP 634170.

## 4.2 Relationship to Highway Strategic Planning

The siting of a Highway Service Centre in the Maclean locality has been the subject of regional strategic planning since 1995 when the then Department of Urban Affairs and Planning published the results of research concerning large number of commercial / retail enterprises that had direct access to the Pacific Highway in out of town situations (DUAP, 1995). With the Highway upgrade program in its early stages, the Department and the roads authorities considered that policy was required to protect the upgraded highway's safety and efficiency, and the governments' considerable investment in it.

In 1998, the Department published a discussion paper which included draft policy aimed at keeping retailing activity within settlements, where it is best placed to serve the community, but at the same time providing for strategically placed Highway Service Centres.

The policy was finalised and implemented via Ministerial Direction to Councils (MP, 1998). The policy, and direction, has since been reviewed several times to coincide with the finalisation of highway design and to reflect the outcomes of further research commissioned by RMS.

Ministerial Local Planning Direction 5.4 facilitates the establishment of Highway Service Centres in specified locations provided that the RMS is satisfied the Highway Service Centre can be safely and efficiently integrated into the highway interchange. At Maclean the specified location is the southern interchange.

## 4.3 Explanation of the Provisions of the Draft Plan

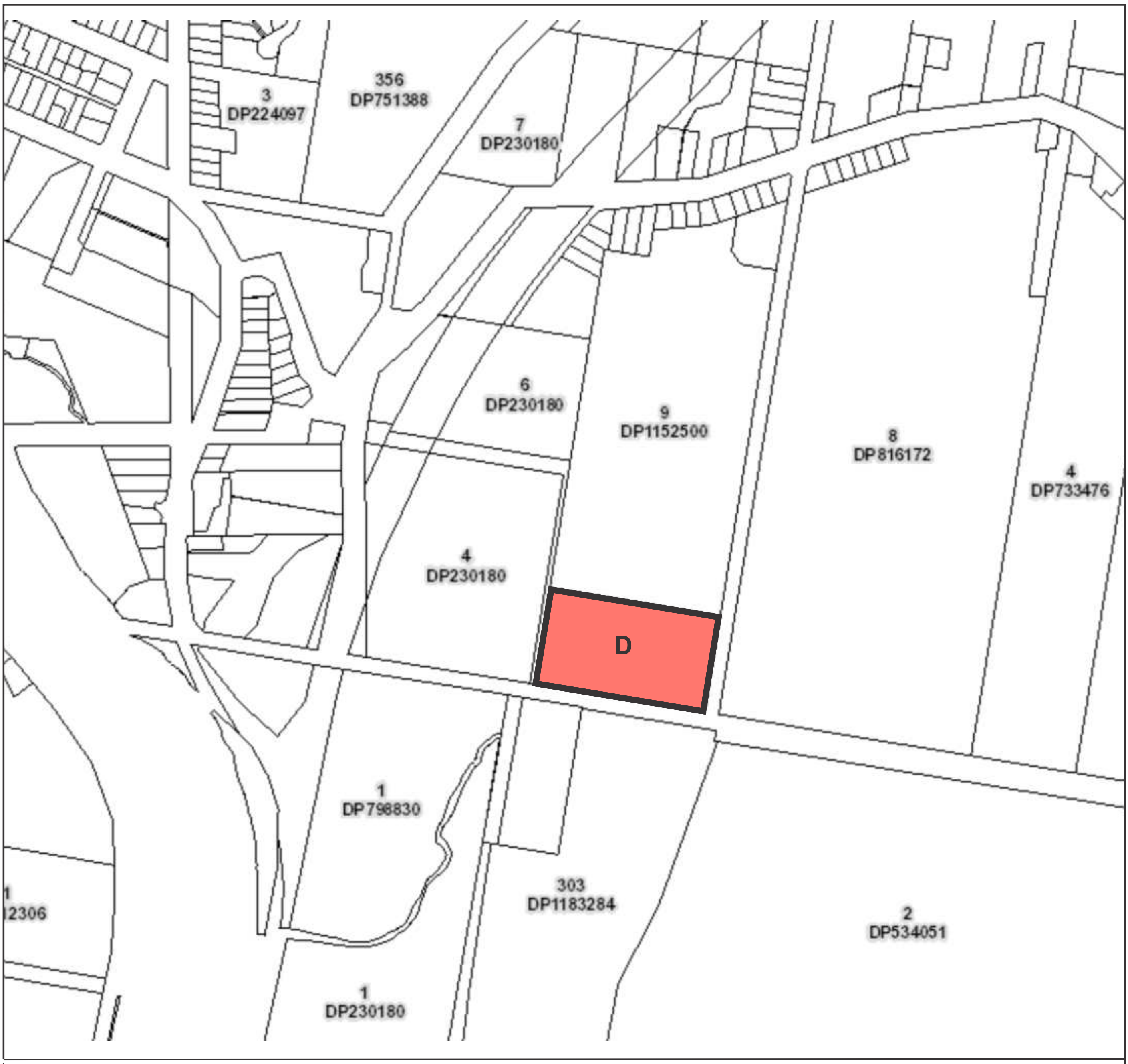
It is proposed that the Highway Service Centre at the subject site will be facilitated by way of the addition of a clause to Schedule 1 of CVLEP11. Below is the style of enabling the clause that we anticipate would be appropriate.[1]

*3 Use of certain land at Townsend*

*(1) This clause applies to Lot 2 DP 634170 Schwonberg Street, Townsend and identified as "Area D" on the Additional Permitted Uses Map.*

*(2) Development for the purpose of a Highway Service Centre is permitted with development consent.*

[1] This clause is based on the Highway Service Centre enabling provisions set out in Ballina LEP 2012 Schedule 1, Item 3.




Source: Planners North, March 2020

North

0 100 200m

1 : 10 000 @ A4

**Legend**

Subject site

D Additional Permissable Uses Zone

**Plan 4.1**

**CONCEPT LEP**

PLANNERS NORTH
1707.3198

# 5 STATUTORY AND STRATEGIC PLANNING

*Sections 5.1 and 5.2 document the range of statutory planning controls and strategic planning guidance applicable in the subject case.*

## 5.1 STATUTORY CONSIDERATIONS

Pursuant to the EP&A Act, 1979, a number of statutes are potentially applicable to any single development proposal. This section reviews the range of instruments and notes their application in terms of the subject development application proposal.

### 5.1.1 DEEMED ENVIRONMENTAL PLANNING INSTRUMENTS

No deemed environmental planning instruments apply to the subject land.

### 5.1.2 LOCAL ENVIRONMENTAL PLANS

Clarence Valley Local Environmental Plan 2011 (CVLEP11) is applicable to the land. The key provisions relevant to the site are:

| | |
|---|---|
| Land Zoning | RU2<br>Rural Landscape Zone |

**Land Zoning Map**


Legend RU2

| | |
|---|---|
| Minimum Lot Size | 40ha |
| Acid Sulfate Soil Classification | Class 3 |
| Height of Buildings | No height limit specified |
| Flood Planning | Flood planning area |

### 5.1.3 STATE ENVIRONMENTAL PLANNING POLICIES

A search on the Planning Portal website on 1st July 2020 revealed the following State Environmental Planning Policies applying to this land:

- *SEPP (Affordable Rental Housing) 2009*
- *SEPP (Building Sustainability Index: BASIX) 2004*
- *SEPP (Coastal Management) 2018*
- *SEPP (Concurrences) 2018*
- *SEPP (Educational Establishments and Child Care Facilities) 2017*
- *SEPP (Exempt and Complying Development Codes) 2008*
- *SEPP (Housing for Seniors or People with a Disability) 2004*
- *SEPP (Infrastructure) 2007*
- *SEPP (Koala Habitat Protection) 2019*
- *SEPP (Mining, Petroleum Production and Extractive Industries) 2007*
- *SEPP (Miscellaneous Consent Provisions) 2007*
- *SEPP (Primary Production and Rural Development) 2019*
- *SEPP No 21—Caravan Parks*
- *SEPP No 33—Hazardous and Offensive Development*
- *SEPP No 36—Manufactured Home Estates*
- *SEPP No 44—Koala Habitat Protection*
- *SEPP No 50—Canal Estate Development*
- *SEPP No 55—Remediation of Land*
- *SEPP No 64—Advertising and Signage*
- *SEPP No 65—Design Quality of Residential Apartment Development*

#### 5.1.4 Certified Draft Plans

No draft plan is known to exist which would impinge upon the subject proposal.

### 5.2 Contribution Plans

The Clarence Valley Contribution Plan applies to the development of this land. It is anticipated that any rezoning of the land to facilitate a Highway Service Centre development would subject of development contributions at the specified rate.

### 5.3 Council Strategic Planning

Council has published various Strategic Plans for its Local Government Area. Plans of relevance to the subject planning proposal include:

- *Clarence Valley Aboriginal Heritage Study*
- *Clarence Valley Council Crime Prevention Strategy*
- *Clarence Valley Cultural Plan*
- *Clarence Valley Economic Development Strategic Plan*
- *Clarence Valley Industrial Lands Strategy*
- *Clarence Valley Settlement Strategy*
- *Clarence Valley Social Plan -2010-2014*
- *Clarence Valley Sustainability Initiative - Our Sustainability Framework - March 2006*
- *Contributions Plan 2011*
- *Crime Prevention Strategy*
- *Cultural and Community Facilities Plan*
- *Development Servicing Plans for Sewerage Services*
- *Development Servicing Plans for Water Supply Services*
- *Disability Inclusion Action Plan*
- *Interim Valley Vision 2024 - Corporate Strategic Plan*
- *Lower Clarence Retail Strategy*
- *Maclean Community Based Heritage Study*
- *Youth Strategic Plan*

# 6 JUSTIFICATION

*This section looks at the strategic planning considerations relevant to the proposal and consistency with relevant Directions.*

## 6.1 Relationship to Strategic Planning Proposal

### 6.1.1 Consistency with Relevant Subregional Planning Strategies

North Coast 2036 Regional Plan (2017)

The regional strategic planning context relevant to this Planning Proposal is the North Coast Regional Plan (NCRP). The NCRP is an initiative of the NSW Government to guide sustainable growth across the North Coast Region.

Goals, directions and principles defined by the new Regional Plan area set out at **Table 4.1.**

**Table 6.1 Assessment against Plan Goals, Directions and Actions**

| Goal / Direction / Principle | Consistency |
|---|---|
| GOAL 1: THE MOST STUNNING ENVIRONMENT IN NSW | |
| PRINCIPLE 1: DIRECT GROWTH TO IDENTIFIED URBAN GROWTH AREAS<br><br>Urban growth areas have been identified to achieve a balance between urban expansion and protecting coastal and other environmental assets. They help maintain the distinctive character of the North Coast, direct growth away from significant farmland and sensitive ecosystems and enable efficient planning for infrastructure and services. | The subject locality has been identified via various strategic planning endeavours dating back to 1995 as an appropriate location for a Highway Service Centre. |
| PRINCIPLE 2: MANAGE THE SENSITIVE COASTAL STRIP<br><br>The coastal strip comprises land east of the planned Pacific Highway alignment plus the urban areas of Tweed Heads around the Cobaki Broadwater. The coastal strip is ecologically diverse and contains wetlands, lakes, estuaries, aquifers, significant farmland, and has areas of local, State, national and international environmental significance. Much of this land is also subject to natural hazards, including flooding, coastal inundation, erosion and recession.<br><br>Demand for new urban and rural residential land in this area is high. To safeguard the sensitive coastal environment, rural residential development will be limited in this area, and only minor and contiguous variations to urban growth area boundaries will be considered. | The land is located immediately adjacent to the new Pacific Highway route and consistent with the principle of managing the coastal strip. |
| PRINCIPLE 3: PROVIDE GREAT PLACES TO LIVE AND WORK IN A UNIQUE ENVIRONMENT<br><br>Making cities and centres the focus of housing diversity, jobs and activities makes communities more vibrant and active, reduces pressure on the environment, and makes it easier for residents to travel to work and access services.<br><br>The Plan guides councils in preparing local growth management strategies and planning proposals to deliver great places to live and work that maximise the advantages of the North Coast's unique environment. | By its very nature, a Highway Service Centre is located proximate to the Highway and in bypassed towns like Maclean away from the existing village centre. |
| **DIRECTION 1:** Deliver environmentally sustainable growth | |
| Actions | |

| Goal / Direction / Principle | Consistency |
|---|---|
| 1.1 Focus future urban development to mapped urban growth areas. | N/A |
| 1.2 Review areas identified as 'under investigation' within urban growth areas to identify and map sites of potentially high environmental value. | N/A |
| 1.3 Identify residential, commercial or industrial uses in urban growth areas by developing local growth management strategies endorsed by the Department of Planning and Environment. | The locality on the southern side of Maclean has been identified in regional strategic planning undertaken by the Department and RMS. |
| 1.4 Prepare land release criteria to assess appropriate locations for future residential, commercial and industrial uses. | Consistent |
| **DIRECTION 2**: Enhance biodiversity, coastal and aquatic habitats, and water catchments | |
| Actions | |
| 2.1 Focus development to areas of least biodiversity sensitivity in the region and implement the 'avoid, minimise, offset' hierarchy to biodiversity, including areas of high environmental value. | The subject site has been used for farming for some decades as sewerage treatment plant facility until 2010. No biodiversity issues arise in relation to the development of the subject site. |
| 2.2 Ensure local plans manage marine environments, water catchment areas and groundwater sources to avoid potential development impacts. | Consistent |
| **DIRECTION 3**: Manage natural hazards and climate change | |
| Actions | |
| 3.1 Reduce the risk from natural hazards, including the projected effects of climate change, by identifying, avoiding and managing vulnerable areas and hazards. | The subject site is prone to flooding. Fill levels will be defined to ensure that the project takes into account climate change considerations. |
| 3.2 Review and update floodplain risk, bushfire and coastal management mapping to manage risk, particularly where urban growth is being investigated. | The subject site is prone to flooding. Fill levels will be defined to ensure that the project takes into account climate change. |
| 3.3 Incorporate new knowledge on regional climate projections and related cumulative impacts in local plans for new urban development. | Consistent |
| **DIRECTION 4:** Promote renewable energy opportunities | |

| Goal / Direction / Principle | Consistency |
|---|---|
| Actions | |
| 4.1 Diversify the energy sector by identifying renewable energy resource precincts and infrastructure corridors with access to the electricity network. | Consistent |
| 4.2 Enable appropriate smaller-scale renewable energy projects using bio-waste, solar, wind, small-scale hydro, geothermal or other innovative storage technologies. | Consistent |
| 4.3 Promote appropriate smaller and community-scale renewable energy projects. | Consistent |
| GOAL 2: A THRIVING, INTERCONNECTED ECONOMY | |
| **DIRECTION 5**: Strengthen communities of interest and cross-regional relationships | |
| Actions | |
| 5.1 Collaborate on regional and intra-regional housing and employment land delivery, and industry development. | Consistent |
| 5.2 Integrate cross-border land use planning between NSW and South East Queensland, and remove barriers to economic, housing and jobs growth. | N/A |
| 5.3 Encourage ongoing cooperation and land use planning between the City of Gold Coast and Tweed Shire Council. | N/A |
| 5.4 Prepare a regional economic development strategy that drives economic growth opportunities by identifying key enabling infrastructure and other policy interventions to unlock growth. | N/A |
| **DIRECTION 6**: Develop successful centres of employment | |
| Actions | |
| 6.1 Facilitate economic activity around industry anchors such as health, education and airport facilities by considering new infrastructure needs and introducing planning controls that encourage clusters of related activity | N/A |
| 6.2 Promote knowledge industries by applying flexible planning controls, providing business park development opportunities and identifying opportunities for start-up industries. | N/A |
| 6.3 Reinforce centres through local growth management strategies and local environmental plans as primary mixed-use locations for commerce, housing, tourism, social activity and regional services. | N/A |
| 6.4 Focus retail and commercial activities in existing centres and develop place-making focused planning strategies for centres. | N/A |
| 6.5 Promote and enable an appropriate mix of land uses and prevent the encroachment of sensitive uses on employment land through local planning controls. | Consistent |
| 6.6 Deliver an adequate supply of employment land through local growth management strategies and local environmental plans to support jobs growth. | N/A |
| 6.7 Ensure employment land delivery is maintained through an annual North Coast Housing and Land Monitor. | N/A |
| **DIRECTION 7**: Coordinate the growth of regional cities | |

| Goal / Direction / Principle | Consistency |
|---|---|
| 7.1 Prepare action plans for regional cities that:<br>• ensure planning provisions promote employment growth and greater housing diversity;<br>• promote new job opportunities that complement existing employment nodes around existing education, health and airport precincts;<br>• identify infrastructure constraints and public domain improvements that can make areas more attractive for investment; and<br>• deliver infrastructure and coordinate the most appropriate staging and sequencing of development. | N/A |
| **DIRECTION 8**: Promote the growth of tourism | |
| Actions | |
| 8.1 Facilitate appropriate large-scale tourism developments in prime tourism development areas such as Tweed Heads, Tweed Coast, Ballina, Byron Bay, Coffs Harbour and Port Macquarie. | N/A |
| 8.2 Facilitate tourism and visitor accommodation and supporting land uses in coastal and rural hinterland locations through local growth management strategies and local environmental plans. | Consistent |
| 8.3 Prepare destination management plans or other tourism-focused strategies that:<br>• identify culturally appropriate Aboriginal tourism opportunities;<br>• encourage tourism development in natural areas that support conservation outcomes; and<br>• strategically plan for a growing international tourism market. | Consistent |
| 8.4 Promote opportunities to expand visitation to regionally significant nature-based tourism places, such as Ellenborough Falls, Dorrigo National Park, Wollumbin-Mount Warning National Park, Iluka Nature Reserve and Yuraygir Coastal Walk. | N/A |
| 8.5 Preserve the region's existing tourist and visitor accommodation by directing permanent residential accommodation away from tourism developments, except where it is ancillary to existing tourism developments or part of an area otherwise identified for urban expansion in an endorsed local growth management strategy. | Consistent |
| **DIRECTION 9**: Strengthen regionally significant transport corridors | |
| Actions | |
| 9.1 Enhance the competitive value of the region by encouraging business and employment activities that leverage major inter-regional transport connections, such as the Pacific Highway, to South East Queensland and the Hunter. | Consistent |
| 9.2 Identify buffer and mitigation measures to minimise the impact of development on regionally significant transport infrastructure including regional and state road network and rail corridors. | Consistent |

| Goal / Direction / Principle | Consistency |
|---|---|
| 9.3 Ensure the effective management of the State and regional road network by:<br>• preventing development directly adjoining the Pacific Highway;<br>• preventing additional direct 'at grade' access to motorway-class sections of the Pacific Highway;<br>• locating Highway Service Centres on the Pacific Highway at Chinderah, Ballina, Maclean, Woolgoolga, Nambucca Heads, Kempsey and Port Macquarie, approved by the Department of Planning and Environment and Roads and Maritime Services; and<br>• identifying strategic sites for major road freight transport facilities. | Consistent |
| **DIRECTION 10**: Facilitate air, rail and public transport infrastructure | |
| Actions | |
| 10.1 Deliver airport precinct plans for Ballina, Byron, Lismore, Coffs Harbour and Port Macquarie that capitalise on opportunities to diversify and maximise the potential of value-adding industries close to airports. | Consistent |
| 10.2 Consider airport-related employment opportunities and precincts that can capitalise on the expansion proposed around Gold Coast Airport. | N/A |
| 10.3 Protect the North Coast Rail Line and high-speed rail corridor to ensure network opportunities are not sterilised by incompatible land uses or land fragmentation. | N/A |
| 10.4 Provide public transport where the size of the urban area has the potential to generate sufficient demand. | Consistent |
| 10.5 Deliver a safe and efficient transport network to serve future release areas. | Consistent |
| **DIRECTION 11**: Protect and enhance productive agricultural lands | |
| Actions | |
| 11.1 Enable the growth of the agricultural sector by directing urban and rural residential development away from important farmland and identifying locations to support existing and small-lot primary production, such as horticulture in Coffs Harbour. | N/A |
| 11.2 Deliver a consistent management approach to important farmland across the region by updating the Northern Rivers Farmland Protection Project (2005) and Mid North Coast Farmland Mapping Project (2008). | N/A |
| 11.3 Identify and protect intensive agriculture clusters in local plans to avoid land use conflicts, particularly with residential and rural residential expansion. | N/A |
| 11.4 Encourage niche commercial, tourist and recreation activities that complement and promote a stronger agricultural sector, and build the sector's capacity to adapt to changing circumstances. | N/A |
| 11.5 Address sector-specific considerations for agricultural industries through local plans. | N/A |
| **DIRECTION 12**: Grow agribusiness across the region | |
| Actions | |

| Goal / Direction / Principle | Consistency |
|---|---|
| 12.1 Promote the expansion of food and fibre production, agrichemicals, farm machinery, wholesale and distribution, freight and logistics, and processing through flexible planning provisions in local growth management strategies and local environmental plans. | N/A |
| 12.2 Encourage the co-location of intensive primary industries, such as feedlots and compatible processing activities. | N/A |
| 12.3 Examine options for agribusiness to leverage proximity from the Gold Coast and Brisbane West Wellcamp airports. | N/A |
| 12.4 Facilitate investment in the agricultural supply chain by protecting assets, including freight and logistics facilities, from land use conflicts arising from the encroachment of incompatible land uses. | N/A |
| **DIRECTION 13**: Sustainably manage natural resources | |
| Actions | |
| 13.1 Enable the development of the region's natural, mineral and forestry resources by directing to suitable locations land uses such as residential development that are sensitive to impacts from noise, dust and light interference. | N/A |
| 13.2 Plan for the ongoing productive use of lands with regionally significant construction material resources in locations with established infrastructure and resource accessibility. | N/A |
| GOAL 3: VIBRANT AND ENGAGED COMMUNITIES | |
| **DIRECTION 14**: Provide great places to live and work | |
| Actions | |
| 14.1 Prepare precinct plans in growth areas, such as Kingscliff, or centres bypassed by the Pacific Highway, such as Woodburn and Grafton, to guide development and establish appropriate land use zoning, development standards and developer contributions. | N/A |
| 14.2 Deliver precinct plans that are consistent with the Precinct Plan Guidelines (Appendix C). | N/A |
| **DIRECTION 15**: Develop healthy, safe, socially engaged and well-connected communities | |
| Actions | |
| 15.1 Deliver best-practice guidelines for planning, designing and developing healthy built environments that respond to the ageing demographic and subtropical climate. | Consistent |
| 15.2 Facilitate more recreational walking and cycling paths and expand interregional and intra-regional walking and cycling links, including the NSW Coastline Cycleway. | Consistent |
| 15.3 Implement actions and invest in boating infrastructure priorities identified in regional boating plans to improve boating safety, boat storage and waterway access. | N/A |

| Goal / Direction / Principle | Consistency |
|---|---|
| 15.4 Create socially inclusive communities by establishing social infrastructure benchmarks, minimum standards and social impact assessment frameworks within local planning. | Consistent |
| 15.5 Deliver crime prevention through environmental design outcomes through urban design processes. | Consistent |
| **DIRECTION 16**: Collaborate and partner with Aboriginal communities | |
| Actions | |
| 16.1 Develop partnerships with Aboriginal communities to facilitate engagement during the planning process, including the development of engagement protocols. | Consistent |
| 16.2 Ensure Aboriginal communities are engaged throughout the preparation of local growth management strategies and local environmental plans. | Consistent |
| **DIRECTION 17**: Increase the economic self-determination of Aboriginal communities | |
| Actions | |
| 17.1 Deliver opportunities to increase the economic independence of Aboriginal communities through training, employment and tourism. | N/A |
| 17.2 Foster closer cooperation with Local Aboriginal Land Councils to identify the unique potential and assets of the North Coast communities. | Consistent |
| 17.3 Identify priority sites with economic development potential that Local Aboriginal Land Councils may wish to consider for further investigation. | Consistent |
| **DIRECTION 18**: Respect and protect the North Coast's Aboriginal heritage | |
| Actions | |
| 18.1 Ensure Aboriginal objects and places are protected, managed and respected in accordance with legislative requirements and the wishes of local Aboriginal communities. | Consistent |
| 18.2 Undertake Aboriginal cultural heritage assessments to inform the design of planning and development proposals so that impacts to Aboriginal cultural heritage are minimised and appropriate heritage management mechanisms are identified. | Consistent |
| 18.3 Develop local heritage studies in consultation with the local Aboriginal community, and adopt appropriate measures in planning strategies and local plans to protect Aboriginal heritage. | Consistent |
| 18.4 Prepare maps to identify sites of Aboriginal heritage in 'investigation' areas, where culturally appropriate, to inform planning strategies and local plans to protect Aboriginal heritage. | Consistent |
| **DIRECTION 19**: Protect historic heritage | |
| Actions | |
| 19.1 Ensure best-practice guidelines are considered such as the Australia International Council on Monuments and Sites (ICOMOS) Charter for Places of | N/A |

| Goal / Direction / Principle | Consistency |
|---|---|
| Cultural Significance and the NSW Heritage Manual when assessing heritage significance. | |
| 19.2 Prepare, review and update heritage studies in consultation with the wider community to identify and protect historic heritage items, and include appropriate local planning controls. | N/A |
| 19.3 Deliver the adaptive or sympathetic use of heritage items and assets. | N/A |
| **DIRECTION 20**: Maintain the region's distinctive built character | |
| Actions | |
| 20.1 Deliver new high-quality development that protects the distinct character of the North Coast, consistent with the North Coast Urban Design Guidelines (2009). | Consistent |
| 20.2 Review the North Coast Urban Design Guidelines (2009). | N/A |
| **DIRECTION 21**: Coordinate local infrastructure delivery | |
| Actions | |
| 21.1 Undertake detailed infrastructure service planning to support proposals for new major release areas. | N/A |
| 21.2 Maximise the cost-effective and efficient use of infrastructure by directing development towards existing infrastructure or promoting the co-location of new infrastructure. | N/A |
| GOAL 4: GREAT HOUSING CHOICE AND LIFESTYLE OPTIONS | |
| **DIRECTION 22**: Deliver greater housing supply | |
| Actions | |
| 22.1 Deliver an appropriate supply of residential land within local growth management strategies and local plans to meet the region's projected housing needs. | N/A |
| 22.2 Facilitate housing and accommodation options for temporary residents by:<br>• preparing planning guidelines for seasonal and itinerant workers accommodation to inform the location and design of future facilities; and<br>• working with councils to consider opportunities to permit such facilities through local environmental plans. | N/A |
| 22.3 Monitor the supply of residential land and housing through the North Coast Housing and Land Monitor. | N/A |
| **DIRECTION 23**: Increase housing diversity and choice | |
| Actions | |
| 23.1 Encourage housing diversity by delivering 40 per cent of new housing in the form of dual occupancies, apartments, townhouses, villas or dwellings on lots less than 400 square metres, by 2036. | N/A |
| 23.2 Develop local growth management strategies to respond to changing housing needs, including household and demographic changes, and support initiatives to increase ageing in place. | Consistent |

| Goal / Direction / Principle | Consistency |
|---|---|
| **DIRECTION 24**: Deliver well-planned rural residential housing areas | |
| Actions | |
| 24.1 Facilitate the delivery of well-planned rural residential housing areas by:<br>• identifying new rural residential areas in a local growth management strategy or rural residential land release strategy endorsed by the Department of Planning and Environment; and<br>• ensure that such proposals are consistent with the Settlement Planning Guidelines: Mid and Far North Coast Regional Strategies (2007) or land release criteria (once finalised). | N/A |
| 24.2 Enable sustainable use of the region's sensitive coastal strip by ensuring new rural residential areas are located outside the coastal strip, unless already identified in a local growth management strategy or rural residential land release strategy endorsed by the Department of Planning and Environment. | N/A |
| **DIRECTION 25**: Deliver more opportunities for affordable housing | |
| Actions | |
| 25.1 Deliver more opportunities for affordable housing by incorporating policies and tools into local growth management strategies and local planning controls that will enable a greater variety of housing types and incentivise private investment in affordable housing. | N/A |
| 25.2 Prepare guidelines for local housing strategies that will provide guidance on planning for local affordable housing needs. | N/A |

Community Strategic Plan

Council has published a Community Strategic Plan. That Plan covers the period to 2027. Set out below in **Table 6.2** are the key goals of that Plan. Concise comments in relation to the relationship between the Planning Proposal and Council's Community Strategy are set out in the left-hand column in **Table 6.2**.

**TABLE 6.2 COMMUNITY STRATEGIC PLAN 2027**

| **Society** | |
|---|---|
| **Community Outcome 1.1: To have proud and inviting communities that:** | |
| ***Community Strategies*** | |
| 1.1.1 Encourage vibrant and welcoming towns and villages | Consistent - it is proposed that the architectural design of the new Maclean Highway Service Centre will provide an encouraging and welcoming character to Maclean township. |
| 1.1.2 Respect the heritage of the region by highlighting and enhancing our unique characteristics | The cultural and heritage characteristics of Maclean will be respected in the architectural plans prepared for development application purposes. |
| 1.1.3 Support, encourage and celebrate community participation, community organisations and volunteerism | N/A |

| | |
|---|---|
| 1.1.4 Encourage greater awareness of our earliest communities and inhabitants, in partnership with local Aboriginal and Torres Strait Islander communities | Consistent |
| **Community Outcome 1.2: To have a safe, active and healthy region that:** | |
| ***Community Strategies*** | |
| 1.2.1 Provides, maintains and develops sport and recreation facilities and encourages greater utilisation and participation | N/A |
| 1.2.2 Improves outcomes for the Clarence Valley through partnerships with key agencies and community organisations | N/A |
| 1.2.3 Provides effective regulation of environmental legislation | Consistent |
| 1.2.4 With our partners, promotes community safety | Consistent |
| **Community Outcome 1.3: To have a diverse and creative culture that:** | |
| ***Community Strategies*** | |
| 1.3.1 Supports arts, learning, cultural services and festivals | Consistent |
| 1.3.2 Supports a diverse and rich local Aboriginal and Torres Strait Islander culture | Consistent |
| **Community Outcome 1.4: To have access and equity of services that:** | |
| ***Community Strategies*** | |
| 1.4.1 Provides quality community care, ageing and disability services | N/A |
| 1.4.2 Encourages the supply of affordable and appropriate housing | N/A |
| 1.4.3 Fosters an inclusive and equitable community | N/A |
| 1.4.4 Provides required public transport infrastructure and work with key partners to support the provision of cost effective public transport | Consistent |
| **Infrastructure** | |
| **Community Outcome 2.1 To have communities that are well serviced with appropriate infrastructure. In order to do this we will:** | |
| ***Community Strategies*** | |
| 2.1.1 Maintain and renew water and sewer networks | The proponent will provide for the extension of water & sewerage networks to meet the needs of the proposed Highway Service Centre. |
| 2.1.2 Ensure adequate natural disaster management | Consistent |
| 2.1.3 Provide strategic asset management planning | Consistent |
| 2.1.4 Manage and enhance our parks, open spaces and facilities | N/A |

| | | |
|---|---|---|
| 2.1.5 | Provide safe and effective vehicular and pedestrian networks that balance asset conditions with available resources. | N/A |
| **Economy** | | |
| Community Outcome 3.1 To have an attractive and diverse environment for business, tourism and industry that: | | |
| ***Community Strategies*** | | |
| 3.1.1 | Promotes the Clarence region as a wonderful place to invest, live, work, and visit | Consistent |
| 3.1.2 | Grows the Clarence Valley economy through supporting local business and industry | Consistent |
| 3.1.3 | Provides land use planning that facilitates and balances economic growth, environmental protection and social equity | Consistent |
| 3.1.4 | With our partners, encourages the development of a skilled and flexible workforce to match the requirements of business and industry | Consistent |
| 3.1.5 | Attracts and grows events that contribute to the economy with a focus on high participatory events | N/A |
| 3.1.6 | Develops initiatives capitalising on Clarence Valley's competitive advantages | Consistent |
| **Environment** | | |
| **Community Outcome 4.1 To preserve and enhance our natural environment by:** | | |
| ***Community Strategies*** | | |
| 4.1.1 | Managing our coastal zone, waterways, catchments and floodplains in an ecologically sustainable manner | Consistent |
| 4.1.2 | Promoting sustainable natural resource management | Consistent |
| **Community Outcome 4.2 To foster a balance between development and the environment considering climate change impacts as we:** | | |
| ***Community Strategies*** | | |
| 4.2.1 | Promote, plan and implement strategies that reduce carbon emissions, improve energy efficiencies and increase the use of renewable energy | Consistent |
| 4.2.2 | Plan, resource and respond to natural hazards and disasters taking into account impacts from climate change | Consistent |
| 4.2.3 | Provide efficient and effective solid waste management services that prioritises resource recovery and minimises environmental impacts | Consistent |
| 4.2.4 | With our partners, promote and encourage sustainable and innovative agricultural practices | Consistent |

| | |
|---|---|
| 4.2.5 Educate the community, business and industry about sustainable practices in the home, at work and in public places | N/A |
| **Leadership** | |
| **Community Outcome 1.5 To have a strong, accountable and representative government that:** | |
| ***Community Strategies*** | |
| 5.1.1 Develops a clear plan for the community through integrated planning and reporting | N/A |
| 5.1.2 Creates awareness of Council's roles, responsibilities and services | N/A |
| 5.1.3 Engages with the community to inform decision making | N/A |
| 5.1.4 Ensures transparent accountable decision making for our community | N/A |
| 5.1.5 Represents our community at regional, state and federal levels | N/A |
| 5.1.6 Ensures decisions reflect the long-term interests of the community and support financial and infrastructural sustainability | N/A |
| 5.1.7 Undertakes the civic duties of Council in an ethical manner | N/A |
| 5.1.8 Ensures good governance, effective risk management and statutory compliance | N/A |
| **Objective 5.2 To have an effective and efficient organisation that:** | |
| ***Community Strategies*** | |
| 5.2.1 Operates in a financially responsible and sustainable manner | N/A |
| 5.2.2 Makes Council a preferred employer | N/A |
| 5.2.3 Fosters an organisational culture focused on customer service excellence, innovation and continuous improvement | N/A |
| 5.2.4 Ensures a safe and healthy work environment | Consistent |
| 5.2.5 Manages and value our corporate information and knowledge | Consistent |

## 6.2 Consistency with State Environmental Planning Policies

An assessment of the Planning Proposal against applicable State Environmental Planning Policies (SEPPs) is provided in **Table 6.3** below.

**Table 6.3 Consistency with relevant SEPPs**

| State Environmental Planning Policies (SEPPs) | Consistent | | N/A | Comment |
|---|---|---|---|---|
| | YES | NO | | |
| SEPP Affordable Rental Housing | | | ✓ | |
| SEPP Building Sustainability Index (BASIX) 2004 | | | ✓ | |
| SEPP Coastal Management 2018 | ✓ | | | Part of the subject site is located within the "Coastal Environmental Area" mapped pursuant to the CM SEPP. The proposal will be carried out in accordance with the provisions of Clause 13 of the CM SEPP. |
| SEPP Concurrences 2018 | ✓ | | | |
| SEPP Educational Establishments and Child Care Facilities 2017 | | | ✓ | |
| SEPP Exempt and Complying Development Codes 2008 | ✓ | | | |
| SEPP Housing for Seniors or People with a Disability 2004 | | | ✓ | |
| SEPP Infrastructure 2007 | ✓ | | | The proposal will require, at DA stage, referral pursuant to the infrastructure. |
| SEPP Mining, Petroleum Production and Extractive Industries 2007 | ✓ | | | |
| SEPP Miscellaneous Consent Provisions 2007 | | ✓ | | |
| SEPP Primary Production and Rural Development 2019 | ✓ | | | |
| SEPP No 21 – Caravan Parks | | | ✓ | |
| SEPP No 33 – Hazardous and Offensive Development | ✓ | | | |
| SEPP No 36 – Manufactured Home Estates | | | ✓ | |
| SEPP Koala Habitat Protection 2019. | ✓ | | | The land is partially mapped under the SEPP. This aspect will be the subject of detailed analysis and development application assessment stage. |
| SEPP No 50 – Canal Estate Development | | | ✓ | |

| State Environmental Planning Policies (SEPPs) | Consistent | | N/A | Comment |
|---|---|---|---|---|
| | YES | NO | | |
| SEPP No – Remediation of Land | ✓ | | | The site is the subject of a contamination verification certificate. See **Volume 3** in the Bundle of Technical Reports. |
| SEPP No 64 – Advertising and Signage | ✓ | | | |
| SEPP No 65 – Design Quality of Residential Apartment Development | | | ✓ | |

### 6.2.1 Consistency with applicable Ministerial Directions

A summary assessment of the Planning Proposal against the Directions issued by the Minister for Planning under Section 3.33 of the EP&A Act is provided in **Table 6.4** below.

**Table 6.4 Assessment against Section 117 Directions**

| Ministerial Directions | Consistent | | N/A | Comment |
|---|---|---|---|---|
| | YES | NO | | |
| **1. Employment and Resources** | | | | |
| 1.1 Business and Industrial Zones | | | ✓ | N/A |
| 1.2 Rural Zones | | | ✓ | N/A |
| 1.3 Mining, Petroleum Production and Extractive Industries | | | ✓ | N/A |
| 1.4 Oyster Aquaculture | | | ✓ | N/A |
| 1.5 Rural Lands | | | ✓ | N/A |
| **2. Environment and Heritage** | | | | |
| 2.1 Environment Protection Zones | ✓ | | | There are no characteristics of the site which warrant the application of Environmental Protection Zones. |
| 2.2 Coastal Protection | ✓ | | | The western part of the site is mapped pursuant to the Coastal Management SEPP. |
| 2.3 Heritage Conservation | ✓ | | | There are no heritage items defined at the site. |
| 2.4 Recreation Vehicle Areas | | | ✓ | N/A |
| 2.5 Applications of E2 and E3 zonings and environmental overlays in Far North Coast LEP's | | | ✓ | No E zonings are applicable to the subject site. |
| **3. Housing, Infrastructure and Urban Development** | | | | |
| 3.1 Residential Zones | | | ✓ | N/A |
| 3.2 Caravan Parks and Manufactured Home Estates | | | ✓ | N/A |
| 3.3 Home Occupations | | | ✓ | N/A |
| 3.4 Integrating Land Use and Transport | | | ✓ | N/A |

| Ministerial Directions | Consistent | | N/A | Comment |
|---|---|---|---|---|
| | YES | NO | | |
| 3.5 Development Near Regulated Airports and Defense Airfields | | | ✓ | N/A |
| 3.6 Shooting Ranges | | | ✓ | N/A |
| 3.7 Reduction in non-hosted short term rental accommodation period | | | ✓ | N/A |
| **4. Hazard and Risk** | | | | |
| 4.1 Acid Sulfate Soils | ✓ | | | Given the depth of filling proposed, Acid Sulfate Soil management at the subject site, Is not considered to be a Planning Proposal level of detail issue. |
| 4.2 Mine Subsidence and Unstable Land | | | ✓ | N/A |
| 4.3 Flood Prone Land | ✓ | | | |
| 4.4 Planning for Bushfire Protection | ✓ | | | |
| **5. Regional Planning** | | | | |
| 5.1 Implementation of Regional Strategies | ✓ | | | |
| 5.2 Sydney Drinking Water Catchments | | | ✓ | N/A |
| 5.3 Farmland of State and Regional Significance on the NSW Far North Coast | | | ✓ | N/A |
| 5.4 Commercial and Retail Development along the Pacific Highway, North Coast | ✓ | | | The subject site is consistent with the specifications set out in Ministerial Direction 5.4 in relation to a site adjacent to the interchange on the southern outskirts of Maclean. |
| 5.8 Second Sydney Airport: Badgerys Creek | | | ✓ | N/A |
| 5.9 North West Rail Link Corridor Strategy | | | ✓ | N/A<br>This Direction does not apply to the Clarence Valley Council area. |
| 5.10 Implementation of Regional Plans | ✓ | | | The applicable regional plan is the North Coast Regional Plan 2036. Refer to **Table 6.1** for analysis in terms of consistency with the Regional Plan. |
| 5.11 Development of Aboriginal Land Council land | | | ✓ | |
| **6. Local Plan Making** | | | | |
| 6.1 Approval and Referral Requirements | ✓ | | | General arrangements with respect to development |

| Ministerial Directions | Consistent | | N/A | Comment |
|---|---|---|---|---|
| | YES | NO | | |
| | | | | approval are embodied in the amendments proposed. |
| 6.2 Reserving Land for Public Purposes | | | ✓ | N/A |
| 6.3 Site Specific Provisions | | | ✓ | N/A |
| **7. Metropolitan Planning** | | | | |
| 7.1 Implementation of the Metropolitan Plan for Sydney 2036 | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.2 Implementation of Greater Macarthur Land Release Investigation | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.3 Parramatta Road Corridor Urban Transformation Strategy | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.4 Implementation of North West Priority Growth Area Land Use and Infrastructure Implementation Plan | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.5 Implementation of Greater Parramatta Priority Growth Area Interim Land Use and Infrastructure Implementation Plan | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.8 Implementation of Western Sydney Aerotropolis Interim Land Use and Infrastructure Implementation Plan | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.9 Implementation of Bayside West Precincts 2036 Plan | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |
| 7.10 Implementation of Planning Principles for the Cooks Cove Precinct | | | ✓ | This Direction does not apply to the Clarence Valley Council area. |

## 6.3 Commonwealth Interests

There are no Federal government interests relevant in this subject's circumstances.

## 6.4 Community Consultation

No site specific community consultation has been carried out by Hargreaves Property Group in relation to this Planning Proposal at this time. However, the concept of locating a Highway Service Centre at the southern interchange of Maclean township has been the subject of published strategic planning reports over two decades. Site specific consultation will occur with the local community and wider shire community as the Planning Proposal progresses.

# 7 CONCLUSION

*This section sets out brief concluding remarks in relation to the merits of the planning proposal to facilitate the establishment of a Highway Service Centre at the southern side of Maclean.*

This Planning Proposal seeks a site-specific planning instrument amendment to amend the zoning of CVEP11 via an additional Item to Schedule 1.

In our opinion, there is a legitimate need for a Highway Service Centre at Maclean and the subject site is capable of development and use in a manner which mitigates potential adverse impacts consistent with:

- Good town planning practice and the constraints applying to the property;
- Provide in relevant departmental publications;
- Section 117 Directions issued by the Minister for Planning;
- The North Coast Regional Plan 2036;
- Various relevant State Environmental Planning Policies; and
- The Community Strategic Plan published by Clarence Valley Council.

Stephen Connelly RPIA (Fellow)
Partnership Principal
**PLANNERS NORTH**

•

## REFERENCES

CVC. (2011). *Clarence Valley Council Local Environmental Plan 2011,* Clarence Valley Council.

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DUAP & RTA. (1988.) *Planning Policy on Commercial/Retail Development Along the Pacific Highway from the Queensland Border to Hexham.* Department of Urban Affairs and Planning & Roads and Traffic Authority of NSW.

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# ANNEXURE A

Planning Proposal application form

Print

clarence VALLEY COUNCIL

**Contact Details:**
Postal Address: Locked Bag 23,
GRAFTON NSW 2460
Telephone: (02) 6643 0200
Email: council@clarence.nsw.gov.au

**Office Locations:**
2 Prince Street, Grafton
50 River Street, Maclean

# Request to support/prepare a Planning Proposal

| | |
|---|---|
| Application No: REZ | Fee $5,000.00 (2020/21) |
| Date Lodged: | Receipt: |

*Note - this form is used to request Council to support a planning proposal to amend Clarence Valley Local Environmental Plan 2011 (CVLEP 2011) or rezone land; * Pre Gateway Assessment - Initial Application fee*

## 1. Applicant details

| Surname/s or Company name | Given name/s | |
|---|---|---|
| Hargreaves Property Group | | |
| **Postal address** | | |
| c/o PLANNERS NORTH, PO Box 538 | | |
| **Suburb/town/locality** | **State** | **Post Code** |
| Lennox Head | NSW | 2478 |
| **Telephone no. (bus hours)** | **Email address** | |
| 1300 66 00 87 | steve@plannersnorth.com.au | |
| **Applicant/s signature** | | **Date** |
| SJ CONNELLY, TOWN PLANNER FOR THE APPLICANT | | 3/7/20 |

## 2. Owners details and consent

| Owners surname (all owners); Company name if owned by company | Given name/s |
|---|---|
| Corbett Haulage Pty Ltd | |
| Telephone no.s | |
| Signature of all owners (If the owner of the property is a company, the company seal or proof of authority to sign must be provided) | Date |
| An authority from the land owner to lodge this application is attached. | |

## 3. Land/property detail

| Lot No./s | Section No./s | Deposited Plan/Strata Plan No.s |
|---|---|---|
| Lot 2 | | DP 634170 |
| **Address** | | |
| 2 Schwonberg Street, | | |
| **Suburb/town/locality** | **State** | **Post Code** |
| Townsend | NSW | 2463 |

## 4. Details of Request/Proposal

Council is requested to amend CVLEP 2011 as follows:

| | |
|---|---|
| Rezone land to: (specify requested zone opposite) | No zoning change is sought, just an addition to LEP Schedule 1. |
| Where a change of zone is not requested, specify (opposite) how the CVLEP 2011 should be amended. | We seek an addition to Schedule 1 of the LEP to permit the the construction of a Highway Service Centre. |

| Describe briefly (below) the development that is intended as a result of amending CVLEP 2011 |
|---|
| The construction of a Highway Service Centre. |

| 5. Political donations | | | | |
|---|---|---|---|---|
| Having made enquiries, are you aware of any reportable political donation or gift made by anyone with a financial interest in this DA (including the owner) within the last 2 years? | Yes | ☐ | No | X |
| A disclosure statement of a reportable political donation or gift must accompany a development application if the reportable donation or gift was made within 2 years of the application being lodged. If the donation or gift is made after the lodgement of the application, a disclosure statement must be sent to Council within 7 days of the donation or gift being made.<br>Disclosure statement is available from Council's Customer Service Centre or may be downloaded from Council's web site at www.clarence.nsw.gov.au For further information refer to the Disclosure Statement Form. | | | | |

| 6. Applicants declaration | |
|---|---|
| I/we declare that the information given in this request is true and correct. I also understand that, if incomplete, the request may be delayed or rejected. I understand that payment of fees may not result in the desired outcome. I understand that timeframes cannot be guaranteed and may vary. | |
| Signature/s:<br>SJ CONNELLY, TOWN PLANNER FOR THE APPLICANT | Date: 3/7/20 |

| 7. Notes and instructions on submitting this request and preparing a planning proposal | | | | | |
|---|---|---|---|---|---|
| (a) List of matters to be provided with application/request | | | | | |
| ▪ draft planning proposal - three (3) double sided copies (2 bound, 1 unbound) and one (1) electronic copy on disc and supporting material. See also 7(c) below - tick opposite if provided | | | | | SUPPLIED |
| ▪ Completed application/request form - tick opposite if provided | | | | | SUPPLIED |
| (b) Pre - lodgement consultation – sections 1.3 and 1.4 *"A guide to preparing planning proposals"* | | | | | |
| Has a Pre - lodgement consultation meeting been held with Council's Strategic and Economic Planning Staff? – provide response opposite | | Yes | X | No | ☐ |
| (c) Information pertaining to preparation of planning proposals | Planning proposals submitted to Council for support are to be prepared in accordance with both Councils *"Guideline for rezoning and planning proposals"* and the current version Department of Planning and Environment's *"A guide to preparing planning proposals"*. A copy of the latter guideline can be downloaded from the Departments website by following the link below:<br><br>http://www.planning.nsw.gov.au/LocalPlanning/GatewayProcess/tabid/291/language/en-US/Default.aspx | | | | |

**Privacy Advice**

The personal information that Council has collected or is collecting from you is personal information for the purposes of the Privacy and Personal Information Protection Act 1998 (PPIPA). Council will only use this information in accordance with the PPIPA.

The supply of this information by you is voluntary. However, if you cannot provide or do not wish to provide the information sought, the Council may be limited in dealing with your application/request. Council requires this personal information from you in order to process your application.

You may make application for access or amendment to your personal information held by Council. Council will consider any such application in accordance with the PPIPA. Council is to be regarded as the agency that holds the information.

# LAND OWNER AUTHORITY

## TO WHOM IT MAY CONCERN

This is to advise that PLANNERS NORTH abn: 56 291 496 553 has been engaged by:

| | | | |
|---|---|---|---|
| Client Name: | Hargreaves Property Group | | |
| Client Address: | PO Box 123, Pennant Hills NSW 1715 | | |
| Dated: | 30/06/2020 | | |
| in respect to land described as: | | | |
| No: 2 | | Street: | Schwonberg Street |
| Locality/Suburb: | Townsend NSW 2463 | | |
| Real Property Description: | LOT/SECTION/DP Lot 2 DP634170 | | |

The owner of the abovementioned land hereby authorises PLANNERS NORTH or its agents to:

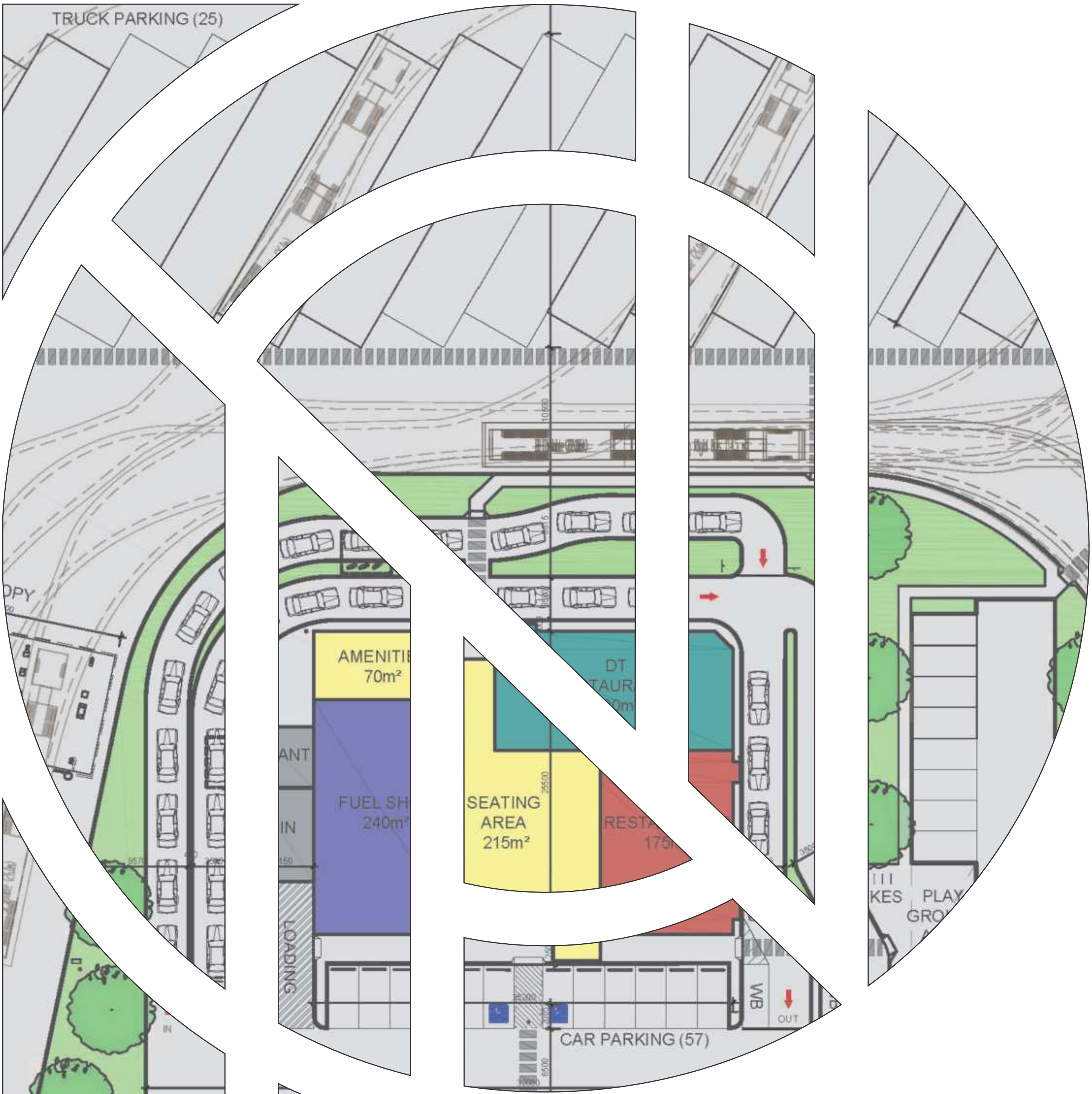
1. Inspect Records
2. Carry out searches and site inspections
3. Take Site Samples
4. Lodge applications, objections or appeals

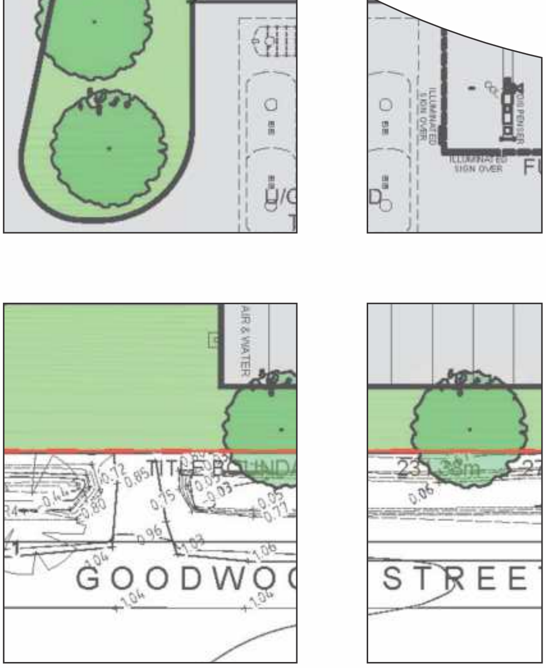
The owner confirms that no Reportable Political Donations have been made in the last 2 years by persons or companies associated with the subject land. We will immediately notify PLANNERS NORTH if the Reportable Political Donation situation changes.

| Signed: | |
|---|---|
| B. Corbett | PRINT NAME Bradley Corbett<br>POSITION (if applicable) Sole Director |
| | PRINT NAME<br>POSITION (if applicable) |
| | PRINT NAME<br>POSITION (if applicable) |

*This form needs to be completed and signed by all persons who own the subject land. If the land is owned by a company, please ensure that at least **two Directors** of that company sign the form, unless a sole director company.*

v2 review





# Planning Proposal
# Supporting Documents Bundle

## Maclean Highway Service Centre
## Lot 2 DP634170
## Schwonberg Street, Townsend

**PLANNERS NORTH**, July 2020

## SUPPORTING DOCUMENTS BUNDLE

Volume 1 Civil Engineering Assessment

Volume 2 Archaeological Assessment

Volume 3 Contamination Verification

Volume 4 Traffic & Parking Assessment

PLANNERS NORTH

*1707.3198*

# VOLUME 1

Civil Engineering Assessment

PLANNERS NORTH

*1707.3198*

# Engineering Issues Report, Proposed Maclean Highway Service Centre

For

Hargreaves Property Group Pty Ltd

July 2020

de Groot & Benson Pty Ltd

# Engineering Issues Report, Proposed Maclean Highway Service Centre

For

Hargreaves Property Group Pty Ltd

July 2020

de Groot & Benson Pty Ltd
ACN 052 300 571
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PO Box 1908
Coffs Harbour NSW 2450

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# DOCUMENT CONTROL STATUS

| Issue | Rev. | Issued To | Qty | Date | Reviewed | Approved |
|---|---|---|---|---|---|---|
| Draft | D2 | Hargreaves Property Group | PDF | 09-06-2020 | GJK | GJK |
| 2nd Draft | D2 | Hargreaves Property Group | PDF | 25-06-2020 | GJK | GJK |
| Final | - | Hargreaves Property Group | PDF | 25-06-2020 | GJK | GJK |

| | |
|---|---|
| Printed: | 1 July, 2020 12:43 PM |
| Last Saved: | 1 July 2020 12:21 PM |
| File Name: | S:\20\20033 Lot 2 Schwongberg St Townsend\WP\20033 2020-06-03 Engineering Issues Report.docx |
| Project Manager: | Graham Knight |
| Name of Organisation: | Hargreaves Property Group |
| Name of Project: | Engineering Issues Report |
| Name of Document: | Proposed Maclean Highway Service Centre |
| Job Number: | 20033 |

# 1 SUMMARY

The proposal is to develop lot 2 DP 634170 on the corner of Schwongberg and Goodwood Streets Townsend as a highway service centre comprising retail fuel, food and rest for local and highway traffic, including full facilities for trucks.

The proposed development is shown on TRG's drawing 19097 SK02 and our drawings 20033-PP01 to PP05. With respect to engineering issues raised by the proposed development:

- Adequate road access can be provided through a widening and lifting of Goodwood Street, providing direct access to the new Pacific Highway via the southern Maclean interchange;

- In the order of 80,000 cu.m of fill and pavement materials will need to be imported to the site during construction. While significant, the local road network is suitably sized for such traffic;

- The site is underlain by deep (20-30 m) "Holocene mud", being very soft alluvial soils, laid down in recent geological time with rising sea levels post recent ice ages. The proposed filling is likely to cause in the order of 2 to 3 m of consolidation. To manage such will likely require the installation of sub-soil wick drainage, preloading and additional considerations in the design of building footings, pavements and plumbing. All of which will add significant additional cost to the project.

- The filling is required to provide flood protection to the development. The buildings are proposed to be above the predicted 100-yr ARI flood level and the road access at approximately the 20-yr ARI flood level. Flood management and evacuations plans will be prepared.

- The filling has the potential to cause a small impact on the surrounding flood behaviour due to lost floodplain storage. In the absence of detailed flood modelling, the maximum impact felt locally around Townsend, and assuming no compensatory flood storage is provided, is likely to be in the order of a 6 mm rise in peak flood levels. In accordance with Clause D5.2.2 ii of Council's Business Zones DCP, this can be considered as negligible. The recent highway works may however provide the opportunity to mitigate this impact further by providing compensatory flood storage. Much of the fill required may possibly be sourced from a spoil stockpile located 1.5 km south of the site, located within the same local floodplain.

- Through a means of hydrocarbon spill capture, a bio retention basin and swale drainage, adequate stormwater management compliant with Council's DCP can be achieved;

- The provisioning of water, sewer, power and telecommunications can also be achieved. A private sewage pump station with 1.5 km of rising main along Schwongberg Street, plus possible realignment of a Ø300 mm water main along Goodwood Street will be required.

It is concluded that the engineering challenges in provisioning the development with access and services, managing its stormwater, protecting it from flooding and ensuring it does not cause flooding, are all achievable.

# 2 INTRODUCTION

This report has been prepared by de Groot and Benson P/L on engagement by Hargreaves Property Group to investigate the engineering issues associated with the proposed Maclean highway service centre located on lot 2 DP 634170 (corner of Schwongberg and Goodwood Streets Townsend). This report is to accompany a Planning Proposal to allow the development to proceed to development application.

The proposed development, as shown of TRG's drawing 19097 SK02, comprises a large retail fuel outlet (service station) with eat in and drive through eateries and extensive parking for highway trucks. The centre will have direct convenient access to the Pacific Highway, both directions, via the nearby and newly completed southern Maclean highway interchange.

This report examines the geotechnical, earthworks, flood impacts, stormwater management and utility servicing aspects of the proposal.

# 3 EARTHWORKS

To manage the flood risk, a building floor level above the 100-yr ARI flood level is proposed to manage the flood risk. The existing site is quite flat and very low lying. Surveyed levels are generally between RL 0.0 and 1.0 m AHD, being between mean sea and high tide level.

The 100-yr ARI flood level, as provided by Council's flood mapping, is approximately RL 4.2 m AHD. For the purpose of this assessment, the following levels, as shown on drawing 20033-PP02 to PP05, are proposed:

- Building floor level of RL 4.7 m AHD;
- The car service forecourt level of RL 4.35 – 4.50 m AHD;
- The truck service forecourt level of RL 3.10 – 3.20 m AHD;
- Road access from the elevated interchange at no lower than RL 3.10 m AHD (20-yr Flood Level);
- Truck parking surrounding the buildings generally grading between RL 1.20 – 2.50 m AHD.

These levels will be subject to detailed design and optimisation. But, for the scale of the proposed development, with a building floor level above the 100-yr ARI flood, they are considered a realistic estimation of what would be required.

The difference between these levels and the existing levels, including the raised and widened Goodwood Street, amounts to approximately 57,000 cu.m. The total amount of fill and pavement material that will be needed is however substantially more to take into account the anticipated consolidation of the soft underlying alluvial muds. In the order of 80,000 cu.m is likely to be required, refer to the following Geotechnical Issues section.

There is no real scope to 'win' the required fill from within the property because there is limited land remaining on the property to excavate; such excavation would likely yield fill of unsuitable quality; would create a water body; and would potentially destabilise the development and surrounding property. The only viable option will be to import the materials, equating to approximately 7,000 truck and dog loads. As discussed under Flood Impacts, the sourcing of this fill from selected areas within the flood plain is advantageous if possible. Otherwise it can be imported from wherever a commercially viable source can be found.

Access to the site will be via the new or old highways, the interchange and a reconstructed Goodwood Street. Although substantial, the construction traffic will not significantly impact traffic or pavements on these major roads.

The proposed levels includes the reconstruction of Goodwood Street along the service centre frontage to join into that recently constructed from the interchange roundabout. The reconstruction will lift the road to RL 3.20 m AHD (being the approximate 20-yr ARI flood level). This lifting will include part of the recently constructed ramp up to the interchange roundabout. This level was selected as it will provide a reasonable flood evacuation level and will allow the elevated road embankment to fit within the existing road reserve boundaries, albeit with steep batters of up to 1:2 in some locations. A higher level is possible with either a shifting of the road alignment to the north, or introduction of retaining structures where required, or permission gained from the southern neighbour to spill the road embankment toe into their property.

The raising of the road will probably also require either the lengthening of the recently constructed culverts under the ramp up to the interchange roundabout, or local retaining structures around the existing headwalls.

# 4 GEOTECHNICAL ISSUES

The proposed site is on a floodplain made up of deep soft alluvial soils. It is anticipated that the geotechnical conditions will be similar to that underlying the recent and adjacent highway interchange construction, being 20 to 30 m of "Holocene muds", which are very soft alluvial soils deposited by the river during rising sea levels since recent ice ages. The construction of the embankments for the interchange experienced up to 5 m of consolidation. Given the fill proposed, it is possible that the proposed development will generate up to 3 m or so of consolidation.

A simple consequence is that additional fill is required to compensate. To achieve the proposed 57,000 cu.m lifting of the finished surface, in the order of 80,000 cu.m of fill may be required, even more depending on any adoption of preloading.

Consolidation takes time. The construction of buildings, pavements and services over land that is actively consolidating will be subject to damage, even where appropriately designed.

A successful strategy often adopted, as was the case for the interchange, is to force and accelerate the consolidation prior to the construction of buildings, pavements and services. This can be done by installing vertical wick drains through the underlying alluvial soils and then to pre-load the site, being the placing of greater fill than needed. The extra load and reduced drainage path length of the wick drains speeds up the majority of the consolidation to perhaps a year or less, rather than decades. Once consolidation has reduced to an acceptable degree, the excess load can be reduced, slowing consolidation further and allowing the economic construction of buildings, pavements and services to proceed.

Subject to further detailed geotechnical investigation, such a strategy is expected to be required for the proposal. It will of course add considerable cost and delay to the project compared to a site founded on more favourable strata. But, as with the construction of the interchange, there is no cause to consider that is would not be successful.

# 5 FLOOD IMPACTS

## 5.1 Flood Behaviour

The proposed site is located on the Clarence River floodplain, south of Townsend and west of Gulmarrad, as shown in Figure 4.1. The existing topography across the site and much of the floodplain is very low lying and flat. The detailed survey of the property shows that the ground level across the site is around RL 0.5 m AHD. Table drains along Schwongberg and Goodwood Streets are down to RL 0.0 m AHD and generally hold water. RL 0.0 is approximately mean sea level. High tide in the river will be in the order of RL 0.5 m AHD.

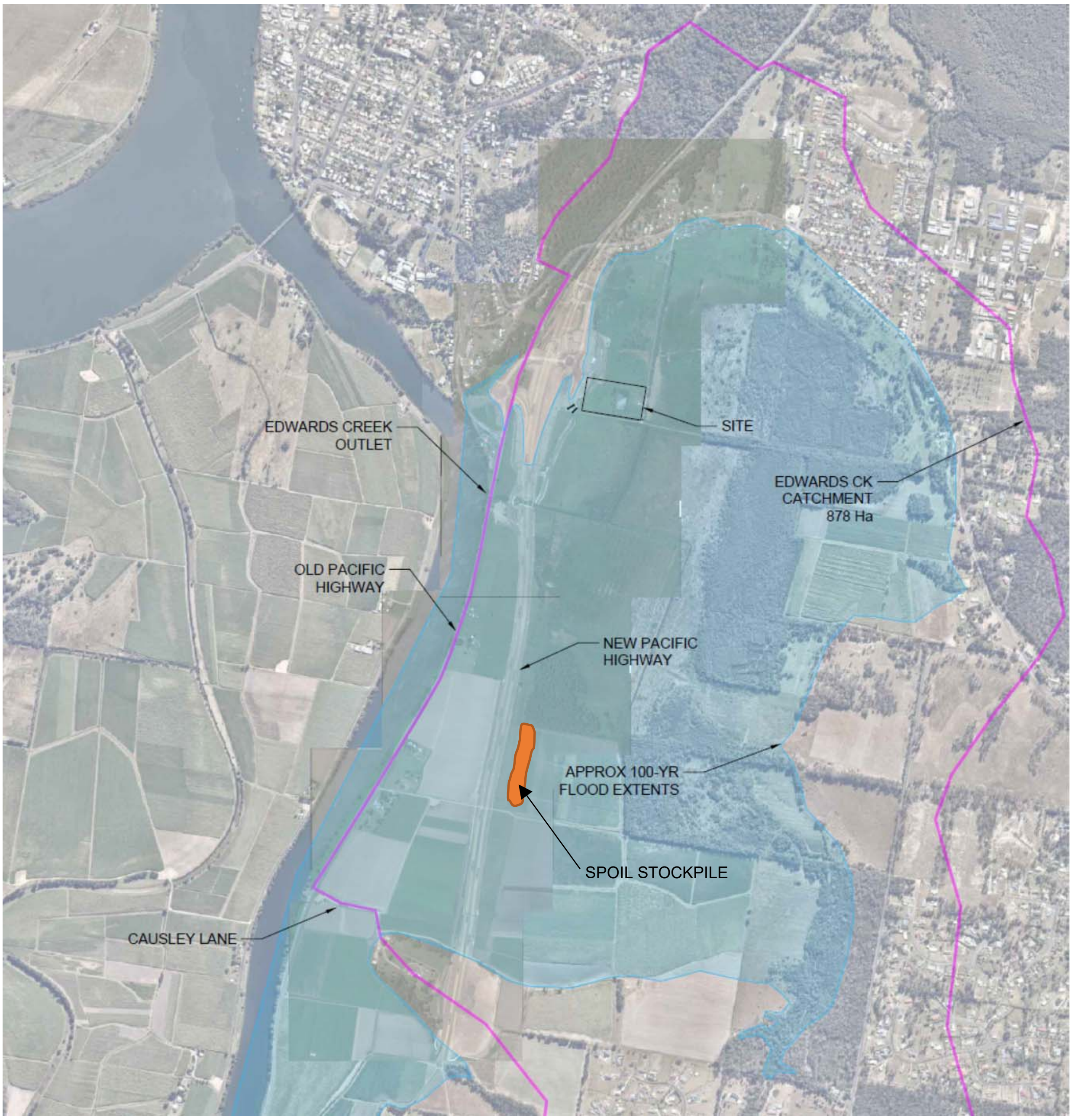



*Figure 4.1 – Townsend – Gulmarrad Floodplain*

The floodplain in this area is protected by a levee formed by the old Pacific Highway and Causley Lane, as shown in Figure 4.1. The floodplain behind the levee drains by very flat open drains to Edwards Creek, which discharges to the river via a set of flood gates where it passes under the Old Pacific Highway. It is the levee and its automatic flood gates that allows the floodplain to be as dry as it is. Without them, the floodplain would be more affected by high tides.

The levee provides some flood protection from mainstream river flooding in small events of up to around 10-yr ARI. Council's flood mapping shows no flood inundation east of the old highway in the 5-yr ARI event, but extensive inundation in the 20-yr ARI flood.

The predicted flood levels in the river opposite the site, as provided by Council's flood mapping, are approximately:

- 5-yr ARI = 2.7 m AHD (not that of the floodplain);
- 20-yr ARI = 3.1 m AHD;
- 50-yr ARI = 4.0 m AHD;
- 100-yr ARI = 4.2 m AHD;
- PMF = 6.1 m AHD.

A study of ELVIS survey data (Intergovernmental Committee on Survey and Mapping) shows that the lowest point along the old Pacific Highway is between Causley Lane and the BP service station 400 m to the north. Here the old highway is around RL 3.0 m AHD while the river flood levels will be a little higher (by about 0.05 m) than those listed above.

Council's flood mapping doesn't show the flood level across the floodplain in the 5-yr ARI event. Here the flood level will depend on the volume of inflows from the local catchment that will pond across the floodplain, unable to discharge through the flood gates because the flood level in the river is higher.

A model of the Townsend and Gulmarrad floodplain was created from ELVIS data to determine a stage-storage relationship. Note, the ELVIS data predates the newly constructed Pacific Highway. The following was calculated for a 5-yr ARI event:

- The floodplain is dry prior the event (no ponding above the ELVIS survey);
- The floodgates work and there is no backflow from the river;
- Total Edwards Creek catchment = 878 Ha;
- Assumed runoff co-efficient of 0.9 from a wet catchment;
- Runoff unable to discharge to the river for 120 hrs (5 days);
- 5-yr ARI rainfall over those 5 days = 279 mm (from latest BOM IFD data);
- Inflow = 2,200,000 cu.m (2,200 ML).
- The ponding depth across the floodplain will reach RL 1.23 m AHD.

Flood behaviour across the floodplain will generally be slow moving ponding flood water. However, in some areas at certain times, flood velocities and flows maybe quite high. In events larger than about 10-yr ARI, when the levee overtops, the flood level across the floodplain is likely to climb quite quickly from potentially quite low levels to RL 3.0 m AHD. There will be high velocities where the levee is overtopped, and then again around the openings through the new highway embankments.

The flows and velocities in and around the site will however remain relatively slow. The site can be considered to be in a flood storage area rather than a floodway or flood fringe. Filling at the site will not obstruct conveyance of flood waters.

## 5.2 DCP Requirements

The provisions of Clarence Valley Council Business Zones DCP is expected to apply. Part D and schedules D4 cover flooding.

In general, these require that the risk of flooding not threaten the viability of the development, the development not significantly adversely impact on surrounding flood behaviour, and appropriate evacuation be available.

Of interest is that commercial and industrial floor levels under schedule D4 need only be 0.5 m above the 5-yr ARI flood level. In this case, as discussed below, this equates to just RL 1.75 m AHD. Construction at such a level would be at substantial risk of deep inundation in larger events and would unlikely meet the performance criteria of D3.1(b).

To reduce the risk of damage to the development by flooding, and for the purpose of this assessment, a floor level for the proposed buildings of RL 4.70 m AHD was adopted. This being 0.5 m above the 100-yr ARI flood level.

## 5.3 Impact of Flooding on the Development

The surrounding flood behaviour is that of "flood storage", being slow moving flood water not associated with conveyance of flood flows down the river system. The proposed earthwork filling will not be subject to significant damage from flood inundation. The only caveat here is that the design of steep embankment filling should consider saturation of soils followed by rapid draw down of floodwater, which may lead to batter instability. Means to prevent this with appropriate filling materials and batter construction are relatively straight forward and economical.

It is proposed that the building floor level be set at 0.5 m above the 100-yr ARI flood level. This will reduce the risk of flood damage to the buildings and their contents to a level generally acceptable by the community and the insurance industry. It is more than what Council's DCP requires.

With the building floor level set, drawings 20033-PP02 to PP05 show conceptually how the remaining development would typically be graded. These levels have been determined to:

- Provide easy convenient and accessible paths of travel from the main car fuelling forecourt into the building. This forecourt will be above the 100-yr ARI flood level;

- Set the truck fuelling area at approximately the 20-yr ARI flood level. This level being selected as a compromise between earthwork volumes, its impact of floodplain storage and flood protection of the bowsers. It is noted that the damageable equipment in the bowsers is typically a metre or so above the ground and is relatively inexpensive to replace;

- Provide a safe vehicular evacuation level at the 20-yr ARI flood level, as discussed further in the next section;

- Provide car and truck parking pavements that can be adequately drained (refer to the Stormwater Management section). These pavements typically lie between the 5-yr ARI and 20-yr ARI flood levels. The pavements themselves, if designed appropriately, will be at little risk of damage from flood inundation. The vehicles on them can be easily evacuated given the slow rise of flood waters.

It is noted that the fuel tanks will be underground and below flood levels. With vent pipes appropriately set, modern fuel tanks, pumps and plumbing are fully contained and not subject to damage or leakage when their area is inundated by flood waters and their surrounding soils become saturated. The tanks are design to resist buoyant uplift forces.

With consideration to flood inundation during the design of embankments and pavements, the proposed development can have an acceptably low risk of flood damage – within that normally accepted by approval agencies and the insurance and development industries.

With respect to the DCP schedule D4, the requirements for Floor and Pad Levels, Building Components and Structural Soundness can all be comfortably met.

Nevertheless, the risk cannot be entirely removed as floods greater than the 100-yr ARI flood can happen. The currently predicted probable maximum flood is RL 6.10 m AHD, some 1.4 m above the proposed floor level. The risk of such a flood is however essentially zero. A flood of perhaps 200 to 500- yr ARI will potentially see shallow flood water enter the building. With current predicted climate change, this ARI will reduce. In fifty years time, the suggested life span of the development, a 100-yr ARI flood may cause shallow floor level inundation.

## 5.4 Flood Evacuation

The proposed development includes a vehicular access, via a raised Goodwood Street at the 20-yr ARI flood level (3.1 m AHD). This allows access to the higher and newly constructed highway interchange roundabout. The new highway itself is above the 100-yr ARI flood level to the north. The levels of the new highway to the south are unknown, but is expected to be above the 20-yr ARI flood and probably around the 100-yr ARI level.

The raising of Goodwood Street to the 20-yr ARI flood level was selected as a compromise between excessive engineering to raise higher and the adequate warning time available to evacuate, plus the inconvenience of such evacuation.

It is expected that raising the road to the 20-yr ARI flood level can be achieved with a conventional battered embankment within the existing road reserve and possibly without the need to lengthen the existing culverts, subject to detailed investigation. Raising the road higher is likely to need either retaining structures, realignment of the road, culvert extensions and/or negotiations with the southern neighbour to allow filling on their property, if not the acquisition of greater road reserve.

The location of the development on the lower Clarence does offer substantial warning time to allow for flood evacuations (potentially 1 to 2 days). With an appropriate evacuation plan in place, the development should have ample time to evacuate people and vehicles out of harm's way.

However, any level lower than that proposed is not recommended. The local floodplain is protected by a levee formed by the old highway and Causley Lane, as discussed previously. Flood waters will initially rise very slowly. But when the levee is overtopped in an event larger than about 10-yr ARI, flood waters may rise quickly until they equalise with the river level. This would still take several hours and is likely to be further slowed by the recent highway construction. Council's flood animation clearly shows this effect. It is considered prudent to have the evacuation route slightly above the levee level so that the possible rapid flood level rise doesn't cut the evacuation route.

With the evacuation route at the proposed level, compliance with the DCP schedule D4 and evacuation requirements 3 and 6 are considered achievable.

## 5.5 Impact of the Development on Flooding

The proposed development will place some 57,000 cu.m of fill in the floodplain. This will potentially have an impact on flooding, by two mechanisms – obstruction and loss of floodplain storage. In the proposed location, away from the river and protected by both the old and new highways, the filling will offer no obstruction to mainstream river flood conveyance. Nor should it obstruct smaller local flows draining to Edwards Creek. Purely by inspection of the topography, an experienced flood engineer will conclude that the development will not cause flood obstruction.

However, the development does lie in a part of the floodplain that can be considered as flood storage. The filling, unless compensated for, will reduce floodplain storage. Detailed flood modelling is needed to fully estimate the extent and range of impact. Such modelling is beyond the scope of this assessment. Rather, some calculations have been undertaken to estimate the likely scale of the impact.

Estimating the impact in small events where the river does not overtop the levee can be reliably calculated purely by stage-storage volumes as shown in Figure 4.2.

The calculation finds that in the 5-yr ARI event, the loss of floodplain storage would be approximately 20,600 cu.m and would cause a 6 mm rise in ponding water levels behind the levee.

The same calculation can be undertaken for larger events where the levee is overtopped, but will yield higher results than reality. The calculation estimates an 11 and 12 mm increase in flood levels for the 20-yr and 100-yr ARI events.

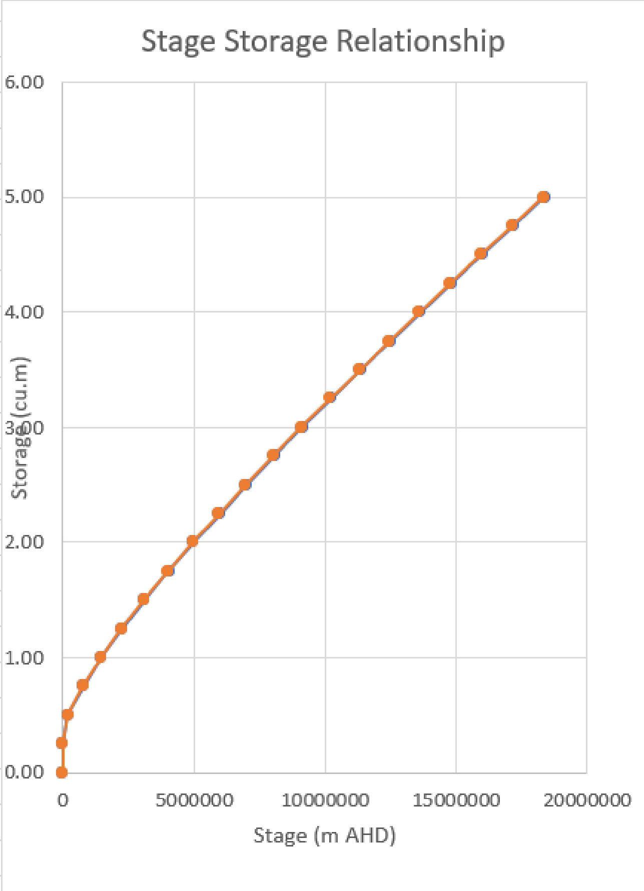
However, the overtopping of the levee complicates matters. Rather than the displaced volume causing an increase in flood water confined just to the Townsend – Gulmarrad floodplain, it will be spread out far wider and be less. By inspection of the 100-yr ARI flood mapping in Figure 4.3, the increase would be spread across the full width of the flood plain on boths sides of the river and across the river itself. This would see an approximate doubling of the area and halving of the impact upstream of Maclean. This increase would ever so slightly increase the flood surface gradient, pushing slightly more floodwater through the choke past Maclean where it would the spread out even further.

By judgement alone, based on decades of flood modelling experience, and assuming that the new highway is not a major hydraulic restriction, the flood impact in events of 20-yr ARI and greater, should only be in the order of 5 mm locally around Townsend and diminish downstream to perhaps 2 mm or so opposite Maclean. Such an impact can be considered as insignificant.

**Townsend/Gulmarrad Floodplain Storage**

Floodplain stoage calaculation for the floodplain east of the old Pacific Highway and north of Causley Lane, being the floodplain protected by a levee. The calculation excludes the recently constructed new highway.

| Stage (m AHD) | Existing Storage (cu.m) | Proposed Storage (cu.m) | Loss (cu.m) |
|---|---|---|---|
| 0.00 | 6 | 3 | 3 |
| 0.25 | 2942 | 2854 | 88 |
| 0.50 | 201061 | 198665 | 2396 |
| 0.75 | 778526 | 770691 | 7835 |
| 1.00 | 1477694 | 1463636 | 14058 |
| 1.25 | 2265454 | 2244821 | 20633 |
| 1.50 | 3121923 | 3094968 | 26955 |
| 1.75 | 4037045 | 4004581 | 32464 |
| 2.00 | 4994611 | 4957720 | 36891 |
| 2.25 | 5985392 | 5944848 | 40544 |
| 2.50 | 7008367 | 6964656 | 43711 |
| 2.75 | 8058674 | 8012064 | 46610 |
| 3.00 | 9134712 | 9085441 | 49271 |
| 3.25 | 10237390 | 10186038 | 51352 |
| 3.50 | 11363931 | 11311040 | 52891 |
| 3.75 | 12506583 | 12452409 | 54174 |
| 4.00 | 13662348 | 13607133 | 55215 |
| 4.25 | 14830654 | 14774596 | 56058 |
| 4.50 | 16010144 | 15953461 | 56683 |
| 4.75 | 17198733 | 17141757 | 56976 |
| 5.00 | 18394128 | 18337153 | 56975 |




Catchment area behind the levee: 8777032 sq.m

For an inflow volume of:

| ARI | Hours | Rainfall | Runoff (%) | Volume (cu.m) | Existing Depth (m AHD) | Proposed Depth (m AHD) | Impact (mm) |
|---|---|---|---|---|---|---|---|
| 5 | 120 | 279 | 90% | 2203913 | 1.230 | 1.237 | 6 |
| 20 | | | | 9575000 | 3.100 | 3.111 | 11 |
| 100 | | | | 14595000 | 4.200 | 4.212 | 12 |

*Figure 4.2 – Floodplain Stage – Storage Relationship and Flood Impact*

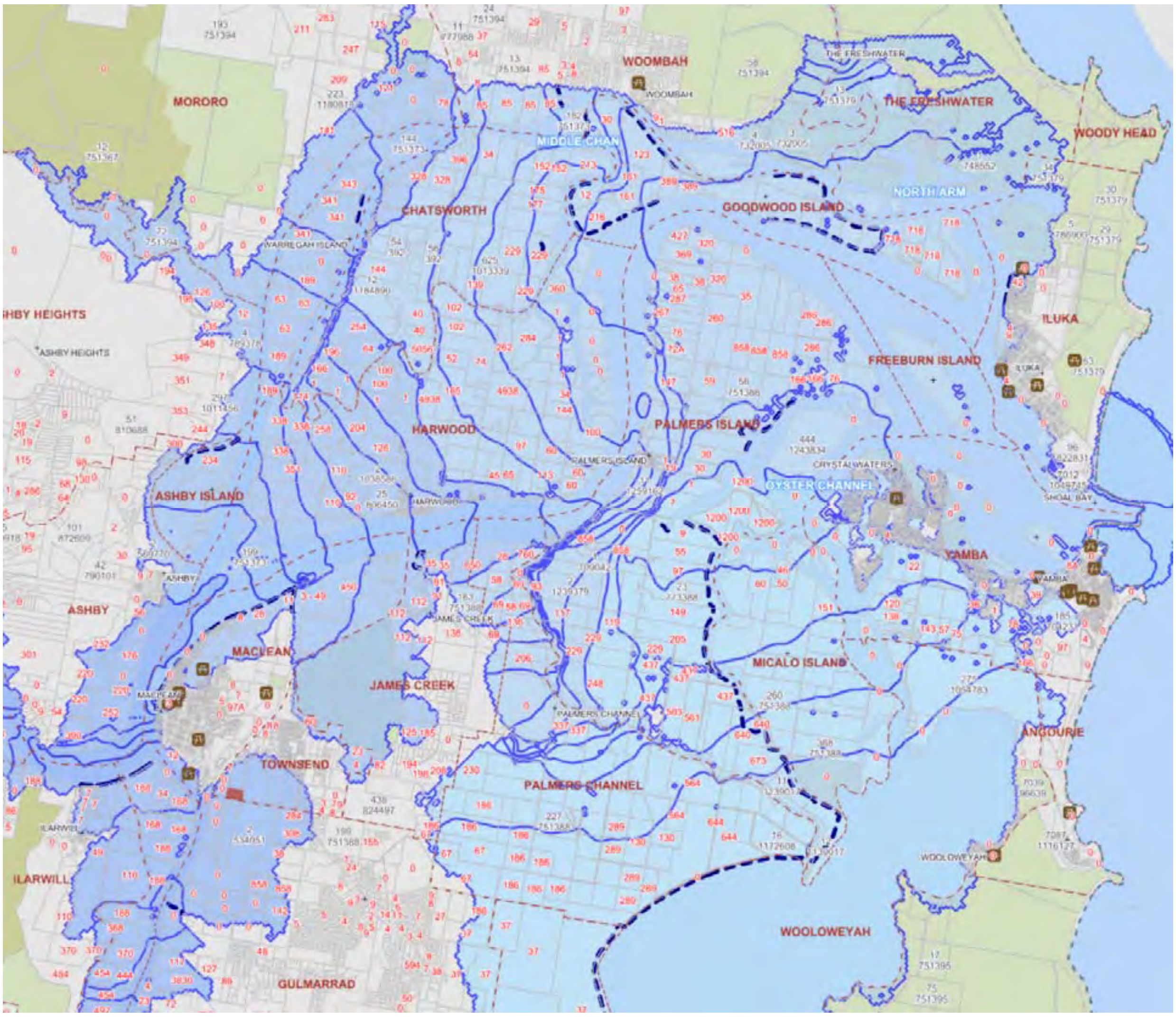



*Figure 4.3 – 100-yr Flood Extents.*

This impact can be further mitigated, if the fill needed for the development is excavated from an appropriate location in the floodplain. It should be excavated from somewhere reasonably close to the development and from the same elevation range as it is placed (i.e. between 0.5 and 4.5 m AHD if possible). Excavation outside this range will have no benefit.

Discussions with Pacific Complete, the builders of the new highway, suggests that there may be opportunities to win such fill. There is a spoil stockpile of approximately 48,000 cu.m some 1.5 km south of the site, as approximately shown in figure 4.1. This material is likely to be suitable for structural filling, much of it is from within the required compensatory elevation range, and, while a little remote from the site, is still within the same flood storage area. Its location is such that it could also prove to be the most economic source of structural fill.

There are other possible sources of compensatory flood storage fill closer to the site. Stabilising fill berms and buttresses were placed as part of the interchange construction. Some of which are no longer required. The material from which is unlikely to be suitable for structural fill, but could be suitable for preloading operations and then removed from the floodplain.

By sourcing fill from these locations, much of the flood impact of the development, small as it is, could be further mitigated to near zero.

Future timing of the development will require negotiation with the RMS to secure the fill rather than Pacific Complete. Such negotiations cannot at this time be guaranteed. With respect to the planning proposal, Council should consider the worst case, being that no compensatory flood storage is achieved. In which case the anticipate flood impacts are in the order of 6 mm locally around Townsend and diminishing beyond.

With respect to Council's DCP and clause D5.2.2 ii), an impact of 6 mm can be considered negligible.

# 6 STORMWATER MANAGEMENT

Part G of Council's Business Zones DCP, specifically tables G1 and G2 sets out the stormwater management requirements.

Drawings 20033-PP02 to PP05 show how the stormwater management requirements of the DCP could be achieved. The measures include:

- Separate capture of pavement's where there is a risk of fuel spills (around the car and truck bowsers and the tanker filling point). These pavements will first drain through a SPEL Puracepter hydrocarbon capture system. The SPEL Puraceptor is the well proven industry standard for hydrocarbon capture. The system uses a combination of differing fluid densities and a float valve to separate hydrocarbons from denser water. Stormwater passes through while hydrocarbons are captured. The system is generally sized to be able to capture the largest possible fuel spill, being that from a tanker filling accident.

- Runoff from the roof and pavements then pass through either a bio-retention basin, which will form part of the landscaping along Goodwood Street frontage, or along a bio-swale drainage which connects to an existing channel that runs parallel to the west boundary.

- The truck parking pavements make up about half the development footprint. Occasional flooding of these pavements is tolerable as the trucks can be easily moved and the pavements adequately designed. Subsequently, to reduce the fill required and its impacts on flooding, these pavements were set as low as could be reliably drained. That proposed, as shown on the drawings, is too low to be drained by conventional pipe and pits. The pipes would be too deep to discharge to Schwongberg or Goodwood Streets. Instead, the pavements will sheet flow off into deep concrete dish drains along the northern and eastern boundaries. These will fall at a gentle 0.3 – 0.5% to flow into a bio-swale drain which discharges to an existing channel that runs parallel to the west boundary. To support the pavement and dish drain along the northern and eastern boundaries, a spill batter into the northern neighbouring land and the Schwongberg Road reserve will be required, or a low retaining wall, to max 1.2m high on the boundary.

- Only the higher pavements, those around the building, fuelling forecourts and flood access path will be drained by a pipe and pit system, which will drain to a bio-retention basin/garden. This basin can be sized to also provide on-site detention (OSD), to reduce short duration event peak runoff rates to compensate for the development's increase in impervious area. Note, OSD is only a measure targeted at short duration runoff peaks. It is not a flood mitigation measure and, in this case, would not achieve any real practical benefit. It can be included nonetheless as it is a requirement of the DCP.

The swale and bio-retention, as shown on the drawings, have been modelled in MUSIC and found to achieve the stormwater quality targets set out in Table G2 of the DCP. Final discharge will be to the existing table drains in Schwongberg and Goodwood Streets. Further works along these drains and culverts under the roads may be warranted upon detailed design and in consultation with Council.

# 7 SERVICES

## 7.1 Sewerage

The existing lot is not currently serviced by Council's reticulated sewer. Nor is there any prospect to connected it to Council's sewer in Townsend by gravity. The proposed development will need to have its own sewage pump station. It is anticipated that this will be a private sewage pump station, owned and operated by the property owners to Council's requirements. As shown on the drawings, it is proposed that it will pump its sewage via a new sewer rising main 1.5 km north along Schwongberg Street to Council's existing sewage pump station at the corner with Jubilee Street.

Further investigation during detailed design will be needed to determine if any upgrading of Council's sewage pump station is required, or if other means of managing sewage flows is warranted, such as direct connection to Council's rising main with telemetry control to avoid synchronised pumping. This may require additional sewage storage on site.

## 7.2 Water

The property has been serviced by reticulated town water in the past, via an existing Ø375 mm water main that cuts through the west portion of the property in an easement. The same main then reduces to Ø300 mm, turns are runs along the Goodwood Street frontage. An existing water service to the previous development on the property exists off this main. This main has ample capacity to service the potable and fire fighting demands of the development. No works to upgrade Council's water infrastructure is anticipated other than fitting an appropriate sized water service.

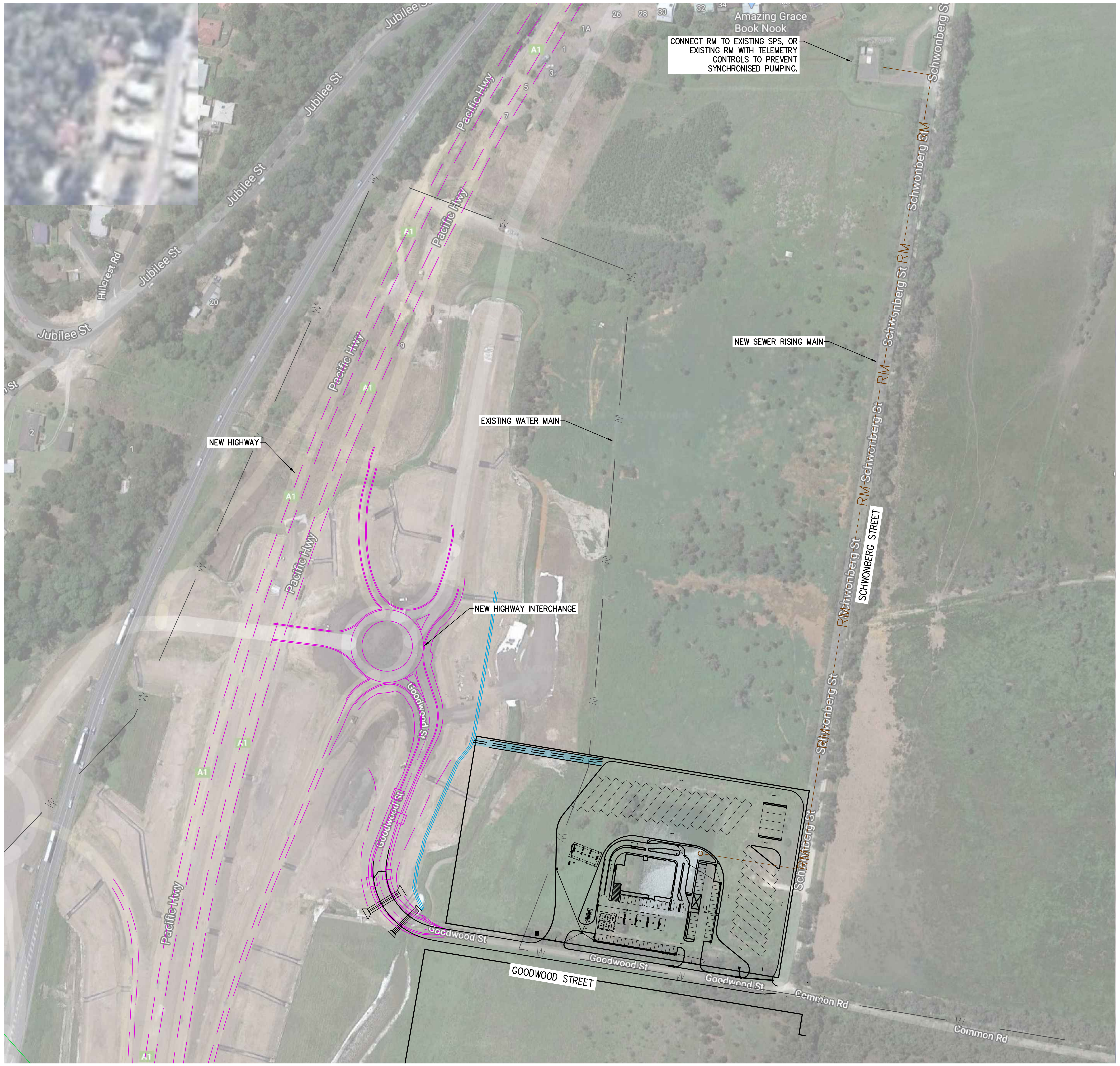
It is noted that the proposed lifting and widening of Goodwood Street may not be compatible with the alignment of the existing water mains. Some realignment and adjustment to the mains along Goodwood Street may be required upon detailed design and consultation with Council. Likewise, the concept design, as shown on the drawings, places fill and pavement over the existing main as it passes through the property in an easement. Council may require adjustments to this main. The drawings show that there is ample scope to realign the main if so required.

## 7.3 Power

The property has in the past been serviced by overhead power and high voltage overhead powerlines cross the western portion of the property in an easement. The provision of adequate power via an anticipated new on-site transformer is expected to be readily achievable. The existing overhead lines crossing Goodwood Street will need to be surveyed and lifted if adequate clearance to the raised Goodwood Street cannot be achieved.

## 7.4 Telecommunications

Any existing provision of fixed line telecommunications to the property is unknown. However, given the property's proximity to Townsend and Maclean, adequate provisioning is expected to be readily achievable.




30 0 30 60 90 120 150

SCALE OF METRES 1:1500

| REV. | DATE | REVISION | DR.BY | AP.BY |
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| A | 25/06/2020 | FOR PLANNING PROPOSAL | MLK | GJK |

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| Surveyed: GAVIN WELSH | Datum: | |
| Drawn: MLK | Designed: GJK | Approved: GJK |
| Checked: GJK | Date: 2020 | No. of dwgs: 5 |

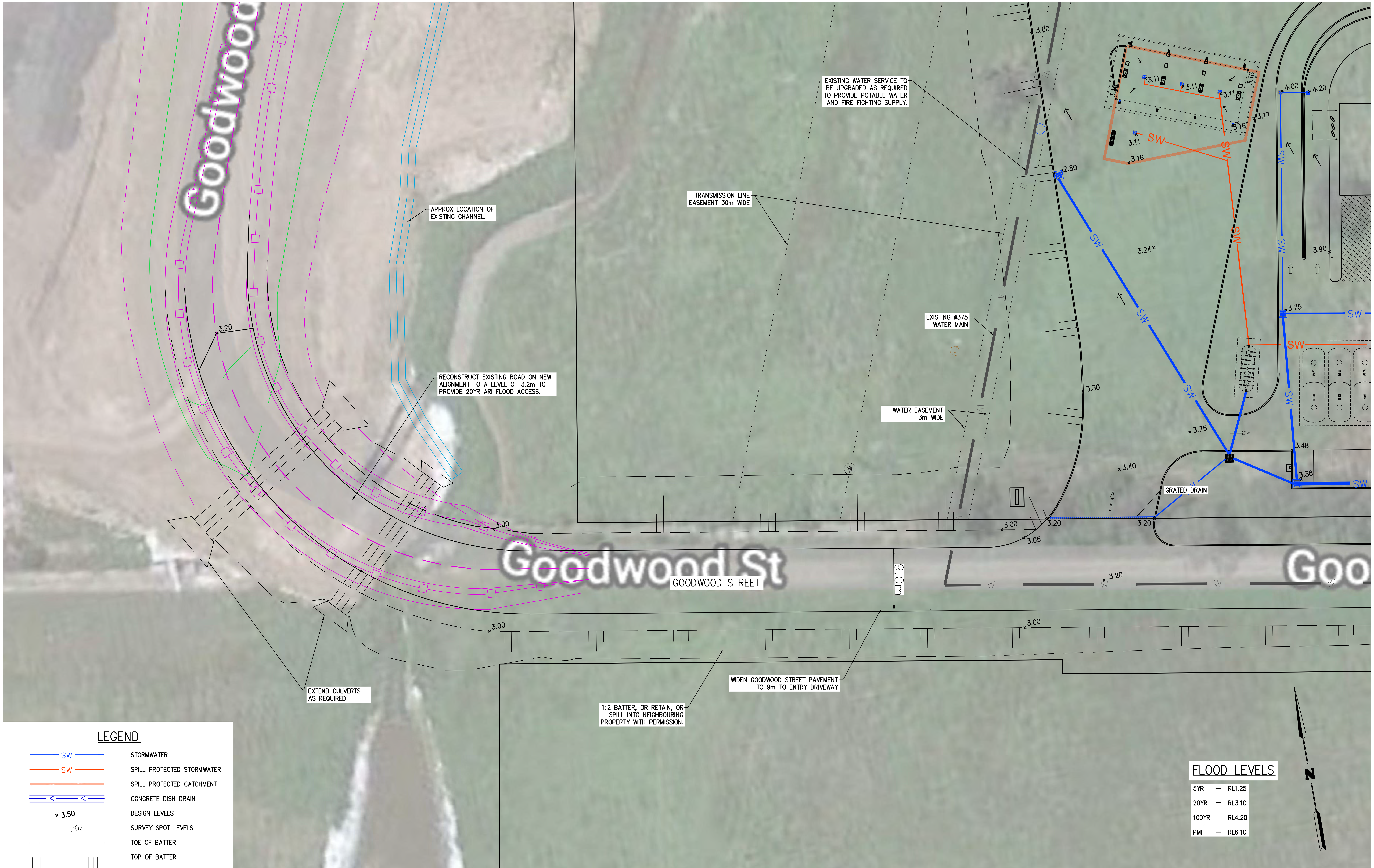
Project:
LOT 2 SCHWONBERG STR TOWNSEND

Client:
HARGREAVES PROPERTY GROUP

PLANNING PROPOSAL
ENGINEERING GA PLAN



Project No. 20033
Drawing No. PP01
Amendment No. A




## LEGEND

| | |
|---|---|
| SW | STORMWATER |
| SW | SPILL PROTECTED STORMWATER |
| | SPILL PROTECTED CATCHMENT |
| < < | CONCRETE DISH DRAIN |
| × 3.50 | DESIGN LEVELS |
| 1:02 | SURVEY SPOT LEVELS |
| | TOE OF BATTER |
| | TOP OF BATTER |
| | EXISTING HIGHWAY |
| | EXISTING HIGHWAY CRASH BARRIER |
| W | EXISTING ø400 WATER MAIN |
| RM | SEWER RISING MAIN |

## FLOOD LEVELS

| | | |
|---|---|---|
| 5YR | — | RL1.25 |
| 20YR | — | RL3.10 |
| 100YR | — | RL4.20 |
| PMF | — | RL6.10 |

5 0 5 10 15 20 25

SCALE OF METRES 1:250

| REV. | DATE | REVISION | DR.BY | AP.BY |
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| Checked: GJK | Date: 2020 | No. of dwgs: 5 |

Project:
LOT 2 SCHWONBERG STR
TOWNSEND

Client:
HARGREAVES PROPERTY GROUP

PLANNING PROPOSAL CIVIL PLAN (1 OF 3)



Project No. 20033

Drawing No. PP02

Amendment No. A


**PLANNING PROPOSAL CONCEPT**

The civil works shown on these drawings are conceptual only. They have been prepared to demonstrate the size a retailed fuel service centre and how it could be arranged to manage its stormwater and flood impacts. The widths and heights of road works, and the extent of filling and batters is entirely conceptual and subject to further design and consultation with CVC through the development and construction approval processes.

**FLOOD MANAGEMENT**

The flood protection and management is to comply with CVC's DCP. That shown on this Planning Proposal Concept Is to:

- Have the building floor level at RL 4.70 m AHD, being 0.5 m above the 100–yr ARI flood level.
- Have a continuous flood access path from the recently constructed highway interchange to the building at or above the 20–yr ARI flood level of 3.1 m AHD. This will require part of Goodwood Street, including some that has recently been constructed, to be lifted.
- To minimise the loss of floodplain storage and to reduce the filling required, the proposed pavements around the building and flood access route will grade down at acceptable gradients for truck and vehicle manoeuvring. Truck parking areas will drop to RL 1.2 m AHD around the northern and western edges and be subject to flood inundation in minor flood events.

**STORMWATER MANAGEMENT**

The proposed stormwater management is to comply with CVC's DCP with respect to stormwater quality. That shown on this Planning Proposal Concept has been modelled in MUSIC and sized to achieve compliance. The conceptual treatment measures comprise:

- The fueling area pavements drained by separate pipe and pit drainage to a SPEL Puraceptor hydrocarbon capture device, sized to capture the largest feasible spill from a refueling tanker.
- The stormwater discharge from the SPEL puraceptor, plus runoff from greater than 95% of the remaining development (roofs, pavements and gardens) to discharge through either a bio–retention basin or bio–swales as shown.
- The final discharge points and subsequent downstream works, if any, are to be determined in consultation with CVC. That conceptually shown is into the existing table drains along Goodwood Rd and Schwongberg St, plus the recently constructed open drain west of the property.
- While not shown on this concept, roofwater capture and reuse will assist with stormwater quality treatment.
- On–site Stormwater Detention (OSD) is not proposed as it would achieve no significant material benefit. Provision can be made should it nevertheless be require.

**LEGEND**

| | |
|---|---|
| SW | STORMWATER |
| SW | SPILL PROTECTED STORMWATER |
| | SPILL PROTECTED CATCHMENT |
| | CONCRETE DISH DRAIN |
| × 3.50 | DESIGN LEVELS |
| 0.41 | SURVEY SPOT LEVELS |
| | TOE OF BATTER |
| | TOP OF BATTER |
| | EXISTING HIGHWAY |
| | EXISTING HIGHWAY CRASH BARRIER |
| W | EXISTING ø400 WATER MAIN |
| RM | SEWER RISING MAIN |

N

5 0 5 10 15 20 25

SCALE OF METRES 1:250

**FLOOD LEVELS**

| | | |
|---|---|---|
| 5YR | — | RL1.25 |
| 20YR | — | RL3.10 |
| 100YR | — | RL4.20 |
| PMF | — | RL6.10 |

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| Checked: GJK | Date: 2020 | No. of dwgs: 5 | |

Project: LOT 2 SCHWONBERG STR TOWNSEND

Client: HARGREAVES PROPERTY GROUP

PLANNING PROPOSAL CIVIL PLAN (2 OF 3)

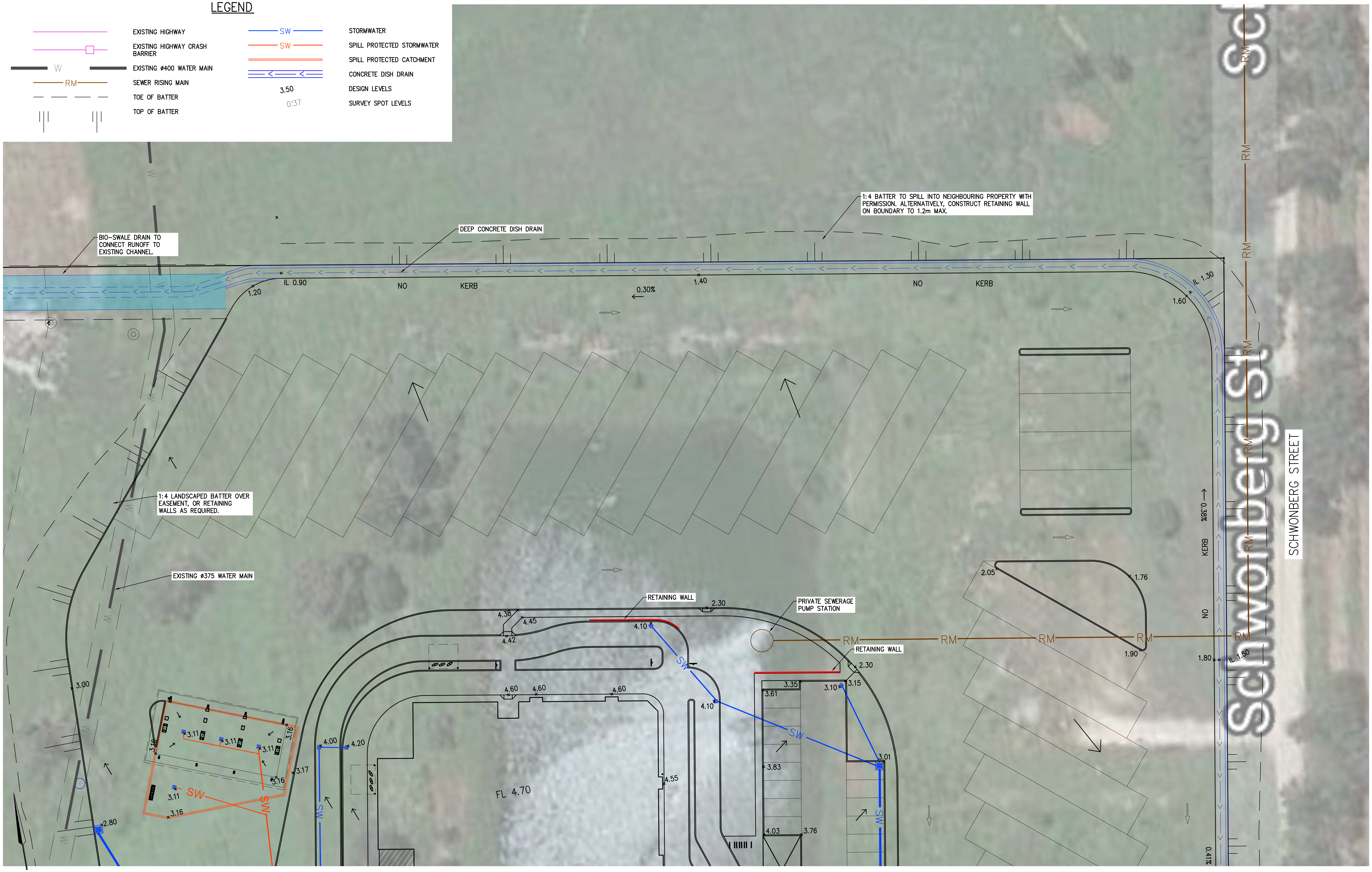
Project No. 20033

Drawing No. PP03

Amendment No. A

## LEGEND

| | |
|---|---|
| W | EXISTING HIGHWAY |
| | EXISTING HIGHWAY CRASH BARRIER |
| W | EXISTING ø400 WATER MAIN |
| RM | SEWER RISING MAIN |
| | TOE OF BATTER |
| | TOP OF BATTER |
| SW | STORMWATER |
| SW | SPILL PROTECTED STORMWATER |
| | SPILL PROTECTED CATCHMENT |
| | CONCRETE DISH DRAIN |
| 3.50 | DESIGN LEVELS |
| 0.37 | SURVEY SPOT LEVELS |

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## FLOOD LEVELS

5YR — RL1.25
20YR — RL3.10
100YR — RL4.20
PMF — RL6.10

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| Checked: GJK | Date: 2020 | No. of dwgs: 5 | |

Project: LOT 2 SCHWONBERG STR TOWNSEND

Client: HARGREAVES PROPERTY GROUP

PLANNING PROPOSAL CIVIL PLAN (3 OF 3)



Project No. 20033
Drawing No. PP04
Amendment No. A


## FLOOD LEVELS

| | | |
|---|---|---|
| 5YR | — | RL1.25 |
| 20YR | — | RL3.10 |
| 100YR | — | RL4.20 |
| PMF | — | RL6.10 |

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| REV. | DATE | REVISION | DR.BY | AP.BY |
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| Drawn: MLK | Designed: GJK | Approved: GJK |
| Checked: GJK | Date: 2020 | No. of dwgs: 5 |

Project: LOT 2 SCHWONBERG STR TOWNSEND

Client: HARGREAVES PROPERTY GROUP

Title: BULK EARTHWORKS



Project No. 20033

Drawing No. PP05

Amendment No. A

# VOLUME 2

Archaeological Assessment

PLANNERS NORTH

EVERICK HERITAGE

# Maclean Highway Service Centre, Townsend NSW

Aboriginal Cultural Heritage Assessment

Prepared for Hargreaves Property Group

Everick Heritage Pty Ltd

April 2020

EVERICK HERITAGE

**Report Reference:**

DRAFT Hill, T. R. Mazlin and M. Finlayson 2020. *Maclean Highway Service Centre: Townsend NSW.* Everick Heritage Pty Ltd unpublished report prepared for Hargreaves Property Group.

EVERICK HERITAGE

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| Ver. | Author(s) | Sections Edited | Date | Authorised |
|---|---|---|---|---|
| 1 | T. Hill | All | 10.03.2020 | T. Robins |
| 2 | T. Hill & R. Mazlin | 5-9 | 25.03.2020 | T. Robins |
| 3 | M. Finlayson | All | 25.03.2020 | T. Robins |
| | R. Mazlin | 6, 7 & 8 | 06.04.2020 | T. Robins |


## Executive Summary

The following is a report detailing the results of an Aboriginal Cultural Heritage Assessment ('ACHA') and for the proposed Maclean Highway Service Centre, Maclean NSW ('the Proposed Works'). Everick Heritage Pty Ltd (the 'Consultant') were commissioned by Hargreaves Property Group (the 'Proponent') to support a development application to Clarence Valley Council.

The methods used for this assessment are in compliance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DEECW 2010) ('CoPAI') and all relevant legislation as described in Section 2 of this Report. The following are the broad requirements for compliance with the CoPAI;

a) consultation with the Yaegl Traditional Owners Aboriginal Corporation ('TOAC');

b) searches of applicable heritage registers;

c) review of ethnographic and historic resources relevant to the region;

d) review previous archaeological work and the landscape context;

e) summarise the local and regional character of Aboriginal land use and its material traces;

f) formulate a predictive model;

g) conduct an archaeological survey with representatives of the Yaegl TOAC to identify the potential for harm to Aboriginal objects and appropriate management response; and

h) report on findings and recommended management strategies.

The ACHA has been commissioned to provide for the construction of a service centre at the new South Maclean interchange on the Pacific Highway. The project specifically includes construction activities at within Lot 2 DP634170, being the construction of the following:

- Fuel shop and fuel bowsers (light and heavy vehicle).
- Three (3) restaurants.
- Seating and amenities areas.
- Car, truck and bike parking.

## Results

No Aboriginal objects or sites were identified during survey

As a result of the desktop study, field inspection and consultation with Yaegl TOAC, the following can be concluded:

a) No Aboriginal sites or cultural significance, including archaeological sites, are known to occur within the Project Area.

b) The Project Area has been substantially disturbed by cut and fill earth works and there are no intact topsoil deposits which have not been disturbed to some degree.

c) Having consideration for the predictive model it is not considered that the Project Area had a high potential to contain Aboriginal sites as it is likely that the main Aboriginal occupation sites would be closer to the coastline and Lake Innes to the south of the Project Area.

Based on the desktop assessment it is not considered that the Proposed Works, being construction of the highway service centre, will likely impact on Aboriginal objects. As such, additional community consultation and archaeological investigation is not required to comply with the National Parks and Wildlife Act (1974) and Regulations (2019).

The assessment has concluded that ground disturbing works within the Project Area are unlikely to impact on Aboriginal objects and will not impact on any known places or sites of cultural significance to the Aboriginal community. As such additional consultation and archaeological investigation is not required. However, the following recommendations are provided as a precautionary measure to mitigate impacts to potential Aboriginal heritage values.

### Recommendation 1: Aboriginal Objects Find Procedure

It is recommended that if suspected Aboriginal material has been uncovered because of development activities within the Project Area:

a) work in the surrounding area is to stop immediately;

b) a temporary fence is to be erected around the site, with a buffer zone of at least 10 metres around the known edge of the site;

c) an appropriately qualified archaeological consultant is to be engaged to identify the material; and

d) should the works be deemed to have harmed the Aboriginal objects the DPI&E should be notified immediately via the EPA Enviro Hotline.

Having consideration for the outcomes of the Community Consultation it is recommended that representatives of the Yaegl TOAC are engaged during the initial earthworks affecting any residual topsoil deposits to support the implementation of the Aboriginal Objects Find Procedure as “spotters” and to provide civil contractors with a cultural heritage induction prior to commencement.

### Recommendation 2: Aboriginal Human Remains

Although it is unlikely that Aboriginal Human Remains will be located at any stage during earthworks within the Project Area, should this event arise it is recommended that all works must halt in the immediate area to prevent any further impacts to the remains. The site should be cordoned off and the remains themselves should be left untouched. The nearest Police Station (Maclean), the Yaegl TOAC and the DPI&E Regional Office (Coffs Harbour) are all to be notified as soon as possible. If the remains are found to be of Aboriginal origin and the police do not wish to investigate the Site for criminal activities, the Aboriginal community and the DPI&E should be consulted as to how the remains should be dealt with. Work may only resume after agreement is reached between all notified parties, provided it is in accordance with all parties' statutory obligations.

It is also recommended that in all dealings with Aboriginal Human Remains, workers or contractors should use respectful language, bearing in mind that they are the remains of Aboriginal people rather than scientific specimens.

EVERICK HERITAGE

# DEFINITIONS

The following definitions apply to the terms used in this report:

**Aboriginal Object** means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

**Aboriginal Place** means any place declared to be an Aboriginal Place (under s. 84 of the NPW Act) by the Minister administering the NPW Act, by order published in the NSW Government Gazette, because the Minister is of the opinion that the place is or was of special significance with respect to Aboriginal culture. It may or may not contain Aboriginal Objects.

**ACHAR** means Aboriginal Cultural Heritage Assessment Report

**ACHCRP Guidelines** means the Aboriginal Cultural Heritage Consultation Requirements for Proponents (2010).

**AHIMS** means Aboriginal Heritage Information Management System

**AHIP** means Aboriginal Heritage Impact Permit.

**CoPAI** means the Code of Practice for Archaeological Investigation in New South Wales (2010).

**Due Diligence Code** means the Due Diligence Code for the Protection of Aboriginal Objects in NSW (2010).

**DPI&E** Means Department of Planning, Infrastructure and Environment.

**LEP** means Local Environment Plan

**NPW Act** means the National Parks and Wildlife Act 1974 (NSW).

**NSW** means New South Wales.

**Project Area** means the proposed Maclean Highway Service Centre located at 2 Swonberg Street, Townsend NSW comprising all of Lot 2 DP634170.

**Proponent** means Hargreaves Property Group and all associated employees, contractors and subcontractors of the same.

**RAP** means Registered Aboriginal Party

**The Consultant** means qualified archaeological staff and/or contractors of Everick Heritage Pty Ltd.

**TOAC** means Traditional Owner Aboriginal Corporation.

# Contents

EVERICK HERITAGE

## Figures



FIGURES

## Tables

# 1. INTRODUCTION

## 1.1. Scope of this Assessment

The following is a report detailing the results of an Aboriginal Cultural Heritage Assessment ('ACHA') and for the proposed Maclean Highway Service Centre, Maclean NSW ('the Proposed Works'). Everick Heritage Pty Ltd (the 'Consultant') were commissioned by Hargreaves Property Group (the 'Proponent') to support a development application to Clarence Valley Council.

## 1.2. Assessment Methodology

The methods used for this assessment are in compliance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DEECW 2010) ('CoPAI') and all relevant legislation as described in Section 2 of this Report. The following are the broad requirements for compliance with the CoPAI;

i) consultation with the Yaegl Traditional Owners Aboriginal Corporation ('TOAC');

j) searches of applicable heritage registers;

k) review of ethnographic and historic resources relevant to the region;

l) review previous archaeological work and the landscape context;

m) summarise the local and regional character of Aboriginal land use and its material traces;

n) formulate a predictive model;

o) conduct an archaeological survey with representatives of the Yaegl TOAC to identify the potential for harm to Aboriginal objects and appropriate management response; and

p) report on findings and recommended management strategies.

## 1.3. Project Description

The ACHA has been commissioned to provide for the construction of a the service centre at the new south Maclean interchange on the Pacific Highway (Figure 1). The Project specifically includes construction activities at within Lot 2 DP634170, being the construction of the following;

- Fuel shop and fuel bowsers (light and heavy vehicle);
- Three (3) restaurants;
- Seating and amenities areas;
- Car, truck and bike parking (see Figure 2).

## 1.4. Report Authorship

The ACHAR was prepared by Principal Consultant (Northern NSW) Tim Hill, Archaeologist Robbie Mazlin and Graduate Archaeologist Matt Finlayson. The Aboriginal community consultation was conducted by Tim Hill.


Figure 1: Location of Proposed Works

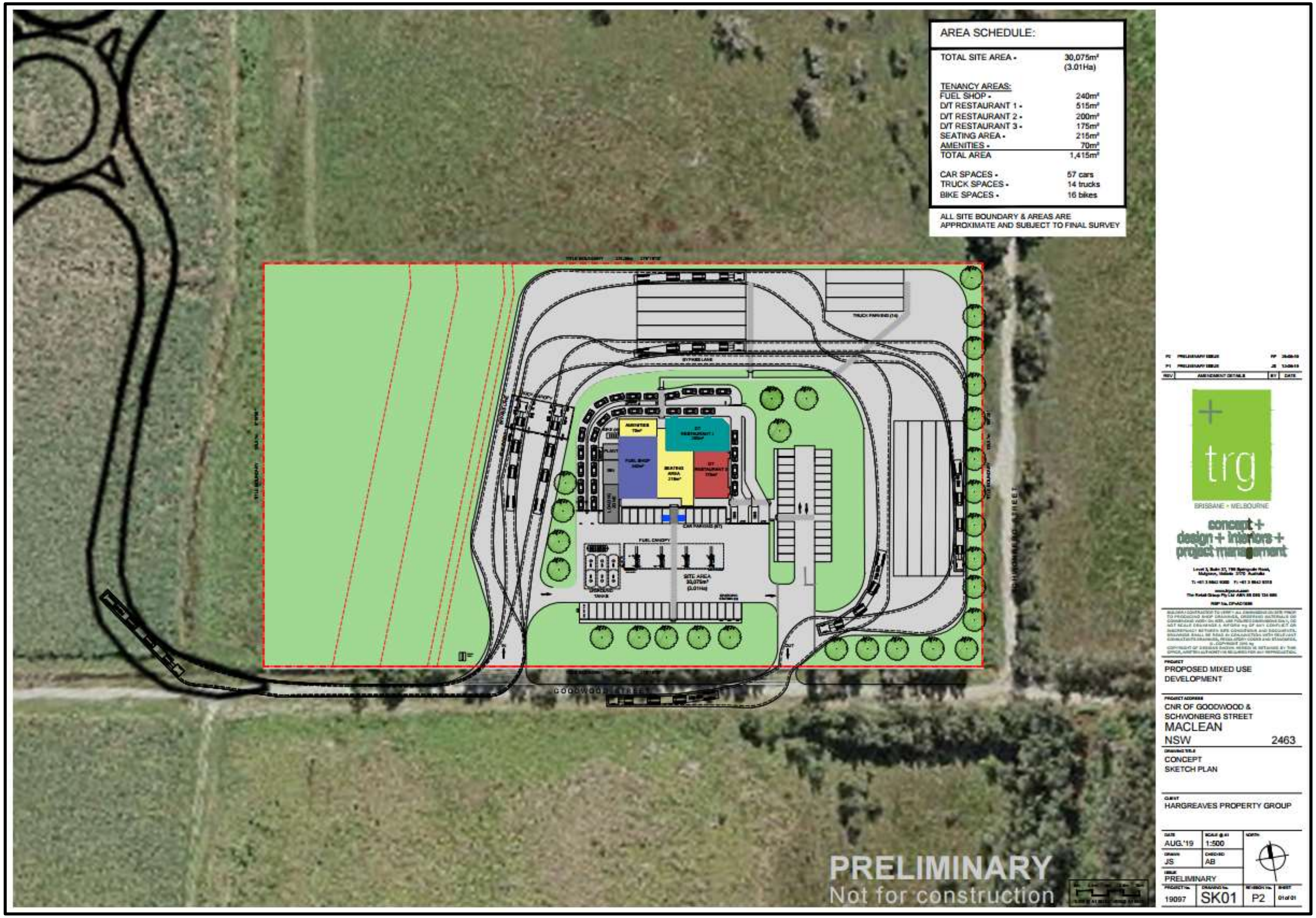


Figure 2: Proposed Maclean Highway Service Centre.

# 2. LEGISLATIVE AND PLANNING CONTEXT

The primary State legislation concerning cultural heritage in NSW is the National Parks and Wildlife Act 1974 (NSW) (NPW Act) and Local Environment Plans (LEP) made under the Environmental Planning & Assessment Act 1979 (NSW). The Commonwealth also has a role in the protection of nationally significant cultural heritage through the Environmental Protection and Biodiversity Conservation Act 1999 (Cth), The Protection of Movable Cultural Heritage Act 1986 (Cth) and the Historic Shipwrecks Act 1976 (Cth).

For the purposes of this assessment the State and local legislation are most relevant. The consent authority will be the Office of Environmental and Heritage ('OEH'). The information below lists the legislative and policy framework within which this assessment is set.

## 2.1. The National Parks and Wildlife Act 1974 (NSW)

The NPW Act is the primary legislation concerning the identification and protection of Aboriginal cultural heritage. It provides for the management of both Aboriginal Objects and Aboriginal Places. Under the NPW Act, an Aboriginal Object is any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area, regardless of whether the evidence of habitation occurred before or after non-Aboriginal settlement of the land. This means that every Aboriginal Object, regardless of its size or seeming isolation from other Objects, is protected under the Act.

An Aboriginal Place is an area of particular significance to Aboriginal people which has been declared an Aboriginal Place by the Minister. The drafting of this legislation reflects the traditional focus on Objects, rather than on areas of significance such as story places and ceremonial grounds. However, a gradual shift in cultural heritage management practices is occurring towards recognising the value of identifying the significance of areas to Indigenous peoples beyond their physical attributes. With the introduction of the National Parks and Wildlife Amendment Act 2010 (NSW) the former offence provisions under Section 86 of 'disturbing', 'moving', 'removing' or 'taking possession' of Aboriginal Objects or Places have been replaced by the new offence of 'harming or desecrating'. The definition of 'harm' is 'destroying, defacing or damaging an Object'. Importantly, in the context of the management recommendations in this assessment, harm to an Object that is 'trivial or negligible' will not constitute an offence.

The amendments also significantly strengthen the penalty provisions. The issue of intent to harm Aboriginal cultural heritage has been formally addressed by separating it from inadvertent harm. The penalty for individuals who inadvertently harm Aboriginal Objects has been set at up to $55,000, while for corporations it is $220,000. Also introduced is the concept of 'circumstances of aggravation' which allows for harsher penalties (up to $110,000) for individuals who inadvertently harm Aboriginal heritage in the course of undertaking a commercial activity or have a record for committing similar offences. For those who knowingly harm Aboriginal cultural heritage, the penalty will rise substantially. The maximum penalty will be set at $275,000 or one year imprisonment for individuals, while for corporations it will rise to $1,100,000.

Where a land user has or is likely to undertake activities that will harm Aboriginal Objects, the Director General of the Department of Planning, Infrastructure and Environment ('DPI&E') has a range of enforcement powers, including stop work orders, interim protection orders and remediation orders. The amended regulations also allow for a number of penalties in support of these provisions. The NPW Act also now includes a range of defense provisions for unintentionally harming Aboriginal Objects:

a) Undertaking activities that are prescribed as 'Low Impact'.

b) Acting in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (2010) (the 'Due Diligence Code').

c) Using a consulting archaeologist who correctly applies the CoPAI.

d) Acting in accordance with an AHIP.

The regulations allow for a range of low impact activities to be undertaken without the need to consult the OEH or a consulting archaeologist. Generally, those who undertake activities of this nature will not be committing an offence, even if they inadvertently harm Aboriginal Objects. For the purposes of this assessment it is not considered that the proposed management works are 'low impact activities'.

## 2.2. Due Diligence Code

The Due Diligence Code operates by posing a series of questions for land users before they commence development. These questions are based around assessing the potential for an area of land to contain Aboriginal Objects and previous ground disturbance. An activity will generally be unlikely to harm Aboriginal Objects where it:

a) will cause no additional ground disturbance; or

b) is in a developed area; or

c) in a significantly disturbed area.

Where these criteria are not fulfilled, further assessment for Aboriginal cultural heritage will typically be required prior to commencing the activity.

## 2.3. The ACHCRP Guidelines (2010) and Community Consultation.

The ACHCRP Guidelines provide an acceptable framework for conducting Aboriginal community consultation in preparation for impacts to Aboriginal cultural heritage. Proponents are required to follow them where a Project is likely to impact on cultural heritage and where they require an Aboriginal Heritage

Impact Permit ('AHIP'). However, it has been standard practice to undertake consultation with Aboriginal sites officers from the Local Aboriginal Land Council ('LALC') to assist the proponent to understand their requirements for additional consultation which may include Elders Groups, native title applicant groups or other knowledge holders who might have a particular type of knowledge about an area.

The ACHCRP Guidelines typically take a minimum of 90 days to complete. However, in complicated Projects this period may need to be extended by several months. The Guidelines require public notice of the assessment, preparation of a proposed methodology, undertaking site meetings and excavations where required, the production of a draft report, which is distributed to the registered Aboriginal parties and the production of a final report.

Although not strictly required, a thorough consultation process will treat the ACHCRP Guidelines as a minimum standard of community consultation where impacts to Aboriginal objects cannot reasonably be avoided. Generally, consultants must go to further effort to identify the significance of a given site to the Aboriginal community. This will likely include undertaking additional site inspections if requested by Aboriginal stakeholders, fully resourcing the community by providing copies of past archaeological and environmental assessments in the region and meeting with community members to seek their opinions of the site.

## 2.4. The Clarence Valley Local Environmental Plan 2011

The Clarence Valley LEP 2011 provides statutory protection for items already listed as being of heritage significance (Schedule 5), items that fall under the ambit of the Heritage Act 1977 (NSW) and Aboriginal Objects under the National Parks and Wildlife Act 1974 (NSW). It aims to ensure best practice components of the heritage decision making process are followed.

Under the Clarence Valley LEP 2011, development consent is required from Clarence Valley Council for any of the following actions (Part 5.10.4):

a) demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance):
    i. a heritage item,
    ii. an Aboriginal object,
    iii. a building, work, relic or tree within a conservation area,
b) altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item,
c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed,

d) disturbing or excavating an Aboriginal place of heritage significance,

e) erecting a building on land:

  i. on which a heritage item is located or that is within a heritage conservation area, or

  ii. on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance

f) subdividing land:

  i. on which a heritage item is located or that is within a heritage conservation area, or

  ii. on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.

Regarding Aboriginal Cultural Heritage significance (Part 5.10.8) the consent authority must, before granting consent under this clause to the carrying out of development in a place of Aboriginal heritage significance;

a) consider the effect of the proposed development on the heritage significance of the place and any Aboriginal object known or reasonably likely to be located at the place, and

b) notify the local Aboriginal communities (in such way as it thinks appropriate) about the application and take into consideration any response received within 28 days after the notice is sent.

The Project Area is not identified as an item of environmental heritage (Schedule 5) under the Clarence Valley Local Environment Plan ('LEP') 2011.

# 3. ABORIGINAL COMMUNITY CONSULTATION

The DPI&E have issued their consultation requirements (ACHCRP Guidelines), which act as a guide for conducting the community consultation process. It contains a number of minimum consultation standards, one of which requires the preparation of a methodology for conducting the Cultural Heritage Assessment. This methodology outlines the basic steps that need to be undertaken to determine the nature of the cultural heritage of the site, and the approaches required to manage that heritage.

## 3.1. Community Knowledge

We will work with the Aboriginal community to identify and address their concerns; not only about known sites in the region, but also cultural values such as historic and spiritual significance, and other values relating to flora and fauna of the area. We recognise that there may be Traditional knowledge that would have to be treated in a confidential manner, and we would be seeking advice from Aboriginal Parties as to the appropriate protocols to be adopted, in regard to such knowledge.

Everick makes a commitment to the Aboriginal community to document the consultation process as fully as possible. We will include all written comments we receive from the Aboriginal community in our final report. This is regardless of whether they are critical of the process we have undertaken or our final recommendations. In doing so, we hope to make an informed and accurate assessment of the significance of any cultural heritage within the Project Area.

Email correspondence and phone calls were made to the Yaegl TOAC on 5 March 2020 and a return phone call was received from Uncle Bill Walker on 6 March 2020 to confirm the availability of Mr. Firlin Laurie for the field work on Thursday 12 March 2020. Unfortunately, this site inspection was postponed due to scheduling problems on Everick's behalf (see Appendix A). A site inspection was undertaken with Mr. Firlin on 17 March 2020.

# 4. DESKTOP ASSESSMENT: ABORIGINAL CULTURAL HERITAGE

## 4.1. Environmental Context

### 4.1.1. Topography and Hydrology.

The Project Area is located on a broad floodplain between the South Am of the Clarence River and Wooloweyah Lagoon (see Figure 3). There is no significant relief across the floodplain and it is possible that the Project Area comprises reclaimed swampland. The Clarence South Arm is 500 metres to the south west of the Project Area and is tidal in this part of the river system. The nearby Yaegl Nature Reserve comprises predominately floodplain paperbark forest which is considered to have been extensive in the Clarence floodplain prior to European settlement.

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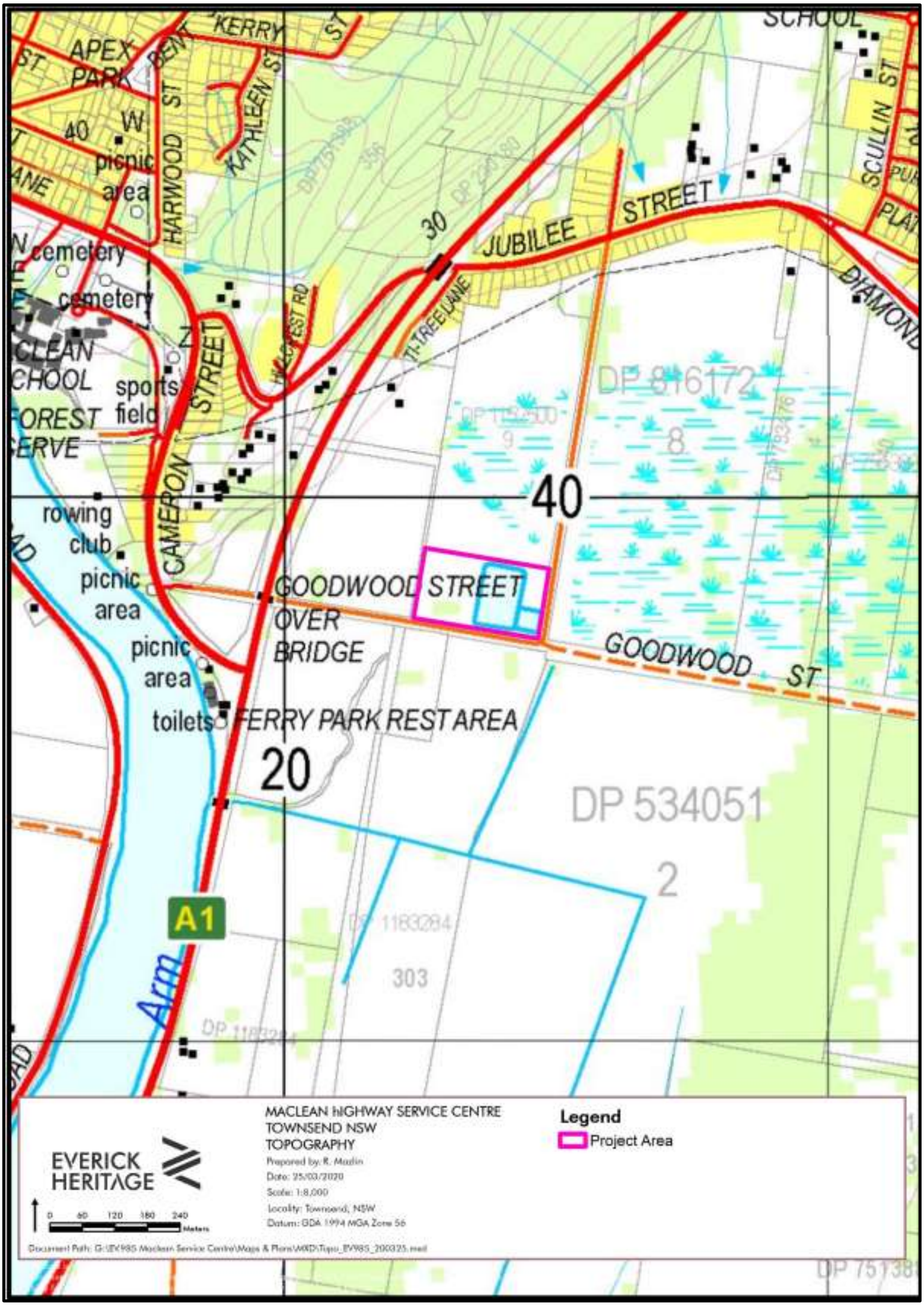


Figure 3: Topography of the Project Area.

### 4.1.2. Soil Landscapes

The Project Area is mapped as being part of the 'Cowper' but immediately adjacent to the 'Everlasting' soil landscape (Morand 2001 see Table 1 Figure 4);

**Table 1: Summary of soil landscape descriptions.**

| Soil landscape | Description | Vegetation model |
|---|---|---|
| Cowper (Morand 2001:14) | **Landscape**—major levees lining the main channels of the Clarence River and associated tributaries. Slopes 0 – 6%; relief 1 – 5 m; elevation 2 – 6 m. Completely cleared.<br><br>**Soils**—deep (>200 cm), well-drained Brown Dermosols and Brown Kandosols (affinity with Brown Earths). | The original open to closed-forest has been almost completely cleared. The Rainforest Reserve at Maclean is the sole remaining patch of the original Clarence River floodplain sub-tropical rainforest (Mount King Ecological Surveys 1995). Species present include *Castanospermum australe* (black bean), *Dysoxylum muelleri* (red bean), *Cryptocarya obovate* (pepperberry tree), *Elaeocarpus grandis* (blue quandong), *Aphananthe philippensis* (rough-leaved elm) and *Streblus brunonianus* (whalebone tree). *Eucalyptus amplifolia* (cabbage gum) is a common tree lining streambanks and is often associated with *Casuarina cunninghamiana* (river oak) and/or any of the previously mentioned species. |
| Everlasting (Morand 2001:184) | **Landscape**—estuarine backswamps of the Clarence and Richmond Rivers. Slopes 0 – 1%; local relief 0 – 1 m; elevation 0 – 2 m. Grassland with isolated trees, otherwise paperbark closed-forest.<br><br>**Soils**—deep (>200 cm), poorly drained Sulfuric/Sulfidic Redoxic Hydrosols (Humic Gleys) | Tall paperbark closed-forest/swamp complex, extensively cleared in places (e.g., south of Common Road, Maclean), relatively undisturbed in others (e.g., swamp adjacent access road to Pacific Highway, Maclean).<br><br>Tulau (1999a) notes that the dominant plant species in the central swamp (on the adjoining Bare Point 1:100 000 Sheet) is *Eleocharis equisetina*, with *Casuarina glauca* (swamp oak) the dominant fringing tree species, with occurrences of *Melaleuca linariifolia*. Other species include Paspalum distichum, Phragmites australis (common reed), *Pseudoraphis spinescens* and *Cyperus polystachyos*. |

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Figure 4: Project Area soil landscape mapping.

## 4.2. The OEH Aboriginal Heritage Information Management System (AHIMS)

An 'Extensive' search was undertaken of the AHIMS database (Reference: 490266) on 11 March 2020 (Table 2 and Appendix B). The search area was defined as Lot 2 DP634170 with a buffer of 1 km. One (1) Aboriginal site was returned by the AHIMS search, being the Hillcrest Reserve recorded by Katrina Stankowski, which is understood to be an Aboriginal historic site in Maclean which now comprises the current Aboriginal housing area to the west of the Pacific Highway (see Australian Museum Consulting 2015). The site coordinates were recorded in the AGD datum and when converted to the GDA datum this site coordinate is considered accurate. The other entry returned is a PAD. This PAD 15 'site' is located near to the north of the Project Area on a ridge crest that runs eastward from Hillcrest Reserve and is not considered to extend into the Project Area (see **Figure 5**). The site record for PAD 15 indicate that it is not a site.

**Table 2: AHIMS search results (Reference: 490266).**

| Site ID | Site Name | Easting | Northing | Site Type |
|---|---|---|---|---|
| 13-1-0117 | Hillcrest Reserve | 519880 | 6740071 | Habitation Structure; Potential Archaeological Deposit |
| 09-1-0208 | PAD 15 | 520235 | 6740251 | Potential Archaeological Deposit |

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Figure 5: AHIMS search results (#490266).

## 4.3. Other Heritage Registers

The following heritage registers were accessed on 03 March 2020:

- **The National Heritage List (Australian Heritage Council):** Contains no Aboriginal heritage listings within or within close proximity to the Project Area.
- **Commonwealth Heritage List (Australian Heritage Council):** Contains no Aboriginal heritage listings within or within close proximity to the Project Area.
- **The State Heritage Register:**
    a) contains no Aboriginal heritage listings in Section 1 (Items listed under the NSW Act as Aboriginal Places) within or within close proximity to the Project Area;
    b) contains no Aboriginal heritage listings in Section 2 (Items listed under the NSW Heritage Act) within or within close proximity to the Project Area;
    c) contains no Aboriginal heritage listings in Section 3 (Items listed by Local Government and State Agencies) within or within close proximity to the Project Area.
- **Clarence Valley LEP (2011):** Contains two items of local heritage significance in close proximity to the Project Area, being the Former Ashby Ferry site at the current visitor information centre opposite the Pacific Highway and the Hillcrest residence (Table 3 and **Figure 6**).

**Table 3: Clarence Valley LEP sites.**

| Heritage Item | Location |
|---|---|
| Punt and Former Ashby Ferry (I194) | Lot 434, DP 823599 |
| Residence “Hillcrest” (I220) | Lots 61 and 62, DP 1036148 |

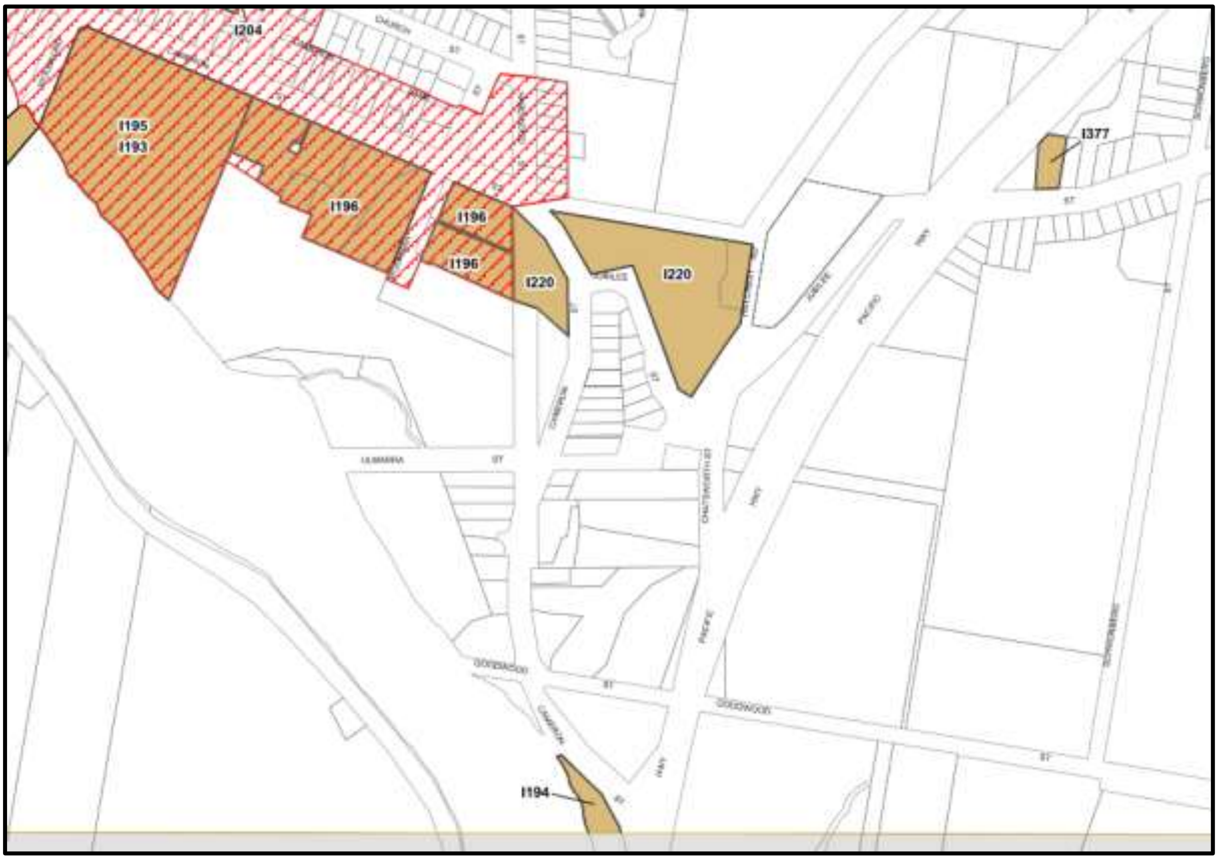


Figure 6: Local heritage listings (Clarence LEP 2011).

# 5. SELECTED ARCHAEOLOGICAL SYNTHESIS AND PREDICTIONS

## 5.1. Ethnohistory

The Aboriginal people of the lower Clarence River were part of linguistically and culturally associated groups called the Bundjalung, the coastal extent of which occupied the Clarence to Logan Rivers and west to the Dividing Range (Crowley 1978). Tindale (1974) recorded a Jiegera tribe occupying the Clarence River upstream to Grafton. Modern usage refers to the 'Yargir' (Yaegl) as the traditional Aboriginal occupants. Heron (1991) records that the 'Yargir' is more closely related to the southern Gumbaybggir than the Bundjaung, their territory extended south to Corindi Beach, west to Ulmara and north to the Clarence River including 98 of the 100 islands of the Clarence River (Heron 1991: 10). While 'Yargir' country is smaller than neighbouring territories, it is one of the richest in the region in terms of natural resources (Heron 1991: 16).

A review of sightings of Aboriginal coastal groups in Coleman's review of ethnohistorical sources led her to the conclusion that in the initial stages of European contact, observers of coastal groups described; '…consistently high, semi sedentary local populations on the coast with a highly sophisticated organic material culture which vanished almost overnight with European contact' (Coleman 1982: 7). Population densities for the lower Clarence are considered high, no doubt reflecting the wide variety of ecologies and hunting/gathering opportunities contained. Fry, Commissioner for Lands in the Clarence District, estimated the population for the Clarence as between 525 and 1,050 persons (Fry 1894 in Belshaw 1978), a density of one person per three to six square miles.

Later researchers consider that populations for the coastal plains and estuaries were much higher, at possibly one person per three square miles between the Clarence and Evans Rivers (Belshaw 1978: 730). In areas where marine and terrestrial foods were particularly abundant, which would apply to the lower Clarence, estimates may be placed even higher (Pierce 1978; Heron 1991). Population estimates by eye-witnesses of Aboriginal numbers for the coastal regions, immediately after European settlement, are highly likely to be underestimates of pre contact numbers due to the impacts of diseases, particularly small pox that spread throughout coastal groups prior to official settlement.

Land belonged to clan groups whose boundaries had been established in Yargir mythology (Godwin and Creamer 1984). Contact between local clans and more distant groups took place for the purposes of exchange, inter marriage, initiations, armed conflict and at times of seasonally abundant food supply. There are two current demographic models to describe possible settlement/movement patterns. One suggests that clan groups would range between the sea coast and the foothills of the coastal ranges on a seasonal basis (McBryde 1974). On ethno-historical evidence McBryde suggests that some seasonal movement was common and that the basic subsistence economy of hunting, fishing and gathering was neither static, nor completely migratory, but characterised by movement between the coast and the foothills (McBryde 1974: 337). A number of early references refer to seasonal movement on a limited scale including Ainsworth (1922) on the Richmond River, Dawson (1935: 25) and McFarlane (1934) on the Clarence River, The archaeological evidence for movement within the coastal river valleys is less conclusive (McBryde 1974: 338), however Godwin concludes that movement from the tablelands to the Coast was common, particularly for winter fish runs (1988).

From the few eye-witness sources available for the North Coast we can suggest that contact between members of the coastal clans was frequent and may have involved relatively large numbers. Bray records that the coastal Coodjinburra '…used to mix very much with the Ballina Richmond River Blacks' (Bray 1901:9). However, it may have been a way of life that rapidly disappeared under the impacts of disease and restrictions on Aboriginal groups by 'authorities' on the movement of Aboriginal people. A review of sightings of Aboriginal coastal groups in Coleman's review of ethnohistorical sources led her to a conclusion that in the initial stages of European contact, observers of coastal groups describe, '…consistently high, semi sedentary local populations on the coast with a highly sophisticated organic material culture which vanished almost overnight with European contact' ( Coleman 1982:7).

McBryde (1974) argues for a seasonal movement of people along the coast in summer exploiting marine foods and hunting inland in winter. On the ethno-historical evidence McBryde suggested that some seasonal movement was usual and that the basic subsistence economy of hunting, fishing and gathering was neither static, nor completely migratory, but characterised by movement between the coast and the foothills (McBryde 1974: 337). A number of early references refer to seasonal movement on a limited scale including Ainsworth (1922) on the Richmond River and Dawson (1935) and McFarlane on the Clarence River. Bray (1923) states that the Lismore 'tribe' used to go to Ballina at the mouth of the river. Sullivan (1964: 20) recorded that inland groups were allowed to come to the Tweed coast for a time. The archaeological evidence for movement within the coastal river valleys is less conclusive (McBryde 1974: 338), however Godwin (1988) proposed a model for the Macleay River where Aboriginal groups from the Tablelands regularly came down to the coast during the winter for 'fish runs'. Based on the available ethnohistorical evidence the sub-coastal groups, such as those around Maclean, were mobile within the river valleys most of the year.

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Figure 7: 'Group of Blacks, Clarence River' (Source J. W. Lindt AM Consulting 2015:25).

Figure 8: 'Camp of Australian Aboriginals' (source F. Henningham 1935 source AM Consulting 2015:17).

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## 5.2. Previous Archaeological Research

### 5.2.1. Woolgoolga to Ballina Pacific Highway Upgrade (RMS 2010, 2013)

Aboriginal cultural heritage assessments in relation to the Pacific Highway Upgrade ('PHU') Woolgoolga to Ballina, have been the most numerous comprehensive studies in this region, be it by necessity, in a narrow corridor of search and subsequent archaeological investigations. The Aboriginal heritage assessment for the preliminary design identified PAD 15 to the north of the Project Area however following archaeological testing this area was determined not to be a PAD. The Maclean Interchange was assessed as part of the Ancillary facilities and design changes study (Jacobs 2013), however no sites or PADs were identified at the interchange itself.

### 5.2.2. Boundary Road Gulmarrad (Everick 2017)

Everick was commissioned to undertake an archaeological assessment for a proposed mixed-use residential subdivision at Boundary Road Gulmarrad (Everick 2017). This investigation included elevate ground above an extensive swamp and wetland to the north of Gulmarrad, however did not identify any archaeological sites or PADs.

### 5.2.3. Rosella Road Gulmarrad (Everick 2018)

Everick was commissioned to undertake an Aboriginal Cultural Heritage Assessment Report to support an AHIP for works around a scarred tree as part of the Rosella Road residential subdivision (Everick 2018). The modification of the tree was consistent with the collection of bark for a canoe or shelter and had resulted in the premature death of the tree, which was subsequently retained within the residential subdivision.

## 5.3. Predictive Modelling

The following model can be proposed for archaeological sites within the sub-coastal zone of the Clarence River;

> The subcoastal zone of the Clarence Valley is less likely to contain large and diverse Aboriginal archaeological sites when compared to the open beachfront, rocky headland and estuarine environments of the coastline. The elevated ridge that forms the Hillcrest reserve to the north east

of the Project Area was likely the focus of travel and campsites as it provided elevated and flat passage through the inundated wetlands of the Clarence floodplain. While the paperbark forests would have provided Aboriginal people of the region food and other resource the forests were extensive throughout the sub-coastal area it is likely that the larger and permanent campsites of the Bundjalung would have been on elevated ground. Notwithstanding the extent of historical disturbance of the sub-coastal zone from logging, pastoralism and horticulture it is unlikely that large and complex Aboriginal archaeological sites would have been deposited in the Project Area.

# 6. FIELD SURVEY: ABORIGINAL CULTURAL HERITAGE

## 6.1. Constraints to Site Detection

An assessment of the constraints to site detection is made to assist in formulating a view as to the effectiveness of the field inspection to find Aboriginal sites and cultural heritage materials. It also assists in the forming of a view of the likelihood of concealed sites, keeping in mind a site-specific knowledge of the disturbance impacts that European land uses and natural processes may have had on the 'survivability' of Aboriginal sites in a Project Area.

The constraints to site detection are almost always most influenced by post European settlement land uses and seldom by natural erosion processes. The area of surface exposure and the degree of surface visibility within exposed surfaces are usually the product of 'recent' land uses for example land clearing, ploughing, road construction, natural erosion and accelerated (manmade) erosion (McDonald et.al. 1990:92). In this case the major 'manmade' constraints to Aboriginal site survivability and detection are due to the following;

- Reclamation of the original swampland and use for sugar cane/ horticulture;
- Removal of original soils for the sewerage treatment works;
- Removal of soils for construction stockpile areas; and
- Inundation of lowlying areas from surface water, including in a dam.

## 6.2. Site inspection

To achieve as thorough and effective an archaeological assessment as possible a systematic ground survey of all the Project Area was undertaken. Due to the recent earth works associated with access tracks and stockpiling, surface visibility was 80% and the visible area available to potentially detect Aboriginal sites was also 80%. The effective coverage can be confidently estimated at approximately 64%.

A site inspection of the Project Area was undertaken on Tuesday 18 February 2020 with Mr Firlin Laurie from Yaegl Traditional Owners Aboriginal Corporation ('TOAC') and Tim Hill (Everick Heritage Principal Northern NSW). The site inspection aimed to identify the potential for the Project Area to contain Aboriginal archaeological sites (Table 4) and to document the nature and extent of previous soil disturbance and locate intact soils with the potential to contain archaeological sites (Figure 9 - Figure 11).

Table 4: Survey coverage

| Survey Unit | Landform | Survey Unit Area (m2) | Visibility (%) | Exposure (%) | Effective Coverage Area (m2) | Effective Coverage (%) |
|---|---|---|---|---|---|---|
| Lowlying alluvial | Flat | 5000 | 80 | 80 | 3200 | 64 |

Figure 9: Typical ground surface visibility and around soil stockpiles.

Figure 10: Simple formed access and soil stockpiles.

Figure 11: Council stockpile area with grass cover.

# 7. RESULTS OF ABORIGINAL CULTURAL HERITAGE ASSESSMENT

## 7.1. Results of consultation and survey

As a result of the desktop study, field inspection and consultation with Yaegl TOAC, the following can be concluded:

a) No Aboriginal sites or cultural significance, including archaeological sites, are known to occur within the Project Area.

b) The Project Area has been substantially disturbed by cut and fill earth works and there are no intact topsoil deposits which have not been disturbed to some degree.

c) Having consideration for the predictive model it is not considered that the Project Area had a high potential to contain Aboriginal sites as it is likely that the main Aboriginal occupation sites would be closer to the coastline and Lake Innes to the south of the Project Area.

Based on the desktop assessment it is not considered that the Proposed Works, being construction of the highway service centre will likely impact on Aboriginal objects. As such, additional community consultation and archaeological investigation is not required to comply with the National Parks and Wildlife Act (1974) and Regulations (2019).

# 8. RECOMMENDATIONS

The assessment has concluded that ground disturbing works within the Project Area are unlikely to impact on Aboriginal objects and will not impact on any known places or sites of cultural significance to the Aboriginal community. As such additional consultation and archaeological investigation is not required. However, the following recommendations are provided for the as a precautionary measure to mitigate impacts to potential Aboriginal heritage values.

## Recommendation 1: Aboriginal Objects Find Procedure

It is recommended that if suspected Aboriginal material has been uncovered because of development activities within the Project Area:

a) work in the surrounding area is to stop immediately;

b) a temporary fence is to be erected around the site, with a buffer zone of at least 10 metres around the known edge of the site;

c) an appropriately qualified archaeological consultant is to be engaged to identify the material; and

d) should the works be deemed to have harmed the Aboriginal objects the DPI&E should be notified immediately via the EPA Enviro Hotline.

Having consideration for the outcomes of the Community Consultation it is recommended that representatives of the Yaegl TOAC are engaged during the initial earthworks affecting any residual topsoil deposits to support the implementation of the Aboriginal Objects Find Procedure as “spotters” and to provide civil contractors with a cultural heritage induction prior to commencement.

## Recommendation 2: Aboriginal Human Remains

Although it is unlikely that Aboriginal Human Remains will be located at any stage during earthworks within the Project Area, should this event arise it is recommended that all works must halt in the immediate area to prevent any further impacts to the remains. The site should be cordoned off and the remains themselves should be left untouched. The nearest Police Station (Maclean), the Yaegl TOAC and the DPI&E Regional Office (Coffs Harbour) are all to be notified as soon as possible. If the remains are found to be of Aboriginal origin and the police do not wish to investigate the Site for criminal activities, the Aboriginal community and the DPI&E should be consulted as to how the remains should be dealt with. Work may only resume after agreement is reached between all notified parties, provided it is in accordance with all parties’ statutory obligations.

It is also recommended that in all dealings with Aboriginal Human Remains, workers or contractors should use respectful language, bearing in mind that they are the remains of Aboriginal people rather than scientific specimens.

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# APPENDIX A: CORRESPONDENCE WITH YAEGL TOAC

**From:** Tim Hill

**Sent:** Thursday, 5 March 2020 1:57 PM

**To:** YaeglTOAC@outlook.com

**Subject:** Cultural Site Inspection- Maclean Service Centre

Hi Can you please make contact regarding the cultural site inspection for the proposed Maclean Service Centre at Townsend. I have provided a location image below and a plan provided by our client. Please call on 0422309822. ta

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The linked image cannot be displayed. The file may have been moved, renamed, or deleted. Verify that the link points to the correct file and location.

Tα

## Tim Hill

BA (Hons)

### Principal (Coffs Harbour)

Ph: (02) 6655 0225

Mob: 0422 309 822

# APPENDIX B: AHIMS EXTENSIVE SEARCH RESULTS

Office of Environment & Heritage

**AHIMS Web Services (AWS)**

**Extensive search - Site list report**

Your Ref/PO Number : EV985 Maclean Highway Se

Client Service ID : 490266

| SiteID | SiteName | Datum | Zone | Easting | Northing | Context | Site Status | SiteFeatures | SiteTypes | Reports |
|---|---|---|---|---|---|---|---|---|---|---|
| 13-1-0117 | Hillcrest Reserve | AGD | 56 | 519880 | 6740071 | Open site | Valid | Habitation Structure : 1, Potential Archaeological Deposit (PAD) : 1 | | |
| | **Contact** T Russell | **Recorders** | Ms.Katrina Stankowski | | | | | **Permits** | | |
| 09-1-0208 | PAD 15 | GDA | 56 | 520235 | 6740251 | Open site | Valid | Potential Archaeological Deposit (PAD) : 1 | | |
| | **Contact** | **Recorders** | Ms.Vanessa Edmonds,Jacobs Group (Australia) Pty Ltd - Darwin | | | | | **Permits** | | |

**Report generated by AHIMS Web Service on 11/03/2020 for Tim Hill for the following area at Lot : 2, DP:DP634170 with a Buffer of 1000 meters. Additional Info : ACHA report. Number of Aboriginal sites and Aboriginal objects found is 2**



Page 1 of 1

# VOLUME 3

## Contamination Verification

PLANNERS NORTH

# SITE AUDIT REPORT

## Townsend Sewage Treatment Plant
## Corner of Schwonberg and Goodwood Streets, Townsend, NSW, 2463

Prepared for:

## Ledonne Constructions Pty Ltd

David Gregory
NSW EPA Accredited Contaminated Land Site Auditor
Accreditation Number: 1501

Audit Ref: DG006

## Final Report

June 2019 **Report Reference:** 1601147cSARRptFinalV01_07.06.19

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# DOCUMENT CONTROL

## SITE AUDIT REPORT

Townsend Sewage Treatment Plant,
Corner of Schwonberg and Goodwood Streets,
Townsend, NSW 2463

## PREPARED FOR

Ledonne Constructions Pty Ltd
43 Planthurst Road,
Carlton, NSW 2218

**Report Reference:** 1601147cSARRptFinalV01_07.06.19.docx

**Date:** 21 June 2019

### DISTRIBUTION AND REVISION REGISTER

| Revision Number | Date | Description | Distribution | | |
|---|---|---|---|---|---|
| | | | Client | Council | NSW EPA |
| Final | 07.06.19 | Site Audit Report 1601147cSARRptFinalV01_07.06.19.docx | SAS/SAR (e) | SAS(e) | SAS(e) |

Notes: SAS – Site Audit Statement; SAR – Site Audit Report; e - electronic

**Issued by:** Geo-Logix Pty Ltd

**ABN:** 86 116 892 936

**David Gregory**

NSW EPA Accredited Site Auditor #1501

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# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ACM | Asbestos Containing Materials |
| AHD | Australian Height Datum |
| BaP(TEQ) | Benzo(a)pyrene Toxic Equivalence Quotient |
| BaP | Benzo(a)pyrene |
| BOD | Biological Oxygen Demand |
| BTEXN | Benzene, Toluene, Ethylbenzene, Xylenes, Naphthalene |
| CEC | Cation Exchange Capacity |
| CLM Act | Contaminated Land Management Act 1997 |
| COPC | Contaminants of Potential Concern |
| DDT | Dichlorodiphenyltrichloroethane |
| DEC | Department of Environment & Conservation |
| DECCW | Department of Environment Climate Change & Water |
| DQOs | Data Quality Objectives |
| DSI | Detailed Site Investigation |
| EILs | Ecological Investigation Levels |
| ESLs | Ecological Screening Levels |
| EPA | Environment Protection Agency (NSW) |
| GME | Groundwater Monitoring Event |
| HILs | Health Based Investigation Levels |
| HSLs | Health Screening Levels |
| LCS | Laboratory Control Sample |
| Metals | Arsenic (As), Aluminium (Al), Copper (Cu), Lead (Pb), Zinc (Zn), Chromium (Cr), Nickel (Ni) Mercury (Hg), Cadmium (Cd), Iron (Fe), Manganese (Mn), Selenium (Se) |
| NEPC | National Environmental Protection Council |
| OCPs | Organochlorine Pesticides |
| OEH | Office of Environment and Heritage (NSW) |
| PAH | Polyaromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| PCSM | Preliminary Conceptual Site Model |
| PFAS | Per-and poly-fluoroalkyl substances |
| RAP | Remediation Action Plan |
| RPD | Relative Percent Difference |
| SAQP | Sample, Analysis and Quality Plan |
| SAR | Site Audit Report |
| SAS | Site Audit Statement |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TRH | Total Recoverable Hydrocarbons |
| VOC | Volatile Organic Compounds |

# 1. INTRODUCTION

A site contamination audit has been completed of the former Clarence Valley Council (CVC) Townsend Sewage Treatment Plant (STP) located at corner of Schwonberg and Goodwood Streets, Townsend, NSW.

The purpose of the audit was to assess the suitability of the site for rezoning from SP2 Infrastructure to RU1 Primary Production. As there is no national standard for agricultural / primary production land, CVC requested the site be audited against Residential A Land Use Standards as defined in NEPC 2013.

Particulars of the audit are defined below:

| | |
|---|---|
| Requested by: | Mr Shaun Zimmerman – Ledonne Constructions Pty Ltd |
| Commencement date: | 17 January 2017 |
| Auditor: | David Gregory |
| Accreditation No: | 1501 |
| Audit Ref No: | DG006 |
| Statutory / Non Statutory: | Statutory |
| Purpose: | Land use suitability assessment as per *Section 4* (definition of 'site audit' *(b)(iii)*) of the *Contaminated Land Management Act 1997* (*CLM Act*) |
| | Residential A |

## 1.1 Site Audit Objectives and Scope

It is understood the former STP was to be remediated to a residential standard that would enable CVC to rezone the site from SP2 Infrastructure to RU1 Primary Production.

The Audit was carried out to comply with the NSW EPA approval for surrender of the STP Environmental Protection Licence (EPL 2507).

## 1.2 Documents Reviewed

The following documents were reviewed during the audit:

- Preliminary Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, February 2017 (Ref#16026 TE R01 V3);
- Data Quality Objectives and Sampling, Analysis and Quality Plan – groundwater and soil investigation – Townsend Sewerage Treatment Plant, Lot 2 DP 634170, Corner of Schwonberg and Goodwood Street, Townsend NSW 2463. Cavvanba Consulting, December 2016 (Ref#16026 TE R02);
- Detailed Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, August 2017 (Ref#16026 IL R03 V4);

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- Acid Sulfate Soil Management Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanbah Consulting, July 2017 (Ref#16026 TE R04);
- Detailed Site Investigation – Addendum – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, October 2017 (Ref#16026 IL R05);
- Remediation Action Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, February 2018 (Ref#16026 IL R06);
- Validation Report – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, June 2019 (Ref#16026 IL R08)

In addition, relevant information provided in the following documents was also considered:

- Review of Environmental Factors, Townsend Sewage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463. Cavvanba Consulting, 2018 (Ref. 16026 TE R07);
- NSW Environmental Protection Licence #2507 (1st October 2014) - Townsend Sewerage Treatment;
- Report on Preliminary Contamination Assessment, Proposed Decommissioning & Rehabilitation Maclean, Townsend & Ilarwill STP. Douglas Partners, August 2005 (Ref:39098); and
- Redundant Sewer Treatment Plants at Junction Hill (3), South Grafton, Maclean, Ilarwill and Townsend, Future Land Use Assessment. GHD, June 2010 (Ref#22/15090/14122).

## 1.3 Audit Correspondence

Relevant auditor advice and correspondence relating to the audit assessment is included in Appendix A.

**Table 1: Audit Chronology**

| Date | Assessment / Site Audit |
|---|---|
| 17 December 2016 | Auditor Site Inspection |
| 17 January 2017 | Commence audit & notify NSW EPA |
| 19 January 2017 | Issue Interim Advice #1 – Preliminary Site Investigation |
| 25 January 2017 | Issue Interim Advice #2 – Sampling Analysis Quality Plan |
| 8 August 2017 | Issue Interim Audit Advice #3 – Detailed Site Investigation |
| 20 November 2017 | Issue Interim Audit Advice #4 – DSI Addendum7 March 2018 |
| 7 March 2018 | Issue Interim Audit Advice #5 – RAP |
| 6 August 2018 | Auditor Site Inspection (Remediation Completion) |
| 14 May 2019 | Issue Interim Advice #6 – Validation |
| 21 June 2019 | Issue Site Audit Statement and Site Audit Report |

# 2. SITE DESCRIPTION AND HISTORY

## 2.1 Site Identification

**Table 2: Site Identification**

| Street Address | Lot & Plan | Audit Area | Zoning |
|---|---|---|---|
| Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463 | Lot 2 DP 634170 | 30,000m$^2$ | SP2 Infrastructure |

The audit area is presented in Figure 1.

## 2.2 Site Condition and Surrounding Land Use

The site was the former Townsend STP on the corner of Schwonberg Street and Goodwood Street, Townsend and approximately 1.2km south-west of the Townsend village. The site has a total area of approximately 3 hectares.

The Townsend STP was a small – medium scale operation which provided sewerage waste water treatment (average of 130kL/day) for Townsend. It is also understood Townsend STP received pump out effluent from septics throughout the Maclean region and later from all over the CVC area. Effluent was received at the STP via a pump station located on Schwonberg Street near Cameron Street and via septic pump out trucks. It is noted septage from truck pump outs was not disposed at Townsend.

The STP comprised an oxidation pond which was fed effluent by a rising main from the offsite pump station. Wastewater in the oxidation pond discharged to a smaller polishing pond which then piped wastewater to the utilisation area (infiltration) located immediately west of the ponds. Two concrete septic tanks were used to receive pump out waste prior to discharging to the oxidation pond. Biosolids were collected in the septic tanks and stockpiled onsite (small volumes). It is understood biosolids have never been dredged from the treatment ponds.

Holding ponds were constructed by excavating 1m to 3m below surface into the groundwater table and the excavated natural material was used to build the pond walls, with additional imported fill material placed on top at a later date. Some of the inflow pipe network and baffles within the ponds contained asbestos.

In 2014 the STP received approximately 1200 tonnes of material from Yamba STP (Yamba STP Stockpile).

In addition, approximately 600 tonnes of soil, construction and building waste was deposited on the eastern portion of the site, adjacent south of the Yamba STP Stockpile. During site visit in December 2016, fragments of Asbestos Piping were noted by the Auditor on the surface of these stockpiles (Asbestos Waste Stockpile).

The site is located in an area of mainly cattle grazing / agricultural landuse, with surrounding land uses identified as:

- **North:** Undeveloped land, followed by failed plantation and/or cattle grazing;
- **East:** Schwonberg Street, followed by cattle grazing land;

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- **West:** Access road and unnamed creek, followed by agricultural land;
- **South:** Goodwood Street, followed by agricultural land.

## 2.3 Site History

The consultant's site history findings are summarised below.

**Table 3: Site History Summary**

| Year | Uses |
|---|---|
| Prior 1983 | Likely grazing/agriculture; mostly low-lying swamp/scrub with scattered trees |
| 1983 – 2010 | The site was used as a STP (no structures on-site, excluding the ponds, associated pipe outlets and concrete settlement tanks). |
| 2010 | STP operations ceased 2010 and site use has not changed since. |

The information relating to the site history considered by Cavvanba Consulting (CC) is presented below. A licence in relation to the site operation as a former STP was found for the site, surrendered on 23 November 2016. No issues of contention were identified in the record searches for the property and the NSW Workcover Stored Chemical Information Database did not identify any dangerous goods licences.

**Table 4: Summary of Site History Information Sources**

| Information Source | Consultant |
|---|---|
| Site Inspection | ☒ |
| Site Interviews | ☒ |
| Dial Before You Dig Plans | ☒ |
| Site Plans, Haz Mat Registers, Process Diagrams | ☒ |
| S149 Property Certificate (2 & 5) | ☒ |
| Historical Title Deeds | ☒ |
| Historical Aerial Photos | ☒ |
| Safework NSW Stored Chemical Information Database | ☒ |
| NSW EPA Contaminated Land Public Records | ☒ |
| List of Contaminated Sites Notified to EPA (s60 CLM Act 1997) | ☒ |
| Public Register under section 308 of the Protection of the Environment Operations Act 1997 | ☒ |
| Council Records Search | ☒ |
| Review of historical environmental reports applicable to the site | ☒ |

## 2.4 Topography and Hydrology

The nearest water bodies are drainage channels located directly adjacent to the south, east and west of the site. The Clarence River is located approximately 450m southwest of the site.

CC reported:

- site topography as relatively flat with a slight general fall towards the north/north-east; and
- site is located on a low lying flood plain at an elevation of 1 - 4 m AHD.

## 2.5 Geology

Based on the Grafton Area Coastal Quaternary Geology Map (Geological Survey of New South Wales, 2008), the site lies within Holocene levee, consisting of fluvial sand, silt and clay.

CC indicates the Clarence Valley Council Mapping website shows the site to be located on Class 3 acid sulfate soils. This reports that works at 1m to 3m below the ground surface, or works by which the water-table is likely to be lowered by 1m to 3m are likely to encounter acid sulfate soils.

CC described the site stratigraphy over the majority of the site, excluding pond walls, as follows:

- Clayey silt topsoil to depths of 0.3m;
- Brown and red brown sandy silty clay to approximately 0.8m; and
- Dark brown and red brown to grey saturated soft clay to the maximum investigation depth of 2.0m.

CC identified layer of road base, approximately 0.5m, covering part of the eastern portion of the site, adjacent to the Yamba STP stockpile and Asbestos Waste Stockpile.

### 2.5.1 Pond Walls Fill

CC described the fill in the pond walls generally to consist of light brown clayey sand. CC reported this material was homogeneous at all locations investigated and contained no observable contamination or anthropogenic material.

### 2.5.2 Yamba STP Stockpile

Approximately 1200 tonnes of soil stockpiled on the northeast corner of the site. CC describe the material as fill comprising gravelly sand, dark brown, loose, dry to moist, with anthropogenic inclusions of wood, plastic, concrete, brick, rags, geofabric, steel, wire, pipe and bitumen.

### 2.5.3 Asbestos Waste Stockpile

Approximately 600 tonnes of soil waste from an unknown origin, stockpiled on the eastern portion of the site, south of the Yamba STP Stockpile. CC describe the material as fill comprising gravelly clayey sand, grey to brown, containing concrete, PVC, plastic, wood, geofabric, asphalt, and asbestos fragments. A portion of the stockpile was noted to comprise mulch.

## 2.6 Hydrogeology

CC reported groundwater at depths of 0.9 – 1.0m below the natural ground surface during investigation work. Following the installation of three groundwater wells, CC determined groundwater flow direction to be towards the west/southwest. Regionally groundwater is anticipated to flow west towards the Clarence River.

CC described the groundwater as neutral to acidic pH, moderately reducing to well oxygenated, high total dissolved solids (TDS) and associated with excessive scaling, corrosion and unsatisfactory taste.

Groundwater quality parameters collected during sampling events in February 2017 and August 2017 were reported by CC as:

**Table 5: Groundwater Quality Parameters**

| Round | Depth to water (m) | Dissolved Oxygen (ppm) | Electrical Conductivity (mS/cm) | pH (units) | Redox Potential (mV) | Temp (c) |
|---|---|---|---|---|---|---|
| Feb 2017 | 0.24 – 0.43 | 0.99 – 2.46 | 6.50 – 9.47 | 4.92 – 6.63 | 253 - 413 | 22.57 – 25.05 |
| Aug 2017 | 0.610 – 1.034 | 1.56 – 4.09 | 5.59 – 10.5 | 5.16 – 6.26 | 266 – 364 | 18.22 – 19.89 |

Groundwater is brackish, unsuitable for potable supply. A search of NSW Department of Primary Industries Office of Water licensed bores, conducted by CC, did not identify any registered groundwater bores within a 500m radius of the site.

## 2.7 Potential Contaminants of Concern

CC concluded the principle sources of contamination relate to the use of the site as a STP and identified the following contaminants of potential concern (COPC).

**Table 6: Summary of Potential Contamination**

| Area | Potential Source | Activity | Potential Contaminants |
|---|---|---|---|
| Utilisation Areas | Effluent/influent | STP operation and effluent/influent in the utilisation areas potentially containing a range of contaminants. | Heavy metals, Nutrients, Microbial Indicators, TRH, BTEXN, PAHs, OCPs, OPPs, PCBs, BOD, PFAS, VOCs, SVOCs Phenols |
| Pond Walls | Fill material | Importing fill material for the construction of pond walls.<br>Yamba STP Stockpile.<br>Asbestos Waste Stockpile. | Heavy metals, TRH, BTEXN, PAHs, OCPs, PCBs, Asbestos |
| Pond sediment | Biosolids | STP operation and biosolids collected at the bottom of effluent ponds | Heavy metals, OCPs, PCBs, TRH, BTEX, PFAS, PAHs |
| Ponds and adjacent | Associated pipework and corrugated sheeting (baffles) | STP infrastructure | ACM |
| Entire Site | Pesticides/herbicides | Localised pesticide/herbicide use | Heavy metals, OCPs, OPPs |

Nutrients = Ammonia, Nitrite, Nitrate, Total Kjeldahl, Total Nitrogen, Total Phosphorus and Reactive Phosphorous

Metals (groundwater) = Al, As, Cd, Cr, Cu, Pb, Ni, Se, Zn, Fe, Hg

Microbial indicators = E. Coli and Thermotolerant Faecal Coliforms

PFAS = Per- and Polyfluorinated Alkyl Substances

Metals (biosolids) = As, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Se

Metals (soil) = As, Cd, Cr, Cu, Ni, Pb, Zn, Hg

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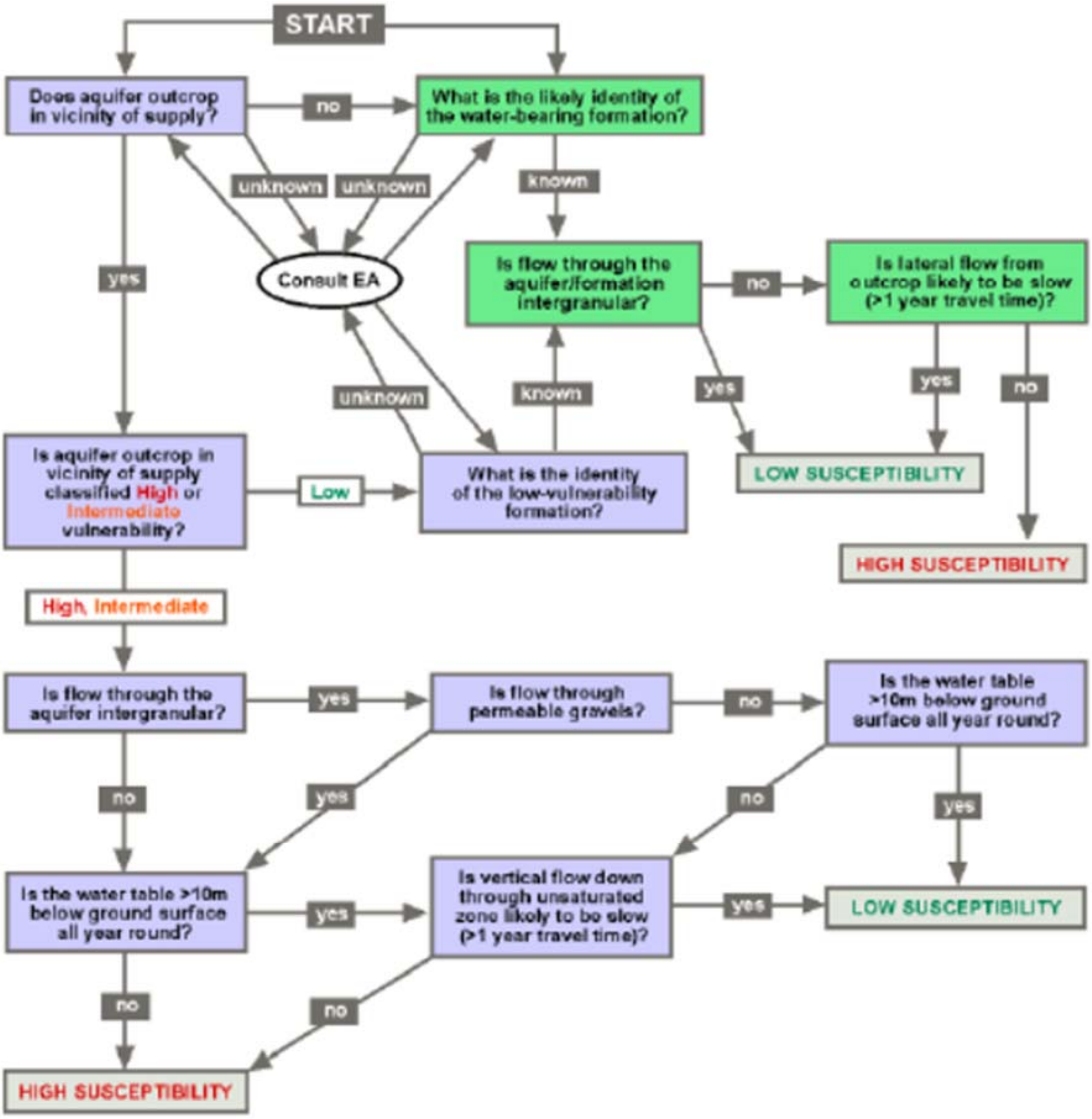
To assess the risk of pathogens as a primary contaminant of concern, CC took into consideration the Aquifer Pathogen Pollution Susceptibility Rating flow chart from a review for the UK Groundwater Forum in 2001 by Brian Morris, formerly of the British Geological Survey, titled “Pathogens and groundwater”.

Aquifer Pathogen Pollution Susceptibility Rating




CC concluded the pathogen risk to be “low susceptibility” based on the following factors:

- No drinking water aquifers in vicinity of site;
- Groundwater is shallow, unpotable, and vulnerable to urban / agricultural pollution;
- Saturated zone is Clay limiting transport rates and increase potential for attenuation.

The Auditor concurs.

## 2.8 Conceptual Site Model

CC developed a preliminary conceptual site model (CSM) that was continually updated throughout the investigations. The potentially complete pathways identified by CC in the CSM post investigations are summarised below.

**Table 7: Conceptual Site Model**

| Source | Media | Receptors | Point of Exposure | Routes of Exposure | Pathways |
|---|---|---|---|---|---|
| Imported fill material - Pond walls and Yamba STP Stockpile<br>Contaminated Effluent/influent over utilisation areas<br>Biosolids | Soil<br>Indoor Air<br>Outdoor Air<br>Groundwater<br>Surface water | Human Health | During residential construction<br>Resident occupation<br>Neighbouring residents | Ingestion<br>Inhalation<br>Dermal | Resolved |
| | | Environment / Ecology | Resident Yards<br>Adjacent drainage channel<br>Clarence River<br>Groundwater | Ingestion<br>Dermal<br>Uptake | Resolved;<br>Biosolids require waste removal |
| ASS | Soil<br>Groundwater<br>Surface water | Environment / Ecology | Adjacent drainage channel<br>Clarence River<br>Groundwater | Dermal<br>Uptake | Management Required |
| ACM<br>Asbestos Waste Stockpile | Soil<br>Outdoor Air | Human Health | Construction / maintenance workers | Inhalation<br>Ingestion<br>Dermal Contact | Management Required |

## 2.9 Auditor Comments

The consultant has obtained and considered sufficient evidence to establish the site history and potential for contamination of the land. Uncertainty associated with liquid waste streams was addressed by adopting broad contaminant suites for screening purposes.

CC conceptual model was generally appropriate for the potential contaminating activities that occurred onsite. It is recognised the risk pathway associated with asbestos (ACM) is via inhalation, not via ingestion or dermal contact. The pathogen risk was appropriately addressed. Pathogens attenuate naturally and do not have a long residence time in the environment.

# 3. ASSESSMENT CRITERIA

The environmental objective was to remediate the site to a standard that would enable residential land use consistent with the NEPC Residential A conceptual model. The assessment criteria adopted by the consultant for contamination assessment and validation are detailed below.

## 3.1 Soils

The consultant adopted soil assessment and validation criteria from the sources identified in the following table.

**Table 8: Summary of Soil Assessment and Validation Criteria**

| Criteria | Auditor Comments | Assessment | Validation |
|---|---|---|---|
| NEPC (2013) Health Investigation Levels – Residential A (HIL A) | Appropriate | ☒ | ☒ |
| NEPC (2013) Health Screening Levels for vapour intrusion – HSLs A & B(low – high density residential, sand geology, 0-<1 m) | Appropriate | ☒ | ☐ |
| NEPC (2013) Environmental Investigation Levels (EILs), soil-specific added contaminant limits for aged metals and DDT in soils for urban residential/public open space. | Appropriate.<br>EILs calculated using site specific values of CEC 12.9 and pH of 4.8. | ☒ | ☒ |
| NEPC (2013) Environmental Screening Levels (ESLs), urban residential and public open space for coarse soil texture | Appropriate. | ☒ | ☐ |
| Asbestos - if suspected ACM is visually observed during the investigation, then will be tested and criteria applied. | Appropriate. | ☒ | ☐ |
| ASSMAC (1998) Acid Sulfate Soils Planning Guidelines | Appropriate. | ☒ | ☐ |
| Dear et.al. (2002) Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines v 4.0 | Used for target levels for ASS post treatment. Appropriate. | ☐ | ☒ |
| Aesthetics | CC applied NEPC (2013) Management Limits for TPH fractions F1 – F4 in soil as aesthetic considerations for petroleum hydrocarbons.<br>CC conducted an aesthetics assessment during and after remedial works with consideration to NEPC (2013).<br>Observations during field work reported by CC indicated anthropogenic material in the Yamba STP stockpile (specific ENM exemption issued by NSW EPA; anthropogenic material screened out prior to reuse) and Asbestos Waste Stockpile (removed from site). CC do not indicate the presence of anthropogenic material in other fill on site. Additionally, fill imported for levelling purposes after remediation was classified ENM, VENM and a specific ENM exemption.<br>With the exception of biosolids (which was removed from site), aesthetics is not considered an issue. | ☒ | ☒ |

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## 3.2 Biosolids

The consultant adopted biosolids assessment and waste classification criteria from the following sources.

**Table 9: Summary of Biosolids Assessment and Waste Classification Criteria**

| Criteria | Auditor Comments |
|---|---|
| NSW EPA (2000) Environmental Guidelines: Use and Disposal of Biosolids Products – residential land use | Appropriate. |
| Australian Government Department of Health (2017) Health Based Guidance Values for PFAS for use in site investigations in Australia – for residential land use | Note:<br>The assessment of PFAS in biosolids was overseen and endorsed by the NSW EPA. |

## 3.3 Groundwater and Surface Waters

The consultant adopted groundwater and surface water assessment and validation criteria from the sources identified in the following table.

**Table 10: Summary of Groundwater Assessment and Validation Criteria**

| Criteria | Auditor Comments | Assessment | Validation |
|---|---|---|---|
| NEPC (2013) Groundwater Investigation Levels (GILs) for Marine Waters. | GILS for marine water were adopted on the basis that the receiving system for groundwater at the site is the Clarence River (marine). Low reliability trigger values, ANZECC (2000) were adopted in the absence of high reliability values (aluminium, arsenic, selenium and nitrate). | ☒ | ☒ |
| NEPC (2013) Groundwater Investigation Levels (GILs) for Drinking Water. | Groundwater Drinking water GILs were applied. These are considered inappropriate given the salinity and vulnerability of shallow groundwater. | ☒ | ☒ |
| NHMRC (2008) Guidelines for Managing Risks in Recreational Water | Recreational screening criteria derived by applying a multiplication factor of 10 to Drinking Water Guideline, as per NHMRC (2008). | ☒ | ☒ |
| NEPC (2013) Groundwater Health Screening Levels for vapour intrusion – HSLs A & B (low – high density residential, 2-<4m in sand). | Auditor considers these appropriate, noting that a site specific assessment would be required if petroleum was encountered given that groundwater is shallower than 2m. | ☒ | ☐ |
| Australian Government Department of Health (2017) Health Based Guidance Values for PFAS for use in site investigations in Australia | Note: these values include accounting for bioaccumulation and consumption of plants only. | ☒ | ☐ |
| ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality | CC used interim criteria for Iron from CCREM (1987) Canadian Water Quality Guidelines. Canadian Council of Resource and Environment Ministers, Ontario, as recommended by ANZECC (2000).<br>Criteria for water quality parameters for pond water discharge from ANZECC (2000).<br>Appropriate. | ☒ | ☒ |

# 4. EVALUATION OF DATA QUALITY

The auditor has assessed the overall quality of the data presented by the referenced reports.

## 4.1 Summary of site works completed

The site investigation and remediation/validation works is summarised in the table below.

**Table 11: Summary of Site Works**

| Works | Date | Consultant | Description |
|---|---|---|---|
| Detailed Site Investigation | February 2017 | Cavvanba | • Completion of 44 testpits (TP01 – TP44) and sampling of shallow soils of the utilisation area, pond walls (fill), Yamba STP Stockpile and Asbestos Waste Stockpile. The sampling was intended to be systematic, but applied a higher density to pond walls and stockpiles;<br>• Five samples of biosolids collected from the base of the two ponds that comprise the former STP;<br>• Installation and sampling of three groundwater monitoring wells; and<br>• Laboratory analysis of samples for COPC and soil samples for ASS status. |
| Detailed Site Investigation - Addendum | August 2017 | Cavvanba | • Completion of a further four testpits (TP27A – D) and soil sampling to delineate a TRH hotspot identified at TP27 during the initial investigation;<br>• Soil sampling at 0.5m depth at TP27 for vertical delineation (TP27_0.5);<br>• Additional three samples collected of the biosolids from the base of ponds;<br>• A second round of groundwater sampling from all three installed groundwater monitoring wells; and<br>• Laboratory analysis of samples for COPC. |
| Remediation | April – November 2018 | Cavvanba | • Biosolids, ACM associated with the overflow pipework/baffles and the Asbestos Waste Stockpile were removed and disposed of off-site. Further sampling of biosolids was undertaken for waste classification purposes;<br>• The soils comprising the pond walls were treated for ASS prior to backfilling the pond excavations;<br>• Yamba STP Stockpile (specific ENM exemption) screened for anthropogenic material and applied to former pond area;<br>• ENM material imported from Woodford Island (specific ENM exemption), treated for ASS and applied to former pond area; and<br>• Placement of imported ENM/VENM from South Grafton STP for site levelling purposes, applied to former pond area. |
| Validation | March - November 2018 | Cavvanba | • Validation sampling of soils across former pond areas, groundwater and surface water; |

| Works | Date | Consultant | Description |
|---|---|---|---|
| | | | • Validation sampling of ASS treated soils (pond walls and Woodford Island ENM); and<br>• Visual clearance for biosolids and Asbestos Waste Stockpile. |

## 4.2 QA/QC Assessment – Sampling and Analysis

The auditor's assessment of sampling and analysis data quality is presented in the table below.

**Table 12: Sampling and Analysis QA/QC Assessment**

| Sampling and Analysis Plan and Sampling Methodology | Comments |
|---|---|
| Data Quality Objectives | CC followed the seven step DQO process throughout the investigations and validation stages. Some refining of the steps was necessary to ensure clear decision rules were established for site validation. |
| Sampling Pattern and Locations | **Soil Investigation:**<br>CC completed the soil sampling plan in two steps. The initial sampling plan comprised collecting shallow soil samples from 44 test pit locations across the entire site. These locations are shown in Figure 2. These test pit locations comprised:<br>• 20 over the utilisation area (TP14 – TP33);<br>• 15 targeting the fill of pond walls (TP01 – TP13; TP34, TP35);<br>• Four investigating the Asbestos Waste Stockpile (TP36 – TP39);<br>• Four investigating the Yamba STP Stockpile (TP41 – TP44); and<br>• TP40 grid based point, area of road base.<br>CC collected samples for ASS testing at ten of these test pit locations, representative across the site (TP01, TP05, TP08, TP12, TP17, TP21, TP25, TP29, TP33, TP40).<br>The initial investigation identified TRH F2 and F3 impacted soil in excess of assessment criteria at location TP27 in the utilisation area. The additional works comprised shallow soil samples collected from:<br>• Five test pits to delineate TRH at TP27; four 5m in each direction from TP27 and one at TP27 for vertical delineation (0.5m).<br>**Soil Validation:**<br>Following remediation works and backfilling of the STP ponds CC collected 17 surface soil samples on an approximate 20m systematic grid over the former pond area. The sample locations are presented on Figure 3.<br>The pond walls excavated and treated with lime prior to filling in the pond void. ASS treatment validation sampling was conducted insitu (AS01 – AS10, AS06A – AS10A). The samples locations are presented on Figure 4.<br>**Groundwater:**<br>CC installed three groundwater monitoring wells at the site (MW01 – MW03). CC reported the locations were chosen to target the ponds and ensure triangulation for groundwater flow direction purposes.<br>**Surface Water:**<br>Samples from the drainage channel located immediately south of the STP were collected prior to and following the completion of remediation. Samples were taken adjacent to the site, and at downgradient and upgradient locations (SW01 – SW03).<br>In the Auditor's opinion these sampling locations adequately target the main areas of concern. |

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| Sampling and Analysis Plan and Sampling Methodology | Comments |
|---|---|
| Sampling Density and Depths | **Soil Investigation:**<br>CC defined the initial sampling strategy as being in accordance with NSW EPA (1995) Sampling Design Guidelines with 47 systematic locations on a 25.3m square sample grid to detect a circular hotspot of 29.8m diameter with 95% confidence. The Auditor notes these figures are incorrect. CC completed 44 test pits on a rough grid over the site, sampling shallow soils over the western portion (utilisation area), fill of the pond walls, the Asbestos Waste Stockpile and Yamba STP Stockpile. It is noted that the grid was not entirely adhered to in all areas as the sampling targeted the pond walls and stockpiles at a higher density due to the likely presence of contamination sources.<br>For the site area of 30,000m$^2$ the NSW EPA (1995) Sampling Design Guidelines require a minimum of 40 locations for site characterisation. All samples were tested for COPC heavy metals, while it is noted that approximately half of the samples from the pond wall fill and utilisation area selected for analysis of additional identified COPC TRH, BTEXN, PAHs, OCPs, PCBs. All samples from the Asbestos Waste Stockpile and Yamba STP Stockpile were analysed for all identified COPC.<br>The auditor was satisfied that there were a sufficient number of samples locations, with the appropriate depths sampled, targeting areas of known fill, with exception to:<br>• TRH impacted soil identified at TP27;<br>• Yamba STP Stockpile; and<br>• Asbestos Waste Stockpile.<br>The results of the initial investigation identified TRH F2 and F3 impacted soil above assessment criteria at location TP27 in the northwest of the utilisation area. CC carried out further works for the delineation of the TRH hotspot identified at TP27 with the surface soils sampled 5m from TP27 in each direction, and TP27 sampled at 0.5m for vertical delineation. Silica Gel Cleanup was performed on the TP27 delineation samples prior to analysis. Silica Gel Cleanup removes vegetable and animal oils from the sample leaving behind the petroleum based compounds.<br>The utilisation area covers and approximate area of 14,000m$^2$, for which the NSW EPA (1995) Sampling Design Guidelines require a minimum of 20 locations for characterisation, systematic for hotspot detection. With only 10 of these samples analysed for TRH, it is noted that the sampling for TRH was not systematic, nor did it meet minimum sampling standards for the area size.<br>However, the Auditor is satisfied there were a sufficient number of sample locations to characterise the extent of TRH to shallow soils across the utilisation area. Rationale is included in Section 5.2.2.<br>Additionally:<br>• Asbestos Waste Stockpile –classified and removed from site, covered in Section 6.3 Waste Audit;<br>• Biosolids – classified and removed from site, covered in Section 5.2.8 and Section 6.3.3;<br>• Yamba STP Stockpile – Specific ENM Exemption; covered in Section 6.4.1; and<br>• Imported fill – covered in Section 6.4.<br>**Soil Validation:**<br>Investigations identified elevated levels of heavy metals in biosolids. Surface soil validation samples were collected from the former pond areas after the backfilling for analysis of heavy metals. 17 samples were collected on a 20m grid. The sampling density meets NSW EPA (1995) Sampling Design Guidelines for the area size 6,100 m$^2$. |

Geo-Logix

| Sampling and Analysis Plan and Sampling Methodology | Comments |
|---|---|
| | **Acid Sulfate Soils – Pond Walls:**<br>The material comprising pond walls (acid sulphate soils) was excavated and applied over the former pond area. CC conducted the treatment and validation of acid sulfate soils over the former pond area in two stages. After initial treatment and application, ten validation soil samples were collected in situ from the treated soils (AS01 – AS10). Exceedances in site criteria were identified so the treated soils from areas where site criteria exceeded were excavated re-treated, re-applied and additional five samples were collected in situ over this area (AS06A – AS10A).<br>**Acid Sulfate Soils – Woodford Island ENM:**<br>The 2170m$^3$ of material excavated and stockpiled at Woodford Island STP (site-specific ENM exemption approved by NSW EPA) was treated and sampled for ASS onsite at Townsend in three treatment rounds of 10 samples (ASENM01 – ASENM30).<br>**Groundwater and surface water:**<br>Three groundwater wells were installed onsite to investigate potential contamination impact to groundwater beneath the site. CC conducted five groundwater sampling events in total; two rounds during the investigation stage, one prior to remediation and two after remediation works.<br>Three rounds of upgradient, adjacent and downgradient surface samples were taken of the drainage channel immediately to the south of the site; one round prior to remediation and two rounds after remediation works.<br>The Auditor considers the sample density adequate, all environmental media was appropriately sampled. |
| Well Construction | CC report the groundwater monitoring wells were constructed of 50 mm diameter Class 18 uPCV, with the screen extending from 0.5 metres below ground (mbg) – 2.0 mbg into natural sandy clayey silt and silty clay. A filter pack extends to the top of the screen and a bentonite seal to surface. The Auditor considers well construction methods were appropriate. |
| Sample Collection Method | **Soil Investigation:** CC reported soil samples were collected either directly from the test pit, where accessible, or from the excavator bucket. Biosolid samples were collected directly from the excavator bucket. Appropriate sampling methodology practices with respect to minimising cross contamination eg. Sampling from centre of bucket and new gloves for the collection each sample are detailed in the CC Standard Operating Procedures (SOPs), and it is understood that these were followed.<br>**Soil Validation:** CC reported surface soil samples for validation of former pond area after biosolids removal were collected by hand. Soil samples for ASS analysis were collected in situ by hand following placement of the treated former pond wall soil. Samples of biosolids were collected by hand from the stockpiled biosolids. New gloves were reportedly used for each new sample.<br>**Groundwater:** The first groundwater monitoring event (GME) was sampled using disposable plastic bailers, which was an alternate method to what was provided in the SAQP. The Auditor requested for a second GME to be completed to verify results. The subsequent GMEs were sampled using low flow sampling technique which the Auditor considers a more suitable technique. Water quality parameters have been measured during all GMEs.<br>**Surface Water:**<br>Three surface water locations were sampled using a disposable PVC bailer. A new bailer was used for each sample location.<br>CC report that samples for analysis of PFAS were collected in accordance with Government of Western Australia (2016) Interim guidance on the assessment and management of perfluoroalkyl and polyfluoroalkyl substances (PFAS) – contaminated sites guidelines. |

Geo-Logix

| Sampling and Analysis Plan and Sampling Methodology | Comments |
|---|---|
| | The sample collection methods described by CC as considered appropriate by the Auditor. |
| Decontamination Procedures | CC have reported:<br>• Decontamination of the interface probe was conducted between each monitoring well and no other re-usable equipment was used;<br>• Groundwater and surface water samples were collected using single use disposable bailers or dedicated LDPE tubing; and<br>• Soil samples were collected directly from the centre of the bucket of the excavator, ensuring it had not come into contact with the walls of the bucket.<br>The Auditor considers the decontamination procedures described appropriate. |
| Sample Handling & Preservation | Review of information reported by CC and the laboratory indicate samples:<br>• placed into laboratory prepared sample containers and appropriately preserved;<br>• to be analysed for dissolved metals were filtered in the field using a disposable 0.45micron filter;<br>• to be analysed for volatile substances filled with no bubbles/headspace;<br>• placed on ice; and<br>• transferred to laboratory under chain of custody.<br>It is noted that the secondary laboratory for some GME were not sent a field filtered sample for dissolved metals analysis. The samples were filtered in the laboratory from an unpreserved sample. This is not considered to affect the outcome of this audit. |
| Sample Logs and Calibration of Equipment | CC have provided samples logs / sample descriptions for all samples. A photo-ionisation detector (PID) has been used to screen soil samples and the calibration certificates has been provided. Water quality parameters have been taken during GMEs and surface water sampling and calibration certificates have been provided. |
| Chain of Custody | Have been provided and are acceptable. |

## 4.3 QA/QC Assessment – Field and Lab Quality

The auditor’s assessment of field and laboratory data quality and quality assurance / quality control is presented in the table below.

### Table 13: Sampling and Analysis QA/QC Assessment

| Field and Lab QA/QC | Auditor Comments |
|---|---|
| Field Quality Control Samples | Field intra-laboratory duplicates, trip blanks and spikes were undertaken at appropriate frequencies in accordance with NEPM.<br>The rate at which field inter-laboratory duplicates were collected for soils/biosolids were not be in accordance with NEPC. There are some inter-laboratory duplicate data reported that are within acceptable ranges and thus this exceedance is not considered to effect the outcomes of the investigation and validation.<br>No groundwater rinsate samples were collected. The Auditor notes that the use of the interface probe in each of the wells is a potential source of cross contamination between wells. Given there was no groundwater contamination of significance, this oversight does not impact on the outcome of the Audit. |
| Field quality control results | The results from all field quality control samples were within appropriate limits, with the exception of the following:<br>**Soil Investigation:** |

| Field and Lab QA/QC | Auditor Comments |
| --- | --- |
| | • Soils duplicate pair TP01_0.1/QS01 RPDs for arsenic (50%) and lead (52%);<br>• Soils triplicate pair TP01_0.1/QS01 RPD for lead (52%);<br>**Groundwater:**<br>• In the first GME, duplicate pair MW01/QW01 RPD for nitrate (67%). This outlier is considered acceptable as the results were only marginally above the limit of reporting (LOR) (0.01 and 0.02 ug/L);<br>• In the first GME, triplicate pair MW01/QW02 RPDs for ammonia (142%), total nitrogen (97%), total phosphorus (100%);<br>• In the pre-remediation March 2018 sampling round, triplicate pair MW03/QW02 RPDs for aluminium (57%), iron (90%) and total nitrogen (125%);<br>• In the post remediation January 2019 sampling round, triplicate pair MW03/QW02 RPDs for arsenic (167%). This outlier is considered acceptable as the results were only marginally above LOR (1 and 3 ug/L);<br>• In the post remediation January 2019 sampling round, triplicate pair MW03/QW02 RPDs for ammonia (139%), total nitrogen (73%) and total phosphorus (176%), considered to be sample heterogeneity;<br>• In the post remediation March 2019 sampling round, triplicate pair MW02/QW04 RPDs for nitrite (127%). This outlier is considered acceptable as the results were only marginally above LOR (0.01 and 0.02 ug/L); and<br>• In the post remediation March 2019 sampling round, triplicate pair MW02/QW04 RPDs for total phosphorous (91%).<br>Surface Water:<br>• In the pre-remediation March 2018 sampling round, duplicate pair SW03/QW03 RPD for nitrate (67%). This outlier is considered acceptable as the results were only marginally above LOR (0.01 and 0.02 ug/L);<br>• In the pre-remediation March 2018 sampling round, triplicate pair SW03/QW04 RPD for ammonia (78%);<br>• In the post remediation January 2019 sampling round, triplicate pair SW03/QW04 RPD for copper (67%). This outlier is considered acceptable as the results were only marginally above LOR (1 and 2 ug/L); and<br>• In the post remediation March 2019 sampling round, duplicate pair SW03/QW01 RPD for nitrate (59%). This outlier is considered acceptable as the results were only marginally above LOR (0.01 and 0.06 ug/L).<br>The recoveries for the some of the trip spikes were outside the required limits. This outlier is not considered significant to the outcome of this Audit as BTEXN was not a COC (Contaminant of Concern).<br>Many of the soil and biosolids RPD exceedances are likely attributable to sample heterogeneity. The groundwater RPD exceedances were also likely a function of sample heterogeneity as those samples were turbid and highly disturbed. A change in groundwater sampling method was recommended and subsequent sample integrity improved.<br>Overall the data quality is considered reliable. |
| NATA registered laboratory and NATA endorsed methods | Laboratories used were ALS, Envirolab, EAL at Southern Cross University, Eurofins, All laboratory certificates provided were NATA stamped. |
| Analytical Methods | Analytical methods were included in the laboratory certificates and were reported as appropriate with exception to below.<br>The laboratory certificate for the groundwater samples of the first GME in February 2017 (ES1703115) makes microbiological comment multiple tubes technique (AS4276.6) "was performed instead of membrane filtration because the sample was turbid / colourful; therefore was undesirable for filtration. This is not considered significant given the STP has not operated since 2010. |

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<table>
<tr><th>Field and Lab QA/QC</th><th>Auditor Comments</th></tr>
<tr><td></td><td>The laboratory certificates also appear to indicate the NATA accreditation does not cover PFAS analytical methods for biosolids. The lab explained they were using standard soil extraction methods which is industry standard and were seeking accreditation. Biosolids characterisation was reviewed and approved by the NSW EPA.<br><br>The laboratory certificate for the analysis of AS01 of the Woodford Island ASS treatment done by Environmental Analysis Laboratory at the Southern Cross University indicates that NATA accreditation did not cover the procedures used. This is not considered to be significant to the outcome of the treatment result as the analysis was only one of the ten samples and the result was not close the criteria.</td></tr>
<tr><td>Holding times</td><td>Investigations: Review of the laboratory certificates indicate holding times were breached for the following:<br>• TRH/BTEX for the soil trip blanks and spikes in the DSI works (2 days);<br>• Exchangeable cations (5 days) and pH (20 days) for TP37_0.5 (from Asbestos Waste Stock pile) and TP41_0.5 (from Yamba STP Stockpile) in the DSI works;<br>• pH, ammonia, TKN, faecal coliforms and E.Coli for the groundwater samples of the first GME February 2017 (1 – 2 days);<br>• pH, nitrite, reactive phosphorous, BOD, faecal coliforms and E.Coli for the groundwater samples of the second GME August 2017 (2 – 3 days); and<br>• BTEX for water trip spike of the second GME August 2017 (2 days);<br><br>The breach of holding time for the soil trip blanks and spikes (BTEX) are not considered to affect the outcome of the investigation as VOCs were not a COC. The investigation was looking at semi-volatile portions of TRH.<br><br>The exchangeable cations and pH results obtained during the DSI works were inappropriately used to calculated site-specific EILs. Samples of natural material from the site were analysed for exchangeable cations and pH for re-calculation of site-specific EILs. The breach in holding time for exchangeable cations and pH for these samples are irrelevant.<br><br>The breach for EColi and BOD would result in an increase in reported levels. As they were within acceptable standards no further assessment was considered necessary. The remainder compounds were evaluated in subsequent groundwater rounds.<br><br>Validation: Review of the laboratory certificates indicates that holding times were breached for the following:<br>• ASS testing of samples from Woodford Island ENM ASS Treatment Events 2 and 3 (7-10days);<br>• Nitrite and reactive phosphorus for the triplicate samples of the pre-remediation March 2018 GME (2 days);<br>• Nitrite and reactive phosphorus for the groundwater samples of the post remediation January 2019 GME (4 days). Nutrients were also noted to be analysed outside holding time for the triplicate samples for January 2019 GME (6 days);<br>• Nitrite and reactive phosphorus for the triplicate samples of the post remediation March 2019 GME (4-5 days);<br><br>CC report in reference to the holding time breach for Woodford Island ENM ASS testing:<br>• Exceedances were unavoidable due to the remote nature of the works; and<br>• Exceedances of holding times would likely lead to further oxidation of the soil, resulting in a lower pH which would be considered conservative for validation purposes.<br><br>The Auditor does not consider the exceedance as significant.<br><br>The exceedance of holding times for some nutrients in groundwater samples is not considered significant as there were results for nutrients obtained that were in holding times.</td></tr>
</table>

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<table>
<tr><th>Field and Lab QA/QC</th><th>Auditor Comments</th></tr>
<tr><td>Practical Quantitation Limits (PQL)</td><td> Soil and Biosolids: PQLs were appropriate and less than threshold criteria for the contaminants of concern, with exception to TP36_0.5 in the DSI works. The PQL for this sample for PAHs was raised from 0.5 mg/kg to 1.0 mg/g due to high moisture content of the sample. This resulted in a PQL marginally higher than the ESL criteria of 0.7 mg/kg for BaP. All analytical results for PAHs for this sample were non-detectable and this marginal PQL exceedance of the criteria is not considered significant. Groundwater: PQLs were appropriate and less than threshold criteria for the contaminant of concern, with exception to: <ul><li>Aluminium (10 ug/L), above the GIL 0.5 ug/L. This is not considered to affect the outcome of the groundwater conclusions as Aluminium was detected at concentrations well above PQL in many samples;</li><li>Selenium (10 ug/L), above the GIL 3.0 ug/L.</li><li>B(a)P for MW01 in the first GME in February 2017 (0.5 ug/L), above the drinking water criteria of 0.01 ug/L and recreational water criteria of 0.1 ug/L. This considered acceptable as it was not necessary to compare to this criteria.</li></ul> The auditor notes that there are errors of the PQLs presented in the analytical summary tables throughout the reports. The Auditor as commented on the appropriateness of the PQLs through the investigation and validation works based on PQLs presented in the laboratory certificates presented in the appendices. </td></tr>
<tr><td>Laboratory Quality Control Samples</td><td> Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks and duplicates were undertaken by the laboratory and at appropriate frequencies in accordance with NATA certification, with exception to the below: Soil Investigations: <ul><li>Laboratory duplicates and matrix spikes in biosolids and soils not completed for OCPs/ PCBs. Considered acceptable as LCS run at acceptable rates and results with acceptable ranges and all sample results for the analytes were non-detect (Reports ES1702963, ES1721326);</li><li>Laboratory duplicates and matrix spikes not completed at required rates for PAH/phenols for the leachate analysis for biosolids in DSI Addendum. Considered acceptable as LCS run at acceptable rates and results with acceptable ranges and all sample results for the analytes were non-detect (Report ES1721326); and</li></ul> Soil Validation: <ul><li>Laboratory duplicates not completed at the required rate for arsenic for the soil validation sampling of the former pond area. Considered to not impact on the outcome of site validation as there was one duplicate run for arsenic and the results were found to be within acceptable limits (Report ES1903624);</li><li>The analysis of AS01 of the Woodford Island ENM ASS testing was conducted by Environmental Analysis Laboratory at the Southern Cross University, Lismore. The report did not include any information about laboratory quality control samples run. This is not considered to be significant to the outcome of the treatment result as the analysis was only one of the ten samples and the result was not close the criteria. The aim of the sampling was to indicate if the treatment had been successful.</li></ul> Groundwater: <ul><li>Laboratory duplicates and matrix spikes for TRH semi volatile and semi volatile organic compounds not undertaken for both rounds of groundwater sampling. Considered acceptable as laboratory duplicates and matrix were undertaken for TRH volatiles/BTEXN and were with acceptable limits. In addition, all sample results for the analytes were non-detect (Reports ES1703115, ES1721120).</li><li>Laboratory duplicates not completed at the required rates for TKN and total phosphorus for the January 2019 post remediation GME. Considered to not impact on the outcome of site validation as there was one duplicate run for both</li></ul></td></tr>
</table>

| Field and Lab QA/QC | Auditor Comments |
|---|---|
| | analytes and results were found to be within acceptable limits (Report ES1903624); and<br>• LCS marginally outside the required rate for total phosphorus for the pre-remediation March 2018 GME. Considered acceptable and to not have an impact on the groundwater conclusions as there have been some LCS run for this analyte with the batch and these results were acceptable. Other laboratory QC data for total phosphorus was also reported with acceptable limits (Report ES1806581). |
| Laboratory Quality Control Results | **Soil Investigation:**<br>• Matrix spike recovery for zinc for biosolids sample ES1702834-002 collected during the DSI works was reported as not determined due to the background level greater than or equal to 4x spike level. Considered acceptable as other matrix spike recoveries for other metals within this batch were determined within acceptable limits. In addition, other quality control samples for zinc within this batch were also within acceptable limits (Report ES1702963);<br>**Groundwater:**<br>• LCS recoveries for a number of phenolic compounds, nitroaromatics/ketones, anilines/benzidines and organochlorine pesticides in sample QC-751073-002 from the first groundwater sampling round February 2017 were marginally outside the acceptable limits. These outliers are considered to not affect the reliability of these results as there were a great number of LCS recoveries for similar compounds that were detected within acceptable limits, and all results were reported below LOR for these analytes (Report ES1703115);<br>• Matrix spike recovery for ammonia in sample ES1721079—001 from the second groundwater sampling round August 2017 was reported as not determined due to the background level greater than or equal to 4x spike level. Considered acceptable as other matrix spike recoveries for ammonia within this batch were determined within acceptable limits (Report ES1721120); and<br>• Matrix spike recovery for Nitrite as N in groundwater sample ES1806558-001 of the pre-remediation March 2018 GME reported as an outlier (4.48%) due to “matrix interferences”. Considered acceptable as other matrix spike recoveries for other nutrients within this batch were determined within acceptable limits. In addition, other quality control samples for nitrite within this batch were also within acceptable limits (Report ES1806581). |

## 4.4 Auditor Comments

In reference to the dataset as a whole, the Auditor concludes the data set is a sufficient representation of environmental conditions:

- Complete – all sample locations, depths and methodology are considered appropriate and performance in the field and laboratory considered adequate;
- Representative – as appropriate media were characterised, including shallow soils in the utilisation areas, fill and natural soils of former pond areas, biosolids at base of ponds, groundwater and surface water from adjacent drainage canal;
- Precise – Overall an acceptable number of field and laboratory duplicates samples were collected and analysed and were found to be in acceptable limits. Minor exceedances were noted although these are not considered to be significant to the outcome of the Audit, as explained in Table 13;

- Comparable – standard techniques have been employed in the field and laboratory, NATA accredited laboratories were used during the investigation and validation works and samples were collected in and preserved in appropriate containers;
- Accurate – the data is likely to be accurate and reliable. An appropriate number of field QC samples were collected, standard methods were employed during sampling and the laboratory QC data was generally found to be within acceptable limits. Any exceedances are noted and discussed in Table 13.

# 5. INVESTIGATIONS

## 5.1 Preliminary Site Investigation

CC performed a Preliminary Site Investigation (PSI) in January 2017 as part of a due diligence process for CVC. The objectives of the PSI were:

- Identify all past and present potentially contaminating activities;
- Identify potential contaminants;
- Discuss the site conditions;
- Provide a preliminary assessment of site contamination with respect to the proposed land use; and
- Assess the need for further investigation.

The report included a review of site history, site setting, regional geology/hydrogeology and development of a CSM. The potential sources of site contamination were identified to be associated with the use of the site as a STP, the presence of ACM and importation of fill material.

## 5.2 Detailed Site Investigation and Addendum

CC performed a Detailed Site Investigation (DSI) in February – August 2017 to investigate the nature and extent of any existing or potential contamination of the land for the purposes of developing a remediation plan. Following the results of the DSI, additional investigation works were conducted by CC from August – October 2017 and reported as the DSI – Addendum. The results of these investigation works are summarised below.

### 5.2.1 Soil Investigations – Pond Walls

The investigation works included completion of test pits and soil sampling at:

- 44 locations (TP01 – TP44) across the site on an approximate systematic-grid to depths 1.0m - 3m. Bias was given to areas of fill identified onsite, including the fill comprising the pond walls (15 sample locations; TP01 – TP13; TP34 and TP35).

A summary of the soil analytical program undertaken by CC of pond wall fill samples is presented in the below table.

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**Table 14: Summary of Soil Analytical Results – Pond Walls**

| Sample Locations | Sample Type | n Primary Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Metals | TRH | TRH silica gel cleanup | BTEXN | PAHs | OCPs | PCBs | pH, CEC |
| Pond Walls | Fill | 13 | 4 | 0 | 4 | 4 | 4 | 4 | 0 |

Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

A summary of the analytical results of pond wall fill samples is presented in the below table. Analytical summary tables from the investigation works are provided in Appendix B.

**Table 15: Summary of Soil Analytical Results – Pond Walls**

| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| Soil Samples | Metals | 13 | ND | 79 (zinc) | 0 | 0 |
| | BTEXN | 4 | ND | ND | 0 | 0 |
| | F1 | 4 | ND | ND | 0 | 0 |
| | F2 | 4 | ND | ND | 0 | 0 |
| | F3 | 4 | ND | ND | 0 | 0 |
| | F4 | 4 | ND | ND | 0 | 0 |
| | Total PAHs | 4 | ND | ND | 0 | 0 |
| | OCPS/PCBS | 4 | ND | ND | 0 | 0 |

ND = Not detected above laboratory limits of reporting, NA = Not Applicable

COPC were not reported in pond wall fill samples in excess of ecological and health based residential land use criteria. In addition, no ACM was observed in the test pits during site works.

The Auditor agrees with the conclusions of CC that the soil within the pond walls was suitable to remain onsite under a residential land use scenario.

### 5.2.2 Soil Investigations – Utilisation Area

The 40 investigation test pits and soil sampling completed during the DSI investigation works included 20 test pits location within the utilisation area (TP14 – TP33). Semi-volatile TRH impact was identified at TP37 above assessment criteria. CC collected a further five test pits during the DSI Addendum works at locations around TP27 to delineate identified TRH in soil (TP27A, TP27B, TP27C, TP27D), with an additional sample taken at 0.5m at TP27 for vertical delineation (TP08_0.5).

A summary of the soil analytical program undertaken by CC of the soil sampling over the utilisation area is presented in the below table.

**Table 16: Summary of Soil Analytical Program – Utilisation Area**

| Sample Locations | Sample Type | n Primary Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Metals | TRH | TRH silica gel cleanup | BTEXN | PAHs | OCPs | PCBs | pH, CEC |
| Utilisation Area | Shallow soils | 20 | 10 | 0 | 10 | 10 | 10 | 10 | 0 |
| TRH delineation at TP27 | Shallow soils | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 2 |

Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

A summary of the analytical results of soil sampling over the utilisation area is presented in the below tables.

**Table 17: Summary of Soil Analytical Results – Utilisation Area**

| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| Soil Samples | Metals | 20 | ND | 77 (zinc) | 0 | 0 |
| | BTEXN | 15 | ND | ND | 0 | 0 |
| | F1 | 10 | ND | ND | 0 | 0 |
| | F2 | 10 | ND | 180 | 1 | 1 |
| | F3 | 10 | ND | 550 | 0 | 1 |
| | F4 | 10 | ND | 200 | 0 | 0 |
| | F2 (silica gel cleanup) | 5 | ND | ND | 0 | 0 |
| | F3 (silica gel cleanup) | 5 | ND | ND | 0 | 0 |
| | F4 (silica gel cleanup) | 5 | ND | ND | 0 | 0 |
| | Total PAHs | 10 | ND | ND | 0 | 0 |
| | OCPS/PCBS | 10 | ND | ND | 0 | 0 |

Shaded – exceeds GILs

ND = Not detected above laboratory limits of reporting

NA = Not Applicable

The Auditor notes for the size of the utilisation area, 20 systematic sample locations are required as per minimum sampling standards for characterisation. With respect to TRH, there were only 10 non-systematic sample locations. However, the Auditor is satisfied there were a sufficient number of sample locations to characterise the extent of TRH to shallow soils across the utilisation area based on the following:

- Total 14 samples, including the TP27 delineation samples, with locations spread over the area;

- Petroleum compounds were not detected in soils samples around TP27, which may be indicative of vegetable/animal oils or minor, insignificant, petroleum impact;
- The potential contaminating source is a diffuse source applied by soaking over the field; and
- The absence of TRH in groundwater.

The results of the investigation defined a TRH F2 and F3 hotspot at location TP27 marginally in excess of health and ecologically based residential land use criteria. Upon discussion with the laboratory CC concluded the TRH impact was biogenic in origin and not petrogenic associated with a petroleum source.

The Auditor consulted with Dr Bob Symonds, approved Auditor Expert Support Chemist, whom concurred the analytical chemistry was consistent with a biogenic source. Based on expert advice the Auditor considers no further assessment necessary.

### 5.2.3 Soil Investigations – Asbestos Waste Stockpile

A total of 5 test pits (TP36 – TP39, TP37B) were completed to investigate the Asbestos Waste Stockpile. Ten samples were collected, 2 from each test pit at varying depths.

A summary of the soil analytical program undertaken by CC of the soil sampling from the Asbestos Waste Stockpile is presented in the below table.

**Table 18: Summary of Soil Analytical Program – Asbestos Waste Stockpile**

| Sample Locations | Sample Type | n Primary Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Metals | TRH | TRH silica gel cleanup | BTEXN | PAHs | OCPs | PCBs | pH, CEC |
| Asbestos Waste Stockpiles | Fill | 8 | 8 | 0 | 8 | 8 | 8 | 8 | 0 |
| | | 2 | 2 | 0 | 2 | 2 | 0 | 0 | 0 |

Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

A summary of the analytical results of soil sampling from the Asbestos Waste Stockpiles is presented in the below tables.

**Table 19: Summary of Soil Analytical Results – Asbestos Waste Stockpile**

| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| Soil Samples | Metals | 10 | ND | 37 (zinc) | 0 | 0 |
| | BTEXN | 10 | ND | ND | 0 | 0 |
| | F1 | 10 | ND | ND | 0 | 0 |
| | F2 | 10 | ND | 80 | 0 | 0 |
| | F3 | 10 | ND | 440 | 0 | 1 |
| | F4 | 10 | ND | 220 | 0 | 0 |
| | Total PAHs | 10 | ND | 15.4 | 0 | 0 |

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| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| | B(a)P | 10 | ND | 2.0 | NA | 1 |
| | OCPS/PCBS | 8 | ND | ND | 0 | 0 |

Shaded – exceeds GILs

ND = Not detected above laboratory limits of reporting

NA = Not Applicable

COPC were identified in the Asbestos Waste Stockpile in excess of site criteria. ACM fragments were observed on the stockpile. The material was deemed unsuitable for reuse onsite and was classified for removal from site. Waste classification of the Asbestos Waste Stockpile is discussed in Section 6.3.2.

Test pit (TP40) was completed east of the Asbestos Waste Stockpile. CC reported 0.5m of road base fill above the natural ground surface at this location. The sample was analysed for the above COPC and all results were reported as below detection limits.

### 5.2.4 Soil Investigations – Yamba STP Stockpile

A total of 4 test pits (TP41 – TP39, TP37B) were completed to investigate the Asbestos Waste Stockpile. Ten samples were collected, 2 from each test pit at varying depths.

A summary of the soil analytical program undertaken by CC of the soil sampling for the Yamba STP Stockpile is presented in the below table.

**Table 20: Summary of Soil Analytical Program – Yamba STP Stockpile**

| Sample Locations | Sample Type | n Primary Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Metals | TRH | TRH silica gel cleanup | BTEXN | PAHs | OCPs | PCBs | pH, CEC |
| Yamba STP Stockpile | Fill | 10 | 10 | 0 | 10 | 10 | 10 | 10 | 0 |

Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

A summary of the analytical results of soil sampling of the Yamba STP Stockpile is presented in the below tables.

**Table 21: Summary of Soil Analytical Results – Yamba STP Stockpile**

| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| Soil Samples | Metals | 10 | ND | 22 (zinc) | 0 | 0 |
| | BTEXN | 10 | ND | ND | 0 | 0 |
| | F1 | 10 | ND | ND | 0 | 0 |
| | F2 | 10 | ND | ND | 0 | 0 |
| | F3 | 10 | ND | 160 | 0 | 0 |

| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| | F4 | 10 | ND | ND | 0 | 0 |
| | Total PAHs | 10 | ND | ND | 0 | 0 |
| | OCPS/PCBS | 10 | ND | ND | 0 | 0 |

ND = Not detected above laboratory limits of reporting, NA = Not Applicable

No COPC exceedances of site criteria were reported. CC reported inclusions of anthropogenic material to exceed 2%. CC applied to the NSW EPA for a Specific ENM Exemption. This is covered in Section 6.4.1.

### 5.2.5 Acid Sulfate Soils

To investigate the ASS status of soils at the site, CC collected soil samples for ASS testing every 0.5mbg to 2.0mbg from testpits TP01, TP05, TP08, TP12, TP21, TP25, TP29, TP33, TP40 (AS01_0.5 – AS10_2.0).

All samples were tested for pH and pHFOX, with AS01_2.0, AS02_2.0, AS03_0.5, AS04_0.5, AS05_0.5, AS06_1.5, AS07_1.5, AS08_2.0, AS09_1.5 and AS10_2.0 run for the full Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS) suite.

CC identified the presence of potential acid sulfate soils on-site and appropriately developed an Acid Sulfate Soils Management Plan (ASSMP) for the site.

### 5.2.6 Groundwater

Investigations performed by CC included installation of three groundwater monitoring wells and two rounds of groundwater sampling.

A summary of the groundwater analytical program undertaken by CC during investigation works is presented in the below table.

**Table 22: Summary of Groundwater Analytical Program - Investigations**

| Sampling Round | n Primary Samples | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metals | TRH BTEXN | PAHs | E.Coli | TFC | BOD | Nutrients | VOCs | Phenolics | PCBs | OCPs /OPPs | PFAS |
| 08/02/2017 | 3 | 3 | 1 | 3 | 0 | 3 | 3 | 1 | 1 | 1 | 1 | 1 |
| 21/08/2017 | 3 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |

Metals – Al, As, Cd, Cr, Cu, Pb, Ni, Se, Zn, Fe, Hg

TFC = Thermotolerant Faecal Coliforms

A summary of the analytical results of these groundwater sampling rounds is presented in the below tables.

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### Table 23: Summary of Groundwater Analytical Results – First and Second GMEs

| COPC | n | 8 Feb 2017 | | | 21 Aug 2017 | | |
|---|---|---|---|---|---|---|---|
| | | Min | Max | n>GIL | Min | Max | n>GIL |
| | | ug/L | | | ug/L | | |
| Aluminium | 3 | 80 | 5760 | 3 | 20 | 2850 | 3 |
| Arsenic | 3 | 6 | 11 | 3 | 2 | 3 | 2 |
| Cadmium | 3 | ND | 1.2 | 2 | ND | 0.4 | 0 |
| Chromium | 3 | ND | 2 | 0 | ND | 1 | 0 |
| Copper | 3 | ND | 3 | 2 | ND | ND | 0 |
| Lead | 3 | ND | 2 | 0 | ND | ND | 0 |
| Nickel | 3 | 3 | 269 | 2 | 3 | 121 | 2 |
| Selenium | 3 | ND | ND | 0 | ND | ND | 0 |
| Zinc | 3 | 17 | 734 | 3 | ND | 479 | 2 |
| Mercury | 3 | ND | ND | 0 | ND | ND | 0 |
| Iron | 3 | 31,700 | 214,000 | 3 | 30,900 | 108,000 | 3 |
| BTEXN | 3 | ND | ND | 0* | ND | ND | 0* |
| TRH | 3 | ND | ND | 0* | ND | ND | 0* |
| PAHs | 1 | ND | ND | 0 | -- | -- | -- |
| VOCs | 1 | ND | ND | 0 | -- | -- | -- |
| Phenolics | 1 | ND | ND | NA | -- | -- | -- |
| PCBs | 1 | ND | ND | NA | -- | -- | -- |
| OCPs/OPPs | 1 | ND | ND | NA | -- | -- | -- |
| PFAS | 1 | ND | ND | NA | -- | -- | -- |
| E.Coli MPN/100 | | | | | | | |
| E.Coli | 3 | ND | 13 | 0 | -- | -- | -- |
| TFC | 3 | -- | -- | -- | ND | ND | 0 |
| Nutrients mg/L | | | | | | | |
| BOD | 3 | ND | 32 | NA | ND | 11 | NA |
| Ammonia | 3 | 0.96 | 7.95 | 1 | 1.31 | 1.92 | 0 |
| Nitrite | 3 | ND | 0.01 | NA | ND | ND | NA |
| Nitrate | 3 | ND | 0.11 | 0 | ND | ND | 0 |
| Nitrate and Nitrite as N | 3 | ND | 0.11 | NA | ND | ND | NA |
| TKN | 3 | 39.9 | 60 | NA | 2.6 | 10 | NA |
| Total Nitrogen | 3 | 39.9 | 60 | NA | 2.6 | 10 | NA |
| Total Phosphorus | 3 | 7.7 | 14.5 | NA | 0.02 | 1 | NA |

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| COPC | n | 8 Feb 2017 | | | 21 Aug 2017 | | |
|---|---|---|---|---|---|---|---|
| | | Min | Max | n>GIL | Min | Max | n>GIL |
| | | ug/L | | | ug/L | | |
| Reactive Phosphorus | 3 | ND | ND | NA | ND | 0.02 | NA |

Shaded – exceeds GILs

TFC = Thermotolerant Faecal Coliforms

ND = Not detected above laboratory limits of reporting

NA = Not Applicable

n = number of primary samples

-- = not analysed

* HSLs criteria

Metals, including aluminium, arsenic, cadmium, copper, nickel, zinc, iron, were identified at concentrations above GILs marine water criteria during one or both rounds of sampling. CC concluded further sampling of groundwater was required to identify if dissolved metals in groundwater were a regional issue, likely due to presence of acid sulfate soils, or a result of the operation of STP.

Ammonia was also identified at concentrations above GILs marine water criteria in MW01 during the first round of sampling. Of particular note however is the reduction of nutrients from the first round to second round of sampling, likely a product of the sampling method. CC conclude the exceedance of ammonia of little concern given the low hydraulic gradient, associated low groundwater flow rate, and likely attenuation given the site is now decommissioned.

The Auditor requested further groundwater monitoring and analysis post remediation.

### 5.2.7 ACM

CC identified former pipework as comprising ACM on-site and appropriately identified the requirement for management and removal during remedial works.

### 5.2.8 Biosolids

To investigate the contamination status of the biosolids at the base of the ponds, CC collected eight samples of biosolids (BS01 – BS05; BS100 – BS102).

A summary of the analytical program undertaken by CC is presented in the below table.

**Table 24: Summary of Biosolids Analytical Program – Investigations**

| Sample Locations | Sample Type | n Primary Samples | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Metals | Metals (Neutral Leach, TCLP) | TRH | TRH silica gel cleanup | BTEXN | Selenium | OCPs | PCBs | PFAS | pH, CEC |
| Base of ponds | Biosolids | 8 | 0 | 3 | 0 | 3 | 3 | 8 | 8 | 3 | 0 |

Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

The analytical results of preliminary testing of biosolids reported met “Grade A” Criteria for the contaminants analysed. CC conducted further sampling and analysis of biosolids during validation stage for waste classification of biosolids. Waste classification and removal of biosolids was overseen and approved by NSW EPA. Further discussion of waste classification and removal of biosolids is included in Section 6.3.3 Biosolids Waste Classification and Disposal.

# 6. REMEDIATION

## 6.1 Remediation Action Plan

A Remediation Action Plan (RAP) was prepared by CC in February 2018 in general accordance with OEH (2011). The objectives of the RAP were to:

- Summarise background information and current conditions at the site;
- Summarise the nature and extent of contamination at the site;
- Describe the regulatory issues associated with the proposed remediation;
- Describe the overall remedial strategy to remove unacceptable risks to human health and the environment associated with the identified contaminants; and
- Describe the remedial works to be conducted, including environmental management and occupational health and safety (OH&S).

The key elements of the plan involved:

- Discharge of pond water;
- Excavation and removal of biosolids from the site;
- Removal of the Asbestos Waste Stockpile and ACM associated with the former pipework and baffles with pond;
- Treatment of pond walls on-site for ASS with lime; and
- Backfilling pond walls into pond void.

## 6.2 Remediation Works

The remediation works performed by CC are described in the Validation Report (CC, 2019) and are summarised in the table below.

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**Table 25: Summary of Remediation Works**

| Stage | Overview |
|---|---|
| Remediation<br>April – February 2019 | • Dewatering the ponds;<br>• Dewatering the biosolids;<br>• Removal of Asbestos Waste Stockpile;<br>• Removal of ACM associated with overflow pipework;<br>• Removal of biosolids from the site;<br>• Treatment of the pond walls for ASS;<br>• Backfilling of pond void using the pond walls;<br>• Backfilling of pond void using Yamba STP Stockpile;<br>• Treatment an application of lime treated ENM material from Woodford Island over former pond area; and<br>• Importation of ENM from South Grafton STP and application to former pond area. |

## 6.3 Waste Audit

A waste audit is provided in Appendix C.

### 6.3.1 ACM

ACM baffles and pipework (1.46 tonnes) was removed by an appropriately licenced contractor and disposed at an appropriate facility. Waste disposal dockets have been included in the validation report (CC, 2019) issued by the facility.

### 6.3.2 Asbestos Waste Stockpile

The Asbestos Waste Stockpile was classified was Special Restricted Waste (asbestos) in accordance with NDW EPA (2014) Waste Classification Guidelines. CC applied to QLD Department of Environment and Science (DES) for the waste to be trucked and disposed at Veolia Ti Tree Bioenergy, Willowbank, QLD. Documentation indicates 627.70 tonnes of waste was transported to the facility between April and May 2018. Documentation of approval from QLD DES, waste classification letter and waste disposal dockets have been supplied by CC. It is noted that QLD DES approval (consignment number 24-12-1549) is for a maximum of 600 tonnes.

### 6.3.3 Biosolids Waste Classification and Disposal

Waste classification and removal of biosolids were approved and overseen by NSW EPA and are not part of the scope of this Audit. CC reported 5333.25 tonnes of biosolids were removed and disposed of at Veolia Ti Tree Bioenergy Facility, Willowbank QLD. CC have supplied waste disposal dockets issued by the facility.

### 6.3.4 Pond water discharge

Water from the former oxidation and maturation ponds were pumped and discharged into the adjacent drainage channel to the south of the site during remediation works. Water quality was monitored in the drain during discharge with the objective of meeting the following criteria:

- ≤50% change in dissolved oxygen;
- ≤ 2pH unit change;
- ≤50% EC change.

CC report that these water quality parameter were not met during the pond dewatering, with a decrease of electrical conductivity of 69% and increase of dissolved oxygen of 425%. pH remained within the target range. CC conclude that a decrease in electrical conductivity and increase of dissolved oxygen is not considered to have a negative environmental impact to the receiving environment as these results would be similar to a natural rain event.

The auditor agrees.

## 6.4 Imported Fill

Imported fill was required to fill the pond void and level the site. Fill was received from three separate sources and is summarised in the below table.

**Table 26: Summary of Imported Fill**

| Source | Classification | Tonnage/Volume |
|---|---|---|
| Yamba STP Stockpile | Specific ENM Exemption | ~1200 t |
| Woodford Island STP | Specific ENM Exemption | 2170 $m^3$ / ~3106.5 t |
| South Grafton STP | General ENM / VENM Exemptions | 5968.33 $m^3$ / ~8952.5 t |

### 6.4.1 Yamba STP Stockpile

Approval for the reuse of the 1200 tonne Yamba STP Stockpile onsite was sought from the NSW EPA by CC. Documentation indicates NSW EPA issued a resource recovery order and exemption for the Yamba STP Stockpile on 23 March 2018. This documentation has been supplied by CC in the validation report (CC, 2019). It is noted the approval was sought for 3000 tonnes, however, CC have explained this was a reporting error and the estimation 1200 tonnes is based on correspondence between CVC and NSW EPA in June 2014.

The order and exemption gave approval for the Yamba STP Stockpile to be applied to the site, following the removal of large pieces of construction and demolition waste. CC report anthropogenic material was screened from the Yamba STP Stockpile prior to filling in the pond void.

CC do not report where this anthropogenic material was disposed of. It is assumed the anthropogenic material screened from the Yamba STP Stockpile was removed from the site and disposed of with the Asbestos Waste Stockpile.

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### 6.4.2 Woodford Island ENM

Approval for the use of material excavated during the construction of the Woodford Island STP onsite for fill was sought from the NSW EPA by CC. As the Woodford Island excavated material was identified as ASS, CC prepared an ASSMP as part of the application. Documentation indicates NSW EPA issued a resource recovery order and exemption for the Woodford Island STP excavated material on 6 September 2018. This documentation has been supplied by CC in the validation report (CC, 2019).

The order and exemption gave approval for 3000 tonnes of the Woodford Island STP excavated material to be used as fill on-site, subsequent to the onsite treatment for ASS. Correspondence included from the NSW EPA indicates the material imported onsite must not exceed 3000 tonnes, as exceeding 6000 tonne of waste processing in total for the site (including Yamba STP Stockpile) will require an EPL.

CC report 3106.5 tonnes of excavated material imported and used as fill onsite. The marginal exceedance of 3000 tonnes is considered acceptable as the annual 6000 tonne limit has not been exceeded.

It is noted the sampling frequency was based on less than 3000 tonnes (7 samples). With the material totalling 3106.5 tonnes, the sampling frequency required was 10 samples.

### 6.4.3 South Grafton STP ENM/VENM

CC report approximately 8952.50 tonnes of material stockpiled at the CVC Maclean STP was transported to the site between May and November 2018. CC report the material was a combination of VENM and ENM sourced from the former South Grafton STP. The VENM and ENM documentation has been included in the validation report.

# 7. SITE VALIDATION

The site validation works performed by CC are described in the Validation Report (CC, 2019) and are summarised in the table below.

**Table 27: Summary of Site Validation Works**

| Stage | Overview |
|---|---|
| Validation<br>March – March 2019 | • Former Pond Area: 17 systematic grid-based soil samples for metals analysis<br>• ASS sampling of pond walls during treatment process;<br>• ASS sampling of Woodford Island ENM during treatment process;<br>• Pre-remediation groundwater and surface water sampling;<br>• Post-remediation groundwater and surface water sampling;<br>• Asbestos Waste Stockpile removal clearance;<br>• Pondwater discharge monitoring; and<br>• Visual clearance of biosolids removal. |

## 7.1 Former Pond Area

CC collected 17 surface soil samples on an approximate 20m systematic grid for analysis of heavy metals for validation of this area (VS01 – VS17). The analytical results are summarised in the below table. Validation analytical summary tables are provided in Appendix D.

**Table 28: Summary of Soil Analytical Results – Former Pond Area**

| Sample Type | COPC | n primary samples | Min | Max | n>HIL/HSL | n>EIL/ESLs |
|---|---|---|---|---|---|---|
| | | | mg/kg | | | |
| Soil Samples | Metals | 17 | ND | 56 (zinc) | 0 | 0 |

ND = Not detected above laboratory limits of reporting

Metals – As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

### 7.1.1 Auditor comments

No exceedances of residential land use criteria or ecological investigation levels were identified for metals in surface soils in the former pond area. With the removal and validation of biosolids and ACM, the Auditor concludes this area of the site was remediated to a standard acceptable for residential land use.

## 7.2 Acid Sulfate Soils – Pond Walls

CC undertook ASS treatment and validation as two events:

- Treatment Event 1; and
- Treatment Event 2.

CC reports samples were collected in-situ following placement of the treated soils. CC reviewed the liming strategy after Treatment Event 1 when samples collected from some treated pond wall soils were found to exceed site criteria (AS06 – AS10). CC reported lime was thoroughly mixed through the entire soil profile to ensure adequate treatment. The re-treated area is shown in Figure 4.

Ten validation samples were collected during Treatment Event 1 (AS01 – AS10) and five during Treatment Event 2 (AS06A – AS10A) and sent for pHF and SPOCAS analysis. The analytical results are summarised in the tables below.

**Table 29: Summary of Treatment Event 1 and Treatment Event 2 Analytical Results**

| Sample Type | COPC | n primary samples | Treatment Event 1 | | | | Treatment Event 2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | n> <1000t Criteria | n> >1000t Criteria | Min | Max | n> <1000t Criteria | n> >1000t Criteria |
| ASS Soils | pH(F) | 10 | 3.9 | 8.68 | 5 | 5 | 4.7 | 8.68 | 3 | 3 |
| | Net acidity (%S) | 10 | -0.47 | 0.21 | 5 | 4 | -0.93 | 0.07 | 4 | 2 |
| | Net acidity (TPA) | 10 | -3096 | 134 | 5 | 4 | -3096 | 43 | 4 | 2 |

### 7.2.1 Auditor comments

Exceedances for site criteria were reported after Treatment Event 2. CC report the volume of material associated with the exceedances of criteria (i.e. AS06A – AS10A) was considered to be approximately 50 – 60 $m^3$ (i.e. less than 100 tonnes). CC consider the risk associated with the residual acidic soils is low and further treatment is not considered to be necessary based on the following:

- The samples which exceed criteria are of a small volume of material (i.e. less than 100 tonnes);
- The overlying soil in this area of the site is ENM, sourced from Woodford Island. This soil has negative net acidity values which should buffer underlying soil;
- The site is located in an area of naturally occurring acid sulfate soils; and
- Dear et al (2014) guidelines state for treatment verification that no single sample shall exceed a net acidity of 62 mol H+/tonne, for which the sample results did not.

The Auditor concurs and considers the minor exceedances to be insignificant.

## 7.3 Acid Sulphate Soils – Woodford Island ENM

CC undertook ASS treatment and validation as three events:

- Treatment Event 1;
- Treatment Event 2; and
- Treatment Event 3.

CC reports a total of ten validation samples were collected each 1000 tonnes of treated ASS material as per the resource recovery order and exemption. The sampling frequency meets NEPC (2013) for stockpiles.

**Table 30: Summary of Treatment Event 1 and Treatment Event 2 Analytical Results**

| Treatment Event | Samples | COPC | n primary samples | Min | Max | n> Criteria |
|---|---|---|---|---|---|---|
| 1 | ASENM01 – ASENM10 | pH(F) | 10 | 8.2 | 8.4 | 0 |
| | | Net acidity (%S) | 10 | -0.5 | -0.21 | 0 |
| | | Net acidity (TPA) | 10 | -305 | -130 | 0 |
| 2 | ASENM11 – ASENM20 | pH(F) | 10 | 6.8 | 8.4 | 0 |
| | | Net acidity (%S) | 10 | -0.46 | ND | 0 |
| | | Net acidity (TPA) | 10 | -131 | -69 | 0 |
| 3 | ASENM21 – ASENM30A | pH(F) | 10 | 6.8 | 8.4 | 0 |
| | | Net acidity (%S) | 10 | -0.45 | 0.00 | 0 |

| Treatment Event | Samples | COPC | n primary samples | Min | Max | n> Criteria |
|---|---|---|---|---|---|---|
| | | Net acidity (TPA) | 10 | -278.83 | 1.67 | 0 |

### 7.3.1 Auditor comments

It is noted ASENM30 initially failed. Upon further treatment, this area was resampled and the results met criteria. The Auditor considers acid sulfate soils have been adequately treated.

## 7.4 Groundwater and Surface Water

To investigate the elevated metals present in groundwater, CC performed one additional GMEs pre-remediation works and two post- remediation works. In addition, to investigate off-site surface water conditions with, CC collected samples from the drainage channel immediately adjacent to the STP prior to and following the completion of remediation.

The surface water locations comprised:

- SW01 – drainage channel, downgradient;
- SW02 – drainage channel, adjacent to site; and
- SW03 – drainage channel, upgradient location.

A summary of the analytical program undertaken by CC for the additional GMEs and surface water sampling is presented in the below table.

**Table 31: Summary of Groundwater and Surface Water Analytical Program – Validation**

| Sampling Round | n primary samples | |
|---|---|---|
| | Metals | Nutrients |
| Pre-remediation groundwater March 2018 | 3 | 3 |
| Pre-remediation surface water March 2018 | 3 | 3 |
| Post remediation ground water January 2019 | 3 | 3 |
| Post remediation surface water January 2019 | 3 | 3 |
| Post remediation ground water March 2019 | 3 | 3 |
| Post remediation surface water March 2019 | 3 | 3 |

Metals – Al, As, Cd, Cr, Cu, Pb, Ni, Se, Zn, Fe, Hg

A summary of the groundwater analytical results pre- and post-remediation is provided in the table below.

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## Table 32: Summary of Groundwater Analytical Results – Pre- and Post-Remediation

| COPC | n | Pre-remediation March 2018 | | | Post-remediation January 2019 | | | Post-remediation March 2019 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | n>GIL | Min | Max | n>GIL | Min | Max | n>GIL |
| | | ug/L | | | ug/L | | | ug/L | | |
| Aluminium | 3 | 240 | 3110 | 3 | ND | 140 | 2* | 110 | 2,350 | 3 |
| Arsenic | 3 | 1 | 4 | 2 | 1 | 7 | 2 | 3 | 8 | 3 |
| Cadmium | 3 | 0.4 | 2.7 | 1 | ND | ND | 0 | 0.2 | 1.2 | 1 |
| Chromium | 3 | ND | 2 | 0 | ND | ND | 0 | ND | 1 | 0 |
| Copper | 3 | ND | 2 | 1 | ND | 1 | 0 | ND | ND | 0 |
| Lead | 3 | ND | ND | 0 | ND | ND | 0 | ND | ND | 0 |
| Nickel | 3 | 35 | 169 | 3 | 2 | 8 | 1 | 31 | 77 | 3 |
| Selenium | 3 | ND | ND | 0 | ND | ND | 0 | ND | ND | 0 |
| Zinc | 3 | 268 | 797 | 3 | ND | 10 | 0 | 157 | 426 | 3 |
| Mercury | 3 | ND | ND | 0 | ND | ND | 0 | ND | ND | 0 |
| Iron | 3 | 9,960 | 69,000 | 3 | 3,990 | 58,900 | 3 | 11,900 | 69,000 | 3 |
| Nutrients mg/L | | | | | | | | | | |
| Ammonia | 3 | 1.09 | 4.68 | 0 | 1.39 | 10.9 | 1 | 0.89 | 6.72 | 1 |
| Nitrite | 3 | ND | ND | NA | ND | ND | NA | ND | 0.09 | NA |
| Nitrate | 3 | ND | 0.32 | 0 | ND | 0.08 | 0 | 0.55 | 9.19 | 2 |
| Nitrate + Nitrite as N | 3 | ND | 0.32 | NA | ND | 0.08 | NA | 0.55 | 9.28 | NA |
| TKN | 3 | 2.8 | 7.1 | NA | 21.9 | 285 | NA | 9.8 | 42.7 | NA |
| Total Nitrogen | 3 | 2.8 | 7.4 | NA | 22 | 285 | NA | 13.2 | 44.1 | NA |
| Total Phosphorus | 3 | 0.14 | 0.71 | NA | 4.76 | 121 | NA | 1.87 | 12.8 | NA |
| Reactive Phosphorus | 3 | 0.09 | 0.36 | NA | ND | ND | NA | ND | ND | ND |

Shaded – above GILs

ND = Not detected above laboratory limits of reporting

NA = Not Applicable

GW = groundwater

n = number of primary samples

-- = not analysed

* Note: LOR 10 ug/L, above the GIL of 0.5 ug/L

A summary of the analytical results of the surface water sampling is presented in the below tables.

**Table 33: Summary of Surface Water Analytical Results Pre- and Post-Remediation**

| COPC | n | Pre-remediation March 2018 | | | Post-remediation January 2019 | | | Post-remediation March 2019 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | n>GIL | Min | Max | n>GIL | Min | Max | n>GIL |
| | | ug/L | | | ug/L | | | ug/L | | |
| Aluminium | 3 | ND | 150 | 1* | ND | 30 | 1* | ND | 10 | 1* |
| Arsenic | 3 | ND | 2 | 0 | ND | 9 | 2 | ND | 2 | 0 |
| Cadmium | 3 | ND | 0.3 | 0 | ND | ND | 0 | ND | 0.1 | 0 |
| Chromium | 3 | ND | ND | 0 | ND | ND | 0 | ND | ND | 0 |
| Copper | 3 | ND | ND | 0 | ND | 2 | 1 | 2 | 3 | 3 |
| Lead | 3 | ND | ND | 0 | ND | ND | 0 | ND | ND | 0 |
| Nickel | 3 | 14 | 37 | 3 | 2 | 4 | 0 | 5 | 9 | 2 |
| Selenium | 3 | ND | ND | 0 | ND | ND | 0 | ND | ND | 0 |
| Zinc | 3 | ND | 178 | 1 | ND | 130 | 1 | 10 | 26 | 1 |
| Mercury | 3 | ND | ND | 0 | ND | ND | 0 | ND | 6.6 | 2 |
| Iron | 3 | 810 | 5,980 | 3 | 70 | 190 | 0 | ND | 60 | 0 |
| Nutrients mg/L | | | | | | | | | | |
| Ammonia | 3 | 0.96 | 7.59 | 2 | -- | -- | -- | 1.01 | 4.35 | 0 |
| Nitrite | 3 | ND | ND | NA | -- | -- | -- | 0.02 | 0.09 | NA |
| Nitrate | 3 | 0.01 | 0.02 | 0 | -- | -- | -- | 0.02 | 0.08 | 0 |
| Nitrate + Nitrite as N | 3 | 0.01 | 0.02 | 0 | -- | -- | -- | 0.08 | 0.11 | NA |
| TKN | 3 | 2.2 | 10 | NA | -- | -- | -- | 2.2 | 6 | NA |
| Total Nitrogen | 3 | 2.2 | 10 | NA | -- | -- | -- | 2.3 | 6.1 | NA |
| Total Phosphorus | 3 | 0.05 | 0.1 | NA | -- | -- | -- | 0.04 | 0.2 | NA |
| Reactive Phosphorus | 3 | 0.02 | 0.04 | NA | -- | -- | -- | ND | ND | NA |

Shaded – above GILs

ND = Not detected above laboratory limits of reporting

NA = Not Applicable

GW = groundwater

n = number of primary samples

-- = not analysed

* Note: LOR 10 ug/L, above the GIL of 0.5 ug/L

### 7.4.1 Auditor comments

The consultant has concluded the presence of elevated metals in groundwater and surface water are representative of local environmental conditions and disturbance of acid sulfate soils during construction of the ponds, rather than being directly associated with anthropogenic contamination from the use of the site as a STP.

The maximum reported concentrations of dissolved metals in groundwater and drainage canal surface waters post site remediation are presented below. Exceedances considered by the Auditor as significant, given the GILs represent trigger levels at the point of discharge, are highlighted in bold:

**Table 34: Significant Exceedances of GIL Trigger Levels Post Remediation March 2019**

| Metal | Groundwater (ug/L) | Surface Water (ug/L) | GILs Marine (ug/L) |
|---|---|---|---|
| Iron | **69,000** | **60** | 300 (Canadian) |
| Aluminium | **2,350** | **10** | 0.5 (LRTV) |
| Arsenic | 8 | 2 | 2.3 (LRTV) |
| Cadmium | 1.2 | 0.1 | 0.7 |
| Chromium | 1 | ND | 4.4 |
| Copper | ND | 3 | 1.3 |
| Lead | ND | ND | 4.4 |
| Nickel | 77 | 9 | 7 |
| Zinc | 426 | 26 | 15 |
| Selenium | ND | ND | 3 |
| Mercury | ND | 6.6 (upgradient) | 0.1 |

The auditor has considered the groundwater and surface water data and concurs with the consultant's view that the elevated metals concentrations are likely due to acidic groundwater and surface waters, a function of oxidation of acid sulfate soils that exist beneath the site and surrounding area, rather than an anthropogenic source. Evidence to support this conclusion includes:

- The pH of groundwater and surface water within the surrounding drains is acidic. Metal solubility increases with increasing acidity;
- Upgradient surface water concentrations of metals exceed site criteria;
- Aluminium and iron are naturally abundant metals in soil. Localised areas of high groundwater acidity would be expected in acid sulphate soil environments where there is a potential for oxidation of iron sulphides. Oxidation of acid sulphate soils at the site may have occurred from a number of activities including pond construction, environmental drilling, and natural processes such as fluctuations in water table elevation and bioturbation. Where groundwater flow rates are low, dissolved metal concentrations would be expected to increase in concentration;
- Iron fouling is observed on the walls of the drains and in surface waters in the drain (including upstream locations). Iron fouling indicates there are naturally high levels of soluble iron in the environment;

- There were no other toxicants detected in groundwater that would suggest an anthropogenic source of contamination originating from the former sewerage treatment operation.

The Auditor does not consider the groundwater condition requires further assessment or evaluation. The Auditor has notified and discussed the groundwater condition with NSW EPA as required under s4.4.2 of the Auditor Guidelines (NSW EPA, 2017).

### 7.5 ACM

CC conducted a visual inspection for validation of ACM pipework removal once it was removed by a licenced contractor. The Auditor considers this sufficient.

### 7.6 Asbestos Waste Stockpile

CC conducted a visual inspection for validation of the removal of the Asbestos Waste Stockpile. CC have clearance certificate. The Auditor considers this sufficient.

### 7.7 Biosolids

CC conducted visual inspection for validation of biosolids removal. CC report natural underlying clay was visible at the surface of the former pond areas and have provided a photographic log. The Auditor considers this sufficient.

### 7.8 Aesthetics

CC conducted an aesthetics assessment during and after remedial works with consideration to NEPC.

Observations during field work reported by CC indicated anthropogenic material in the Yamba STP stockpile (specific ENM exemption issued by NSW EPA; anthropogenic material screened out prior to reuse) and Asbestos Waste Stockpile (removed from site). CC do not indicate the presence of anthropogenic material in other fill on site. Additionally, fill imported for levelling purposes after remediation was classified ENM, VENM and a specific ENM exemption.

With the exception of biosolids (which was removed from site), aesthetics is not considered an issue.

## 8. REGULATORY COMPLIANCE

Investigation and remediation activities were reviewed against relevant National and NSW guidelines and directions. A summary of the auditor's considerations is presented in the table below.

**Table 35: Compliance with Regulatory Guidelines and Directions**

| Guideline | Auditor Comments |
|---|---|
| Guidelines for Consultants reporting on Contaminated Sites (OEH, 1997) | The environmental investigations and remediation were reported in accordance with these guidelines. |

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| Guideline | Auditor Comments |
|---|---|
| Guidelines for the Assessment and Management of Groundwater Contamination (DEC, 2007); | The consultant considered the guidelines for determining groundwater environmental value. |
| National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013), (NEPC, 2013) | The consultant followed the DQO process for design of sampling programmes, generally adhered to appropriate QA/QC, adopted appropriate sampling methods and applied the appropriate screening values for the assessment and validation of site remediation. |
| Sampling Design Guidelines (NSW EPA 1995); | The consultant adopted appropriate systematic sampling for site validation. |
| Waste Classification Guidelines (NSW EPA, 2014)<br>Protection of the Environment Waste Regulations (2014) | All biosolids wastes were assessed in accordance with the guideline. Biosolids were characterised in accordance with NSW EPA (2000) Environmental Guidelines – Use and Disposal of Biosolid Products under EPA direction.<br>Asbestos contaminated soils was assessed under the NSW EPA Waste Classifications Guidelines. The waste was accepted by QLD DES to be transported to a waste facility in QLD.<br>Wastes were disposed to facilities licenced to accept the waste. |
| Working with Asbestos Guide 2008 (NSW Workcover, 2008) | A licenced asbestos removal contractor removed the overflow pipework (ACM). The consultant, a licensed asbestos assessor, inspected the area post removal and issued a clearance certificate. Approximately 1.46t of ACM was disposed to Grafton Landfill which is licensed to receive asbestos waste. |
| Appropriate licences and consents for installation of a groundwater bore obtained from the NSW Office of Water | Groundwater bore licences were not obtained. |

# 9. AUDITOR CONCLUSIONS

CC conducted assessment and remediation of the site in accordance with appropriate guidelines. All waste associated with the former STP was classified and disposed lawfully. Site remediation works was primarily civil related, treating pond walls with lime to reduce acidity for infilling the pond. Two rounds of lime treatment was requited to neutralise acidity.

Pond water was discharged to the surface water drain south of the site. Pond water was tested prior to discharge and was deemed fit for disposal under the existing EPL. Monitoring of the drain surface water during dewatering indicated there was no significant change in surface water quality during discharge.

Biosolids at the base of the ponds were excavated, characterised and disposed offsite under direction from NSW EPA.

Groundwater beneath the former STP remains elevated in dissolved metals, primarily nickel, zinc, aluminium and iron. Evidence suggests the metals represent background environmental conditions given the absence of pollution indicators. The groundwater condition has been notified and discussed with the NSW EPA. No further groundwater works are necessary.

At completion of remediation the site surface was sampled systematically for metals that may have mobilised from acid sulphate soil works. All sample results were below residential land use and environmental investigation screening criteria.

# 10. EVALUATION OF LAND USE SUITABILITY

In assessing the suitability of a site for an existing or proposed land use in an urban context, Auditors must follow the decision making process for assessing urban redevelopment sites that is defined in *Appendix A* of the *Guidelines for the NSW Site Auditor Scheme* (NSW EPA, 2017).

The audit objective is to determine whether the site is suitable for:

- Residential A land use

The audit findings for each stage of the decision making process are detailed below:

**All site assessment, remediation and validation reports follow applicable guidelines.**

The consultant's reports have been prepared in general accordance with applicable guidelines. The reports provide suitable documentation for independent verification of the consultant's conclusions.

**Aesthetic issues have been addressed.**

Yes.

**Soils have been assessed against relevant health based investigation levels and potential for migration of contamination from soil to groundwater has been considered.**

Soils were assessed against appropriate health and ecological based criteria. Biosolids, asbestos contaminated soil and ACM pipework have been removed from the site. Groundwater is not considered to be impacted by former STP operations.

**Groundwater has been assessed against relevant health based investigation levels and, if required, any potential impacts to buildings and structures from the presence of contaminants considered.**

There is no groundwater contamination condition that would impact upon building structures.

**Hazardous ground gases have been assessed against relevant health-based investigation levels and screening values.**

No assessment of gases was undertaken. No contamination condition was identified that would result in hazardous ground gases.

**Any issues relating to local area background soil concentrations that exceed appropriate soil assessment criteria have been adequately addressed in the site assessment reports.**

Not relevant.

**All impacts of chemical mixtures have been assessed.**

Not relevant

**Any potential ecological risks have been assessed.**

Yes. Elevated metals in groundwater considered a regional issue and not a result of former STP operations.

**Any evidence of, or potential for, migration of contaminants from the site has been appropriately addressed, including potential risks to offsite receptors, and reported to the site owner or occupier.**

Not relevant. Elevated metals in groundwater considered a regional issue.

**The site management strategy is appropriate including post-remediation environmental plans.**

Not required.

The Auditor considers the site has been remediated to an acceptable standard for residential land use with accessible soil, including garden (home grown produce less than 10% fruit and vegetable intake), excluding poultry.

# 11. LIMITATIONS

This report should be read in full, and no executive summary, conclusion or other section of the report may be used or relied on in isolation, or taken as representative of the report as a whole. No responsibility is accepted by Geo-Logix, and to the extent permitted by law any duty of care that may arise is excluded, in relation to any use of any part of this report other than on this basis.

This report has been prepared for the use by the Client for the purpose stated in Geo-Logix Proposal Q484R3. Geo-Logix accepts no liability for use or interpretation by any third party other than the regulatory and planning authorities as required under the *Contaminated Land Management Act 1997* and *State Environment Planning Policy 55.*

To the extent permitted by law, any duty of care to a third party that would or may arise in respect of a person (other than the Client) who relies on the report without having been granted Geo-Logix' express written consent, is excluded. Third parties should make their own enquiries as to the condition of the site.

Unless otherwise expressly stated, the scope of this report is limited to an independent review of the information and data contained in the reports provided by the Client. No physical investigations have been undertaken of the Site and no information, whether written or oral, has been considered or reviewed by Geo-Logix other than as expressly contained in the Client provided reports (Client Reports).

Unless otherwise expressly stated, the conclusions stated in this report are based solely on the information, scope of works, analysis and data contained in the Client Reports. Geo-Logix has undertaken every reasonable effort to verify the accuracy of the information or data in the Client Reports throughout the Audit. No liability will be accepted for unreported omissions, alterations or errors in the Client Reports. Accordingly, the data and information provided by the Client are taken and interpreted in good faith.

Given the nature of asbestos, and the difficulties involved in identifying asbestos fibres, despite the exercise of all reasonable due care and diligence, thorough investigations may not always reveal its presence in either buildings or fill. Even if asbestos has been tested for and those tests' results do not reveal the presence of asbestos at those specific points of sampling, asbestos or asbestos containing materials may still be present at the Site, particularly if fill has been imported at any time, buildings constructed prior to 1980 have been demolished on the Site or materials from such buildings have been disposed of on the Site.

Geo-Logix has prepared this report with the diligence, care and skill which a reasonable person would expect from an Accredited Site Auditor. This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, Geo-Logix Pty Ltd and the Site Auditor reserves the right to review the report in the context of the additional information.

# 12. REFERENCES


ASSMAC (1998) Acid Sulfate Soil Manual, Acid Sulphate Soil Management Advisory Committee, NSW, August 1998.

Australian Government Department of Health (2017) Health Based Guidance Values for PFAS for use in site investigations in Australia.

Australian Standard 4428.1. Guide to the investigation and sampling of sites with potentially contaminated soil – Non-volatile and semi volatile compounds. Standards Australia 2005.

Cavvanba Consulting, Preliminary Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. February 2017, Ref#16026 TE R01 V3.

Cavvanba Consulting, Data Quality Objectives and Sampling, Analysis and Quality Plan – groundwater and soil investigation – Townsend Sewerage Treatment Plant, Lot 2 DP 634170, Corner of Schwonberg and Goodwood Street, Townsend NSW 2463. December 2016 (Ref#16026 TE R02).

Cavvanba Consulting, Detailed Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. August 2017 (Ref#16026 IL R03 V4).

Cavvanba Consulting, Acid Sulfate Soil Management Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. July 2017 (Ref#16026 TE R04).

Cavvanba Consulting, Detailed Site Investigation – Addendum – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. October 2017 (Ref#16026 IL R05).

Cavvanba Consulting, Remediation Action Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. February 2018 (Ref#16026 IL R06).

Cavvanba Consulting, Validation Report – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, April 2019 (Ref#16026 IL R08)

Government of Western Australia (2016) Interim guidance on the assessment and management of perfluoroalkyl and polyfluoroalkyl substances (PFAS) – contaminated sites guidelines

Hashimoto T.R & Troedson A.L. (2008) Grafton 1:100 000 and 1:25 000, Coastal Quaternary Geology Map Series. Geological Survey of New South Wales, Maitland.

National Environment Protection Council (2013), National Environment Protection (Assessment of Site Contamination) Measure 1999 (Amended 2013).

NHMRC (2008) Guidelines for Managing Risks in Recreational Water, National Health and Medical Research Council, February 2018.

NSW Department of Environment & Conservation (2007). Guidelines for the Assessment and Management of Groundwater Contamination.

NSW Environmental Protection Agency (2000) Environmental Guidelines: Use and Disposal of Biosolids Products – residential land use

NSW Environment Protection Agency (1995). Contaminated Sites: Sampling Design Guidelines.

NSW Environment Protection Agency (2015). Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997

NSW Environment Protection Agency (2017). Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd edit.).

NSW Government, Environmental Planning and Assessment Act 1979

NSW Government, Contaminated Land Management Act 1997

NSW Office of Environment & Heritage (2011). Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites.

# FIGURES

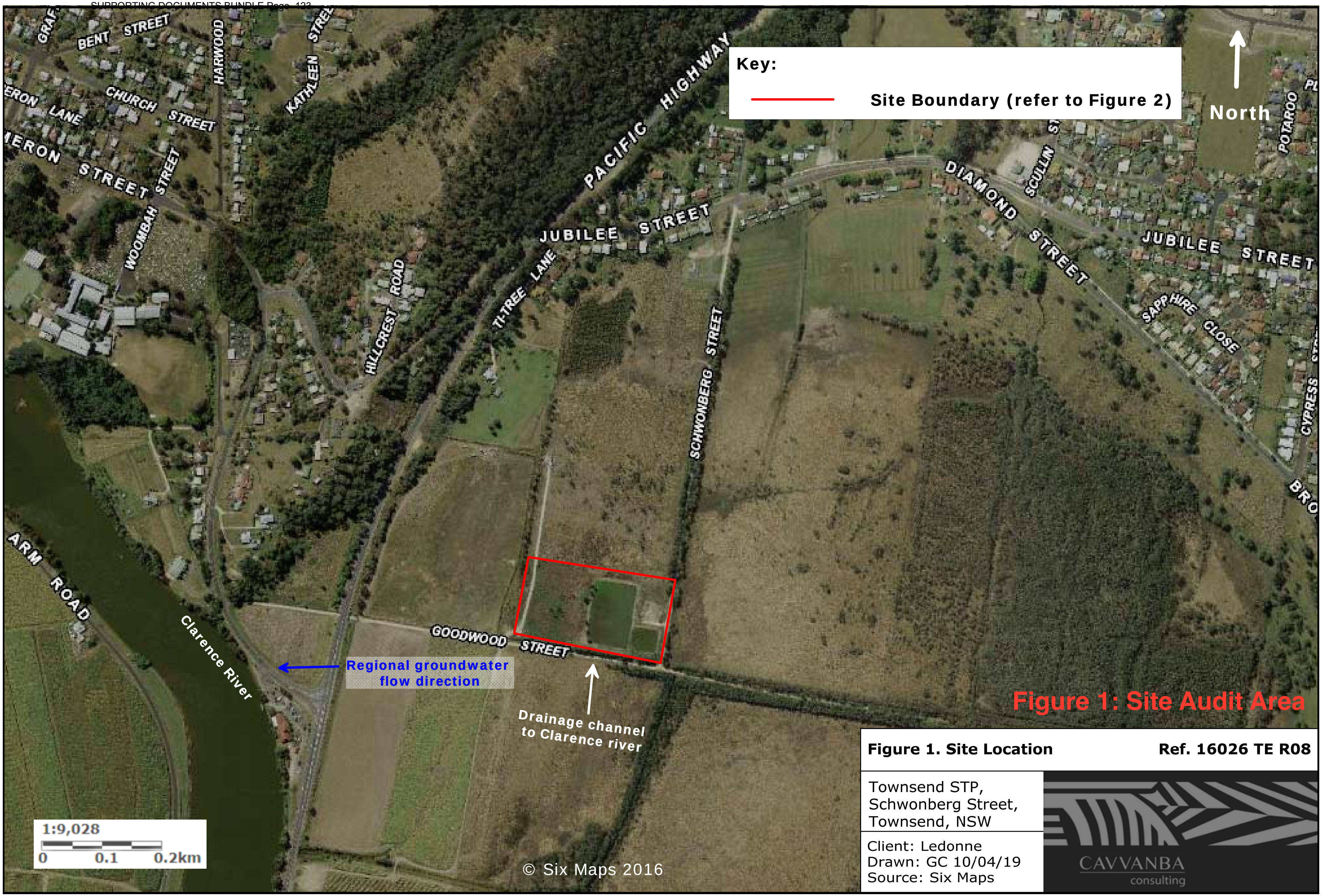


**Figure 1. Site Location** Ref. 16026 TE R08

Townsend STP,
Schwonberg Street,
Townsend, NSW

Client: Ledonne
Drawn: GC 10/04/19
Source: Six Maps

CAVVANBA consulting


**Figure 2: DSI and DSI Addendum Sample Locations**



Approximate Scale

0 m 25 m

Key

- Site boundary
- Monitoring Wells
- Test Pits
- Stockpile

**Figure 2. Townsend Sample Locations**
**Ref. 16026 TE R05**

Townsend STP,
Schwonberg Street,
Townsend, NSW

Client: Ledonne
Drawn: RN 23/10/17
Source: Six Maps

CAVVANBA consulting


Figure 3: Validation Sample Locations

Figure 2. Validation Sample Locations Ref. 16026 TE R08

Townsend STP, Schwonberg Street, Townsend, NSW

Client: Ledonne
Drawn: GC 10/04/19
Source: Six Maps

CAVVANBA consulting


Figure 4: ASS Validation Sample Locations

# APPENDIX A

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# AUDITOR COMMENTS

| | | | |
|---|---|---|---|
| **Site:** | Lot 2 DP 634170 Townsend STP | **Accredited Auditor:** | David Gregory (#1501) |
| **Proposed Land Use:** | Residential A | **Date of Review:** | 14 May 2019 |
| **Client:** | Ledonne Constructions Pty Ltd | **Interim Advice:** | #6 |
| **Audited Reports:** | As per Interim Advice Letter#6 (1601147c) | | |
| **Consultant:** | Cavvanba Consulting Pty Ltd | | |

| General Matters | Auditor Comments | Consultants Responses | Auditor Responses |
|---|---|---|---|
| Pond Water Discharge | The records for pond water discharge indicate the discharge criteria was exceed yet this is not identified in the report. Please review the records and consider. RAP indicated further investigation would be undertaken if exceeded. Please comment and amend report. Is there any evidence of impact, were the discharge rates consistent with the operational licence conditions? | A discussion has been included in the report, as follows:<br><br>During discharge monitoring the following observations were made within the channel:<br>• pH was within the acceptable range (i.e. within 2 pH units);<br>• Electrical conductivity decreased to 4.0 mS/cm from 13.0 (69% decrease); and<br>• Dissolved oxygen increased from 6.77 to a maximum of 28.8 (425% increase).<br><br>Decreasing electrical conductivity and increase of dissolved oxygen is not considered to have a negative environmental impact, considering that this would be similar to a natural rain even. No evidence of negative impact to the receiving environment was identified during discharge.<br><br>In addition, the limits outlined in the EPL are annual limits, which were not exceeded. No short-term discharge limits are applicable. | Page 28 States criteria was met. State it was not met and follow through with this acceptable explanation. |

| | | | |
|---|---|---|---|
| Acid Sulphate Soils | It is noted Cavaanba had treated the pond walls with lime on two occasions. Treatment in the first event did not meet the remediation goals for pH and acidity. A second treatment was performed and a similar result was achieved, the remediation criteria was not achieved. Cavvanba applied statistical analysis of the data set and concluded the treatment objective had been met. This may be appropriate if there is homogeneous mixture of lime through the soil. This has not been the case, it is clear the statistics have been skewed by an outlier, a sample that contained a lot of lime. Remove any reference to statistical analysis.<br>The remediation targets were not met for the second treatment event. Justification is needed to explain why no further treatment of the pond walls soils is required. I understand this soil is now covered with soil from Woodford Island. I would suggest Cavaanba consider the treatment volumes and evaluate whether the less stringent criteria for validation can be applied. What was the volume treated? Cavaanba could also consider the value of overlying soils and their potential buffering capacity, and could elaborate on the significance of acidity and the risk. How does the treated soil compare to insitu soils? Are they in equilibrium with the undisturbed environment? Further evaluation and justification is required. | Section 8.1 has been amended to take these comments into consideration. A discussion has been included in Section 9.1 and is summarised below:<br><br>*The volume of material associated with the exceedances of criteria (i.e. AS06A – AS10A) is considered to be approximately 50 – 60 m$^3$ (i.e. less than 100 tonnes). Based on the following discussion, the risk associated with the residual acidic soils is considered low and further treatment is not considered to be necessary:*<br>• The samples which exceed criteria are of a small volume of material (i.e. less than 100 tonnes);<br>• the overlying soil in this area of the site is ENM, sourced from Woodford Island. This soil has negative net acidity values which increases the buffering capacity;<br>• the site is located in an area of naturally occurring acid sulfate soils, and the soils are in equilibrium with the undisturbed environment;<br>• in addition, Dear et al (2014), Queensland best practice guidance for medium to fine- textured soils states for verification that no single sample shall exceed a net acidity of 62 mol H+/tonne. We did not exceed this criteria.<br><br>The former acid sulfate soils were considered suitable for reuse following treatment and were placed within the former pond void.<br><br>Tables amended as per comments. | Table 4.5: Monitoring Requirements does not display criteria based on <1000t volumes disturbed. Amend table to include criteria based on volumes disturbed.<br><br>Criteria has not been amended in Tables 8.1 and 8.2.<br><br>What was the volume of the entire material treated? Was the entire lot less than 1000t? Is this all being compared against the <1000t criteria? Please make clear and ensure all exceedances are made clear.<br><br>Incorrect pHs are still displayed in Table 8.1.<br><br>The incorrect Net Acidity %S -4.95 for AS01 is still displayed both Tables 8.1 and 8.2. |

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|---|---|---|---|
| | Data Entry – check tables there are data entry errors in the Acid Sulphate Soils results tables. | | |
| Woodford Island ASS | The exemption to use this soil onsite was issued by the NSW EPA on the condition the soils were treated with lime prior to being disposed at Townsend. It is noted this was not done and treatment occurred at Townsend. Can you provide evidence this was acceptable to the NSW EPA.<br><br>The Woodford Island ENM samples were sent to Southern Cross Uni for analysis. It is noted the Uni subcontracted the samples for organic analysis to Envirolab. There is no evidence Southern Cross Uni adhered to industry standard with respect to sample transport and preservation procedures (COC, chilled samples etc). Can you provide evidence the procedures were adhered to? If not, provide rationale why the data can be considered reliable. | Correspondence with NSW EPA is provided, which includes discussion regarding the quantity of material that may be processed on a site without requiring an environment protection license<br>– i.e. waste processing. This implies the material is being treated at the receiving site. The Order states:<br><br>*Before land application of Woodford Island STP excavated material, an environmental practitioner must implement the Acid Sulfate Soil Management Plan, Woodford Island Sewage Treatment Plant V03 ('Management Plan'; Appendix 1 to this order), including:*<br>*4.1.1 Neutralisation treatment of material using agricultural lime to achieve a pH range between 5.5 and 8.5 as per the Management Plan; and*<br>*4.1.2 Validation by testing of pH and the chromium reducible suite that the neutralisation treatment was successful.*<br><br>The application to land is the end use, not receival at the site. Treatment at Townsend was lawful and met the EPA's expectations. The ASSMP also clearly stated that Townsend was the processing site.<br><br>EAL (Environmental Analysis Laboratory) states that the samples are stored in a fridge before being sent in an esky with ice bricks. A copy of this email has been included.<br><br>A copy of the COC and SRN provided by Envirolab are included in the appropriate appendix. Based on this information, the data is considered to be reliable. | Acceptable. |
| S4.4.2 | Lists different RAC for ASS | Amended. | This includes >1000t criteria but does not include <1000t criteria.<br><br>Same as Table 4.5; >1000t criteria but no <1000t criteria. |

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| | | | |
|---|---|---|---|
| 4.4.3 | Clearly state what the EC value of groundwater means – ie brackish, saline? | Brackish – comment added to Table 4.6. | |
| Groundwater Discussion | This section could benefit from a discussion on the groundwater flow regime. For example low flow conditions equals low contaminant flux, which is important in evaluating the risk to surface waters. Further the elevated metals may not be from the STP alone, it is likely they originated from disturbance of acid sulphate soils during construction of the ponds.<br><br>A discussion of the scale of the project with respect to regional setting is required to communicate the significance of the groundwater condition (insignificant in my view). Regionally there is heavy agriculture, actual ASS soils and metals leaching (neighbouring property), stock utilisation, highway construction etc. Further groundwater beneficial use is limited, groundwater flux to Clarence River would be so low metals impact would be immeasurable. The site groundwater would not constitute a source of significance and in time will improve. | Additional points have been added to the discussion provided in Sections 11.3 and 11.4.<br><br>Historical flood imagery has also been included as Figure 6 to demonstrate the extent of flooding which has occurred on-site, and further strengthen the discussion regarding influences on the environment from surrounding landuses and flooding, localised and regional. | Acceptable |

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| | | | |
|---|---|---|---|
| 7.4 Data usability | There appears to be no data usability summary for Mar 2018 GW sampling round in Appendix L.<br><br>No rinsate blanks collected during any groundwater sampling (interface probe), comment on significance. | This has been included in Appendix L.<br><br>A comment has been included in the data usability reviews with respect to this. | Mentions no trip spike or blank, but there are trip spike results/blanks in Table 14?<br><br>The laboratory certificates for the March 2018 sampling round have not been included in the Appendix as previously requested. |

| | | | |
|---|---|---|---|
| 7.1.3 Former Pond Area | What is the total area of the former pond area. This is needed to confirm the sample number meets minimum sampling guidelines.<br><br>What is the diameter of hotspot able to be detected? Please comment.<br><br>Figure 2 shows the validation sample locations. The scale shows these locations more on a 35-45m grid. Please comment. | Table 7.2 has been updated to incorporate this information. The area of the former ponds is approximately 6,100 $m^2$, and requires 17 samples in accordance with NSW EPA sampling design guideline minimum sample density. This results in a 18.9 m systematic grid and detection of 22.4 m hotspots. The scale on the figure was erroneous and has been amended.<br><br>It is also noted that this material meets the definition of VENM / ENM and in accordance with the NSW EPA Site auditor guidelines:<br><br>*The resource recovery order ('order') and resource recovery exemption ('exemption') framework facilitates the lawful re-use of waste received from offsite, including for filling purposes. Auditors must check that fill material received, or that is intended to be received, has been assessed against the relevant order and exemption. Soil investigation and screening levels are not appropriate criteria for assessing incoming fill material. Soil investigation and screening levels may be used in addition to orders and exemptions to ensure incoming material does not pose an unacceptable risk to human health or the environment at the site and the site is suitable for the proposed use.*<br><br>Therefore, the use of investigation and comparison to screening levels is considered supplementary to the importation of VENM and ENM. There were no observations which contradicted the nature of the material as received, before or after its application to the land, and therefore any investigation was considered to be supplementary to the classification and limited rather than attempting to identify 'hotspots'. For metals, background will vary between types of parent material, e.g. soils derived from mafic rocks will have higher nickel content than those derived from sandstones. The data collected displays concentrations of heavy metals which are consistent and characteristic of sandstone and shale. No additional sampling is considered necessary. Table 1 shows the average concentrations of trace elements in main rock types. | I think you have misinterpreted what the Auditor requested. All we were after was confirmation the sampling grid was accurate as the map indicated it was not was reported. Further we just wanted a comment on the hotspot size. All this other response and tables is not needed. Please remove and from report and just make comment on the grid size, area and hotspot size and that is was validated as per Sampling Design Guidelines and meets NEPM statistical qualifiers. You conclusions should refer to the statistical based validation plan and make comment there are no hotspots at a 95% statistical degree of confidence. You are setting limits on the conclusions. Could be a 5m hotspot onsite, we don't know. 5m hotspot not important in the context of the residential land use and validation strategy. |

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<table>
<tr>
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Table 1: Average concentrations of trace elements in main rock types (ppm)
<table>
<tr><th>Metal</th><th>Ultramafic igneous</th><th>Mafic igneous</th><th>Intermediate igneous</th><th>Siliceous igneous</th><th>Shales</th><th>Sandstones</th><th>Carbonates</th></tr>
<tr><td>As</td><td>-</td><td>2</td><td>-</td><td>1.5</td><td>10</td><td>1</td><td>1</td></tr>
<tr><td>Cr</td><td>2,000</td><td>200</td><td>50</td><td>25</td><td>100</td><td>35</td><td>11</td></tr>
<tr><td>Cu</td><td>20</td><td>100</td><td>35</td><td>20</td><td>50</td><td>5</td><td>4</td></tr>
<tr><td>Pb</td><td>< 1</td><td>8</td><td>15</td><td>20</td><td>20</td><td>7</td><td>9</td></tr>
<tr><td>Mn</td><td>1,500</td><td>2,000</td><td>1,200</td><td>600</td><td>850</td><td>50</td><td>1,100</td></tr>
<tr><td>Ni</td><td>2,000</td><td>160</td><td>55</td><td>8</td><td>80</td><td>2</td><td>4</td></tr>
<tr><td>Zn</td><td>-</td><td>100</td><td>-</td><td>50</td><td>90</td><td>16</td><td>20</td></tr>
</table>
Notes: From Gray J. M. and Murphy B.W. (1999) Parent Material and Soils, A Guide to the Influence of Parent Material on Soil distribution in Eastern Australia, Technical Report No. 45. NSW Department of Land and Water Conservation, Sydney.
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<tr>
<td>7.1.6 Biosolids stockpile</td>
<td>These calculations are based on 37 samples, however, only 23 biosolids samples were analysed for COPC detailed in NSW EPA (2000) biosolids guidelines and therefore only 23 samples can be used in these calculations. The other 14 were analysed for PFAS only.<br><br>Please explain how total solids estimate of 44.6% was derived? Average moisture content appears to be 45.6% in laboratory report, total solids 54.4%. This would result in a sampling frequency that does not meet the guidelines. Please check calculation and values used. If the sampling frequency does not meet guidelines, please state this and explain why it is acceptable.</td>
<td>Section 7.1.6 has been rewritten.<br><br>Initial sampling was conducted in accordance with the biosolids guidelines. However, following detection of PFAS compounds and discussion with the EPA, off-site disposal was the only option available for this material.<br><br>The maximum PFOS & PFHxS concentration detected was 0.0015 mg/kg compared to the general solid waste criteria of 1.8 mg/kg, so three orders of magnitude below the criteria (0.08% of the criteria). The maximum PFOA concentration detected was 0.0057 mg/kg compared to the general solid waste criteria of 18 mg/kg, so four orders of magnitude below the criteria (0.03% of the criteria).<br><br>The disposal of these materials to Queensland was conducted lawfully under an interjurisdictional consignment application process based on the data we have presented in this validation report. This included preapproval by the receiving landfill and also Department of Environment and Science (DES).</td>
<td>Ok.<br><br>Biosolids Waste Classification documentation appears to be missing:<ul><li>Attachment D – Landfill letter of acceptance; and</li><li>Attachment E – Cavvanba's General Limitations to Environmental Information.</li></ul></td>
</tr>
</table>

| | | | |
|---|---|---|---|
| Table 3.1 | TRH Impact in Soil – please explain why no further assessment of TRH impact is required. Statistical analysis has previously been mentioned by the Auditor as not appropriate. | This table has been updated to take into account the auditor comments from the DSI addendum report. | Ok |
| Table 4.7 Groundwater and surface water remediation criteria | Table 4.7 – Nitrate criteria – check units – are these presented in mg/L or ug/L – it is not clear | Table 4.7 criteria has been updated to ensure clarity. | Ok |
| Table 6.1 Additional soil imported to sire for levelling purposes | Section 6.3 states South Grafton STP material totalled 5968.33 tonnes. If this is accurate, please amend estimate of 4000 tonnes from Table 6.1.<br><br>The imported fill register does not appear to be included in Appendix I – please include. | Information in Table 6.1 has been amended for this section based on the imported fill register.<br><br>This has been included. | Substantial volume change from initial report. Woodford Island should have had 10 samples with that much volume (only taken 7). Auditor to note in SAR |
| Table 8.3 Net acidity summary - Woodford Island ENM | Shows results from ASENM30A, which appears to have been sampled on a different date to the other samples. Please correct sample name and sampling date.<br><br>What is the significance of the holding time breaches, treatment batch 2 was 10 days outside holding time, and treatment 3 was 7 days outside holding time. Please undertake a data usability assessment on the ASS samples.<br><br>Please amend report to explain why another sample was taken on a different date, how was the stockpile retreated. | A data usability discussion for the holding time breaches for acid sulfate soils is included in Section 8.2. Due to the remote nature of the works, delays in laboratory analysis for acid sulfate soils are unavoidable and typical do exceed the short holding times.<br><br>Exceedances of holding times would likely lead to further oxidation of the soil, resulting in a lower pH which would be considered conservative for validation purposes. An example of this is the further treatment required for one sample (ASENM30) from Round 3.<br><br>As above. | The laboratory certificate with results of ASENM30A has not been included in Appendix (ES1834117). |

| | | | |
|---|---|---|---|
| Table 2: Soil and Biosolids Analytical Summary | Please check aged EILs. We do not get the same results from 12.9 CEC 4.8 pH using the NEPM EIL calculator.<br><br>Please amend in Table 4.4 | Amended in Table 2 and also Table 4.4 within report. No changes to exceedances identified. | Ok |
| Table 6: Soil analytical summary, pH(F) and net acidity | AS01 – other data appears to show is have a different sampling date – please check. There are no COCs for AS01 – AS10 treatment round 1.<br><br>AS01 – please show how the figure of -4.95 %S was derived – this is not presented in the laboratory certificate.<br><br>Check pHs – data entry errors. | Sample date for AS01 has been amended.<br><br>COCs for AS01 – AS10 have been included.<br><br>Is is a typographic error. Has been amended to "-" which mean not presented in the lab report.<br><br>Amended. | Sampling date has only been changed for Treatment Event 1 – not Treatment Event 2<br><br>-4.95 has not been removed from Treatment Event 2<br><br>What Criteria is Treatment Event 1 being compared against? Make clear what is over which criteria.<br><br>Not all pH exceedances are highlighted in this table.<br><br>Removed statistics from this table. |
| Table 9: Groundwater Analytical Summary, BTEXN, TRHs (ug/L) | Check F2 criteria – 1000ug/L not NL. Correct in Table 4.7 | Added. | ok |

| | | | |
|---|---|---|---|
| Table 11: Groundwater and Surface Water Analytical Summary, Metals (ug/L) | Check MW01 31/01/19 Fe result – 3,990 ug/L not 39,000?<br><br>Check SW03 31/01/19 Fe result – 190ug/L not ND?<br><br>Check MW03 21/03/19 Cd result – 1.2ug/L not 0.12: note this is an exceedance of Marine GILs, highlight and amend accordingly<br><br>Check sample date of SW March 2019 round. Sample logs, laboratory certificates, tables do not correlate – 20/03/2019 or 21/03/2019? | Amended.<br><br>Amended.<br><br>Amended in analytical tables and also Table 10.2 in the report.<br><br>SW01 = 21/03/19, SW02 and SW03 = 20/03/19 as per lab report and COC. Error on field sheets for SW02 and SW03. | ok |
| Table 12: Groundwater and Surface Water Analytical Summary | Please highlighted exceedances of Marine GILs for Nitrate and discuss significance of exceedances.<br><br>Please highlight exceedance of mercury in surface water and discuss significance of exceedances.<br><br>Check Nitrate Drinking Water GILs criteria – should be 50 mg/L not 13,000 | Amended. Discussion included in Section 11.2 of the report.<br><br>Amended. Discussion included in Section 11.3 of the report.<br><br>Amended. | Typo, mercury was found in surface water not groundwater. Change. |

| | | | |
|---|---|---|---|
| Table 14: Groundwater Analytical Summary, Quality Control | Nutrient RPD % have not been included for GME 8/2/2017, 21/8/2017, 1/3/18 and surface water sampling 1/3/18. There are exceedances. Please include all RPDs and highlight exceedances.<br><br>Check QW01 8/2/17 Al result 5.710 , Cr 2000 and Zn 719. Data entry errors. Recalculate RPDs.<br><br>Check MW01/QW02/QW04 21/03/2019 and MW03/QW01/QW02 results for Pb and Ni. Data entry errors. Recalculate RPDs accordingly.<br><br>Check SW03 31/01/2019 Fe result. Data entry error. Calculate RPD.<br><br>Check QW03 21/03/2019 Cu result. Data entry error.<br><br>Check QW02 31/01/19 Interlaboratory duplicate Nutrients result. Data entry errors resulting in incorrect RPDs. | These RPDs have been included and exceedances discussed in the data usability summaries.<br><br>Amended.<br><br>Amended.<br><br>Amended.<br><br>Amended.<br><br>Amended. | The RPD exceedances for the March 2018 round have not been discussed in the data usability summary.<br><br>Lead and Nickel results are still swapped around in many of the pages in Table 14 – please check every page<br><br>The amended Fe SW03/QW03 31/01/19 and resultant RPD appear to have been amended incorrectly |
| Appendix B | Photolog, missing. | Amended. | Ok. |
| Table 7 – biosolids waste classification | Interlaboratory duplicate 28/9/2018 should be labelled QS400. Check PFOA result. Data entry error. | The sample ID is labelled QS400. PFOA result updated as per laboratory report. | Ok. |

Acronyms:
COPC – Contaminants of potential concern
DSI – Detailed Site Investigation
EPL – Environmental protection Licence
PFAS – Perflouroalkyl Substances
PSI – Preliminary Site Investigation
STP - Sewerage Treatment Plant

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May 14 2019

Ledonne Constructions Pty Ltd
43 Planthurst Road
Carlton NSW 2218

Via Email – Shaun@ledonne.com.au

**RE:** **Interim Audit Advice 6**

**SITE:** **Remediation Validation Townsend STP**

---

Dear Shaun,

Thank you for the draft Remediation Validation Report prepared by Cavvanba Consulting referenced below:

- Validation Report, Townsend Sewerage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463. April 2019 Ref# 16026 TE R08

I have considered the report. Please have the consultant consider the Auditor comments in the attached table. There are some items identified by the Auditor that require further consideration by the consultant as the remediation criteria as defined in the RAP were not met. The implications of those oversights needs to be considered and communicated in the context of risk.

As remediation targets were not technically met I would like to review the Consultants response to the Auditors comments table prior to having them finalise the Validation Report. This is to ensure satisfactory consideration of the remediation validation has been undertaken prior to finalising the Validation Report and Site Audit.

Please do not hesitate to contact me on 02 9979 1722 should you wish to discuss this correspondence further.

Yours sincerely

David Gregory

**NSW EPA Accredited Site Auditor #1501**
**Geo-Logix Pty Ltd**

Auditor Comments Table

## Limitations:

*This interim advice does not constitute a site audit report or statement, nor does it pre-empt the conclusion to be drawn at the end of the site audit process. The site audit statement will be issued at the end of the site audit process.*

## David Gregory

**From:** David Gregory
**Sent:** Wednesday, 7 March 2018 2:02 PM
**To:** 'Kevin Brown'; Shaun Zimmerman
**Cc:** Ross Nicolson
**Subject:** Townsend RAP

Kevin, Shaun

I have reviewed the RAP for Townsend. The RAP is acceptable, my comments below:

1) TRH F2 RAC is 1000 ug/L Table 8.2

With all STP ponds I assume there will be some nominal level of compaction? It would be good to have the land restored as best as practicable to its original condition.

**David Gregory | Director**
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November 20 2017

Ledonne Constructions Pty Ltd
43 Planthurst Road
Carlton NSW 2218

Via Email – Shaun@ledonne.com.au

**RE: Interim Audit Advice 4**

**SITE: DSI Addendum Townsend**

Dear Shaun,

Thank you for the DSI addendum for Townsend. The purpose of the DSI addendum was to collect the following information:

- Further characterise the extents and magnitude of TRH C10 – C16 in shallow soil across the utilisation areas;
- Conduct additional preliminary sampling and characterisation of biosolids;
- Conduct another round of groundwater sampling for contaminant assessment using low flow sampling techniques.

I have considered the investigation findings and make the following comments:

## Soil Assessment

1. The DSI identified TRH C10-C16 in shallow surface soils in the utilisation area at location TP27 at a concentration in excess of the environmental and health based Tier 1 Screening Levels for residential land use. A total of 10 soil surface soil samples were collected for the utilisation area and analysed for TRH.

   The sampling for TRH was not systematic, nor has it met minimum sampling standards for an area of the size. Cavvanbah conducted further soil assessment around location TP27 and performed Silica Gel Cleanup on the samples prior to analysis. Silica Gel Cleanup removes vegetable and animal oils from the sample leaving behind the petroleum based compounds.

   Petroleum compounds were not detected in soil samples around location TP27 therefore the historical soil result is either indicative of vegetable/animal oils or minor, insignificant, petroleum impact.

   I concur with Cavvanba that no further assessment of the utilisation area soil is necessary. However I would encourage Cavvanbah to revisit their rationale why no further assessment is necessary. In particular;

   - The decision rule (not contaminated) was based on the NEPM statistical qualifiers. For the TRH HSL exceedance there was only 1 sample in 10 where it was detected. You cannot do statistics on 1 detection, further the sampling was not systematic. Given the potential contaminating source is a diffuse source applied by soaking over the field the sample spread is considered sufficient. The absence of TRH in groundwater provides further supporting evidence TRH is not a contaminant of concern.

- I concur with the assessment of the TRH ESLs, no further ESL assessment is required.

## Biosolids

2. Preliminary testing of biosolids was completed. The results were encouraging for Grade A Biosolids Classification.

   Per-and poly-fluoroalkyl substances (PFAS) were not detected in the three additional biosolid samples.

   I understand biosolid application to land is being considered once they have been excavated and dewatered. Whilst PFAS was not detected in the three biosolid samples I would like to adopt a precautionary approach with respect to PFAS and request further biosolid sampling at the time of remediation.

   I request the following additional PFAS assessment be conducted when the biosolids are being assessed and graded:

   - PFAS analysis and Total Oxidisable Precursor Assay (TOPA) on biosolids; and
   - ASLP Leaching Test on biosolids with PFAS & TOPA analysis on the leachate.

## Groundwater Assessment

3. The integrity of the second round of groundwater sampling is very good and provides a clearer representation of groundwater conditions. In particular;

   - Substantial reduction in Total Nitrogen and Total Phosphorous (TP) between first and second round sampling. The Nitrogen is organically bound nitrogen and the TP no doubt was elevated in the first round due to sample turbidity. Nutrients no longer warrant further consideration;
   - Ammonia was reported at similar concentrations between sampling rounds. Ammonia is background as indicated by sample MW3, collected upgradient of the STP. No further assessment of ammonia is required;
   - BOD was generally low compared to background, E.Coli is low and within background levels, and Thermotolerant Faecal Coliforms were not detected in groundwater. In association with the nutrient results in can be concluded the STP has not resulted in significant organic pollution of groundwater;
   - I don’t agree with Cavvanba’s interpretation that metals in groundwater within direct proximity of the STP ponds have originated from acid sulphate soil disturbance or historical use of agricultural fertilisers. The same ground conditions exist at location MW3 which is upgradient of the STP. Groundwater at MW3 is elevated in iron which would suggest acid sulphate soil disturbance yet there are no elevated levels of other metals.

     Metals are contaminants of concern at STPs and the most obvious source of metal contamination to groundwater in immediate proximity to the STP ponds are the STP ponds. It is my opinion the metals are directly related to the STP and therefore constitutes groundwater contamination.

- Cavvanba has considered groundwater beneficial use and distance to surface water receptors and has concluded the presence of elevated metals in groundwater would not present an unacceptable risk to the environment.

  I concur, however there is a drainage channel immediately adjacent to the STP that could be a direct conduit to the Clarence River for discharge of contaminated groundwater. Further evaluation of this pollutant transport pathway is required

Please note the following identified reporting issues:

- There is a paragraph stating groundwater flow direction is uncertain. Is it? The flow direction has been consistent for two monitoring events. Groundwater flow direction is to the west south west (report states south).
- Darcy velocity is not the average rate of groundwater flow velocity through the aquifer. It is the seepage velocity, which is the Darcy Velocity divided by the effective porosity of the saturated media.
- Data entry errors in the groundwater QC tables resulting in erroneous RPDs;

## Conclusion:

Excluding the waste stockpiles onsite at Townsend STP which are being assessed, the issues requiring further consideration include:

- PFAS assessment of biosolids during remediation; and
- Groundwater – Drainage Channel – Clarence River Pathway.

Please do not hesitate to contact me on 02 9979 1722 should you wish to discuss this correspondence further.

Yours sincerely

David Gregory

**NSW EPA Accredited Site Auditor #1501**
**Geo-Logix Pty Ltd**

## Limitations:

*This interim advice does not constitute a site audit report or statement, nor does it pre-empt the conclusion to be drawn at the end of the site audit process. The site audit statement will be issued at the end of the site audit process.*

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8 August 2017

Ledonne Constructions Pty Ltd
43 Planthurst Road
Carlton NSW 2218

Via Email – Shaun@ledonne.com.au

**RE: Interim Audit Advice Townsend – DSI Version 4**

---

Dear Shaun,

Thank you for provision of the above documents. Please find below my review and comments:

## DETAILED SITE ASSESSMENT REPORT V4

### Assessment Levels for Soil and Groundwater

There are still errors in the assessment levels documented in the tables as defined below:

- Table 7.2 & 7.3 F4 TRHs >C34-C40 – should be 2800 mg/kg;
- Table 7.6 Copper Marine Water – should be 1.3 ug/l
- Table 7.6 Nitrate Marine Value – should be 700 ug/l (LRTV)
- Table 7.6 Lead Marine Water – should be 4.4ug/l
- Table 7.6 Nickel Marine – should be 7 ug/l
- Table 7.6 Naphthalene Marine – should be 50 ug/l.

I am sure there are more examples in the tables in the attachments. I have bought this to the consultant's attention several times now.

Please have the consultant go through all STP DSI reports and double check the assessment criteria in all tables. This continual oversight is resulting in delays and inefficient auditing.

### Site Specific Ecological Levels

These need to be derived based on actual site specific soil conditions.

Please have the consultant collect actual site specific soil data so that site specific EILs can be derived. Once site specific EILs are derived the soil sampling data will need to be re-evaluated against the new EILs.

### Assessment of Pond Walls

- Table 7.1 indicates 12 samples were analysed from the pond walls. I believe there were 15 samples (TP1 – TP13, TP34, TP35).

I concur with the consultant's conclusion re the results of assessment. The material in the pond walls are natural soils, no doubt scalped out of the ground to form the ponds, and are suitable to remain onsite.

### Utilisation Area

- Table 7.2 states 24 samples were analysed for some contaminants and 12 samples for other contaminants. I believe it should be 20 samples (not 24) and 10 samples (not 12).

Very low levels of hydrocarbons were reported in shallow soil at sample location TP27. I concur with the consultants recommendations to resample and perform silica gel cleanup.

There was no indication the utilisation area has be impacted by contamination. Subject to a successful outcome from resampling the utilisation area can be considered validated.

### Waste Stockpiles

The sampling frequency (9 samples) just fell short of the minimum sampling frequency as per NEPM (9 10 samples). When I inspected these stockpiles in December 2016 I observed asbestos containing materials within. Please refer to my Interim Advice #1. I consider these stockpiles as containing asbestos.

As opposed to the Yamba STP stockpile, these stockpiles, which are of unknown origin, were not authorised to be placed on the land.

These stockpiles will need to be removed and disposed to a landfill licenced to receive the waste. The consultant is required to characterise the waste in accordance with the NSW EPA Waste Classification Guidelines (2014).

### Biosolids

I understand the NSW EPA is providing oversight for biosolids reuse. Please ensure I am updated and provided with the supporting documentation. I will need evidence of NSW EPA approval to conclude the audit.

### Yamba STP Stockpile

In prior reports it was thought the Yamba STP stockpile contained biosolids. It is understood this is not the case, the stockpile composed of soil, gravel, bricks, concrete, PVC pipes, and plastic waste.

The stockpile was sampled at the NEPM recommended stockpile sampling frequency. Contaminants of concern were not reported at concentration in excess of the adopted human health and environmental screening criteria.

It is noted in Section 3.6 of the DSI report that NSW EPA authorised the stockpiling of this waste onsite. Condition D of the approval states;

- " The classification of this material will determine its future use"

I have not been provided with the NSW EPA authorisation.

As the NSW EPA enabled the material to be stockpiled on the site they should be consulted to provide authorisation for its fate, whatever that may entail.

Based on the stockpile assessment results I would support an application for onsite reuse, provided the anthropogenic materials were screened out and disposed offsite.

### Groundwater

I don't concur with the consultants view on groundwater at this time. As indicated I believe it would be prudent to conduct another round of groundwater sampling and analysis utilising low flow techniques.

If the results suggest further characterisation is necessary it can be undertaken as part of the Remediation Action Plan.

### Acid sulphate soils

I note field pH testing on soils within the ponds walls would classify them as actual acid sulphate soils (pH < 4 ASS). This would be expected given they have been excavated from the native ground, which has been assessed as potential acid sulphate soils (PASS), and have since oxidised.

I concur with the consultant that an Acid Sulphate Soil Management Plan (ASSMP) will be required for remediation works that disturb the ground.

I have not reviewed the ASSMP at this time. I propose to do that at the time I review the Remediation Action Plan.

### Proposed Additional Sampling

I generally concur with the proposed additional sampling, however make the following comments:

- Please include QA/QC samples for all media sampled;
- Please collect soil samples for analysis of physical properties so that site specific ecological investigation levels can be determined.
- The Yamba Stockpile cannot be classed as ENM as it contains too much foreign materials. As NSW EPA authorised the material to be stored onsite they should be consulted to determine the fate of the stockpile and testing requirements.

Please do not hesitate to contact me on 02 9979 1722 should you wish to discuss this correspondence further.

Yours sincerely

David Gregory
**NSW EPA Accredited Site Auditor #1501**
**Geo-Logix Pty Ltd**

# Auditor Response Table

| | | | |
|---|---|---|---|
| Site: | Townsend Sewage Treatment Plan | Accredited Auditor: | David Gregory (#1501) |
| Proposed Development: | - | Date of Review: | 14 May 2019 |
| Proposed Land Use: | Residential with Gardens and Accessible Soils | Interim Advice: | - |
| Client: | Ledonne Constructions | | |
| Audited Reports: | Draft Validation Report – Ref: 16026 TE R08 | | |
| Consultant: | Cavvanba | | |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| Asbestos Waste Stockpiles | PSI - 2000 - 3000m3 | Section 5.1 within the PSI states:<br><br>*An area of stockpiled soil is present to the north of the concrete tanks, which potentially contains ACMs and is assumed to be approximately 2,000 – 3,000 m3 in volume.*<br><br>Section 1.1 of the PSI also states that:<br><br>*In the north eastern portion of the site, material is stockpiled which reportedly consists of biosolids sourced from Yamba STP (operated by Clarence Valley Council), as well as imported fill which may include asbestos containing materials (ACMs).*<br><br>At the time of reporting it was therefore not certain whether materials could be separated. This volume therefore includes both the Yamba soil and those other wastes suspected of containing ACMs. The materials were |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| | | superficially similar due to vegetation overgrowth. The volumes were later amended within the DSI based on intrusive investigation including test pitting. |
| | DSI - 600t<br>Waste Classification - 300m3<br>Approval for 20 loads 600t<br>Validation - 627.70 / 418.47m3 21 loads. | Section 2.7 within the DSI states:<br><br>*Waste stockpiles were present in close proximity to the vehicular access from Schwonberg Street at Townsend STP and were investigated (TP36 – TP39). It is assumed to be approximately 600 tonnes (approximately 300 m3 in volume).* |
| | Was the initial volume grossly over estimated? Or was the asbestos stockpile separated from some other waste stockpiles? | The volume had initially been grossly over-estimated during the PSI. Ledonne provided a preliminary estimation of waste volumes, which were difficult to determine due to the superficial vegetation overgrowth. |
| Yamba STP Stockpile | PSI - 1200t | Section 4.5.3 within the PSI states:<br><br>*In 2014, approximately 1,200 tonnes of biosolids were transported from the Yamba STP to the Townsend STP.*<br><br>This is based on the email between CVC and EPA 18 June 2014. A copy of the email is also included within Appendix F of the validation report V3. |

CAVVANBA

| General | Auditor comment | Cavvanba response |
|---|---|---|
| | DSI - 3000t was trucked in 2014<br>ENM Exemption - 3000t<br>Validation Report V1 - 3000t | Section 2.6 within the DSI states:<br><br>*It is assumed to be approximately 3,000 tonnes (~1,500 m3 in volume). This material is understood to have been sourced from the former Yamba STP.*<br><br>The volume was based on information provided by Ledonne. This appears to have been miscalculated by Cavvanba by incorrectly recording the weight (tonnes) as volume (m3), and then converting volume to weight. The correct value should have been 1,500 tonnes (i.e. not m3), which is an overestimation of the original 1,200 tonnes described in the PSI to ensure adequate sample collection frequency. |
| | Validation Report V2 - has been amended to 1200t? How much was there? Is there a truck register for this material? | There was a total of 1,200t transported from the Yamba STP.<br><br>As previously stated, this was based on the email between CVC and EPA on 18 June 2014. A copy of the email is also included within Appendix F of the validation report V3. For material volumes Cavvanba relies on the information provided by Ledonne.<br><br>Ledonne Constructions has no truck register for this material as the material was delivered to site by Clarence valley council prior to the contract works. |

| General | Auditor comment | Cavvanba response |
| --- | --- | --- |
| Woodford Island | Validation V1 - 2170 t<br>Validation V2 - 2170 m3 = 3906t (volume calculated on imported fill register)<br>ENM exemption for 3000t only<br>- Should have had 10 samples and only have 7 samples<br>- The EPA stipulated that the material must be processed in batches of 1000t or less or otherwise needed an EPL- this amount would have required 4 treatment batches in order to do it in batches of 1000t or less? | Table 6.1 has been amended within V3 of the validation report – approximately 3,106.5 tonnes were imported to the site using the conversion rate: 1 m3=1.5 tonne for sandy soils.<br><br>This conversion is considered to be appropriate. However, Cavvanba recognises that the ENM exemption has strict sampling frequency for volume thresholds, being 7 samples for 2,000-3,000 tonnes, and 10 samples for 3,000 – 4,000 tonnes. This volume discrepancy is therefore considered marginal and unlikely to result in inappropriately classified material. |
| | The EPA also specifically point out that the material coming from Woodford Island must not exceed 3000t as there was already had a resource recovery order and exemption for the Yamba STP stockpile 3000t to be processed to remove large physical contaminants. The EPA point out that regulatory action will be taken if more than 3000t is trucked from Woodford Island.<br><br>Having the Woodford Island material being over 3000t would mean that they exceed 6000t of waste processing requiring an EPL. | Regarding the 6,000-tonnage threshold, in combination with the discussion regarding the Yamba stockpile, this is not considered to have been exceeded. |

CAVVANBA

| General | Auditor comment | Cavvanba response |
| --- | --- | --- |
| South Grafton STP ENM/VENM | VENM certification is for 1500m3<br>ENM documentation is for 4000t<br>5968.m3 = 9550t was trucked from Maclean STP (originally from ST South Grafton) volume calculated on imported fill register)<br><br>Classification documentation from South Grafton only totals ~6400t Large discrepancy of 3150 tonnes (if use 1.6 for m3 to t conversion). Are there trucking records of how much trucked from South Grafton to Maclean? | Refer to attached VENM and ENM certificates.<br><br>ENM = 4,000t; and<br>VENM = 5,000 m3. (not 1500m3) extra 3500 m3<br><br>Therefore, the additional volume is VENM.<br><br>VENM was temporarily stockpiled at Maclean.<br>Refer to attached spread sheet. |

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25 January 2017

Ledonne Constructions Pty Ltd
43 Planthurst Road
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Via Email – Shaun@ledonne.com.au

**RE:** **Interim Audit Advice 2**

**SITE:** **Townsend STP – Sampling Analysis Quality Plan**

## INTRODUCTION

Dear Shaun,

I have reviewed the following sampling analysis plan proposed for the Townsend STP;

- Data Quality Objectives and Sampling, Analysis and Quality Plan – groundwater and soil investigation, Townsend Sewage Treatment Plant, Lot 2 DP 634170, Corner of Schwonberg and Goodwood Street, Townsend NSW 2463. Cavvanba Consulting, December 2016, Ref. 16026 TE R02.

My comments are presented below:

In general the SAQP has been prepared in accordance with the DQO principles. I find the objectives in the DQO to be on the broad side and rather non-specific to the intended problems. The problems I would consider require attention in the DQO section include the following:

- Has the STP operation contaminated surface soils onsite?
- Has contaminated fill been applied to the site?
- Are biosolids stockpiled onsite suitable for onsite reuse?
- Are biosolids at the base of the effluent ponds suitable for reuse onsite?
- Are stockpiles onsite contaminated;
- Does pond water contain toxicants or stressors that would impact the environment if released to the surface drain?
- Has groundwater been contaminated by the STP operations?
- Does contamination from any of the above prevent the land being used for the most sensitive uses as defined under RU1 zoning.

That said I believe the sampling plan is appropriate for assessing site contamination. The consultant has recognised additional stockpile sampling may be necessary.

As with Ilarwill and Maclean STPs, my primary concern is that the land use has not been defined clearly. Because the site is being remediated to a zoning standard as opposed to a particular development, the consultant will need to assess and remediate the site to the most sensitive possible use under that zoning if the site is to be considered suitable for all zoning uses.

Consequently, the consultant is required to clearly define the most sensitive use as agreed by stakeholders and develop a theoretical conceptual model that defines the exposure pathways relevant to that theoretical land use. For example, if CVC decide to remediate to residential land use with less than 10% home grown vegetable intake and no poultry, the consultant will need to evaluate the exposure pathways associated with that land use which includes ingestion, inhalation, dermal contact, etc. If CVC want residential land use with substantial intake form vegetables, poultry and eggs, site specific risk assessment will be necessary as the NEPM (2013) Health Based Soil Investigation Levels do not consider these exposure pathways.

It is highly recommended that the DQOs / CSM be resolved prior to remediation commencing to avoid oversights which will prohibit or delay the issuance of the Site Audit Statement. The existing sampling plan may not be sufficient to address more sensitive site uses.

In addition to the above please add the following COPC to the sampling schedule:

- Biosolids – add selenium, PCBs, Phenols and pH;
- Groundwater – add selenium, $BOD_5$, TDS, pH, E-Coli. One sample for broad screen of contaminants including VOCs, SVOCs, PFAS.

## NEXT STEPS

Please consider the Audit comments and provide a formal response. I cannot provide a Site Audit Statement until all issues identified in interim advice documents are satisfactorily addressed.

Please do not hesitate to contact me on 02 9979 1722 should you wish to discuss this further.

Yours sincerely

David Gregory
**NSW EPA Accredited Site Auditor #1501**
**Geo-Logix Pty Ltd**

**GEO-LOGIX PTY LTD**
ABN 86 116 892 936

Unit 2309
4 Daydream Street
Warriewood, NSW 2102

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**F** 02 9979 1222
**W** www.geo-logix.com.au

19th January 2017

Ledonne Constructions Pty Ltd
43 Planthurst Road
Carlton NSW 2218

Via Email – Shaun@ledonne.com.au

**RE:** **Interim Audit Advice 1**

**SITE:** **Townsend STP – Cnr Schwonberg and Goodwood Street, Townsend NSW, Lot 2 DP 634170**

## INTRODUCTION

Ledonne Constructions Pty Ltd commissioned David Gregory, NSW EPA Accredited Site Auditor (Accreditation #1501), to perform Site Audit Services for the proposed decommissioning and rehabilitation of the Clarence Valley Council (CVC) Townsend Sewerage Treatment Plant (STP), located in Townsend NSW.

The STP is located on Lot 2 DP 634170, on the corner of Schwonberg Street and Goodwood Street, Townsend and approximately 1.2km south-west of the Townsend village. The site has a total area of approximately 3 hectares. It is understood the STP is to be remediated to a standard that will allow CVC to rezone the site from SP2 Infrastructure to RU1 Primary Production.

The Townsend STP was a small – medium scale operation which provided sewerage waste water treatment (average of 130kL/day) for Townsend. It is also understood Townsend STP received pump out effluent from septics throughout the Maclean region and later from all over the Clarence Valley Council area.

Effluent was received at the STP via a pump station located on Schwonberg Street near Cameron Street and via septic pump out trucks. It is noted septage from truck pump outs was not disposed at Townsend.

The STP comprised an oxidation pond which was fed effluent by a rising main from the offsite pump station. Wastewater in the oxidation pond discharged to a smaller polishing pond which then piped wastewater to the utilisation area (infiltration) located immediately west of the ponds. Two concrete septic tanks were used to receive pump out waste prior to discharging to the oxidation pond. Biosolids were collected in the septic tanks and stockpiled onsite (small volumes). It is understood biosolids have never been dredged from the treatment ponds.

In 2014 the STP received approximately 1200 tonnes of biosolids from the Yamba STP. Approximately 2000m$^3$ of soil, construction and building waste has been deposited on the eastern portion of the site. During my site visit in December 2016 fragments of Asbestos Piping were noted on the surface of some stockpiles.

The ultimate purpose of Site Auditor Services is to deliver a Site Audit Report (SAR) and Section A Site Audit Statement (SAS) certifying the suitability of the Site for the proposed land use. At the time of this interim advice the Audit is non-statutory as it is not being required by a regulatory instrument under the *Contaminated Land Management Act 1997 (CLM Act)*, the *Environmental Planning and Assessment Act (1997)* nor any other *Act*.

A review of Environmental Information was conducted to assess their adequacy against the guidelines made or approved by NSW EPA under *Section 105* of *CLM Act*. Review findings and advice included in the attached Auditor Comments Table and within this letter constitute Interim Audit Advice #1.

This interim advice does not constitute a SAR / SAS nor does it pre-empt any conclusions made at the end of the site audit process. It provides an opportunity to supply further information or make amendments to reports or activities to ensure requirements of the contaminated land guidelines are met. The SAR / SAS will be issued at the completion of satisfactory remediation and validation.

## REVIEWED DOCUMENTS

The environmental reports which were reviewed and are the subject of this Interim Advice are listed below:

- *Preliminary Site Investigation – Townsend Sewerage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting*, *January 2017* (Ref#16026 TE R01v2);

In addition to the above, I have considered relevant information provided in the following documents to assist in my assessment of site contamination:

- *NSW Environmental Protection Licence #2507 (1st October 2014) - Townsend Sewerage Treatment*

- *Report on Preliminary Contamination Assessment, Proposed Decommissioning & Rehabilitation Maclean, Townsend & Ilarwilll STP*. *Douglas Partners, August 2005 (Ref:39098);*

- *Redundant Sewer Treatment Plants at Junction Hill (3), South Grafton, Maclean, Ilarwilll and Townsend, Future Land Use Assessment. GHD, June 2010 (Ref#22/15090/14122).*

## PRELIMINARY SITE ASSESSMENT

I consider the consultant, Cavvanba, has generally prepared a draft Preliminary Site Investigation Report in accordance with guidelines approved under *s105* of the *CLM Act* and the *National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended 2013)*.

The typical sources of historical site information have been obtained by Cavvanba and appropriately considered and interpreted with respect to potential land contamination. I have identified minor omissions which are discussed in the attached Auditor Comments Table.

Whilst the report is mostly complete Cavvanba should consider the following as I believe the information will greatly assist in defining the contamination risk profile:

- Review the results of annual environmental monitoring as required by the Environmental Protection Licence and incorporate a summary of findings in the PSI. Please provide the Auditor a copy of any annual reports held on CVC file;

- Obtain and summarise any classification data for the Yamba biosolids that were disposed onsite;
- Provide further discussion on the pathogen risk. I have provided a reference paper to assist Cavvanba. I consider the Aquifer Pathogen Pollution Susceptibility Rating as presented in Figure 11 a reasonable approach for preliminary assessment of pathogen groundwater risk; and,
- Most importantly, undertake immediate action to manage the potential asbestos health risk at Townsend STP. A suitably qualified environment consultant should be engaged to implement appropriate management until such time as the site can be assessed in detail. The consultant should also consider Council's obligation to notify NSW EPA of the contamination under s60 of the Contaminated Land Management Act (1997).

## NEXT STEP

Please consider the Audit comments and formerly respond in the attached Auditor Comments Table. On the provision Cavvanba provides responses which satisfactorily address Audit comments I can provide confirmation the PSI can be finalised.

Following completion of the PSI a Sampling Analysis Quality Plan should be prepared and submitted for my consideration prior to undertaking Detailed Site Assessment.

Please do not hesitate to contact me on 02 9979 1722 should you wish to discuss this further.

Yours sincerely

David Gregory
**NSW EPA Accredited Site Auditor #1501**
**Geo-Logix Pty Ltd**

**ATTACHMENTS**

1601147cIA#1 Auditor Comments Table

CAVVANBA

# Auditor Response Table

| | | | |
|---|---|---|---|
| Site: | Townsend Sewage Treatment Plan | Accredited Auditor: | David Gregory (#1501) |
| Proposed Development: | - | Date of Review: | 14 May 2019 |
| Proposed Land Use: | Residential with Gardens and Accessible Soils | Interim Advice: | #6 |
| Client: | Ledonne Constructions | | |
| Audited Reports: | Draft Validation Report – Ref: 16026 TE R08 | | |
| Consultant: | Cavvanba | | |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| Pond Water Discharge | The records for pond water discharge indicate the discharge criteria was exceed yet this is not identified in the report. Please review the records and consider. RAP indicated further investigation would be undertaken if exceeded. Please comment and amend report. Is there any evidence of impact, were the discharge rates consistent with the operational licence conditions? | A discussion has been included in the report, as follows:<br><br>During discharge monitoring the following observations were made within the channel:<br>• pH was within the acceptable range (i.e. within 2 pH units);<br>• Electrical conductivity decreased to 4.0 mS/cm from 13.0 (69% decrease); and<br>• Dissolved oxygen increased from 6.77 to a maximum of 28.8 (425% increase).<br><br>Decreasing electrical conductivity and increase of dissolved oxygen is not considered to have a negative environmental impact, considering that this would be similar to a natural rain even. No evidence of negative impact to the receiving environment was identified during discharge.<br><br>In addition, the limits outlined in the EPL are annual limits, which were not exceeded. No short-term discharge limits are applicable. |
| Acid Sulphate Soils | It is noted Cavaanba had treated the pond walls with lime on two occasions. Treatment in the first event did not meet the remediation goals for pH and acidity. A second treatment was | Section 8.1 has been amended to take these comments into consideration. A discussion has been included in Section 9.1 and is summarised below:<br><br>*The volume of material associated with the exceedances of criteria (i.e. AS06A – AS10A) is considered to be approximately 50 – 60 m$^3$ (i.e. less than 100 tonnes). Based on the following* |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| | performed and a similar result was achieved, the remediation criteria was not achieved.<br><br>Cavvanba applied statistical analysis of the data set and concluded the treatment objective had been met. This may be appropriate if there is homogeneous mixture of lime through the soil. This has not been the case, it is clear the statistics have been skewed by an outlier, a sample that contained a lot of lime. Remove any reference to statistical analysis.<br><br>The remediation targets were not met for the second treatment event. Justification is needed to explain why no further treatment of the pond walls soils is required. I understand this soil is now covered with soil from Woodford Island.<br><br>I would suggest Cavaanba consider the treatment volumes and evaluate whether the less stringent criteria for validation can be applied. What was the volume treated? Cavaanba could also consider the value of overlying soils and their potential buffering capacity, and could elaborate on the significance of acidity and the risk. How does the treated soil compare to insitu soils? Are they in equilibrium with the undisturbed environment? Further evaluation and justification is required. | *discussion, the risk associated with the residual acidic soils is considered low and further treatment is not considered to be necessary:*<br>• *The samples which exceed criteria are of a small volume of material (i.e. less than 100 tonnes);*<br>• *the overlying soil in this area of the site is ENM, sourced from Woodford Island. This soil has negative net acidity values which increases the buffering capacity;*<br>• *the site is located in an area of naturally occurring acid sulfate soils, and the soils are in equilibrium with the undisturbed environment;*<br>• *in addition, Dear et al (2014), Queensland best practice guidance for medium to fine-textured soils states for verification that no single sample shall exceed a net acidity of 62 mol H+/tonne. We did not exceed this criteria.*<br><br>*The former acid sulfate soils were considered suitable for reuse following treatment and were placed within the former pond void.* |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| | Data Entry – check tables there are data entry errors in the Acid Sulphate Soils results tables. | Tables amended as per comments. |
| Woodford Island ASS | The exemption to use this soil onsite was issued by the NSW EPA on the condition the soils were treated with lime prior to being disposed at Townsend. It is noted this was not done and treatment occurred at Townsend. Can you provide evidence this was acceptable to the NSW EPA.<br><br>The Woodford Island ENM samples were sent to Southern Cross Uni for analysis. It is noted the Uni subcontracted the samples for organic analysis to Envirolab. There is no evidence Southern Cross Uni adhered to industry standard with respect to sample transport and preservation procedures (COC, chilled samples etc). Can you provide evidence the procedures were adhered to? If not, provide rationale why the data can be considered reliable. | Correspondence with NSW EPA is provided, which includes discussion regarding the quantity of material that may be processed on a site without requiring an environment protection license – i.e. waste processing. This implies the material is being treated at the receiving site. The Order states:<br><br>*Before land application of Woodford Island STP excavated material, an environmental practitioner must implement the Acid Sulfate Soil Management Plan, Woodford Island Sewage Treatment Plant V03 ('Management Plan'; Appendix 1 to this order), including:*<br>*4.1.1. Neutralisation treatment of material using agricultural lime to achieve a pH range between 5.5 and 8.5 as per the Management Plan; and*<br>*4.1.2. Validation by testing of pH and the chromium reducible suite that the neutralisation treatment was successful.*<br><br>The application to land is the end use, not receival at the site. Treatment at Townsend was lawful and met the EPA's expectations. The ASSMP also clearly stated that Townsend was the processing site.<br><br>EAL (Environmental Analysis Laboratory) states that the samples are stored in a fridge before being sent in an esky with ice bricks. A copy of this email has been included.<br><br>A copy of the COC and SRN provided by Envirolab are included in the appropriate appendix. Based on this information, the data is considered to be reliable. |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| S4.4.2 | Lists different RAC for ASS. | Amended. |
| 4.4.3 | Clearly state what the EC value of groundwater means – ie brackish, saline? | Brackish – comment added to Table 4.6. |
| Groundwater discussion | This section could benefit from a discussion on the groundwater flow regime. For example low flow conditions equals low contaminant flux, which is important in evaluating the risk to surface waters. Further the elevated metals may not be from the STP alone, it is likely they originated from disturbance of acid sulphate soils during construction of the ponds.<br><br>A discussion of the scale of the project with respect to regional setting is required to communicate the significance of the groundwater condition (insignificant in my view). Regionally there is heavy agriculture, actual ASS soils and metals leaching (neighbouring property), stock utilisation, highway construction etc. Further groundwater beneficial use is limited, groundwater flux to Clarence River would be so low metals impact would be immeasurable. The site groundwater would not constitute a source of significance and in time will improve. | Additional points have been added to the discussion provided in Sections 11.3 and 11.4.<br><br>Historical flood imagery has also been included as Figure 6 to demonstrate the extent of flooding which has occurred on-site, and further strengthen the discussion regarding influences on the environment from surrounding landuses and flooding, localised and regional. |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| 7.4 Data usability | There appears to be no data usability summary for Mar 2018 GW sampling round in Appendix L.<br><br>No rinsate blanks collected during any groundwater sampling (interface probe), comment on significance. | This has been included in Appendix L.<br><br>A comment has been included in the data usability reviews with respect to this. |
| 7.1.3 Former Pond Area | What is the total area of the former pond area. This is needed to confirm the sample number meets minimum sampling guidelines.<br><br>What is the diameter of hotspot able to be detected? Please comment.<br><br>Figure 2 shows the validation sample locations. The scale shows these locations more on a 35-45m grid. Please comment. | Table 7.2 has been updated to incorporate this information. The area of the former ponds is approximately 6,100 $m^2$, and requires 17 samples in accordance with NSW EPA sampling design guideline minimum sample density. This results in a 18.9 m systematic grid and detection of 22.4 m hotspots. The scale on the figure was erroneous and has been amended.<br><br>It is also noted that this material meets the definition of VENM / ENM and in accordance with the NSW EPA Site auditor guidelines:<br><br>*The resource recovery order ('order') and resource recovery exemption ('exemption') framework facilitates the lawful re-use of waste received from offsite, including for filling purposes. Auditors must check that fill material received, or that is intended to be received, has been assessed against the relevant order and exemption. Soil investigation and screening levels are not appropriate criteria for assessing incoming fill material. Soil investigation and screening levels may be used in addition to orders and exemptions to ensure incoming material does not pose an unacceptable risk to human health or the environment at the site and the site is suitable for the proposed use.*<br><br>Therefore, the use of investigation and comparison to screening levels is considered supplementary to the importation of VENM and ENM. There were no observations which contradicted the nature of the material as received, before or after its application to the land, and therefore any investigation was considered to be supplementary to the classification and limited rather than attempting to identify 'hotspots'. For metals, background will vary between types of parent material, e.g. soils derived from mafic rocks will have higher nickel content than those derived from sandstones. The data collected displays concentrations of heavy metals which are consistent and characteristic of sandstone and shale. No additional sampling is considered necessary. Table 1 shows the average concentrations of trace elements in main rock types. |

<table>
<tr><th>General</th><th>Auditor comment</th><th>Cavvanba response</th></tr>
<tr><td></td><td></td><td>

**Table 1: Average concentrations of trace elements in main rock types (ppm)**

| Metal | Ultramafic igneous | Mafic igneous | Intermediate igneous | Siliceous igneous | Shales | Sandstones | Carbonates |
|---|---|---|---|---|---|---|---|
| As | - | 2 | - | 1.5 | 10 | 1 | 1 |
| Cr | 2,000 | 200 | 50 | 25 | 100 | 35 | 11 |
| Cu | 20 | 100 | 35 | 20 | 50 | 5 | 4 |
| Pb | < 1 | 8 | 15 | 20 | 20 | 7 | 9 |
| Mn | 1,500 | 2,000 | 1,200 | 600 | 850 | 50 | 1,100 |
| Ni | 2,000 | 160 | 55 | 8 | 80 | 2 | 4 |
| Zn | - | 100 | - | 50 | 90 | 16 | 20 |

Notes: From Gray J. M. and Murphy B.W. (1999) *Parent Material and Soils, A Guide to the Influence of Parent Material on Soil distribution in Eastern Australia*, Technical Report No. 45. NSW Department of Land and Water Conservation, Sydney.

</td></tr>
<tr><td>7.1.6 Biosolids stockpile</td><td>These calculations are based on 37 samples, however, only 23 biosolids samples were analysed for COPC detailed in NSW EPA (2000) biosolids guidelines and therefore only 23 samples can be used in these calculations. The other 14 were analysed for PFAS only.<br><br>Please explain how total solids estimate of 44.6% was derived?</td><td>Section 7.1.6 has been rewritten.<br><br>Initial sampling was conducted in accordance with the biosolids guidelines. However, following detection of PFAS compounds and discussion with the EPA, off-site disposal was the only option available for this material.<br><br>The maximum PFOS & PFHxS concentration detected was 0.0015 mg/kg compared to the general solid waste criteria of 1.8 mg/kg, so three orders of magnitude below the criteria (0.08% of the criteria). The maximum PFOA concentration detected was 0.0057 mg/kg compared to the general solid waste criteria of 18 mg/kg, so four orders of magnitude below the criteria (0.03% of the criteria).</td></tr>
</table>

| General | Auditor comment | Cavvanba response |
|---|---|---|
| | Average moisture content appears to be 45.6% in laboratory report, total solids 54.4%. This would result in a sampling frequency that does not meet the guidelines. Please check calculation and values used. If the sampling frequency does not meet guidelines, please state this and explain why it is acceptable. | The disposal of these materials to Queensland was conducted lawfully under an interjurisdictional consignment application process based on the data we have presented in this validation report. This included preapproval by the receiving landfill and also Department of Environment and Science (DES). |
| Table 3.1 | TRH Impact in Soil – please explain why no further assessment of TRH impact is required. Statistical analysis has previously been mentioned by the Auditor as not appropriate. | This table has been updated to take into account the auditor comments from the DSI addendum report. |
| Table 4.7 Groundwater and surface water remediation criteria | Table 4.7 – Nitrate criteria – check units – are these presented in mg/L or ug/L – it is not clear. | Table 4.7 criteria has been updated to ensure clarity. |
| Table 6.1 Additional soil imported to sire for levelling purposes | Section 6.3 states South Grafton STP material totalled 5968.33 tonnes. If this is accurate, please amend estimate of 4000 tonnes from Table 6.1.<br><br>The imported fill register does not appear to be included in Appendix I – please include. | Information in Table 6.1 has been amended for this section based on the imported fill register.<br><br>This has been included. |
| Table 8.3 Net acidity summary | Shows results from ASENM30A, which appears to have been sampled on a different date to the other samples. | Apologies for the confusion. Following receipt of the Round 3 results, further treatment was conducted for the acid sulfate soils for ASENM30. The result is presented above as Round 4. |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| - Woodford Island ENM | Please correct sample name and sampling date.<br><br>What is the significance of the holding time breaches, treatment batch 2 was 10 days outside holding time, and treatment 3 was 7 days outside holding time. Please undertake a data usability assessment on the ASS samples.<br><br>Please amend report to explain why another sample was taken on a different date, how was the stockpile retreated. | A data usability discussion for the holding time breaches for acid sulfate soils is included in Section 8.2. Due to the remote nature of the works, delays in laboratory analysis for acid sulfate soils are unavoidable and typical do exceed the short holding times.<br><br>Exceedances of holding times would likely lead to further oxidation of the soil, resulting in a lower pH which would be considered conservative for validation purposes. An example of this is the further treatment required for one sample (ASENM30) from Round 3.<br><br>As above. |
| Table 2: Soil and Biosolids Analytical Summary | Please check aged EILs. We do not get the same results from 12.9 CEC 4.8 pH using the NEPM EIL calculator.<br><br>Please amend in Table 4.4. | Amended in Table 2 and also Table 4.4 within report. No changes to exceedances identified. |
| Table 6: Soil analytical summary, pH(F) and net acidity | AS01 – other data appears to show is have a different sampling date – please check. There are no COCs for AS01 – AS10 treatment round 1.<br><br>AS01 – please show how the figure of -4.95 %S was derived – this is not presented in the laboratory certificate.<br><br>Check pHs – data entry errors. | Sample date for AS01 has been amended.<br><br>COCs for AS01 – AS10 have been included.<br><br>Is is a typographic error. Has been amended to "-" which mean not presented in the lab report.<br><br>Amended. |
| Table 9: Groundwater | Check F2 criteria – 1000ug/L not NL. Correct in Table 4.7 | Added. |

| General | Auditor comment | Cavvanba response |
|---|---|---|
| Analytical Summary, BTEXN, TRHs (ug/L) | | |
| Table 11: Groundwater and Surface Water Analytical Summary, Metals (ug/L) | Check MW01 31/01/19 Fe result – 3,990 ug/L not 39,000?<br><br>Check SW03 31/01/19 Fe result – 190ug/L not ND?<br><br>Check MW03 21/03/19 Cd result – 1.2ug/L not 0.12: note this is an exceedance of Marine GILs, highlight and amend accordingly<br><br>Check sample date of SW March 2019 round. Sample logs, laboratory certificates, tables do not correlate – 20/03/2019 or 21/03/2019? | Amended.<br><br>Amended.<br><br>Amended in analytical tables and also Table 10.2 in the report.<br><br>SW01 = 21/03/19, SW02 and SW03 = 20/03/19 as per lab report and COC. Error on field sheets for SW02 and SW03. |
| Table 12: Groundwater and Surface Water Analytical Summary | Please highlighted exceedances of Marine GILs for Nitrate and discuss significance of exceedances.<br><br>Please highlight exceedance of mercury in surface water and discuss significance of exceedances.<br><br>Check Nitrate Drinking Water GILs criteria – should be 50 mg/L not 13,000. | Amended. Discussion included in Section 11.2 of the report.<br><br>Amended. Discussion included in Section 11.3 of the report.<br><br>Amended. |
| Table 14: Groundwater Analytical | Nutrient RPD % have not been included for GME 8/2/2017, 21/8/2017, 1/3/18 and surface water sampling 1/3/18. There are | These RPDs have been included and exceedances discussed in the data usability summaries. |

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| General | Auditor comment | Cavvanba response |
|---|---|---|
| Summary, Quality Control | exceedances. Please include all RPDs and highlight exceedances. | |
| | Check QW01 8/2/17 Al result 5.710 , Cr 2000 and Zn 719. Data entry errors. Recalculate RPDs. | Amended. |
| | Check MW01/QW02/QW04 21/03/2019 and MW03/QW01/QW02 results for Pb and Ni. Data entry errors. Recalculate RPDs accordingly. | Amended. |
| | Check SW03 31/01/2019 Fe result. Data entry error. Calculate RPD. | Amended. |
| | Check QW03 21/03/2019 Cu result. Data entry error. | Amended. |
| | Check QW02 31/01/19 Interlaboratory duplicate Nutrients result. Data entry errors resulting in incorrect RPDs. | Amended. |
| Appendix B | Photolog, missing. | Amended. |
| Table 7 – biosolids waste classification | Interlaboratory duplicate 28/9/2018 should be labelled QS400. Check PFOA result. Data entry error. | The sample ID is labelled QS400. PFOA result updated as per laboratory report. |

**ross@cavvanba.com**

**From:** Graham Lancaster <Graham.Lancaster@scu.edu.au>
**Sent:** Tuesday, 14 May 2019 5:00 PM
**To:** ross@cavvanba.com
**Cc:** eal
**Subject:** Re: Lab queries

Ross,

Yes we samples are stored in reception fridge then sent onto Envirolab in an esky with ice pricks. We also send a COC to Envirolab for the subcontract and can chase a copy of this if you provide a job number.

Thanks

**Graham Lancaster** BAppSc(Hons)(UNENR)
**Laboratory Director/Manager**
Environmental Analysis Laboratory
**T** 02 6620 3678 **M** 0419 984 088

EAL Environmental Analysis Laboratory
Southern Cross University

**LISMORE CAMPUS**
Military Road, East Lismore NSW 2480
**www.scu.edu.au/eal** CRICOS Provider: 01241G



**From:** Ross Nicolson <ross@cavvanba.com>
**Date:** Tuesday, 14 May 2019 at 4:53 pm
**To:** Graham Lancaster <Graham.Lancaster@scu.edu.au>
**Cc:** eal <eal@scu.edu.au>
**Subject:** RE: Lab queries

Hi Graham,

We sampled them. The auditor was concerned about the shipping to envirolab from your lab for the organics analysis.

Do you have a statement for that process?

Thanks,

**From:** Graham Lancaster <Graham.Lancaster@scu.edu.au>
**Sent:** Tuesday, 14 May 2019 4:51 PM
**To:** ross@cavvanba.com
**Cc:** eal <eal@scu.edu.au>
**Subject:** Re: Lab queries

Ross,

Did we collect samples? Yes we obviously adhere to all sample preservation procedures. See collection sheet we send out for acid sulfate.

If we collect samples then we use appropriate containers, esky and ice bricks and book in samples on arrival back to lab – straight in fridge or freezer.

SRN and COC attached for H2287.

Thanks

**Graham Lancaster** BAppSc(Hons)(UNENR)
**Laboratory Director/Manager**
Environmental Analysis Laboratory
**T** 02 6620 3678 **M** 0419 984 088

EAL Environmental Analysis Laboratory

Southern Cross University

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Military Road, East Lismore NSW 2480
www.scu.edu.au/eal CRICOS Provider: 01241G

**SCU respects our environment. Please be green and read from the screen.**

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**From:** Ross Nicolson <ross@cavvanba.com>
**Date:** Tuesday, 14 May 2019 at 4:41 pm
**To:** eal <eal@scu.edu.au>
**Cc:** Graham Lancaster <Graham.Lancaster@scu.edu.au>
**Subject:** Lab queries

Hi,

Couple of queries:

I have received a comment from the auditor regarding the following: *There is no evidence Southern Cross Uni adhered to industry standard with respect to sample transport and preservation procedures (COC, chilled samples etc). Can you provide evidence the procedures were adhered to?*

Would you be able to provide a response to the previous question?

Also, I was hoping to get a copy of a chain of custody for a batch from last year.

Batch CAV002-AS-H2287.

Thanks,

Best Regards,

Ross Nicolson
Senior Environmental Scientist – Contaminated Land
CEnvP (Certified Environmental Practitioner)

*NSW Site Auditing*
*QLD Contaminated Land Auditing*
*Licensed Asbestos Assessments*

**Cavvanba Consulting Pty Ltd**

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When sending electronic reports and/or files, please use Cavvanba Consulting's secure internet-based file delivery system located at Cavvanba Consulting DropBox. In "subject", please include client and site name.

**ross@cavvanba.com**

**From:** ross@cavvanba.com
**Sent:** Thursday, 11 April 2019 10:29 AM
**To:** Glen Chisnall
**Subject:** FW: Woodford Island STP Acid Sulphate Soils management plan

**From:** Ingrid Errington <Ingrid.Errington@epa.nsw.gov.au>
**Sent:** Friday, 3 August 2018 11:32 AM
**To:** ross@cavvanba.com; shaun@ledonne.com.au
**Cc:** EPA RSD North Coast Region Mailbox <north.coast@epa.nsw.gov.au>
**Subject:** Woodford Island STP Acid Sulphate Soils management plan

Hi Ross and Shaun,

I've gone through the documents provided for the Woodford Island STP application, and having discussed your application with North Coast regional staff, we broadly agree that the proposal is appropriate. As discussed on the phone though, a couple of matters need to be addressed before proceeding.

First, limits apply to the quantity of material a site may process without requiring an environment protection license (EPL) under Schedule 1 of the Protection of the Environment Operations Act 1997, see 'Waste processing (non-thermal treatment'). In particular:

- At any one time, a site may not have more than 1000 tonnes of waste on site. In practice, this means that material from Woodford Island must be processed in batches of less than 1000 tonnes, or you must pursue an EPL. We don't anticipate this to be a major impediment to the proposal, but it must be taken into consideration when developing the works plan.
- Over the course of one year, a site may not process more than a total of 6000 tonnes without an EPL. In the case of the former Townsend STP, a resource recovery order and exemption has already been issued for the processing of approximately 3000 tonnes of material to remove large physical contaminants. If all 3000 tonnes from Woodford Island were sent to Townsend, care must be taken that the total quantity of material did not exceed 6000 tonnes; regulatory action may be taken were this to happen. Again, this should be achievable with appropriate planning, especially as the former Maclean STP site also requires material for rehabilitation.

With regards to the Acid Sulphate Soil Management Plan (ASSMP), I've mainly focused on the plan developed specifically for this project, and less so the Ledonne plan from 2016. This is because the ASSMP would be included as an attachment to the order so must largely stand alone. To this end, some gaps must be addressed as follows:

- Please provide additional detail about the aglime mixing method (section 5.5);
- The volumes described in Table 5.1 are not relevant to a project of this scale, and a validation plan specific to this project must be developed. This may draw from the EPA Victoria sampling guidelines as per section 5.9;
- Please define the upper bound for target soil pH (Table 5.2);
- Section 5.10 states that the pH of water discharged to the surrounding environment must be within a 'suitable range'. Is discharging water a part of this plan? If not, please remove this statement. If discharging water is planned, you must investigate potential receptors and explain what is meant by a 'suitable range' of pH. Consideration must also be given to factors other than pH that might influence the suitability of water discharge and how these will be managed; and
- Section 7.1 and 7.2 raises the possibility for the ASSMP procedures to be varied, or for the ASSMP to be revised and updated throughout the project. Please elaborate on the circumstances that might trigger the need to make changes (e.g. an unexpected finds protocol). Please make note in the ASSMP that any variations or revisions must be reviewed by the EPA and approved in writing.

- We are happy for the ‘Contractor’s erosion and sediment control plan’ to apply to this project, and for that document to remain separate from the ASSMP. However, please make reference to this document in the ASSMP.

Happy to chat if further clarification is required.

Kind regards,

**Dr Ingrid Errington**
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# AUDITOR COMMENTS

**Site:** Lot 2 DP 634170 Townsend STP

**Proposed Land Use:** Agriculture

**Client:** Ledonne Constructions Pty Ltd

**Audited Reports:** As per Interim Advice Letter#1 (1601147c)

**Consultant:** Cavvanba Consulting Pty Ltd

**Accredited Auditor:** David Gregory (#1501)

**Date of Review:** 19th January 2017

**Interim Advice:** #1

| General Matters | Auditor Comments | Consultants Responses |
|---|---|---|
| Guideline Reference | Section 1.3 – refers to the draft Auditor Guidelines. These are still in draft and as yet have not been approved under the Contaminated Land Management Act. The correct reference would be the existing Site Auditor Guidelines. | Complete:<br><br>This has been updated. |
| Site Description | The drain on the southern site boundary has not been identified in the report. Please amend and consider the environmental implications of drains to the south and west in the Conceptual Site Model. | Complete:<br><br>Added to CSM and site description. |
| STP Operation Period | The period of STP operation is not clear. Please confirm. | Complete:<br><br>It is understood that the replacement Woodford Island STP opened in June 2010, and that the Maclean, Ilarwill and Townsend were subsequently made redundant. Therefore the sites have not received liquid wastes in approximately 6 years. |
| Utilisation Area | The 2004 aerial photo gives the impression of hummocky ground, perhaps fill. It is noted in the 2011 aerial photo the utilisation area is flat and trees present in 2004 no longer exist. Is it known whether the utilisation area was used to stockpile fill or biosolids? | Incomplete:<br><br>This question will be posed to Council. This area will be investigated during the DSI. |

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|---|---|---|
| Section 4.8 | This section suggests there are no sewer lines leading into the site. I was under impression the effluent was pumped from a pumping station via sewer lines into the northern portion of the oxidation pond. Can you please clarify? | Complete:<br><br>Report has been updated to take this into consideration. |
| Acid Sulphate Soils | Acid sulphate soils assessment will be required for development of a RAP. | Complete:<br><br>Acknowledged. This will be based on the sampling for acid sulphate soil which has been included in the SAQP. |
| Groundwater Bores | It is noted that the results of a bore search did not identify bores within proximity of the site. The Douglas Partners Report (2005) refers to a couple of groundwater wells located on the land to the east. Are these bores still present and what were they used for? | Complete:<br><br>The bores referred to in the DP Report are geotechnical bores, which were indeed advanced to the east of the site. There are no groundwater wells associated with these bores. |
| Town Operations | Are there, or were there, any commercial / industrial premises in Townsend that could present a unique source of contamination to wastewater during the period of STP operation? It is noted the STP received trucked effluent from all over CVC. Given the uncertainty around the composition of waste streams some broad environmental contaminant screening will be necessary during the DSI. | Partly complete:<br><br>Cavvanba will obtain information directly from Council. We don't think this is significant, however as a conservative measure one of the monitoring wells from each site will be tested for a broad suite of analytes, as per the Auditor's recommendation. |
| Receipt of Biosolids from Yamba | In 2014 it is known approximately 1200 tonnes of biosolids were transported from Yamba STP to the Townsend STP. Under the *NSW EPA Guidelines for the Use and Disposal of Biosolids* the contaminant grade and stabilisation grade would have been determined to assess the suitability of the biosolids for disposal. It would be useful to provide a brief summary of the findings of the biosolids classification in the PSI | Incomplete:<br><br>This question will be posed to Council. If a report exists, it will be summarised in the PSI document. |

| | | |
|---|---|---|
| Pathogen Risk | Further discussion is required regarding the risk of contamination from pathogens. It is evident the ponds were excavated into the saturated zone and therefore influent wastewater and biosolids would have been in direct contact with groundwater. Consideration of pathogen residence times, STP operation period, groundwater recharge frequency (floods, rainfall), subsurface soil types, STP EPL environmental monitoring data, and identified groundwater users would provide further lines of evidence to support a low risk conclusion. I have attached a paper that provides an aquifer pathogen pollution susceptibility rating. The auditor would consider reference to this matrix as acceptable for preliminary assessment of groundwater pathogen risk.<br>Cavvanba has identified the tidal drains at the western margin of the ponds as a sensitive surface water receptor. There is also a drain at the southern site boundary. Given the ponds are excavated into the groundwater in immediate proximity of the drains it is reasonable to conclude the ponds were hydraulically connected to the drain. That said, what would the pathogen risk be to the drain? Has there been any recent testing of water in the ponds or drain?<br>It is likely some groundwater testing and surface water testing in the drain will be necessary during a DSI to confirm pathogen assumptions. | Complete:<br><br>Cavvanba will review the document and update this discussion, along with the additional information described above to be obtained from Council. |
| Environmental Protection Licence (EPL) | Environmental monitoring was required during the operation of the STP. Annual reports were required to be submitted to the NSW EPA. The Annual reports should be reviewed and results of monitoring summarised in the PSI. The information is considered necessary and will inform the consultant and Auditor of the potential for contamination of the surrounding environment. | Incomplete. This will be included in the DSI:<br><br>Cavvanba will obtain information directly from Council. |

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|---|---|---|
| Conceptual Site Model | Figure 2 – directions on the Conceptual Model (East – West) wrong way round.<br><br>Potential Effected Media – does not contain surface waters in drains to south and west, please amend.<br><br>Potential Receptors – should include trespassers and workers given there is visible ACM on the surface of waste stockpiles.<br><br>A detailed list of contaminants of potential concern will be required in the Sampling Analysis Quality Plan. When preparing the COPC list please have regard to PFAS compounds, Biosolids COPC as per the EPA Biosolids Guidelines, COPC as identified in the EPL. It is also recommended a broad screen of contaminants be considered for groundwater given the ponds were excavated into groundwater and uncertainty associated with wastewater composition over the period of the STP operation. | Complete:<br><br>Added to CSM.<br><br>Added to CSM.<br><br>Added to CSM.<br><br>Cavvanba will take the PFAS compounds, Biosolids and potential broad screen of groundwater contaminants into consideration, and update the SAQP accordingly. |
| **Requiring Immediate Attention** | Stockpiles onsite contain visible ACM on the surface. The presence of asbestos in stockpiles may present an unacceptable risk to the public (given site is not secure) and CVC workers accessing the site. Until such time as the site can be assessed and/or remediated the potential risk requires management. At a minimum warning signs should be erected and visible ACM removed from the surface of the stockpiles. Where ACM is prevalent in a stockpile it should be covered and secured from the weather with heavy duty plastic. A suitably qualified consultant should be engaged to deal with the immediate risk in a manner consistent with both jurisdictional and national work health and safety legislation and guidance. The Duty to Notify the NSW EPA of the contamination as required by s60 of the Contaminated Land Management Act (1997) also requires consideration. | Complete:<br><br>The site is currently fenced and locked.<br><br>It is understood that access to the site is restricted to persons associated with the investigation and remediation works.<br><br>The risks associated with bonded ACMs will be appropriately addressed in SWMS, JSA's and included in site inductions and toolbox talks. |

Acronyms:
COPC – Contaminants of potential concern
DSI – Detailed Site Investigation
EPL – Environmental protection Licence
PFAS – Perflouroalkyl Substances
PSI – Preliminary Site Investigation
STP - Sewerage Treatment Plant

# APPENDIX B

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | PID (ppm) | Date sampled | Description | Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TRHs | BTEXN | PAHs | 8 metals | pH, CEC | OCPs | PCBs |
| *Soil - Test Pits* | | | | | | | | | | | |
| TP01 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey silt. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | • | • | • | • | | • | • |
| TP02 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP03 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP04 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP05 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP06 | 0.5 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP07 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP08 | 1.0 | 0.0 | 01/02/17 | Sandy silty CLAY. Brown with yellow jarosite staining. Moist, medium plasticity. | • | • | • | • | | • | • |
| TP09 | 0.4 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP10 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP11 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | • | • | • | • | | • | • |
| TP11 | 1.1 | 0.0 | 01/02/17 | Sandy silty CLAY. Brown with yellow jarosite staining. Moist, medium plasticity. | • | • | • | • | | • | • |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TP12 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP13 | 0.4 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | • | | | |
| TP14 | 0.4 | 0.0 | 15/02/17 | Sandy silty CLAY. Brown and red brown. Soft and moist. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP15 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP16 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP17 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP18 | 0.4 | 0.0 | 15/02/17 | Sandy clayey CLAY. Dark brown and red brown mottled. Soft and moist. Medium plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP19 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP20 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP21 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP22 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP23 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP24 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP25 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP26 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP27 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TP28 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP29 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP30 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP31 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP32 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP33 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | • | • | • | | • | • |
| TP34 | 0.1 | 0.0 | 02/02/17 | FILL: Clayey sand. Light brown. Loose, dry. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| TP35 | 0.1 | 0.0 | 02/02/17 | FILL: Clayey sand. Light brown. Loose, dry. No observable contamination, no anthropogenic inclusions. | | | | • | | | |
| *Waste stockpiles* | | | | | | | | | | | |
| TP36 | 0.1 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | • | • | • | | • | • |
| TP36 | 0.5 | 0.0 | 02/02/17 | FILL: Mulch. Moist. No observable contamination, no ACM observed. | • | • | • | • | | • | • |
| TP37 | 0.1 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | • | • | • | | • | • |
| TP37 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | • | • | • | | • | • |
| TP38 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC, wood. No ACM observed. | • | • | • | • | | • | • |
| TP38 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC, wood. No ACM observed. | • | • | • | • | | • | • |
| TP39 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC plastic, black plastic liner, wood. No ACM observed. | • | • | • | • | | • | • |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TP39 | 2.0 | 0.0 | 02/02/17 | Silty CLAY. Grey, contains tree branches. Very moist. | • | • | • | • | | • | • |
| TP40 | 0.1 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Road base. | • | • | • | • | | • | • |
| *Imported material from Yamba STP* | | | | | | | | | | | |
| TP41 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | • | • | • | | • | • |
| TP41 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | • | • | • | | • | • |
| TP41 | 1.5 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | • | • | • | | • | • |
| TP42 | 3.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete, brick and rags. | • | • | • | • | | • | • |
| TP42 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete, brick and rags. | • | • | • | • | | • | • |
| TP42 | 2.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Moist. Contains wood, plastic, concrete, brick and rags. | • | • | • | • | | • | • |
| TP43 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | • | • | • | | • | • |
| TP43 | 2.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Moist. Contains wood, plastic, concrete and brick. | • | • | • | • | | • | • |
| TP44 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete, brick and rags. | • | • | • | • | | • | • |
| TP44 | 2.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Moist. Contains wood, plastic, concrete, brick and rags. | • | • | • | • | | • | • |
| *Biosolids* | | | | | | | | | | | |
| BS01 | - | 0.0 | 02/02/17 | Black silt | | | | • | | • | • |
| BS02 | - | 0.0 | 02/02/17 | Black silt | | | | • | | • | • |
| BS03 | - | 0.0 | 02/02/17 | Black silt | | | | • | | • | • |
| BS04 | - | 0.0 | 02/02/17 | Black silt | | | | • | | • | • |
| BS05 | - | 0.0 | 02/02/17 | Black silt | | | | • | | • | • |
| *Acid Sulfate soils sample summary is included on Table 6.* | | | | | | | | | | | |

**Table 2: Soil Analytical Summary, Metals**

| Sample | Depth (m) | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| *Analytical - Test pits* | | | | | | | | | | |
| TP01 | 0.1 | 6 | nd | 21 | 18 | 10 | 8 | - | 40 | nd |
| TP02 | 0.1 | 8 | nd | 21 | 14 | 18 | 9 | - | 40 | nd |
| TP03 | 0.1 | 8 | nd | 28 | 21 | 16 | 14 | - | 53 | nd |
| TP04 | 0.1 | 8 | nd | 25 | 17 | 16 | 11 | - | 49 | nd |
| TP05 | 0.1 | 9 | nd | 26 | 18 | 15 | 10 | - | 44 | nd |
| TP06 | 0.5 | 11 | nd | 29 | 20 | 16 | 12 | - | 56 | nd |
| TP07 | 0.1 | 10 | nd | 26 | 19 | 17 | 11 | - | 53 | nd |
| TP08 | 1.0 | 10 | nd | 27 | 17 | 14 | 19 | - | 79 | nd |
| TP09 | 0.4 | 12 | nd | 26 | 20 | 18 | 10 | - | 52 | nd |
| TP10 | 0.1 | 10 | nd | 25 | 20 | 18 | 11 | - | 53 | nd |
| TP11 | 0.1 | 12 | nd | 26 | 20 | 16 | 11 | - | 53 | nd |
| TP11 | 1.1 | 6 | nd | 28 | 13 | 17 | 16 | - | 57 | nd |
| TP12 | 0.1 | 14 | nd | 28 | 21 | 20 | 10 | - | 50 | nd |
| TP13 | 0.4 | 7 | nd | 20 | 16 | 12 | 8 | - | 38 | nd |
| TP14 | 0.4 | nd | nd | 27 | 24 | 22 | 21 | - | 56 | nd |
| TP15 | 0.1 | 8 | nd | 18 | 18 | 18 | 10 | - | 52 | nd |
| TP16 | 0.1 | 11 | nd | 27 | 26 | 19 | 19 | - | 59 | nd |
| TP17 | 0.1 | 13 | nd | 25 | 22 | 17 | 13 | - | 50 | nd |
| TP18 | 0.4 | 12 | nd | 29 | 29 | 20 | 20 | - | 64 | 0.1 |
| TP19 | 0.1 | 8 | nd | 23 | 22 | 16 | 13 | - | 45 | nd |
| TP20 | 0.1 | 11 | nd | 23 | 20 | 16 | 14 | - | 52 | nd |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TP21 | 0.1 | 9 | nd | 24 | 22 | 17 | 14 | - | 54 | nd |
| TP22 | 0.1 | 9 | nd | 24 | 23 | 19 | 15 | - | 58 | nd |
| TP23 | 0.1 | 7 | nd | 19 | 15 | 18 | 12 | - | 67 | nd |
| TP24 | 0.1 | 7 | nd | 22 | 35 | 18 | 15 | - | 77 | nd |
| TP25 | 0.1 | 7 | nd | 27 | 21 | 17 | 18 | - | 63 | nd |
| TP26 | 0.1 | 11 | nd | 28 | 23 | 18 | 19 | - | 68 | nd |
| TP27 | 0.1 | 6 | nd | 18 | 27 | 16 | 14 | - | 65 | nd |
| TP28 | 0.1 | 8 | nd | 26 | 24 | 19 | 17 | - | 54 | nd |
| TP29 | 0.1 | 9 | nd | 22 | 22 | 18 | 16 | - | 69 | nd |
| TP30 | 0.1 | 10 | nd | 27 | 25 | 20 | 19 | - | 66 | nd |
| TP31 | 0.1 | 8 | nd | 24 | 26 | 19 | 18 | - | 71 | nd |
| TP32 | 0.1 | 7 | nd | 20 | 34 | 16 | 14 | - | 76 | nd |
| TP33 | 0.1 | 9 | nd | 21 | 23 | 16 | 14 | - | 66 | nd |
| TP34 | 0.1 | 10 | nd | 22 | 18 | 17 | 9 | - | 45 | nd |
| TP35 | 0.1 | 10 | nd | 23 | 18 | 15 | 10 | - | 49 | nd |
| *Analytical - Waste Stockpiles* | | | | | | | | | | |
| TP36 | 0.1 | nd | nd | 8 | nd | 11 | 3 | - | 18 | nd |
| TP36 | 0.5 | nd | nd | 3 | 9 | nd | 2 | - | 36 | nd |
| TP37 | 0.1 | nd | nd | 6 | nd | 6 | nd | - | 9 | nd |
| TP37 | 0.5 | nd | nd | 5 | nd | 10 | nd | - | 5 | nd |
| TP38 | 0.5 | nd | nd | 12 | 5 | 12 | 3 | - | 37 | nd |
| TP38 | 1.0 | nd | nd | 7 | nd | 8 | nd | - | 10 | nd |
| TP39 | 0.5 | nd | nd | 4 | nd | 5 | nd | - | 7 | nd |
| TP39 | 2.0 | 7 | nd | 6 | 8 | 7 | nd | - | 8 | nd |
| TP40 | 0.1 | nd | nd | 7 | 8 | 10 | 3 | - | 31 | nd |
| *Analytical - Imported material from Yamba STP* | | | | | | | | | | |
| TP41 | 0.5 | nd | nd | 4 | 8 | nd | nd | - | 10 | nd |
| TP41 | 1.0 | nd | nd | 5 | 10 | 8 | nd | - | 16 | nd |
| TP41 | 1.5 | nd | nd | 4 | 10 | nd | nd | - | 9 | nd |
| TP42 | 3.0 | nd | nd | 4 | 10 | 9 | nd | - | 19 | nd |
| TP42 | 1.0 | nd | nd | 4 | 22 | 8 | nd | - | 22 | nd |
| TP42 | 2.0 | nd | nd | 4 | 10 | 8 | nd | - | 16 | nd |
| TP43 | 1.0 | nd | nd | 4 | 8 | 7 | nd | - | 15 | nd |
| TP43 | 2.0 | nd | nd | 4 | 9 | 6 | nd | - | 14 | nd |
| TP44 | 1.0 | nd | nd | 5 | 9 | 6 | nd | - | 16 | nd |
| TP44 | 2.0 | nd | nd | 5 | nd | 7 | nd | - | 12 | nd |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Criteria* | | | | | | | | | | |
| HILs - Residential A | | 100 | 20 | 100 | 6,000 | 300 | 400 | 200 | 7,400 | 40 |
| EILs - Urban residential and public open space (aged) | | 100 | - | 410 | 55 | 1,100 | 100 | - | 130 | - |
| *Analytical - Biosolids* | | | | | | | | | | |
| BS01 | - | 5 | nd | 24 | 23 | 16 | 16 | nd | 61 | nd |
| BS02 | - | 7 | nd | 24 | 21 | 17 | 17 | nd | 61 | nd |
| BS03 | - | 14 | nd | 21 | 30 | 15 | 25 | nd | 113 | nd |
| BS04 | - | 8 | nd | 21 | 29 | 16 | 23 | nd | 96 | nd |
| BS05 | - | 9 | nd | 18 | 82 | 21 | 24 | nd | 130 | 0.1 |
| *Criteria* | | | | | | | | | | |
| Biosolids - Grade A | | 20 | 3 | 100 | 100 | 150 | 60 | 5 | 200 | 1 |

See table notes at end of section

**Table 3: Soil Analytical Summary, BTEXN and TRHs (mg/kg)**

| Sample | Depth (m) | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* |
| *Analytical - test pits* | | | | | | | | | | | |
| TP01 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP08 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 1.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP14 | 0.4 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP16 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP18 | 0.4 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP20 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP22 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP25 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP27 | 0.1 | nd | nd | nd | nd | nd | nd | nd | **180** | **550** | 200 |
| TP29 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | 100 | nd |
| TP31 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | 200 | 120 |
| TP33 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

| Sample | Depth (m) | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* |
| *Analytical - test pits* | | | | | | | | | | | |
| *Analytical - Waste stockpiles* | | | | | | | | | | | |
| TP36 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP36 | 0.5 | nd | nd | nd | nd | nd | nd | nd | 80 | **440** | 220 |
| TP37 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP38 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP38 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP39 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP39 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP40 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - Imported material from Yamba STP* | | | | | | | | | | | |
| TP41 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 3.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | 160 | nd |
| TP42 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | 140 | nd |
| TP43 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

| Sample | Depth (m) | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* |
| *Analytical - test pits* | | | | | | | | | | | |
| TP43 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Statistics* | | | | | | | | | | | |
| Samples analysed | | 14 | 14 | 14 | 15 | 14 | 15 | 15 | 15 | 15 | 15 |
| Detects | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 2 | 4 | 3 |
| % detect | | 0% | 0% | 0% | 7% | 0% | 7% | 7% | 13% | 27% | 20% |
| Maximum | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180 | **550** | 200 |
| Mean | | nd | nd | nd | nd | nd | nd | nd | 180 | 283 | 160 |
| Median | | nd | nd | nd | nd | nd | nd | nd | 180 | 200 | 160 |
| Minimum | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 120 |
| Coefficient of variation (CV) | | - | - | - | - | - | - | - | - | - | - |
| Standard deviation | | - | - | - | - | - | - | - | - | - | - |
| *Criteria - residential landuse with sandy soils* | | | | | | | | | | | |
| Health levels 0m to <1m | | 0.5 | 160 | 55 | 40 | | 3 | 45 | 110 | no limit | no limit |
| Health levels 1m to <2m | | 0.5 | 220 | no limit | 60 | | no limit | 70 | 240 | no limit | no limit |
| Health levels 2m to <4m | | 0.5 | 310 | no limit | 96 | | no limit | 110 | 440 | no limit | no limit |
| Health levels 4m+ | | 0.5 | 540 | no limit | 170 | | no limit | 200 | no limit | no limit | no limit |

| Sample | Depth (m) | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* |
| *Analytical - test pits* | | | | | | | | | | | |
| Health investigation level | | **-** | - | - | - | - | - | - | - | - | - |
| Ecological levels | | 65 | 105 | 125 | 45 | | 170 | 180 | **120** | **300** | 5,600 |
| Management limits | | - | - | - | - | | - | - | 1,000 | 3,500 | 10,000 |
| Direct Contact Criteria | | 430 | 99,000 | 27,000 | 81,000 | | - | 26,000 | 20,000 | 27,000 | 38,000 |

See table notes at end of section

**Table 4: Soil Analytical Summary, PAHs (mg/kg)**

| Sample | Depth (m) | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *-* | *-* |
| *Analytical - test pits* | | | | | | | | | | | | | | | | | | | |
| TP01 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP08 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 1.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP14 | 0.4 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP16 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP18 | 0.4 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP20 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP22 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP25 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP27 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP29 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP31 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP33 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - waste stockpiles* | | | | | | | | | | | | | | | | | | | |
| TP36 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP36 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.5 | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1 | 15.4 | 2.6 |
| TP38 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP38 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP39 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

| Sample | Depth (m) | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | - | - |
| *Analytical - test pits* | | | | | | | | | | | | | | | | | | | |
| TP39 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP40 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - imported material from Yamba STP* | | | | | | | | | | | | | | | | | | | |
| TP41 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 3.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP43 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP43 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | | | | |
| Samples analysed | | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Detects | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| % detect | | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 0% | 3% | 3% | 3% |
| Maximum | | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1.0 | 15.4 | 2.6 |
| Mean | | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1.0 | 15.4 | 2.6 |
| Median | | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1.0 | 15.4 | 2.6 |
| Minimum | | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | | | | | | | | | | | | | |
| HILs - Residential A | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 300 | 3 |
| ESLs - Urban residential and public open space | | 170 | NL | NL | NL | NL | NL | NL | NL | NL | NL | NL | NL | **0.7** | NL | NL | NL | NL | NL |

See table notes at end of section

**Table 5: Soil Analytical Summary, OCPs and PCBs**

| Sample | Depth (m) | Heptachlor | Total Chlordane (sum) | Endrin | Endosulfan (sum) | Methoxychlor | Sum of Aldrin + Dieldrin | Sum of DDD + DDE + DDT | Hexachlorobenzene (HCB) | Lindane | BHC | PCBs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2 / 0.02* | *0.1 / 0.02* | *0.05* | *0.05* | *0.2* | *0.05 / 0.02* | *0.05* | *0.02* | *0.02* | *0.02* | *0.1* |
| *Analytical - Test pits* | | | | | | | | | | | | |
| TP01 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP08 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 1.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP14 | 0.4 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP16 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP18 | 0.4 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP20 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP22 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP25 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP27 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP29 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP31 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP33 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - Waste Stockpiles* | | | | | | | | | | | | |
| TP36 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP36 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP38 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP38 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP39 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP39 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP40 | 0.1 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - imported material from Yamba STP* | | | | | | | | | | | | |
| TP41 | 0.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.5 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 3.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP43 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP43 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 1.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 2.0 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | | | | | | |
| HILs- Residential A | | 6 | 50 | 10 | 270 | 300 | 6 | 240 | 10 | - | - | 1 |
| EILs - Urban residential and public open space | | - | - | - | - | - | - | 180 (DDT only) | - | - | - | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Analytical - Biosolids* | | | | | | | | | | | | |
| BS01 | - | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| BS02 | - | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| BS03 | - | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| BS04 | - | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| BS05 | - | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | | | | | | |
| Bisolids - Grade A | | 0.02 | 0.02 | - | - | - | 0.02 / 0.02 | 0.5 | 0.02 | 0.02 | 0.02 | 0.3 |

See table notes at end of section

**Table 6: Soil Analytical Summary, ASS Description and Analytical Summary**

| Sample | Depth (m) | Date sampled | Reactivity* | pH(F) | pH(FOX) | pH change | Bulk Density** | Description | Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | pHF | pHFOX | SPOCAS |
| *Analytical - Test Pits* | | | | | | | | | | | |
| AS01 | 0.5 | 1/02/2017 | 3 | 3.2 | 1.6 | 1.6 | 1.60 | Clayey SILT | • | • | |
| AS01 | 1.0 | 1/02/2017 | 4 | 3.1 | 1.7 | 1.4 | 1.05 | Sandy silty CLAY | • | • | |
| AS01 | 1.5 | 1/02/2017 | 4 | 3.5 | 2.1 | 1.4 | 1.05 | Silty CLAY | • | • | |
| AS01 | 2.0 | 1/02/2017 | 4 | 4.9 | 2.3 | 2.6 | 1.05 | Silty CLAY | • | • | • |
| AS02 | 0.5 | 1/02/2017 | 3 | 3.4 | 1.6 | 1.8 | 1.60 | Clayey SAND | • | • | |
| AS02 | 1.0 | 1/02/2017 | 3 | 3.2 | 1.7 | 1.5 | 1.05 | Sandy silty CLAY | • | • | |
| AS02 | 1.5 | 1/02/2017 | 3 | 3.4 | 1.8 | 1.6 | 1.05 | Silty CLAY | • | • | |
| AS02 | 2.0 | 1/02/2017 | 4 | 3.6 | 2.3 | 1.3 | 1.05 | Silty CLAY | • | • | • |
| AS03 | 0.5 | 1/02/2017 | 3 | 3.3 | 1.7 | 1.6 | 1.60 | Clayey SAND | • | • | • |
| AS03 | 1.0 | 1/02/2017 | 4 | 3.1 | 2.6 | 0.5 | 1.05 | Sandy Silty CLAY | • | • | |
| AS03 | 1.5 | 1/02/2017 | 3 | 3.8 | 1.9 | 1.9 | 1.05 | Silty CLAY | • | • | |
| AS03 | 2.0 | 1/02/2017 | 4 | 5.5 | 2.8 | 2.7 | 1.05 | Silty CLAY | • | • | |
| AS04 | 0.5 | 1/02/2017 | 3 | 3.4 | 1.7 | 1.7 | 1.60 | Clayey SAND | • | • | • |
| AS04 | 1.0 | 1/02/2017 | 3 | 3.3 | 1.6 | 1.7 | 1.05 | Sandy silty CLAY | • | • | |
| AS04 | 1.5 | 1/02/2017 | 3 | 3.2 | 1.8 | 1.4 | 1.05 | Silty CLAY | • | • | |
| AS04 | 2.0 | 1/02/2017 | 4 | 5.0 | 2.4 | 2.6 | 1.05 | Silty CLAY | • | • | |
| AS05 | 0.5 | 2/02/2017 | 3 | 4.1 | 2.1 | 2.0 | 1.05 | Sandy Silty CLAY | • | • | • |
| AS05 | 1.0 | 15/02/2017 | 3 | 4.2 | 1.8 | 2.4 | 1.05 | Silty CLAY | • | • | |
| AS05 | 1.5 | 15/02/2017 | 3 | 4.1 | 1.9 | 2.2 | 1.05 | Silty CLAY | • | • | |
| AS05 | 2.0 | 15/02/2017 | 4 | 7.8 | 1.9 | 5.9 | 1.05 | Silty CLAY | • | • | |
| AS06 | 0.5 | 15/02/2017 | 3 | 4.8 | 2.4 | 2.4 | 1.05 | Sandy silty CLAY | • | • | |
| AS06 | 1.0 | 15/02/2017 | 3 | 4.3 | 2.2 | 2.1 | 1.05 | Silty CLAY | • | • | |
| AS06 | 1.5 | 2/02/2017 | 4 | 5.4 | 2.2 | 3.2 | 1.05 | Silty CLAY | • | • | • |
| AS06 | 2.0 | 15/02/2017 | 4 | 6.6 | 1.8 | 4.8 | 1.05 | Silty CLAY | • | • | |
| AS07 | 0.5 | 15/02/2017 | 3 | 4.5 | 2.1 | 2.4 | 1.05 | Sandy silty CLAY | • | • | |
| AS07 | 1.0 | 15/02/2017 | 3 | 4.3 | 2.4 | 1.9 | 1.05 | Silty CLAY | • | • | |
| AS07 | 1.5 | 2/02/2017 | 3 | 4.6 | 2.4 | 2.2 | 1.05 | Silty CLAY | • | • | • |
| AS07 | 2.0 | 15/02/2017 | 4 | 7.1 | 1.8 | 5.3 | 1.05 | Silty CLAY | • | • | |
| AS08 | 0.5 | 15/02/2017 | 3 | 4.3 | 2.3 | 2.0 | 1.05 | Sandy silty CLAY | • | • | |
| AS08 | 1.0 | 15/02/2017 | 3 | 4.2 | 2.0 | 2.2 | 1.05 | Silty CLAY | • | • | |
| AS08 | 1.5 | 15/02/2017 | 4 | 5.6 | 1.8 | 3.8 | 1.05 | Silty CLAY | • | • | |
| AS08 | 2.0 | 15/02/2017 | 4 | 7.8 | 1.8 | 6.0 | 1.05 | Silty CLAY | • | • | • |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS09 | 0.5 | 15/02/2017 | 3 | 4.6 | 2.5 | 2.1 | 1.05 | Sandy silty CLAY | • | • | |
| AS09 | 1.0 | 15/02/2017 | 3 | 4.3 | 2.2 | 2.1 | 1.05 | Silty CLAY | • | • | |
| AS09 | 1.5 | 15/02/2017 | 4 | 5.0 | 2.0 | 3.0 | 1.05 | Silty CLAY | • | • | • |
| AS09 | 2.0 | 15/02/2017 | 4 | 4.7 | 2.0 | 2.7 | 1.05 | Silty CLAY | • | • | |
| AS10 | 0.5 | 2/02/2017 | 3 | 4.8 | 2.9 | 1.9 | 1.60 | Gravelly clayey SAND | • | • | |
| AS10 | 1.0 | 2/02/2017 | 3 | 5.9 | 2.7 | 3.2 | 1.05 | Sandy silty CLAY | • | • | |
| AS10 | 1.5 | 2/02/2017 | 4 | 5.5 | 3.3 | 2.2 | 1.05 | Silty CLAY | • | • | |
| AS10 | 2.0 | 2/02/2017 | 4 | 6.1 | 3.0 | 3.1 | 1.05 | Silty CLAY | • | • | • |

* Reactivity recorded following addition of hydrogen peroxide, 1 = slight, 2 = moderate, 3 = strong, 4 = extreme
** Bulk density - WA DEC website values used in the absence of site-specific data.

**Table 7: Soil Analytical Summary, SPOCAS Suite**

| Sample | Depth (m) | Titratable Actual Acidity (TAA) 23F | Titratable Peroxide Acidity (TPA) 23G | Net Acidity (sulfur units) | Net Acidity (acidity units) | Liming Rate (including bulk density) |
|---|---|---|---|---|---|---|
| *Units* | | *mol H+/t* | *mol H+/t* | *% S* | *mol H+/t* | *kg CaCO3/m3 soil* |
| *LORs* | | *2* | *2* | *0.02* | *10* | *1* |
| *Analytical* | | | | | | |
| AS01 | 2.0 | 83 | 634 | **1.05** | **654** | 49 |
| AS02 | 2.0 | 168 | 680 | **1.09** | **682** | 51 |
| AS03 | 0.5 | 222 | 296 | **0.66** | **409** | 31 |
| AS04 | 0.5 | 186 | 281 | **0.60** | **378** | 28 |
| AS05 | 0.5 | 116 | 193 | **0.25** | **158** | 12 |
| AS06 | 1.5 | 58 | 952 | **1.67** | **1040** | 78 |
| AS07 | 1.5 | 80 | 288 | **0.26** | **161** | 12 |
| AS08 | 2.0 | 26 | 1070 | **1.67** | **1040** | 78 |
| AS09 | 1.5 | 64 | 450 | **0.77** | **480** | 36 |
| AS10 | 2.0 | 24 | 204 | **0.23** | **143** | 11 |
| *Criteria* | | | | | | |
| Action Threshold (Any texture, > 1,000 tonnes of material disturbed) | | - | **-** | **0.03** | **18** | **-** |
| Action Threshold (Fine texture, <1,000 tonnes of material disturbed) | | **-** | **-** | **0.1** | **62** | **-** |

See table notes at end of section

**Table 8: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | TP01_0.1 | QS01 | **RPD** | TP20_0.1 | QS03 | **RPD** | TP20_0.1 | QS04 | **RPD** | TP37_0.5 | QS05 | **RPD** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | % | *Primary* | *Duplicate* | % | *Primary* | *Duplicate* | % | *Primary* | *Duplicate* | % |
| *Date* | - | 01/02/17 | 01/02/17 | - | 15/02/17 | 15/02/17 | - | 15/02/17 | 15/02/17 | - | 02/02/17 | 02/02/17 | - |
| *Media* | *Soil* | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | - |
| *Heavy metals* | | | | | | | | | | | | | |
| Arsenic | 5 | 6 | 10 | **50** | 11 | 9 | 20 | 11 | 12 | 9 | nd | nd | - |
| Cadmium | 1 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| Chromium | 2 | 21 | 25 | 17 | 23 | 25 | 8 | 23 | 26 | 12 | 6 | 4 | 40 |
| Copper | 5 | 18 | 20 | 11 | 20 | 21 | 5 | 20 | 24 | 18 | nd | nd | - |
| Lead | 5 | 10 | 17 | **52** | 16 | 18 | 12 | 16 | 18 | 12 | 6 | 6 | 0 |
| Nickel | 2 | 8 | 11 | 32 | 14 | 16 | 13 | 14 | 16 | 13 | nd | nd | - |
| Zinc | 5 | 40 | 56 | 33 | 52 | 55 | 6 | 52 | 60 | 14 | 9 | 8 | 12 |
| Mercury | *0.1* | nd | 0.2 | - | nd | nd | - | nd | nd | - | nd | nd | - |
| *Organics* | | | | | | | | | | | | | |
| Benzene | 0.2 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| Toluene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| Ethyl benzene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| meta- & para-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| ortho-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| TRHs C6 – C10 | 10 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| TRHs >C10 - C16 | 50 | nd | 160 | - | nd | nd | - | nd | nd | - | nd | nd | - |
| TRHs >C16 - C34 | 100 | nd | nd | - | 140 | nd | - | 140 | nd | - | nd | nd | - |
| TRHs >C34 - C40 | 100 | nd | nd | - | 170 | nd | - | 170 | nd | - | nd | nd | - |
| Total PAHs | - | nd | nd | - | nd | nd | | nd | nd | | nd | nd | - |
| OCPs | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| PCBs | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| *Data Quality Indicator* | | - | - | *<50%* | - | - | *<50%* | - | - | *<50%* | - | - | *<50%* |

See tables notes at end of section

**Table 8: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | TP01_0.1 | QS02 | **RPD** | TP37_0.5 | QS06 | **RPD** | Trip Blank | Trip Blank | Trip Spike | Trip Spike | Trip Spike | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Interlaboratory Dupliate* | % | *Primary* | *Interlaboratory Dupliate* | % | *Lab prep* | *Lab prep* | *Field* | *Lab* | *Recovery* | *Field* | *Lab* | *Recovery* |
| *Date* | - | 01/02/17 | 01/02/17 | - | 02/02/17 | 02/02/17 | - | *02/02/17* | *07/02/17* | *02/02/17* | - | - | *07/02/17* | - | - |
| *Media* | *Soil* | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | *Soil* | *Soil* | | *Soil* | *Soil* | |
| *Heavy metals* | | | | | | | | | | | | | | | |
| Arsenic | 5 | 6 | 7 | - | nd | nd | - | - | - | - | - | - | - | - | - |
| Cadmium | 1 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| Chromium | 2 | 21 | 23 | 9 | 6 | 7 | 15 | - | - | - | - | - | - | - | - |
| Copper | 5 | 18 | 19 | 5 | nd | 4 | - | - | - | - | - | - | - | - | - |
| Lead | 5 | 10 | 17 | **52** | 6 | 6 | 0 | - | - | - | - | - | - | - | - |
| Nickel | 2 | 8 | 11 | 32 | nd | 3 | - | - | - | - | - | - | - | - | - |
| Zinc | 5 | 40 | 50 | 22 | 9 | 14 | 43 | - | - | - | - | - | - | - | - |
| Mercury | *0.1* | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| *Organics* | | | | | | | | | | | | | | | |
| Benzene | 0.2 | nd | nd | - | nd | nd | - | nd | nd | nd | nd | - | nd | 0.4 | - |
| Toluene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 4.3 | 5 | 86 | 9.4 | 17.5 | **54** |
| Ethyl benzene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 0.8 | 0.9 | 89 | 1.6 | 2.3 | 70 |
| meta- & para-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 4.3 | 4.8 | 90 | 9.2 | 12.6 | 73 |
| ortho-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 2 | 2.2 | 91 | 4 | 5.1 | 78 |
| TRHs C6 – C10 | 10 | nd | nd | - | nd | nd | - | nd | nd | 11.4 | 12.9 | 88 | 55 | 79 | 70 |
| TRHs >C10 - C16 | 50 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| TRHs >C16 - C34 | 100 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| TRHs >C34 - C40 | 100 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| Total PAHs | - | nd | nd | | nd | nd | | | | | | | | | |
| OCPs | - | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| PCBs | - | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| *Data Quality Indicator* | | - | - | *<50%* | - | - | *<50%* | *nd* | *nd* | - | - | *70-130%* | - | - | *70-130%* |

## Soil Analytical Summary Table Notes

LOR denotes limit of reporting (standard LOR unless otherwise shown)

PBILs denotes phytotoxicity based investigation levels

nd denotes not detected above the LOR

NL denotes non-limiting

- denotes not analysed/not available

**Bold** - Exceeds landuse criteria

^ denotes raised LOR

TRH C6-C10 F1 = TRH C6-C10 minus BTEX compounds

*analyte list shown on laboratory report

1. Methyl mercury / inorganic mercury
2. Netherlands protection of terrestrial organisms/ Netherlands human health based and human health and ecologically based protection level.
3. Criteria for phenol

**Soil Analytical Summary Table Notes**

Table notes:

* Reactivity recorded following addition of hydrogen peroxide, 1 = slight, 2 = moderate, 3 = strong, 4 = extreme

** Bulk density - WA DEC website values used in the absence of site-specific data.
**Bold** - Exceeds criteria

| Default bulk density values for soil types (to be used in the absence of site-specific data) | Natural (in-situ) bulk density (tonne/m3) |
|---|---|
| Sand | 1.6 |
| Loamy sand | 1.5 |
| Sandy loam | 1.4 |
| Loam | 1.3 |
| Silty loam | 1.2 |
| Clay loam | 1.1 |
| Clay | 1.05 |
| Peat | 1 |

Source: WA DEC website
http://www.der.wa.gov.au/your-environment/acid-sulfate-soils/67-lime-rate-calculations-for-neutralising-acid-sulfate-soils

**Table 9: Groundwater Analytical Summary, BTEXN, TRHs (ug/L)**

| Sample location | Date | Benzene | Toluene | Ethyl benzene | Xylenes | Naphthalene | C6 - C10 TRHs | F1 C6 - C10 TRHs | F2 >C10 - C16 TRHs | F3 >C16 - C34 TRHs | F4 >C34 - C40 TRHs | >C10 - C40 TRHs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *1* | *2* | *2* | *2* | *2* | *20* | *20* | *100* | *100* | *100* | *100* |
| *Analytical* | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| MW02 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| MW03 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria - Residential* | | | | | | | | | | | | |
| Health levels 2 m - < 4 m | | 800 | NL | NL | NL | NL | - | 1,000 | NL | NL | NL | NL |
| Marine water [1] | | 500 | - | - | - | 50 | - | - | - | - | - | - |
| Drinking water[2] | | 1 | 800 (25) | 300 (3) | 600 (20) | - | - | - | - | - | - | - |
| Recreational Criteria | | 10 | 8000 | 3000 | 6000 | - | - | - | - | - | - | - |

See tables notes at end of section

**Table 10: Groundwater Analytical Summary, PAHs (ug/L)**

| Sample | Depth (m) | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *0.5* | *1* | *1* | *1* | *0.5* | *0.5* |
| *Analytical* | | | | | | | | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | | | | |
| Samples analysed | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Detects | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % detect | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Maximum | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mean | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Median | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Minimum | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *Criteria* | | | | | | | | | | | | | | | | | | | |
| Marine water GILs | | 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Drinking Water | | - | - | - | - | - | - | - | - | - | - | - | - | 0.01 | - | - | - | - | - |
| Recreational Criteria | | - | - | - | - | - | - | - | - | - | - | - | - | 0.1 | - | - | - | - | - |

See table notes at end of section

**Table 11: Groundwater Analytical Summary, Metals (ug/L)**

| Sample | Depth (m) | pH | Aluminium | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Iron | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *pH units* | *10* | *1* | *0.1* | *1* | *1* | *1* | *1* | *10* | *5* | *50* | *0.1* |
| *Analytical* | | | | | | | | | | | | | |
| MW01 | 08/02/17 | 4.98 | **5,760** | **11** | **12** | **2** | **3** | 2 | **269** | nd | **734** | **214,000** | nd |
| MW02 | 08/02/17 | 4.92 | **890** | 8 | **8** | nd | **2** | nd | **68** | nd | **367** | **31,700** | nd |
| MW03 | 08/02/17 | 6.63 | **80** | 6 | nd | **2** | nd | nd | **3** | nd | **17** | **163,000** | nd |
| *Criteria* | | | | | | | | | | | | | |
| GILs - Drinking Water | | - | - | 10 | **2** | 50* | 2,000 | 10 | **20** | 10 | - | - | 1 |
| GILs - Marine water | | - | **0.5** | **2.3 / 4.5**** | **0.7** | 4.4 | **1.3** | 4.4 | **7** | 3 | **15** | **300***** | 0.1 |
| Recreational Criteria | | | **-** | 100 | 20 | 500 | 20,000 | 100 | 200 | 100 | **-** | **-** | 10 |

* - Chromium criteria as Cr(VI)

** - Arsenic criteria as As (III) / As (V)

*** - Canadian interim value

See table notes at end of section

**Table 12: Groundwater Analytical Summary, E.Coli, Biochemical Oxygen Demand and Nutrients (mg/L)**

| Sample location | Date | E.Coli (MPN/100) | Biochemical Oxygen Demand | Nutrients: Ammonia | Nitrite | Nitrate | Nitrate + Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen | Total Phosphorus | Reactive Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | 2 (MPN/100) | *2* | *0.01* | *0.01* | *0.01* | *0.01* | *0.1* | *0.1* | *0.01* | *0.01* |
| *Analytical* | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | 32 | **0.96** | 0.01 | 0.01 | 0.02 | 60 | 60 | 14.5 | nd |
| MW02 | 08/02/17 | 5 | nd | **1.79** | nd | 0.11 | 0.11 | 53.4 | 53.5 | 7.7 | nd |
| MW03 | 08/02/17 | 13 | 5 | **7.95** | 0.01 | nd | nd | 39.9 | 39.9 | 12.4 | nd |
| *Statistics* | | | | | | | | | | | |
| Number of detects | | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 0 |
| Percentage non detect | | 33% | 33% | 0% | 33% | 33% | 33% | 0% | 0% | 0% | 100% |
| Maximum | | 13 | 32 | 7.95 | 0.01 | 0.11 | 0.11 | 60 | 60 | 14.5 | 0 |
| *Criteria* | | | | | | | | | | | |
| GILs - Drinking Water | | - | - | - | 3 | 50 | - | - | - | - | - |
| GILs - Marine water | | - | - | **0.91** | - | - | - | - | - | - | - |
| Recreational Water | | 150/1000 | - | - | - | 130,000 | - | - | - | - | - |

See tables notes at end of section

**Table 13: Groundwater Analytical Summary, Volatile Organic Compounds, Per- and Polyfluorinated Alkyl Substances (PFAS) ug/L**

| Sample | Date | Total Phenolic Compounds | Total PCBs | Total OCPs | Total OPPs | PFOS & PFHxS | PFOA |
|---|---|---|---|---|---|---|---|
| *LORs* | | - | - | - | - | *0.05* | 0.05 |
| *Analytical* | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | |
| GILs - Drinking Water | | - | - | - | - | - | - |
| GILs - Fresh water | | - | - | - | - | - | - |
| Department of Health (2017) Drinking Water | | - | - | - | - | 0.07 | 0.56 |
| Department of Health (2017) - Recreational Water | | - | - | - | - | 0.7 | 5.6 |

See table notes at end of section

For a complete VOC scan results, please refer to the laboratory report.

**Table 14: Groundwater Analytical Summary, Quality Control (ug/L)**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *08/02/17* | *08/02/17* | | *08/02/17* | | *08/02/17* | *08/02/17* | *08/02/17* | - |
| *Metals* | | | | | | | | | | |
| Aluminium | 0.01 | 5.760 | 5.710 | 1 | 6 | 5 | | | | |
| Arsenic | 0.001 | 0.011 | 0.010 | 10 | 0.01 | 0 | - | - | - | - |
| Cadmium | 0.0001 | 0.0012 | 0.0016 | 29 | 0.0017 | 0 | - | - | - | - |
| Chromium | 0.001 | 0.002 | 0.002 | 0 | 0.002 | 0 | - | - | - | - |
| Copper | 0.001 | 0.003 | 0.002 | 40 | 0.002 | 0 | - | - | - | - |
| Nickel | 0.001 | 0.269 | 0.266 | 1 | 0.21 | 13 | - | - | - | - |
| Lead | 0.001 | 0.002 | 0.002 | 0 | 0.002 | 0 | - | - | - | - |
| Selenium | 0.01 | nd | nd | - | nd | - | | | | |
| Zinc | 0.005 | 0.734 | 0.66 | 11 | 0.67 | 2 | - | - | - | - |
| Iron | 0.05 | 214 | 207 | 3 | 190 | 16 | | | | |
| Mercury | 0.0001 | nd | nd | - | nd | - | - | - | - | - |
| *TRHs* | | | | | | | | | | |
| C6 - C10 Fraction minus BTEX (F1) | 20 | nd | nd | - | nd | - | nd | - | - | - |
| > C10 - C16 Fraction (F2) | 50 | nd | nd | - | nd | - | - | - | - | - |
| > C16 - C34 Fraction | 100 | nd | nd | - | nd | - | - | - | - | - |
| < C34 - C40 Fraction | 50 | nd | nd | - | nd | - | - | - | - | - |
| > C10 - C40 Fraction (sum) | 50 | nd | nd | - | nd | - | - | - | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *BTEXN* | | | | | | | | | | |
| Benzene | 1 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| Toluene | 2 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| Ethylbenzene | 2 | nd | nd | - | nd | - | nd | 15 | *20* | 75 |
| meta- & para-Xylene | 2 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| ortho-xylene | 2 | nd | nd | - | nd | - | nd | 17 | *20* | 85 |
| Naphthalene | 5 | nd | nd | - | nd | - | nd | - | - | - |
| Sum of PAHs | 2 | nd | nd | - | nd | - | nd | - | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | *<50%* | *nd* | - | - | *70-130%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

## Groundwater Analytical Summary Table Notes

LOR denotes limit of reporting (standard LOR unless otherwise shown)

nd denotes not detected above the LOR

**Bold** - Exceeds criteria

^ denotes LOR raised

- denotes not analysed/not available

* TPHs in waters used as screening analysis. If > LOR, check specific toxicants e.g. BTEX, PAHs, etc. For recreational waters/aesthetics, oil/petrol not to be noticeable as a visible film on the water or detectable by odour.

1. Aquatic ecosystem criteria from Australian New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* , including Table 3.4.1 and Section 8.3.7.

DECCW/DERM specify that the 95% species protection levels are to be applied for slightly to moderately-disturbed ecosystems (most urban catchments) and the 99% species protection levels for pristine or vulnerable ecosystems or where the contaminants are intractable (e.g. bioaccumulative).

2. Drinking water criteria from National Health and Medical Research Council (NHMRC) & Natural Resource Management Ministerial Council (NRMMC) (2011) *Australian Drinking Water Guidelines* .

The guideline values are health related and are described as the concentration that does not result in any significant risk to the health of the consumer over a lifetime of consumption. Numbers in brackets are aesthetic values, e.g. appearance, taste and/or odour. The guideline values relate to the quality of water at the point of use, e.g. kitchen or bathroom tap.

While exposure is predominately through ingestion, skin adsorption and/or inhalation are considered in calculating the guideline value (Page 6-7, NHMRC/NRMMC 2004). However, this only addresses consumption/use of drinking water, it does not address inhalation from subsurface, and drinking water criteria should not be used as risk assessment screening values for onsite contaminant concentrations.

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | PID (ppm) | Date sampled | Description | Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TRHs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | 8 metals (Neutral Leach, TCLP) | Selenium | pH, CEC | OCPs | PFAS | PCBs |
| *Soil* | | | | | | | | | | | | | | | |
| TP01 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey silt. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | • | | • | • | • | | | | • | | • |
| TP02 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP03 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP04 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP05 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP06 | 0.5 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP07 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP08 | 1.0 | 0.0 | 01/02/17 | Sandy silty CLAY. Brown with yellow jarosite staining. Moist, medium plasticity. | • | | • | • | • | | | | • | | • |
| TP09 | 0.4 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP10 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP11 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | • | | • | • | • | | | | • | | • |
| TP11 | 1.1 | 0.0 | 01/02/17 | Sandy silty CLAY. Brown with yellow jarosite staining. Moist, medium plasticity. | • | | • | • | • | | | | • | | • |
| TP12 | 0.1 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP13 | 0.4 | 0.0 | 01/02/17 | FILL: Clayey sand. Light brown, loose, dry. No observable contamination, no anthropogenic inclusions. Reworked natural. | | | | | • | | | | | | |
| TP14 | 0.4 | 0.0 | 15/02/17 | Sandy silty CLAY. Brown and red brown. Soft and moist. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | PID (ppm) | Date sampled | Description | Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TRHs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | 8 metals (Neutral Leach, TCLP) | Selenium | pH, CEC | OCPs | PFAS | PCBs |
| *Soil* | | | | | | | | | | | | | | | |
| TP15 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP16 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP17 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP18 | 0.4 | 0.0 | 15/02/17 | Sandy clayey CLAY. Dark brown and red brown mottled. Soft and moist. Medium plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP19 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP20 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP21 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP22 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP23 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP24 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP25 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP26 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP27 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP27 | 0.5 | 0.0 | 23/08/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | | | | | • | | | |
| TP27A | 0.1 | 0.0 | 23/08/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | | | | | • | | | |

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | PID (ppm) | Date sampled | Description | Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TRHs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | 8 metals (Neutral Leach, TCLP) | Selenium | pH, CEC | OCPs | PFAS | PCBs |
| *Soil* | | | | | | | | | | | | | | | |
| TP27B | 0.1 | 0.0 | 23/08/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | | | | | | | | |
| TP27C | 0.1 | 0.0 | 23/08/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | | | | | | | | |
| TP27D | 0.1 | | 23/08/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | | | | | | | | |
| TP28 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP29 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP30 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP31 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP32 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP33 | 0.1 | 0.0 | 15/02/17 | Clayey SILT. Light brown. Loose, dry, low plasticity. No observable contamination, no anthropogenic inclusions. | • | | • | • | • | | | | • | | • |
| TP34 | 0.1 | 0.0 | 02/02/17 | FILL: Clayey sand. Light brown. Loose, dry. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| TP35 | 0.1 | 0.0 | 02/02/17 | FILL: Clayey sand. Light brown. Loose, dry. No observable contamination, no anthropogenic inclusions. | | | | | • | | | | | | |
| *Waste stockpiles* | | | | | | | | | | | | | | | |
| TP36 | 0.1 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | | • | • | • | | | | • | | • |
| TP36 | 0.5 | 0.0 | 02/02/17 | FILL: Mulch. Moist. No observable contamination, no ACM observed. | • | | • | • | • | | | | • | | • |
| TP37 | 0.1 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | | • | • | • | | | | • | | • |
| TP37 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | | • | • | • | | | | • | | • |

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | PID (ppm) | Date sampled | Description | Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TRHs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | 8 metals (Neutral Leach, TCLP) | Selenium | pH, CEC | OCPs | PFAS | PCBs |
| *Soil* | | | | | | | | | | | | | | | |
| TP37B | 0.1 | 0.0 | 23/08/17 | FILL: Gravelly clayey sand. Grey. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | | • | • | • | | | | | | |
| TP37B | 0.5 | 0.0 | 23/08/17 | FILL: Gravelly clayey sand. Grey. Contains concrete, PVC, plastic, wood, geofabric, asphalt. No ACM observed. | • | | • | • | • | | | | | | |
| TP38 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC, wood. No ACM observed. | • | | • | • | • | | | | • | | • |
| TP38 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC, wood. No ACM observed. | • | | • | • | • | | | | • | | • |
| TP39 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Grey to brown. Contains concrete, PVC plastic, black plastic liner, wood. No ACM observed. | • | | • | • | • | | | | • | | • |
| TP39 | 2.0 | 0.0 | 02/02/17 | Silty CLAY. Grey, contains tree branches. Very moist. | • | | • | • | • | | | | • | | • |
| TP40 | 0.1 | 0.0 | 02/02/17 | FILL: Gravelly clayey sand. Road base. | • | | • | • | • | | | | • | | • |
| *Imported material from Yamba STP* | | | | | | | | | | | | | | | |
| TP41 | 0.5 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | | • | • | • | | | | • | | • |
| TP41 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | | • | • | • | | | | • | | • |
| TP41 | 1.5 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | | • | • | • | | | | • | | • |
| TP42 | 3.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete, brick and rags. | • | | • | • | • | | | | • | | • |
| TP42 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete, brick and rags. | • | | • | • | • | | | | • | | • |
| TP42 | 2.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Moist. Contains wood, plastic, concrete, brick and rags. | • | | • | • | • | | | | • | | • |
| TP43 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete and brick. | • | | • | • | • | | | | • | | • |
| TP43 | 2.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Moist. Contains wood, plastic, concrete and brick. | • | | • | • | • | | | | • | | • |
| TP44 | 1.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Dry. Contains wood, plastic, concrete, brick and rags. | • | | • | • | • | | | | • | | • |
| TP44 | 2.0 | 0.0 | 02/02/17 | FILL: Gravelly SAND. Light brown. Moist. Contains wood, plastic, concrete, brick and rags. | • | | • | • | • | | | | • | | • |
| *Biosolids* | | | | | | | | | | | | | | | |
| BS01 | - | 0.0 | 02/02/17 | Black silt | | | | | • | | | | • | | • |
| BS02 | - | 0.0 | 02/02/17 | Black silt | | | | | • | | | | • | | • |

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | PID (ppm) | Date sampled | Description | Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TRHs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | 8 metals (Neutral Leach, TCLP) | Selenium | pH, CEC | OCPs | PFAS | PCBs |
| *Soil* | | | | | | | | | | | | | | | |
| BS03 | - | 0.0 | 02/02/17 | Black silt | | | | | • | | | | • | | • |
| BS04 | - | 0.0 | 02/02/17 | Black silt | | | | | • | | | | • | | • |
| BS05 | - | 0.0 | 02/02/17 | Black silt | | | | | • | | | | • | | • |
| BS100 | - | 0.0 | 23/08/17 | Black silt | • | | • | | • | | • | | • | • | • |
| BS101 | - | 0.0 | 23/08/17 | Black silt | • | | • | | • | | • | | • | • | • |
| BS102 | - | 0.0 | 23/08/17 | Black silt | • | | • | | • | | • | | • | • | • |
| *Acid Sulfate soils sample summary is included on Table 6.* | | | | | | | | | | | | | | | |

**Table 2: Soil Analytical Summary, Metals**

| Sample | Depth (m) | Date Sampled | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| *Analytical - Test pits* | | | | | | | | | | | |
| TP01 | 0.1 | 15/02/2017 | 6 | nd | 21 | 18 | 10 | 8 | - | 40 | nd |
| TP02 | 0.1 | 15/02/2017 | 8 | nd | 21 | 14 | 18 | 9 | - | 40 | nd |
| TP03 | 0.1 | 15/02/2017 | 8 | nd | 28 | 21 | 16 | 14 | - | 53 | nd |
| TP04 | 0.1 | 15/02/2017 | 8 | nd | 25 | 17 | 16 | 11 | - | 49 | nd |
| TP05 | 0.1 | 15/02/2017 | 9 | nd | 26 | 18 | 15 | 10 | - | 44 | nd |
| TP06 | 0.5 | 15/02/2017 | 11 | nd | 29 | 20 | 16 | 12 | - | 56 | nd |
| TP07 | 0.1 | 15/02/2017 | 10 | nd | 26 | 19 | 17 | 11 | - | 53 | nd |
| TP08 | 1.0 | 15/02/2017 | 10 | nd | 27 | 17 | 14 | 19 | - | 79 | nd |
| TP09 | 0.4 | 15/02/2017 | 12 | nd | 26 | 20 | 18 | 10 | - | 52 | nd |
| TP10 | 0.1 | 15/02/2017 | 10 | nd | 25 | 20 | 18 | 11 | - | 53 | nd |
| TP11 | 0.1 | 15/02/2017 | 12 | nd | 26 | 20 | 16 | 11 | - | 53 | nd |
| TP11 | 1.1 | 15/02/2017 | 6 | nd | 28 | 13 | 17 | 16 | - | 57 | nd |
| TP12 | 0.1 | 15/02/2017 | 14 | nd | 28 | 21 | 20 | 10 | - | 50 | nd |
| TP13 | 0.4 | 15/02/2017 | 7 | nd | 20 | 16 | 12 | 8 | - | 38 | nd |
| TP14 | 0.4 | 15/02/2017 | nd | nd | 27 | 24 | 22 | 21 | - | 56 | nd |
| TP15 | 0.1 | 15/02/2017 | 8 | nd | 18 | 18 | 18 | 10 | - | 52 | nd |
| TP16 | 0.1 | 15/02/2017 | 11 | nd | 27 | 26 | 19 | 19 | - | 59 | nd |
| TP17 | 0.1 | 15/02/2017 | 13 | nd | 25 | 22 | 17 | 13 | - | 50 | nd |
| TP18 | 0.4 | 15/02/2017 | 12 | nd | 29 | 29 | 20 | 20 | - | 64 | 0.1 |
| TP19 | 0.1 | 15/02/2017 | 8 | nd | 23 | 22 | 16 | 13 | - | 45 | nd |
| TP20 | 0.1 | 15/02/2017 | 11 | nd | 23 | 20 | 16 | 14 | - | 52 | nd |
| TP21 | 0.1 | 15/02/2017 | 9 | nd | 24 | 22 | 17 | 14 | - | 54 | nd |
| TP22 | 0.1 | 15/02/2017 | 9 | nd | 24 | 23 | 19 | 15 | - | 58 | nd |

**Table 2: Soil Analytical Summary, Metals**

| Sample | Depth (m) | Date Sampled | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| TP23 | 0.1 | 15/02/2017 | 7 | nd | 19 | 15 | 18 | 12 | - | 67 | nd |
| TP24 | 0.1 | 15/02/2017 | 7 | nd | 22 | 35 | 18 | 15 | - | 77 | nd |
| TP25 | 0.1 | 15/02/2017 | 7 | nd | 27 | 21 | 17 | 18 | - | 63 | nd |
| TP26 | 0.1 | 15/02/2017 | 11 | nd | 28 | 23 | 18 | 19 | - | 68 | nd |
| TP27 | 0.1 | 15/02/2017 | 6 | nd | 18 | 27 | 16 | 14 | - | 65 | nd |
| TP27 | 0.5 | 23/08/2017 | - | - | - | - | - | - | - | - | - |
| TP27A | 0.1 | 23/08/2017 | - | - | - | - | - | - | - | - | - |
| TP27B | 0.1 | 23/08/2017 | - | - | - | - | - | - | - | - | - |
| TP27C | 0.1 | 23/08/2017 | - | - | - | - | - | - | - | - | - |
| TP27D | 0.1 | 23/08/2017 | - | - | - | - | - | - | - | - | - |
| TP28 | 0.1 | 15/02/2017 | 8 | nd | 26 | 24 | 19 | 17 | - | 54 | nd |
| TP29 | 0.1 | 15/02/2017 | 9 | nd | 22 | 22 | 18 | 16 | - | 69 | nd |
| TP30 | 0.1 | 15/02/2017 | 10 | nd | 27 | 25 | 20 | 19 | - | 66 | nd |
| TP31 | 0.1 | 15/02/2017 | 8 | nd | 24 | 26 | 19 | 18 | - | 71 | nd |
| TP32 | 0.1 | 15/02/2017 | 7 | nd | 20 | 34 | 16 | 14 | - | 76 | nd |
| TP33 | 0.1 | 15/02/2017 | 9 | nd | 21 | 23 | 16 | 14 | - | 66 | nd |
| TP34 | 0.1 | 15/02/2017 | 10 | nd | 22 | 18 | 17 | 9 | - | 45 | nd |
| TP35 | 0.1 | 15/02/2017 | 10 | nd | 23 | 18 | 15 | 10 | - | 49 | nd |
| *Analytical - Waste Stockpiles* | | | | | | | | | | | |
| TP36 | 0.1 | 15/02/2017 | nd | nd | 8 | nd | 11 | 3 | - | 18 | nd |
| TP36 | 0.5 | 15/02/2017 | nd | nd | 3 | 9 | nd | 2 | - | 36 | nd |
| TP37 | 0.1 | 15/02/2017 | nd | nd | 6 | nd | 6 | nd | - | 9 | nd |
| TP37B | 0.1 | 23/08/2017 | nd | nd | 4 | nd | 6 | nd | - | 5 | nd |
| TP37B | 0.5 | 23/08/2017 | nd | nd | 8 | nd | 6 | nd | - | 5 | nd |

**Table 2: Soil Analytical Summary, Metals**

| Sample | Depth (m) | Date Sampled | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| TP37 | 0.5 | 15/02/2017 | nd | nd | 5 | nd | 10 | nd | - | 5 | nd |
| TP38 | 0.5 | 15/02/2017 | nd | nd | 12 | 5 | 12 | 3 | - | 37 | nd |
| TP38 | 1.0 | 15/02/2017 | nd | nd | 7 | nd | 8 | nd | - | 10 | nd |
| TP39 | 0.5 | 15/02/2017 | nd | nd | 4 | nd | 5 | nd | - | 7 | nd |
| TP39 | 2.0 | 15/02/2017 | 7 | nd | 6 | 8 | 7 | nd | - | 8 | nd |
| TP40 | 0.1 | 15/02/2017 | nd | nd | 7 | 8 | 10 | 3 | - | 31 | nd |
| *Analytical - Imported material from Yamba STP* | | | | | | | | | | | |
| TP41 | 0.5 | 15/02/2017 | nd | nd | 4 | 8 | nd | nd | - | 10 | nd |
| TP41 | 1.0 | 15/02/2017 | nd | nd | 5 | 10 | 8 | nd | - | 16 | nd |
| TP41 | 1.5 | 15/02/2017 | nd | nd | 4 | 10 | nd | nd | - | 9 | nd |
| TP42 | 3.0 | 15/02/2017 | nd | nd | 4 | 10 | 9 | nd | - | 19 | nd |
| TP42 | 1.0 | 15/02/2017 | nd | nd | 4 | 22 | 8 | nd | - | 22 | nd |
| TP42 | 2.0 | 15/02/2017 | nd | nd | 4 | 10 | 8 | nd | - | 16 | nd |
| TP43 | 1.0 | 15/02/2017 | nd | nd | 4 | 8 | 7 | nd | - | 15 | nd |
| TP43 | 2.0 | 15/02/2017 | nd | nd | 4 | 9 | 6 | nd | - | 14 | nd |
| TP44 | 1.0 | 15/02/2017 | nd | nd | 5 | 9 | 6 | nd | - | 16 | nd |
| TP44 | 2.0 | 15/02/2017 | nd | nd | 5 | nd | 7 | nd | - | 12 | nd |
| *Criteria* | | | | | | | | | | | |
| HILs - Residential A | | | 100 | 20 | 100 | 6,000 | 300 | 400 | 200 | 7,400 | 40 |
| EILs - Urban residential and public open space (aged) | | | 100 | - | 410 | 85 | 1,100 | 200 | - | 240 | - |
| *Analytical - Biosolids* | | | | | | | | | | | |
| BS01 | - | 15/02/2017 | 5 | nd | 24 | 23 | 16 | 16 | nd | 61 | nd |

**Table 2: Soil Analytical Summary, Metals**

| Sample | Depth (m) | Date Sampled | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| BS02 | - | 15/02/2017 | 7 | nd | 24 | 21 | 17 | 17 | nd | 61 | nd |
| BS03 | - | 15/02/2017 | 14 | nd | 21 | 30 | 15 | 25 | nd | 113 | nd |
| BS04 | - | 15/02/2017 | 8 | nd | 21 | 29 | 16 | 23 | nd | 96 | nd |
| BS05 | - | 15/02/2017 | 9 | nd | 18 | 82 | 21 | 24 | nd | 130 | 0.1 |
| BS100 | - | 23/08/2017 | 9 | nd | 19 | 16 | 12 | 17 | nd | 57 | nd |
| BS101 | - | 23/08/2017 | 8 | nd | 17 | 15 | 10 | 29 | nd | 76 | nd |
| BS102 | - | 23/08/2017 | nd | nd | 14 | 14 | 9 | 5 | nd | 21 | nd |
| *Criteria* | | | | | | | | | | | |
| Biosolids - Grade A | | | 20 | 3 | 100 | 100 | 150 | 60 | 5 | 200 | 1 |

See table notes at end of section

**Table 2: Soil Analytical Summary, Neutral Leach and TCLP Metals (mg/L)**

| | | | Neutral Leach | | | | | | | | TCLP | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Depth (m) | Date | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Zinc | Mercury | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Zinc | Mercury |
| *LORs* | | | *0.001* | *0.0001* | *0.001* | *0.001* | *0.001* | *0.001* | *0.005* | *0.0001* | *0.1* | *0.05* | *0.1* | *0.1* | *0.1* | *0.1* | *0.1* | *0.001* |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | | | | |
| BS100 | - | 23/08/17 | 0.007 | 0.0004 | 0.008 | 0.018 | 0.003 | 0.006 | 0.377 | nd | nd | nd | nd | nd | nd | nd | 0.2 | nd |
| BS101 | - | 23/08/17 | 0.005 | 0.0003 | 0.01 | 0.012 | 0.003 | 0.01 | 0.456 | nd | nd | nd | nd | nd | nd | nd | 0.2 | nd |
| BS102 | - | 23/08/17 | 0.009 | 0.0004 | 0.013 | 0.012 | 0.009 | 0.005 | 0.628 | nd | nd | nd | nd | nd | nd | nd | 0.2 | nd |
| *Criteria* | | | | | | | | | | | | | | | | | | |
| Biosolids - Grade A | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

See table notes at end of section

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**Table 3: Soil Analytical Summary, BTEXN and TRHs (mg/kg)**

| | | | BTEX | | | | | | TRH | | | | TRH Silica Gel Cleanup | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Depth (m) | Date Sampled | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
| *LORs* | | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* | *10* | *50* | *100* | *100* |
| *Analytical - test pits* | | | | | | | | | | | | | | | | |
| TP01 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP08 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP11 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP11 | 1.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP14 | 0.4 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP16 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP18 | 0.4 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP20 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP22 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP25 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP27 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | **180** | **550** | 200 | - | - | - | - |
| TP27 | 0.5 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP27A | 0.1 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP27B | 0.1 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP27C | 0.1 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP27D | 0.1 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP29 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | 100 | nd | - | - | - | - |
| TP31 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | 200 | 120 | - | - | - | - |
| TP33 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |

**Table 3: Soil Analytical Summary, BTEXN and TRHs (mg/kg)**

| | | | BTEX | | | | | | TRH | | | | TRH Silica Gel Cleanup | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Depth (m) | Date Sampled | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
| *LORs* | | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* | *10* | *50* | *100* | *100* |
| *Analytical - Waste stockpiles* | | | | | | | | | | | | | | | | |
| TP36 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP36 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | 80 | **440** | 220 | - | - | - | - |
| TP37 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP37 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP37B | 0.1 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP37B | 0.5 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| TP38 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP38 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP39 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP39 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP40 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| *Analytical - Imported material from Yamba STP* | | | | | | | | | | | | | | | | |
| TP41 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP41 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP41 | 1.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP42 | 3.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP42 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | 160 | nd | - | - | - | - |
| TP42 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | 140 | nd | - | - | - | - |
| TP43 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP43 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |

**Table 3: Soil Analytical Summary, BTEXN and TRHs (mg/kg)**

| | | | BTEX | | | | | | TRH | | | | TRH Silica Gel Cleanup | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | Depth (m) | Date Sampled | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
| *LORs* | | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* | *10* | *50* | *100* | *100* |
| TP44 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| TP44 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | | |
| BS100 | - | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| BS101 | - | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| BS102 | - | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | |
| Samples analysed | | | 19 | 19 | 19 | 20 | 19 | 20 | 20 | 15 | 15 | 15 | 1 | 5 | 5 | 5 |
| Detects | | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 2 | 4 | 3 | 1 | 0 | 0 | 0 |
| % detect | | | 0% | 0% | 0% | 5% | 0% | 5% | 5% | 13% | 27% | 20% | 100% | 0% | 0% | 0% |
| Maximum | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 180 | **550** | 200 | 0 | 0 | 0 | 0 |
| Mean | | | nd | nd | nd | nd | nd | nd | nd | 180 | 283 | 160 | nd | nd | nd | nd |
| Median | | | nd | nd | nd | nd | nd | nd | nd | 180 | 200 | 160 | nd | nd | nd | nd |
| Minimum | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 120 | 0 | 0 | 0 | 0 |
| Coefficient of variation (CV) | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Standard deviation | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Criteria - residential landuse with sandy soils* | | | | | | | | | | | | | | | | |
| Health levels 0m to <1m | | | 0.5 | 160 | 55 | 40 | | 3 | 45 | **110** | no limit | no limit | 45 | **110** | no limit | no limit |
| Health levels 1m to <2m | | | 0.5 | 220 | no limit | 60 | | no limit | 70 | 240 | no limit | no limit | 70 | 240 | no limit | no limit |
| Health levels 2m to <4m | | | 0.5 | 310 | no limit | 96 | | no limit | 110 | 440 | no limit | no limit | 110 | 440 | no limit | no limit |
| Health levels 4m+ | | | 0.5 | 540 | no limit | 170 | | no limit | 200 | no limit | no limit | no limit | 200 | no limit | no limit | no limit |
| Health investigation level | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Ecological levels | | | 65 | 105 | 125 | 45 | | 170 | 180 | **120** | **300** | 2,800 | 180 | **120** | **300** | 2,800 |
| Management limits | | | - | - | - | - | | - | - | 1,000 | 3,500 | 10,000 | - | 1,000 | 3,500 | 10,000 |
| Direct Contact Criteria | | | 430 | 99,000 | 27,000 | 81,000 | | - | 26,000 | 20,000 | 27,000 | 38,000 | 26,000 | 20,000 | 27,000 | 38,000 |

See table notes at end of section

**Table 4: Soil Analytical Summary, PAHs (mg/kg)**

| Sample | Depth (m) | Date Sampled | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ (zero LOR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | - | - |
| *Analytical - test pits* | | | | | | | | | | | | | | | | | | | | |
| TP01 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP08 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP11 | 1.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP14 | 0.4 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP16 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP18 | 0.4 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP20 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP22 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP25 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP27 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP29 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP31 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP33 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - waste stockpiles* | | | | | | | | | | | | | | | | | | | | |
| TP36 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP36 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1 | 15.4 | 2.6 |
| TP37B | 0.1 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP37B | 0.5 | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP38 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP38 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP39 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |

**Table 4: Soil Analytical Summary, PAHs (mg/kg)**

| Sample | Depth (m) | Date Sampled | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ (zero LOR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *-* | *-* |
| TP39 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP40 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Analytical - imported material from Yamba STP* | | | | | | | | | | | | | | | | | | | | |
| TP41 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP41 | 1.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 3.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP42 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP43 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP43 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| TP44 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | | | | | |
| Samples analysed | | | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| Detects | | - | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| % detect | | - | 0% | 0% | 0% | 0% | 0% | 0% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 0% | 3% | 3% | 3% |
| Maximum | | - | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1.0 | 15.4 | 2.6 |
| Mean | | - | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1.0 | 15.4 | 2.6 |
| Median | | - | nd | nd | nd | nd | nd | nd | 2.4 | 2.4 | 1.8 | 1.5 | 2.3 | 1.1 | **2.0** | 0.9 | nd | 1.0 | 15.4 | 2.6 |
| Minimum | | - | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria* | | - | | | | | | | | | | | | | | | | | | |
| HILs - Residential A | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 300 | 3 |
| ESLs - Urban residential and public open space | | - | 170 | NL | NL | NL | NL | NL | NL | NL | NL | NL | NL | NL | **0.7** | NL | NL | NL | NL | NL |

See table notes at end of section

**Table 5: Soil Analytical Summary, OCPs and PCBs**

| Sample | Depth (m) | Date Sampled | Heptachlor | Total Chlordane (sum) | Endrin | Endosulfan (sum) | Methoxychlor | Sum of Aldrin + Dieldrin | Sum of DDD + DDE + DDT | Hexachlorobenzene (HCB) | Lindane | BHC | PCBs | PFOS & PFHxS | PFOA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *0.2 / 0.02* | *0.1 / 0.02* | *0.05* | *0.05* | *0.2* | *0.05 / 0.02* | *0.05* | *0.02* | *0.02* | *0.02* | *0.1* | *0.02* | *0.1* |
| *Analytical - Test pits* | | | | | | | | | | | | | | | |
| TP01 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP08 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP11 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP11 | 1.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP14 | 0.4 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP16 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP18 | 0.4 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP20 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP22 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP25 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP27 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP29 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP31 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP33 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| *Analytical - Waste Stockpiles* | | | | | | | | | | | | | | | |
| TP36 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP36 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP37 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP37 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP38 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP38 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP39 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP39 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP40 | 0.1 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| *Analytical - imported material from Yamba STP* | | | | | | | | | | | | | | | |
| TP41 | 0.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP41 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP41 | 1.5 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP42 | 3.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |

**Table 5: Soil Analytical Summary, OCPs and PCBs**

| Sample | Depth (m) | Date Sampled | Heptachlor | Total Chlordane (sum) | Endrin | Endosulfan (sum) | Methoxychlor | Sum of Aldrin + Dieldrin | Sum of DDD + DDE + DDT | Hexachlorobenzene (HCB) | Lindane | BHC | PCBs | PFOS & PFHxS | PFOA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *0.2 / 0.02* | *0.1 / 0.02* | *0.05* | *0.05* | *0.2* | *0.05 / 0.02* | *0.05* | *0.02* | *0.02* | *0.02* | *0.1* | *0.02* | *0.1* |
| TP42 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP42 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP43 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP43 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP44 | 1.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| TP44 | 2.0 | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| *Criteria* | | | | | | | | | | | | | | | |
| HILs- Residential A | | | 6 | 50 | 10 | 270 | 300 | 6 | 240 | 10 | - | - | 1 | - | - |
| EILs - Urban residential and public open space | | | - | - | - | - | - | - | 180 (DDT only) | - | - | - | - | - | - |

**Table 5: Soil Analytical Summary, OCPs and PCBs**

| Sample | Depth (m) | Date Sampled | Heptachlor | Total Chlordane (sum) | Endrin | Endosulfan (sum) | Methoxychlor | Sum of Aldrin + Dieldrin | Sum of DDD + DDE + DDT | Hexachlorobenzene (HCB) | Lindane | BHC | PCBs | PFOS & PFHxS | PFOA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *0.2 / 0.02* | *0.1 / 0.02* | *0.05* | *0.05* | *0.2* | *0.05 / 0.02* | *0.05* | *0.02* | *0.02* | *0.02* | *0.1* | *0.02* | *0.1* |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | |
| BS01 | - | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| BS02 | - | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| BS03 | - | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| BS04 | - | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| BS05 | - | 15/02/2017 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - |
| BS100 | - | 23/08/2017 | nd | nd | - | - | - | nd | - | nd | nd | nd | nd | nd | nd |
| BS101 | - | 23/08/2017 | nd | nd | - | - | - | nd | - | nd | nd | nd | nd | nd | nd |
| BS102 | - | 23/08/2017 | nd | nd | - | - | - | nd | - | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | | | | | | | | | |
| Bisolids - Grade A | | | 0.02 | 0.02 | - | - | - | 0.02 / 0.02 | 0.5 | 0.02 | 0.02 | 0.02 | 0.3 | - | - |

See table notes at end of section

**Table 6: Soil Analytical Summary, ASS Description and Analytical Summary**

| Sample | Depth (m) | Date sampled | Reactivity* | pH(F) | pH(FOX) | pH change | Bulk Density** | Description | Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | pHF | pHFOX | SPOCAS |
| *Analytical - Test Pits* | | | | | | | | | | | |
| AS01 | 0.5 | 1/02/2017 | 3 | 3.2 | 1.6 | 1.6 | 1.60 | Clayey SILT | • | • | |
| AS01 | 1.0 | 1/02/2017 | 4 | 3.1 | 1.7 | 1.4 | 1.05 | Sandy silty CLAY | • | • | |
| AS01 | 1.5 | 1/02/2017 | 4 | 3.5 | 2.1 | 1.4 | 1.05 | Silty CLAY | • | • | |
| AS01 | 2.0 | 1/02/2017 | 4 | 4.9 | 2.3 | 2.6 | 1.05 | Silty CLAY | • | • | • |
| AS02 | 0.5 | 1/02/2017 | 3 | 3.4 | 1.6 | 1.8 | 1.60 | Clayey SAND | • | • | |
| AS02 | 1.0 | 1/02/2017 | 3 | 3.2 | 1.7 | 1.5 | 1.05 | Sandy silty CLAY | • | • | |
| AS02 | 1.5 | 1/02/2017 | 3 | 3.4 | 1.8 | 1.6 | 1.05 | Silty CLAY | • | • | |
| AS02 | 2.0 | 1/02/2017 | 4 | 3.6 | 2.3 | 1.3 | 1.05 | Silty CLAY | • | • | • |
| AS03 | 0.5 | 1/02/2017 | 3 | 3.3 | 1.7 | 1.6 | 1.60 | Clayey SAND | • | • | • |
| AS03 | 1.0 | 1/02/2017 | 4 | 3.1 | 2.6 | 0.5 | 1.05 | Sandy Silty CLAY | • | • | |
| AS03 | 1.5 | 1/02/2017 | 3 | 3.8 | 1.9 | 1.9 | 1.05 | Silty CLAY | • | • | |
| AS03 | 2.0 | 1/02/2017 | 4 | 5.5 | 2.8 | 2.7 | 1.05 | Silty CLAY | • | • | |
| AS04 | 0.5 | 1/02/2017 | 3 | 3.4 | 1.7 | 1.7 | 1.60 | Clayey SAND | • | • | • |
| AS04 | 1.0 | 1/02/2017 | 3 | 3.3 | 1.6 | 1.7 | 1.05 | Sandy silty CLAY | • | • | |
| AS04 | 1.5 | 1/02/2017 | 3 | 3.2 | 1.8 | 1.4 | 1.05 | Silty CLAY | • | • | |
| AS04 | 2.0 | 1/02/2017 | 4 | 5.0 | 2.4 | 2.6 | 1.05 | Silty CLAY | • | • | |
| AS05 | 0.5 | 2/02/2017 | 3 | 4.1 | 2.1 | 2.0 | 1.05 | Sandy Silty CLAY | • | • | • |
| AS05 | 1.0 | 15/02/2017 | 3 | 4.2 | 1.8 | 2.4 | 1.05 | Silty CLAY | • | • | |
| AS05 | 1.5 | 15/02/2017 | 3 | 4.1 | 1.9 | 2.2 | 1.05 | Silty CLAY | • | • | |
| AS05 | 2.0 | 15/02/2017 | 4 | 7.8 | 1.9 | 5.9 | 1.05 | Silty CLAY | • | • | |
| AS06 | 0.5 | 15/02/2017 | 3 | 4.8 | 2.4 | 2.4 | 1.05 | Sandy silty CLAY | • | • | |
| AS06 | 1.0 | 15/02/2017 | 3 | 4.3 | 2.2 | 2.1 | 1.05 | Silty CLAY | • | • | |
| AS06 | 1.5 | 2/02/2017 | 4 | 5.4 | 2.2 | 3.2 | 1.05 | Silty CLAY | • | • | • |
| AS06 | 2.0 | 15/02/2017 | 4 | 6.6 | 1.8 | 4.8 | 1.05 | Silty CLAY | • | • | |
| AS07 | 0.5 | 15/02/2017 | 3 | 4.5 | 2.1 | 2.4 | 1.05 | Sandy silty CLAY | • | • | |
| AS07 | 1.0 | 15/02/2017 | 3 | 4.3 | 2.4 | 1.9 | 1.05 | Silty CLAY | • | • | |
| AS07 | 1.5 | 2/02/2017 | 3 | 4.6 | 2.4 | 2.2 | 1.05 | Silty CLAY | • | • | • |
| AS07 | 2.0 | 15/02/2017 | 4 | 7.1 | 1.8 | 5.3 | 1.05 | Silty CLAY | • | • | |
| AS08 | 0.5 | 15/02/2017 | 3 | 4.3 | 2.3 | 2.0 | 1.05 | Sandy silty CLAY | • | • | |
| AS08 | 1.0 | 15/02/2017 | 3 | 4.2 | 2.0 | 2.2 | 1.05 | Silty CLAY | • | • | |
| AS08 | 1.5 | 15/02/2017 | 4 | 5.6 | 1.8 | 3.8 | 1.05 | Silty CLAY | • | • | |
| AS08 | 2.0 | 15/02/2017 | 4 | 7.8 | 1.8 | 6.0 | 1.05 | Silty CLAY | • | • | • |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AS09 | 0.5 | 15/02/2017 | 3 | 4.6 | 2.5 | 2.1 | 1.05 | Sandy silty CLAY | • | • | |
| AS09 | 1.0 | 15/02/2017 | 3 | 4.3 | 2.2 | 2.1 | 1.05 | Silty CLAY | • | • | |
| AS09 | 1.5 | 15/02/2017 | 4 | 5.0 | 2.0 | 3.0 | 1.05 | Silty CLAY | • | • | • |
| AS09 | 2.0 | 15/02/2017 | 4 | 4.7 | 2.0 | 2.7 | 1.05 | Silty CLAY | • | • | |
| AS10 | 0.5 | 2/02/2017 | 3 | 4.8 | 2.9 | 1.9 | 1.60 | Gravelly clayey SAND | • | • | |
| AS10 | 1.0 | 2/02/2017 | 3 | 5.9 | 2.7 | 3.2 | 1.05 | Sandy silty CLAY | • | • | |
| AS10 | 1.5 | 2/02/2017 | 4 | 5.5 | 3.3 | 2.2 | 1.05 | Silty CLAY | • | • | |
| AS10 | 2.0 | 2/02/2017 | 4 | 6.1 | 3.0 | 3.1 | 1.05 | Silty CLAY | • | • | • |

* Reactivity recorded following addition of hydrogen peroxide, 1 = slight, 2 = moderate, 3 = strong, 4 = extreme
** Bulk density - WA DEC website values used in the absence of site-specific data.

**Table 7: Soil Analytical Summary, SPOCAS Suite**

| Sample | Depth (m) | Titratable Actual Acidity (TAA) 23F | Titratable Peroxide Acidity (TPA) 23G | Net Acidity (sulfur units) | Net Acidity (acidity units) | Liming Rate (including bulk density) |
|---|---|---|---|---|---|---|
| *Units* | | *mol H+/t* | *mol H+/t* | *% S* | *mol H+/t* | *kg CaCO3/m3 soil* |
| *LORs* | | *2* | *2* | *0.02* | *10* | *1* |
| *Analytical* | | | | | | |
| AS01 | 2.0 | 83 | 634 | **1.05** | **654** | 49 |
| AS02 | 2.0 | 168 | 680 | **1.09** | **682** | 51 |
| AS03 | 0.5 | 222 | 296 | **0.66** | **409** | 31 |
| AS04 | 0.5 | 186 | 281 | **0.60** | **378** | 28 |
| AS05 | 0.5 | 116 | 193 | **0.25** | **158** | 12 |
| AS06 | 1.5 | 58 | 952 | **1.67** | **1040** | 78 |
| AS07 | 1.5 | 80 | 288 | **0.26** | **161** | 12 |
| AS08 | 2.0 | 26 | 1070 | **1.67** | **1040** | 78 |
| AS09 | 1.5 | 64 | 450 | **0.77** | **480** | 36 |
| AS10 | 2.0 | 24 | 204 | **0.23** | **143** | 11 |
| *Criteria* | | | | | | |
| Action Threshold (Any texture, > 1,000 tonnes of material disturbed) | | - | - | **0.03** | **18** | - |
| Action Threshold (Fine texture, <1,000 tonnes of material disturbed) | | - | - | **0.1** | **62** | - |

See table notes at end of section

**Table 8: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | TP01_0.1 | QS01 | **RPD** | TP20_0.1 | QS03 | **RPD** | TP20_0.1 | QS04 | **RPD** | TP37_0.5 | QS05 | **RPD** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Duplicate* | *%* | *Primary* | *Duplicate* | *%* | *Primary* | *Duplicate* | *%* |
| *Date* | - | 01/02/17 | 01/02/17 | - | 15/02/17 | 15/02/17 | - | 15/02/17 | 15/02/17 | - | 02/02/17 | 02/02/17 | - |
| *Media* | *Soil* | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | - |
| *Heavy metals* | | | | | | | | | | | | | |
| Arsenic | 5 | 6 | 10 | **50** | 11 | 9 | 20 | 11 | 12 | 9 | nd | nd | - |
| Cadmium | 1 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| Chromium | 2 | 21 | 25 | 17 | 23 | 25 | 8 | 23 | 26 | 12 | 6 | 4 | 40 |
| Copper | 5 | 18 | 20 | 11 | 20 | 21 | 5 | 20 | 24 | 18 | nd | nd | - |
| Lead | 5 | 10 | 17 | **52** | 16 | 18 | 12 | 16 | 18 | 12 | 6 | 6 | 0 |
| Nickel | 2 | 8 | 11 | 32 | 14 | 16 | 13 | 14 | 16 | 13 | nd | nd | - |
| Zinc | 5 | 40 | 56 | 33 | 52 | 55 | 6 | 52 | 60 | 14 | 9 | 8 | 12 |
| Mercury | *0.1* | nd | 0.2 | - | nd | nd | - | nd | nd | - | nd | nd | - |
| *Organics* | | | | | | | | | | | | | |
| Benzene | 0.2 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| Toluene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| Ethyl benzene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| meta- & para-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| ortho-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| TRHs C6 – C10 | 10 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| TRHs >C10 - C16 | 50 | nd | 160 | - | nd | nd | - | nd | nd | - | nd | nd | - |
| TRHs >C16 - C34 | 100 | nd | nd | - | 140 | nd | - | 140 | nd | - | nd | nd | - |
| TRHs >C34 - C40 | 100 | nd | nd | - | 170 | nd | - | 170 | nd | - | nd | nd | - |
| Total PAHs | - | nd | nd | - | nd | nd | | nd | nd | | nd | nd | - |
| OCPs | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| PCBs | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - |
| *Data Quality Indicator* | | - | - | *<50%* | - | - | *<50%* | - | - | *<50%* | - | - | *<50%* |

See tables notes at end of section

**Table 8: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | TP01_0.1 | QS02 | **RPD** | TP37_0.5 | QS06 | **RPD** | Trip Blank | Trip Blank | Trip Spike | Trip Spike | Trip Spike | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Interlaboratory Dupliate* | *%* | *Primary* | *Interlaboratory Dupliate* | *%* | *Lab prep* | *Lab prep* | *Field* | *Lab* | *Recovery* | *Field* | *Lab* | *Recovery* |
| *Date* | - | 01/02/17 | 01/02/17 | - | 02/02/17 | 02/02/17 | - | *02/02/17* | *07/02/17* | *02/02/17* | - | - | *07/02/17* | - | - |
| *Media* | *Soil* | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | *Soil* | *Soil* | | *Soil* | *Soil* | |
| *Heavy metals* | | | | | | | | | | | | | | | |
| Arsenic | 5 | 6 | 7 | - | nd | nd | - | - | - | - | - | - | - | - | - |
| Cadmium | 1 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| Chromium | 2 | 21 | 23 | 9 | 6 | 7 | 15 | - | - | - | - | - | - | - | - |
| Copper | 5 | 18 | 19 | 5 | nd | 4 | - | - | - | - | - | - | - | - | - |
| Lead | 5 | 10 | 17 | **52** | 6 | 6 | 0 | - | - | - | - | - | - | - | - |
| Nickel | 2 | 8 | 11 | 32 | nd | 3 | - | - | - | - | - | - | - | - | - |
| Zinc | 5 | 40 | 50 | 22 | 9 | 14 | 43 | - | - | - | - | - | - | - | - |
| Mercury | *0.1* | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| *Organics* | | | | | | | | | | | | | | | |
| Benzene | 0.2 | nd | nd | - | nd | nd | - | nd | nd | nd | nd | - | nd | 0.4 | - |
| Toluene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 4.3 | 5 | 86 | 9.4 | 17.5 | **54** |
| Ethyl benzene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 0.8 | 0.9 | 89 | 1.6 | 2.3 | 70 |
| meta- & para-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 4.3 | 4.8 | 90 | 9.2 | 12.6 | 73 |
| ortho-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | 2 | 2.2 | 91 | 4 | 5.1 | 78 |
| TRHs C6 – C10 | 10 | nd | nd | - | nd | nd | - | nd | nd | 11.4 | 12.9 | 88 | 55 | 79 | 70 |
| TRHs >C10 - C16 | 50 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| TRHs >C16 - C34 | 100 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| TRHs >C34 - C40 | 100 | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| Total PAHs | - | nd | nd | | nd | nd | | | | | | | | | |
| OCPs | - | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| PCBs | - | nd | nd | - | nd | nd | - | - | - | - | - | - | - | - | - |
| *Data Quality Indicator* | | - | - | *<50%* | - | - | *<50%* | *nd* | *nd* | - | - | *70-130%* | - | - | *70-130%* |

**Table 8: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | BS100 | QS100 | **RPD** | BS100 | QS200 | **RPD** | ENM01 (C/D) | ENM100 | **RPD** | ENM01 (C/D) | ENM200 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Duplicate* | *%* | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | 23/08/17 | 23/08/17 | - | 23/08/17 | 23/08/17 | - | 23/08/17 | 23/08/17 | - | 23/08/17 | 23/08/17 | - | *23/08/17* | *23/08/17* | - | - |
| *Media* | | *Biosolids* | *Biosolids* | - | *Biosolids* | *Biosolids* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | - | *Soil* | *Soil* | *Soil* | |
| *Heavy metals* | | | | | | | | | | | | | | | | | |
| Arsenic | 5 | 9 | 10 | 11 | 9 | 8 | 12 | nd | - | - | nd | - | - | - | - | - | - |
| Cadmium | 1 | nd | nd | - | nd | nd | - | nd | - | - | nd | - | - | - | - | - | - |
| Chromium | 2 | 19 | 20 | 5 | 19 | 17 | 11 | 6 | - | - | 6 | - | - | - | - | - | - |
| Copper | 5 | 16 | 16 | 0 | 16 | 15 | 6 | 11 | - | - | 11 | - | - | - | - | - | - |
| Lead | 5 | 12 | 12 | 0 | 12 | 12 | 0 | 7 | - | - | 7 | - | - | - | - | - | - |
| Nickel | 5 | 17 | 15 | 13 | 17 | 15 | 13 | nd | - | - | nd | - | - | - | - | - | - |
| Zinc | 2 | 57 | 57 | 0 | 57 | 57 | 0 | 18 | - | - | 18 | - | - | - | - | - | - |
| Mercury | *0.1* | nd | nd | - | nd | nd | - | nd | - | - | nd | - | - | - | - | - | - |
| *Organics* | | | | | | | | | | | | | | | | | |
| Benzene | 0.2 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | nd | - |
| Toluene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | 7.5 | 13.2 | **57** |
| Ethyl benzene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | 0.8 | 1.7 | **47** |
| meta- & para-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | 5.4 | 8.6 | **63** |
| ortho-Xylene | 0.5 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | 1.9 | 3.5 | **54** |
| TRHs C6 – C10 | 10 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | nd | 31 | 39 | 79 |
| TRHs >C10 - C16 | 50 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | - | - | - | - |
| TRHs >C16 - C34 | 100 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | - | - | - | - |
| TRHs >C34 - C40 | 100 | nd | nd | - | nd | nd | - | nd | nd | - | nd | nd | - | - | - | - | - |
| Total PAHs | - | - | - | - | - | - | | nd | nd | - | nd | nd | - | - | - | - | - |
| OCPs | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PCBs | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *Data Quality Indicator* | | - | - | *<50%* | - | - | *<50%* | - | - | *<50%* | - | - | *<50%* | *nd* | - | - | *70-130%* |

See tables notes at end of section

**Soil Analytical Summary Table Notes**

LOR denotes limit of reporting (standard LOR unless otherwise shown)

PBILs denotes phytotoxicity based investigation levels

nd denotes not detected above the LOR

NL denotes non-limiting

- denotes not analysed/not available

**Bold** - Exceeds landuse criteria

^ denotes raised LOR

TRH C6-C10 F1 = TRH C6-C10 minus BTEX compounds

*analyte list shown on laboratory report

1. Methyl mercury / inorganic mercury
2. Netherlands protection of terrestrial organisms/ Netherlands human health based and human health and ecologically based protection level.
3. Criteria for phenol

**Soil Analytical Summary Table Notes**

Table notes:

* Reactivity recorded following addition of hydrogen peroxide, 1 = slight, 2 = moderate, 3 = strong, 4 = extreme

** Bulk density - WA DEC website values used in the absence of site-specific data.

**Bold** - Exceeds criteria

| Default bulk density values for soil types (to be used in the absence of site-specific data) | Natural (in-situ) bulk density (tonne/m3) |
|---|---|
| Sand | 1.6 |
| Loamy sand | 1.5 |
| Sandy loam | 1.4 |
| Loam | 1.3 |
| Silty loam | 1.2 |
| Clay loam | 1.1 |
| Clay | 1.05 |
| Peat | 1 |

Source: WA DEC website

http://www.der.wa.gov.au/your-environment/acid-sulfate-soils/67-lime-rate-calculations-for-neutralising-acid-sulfate-soils

**Table 9: Groundwater Analytical Summary, BTEXN, TRHs (ug/L)**

| Sample location | Date | Benzene | Toluene | Ethyl benzene | Xylenes | Naphthalene | C6 - C10 TRHs | F1 C6 - C10 TRHs | F2 >C10 - C16 TRHs | F3 >C16 - C34 TRHs | F4 >C34 - C40 TRHs | >C10 - C40 TRHs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *1* | *2* | *2* | *2* | *2* | *20* | *20* | *100* | *100* | *100* | *100* |
| *Analytical* | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 21/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| MW02 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 21/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| MW03 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 22/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria - Residential* | | | | | | | | | | | | |
| Health levels 2 m - < 4 m | | 800 | NL | NL | NL | NL | - | 1,000 | NL | NL | NL | NL |
| Marine water [1] | | 500 | - | - | - | 50 | - | - | - | - | - | - |
| Drinking water[2] | | 1 | 800 (25) | 300 (3) | 600 (20) | - | - | - | - | - | - | - |
| Recreational Criteria | | 10 | 8000 | 3000 | 6000 | - | - | - | - | - | - | - |

See tables notes at end of section

**Table 10: Groundwater Analytical Summary, PAHs (ug/L)**

| Sample | Depth (m) | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *0.5* | *1* | *1* | *1* | *0.5* | *0.5* |
| *Analytical* | | | | | | | | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | | | | |
| Samples analysed | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Detects | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % detect | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Maximum | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mean | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Median | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Minimum | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *Criteria* | | | | | | | | | | | | | | | | | | | |
| Marine water GILs | | 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Drinking Water | | - | - | - | - | - | - | - | - | - | - | - | - | 0.01 | - | - | - | - | - |
| Recreational Criteria | | - | - | - | - | - | - | - | - | - | - | - | - | 0.1 | - | - | - | - | - |

See table notes at end of section

**Table 11: Groundwater Analytical Summary, Metals (ug/L)**

| Sample | Depth (m) | pH | Aluminium | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Iron | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *pH units* | *10* | *1* | *0.1* | *1* | *1* | *1* | *1* | *10* | *5* | *50* | *0.1* |
| *Analytical* | | | | | | | | | | | | | |
| MW01 | 08/02/17 | 4.98 | **5,760** | **11** | **1.2** | 2 | **3** | 2 | **269** | nd | **734** | **214,000** | nd |
| | 21/08/17 | 5.19 | **1,890** | **3** | 0.4 | 1 | nd | nd | **121** | nd | **380** | **108,000** | nd |
| MW02 | 08/02/17 | 4.92 | **890** | **8** | **0.8** | nd | **2** | nd | **68** | nd | **367** | **31,700** | nd |
| | 21/08/17 | 5.16 | **2,850** | **3** | 0.4 | 1 | nd | nd | **100** | nd | **479** | **30,900** | nd |
| MW03 | 08/02/17 | 6.63 | **80** | **6** | nd | 2 | nd | nd | 3 | nd | **17** | **163,000** | nd |
| | 22/08/17 | 6.26 | **20** | 2 | nd | nd | nd | nd | 3 | nd | nd | **107,000** | nd |
| *Criteria* | | | | | | | | | | | | | |
| GILs - Drinking Water | | - | - | 10 | **2** | 50* | 2,000 | 10 | **20** | 10 | - | - | 1 |
| GILs - Marine water | | - | **0.5** | **2.3 / 4.5**** | **0.7** | 4.4 | **1.3** | 4.4 | **7** | 3 | **15** | **300***** | 0.1 |
| Recreational Criteria | | | **-** | 100 | 20 | 500 | 20,000 | 100 | 200 | 100 | **-** | **-** | 10 |

* - Chromium criteria as Cr(VI)

** - Arsenic criteria as As (III) / As (V)

*** - Canadian interim value

See table notes at end of section

**Table 12: Groundwater Analytical Summary, E.Coli, Biochemical Oxygen Demand and Nutrients (mg/L)**

| Sample location | Date | E.Coli (MPN/100) | Thermotolerant Faecal Coliforms | Biochemical Oxygen Demand | Nutrients: Ammonia | Nitrite | Nitrate | Nitrate + Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen | Total Phosphorus | Reactive Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | 2 (MPN/100) | 2 (TFC/100) | *2* | *0.01* | *0.01* | *0.01* | *0.01* | *0.1* | *0.1* | *0.01* | *0.01* |
| *Analytical* | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | - | 32 | **0.96** | 0.01 | 0.01 | 0.02 | 60 | 60 | 14.5 | nd |
| | 21/08/17 | - | nd | 11 | **1.92** | nd | nd | nd | 3.6 | 3.6 | 0.05 | nd |
| MW02 | 08/02/17 | 5 | - | nd | **1.79** | nd | 0.11 | 0.11 | 53.4 | 53.5 | 7.7 | nd |
| | 21/08/17 | - | nd | nd | **1.31** | nd | nd | nd | 2.6 | 2.6 | 0.02 | 0.02 |
| MW03 | 08/02/17 | 13 | - | 5 | **7.95** | 0.01 | nd | nd | 39.9 | 39.9 | 12.4 | nd |
| | 22/08/17 | - | nd | 9 | **1.76** | nd | nd | nd | 10 | 10 | 1 | nd |
| *Statistics* | | | | | | | | | | | | |
| Number of detects | | 2 | | 4 | 6 | 2 | 2 | 2 | 6 | 6 | 6 | 1 |
| Percentage non detect | | 33% | | 33% | 0% | 67% | 67% | 67% | 0% | 0% | 0% | 83% |
| Maximum | | 13 | | 32 | **7.95** | 0.01 | 0.11 | 0.11 | 60 | 60 | 14.5 | 0.02 |
| *Criteria* | | | | | | | | | | | | |
| GILs - Drinking Water | | - | | - | - | 3 | 13,000 | - | - | - | - | - |
| GILs - Marine water | | - | | - | **0.91** | - | 0.7 | - | - | - | - | - |
| Recreational Water | | 150/1000 | | - | - | - | 130,000 | - | - | - | - | - |

See tables notes at end of section

**Table 13: Groundwater Analytical Summary, Volatile Organic Compounds, Per- and Polyfluorinated Alkyl Substances (PFAS) ug/L**

| Sample | Date | Total Phenolic Compounds | Total PCBs | Total OCPs | Total OPPs | PFOS & PFHxS | PFOA |
|---|---|---|---|---|---|---|---|
| *LORs* | | - | - | - | - | *0.05* | 0.05 |
| *Analytical* | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | |
| GILs - Drinking Water | | - | - | - | - | - | - |
| GILs - Fresh water | | - | - | - | - | - | - |
| Department of Health (2017) Drinking Water | | - | - | - | - | 0.07 | 0.56 |
| Department of Health (2017) - Recreational Water | | - | - | - | - | 0.7 | 5.6 |

See table notes at end of section

For a complete VOC scan results, please refer to the laboratory report.

**Table 14: Groundwater Analytical Summary, Quality Control (ug/L)**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *08/02/17* | *08/02/17* | | *08/02/17* | | *08/02/17* | *08/02/17* | *08/02/17* | - |
| *Metals* | | | | | | | | | | |
| Aluminium | 10 | 5,760 | 5,710 | 1 | 6,000 | 5 | | | | |
| Arsenic | 1 | 11 | 10 | 10 | 10 | 10 | - | - | - | - |
| Cadmium | 0.1 | 1.2 | 1.6 | 29 | 1.7 | 6 | - | - | - | - |
| Chromium | 1 | 2 | 2 | 0 | 2 | 0 | - | - | - | - |
| Copper | 1 | 3 | 2 | 40 | 2 | 9 | - | - | - | - |
| Nickel | 1 | 269 | 266 | 1 | 210 | 32 | - | - | - | - |
| Lead | 1 | 2 | 2 | 0 | 2 | 0 | - | - | - | - |
| Selenium | 10 | nd | nd | - | nd | - | | | | |
| Zinc | 5 | 734 | 660 | 11 | 670 | 12 | - | - | - | - |
| Iron | 50 | 214,000 | 207,000 | 3 | 190,000 | 16 | | | | |
| Mercury | 0.1 | nd | nd | - | nd | - | - | - | - | - |
| *TRHs* | | | | | | | | | | |
| C6 - C10 Fraction minus BTEX (F1) | 20 | nd | nd | - | nd | - | nd | - | - | - |
| > C10 - C16 Fraction (F2) | 50 | nd | nd | - | nd | - | - | - | - | - |
| > C16 - C34 Fraction | 100 | nd | nd | - | nd | - | - | - | - | - |
| < C34 - C40 Fraction | 50 | nd | nd | - | nd | - | - | - | - | - |
| > C10 - C40 Fraction (sum) | 50 | nd | nd | - | nd | - | - | - | - | - |

**Table 14: Groundwater Analytical Summary, Quality Control (ug/L)**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *08/02/17* | *08/02/17* | | *08/02/17* | | *08/02/17* | *08/02/17* | *08/02/17* | - |
| *BTEXN* | | | | | | | | | | |
| Benzene | 1 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| Toluene | 2 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| Ethylbenzene | 2 | nd | nd | - | nd | - | nd | 15 | *20* | 75 |
| meta- & para-Xylene | 2 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| ortho-xylene | 2 | nd | nd | - | nd | - | nd | 17 | *20* | 85 |
| Naphthalene | 5 | nd | nd | - | nd | - | nd | - | - | - |
| Sum of PAHs | 2 | nd | nd | - | nd | - | nd | - | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | *<50%* | *nd* | - | - | *70-130%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Groundwater Analytical Summary, Quality Control (ug/L)**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | MW01 | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *21/08/17* | *21/08/17* | | *21/08/17* | *21/08/17* | | *21/08/17* | *21/08/17* | *21/08/17* | - |
| *Metals* | | | | | | | | | | | |
| Aluminium | 10 | 1,890 | 2,140 | 12 | 1,890 | 2000 | 7 | | | | |
| Arsenic | 1 | 3 | 3 | 0 | 3 | 4 | 38 | - | - | - | - |
| Cadmium | 0.1 | 0.4 | 0.4 | 0 | 0.4 | 0.5 | 29 | - | - | - | - |
| Chromium | 1 | 1 | 1 | 0 | 1 | 1 | 0 | - | - | - | - |
| Copper | 1 | nd | nd | - | nd | nd | - | - | - | - | - |
| Nickel | 1 | nd | nd | - | nd | 110 | - | - | - | - | - |
| Lead | 1 | 121 | 114 | 6 | 121 | nd | - | - | - | - | - |
| Selenium | 10 | nd | nd | - | nd | nd | - | | | | |
| Zinc | 5 | 380 | 368 | 3 | 380 | 350 | 10 | - | - | - | - |
| Iron | 50 | 108,000 | 107,000 | 1 | 108,000 | 120,000 | 14 | | | | |
| Mercury | 0.1 | nd | nd | - | nd | nd | - | - | - | - | - |
| *TRHs* | | | | | | | | | | | |
| C6 - C10 Fraction minus BTEX (F1) | 20 | nd | nd | - | nd | nd | - | nd | - | - | - |
| > C10 - C16 Fraction (F2) | 50 | nd | nd | - | nd | nd | - | - | - | - | - |
| > C16 - C34 Fraction | 100 | nd | nd | - | nd | nd | - | - | - | - | - |
| < C34 - C40 Fraction | 50 | nd | nd | - | nd | nd | - | - | - | - | - |
| > C10 - C40 Fraction (sum) | 50 | nd | nd | - | nd | nd | - | - | - | - | - |

**Table 14: Groundwater Analytical Summary, Quality Control (ug/L)**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | MW01 | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *21/08/17* | *21/08/17* | | *21/08/17* | *21/08/17* | | *21/08/17* | *21/08/17* | *21/08/17* | - |
| *BTEXN* | | | | | | | | | | | |
| Benzene | 1 | nd | nd | - | nd | nd | - | nd | 16 | *20* | 80 |
| Toluene | 2 | nd | nd | - | nd | nd | - | nd | 16 | *20* | 80 |
| Ethylbenzene | 2 | nd | nd | - | nd | nd | - | nd | 15 | *20* | 75 |
| meta- & para-Xylene | 2 | nd | nd | - | nd | nd | - | nd | 16 | *20* | 80 |
| ortho-xylene | 2 | nd | nd | - | nd | nd | - | nd | 17 | *20* | 85 |
| Naphthalene | 5 | nd | nd | - | nd | nd | - | nd | - | - | - |
| Sum of PAHs | 2 | nd | nd | - | nd | nd | - | nd | - | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | *<50%* | *nd* | - | - | *70-130%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

## Groundwater Analytical Summary Table Notes

LOR denotes limit of reporting (standard LOR unless otherwise shown)

nd denotes not detected above the LOR

**Bold** - Exceeds criteria

^ denotes LOR raised

- denotes not analysed/not available

* TPHs in waters used as screening analysis. If > LOR, check specific toxicants e.g. BTEX, PAHs, etc. For recreational waters/aesthetics, oil/petrol not to be noticeable as a visible film on the water or detectable by odour.

1. Aquatic ecosystem criteria from Australian New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, including Table 3.4.1 and Section 8.3.7.

DECCW/DERM specify that the 95% species protection levels are to be applied for slightly to moderately-disturbed ecosystems (most urban catchments) and the 99% species protection levels for pristine or vulnerable ecosystems or where the contaminants are intractable (e.g. bioaccumulative).

2. Drinking water criteria from National Health and Medical Research Council (NHMRC) & Natural Resource Management Ministerial Council (NRMMC) (2011) *Australian Drinking Water Guidelines*.

The guideline values are health related and are described as the concentration that does not result in any significant risk to the health of the consumer over a lifetime of consumption. Numbers in brackets are aesthetic values, e.g. appearance, taste and/or odour. The guideline values relate to the quality of water at the point of use, e.g. kitchen or bathroom tap.

While exposure is predominately through ingestion, skin adsorption and/or inhalation are considered in calculating the guideline value (Page 6-7, NHMRC/NRMMC 2004). However, this only addresses consumption/use of drinking water, it does not address inhalation from subsurface, and drinking water criteria should not be used as risk assessment screening values for onsite contaminant concentrations.

# APPENDIX C

Geo-Logix

## Waste Management Audit – Townsend Sewage Treatment Plan, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463

| Waste Type | Description | Volume | Waste Report | Waste Class | Disposal Location | Relevant EP Licence | Disposal Evidence |
|---|---|---|---|---|---|---|---|
| ACM | Over-flow pipework and baffles associated with the former Townsend STP | 1.46 tonnes | N/A | Asbestos | Grafton Regional Landfill, Clarence Valley Council, 704 Armidale Road, South Grafton | Yes ☒ [Comment if no] | Dockets 11 May 2018 and 19 Jun 2018 |
| Asbestos contaminated soil | Asbestos Waste Stockpile | 627.70 tonnes | Cavvanba (2018) Waste Classification, asbestos contaminated material, Corner of Schwonberg and Goodwood Streets, Townsend NSW. Ref: 16026 TE L02 | Special Restricted Waste (asbestos) | Ti Tree Bioenergy Facility, Veolia Environmental Services (Australia) Pty Ltd, 55 Champions Way, Willowbank, QLD | Yes ☒ [Comment if no] | Dockets for disposal provided totaling 627.70 t |
| Biosolids | Biosolids removed from base of oxidation and maturation ponds | 5333.25 tonnes | Cavvanba (2018) Waste Classification, biosolids stockpile, Former Townsend STP, Corner Schwonberg and Goodwood Streets, Townsend NSW. Ref: 16026.3 TE L01 | Approved by NSW EPA | Ti Tree Bioenergy Facility, Veolia Environmental Services (Australia) Pty Ltd, 55 Champions Way, Willowbank, QLD | Yes ☐ Classification approved by NSW EPA | Dockets for disposal provided totaling 5333.25 t |
| Pond water discharges | Water from the former STP ponds to be discharged as part for the surrender of Environmental | ? | N/A | Pond water was tested on 22 August 2016 for Oil and Grease, TDS and BOD. Results conservatively compared to criteria | Pond water was pumped and discharged into adjacent drainage channel to the south of site | Yes ☒ Volume limited to 33,000L a day under EPL. | Discharge logs kept.. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Protection License (EPL) for the site. | | | in Maclean STP EPL License 1660.<br>Water quality parameters monitored during discharge. Exceedances discussed in Section 6.3.4, not considered significant. | | | |

## References

Section 4.3.7, *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme,* 3rd Edition

*Waste Classification Guidelines – Part 1: Classifying Waste* (EPA 2014).

*Validation Report – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, June 2019 (Ref#16026 TE R08 V3)*

# APPENDIX D

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | Date sampled | Description | 8 metals (Neutral Leach, TCLP) | Selenium | OCPs | PFAS | PFAS (TOPA) | PCBs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | pH | Net acidity (%S) | Net acidity (acidity units) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Analytical soil - Validation grid* | | | | | | | | | | | | | | | | |
| VS01 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS02 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS03 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS04 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS05 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS06 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS07 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS08 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS09 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS10 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS11 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS12 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS13 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS14 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS15 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS16 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| VS17 | 0.1 | 31/01/19 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | • | | | |
| *Analytical soil - Acid Sulfate Soils (former pond walls)* | | | | | | | | | | | | | | | | |
| AS01 | 0.1 | 12/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS02 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS03 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS04 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS05 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS06 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS07 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS08 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS09 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS10 | 0.1 | 24/07/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS06A | 0.1 | 10/09/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS07A | 0.1 | 10/09/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS08A | 0.1 | 10/09/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS09A | 0.1 | 10/09/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| AS10A | 0.1 | 10/09/18 | Fill: Sandy clayey silt. Red, brown and grey mottled. Low plasticity. Dry | | | | | | | | | | | • | • | • |
| *Analytical soil - Woodford Island ENM - Round 1* | | | | | | | | | | | | | | | | |
| ASENM01 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM02 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM03 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM04 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM05 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM06 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM07 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM08 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM09 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM10 | 0.1 | 18/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| *Analytical soil - Woodford Island ENM - Round 2* | | | | | | | | | | | | | | | | |
| ASENM11 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM12 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM13 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM14 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM15 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM16 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM17 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM18 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM19 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM20 | 0.1 | 28/09/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| *Analytical soil - Woodford Island ENM - Round 3* | | | | | | | | | | | | | | | | |

**Table 1: Sample Description and Analytical Summary**

| Sample | Depth (m) | Date sampled | Description | 8 metals (Neutral Leach, TCLP) | Selenium | OCPs | PFAS | PFAS (TOPA) | PCBs | TRHs (silica gel cleanup) | BTEXN | PAHs | 8 metals | pH | Net acidity (%S) | Net acidity (acidity units) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASENM21 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM22 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM23 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM24 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM25 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM26 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM27 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM28 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| ASENM29 | 0.1 | 25/10/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| *Analytical soil - Woodford Island ENM - Round 4* | | | | | | | | | | | | | | | | |
| ASENM30A | 0.1 | 13/11/2018 | Fill: Silty sand. Red to brown. Loose and dry. | | | | | | | | | | | • | • | • |
| *Analytical biosolids* | | | | | | | | | | | | | | | | |
| BS01 | - | 15/02/2017 | Black Silt | | | • | | | • | | | | • | | | |
| BS02 | - | 15/02/2017 | Black Silt | | | • | | | • | | | | • | | | |
| BS03 | - | 15/02/2017 | Black Silt | | | • | | | • | | | | • | | | |
| BS04 | - | 15/02/2017 | Black Silt | | | • | | | • | | | | • | | | |
| BS05 | - | 15/02/2017 | Black Silt | | | • | | | • | | | | • | | | |
| BS100 | - | 23/08/2017 | Black Silt | • | • | • | • | | • | • | • | | • | | | |
| BS101 | - | 23/08/2017 | Black Silt | • | • | • | • | | • | • | • | | • | | | |
| BS102 | - | 23/08/2017 | Black Silt | • | • | • | • | | • | • | • | | • | | | |
| BS200 | - | 2/05/2018 | Black Silt | | | • | | • | • | | | | • | | | |
| BS201 | - | 2/05/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS202 | - | 6/06/2018 | Black Silt | | | • | | • | • | | | | • | | | |
| BS203 | - | 6/06/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS204 | - | 6/06/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS205 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS206 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS207 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS208 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS209 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS210 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS211 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS212 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS213 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS214 | - | 24/07/2018 | Black Silt | | | • | | | • | | | | • | | | |
| BS215 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS216 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS217 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS218 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS219 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS220 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS221 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS222 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS223 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS224 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS225 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS226 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS227 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |
| BS228 | - | 28/09/2018 | Black Silt | | | | | • | | | | | | | | |

**Table 2: Soil and Biosolids Analytical Summary, Metals**

| Sample | Depth (m) | Date | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| *Analytical soil - Validation Grid* | | | | | | | | | | | |
| VS01 | 0.1 | 31/01/19 | nd | nd | 10 | 5 | 8 | 4 | - | 21 | nd |
| VS02 | 0.1 | 31/01/19 | nd | nd | 9 | nd | 10 | nd | - | 9 | nd |
| VS03 | 0.1 | 31/01/19 | 12 | nd | 7 | 7 | 17 | 2 | - | 26 | nd |
| VS04 | 0.1 | 31/01/19 | nd | nd | 9 | 5 | 10 | 3 | - | 14 | nd |
| VS05 | 0.1 | 31/01/19 | nd | nd | 8 | nd | 9 | nd | - | 10 | nd |
| VS06 | 0.1 | 31/01/19 | nd | nd | 5 | nd | 6 | nd | - | nd | nd |
| VS07 | 0.1 | 31/01/19 | nd | nd | 8 | nd | 6 | 3 | - | 12 | nd |
| VS08 | 0.1 | 31/01/19 | 8 | nd | 9 | nd | 14 | nd | - | 12 | nd |
| VS09 | 0.1 | 31/01/19 | 7 | nd | 24 | 20 | 19 | 11 | - | 56 | nd |
| VS10 | 0.1 | 31/01/19 | nd | nd | 14 | 10 | 12 | 6 | - | 26 | nd |
| VS11 | 0.1 | 31/01/19 | 6 | nd | 8 | 14 | 41 | 3 | - | 53 | nd |
| VS12 | 0.1 | 31/01/19 | nd | nd | 7 | 6 | 14 | nd | - | 23 | nd |
| VS13 | 0.1 | 31/01/19 | nd | nd | 6 | nd | 7 | nd | - | 8 | nd |
| VS14 | 0.1 | 31/01/19 | nd | nd | 9 | 10 | 29 | 3 | - | 36 | nd |
| VS15 | 0.1 | 31/01/19 | 8 | nd | 6 | nd | 9 | nd | - | 6 | nd |
| VS16 | 0.1 | 31/01/19 | nd | nd | 26 | 19 | 23 | 13 | - | 54 | nd |
| VS17 | 0.1 | 31/01/19 | nd | nd | 24 | 18 | 16 | 13 | - | 56 | nd |
| *Statistics* | | | | | | | | | | | |
| Samples analysed | | | 17 | 17 | 17 | 17 | 17 | 17 | 0 | 17 | 17 |
| Number of detects | | | 5 | 0 | 17 | 10 | 17 | 10 | - | 16 | 0 |
| % detect | | | 29% | 0% | 100% | 59% | 100% | 59% | - | 94% | 0% |
| Maximum | | | 12 | <1 | 26 | 20 | 41 | 13 | - | 56 | <0.1 |
| Mean | | | 2.41 | <1 | 11.12 | 6.71 | 14.71 | 3.59 | - | 24.82 | <0.1 |
| *Criteria* | | | | | | | | | | | |
| HILs - Residential A | | | 100 | 20 | 100 | 6,000 | 300 | 400 | - | 7,400 | 40 |
| EILs - Urban residential and public open space (aged) | | | 100 | - | 410 | 90 | 1,100 | 200 | - | 230 | - |

**Table 2: Soil and Biosolids Analytical Summary, Metals**

| Sample | Depth (m) | Date | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | | *5* | *1* | *2* | *5* | *5* | *2* | *5* | *5* | *0.1* |
| *Analytical - Biosolids* | | | | | | | | | | | |
| BS01 | - | 15/02/17 | 5 | nd | 24 | 23 | 16 | 16 | nd | 61 | nd |
| BS02 | - | 15/02/17 | 7 | nd | 24 | 21 | 17 | 17 | nd | 61 | nd |
| BS03 | - | 15/02/17 | 14 | nd | 21 | 30 | 15 | 25 | nd | 113 | nd |
| BS04 | - | 15/02/17 | 8 | nd | 21 | 29 | 16 | 23 | nd | 96 | nd |
| BS05 | - | 15/02/17 | 9 | nd | 18 | 82 | 21 | 24 | nd | 130 | 0.1 |
| BS100 | - | 23/08/17 | 9 | nd | 19 | 16 | 12 | 17 | nd | 57 | nd |
| BS101 | - | 23/08/17 | 8 | nd | 17 | 15 | 10 | 29 | nd | 76 | nd |
| BS102 | - | 23/08/17 | nd | nd | 14 | 14 | 9 | 5 | nd | 21 | nd |
| BS200 | - | 2/05/18 | 6 | nd | 24 | **135** | 18 | 14 | nd | 96 | nd |
| BS201 | - | 2/05/18 | 7 | nd | 24 | **130** | 19 | 18 | nd | 124 | nd |
| BS202 | - | 6/06/18 | 8 | nd | 22 | **333** | 28 | 20 | nd | **341** | 0.2 |
| BS203 | - | 6/06/18 | 9 | nd | 22 | **298** | 26 | 20 | nd | **298** | 0.2 |
| BS204 | - | 6/06/18 | 10 | nd | 24 | **285** | 26 | 23 | nd | **308** | 0.2 |
| BS205 | - | 24/07/18 | 8 | nd | 20 | **405** | 31 | 18 | nd | **358** | 0.2 |
| BS206 | - | 24/07/18 | 8 | nd | 18 | **186** | 22 | 18 | nd | **241** | 0.1 |
| BS207 | - | 24/07/18 | 6 | nd | 12 | 22 | 11 | 8 | nd | 47 | nd |
| BS208 | - | 24/07/18 | 6 | nd | 15 | 21 | 11 | 11 | nd | 54 | nd |
| BS209 | - | 24/07/18 | 8 | nd | 16 | 29 | 13 | 12 | nd | 66 | nd |
| BS210 | - | 24/07/18 | 7 | nd | 15 | 19 | 12 | 11 | nd | 54 | nd |
| BS211 | - | 24/07/18 | 9 | nd | 21 | 31 | 16 | 15 | nd | 76 | nd |
| BS212 | - | 24/07/18 | 7 | nd | 21 | 74 | 18 | 16 | nd | 111 | nd |
| BS213 | - | 24/07/18 | 8 | nd | 18 | 66 | 16 | 15 | nd | 98 | nd |
| BS214 | - | 24/07/18 | 8 | nd | 21 | **166** | 23 | 17 | nd | 186 | 0.1 |
| *Biosolid Statistics* | | | | | | | | | | | |
| Samples analysed | | | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| Number of detects | | | 22 | 0 | 23 | 23 | 23 | 23 | 0 | 23 | 4 |
| % detect | | | 96% | 0% | 100% | 100% | 100% | 100% | 0% | 100% | 17% |
| Maximum | | | 14 | <1 | 24 | **405** | 31 | 29 | <5 | **358** | 0.2 |
| Mean | | | 10 | <1 | 23 | 125 | 21 | 20 | <5 | 151 | 1 |
| *Criteria* | | | | | | | | | | | |
| Biosolids - Grade A | | | 20 | 3 | 100 | **100** | 150 | 60 | 5 | **200** | 1 |

See table notes at end of section

**Table 3: Biosolids Analytical Summary, Neautral Leach and TCLP Metals, Benzo(a)pyrene and PFAS (Ug/L)**

| Sample | Depth (m) | Date | ASLP (Neutral Leach) | | | | | | | | | | TCLP | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Zinc | Mercury | PFOS & PFHxS (TOPA) (ug/L) | PFOA (TOPA) (ug/L) | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Zinc | Mercury |
| *LORs* | | | *0.001* | *0.0001* | *0.001* | *0.001* | *0.001* | *0.001* | *0.005* | *0.0001* | *0.01* | *0.01* | *0.1* | *0.05* | *0.1* | *0.1* | *0.1* | *0.1* | *0.1* | *0.001* |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | | | | | | |
| BS100 | - | 23/08/17 | 0.007 | 0.0004 | 0.008 | 0.018 | 0.003 | 0.006 | 0.377 | nd | - | - | nd | nd | nd | nd | nd | nd | 0.2 | nd |
| BS101 | - | 23/08/17 | 0.005 | 0.0003 | 0.01 | 0.012 | 0.003 | 0.01 | 0.456 | nd | - | - | nd | nd | nd | nd | nd | nd | 0.2 | nd |
| BS102 | - | 23/08/17 | 0.009 | 0.0004 | 0.013 | 0.012 | 0.009 | 0.005 | 0.628 | nd | - | - | nd | nd | nd | nd | nd | nd | 0.2 | nd |
| BS200 | - | 02/05/18 | - | - | - | - | - | - | - | - | nd | nd | - | - | - | - | - | - | - | - |
| BS202 | - | 06/06/18 | - | - | - | - | - | - | - | - | 0.02 | 0.05 | - | - | - | - | - | - | - | - |
| *Criteria* | | | | | | | | | | | | | | | | | | | | |
| Biosolids - Grade A | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

See table notes at end of section

**Table 4: Biosolids Analytical Summary, BTEXN and TRHs (mg/kg)**

| Sample | Depth (m) | Date sampled | BTEXN | | | | | | TRH | | | | TRH Silica Gel Cleanup | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benzene | Toluene | Ethyl benzene | meta- & para-Xylenes | ortho-Xylene | Naphthalene | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 | F1 TRHs C6 - C10 | F2 TRHs >C10 - C16 | F3 TRHs >C16 - C34 | F4 TRHs >C34 - C40 |
| *LORs* | | | *0.2* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *10* | *50* | *100* | *100* | *10* | *50* | *100* | *100* |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | | |
| BS100 | - | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| BS101 | - | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| BS102 | - | 23/08/2017 | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | |
| Samples analysed | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | 3 | 3 | 3 |
| Detects | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | - | - | 0 | 0 | 0 |
| % detect | | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | - | - | - | - | 0% | 0% | 0% |
| Maximum | | | <0.2 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <10 | - | - | - | - | <50 | <100 | <100 |
| Mean | | | <0.2 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <10 | - | - | - | - | <50 | <100 | <100 |
| Median | | | <0.2 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <10 | - | - | - | - | <50 | <100 | <100 |
| Minimum | | | <0.2 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <10 | - | - | - | - | <50 | <100 | <100 |
| *Criteria - residential landuse with sandy soils* | | | | | | | | | | | | | | | | |
| Health levels 0m to <1m | | | 0.5 | 160 | 55 | 40 | | 3 | 45 | 110 | no limit | no limit | 45 | 110 | no limit | no limit |
| Health levels 1m to <2m | | | 0.5 | 220 | no limit | 60 | | no limit | 70 | 240 | no limit | no limit | 70 | 240 | no limit | no limit |
| Health levels 2m to <4m | | | 0.5 | 310 | no limit | 96 | | no limit | 110 | 440 | no limit | no limit | 110 | 440 | no limit | no limit |
| Health levels 4m+ | | | 0.5 | 540 | no limit | 170 | | no limit | 200 | no limit | no limit | no limit | 200 | no limit | no limit | no limit |
| Health investigation level | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Ecological levels | | | 50 | 85 | 70 | 105 | | 170 | 180 | 120 | 300 | 2,800 | 180 | 120 | 300 | 2,800 |
| Management limits | | | - | - | - | - | | - | - | 1,000 | 3,500 | 10,000 | - | 1,000 | 3,500 | 10,000 |
| Direct Contact Criteria | | | 430 | 99,000 | 27,000 | 81,000 | | - | 26,000 | 20,000 | 27,000 | 38,000 | 26,000 | 20,000 | 27,000 | 38,000 |

See table notes at end of section

**Table 5: Biosolids Analytical Summary, OCPs, PCBs and PFAS (mg/kg)**

| Sample | Date sampled | Heptachlor | Total Chlordane (sum) | Endrin | Endosulfan (sum) | Methoxychlor | Sum of Aldrin + Dieldrin | Sum of DDD + DDE + DDT | Hexachlorobenzene (HCB) | Lindane | BHC | PCBs | PFOS & PFHxS | PFOA | PFOS & PFHxS (TOPA) | PFOA (TOPA) | *Sum of TOP C4 - C14 Carboxylates and C4 - C8 Sulfonates |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2 / 0.02* | *0.1 / 0.02* | *0.05* | *0.05* | *0.2* | *0.05 / 0.02* | *0.05* | *0.02* | *0.02* | *0.02* | *0.1* | *0.0002* | *0.0002* | *0.0002* | *0.0002* | *0.0002* |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | | | |
| BS01 | 15/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS02 | 15/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS03 | 15/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS04 | 15/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS05 | 15/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS100 | 23/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - |
| BS101 | 23/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - |
| BS102 | 23/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - |
| BS200 | 2/05/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | 0.0002 | 0.0015 | - |
| BS201 | 2/05/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS202 | 6/06/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | 0.0013 | 0.0057 | - |
| BS203 | 6/06/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS204 | 6/06/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS205 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS206 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS207 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS208 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS209 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS210 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS211 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS212 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS213 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS214 | 24/07/18 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | - | - | - | - | - |
| BS215 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0011 | nd | 0.0011 |
| BS216 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.001 | 0.004 | 0.007 |
| BS217 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0007 | 0.0037 | 0.0059 |
| BS218 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0006 | 0.0022 | 0.0039 |
| BS219 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0014 | 0.0015 | 0.0036 |
| BS220 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0015 | 0.0031 | 0.0061 |
| BS221 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.001 | 0.0031 | 0.0058 |
| BS222 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0011 | 0.0018 | 0.0052 |
| BS223 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0006 | 0.0018 | 0.0033 |

**Table 5: Biosolids Analytical Summary, OCPs, PCBs and PFAS (mg/kg)**

| Sample | Date sampled | Heptachlor | Total Chlordane (sum) | Endrin | Endosulfan (sum) | Methoxychlor | Sum of Aldrin + Dieldrin | Sum of DDD + DDE + DDT | Hexachlorobenzene (HCB) | Lindane | BHC | PCBs | PFOS & PFHxS | PFOA | PFOS & PFHxS (TOPA) | PFOA (TOPA) | *Sum of TOP C4 - C14 Carboxylates and C4 - C8 Sulfonates |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *0.2 / 0.02* | *0.1 / 0.02* | *0.05* | *0.05* | *0.2* | *0.05 / 0.02* | *0.05* | *0.02* | *0.02* | *0.02* | *0.1* | *0.0002* | *0.0002* | *0.0002* | *0.0002* | *0.0002* |
| *Analytical - Biosolids* | | | | | | | | | | | | | | | | | |
| BS224 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0006 | 0.001 | 0.0021 |
| BS225 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | nd | nd | nd |
| BS226 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | nd | nd | nd |
| BS227 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | nd | 0.0002 | 0.0008 |
| BS228 | 28/09/18 | - | - | - | - | - | - | - | - | - | - | - | - | - | nd | 0.0002 | 0.0002 |
| *Biosolid Statistics* | | | | | | | | | | | | | | | | | |
| Samples analysed | | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 3 | 3 | 16 | 16 | 14 |
| Number of detects | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 13 | 12 |
| % detect | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 88% | 81% | 86% |
| Maximum | | <0.02 | <0.02 | <0.05 | <0.05 | <0.2 | <0.02 | <0.05 | <0.02 | <0.02 | <0.02 | <0.1 | <0.0002 | <0.0002 | 0.0015 | 0.0057 | 0.007 |
| Mean | | <0.02 | <0.02 | <0.05 | <0.05 | <0.2 | <0.02 | <0.05 | <0.02 | <0.02 | <0.02 | <0.1 | <0.0002 | <0.0002 | 0.00069 | 0.00186 | 0.00321 |
| *Criteria* | | | | | | | | | | | | | | | | | |
| Biosolids - Grade A | | 0.02 | 0.02 | - | - | - | 0.02 / 0.02 | 0.5 | 0.02 | 0.02 | 0.02 | 0.3 | - | - | - | - | - |

See table notes at end of section

**Table 6: Soil analytical summary, pH(F) and net acidity**

| Sample | Depth (m) | Date sampled | pH(F) | Net acidity (%S) | Net acidity (acidity units) |
|---|---|---|---|---|---|
| *LORs* | | | *0.1* | *0.02* | *10* |
| *Analytical - Soil Treatment Event 1* | | | | | |
| AS01 | 0.1 | 12/07/2018 | 8.68 | - | -3096 |
| AS02 | 0.1 | 24/07/2018 | 6.7 | 0.01 | 7 |
| AS03 | 0.1 | 24/07/2018 | 7.9 | -0.47 | -294 |
| AS04 | 0.1 | 24/07/2018 | 8 | -0.26 | -163 |
| AS05 | 0.1 | 24/07/2018 | 6.1 | 0.03 | 17 |
| AS06 | 0.1 | 24/07/2018 | **4.6** | **0.04** | **25** |
| AS07 | 0.1 | 24/07/2018 | **4.6** | **0.07** | **46** |
| AS08 | 0.1 | 24/07/2018 | 3.9 | **0.21** | **134** |
| AS09 | 0.1 | 24/07/2018 | **4.7** | **0.06** | **38** |
| AS10 | 0.1 | 24/07/2018 | 4.1 | **0.14** | **89** |
| *Analytical - Soil Treatment Event 2* | | | | | |
| AS01 | 0.1 | 24/07/2018 | 8.68 | -4.95 | -3096 |
| AS02 | 0.1 | 24/07/2018 | 6.7 | 0.01 | 7 |
| AS03 | 0.1 | 24/07/2018 | 7.9 | -0.47 | -294 |
| AS04 | 0.1 | 24/07/2018 | 8 | -0.26 | -163 |
| AS05 | 0.1 | 24/07/2018 | 6.1 | 0.03 | 17 |
| AS06A | 0.1 | 10/09/2018 | 4.7 | 0.05 | 30 |
| AS07A | 0.1 | 10/09/2018 | 4.7 | **0.07** | **43** |
| AS08A | 0.1 | 10/09/2018 | 8.4 | -0.93 | -581 |
| AS09A | 0.1 | 10/09/2018 | 4.7 | **0.06** | **40** |
| AS10A | 0.1 | 10/09/2018 | 5.8 | 0.04 | 23 |
| *Statistics* | | | | | |
| Mean | | | 6.6 | -0.6 | -397.4 |
| 95% UCL | | | 7.49 | -0.15 | -92.20 |
| *Criteria* | | | | | |
| Criteria (medium texture, less than 1,000 tonnes) | | | > 5.5 | <0.06 | <36 |

**Table 6: Soil analytical summary, pH(F) and net acidity**

| Sample | Depth (m) | Date sampled | pH(F) | Net acidity (%S) | Net acidity (acidity units) |
|---|---|---|---|---|---|
| *LORs* | | | *0.1* | *0.02* | *10* |
| *Analytical - Soil Woodford Island ENM - Round 1* | | | | | |
| ASENM01 | 0.1 | 18/09/2018 | 8.2 | -0.38 | -239 |
| ASENM02 | 0.1 | 18/09/2018 | 8.3 | -0.26 | -162 |
| ASENM03 | 0.1 | 18/09/2018 | 8.3 | -0.32 | -200 |
| ASENM04 | 0.1 | 18/09/2018 | 8.2 | -0.37 | -232 |
| ASENM05 | 0.1 | 18/09/2018 | 8.3 | -0.5 | -311 |
| ASENM06 | 0.1 | 18/09/2018 | 8.2 | -0.21 | -130 |
| ASENM07 | 0.1 | 18/09/2018 | 8.4 | -0.46 | -286 |
| ASENM08 | 0.1 | 18/09/2018 | 8.4 | -0.29 | -181 |
| ASENM09 | 0.1 | 18/09/2018 | 8.4 | -0.49 | -305 |
| ASENM10 | 0.1 | 18/09/2018 | 8.2 | -0.31 | -193 |
| *Analytical - Soil Woodford Island ENM - Round 2* | | | | | |
| ASENM11 | 0.1 | 28/09/2018 | 8.4 | -0.32 | -201 |
| ASENM12 | 0.1 | 28/09/2018 | 8.2 | -0.17 | -109 |
| ASENM13 | 0.1 | 28/09/2018 | 8.1 | -0.14 | -87 |
| ASENM14 | 0.1 | 28/09/2018 | 7.2 | nd | nd |
| ASENM15 | 0.1 | 28/09/2018 | 8.2 | -0.46 | -289 |
| ASENM16 | 0.1 | 28/09/2018 | 8.3 | -0.21 | -131 |
| ASENM17 | 0.1 | 28/09/2018 | 8 | -0.11 | -69 |
| ASENM18 | 0.1 | 28/09/2018 | 6.8 | nd | nd |
| ASENM19 | 0.1 | 28/09/2018 | 8.1 | -0.17 | -106 |
| ASENM20 | 0.1 | 28/09/2018 | 8 | -0.15 | -94 |
| *Analytical - Soil Woodford Island ENM - Round 3* | | | | | |
| ASENM21 | 0.1 | 25/10/2018 | 8.1 | -0.15 | -95.57 |
| ASENM22 | 0.1 | 25/10/2018 | 8.3 | -0.23 | -144.53 |
| ASENM23 | 0.1 | 25/10/2018 | 6.9 | 0 | 1.67 |
| ASENM24 | 0.1 | 25/10/2018 | 8.3 | -0.24 | -147.87 |
| ASENM25 | 0.1 | 25/10/2018 | 8.4 | -0.32 | -196.87 |
| ASENM26 | 0.1 | 25/10/2018 | 8.4 | -0.4 | -250 |
| ASENM27 | 0.1 | 25/10/2018 | 6.8 | -0.07 | -45.73 |
| ASENM28 | 0.1 | 25/10/2018 | 8.2 | -0.18 | -109.4 |
| ASENM29 | 0.1 | 25/10/2018 | 8 | -0.45 | -278.83 |
| *Analytical - Soil Woodford Island ENM - Round 4* | | | | | |
| ASENM30A | 0.1 | 13/11/2018 | 8.4 | -0.32 | -199 |
| *Statistics* | | | | | |
| Mean | | | 6.6 | -0.6 | -397.4 |
| 95% UCL | | | 7.5 | -0.15 | -92 |
| *Criteria* | | | | | |
| Criteria outlined in Woodford Island ASSMP (Cavvanba, 2018) | | | 5.5 - 8.5 | <0.03 | <18 |

**Table 7: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | BS100 | QS100 | **RPD** | BS100 | QS200 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | % | *Primary* | *Duplicate* | % |
| *Date* | | 23/08/17 | 23/08/17 | - | 23/08/17 | 23/08/17 | - |
| *Media* | | *Biosolids* | *Biosolids* | - | *Biosolids* | *Biosolids* | - |
| *Heavy metals* | | | | | | | |
| Arsenic | 5 | 9 | 10 | 11 | 9 | 8 | 12 |
| Cadmium | 1 | nd | nd | - | nd | nd | - |
| Chromium | 2 | 19 | 20 | 5 | 19 | 17 | 11 |
| Copper | 5 | 16 | 16 | 0 | 16 | 15 | 6 |
| Lead | 5 | 12 | 12 | 0 | 12 | 12 | 0 |
| Nickel | 5 | 17 | 15 | 13 | 17 | 15 | 13 |
| Zinc | 2 | 57 | 57 | 0 | 57 | 57 | 0 |
| Mercury | *0.1* | nd | nd | - | nd | nd | - |
| *Organics* | | | | | | | |
| Benzene | 0.2 | nd | nd | - | nd | nd | **-** |
| Toluene | 0.5 | nd | nd | - | nd | nd | **-** |
| Ethyl benzene | 0.5 | nd | nd | - | nd | nd | **-** |
| meta- & para-Xylene | 0.5 | nd | nd | - | nd | nd | **-** |
| ortho-Xylene | 0.5 | nd | nd | - | nd | nd | **-** |
| TRHs C6 – C10 | 10 | nd | nd | - | nd | nd | **-** |
| TRHs >C10 - C16 | 50 | nd | nd | - | nd | nd | **-** |
| TRHs >C16 - C34 | 100 | nd | nd | - | nd | nd | - |
| TRHs >C34 - C40 | 100 | nd | nd | - | nd | nd | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | *<50%* |

See tables notes at end of section

**Table 7: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | BS225 | QC300 | **RPD** | BS100 | QS400 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Inter-laboratory Duplicate* | *%* |
| *Date* | | 28/09/18 | 28/09/18 | - | 28/09/18 | 28/09/18 | - |
| *Media* | | *Biosolids* | *Biosolids* | - | *Biosolids* | *Biosolids* | - |
| *PFAS Sums* | | | | | | | |
| Sum of PFAS | 0.0002 | nd | nd | - | nd | nd | - |
| Sum of PFHxS and PFOS | 0.0002 | nd | nd | - | nd | 0.0002 | - |
| Sum of TOP C4 - C14 Carboxylates and C4 - C8 Sulfonates | 0.0002 | nd | nd | - | nd | nd | - |
| Sum of TOP C4 - C14 as Fluorine | 0.0002 | nd | nd | - | nd | nd | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | *<50%* |

See tables notes at end of section

**Table 7: Soil Analytical Summary, Quality Control (mg/kg)**

| Analyte | LOR mg/kg | VS10 | QS01 | **RPD** | VS10 | QS02 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlaboratory Duplicate* | *%* |
| *Date* | - | 31/01/19 | 31/01/19 | - | 31/01/19 | 31/01/19 | - |
| *Media* | *Soil* | *Soil* | *Soil* | - | *Soil* | *Soil* | - |
| *Heavy metals* | | | | | | | |
| Arsenic | *5* | nd | nd | - | nd | 4 | - |
| Cadmium | *1* | nd | nd | - | nd | nd | - |
| Chromium | *2* | 14 | 12 | 15 | 14 | 12 | 15 |
| Copper | *5* | 10 | 8 | 22 | 10 | 8 | 22 |
| Lead | *5* | 12 | 10 | 18 | 12 | 11 | 9 |
| Nickel | *2* | 6 | 4 | 40 | 6 | 5 | 18 |
| Zinc | *5* | 26 | 24 | 8 | 26 | 20 | 26 |
| Mercury | *0.1* | nd | nd | - | nd | nd | - |
| *Data Quality Indicator* | | - | - | *<50%* | - | - | *<50%* |

See tables notes at end of section

## Soil Analytical Summary Table Notes

LOR denotes limit of reporting (standard LOR unless otherwise shown)

PBILs denotes phytotoxicity based investigation levels

nd denotes not detected above the LOR

NL denotes non-limiting

- denotes not analysed/not available

**Bold** - Exceeds landuse criteria

^ denotes raised LOR

TRH C6-C10 F1 = TRH C6-C10 minus BTEX compounds

*analyte list shown on laboratory report

1. Methyl mercury / inorganic mercury
2. Netherlands protection of terrestrial organisms/ Netherlands human health based and human health and ecologically based protection level.
3. Criteria for phenol

**Table 9: Groundwater Analytical Summary, BTEXN, TRHs (ug/L)**

| Sample location | Date | Benzene | Toluene | Ethyl benzene | Xylenes | Naphthalene | C6 - C10 TRHs | F1 C6 - C10 TRHs | F2 >C10 - C16 TRHs | F3 >C16 - C34 TRHs | F4 >C34 - C40 TRHs | >C10 - C40 TRHs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *1* | *2* | *2* | *2* | *2* | *20* | *20* | *100* | *100* | *100* | *100* |
| *Analytical* | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 21/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| MW02 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 21/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| MW03 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| | 22/08/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Criteria - Residential* | | | | | | | | | | | | |
| Health levels 2 m - < 4 m | | 800 | NL | NL | NL | NL | - | 1,000 | 1,000 | NL | NL | NL |
| Marine water [1] | | 500 | - | - | - | 50 | - | - | - | - | - | - |
| Drinking water[2] | | 1 | 800 (25) | 300 (3) | 600 (20) | - | - | - | - | - | - | - |
| Recreational Criteria | | 10 | 8000 | 3000 | 6000 | - | - | - | - | - | - | - |

See tables notes at end of section

**Table 10: Groundwater Analytical Summary, PAHs (ug/L)**

| Sample | Depth (m) | Naphthalene | Acenaphthylene | Acenaphthene | Fluorene | Phenanthrene | Anthracene | Fluoranthene | Pyrene | Benz(a)anthracene | Chrysene | Benzo(b)fluoranthene | Benzo(k)fluoranthene | Benzo(a)pyrene | Indeno(1.2.3.cd)pyrene | Dibenz(a.h)anthracene | Benzo(g.h.i)perylene | Total PAHs | B(a)P TEQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *LORs* | | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *1* | *0.5* | *1* | *1* | *1* | *0.5* | *0.5* |
| *Analytical* | | | | | | | | | | | | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd | nd |
| *Statistics* | | | | | | | | | | | | | | | | | | | |
| Samples analysed | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Detects | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| % detect | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Maximum | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mean | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Median | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Minimum | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *Criteria* | | | | | | | | | | | | | | | | | | | |
| Marine water GILs | | 50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Drinking Water | | - | - | - | - | - | - | - | - | - | - | - | - | 0.01 | - | - | - | - | - |
| Recreational Criteria | | - | - | - | - | - | - | - | - | - | - | - | - | 0.1 | - | - | - | - | - |

See table notes at end of section

**Table 11: Groundwater and Surface water Analytical Summary, Metals (ug/L)**

| Sample | Depth (m) | pH | Aluminium | Arsenic | Cadmium | Chromium | Copper | Lead | Nickel | Selenium | Zinc | Iron | Mercury |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *LORs* | *pH units* | *10* | *1* | *0.1* | *1* | *1* | *1* | *1* | *10* | *5* | *50* | *0.1* |
| *Analytical - Groundwater* | | | | | | | | | | | | | |
| MW01 | 08/02/17 | 4.98 | 5,760 | 11 | 1.2 | 2 | 3 | 2 | 269 | nd | 734 | 214,000 | nd |
| | 21/08/17 | 5.19 | 1,890 | 3 | 0.4 | 1 | nd | nd | 121 | nd | 380 | 108,000 | nd |
| | 01/03/18 | 4.92 | 2,330 | 4 | 0.5 | nd | nd | nd | 104 | nd | 340 | 69,000 | nd |
| | 31/01/19 | 5.12 | 140 | 6 | nd | nd | nd | nd | 8 | nd | 6 | 3,990 | nd |
| | 21/03/19 | 6.41 | 200 | 8 | 0.2 | nd | nd | nd | 60 | nd | 157 | 57,800 | nd |
| MW02 | 08/02/17 | 4.92 | 890 | 8 | 0.8 | nd | 2 | nd | 68 | nd | 367 | 31,700 | nd |
| | 21/08/17 | 5.16 | 2,850 | 3 | 0.4 | 1 | nd | nd | 100 | nd | 479 | 30,900 | nd |
| | 01/03/18 | 4.63 | 3,110 | 1 | 2.7 | 2 | 2 | nd | 169 | nd | 797 | 9,960 | nd |
| | 31/01/19 | 5.58 | 140 | 7 | nd | nd | 1 | nd | 3 | nd | nd | 14,800 | nd |
| | 21/03/19 | 5.09 | 2,350 | 3 | 0.4 | nd | nd | nd | 77 | nd | 361 | 11,900 | nd |
| MW03 | 08/02/17 | 6.63 | 80 | 6 | nd | 2 | nd | nd | 3 | nd | 17 | 163,000 | nd |
| | 22/08/17 | 6.26 | 20 | 2 | nd | nd | nd | nd | 3 | nd | nd | 107,000 | nd |
| | 01/03/18 | 5.68 | 240 | 3 | 0.4 | 1 | nd | nd | 35 | nd | 268 | 59,800 | nd |
| | 31/01/19 | 5.62 | nd | 1 | nd | nd | nd | nd | 2 | nd | 10 | 58,900 | nd |
| | 21/03/19 | 6.15 | 110 | 3 | 1.2 | 1 | nd | nd | 31 | nd | 426 | 69,000 | nd |
| *Analytical - Surface water* | | | | | | | | | | | | | |
| SW01 | 01/03/18 | 6.88 | nd | 2 | nd | nd | nd | nd | 15 | nd | nd | 810 | nd |
| | 31/01/19 | 9.38 | nd | 9 | nd | nd | nd | nd | 4 | nd | nd | 160 | nd |
| | 21/03/19 | 7.04 | nd | 2 | 0.1 | nd | 2 | nd | 9 | nd | 10 | nd | nd |
| SW02 | 01/03/18 | 7.06 | nd | 2 | nd | nd | nd | nd | 14 | nd | nd | 5,980 | nd |
| | 31/01/19 | 9.41 | 30 | 8 | nd | nd | nd | nd | 4 | nd | nd | 70 | nd |
| | 20/03/19 | 7.77 | nd | 2 | nd | nd | 3 | nd | 9 | nd | 11 | nd | 0.2 |
| SW03 | 01/03/18 | 6.03 | 150 | nd | 0.3 | nd | nd | nd | 37 | nd | 178 | 5,460 | nd |
| | 31/01/19 | 6.79 | nd | nd | nd | nd | 2 | nd | 2 | nd | 130 | 190 | nd |
| | 20/03/19 | 6.71 | 10 | nd | nd | nd | 3 | nd | 5 | nd | 26 | 60 | 6.6 |
| *Statistics* | | | | | | | | | | | | | |
| Number of samples analysed | | | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| Number of detects | | | 13 | 16 | 8 | 6 | 4 | 1 | 18 | 0 | 12 | 17 | - |
| Percentage non detect | | | 72% | 89% | 44% | 33% | 22% | 6% | 100% | 0% | 67% | 94% | 0% |
| Maximum | | | 5,760 | 11 | 3 | 2 | 3 | 2 | 269 | 0 | 797 | 214,000 | <0.1 |
| *Criteria* | | | | | | | | | | | | | |
| GILs - Drinking Water | | - | - | 10 | 2 | 50* | 2,000 | 10 | 20 | 10 | - | - | 1 |
| GILs - Marine water | | - | 0.5 | 2.3 / 4.5** | 0.7 | 4.4 | 1.3 | 4.4 | 7 | 3 | 15 | 300*** | 0.1 |
| Recreational Criteria | | | - | 100 | 20 | 500 | 20,000 | 100 | 200 | 100 | - | - | 10 |

* - Chromium criteria as Cr(VI)
** - Arsenic criteria as As (III) / As (V)
*** - Canadian interim value
See table notes at end of section

**Table 12: Groundwater and Surface water Analytical Summary, E.Coli, Biochemical Oxygen Demand and Nutrients (mg/L)**

| Sample location | Date | | | | | Nutrients | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | E.Coli (MPN/100) | Thermotolerant Faecal Coliforms | Biochemical Oxygen Demand | Ammonia | Nitrite | Nitrate | Nitrate + Nitrite as N | Total Kjeldahl Nitrogen | Total Nitrogen | Total Phosphorus | Reactive Phosphorus |
| *LORs* | | *pH units* | 2 (MPN/100) | 2 (TFC/100) | *2* | *0.01* | *0.01* | *0.01* | *0.01* | *0.1* | *0.1* | *0.01* | *0.01* |
| *Analytical - Groundwater* | | | | | | | | | | | | | |
| MW01 | 08/02/17 | 4.98 | nd | - | 32 | 0.96 | 0.01 | 0.01 | 0.02 | 60 | 60 | 14.5 | nd |
| | 21/08/17 | 5.19 | - | nd | 11 | 1.92 | nd | nd | nd | 3.6 | 3.6 | 0.05 | nd |
| | 01/03/18 | 4.92 | - | - | - | 1.14 | nd | nd | nd | 2.8 | 2.8 | 0.14 | 0.09 |
| | 31/01/19 | 5.12 | - | - | - | **10.9** | nd | nd | nd | 285 | 285 | 121 | nd |
| | 21/03/19 | 6.41 | - | - | - | 0.89 | 0.06 | **1.34** | 1.4 | 42.7 | 44.1 | 12.8 | nd |
| MW02 | 08/02/17 | 4.92 | 5 | - | nd | 1.79 | nd | 0.11 | 0.11 | 53.4 | 53.5 | 7.7 | nd |
| | 21/08/17 | 5.16 | - | nd | nd | 1.31 | nd | nd | nd | 2.6 | 2.6 | 0.02 | 0.02 |
| | 01/03/18 | 4.63 | - | - | - | 1.09 | nd | 0.02 | 0.02 | 5.8 | 5.8 | 0.71 | 0.29 |
| | 31/01/19 | 5.58 | - | - | - | 1.24 | nd | 0.08 | 0.08 | 21.9 | 22 | 5.44 | nd |
| | 21/03/19 | 5.09 | - | - | - | 1.77 | 0.09 | **9.19** | 9.28 | 9.8 | 19.1 | 1.87 | nd |
| MW03 | 08/02/17 | 6.63 | 13 | **-** | 5 | **7.95** | 0.01 | nd | nd | 39.9 | 39.9 | 12.4 | nd |
| | 22/08/17 | 6.26 | - | nd | 9 | 1.76 | nd | nd | nd | 10 | 10 | 1 | nd |
| | 01/03/18 | 5.68 | - | - | - | 4.68 | nd | 0.32 | 0.32 | 7.1 | 7.4 | 0.47 | 0.36 |
| | 31/01/19 | 5.62 | - | - | - | 1.39 | nd | nd | nd | 27.8 | 27.8 | 4.76 | nd |
| | 21/03/19 | 6.15 | - | - | - | **6.72** | nd | 0.55 | 0.55 | 12.7 | 13.2 | 2.27 | nd |
| *Analytical - Surface water* | | | | | | | | | | | | | |
| SW01 | 01/03/18 | 6.88 | - | - | - | **7.59** | nd | 0.02 | 0.02 | 10 | 10 | 0.1 | 0.04 |
| | 31/01/19 | 9.38 | - | - | - | - | - | - | - | - | - | - | - |
| | 21/03/19 | 7.04 | - | - | - | 4.35 | 0.02 | 0.08 | 0.1 | 6 | 6.1 | 0.2 | nd |
| SW02 | 01/03/18 | 7.06 | - | - | - | **6.67** | nd | 0.01 | 0.01 | 8.8 | 8.8 | 0.06 | 0.02 |
| | 31/01/19 | 9.41 | - | - | - | - | - | - | - | - | - | - | - |
| | 20/03/19 | 7.77 | - | - | - | 4.25 | 0.09 | 0.02 | 0.11 | 5.8 | 5.9 | 0.11 | nd |
| SW03 | 01/03/18 | 6.03 | - | - | - | 0.96 | nd | 0.02 | 0.02 | 2.2 | 2.2 | 0.05 | 0.03 |
| | 31/01/19 | 6.79 | - | - | - | - | - | - | - | - | - | - | - |
| | 20/03/19 | 6.71 | - | - | - | 1.01 | 0.02 | 0.06 | 0.08 | 2.2 | 2.3 | 0.04 | nd |
| *Statistics* | | | | | | | | | | | | | |
| Number of samples analysed | | | 3 | 3 | 6 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Number of detects | | | 2 | 0 | 4 | 15 | 6 | 12 | 12 | 15 | 15 | 15 | 7 |
| Percentage non detect | | | 67% | 0% | 67% | 100% | 40% | 80% | 80% | 100% | 100% | 100% | 47% |
| Maximum | | | 13 | <2 | 32 | 10.90 | 0.09 | 9.19 | 9.28 | 285 | 285 | 121.0 | 0.36 |
| *Criteria* | | | | | | | | | | | | | |
| GILs - Drinking Water | | | - | - | - | - | 3 | 50 | - | - | - | - | - |
| GILs - Marine water | | | - | - | - | **5.96** [1] | - | **0.7** | - | - | - | - | - |
| Recreational Water | | | 150/1000 | 150/1000 | - | - | - | 500 | - | - | - | - | - |

1. ANZECC 2000 - Marine Trigger Value calculated using the minimum pH value of 6.0

See tables notes at end of section

**Table 13: Groundwater Analytical Summary, Volatile Organic Compounds, Per- and Polyfluorinated Alkyl Substances (PFAS) ug/L**

| Sample | Date | Total VOCs | Total Phenolic Compounds | Total PCBs | Total OCPs | Total OPPs | PFOS & PFHxS | PFOA |
|---|---|---|---|---|---|---|---|---|
| *LORs* | | - | - | - | - | - | *0.05* | 0.05 |
| *Analytical* | | | | | | | | |
| MW01 | 08/02/17 | nd | nd | nd | nd | nd | nd | nd |
| *Criteria* | | | | | | | | |
| GILs - Drinking Water | | - | - | - | - | - | - | - |
| GILs - Fresh water | | - | - | - | - | - | - | - |
| Department of Health (2017) Drinking Water | | - | - | - | - | - | 0.07 | 0.56 |
| Department of Health (2017) - Recreational Water | | - | - | - | - | - | 0.7 | 5.6 |

See table notes at end of section

For a complete VOC scan results, please refer to the laboratory report.

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *08/02/17* | *08/02/17* | | *08/02/17* | | *08/02/17* | *08/02/17* | *08/02/17* | - |
| *Metals (ug/L)* | | | | | | | | | | |
| Aluminium | 10 | 5,760 | 5,710 | 1 | 6,000 | 5 | | | | |
| Arsenic | 1 | 11 | 10 | 10 | 10 | 10 | - | - | - | - |
| Cadmium | 0.1 | 1.2 | 1.6 | 29 | 1.7 | 6 | - | - | - | - |
| Chromium | 1 | 2 | 2 | 0 | 2 | 0 | - | - | - | - |
| Copper | 1 | 3 | 2 | 40 | 2 | 9 | - | - | - | - |
| Nickel | 1 | 269 | 266 | 1 | 210 | 32 | - | - | - | - |
| Lead | 1 | 2 | 2 | 0 | 2 | 0 | - | - | - | - |
| Selenium | 10 | nd | nd | - | nd | - | | | | |
| Zinc | 5 | 734 | 719 | 2 | 670 | 12 | - | - | - | - |
| Iron | 50 | 214,000 | 207,000 | 3 | 190,000 | 16 | | | | |
| Mercury | 0.1 | nd | nd | - | nd | - | - | - | - | - |
| *TRHs (ug/L)* | | | | | | | | | | |
| C6 - C10 Fraction minus BTEX (F1) | 20 | nd | nd | - | nd | - | nd | - | - | - |
| > C10 - C16 Fraction (F2) | 50 | nd | nd | - | nd | - | - | - | - | - |
| > C16 - C34 Fraction | 100 | nd | nd | - | nd | - | - | - | - | - |
| < C34 - C40 Fraction | 50 | nd | nd | - | nd | - | - | - | - | - |
| > C10 - C40 Fraction (sum) | 50 | nd | nd | - | nd | - | - | - | - | - |

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | % | *Interlab Duplicate of MW01* | % | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *08/02/17* | *08/02/17* | | *08/02/17* | | *08/02/17* | *08/02/17* | *08/02/17* | - |
| *BTEXN (ug/L* | | | | | | | | | | |
| Benzene | 1 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| Toluene | 2 | nd | nd | - | nd | **-** | nd | 16 | *20* | 80 |
| Ethylbenzene | 2 | nd | nd | - | nd | **-** | nd | 15 | *20* | 75 |
| meta- & para-Xylene | 2 | nd | nd | - | nd | - | nd | 16 | *20* | 80 |
| ortho-xylene | 2 | nd | nd | - | nd | - | nd | 17 | *20* | 85 |
| Naphthalene | 5 | nd | nd | - | nd | - | nd | - | - | - |
| Sum of PAHs | 2 | nd | nd | - | nd | - | nd | - | - | - |
| *Nutrients (mg/L)* | | | | | | | | | | |
| Ammonia | 0.01 | 0.96 | 0.94 | 2 | 3.7 | **142** | - | - | - | - |
| Nitrite | 0.01 | 0.01 | 0.01 | 0 | nd | - | - | - | - | - |
| Nitrate | 0.01 | 0.01 | nd | - | 0.008 | 22 | - | - | - | - |
| Nitrate + Nitrite as N | 0.01 | 0.02 | 0.01 | **67** | - | - | - | - | - | - |
| Total Kjeldahl Nitrogen | 0.1 | 60 | 69.6 | 15 | - | - | - | - | - | - |
| Total Nitrogen | 0.1 | 60 | 69.6 | 15 | 20 | **97** | - | - | - | - |
| Total Phosphorus | 0.01 | 14.5 | 13.2 | 9 | 4.2 | **100** | - | - | - | - |
| Reactive Phosphorus | 0.01 | nd | nd | - | - | - | - | - | - | - |
| E.coli | MPN/100 | nd | nd | - | nd | - | - | - | - | - |
| *Data Quality Indicator* | - | - | - | ***<50%*** | - | ***<50%*** | - | - | - | *70-130%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | MW01 | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *21/08/17* | *21/08/17* | - | *21/08/17* | *21/08/17* | - | *21/08/17* | *21/08/17* | *21/08/17* | - |
| *Metals (ug/L)* | | | | | | | | | | | |
| Aluminium | 10 | 1,890 | 2,140 | 12 | 1,890 | 2000 | 7 | | | | |
| Arsenic | 1 | 3 | 3 | 0 | 3 | 4 | 38 | - | - | - | - |
| Cadmium | 0.1 | 0.4 | 0.4 | 0 | 0.4 | 0.5 | 29 | - | - | - | - |
| Chromium | 1 | 1 | 1 | 0 | 1 | 1 | 0 | - | - | - | - |
| Copper | 1 | nd | nd | - | nd | nd | - | - | - | - | - |
| Nickel | 1 | nd | nd | - | nd | 110 | - | - | - | - | - |
| Lead | 1 | 121 | 114 | 6 | 121 | nd | - | - | - | - | - |
| Selenium | 10 | nd | nd | - | nd | nd | - | | | | |
| Zinc | 5 | 380 | 368 | 3 | 380 | 350 | 10 | - | - | - | - |
| Iron | 50 | 108,000 | 107,000 | 1 | 108,000 | 120,000 | 14 | | | | |
| Mercury | 0.1 | nd | nd | - | nd | nd | - | - | - | - | - |
| *TRHs (ug/L)* | | | | | | | | | | | |
| C6 - C10 Fraction minus BTEX (F1) | 20 | nd | nd | - | nd | nd | - | nd | - | - | - |
| > C10 - C16 Fraction (F2) | 50 | nd | nd | - | nd | nd | - | - | - | - | - |
| > C16 - C34 Fraction | 100 | nd | nd | - | nd | nd | - | - | - | - | - |
| < C34 - C40 Fraction | 50 | nd | nd | - | nd | nd | - | - | - | - | - |
| > C10 - C40 Fraction (sum) | 50 | nd | nd | - | nd | nd | - | - | - | - | - |

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW01 | QW01 | **RPD** | MW01 | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate of MW01* | *%* | *Lab prep* | *Field* | *Lab* | *Recovery* |
| *Date* | - | *21/08/17* | *21/08/17* | - | *21/08/17* | *21/08/17* | - | *21/08/17* | *21/08/17* | *21/08/17* | - |
| *BTEXN (ug/L)* | | | | | | | | | | | |
| Benzene | 1 | nd | nd | - | nd | nd | - | nd | 16 | *20* | 80 |
| Toluene | 2 | nd | nd | - | nd | nd | - | nd | 16 | *20* | 80 |
| Ethylbenzene | 2 | nd | nd | - | nd | nd | - | nd | 15 | *20* | 75 |
| meta- & para-Xylene | 2 | nd | nd | - | nd | nd | - | nd | 16 | *20* | 80 |
| ortho-xylene | 2 | nd | nd | - | nd | nd | - | nd | 17 | *20* | 85 |
| Naphthalene | 5 | nd | nd | - | nd | nd | - | nd | - | - | - |
| Sum of PAHs | 2 | nd | nd | - | nd | nd | - | nd | - | - | - |
| *Nutrients (mg/L)* | | | | | | | | | | | |
| Ammonia | 0.01 | 1.92 | 1.99 | 4 | 1.92 | 3 | 26 | - | - | - | - |
| Nitrite | 0.01 | nd | nd | - | nd | nd | - | - | - | - | - |
| Nitrate | 0.01 | nd | nd | - | nd | 0.009 | - | - | - | - | - |
| Nitrate + Nitrite as N | 0.01 | nd | nd | - | nd | - | - | - | - | - | - |
| Total Kjeldahl Nitrogen | 0.1 | 3.6 | 3.7 | 3 | 3.6 | - | - | - | - | - | - |
| Total Nitrogen | 0.1 | 3.6 | 3.7 | 3 | 3.6 | 3.3 | 9 | - | - | - | - |
| Total Phosphorus | 0.01 | 0.05 | 0.05 | 0 | 0.05 | nd | - | - | - | - | - |
| Reactive Phosphorus | 0.01 | nd | nd | - | nd | - | - | - | - | - | - |
| E.coli | MPN/100 | nd | nd | - | nd | nd | - | - | - | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | *<50%* | - | - | - | *70-130%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW03 | QW01 | **RPD** | MW03 | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate of MW03* | *%* | *Lab prep* | *Field* | *Lab* | |
| *Date* | - | *01/03/18* | *01/03/18* | - | *01/03/18* | *01/03/18* | - | *26/02/18* | *26/02/18* | *26/02/18* | - |
| *Metals (ug/L)* | | | | | | | | | | | |
| Aluminium | 10 | 240 | 280 | 15 | 240 | 370 | **57** | - | - | - | - |
| Arsenic | 1 | 3 | 4 | 29 | 3 | 1 | 25 | - | - | - | - |
| Cadmium | 0.1 | 0.4 | 0.7 | **55** | 0.4 | 1 | 5 | - | - | - | - |
| Chromium | 1 | 1 | 1 | 0 | 1 | nd | - | - | - | - | - |
| Copper | 1 | nd | nd | - | nd | nd | - | - | - | - | - |
| Nickel | 1 | nd | nd | - | nd | 42 | - | - | - | - | - |
| Lead | 1 | 35 | 42 | 18 | 3.5 | nd | - | - | - | - | - |
| Selenium | 10 | nd | nd | - | nd | nd | - | | | | |
| Zinc | 5 | 268 | 358 | 29 | 268 | 380 | 43 | - | - | - | - |
| Iron | 50 | 59,800 | 41,800 | 35 | 59,800 | 26,000 | **90** | | | | |
| Mercury | 0.1 | nd | nd | - | nd | nd | - | - | - | - | - |
| *TRHs (ug/L)* | | | | | | | | | | | |
| C6 - C10 Fraction minus BTEX (F1) | 20 | - | - | - | - | - | - | nd | - | - | - |
| > C10 - C16 Fraction (F2) | 50 | - | - | - | - | - | **-** | - | - | - | - |
| > C16 - C34 Fraction | 100 | - | - | - | - | - | **-** | - | - | - | - |
| < C34 - C40 Fraction | 50 | - | - | - | - | - | - | - | - | - | - |
| > C10 - C40 Fraction (sum) | 50 | - | - | - | - | - | **-** | - | - | - | - |

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW03 | QW01 | **RPD** | MW03 | QW02 | **RPD** | Trip Blank | Trip Spike | Trip Spike | Trip Spike Recovery |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate of MW03* | *%* | *Lab prep* | *Field* | *Lab* | |
| *Date* | - | *01/03/18* | *01/03/18* | - | *01/03/18* | *01/03/18* | - | *26/02/18* | *26/02/18* | *26/02/18* | - |
| *BTEXN (ug/L)* | | | | | | | | | | | |
| Benzene | 1 | - | - | - | nd | nd | - | nd | 15 | *20* | 75 |
| Toluene | 2 | - | - | - | nd | nd | **-** | nd | 15 | *20* | 75 |
| Ethylbenzene | 2 | - | - | - | nd | nd | **-** | nd | 15 | *20* | 75 |
| meta- & para-Xylene | 2 | - | - | - | nd | nd | - | nd | 15 | *20* | 75 |
| ortho-xylene | 2 | - | - | - | nd | nd | - | nd | 16 | *20* | 80 |
| Naphthalene | 5 | - | - | - | nd | nd | - | nd | 18 | *20* | 90 |
| Sum of PAHs | 2 | - | - | - | nd | nd | - | nd | - | - | - |
| *Nutrients (mg/L)* | | | | | | | | | | | |
| Ammonia | 0.01 | 4.68 | 4.62 | 1 | 4.68 | - | - | - | - | - | - |
| Nitrite | 0.01 | nd | nd | - | nd | 0.007 | - | - | - | - | - |
| Nitrate | 0.01 | 0.32 | 0.31 | - | 0.32 | nd | - | - | - | - | - |
| Nitrate + Nitrite as N | 0.01 | 0.32 | 0.31 | - | 0.32 | - | - | - | - | - | - |
| Total Kjeldahl Nitrogen | 0.1 | 7.1 | 6.7 | 6 | 7.1 | - | - | - | - | - | - |
| Total Nitrogen | 0.1 | 7.4 | 7 | 6 | 7.4 | 1.7 | **125** | - | - | - | - |
| Total Phosphorus | 0.01 | 0.47 | 0.43 | 9 | 0.47 | 0.6 | 24 | - | - | - | - |
| Reactive Phosphorus | 0.01 | 0.36 | 0.31 | - | 0.36 | - | - | - | - | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | ***<50%*** | - | - | - | - |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Surface water Analytical Summary, Quality Control**

| Analyte | LOR ug/L | SW03 | QW03 | **RPD** | SW03 | QW04 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | % | *Primary* | *Interlab Duplicate of SW03* | % |
| *Date* | - | *01/03/18* | *01/03/18* | - | *01/03/18* | *01/03/18* | - |
| *Metals (ug/L)* | | | | | | | |
| Aluminium | 10 | 150 | 160 | 6 | 150 | 180 | 18 |
| Arsenic | 1 | nd | nd | - | nd | nd | - |
| Cadmium | 0.1 | 0.3 | 0.3 | 0 | 0.3 | 0.4 | 29 |
| Chromium | 1 | nd | nd | - | nd | nd | - |
| Copper | 1 | nd | nd | - | nd | nd | - |
| Nickel | 1 | nd | nd | - | nd | 38 | - |
| Lead | 1 | 37 | 38 | 3 | 37 | nd | - |
| Selenium | 10 | nd | nd | - | nd | nd | - |
| Zinc | 5 | 178 | 182 | 2 | 178 | 180 | 1 |
| Iron | 50 | 5,460 | 5,360 | 2 | 5,460 | 5,600 | 3 |
| Mercury | 0.1 | nd | nd | - | nd | nd | - |
| *Nutrients (mg/L)* | | | | | | | |
| Ammonia | 0.01 | 0.96 | 0.96 | 0 | 0.96 | 0.42 | **78** |
| Nitrite | 0.01 | nd | nd | - | nd | nd | - |
| Nitrate | 0.01 | 0.02 | 0.01 | **67** | 0.02 | nd | - |
| Nitrate + Nitrite as N | 0.01 | 0.02 | 0.01 | **67** | 0.02 | - | - |
| Total Kjeldahl Nitrogen | 0.1 | 2.2 | 2 | 10 | 2.2 | - | - |
| Total Nitrogen | 0.1 | 2.2 | 2 | 10 | 2.2 | 1.7 | 26 |
| Total Phosphorus | 0.01 | 0.05 | 0.07 | 33 | 0.05 | nd | - |
| Reactive Phosphorus | 0.01 | 0.03 | 0.04 | 29 | 0.03 | - | - |
| *Data Quality Indicator* | - | - | - | ***<50%*** | - | - | *<50%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW03 | QW01 | **RPD** | MW03 | QW02 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate* | *%* |
| *Date* | - | *31/01/19* | *31/01/19* | - | *31/01/19* | *31/01/19* | - |
| *Metals* | | | | | | | |
| Aluminium | 10 | nd | nd | - | nd | - | - |
| Arsenic | 1 | 1 | 1 | 0 | 1 | 3 | **167** |
| Cadmium | 0.1 | nd | nd | - | nd | nd | - |
| Chromium | 1 | nd | nd | - | nd | nd | - |
| Copper | 1 | nd | nd | - | nd | nd | - |
| Nickel | 1 | 2 | 2 | 0 | 2 | 2 | 0 |
| Lead | 1 | nd | nd | 0 | nd | nd | - |
| Selenium | 10 | nd | nd | - | nd | - | - |
| Zinc | 5 | 10 | 10 | 0 | 10 | 8 | 26 |
| Iron | 50 | 58,900 | 65,000 | 10 | 58,900 | - | - |
| Mercury | 0.1 | nd | nd | - | nd | nd | - |
| *Nutrients (mg/L)* | | | | | | | |
| Ammonia | 0.01 | 1.39 | 1.4 | 1 | 1.39 | 7.7 | **139** |
| Nitrite | 0.01 | nd | nd | - | nd | 0.009 | - |
| Nitrate | 0.01 | nd | nd | - | nd | 0.01 | - |
| Nitrate + Nitrite as N | 0.01 | nd | nd | - | nd | - | - |
| Total Kjeldahl Nitrogen | 0.1 | 27.8 | 31.6 | 13 | 27.8 | - | - |
| Total Nitrogen | 0.1 | 27.8 | 31.6 | 13 | 27.8 | 13 | **73** |
| Total Phosphorus | 0.01 | 4.76 | 5.54 | 15 | 4.76 | 0.3 | **176** |
| Reactive Phosphorus | 0.01 | nd | nd | - | nd | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | ***<50%*** |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Surface water Analytical Summary, Quality Control (ug/L)**

| Analyte | LOR ug/L | SW03 | QW03 | **RPD** | SW03 | QW04 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate* | *%* |
| *Date* | - | *31/01/19* | *31/01/19* | - | *31/01/19* | *31/01/19* | - |
| *Metals (ug/L)* | | | | | | | |
| Aluminium | 10 | nd | nd | - | nd | - | - |
| Arsenic | 1 | nd | nd | - | nd | 3 | - |
| Cadmium | 0.1 | nd | nd | - | nd | nd | - |
| Chromium | 1 | nd | nd | - | nd | nd | - |
| Copper | 1 | 2 | 2 | - | 2 | 1 | **67** |
| Nickel | 1 | nd | nd | - | nd | 2 | - |
| Lead | 1 | 2 | 2 | 0 | 2 | nd | - |
| Selenium | 10 | nd | nd | - | nd | - | - |
| Zinc | 5 | 130 | 136 | 5 | 130 | 96 | 30 |
| Iron | 50 | 190 | 60 | **104** | 190 | - | - |
| Mercury | 0.1 | nd | nd | - | nd | nd | - |
| *Data Quality Indicator* | - | - | - | ***<50%*** | - | - | ***<50%*** |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Groundwater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | MW02 | QW03 | **RPD** | MW02 | QW04 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate* | *%* |
| *Date* | - | *21/03/19* | *21/03/19* | - | *21/03/19* | *21/03/19* | - |
| *Metals (ug/L)* | | | | | | | |
| Aluminium | 10 | 2,350 | 2,330 | 1 | 2,350 | 2,200 | 8 |
| Arsenic | 1 | 3 | 3 | 0 | 3 | 4 | 38 |
| Cadmium | 0.1 | 0.4 | 0.5 | 22 | 0.4 | 0.4 | 0 |
| Chromium | 1 | nd | nd | - | nd | nd | - |
| Copper | 1 | nd | 1 | - | nd | nd | - |
| Nickel | 1 | nd | nd | - | nd | 73 | - |
| Lead | 1 | 77 | 76 | 1 | 77 | nd | - |
| Selenium | 10 | nd | nd | - | nd | nd | - |
| Zinc | 5 | 361 | 379 | 5 | 361 | 370 | 3 |
| Iron | 50 | 11,900 | 11,600 | 3 | 11,900 | 12,000 | 1 |
| Mercury | 0.1 | nd | nd | - | nd | nd | - |
| *Nutrients (mg/L)* | | | | | | | |
| Ammonia | 0.01 | 1.77 | 1.71 | 3 | 1.77 | 2.6 | 38 |
| Nitrite | 0.01 | 0.09 | 0.06 | 40 | 0.09 | 0.02 | **127** |
| Nitrate | 0.01 | 9.19 | 8.78 | 5 | 9.19 | 7.6 | 19 |
| Nitrate + Nitrite as N | 0.01 | 9.28 | 8.84 | 5 | 9.28 | - | - |
| Total Kjeldahl Nitrogen | 0.1 | 9.8 | 8.3 | 17 | 9.8 | - | - |
| Total Nitrogen | 0.1 | 19.1 | 17.1 | 11 | 19.1 | 25 | 27 |
| Total Phosphorus | 0.01 | 1.87 | 1.42 | 27 | 1.87 | 0.7 | **91** |
| Reactive Phosphorus | 0.01 | nd | nd | - | nd | - | - |
| *Data Quality Indicator* | - | - | - | *<50%* | - | - | ***<50%*** |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

**Table 14: Surfacewater Analytical Summary, Quality Control**

| Analyte | LOR ug/L | SW03 | QW01 | **RPD** | SW03 | QW02 | **RPD** |
|---|---|---|---|---|---|---|---|
| *Type* | - | *Primary* | *Duplicate* | *%* | *Primary* | *Interlab Duplicate* | *%* |
| *Date* | - | *20/03/19* | *20/03/19* | - | *20/03/19* | *20/03/19* | - |
| *Metals (ug/L)* | | | | | | | |
| Aluminium | *10* | 10 | nd | - | 10 | 10 | 0 |
| Arsenic | *1* | nd | nd | - | nd | nd | - |
| Cadmium | *0.1* | nd | nd | - | nd | 0.1 | - |
| Chromium | *1* | nd | nd | - | nd | nd | - |
| Copper | *1* | 3 | 3 | 0 | 3 | nd | - |
| Nickel | *1* | nd | nd | - | nd | 4 | - |
| Lead | *1* | 5 | 5 | 0 | 5 | nd | - |
| Selenium | *10* | nd | nd | - | nd | nd | - |
| Zinc | *5* | 26 | 26 | 0 | 26 | 24 | 8 |
| Iron | *50* | 60 | 50 | 18 | 60 | 54 | 11 |
| Mercury | *0.1* | 6.6 | 6.4 | 3 | 6.6 | 6.4 | 3 |
| *Nutrients (mg/L)* | | | | | | | |
| Ammonia | *0.01* | 1.01 | 1.21 | 18 | 1.01 | 1.1 | 9 |
| Nitrite | *0.01* | 0.02 | 0.02 | 0 | 0.02 | 0.014 | 35 |
| Nitrate | *0.01* | 0.06 | 0.11 | **59** | 0.06 | 0.064 | 6 |
| Nitrate + Nitrite as N | *0.01* | 0.08 | 0.13 | 48 | 0.08 | - | - |
| Total Kjeldahl Nitrogen | *0.1* | 2.2 | 2 | 10 | 2.2 | - | - |
| Total Nitrogen | *0.1* | 2.3 | 2.1 | 9 | 2.3 | 1.9 | 19 |
| Total Phosphorus | *0.01* | 0.04 | 0.03 | 29 | 0.04 | nd | - |
| Reactive Phosphorus | *0.01* | nd | nd | - | nd | - | - |
| *Data Quality Indicator* | - | - | - | ***<50%*** | - | - | *<50%* |

See tables notes at end of section

* Date Trip Spike/Blank used in the field

## Groundwater Analytical Summary Table Notes

LOR denotes limit of reporting (standard LOR unless otherwise shown)

nd denotes not detected above the LOR

**Bold** - Exceeds criteria

^ denotes LOR raised

- denotes not analysed/not available

* TPHs in waters used as screening analysis. If > LOR, check specific toxicants e.g. BTEX, PAHs, etc. For recreational waters/aesthetics, oil/petrol not to be noticeable as a visible film on the water or detectable by odour.

1. Aquatic ecosystem criteria from Australian New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* , including Table 3.4.1 and Section 8.3.7.

DECCW/DERM specify that the 95% species protection levels are to be applied for slightly to moderately-disturbed ecosystems (most urban catchments) and the 99% species protection levels for pristine or vulnerable ecosystems or where the contaminants are intractable (e.g. bioaccumulative).

2. Drinking water criteria from National Health and Medical Research Council (NHMRC) & Natural Resource Management Ministerial Council (NRMMC) (2011) *Australian Drinking Water Guidelines* .

The guideline values are health related and are described as the concentration that does not result in any significant risk to the health of the consumer over a lifetime of consumption. Numbers in brackets are aesthetic values, e.g. appearance, taste and/or odour. The guideline values relate to the quality of water at the point of use, e.g. kitchen or bathroom tap.

While exposure is predominately through ingestion, skin adsorption and/or inhalation are considered in calculating the guideline value (Page 6-7, NHMRC/NRMMC 2004). However, this only addresses consumption/use of drinking water, it does not address inhalation from subsurface, and drinking water criteria should not be used as risk assessment screening values for onsite contaminant concentrations.

# APPENDIX E

NSW EPA

NSW Site Auditor Scheme

# Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

## Part I: Site audit identification

Site audit statement no. DG006

This site audit is a:

☑ statutory audit

☐ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

### Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name: David Gregory

Company: Geo-Logix Pty Ltd

Address: Unit 2309/4 Daydream Street, Warriewood, NSW

Postcode 2102

Phone (02) 9979 1722

Email dgregory@geo-logix.com.au

### Site details

Former Townsend Sewerage Treatment Facility, Corner Schwonberg and Goodwood Streets, Townsend, NSW

Postcode 2463

## Property description

(Attach a separate list if several properties are included in the site audit.)

Lot 2 DP 634170

Local government area: Clarence Valley Council

Area of site (include units, e.g. hectares) 3 Ha

Current zoning: SP2

## Regulation and notification

To the best of my knowledge:

☐ **the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985,* as follows: (provide the no. if applicable)

- ☐ Declaration no.
- ☐ Order no.
- ☐ Proposal no.
- ☐ Notice no.

☑ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985.*

To the best of my knowledge:

☐ the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

☑ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997.*

## Site audit commissioned by

Name Shaun Zimmerman

Company Ledonne Constructions P/L

Address 28 Hyde Street, South Grafton NSW

Postcode 2460

Phone: 66433240

Email shaun@ledonne.com.au

**Contact details for contact person** (if different from above)

Name

Phone

Email

**Nature of statutory requirements** (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)

☐ Requirements imposed by an environmental planning instrument (please specify, including date of issue)

☐ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)

☑ Requirements under other legislation (please specify, including date of issue)

Condition of the Surrender of a Licence (EPL 3661) under Section 80(1) Protection of the Environment Operations Act 1997. Date of issue 23rd January 2017

## Purpose of site audit

☑ **A1** To determine land use suitability

Intended uses of the land: Residential A

OR

**A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land: ______

OR

(Tick all that apply)

☐ **B1** To determine the nature and extent of contamination

☐ **B2** To determine the appropriateness of:

- ☐ an investigation plan
- ☐ a remediation plan
- ☐ a management plan

☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

☐ **B4** To determine the compliance with an approved:

- ☐ **voluntary management proposal** or
- ☐ **management order** under the *Contaminated Land Management Act 1997*

☐ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land: ______

## Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Cavvanba Environmental P/L

Titles of reports reviewed:

Preliminary Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, February 2017 (Ref#16026 TE R01 V3);

Data Quality Objectives and Sampling, Analysis and Quality Plan – groundwater and soil investigation – Townsend Sewerage Treatment Plant, Lot 2 DP 634170, Corner of Schwonberg and Goodwood Street, Townsend NSW 2463. Cavvanba Consulting, December 2016 (Ref#16026 TE R02);

Detailed Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, August 2017 (Ref#16026 IL R03 V4);

Acid Sulfate Soil Management Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanbah Consulting, July 2017 (Ref#16026 TE R04);

Detailed Site Investigation – Addendum – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, October 2017 (Ref#16026 IL R05);

Remediation Action Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, February 2018 (Ref#16026 IL R06);

Validation Report – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, June 2019 (Ref#16026 IL R08)

Other information reviewed, including previous site audit reports and statements relating to the site:

Review of Environmental Factors, Townsend Sewage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463. Cavvanba Consulting, 2018 (Ref. 16026 TE R07);

NSW Environmental Protection Licence #2507 (1st October 2014) - Townsend Sewerage Treatment;

Report on Preliminary Contamination Assessment, Proposed Decommissioning & Rehabilitation Maclean, Townsend & Ilarwilll STP. Douglas Partners, August 2005 (Ref:39098); and

Redundant Sewer Treatment Plants at Junction Hill (3), South Grafton, Maclean, Ilarwilll and Townsend, Future Land Use Assessment. GHD, June 2010 (Ref#22/15090/14122).

## Site audit report details

Title: Site Audit Report, Townsend Sewerage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463

Report no. DG006 Date 7.6.2019

# Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
    - (B1) the nature and extent of contamination, and/or
    - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
    - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
    - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
    - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

## Section A1

### I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
- ☑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ ~~Day care centre, preschool, primary school~~
- ☐ ~~Residential with minimal opportunity for soil access, including units~~
- ☐ ~~Secondary school~~
- ☐ ~~Park, recreational open space, playing field~~
- ☐ ~~Commercial/industrial~~
- ☐ ~~Other (please specify):~~

---

**OR**

- ☐ I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.

Overall comments:

## Section A2

### I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry
- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other (please specify):

### EMP details

Title

Author

Date                    No. of pages

### EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

- ☐ requires operation and/or maintenance of **active** control systems[3]
- ☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

Purpose of the EMP:

Description of the nature of the residual contamination:

Summary of the actions required by the EMP:

How the EMP can reasonably be made to be legally enforceable:

How there will be appropriate public notification:

Overall comments:

## Section B

Purpose of the plan[4] which is the subject of this audit:

______________________________

______________________________

______________________________

**I certify that, in my opinion:**

(B1)

- ❑ The nature and extent of the contamination **has** been appropriately determined
- ❑ The nature and extent of the contamination **has not** been appropriately determined

AND/OR (B2)

- ❑ The investigation, remediation or management plan **is** appropriate for the purpose stated above
- ❑ The investigation, remediation or management plan **is not** appropriate for the purpose stated above

AND/OR (B3)

- ❑ The site testing plan:
  - ❑ **is** appropriate to determine
  - ❑ **is not** appropriate to determine

  if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

AND/OR (B4)

- ❑ The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):
  - ❑ **have** been complied with
  - ❑ **have not** been complied with.

  *voluntary management proposal no. ______________________________

  **management order no. ______________________________

AND/OR (B5)

- ❑ The site **can be made suitable** for the following uses:

  (Tick all appropriate uses and strike out those not applicable.)
  - ❑ Residential, including substantial vegetable garden and poultry
  - ❑ Residential, including substantial vegetable garden, excluding poultry

---

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☐ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☐ Park, recreational open space, playing field
- ☐ Commercial/industrial
- ☐ Other (please specify):

______________________________

IF the site is remediated/managed* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title ______________________________

Plan author ______________________________

Plan date ______________________________ No. of pages ______________________________

SUBJECT to compliance with the following condition(s):

______________________________

______________________________

______________________________

______________________________

______________________________

Overall comments:

______________________________

______________________________

______________________________

______________________________

______________________________

______________________________

# Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no.

### I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed

Date 21. 6. 19

# Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

## How to complete this form

### Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

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Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

### Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

### Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

*Environmental management plan*

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

*Active or passive control systems*

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

*Auditor's comments*

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

## Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

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In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

## Where to send completed forms

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- the **NSW Environment Protection Authority**: nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND

- the **local council** for the land which is the subject of the audit.

# APPENDIX F

# STATUTORY GUIDELINES

Section 105 of the *Contaminated Land Management Act 1997* (CLM Act) allows the NSW Environmental Protection Authority (EPA) to make or approve guidelines for purposes connected with the objects of the Act. These guidelines must be considered by the EPA, contaminated land consultants and auditors whenever they are relevant.

The current list of guidelines made or approved by the EPA under s105 are listed below and can be accessed from their website at https://www.epa.nsw.gov.au/

## 1.1 Guidelines made by the EPA

Guidelines for the vertical mixing of soil on former broad-acre agricultural land (reprinted June 2003)

Sampling design guidelines (September 1995)

Guidelines for assessing banana plantation sites (reprinted August 2003)

Guidelines for consultants reporting on contaminated sites (reprinted August 2011)

Guidelines for assessing former orchards and market gardens (June 2005)

Guidelines for the NSW Site Auditor Scheme, 3rd edition (October 2017)

Guidelines for the assessment and management of groundwater contamination (March 2007)

Guidelines on the duty to report contamination under the Contaminated Land Management Act 1997 (September 2015)

Note: All references in the EPA's contaminated sites guidelines to the:

Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, October 2000), are replaced as of 29 August 2018 by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, August 2018), subject to the same terms with the exception of the Water quality for primary industries component which still refer to the ANZECC 2000 guidelines; and

National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 1999) are replaced as of 16 May 2013 by the National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013)

subject to the same terms.

## 1.2 Guidelines Approved by the EPA

**Australian and New Zealand Government (ANZG)**

Australian and New Zealand Guidelines for Fresh and Marine Water Quality, published by ANZG (August 2018)

Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Water Quality for primary industries (ANZECC 2000)

**EnHealth publications (formerly National Environmental Health Forum monographs)**

Composite sampling, Lock, W. H., National Environmental Health Forum Monographs, Soil Series No.3, 1996, SA Health Commission, Adelaide. Email enHealth.Secretariat@health.gov.au for an electronic copy of this publication.

Environmental health risk assessment: Guidelines for assessing human health risks from environmental hazards, Department of Health and Ageing and EnHealth Council, Commonwealth of Australia (2012)

**National Environment Protection Council (NEPC)**

National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013) including Schedule A (Recommended General Process for the Assessment of Site Contamination) and Schedule B (Guidelines) which include.

Guideline on investigation levels for soil and groundwater

Guideline on site characterisation

Guideline on laboratory analysis of potentially contaminated soils

Guideline on site-specific health risk assessment methodology

Guideline on ecological risk assessment

Guideline on methodology to derive ecological investigation levels in contaminated soils

Guideline on ecological investigation levels for arsenic, chromium(iii), copper, DDT, lead, naphthalene, nickel and zinc

Guideline on the framework for risk-based assessment of groundwater contamination

Guideline on derivation of health-based investigation levels

Guideline on community engagement and risk communication

Guideline on competencies and acceptance of environmental auditors and related professionals

**Other Documents**

Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes, NSW Agriculture and CMPS&F Environmental (February 1996)

Australian Drinking Water Guidelines, NHMRC and Natural Resource Management Ministerial Council of Australia and New Zealand (2011)

GEO_LOGIX PTY LTD
ABN 86 116 892 936

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Warriewood NSW 2102

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**Email** info@geo-logix.com.au
**Web** www.geo-logix.com.au

NSW Site Auditor Scheme

# Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

## Part I: Site audit identification

Site audit statement no. DG006

This site audit is a:

☑ statutory audit

☐ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

### Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name: David Gregory

Company: Geo-Logix Pty Ltd

Address: Unit 2309/4 Daydream Street, Warriewood, NSW

Postcode 2102

Phone (02) 9979 1722

Email dgregory@geo-logix.com.au

### Site details

Former Townsend Sewerage Treatment Facility, Corner Schwonberg and Goodwood Streets, Townsend, NSW

Postcode 2463

## Property description

(Attach a separate list if several properties are included in the site audit.)

Lot 2 DP 634170

Local government area: Clarence Valley Council

Area of site (include units, e.g. hectares) 3 Ha

Current zoning: SP2

## Regulation and notification

To the best of my knowledge:

☐ **the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985,* as follows: (provide the no. if applicable)

- ☐ Declaration no.
- ☐ Order no.
- ☐ Proposal no.
- ☐ Notice no.

☑ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985.*

To the best of my knowledge:

☐ the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

☑ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997.*

## Site audit commissioned by

Name Shaun Zimmerman

Company Ledonne Constructions P/L

Address 28 Hyde Street, South Grafton NSW

Postcode 2460

Phone: 66433240

Email shaun@ledonne.com.au

**Contact details for contact person** (if different from above)

Name ______________________________

Phone ______________________________

Email ______________________________

**Nature of statutory requirements** (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land ~~Management Act~~ 1997* (e.g. management order; ~~please specify~~, including date of issue)

______________________________

______________________________

☐ Requirements imposed by an environmental ~~planning~~ instrument (please specify, including date ~~of issue~~)

______________________________

______________________________

☐ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority ~~and date of issue~~)

______________________________

______________________________

☑ Requirements under other legislation (please specify, including date of issue)

Condition of the Surrender of a Licence (EPL 3661) under Section 80(1) Protection of the Environment Operations Act 1997. Date of issue 23rd January 2017

______________________________

## Purpose of site audit

☑ **A1** To determine land use suitability

Intended uses of the land: Residential A

OR

**A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land: ________________

OR

(Tick all that apply)

☐ **B1** To determine the nature and extent of contamination

☐ **B2** To determine the appropriateness of:

- ☐ an investigation plan
- ☐ a remediation plan
- ☐ a management plan

☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

☐ **B4** To determine the compliance with an approved:

- ☐ **voluntary management proposal** or
- ☐ **management order** under the *Contaminated Land Management Act 1997*

☐ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land: ________________

## Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Cavvanba Environmental P/L

Titles of reports reviewed:

Preliminary Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, February 2017 (Ref#16026 TE R01 V3);

Data Quality Objectives and Sampling, Analysis and Quality Plan – groundwater and soil investigation – Townsend Sewerage Treatment Plant, Lot 2 DP 634170, Corner of Schwonberg and Goodwood Street, Townsend NSW 2463. Cavvanba Consulting, December 2016 (Ref#16026 TE R02);

Detailed Site Investigation – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, August 2017 (Ref#16026 IL R03 V4);

Acid Sulfate Soil Management Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanbah Consulting, July 2017 (Ref#16026 TE R04);

Detailed Site Investigation – Addendum – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, October 2017 (Ref#16026 IL R05);

Remediation Action Plan – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, February 2018 (Ref#16026 IL R06);

Validation Report – Townsend STP, Corner of Schwonberg and Goodwood Streets, Townsend NSW 2463. Cavvanba Consulting, June 2019 (Ref#16026 IL R08)

Other information reviewed, including previous site audit reports and statements relating to the site:

Review of Environmental Factors, Townsend Sewage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463. Cavvanba Consulting, 2018 (Ref. 16026 TE R07);

NSW Environmental Protection Licence #2507 (1st October 2014) - Townsend Sewerage Treatment;

Report on Preliminary Contamination Assessment, Proposed Decommissioning & Rehabilitation Maclean, Townsend & Ilarwilll STP. Douglas Partners, August 2005 (Ref:39098); and

Redundant Sewer Treatment Plants at Junction Hill (3), South Grafton, Maclean, Ilarwilll and Townsend, Future Land Use Assessment. GHD, June 2010 (Ref#22/15090/14122).

## Site audit report details

Title: Site Audit Report, Townsend Sewerage Treatment Plant, Corner of Schwonberg and Goodwood Streets, Townsend, NSW 2463

Report no. DG006 Date 7.6.2019

# Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
  - (B1) the nature and extent of contamination, and/or
  - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
  - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
  - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
  - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

## Section A1

### I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
- ☑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ ~~Day care centre, preschool, primary school~~
- ☐ ~~Residential with minimal opportunity for soil access, including units~~
- ☐ ~~Secondary school~~
- ☐ ~~Park, recreational open space, playing field~~
- ☐ ~~Commercial/industrial~~
- ☐ ~~Other (please specify):~~

**OR**

☐ I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.

Overall comments:

## Section A2

### I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ❑ Residential, including substantial vegetable garden and poultry
- ❑ Residential, including substantial vegetable garden, excluding poultry
- ❑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ❑ Day care centre, preschool, primary school
- ❑ Residential with minimal opportunity for soil access, including units
- ❑ Secondary school
- ❑ Park, recreational open space, playing field
- ❑ Commercial/industrial
- ❑ Other (please specify):

______________________________

### EMP details

Title ______________________________

Author ______________________________

Date ______________ No. of pages ______________

### EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

- ❑ requires operation and/or maintenance of **active** control systems[3]
- ❑ requires maintenance of **passive** control systems only[3].

---

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

Purpose of the EMP:

Description of the nature of the residual contamination:

Summary of the actions required by the EMP:

How the EMP can reasonably be made to be legally enforceable:

How there will be appropriate public notification:

Overall comments:

## Section B

Purpose of the plan[4] which is the subject of this audit:

______________________________________________

______________________________________________

______________________________________________

**I certify that, in my opinion:**

(B1)

❑ The nature and extent of the contamination **has** been appropriately determined

❑ The nature and extent of the contamination **has not** been appropriately determined

AND/OR (B2)

❑ The investigation, remediation or management plan **is** appropriate for the purpose stated above

❑ The investigation, remediation or management plan **is not** appropriate for the purpose stated above

AND/OR (B3)

❑ The site testing plan:

- ❑ **is** appropriate to determine
- ❑ **is not** appropriate to determine

if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

AND/OR (B4)

❑ The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):

- ❑ **have been** complied with
- ❑ **have not** been complied with.

*voluntary management proposal no. ______________________________

**management order no. ______________________________

AND/OR (B5)

❑ The site **can be made suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ❑ Residential, including substantial vegetable garden and poultry
- ❑ Residential, including substantial vegetable garden, excluding poultry

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

- ❑ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ❑ Day care centre, preschool, primary school
- ❑ Residential with minimal opportunity for soil access, including units
- ❑ Secondary school
- ❑ Park, recreational open space, playing field
- ❑ Commercial/industrial
- ❑ Other (please specify):

______________________________

IF the site is remediated/managed* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title ______________________________

Plan author ______________________________

Plan date ______________________________ No. of pages ______________________________

SUBJECT to compliance with the following condition(s):

______________________________

______________________________

______________________________

______________________________

______________________________

Overall comments:

______________________________

______________________________

______________________________

______________________________

______________________________

______________________________

# Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no.

**I certify that:**

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
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  AND

- the **local council** for the land which is the subject of the audit.

# VOLUME 4

## Traffic & Parking Assessment

PLANNERS NORTH

1707.3198

# Maclean Highway Service Centre

## Traffic Impact Assessment

Hargreaves Property Group

25 March 2021

**Gold Coast**
Suite 26, 58 Riverwalk Avenue
Robina QLD 4226
P: (07) 5562 5377

**Brisbane**
Level 2, 428 Upper Edward Street
Spring Hill QLD 4000
P: (07) 3831 4442

**Sydney**
Studio 203, 3 Gladstone Street
Newtown NSW 2042
P: (02) 9557 6202

**W**: www.bitziosconsulting.com.au
**E**: admin@bitziosconsulting.com.au



## Document Issue History

| Report File Name | Prepared | Reviewed | Issued | Date | Issued to |
|---|---|---|---|---|---|
| P4539.001R Maclean Service Centre TIA.docx | K. Wu | SP. Power | M. Hearne | 14/05/2020 | daniel@hargreavesproperty.com.au |
| P4539.002R Maclean Service Centre TIA.docx | K. Wu | SP. Power | M. Hearne | 29/05/2020 | daniel@hargreavesproperty.com.au |
| P4539.003R Maclean Service Centre TIA.docx | M. Hearne | SP. Power | M. Hearne | 19/06/2020 | daniel@hargreavesproperty.com.au |
| P4539.004R Maclean Service Centre TIA.docx | M. Hearne | SP. Power | M. Hearne | 23/06/2020 | daniel@hargreavesproperty.com.au |
| P4539.005R Maclean Service Centre TIA.docx | M. Hearne | SP. Power | M. Hearne | 29/06/2020 | daniel@hargreavesproperty.com.au |
| P4539.006R Maclean Service Centre TIA.docx | M. Hearne | SP. Power | M. Hearne | 09/03/2021 | daniel@hargreavesproperty.com.au |
| P4539.007R Maclean Service Centre TIA.docx | M. Hearne | M. Hearne | M. Hearne | 25/03/2021 | daniel@hargreavesproperty.com.au |
| P4539.008R Maclean Service Centre TIA.docx | M. Hearne | M. Hearne | M. Hearne | 25/03/2021 | daniel@hargreavesproperty.com.au |

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## Tables

## Figures



## Appendices

# 1. Introduction

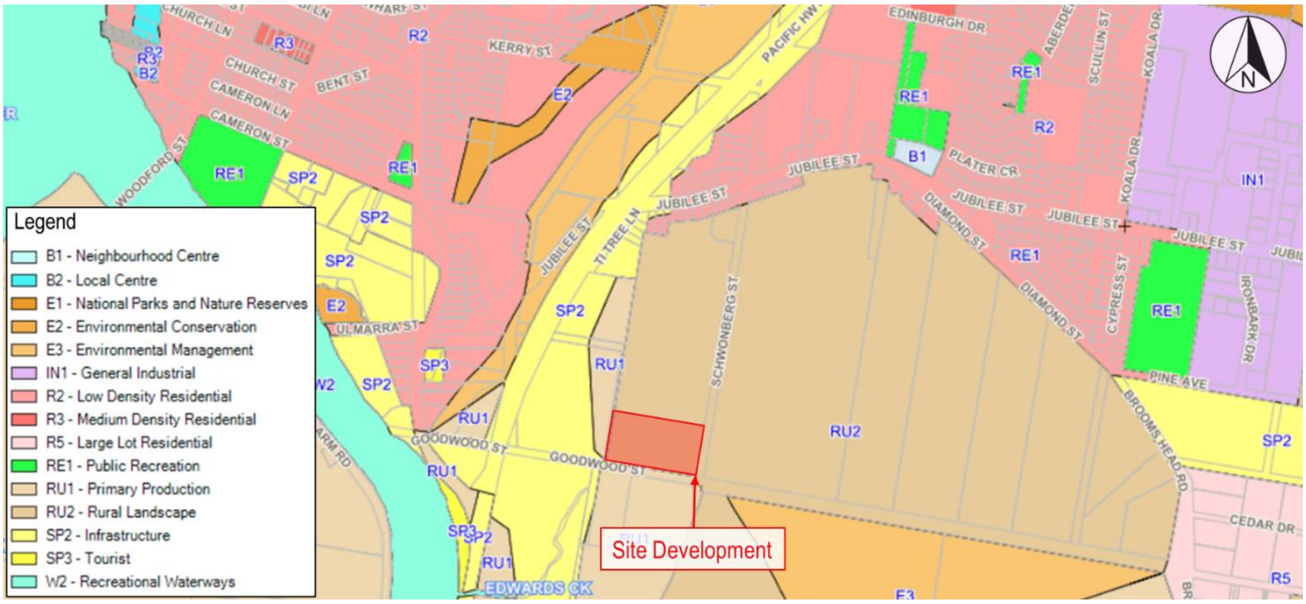
## 1.1 Background

Bitzios Consulting has been commissioned by Hargreaves Property Group to undertake a traffic impact assessment (TIA) for a proposed highway service centre located at the north west corner of the Goodwood Street / Schwonberg Street intersection in Townsend, New South Wales. Bitzios has provided design advice to inform the preliminary design and this advice will be reiterated in this report. The location of the proposed development site is illustrated in Figure 1.1.


*Aerial image sourced from Google Maps*

**Figure 1.1 Site Location**

The site is located within the Clarence Valley Council local government area. A map of the land zoning within the area of the subject site is presented in Figure 1.2.

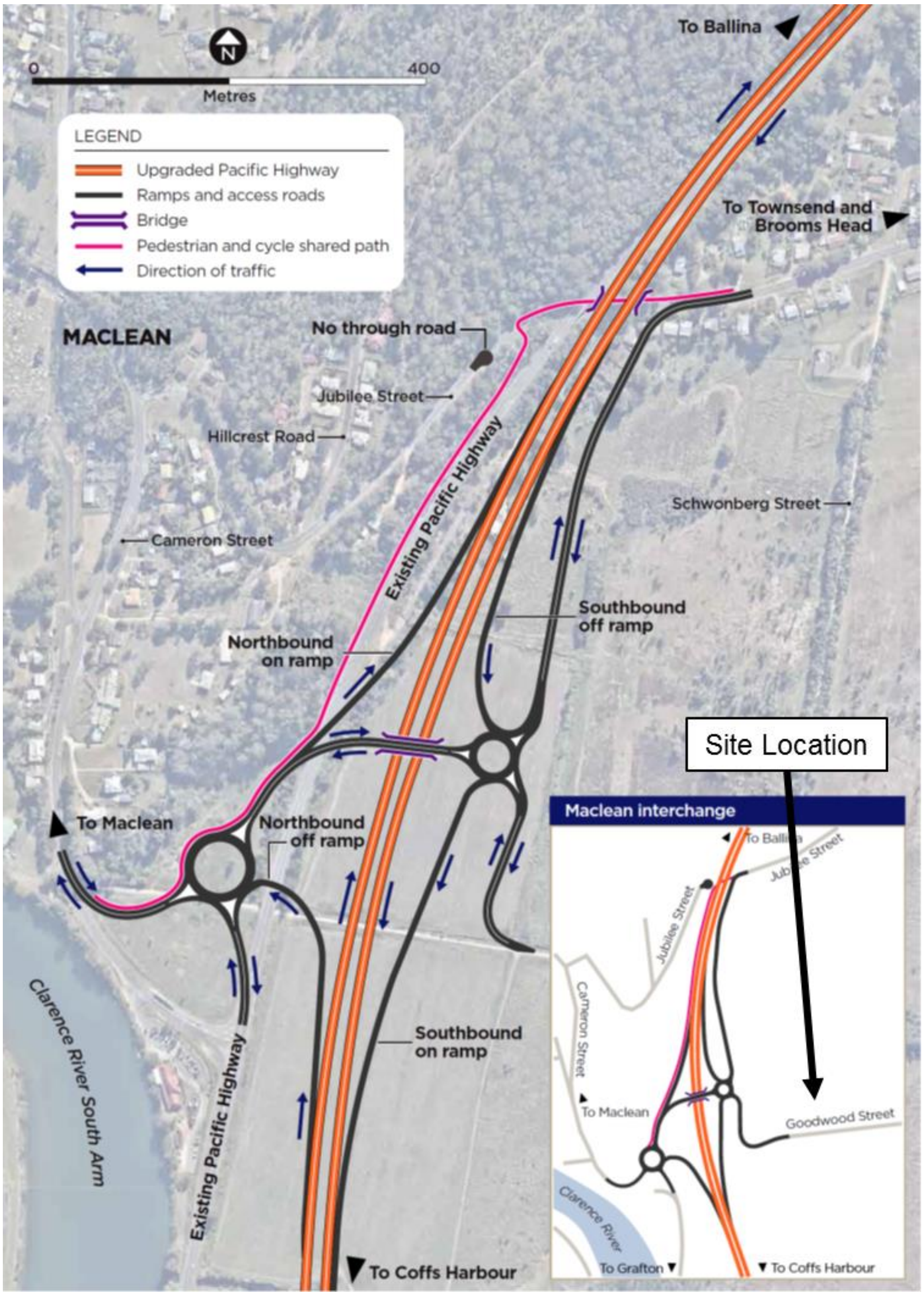



*Sourced from Clarence Valley Council LEP*

**Figure 1.2 Land Zoning Map**

It is noted that the site is within a Rural Landscape land use zone and the developer intends to submit a re-zoning application.

The site is located approximately 400m from the Pacific Highway and the Maclean Interchange. Goodwood Street and Pacific Highway are linked by a pair of roundabouts which provide connections to the north and south, as well as Maclean and Townsend. The arrangement of the Maclean Interchange and its relation to the highway service centre is presented in Figure 1.3.




*Sourced from Transport for NSW*

**Figure 1.3 Woolgoolga to Ballina Pacific Highway Upgrade Layout - Maclean Interchange**

## 1.2 Development Details

### 1.2.1 Existing Development

The current site is unused and does not have any regular visitors. It was previously occupied by a sewerage treatment plant which was removed, drained, and remediated. The site and surrounding area is occupied with rural landscape.

### 1.2.2 Preliminary Proposed Development

The preliminary proposed development has a total site area of 30,075m$^2$ and the indicative floor use is summarised in Table 1.1.

**Table 1.1: Indicative Proposed Development Floor Use**

| Floor Use | Floor Area or Quantity |
|---|---|
| Fuel Shop | 240m2 |
| Restaurant 1 | 200m$^2$ |
| Restaurant 2 | 175m$^2$ |
| Seating Area | 215m$^2$ |
| Amenities | 70m$^2$ |
| Children's Play Area | 55m$^2$ |
| **Total** | **900m$^2$** |
| Car Spaces | 57 |
| Truck Spaces | 25 |
| Bus Spaces | 4 |
| Bike Spaces | 16 |

The proposed development preliminary design plans are attached in **Appendix A**.

## 1.3 Scope

The scope of this assessment includes the following:

- Estimation of the development's traffic generation and distribution onto the external road network
- Assessment of the development's traffic impacts
- Assessment of the site access location and form
- Assessment of the parking provision and layout for general traffic
- Assessment of the loading area layout and service vehicle manoeuvring
- Providing commentary on the existing and future transport network such as surrounding road hierarchy, and public and active transport.

# 2. EXISTING ROAD CONDITIONS

## 2.1 Road Network

Details of the road network surrounding the subject site is presented in Table 2.1

**Table 2.1: Surrounding Road Network Hierarchy**

| Road Name | Jurisdiction | Hierarchy | No. of Lanes (two-way) | Speed Limit |
|---|---|---|---|---|
| Goodwood Street | Clarence Valley Council | Local Access Road | 1 | 50km/h |
| Schwonberg Street | Clarence Valley Council | Local Access Road | 1 | 50km/h |
| Common Road east of Goodwood Street | Clarence Valley Council | Local Access Road | 1 | 50km/h |
| Pacific Highway | Transport for NSW | State Highway | 2 | 100km/h |
| Jubilee Street | Clarence Valley Council | Local Collector | 1 | 50km/h |
| Cameron Street | Clarence Valley Council | Local Collector | 1 | 50km/h |

### 2.1.1 Goodwood Street

Goodwood Street is a two-way one lane unsealed road and runs along the frontage to the proposed site location. Goodwood Street connects to the Maclean Interchange via one of the roundabouts (Figure 1.3), providing the main connection from both Maclean and the highway to the site. Goodwood Street also has access via Schwonberg Street. It has an assumed speed limit of 50km/h. Goodwood Street primarily services private property. There are no pedestrian facilities along this unsealed road.

### 2.1.2 Schwonberg Street

Schwonberg Street is a two-way one lane unsealed narrow road with access to the site. It is an unclassified road with connectivity from Jubilee Street towards the north and Goodwood Street towards the south. Schwonberg Street primarily services private property. There are no pedestrian facilities along this unsealed road. Site observations indicated that Schwonberg street saw no usage by vehicles or pedestrians.

### 2.1.3 Common Road

Common Road is an unsealed narrow road with access at the corner of Goodwood Street / Schwonberg Street. There are no pedestrian facilities along this road. The road discontinues with no formal connection to Boom Head Road to the east at Townsend.

### 2.1.4 Pacific Highway

Pacific Highway is a two-way highway with two lanes in each direction, with road shoulders on each side. Pacific Highway is a classified state road with a speed limit of 100km/h, providing wide connectivity as a north-south corridor. There are no pedestrian facilities along this road. The highway is accessed via the Maclean Interchange, which consists of ,two roundabouts linked by a bridge, and on and off ramps providing seamless connectivity between Maclean to the west, and Townsend and the development site to the east. The Maclean Interchange has direct connectivity to Goodwood Street, Jubilee Street, and Cameron Street.

The interchanges northbound and southbound on and off ramps are one lane, with the roundabouts featuring a wide one circulation lane.

### 2.1.5 Jubilee Street

Jubilee Street is a two-way, one lane road that previously provided connectivity from the Townsend CBD to Maclean through an underpass of the Pacific Highway. Jubilee Street is now split into two sides by the highway:

- The side west of the highway is a no-through road that services residential properties along that street by providing a route to Maclean
- The side east of the highway is the main connection from Townsend to the highway and also to the proposed service centre site.

### 2.1.6 Cameron Street

Cameron Street is a two-way, one lane road primarily providing connectivity from Maclean and to the Pacific Highway. Cameron Street is a local collector road with a speed limit of 50km/h. Cameron Street primarily services the Maclean town area. There are no footpaths along Cameron Street.

## 2.2 Parking

Goodwood Street and Schwonberg Street both feature unsealed roads with no formal indication of parking restrictions. As there are no residences or developments within the surrounding rural area, it is likely that there is very low parking demand.

# 3. Alternative Transport

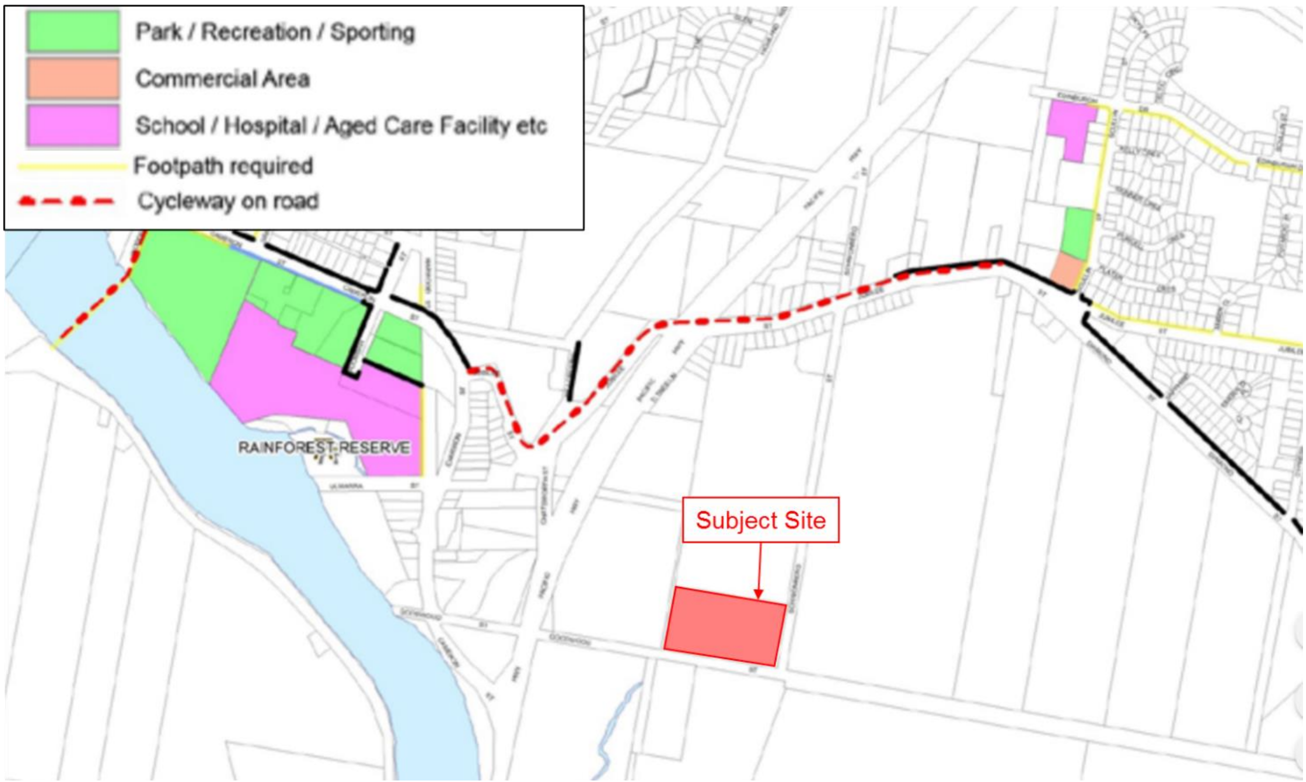
## 3.1 Active Transport

### 3.1.1 Pedestrian Facilities

There are very limited pedestrian facilities within the surrounding area of the subject site. The immediate roads providing access to the site, Goodwood Street and Schwonberg Street are unsealed roads within the rural landscape land use zone and are undeveloped. The surrounding road network, including the Pacific Highway, also does not have pedestrian facilities.

### 3.1.2 Cycle Facilities

There are no cycling routes or facilities within the surrounding area of the subject site. As part of the *Clarence Valley Council Bicycle Plan 2015*, several routes have been identified to be developed to provide connectivity for cyclists, as presented in Figure 3.1




*Source: Clarence Valley Council Bicycle Plan 2015*

**Figure 3.1 Clarence Valley Council Bicycle Plan 2015 – Maclean**

There is a pedestrian and cyclist shared path on the western side of the highway and can be seen in Figure 1.3. This provides a cycling option for people approaching from the north.

## 3.2 Public Transport

### 3.2.1 Railway Services

There are no rail services within the close proximity of the site. The nearest train station is over 37km distance from the site.

### 3.2.2 Bus Services

There are no bus stops within close proximity of the subject site. The nearest bus stops are within the Maclean and Townsend CBD areas, over 1.5km from the site. Furthermore, there is limited pedestrian connectivity from the site to these bus stops.

# 4. Traffic Assessment

## 4.1 Overview

For the purposes of this assessment, the traffic analysis will assess the impacts of the development to the surrounding road network post Pacific Highway upgrade works. The base case in this project was the upgrade case as the only traffic data available was in the upgrade scenario. At this time this traffic assessment was undertaken, the upgrade works had not been completed and collecting the usual traffic data for this project was not feasible.

## 4.2 Traffic Volume Data

Traffic data was provided by the Woolgoolga to Ballina project team from Pacific Complete, a consortium of Laing O'Rourke and Parsons Brinkerhoff that was engaged by Roads and Maritime Services to deliver the Woolgoolga to Ballina Pacific Highway Upgrade. They provided modelling data in the form of an extract from the *Operational Noise Review report Section 6.2.4.* This report contained modelling information of the post-opening interchange, and this formed the basis of the data for this assessment.

The traffic data provided by Pacific Complete was of the highway in its upgraded state. As a result, the base case model for this project was of the upgraded highway without the development.

Traffic surveys were unable to be undertaken for this project due to:

- Substantially reduced traffic volumes due to government travel restrictions in response to the COVID-19 pandemic
- The Maclean Interchange project not yet being fully operational.

As part of the Woolgoolga to Ballina Pacific Highway upgrade works, traffic surveys were undertaken at the existing Pacific Highway prior to construction in 2011. The traffic and noise reviews forecasted for an expected opening year of the Maclean Interchange in 2019. The data was provided in day (7am to 10pm) and night (10pm to 7am) traffic periods. For the purpose of the assessment, only the day traffic period was considered.

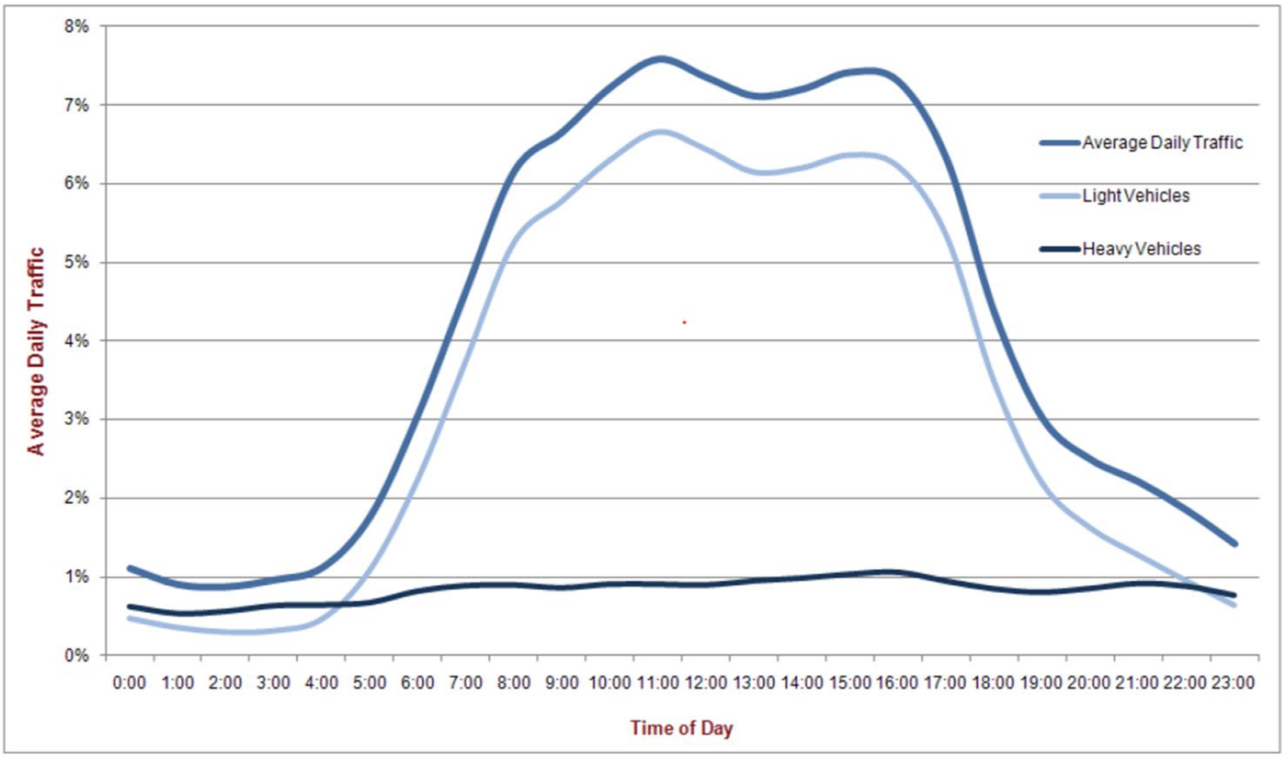
The relevant traffic data is summarised in Table 4.1.

**Table 4.1: Forecasted 2019 Traffic Data – Day Period (7am to 10pm)**

| Road | Direction | Light Vehicles | Heavy Vehicles | Total Vehicles |
|---|---|---|---|---|
| Maclean (South Facing Ramps) | NB | 760 | 114 | 874 |
| | SB | 675 | 101 | 776 |
| Maclean (North Facing Ramps) | NB | 1153 | 172 | 1325 |
| | SB | 1389 | 208 | 1597 |
| Maclean (Interchange Link) | EB | 1771 | 175 | 1946 |
| | WB | 2121 | 210 | 2331 |
| Cameron Street | EB | 421 | 69 | 490 |
| | WB | 415 | 67 | 482 |
| Jubilee Street | EB | 131 | 112 | 243 |
| | WB | 119 | 102 | 221 |

*Source: Woolgoolga to Ballina Pacific Highway upgrade Operational Noise Review RMS 2018*

A profile of traffic on the Pacific Highway between Woolgoolga and Ballina is illustrated in Figure 4.1.




Source: *Woolgoolga to Ballina | Pacific Highway Upgrade Environmental Impact Statement Main Volume 1B Chapter 14 – Traffic and transport NSW RMS 2012*

**Figure 4.1 Profile of Traffic on the Pacific Highway between Woolgoolga and Ballina**

The *Operational Noise Review report* provided the traffic data as total traffic volume along each approach and the corresponding percentage of heavy vehicles. These heavy vehicle percentages were applied to the respective approaches in this to inform the SIDRA modelling. As the heavy vehicle percentage used is sourced from an approved noise model used in the planning of the Maclean Interchange project, it is considered appropriate to directly use these percentages in the model to assess the impacts of the development.

The overall average heavy vehicle percentage for this development is 13.8%.

### 4.2.1 Peak Periods

Using the profile in Figure 4.1, the assumed peak hour periods were taken as the following:

- **AM Peak Hour:** 11am to 12pm
- **PM Peak Hour:** 3pm to 4pm.

These peak hour periods produce the largest, or worst-case, traffic volumes.

## 4.3 Traffic Volumes

### 4.3.1 Predicted Volumes 2023

For the project case of the traffic assessment, a year of opening of 2023 was selected for the development. A trend analysis of the population estimates within the Maclean area was undertaken to predict the change of volume from 2019 to 2023, the anticipated opening year of the development.

The trend analysis developed a growth factor by taking an average of the percentage growth of population estimates sourced for Maclean from profile.id, which gathers its data from census results. This growth factor was applied linearly to the 2019 population estimate for four years to reach a predicted 2023 year population. The effective growth of the population from 2019 to 2023 was calculated to be a 1.55% increase.

As the traffic data provided was for a day period (7am to 10pm), a peak hour factor was required to calculate the peak hour period volumes. This peak hour factor was developed as a proportion of the average daily traffic for the assumed AM (11am to 12pm) and PM (3pm to 4pm) hour periods with the total 15-hour period (7am to 10pm) average daily traffic. The factors were calculated to be 8.61% and 8.50% for the AM and PM peaks respectively. These factors were applied to the predicted 2023 volumes to reach predicted 2023 peak hour volumes for the AM and PM peaks.

### 4.3.2 Turn Movement Distribution

As turn flow distributions were not provided within the traffic data, an analysis was undertaken to estimate the turning movement volumes at the Maclean Interchange. Additionally, there were no forecasted traffic volumes for the existing Pacific Highway leg. These turn movement volumes were developed using a first principles approach and interpolated from the provided data and surrounding attractors and generators.

A summary of the predicted 2023 peak hour volume distribution for the AM and PM peak hours is presented in Figure 4.2 and Figure 4.3, and appended in **Appendix B**.

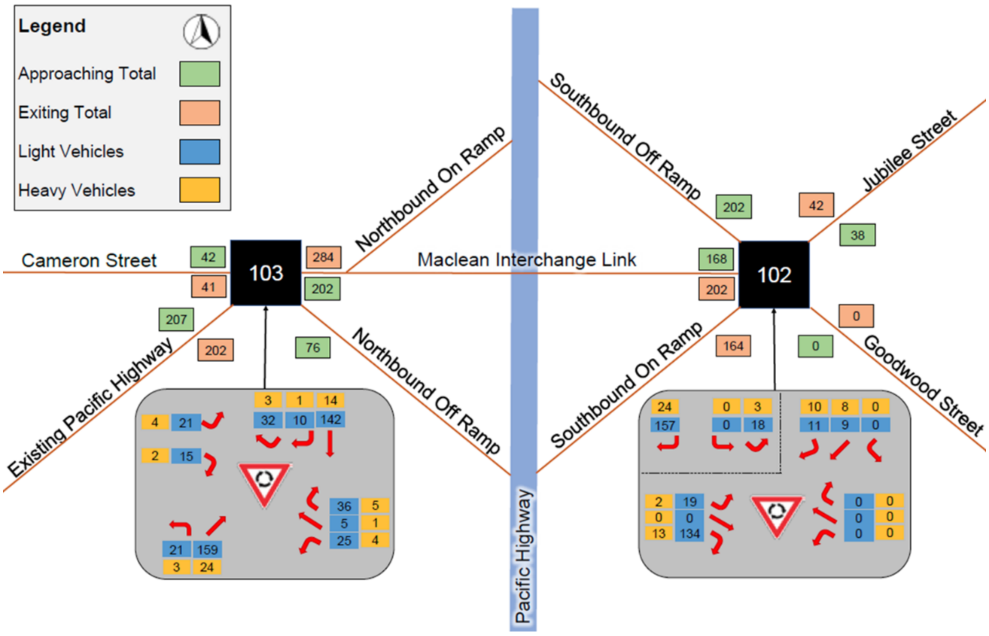



**Figure 4.2** **Predicted 2023 Year Traffic Volumes - AM Peak Hour**

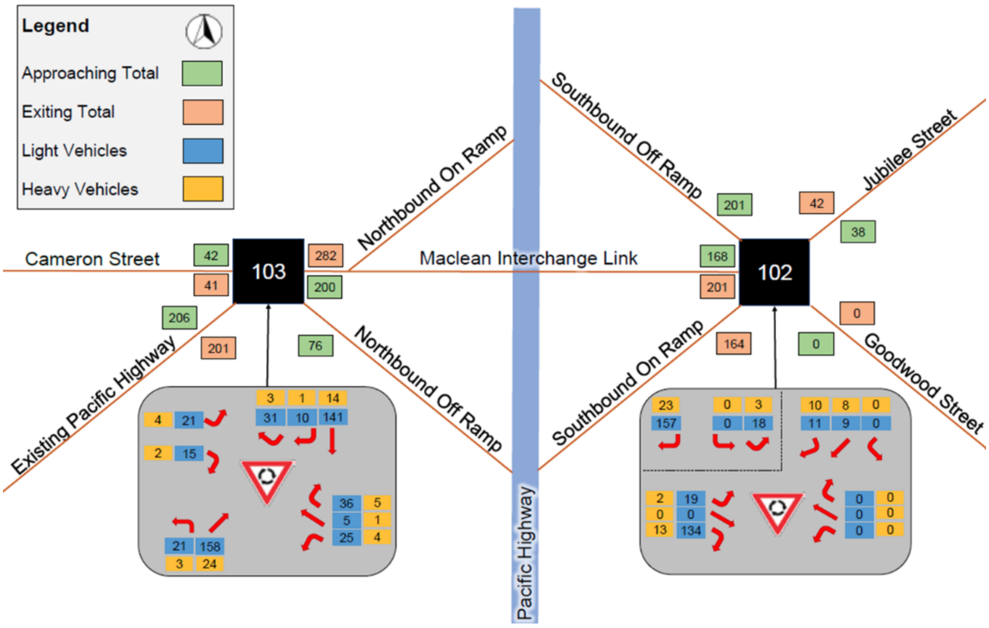



**Figure 4.3** **Predicted 2023 Year Traffic Volumes - PM Peak Hour**

### 4.3.3 Turn Movement Distribution Methodology and Assumptions

The first principles method for calculating the turn movements involved the following steps:

- The available turn movement volumes from each approach were assumed to be the proportion of the outflow at one exit with all other available outflows from that approach
- An Excel solver was used to simultaneously solve each variable output with the calculated proportions, assuming that all turn movements to and from Goodwood Street had no volume, and that all turn movement flows exiting a site must equal to the output flow from the traffic data
- As the sourced traffic data did not present a situation where the total inflows and outflows were equal at an intersection, likely due to undertaking traffic data on different dates and being provided in day period traffic flows, the total inflows were larger than the total outflows. As such, additional traffic volumes were distributed to the exit movements for the eastern roundabout at the northeast and south legs, Jubilee Street and the Southbound On-Ramp respectively.

## 4.4 Development Traffic

### 4.4.1 Existing Trip Generation

The site is currently vacant, and as such, there are no existing trips generated during the peak hour periods from the subject site.

### 4.4.2 Development Trip Generation

Trip generation for the proposed development was calculated using rates provided in the *Roads and Maritime Services Guide to Traffic Generating Developments (GTGD 2002)*.

A summary of the proposed developments land use and its trip generation is provided in Table 4.2.

**Table 4.2: Proposed Development Trip Generation**

| Floor Use | Land Use | Total GFA | AM Peak Trip Generation Rate | PM Peak Trip Generation Rate | AM Peak Generated Traffic Volume | PM Peak Generated Traffic Volume |
|---|---|---|---|---|---|---|
| Fuel Shop | Service Stations | 240m2 | 0.63 x 0.66 x GFA* | 0.66 x GFA | 100 | 158 |
| Restaurant 2 | Restaurants | $375m^2$ | 180 vehicles/hr per food outlet | 180 vehicles/hr per food outlet | 360 | 360 |
| Restaurant 3 | | | | | | |
| Seating Area | N/A | | | | | |
| Amenities | N/A | | | | | |
| **Total Proposed Development Trips** | | | | | **460 Trips** | **518 Trips** |

* Note: *Based on the proportion of surveyed evening to morning total trip percentages within the Roads and Maritime Services Guide to Traffic Generating Developments (GTGD 2002)*

### 4.4.3 Trip Split Distribution

The generated traffic trips for each peak were further split up into incoming and outgoing trips.

Incoming and outgoing service station traffic splits of 50% to 50% during the AM and PM peak respectively. This is because fuel shops are likely to have a high turnover rate.

Incoming and outgoing restaurants traffic splits of 50% to 50% were assumed during the AM peak. This is because the drive through restaurants are likely to be fast food, which will most likely have a high turnover rate. For the PM peak, the incoming and outgoing restaurant splits were assumed to be 60% to 40%. This is because restaurants open during this time will likely attract people staying to dine for a lengthier period than in the morning peak times.

The table of the split values and the calculated traffic volumes is shown in Table 4.3 and Table 4.4.

**Table 4.3: Proposed Development Trip Split Distribution – AM**

| Land Use | Incoming | | | | Outgoing | | | |
|---|---|---|---|---|---|---|---|---|
| | Split | Light | Heavy (%) | Total | Split | Light | Heavy (%) | Total |
| Service Station | 50% | 43 | 7 (14.0%) | 50 | 50% | 43 | 7 (14.0%) | 50 |
| Restaurant | 50% | 154 | 26 (14.4%) | 180 | 50% | 157 | 23 (12.8%) | 180 |
| **Total Trips** | | **197** | **33** | **230** | | **200** | **30** | **230** |

**Table 4.4: Proposed Development Trip Split Distribution – PM**

| Land Use | Incoming | | | | Outgoing | | | |
|---|---|---|---|---|---|---|---|---|
| | Split | Light | Heavy (%) | Total | Split | Light | Heavy (%) | Total |
| Service Station | 50% | 68 | 11 (13.9%) | 79 | 50% | 68 | 11 (13.9%) | 79 |
| Restaurant | 60% | 185 | 31 (14.4%) | 216 | 40% | 125 | 19 (13.2%) | 144 |
| **Total Trips** | | **253** | **42** | **295** | | **193** | **30** | **223** |

### 4.4.4 Trip Distribution

All incoming traffic must enter via Goodwood Street as this is the location of access driveways, which has connectivity via the Pacific Highway. Given the development is a highway service centre primarily providing vehicle refuelling, food options, or as a rest location, it is highly likely that users of the development will arrive via Pacific Highway and Goodwood Street. Schwonberg Street is an unsealed narrow road with limited connectivity to other local roads therefore it will not be the primary route for visitors to the site. It is not suitable for regular vehicle traffic, and was blocked by a tree during a site inspection. Additionally, Google Maps indicates that the route from the Jubliee Street / Schwonberg Street intersection to the proposed site is the same travel time (2 minutes) and distance (1.1km). It is also noted that Schwonberg Street is effectively one-way with limited road width for vehicles to pass each other. As such, it is assumed that all traffic accessing the site will be via Goodwood Street and the Maclean Interchange to the west.

### 4.4.5 Trip Generation Summary

The generated trips from the development are summarised in the stick diagrams presented in Figure 4.4 and Figure 4.5, and appended in **Appendix B**.

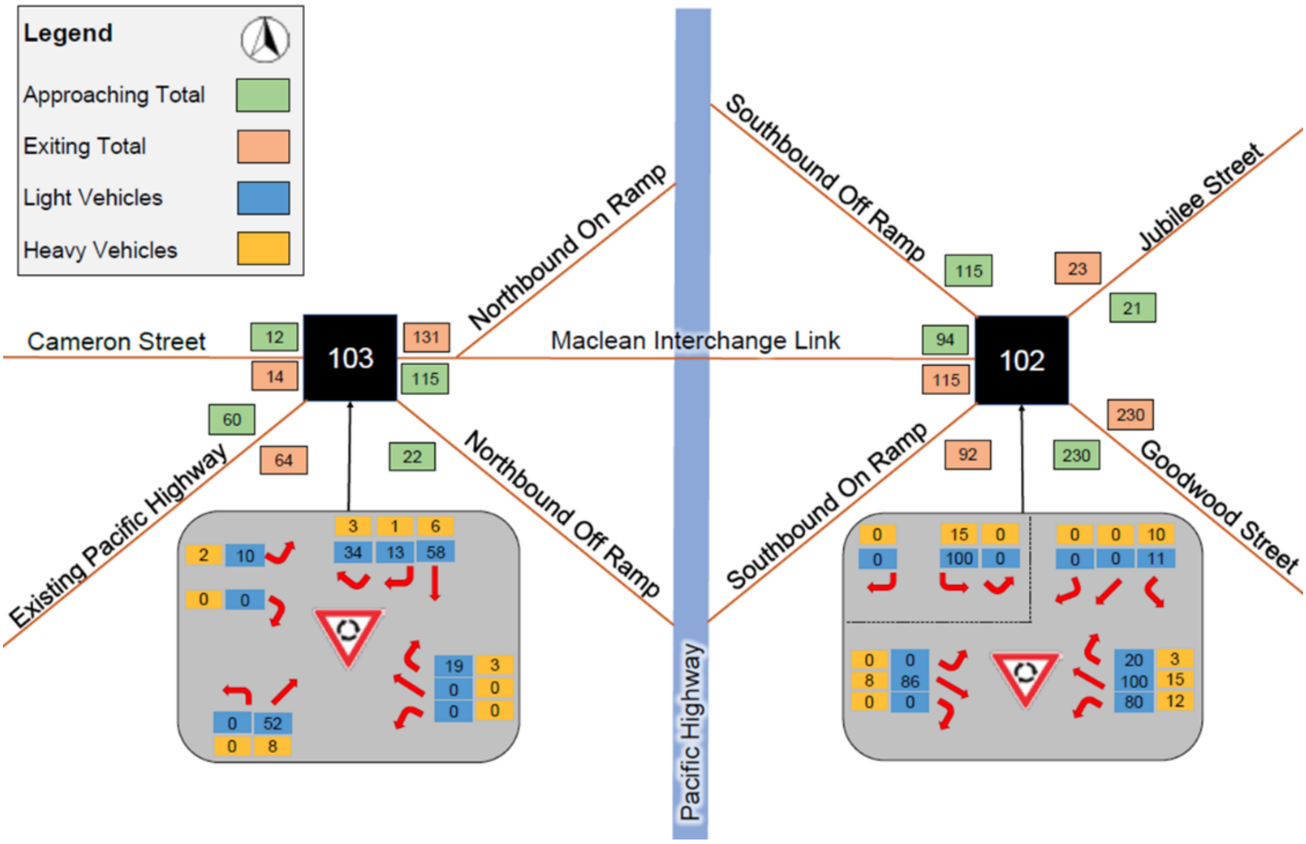



**Figure 4.4** Development Trip Generation - AM Peak Hour

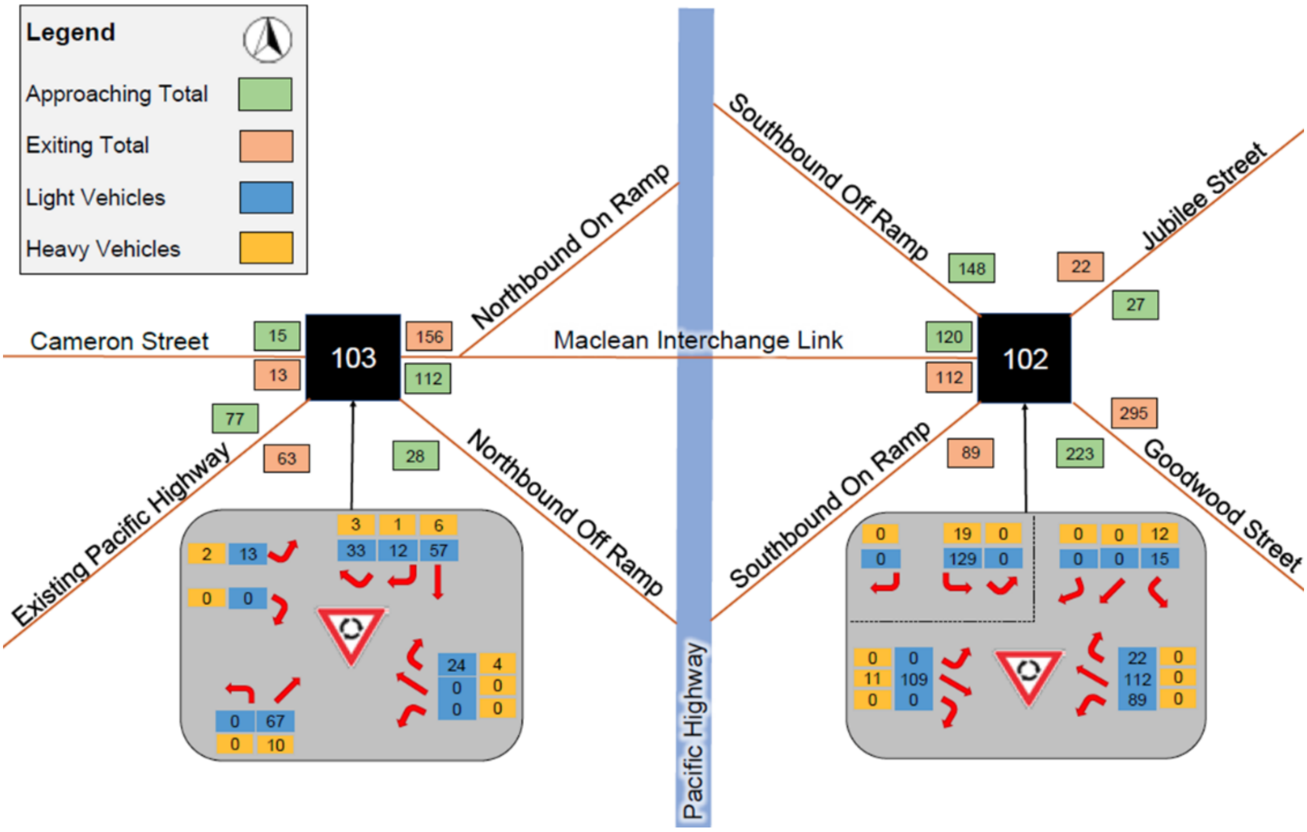



**Figure 4.5** Development Trip Generation - PM Peak Hour

# 5. TRAFFIC MODELLING

## 5.1 Scenarios

SIDRA models were prepared for the following scenarios:

- **Base Case:** traffic conditions based on the Pacific Highway upgrade works layout and traffic data with the predicted 2023 year volumes without development
- **Project Case:** proposed development opening year 2023 traffic conditions with the same intersection layouts as the base case model, including the development traffic
- **Future Case:** future traffic conditions for 2033, 10 years after the opening year of the project, including same intersection layouts as the project case model, however, with volumes increased by 2% per year

The models were prepared for the following intersections:

- Maclean Interchange Eastern Roundabout.
- Maclean Interchange Western Roundabout.

The models were prepared for the following peak periods:

- **AM Peak:** 11:00am to 12:00pm
- **PM Peak:** 3:00pm to 4:00pm.

## 5.2 Modelling Methodology

Each model scenario was prepared for the AM and PM peak volumes.

As the site development is located before the intersection at Goodwood Street / Schwonberg Street, modelling the adjacent intersection will be unnecessary as there are expected to be no existing trips utilising this intersection in all scenarios, as summarised in Section 4.3.2. As such, the Goodwood Street / Schwonberg Street was not included in the network of the model.

Intersection layouts were based on the Woolgoolga to Ballina Pacific Highway upgrade works design plans provided by Transport for NSW. The SIDRA intersections are available in **Appendix C**. Both roundabouts feature one wide circulatory lane with only one lane for each approach and exit.

The turn movements available at each intersection was based on the layout of the Woolgoolga to Ballina Pacific Highway upgrade works provided. It was assumed that vehicles would not use an on-ramp and immediately access an off-ramp and vice versa.

The base case model is based on the upgraded Maclean Interchange opening year with no development. Validation for this project consisted of sense check of the magnitude of queues and delays to be comparable with what is to be expected for a rural model of this location. The base case model will feature as an initial comparison for other scenarios, and a volume growth factor was added to the forecasted 2019 traffic to reach a more critical scenario for 2023 year volumes.

The project case model will provide direct comparison from the base case model with additional generated trips from the development only. This will increase volumes at the Goodwood Street leg, and these trips have been distributed throughout the network.

To assess the long-term operation of the proposed development, a future case model provides an indication of how the network will perform using a 10 year design life scenario. A 2% linear growth factor was applied each year to the volumes based on a nominal rate accepted by the RMS. While this growth rate may seem excessive as it does not align with the population growth of the surrounding area, it provides a robust assessment of the network as a worst case scenario.

## 5.3 Base Case Model Development

### 5.3.1 Base Case Model SIDRA Inputs

The settings of the base models were:

- ‘Current Setup’ was set to New South Wales
- Site Level of Service Method was set to ‘RTA NSW Delays’
- Physical features of the existing intersection geometries were determined using Nearmap aerial imagery, and the layouts defined by the Woolgoolga to Ballina Pacific Highway upgrade works Maclean Interchange design plans
- Vehicle volumes were predicted for the year 2023 based on the obtained forecasted 2019 traffic volumes from the Woolgoolga to Ballina Pacific Highway upgrade works
- Default values for Basic Saturation Flow were used
- Speed limits were input as per existing posted speed limits at each site

### 5.3.2 Base Case Model Layout

SIDRA model layouts reflected the physical features of the intersection geometries based on the latest Nearmap aerial images and the Woolgoolga to Ballina Pacific Highway upgrade works Maclean Interchange design plans. Site pictures and Google Street View were used to determine parking arrangements.

No volumes are expected to be entering Goodwood Street, and the turn movements to and from this leg have been removed in the base case model layout.

An overview for the SIDRA site layouts is presented in Figure 5.1.

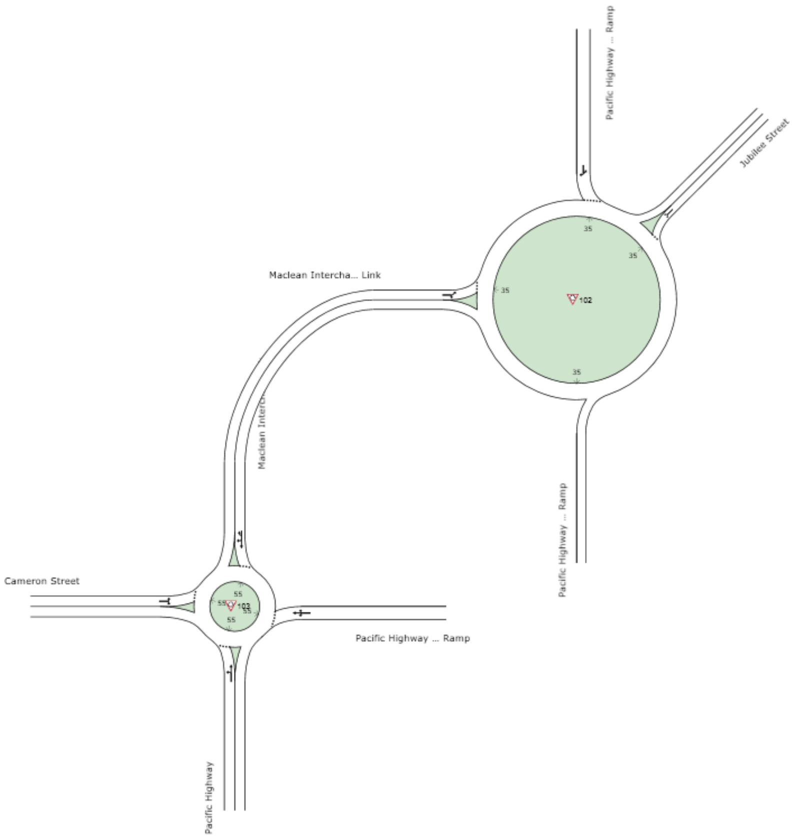



**Figure 5.1** **Base Case Model SIDRA Layout Overview**

**Appendix C** contains details on the SIDRA intersection layouts and lane turn movements used.

### 5.3.3 Base Case Model Calibration and Validation

At the time this assessment was undertaken, the Maclean Interchange upgrade was in progress. The model that was created was based on the proposed final arrangement of the Maclean Interchange. As the service centre would not be operational before the upgrade was completed, there would be no benefit in modelling the pre-upgrade conditions.

The standard traffic surveys that would usually be undertaken for a traffic assessment of this nature were not undertaken due to government travel restrictions resulting from the COVID-19 pandemic which reduced typical traffic volumes to a point where they would not be reflective of typical traffic conditions. Furthermore, as the upgraded interchange was under construction during this assessment, any calibration would be arbitrary. The traffic data was appropriately modified to reach a critical and reasonable scenario that would allow as reasonable of an assessment as could be undertaken given the limitations experienced.

### 5.3.4 Base Case Model Results

The modelled intersection performance results for the base case model in the AM and PM peak is summarised in Table 5.1 and Table 5.2.

**Table 5.1: Base Case Model Interchange Performance – AM Peak**

| Intersection | Approach | Volume (veh/h) | Average Delay (s) | Level of Service | Degree of Saturation |
|---|---|---|---|---|---|
| Eastern Roundabout | North | 214 | 9.4 | A | 0.168 |
| | Northeast | 40 | 8.9 | A | 0.049 |
| | West | 180 | 8.5 | A | 0.104 |
| | **All Vehicles** | **434** | **9.0** | **A** | **0.168** |
| Western Roundabout | North | 214 | 4.4 | A | 0.129 |
| | East | 80 | 7.0 | A | 0.059 |
| | South | 220 | 2.6 | A | 0.151 |
| | West | 44 | 6.5 | A | 0.035 |
| | **All Vehicles** | **558** | **4.3** | **A** | **0.151** |

**Table 5.2: Base Case Model Interchange Performance – PM Peak**

| Intersection | Approach | Volume (veh/h) | Average Delay (s) | Level of Service | Degree of Saturation |
|---|---|---|---|---|---|
| Eastern Roundabout | North | 212 | 9.4 | A | 0.165 |
| | Northeast | 40 | 8.9 | A | 0.049 |
| | West | 177 | 8.5 | A | 0.102 |
| | **All Vehicles** | **428** | **9.0** | **A** | **0.165** |
| Western Roundabout | North | 211 | 4.4 | A | 0.127 |
| | East | 80 | 7.0 | A | 0.059 |
| | South | 217 | 2.6 | A | 0.149 |
| | West | 44 | 6.5 | A | 0.035 |
| | **All Vehicles** | **552** | **4.3** | **A** | **0.149** |

As seen in Table 5.1 and Table 5.2, each approach has a Level of Service (LoS) of A. The average delays and the degree of saturation are observed to be very low.

This indicates that with the provided volumes, there is sufficient spare capacity within the network.

## 5.4 Project Case Model Development

### 5.4.1 Project Case Model Summary

The project case model differs from the base case model in that, traffic volumes include the generated trips from the development. The intersection layout remains identical to the base case model, with additional turn movements to and from Goodwood Street to accommodate the additional trips generated by the proposed development.

The development generated trips were distributed into the network using the same proportions of the incoming and outgoing flows for each approach within the base case. As summarised in Section 4.4.2, it is expected that all generated development trips remain within the west of the site along Goodwood Street and Pacific Highway.

The turn movement volumes are appended in **Appendix B**, and the SIDRA turn movement layout appended in **Appendix C**.

## 5.5 Comparison of Intersection Performance Results

The performance of the project case intersection results under AM and PM peak traffic conditions are compared with the base case results in Table 5.3 and Table 5.4 respectively.

The detailed SIDRA intersection results including pedestrian movement performance results are appended in **Appendix D**.

**Table 5.3: Comparison of Base Case and Project Case Model Results – AM Peak**

| Intersection | Approach | Base Case Model | | | Project Case Model | | |
|---|---|---|---|---|---|---|---|
| | | Average Delay | Level of Service | Degree of Saturation | Average Delay | Level of Service | Degree of Saturation |
| Eastern Roundabout | North | 9.4 | A | 0.168 | 8.1 | A | 0.283 |
| | Northeast | 8.9 | A | 0.049 | 10.4 | A | 0.096 |
| | East | 0 | A | 0.000 | 6.6 | A | 0.246 |
| | West | 8.5 | A | 0.104 | 6.7 | A | 0.180 |
| | **All Vehicles** | **9.0** | **A** | **0.168** | **7.4** | **A** | **0.283** |
| Western Roundabout | North | 4.4 | A | 0.129 | 5.2 | A | 0.199 |
| | East | 7.0 | A | 0.059 | 8.2 | A | 0.081 |
| | South | 2.6 | A | 0.151 | 3.0 | A | 0.208 |
| | West | 6.5 | A | 0.035 | 6.5 | A | 0.050 |
| | **All Vehicles** | **4.3** | **A** | **0.151** | **4.9** | **A** | **0.208** |

**Table 5.4: Comparison of Base Case and Project Case Model Results – PM Peak**

| Intersection | Approach | Base Case Model | | | Project Case Model | | |
|---|---|---|---|---|---|---|---|
| | | Average Delay | Level of Service | Degree of Saturation | Average Delay | Level of Service | Degree of Saturation |
| Eastern Roundabout | North | 9.4 | A | 0.165 | 7.9 | A | 0.314 |
| | Northeast | 8.9 | A | 0.049 | 11.0 | A | 0.111 |
| | East | 0 | A | 0.000 | 6.5 | A | 0.238 |
| | West | 8.5 | A | 0.102 | 6.4 | A | 0.195 |
| | **All Vehicles** | **9.0** | **A** | **0.165** | **7.3** | **A** | **0.314** |
| Western Roundabout | North | 4.4 | A | 0.127 | 5.1 | A | 0.196 |
| | East | 7.0 | A | 0.059 | 8.3 | A | 0.086 |
| | South | 2.6 | A | 0.149 | 3.0 | A | 0.220 |
| | West | 6.5 | A | 0.035 | 6.5 | A | 0.053 |
| | **All Vehicles** | **4.3** | **A** | **0.149** | **4.9** | **A** | **0.220** |

## 5.6 Project Case Model Results

In the base case, it is expected that no vehicles would be accessing Goodwood Street, and as such, experiences no delays. In the project case, within the AM and PM peak, additional vehicles are distributed in the network including Goodwood Street and as a result increases the degree of saturation of the intersection as expected. It is observed that the average delays decrease at the eastern roundabout but increase in the western roundabout.

The comparison of results show that there is a slight increase in delays at the western roundabout, however, all approaches and the overall intersection performance remain at LoS A in the project case in both peak hours.

The results indicate that the development will introduce minimal delays to the network in the opening year.

## 5.7 Future Case Model Development

### 5.7.1 Future Case Model Summary

To assess a 10 year design life of the proposed development, a future case model was developed. The future case model differs from the project case model in that, an annual linear growth of 2% was applied to all volumes. The intersection layout and turn proportions remain identical to the project case model.

## 5.8 Comparison of Intersection Performance Results

The performance of the future case intersection results under AM and PM peak traffic conditions are compared with the project case results in Table 5.5 and Table 5.6 respectively.

The detailed SIDRA intersection results including pedestrian movement performance results are appended in **Appendix D**.

**Table 5.5: Comparison of Project Case and Future Case Model Results – AM Peak**

| Intersection | Approach | Project Case Model | | | Future Case Model | | |
|---|---|---|---|---|---|---|---|
| | | Average Delay | Level of Service | Degree of Saturation | Average Delay | Level of Service | Degree of Saturation |
| Eastern Roundabout | North | 8.1 | A | 0.283 | 8.5 | A | 0.352 |
| | Northeast | 10.4 | A | 0.096 | 12.0 | A | 0.130 |
| | East | 6.6 | A | 0.246 | 7.4 | A | 0.316 |
| | West | 6.7 | A | 0.180 | 6.7 | A | 0.218 |
| | **All Vehicles** | **7.4** | **A** | **0.283** | **7.9** | **A** | **0.352** |
| Western Roundabout | North | 5.2 | A | 0.199 | 5.2 | A | 0.240 |
| | East | 8.2 | A | 0.081 | 8.5 | A | 0.101 |
| | South | 3.0 | A | 0.208 | 3.2 | A | 0.257 |
| | West | 6.5 | A | 0.050 | 7.0 | A | 0.064 |
| | **All Vehicles** | **4.9** | **A** | **0.208** | **5.0** | **A** | **0.257** |

**Table 5.6: Comparison of Project Case and Future Case Model Results – PM Peak**

| Intersection | Approach | Base Case Model | | | Project Case Model | | |
|---|---|---|---|---|---|---|---|
| | | Average Delay | Level of Service | Degree of Saturation | Average Delay | Level of Service | Degree of Saturation |
| Eastern Roundabout | North | 7.9 | A | 0.314 | 8.3 | A | 0.393 |
| | Northeast | 11.0 | A | 0.111 | 12.8 | A | 0.154 |
| | East | 6.5 | A | 0.238 | 7.3 | A | 0.307 |
| | West | 6.4 | A | 0.195 | 6.4 | A | 0.236 |
| | **All Vehicles** | **7.3** | **A** | **0.314** | **7.8** | **A** | **0.393** |
| Western Roundabout | North | 5.1 | A | 0.196 | 5.1 | A | 0.236 |
| | East | 8.3 | A | 0.086 | 8.6 | A | 0.107 |
| | South | 3.0 | A | 0.220 | 3.3 | A | 0.271 |
| | West | 6.5 | A | 0.053 | 7.0 | A | 0.069 |
| | **All Vehicles** | **4.9** | **A** | **0.220** | **5.1** | **A** | **0.271** |

## 5.9 Future Case Model Results

The comparison of results show that there are slight increases to delay at each approach, with the largest increases observed in the northeast approach at the eastern roundabout, and the west approach at the western roundabout, in both peaks. There are also slight increases to the degree of saturation with the largest increases observed at the north and east approaches in the eastern roundabout, and the north and south approach for the western roundabout, in both peaks.

While delay and the degree of saturation are slightly increased at all approaches, the impacts are minimal and the LoS remains A even in a 10-year future scenario. This indicates sufficient spare capacity within this network including the growth and operation of the development.

# 6. Access Assessment

## 6.1 Overview

### 6.1.1 Vehicular Access and Egress

The vehicular access and egress points for the proposed development are both on Goodwood Street. Trucks and regular vehicles utilise a common entry driveway but egress the site via separate exit driveways. The truck and light vehicle refuelling and parking areas are separated.

The layout of the access and egress area is shown in Figure 6.1, and appended in **Appendix A**.

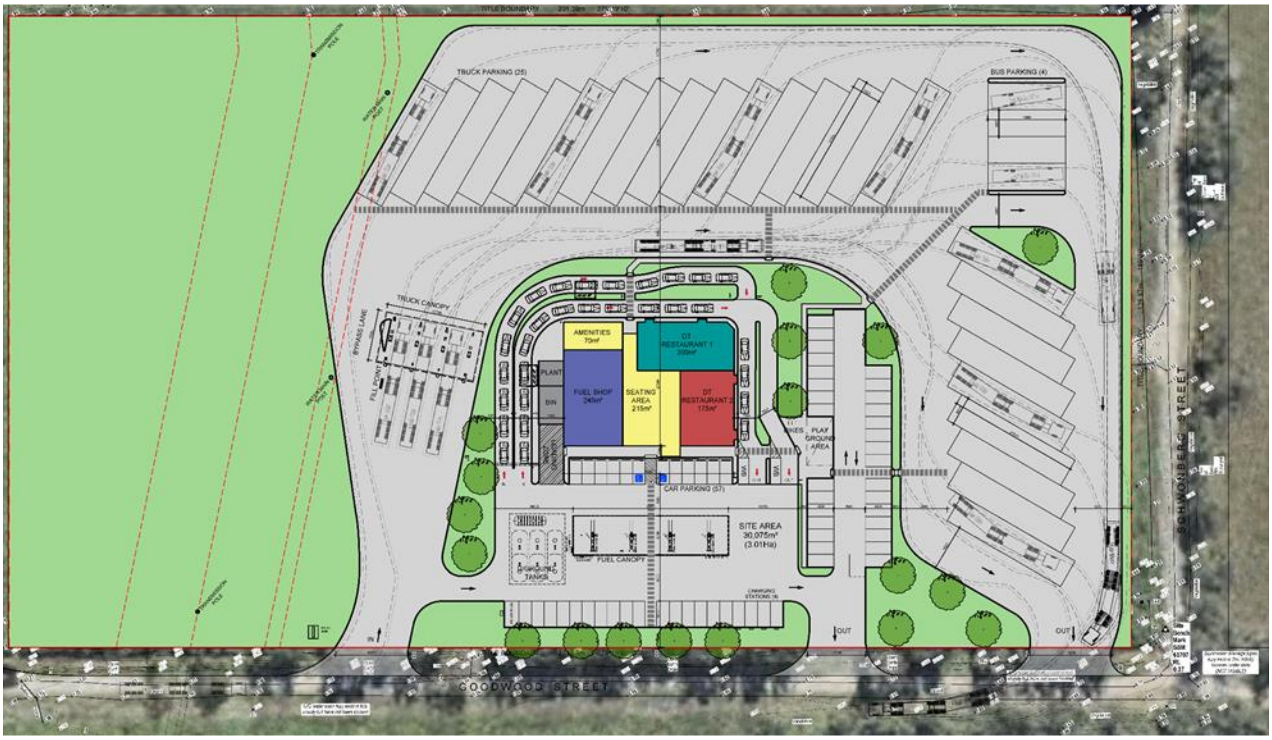



**Figure 6.1 Preliminary Design Layout**

### 6.1.2 Pedestrian and Bicycle Access

Pedestrians and cyclists will be accessing the site via the same driveways as vehicles. Given the nature of the site development as a highway rest location or service centre and the road design of Goodwood Street and Schwonberg Street, it is highly likely that all visitors would arrive to the site via a vehicle. As such, it is expected that the pedestrian access facilities to the site are minimal. There are pedestrian crossings and walkways available to and from the car parks and car refuel stations to the restaurant and fuel shop area.

### 6.1.3 Servicing

It is expected that the site will be serviced by trucks which include:

- Refuse truck for garbage collection
- Delivery vehicles for restaurant and fuel shop within the development.

Based on the Clarence Valley Council Waste Not Development Policy, the Council's bulk bin service truck, a 12.3m front-lift loading refuse collection vehicle (RCV), will undertake collection for waste on-site.

It is anticipated that a 12.5m service vehicle (HRV), will service the site for deliveries.

It is expected that all service trucks will use the loading zone provided.

## 6.2 Design Assessment

### 6.2.1 Access Compliance

The design layout and configuration of the access driveways and internal aisles were checked for compliance against the Clarence Valley Council DCP and AS 2890.1, AS2890.2, AS2890.6.

The following components were checked against AS2890 series design criteria including:

- Aisle Width
- Sight lines.

**User Classes**

The design vehicles likely to access the site include the following:

- 26.0m B-Double
- 12.3m RCV
- 12.5m HRV
- 5.2m B99
- 4.91 B85.

The proposed development indicates the classification, User Class 3A, as defined by AS2890.1: "Full opening, all doors. Additional allowance above minimum single manoeuvre width to facilitate entry and exit".

**Aisle Widths**

Table 6.1 summarises the compliance assessment for the proposed car park arrangement. All dimensions are in millimetres. Noting that, the largest design vehicle requirements the standards provide is for an A-Triple vehicle.

**Table 6.1: Access Compliance Assessment**

| Item | Minimum Requirement (mm) | Provision (mm) | Compliance |
|---|---|---|---|
| Site Access Driveway | 10000 | 15000 | Compliant |
| Facilities Access | 3000 | 4900 | Compliant |
| Site Egress Driveway | 10000 | 16820 | Compliant |
| Facilities Egress | 3000 | 12000 | Compliant |
| Driveway Separation | 3000 | 78940 | Compliant |

**Sight Lines**

For a 50km/h road, the clear sight distance required is 69m. This is satisfied by the proposed development.

The vehicle sight lines required are illustrated in Figure 6.2.

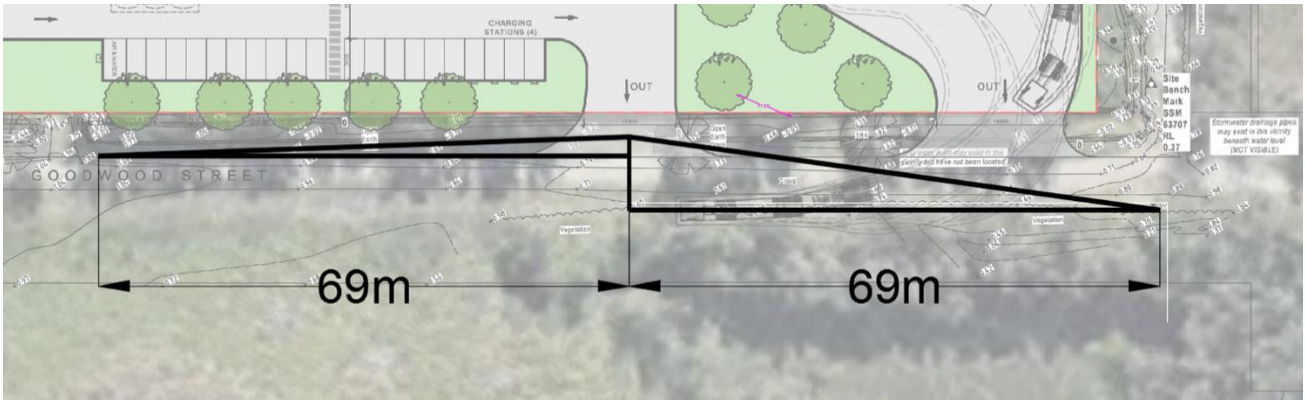



**Figure 6.2** **Vehicle Sight Lines (main egress)**

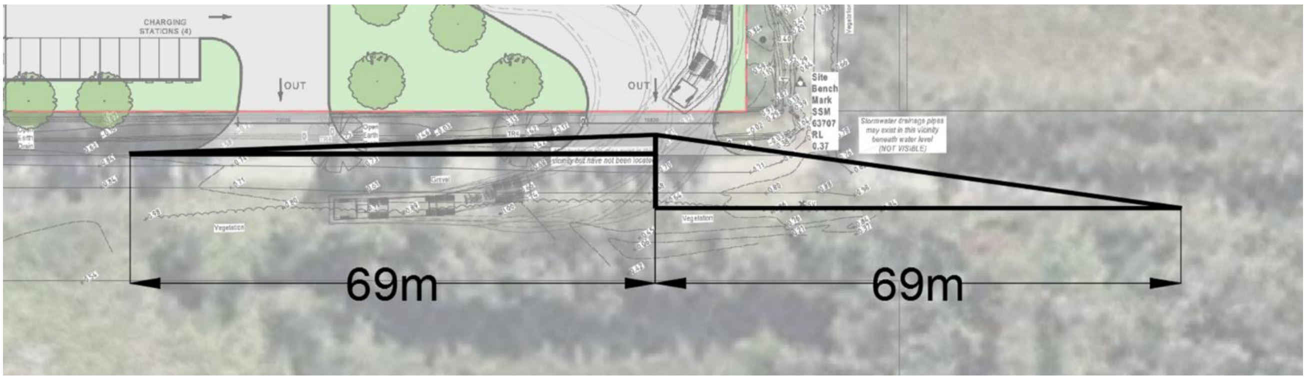



**Figure 6.3** **Vehicle Sight Lines (truck and bus egress)**

The provided sight lines are able to maintain clear sight distances without obstruction to the access driveway towards the west and the Goodwood Street / Schwonberg Street intersection to the east, and is therefore deemed adequate. It is assumed that site clearing of the existing trees on the side of the Goodwood Street road will be undertaken in providing the proposed road design. If these existing trees are maintained, it is anticipated that sight lines will be obstructed by a few trees.

### 6.2.2 Swept Path Analysis

Due to the preliminary stage of the design plans, basic swept paths were undertaken for the access of vehicles, including trucks entering and exiting their parking spaces. The preliminary swept paths indicated that trucks could successfully enter and exit their parking spaces. Some swept paths showed that some trucks may very slightly enter adjacent parking spaces. This is considered to be a negligible issue as:

- The parking spaces are significantly wider and longer than the B-Doubles themselves
- Swept paths are often conservative compared to real-world conditions and it is likely that the vehicles will complete tighter manoeuvres than indicated on the drawings
- In our experience in other projects, swept paths will often fail in AS2890-compliant parking areas due to the swept paths being even more conservative than the standards' car park dimensions

It is therefore our opinion that the swept paths slightly encroaching on adjacent spaces is effectively a non-issue and is not sufficient reason to withhold LEP modification, especially since this is a more high-level assessment than a DA application. During the DA stage, swept paths can be undertaken on the updated design drawings.

Initial swept paths also indicated that that B-doubles turning into the site will encroach on the other side of the road, however, it is expected that Goodwood Street is to be upgraded in order to be able to accommodate the operational traffic to the facility.

# 7. Parking Assessment

## 7.1 Overview

The *Clarence Valley Council Business Zones Development Control Plan (DCP) 2011* outlines a range of vehicle parking rates for land uses in order to regulate parking provisions. Certain requirements are needed for each land use for bicycle, car, and truck parking provisions. The development's car parking design layout was also assessed against AS2890.1, AS2890.2, and AS2890.6.

The parking layout is provided in **Appendix A**.

## 7.2 Parking Requirements and Provisions

### 7.2.1 Parking Space Provision

The Clarence Valley Council DCP does not strictly stipulate parking rates for highway service centres. The required parking provisions has been split for the varying land uses contained within the proposed development. The Transport for NSW document *Highway Service Centres Along the Pacific Highway* Section 1.5 stipulates a minimum of 25 parking spaces for heavy vehicles, and a number of parking spaces for recreation vehicles and coaches. The development includes 25 parking spaces that fit 26 metre B-double sized vehicles, and 4 parking spaces for buses/recreational vehicles.

The parking requirement rates, total amount of parking spaces required, and the number of parking spaces provided in the proposed development are shown in Table 7.1.

**Table 7.1: Parking Space Assessment**

<table>
<tr><th>Type</th><th>Rate</th><th>Quantity</th><th>Requirement</th><th>Proposed Spaces</th></tr>
<tr><td>Restaurant</td><td>- 1 car space/30m² GFA<br>- 1 service vehicle space/400m² GFA</td><td>375m²</td><td>- 13 car spaces<br>- 1 service vehicle space</td><td rowspan="3">- 51 car spaces<br>- 1 service vehicle space<br>- 4 charging stations<br>- 1 air & water station<br>- 2 PWD spaces<br>- 25 truck spaces<br>- 4 Bus/recreation vehicle spaces</td></tr>
<tr><td>Service Station</td><td>- 3 space/work bay<br>- 1 space per 30m2 GFA for convenience store<br>- 1 space per 3 seats for a restaurant</td><td>240m²</td><td>- 0<br>- 8 car spaces<br>- To be confirmed</td></tr>
<tr><td>Highway Service Centre</td><td colspan="3">- 25 heavy vehicles parking spaces<br>- A number of parking spaces for recreation vehicles and coaches</td></tr>
<tr><td colspan="3">Total</td><td>21 + spaces required for seating area<br>1 service vehicle space<br>25 truck spaces<br>Multiple bus/RV spaces</td><td>58 car spaces<br>1 service vehicle space<br>25 truck spaces<br>4 Bus/RV spaces</td></tr>
</table>

The working estimation for number of seats for this facility is 105 restaurant seats.

Currently, of the 56 car spaces available, 13 of them are assigned to the restaurant, and 8 to the service station. The remaining 35 spaces can be assigned to the seating area, which would be adequate for 35 x 3 = 105 restaurant seats.

### 7.2.2 Pedestrian and Cyclist Requirements

The Council DCP does not have specific bicycle parking provisions required. A total of 16 bicycle parking spaces supplied.

## 7.3 Parking Design Compliance

The following components were checked against AS2890 series design criteria including:

- Parking dimensions
- Aisle widths
- Barriers, including bollards and wheel stops.

**User Classes**

The design vehicles likely to access the site for parking include the following:

- 26.0m B-Double
- 12.3m RCV
- 12.5m HRV
- 5.2m B99
- 4.91 B85.

The proposed development indicates the classification, User Class 3A, as defined by AS2890.1: "Full opening, all doors. Additional allowance above minimum single manoeuvre width to facilitate entry and exit".

**Design Compliance**

**Table 7.2: Parking Compliance Assessment**

| Item | Space Type / Number | Minimum Requirement (AS2890) | Provision | Compliance |
|---|---|---|---|---|
| **Parking Dimensions** | | | | |
| Space Dimensions | Car Park Spaces (Northern Row) | 2600 x 5400 | 2600 x 5400 | Compliant |
| | Car Park Spaces (Southern Row) | 2600 x 5400 | 2600 x 5400 | Compliant |
| | Car Park Spaces (East) | 2600 x 5400 | 2600 x 5400 | Compliant |
| | PWD & Shared Area | 2400 x 5400 | 2600 x 5400 | Compliant |
| | Loading Zone | 3500 x 12500 | 5000 x 12500 | Compliant |
| | Heavy Vehicle Parking Spaces | 2500 x 26000 | 6000 x 27000 | Compliant |

| | | | | |
|---|---|---|---|---|
| **Aisle Width** | | | | |
| Parking Aisle | Northern Row | 6600 | 6500 | Can Comply (See Note 1) |
| | Southern Row | 6600 | 9500 | Compliant |
| | East | 6600 | 6500 | Can Comply (See Note 2) |
| Blind Aisle | East | 1000 | 1100 | Compliant |
| Car Circulating Roadway | | 3000 | 4900 | Compliant |
| Truck Circulating Roadway | | 6500 | 8800 | Compliant |
| **Barriers, including Bollards and Wheel Stops** | | | | |
| Bollard | PWD Shared Zone Space | 800±50 from front of space | 500 from front of space | See Note 3 |
| Wheel Stops | Car Park Spaces (Northern Row) | 1100 or 1110 from end of space | 500 from end of space | See Note 4 |

*Dimensions are in millimetres*

### Compliance Notes

1. While the parking aisle width is insufficient, it is expected that the fuel canopy can be shifted south by 100mm to comply, a simple fix for a future iteration of the design.
2. The indicative design plans can easily be modified to address this compliance when the for-construction drawings are prepared.
3. It is understood that the bollard locations are indicative. It is expected that the bollards locations can be moved to comply.
4. It is understood that the wheel stop locations are indicative. It is expected that the bollards locations can be moved to comply.

# 8. Summary

The proposed development was assessed under traffic and transport design principles, with reference to the Clarence Valley Council Development Control Plan, Roads and Maritime Services Guidelines, and Australian Standards. The key findings of the assessment include:

**Development**

- The development is proposed to be located on the north western corner of Goodwood Street / Schwonberg Street.
- The area has limited public transport options as expected in a rural location
- The proposed development is a highway service centre, including a fuel shop, drive through restaurants, and a seating area
- The Maclean Interchange was completed in 2020 and is the is the primary access point for vehicles reaching the site. At the time of preparation of the traffic assessment, this interchange was still under construction and was not yet completed.

**Traffic Assessment and Modelling**

- At the time of this traffic assessment, the Woolgoolga to Ballina Pacific Highway upgrade works were in progress. Any traffic surveys undertaken at this stage would have been obsolete for the purpose of assessment for the proposed development
- Traffic data was sourced from the Pacific Complete Woolgoolga to Ballina project team and formed the basis of the data used in the traffic assessment of the site
- A comparison of the SIDRA results for each scenario was undertaken and observed that impacts to the average delays and degree of saturation within the network was minimal and a level of service A remained at both intersections in both peaks in all scenarios, including an assessment for a 10 year design horizon.
- Modelling results indicate that the network may have additional spare capacity including with the development.

**Parking Assessment and Swept Path Analysis**

- An assessment of the preliminary design plan against parking provisions and requirements was undertaken which identified the proposed parking supply was sufficient for the site usage, with the design providing sufficient supply of light vehicle, heavy vehicle, and bus/recreational vehicle parking spaces
- The car park design was mostly compliant with a few minor issues identified which could easily be addressed in *For Construction* design drawings and it is not anticipated that these minor issues would preclude approval by themselves
- Sight lines are deemed adequate, provided that the existing trees on the northern side of Goodwood Street will be cleared.

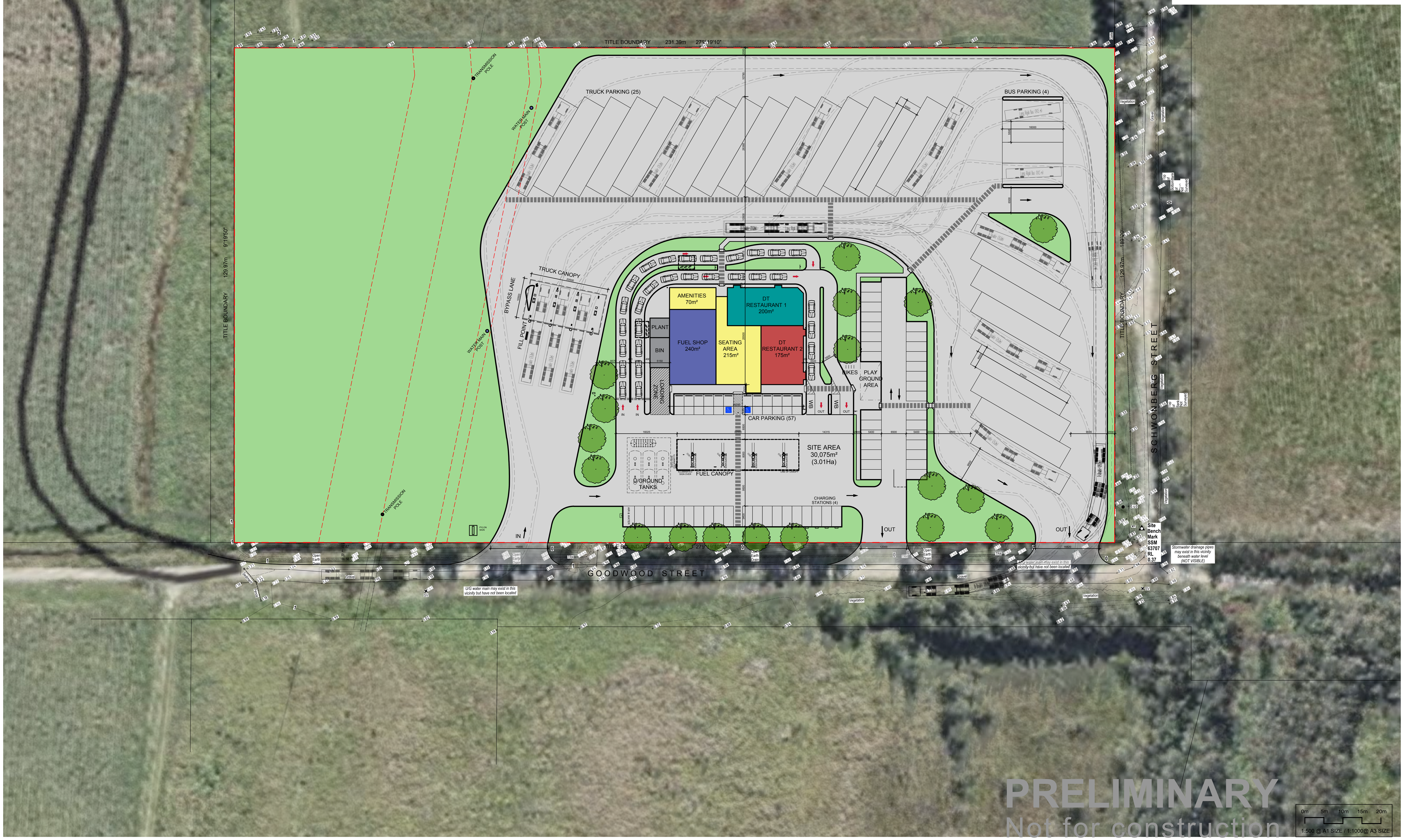
Our findings are such that we find no issues or non-compliances that would preclude approval of the LEP modification with relevant conditioning.

# Appendix A: Preliminary Design Plan

## AREA SCHEDULE:

| | |
|---|---|
| TOTAL SITE AREA - | 30,075m² (3.01Ha) |
| **TENANCY AREAS:** | |
| FUEL SHOP - | 240m² |
| D/T RESTAURANT 1 - | 200m² |
| D/T RESTAURANT 2 - | 175m² |
| SEATING AREA - | 215m² |
| AMENITIES - | 70m² |
| TOTAL AREA - | 900m² |
| CAR SPACES - | 57 cars |
| TRUCK SPACES - | 25 trucks |
| BUS SPACES - | 4 buses |
| BIKE SPACES - | 16 bikes |

ALL SITE BOUNDARY & AREAS ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY




| REV | AMENDMENT DETAILS | BY | DATE |
|---|---|---|---|
| P2 | PRELIMINARY ISSUE | KM | 17-06-20 |
| P1 | PRELIMINARY ISSUE | KM | 15-06-20 |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PROJECT
PROPOSED MIXED USE DEVELOPMENT

PROJECT ADDRESS
CNR OF GOODWOOD & SCHWONBERG STREET
MACLEAN
NSW 2463

DRAWING TITLE
CONCEPT SITE PLAN

CLIENT
HARGREAVES PROPERTY GROUP

| DATE | SCALE @ A1 | NORTH |
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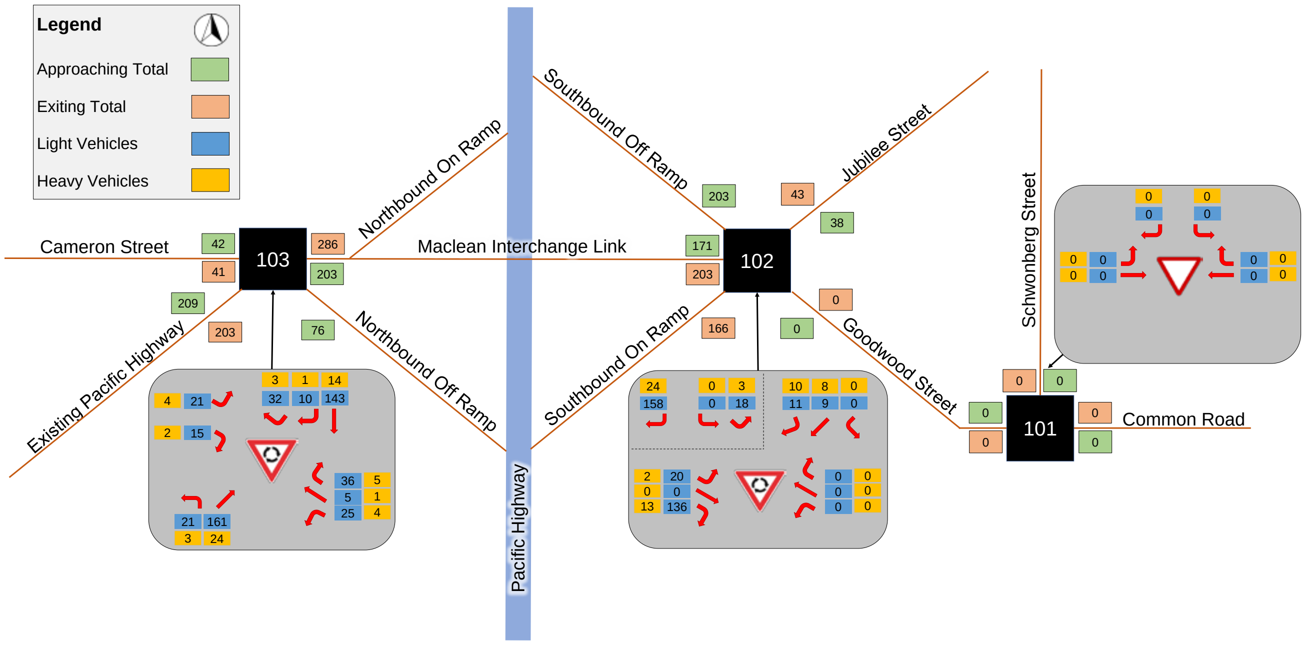
| JUN '20 | 1:500 | |
| DRAWN: JS | CHECKED: AB | |
| ISSUE: PRELIMINARY | | |

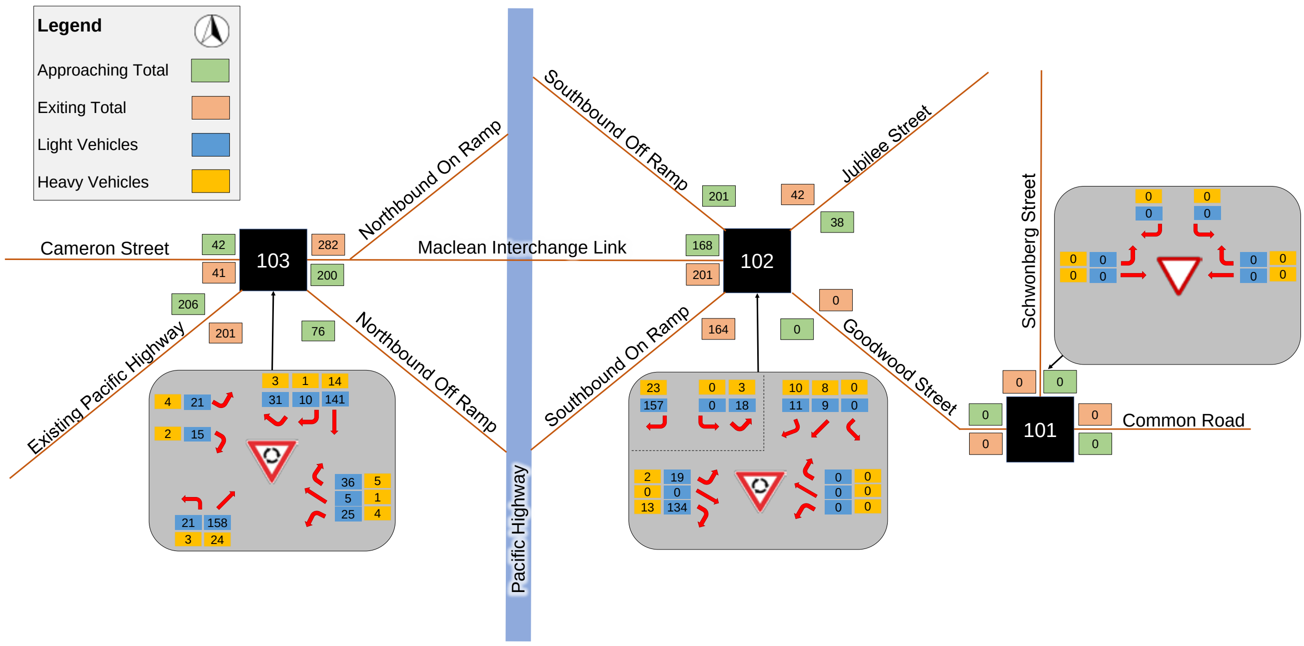
| PROJECT No. | DRAWING No. | REVISION No. | SHEET |
|---|---|---|---|
| 19097 | SK02 | P2 | 01 of 01 |

# Appendix B: Volume Diagrams

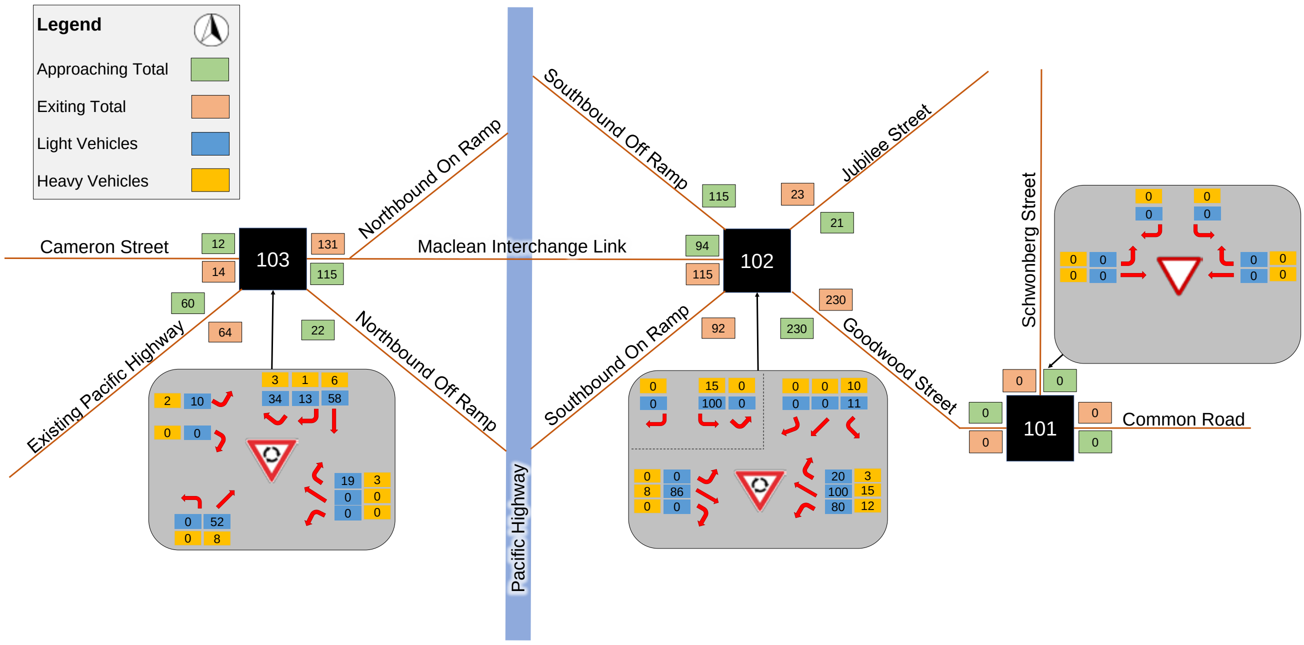
## P4539 Maclean Service Centre TIA
### Traffic Survey Data Analysis
### 11:00 - 12:00 AM Peak LV + HV (BASE CASE)



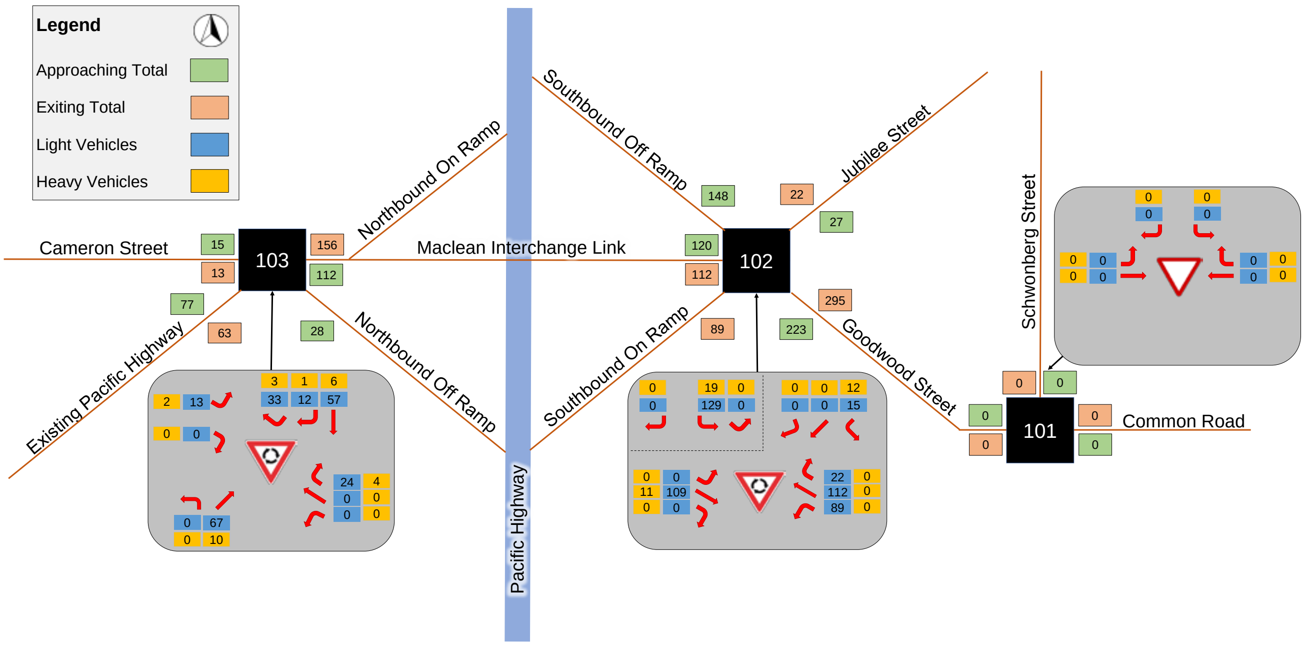

## P4539 Maclean Service Centre TIA
### Traffic Survey Data Analysis
### 15:00 - 16:00 PM Peak LV + HV (BASE CASE)



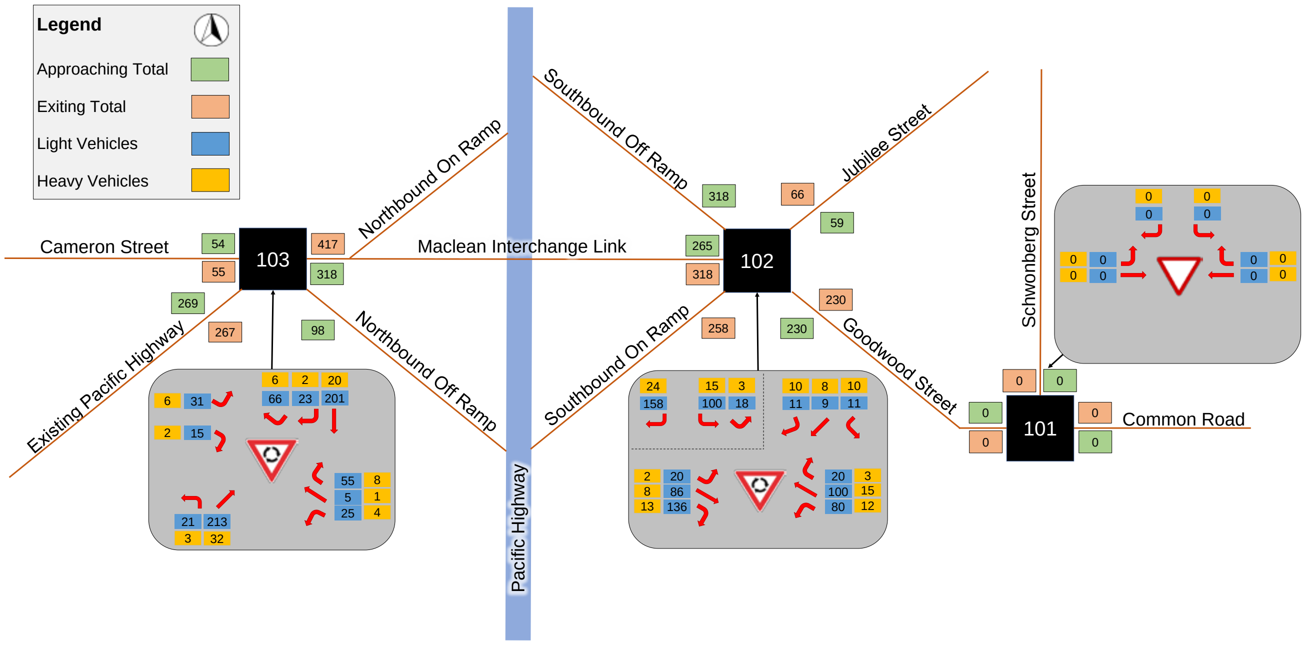
## P4539 Maclean Service Centre TIA
### Traffic Survey Data Analysis
### 11:00 - 12:00 AM Peak LV + HV (DEVELOPMENT TRIPS)



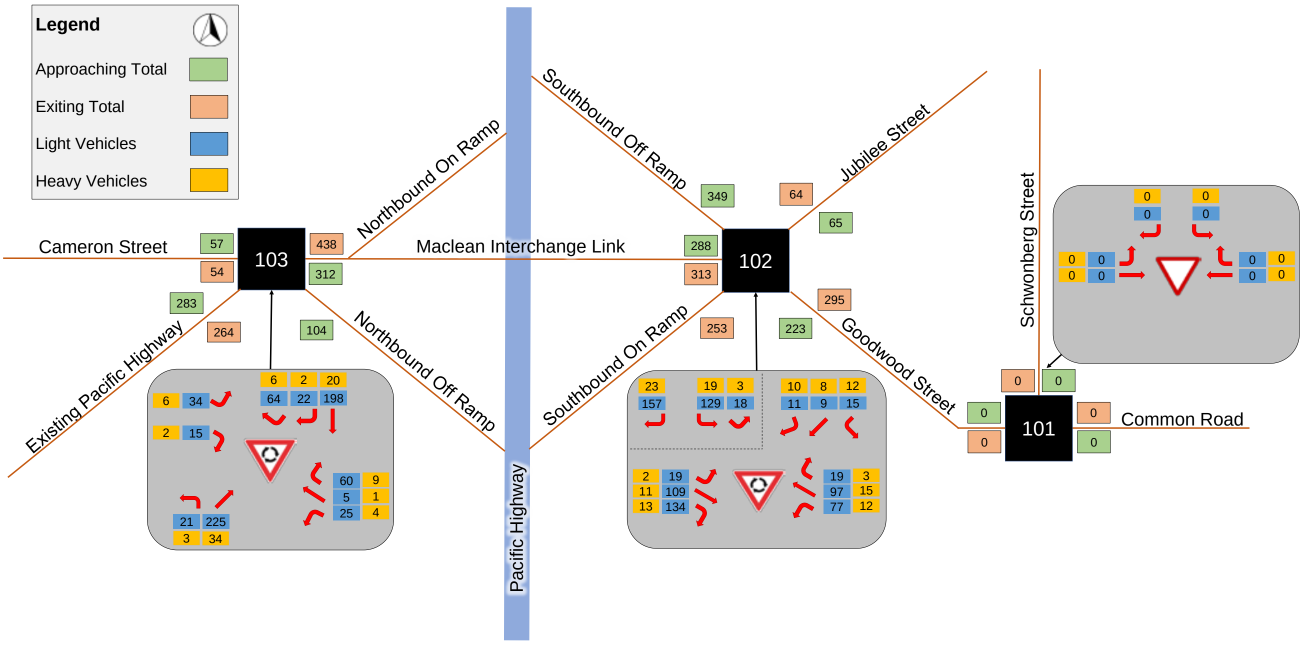

## P4539 Maclean Service Centre TIA
### Traffic Survey Data Analysis
### 15:00 - 16:00 PM Peak LV + HV (DEVELOPMENT TRIPS)



## P4539 Maclean Service Centre TIA
### Traffic Survey Data Analysis
### 11:00 - 12:00 AM Peak LV + HV (PROJECT CASE)




## P4539 Maclean Service Centre TIA
### Traffic Survey Data Analysis
### 15:00 - 16:00 PM Peak LV + HV (PROJECT CASE)

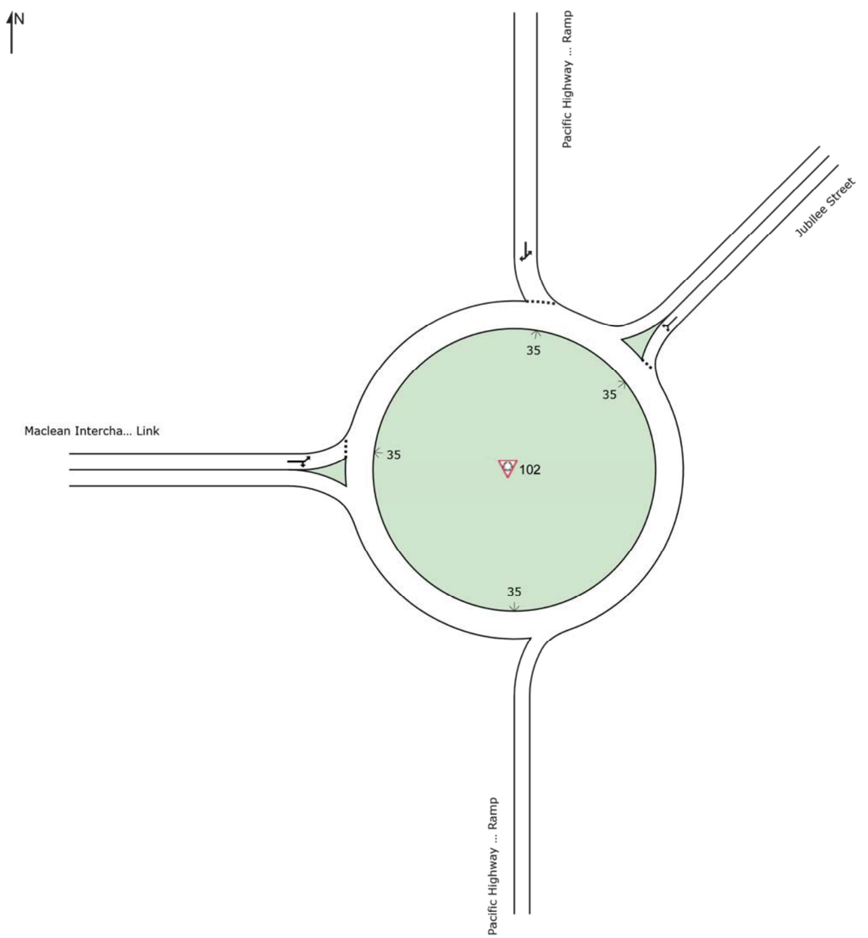


# Appendix C: SIDRA Intersection Layouts

# SITE LAYOUT

## Site: 102  [BASE AM 102 - Maclean Interchange Eastern Roundabout]

BASE AM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

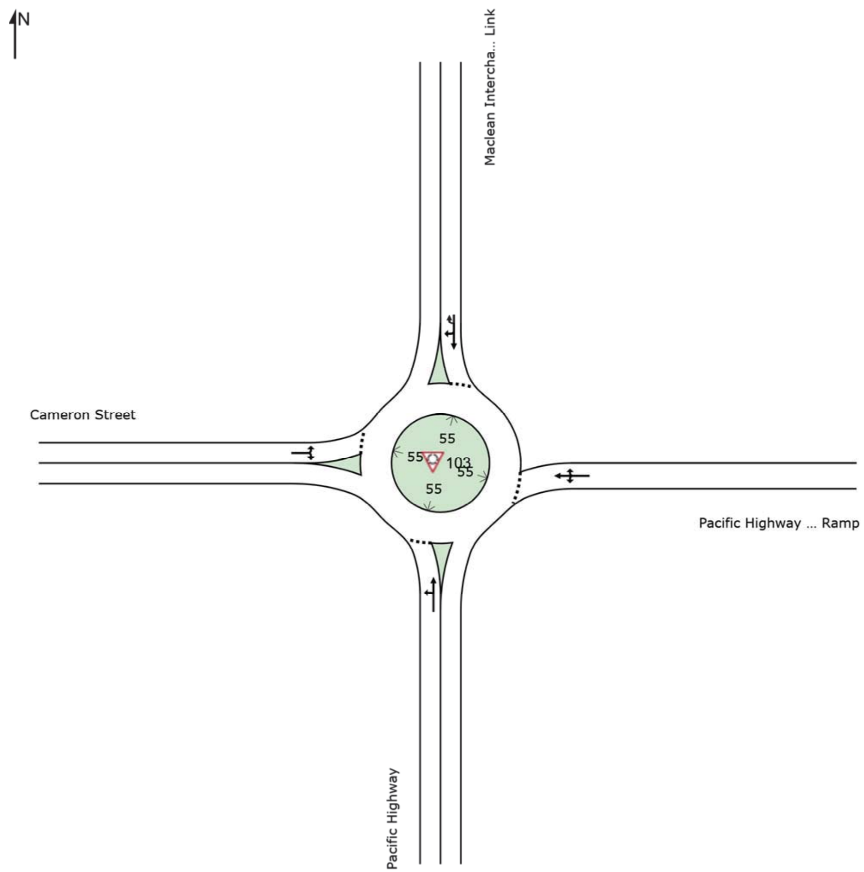





# SITE LAYOUT

## Site: 103  [BASE AM 103 - Maclean Interchange Western Roundabout]

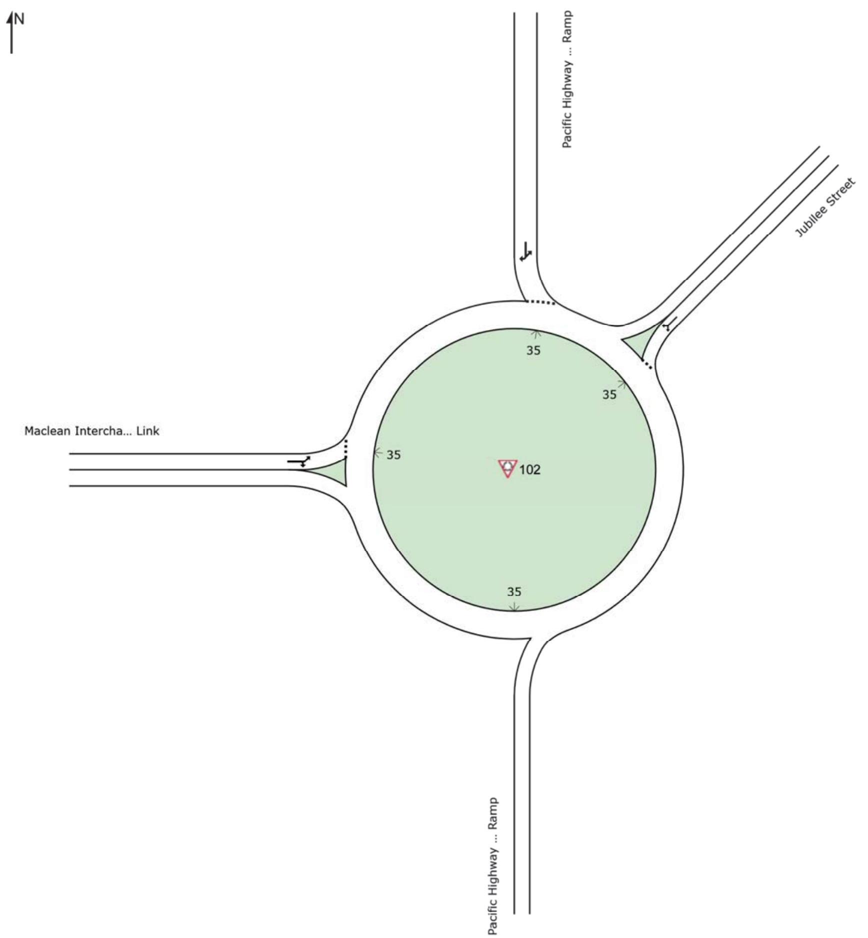
BASE AM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout



# SITE LAYOUT

## Site: 102 [BASE PM 102 - Maclean Interchange Eastern Roundabout]

BASE PM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

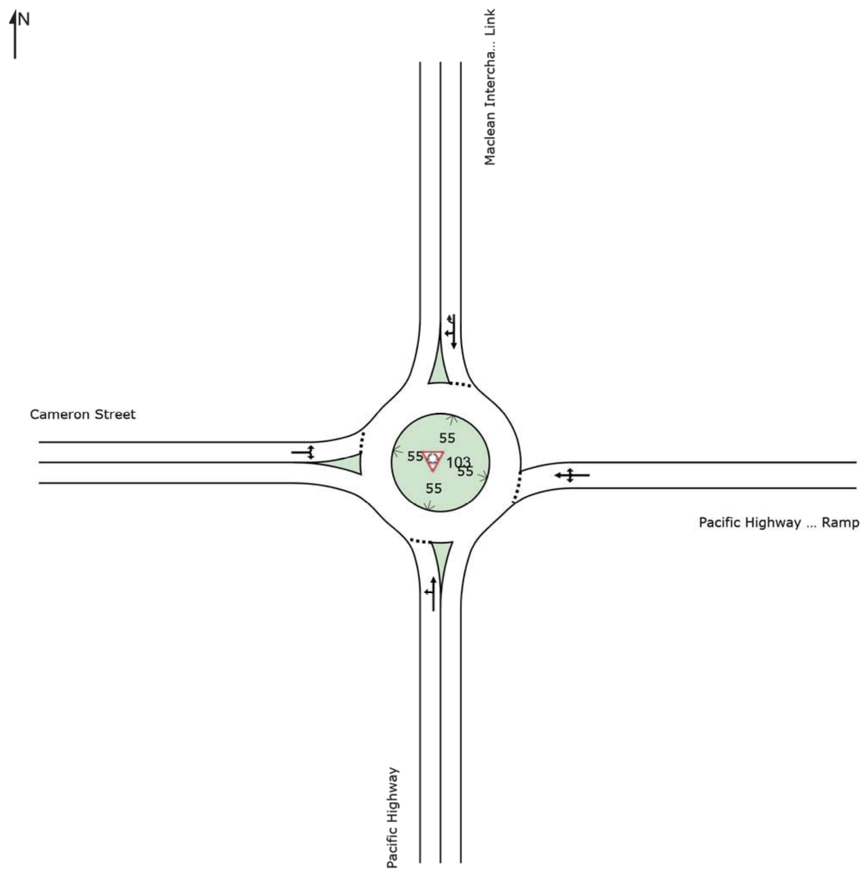





# SITE LAYOUT

## Site: 103 [BASE PM 103 - Maclean Interchange Western Roundabout]

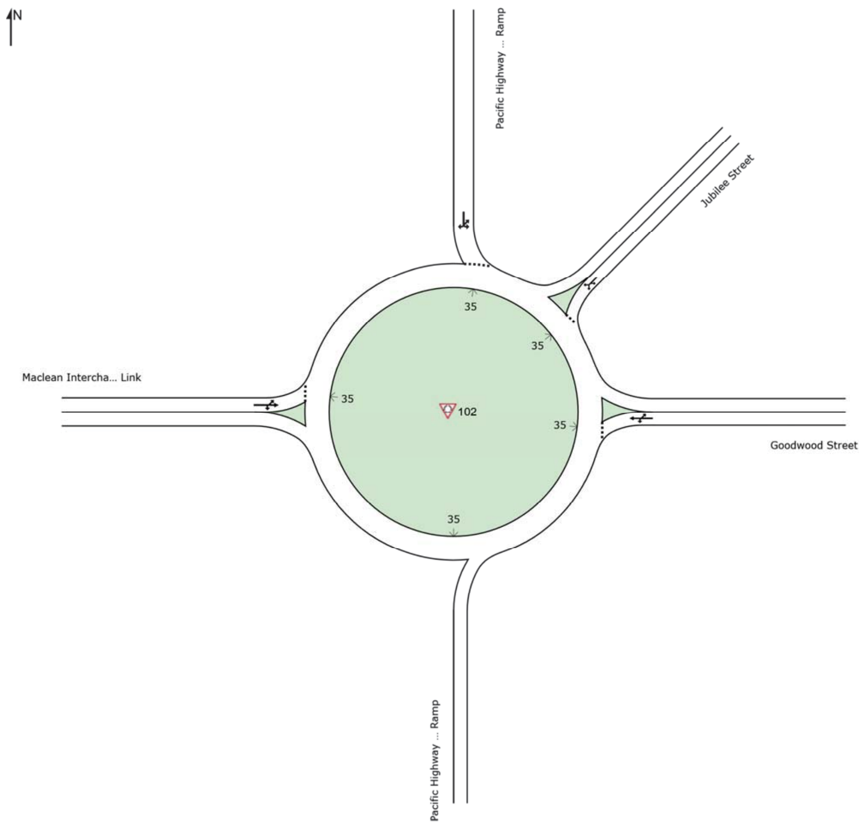
BASE PM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout



## SITE LAYOUT

### Site: 102 [FUTURE AM 102 - Maclean Interchange Eastern Roundabout]

FUTURE AM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

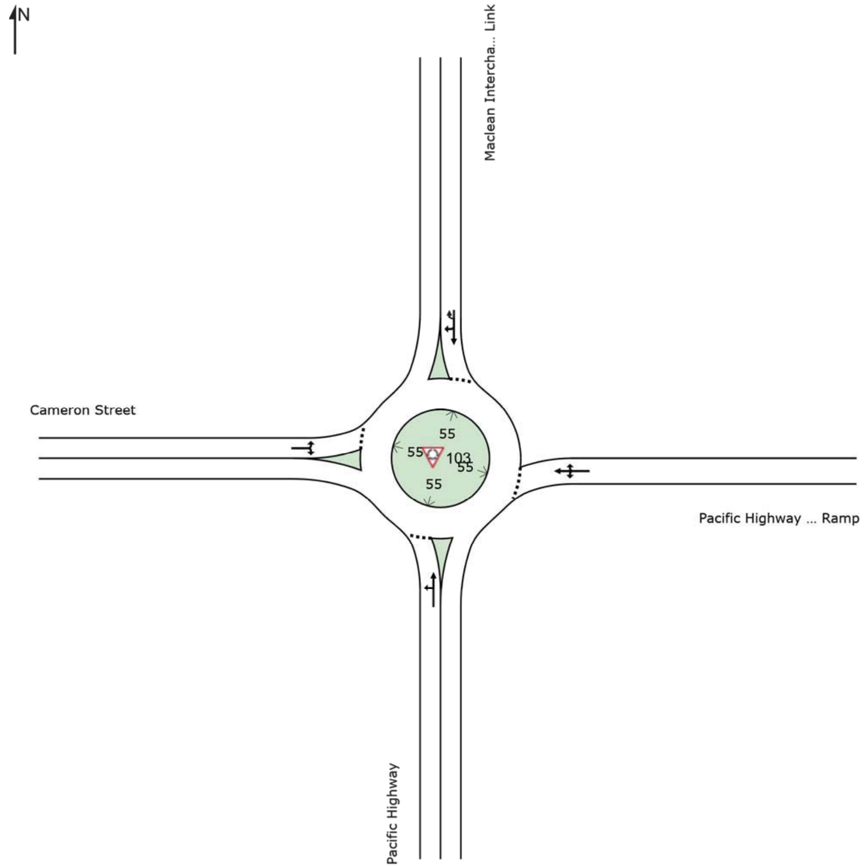





## SITE LAYOUT

### Site: 103 [FUTURE AM 103 - Maclean Interchange Western Roundabout]

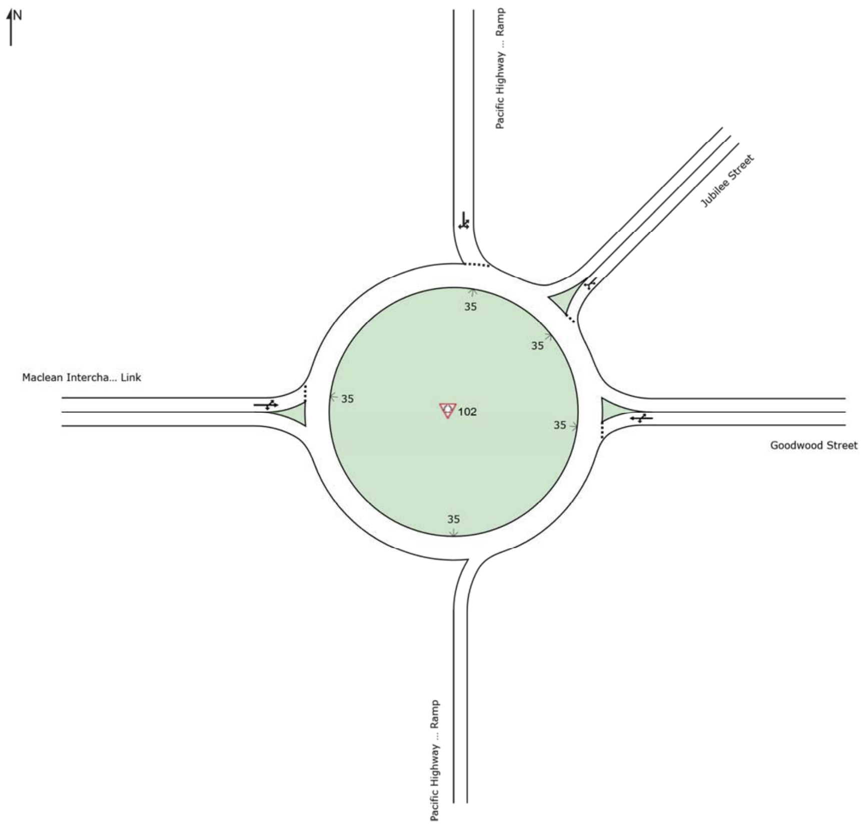
FUTURE AM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout



## SITE LAYOUT

### Site: 102 [FUTURE PM 102 - Maclean Interchange Eastern Roundabout]

FUTURE PM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

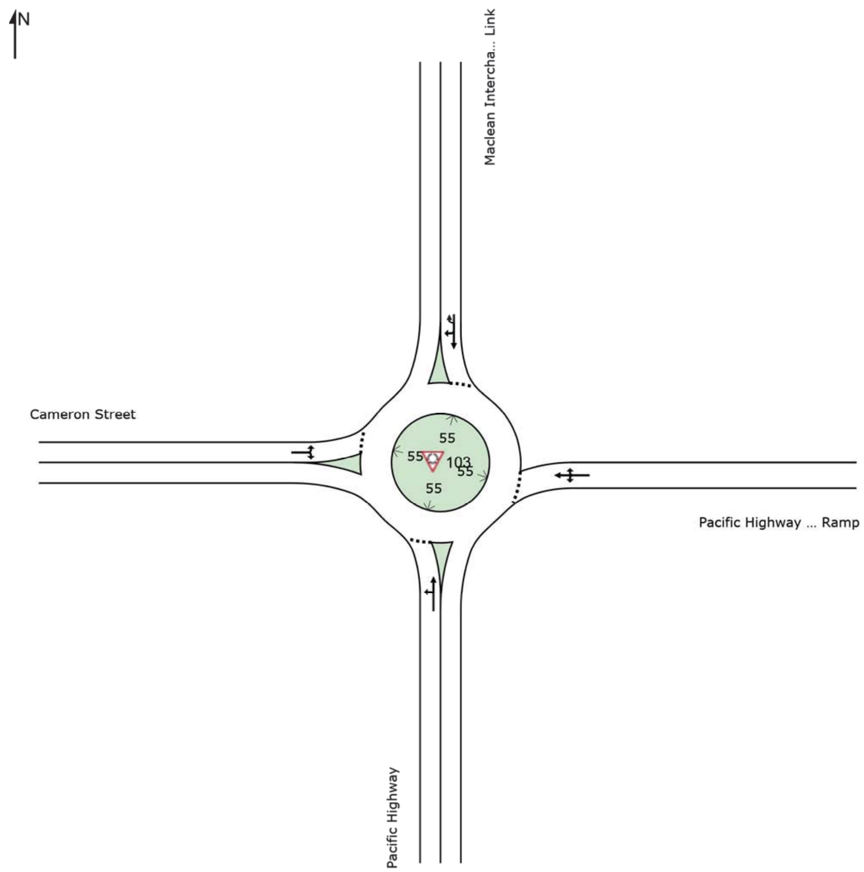





## SITE LAYOUT

### Site: 103 [FUTURE PM 103 - Maclean Interchange Western Roundabout]

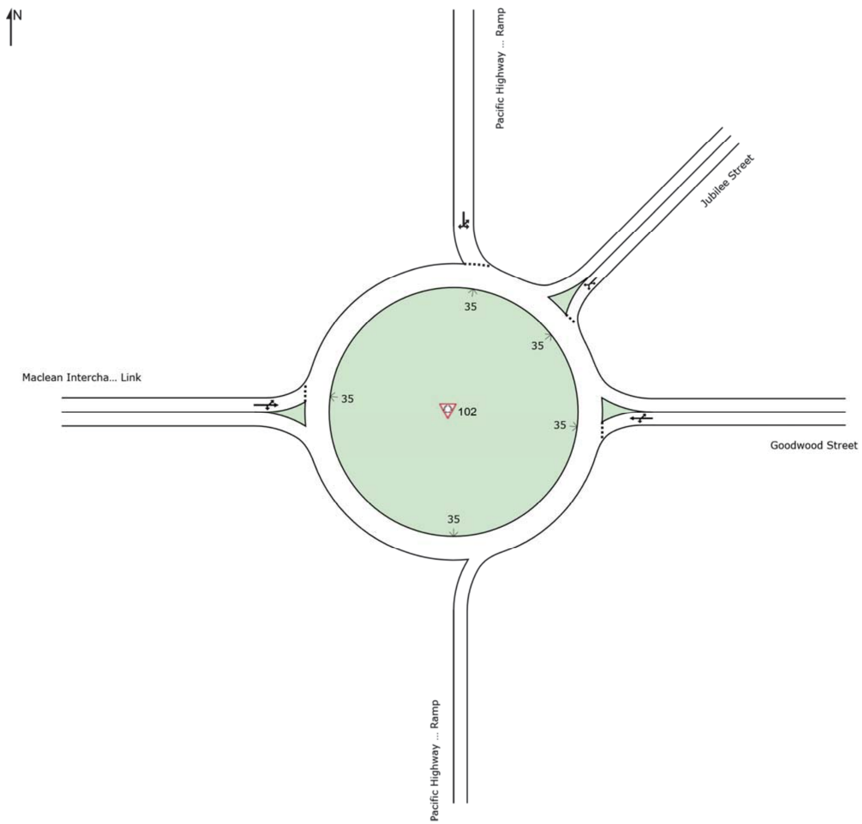
FUTURE PM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout



# SITE LAYOUT

## Site: 102 [PROJECT AM 102 - Maclean Interchange Eastern Roundabout]

PROJECT AM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout



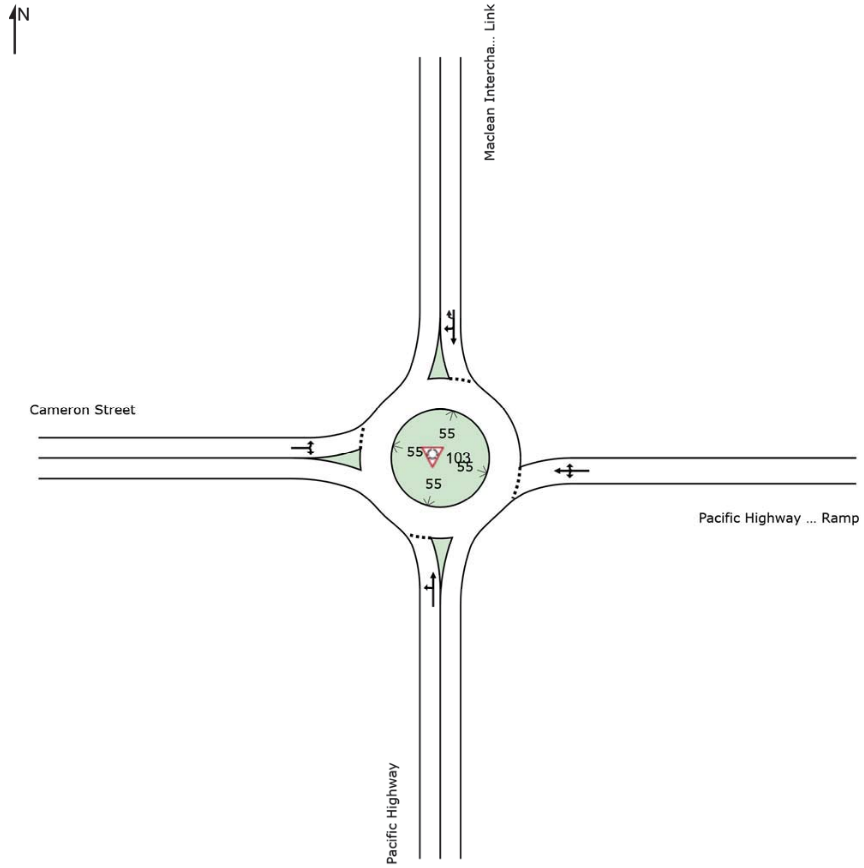


Organisation: BITZIOS CONSULTING | Created: Wednesday, 13 May 2020 12:38:20 PM
Project: P:\P4539 Maclean Service Centre TIA\Technical Work\Models\P4539.001M Model.sip8

# SITE LAYOUT

## Site: 103 [PROJECT AM 103 - Maclean Interchange Western Roundabout]

PROJECT AM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout



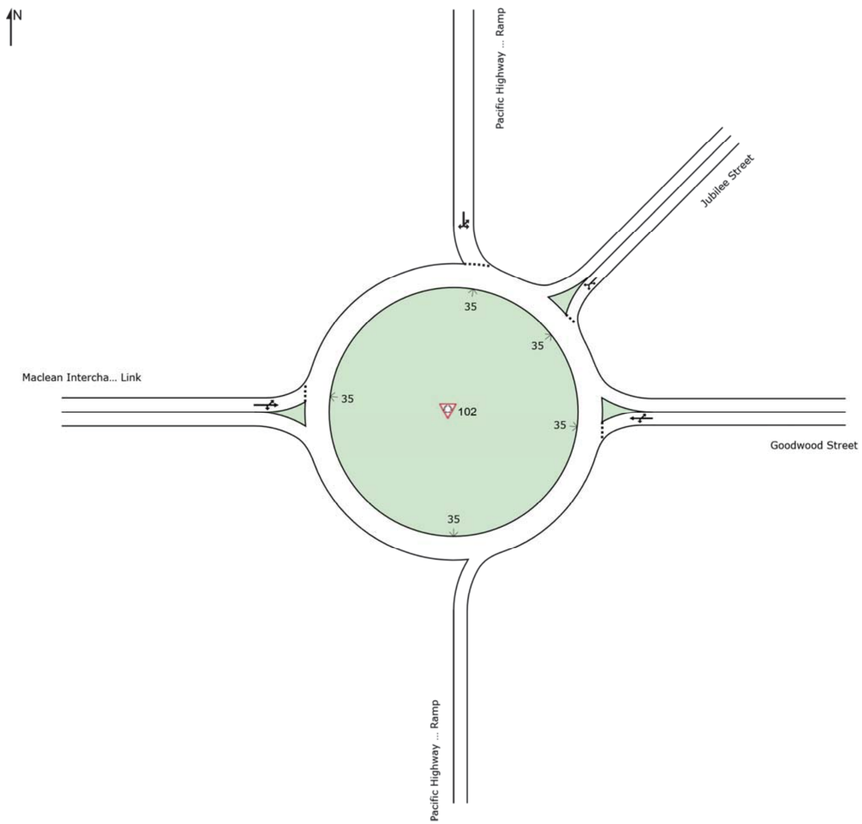


Organisation: BITZIOS CONSULTING | Created: Wednesday, 13 May 2020 12:38:25 PM
Project: P:\P4539 Maclean Service Centre TIA\Technical Work\Models\P4539.001M Model.sip8

## SITE LAYOUT

### Site: 102 [PROJECT PM 102 - Maclean Interchange Eastern Roundabout]

PROJECT PM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout



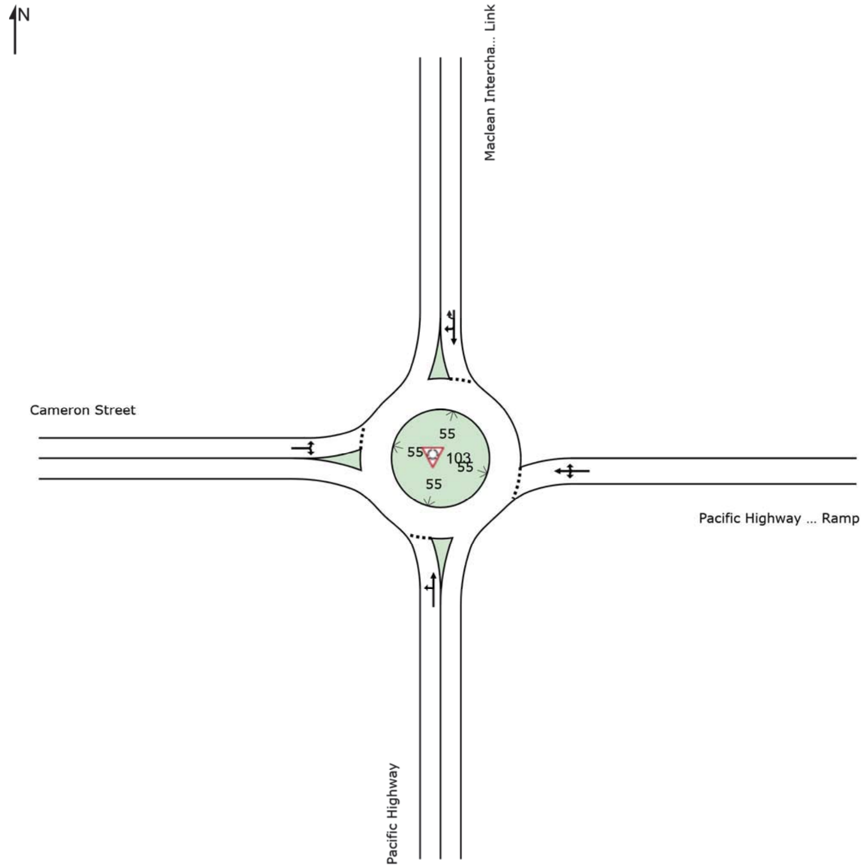


Organisation: BITZIOS CONSULTING | Created: Wednesday, 13 May 2020 12:38:39 PM
Project: P:\P4539 Maclean Service Centre TIA\Technical Work\Models\P4539.001M Model.sip8

## SITE LAYOUT

### Site: 103 [PROJECT PM 103 - Maclean Interchange Western Roundabout]

PROJECT PM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout





Organisation: BITZIOS CONSULTING | Created: Wednesday, 13 May 2020 12:38:45 PM
Project: P:\P4539 Maclean Service Centre TIA\Technical Work\Models\P4539.001M Model.sip8

# Appendix D: SIDRA Results

## MOVEMENT SUMMARY

### Site: 102 [BASE AM 102 - Maclean Interchange Eastern Roundabout]

Network: N1 [BASE AM Network]

BASE AM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NorthEast: Jubilee Street | | | | | | | | | | | | | | |
| 2b | L1 | 18 | 47.1 | 18 | 47.1 | 0.049 | 5.8 | LOS A | 0.2 | 2.0 | 0.56 | 0.59 | 0.56 | 53.3 |
| 1b | R1 | 22 | 47.6 | 22 | 47.6 | 0.049 | 11.4 | LOS A | 0.2 | 2.0 | 0.56 | 0.59 | 0.56 | 47.5 |
| Approach | | 40 | 47.4 | 40 | 47.4 | 0.049 | 8.9 | LOS A | 0.2 | 2.0 | 0.56 | 0.59 | 0.56 | 50.8 |
| North: Pacific Highway - Southbound Off Ramp | | | | | | | | | | | | | | |
| 3a | L3 | 22 | 14.3 | 22 | 14.3 | 0.168 | 4.1 | LOS A | 0.5 | 3.8 | 0.27 | 0.62 | 0.27 | 50.3 |
| 1 | R2 | 192 | 13.2 | 192 | 13.2 | 0.168 | 10.0 | LOS A | 0.5 | 3.8 | 0.27 | 0.62 | 0.27 | 44.7 |
| Approach | | 214 | 13.3 | 214 | 13.3 | 0.168 | 9.4 | LOS A | 0.5 | 3.8 | 0.27 | 0.62 | 0.27 | 45.7 |
| West: Maclean Interchange Link | | | | | | | | | | | | | | |
| 12 | L1 | 23 | 9.1 | 23 | 9.1 | 0.104 | 2.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 0.00 | 52.7 |
| 10 | R2 | 157 | 8.7 | 157 | 8.7 | 0.104 | 9.4 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 0.00 | 53.8 |
| Approach | | 180 | 8.8 | 180 | 8.8 | 0.104 | 8.5 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 0.00 | 53.6 |
| All Vehicles | | 434 | 14.6 | 434 | 14.6 | 0.168 | 9.0 | LOS A | 0.5 | 3.8 | 0.19 | 0.62 | 0.19 | 50.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.


Organisation: BITZIOS CONSULTING | Processed: Friday, 29 May 2020 12:23:55 PM
Project: P:\P4539 Maclean Service Centre TIA\Technical Work\Models\P4539.002M Maclean Service Centre TIA Model.sip8

## MOVEMENT SUMMARY

### Site: 103 [BASE AM 103 - Maclean Interchange Western Roundabout]

Network: N1 [BASE AM Network]

BASE AM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Pacific Highway | | | | | | | | | | | | | | |
| 9 | L2 | 25 | 12.5 | 25 | 12.5 | 0.151 | 3.0 | LOS A | 0.6 | 4.6 | 0.25 | 0.27 | 0.25 | 55.0 |
| 8 | T1 | 195 | 13.0 | 195 | 13.0 | 0.151 | 2.6 | LOS A | 0.6 | 4.6 | 0.25 | 0.27 | 0.25 | 44.7 |
| Approach | | 220 | 12.9 | 220 | 12.9 | 0.151 | 2.6 | LOS A | 0.6 | 4.6 | 0.25 | 0.27 | 0.25 | 47.2 |
| East: Pacific Highway - Northbound Off Ramp | | | | | | | | | | | | | | |
| 6 | L2 | 31 | 13.8 | 31 | 13.8 | 0.059 | 3.2 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 50.1 |
| 5 | T1 | 6 | 16.7 | 6 | 16.7 | 0.059 | 2.9 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 56.0 |
| 4 | R2 | 43 | 12.2 | 43 | 12.2 | 0.059 | 10.3 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 47.8 |
| Approach | | 80 | 13.2 | 80 | 13.2 | 0.059 | 7.0 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 49.6 |
| North: Maclean Interchange Link | | | | | | | | | | | | | | |
| 2 | T1 | 165 | 8.9 | 165 | 8.9 | 0.129 | 2.2 | LOS A | 0.5 | 4.1 | 0.10 | 0.36 | 0.10 | 57.1 |
| 1 | R2 | 12 | 9.1 | 12 | 9.1 | 0.129 | 9.7 | LOS A | 0.5 | 4.1 | 0.10 | 0.36 | 0.10 | 60.6 |
| 1u | U | 37 | 8.6 | 37 | 8.6 | 0.129 | 12.5 | LOS A | 0.5 | 4.1 | 0.10 | 0.36 | 0.10 | 49.0 |
| Approach | | 214 | 8.9 | 214 | 8.9 | 0.129 | 4.4 | LOS A | 0.5 | 4.1 | 0.10 | 0.36 | 0.10 | 56.2 |
| West: Cameron Street | | | | | | | | | | | | | | |
| 12 | L2 | 26 | 16.0 | 26 | 16.0 | 0.035 | 3.7 | LOS A | 0.1 | 1.0 | 0.40 | 0.51 | 0.40 | 47.7 |
| 10 | R2 | 18 | 11.8 | 18 | 11.8 | 0.035 | 10.8 | LOS A | 0.1 | 1.0 | 0.40 | 0.51 | 0.40 | 48.2 |
| Approach | | 44 | 14.3 | 44 | 14.3 | 0.035 | 6.5 | LOS A | 0.1 | 1.0 | 0.40 | 0.51 | 0.40 | 47.9 |
| All Vehicles | | 558 | 11.5 | 558 | 11.5 | 0.151 | 4.3 | LOS A | 0.6 | 4.6 | 0.21 | 0.36 | 0.21 | 51.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.


Organisation: BITZIOS CONSULTING | Processed: Friday, 29 May 2020 12:23:55 PM
Project: P:\P4539 Maclean Service Centre TIA\Technical Work\Models\P4539.002M Maclean Service Centre TIA Model.sip8

## MOVEMENT SUMMARY

### Site: 102 [BASE PM 102 - Maclean Interchange Eastern Roundabout]

**Network: N2 [BASE PM Network]**

BASE PM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NorthEast: Jubilee Street | | | | | | | | | | | | | | |
| 2b | L1 | 18 | 47.1 | 18 | 47.1 | 0.049 | 5.8 | LOS A | 0.2 | 2.0 | 0.56 | 0.59 | 0.56 | 53.3 |
| 1b | R1 | 22 | 47.6 | 22 | 47.6 | 0.049 | 11.4 | LOS A | 0.2 | 2.0 | 0.56 | 0.59 | 0.56 | 47.5 |
| Approach | | 40 | 47.4 | 40 | 47.4 | 0.049 | 8.9 | LOS A | 0.2 | 2.0 | 0.56 | 0.59 | 0.56 | 50.9 |
| North: Pacific Highway - Southbound Off Ramp | | | | | | | | | | | | | | |
| 3a | L3 | 22 | 14.3 | 22 | 14.3 | 0.165 | 4.1 | LOS A | 0.5 | 3.7 | 0.27 | 0.61 | 0.27 | 50.3 |
| 1 | R2 | 189 | 12.8 | 189 | 12.8 | 0.165 | 10.0 | LOS A | 0.5 | 3.7 | 0.27 | 0.61 | 0.27 | 44.7 |
| Approach | | 212 | 12.9 | 212 | 12.9 | 0.165 | 9.4 | LOS A | 0.5 | 3.7 | 0.27 | 0.61 | 0.27 | 45.7 |
| West: Maclean Interchange Link | | | | | | | | | | | | | | |
| 12 | L1 | 22 | 9.5 | 22 | 9.5 | 0.102 | 2.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 0.00 | 52.7 |
| 10 | R2 | 155 | 8.8 | 155 | 8.8 | 0.102 | 9.4 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 0.00 | 53.7 |
| Approach | | 177 | 8.9 | 177 | 8.9 | 0.102 | 8.5 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 0.00 | 53.6 |
| All Vehicles | | 428 | 14.5 | 428 | 14.5 | 0.165 | 9.0 | LOS A | 0.5 | 3.7 | 0.18 | 0.62 | 0.18 | 50.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## MOVEMENT SUMMARY

### Site: 103 [BASE PM 103 - Maclean Interchange Western Roundabout]

**Network: N2 [BASE PM Network]**

BASE PM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Pacific Highway | | | | | | | | | | | | | | |
| 9 | L2 | 25 | 12.5 | 25 | 12.5 | 0.149 | 3.0 | LOS A | 0.6 | 4.5 | 0.25 | 0.27 | 0.25 | 55.0 |
| 8 | T1 | 192 | 13.2 | 192 | 13.2 | 0.149 | 2.6 | LOS A | 0.6 | 4.5 | 0.25 | 0.27 | 0.25 | 44.7 |
| Approach | | 217 | 13.1 | 217 | 13.1 | 0.149 | 2.6 | LOS A | 0.6 | 4.5 | 0.25 | 0.27 | 0.25 | 47.3 |
| East: Pacific Highway - Northbound Off Ramp | | | | | | | | | | | | | | |
| 6 | L2 | 31 | 13.8 | 31 | 13.8 | 0.059 | 3.2 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 50.1 |
| 5 | T1 | 6 | 16.7 | 6 | 16.7 | 0.059 | 2.9 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 56.0 |
| 4 | R2 | 43 | 12.2 | 43 | 12.2 | 0.059 | 10.3 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 47.8 |
| Approach | | 80 | 13.2 | 80 | 13.2 | 0.059 | 7.0 | LOS A | 0.2 | 1.3 | 0.29 | 0.52 | 0.29 | 49.6 |
| North: Maclean Interchange Link | | | | | | | | | | | | | | |
| 2 | T1 | 163 | 9.0 | 163 | 9.0 | 0.127 | 2.2 | LOS A | 0.5 | 4.0 | 0.10 | 0.36 | 0.10 | 57.1 |
| 1 | R2 | 12 | 9.1 | 12 | 9.1 | 0.127 | 9.7 | LOS A | 0.5 | 4.0 | 0.10 | 0.36 | 0.10 | 60.6 |
| 1u | U | 36 | 8.8 | 36 | 8.8 | 0.127 | 12.5 | LOS A | 0.5 | 4.0 | 0.10 | 0.36 | 0.10 | 49.0 |
| Approach | | 211 | 9.0 | 211 | 9.0 | 0.127 | 4.4 | LOS A | 0.5 | 4.0 | 0.10 | 0.36 | 0.10 | 56.2 |
| West: Cameron Street | | | | | | | | | | | | | | |
| 12 | L2 | 26 | 16.0 | 26 | 16.0 | 0.035 | 3.6 | LOS A | 0.1 | 1.0 | 0.40 | 0.51 | 0.40 | 47.7 |
| 10 | R2 | 18 | 11.8 | 18 | 11.8 | 0.035 | 10.7 | LOS A | 0.1 | 1.0 | 0.40 | 0.51 | 0.40 | 48.2 |
| Approach | | 44 | 14.3 | 44 | 14.3 | 0.035 | 6.5 | LOS A | 0.1 | 1.0 | 0.40 | 0.51 | 0.40 | 47.9 |
| All Vehicles | | 552 | 11.6 | 552 | 11.6 | 0.149 | 4.3 | LOS A | 0.6 | 4.5 | 0.21 | 0.36 | 0.21 | 51.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

### Site: 102 [PROJECT AM 102 - Maclean Interchange Eastern Roundabout]  Network: N3 [PROJECT AM Network]

PROJECT AM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: Goodwood Street | | | | | | | | | | | | | | |
| 6 | L2 | 97 | 13.0 | 97 | 13.0 | 0.246 | 5.9 | LOS A | 1.1 | 8.8 | 0.61 | 0.62 | 0.61 | 53.2 |
| 5 | T1 | 121 | 13.0 | 121 | 13.0 | 0.246 | 5.8 | LOS A | 1.1 | 8.8 | 0.61 | 0.62 | 0.61 | 48.1 |
| 4 | R3 | 24 | 13.0 | 24 | 13.0 | 0.246 | 13.3 | LOS A | 1.1 | 8.8 | 0.61 | 0.62 | 0.61 | 56.2 |
| Approach | | 242 | 13.0 | 242 | 13.0 | 0.246 | 6.6 | LOS A | 1.1 | 8.8 | 0.61 | 0.62 | 0.61 | 51.8 |
| NorthEast: Jubilee Street | | | | | | | | | | | | | | |
| 3b | L3 | 22 | 47.6 | 22 | 47.6 | 0.096 | 8.9 | LOS A | 0.4 | 4.1 | 0.71 | 0.71 | 0.71 | 49.5 |
| 2b | L1 | 18 | 47.1 | 18 | 47.1 | 0.096 | 8.2 | LOS A | 0.4 | 4.1 | 0.71 | 0.71 | 0.71 | 52.2 |
| 1b | R1 | 22 | 47.6 | 22 | 47.6 | 0.096 | 13.7 | LOS A | 0.4 | 4.1 | 0.71 | 0.71 | 0.71 | 45.8 |
| Approach | | 62 | 47.5 | 62 | 47.5 | 0.096 | 10.4 | LOS A | 0.4 | 4.1 | 0.71 | 0.71 | 0.71 | 49.5 |
| North: Pacific Highway - Southbound Off Ramp | | | | | | | | | | | | | | |
| 3a | L3 | 22 | 14.3 | 22 | 14.3 | 0.283 | 4.7 | LOS A | 1.0 | 7.7 | 0.41 | 0.64 | 0.41 | 51.2 |
| 3 | L2 | 121 | 13.0 | 121 | 13.0 | 0.283 | 4.6 | LOS A | 1.0 | 7.7 | 0.41 | 0.64 | 0.41 | 51.7 |
| 1 | R2 | 192 | 13.2 | 192 | 13.2 | 0.283 | 10.6 | LOS A | 1.0 | 7.7 | 0.41 | 0.64 | 0.41 | 46.0 |
| Approach | | 335 | 13.2 | 335 | 13.2 | 0.283 | 8.1 | LOS A | 1.0 | 7.7 | 0.41 | 0.64 | 0.41 | 49.2 |
| West: Maclean Interchange Link | | | | | | | | | | | | | | |
| 12 | L1 | 23 | 9.1 | 23 | 9.1 | 0.180 | 2.9 | LOS A | 0.9 | 6.7 | 0.15 | 0.50 | 0.15 | 53.8 |
| 11 | T1 | 99 | 8.5 | 99 | 8.5 | 0.180 | 3.2 | LOS A | 0.9 | 6.7 | 0.15 | 0.50 | 0.15 | 54.2 |
| 10 | R2 | 157 | 8.7 | 157 | 8.7 | 0.180 | 9.5 | LOS A | 0.9 | 6.7 | 0.15 | 0.50 | 0.15 | 54.9 |
| Approach | | 279 | 8.7 | 279 | 8.7 | 0.180 | 6.7 | LOS A | 0.9 | 6.7 | 0.15 | 0.50 | 0.15 | 54.5 |
| All Vehicles | | 918 | 14.1 | 918 | 14.1 | 0.283 | 7.4 | LOS A | 1.1 | 8.8 | 0.40 | 0.60 | 0.40 | 51.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## MOVEMENT SUMMARY

### Site: 103 [PROJECT AM 103 - Maclean Interchange Western Roundabout]  Network: N3 [PROJECT AM Network]

PROJECT AM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Pacific Highway | | | | | | | | | | | | | | |
| 9 | L2 | 25 | 12.5 | 25 | 12.5 | 0.208 | 3.4 | LOS A | 0.9 | 6.7 | 0.36 | 0.31 | 0.36 | 53.9 |
| 8 | T1 | 258 | 13.1 | 258 | 13.1 | 0.208 | 3.0 | LOS A | 0.9 | 6.7 | 0.36 | 0.31 | 0.36 | 42.6 |
| Approach | | 283 | 13.0 | 283 | 13.0 | 0.208 | 3.0 | LOS A | 0.9 | 6.7 | 0.36 | 0.31 | 0.36 | 44.7 |
| East: Pacific Highway - Northbound Off Ramp | | | | | | | | | | | | | | |
| 6 | L2 | 31 | 13.8 | 31 | 13.8 | 0.081 | 3.7 | LOS A | 0.3 | 2.0 | 0.38 | 0.58 | 0.38 | 49.0 |
| 5 | T1 | 6 | 16.7 | 6 | 16.7 | 0.081 | 3.3 | LOS A | 0.3 | 2.0 | 0.38 | 0.58 | 0.38 | 54.9 |
| 4 | R2 | 66 | 12.7 | 66 | 12.7 | 0.081 | 10.8 | LOS A | 0.3 | 2.0 | 0.38 | 0.58 | 0.38 | 46.6 |
| Approach | | 103 | 13.3 | 103 | 13.3 | 0.081 | 8.2 | LOS A | 0.3 | 2.0 | 0.38 | 0.58 | 0.38 | 48.1 |
| North: Maclean Interchange Link | | | | | | | | | | | | | | |
| 2 | T1 | 233 | 9.0 | 233 | 9.0 | 0.199 | 2.3 | LOS A | 0.9 | 7.0 | 0.11 | 0.40 | 0.11 | 55.8 |
| 1 | R2 | 26 | 8.0 | 26 | 8.0 | 0.199 | 9.7 | LOS A | 0.9 | 7.0 | 0.11 | 0.40 | 0.11 | 59.6 |
| 1u | U | 76 | 8.3 | 76 | 8.3 | 0.199 | 12.5 | LOS A | 0.9 | 7.0 | 0.11 | 0.40 | 0.11 | 47.8 |
| Approach | | 335 | 8.8 | 335 | 8.8 | 0.199 | 5.2 | LOS A | 0.9 | 7.0 | 0.11 | 0.40 | 0.11 | 54.7 |
| West: Cameron Street | | | | | | | | | | | | | | |
| 12 | L2 | 39 | 16.2 | 39 | 16.2 | 0.050 | 4.3 | LOS A | 0.2 | 1.6 | 0.50 | 0.54 | 0.50 | 47.7 |
| 10 | R2 | 18 | 11.8 | 18 | 11.8 | 0.050 | 11.4 | LOS A | 0.2 | 1.6 | 0.50 | 0.54 | 0.50 | 48.2 |
| Approach | | 57 | 14.8 | 57 | 14.8 | 0.050 | 6.5 | LOS A | 0.2 | 1.6 | 0.50 | 0.54 | 0.50 | 47.9 |
| All Vehicles | | 778 | 11.4 | 778 | 11.4 | 0.208 | 4.9 | LOS A | 0.9 | 7.0 | 0.27 | 0.40 | 0.27 | 50.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

### Site: 102 [PROJECT PM 102 - Maclean Interchange Eastern Roundabout]   Network: N4 [PROJECT PM Network]

PROJECT PM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: Goodwood Street | | | | | | | | | | | | | | |
| 6 | L2 | 94 | 13.5 | 94 | 13.5 | 0.238 | 5.9 | LOS A | 1.1 | 8.5 | 0.60 | 0.62 | 0.60 | 53.2 |
| 5 | T1 | 118 | 13.4 | 118 | 13.4 | 0.238 | 5.7 | LOS A | 1.1 | 8.5 | 0.60 | 0.62 | 0.60 | 48.2 |
| 4 | R3 | 23 | 13.6 | 23 | 13.6 | 0.238 | 13.2 | LOS A | 1.1 | 8.5 | 0.60 | 0.62 | 0.60 | 56.2 |
| Approach | | 235 | 13.5 | 235 | 13.5 | 0.238 | 6.5 | LOS A | 1.1 | 8.5 | 0.60 | 0.62 | 0.60 | 51.8 |
| NorthEast: Jubilee Street | | | | | | | | | | | | | | |
| 3b | L3 | 28 | 44.4 | 28 | 44.4 | 0.111 | 9.5 | LOS A | 0.5 | 4.8 | 0.74 | 0.74 | 0.74 | 49.2 |
| 2b | L1 | 18 | 47.1 | 18 | 47.1 | 0.111 | 8.9 | LOS A | 0.5 | 4.8 | 0.74 | 0.74 | 0.74 | 51.8 |
| 1b | R1 | 22 | 47.6 | 22 | 47.6 | 0.111 | 14.5 | LOS A | 0.5 | 4.8 | 0.74 | 0.74 | 0.74 | 45.1 |
| Approach | | 68 | 46.2 | 68 | 46.2 | 0.111 | 11.0 | LOS A | 0.5 | 4.8 | 0.74 | 0.74 | 0.74 | 49.1 |
| North: Pacific Highway - Southbound Off Ramp | | | | | | | | | | | | | | |
| 3a | L3 | 22 | 14.3 | 22 | 14.3 | 0.314 | 4.9 | LOS A | 1.1 | 8.9 | 0.44 | 0.64 | 0.44 | 51.4 |
| 3 | L2 | 156 | 12.8 | 156 | 12.8 | 0.314 | 4.7 | LOS A | 1.1 | 8.9 | 0.44 | 0.64 | 0.44 | 51.9 |
| 1 | R2 | 189 | 12.8 | 189 | 12.8 | 0.314 | 10.8 | LOS A | 1.1 | 8.9 | 0.44 | 0.64 | 0.44 | 46.3 |
| Approach | | 367 | 12.9 | 367 | 12.9 | 0.314 | 7.9 | LOS A | 1.1 | 8.9 | 0.44 | 0.64 | 0.44 | 49.7 |
| West: Maclean Interchange Link | | | | | | | | | | | | | | |
| 12 | L1 | 22 | 9.5 | 22 | 9.5 | 0.195 | 2.9 | LOS A | 1.0 | 7.4 | 0.14 | 0.49 | 0.14 | 54.0 |
| 11 | T1 | 126 | 9.2 | 126 | 9.2 | 0.195 | 3.2 | LOS A | 1.0 | 7.4 | 0.14 | 0.49 | 0.14 | 54.4 |
| 10 | R2 | 155 | 8.8 | 155 | 8.8 | 0.195 | 9.5 | LOS A | 1.0 | 7.4 | 0.14 | 0.49 | 0.14 | 55.2 |
| Approach | | 303 | 9.0 | 303 | 9.0 | 0.195 | 6.4 | LOS A | 1.0 | 7.4 | 0.14 | 0.49 | 0.14 | 54.8 |
| All Vehicles | | 974 | 14.2 | 974 | 14.2 | 0.314 | 7.3 | LOS A | 1.1 | 8.9 | 0.41 | 0.60 | 0.41 | 51.8 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## MOVEMENT SUMMARY

### Site: 103 [PROJECT PM 103 - Maclean Interchange Western Roundabout]   Network: N4 [PROJECT PM Network]

PROJECT PM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Pacific Highway | | | | | | | | | | | | | | |
| 9 | L2 | 25 | 12.5 | 25 | 12.5 | 0.220 | 3.4 | LOS A | 0.9 | 7.2 | 0.37 | 0.31 | 0.37 | 53.9 |
| 8 | T1 | 273 | 13.1 | 273 | 13.1 | 0.220 | 3.0 | LOS A | 0.9 | 7.2 | 0.37 | 0.31 | 0.37 | 42.4 |
| Approach | | 298 | 13.1 | 298 | 13.1 | 0.220 | 3.0 | LOS A | 0.9 | 7.2 | 0.37 | 0.31 | 0.37 | 44.5 |
| East: Pacific Highway - Northbound Off Ramp | | | | | | | | | | | | | | |
| 6 | L2 | 31 | 13.8 | 31 | 13.8 | 0.086 | 3.7 | LOS A | 0.3 | 2.1 | 0.38 | 0.58 | 0.38 | 48.9 |
| 5 | T1 | 6 | 16.7 | 6 | 16.7 | 0.086 | 3.3 | LOS A | 0.3 | 2.1 | 0.38 | 0.58 | 0.38 | 54.8 |
| 4 | R2 | 73 | 13.0 | 73 | 13.0 | 0.086 | 10.8 | LOS A | 0.3 | 2.1 | 0.38 | 0.58 | 0.38 | 46.5 |
| Approach | | 109 | 13.5 | 109 | 13.5 | 0.086 | 8.3 | LOS A | 0.3 | 2.1 | 0.38 | 0.58 | 0.38 | 47.9 |
| North: Maclean Interchange Link | | | | | | | | | | | | | | |
| 2 | T1 | 229 | 9.2 | 229 | 9.2 | 0.196 | 2.3 | LOS A | 0.9 | 6.9 | 0.11 | 0.40 | 0.11 | 55.8 |
| 1 | R2 | 25 | 8.3 | 25 | 8.3 | 0.196 | 9.7 | LOS A | 0.9 | 6.9 | 0.11 | 0.40 | 0.11 | 59.7 |
| 1u | U | 74 | 8.6 | 74 | 8.6 | 0.196 | 12.5 | LOS A | 0.9 | 6.9 | 0.11 | 0.40 | 0.11 | 47.9 |
| Approach | | 328 | 9.0 | 328 | 9.0 | 0.196 | 5.1 | LOS A | 0.9 | 6.9 | 0.11 | 0.40 | 0.11 | 54.7 |
| West: Cameron Street | | | | | | | | | | | | | | |
| 12 | L2 | 42 | 15.0 | 42 | 15.0 | 0.053 | 4.4 | LOS A | 0.2 | 1.7 | 0.52 | 0.55 | 0.52 | 47.8 |
| 10 | R2 | 18 | 11.8 | 18 | 11.8 | 0.053 | 11.5 | LOS A | 0.2 | 1.7 | 0.52 | 0.55 | 0.52 | 48.3 |
| Approach | | 60 | 14.0 | 60 | 14.0 | 0.053 | 6.5 | LOS A | 0.2 | 1.7 | 0.52 | 0.55 | 0.52 | 48.0 |
| All Vehicles | | 796 | 11.5 | 796 | 11.5 | 0.220 | 4.9 | LOS A | 0.9 | 7.2 | 0.27 | 0.40 | 0.27 | 50.2 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

### Site: 102 [FUTURE AM 102 - Maclean Interchange Eastern Roundabout]

Network: N5 [FUTRE AM Network]

FUTURE AM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 10 years

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: Goodwood Street | | | | | | | | | | | | | | |
| 6 | L2 | 116 | 13.0 | 116 | 13.0 | 0.316 | 6.7 | LOS A | 1.5 | 12.0 | 0.69 | 0.70 | 0.69 | 52.8 |
| 5 | T1 | 145 | 13.0 | 145 | 13.0 | 0.316 | 6.5 | LOS A | 1.5 | 12.0 | 0.69 | 0.70 | 0.69 | 47.4 |
| 4 | R3 | 29 | 13.0 | 29 | 13.0 | 0.316 | 14.1 | LOS A | 1.5 | 12.0 | 0.69 | 0.70 | 0.69 | 55.7 |
| Approach | | 291 | 13.0 | 291 | 13.0 | 0.316 | 7.4 | LOS A | 1.5 | 12.0 | 0.69 | 0.70 | 0.69 | 51.2 |
| NorthEast: Jubilee Street | | | | | | | | | | | | | | |
| 3b | L3 | 27 | 47.6 | 27 | 47.6 | 0.130 | 10.5 | LOS A | 0.6 | 5.8 | 0.77 | 0.78 | 0.77 | 48.5 |
| 2b | L1 | 21 | 47.1 | 21 | 47.1 | 0.130 | 9.7 | LOS A | 0.6 | 5.8 | 0.77 | 0.78 | 0.77 | 51.1 |
| 1b | R1 | 27 | 47.6 | 27 | 47.6 | 0.130 | 15.3 | LOS B | 0.6 | 5.8 | 0.77 | 0.78 | 0.77 | 44.2 |
| Approach | | 75 | 47.5 | 75 | 47.5 | 0.130 | 12.0 | LOS A | 0.6 | 5.8 | 0.77 | 0.78 | 0.77 | 48.3 |
| North: Pacific Highway - Southbound Off Ramp | | | | | | | | | | | | | | |
| 3a | L3 | 27 | 14.3 | 27 | 14.3 | 0.352 | 5.1 | LOS A | 1.3 | 10.5 | 0.49 | 0.67 | 0.49 | 51.0 |
| 3 | L2 | 145 | 13.0 | 145 | 13.0 | 0.352 | 5.0 | LOS A | 1.3 | 10.5 | 0.49 | 0.67 | 0.49 | 51.4 |
| 1 | R2 | 230 | 13.2 | 230 | 13.2 | 0.352 | 11.0 | LOS A | 1.3 | 10.5 | 0.49 | 0.67 | 0.49 | 45.7 |
| Approach | | 402 | 13.2 | 402 | 13.2 | 0.352 | 8.5 | LOS A | 1.3 | 10.5 | 0.49 | 0.67 | 0.49 | 48.9 |
| West: Maclean Interchange Link | | | | | | | | | | | | | | |
| 12 | L1 | 28 | 9.1 | 28 | 9.1 | 0.218 | 2.9 | LOS A | 1.1 | 8.6 | 0.17 | 0.50 | 0.17 | 53.6 |
| 11 | T1 | 119 | 8.5 | 119 | 8.5 | 0.218 | 3.2 | LOS A | 1.1 | 8.6 | 0.17 | 0.50 | 0.17 | 54.0 |
| 10 | R2 | 188 | 8.7 | 188 | 8.7 | 0.218 | 9.5 | LOS A | 1.1 | 8.6 | 0.17 | 0.50 | 0.17 | 54.8 |
| Approach | | 335 | 8.7 | 335 | 8.7 | 0.218 | 6.7 | LOS A | 1.1 | 8.6 | 0.17 | 0.50 | 0.17 | 54.4 |
| All Vehicles | | 1101 | 14.1 | 1101 | 14.1 | 0.352 | 7.9 | LOS A | 1.5 | 12.0 | 0.46 | 0.63 | 0.46 | 51.2 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## MOVEMENT SUMMARY

### Site: 103 [FUTURE AM 103 - Maclean Interchange Western Roundabout]

Network: N5 [FUTRE AM Network]

FUTURE AM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 10 years

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Pacific Highway | | | | | | | | | | | | | | |
| 9 | L2 | 30 | 12.5 | 30 | 12.5 | 0.257 | 3.6 | LOS A | 1.1 | 8.7 | 0.41 | 0.34 | 0.41 | 53.4 |
| 8 | T1 | 309 | 13.1 | 309 | 13.1 | 0.257 | 3.2 | LOS A | 1.1 | 8.7 | 0.41 | 0.34 | 0.41 | 41.6 |
| Approach | | 340 | 13.0 | 340 | 13.0 | 0.257 | 3.2 | LOS A | 1.1 | 8.7 | 0.41 | 0.34 | 0.41 | 43.8 |
| East: Pacific Highway - Northbound Off Ramp | | | | | | | | | | | | | | |
| 6 | L2 | 37 | 13.8 | 37 | 13.8 | 0.101 | 4.0 | LOS A | 0.3 | 2.7 | 0.43 | 0.61 | 0.43 | 48.7 |
| 5 | T1 | 8 | 16.7 | 8 | 16.7 | 0.101 | 3.6 | LOS A | 0.3 | 2.7 | 0.43 | 0.61 | 0.43 | 54.7 |
| 4 | R2 | 80 | 12.7 | 80 | 12.7 | 0.101 | 11.1 | LOS A | 0.3 | 2.7 | 0.43 | 0.61 | 0.43 | 46.3 |
| Approach | | 124 | 13.3 | 124 | 13.3 | 0.101 | 8.5 | LOS A | 0.3 | 2.7 | 0.43 | 0.61 | 0.43 | 47.8 |
| North: Maclean Interchange Link | | | | | | | | | | | | | | |
| 2 | T1 | 279 | 9.0 | 279 | 9.0 | 0.240 | 2.3 | LOS A | 1.2 | 9.0 | 0.13 | 0.40 | 0.13 | 55.6 |
| 1 | R2 | 32 | 8.0 | 32 | 8.0 | 0.240 | 9.8 | LOS A | 1.2 | 9.0 | 0.13 | 0.40 | 0.13 | 59.5 |
| 1u | U | 91 | 8.3 | 91 | 8.3 | 0.240 | 12.5 | LOS A | 1.2 | 9.0 | 0.13 | 0.40 | 0.13 | 47.6 |
| Approach | | 402 | 8.8 | 402 | 8.8 | 0.240 | 5.2 | LOS A | 1.2 | 9.0 | 0.13 | 0.40 | 0.13 | 54.5 |
| West: Cameron Street | | | | | | | | | | | | | | |
| 12 | L2 | 47 | 16.2 | 47 | 16.2 | 0.064 | 4.7 | LOS A | 0.3 | 2.1 | 0.56 | 0.58 | 0.56 | 47.3 |
| 10 | R2 | 21 | 11.8 | 21 | 11.8 | 0.064 | 11.8 | LOS A | 0.3 | 2.1 | 0.56 | 0.58 | 0.56 | 47.9 |
| Approach | | 68 | 14.8 | 68 | 14.8 | 0.064 | 7.0 | LOS A | 0.3 | 2.1 | 0.56 | 0.58 | 0.56 | 47.5 |
| All Vehicles | | 933 | 11.4 | 933 | 11.4 | 0.257 | 5.0 | LOS A | 1.2 | 9.0 | 0.30 | 0.42 | 0.30 | 50.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

### Site: 102 [FUTURE PM 102 - Maclean Interchange Eastern Roundabout]

**Network: N6 [FUTRE PM Network]**

FUTURE PM 102 - Maclean Interchange Eastern Roundabout
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 10 years

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: Goodwood Street | | | | | | | | | | | | | | |
| 6 | L2 | 112 | 13.5 | 112 | 13.5 | 0.307 | 6.7 | LOS A | 1.5 | 11.6 | 0.68 | 0.69 | 0.68 | 52.8 |
| 5 | T1 | 141 | 13.4 | 141 | 13.4 | 0.307 | 6.5 | LOS A | 1.5 | 11.6 | 0.68 | 0.69 | 0.68 | 47.4 |
| 4 | R3 | 28 | 13.6 | 28 | 13.6 | 0.307 | 14.0 | LOS A | 1.5 | 11.6 | 0.68 | 0.69 | 0.68 | 55.7 |
| Approach | | 282 | 13.5 | 282 | 13.5 | 0.307 | 7.3 | LOS A | 1.5 | 11.6 | 0.68 | 0.69 | 0.68 | 51.2 |
| NorthEast: Jubilee Street | | | | | | | | | | | | | | |
| 3b | L3 | 34 | 44.4 | 34 | 44.4 | 0.154 | 11.4 | LOS A | 0.7 | 6.9 | 0.81 | 0.82 | 0.81 | 48.0 |
| 2b | L1 | 21 | 47.1 | 21 | 47.1 | 0.154 | 10.8 | LOS A | 0.7 | 6.9 | 0.81 | 0.82 | 0.81 | 50.5 |
| 1b | R1 | 27 | 47.6 | 27 | 47.6 | 0.154 | 16.4 | LOS B | 0.7 | 6.9 | 0.81 | 0.82 | 0.81 | 43.2 |
| Approach | | 82 | 46.2 | 82 | 46.2 | 0.154 | 12.8 | LOS A | 0.7 | 6.9 | 0.81 | 0.82 | 0.81 | 47.7 |
| North: Pacific Highway - Southbound Off Ramp | | | | | | | | | | | | | | |
| 3a | L3 | 27 | 14.3 | 27 | 14.3 | 0.393 | 5.4 | LOS A | 1.6 | 12.2 | 0.52 | 0.69 | 0.52 | 51.1 |
| 3 | L2 | 187 | 12.8 | 187 | 12.8 | 0.393 | 5.2 | LOS A | 1.6 | 12.2 | 0.52 | 0.69 | 0.52 | 51.6 |
| 1 | R2 | 227 | 12.8 | 227 | 12.8 | 0.393 | 11.2 | LOS A | 1.6 | 12.2 | 0.52 | 0.69 | 0.52 | 45.8 |
| Approach | | 441 | 12.9 | 441 | 12.9 | 0.393 | 8.3 | LOS A | 1.6 | 12.2 | 0.52 | 0.69 | 0.52 | 49.4 |
| West: Maclean Interchange Link | | | | | | | | | | | | | | |
| 12 | L1 | 27 | 9.5 | 27 | 9.5 | 0.236 | 2.9 | LOS A | 1.3 | 9.5 | 0.17 | 0.49 | 0.17 | 53.9 |
| 11 | T1 | 152 | 9.2 | 152 | 9.2 | 0.236 | 3.2 | LOS A | 1.3 | 9.5 | 0.17 | 0.49 | 0.17 | 54.3 |
| 10 | R2 | 186 | 8.8 | 186 | 8.8 | 0.236 | 9.5 | LOS A | 1.3 | 9.5 | 0.17 | 0.49 | 0.17 | 55.1 |
| Approach | | 364 | 9.0 | 364 | 9.0 | 0.236 | 6.4 | LOS A | 1.3 | 9.5 | 0.17 | 0.49 | 0.17 | 54.7 |
| All Vehicles | | 1168 | 14.2 | 1168 | 14.2 | 0.393 | 7.8 | LOS A | 1.6 | 12.2 | 0.47 | 0.63 | 0.47 | 51.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.




## MOVEMENT SUMMARY

### Site: 103 [FUTURE PM 103 - Maclean Interchange Western Roundabout]

**Network: N6 [FUTRE PM Network]**

FUTURE PM 103 - Maclean Interchange Western Roundabout
Site Category: (None)
Roundabout
Design Life Analysis (Final Year): Results for 10 years

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 85% Back of Queue Vehicles veh | 85% Back of Queue Distance m | Prop. Queued | Effective Stop Rate | Aver. No. Cycles | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Pacific Highway | | | | | | | | | | | | | | |
| 9 | L2 | 30 | 12.5 | 30 | 12.5 | 0.271 | 3.6 | LOS A | 1.2 | 9.3 | 0.42 | 0.34 | 0.42 | 53.3 |
| 8 | T1 | 327 | 13.1 | 327 | 13.1 | 0.271 | 3.2 | LOS A | 1.2 | 9.3 | 0.42 | 0.34 | 0.42 | 41.4 |
| Approach | | 357 | 13.1 | 357 | 13.1 | 0.271 | 3.3 | LOS A | 1.2 | 9.3 | 0.42 | 0.34 | 0.42 | 43.6 |
| East: Pacific Highway - Northbound Off Ramp | | | | | | | | | | | | | | |
| 6 | L2 | 37 | 13.8 | 37 | 13.8 | 0.107 | 3.9 | LOS A | 0.4 | 2.8 | 0.43 | 0.61 | 0.43 | 48.6 |
| 5 | T1 | 8 | 16.7 | 8 | 16.7 | 0.107 | 3.6 | LOS A | 0.4 | 2.8 | 0.43 | 0.61 | 0.43 | 54.6 |
| 4 | R2 | 87 | 13.0 | 87 | 13.0 | 0.107 | 11.1 | LOS A | 0.4 | 2.8 | 0.43 | 0.61 | 0.43 | 46.2 |
| Approach | | 131 | 13.5 | 131 | 13.5 | 0.107 | 8.6 | LOS A | 0.4 | 2.8 | 0.43 | 0.61 | 0.43 | 47.6 |
| North: Maclean Interchange Link | | | | | | | | | | | | | | |
| 2 | T1 | 275 | 9.2 | 275 | 9.2 | 0.236 | 2.3 | LOS A | 1.2 | 8.9 | 0.13 | 0.40 | 0.13 | 55.6 |
| 1 | R2 | 30 | 8.3 | 30 | 8.3 | 0.236 | 9.8 | LOS A | 1.2 | 8.9 | 0.13 | 0.40 | 0.13 | 59.5 |
| 1u | U | 88 | 8.6 | 88 | 8.6 | 0.236 | 12.5 | LOS A | 1.2 | 8.9 | 0.13 | 0.40 | 0.13 | 47.7 |
| Approach | | 394 | 9.0 | 394 | 9.0 | 0.236 | 5.1 | LOS A | 1.2 | 8.9 | 0.13 | 0.40 | 0.13 | 54.5 |
| West: Cameron Street | | | | | | | | | | | | | | |
| 12 | L2 | 51 | 15.0 | 51 | 15.0 | 0.069 | 4.9 | LOS A | 0.3 | 2.3 | 0.58 | 0.59 | 0.58 | 47.3 |
| 10 | R2 | 21 | 11.8 | 21 | 11.8 | 0.069 | 11.9 | LOS A | 0.3 | 2.3 | 0.58 | 0.59 | 0.58 | 47.9 |
| Approach | | 72 | 14.0 | 72 | 14.0 | 0.069 | 7.0 | LOS A | 0.3 | 2.3 | 0.58 | 0.59 | 0.58 | 47.5 |
| All Vehicles | | 955 | 11.5 | 955 | 11.5 | 0.271 | 5.1 | LOS A | 1.2 | 9.3 | 0.32 | 0.42 | 0.32 | 49.8 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# Maclean Service Centre Pty Ltd

## Maclean Service Centre
## Flooding Assessment

April 2021

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# Table index



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# Appendices

# 1. Introduction

## 1.1 Background

Maclean Service Centre Pty Ltd are seeking approval to develop a site as a highway at Lot 2 DP 634170, Schwonberg Street, Townsend, NSW 2463 (see Figure 1-1 below).

The site is located immediately to the east of the Southern Maclean Interchange, recently constructed as part of the Woolgoolga to Ballina Pacific Highway Upgrade. The proposal is for a centre comprising retail fuel, food and rest areas for local and highway traffic, including full facilities for trucks.

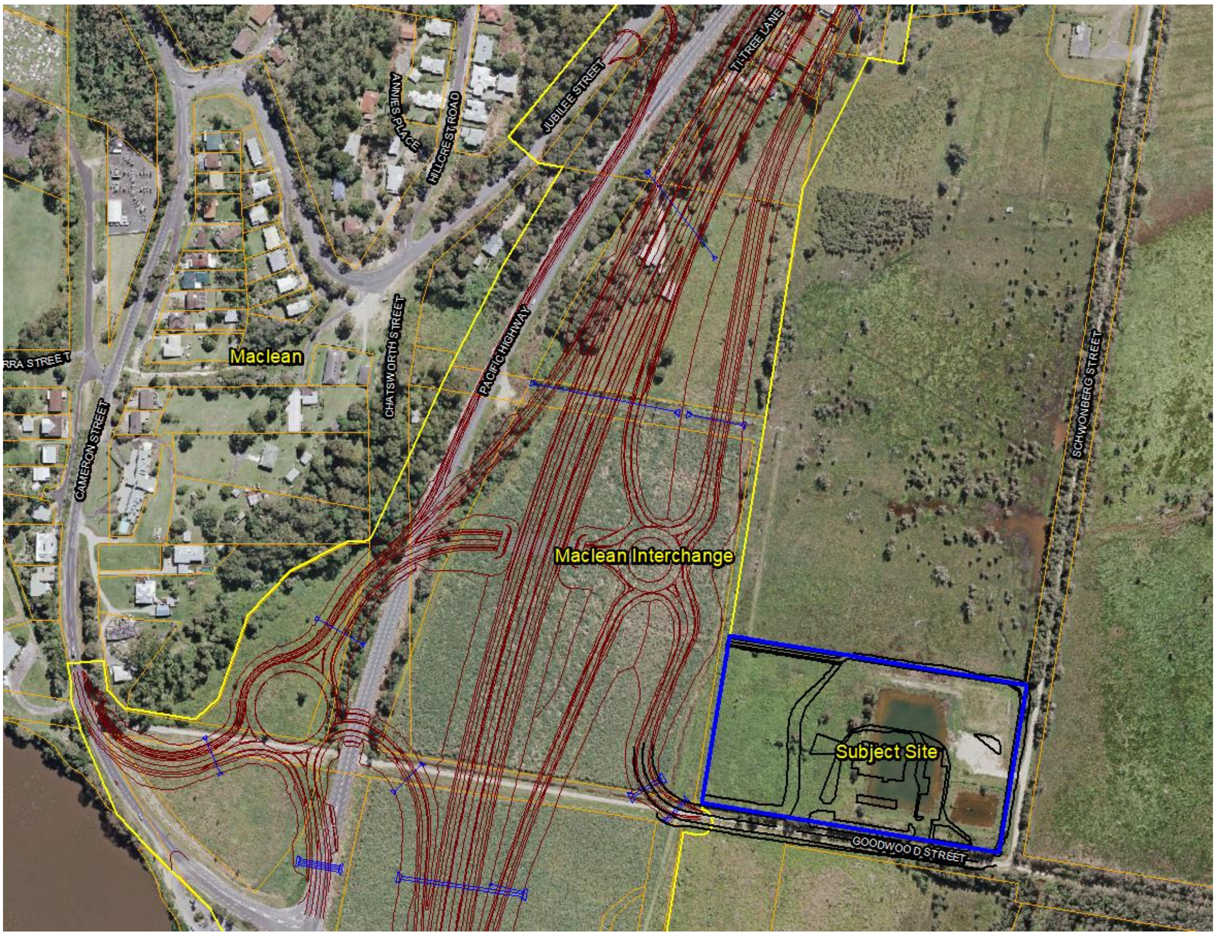


**Figure 1-1 Site Overview**

The proposed development site is currently low-lying with typical elevations across the site of approximately 0.5 mAHD. The existing site is subject to tidal inundation, local flooding from the local catchment area to the north, east and south of the site, and regional flooding from the Clarence River to the west of the site.

As part of the proposed development, approximately 80,000 $m^3$ of fill is proposed within the lot to raise the service centre to above the 1 in 100 AEP flood level associated with the Clarence River floodplain. It is also proposed to raise the adjacent Goodwood Street to a level above the 1 in 20 AEP flood levels to provide a degree of flood immunity between the site access and the on-ramp to the Maclean Highway Interchange.

## 1.2 Scope of Works

The scope of works for this assessment is as per GHD's letter of offer, dated 12 February 2021, as follows:

- Adopt the Updated Lower Clarence River Flood model developed for the Pacific Highway Upgrade for the assessments. The model was received by GHD.
- Configure the proposed development within the flood model and simulate the 1 in 5, 1 in 20 and 1 in 100 AEP flood events.
- Compile flood mapping (level, depth, velocity and hazard) of the pre and post-development conditions for the site, together with flood impact mapping (change in velocity and change in level ). This will allow an assessment of the flood impacts and flood planning levels at the site in accordance with Councils DCP controls.
- Prepare a letter report presenting the results of the flood impact assessment for inclusion in the Planning Proposal for the site. The report will assess the development against Councils DCP and other guidelines. The report will be supported by flood impact mapping and prepared such that it can be included in the Planning Proposal submission.

## 1.3 Assumptions

The Updated Clarence River flood model has been adopted. It is assumed that this flood model (as supplied) represents the 'as constructed' design geometry and drainage associated with the Pacific Highway upgrade. GHD have not reviewed the model for its accuracy.

## 1.4 Limitations

This report has been prepared by GHD for Maclean Service Centre Pty Ltd and may only be used and relied on by Maclean Service Centre Pty Ltd for the purpose agreed between GHD and the Maclean Service Centre Pty Ltd as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Maclean Service Centre Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared. Specifically, this Report does not take into account the effects, implications and consequences of or responses to COVID-19, which is a highly dynamic situation and rapidly changing. These effects, implications, consequences of and responses to COVID-19 may have a material effect on the opinions, conclusions, recommendations, assumptions, qualifications and limitations in this Report, and the entire Report must be re-examined and revisited in light of COVID-19. Where this Report is relied on or used without obtaining this further advice from GHD, to the maximum extent permitted by law, GHD disclaims all liability and responsibility to any person in connection with, arising from or in respect of this Report whether such liability arises in contract, tort (including negligence) or under statute.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Maclean Service Centre Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the Planning Proposal and has had no contribution to, or review of the Planning Proposal other than in preparation of this report]. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the Planning Proposal.

# 2. Methodology

## 2.1 Clarence River Flood Model

The Clarence River flood model is a large two-dimensional (2D) TUFLOW flood model encompassing the majority of the lower Clarence River Floodplain. The flood model covers approximately, 80km of the Clarence River, extending from approximately 15 km upstream of Grafton, through to the ocean outfall at Yamba.

The Clarence River flood model is simulated on a base grid resolution of 60 m, with multiple 2D domains configured to allow more accurate representation of key areas of interest. These key areas of interest are:

- Rural areas of North and South Grafton– represented in the model on a 30 m x 30 m grid.
- Rural areas of North and South Grafton– represented in the model on a 10 m x 10 m grid.
- Pacific Highway Upgrade route – represented in the model with a 20 m x 20 m grid.

The subject site is located within the extents of the 20 m grid resolution area, being adjacent to the upgraded Pacific Highway.

## 2.2 Proposed Development

The proposal is to develop the site as a highway service centre comprising retail fuel, food and rest areas for local and highway traffic, including full facilities for trucks.

As part of this assessment, it was agreed to simulate the model with a “maximised” development footprint, representing a “worst case” development scenario and potential flood impacts due to the proposed development. GHD were therefore provided with a design geometry for the proposed development. This was configured in the flood model simulated.

Figure 2-1 below shows the proposed extents of earthworks and fill across the site, which is proposed as part of the development.

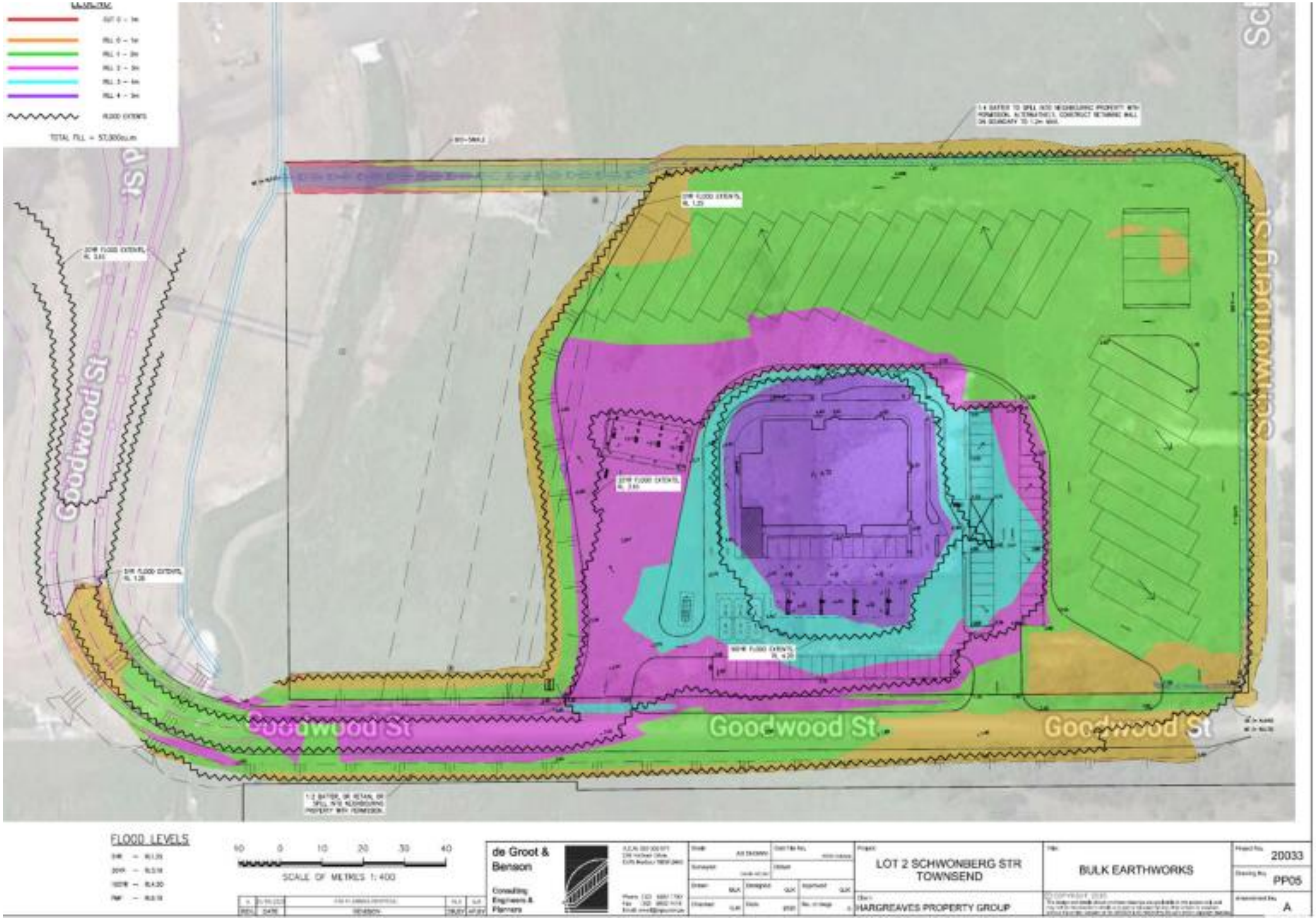


**Figure 2-1 Proposed Development**

## 2.3 Scenario Configurations

The following Scenarios were configured for the purposes of this assessment:

- Scenario 1: representing pre-development conditions at the subject site. For the purposes of this assessment, the Clarence River flood model scenario “dd200” was adopted. This scenario represents the Clarence River flood model configuration “post-construction” of the Woolgoolga to Ballina portion of the Pacific Highway upgrade. The model was simulated for the 1 in 5, 1 in 20 and 1 in 100 AEP flood events.
- Scenario 2: representing post-development conditions at the subject site with the consideration of a proposed fill pad within the Clarence River floodplain. For the purposes of this assessment, the proposed design geometry for the Maclean Service Centre was configured into the flood model to represent a “maximised” fill pad configuration, assuming the full site area is raised to the PMF level. This approach was adopted in order to represent a “worst case” flood afflux outcome in which up to 165,000 $m^3$ of fill would be imported into the floodplain (significantly larger than the 80,000 $m^3$ proposed).

## 2.1 Flood model Simulations

The Clarence River flood model was simulated for the 1 in 5, 1 in 20 and 1 in 100 AEP design flood events for the two scenarios described above in Section 2.3. The following sections of this report document the findings from the flooding assessment.

# 3. Results

## 3.1 Pre-development Conditions (Scenario 1)

The results from the pre-development scenario flood modelling are summarised below in the following sections, with mapping presented in Appendix A.

### 3.1.1 Flood Levels, extents, and depths

Flood levels at the site are summarised below in Table 3-1.

**Table 3-1 Pre-development conditions – Design Flood levels**

| Location | 1 in 5 AEP | 1 in 20 AEP | 1 in 100 AEP |
|---|---|---|---|
| North of Pad | Nil | 3.712 | 4.401 |
| South of Pad | Nil | 3.712 | 4.401 |
| East of Pad | Nil | 3.712 | 4.401 |
| West of Pad | Nil | 3.712 | 4.401 |

With reference to the table above, flood levels surrounding the subject site are the same, consistent with the expected behaviour of flooding in the large flood storage areas of the Clarence River Floodplain.

Existing topography in and around the site shows that site levels range from 0.5 mAHD to 1.7 mAHD. On this basis flood depths at the site are expected to range from between 2.0 to 3.2 m in the 1 in 20 AEP flood event and between 2.7 to 3.9 m in the 1 in 100 AEP event.

The existing eastern on/off-ramp of the Southern Maclean Interchange has a road elevation of approximately 5.0 mAHD, grading down to the existing road surface of Goodwood Street at approximately 1.0 mAHD. Therefore, the existing on/off-ramp from the Interchange is expected to be inundated in the 1 in 20 AEP Clarence River flood event and rarer events, with flood depths in excess of 2.0 m over the on-ramp in the 1 in 20 AEP.

### 3.1.2 Flood Velocities

With reference to the flood mapping in Appendix A, peak velocities for the 1 in 5 AEP, 1 in 20 AEP and 1 in 100 AEP flood events were found be relatively slow, with maximum velocities not exceeding 0.03 m/s.

### 3.1.3 Hydraulic Hazard

Hazard at the subject site is characterised by slow moving, deep floodwaters in the 1 in 20 AEP and 1 in 100 AEP flood events. The subject site and surrounding floodwaters are classified as being “**High Hazard”** in accordance with the NSW Floodplain Development Manual (2005).

## 3.2 Post-Development Conditions (Scenario 2)

The results from the post-development Scenario flood modelling are summarised below in the following sections. Flood mapping presented in Appendix A of this report.

### 3.2.1 Flood Levels, extents, and depths

Flood levels at the site in Scenario 1 are summarised below in Table 3-2.

**Table 3-2 Scenario 2 – Design Flood levels**

| Location | 1 in 5 AEP | 1 in 20 AEP | 1 in 100 AEP |
|---|---|---|---|
| North of Pad | Nil | 3.713 | 4.401 |
| South of Pad | Nil | 3.713 | 4.401 |
| East of Pad | Nil | 3.713 | 4.401 |
| West of Pad | Nil | 3.713 | 4.401 |

With reference to the table above, no flood impacts are noted due to the proposed placement of the fill.

The maximised fill pad provides a pad level of 6.5 mAHD, with the access road to the interchange on/off ramp raised to approximately 4.2 mAHD. On this basis the proposed fill pad would achieve flood immunity in the 1 in 100 AEP flood event plus freeboard (500 mm), whilst the access road would become inundated by up to 0.2 m.

Due to expected flood velocities in the area of the subject site, the depths over the proposed raised access road to the Maclean Interchange are expected to remain safe for vehicular traffic, providing adequate signage and flood depth indicators are provided at the low point.

### 3.2.2 Flood Velocities

With reference to the flood mapping in Appendix A, peak velocities for the 1 in 5 AEP, 1 in 20 AEP and 1 in 100 AEP flood events were found to be slow, with maximum velocities not exceeding 0.03 m/s.

### 3.2.3 Hydraulic Hazard

With reference to the flood mapping in Appendix A, and flood velocities and depths described above, Hydraulic hazard around the subject site is characterised by slow moving, deep floodwaters in the 1 in 20 AEP and 1 in 100 AEP flood events. As the proposed fill pad has been raised above the 1 in 100 AEP flood level, no hydraulic hazard or flood risk exists at the fill pad under post-development conditions.

### 3.2.4 Change in Flood Level (afflux)

Flood afflux, due to proposed maximised fill pad are summarised below in Table 3-3.

With reference to the table below, flood impacts due to the proposed development were found to be generally less than 1 mm in all events up to and including the 1 in 100 AEP flood event.

**Table 3-3 Flood afflux at the site**

| Location | 20% AEP | | | 5% AEP | | | 1% AEP | | |
|---|---|---|---|---|---|---|---|---|---|
| | Existing Scenario (mAHD) | Proposed Scenario (mAHD) | Flood Afflux (mm) | Existing Scenario (mAHD) | Proposed Scenario (mAHD) | Flood Afflux (mm) | Existing Scenario (mAHD) | Proposed Scenario (mAHD) | Flood Afflux (mm) |
| North of Pad | Nil | Nil | Nil | 3.713 | 3.713 | < 1 | 4.401 | 4.401 | < 1 |
| South of Pad | Nil | Nil | Nil | 3.713 | 3.713 | < 1 | 4.401 | 4.401 | < 1 |
| East of Pad | Nil | Nil | Nil | 3.713 | 3.713 | < 1 | 4.401 | 4.401 | < 1 |
| West of Pad | Nil | Nil | Nil | 3.713 | 3.713 | < 1 | 4.401 | 4.401 | < 1 |

## 3.3 Flood Planning Level

The planning proposal for the subject site has recommend that the fill pad level be no lower than the 1 in 100 AEP flood level plus freeboard.

The Clarence Valley Council LEP (2011) and DCP (2013) have identified the freeboard allowance for the site as being 0.5 m, with the required flood planning level for commercial premises to be no lower than the 1 in 5 AEP flood level.

The Planning Proposal has therefore adopted a design pad level above the minimum requirements outlined in Councils requirements for the site.

With reference to the flood levels documented for the site in Section 3.2 of this report, the nominated flood planning level for the site is 4.9 mAHD, being the 1 in 100 AEP flood level plus 0.5 m freeboard.

## 3.4 Flood Warning and evacuation

The Bureau of Meteorology aims to provide up to 24 hours warning of flooding in Clarence Valley area and 12 hours warning of potential events which may overtop the major levee systems at Grafton, South Grafton and Maclean.

On this basis, it is expected that 12-18 hours of warning would be available for the site, given its location immediately south of Maclean.

In the event of a rare to extreme event within the Clarence River Floodplain, evacuation may be required from the site. PMF levels at the subject site are noted to rise to approximately 6.1 mAHD, with the Maclean Levee overtopping at approximately 3.3 m on the Maclean gauge.

The Adjacent Maclean Interchange is located at an elevation of approximately 5.5 mAHD. On this basis, depending on the nominated level for the access road between the subject site and the Maclean Interchange, may be classified as a low flood island with rising road access.

From a review of the available flood mapping for the Clarence River and review of the Lower Clarence River Floodplain Risk Management Plan (2007), areas of Townsend and higher areas of Maclean remain flood free in the PMF flood event. These areas are located approximately 1-2 km to the north of the site.

On the basis of the above, should evacuation from the site be required, evacuation from the site to either Maclean or Townsend would be proposed via the access to the Maclean Interchange. The extents of PMF flooding and potential evacuation routes from the site are shown below in Figure 3-1.

It is recommended that a flood evacuation plan be prepared for the site. The evacuation plan should take into consideration BOM flooding predictions, and weather warnings and co-ordinate response to potential flooding (or isolation due to flooding) at the site accordingly. Additionally, information issued by SES should be followed in all instances.


**Figure 3-1 PMF Flood Extent and potential evacuation routes**

## 3.5 Function and operation of Edwards Creek overflow weir

It is understood that an additional flood relief structure is proposed adjacent the existing box culvert structure on Edwards Creek, south of the Maclean Interchange. This structure is to augment the existing structure, by way of a weir incorporated into downstream side. This would allow river floodwater into Edwards Creek at the same level, as it currently breaches the Clarence River banks at Ferry Reserve. Unless the existing highway is overtopped, Edwards Creek is currently the only location that conveys effluent floodwaters.

Pacific Complete has directed the design team (correspondence dated 08/10/2018) to develop the Edwards Drain culvert design (documented in the report W2B-GHD-A-SC-RPT- 00005 dated May 2018). The Edwards Creek culvert is proposed as 2 cells of 2400 mm (W) x 900 mm (H) diameter RCBC units. The northbound side has a headwall and wing walls perpendicular to the culvert, with a weir structure adjacent to the headwall. Figure 3-2 below shows the proposed general arrangement.

The culvert and connected weir design would convey water from the Clarence River into the drainage system that is connected to the Chaselings Basin. The weir and culverts operate when the water level in the Clarence River is above 2.86 mAHD. The weir and culverts can also operate in reverse when the water level in the drainage system to the east is above 2.86 mAHD and above the Clarence River water level. For further information, please refer to reports W2B-GHD-A-SC-RPT-00005 and W2B-GHD-A-DC-RPT-00005.

Council have provided preliminary correspondence to Maclean Service Centre Pty Ltd, noted the following in relation to the proposed weir:

*“The current flood gates which allow flow from Edwards Creek are proposed to be replaced by TfNSW to an overflow weir. This will effectively hold back local flood flows to the height of the weir thus extending the elevated flood stage levels during a flood event. This has not been considered in the preliminary flood calculations.”*

Based on GHD’s review of the design documentation prepared for Pacific Complete, the existing flood gates are not proposed to be removed and will continue to operate as intended to allow one-way drainage from Edwards Creek to the Clarence River. On this basis, the flood gates at Edwards creek, and the proposed weir configuration are not expected to have any measurable impact on flood levels or behaviour at the subject site. Notwithstanding, the service centre proposal aims to fill the site to a level at or above the 1 in 100 AEP Clarence River flood level. As such, any localised effects on flood levels which may occur at Edwards Creek are not expected to have any impact on the proposed service centre development.

General

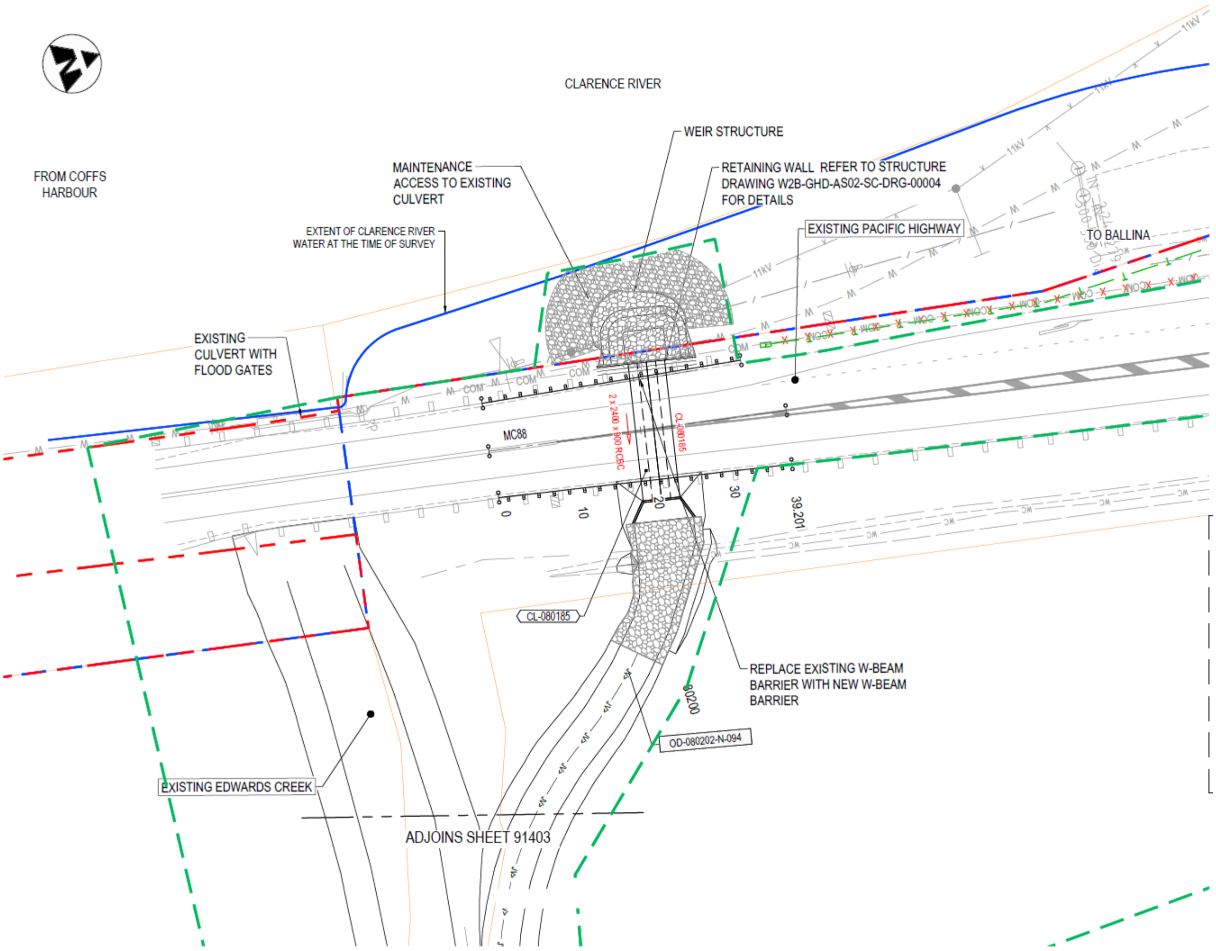


**Figure 3-2 General Arrangement of Edwards Creek weir**

The Updated Lower Clarence River Flood model developed for the Pacific Highway Upgrade has been adopted for the purposes of this study. A review of the model was unable to confirm whether the updated weir arrangement has been appropriately configured within the model. details

## 3.6 Compliance Assessment

A review of Councils development requirements in relation to flooding has been undertaken as part of this assessment. GHD has identified the following:

- The site is located within the Lower Clarence River floodplain
- The classification of this area is considered to form part of the general floodplain
- The site is located withing an area identified as flood storage

Table 3-4 provides a summary of the applicable development controls and GHD’s assessment of these controls.

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**Table 3-4 Review of applicable floodplain development controls for subject site**

| Source of Control | Clause Reference | Relevant flooding related control | Comment/ Response |
|---|---|---|---|
| Clarence Valley Council Business Zones DCP 2011 | D 3.1 (a) | The proposed development should not result in any increased risk to human life. | The proposed development pad is proposed to be located at or above the 1 in 100 AEP flood level for the Clarence River Floodplain. Road raising of the on/off ramp to the Southern Maclean Interchange is also proposed to limit the risk of users of the site becoming inundated by rising flood waters.<br><br>Flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour and therefore no increase in risk to human life is expected due to the proposed development. |
| Clarence Valley Council Business Zones DCP 2011 | D 3.1 (b) | The additional economic and social costs which may arise from damage to property from flooding should not be greater than that which can reasonably be managed by the property owner and general community. | Refer to Comment/Response for D 3.1 (a) |
| Clarence Valley Council Business Zones DCP 2011 | D 3.1 (c) | The proposal should only be permitted where effective warning time and reliable access is available for evacuation from an area potentially affected by floods to an area free of risk from flooding. Evacuation should be consistent with any relevant flood evacuation strategy. | Refer to Comment/Response for D 3.1 (a). filling is proposed to mitigate flood risk to users of the site. Flood evacuation from site (in rarer events) would be facilitated by rising road access to the Maclean Interchange |
| Clarence Valley Council Business Zones DCP 2011 | D 3.1 (d) | Development should not detrimentally increase the potential flood effects on other development or properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain | A flood impact assessment has been undertaken for the site (refer section 3.2). flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour |
| Clarence Valley Council Business Zones DCP 2011 | D 3.1 (e) | Motor vehicles are able to be relocated, undamaged, to an area with substantially less risk from flooding, within effective warning time. | Refer to Section 3.4 of this report. Filling is proposed to mitigate flood risk to users of the site. Flood evacuation (if required) from site would be facilitated by rising road access to the Maclean Interchange towards Townsend or Maclean. |
| Clarence Valley Council Business Zones DCP 2011 | D 3.1 (f) | Procedures would be in place, if necessary, (such as warning systems, signage or evacuation drills) so that people are aware of the need to evacuate and relocate motor vehicles during a flood and are capable of identifying an appropriate evacuation route. | It is recommended that a flood evacuation plan be prepared for the site. |

| Source of Control | Clause Reference | Relevant flooding related control | Comment/ Response |
|---|---|---|---|
| Clarence Valley Council Business Zones DCP 2011 | D 5.1 (a) | The filling of flood liable land must not increase the flood risk on other land within the floodplain. | A flood impact assessment has been undertaken for the site (refer section 3.2). Flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour |
| Clarence Valley Council Business Zones DCP 2011 | D 5.1 (b) | Filling and associated works must not have any unacceptable associated environmental impacts such as detrimental affects on the ecology of riparian corridors. | A flood impact assessment has been undertaken for the site (refer section 3.2). Flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour |
| | D 5.2.1 | The flood impact of the development to be considered to ensure that the development will not increase flood affects elsewhere, having regard to:<br>(i) loss of flood storage;<br>(ii) changes in flood levels and velocities caused by alterations to the flood conveyance; and<br>(iii) the cumulative impact of multiple potential developments in the floodplain.<br>An engineer's report may be required to address potential impacts. | A flood impact assessment has been undertaken for the site (refer section 3.2). Flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour. On this basis, the loss of flood storage due to site filling is not expected to have any off-site impact. |
| | D 5.2.2 | If a Flood Storage Area has been defined in the floodplain, any filling of the floodplain inside this area is not permitted as it will reduce the volume of flood storage available on the floodplain and increase flood effects elsewhere, except:<br>i) where this occurs in conjunction with compensatory excavation, or<br>ii) where, in Council's opinion, such impacts are likely to be negligible | A flood impact assessment has been undertaken for the site (refer section 3.2). flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour |

| Source of Control | Clause Reference | Relevant flooding related control | Comment/ Response |
|---|---|---|---|
| Clarence Valley Council LEP 2011 | 7.3 (3) (a) | Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:<br>a. Is compatible with the flood hazard of the land<br>b. Is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties<br>c. Incorporates appropriate measures to manage risk to life from flood<br>d. Is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses<br>e. Is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding. | A flood impact assessment has been undertaken for the site (refer section 3.2). flood impacts are expected to be < 1mm and therefore have a negligible effect on flood levels and/or behaviour<br>filling is proposed to mitigate flood risk to users of the site. flood evacuation from site (in rarer events) would be facilitated by rising road access to the Maclean Interchange |
| General Floodplain Controls | Floodplain Management Controls Schedule D4 – Floor and pad levels | Unless otherwise specified all floor levels to be no lower than the 5 year flood level plus freeboard unless justified by site specific assessment | Refer Section 3.3 of this report |
| | Floodplain Management Controls Schedule D4 – Floor and pad levels | Primary habitable floor levels to be no lower than the 100 year flood level plus freeboard. If this level is impractical for an infill development in a business zone, the floor level should be as high as possible. | Refer Section 3.3 of this report |
| | Floodplain Management Controls Schedule D4 – Building Components | All structures to have flood compatible building components below the design level of the primary habitable floor level. | Refer Section 3.3 of this report |
| | Floodplain Management Controls Schedule D4 – Structural Soundness | Applicant to demonstrate that the structure can withstand with forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard, or a PMF if required to satisfy evacuation criteria (see below). An engineer's report may be required. | Refer Section 3.3 of this report |
| | Floodplain Management | The flood impact of the development to be considered to ensure that the development will not increase flood effects | Refer Section 3.2 of this report. flood impacts are predicted to be less than 1mm. |

| Source of Control | Clause Reference | Relevant flooding related control | Comment/ Response |
|---|---|---|---|
| | Controls Schedule D4 – Flood Effects | elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyancing; and (iii) the cumulative impact of multiple potential developments in the floodplain. An engineer's report<br>may be required. | |
| | Floodplain Management Controls Schedule D4 – Evacuation | Reliable access for pedestrians or vehicles required during a 100 year flood to a publicly accessible location above the PMF. | Refer Section 3.4 of this report<br>The planning proposal recommends raising the access road to the Southern Maclean Interchange to facilitate reliable and safe access and evacuation from the site in the event of flooding. |
| | Floodplain Management Controls Schedule D4 – Building Components | The development is to be consistent with any relevant flood evacuation strategy, Flood Plan adopted by Council or similar plan | Refer to Section 3.4 of this report .<br>The planning proposal recommends raising the access road to the level of the Southern Maclean Interchange off-ramp to facilitate reliable and save access and evacuation from the site in the event of flooding.<br>Notwithstanding the above, the proposed fill pad is located at or above the 1% AEP flood levels and will operate as a low flood island in the event of a flood.<br>It is recommended a flood evacuation plan be prepared for the site. |
| | Floodplain Management Controls Schedule D4 – Building Components | Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP | |
| | Floodplain Management Controls Schedule D4 – Building Components | Site Emergency Response Flood Plan required where floor levels are below the design floor level, (except for single dwelling houses) | Refer Section 3.4 of this report |
| | Floodplain Management Controls Schedule D4 – Building Components | Applicant to demonstrate that area is available to store goods above the 100 year flood level plus freeboard. | Refer Section 3.3 of this report |

| Source of Control | Clause Reference | Relevant flooding related control | Comment/ Response |
|---|---|---|---|
| | Floodplain Management Controls Schedule D4 – Building Components | No storage of materials below the design floor level which may cause pollution or be potentially hazardous during any flood. | Refer Section 3.3 of this report |

# 4. Summary and conclusion

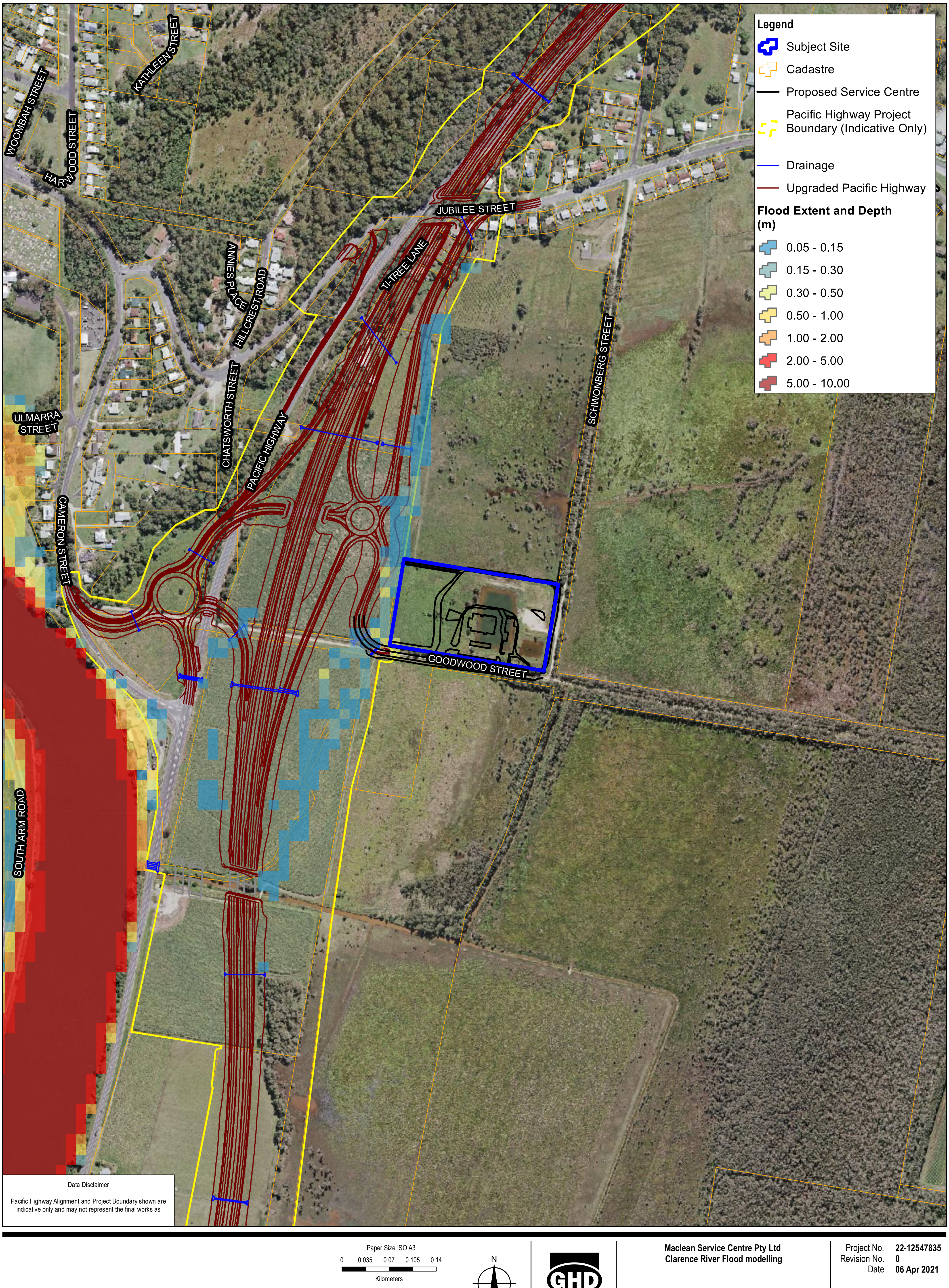
- Maclean Service Centre Pty Ltd are seeking gateway approval for a planning proposal to support rezoning of the site for the development of a proposed highway service centre. The proposal is to develop the site as a highway service centre comprising retail fuel, food and rest areas for local and highway traffic, including full facilities for trucks.
- The site is defined as Lot 2 DP 634170, Schwonberg Street, Townsend, NSW 2463 and is located immediately to the east of the Southern Maclean Interchange, recently constructed as part of the Woolgoolga to Ballina Pacific Highway Upgrade.
- A flood impact assessment of the subject site has been undertaken using the Lower Clarence River Flood Model. the model was configured to represent the proposed development and simulated for the 1 in 5, 1 in 20 and 1 in 100 AEP flood events.
- The flood impact assessment has identified the impact of filling due to the proposed development and loss of flood storage within the Clarence River floodplain has negligible (<1 mm) effect on flood levels in the area. This is attributed to the significant floodplain storage within the Clarence River floodplain.
- In the event of a rare to extreme event within the Clarence River Floodplain, evacuation may be required from the site. Should evacuation from the site be required, evacuation from the site to either Maclean or Townsend would be proposed via the access to the Maclean Interchange. It is recommended that a flood evacuation plan be prepared for the site. The evacuation plan should take into consideration BOM flooding predictions, and weather warnings and co-ordinate response to potential flooding (or isolation due to flooding) at the site accordingly. Additionally, information issued by SES should be followed in all instances
- Notwithstanding, a further assessment of the development against relevant Clarence Valley Council floodplain management controls has been undertaken. The assessment has found that generally the applicable floodplain development controls can be satisfied by the proposal.

# 5. References


- NSW Floodplain Development Manual (2005) (ISBN 0 7347 5476 0)
- Clarence Valley Council Business Zones Development Control Plan (2013)
- Clarence valley Council Local Environment Plan (2011)
- SES Coffs Harbour Local Flood Plan (September 2017)
- Grafton and Lower Clarence Floodplain Risk Management Plan (2007)

# Appendices

# **Appendix A** – Flood Mapping




Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Existing Conditions - 1 in 5 AEP**
**Flood Extent and Depth**

Project No. **22-12547835**
Revision No. **0**
Date **06 Apr 2021**

**Figure 01**

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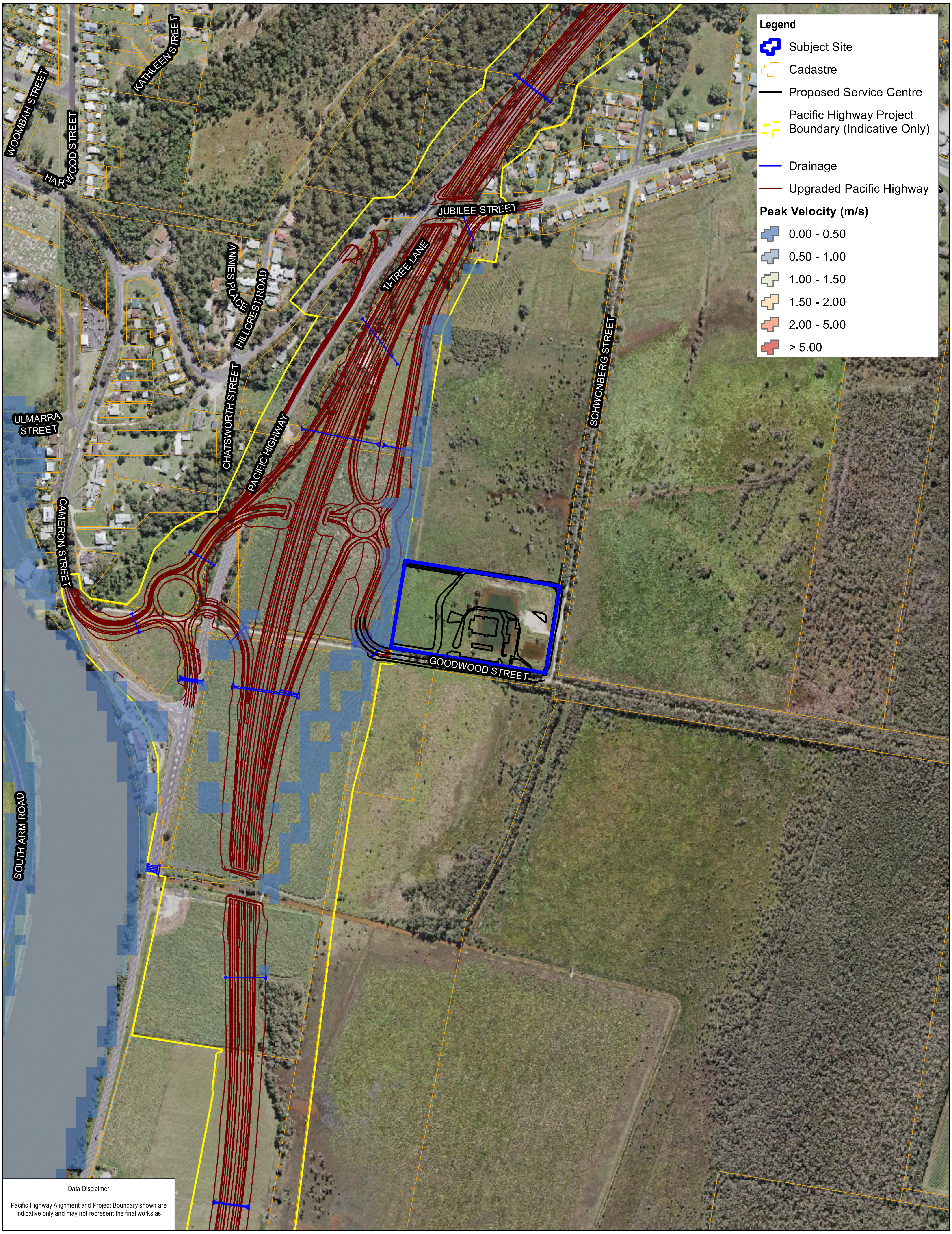


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0 0.035 0.07 0.105 0.14

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Existing Conditions - 1 in 5 AEP**
**Peak Velocity**

Project No. **22-12547835**
Revision No. **0**
Date **06 Apr 2021**

**Figure 02**

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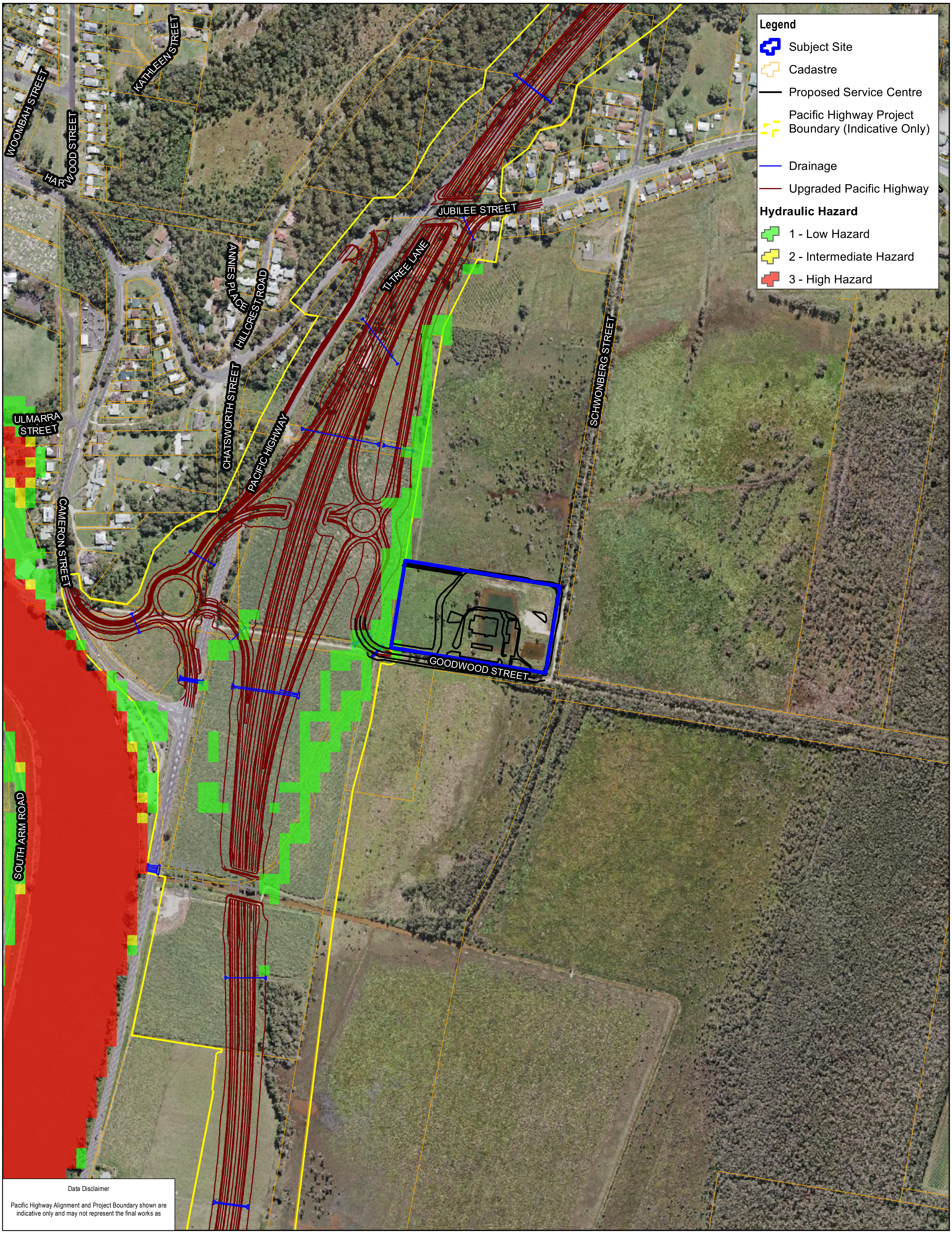


Paper Size ISO A3

0 0.035 0.07 0.105 0.14

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Existing Conditions - 1 in 5 AEP Hydraulic Hazard**

Project No. **22-12547835**
Revision No. **0**
Date **06 Apr 2021**

**Figure 03**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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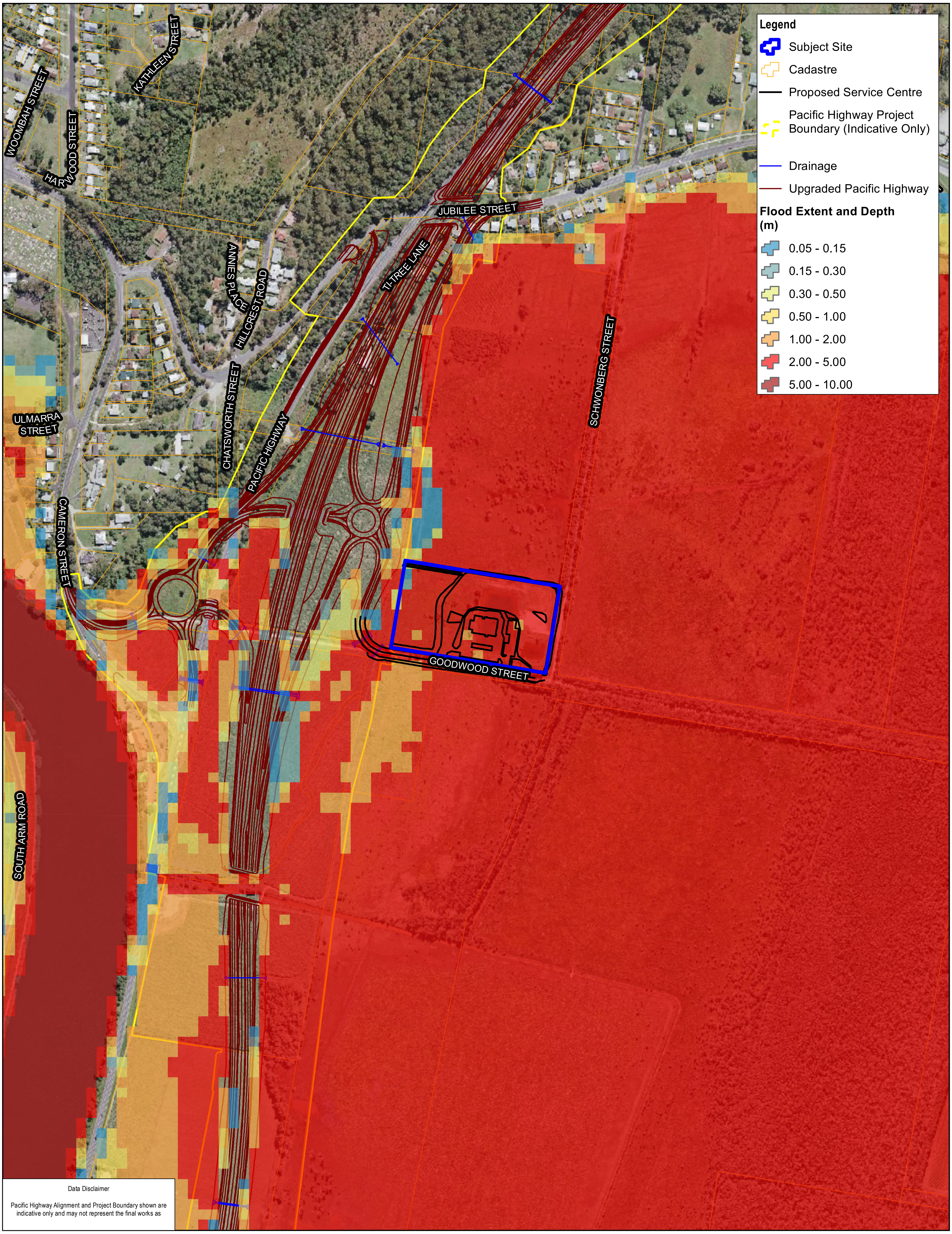


Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

| | |
|---|---|
| Project No. | **22-12547835** |
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| Date | **06 Apr 2021** |

## Existing Conditions - 1 in 20 AEP Flood Extent and Depth

## Figure 04

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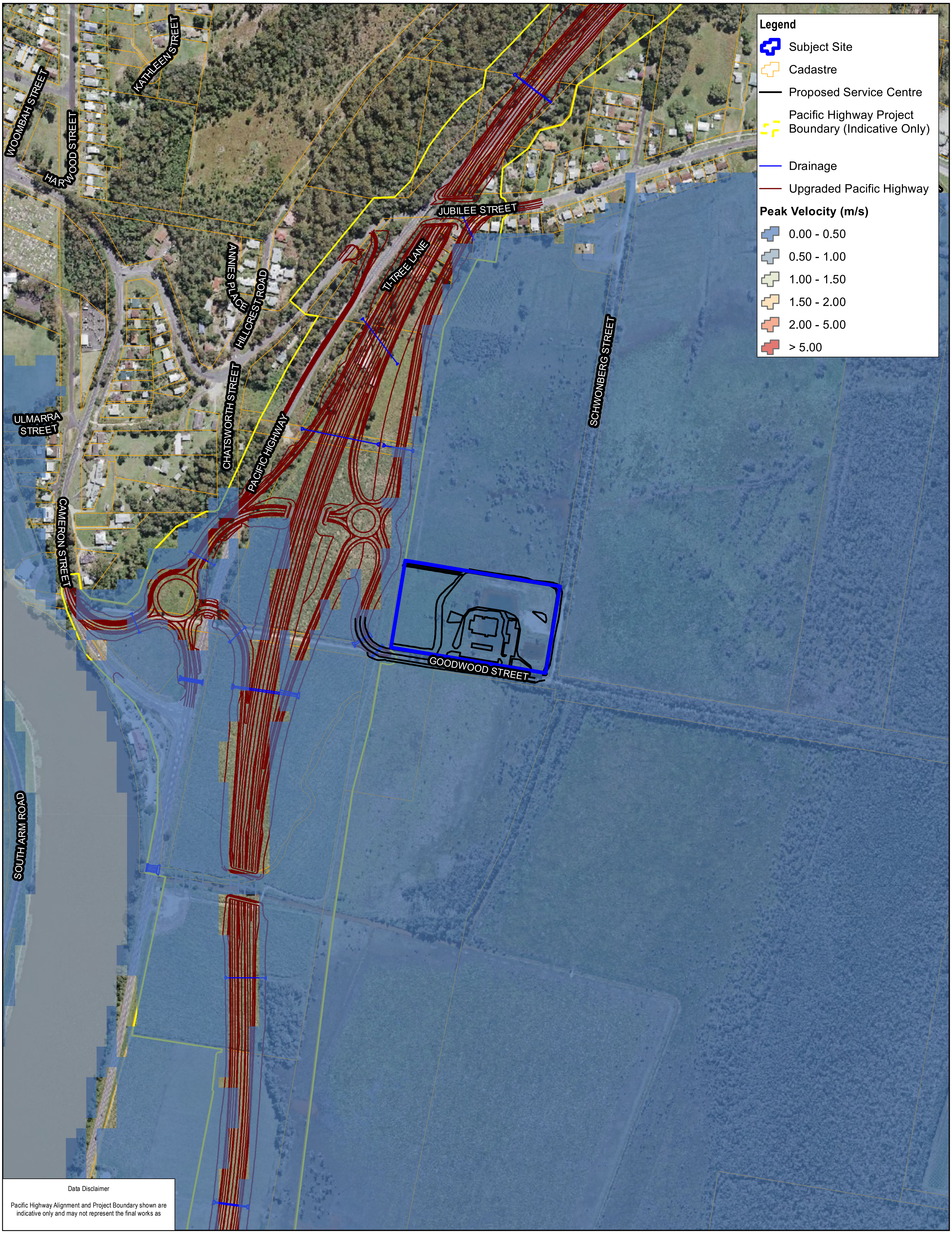


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

## Existing Conditions - 1 in 20 AEP
## Peak Velocity

Project No. **22-12547835**
Revision No. **0**
Date **06 Apr 2021**

# Figure 05

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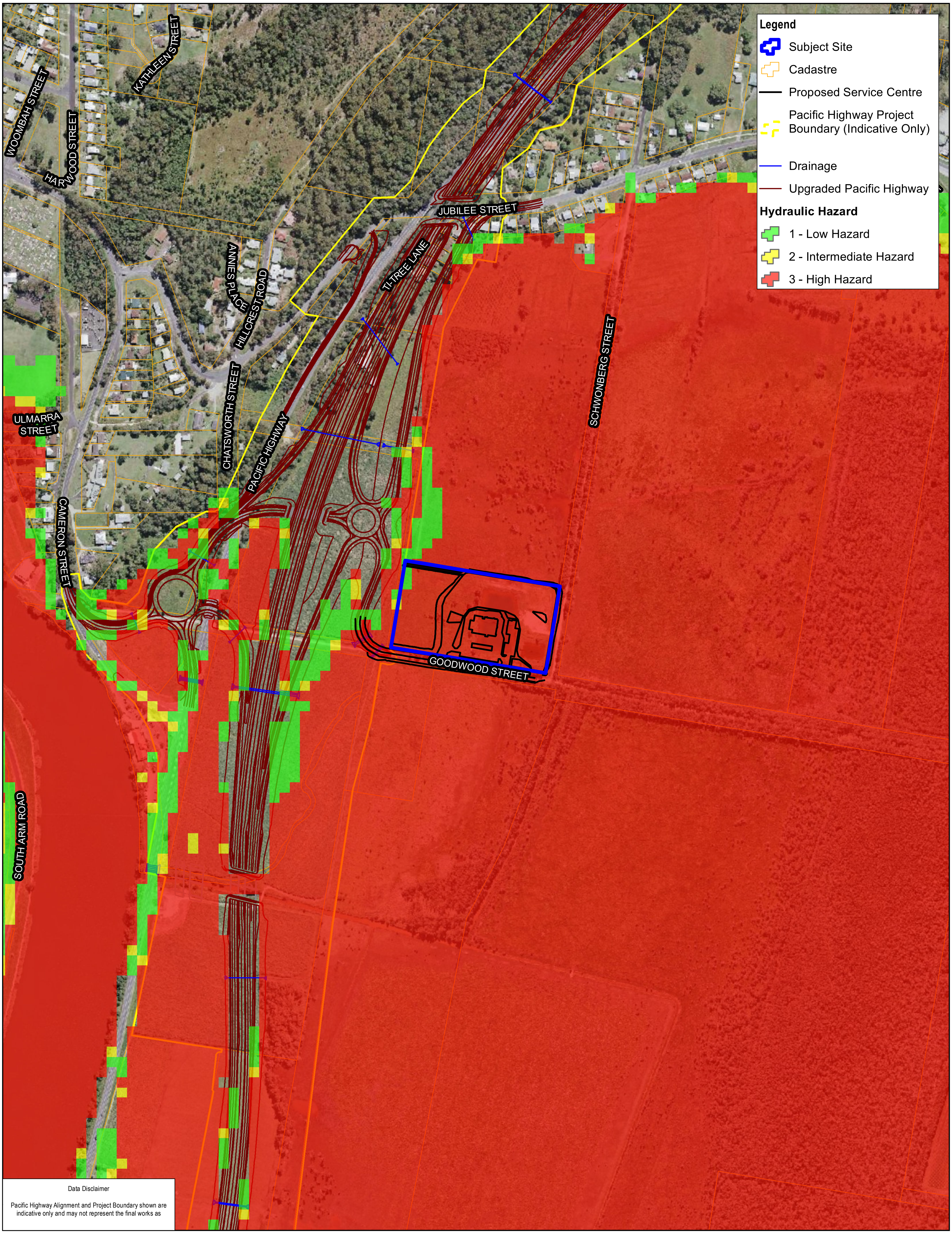


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

## Existing Conditions - 1 in 20 AEP Hydraulic Hazard

| | |
|---|---|
| Project No. | **22-12547835** |
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| Date | **06 Apr 2021** |

**Figure 06**

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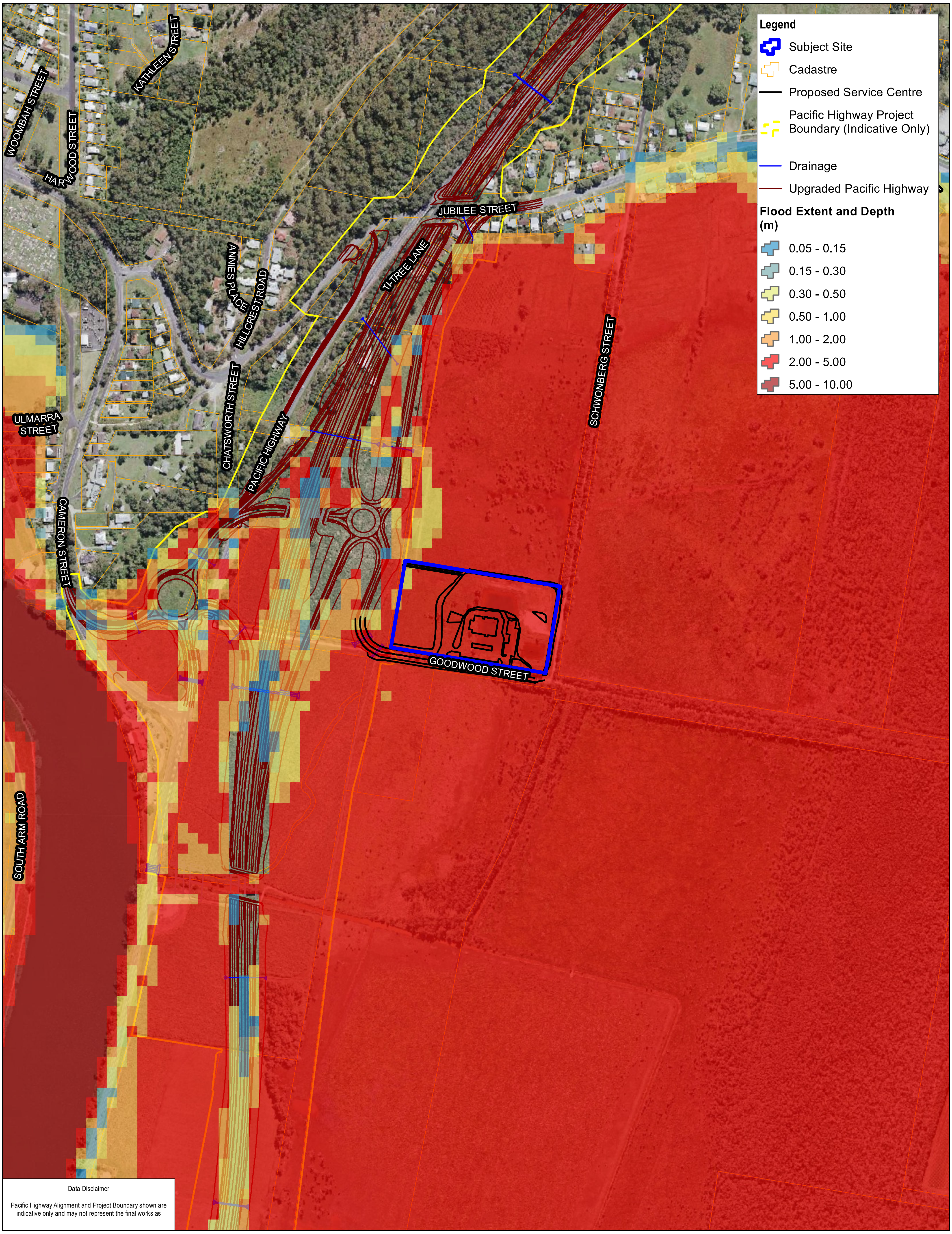


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Existing Conditions - 1 in 100 AEP**
**Flood Extent and Depth**

Project No. **22-12547835**
Revision No. **0**
Date **06 Apr 2021**

**Figure 07**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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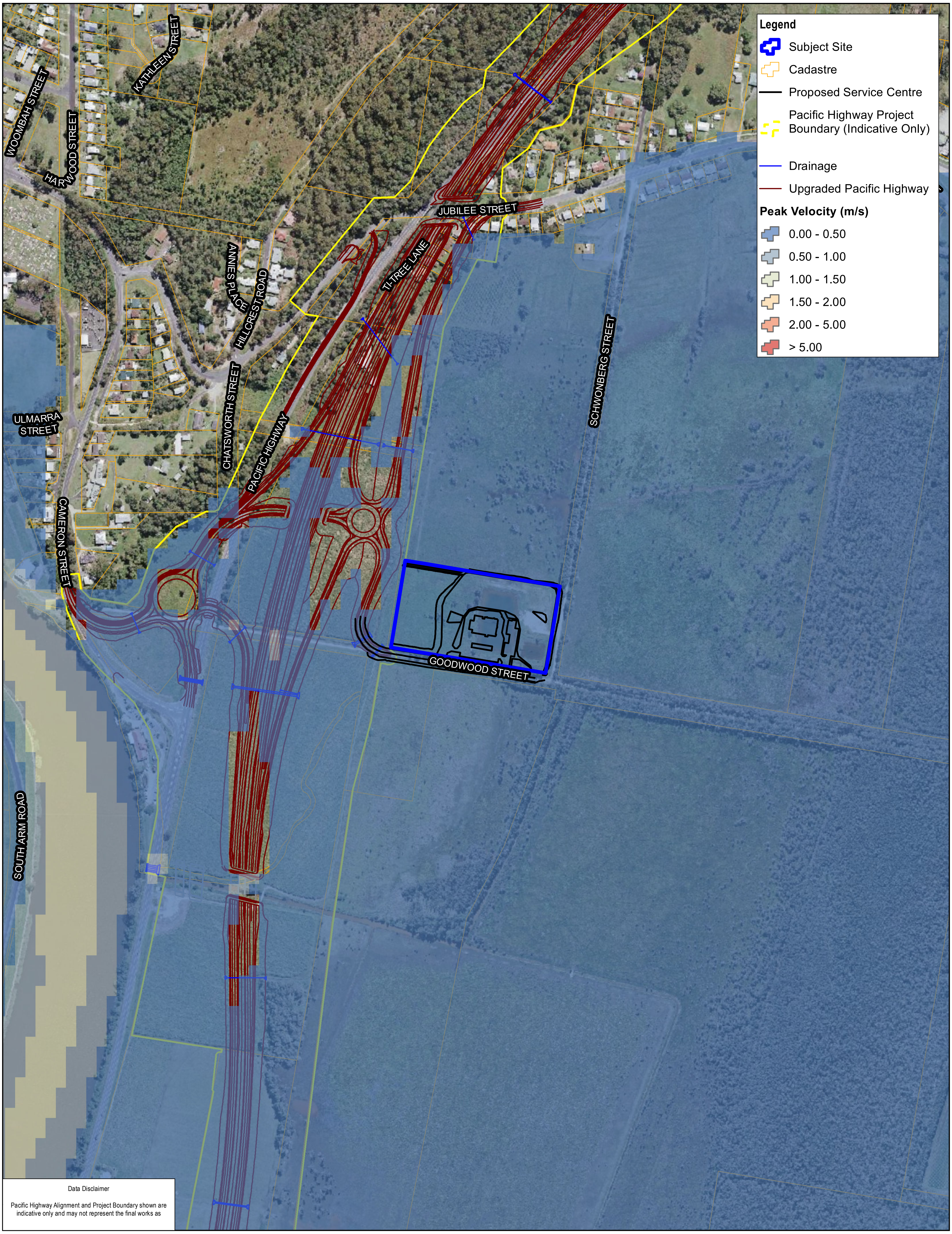


Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Maclean Service Centre Pty Ltd
Clarence River Flood modelling

**Existing Conditions - 1 in 100 AEP**
**Peak Velocity**

| | |
|---|---|
| Project No. | 22-12547835 |
| Revision No. | 0 |
| Date | 06 Apr 2021 |

**Figure 08**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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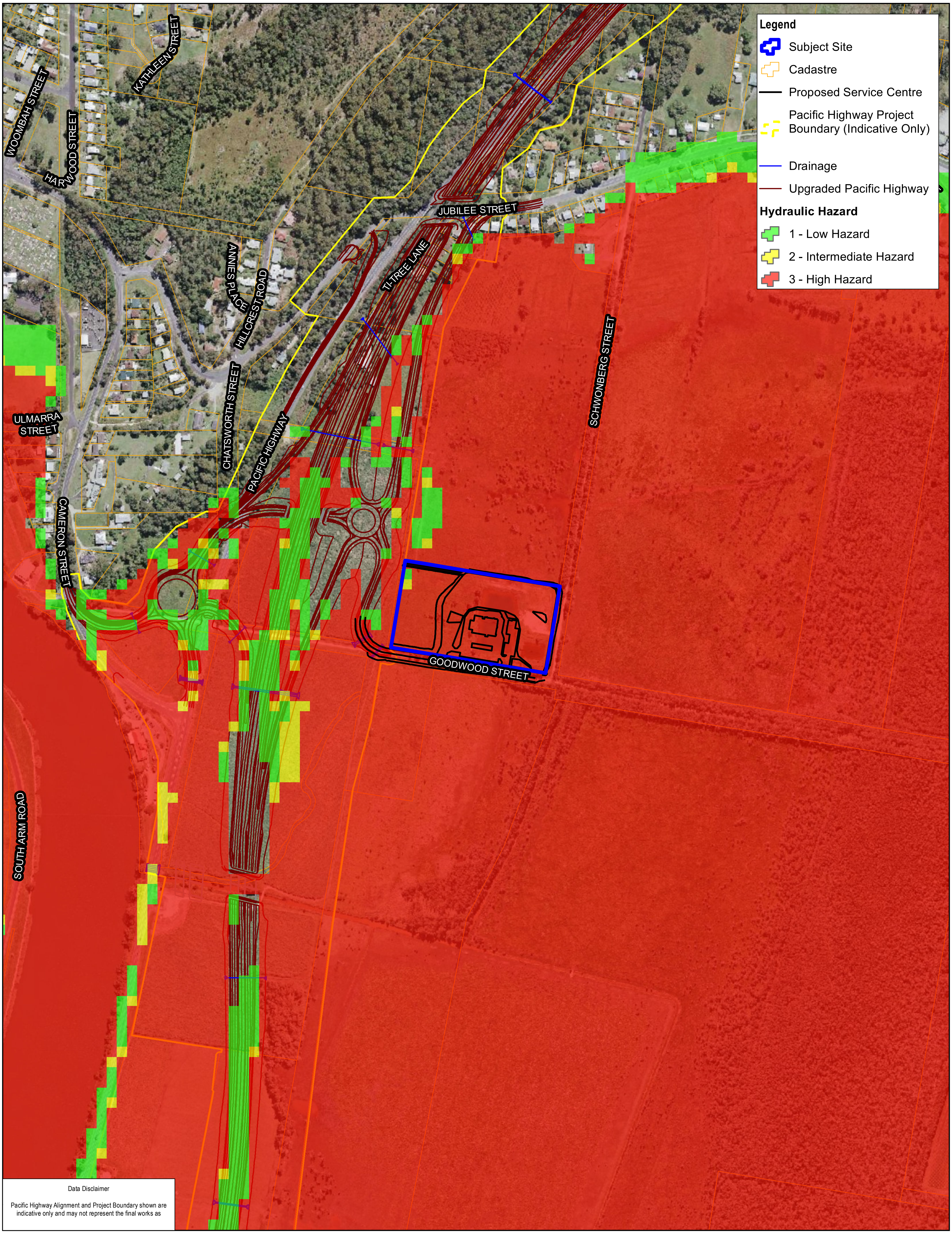


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Existing Conditions - 1 in 100 AEP**
**Hydraulic Hazard**

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**Figure 09**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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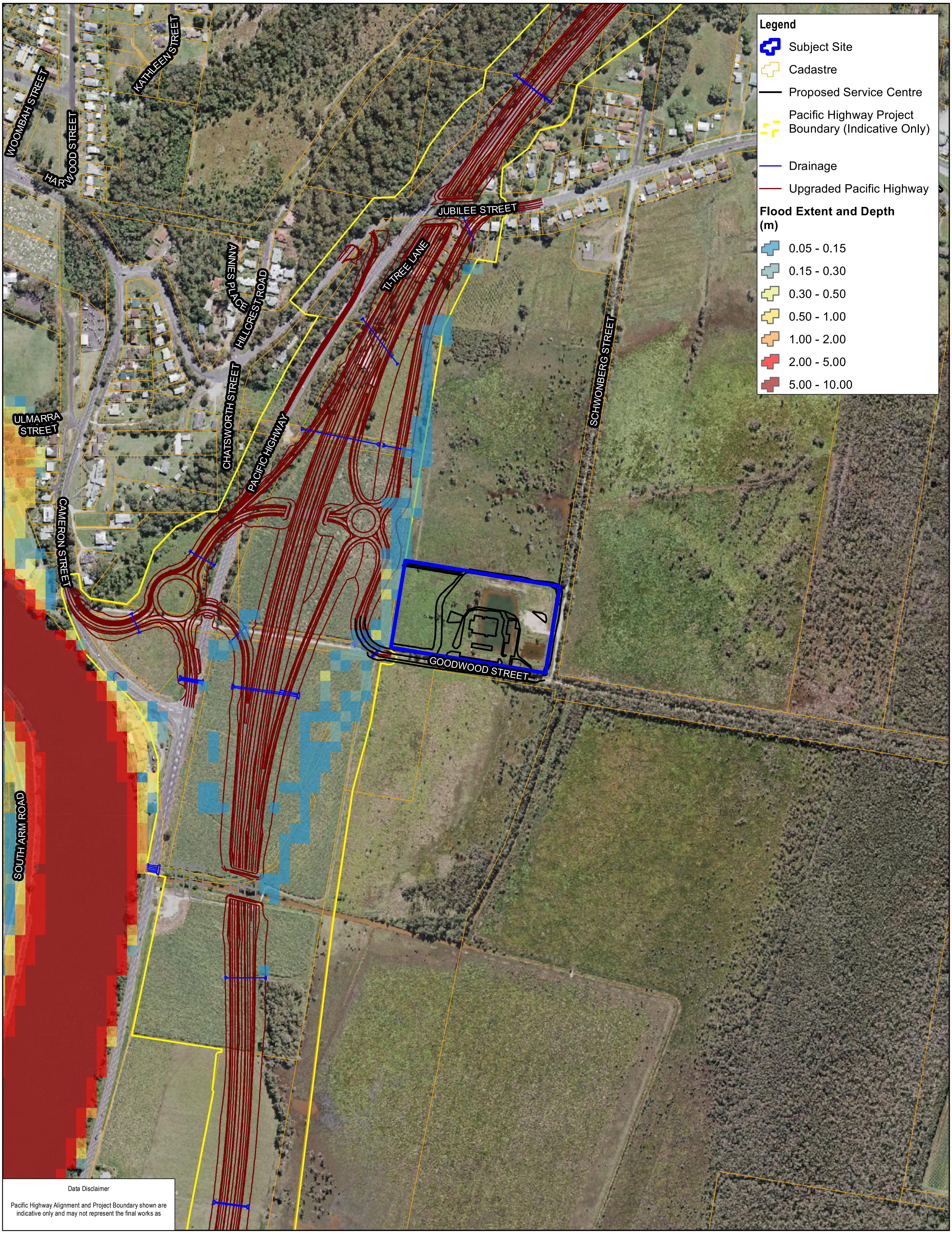


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 5 AEP Flood Extent and Depth**

Project No. **22-12547835**
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Date **06 Apr 2021**

**Figure 10**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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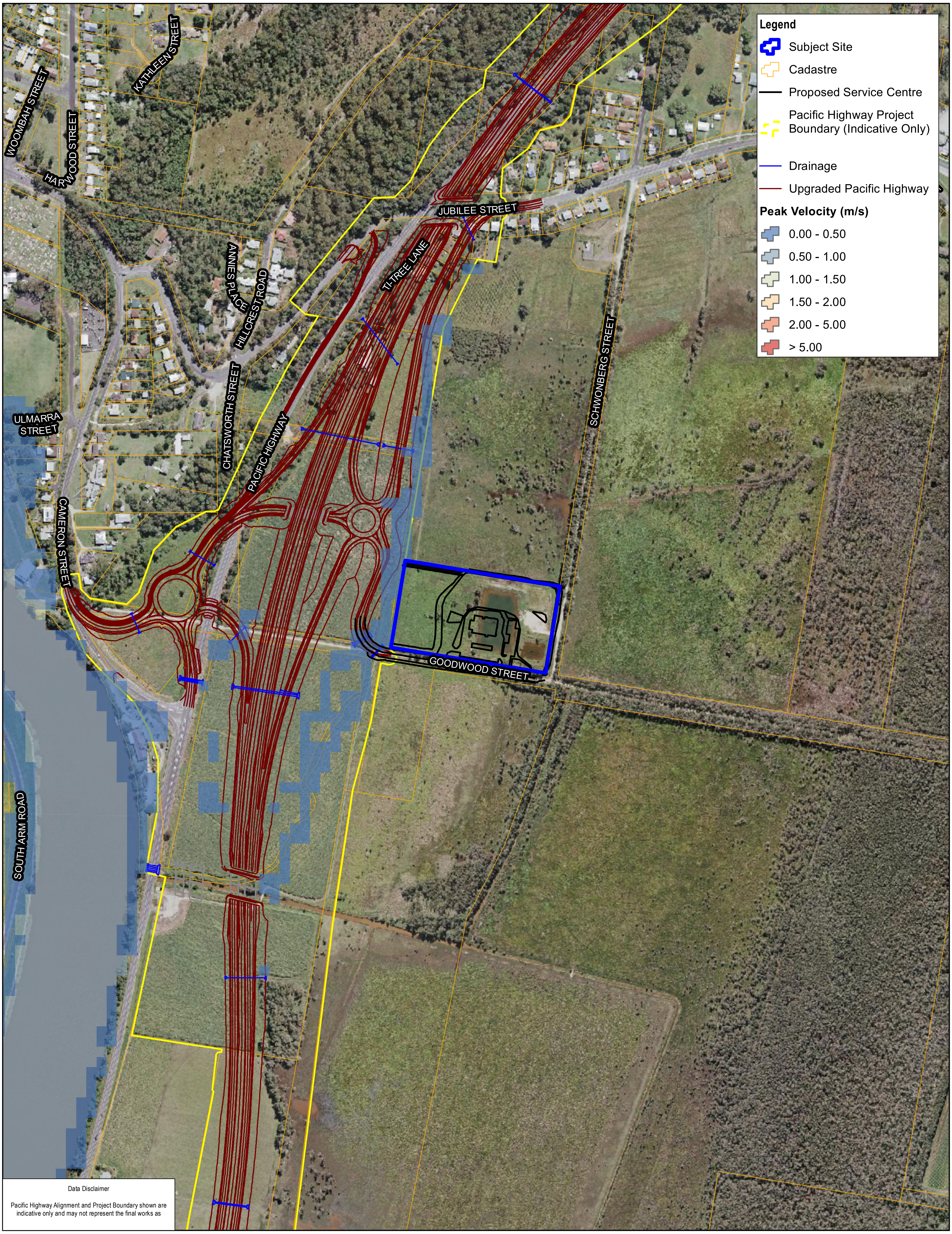


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Maclean Service Centre Pty Ltd
Clarence River Flood modelling

**Proposed Conditions - 1 in 5 AEP**
**Peak Velocity**

Project No. 22-12547835
Revision No. 0
Date 06 Apr 2021

**Figure 11**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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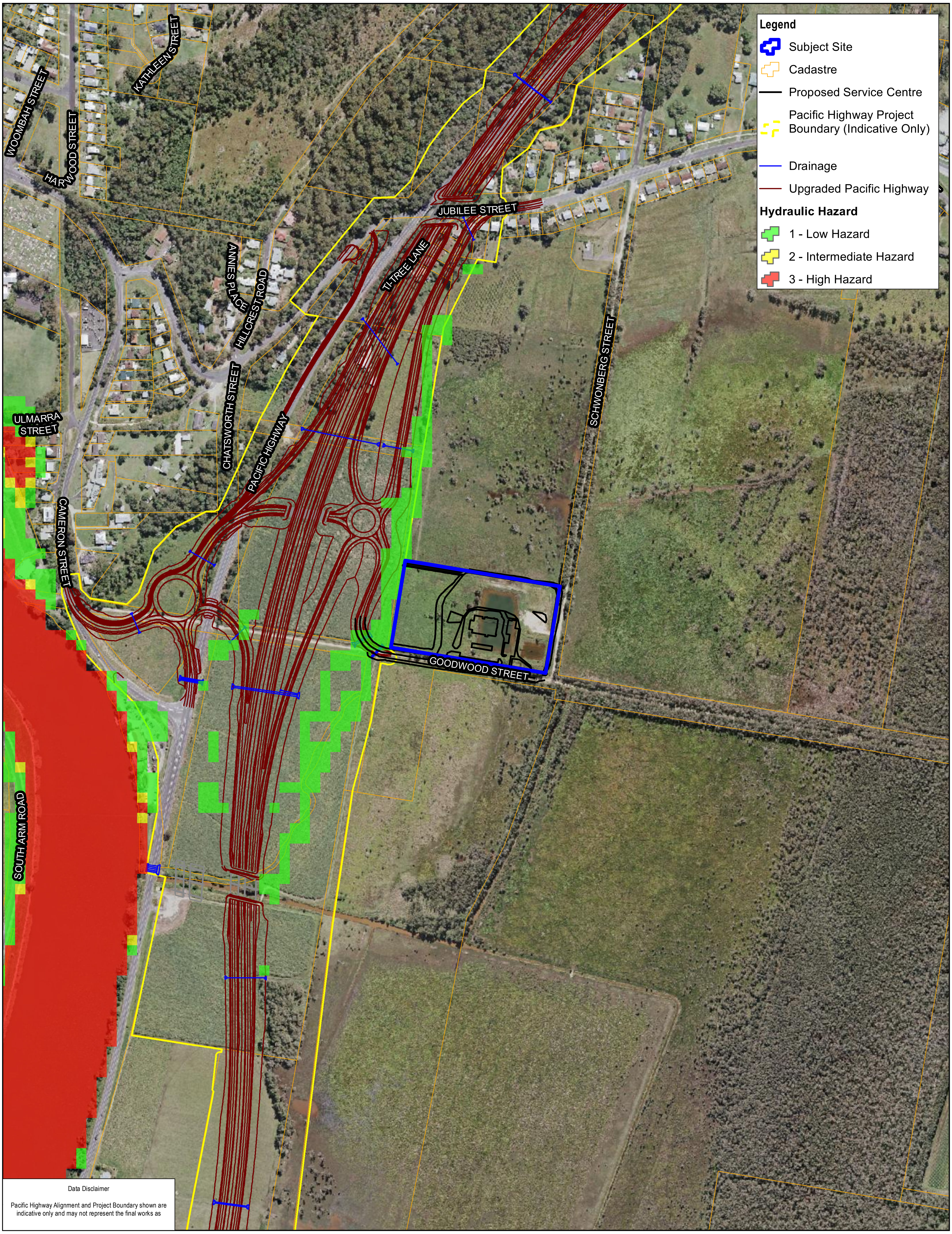


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 5 AEP**
**Hydraulic Hazard**

| | |
|---|---|
| Project No. | **22-12547835** |
| Revision No. | **0** |
| Date | **06 Apr 2021** |

**Figure 12**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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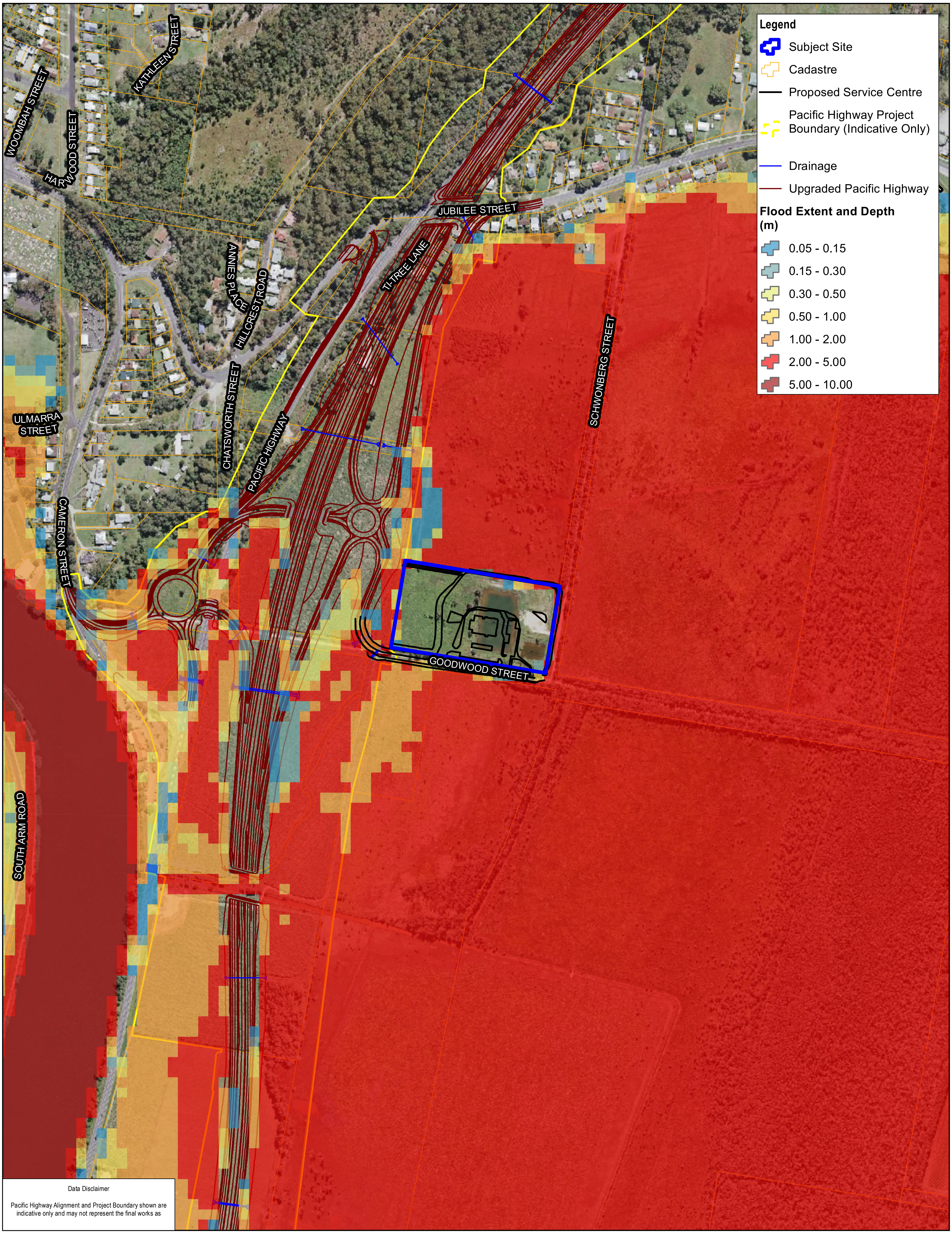


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Kilometers

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 20 AEP**
**Flood Extent and Depth**

Project No. **22-12547835**
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Date **06 Apr 2021**

**Figure 13**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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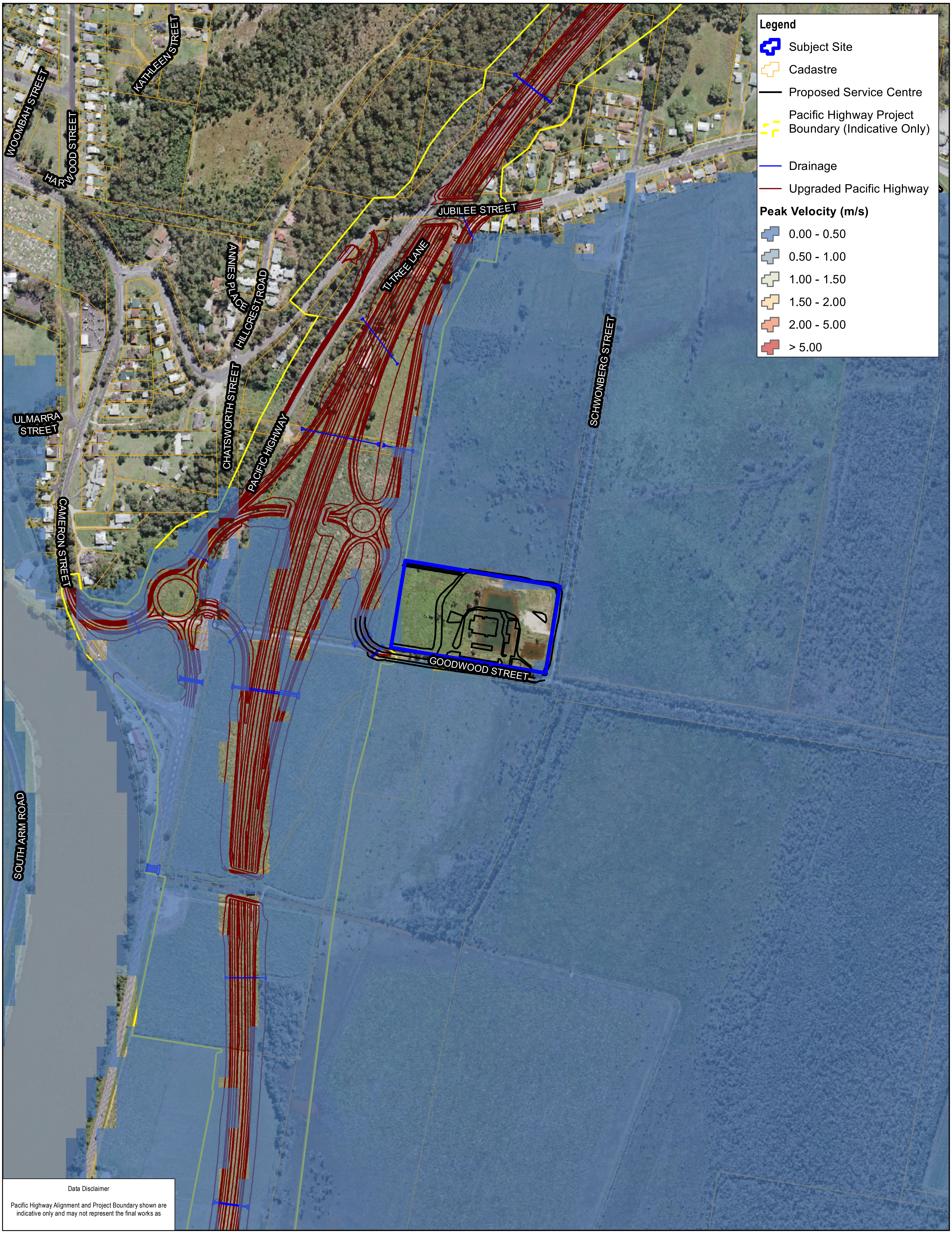


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 20 AEP**
**Peak Velocity**

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Date **06 Apr 2021**

**Figure 14**

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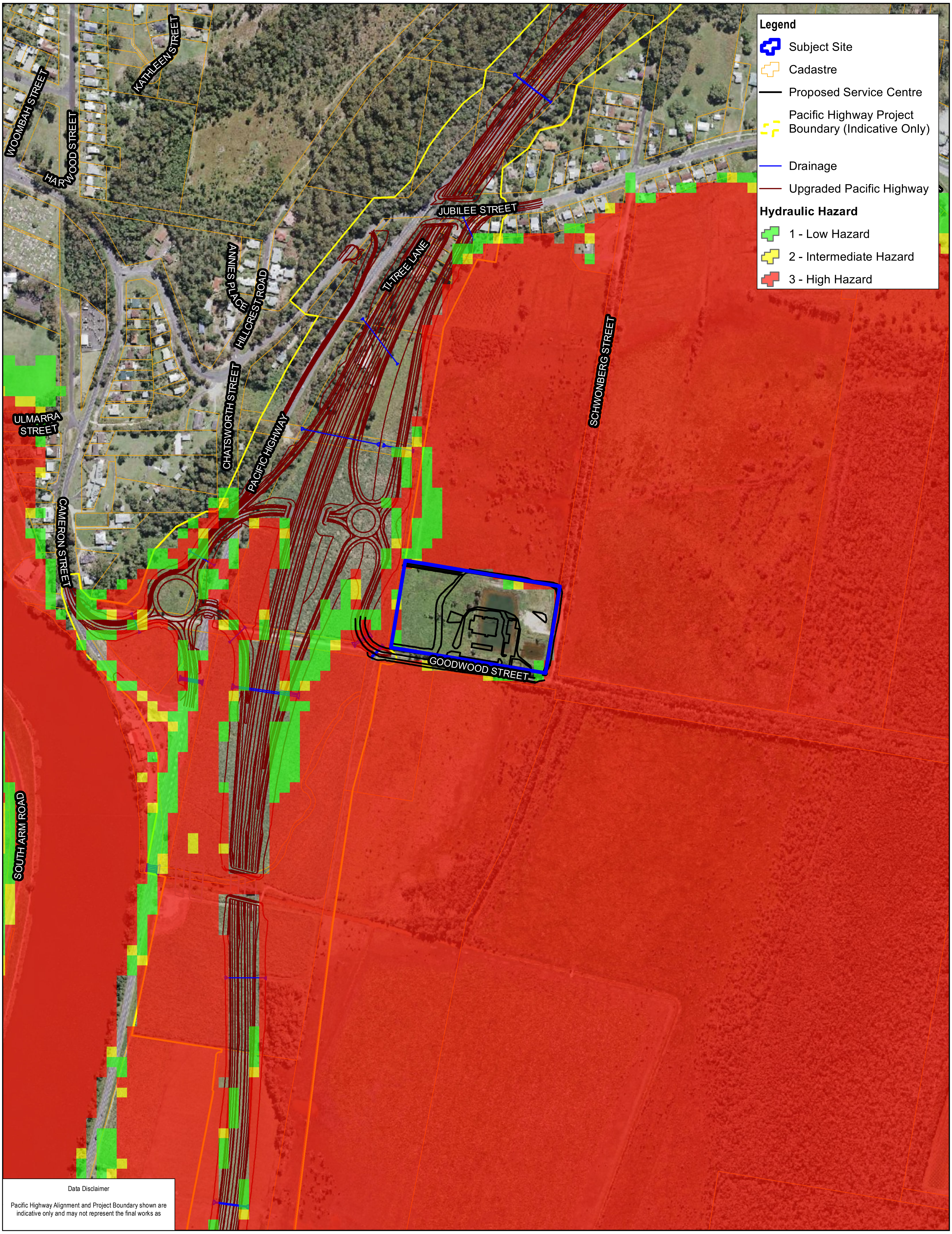


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Pacific Highway Alignment and Project Boundary shown are indicative only and may not represent the final works as

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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**Clarence River Flood modelling**

**Proposed Conditions - 1 in 20 AEP**
**Hydraulic Hazard**

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**Figure 15**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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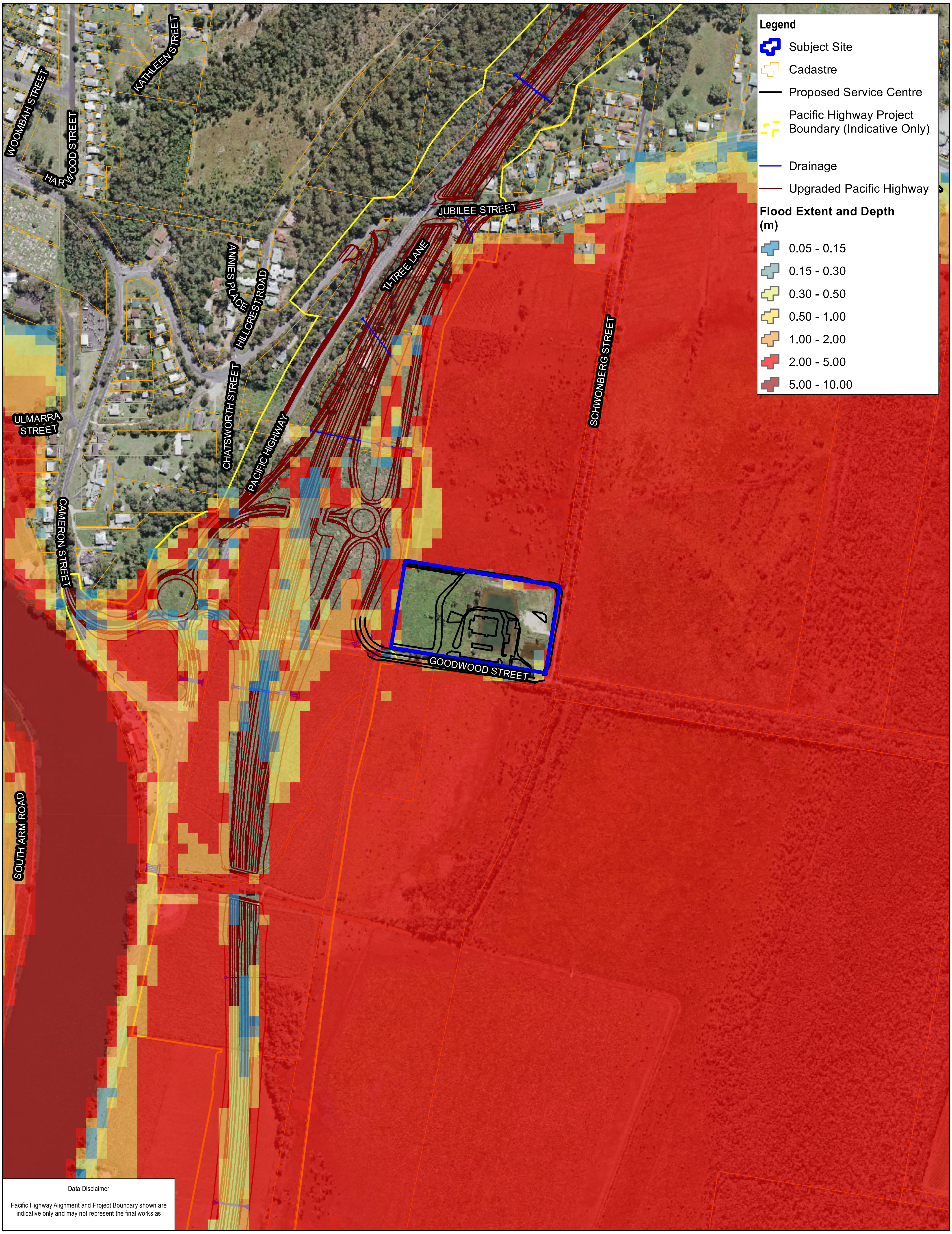


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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Clarence River Flood modelling

**Proposed Conditions - 1 in 100 AEP Flood Extent and Depth**

Project No. 22-12547835
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Date 06 Apr 2021

**Figure 16**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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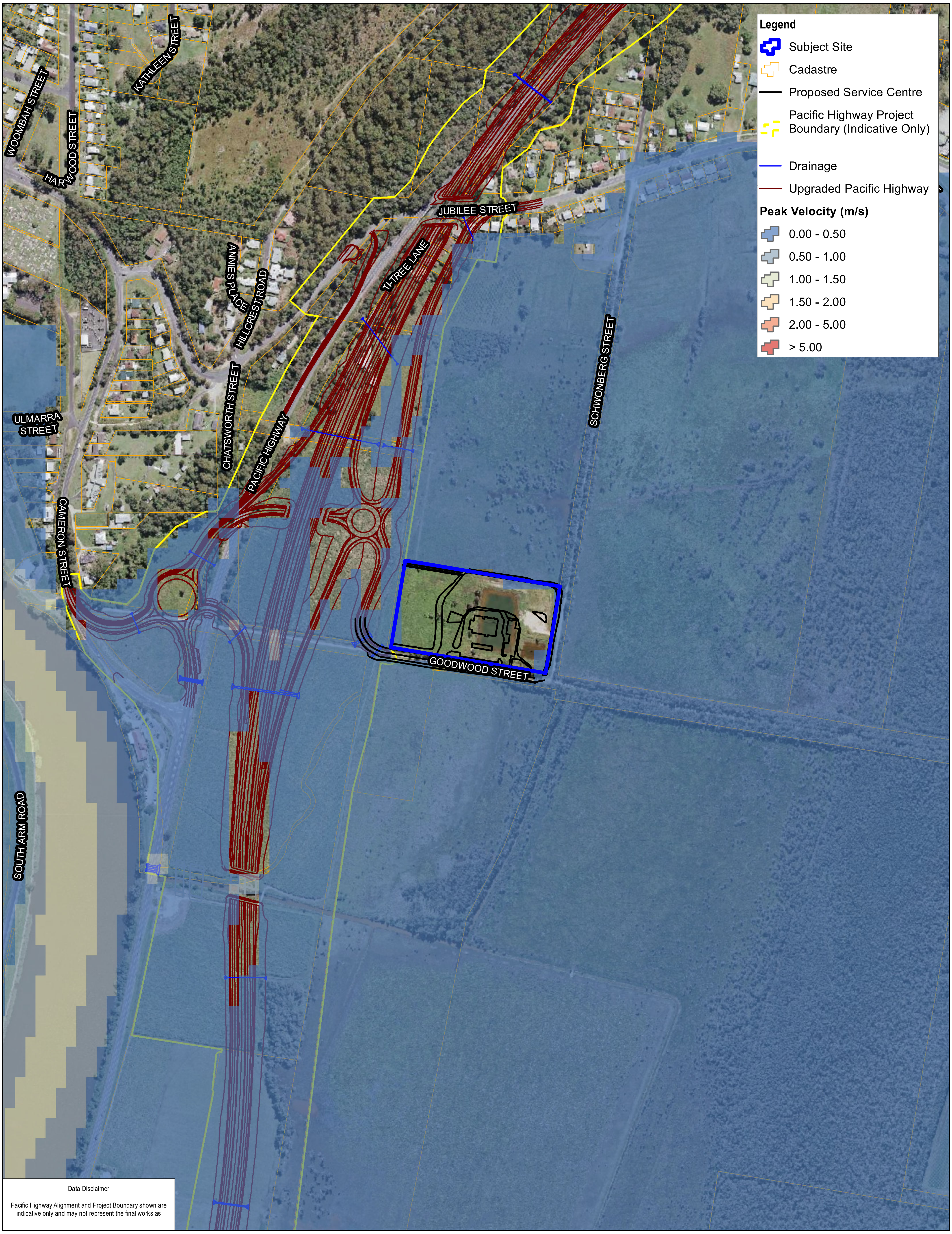


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Kilometers

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 56

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Maclean Service Centre Pty Ltd
Clarence River Flood modelling

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Date 06 Apr 2021

**Proposed Conditions - 1 in 100 AEP**
**Peak Velocity**

**Figure 17**

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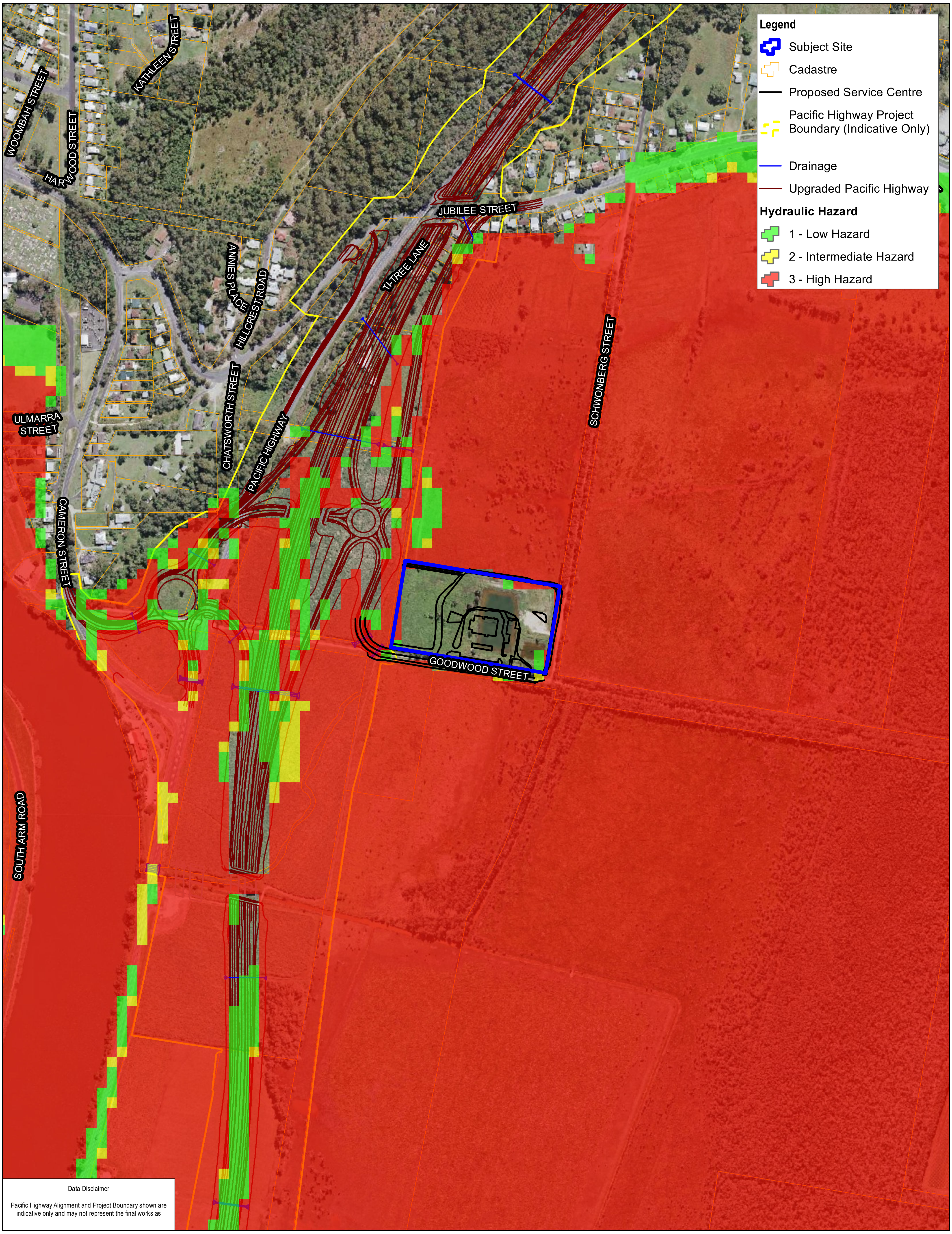


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

## Proposed Conditions - 1 in 100 AEP Hydraulic Hazard

Project No. **22-12547835**
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Date **06 Apr 2021**

# Figure 18

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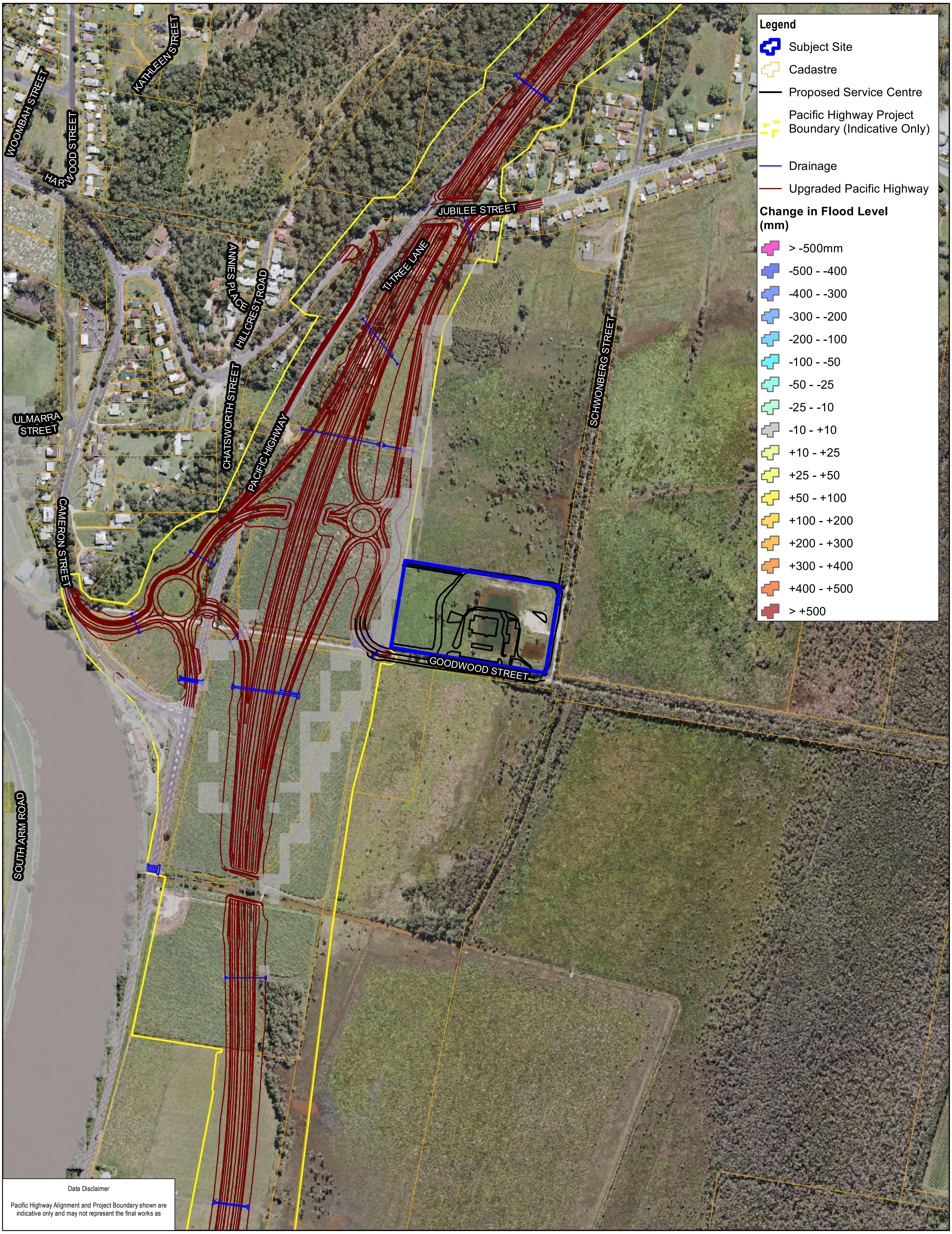


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Kilometers

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 5 AEP**
**Change in Flood Level**

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**Figure 19**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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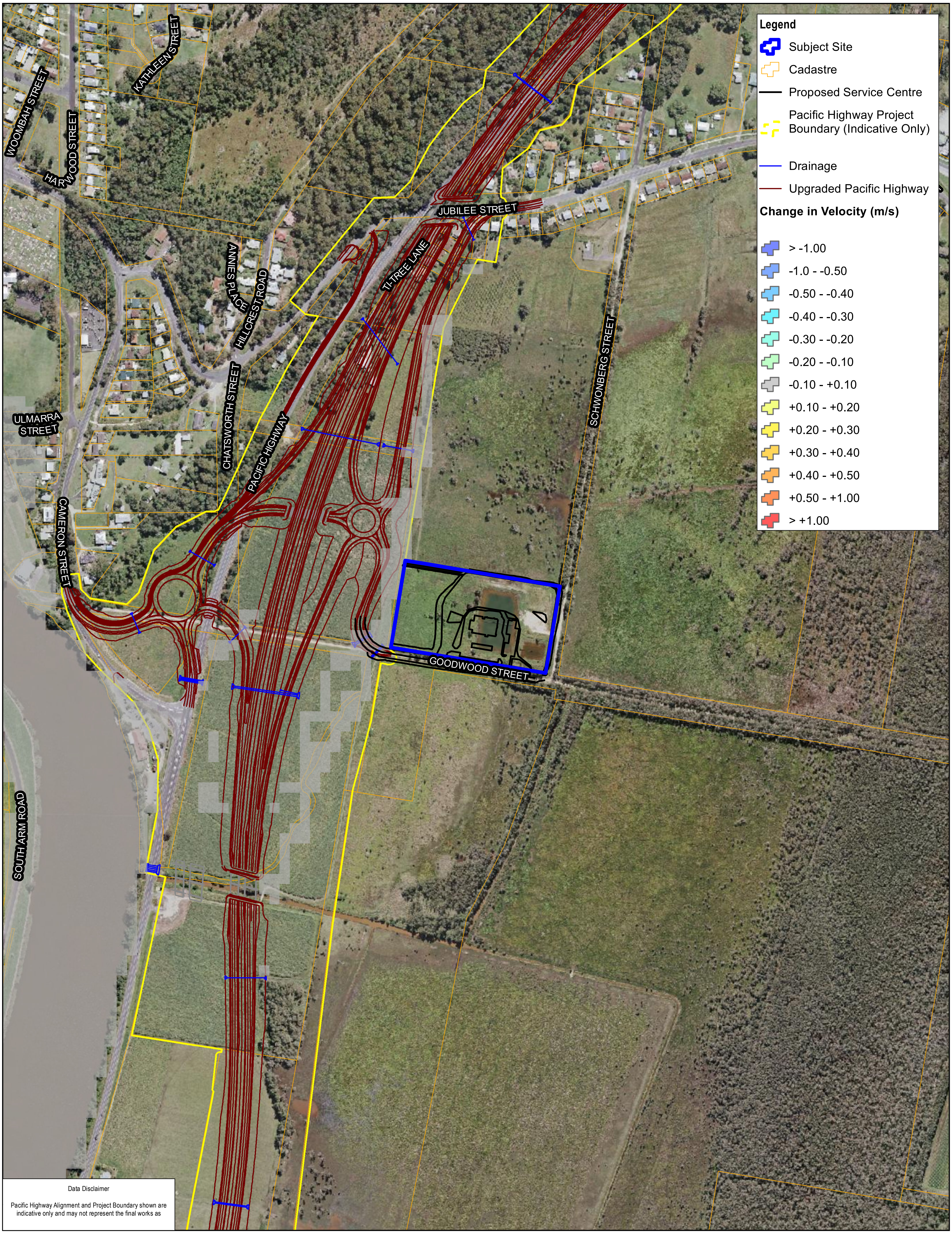


Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 5 AEP**
**Change in Velocity**

Project No. **22-12547835**
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**Figure 20**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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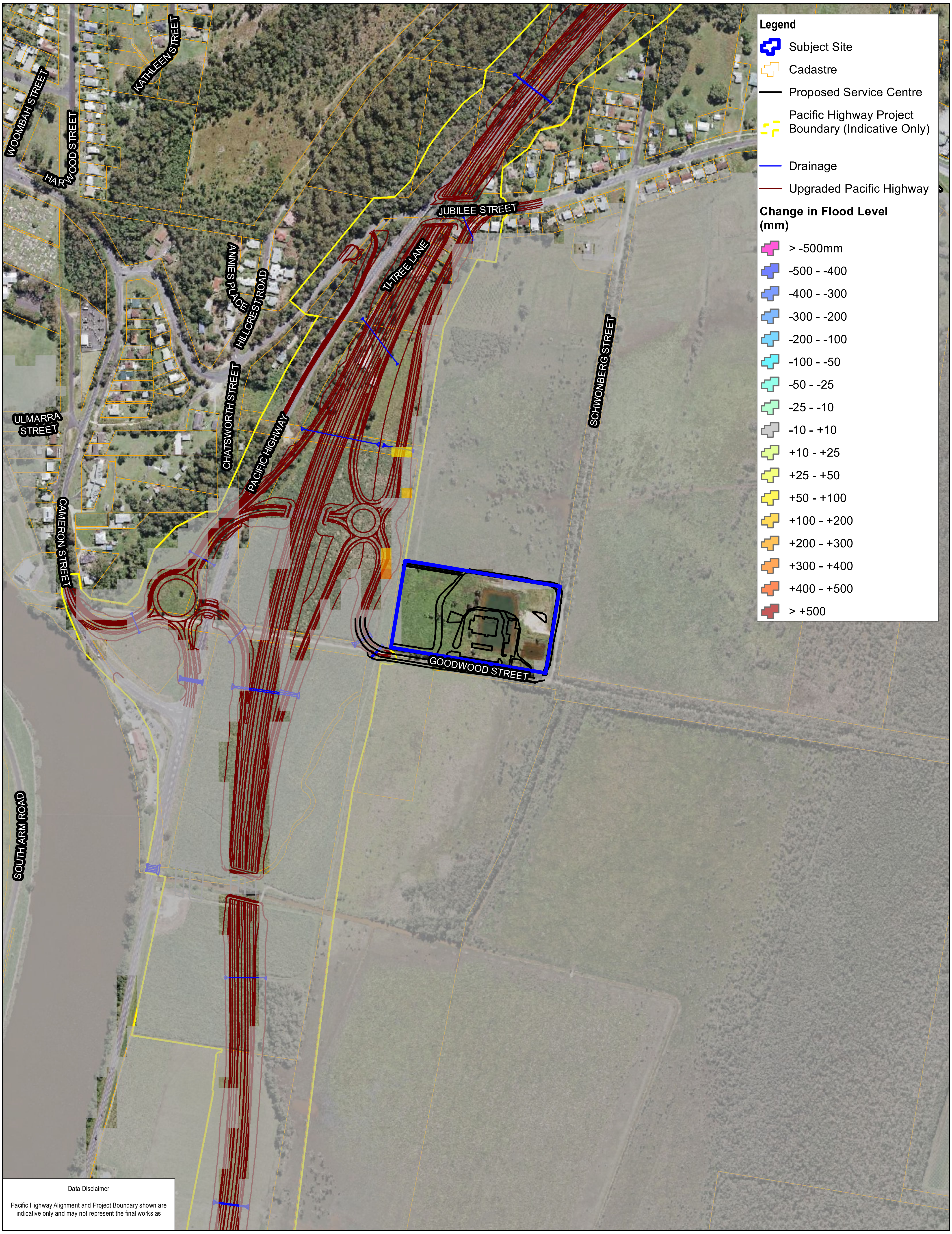


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

Project No. 22-12547835
Revision No. 0
Date 06 Apr 2021

## Proposed Conditions - 1 in 20 AEP Change in Flood Level

## Figure 21

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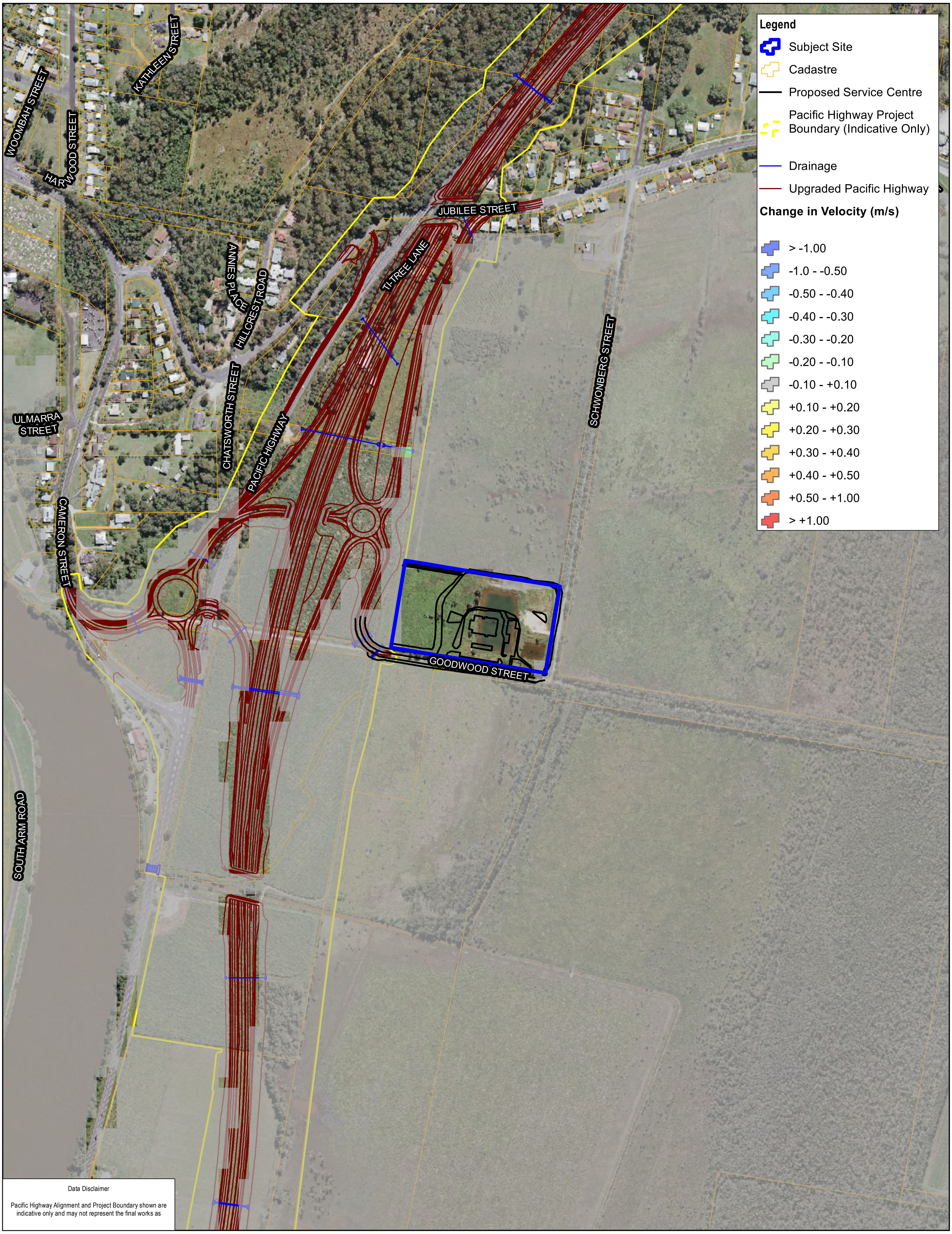


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Maclean Service Centre Pty Ltd
Clarence River Flood modelling

Proposed Conditions - 1 in 20 AEP
Change in Velocity

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Date 06 Apr 2021

Figure 22

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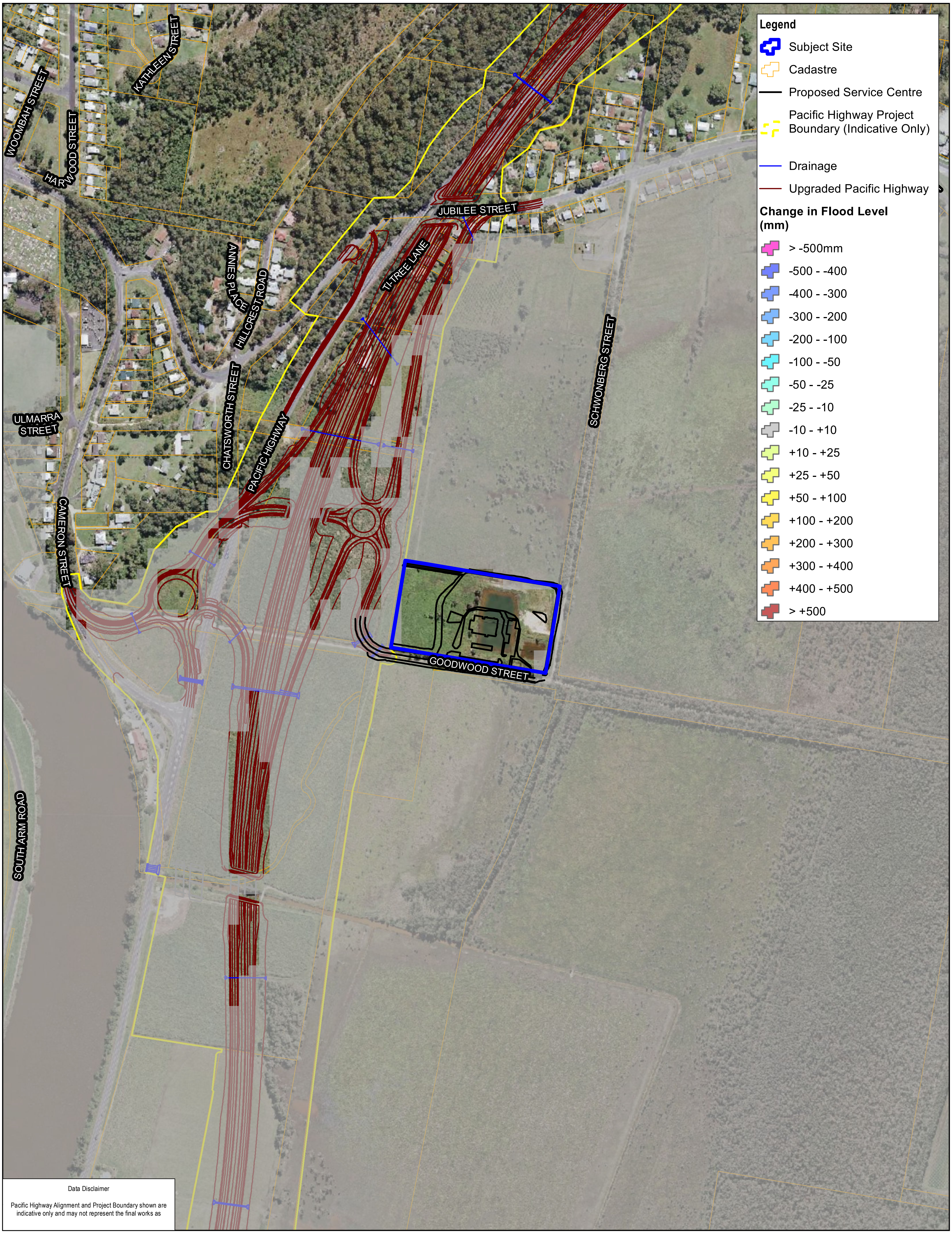


Paper Size ISO A3

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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 100 AEP**
**Change in Flood Level**

| | |
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**Figure 23**

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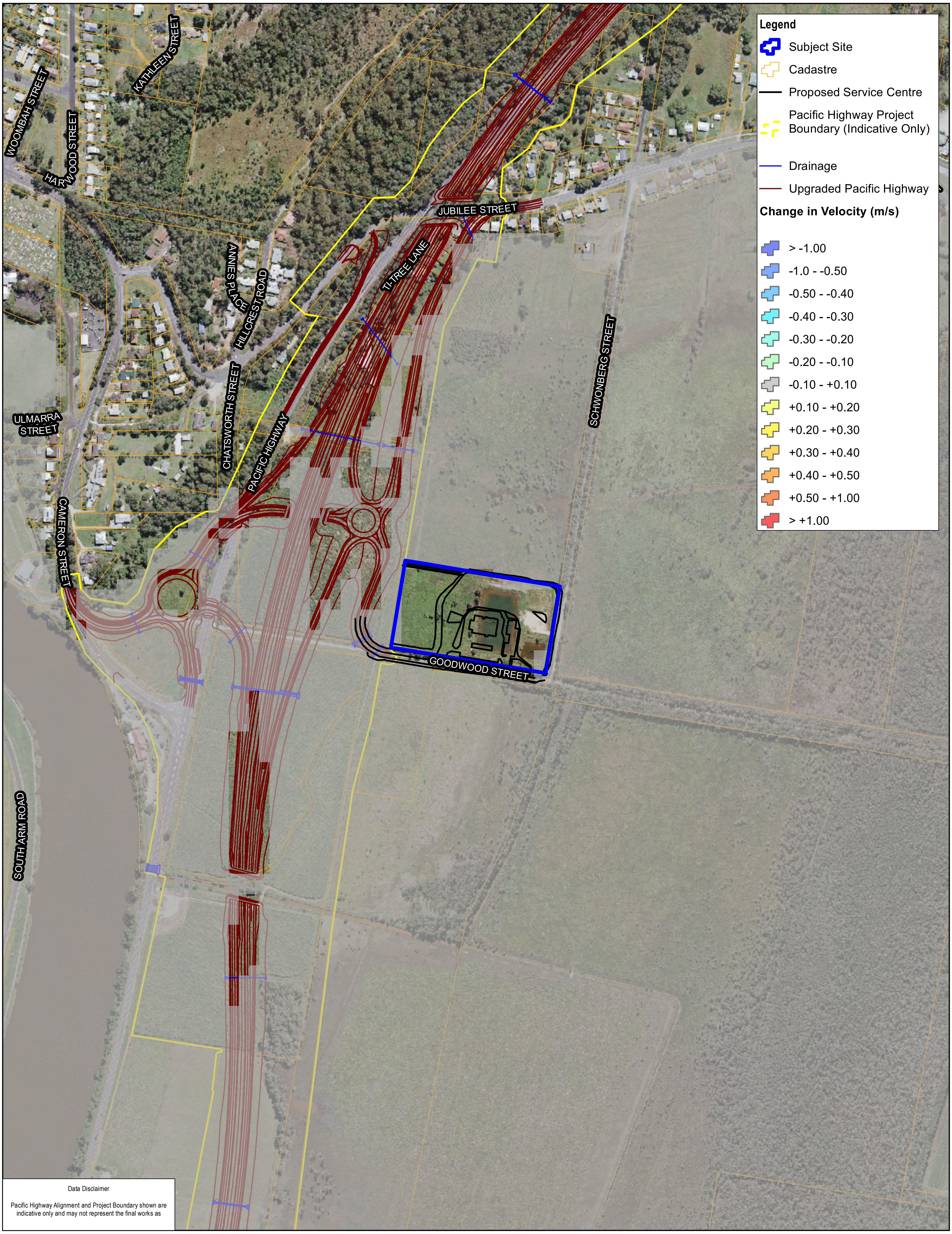


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Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

**Maclean Service Centre Pty Ltd**
**Clarence River Flood modelling**

**Proposed Conditions - 1 in 100 AEP**
**Change in Velocity**

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**Figure 24**

G:\22\12547835\GIS\Maps\Deliverables\12547835_Z001_Flooding_SMA.mxd
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12547835-24880-4/https://projectsportal.ghd.com/sites/pp01_04/macleanservicecentre2/ProjectDocs/12547835-REP-001 Maclean Service Centre Flood Impact Assessment.docx

Document Status

| Revision | Author | Reviewer | | Approved for Issue | | |
|---|---|---|---|---|---|---|
| | | Name | Signature | Name | Signature | Date |
| 0 | S. Douglas | R. Berg | | R. Berg | | 06/04/2021 |
| | | | | | | |
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# Report on Geotechnical Investigation

Proposed Highway Service Centre
2 Schwonberg Street, Townsend

Prepared for
Maclean Service Centre Pty Ltd

Project 105016.00
December 2020

# Document History

Document details

| | | | |
|---|---|---|---|
| Project No. | 105016.00 | Document No. | R.001.Rev0 |
| Document title | Report on Geotechnical Investigation<br>Proposed Highway Service Centre | | |
| Site address | 2 Schwonberg Street, Townsend | | |
| Report prepared for | Maclean Service Centre Pty Ltd | | |
| File name | 105016.00.R.001.Rev0 | | |

Document status and review

| Status | Prepared by | Reviewed by | Date issued |
|---|---|---|---|
| Revision 0 | John Niland / Richard Merifield | Scott McFarlane | 21 December 2020 |
| | | | |
| | | | |
| | | | |

Distribution of copies

| Status | Electronic | Paper | Issued to |
|---|---|---|---|
| Revision 0 | 1 | 0 | Daniel Hargreaves, Maclean Service Centre Pty Ltd |
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

| | Signature | Date |
|---|---|---|
| Author | John Niland | 21 December 2020 |
| Reviewer | | 21 December 2020 |

FS 604853

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Coffs Harbour NSW 2450
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| Appendix C: | CPT Interpretation Plots<br>Pile Capacity Plots |
| Appendix D: | Drawing 1 - Test Location Plan |

**Report on Geotechnical Investigation**
**Proposed Highway Service Centre**
**2 Schwonberg Street, Townsend**

## 1. Introduction

This report presents the results of a geotechnical investigation undertaken for a proposed highway service centre at 2 Schwonberg Street, Townsend. The investigation was commissioned in an email dated 29 October 2020 by Daniel Hargreaves of Maclean Service Centre Pty Ltd and was undertaken with reference to Douglas Partners Pty Ltd (DP) proposal CFH200151 dated 13 October 2020.

It is understood that the proposed development comprises a highway service centre with retail fuel and food facilities servicing the highway traffic and is likely to include the following:

- Raising of site surface levels up to approximately 5 m above the existing surface level due to the possible flood risk at the site;
- Approximately 900 $m^2$ of retail fuel and food building footprint;
- Truck and car fuel bowsers;
- Truck and car parking areas and associated access roads; and
- Widening and raising of Goodwood Street.

A geotechnical investigation was required to assess the subsurface soil conditions and provide comment on the following:

- Groundwater level;
- Acid sulfate soil;
- Geotechnical design considerations;
- Consolidation settlement and preliminary analysis for preload options; and
- Footing options and preliminary footing design parameters.

The investigation included the drilling of five boreholes, six cone penetration tests (CPTs) and laboratory testing of selected samples. The details of the field work and laboratory testing are presented in this report, together with comments and recommendations on the items listed above.

## 2. Site Description

The site (Figure 1) is located at 2 Schwonberg Street, Townsend, as shown on Drawing 1 in Appendix D. The site is relatively flat and low lying. The north-eastern part of the site contained some stockpiles of soil and gravel. There is a vacant low-lying paddock to the north of the site, Schwonberg Street to the east, Goodwood Street to the south and a low lying paddock and the Pacific Highway to the west.

**Figure 1: From the eastern part of the site looking north-west.**

Reference to Google Earth aerial imagery (Figure 2) indicates that there were previously two ponds at the site, which was part of the Maclean-Townsend sewerage scheme. It is understood that the ponds were remediated about 2018.


**Figure 2: Google Earth aerial imagery dated 14 December 2017.**

# 3. Published Data

## 3.1 Geology

Reference to the NSW Geology Statewide data (GSNSW, 2019) indicates that the site is underlain by channel and floodplain derived alluvial soils typically comprising silt, clay, sand and gravel.

## 3.2 Acid Sulfate Soils

Reference to the NSW Acid sulfate soil risk map indicates that there is a high probability of occurrence of acid sulfate soils (ASS) within 1 m to 3 m of the ground level.

# 4. Information Provided

## 4.1 Documents and drawings

For the purpose of the current assessment the following documents were provided:

- Site Audit Report by Geo-Logix, Townsend Sewage Treatment Plant Corner of Schwonberg and Goodwood Streets, Townsend, NSW, 2463. Prepared for: Ledonne Constructions Pty Ltd Report Reference: 1601147cSARRptFinalV01_07.06.19. June 2019;
- Engineering Issues Report by de Groot & Benson Pty Ltd, Proposed Maclean Highway Service Centre for Hargreaves Property Group Pty Ltd. July 2020.
- Planning Proposal drawings PP01 to PP05. De Groot & Benson. Amendment A dated 25/6/2020.
- Drawing SK02 Project 19097, Concept Site Plan. Proposed Mixed Use Development. Preliminary Issue, Dated June 2020.
- Detailed Survey Drawing Set (Ref M20017-1B to M20017-5B) 5 drawings, Dated 13/3/2020. Abbott and Macro Land and Engineering Surveyors.

## 4.2 Proposed bulk earthworks

It is understood the proposed development includes raising of the site by up to 5 m by placing engineered fill. Figure 3 shows the proposed bulk earthworks and level of site filling for the development (taken from Planning Proposal drawing PP05, see reference above).

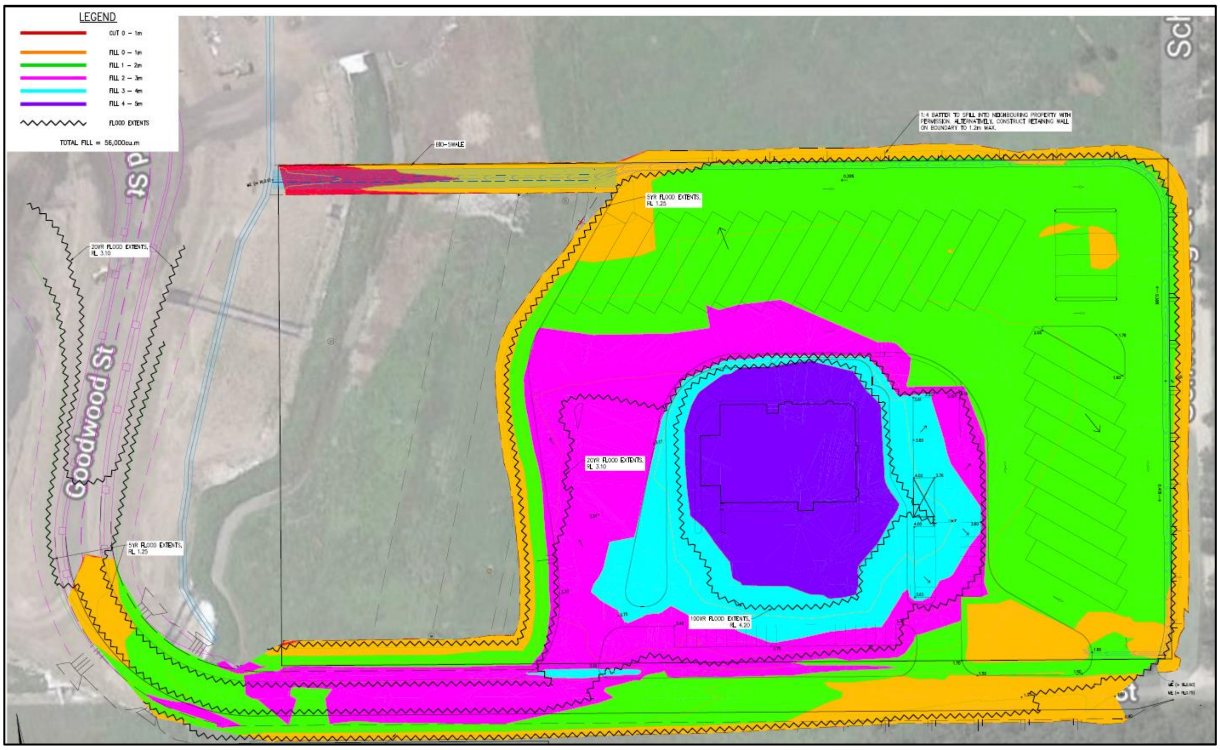


**Figure 3: Proposed bulk earthworks and level of site filling**

## 5. Field Work

### 5.1 Field Work Methods

The field work was undertaken on 17 to 18 November 2020 and comprised six cone penetration tests (CPTs 1 to 6) and the drilling of five boreholes (Bores 1 to 4 and 7).

The CPTs were conducted using a purpose-built truck-mounted CPT rig. A 35 mm diameter instrumented cone and friction sleeve assembly was hydraulically thrust into the soil at a rate of about 2 cm/sec. Cone tip resistance, sleeve friction, pore pressure and inclination from vertical were recorded by a computer data acquisition system for subsequent plotting and analysis.

The CPTs were terminated at about 17.2 m to 21.7 m depth due to refusal in probable weathered rock.

The bores were drilled using a 100 mm diameter hand auger. Bores 1 to 3 and 7 were terminated at 1.5 m depth and Bore 4 was terminated at 2 m depth at the target depth of investigation. A geotechnician from DP logged the subsurface profile at the bore locations and collected samples for subsequent laboratory testing and identification purposes.

The samples were placed in airtight plastic bags then the bags were hand-pressed to remove excess air before being snap-locked and placed in cooled insulated containers which were then transported to the laboratory for subsequent acid sulfate soil testing.

The bores were backfilled with auger cuttings at the completion of drilling.

The test locations were set out from existing site features by a geotechnician from DP. The surface RL of the test locations were interpolated from a client supplied survey plan and are therefore approximate. The coordinates of the test locations were recorded with a hand held GPS which has a typical accuracy of about ± 5 m. The approximate location of the tests are shown on Drawing 1 in Appendix D.

## 5.2 Field Work Results

The subsurface conditions encountered at CPTs 1 to 6 are presented in detail in the CPT plots in Appendix A. These should be read in conjunction with the accompanying notes (Sampling Methods, Soil Descriptions, Cone Penetration Tests, and Symbols and Abbreviations), which explain the descriptive terms and classification methods used in the plots. The borehole logs (Bores 1 to 4 and 7) are also provided in Appendix A.

The subsurface conditions encountered at the CPT locations are summarised in Table 1.

**Table 1: Summary of Subsurface Conditions at CPT Locations**

| CPT | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Typical Stratum | Approximate Depth Range (m) | | | | | |
| Fill: gravelly sand, clay | 0.0 – 0.8 | 0.0 – 0.3 | - | 0.0 – 0.2 | 0.0 – 0.4 | 0.0 – 0.6 |
| Fill: Silty clay and gravel | - | - | - | - | 0.4 – 2.1 | - |
| Silty Sand: Medium dense, possible fill | - | - | - | - | 2.1 – 2.8 | - |
| Silty Clay: Firm to stiff | - | - | 0.0 – 0.9 | - | - | - |
| Clay: Soft to firm | 0.8 – 2.4 | 0.3 – 1.9 | - | - | - | - |
| Silty Sand: Medium dense to dense | - | - | - | - | 2.1 – 2.8 | - |
| Clay: Very soft to soft | 2.4 – 11.6 | 1.9 – 14.0 | 0.9 – 7.6 | 0.2 – 15.8 | 2.8 – 11.5 | 0.6 – 14.2 |
| Silty Clay: Firm to stiff | 11.6 – 15.4 | 14.0 – 14.5 | - | - | - | 14.2 – 15.0 |
| Clay: Stiff to hard | - | 14.5 – 17.6 | 7.6 – 9.6 | - | 11.5 – 15.5 | 15.0 – 17.0 |
| Clay / Sand / Silty Sand: Hard / Medium dense | - | 17.6 – 19.9 | 9.6 – 11.2 | - | - | 17.0 – 21.0 |
| Silty Clay / Clayey Silt: Very stiff to hard | 15.4 – 19.7 | 19.9 – 21.3 | 11.2 – 19.7 | 15.8 – 16.7 | 15.5 – 16.3 | - |
| Clay: Hard, grading to weathered rock | 19.7 – 20.4 | 21.3 – 21.7 | 19.7 – 20.2 | 16.7 – 17.3 | 16.3 – 17.2 | 21.0 – 21.4 |

The auger cuttings obtained while drilling Bore 3 are shown in Figure 4.


**Figure 4**: Bore 1 auger cuttings.

Groundwater was observed at 0.9 m to 1.4 m depth in Bores 2 to 4 and 7. There was no groundwater observed in Bore 1 whilst augering. The remnant CPT holes collapsed at 0.8 m to 1.4 m upon withdrawal of the CPT rods. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will vary with time.

## 6. Laboratory Testing

### 6.1 Acid Sulfate Soil Testing

The ASS samples retrieved from the bores were submitted to Environmental Analysis Laboratory (EAL) a NATA accredited testing laboratory for ASS screening tests. A calibrated pH meter was used for measurement of pH in distilled water ($pH_F$) and pH after oxidation in hydrogen peroxide ($pH_{FOX}$) in accordance with the ASSMAC Guidelines (Stone, Ahern, & Blunden, 1998). A total of 15 soil samples were screened for acid sulfate and the results indicated potential acid sulfate soil in all 15 samples. The screening test results are included in Appendix B.

Based on the results of the screening tests three samples were selected to undergo detailed ASS chromium reducible sulfur ($S_{CR}$) testing. The results of the detailed ASS testing are included in Appendix B.

# 7. Comments

## 7.1 Settlement Analysis

### 7.1.1 Analysis Procedure and Assumptions

Geotechnical 1D consolidation theory was used to estimate settlements for the proposed development using an "in-house" spreadsheet based on established methods for calculating settlements. Details of the approach undertaken for the analysis is summarised below:

- Assessment of available site data, published geotechnical parameters and proposed development drawings;
- Development of representative geotechnical stratigraphy;
- Assessment of the total settlements of the proposed development assuming the ground is not improved;
- Creep settlement analysis using approximate analytical methods; and
- Assessment of the total settlements of the proposed development assuming ground improvement is undertaken.

For the purposes of this report, settlements have been reported to the nearest 5 mm, although this does not reflect the order of accuracy of the settlement predictions but have been presented to allow comparison between different areas of the site.

The following key assumptions have been made in the geotechnical analysis:

- A surcharge of 30 kPa was assumed for the proposed service centre building load applied to the ground;
- An additional surcharge of 20 kPa was assumed for the proposed service centre car parking areas. This has conservatively been assumed to be a long-term load;
- Proposed fill heights of up to 5m based on the supplied fill plan (Drawing PP05);
- No temporary construction surcharge loads have been considered;
- The static groundwater table is located between 0.8 m and 1.4 m below the existing ground level at the location of the CPT's;
- A design life of 40 years has been assumed;
- Assessment of the impacts on any neighbouring properties is considered out of the scope of the settlement analysis, likewise the impact of any neighbouring properties on the proposed development is also considered out of the scope of this analysis. It is recommended that construction be phased to minimise impacts to neighbouring properties eg only adding further preload near site boundaries once sufficient consolidation settlement has occurred and allow a contingency for remediation should surface bulging occur beyond the site boundary; and
- The analysis has been undertaken based on working stress principles and no assessment under earthquake loading has been undertaken.

### 7.1.2 Geotechnical Model

The geotechnical parameters used in the analyses have been derived based on the data obtained from the site investigations (CPTs 1 to 6), previous investigations, past experience and published data. The parameters adopted for the very soft to firm clay geotechnical units in the analyses are summarised in the attached CPT Interpretations in Appendix C.

The estimated settlements across the site are predominantly a function of the thickness of soft clay identified at each test location and depth of the proposed site filling. The placement of fill across the site creates a surcharge load that must be carried by the underlying soils and this in turn leads to settlement and consolidation. Table 2 provides a summary of the soft clay thickness and proposed fill thicknesses and resulting total surface surcharge.

**Table 2: Estimated thickness of soft clay across the site**

| CPT Location | Thickness of soft clay (m) | Proposed depth of site filling (m) | Estimated surface Surcharge Load (kPa) | | | | Comments |
|---|---|---|---|---|---|---|---|
| | | | Filling | Building | Carpark | Total | |
| 1 | 10.8 | 1.5 | 30 | - | 20 | 50 | One-way drainage conditions as soft clay is underlain by stiff to hard clay. |
| 2 | 13.7 | 1.5 | 30 | - | 20 | 50 | |
| 3 | 6.7 | 4.0 | 80 | - | 20 | 100 | |
| 4 | 15.6 | 1.5 | 30 | - | 20 | 50 | |
| 5 | 8.7 | 5.0 | 100 | 30 | - | 130 | |
| 6 | 13.6 | 3.0 | 60 | - | 20 | 80 | |

NOTES to Table 2:, One-way drainage conditions will lead to longer consolidation times. Surface surcharge = (depth of filling) x (weight of filling) + (building/carpark load). All surface loads should be confirmed during detailed design.

### 7.1.3 Ground Improvement

It is anticipated that the time required for the underlying soft clay to reach 95% primary consolidation under the proposed fill loads will be significant without additional ground improvement measures. It is therefore recommended that ground improvement be undertaken in order to manage the high risk of differential settlements post construction where new loads (due to addition of filling and structures), are applied to areas underlain by soft clay.

Several possible ground improvement options may be considered specifically relevant to this site, including:

- Preloading: this involves applying a load to the foundation which is equal or greater to the final loads after construction. The load is usually applied in the form of additional fill material which is later removed. This method is one of the most straightforward ground improvement techniques.

- Wick drains: carried out in conjunction with preloading in order to accelerate the consolidation process by providing a shorter drainage path for the expulsion of water.
- Lime columns: these are formed by mixing dry unslaked limed with the soft clay to form a column of treated soil. They reduce the plasticity and compressibility of the soil.
- Rigid inclusions such as Concrete Injected Columns (CIC). Involves specialised auger drilling on a grid pattern, displacement of the surrounding soil, and injection of concrete through the augers hollow core to form concrete columns. Suited to high embankments, deep soft soils, rapid construction or where settlements need to be kept to small values.
- Dry or Wet soil mix columns. Dry cement or cement-soil slurry is mixed into the ground forming semi-rigid inclusions. Can be designed to achieve small settlements.
- Vacuum consolidation: this involves extraction of pore water under vacuum thereby causing consolidation. There is limited experience with this technique in Australia, and it is likely to be costly.

Although several ground improvement options could be adopted for this site, for initial feasibility and costing purposes we have assessed the effectiveness of preload with wick drains herein as the most suitable option for this site. This involves installing highly permeable “wick” drains across the site prior to applying a load to the surface (i.e. proposed filling) to initiate consolidation in the underlying clay during the construction period with an aim to reduce long term settlement after construction. The load is usually applied in the form of additional fill material which is later removed. This method is one of the most straightforward ground improvement techniques.

The preload should aim to achieve 95% primary consolidation, and the time for this to occur is related to the soft clay thickness and the coefficient of consolidation ($c_v$) which has been estimated for this site to be in the range of 2 m$^2$/year to 3 m$^2$/ year.

## 7.2 Settlement Analysis Results and Discussion

### 7.2.1 Base Case – No Ground Improvement

Based on the CPT results undertaken within the footprint of the proposed development, the soft to firm clay is interpreted to extend across the entire proposed development site and varies in thickness between about 6 m to 16 m

The Compression Index Cce (Cce= Cc/(1+ $e_o$)) for this material is estimated at between 0.25 and 0.4 based on laboratory testing of samples nearby. Generally, the Over Consolidation Ratio (OCR) of the soft to firm clay is in the order of about 1 to 1.5. The OCR indicates that the soft to firm clays are generally in a normally to slightly over consolidated state, hence, a higher magnitude of settlement will occur after the completion of bulk earthworks and construction of the development because these weak clays are loaded beyond this normally to slightly consolidated state. Both the Compression Index and OCR must be confirmed by additional site investigations and oedometer laboratory testing during detailed design.

It is understood that the site will be raised to create a platform for the proposed roads, parking areas and buildings associated with the development. Based on the information provided the proposed depth of fill ranges from about 1 m to 5 m. Primary consolidation settlement estimates have been made based on the subsurface conditions observed at each CPT test location and the approximate level of proposed fill at each location.

Post construction secondary settlement due to creep has been estimated using data from the CPTs, published data and published methods of analysis for estimating creep settlements (Mesri, 1973). It must be appreciated that creep settlements are difficult to predict and the methods available to evaluate such settlements are approximate. Additional borehole drilling, sampling, and laboratory testing of the soft clay is recommended to confirm DP's assumptions regarding creep properties.

A summary of the results of the settlement analysis for the proposed development are summarised in Table 3.

**Table 3: Settlement Estimates with NO Ground Improvement**

| CPT Location | Thickness of soft clay (m) | Estimated surface Surcharge Load (kPa) | Predicted Total[1] Settlement Range (mm) | Time to Reach 95% Primary Consolidation (years) | Vertical Secondary Creep Settlement[2,3] (mm) |
|---|---|---|---|---|---|
| 1 | 10.8 | 50 | 615 – 835 | 65 | 290 |
| 2 | 13.7 | 50 | 820 – 1135 | > 100 | 370 |
| 3 | 6.7 | 100 | 830 – 1125 | 25 | 180 |
| 4 | 15.6 | 50 | 710 – 1000 | > 100 | 420 |
| 5 | 8.7 | 130 | 850 – 1200 | 40 | 230 |
| 6 | 13.6 | 80 | 735 - 1025 | > 100 | 380 |

Notes to Table 3:
1) Vertical primary consolidation settlement predictions are based on 1D analysis and do not include creep settlement.
2) Predictions are based on analytical "in house" spreadsheet using indicative creep rates over a 40 year design life. Creep settlements shown are rounded up to the nearest 10 mm.
3) Creep settlement is most likely to occur after construction / post primary consolidation.

Settlements of such magnitude and the time required to reach 95% consolidation would not be acceptable to most structures or construction programs. Such settlements would likely cause problems with services, road pavements, and other infrastructure associated with the proposed development. The alternatives to address settlement issues include ground improvement (to reduce post-construction settlement), or support of structures on piles. These are discussed in the following sections.

### 7.2.2 Base Case – With Ground Improvement

The most common method of speeding up consolidation of thick clay layers under surcharge or preload is to install vertical wick drains to the base of the soft clay stratum. These shorten the drainage path and allow water to be expelled more quickly. Provided the wick drains fully penetrate the clay stratum the consolidation time is largely independent of clay thickness, being controlled by the wick spacing.

The height of preload required (above the finished proposed fill heights) depends on the final loads, density of the preload material and slope stability considerations. In order to minimise post construction creep, the preload should ideally apply 20 - 40 kPa on top of the proposed fill levels required to raise the site. For the purposes of the current assessment, a preload of between 20 – 30 kPa (i.e. 1 m to

1.5 m of fill) has been assumed above the proposed fill levels. Further analysis and optimisation of the preload design will be required to establish the most cost-effective solution.

It should be noted that correct installation is very important to the performance of the wick drains, hence it is essential that they be installed by an experienced contractor. If wick drains are proposed, it is recommended that further, more detailed geotechnical design of the drains be undertaken in order to optimise drain spacing and time considerations.

A summary of the results of the improved ground settlement analysis for the proposed development area are summarised in Table 4.

**Table 4: Settlement Estimates with Ground Improvement (Wick Drains)**

| Preliminary Proposed Ground[1] Improvement | CPT Location | Thickness of soft clay (m) | Currently Proposed depth of site filling (m) | Preliminary[1] Proposed Preload Fill Height (m) | Time to Reach 95% Primary Consolidation[2,3] (months) |
|---|---|---|---|---|---|
| Wick drains (150mm x 5mm) @ 1.8 m spacing on triangular grid.<br><br>Length of wicks over the full thickness of the soft clay | 1 | 10.8 | 1.5 | 2.5 | 12 - 18 |
| | 2 | 13.7 | 1.5 | 2.5 | |
| | 3 | 6.7 | 4.0 | 5.0 | |
| | 4 | 15.6 | 1.5 | 2.5 | |
| | 5 | 8.7 | 5.0 | 6.5 | |
| | 6 | 14.0 | 3.0 | 4.0 | |

Notes to Table 4:
1) Preload fill height adopted as 1 m to 1.5 m above the currently proposed site levels. Ground improvement proposed is preliminary and further detailed geotechnical design should be undertaken to optimise the ground improvement design.
2) Time to reach 95% primary consolidation is based on 1D analysis using “in house” spreadsheet and exclude creep settlement
3) Creep settlement is most likely to occur after construction / post primary consolidation.

Upon the completion of preloading, some long-term settlement will continue to occur due to recompression and creep, however these would be of considerably lower magnitude and rate. Secondary creep settlements after preloading with wick drains to 95% primary consolidation is estimated at between 50 to 150 mm over a design life of 40 years with the rate of settlement reducing over this design period.

## 7.3 Preload and Site Fill Embankment Stability

The design of the proposed site wide filling and any preload mounds will need to be assessed for the following:

- Bearing capacity failure. The placement of site filling and preload will need to be undertaken in a staged manner (i.e. defined lifts) to ensure the underlying soils can support the additional load;
- Stability at the edges (i.e. slope failure). This will depend on the properties to confirm a suitable batter slope; and

- Requirement for internal reinforcement (i.e. geogrids) within the proposed site filling and/or preload to achieve adequate factors of safety against slope stability and bearing capacity failure.

The above items should be addressed during the detailed design stages for the development.

## 7.4 Preload Construction and Monitoring

The magnitude and rates of settlement are estimates only. It is essential that the preload performance be monitored by geotechnical instrumentation installed prior to placing the fill and preload. These instruments would comprise settlement monitoring plates (SMP) installed on a regular grid, and vibrating wire piezometers installed into the clay stratum. The SMPs would require survey levelling by registered surveyors at the time of installation and at regular intervals during the preload period. The piezometers would be read at regular intervals by geotechnical personnel from Douglas Partners.

The following general procedure would be required for preloading the building platforms and road areas of the site:

- Install settlement monitoring plates (SMP) on a regular grid into the natural ground and survey their location and level.
- Add steel risers and PVC casing to the SMPs.
- Install piezometers (vibrating wire or pneumatic) into the soft day at selected locations.
- Place and compact approved fill (eg quarry overburden, select granular filling) and any geogrid reinforcement to the design finished level and to compaction specification; care will be required not to disturb the settlement plates and risers.
- Place an additional 1 – 1.5 m of fill over and above finished level as the preload. Further steel risers and PVC casing must be added as the fill height increases.
- Record survey levels on the SMP risers (by registered surveyors). Record piezometer readings (by Douglas Partners). The frequency should initially be weekly, however for lengthy preloads, can be extended to fortnightly or greater as the rate of settlement decreases.
- When results indicate that the design settlement criteria have been achieved, the preload may be removed (generally moved to another area, if being staged to minimise the required volume of preload material).

The crest of the top preload batter should coincide or go slightly beyond the edge of the area to be treated. After each monitoring event, the results should be reviewed by Douglas Partners to compare actual with predicted performance and to refine future settlement of the building and platform.

## 7.5 Shallow Foundations

Given the substantial level of site filling proposed, shallow strip, pad or pier footings would likely be founded in imported engineered fill. The allowable bearing pressures for shallow foundations will depend on the type of filling proposed. Provided the filling is clean granular in nature and is placed and compacted in accordance with (AS 3798, 2007), shallow foundations may be proportioned for a maximum allowable bearing pressure of 100 kPa. The allowable bearing pressures should be confirmed during the detailed design stages of the project when the nature and properties of the filling used for site raising are known. Buildings, structures and services supported on the proposed fill will also need to be designed to accommodate future settlement as indicated above. If these structures cannot accommodate settlement, piles will need to be considered as discussed below.

## 7.6 Deep Foundations

In addition to preloading with wick drains, it may also be appropriate to adopt pile foundations for any settlement sensitive structures proposed as part of the development. Major service lines may also require piling to maintain correct grades.

For light commercial type structures, the most suitable pile types are driven precast concrete piles, founded in the stiff clay or preferably weathered rock stratum underlying the soft clay typically encountered at CPT refusal. This pile type has the advantage of not producing any spoil at the surface, thereby avoiding exposure of acid sulfate soils to oxidation. It is noted that the ground conditions are likely to be corrosive/aggressive and all piles should be appropriately treated for the acidic ground conditions at the site.

An important consideration with most pile types, including driven concrete piles, is the effect of downdrag (negative friction) due to the ongoing consolidation of the clays. The downdrag load can be substantial and needs to be incorporated into design as a structural load on the pile.

As a guide, geotechnical pile capacity estimates versus depth have been calculated for driven concrete piles, using the CPT results and an in-house pile capacity program. The results are shown in Appendix C, for 0.25 m square precast concrete piles calculated at two typical CPT locations CPT3 and CPT6. The capacities are for compressive axial loads, and are expressed in terms of the limit state Design Geotechnical Strength (Rd,g) as defined in (AS 2159, 2009), whereby:

Rd,g = $\phi$g Rug, which must exceed the Design Action Effect Ed

Rug is the ultimate geotechnical strength, which is calculated using static theory, and therefore represents an estimate only. The geotechnical strength reduction factor $\phi$g depends on a number of factors including the extent of site investigation, type of analysis and pile testing regime during construction. For the estimates presented in Appendix C, a value of $\phi$g = 0.45 was adopted. Higher values of $\phi$g may be justifiable if sufficient load testing is conducted, as per (AS 2159, 2009).

The results presented in Appendix C indicate that geotechnical capacities in the order of 100 kN to 300 kN will be achievable, depending on pile size and founding depth. The structural capacity of piles should be separately checked (by the piling contractor or structural engineer).

The required founding depth for piles will vary across the site with the soil profile; in general, the founding depth should be two to three pile diameters into stiff underlying clay or weathered rock. The actual capacities and founding depths should be confirmed by the piling contactor, having regard to their own equipment and expertise. Piles driven to refusal on rock would approach the structural capacity of the pile.

The ground around the structures will continue to consolidate over the years, as previously discussed, and the design of services and pavements must take due account of this. The following measures are suggested to mitigate the effects of the ongoing settlement:

- Major services, where grades are important, such as sewer lines and main stormwater lines, should also be piled;
- Connections to structures will need to have flexible joints;
- Minor services should be of flexible construction and allow for differential settlement. Where possible drainage falls should be towards areas of expected greater settlement, so that with time, grades will tend to increase rather than reduce or reverse; and
- Road pavements should be left unsealed for as long as possible, to reduce the risk of damage to the wearing course. All concrete pavements should include dowels at joints to reduce abrupt differential settlements at edges.

Alternatively, ground improvement of road and service areas could be undertaken, for example by installation of preloading with wick drains.

## 7.7 Acid Sulfate Soil Assessment

Acid sulfate soil test results are presented in Section 7.7 and Appendix B.

The QASSIT guidelines (Dear, et al., 2014) suggest that a soil pH < 4 in water is an indicator of actual acid sulfate soils. The results of screening tests therefore suggest the presence of actual acid sulfate soil at Bore 7 / 0.5 m which had a pH of 3.93.

The ASSMAC guidelines also suggest that indicators of potential acid sulfate soils (PASS) include the following:

- Soil pH < 3.5 in $H_2O_2$ (i.e. $pH_{FOX}$); and
- Drop of 1 pH unit or more between $pH_F$ and $pH_{FOX}$;

Results of the acid sulfate soil screening tests indicated ten samples that exhibited soil pH < 3.5 in $H_2O_2$ (i.e. $pH_{FOX}$) and all 16 samples tested exhibited a pH drop of one unit or more.

It is noted that acid sulfate soil screening tests are a qualitative method only and give an indication of the intensity of total acidification (pH). The guidelines indicate that hydrogen peroxide may also oxidise organic matter (in addition to pyrite) to produce acids which are unlikely to form under natural conditions, thus giving falsely high indication of acid sulfate potential.

The results of the screening tests indicated the presence of potential acid sulfate soils, however, more definitive and quantitative ASS results were obtained from detailed laboratory ASS testing by the Chromium Suite method.

As outlined in Dear et al (2014), the action criteria which define the requirement for management of acid sulfate soils vary depending on the amount of soil disturbed and the textural classification of the soil.

The method for determining net acidity (or existing and potential acidity) has been derived from Dear, et al. (2014) and can be summarised as follows:

- When $pH_{KCL}$ < 4.5, Sum of existing and potential acidity = a-Scr + TAA + $a\text{-}S_{NAS}$;
- When 4.5 ≤ $pH_{KCL}$ < 5.5, Sum of existing and potential acidity = a-Scr + TAA; and

- When 5.5 ≤ $pH_{KCL}$ < 6.5, Sum of existing and potential acidity = a-Scr + optional fineness factor.

Where: $a\text{-}S_{Cr}$ = Chromium Reducible Sulfur
$pH_{KCL}$= Potassium chloride suspension pH
TAA = Titratable Actual Acidity
$a\text{-}S_{NAS}$ = Net acid Soluble sulfur

It is anticipated that the majority of the earthworks at the site will comprise fill. Therefore, for assessment purposes it is assumed less than 1,000 tonnes of soil will be disturbed. Therefore, with reference to QASSIT (Dear, et al., 2014), the action criteria to determine whether the acidity levels are above which would require management (ie trigger levels) are as follows:

- Fine textured soils (clay) 62 Mol H+/tonne

A review of the results indicated that an exceedance of the trigger levels occurred in two of the three samples submitted for detailed testing, as follows:

- Bore 3 / 0.4 m: dark grey mottled red brown silty clay; and
- Bore 4 / 1.2 m: dark grey mottled grey silty clay.

The remaining sample (Bore 1 / 0.6 m – gravelly sand fill) returned a net acidity value below the action criteria for acid sulfate soil management.

Based on the results of the investigation the clay / silty clay material at the site is considered to be potential acid sulfate soils.

Hence, excavation of these soils at the site should be undertaken based on an acid sulfate soil management plan. Detailed laboratory testing indicates a liming rate of 9 kg to 17 kg of lime per tonne of excavated soil is required.

## 7.8 General

The following general comments are made:

- Six cone penetration tests (CPTs 1 to 6) were performed at the site. The CPTs were terminated at about 17.2 m to 21.7 m depth due to refusal on weathered rock. The subsurface conditions are dominated by the presence of very soft to soft clay approximately 6 m to 16 m that was encountered in the CPTs;
- Substantial post construction settlements are anticipated in response to site-wide raising/filling of the site in preparation for construction of the proposed development. It is anticipated that without some form of ground improvement these settlements will exceed tolerable limits for construction, although this should be confirmed by a qualified structural engineer;
- Potential settlement / consolidation of the subsurface compressible material could be managed through ground improvement (i.e. wet or dry deep soil soil-mixing, concrete injected columns, preloading with wick drains etc) and structural solutions such as deep piled footings. Preliminary analysis undertaken in the current assessment indicates site preloading with wick drains may provide one viable geotechnical design solution, although further detailed analysis and design will be required to establish the most cost-effective ground improvement option;

- It should be noted that, except for excavation and removal of the clay, ground improvement techniques do not eliminate post-construction settlement: they merely aim to reduce settlement to manageable / tolerable levels.
- Some long term “creep” consolidation of the subsurface material at the site is anticipated. The structural design of buildings and civil design of roads and drainage will need to take account of the anticipated long-term settlements (including differential settlements). Settlement sensitive structures should consider the use of piled footings and adequate articulation;
- Ongoing long-term post construction settlement due to creep is difficult to estimate, particularly without laboratory testing of the soft soils in question. It is recommended that further borehole drilling be undertaken in order to sample and test the underlying soft soils to better understand the material behaviour and potentially lead to a reduction in the estimated settlements;
- Consideration should be given to constructing a trial pad/embankment at the site combined with ongoing settlement monitoring. This could be used to calibrate the analysis undertaken by DP but also establish the effectiveness of several alternative ground improvement options (i.e. surcharge with wick drains); and
- The geotechnical test results indicate that the site could be made suitable for the proposed development providing appropriate ground/site preparation measures are performed (ground improvement).

## 8. References

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## 9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 2 Schwonberg Street, Townsend with reference to DP's proposal CFH200151 dated 13 October 2020 and acceptance received from Daniel Hargreaves of Maclean Service Centre Pty Ltd dated 29 October 2020. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Maclean Service Centre Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical, environmental and groundwater components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

**Douglas Partners Pty Ltd**

# Appendix A

About This Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Information on Cone Penetration Tests
Cone Penetration Test Plots (CPTs 1 to 6)
Borehole Logs (Bores 1 to 4 and 7)

## Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# About this Report

## Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

## Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

## Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

## Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

## Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

## Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

## Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

## Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

## Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

### Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

# Soil Descriptions

## Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

## Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

| Type | Particle size (mm) |
|---|---|
| Boulder | >200 |
| Cobble | 63 - 200 |
| Gravel | 2.36 - 63 |
| Sand | 0.075 - 2.36 |
| Silt | 0.002 - 0.075 |
| Clay | <0.002 |

The sand and gravel sizes can be further subdivided as follows:

| Type | Particle size (mm) |
|---|---|
| Coarse gravel | 19 - 63 |
| Medium gravel | 6.7 - 19 |
| Fine gravel | 2.36 – 6.7 |
| Coarse sand | 0.6 - 2.36 |
| Medium sand | 0.21 - 0.6 |
| Fine sand | 0.075 - 0.21 |

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

| Term | Proportion of sand or gravel | Example |
|---|---|---|
| And | Specify | Clay (60%) and Sand (40%) |
| Adjective | >30% | Sandy Clay |
| With | 15 – 30% | Clay with sand |
| Trace | 0 - 15% | Clay with trace sand |

In coarse grained soils (>65% coarse)
- with clays or silts

| Term | Proportion of fines | Example |
|---|---|---|
| And | Specify | Sand (70%) and Clay (30%) |
| Adjective | >12% | Clayey Sand |
| With | 5 - 12% | Sand with clay |
| Trace | 0 - 5% | Sand with trace clay |

In coarse grained soils (>65% coarse)
- with coarser fraction

| Term | Proportion of coarser fraction | Example |
|---|---|---|
| And | Specify | Sand (60%) and Gravel (40%) |
| Adjective | >30% | Gravelly Sand |
| With | 15 - 30% | Sand with gravel |
| Trace | 0 - 15% | Sand with trace gravel |

The presence of cobbles and boulders shall be specifically noted by beginning the description with 'Mix of Soil and Cobbles/Boulders' with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

# *Soil Descriptions*

## Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

| Description | Abbreviation | Undrained shear strength (kPa) |
|---|---|---|
| Very soft | VS | <12 |
| Soft | S | 12 - 25 |
| Firm | F | 25 - 50 |
| Stiff | St | 50 - 100 |
| Very stiff | VSt | 100 - 200 |
| Hard | H | >200 |
| Friable | Fr | - |

## Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

| Relative Density | Abbreviation | Density Index (%) |
|---|---|---|
| Very loose | VL | <15 |
| Loose | L | 15-35 |
| Medium dense | MD | 35-65 |
| Dense | D | 65-85 |
| Very dense | VD | >85 |

## Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

## Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.

  Soil tends to stick together.

  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.

  Soil tends to stick together, free water forms when handling.

## Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- 'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery).
- 'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- 'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when handling).
- 'Wet' or 'w ≈LL' (i.e. near the liquid limit).
- 'Wet' or 'w >LL' (i.e. wet of the liquid limit).

# Symbols & Abbreviations

Douglas Partners

## Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

## Drilling or Excavation Methods

| | |
|---|---|
| C | Core drilling |
| R | Rotary drilling |
| SFA | Spiral flight augers |
| NMLC | Diamond core - 52 mm dia |
| NQ | Diamond core - 47 mm dia |
| HQ | Diamond core - 63 mm dia |
| PQ | Diamond core - 81 mm dia |

## Water

| | |
|---|---|
| ▷ | Water seep |
| $\underline{\nabla}$ | Water level |

## Sampling and Testing

| | |
|---|---|
| A | Auger sample |
| B | Bulk sample |
| D | Disturbed sample |
| E | Environmental sample |
| $U_{50}$ | Undisturbed tube sample (50mm) |
| W | Water sample |
| pp | Pocket penetrometer (kPa) |
| PID | Photo ionisation detector |
| PL | Point load strength Is(50) MPa |
| S | Standard Penetration Test |
| V | Shear vane (kPa) |

## Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

### Defect Type

| | |
|---|---|
| B | Bedding plane |
| Cs | Clay seam |
| Cv | Cleavage |
| Cz | Crushed zone |
| Ds | Decomposed seam |
| F | Fault |
| J | Joint |
| Lam | Lamination |
| Pt | Parting |
| Sz | Sheared Zone |
| V | Vein |

### Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

| | |
|---|---|
| h | horizontal |
| v | vertical |
| sh | sub-horizontal |
| sv | sub-vertical |

### Coating or Infilling Term

| | |
|---|---|
| cln | clean |
| co | coating |
| he | healed |
| inf | infilled |
| stn | stained |
| ti | tight |
| vn | veneer |

### Coating Descriptor

| | |
|---|---|
| ca | calcite |
| cbs | carbonaceous |
| cly | clay |
| fe | iron oxide |
| mn | manganese |
| slt | silty |

### Shape

| | |
|---|---|
| cu | curved |
| ir | irregular |
| pl | planar |
| st | stepped |
| un | undulating |

### Roughness

| | |
|---|---|
| po | polished |
| ro | rough |
| sl | slickensided |
| sm | smooth |
| vr | very rough |

### Other

| | |
|---|---|
| fg | fragmented |
| bnd | band |
| qtz | quartz |

# *Symbols & Abbreviations*

## Graphic Symbols for Soil and Rock

### General

- Asphalt
- Road base
- Concrete
- Filling

### Soils

- Topsoil
- Peat
- Clay
- Silty clay
- Sandy clay
- Gravelly clay
- Shaly clay
- Silt
- Clayey silt
- Sandy silt
- Sand
- Clayey sand
- Silty sand
- Gravel
- Sandy gravel
- Cobbles, boulders
- Talus

### Sedimentary Rocks

- Boulder conglomerate
- Conglomerate
- Conglomeratic sandstone
- Sandstone
- Siltstone
- Laminite
- Mudstone, claystone, shale
- Coal
- Limestone

### Metamorphic Rocks

- Slate, phyllite, schist
- Gneiss
- Quartzite

### Igneous Rocks

- Granite
- Dolerite, basalt, andesite
- Dacite, epidote
- Tuff, breccia
- Porphyry

# Cone Penetration Tests

Douglas Partners

## Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance $q_c$
- Sleeve friction $f_s$
- Inclination (from vertical) $i$
- Depth below ground $z$

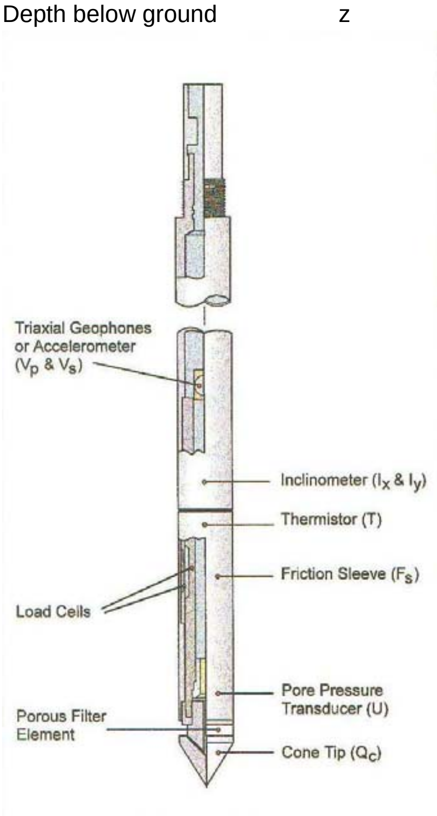



Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

## Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

| Type | Measures |
|---|---|
| Standard | Basic parameters ($q_c$, $f_s$, i & z) |
| Piezocone | Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters |
| Conductivity | Bulk soil electrical conductivity ($\sigma$) plus basic parameters |
| Seismic | Shear wave velocity ($V_s$), compression wave velocity ($V_p$), plus basic parameters |

## Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

# Cone Penetration Tests

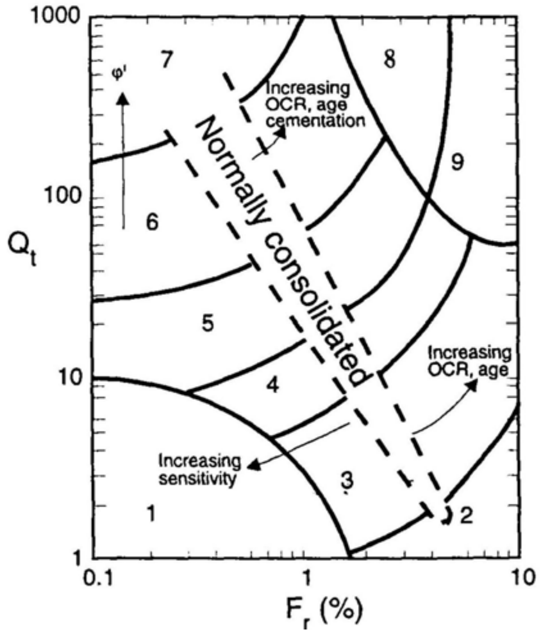



Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

## Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

**Settlement**

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

**Pile Capacity**

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

**Dynamic or Earthquake Analysis**

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus $G_0$. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

**Other Applications**

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

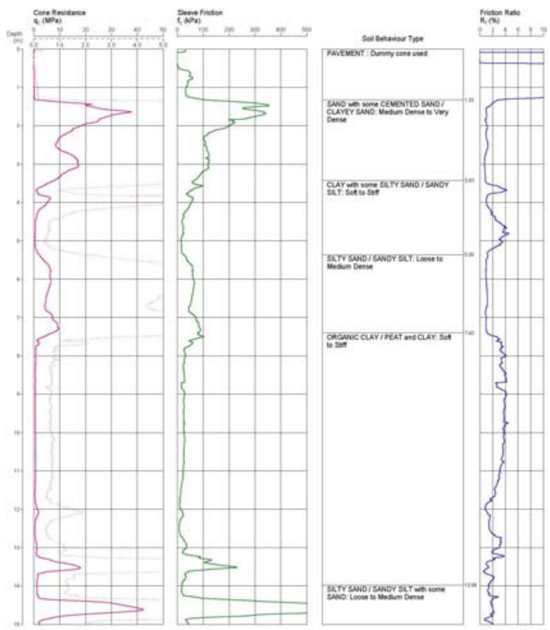


Figure 4: Sample Cone Plot

# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.3 AHD

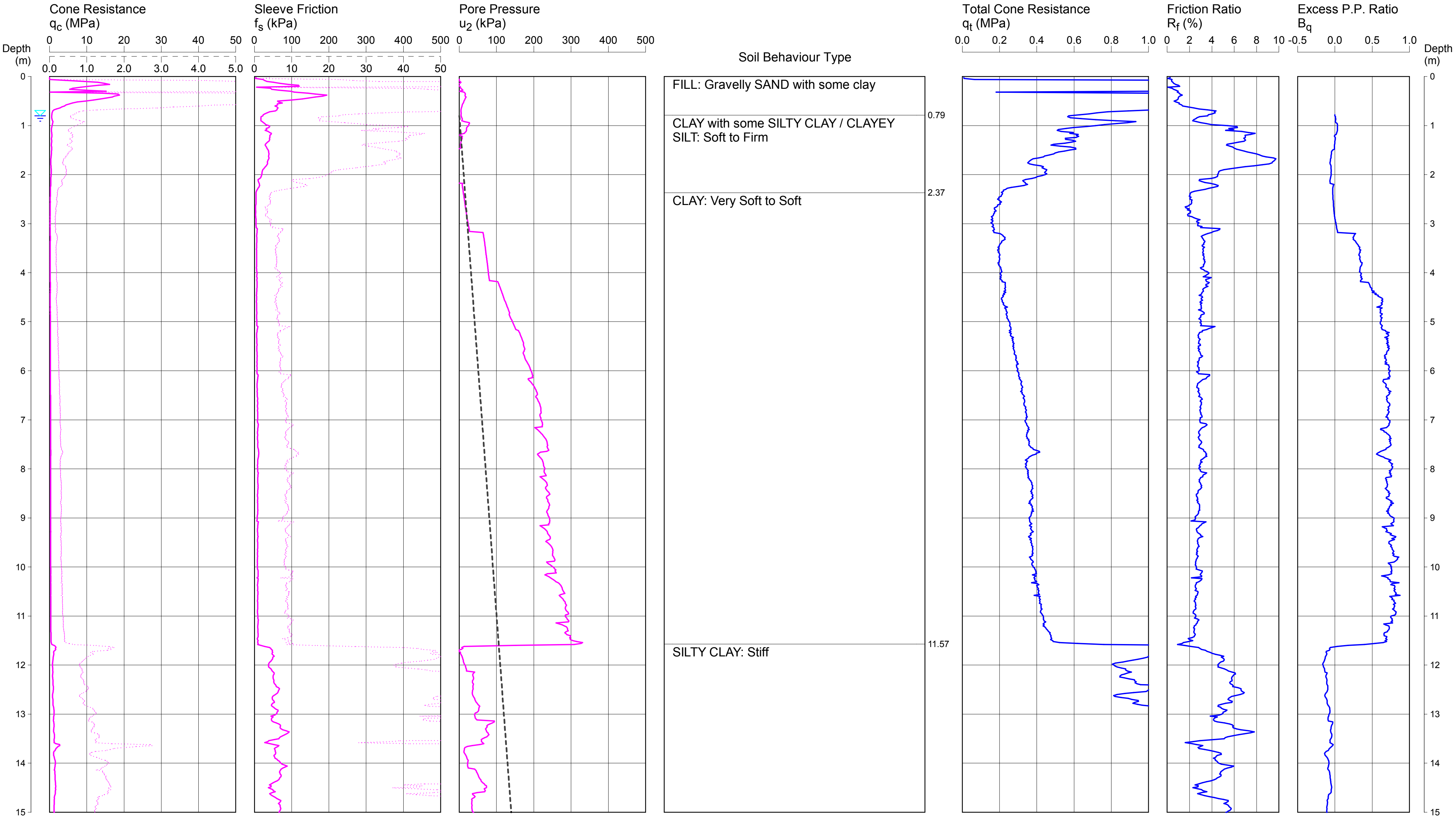
**COORDINATES:** 520468 mE 6739865 mN

# CPT01

**Page 1 of 2**

**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 0.8m DEPTH AFTER WITHDRAWAL OF RODS
RL INTERPOLATED FROM PLANS PROVIDED BY CLIENT

**File:** P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT01.CP5

**Cone ID:** 201150 **Type:** I-CFXY-10

**Water depth after test: 0.80m depth (assumed)**

ConePlot Version 5.9.2



Douglas Partners
Geotechnics / Environment / Groundwater

# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.3 AHD

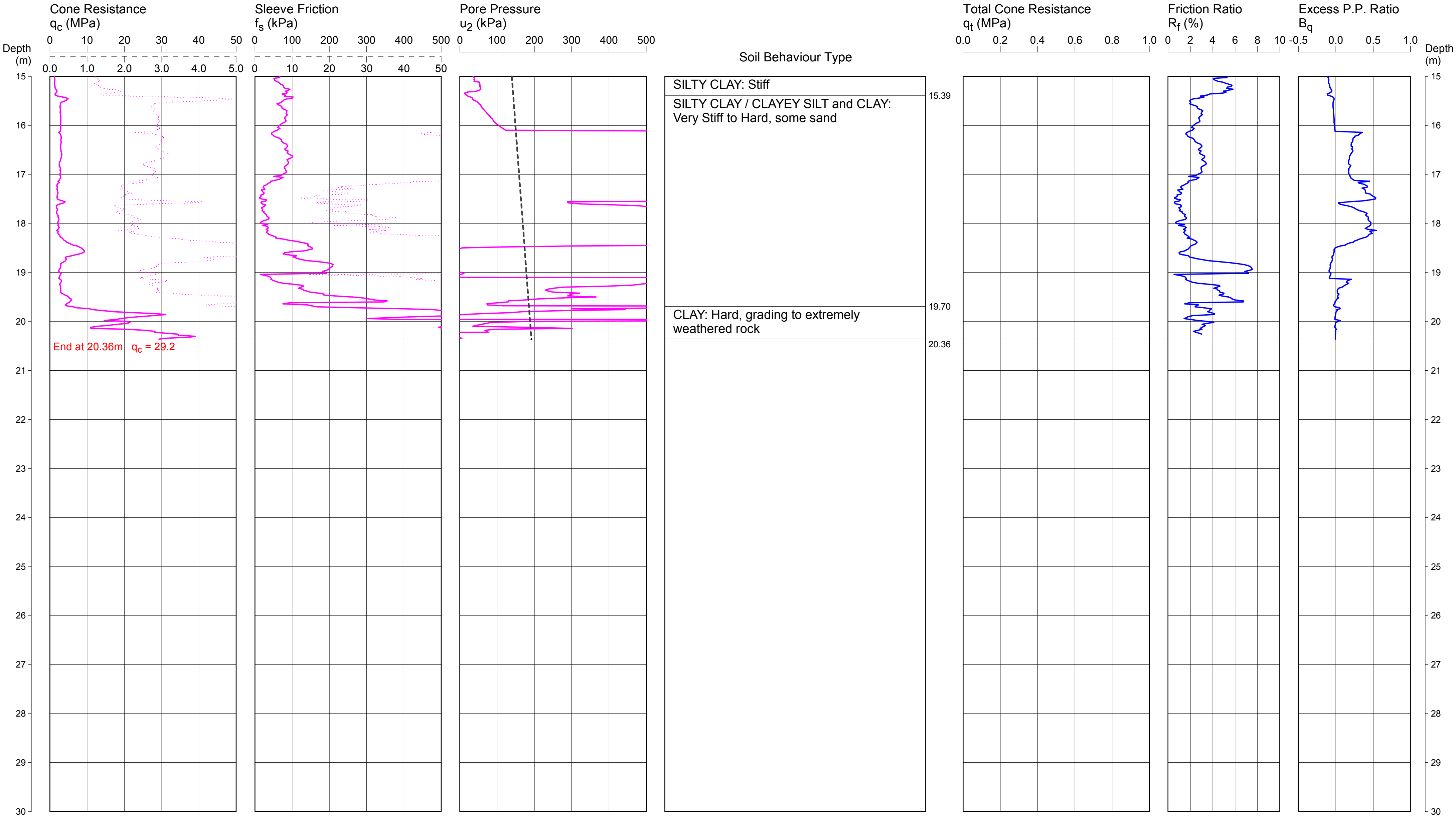
**COORDINATES:** 520468 mE 6739865 mN

# CPT01



**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 0.8m DEPTH AFTER WITHDRAWAL OF RODS
RL INTERPOLATED FROM PLANS PROVIDED BY CLIENT

File: P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT01.CP5
Cone ID: 200105 Type: I-CFXY-20-10

**Water depth after test: 0.80m depth (assumed)**

ConePlot Version 5.9.2


Douglas Partners
*Geotechnics / Environment / Groundwater*

# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.4 AHD

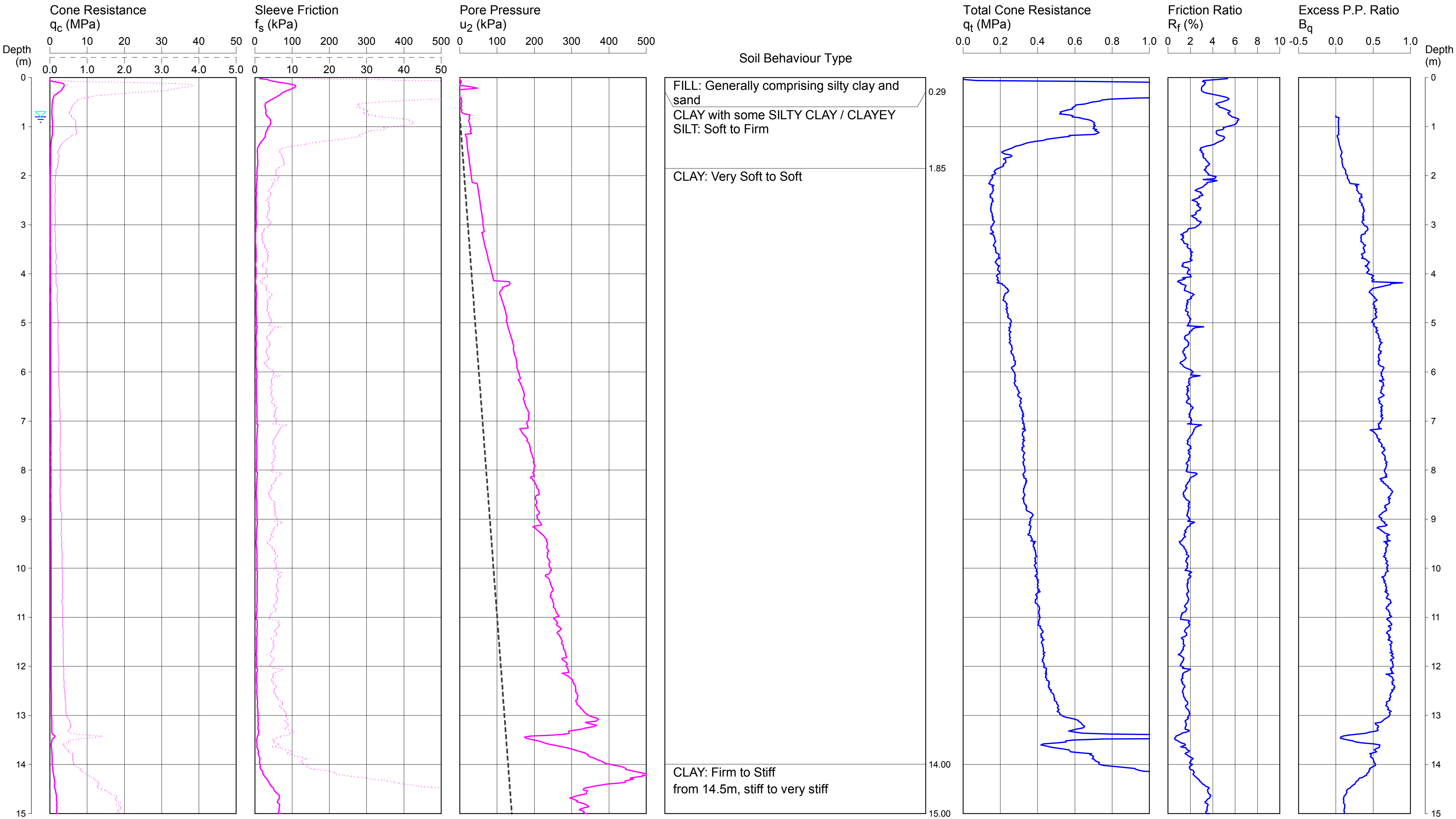
**COORDINATES:** 520462 mE 6739770 mN

# CPT02



**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 0.8m DEPTH AFTER WITHDRAWAL OF RODS.RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

File: P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT02.CP5
Cone ID: 2103 Type: PIEZO P2C10

**Water depth after test: 0.80m depth (assumed)**

ConePlot Version 5.9.2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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.4 AHD

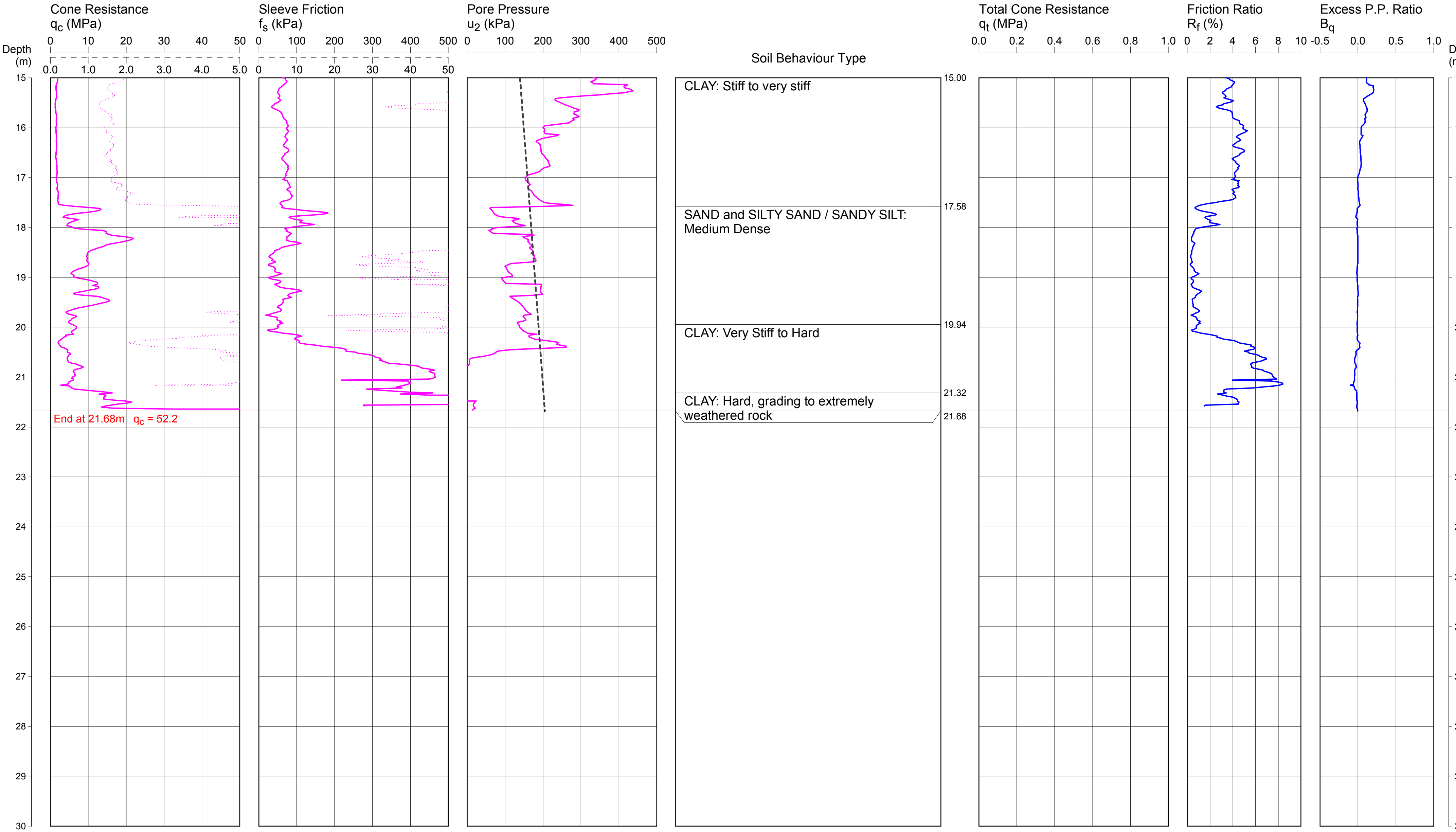
**COORDINATES:** 520462 mE 6739770 mN

# CPT02



**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 0.8m DEPTH AFTER WITHDRAWAL OF RODS.RL INTERPOLATED FROM PLANS SUPPLIED BY CLIENT

**File:** F:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT02.CP5
**Cone ID:** 2010 **Type:** I-CFXY-10

**Water depth after test: 0.80m depth (assumed)**

ConePlot Version 5.9.2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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.7 AHD

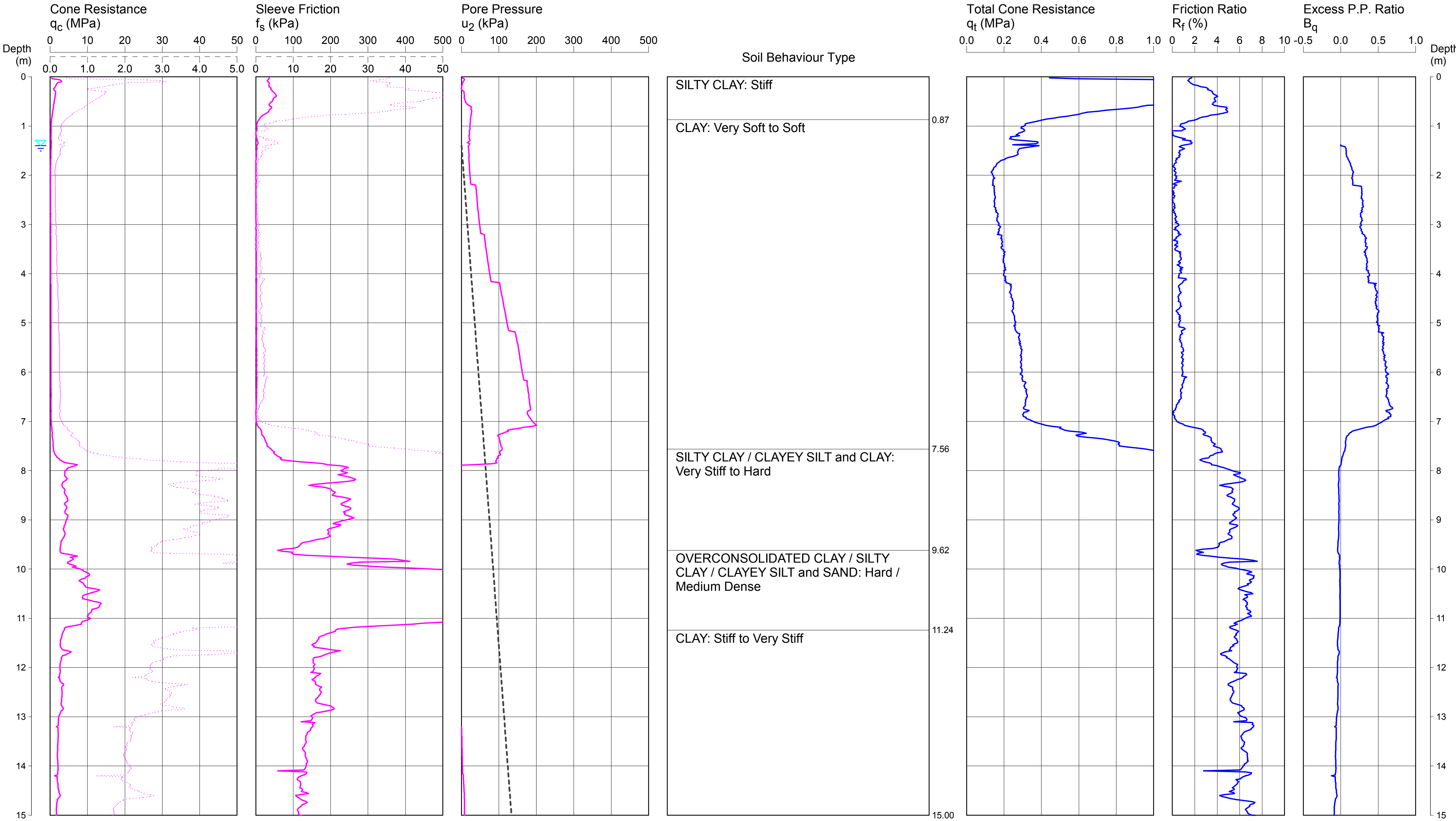
**COORDINATES:** 520334 mE 6739793 mN

# CPT03



**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.4m DEPTH AFTER WITHDRAWAL OF RODS.RL INTERPOLATED FROM PLANS SUPPLIED BY CLIENT

**File:** P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT03.CP5
**Cone ID:** 200309 **Type:** I-CFXY-10

**Water depth after test: 1.40m depth (assumed)**

ConePlot Version 5.9.2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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.7 AHD

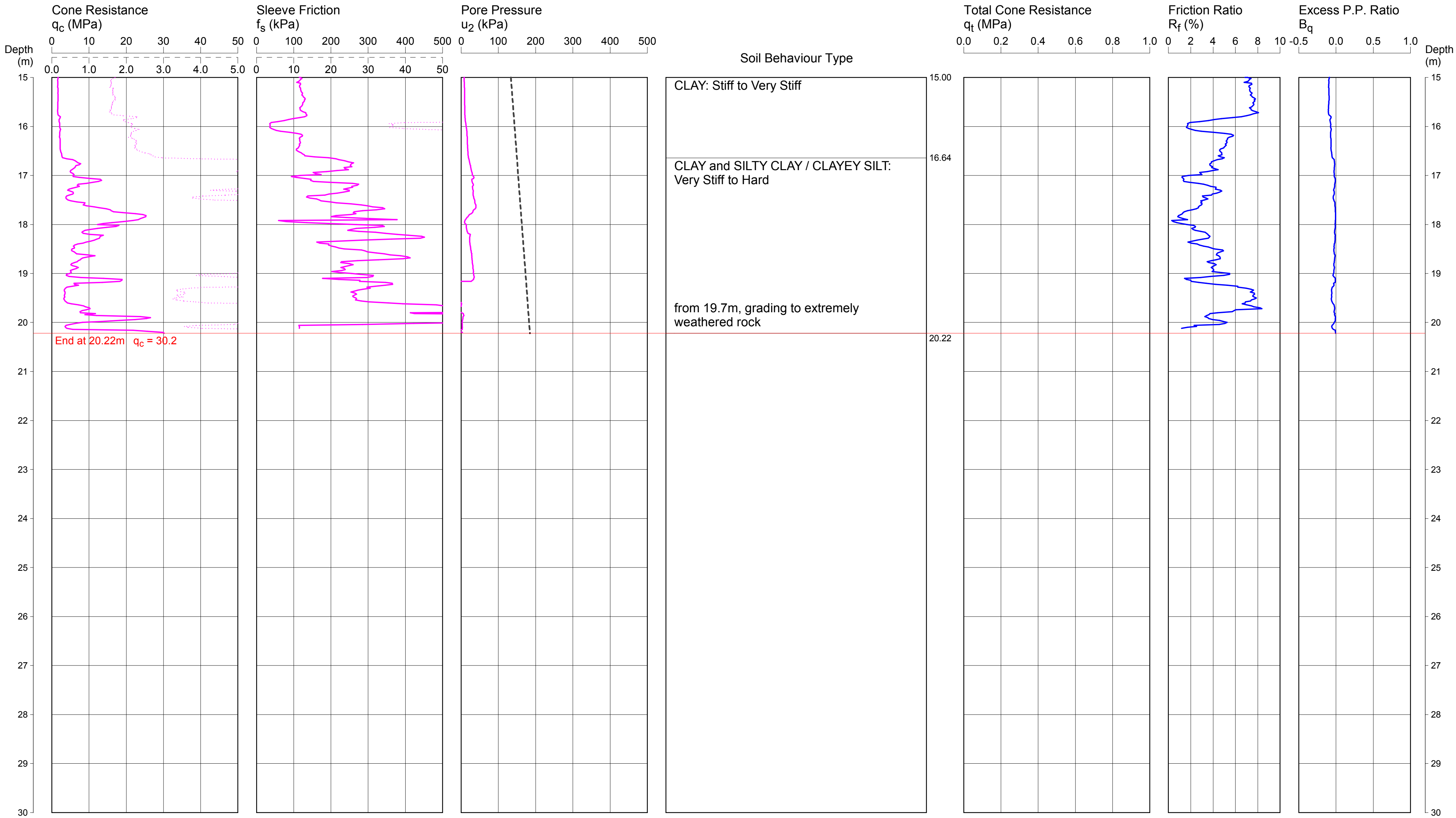
**COORDINATES:** 520334 mE 6739793 mN

# CPT03



**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.4m DEPTH AFTER WITHDRAWAL OF RODS.RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

File: P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT03.CP5
Cone ID: 200309 Type: I-CFXY-10

**Water depth after test: 1.40m depth (assumed)**

ConePlot Version 5.9.2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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.3 AHD

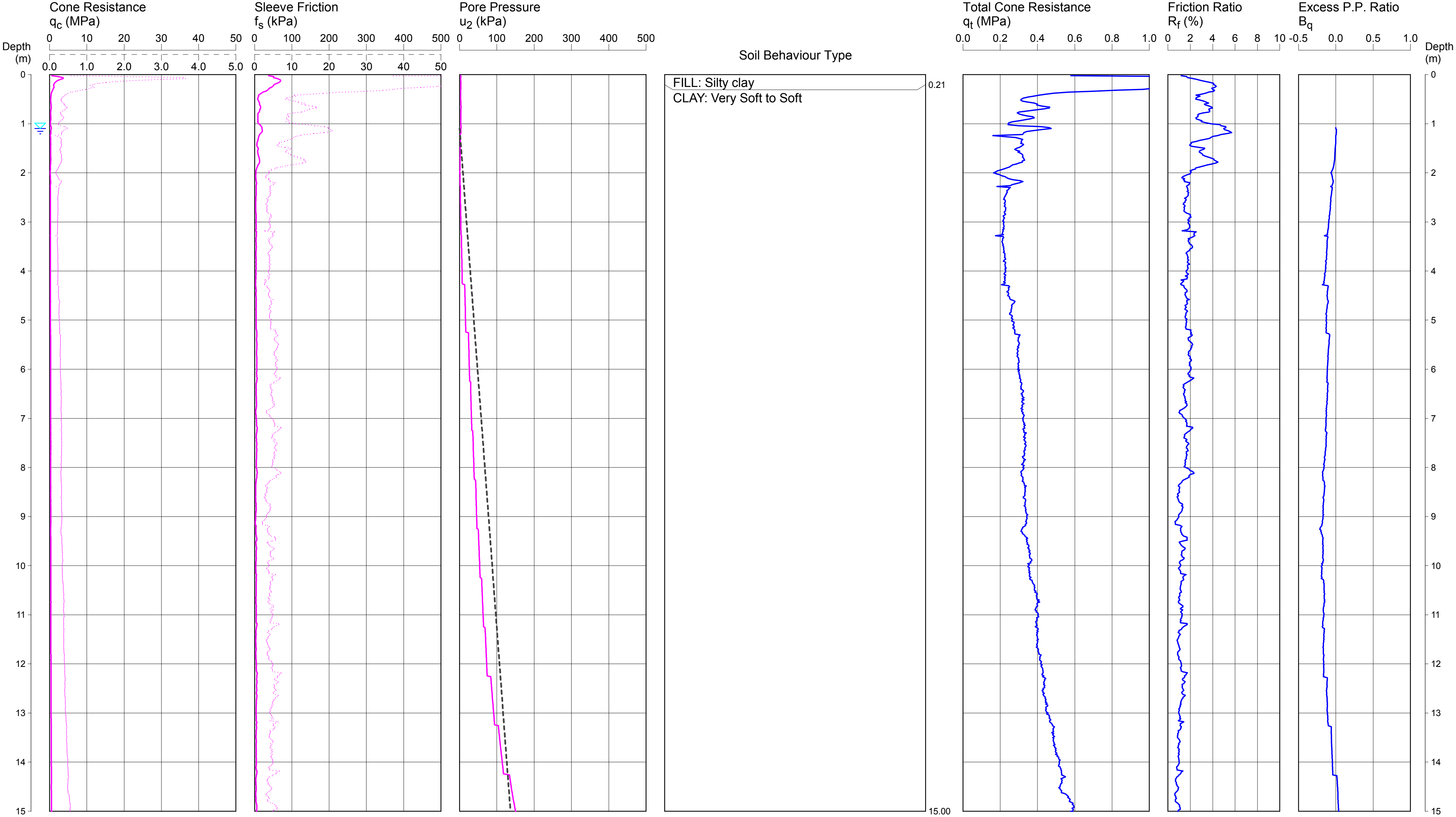
**COORDINATES:** 520390 mE 6739876 mN

# CPT04



**DATE** 17/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.1m DEPTH AFTER WITHDRAWAL OF RODS.RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

File: P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT04.CP5
Cone ID: 200130 Type: I-CFXY-10

**Water depth after test: 1.10m depth (assumed)**

ConePlot Version 5.9.2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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.3 AHD

**COORDINATES:** 520390 mE 6739876 mN

# CPT04



**DATE** 17/11/2020

**PROJECT No:** 105016.00


**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.1m DEPTH AFTER WITHDRAWAL OF RODS.RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

**File:** P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT04.CP5
**Cone ID:** 200150 **Type:** I-CFXY-10

**Water depth after test: 1.10m depth (assumed)**

ConePlot Version 5.9.2


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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.5 AHD

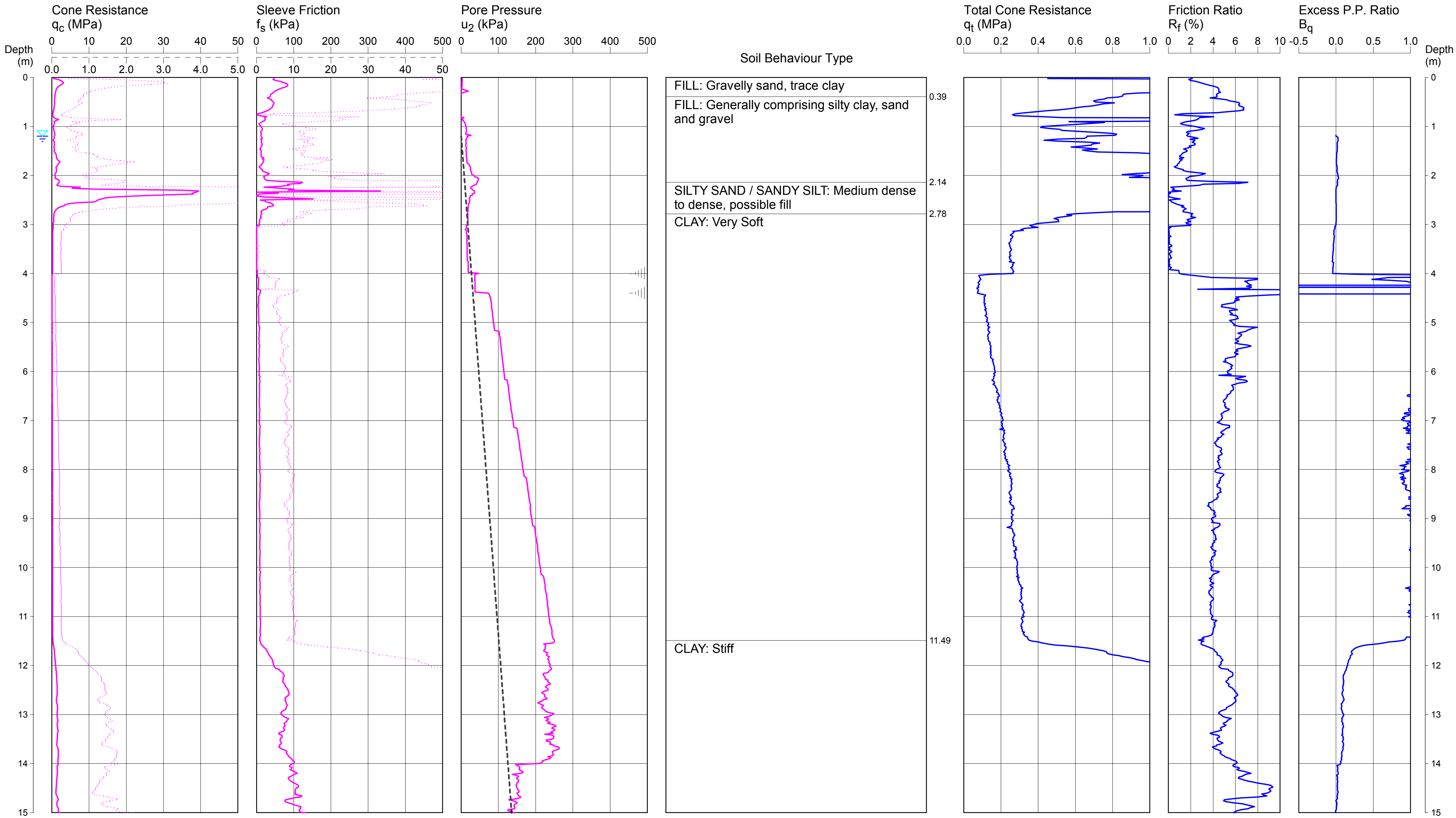
**COORDINATES:** 520384 mE 6739826 mN

# CPT05



**DATE** 18/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.2m DEPTH AFTER WITHDRAWAL OF RODS. RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

File: P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT05A.CP5
Cone ID: 200150 Type: I-CFXY-10

**Water depth after test: 1.20m depth (assumed)**

ConePlot Version 5.9.2


Dissipation Test

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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.5 AHD

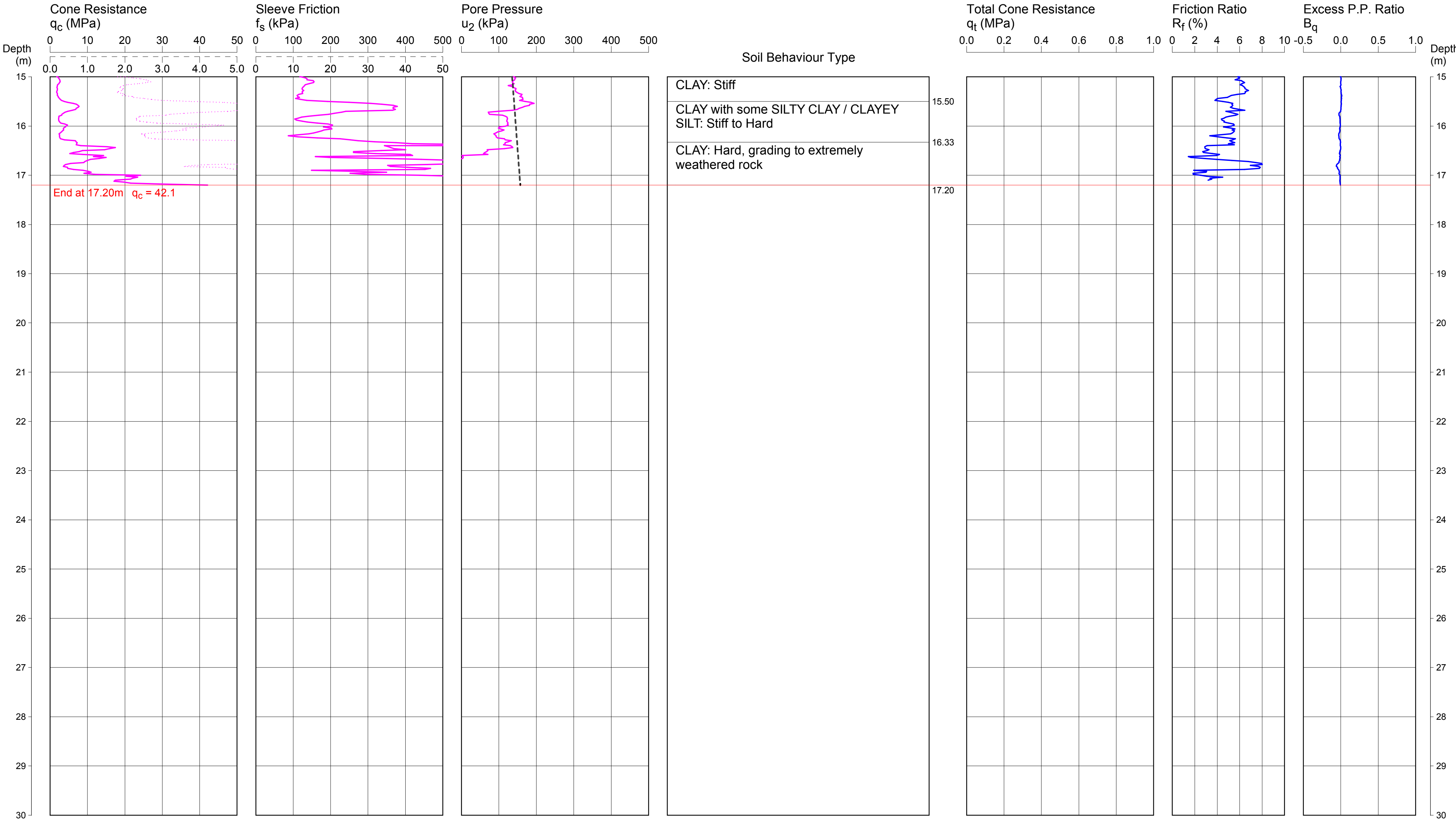
**COORDINATES:** 520384 mE 6739826 mN

## CPT05



**DATE** 18/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.2m DEPTH AFTER WITHDRAWAL OF RODS. RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

File: P:\105016.00 - MACLEAN, Proposed Service Centre\4.0 Field Work\4.1 Logs\CPT\CPT05A.CP5
Cone ID: 200150 Type: I-CFXY-10

**Water depth after test: 1.20m depth (assumed)**

ConePlot Version 5.9.2



Dissipation Test

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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.4 AHD

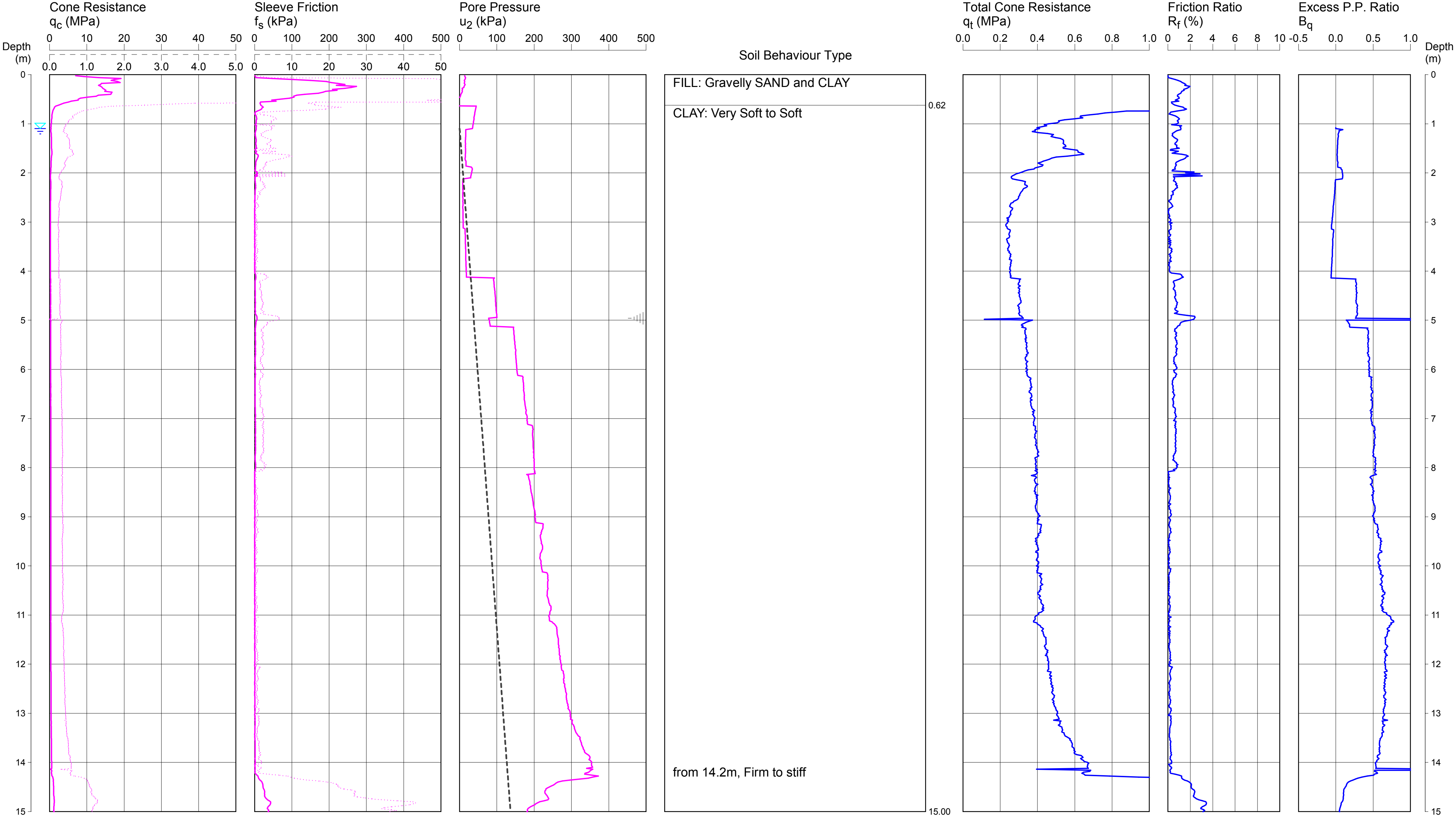
**COORDINATES:** 520431 mE 6739810 mN

## CPT06



**DATE** 18/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.1m DEPTH AFTER WITHDRAWAL OF RODS
RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

**File:** CP5

**Cone ID:** 200310 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2



-ıll Dissipation Test

**Water depth after test: 1.10m depth (assumed)**

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# CONE PENETRATION TEST

**CLIENT:** MACLEAN SERVICE CENTRE PTY LTD

**PROJECT:** PROPOSED HIGHWAY SERVICE CENTRE

**LOCATION:** 2 SCHWONBERG STREET, TOWNSEND

**REDUCED LEVEL:** 0.4 AHD

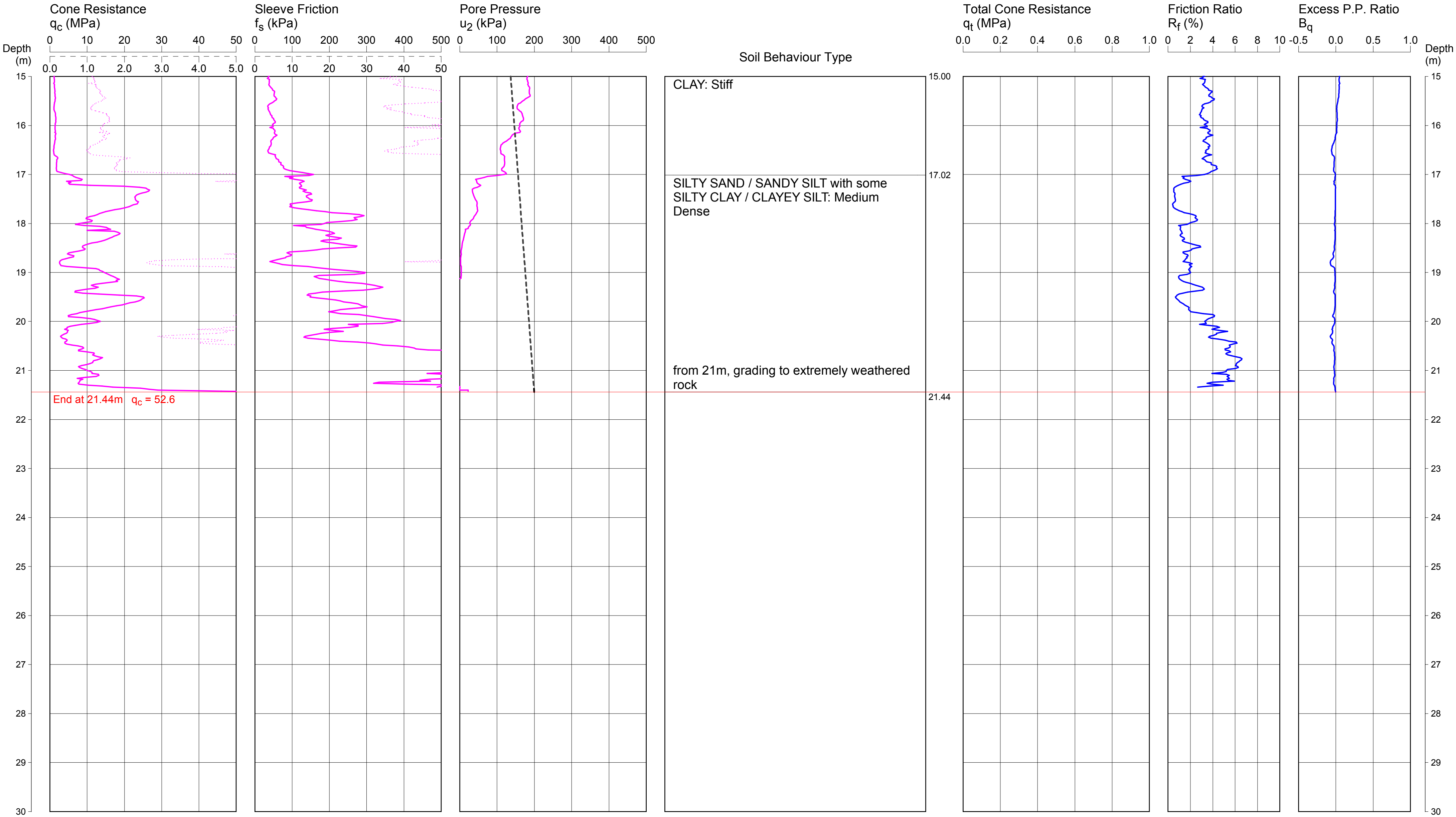
**COORDINATES:** 520431 mE 6739810 mN

## CPT06



**DATE** 18/11/2020

**PROJECT No:** 105016.00




**REMARKS:** HOLE DISCONTINUED DUE TO REFUSAL ON INFERRED WEATHERED ROCK
HOLE COLLAPSE AT 1.1m DEPTH AFTER WITHDRAWAL OF RODS
RL INTERPOLATED FROM PLAN SUPPLIED BY CLIENT

**Water depth after test: 1.10m depth (assumed)**

**File:** CP5

**Cone ID:** 200310 **Type:** I-CFXYP20-10

ConePlot Version 5.9.2



Dissipation Test

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Geotechnics | Environment | Groundwater

# BOREHOLE LOG

**CLIENT:** Maclean Service Centre Pty Ltd
**PROJECT:** Proposed Highway Service Centre
**LOCATION:** 2 Schwongberg St, Townsend

**SURFACE LEVEL:** 0.3 AHD
**EASTING:** 520464
**NORTHING:** 6739865
**DIP/AZIMUTH:** 90°/--

**BORE No:** 1
**PROJECT No:** 105016.00
**DATE:** 17/11/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | | FILL (Gravelly SAND SW): Gravel up to 30mm, brown, with clay, W<PL. | | A | 0.2 | | | | |
| | | From 0.5m, dark brown. | | A | 0.6 | | | | |
| | 0.95 | Silty CLAY CH: High plasticity, dark grey, with organic matter, W~PL, alluvial. | | A | 1.2 | | | | |
| | 1.4 | Sandy CLAY CH: High plasticity, grey, moist, W>PL, alluvial. | | A | 1.45 | | | | |
| | 1.5 | Bore discontinued at 1.5m, limit of investigation | | | | | | | |

**RIG:** Hand tools **DRILLER:** Ussher **LOGGED:** Ussher **CASING:** Uncased
**TYPE OF BORING:** 100mm diameter auger
**WATER OBSERVATIONS:** No free groundwater observed whist augering.
**REMARKS:** Location coordinates are in MGA94 Zone 56. Handheld GPS, coordinates approximate. RL interpolated from plan supplied by client.

**SAMPLING & IN SITU TESTING LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | $U_x$ | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | ▷ | Water seep | S | Standard penetration test |
| E | Environmental sample | ▼ | Water level | V | Shear vane (kPa) |

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# BOREHOLE LOG

**CLIENT:** Maclean Service Centre Pty Ltd
**PROJECT:** Proposed Highway Service Centre
**LOCATION:** 2 Schwongberg St, Townsend

**SURFACE LEVEL:** 0.4 AHD
**EASTING:** 520461
**NORTHING:** 6739767
**DIP/AZIMUTH:** 90°/--

**BORE No:** 2
**PROJECT No:** 105016.00
**DATE:** 17/11/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | | FILL (Silty CLAY CH): High plasticity, dark brown, W<PL | | | | | | | |
| | 0.1 | FILL (Silty SAND SW) : Fine grained, white, moist | | A | 0.12 | | | | |
| | 0.15 | Silty CLAY CH: High plasticity, dark brown mottled red brown, W~PL, alluvial. | | | | | | | |
| 0 | | | | A | 0.5 | | | | |
| | | From 0.55m, dark grey with trace organic material, wet, W>PL. | | | | | | | |
| | | | | A | 0.9 | | | | |
| | 1 | | | | | | | | 1 |
| | | | | | | | | ▼ | |
| | | | | A | 1.3 | | | | |
| -1 | | | | | | | | | |
| | 1.5 | Bore discontinued at 1.5m, limit of investigation | | | | | | | |
| | 2 | | | | | | | | 2 |
| -2 | | | | | | | | | |

**RIG:** Hand tools **DRILLER:** Ussher **LOGGED:** Ussher **CASING:** Uncased
**TYPE OF BORING:** 100mm diameter auger
**WATER OBSERVATIONS:** Free groundwater observed at 1.25m whilst augering.
**REMARKS:** Location coordinates are in MGA94 Zone 56. Handheld GPS, coordinates approximate. RL interpolated from plan supplied by client.

**SAMPLING & IN SITU TESTING LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | $U_x$ | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | ▷ | Water seep | S | Standard penetration test |
| E | Environmental sample | ▼ | Water level | V | Shear vane (kPa) |

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# BOREHOLE LOG

**CLIENT:** Maclean Service Centre Pty Ltd
**PROJECT:** Proposed Highway Service Centre
**LOCATION:** 2 Schwongberg St, Townsend

**SURFACE LEVEL:** 0.7 AHD
**EASTING:** 520329
**NORTHING:** 6739795
**DIP/AZIMUTH:** 90°/--

**BORE No:** 3
**PROJECT No:** 105016.00
**DATE:** 17/11/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | | Silty CLAY CH: High plasticity, brown,trace fine sand, W<PL, alluvial, grassed surface. | | A | 0.1 | | | | |
| | 0.25 | Silty CLAY CH: High plasticity, dark grey mottled red brown, W~PL, moist | | A | 0.4 | | | | |
| 0 | | | | A | 0.8 | | | ▼ | |
| | 1 | | | | | | | | 1 |
| | | From 1.2m, wet, W>PL | | A | 1.4 | | | | |
| | 1.5 | Bore discontinued at 1.5m, limit of investigation | | | | | | | |
| -1 | | | | | | | | | |
| | 2 | | | | | | | | 2 |
| -2 | | | | | | | | | |

**RIG:** Hand tools **DRILLER:** Ussher **LOGGED:** Ussher **CASING:** Uncased
**TYPE OF BORING:** 100mm diameter auger
**WATER OBSERVATIONS:** Free groundwater observed at 0.9m whilst augering.
**REMARKS:** Location coordinates are in MGA94 Zone 56. Handheld GPS, coordinates approximate. RL interpolated from plan supplied by client.

**SAMPLING & IN SITU TESTING LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | $U_x$ | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | ▷ | Water seep | S | Standard penetration test |
| E | Environmental sample | ▼ | Water level | V | Shear vane (kPa) |

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# BOREHOLE LOG

**CLIENT:** Maclean Service Centre Pty Ltd
**PROJECT:** Proposed Highway Service Centre
**LOCATION:** 2 Schwongberg St, Townsend

**SURFACE LEVEL:** 0.3 AHD
**EASTING:** 520393
**NORTHING:** 6739876
**DIP/AZIMUTH:** 90°/--

**BORE No:** 4
**PROJECT No:** 105016.00
**DATE:** 17/11/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | | FILL (Silty CLAY CI): Medium plasticity, brown, trace rootlets, W<PL, dry to moist | | | | | | | |
| | 0.15 | Silty CLAY CH: High Plasticity, dark grey mottled grey, with organic material, W~PL, moist, alluvial. | | A | 0.2 | | | | |
| 0 | | | | | | | | | |
| | | | | A | 0.7 | | | | |
| | 1 | | | | | | | ▼ (1.1) | 1 |
| | | | | A | 1.2 | | | | |
| -1 | | From 1.3m, wet, W>PL | | | | | | | |
| | | | | A | 1.5 | | | | |
| | | | | A | 1.7 | | | | |
| | 2 / 2.0 | Bore discontinued at 2.0m, limit of investigation | | | | | | | 2 |
| -2 | | | | | | | | | |

**RIG:** Hand tools **DRILLER:** Ussher **LOGGED:** Ussher **CASING:** Uncased
**TYPE OF BORING:** 100mm diameter auger
**WATER OBSERVATIONS:** Free groundwater observed at 1.1m whilst augering.
**REMARKS:** Location coordinates are in MGA94 Zone 56. Handheld GPS, coordinates approximate. RL interpolated from plan supplied by client.

**SAMPLING & IN SITU TESTING LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | $U_x$ | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | ▷ | Water seep | S | Standard penetration test |
| E | Environmental sample | ▼ | Water level | V | Shear vane (kPa) |

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# BOREHOLE LOG

**CLIENT:** Maclean Service Centre Pty Ltd
**PROJECT:** Proposed Highway Service Centre
**LOCATION:** 2 Schwongberg St, Townsend

**SURFACE LEVEL:** 0.5 AHD
**EASTING:** 520355
**NORTHING:** 6739836
**DIP/AZIMUTH:** 90°/--

**BORE No:** 7
**PROJECT No:** 105016.00
**DATE:** 17/11/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Depth | Sample | Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | | FILL (Gravelly SAND SW): brown, gravel up to 20mm diameter, trace clay, dry | | | | | | | |
| 0 | 0.35 | Silty CLAY CH: High plasticity, dark brown, W~PL, moist, alluvial. | | A | 0.5 | | | | |
| | 0.75 | Silty CLAY CH: High plasticity, dark grey, trace organic material, W>PL, wet, alluvial. | | A | 0.8 | | | | |
| | | | | A | 1.1 | | | ▼ | |
| -1 | 1.5 | Bore discontinued at 1.5m, limit of investigation | | A | 1.5 | | | | |
| -2 | | | | | | | | | |

**RIG:** Hand tools **DRILLER:** Ussher **LOGGED:** Ussher **CASING:** Uncased
**TYPE OF BORING:** 100mm diameter auger
**WATER OBSERVATIONS:** Free groundwater observed at 1.4m whilst augering.
**REMARKS:** Location coordinates are in MGA94 Zone 56. Handheld GPS, coordinates approximate. RL interpolated from plan supplied by client.

**SAMPLING & IN SITU TESTING LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | $U_x$ | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50) (MPa) |
| C | Core drilling | W | Water sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | ▷ | Water seep | S | Standard penetration test |
| E | Environmental sample | ▼ | Water level | V | Shear vane (kPa) |

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# Appendix B

Laboratory Test Results - EAL

# RESULTS OF ACID SULFATE SOIL ANALYSIS

15 samples supplied by Douglas Partners Pty Ltd on 19th November, 2020. Lab Job No.K0802

Analysis requested by John Niland. Your Job: 105016.00

18 Lawson Crescent COFFS HARBOUR NSW 2450

| Sample Identification | EAL Lab Code | Texture | Moisture Content | | $pH_F$ and $pH_{FOX}$ | | | | KCl-extractable sulfur ($S_{KCl}$) | | Potential Sulfidic Acidity (Chromium Reducible Sulfur - CRS) | | | Actual Acidity (Titratable Actual Acidity - TAA) | Retained Acidity | | Non-treated soil: Acid Neutralising Capacity ($ANC_{BT}$) | | Non-treated soil: Net Acidity | Non-treated soil: Lime Calculation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (% moisture of total wet weight) | (g moisture / g of oven dry soil) | $pH_F$ | $pH_{FOX}$ | pH change | Reaction | (% $S_{KCl}$) | (equiv. mol $H^+$/t) | (% $S_{cr}$) | (mol $H^+$/t) | $pH_{KCl}$ | (mol $H^+$/t) | (%$S_{NAS}$) | (mol $H^+$/t) | (% $CaCO_3$) | (mol $H^+$/t) | (mol $H^+$/t) | (kg $CaCO_3$/t DW) |
| *Method Info.* | | ** | ** | | *(In-house method S21)* | | | | ** | | *(In-house method S20)* | | *(In-house method 16b)* | | ** | | *(In-house method S14)* | | ** | ** |
| **BH1 0.6m** | *K0802/1* | Fine | 11.5 | 0.13 | 6.94 | 3.76 | -3.18 | Medium | .. | .. | 0.020 | 12 | 6.70 | 0 | .. | .. | 0.70 | 140 | 12 | 1 |
| **BH1 1.2m** | *K0802/2* | Fine | 27.8 | 0.38 | 5.06 | 3.48 | -1.58 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH1 1.45m** | *K0802/3* | Fine | 21.0 | 0.27 | 4.61 | 3.59 | -1.02 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH2 0.5m** | *K0802/4* | Fine | 32.2 | 0.47 | 4.08 | 1.89 | -2.20 | Medium | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH2 0.9m** | *K0802/5* | Fine | 33.8 | 0.51 | 4.96 | 2.84 | -2.12 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH2 1.3m** | *K0802/6* | Fine | 36.1 | 0.56 | 5.41 | 3.18 | -2.23 | High | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH3 0.1m** | *K0802/7* | Fine | 19.8 | 0.25 | 6.73 | 4.53 | -2.20 | Medium | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH3 0.4m** | *K0802/8* | Fine | 26.2 | 0.35 | 4.46 | 2.19 | -2.27 | Medium | 0.054 | 33 | 0.009 | 6 | 4.10 | 119 | < 0.001 | 0 | .. | .. | 124 | 9 |
| **BH3 0.8m** | *K0802/9* | Fine | 27.1 | 0.37 | 4.52 | 2.34 | -2.18 | Medium | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH4 0.2m** | *K0802/10* | Fine | 31.2 | 0.45 | 5.17 | 2.01 | -3.16 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH4 1.2m** | *K0802/11* | Fine | 33.2 | 0.50 | 6.61 | 3.16 | -3.45 | Volcanic | .. | .. | 0.349 | 218 | 5.76 | 14 | .. | .. | .. | .. | 232 | 17 |
| **BH4 1.7m** | *K0802/12* | Fine | 39.5 | 0.65 | 6.15 | 2.78 | -3.37 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH7 0.5m** | *K0802/13* | Fine | 31.1 | 0.45 | 3.93 | 2.38 | -1.55 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH7 0.8m** | *K0802/14* | Fine | 30.5 | 0.44 | 5.47 | 2.61 | -2.86 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| **BH7 1.5m** | *K0802/15* | Fine | 31.5 | 0.46 | 5.41 | 3.47 | -1.94 | Volcanic | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

**NOTES:**

1. All analysis is reported on a dry weight (DW) basis, unless wet weight (WW) is specified.
2. Samples are dried and ground immediately upon arrival (unless supplied dried and ground).
3. Analytical procedures are sourced from Sullivan L, Ward N, Toppler N and Lancaster G. 2018. National acid sulfate soils guidance: national acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT. CC BY 4.0.
4. The Acid Base Accounting Equation, where Acid Neutralising Capacity has not been corroborated by other data, is **Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity** (Eq. 3.2; Sullivan et al. 2018 - full reference above).
5. The Acid Base Accounting Equation for post-limed soil materials is **Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity - (post treatment Acid Neutralising Capacity - initial Acid Neutralising Capacity)** (Eq. 3.3; Sullivan et al. 2018 - full reference above).
   While the Acid Neutralising Capacity of a soil material may not be included in the Net Acidity calculation (Note 4), it must be measured to give an Initial Acid Neutralising Capacity if verification testing is planned post-liming.
   **The Inital Acid Neutralising Capacity must be provided by the client to enable EAL to produce Verification Net Acidity and Liming calculations for post-limed soil materials.**
6. The Acid Base Accounting Equation, where Acid Neutralising Capacity has been corroborated by other data, is Net Acidity = Potential Acidity + Actual Acidity + Retained Acidity - Acid Neutralising Capacity (Eq. 3.1; Sullivan et al. 2018 - full reference above).
7. The lime calculation includes a Safety Factor of 1.5 as a safety margin for acid neutralisation (Sullivan et al. 2018). This is only applied to positive values. An increased Safety Factor may be required in some cases.
8. Retained Acidity is required when the $pH_{KCl}$ < 4.5 or where jarosite has been visually observed.
9. A negative Net Acidity result indicates an excess acid neutralising capacity.
10. If insufficient mixing occurs during intial sampling, or during post-liming, or both: the Potential Sulfidic Acidity may be greater in the post-limed sample than in the intial sample; the post-liming Acid Neutralising Capacity may be lower in the post-limed sample than in the intial sample.
11. **An acid sulfate soil management plan is triggered by Net Acidity results greater than the texture dependent criterion: coarse texture ≥ 0.03% S or 18 mol $H^+$/t; medium texture ≥ 0.06% S or 36 mol $H^+$/t; fine texture ≥ 0.1% S or 62 mol $H^+$/t)** (Table 1.1; Sullivan et al. 2018 - full reference above)
12. For projects that disturb > 1000 t of soil material, the coarse trigger of ≥ 0.03% S or ≥ 18 mol $H^+$/t must be applied in accordance with Sullivan et al. (2018) (full reference above).
13. Acid sulfate soil texture triggers can be related to NCST (2009) textures: coarse and peats = sands to loamy sands; medium = clayey sand to light clays; fine = light medium to heavy clays (Sullivan et al. 2018 - full reference above).
14. Bulk density is required to convert liming rates to soil volume based results. Field bulk density rings can be submitted to EAL for bulk density determination.
15. A negative Net Acidity result indicates an excess acid neutralising capacity.
16. '..' is reported where a test is either not requested or not required. Where $pH_{KCl}$ is < 4.5 or > 6.5, zero is reported for $S_{NAS}$ and ANC in Net Acidity calculations, respectively.
17. Results refer to samples as received at the laboratory. This report is not to be reproduced except in full.
18. ** NATA accreditation does not cover the performance of this service.
19. Analysis conducted between sample arrival date and reporting date.
20. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal or on request).
21. Results relate to the samples tested.
22. This report was issued on 03/12/2020 and replaces the report published 20/11/2020. Net Acidity has been added to selected samples.

NATA
WORLD RECOGNISED ACCREDITATION
Accreditation No. 14960
Accredited for compliance with ISO/IEC 17025 - Testing

checked: ................
Graham Lancaster
Laboratory Manager

# Appendix C

CPT Interpretation Plots
Pile Capacity Plots

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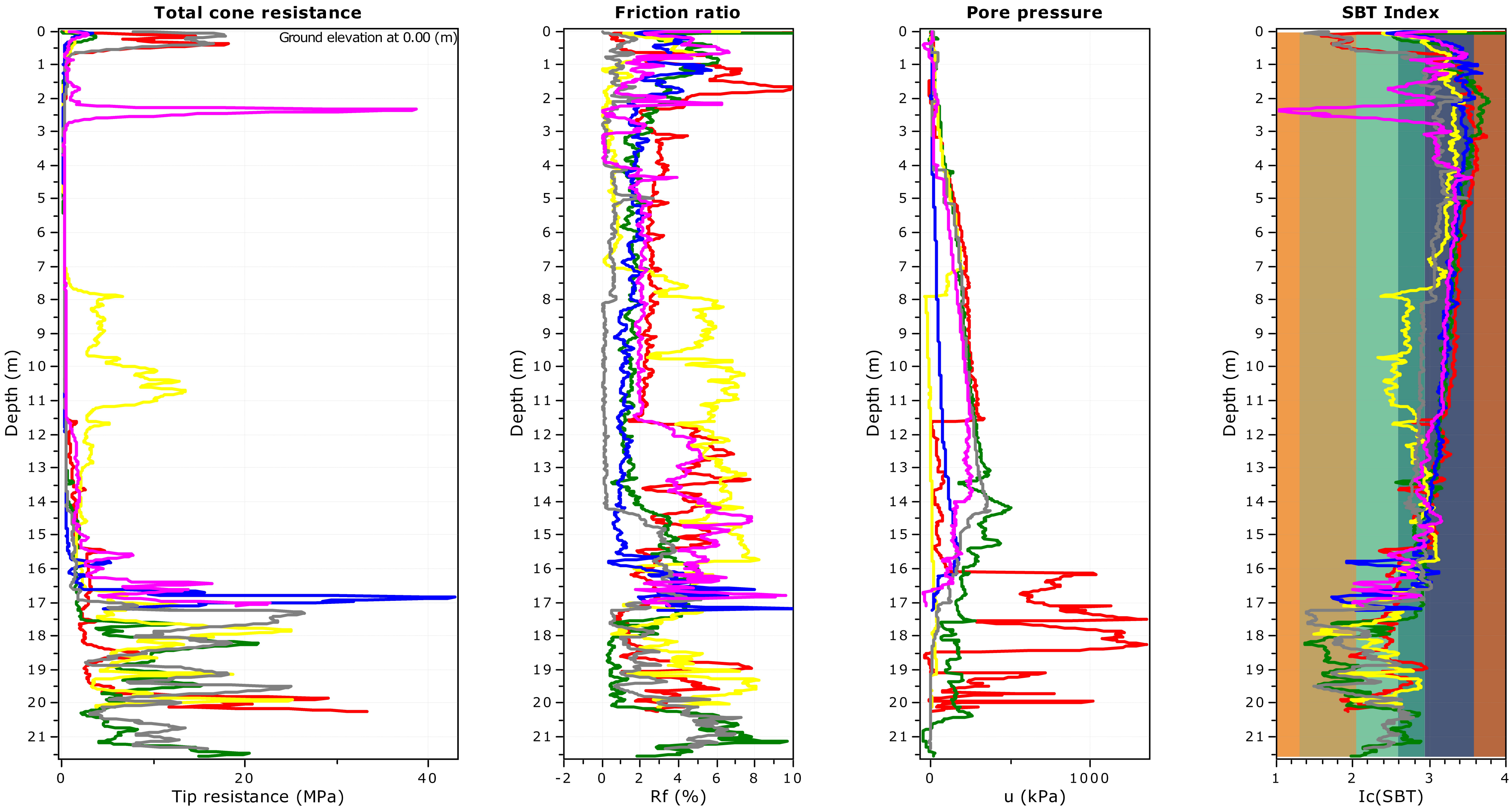
**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**Project:**
**Location:**

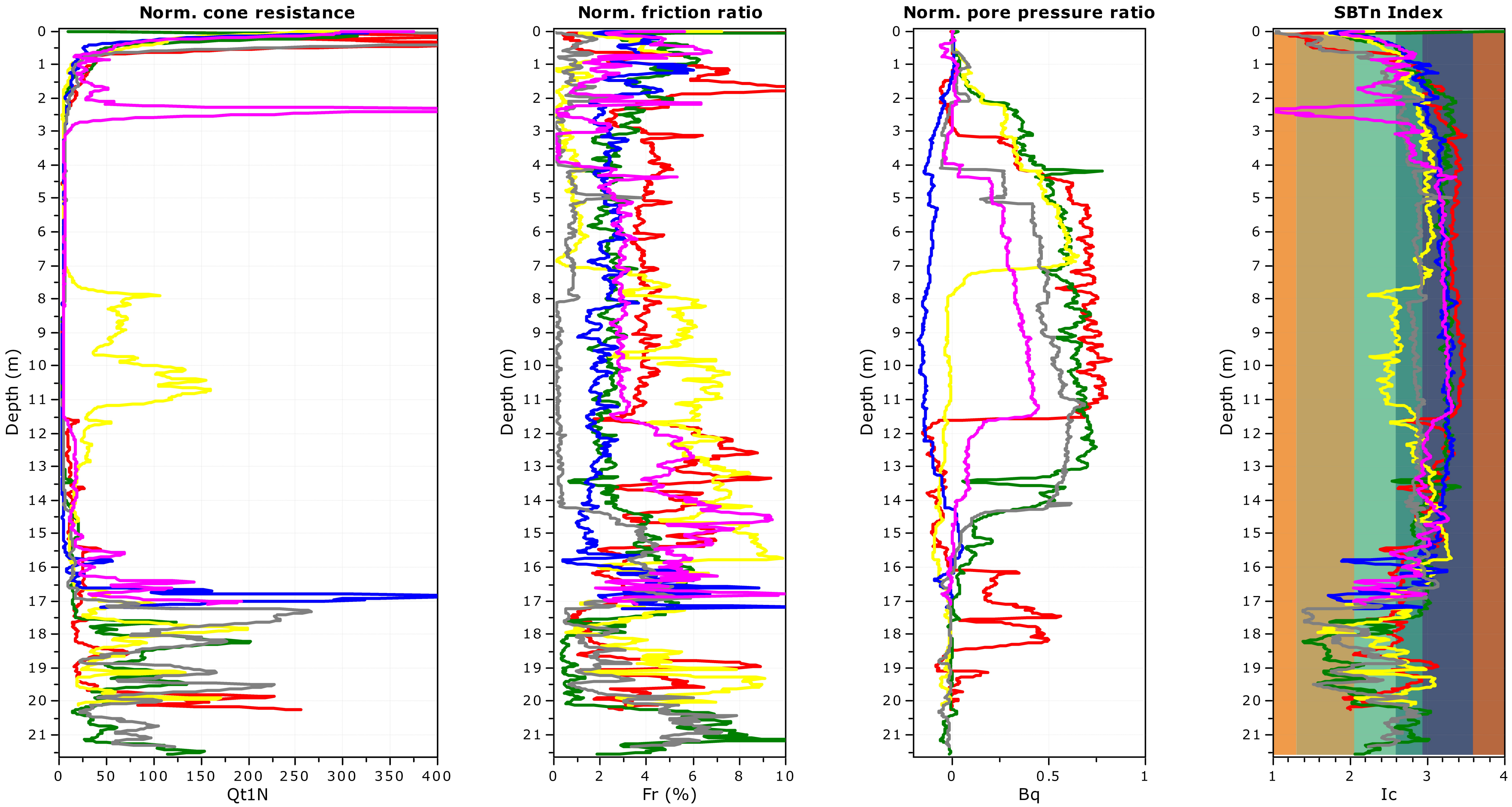
## Overlay basic interpretation plots



**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**Project:**
**Location:**

## Normalized basic plots



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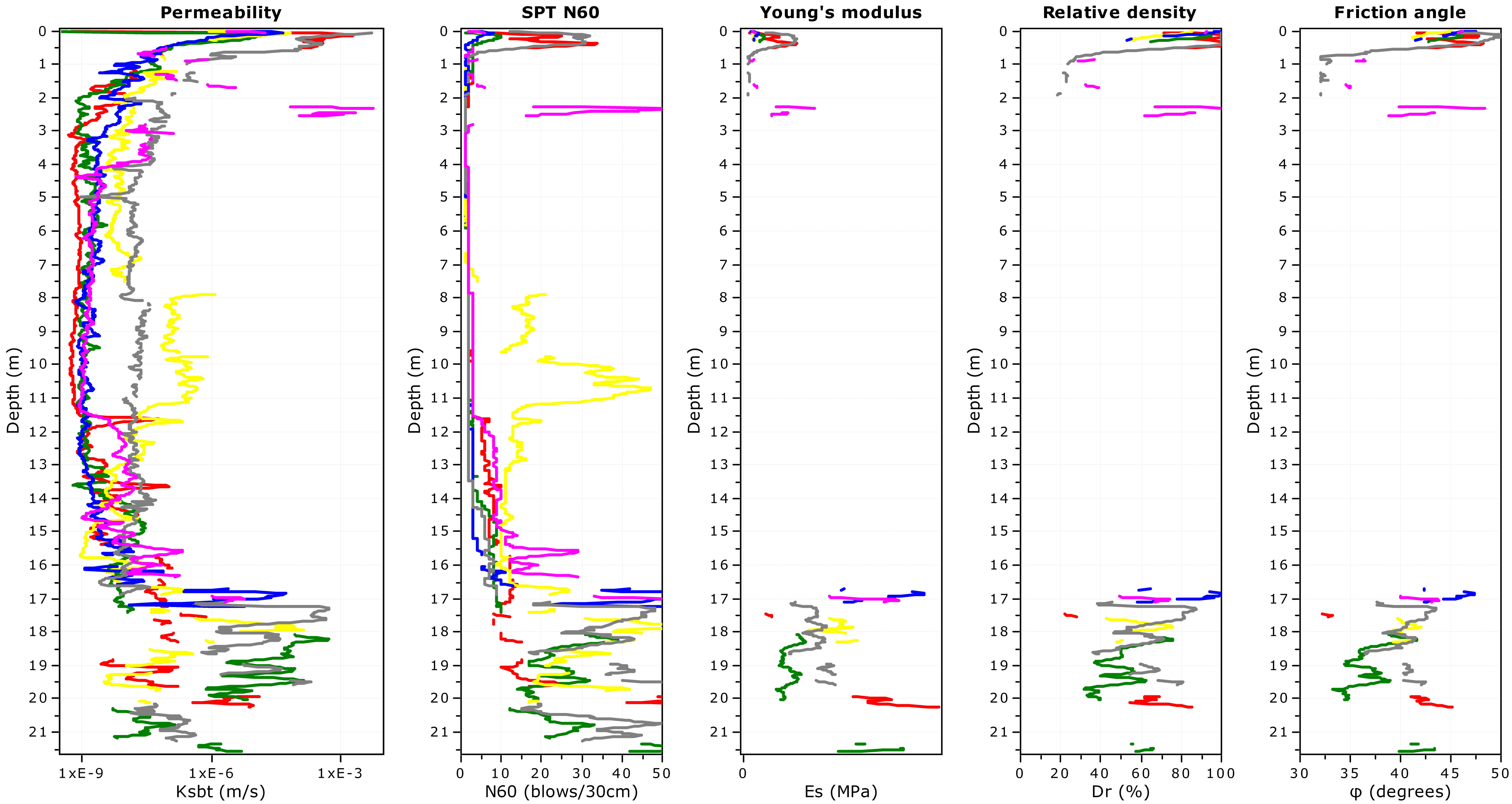
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**Project:**

**Location:**

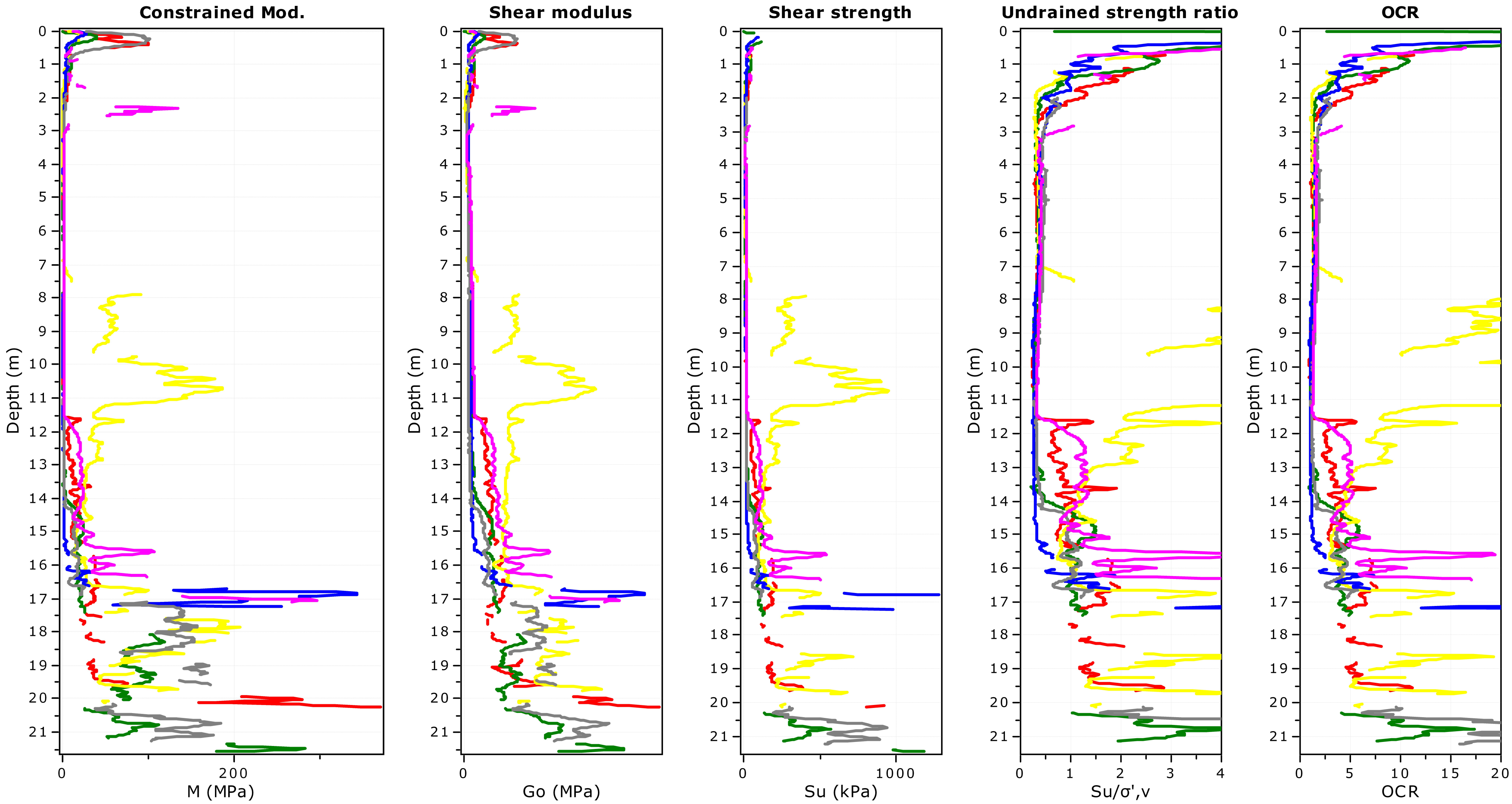
## Overlay estimation plots (1)



**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**Project:**
**Location:**

## Overlay estimation plots (2)



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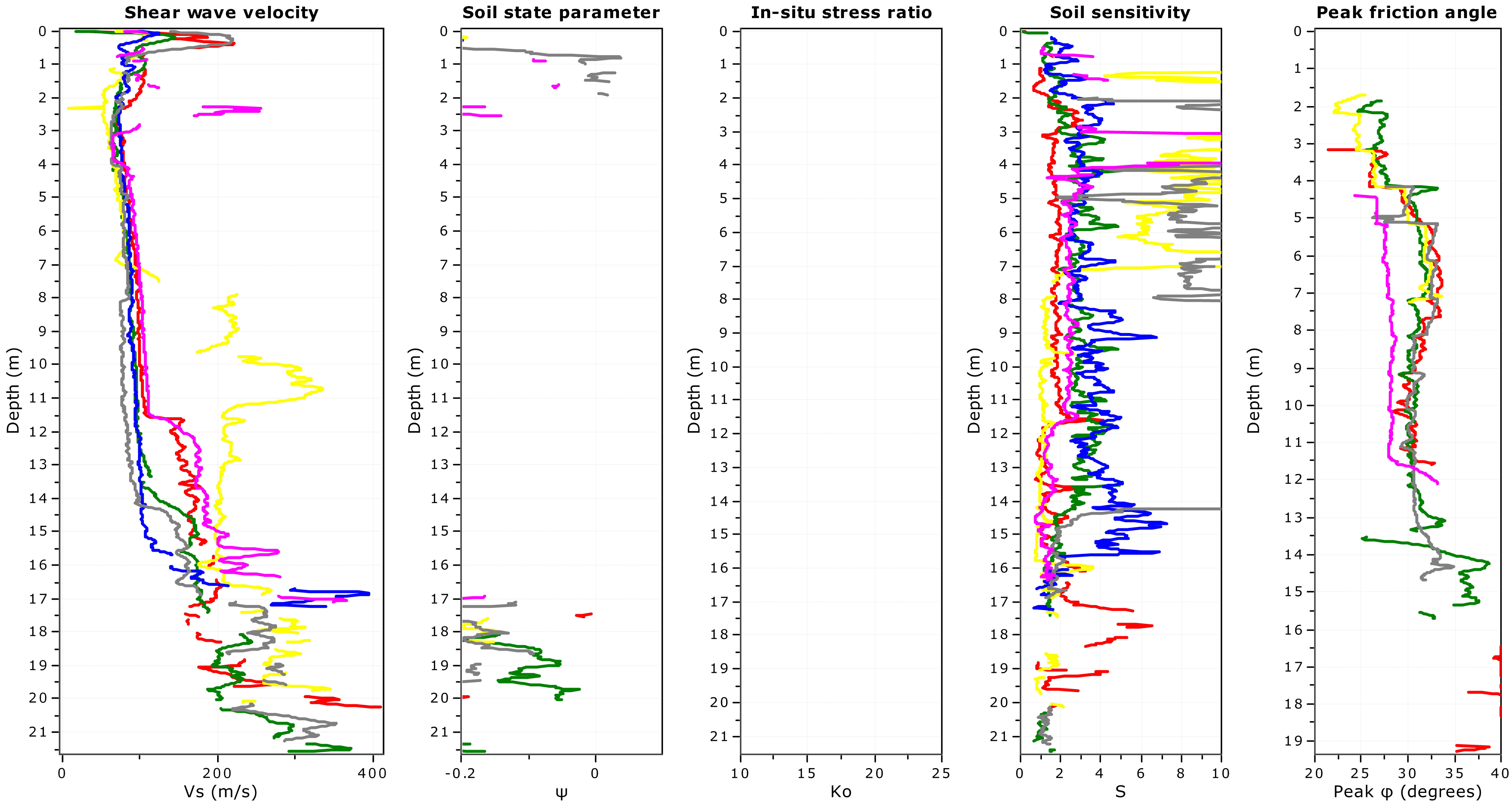
**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**Project:**
**Location:**

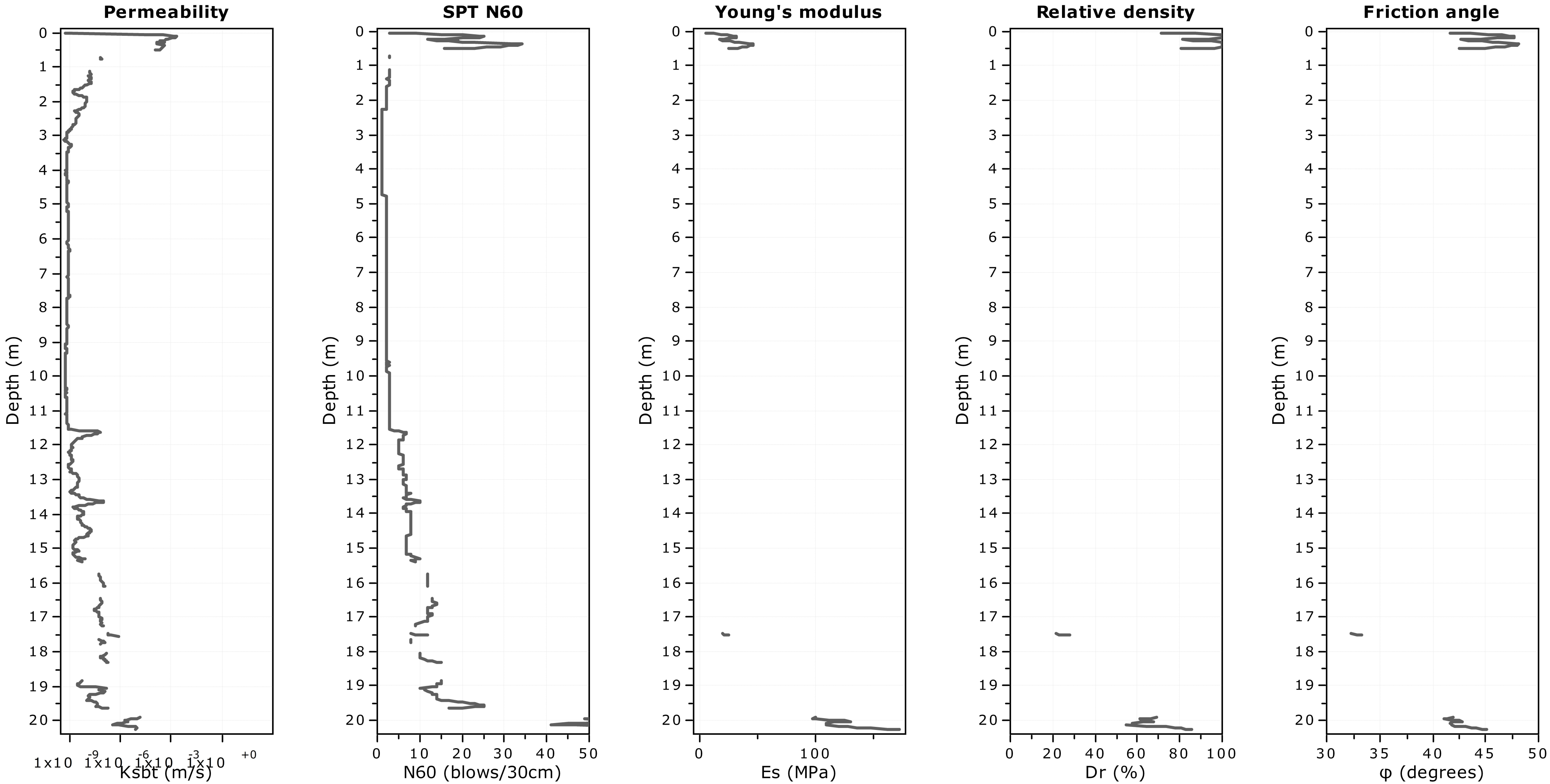
## Overlay estimation plots (3)



**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**CPT: CPT01**
Total depth: 20.26 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**



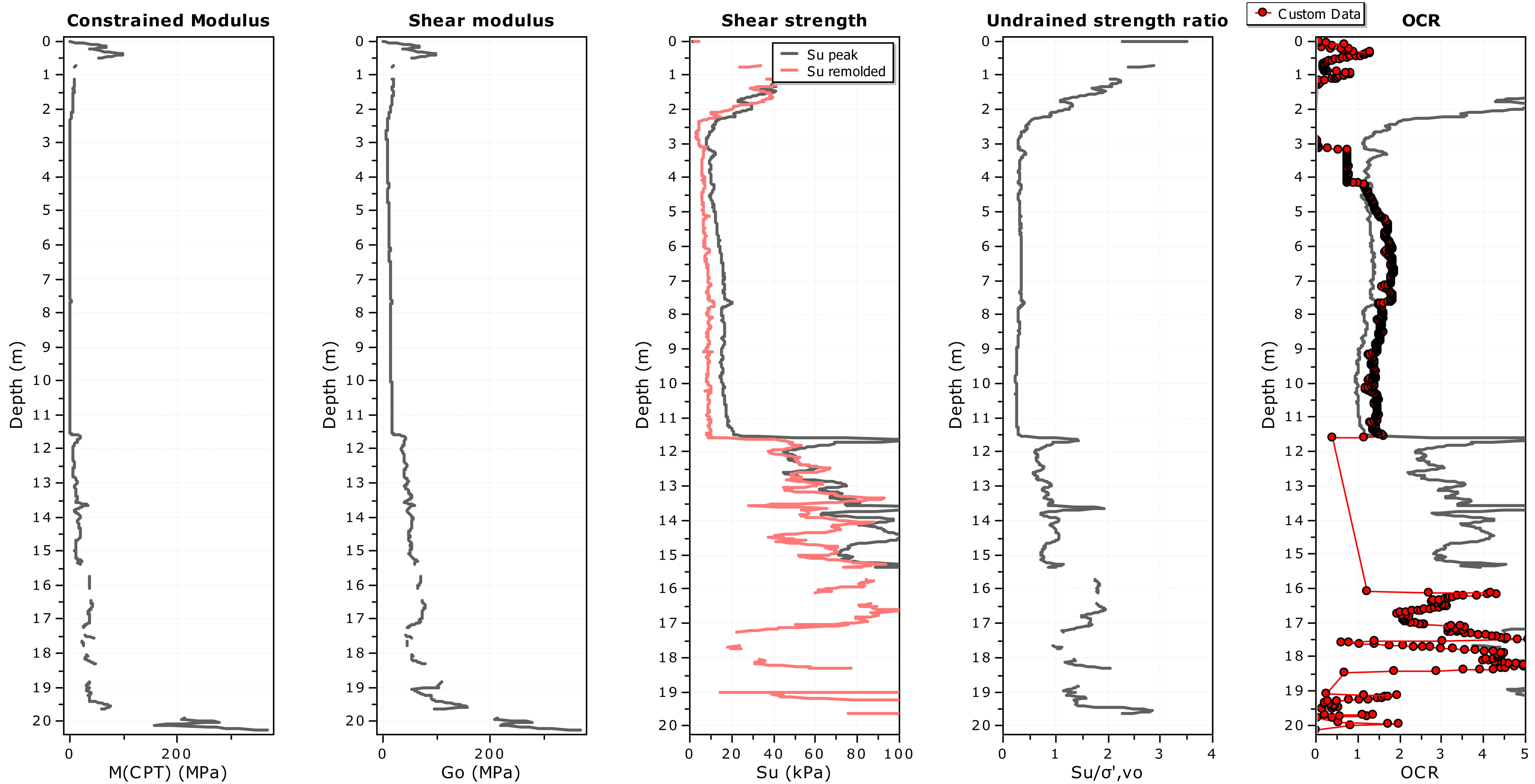

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**CPT: CPT01**
Total depth: 20.26 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**



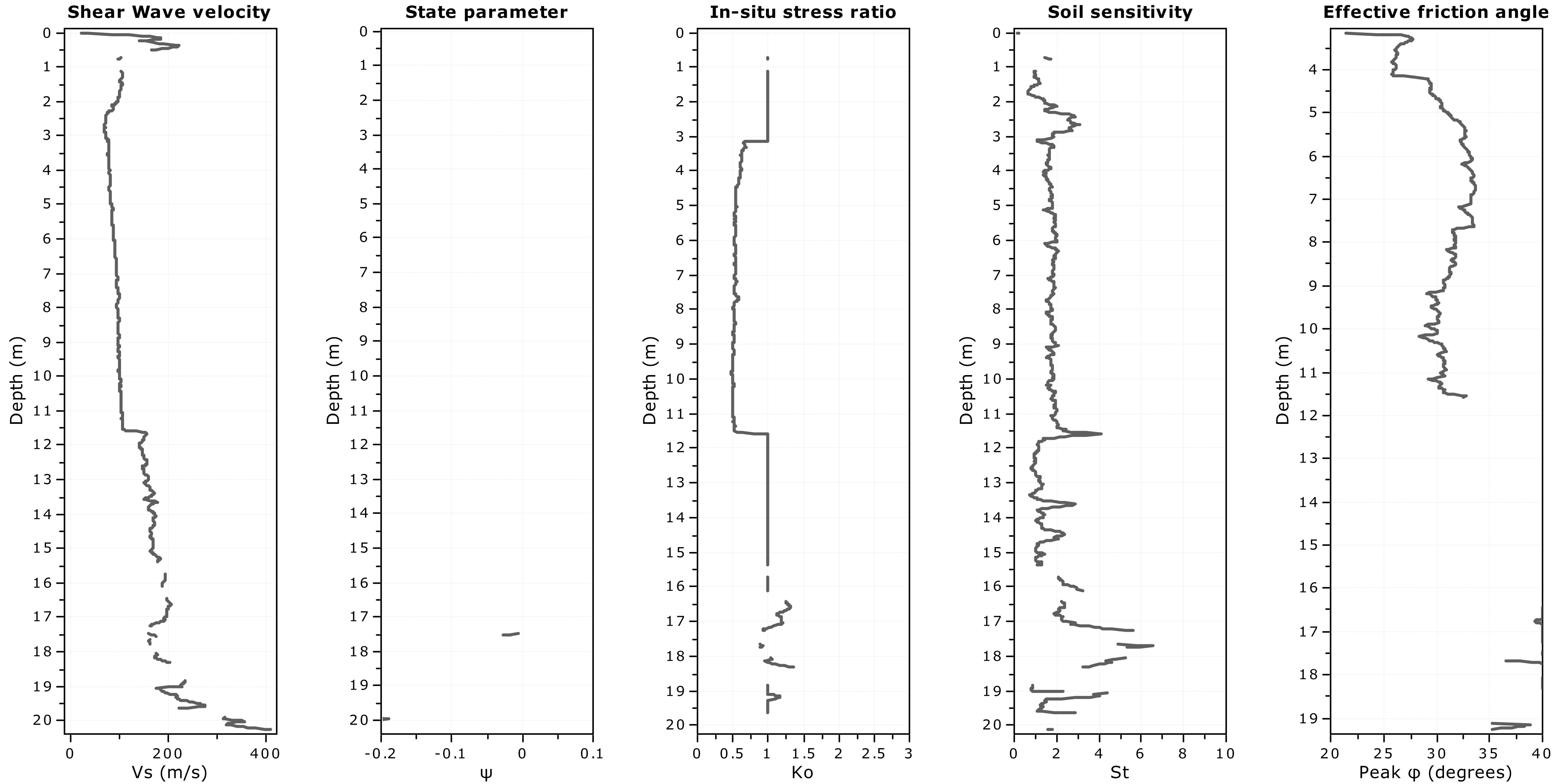

**Calculation parameters**
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14

OCR factor for clays, $N_{kt}$: 0.28
User defined estimation data
Flat Dilatometer Test data

**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

**CPT: CPT01**
Total depth: 20.26 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00
User defined estimation data

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NSW 2450
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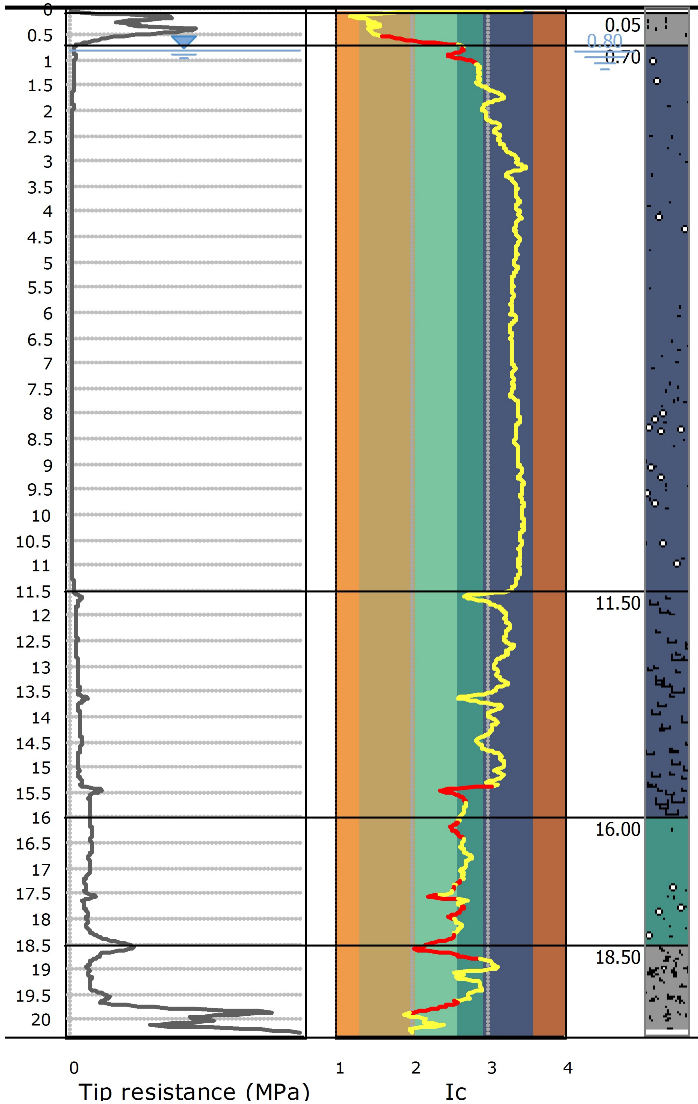
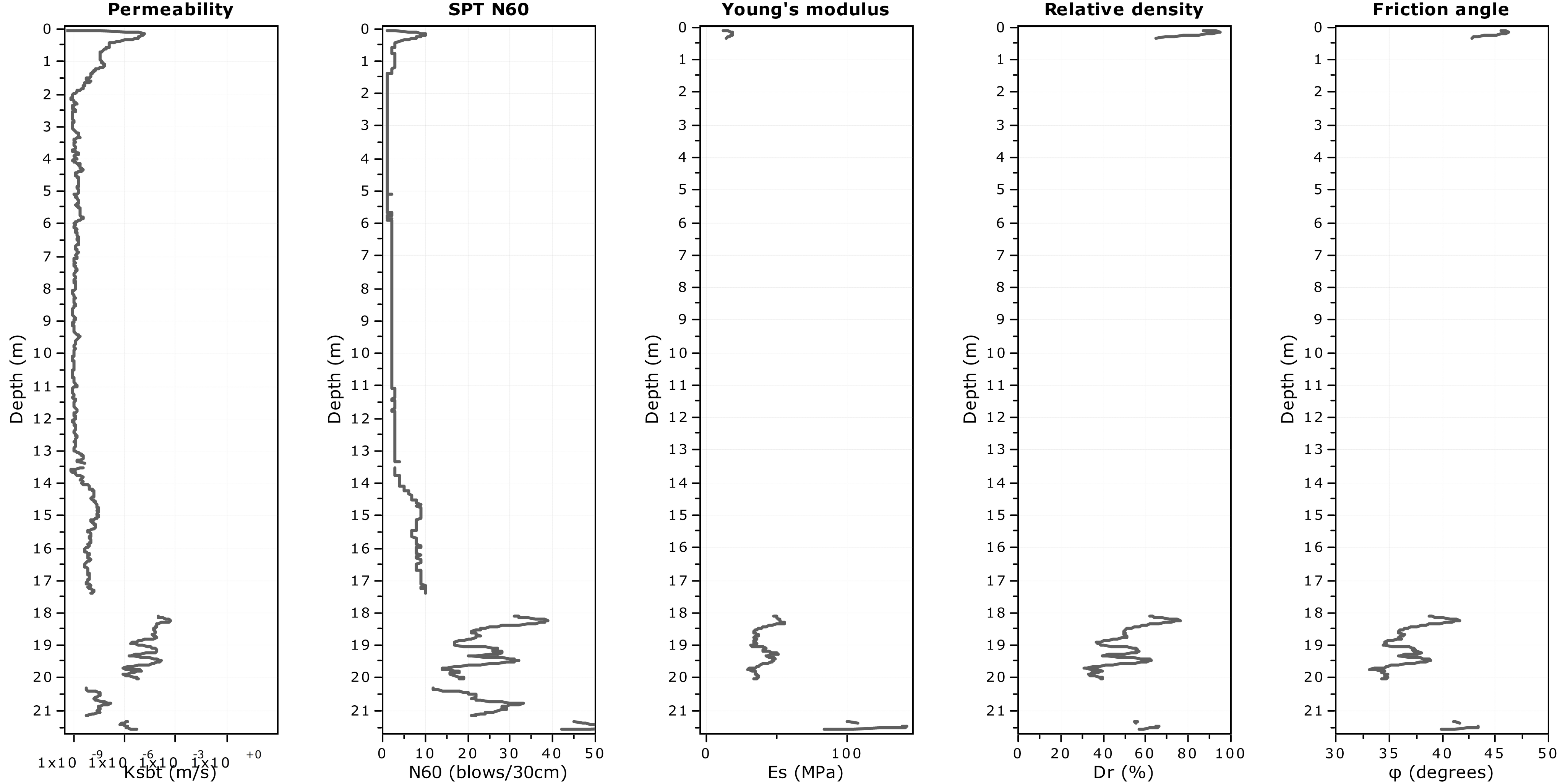
**CPT: CPT01**
Total depth: 20.26 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**



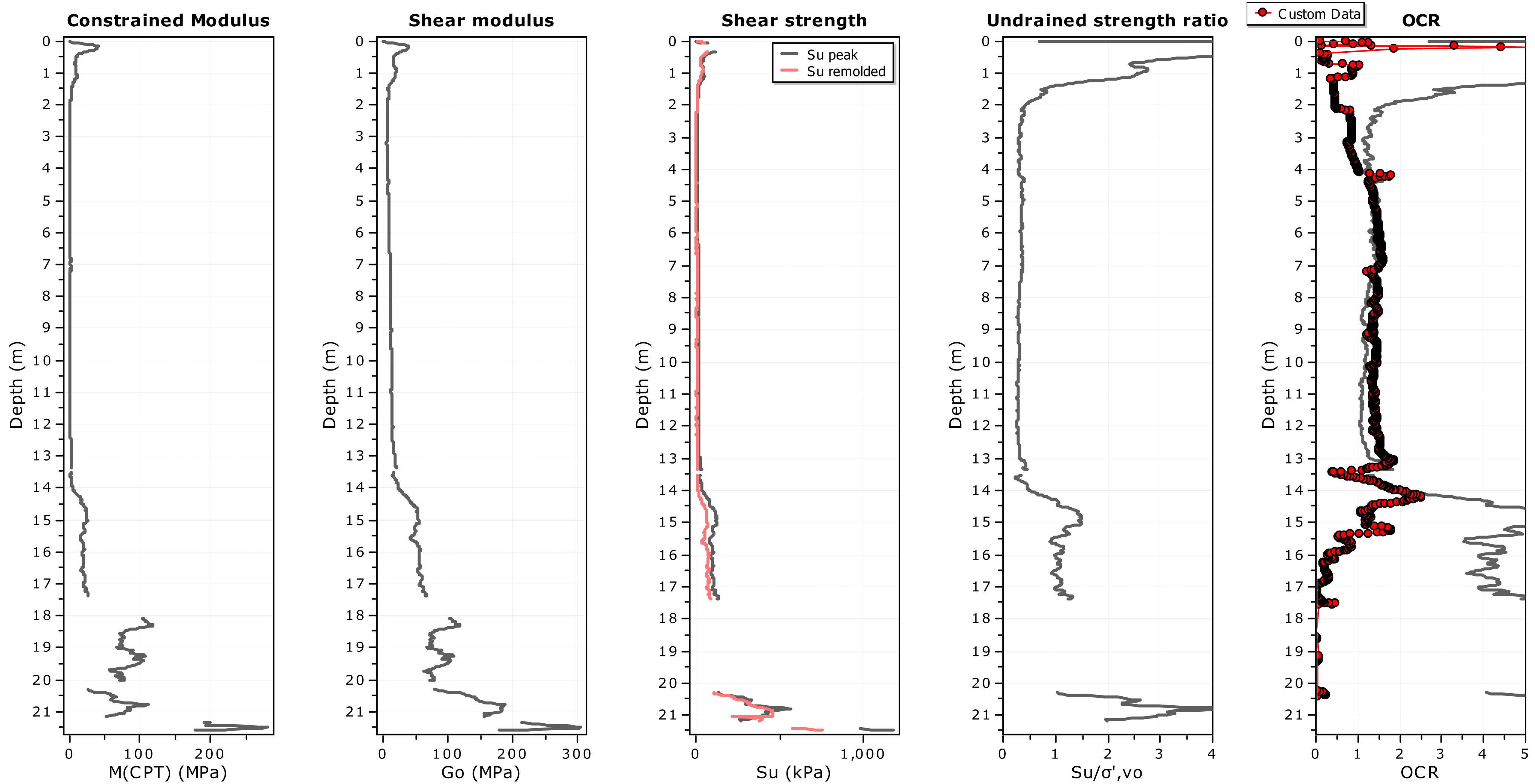

| Depth (m) | Description | qt (MPa) | Ksbt (m/s) | N60 | Es (MPa) | Dr | Phi (°) | M (MPa) | Go (MPa) | Su (kPa) | Su ratio | OCR | Gamma (kN/m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.05 | Very dense/stiff soil | 10.8 | 4.94E-4 | 21.0 | 29.2 | 94.8 | 45.5 | 59.8 | 59.9 | - | - | - | 18.7 |
| 0.70 | Clay | 0.3 | 2.22E-9 | 2.0 | - | - | - | 1.5 | 13.1 | 16.2 | 0.5 | 1.8 | 15.0 |
| 11.50 | Clay | 1.4 | 1.09E-8 | 7.1 | - | - | - | 14.1 | 47.9 | 81.8 | 0.9 | 3.6 | 17.7 |
| 16.00 | Clay & silty clay | 2.8 | 9.52E-8 | 11.4 | - | - | - | 34.8 | 64.2 | 178.2 | 1.6 | 6.1 | 17.9 |
| 18.50 | Very dense/stiff soil | 7.5 | 1.13E-6 | 26.1 | - | - | - | 94.4 | 138.9 | 252.5 | 1.9 | 7.4 | 19.7 |

**Project:**
**Location:**




**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14

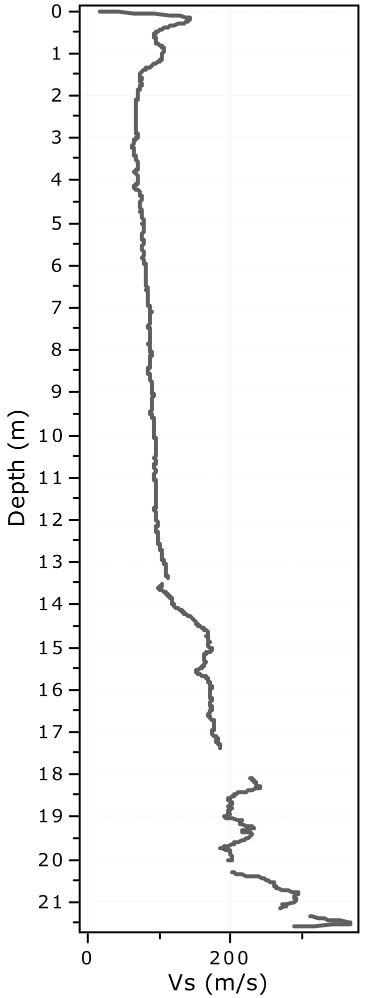
OCR factor for clays, $N_{kt}$: 0.28
User defined estimation data
Flat Dilatometer Test data

**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

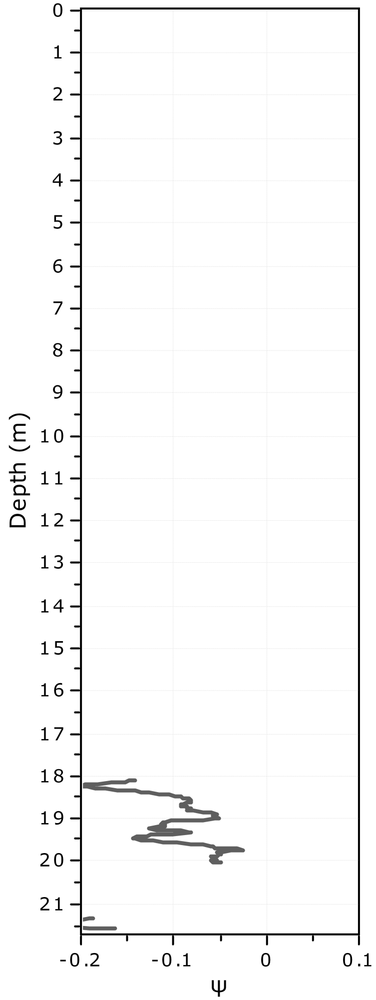
**CPT: CPT02**
Total depth: 21.58 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**

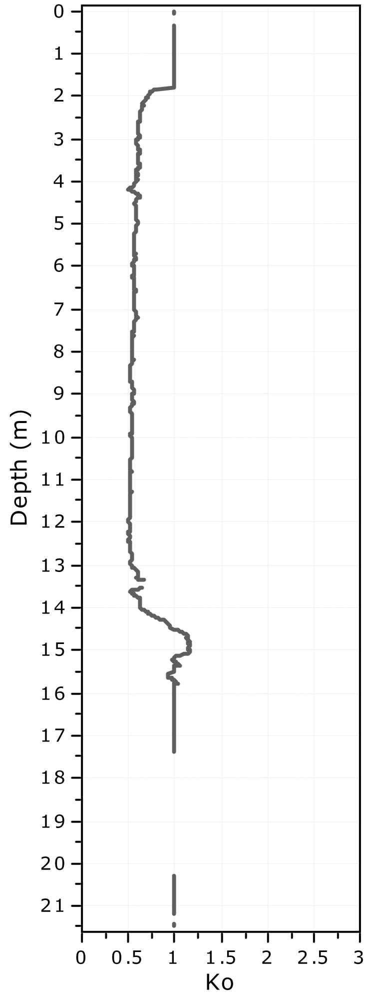
**Shear Wave velocity**



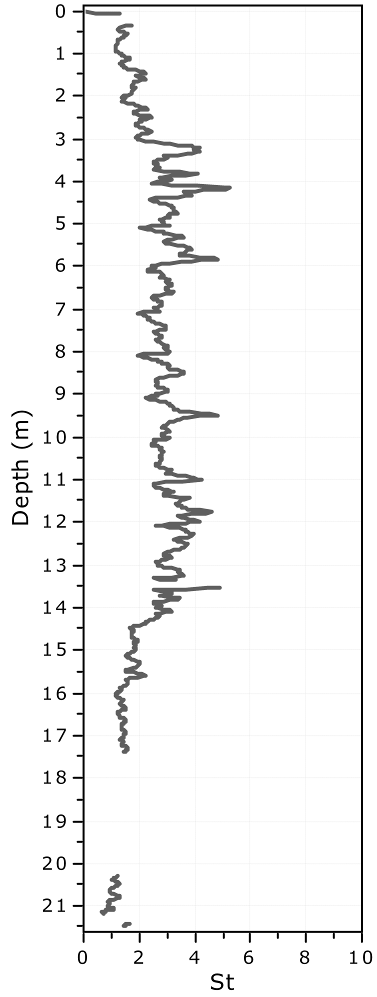

**State parameter**



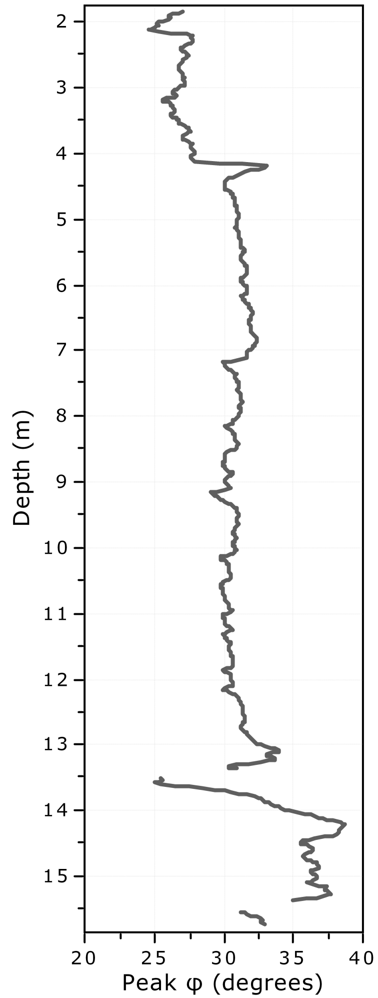

**In-situ stress ratio**




**Soil sensitivity**




**Effective friction angle**




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00
User defined estimation data

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**18 Lawson Cresent**
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NSW 2450
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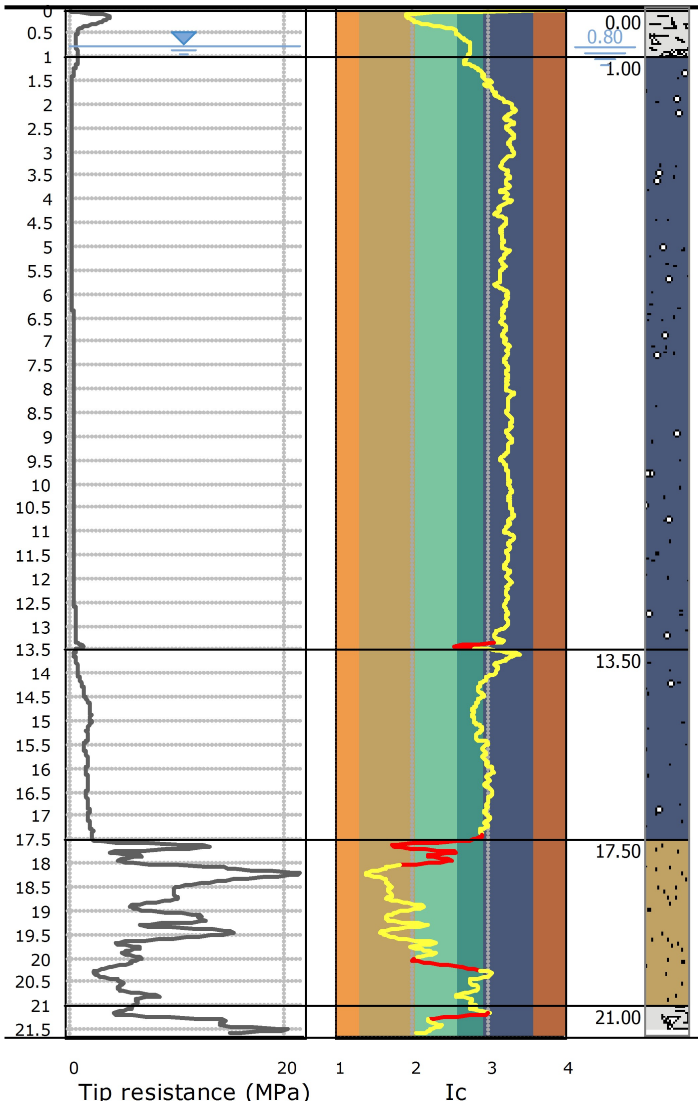
**CPT: CPT02**
Total depth: 21.58 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00

**Project:**
Cone Type:

**Location:**
Cone Operator:




| Description | qt (MPa) | Ksbt (m/s) | N60 | Es (MPa) | Dr | Phi (°) | M (MPa) | Go (MPa) | Su (kPa) | Su ratio | OCR | Gamma (kN/m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Very dense/stiff soil | 1.3 | 2.02E-6 | 4.2 | - | - | - | 15.6 | 21.4 | 48.2 | 4.0 | 15.7 | 17.3 |
| Clay | 0.3 | 2.65E-9 | 1.8 | - | - | - | 1.2 | 11.0 | 15.1 | 0.4 | 1.5 | 14.4 |
| Clay | 1.5 | 1.06E-8 | 7.5 | - | - | - | 17.0 | 47.5 | 90.1 | 1.0 | 4.0 | 17.5 |
| Sand & silty sand | 9.0 | 4.69E-5 | 23.7 | 40.4 | 49.9 | 36.7 | 80.9 | 102.7 | - | - | - | 18.9 |
| Very dense/stiff soil | 10.6 | 5.17E-7 | 38.2 | - | - | - | 143.1 | 210.4 | 564.8 | 4.2 | 16.6 | 20.9 |

**18 Lawson Cresent**
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NSW 2450
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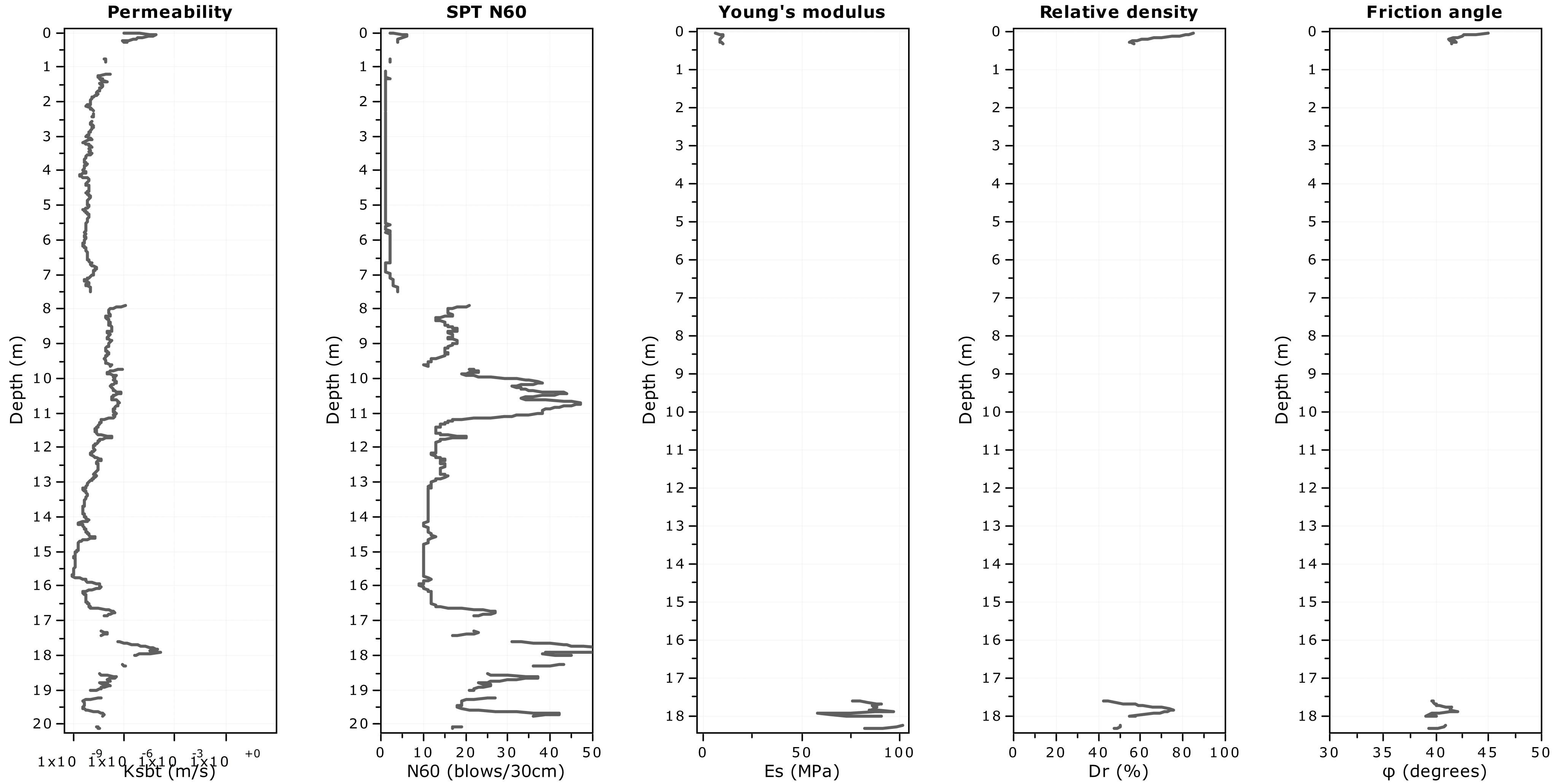
**CPT: CPT03**
Total depth: 20.12 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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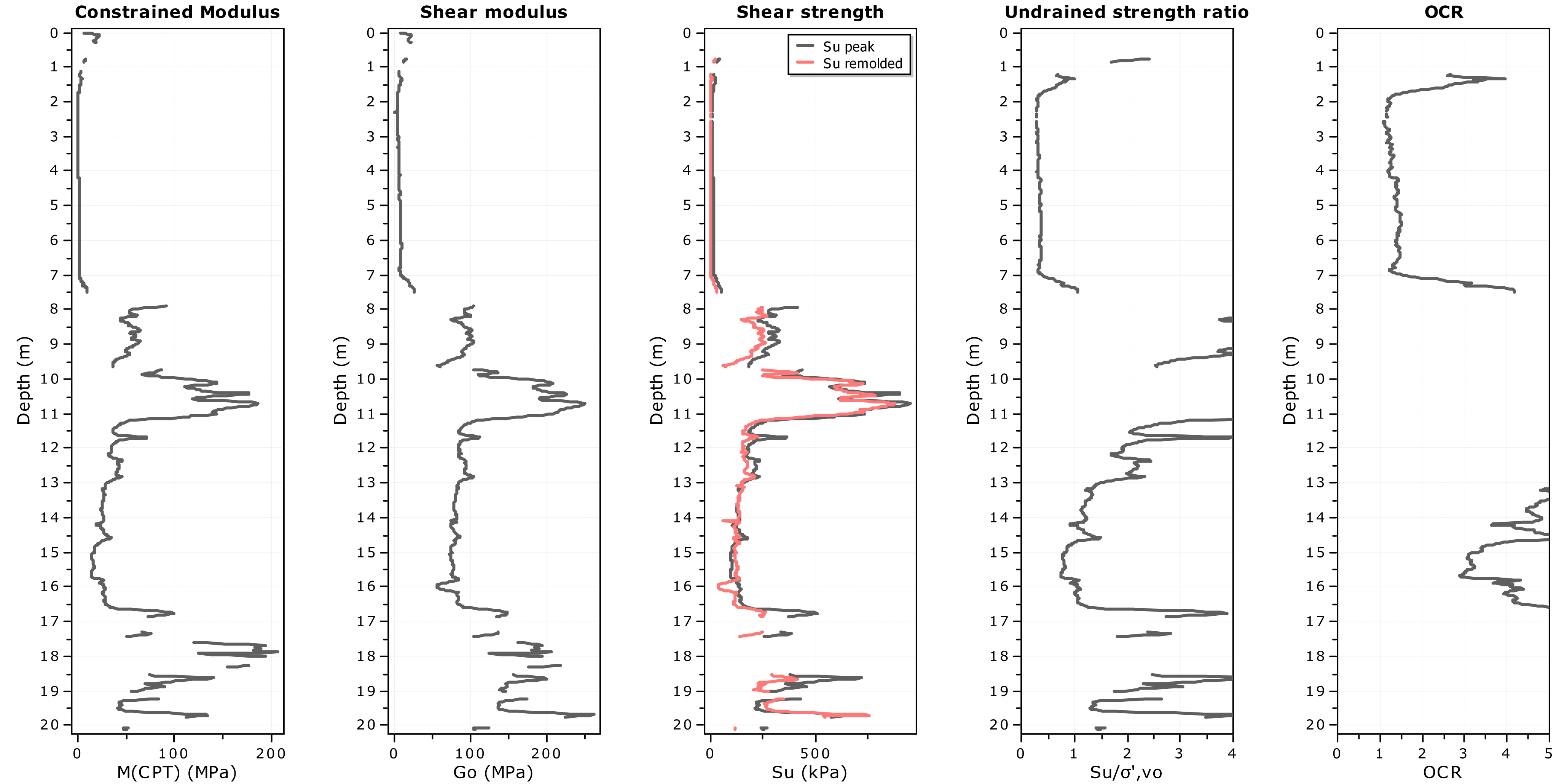
**CPT: CPT03**
Total depth: 20.12 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14

OCR factor for clays, $N_{kt}$: 0.28
User defined estimation data
Flat Dilatometer Test data

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**18 Lawson Cresent**
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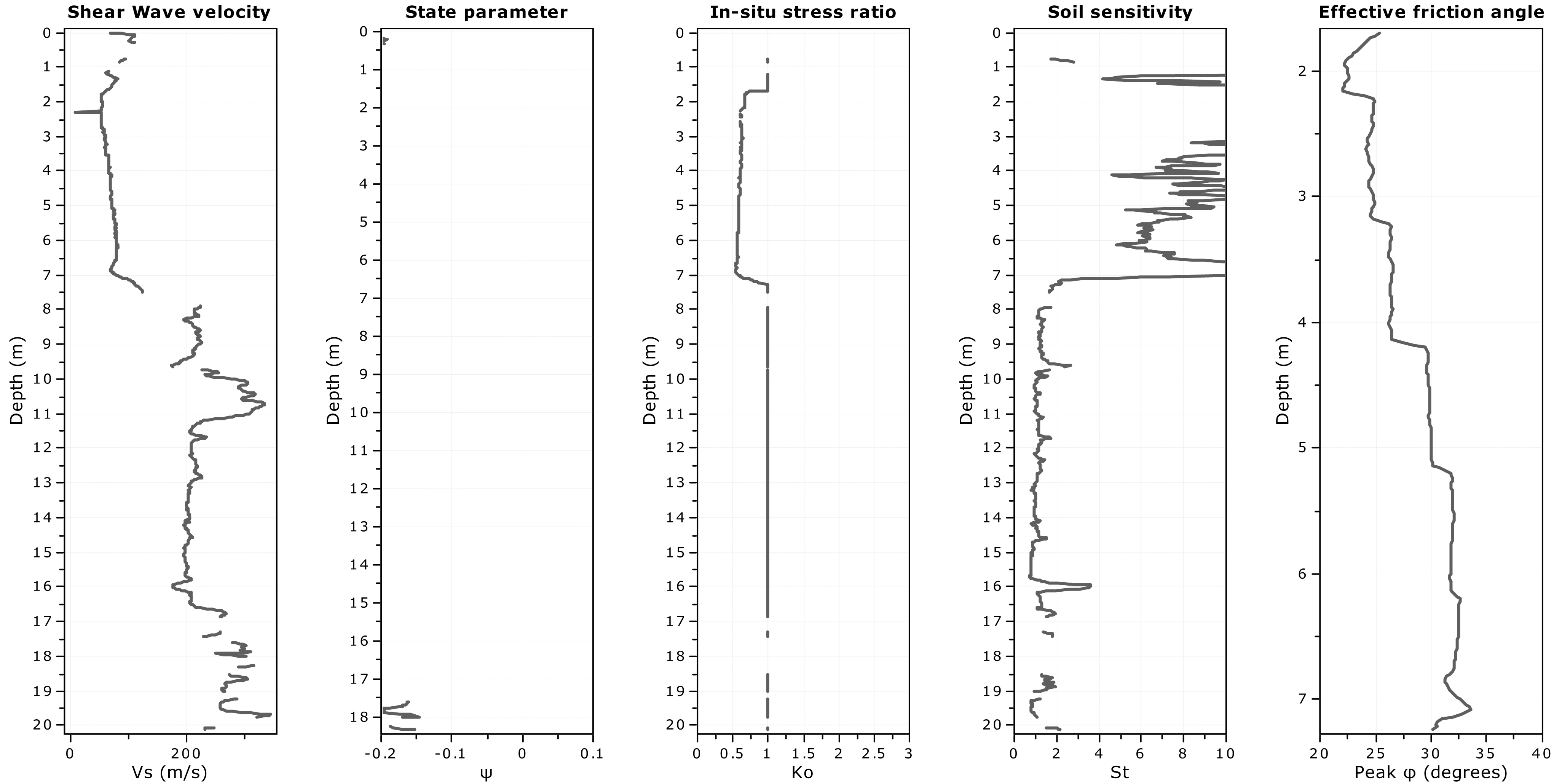
**CPT: CPT03**
Total depth: 20.12 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

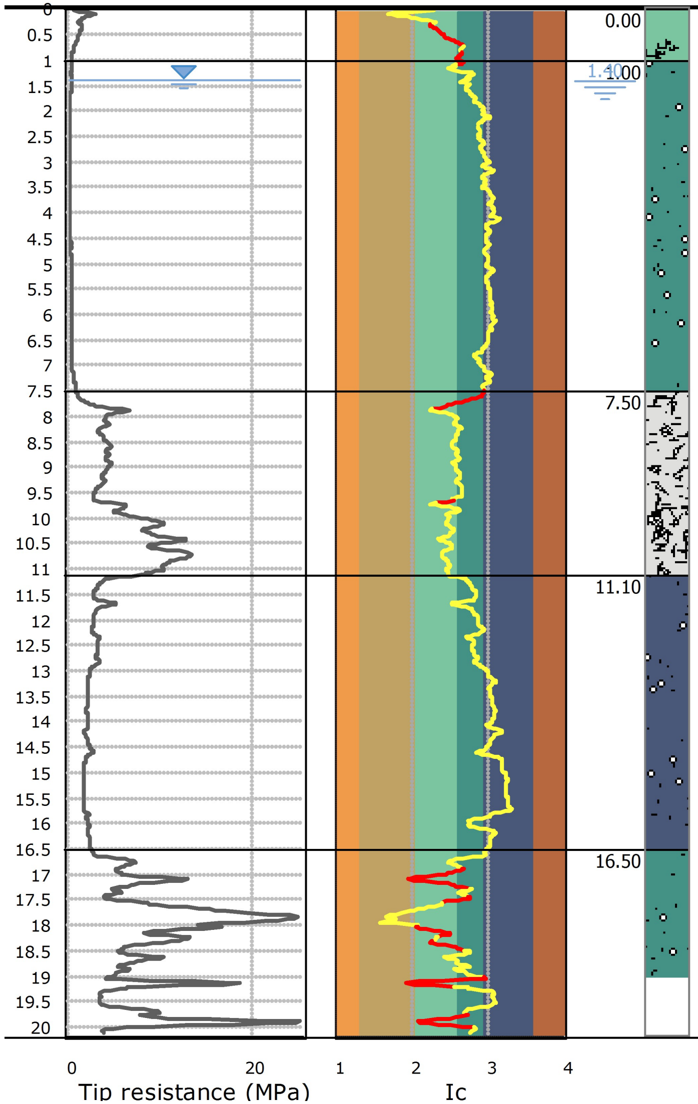
User defined estimation data

**18 Lawson Cresent**
Coffs Harbour
NSW 2450
http://www.douglaspartners.com.au

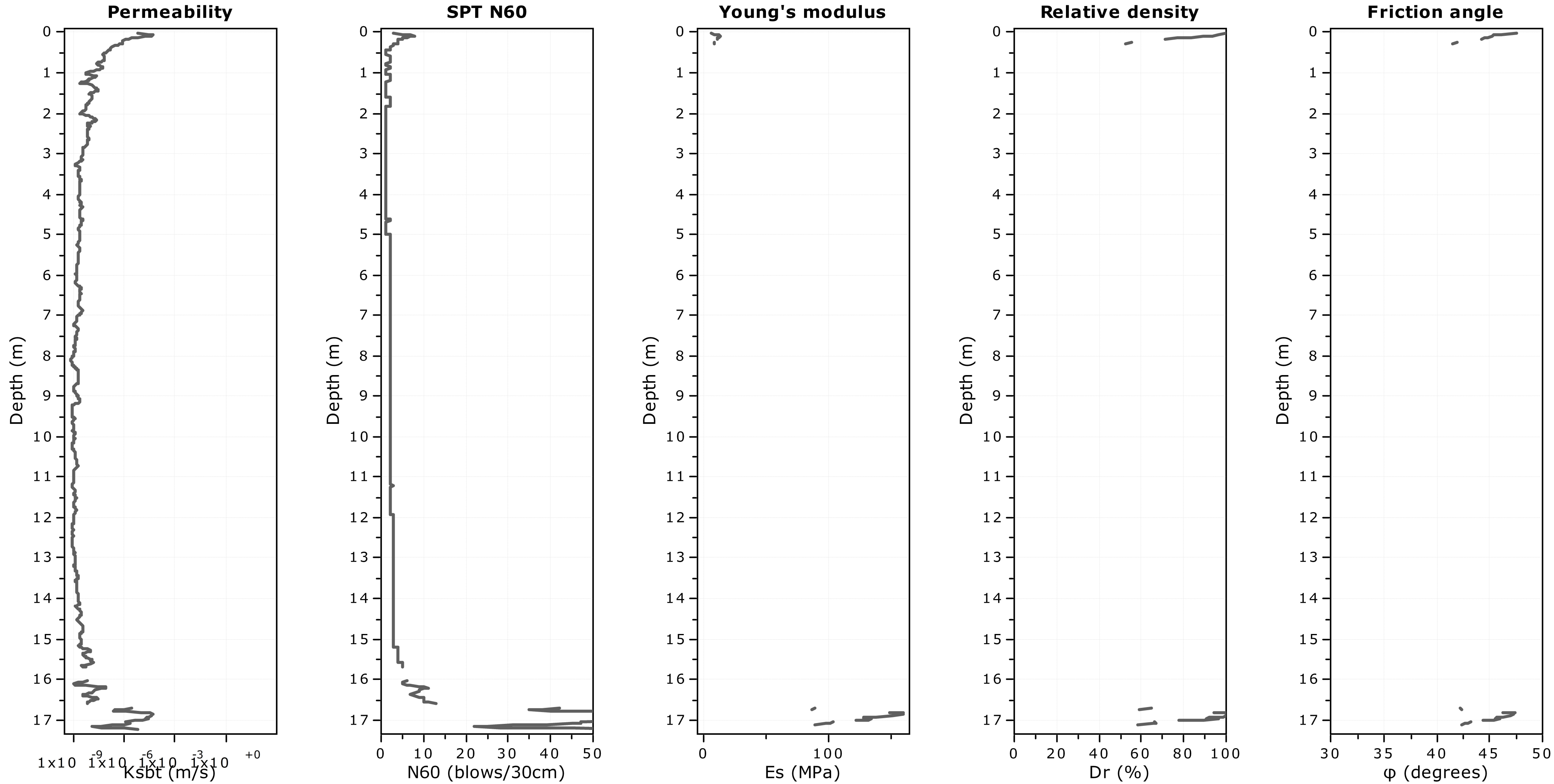
**CPT: CPT03**
Total depth: 20.12 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00

**Project:** Cone Type:
**Location:** Cone Operator:

Depth (m) Elevation: 0.00 (m)

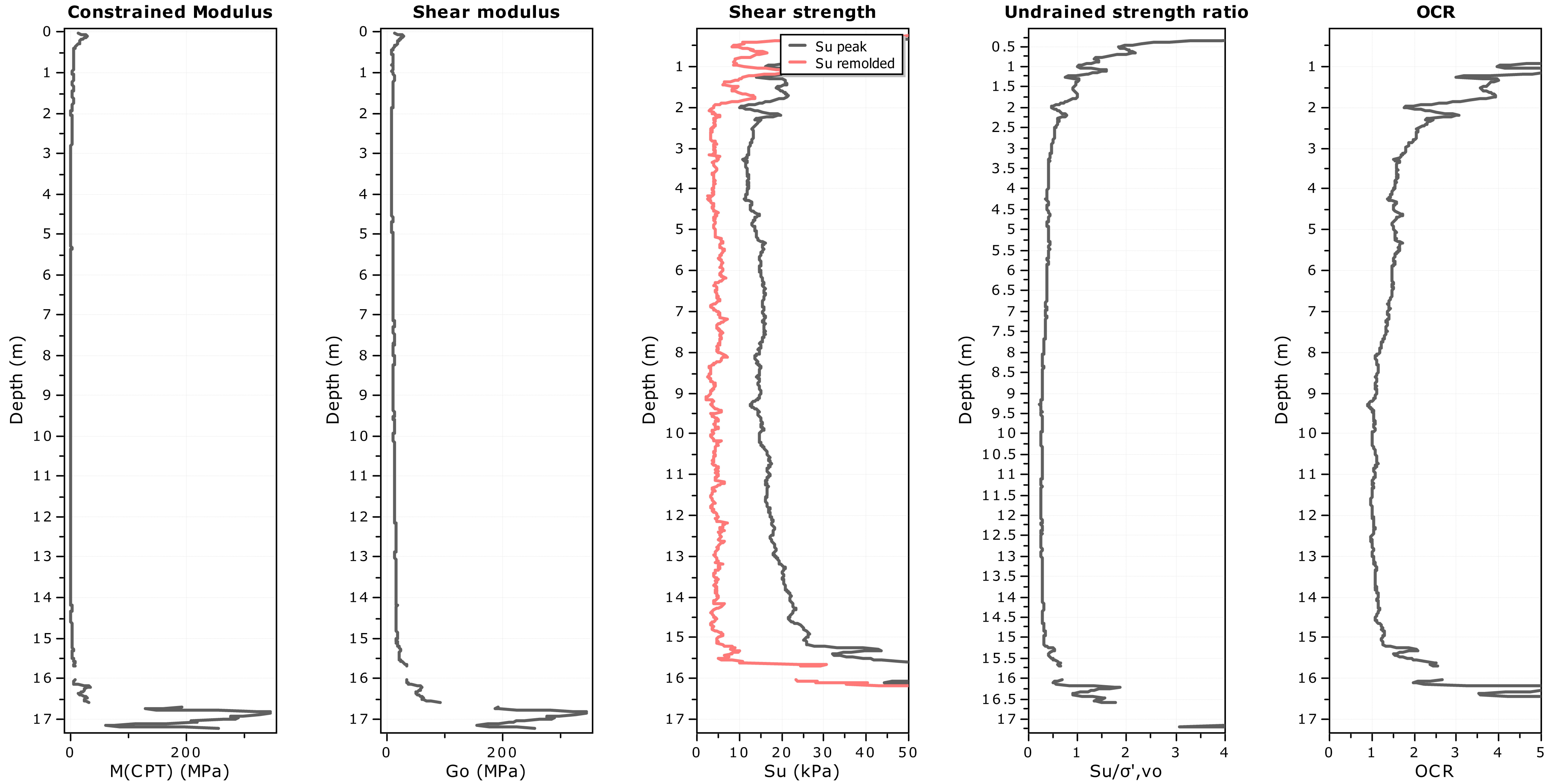



| Depth | Description | qt (MPa) | Ksbt (m/s) | N60 | Es (MPa) | Dr | Phi (°) | M (MPa) | Go (MPa) | Su (kPa) | Su ratio | OCR | Gamma (kN/m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | Silty sand & sandy silt | 1.3 | 1.09E-5 | 3.8 | 9.0 | 67.3 | 42.2 | 15.0 | 17.2 | - | - | - | 17.0 |
| 1.00 | Clay & silty clay | 0.3 | 1.19E-8 | 1.3 | - | - | - | 1.3 | 7.5 | 14.1 | 0.4 | 1.6 | 13.9 |
| 7.50 | Very dense/stiff soil | 6.4 | 2.07E-7 | 23.9 | - | - | - | 87.2 | 134.4 | 444.9 | 6.0 | 23.7 | 20.3 |
| 11.10 | Clay | 2.5 | 1.78E-8 | 12.2 | - | - | - | 30.4 | 83.3 | 158.8 | 1.5 | 6.0 | 19.0 |
| 16.50 | Clay & silty clay | 9.5 | 9.09E-6 | 30.5 | - | - | - | 108.1 | 153.5 | 386.8 | 2.7 | 10.6 | 20.1 |




**Calculation parameters**

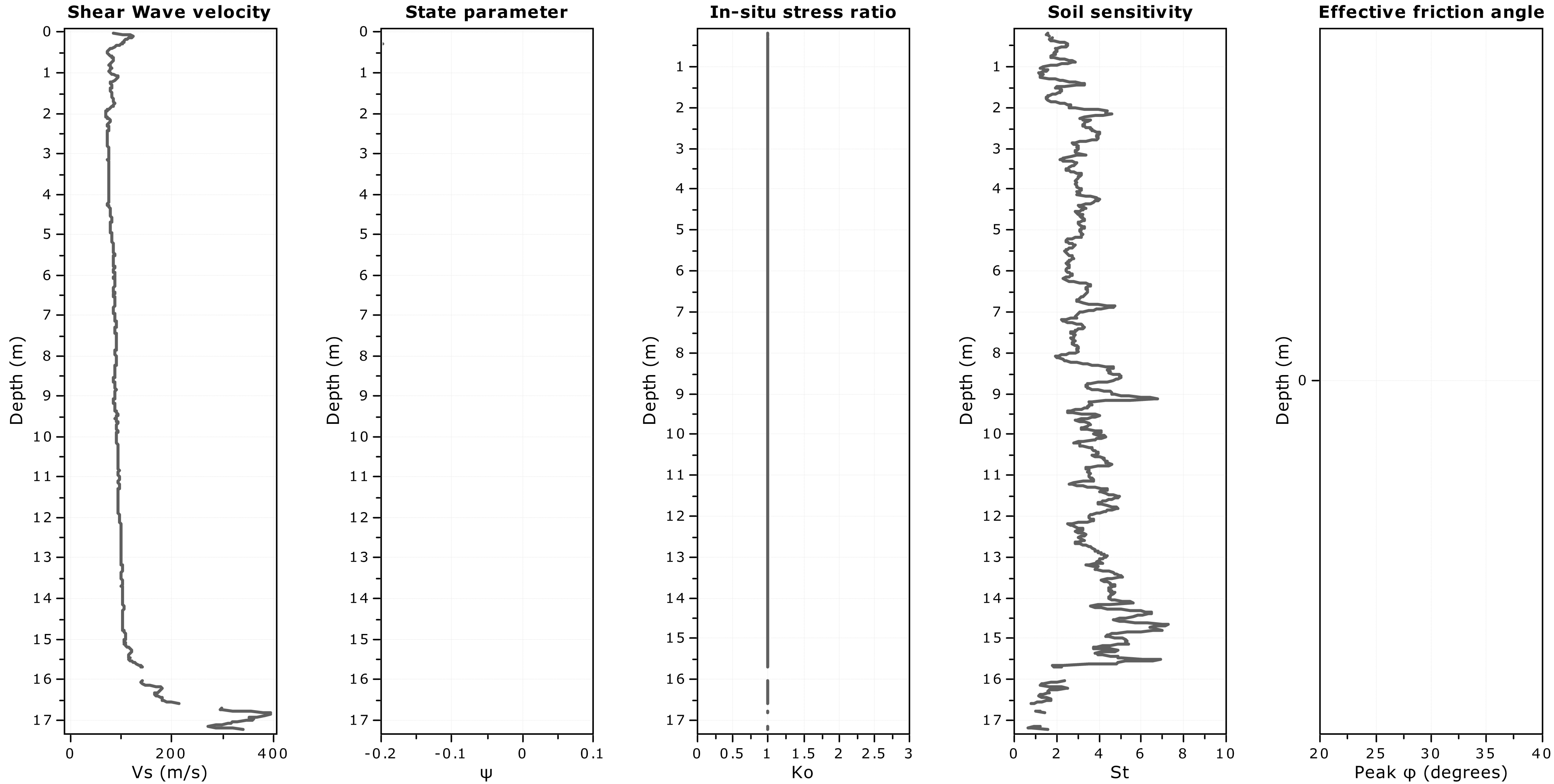
Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14

OCR factor for clays, $N_{kt}$: 0.28
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

User defined estimation data

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NSW 2450
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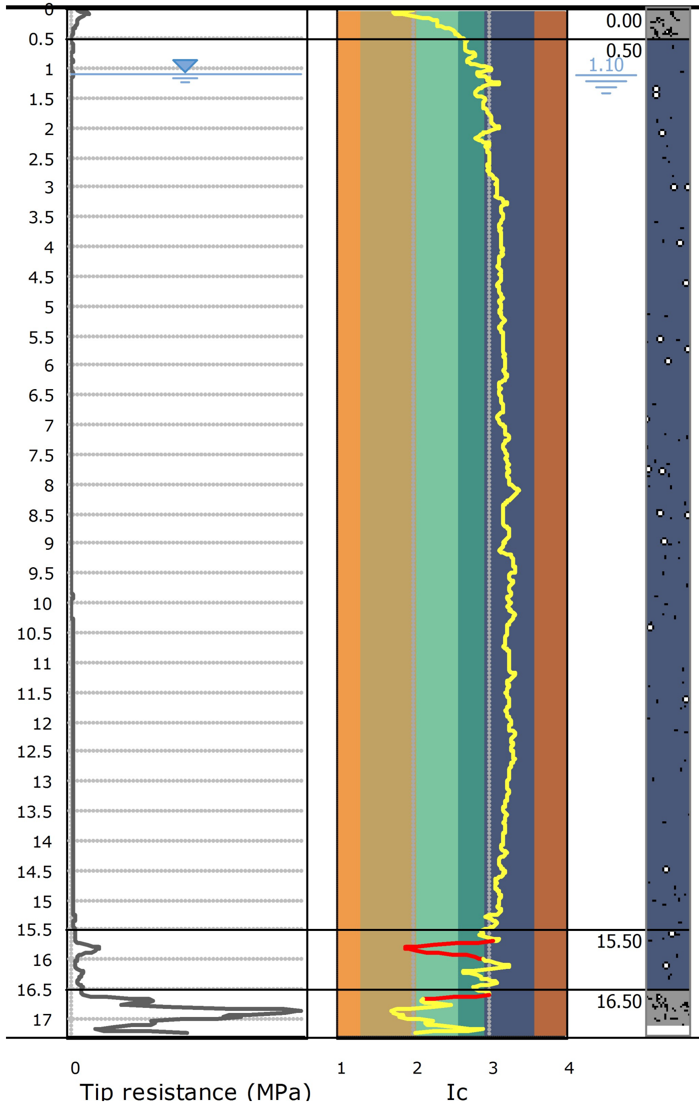
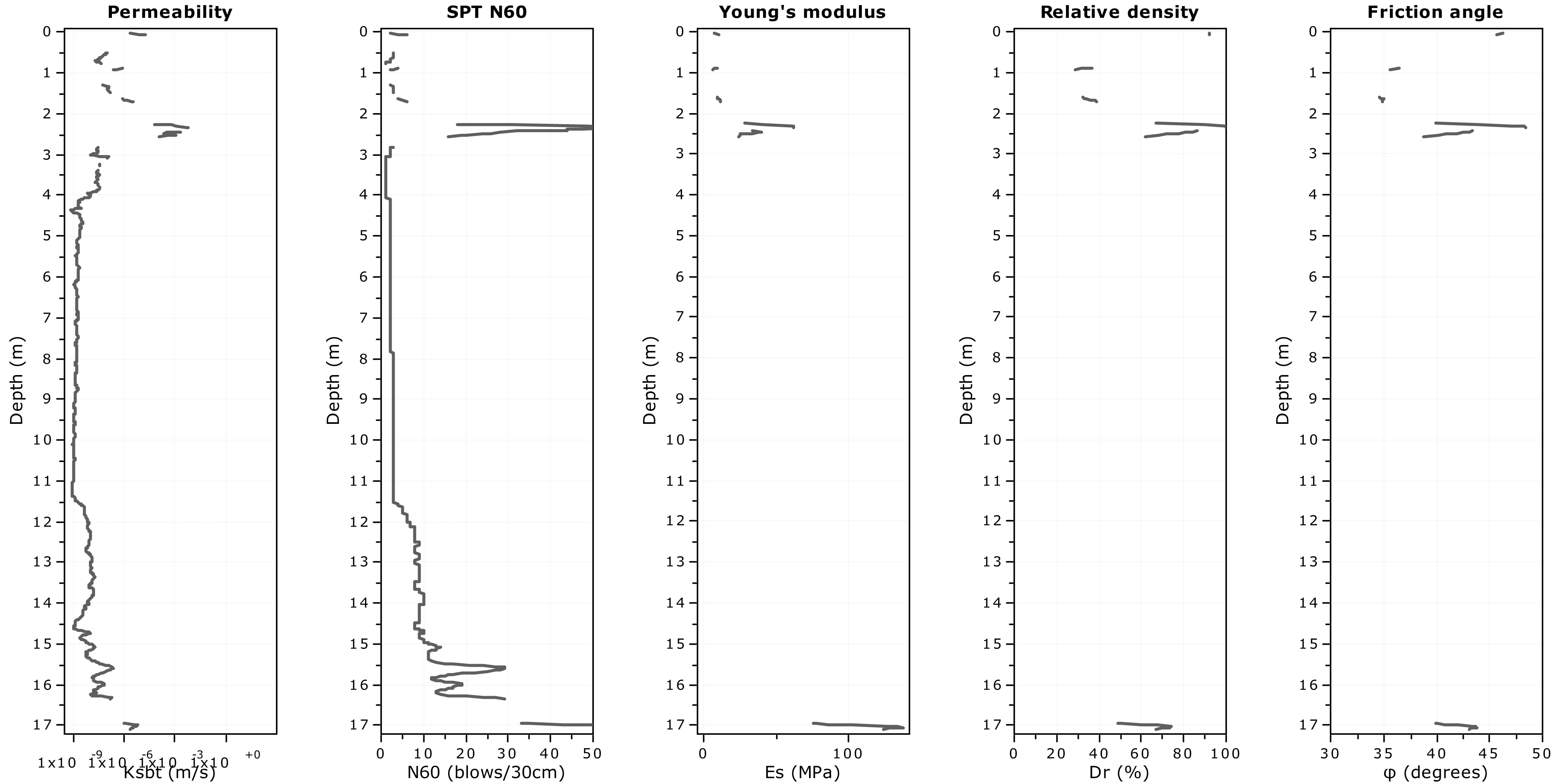
**CPT: CPT04**
Total depth: 17.24 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




| Depth (m) | Description | qt (MPa) | Ksbt (m/s) | N60 | Es (MPa) | Dr | Phi (°) | M (MPa) | Go (MPa) | Su (kPa) | Su ratio | OCR | Gamma (kN/m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | Very dense/stiff soil | 1.2 | 6.13E-6 | 3.6 | 10.6 | 81.6 | 44.7 | 14.6 | 17.2 | - | - | - | 17.0 |
| 0.50 | Clay | 0.4 | 4.31E-9 | 2.0 | - | - | - | 1.4 | 11.8 | 17.1 | 0.4 | 1.7 | 14.4 |
| 15.50 | Clay | 1.4 | 1.49E-8 | 6.9 | - | - | - | 14.2 | 42.8 | 83.6 | 0.9 | 3.7 | 17.2 |
| 16.50 | Very dense/stiff soil | 19.4 | 1.17E-5 | 51.9 | 127.9 | 85.1 | 45.1 | 200.9 | 220.1 | - | - | - | 20.8 |




**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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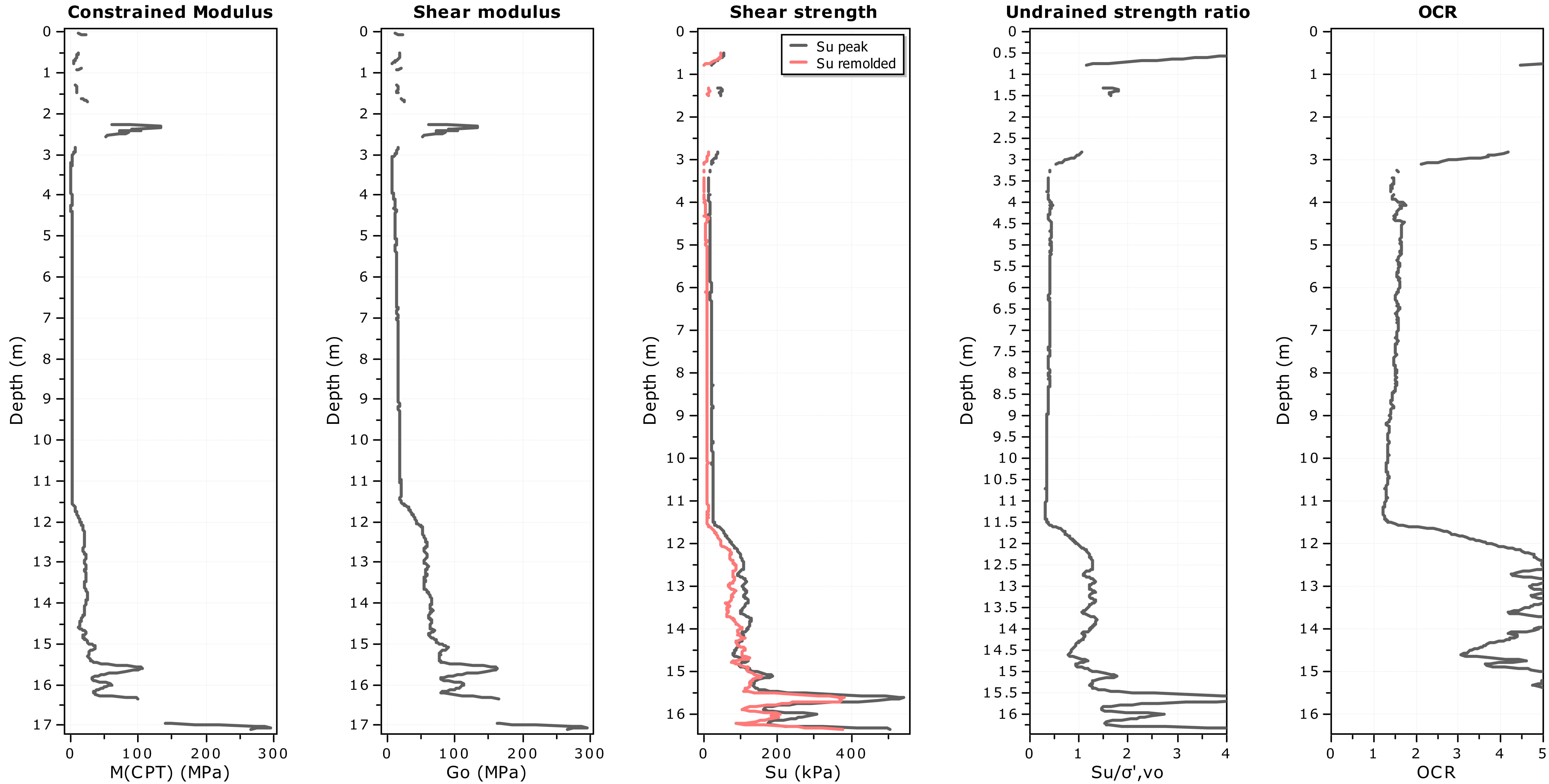
**CPT: CPT05 Corr**
Total depth: 17.10 m, Date: 9/12/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14

OCR factor for clays, $N_{kt}$: 0.28
User defined estimation data
Flat Dilatometer Test data

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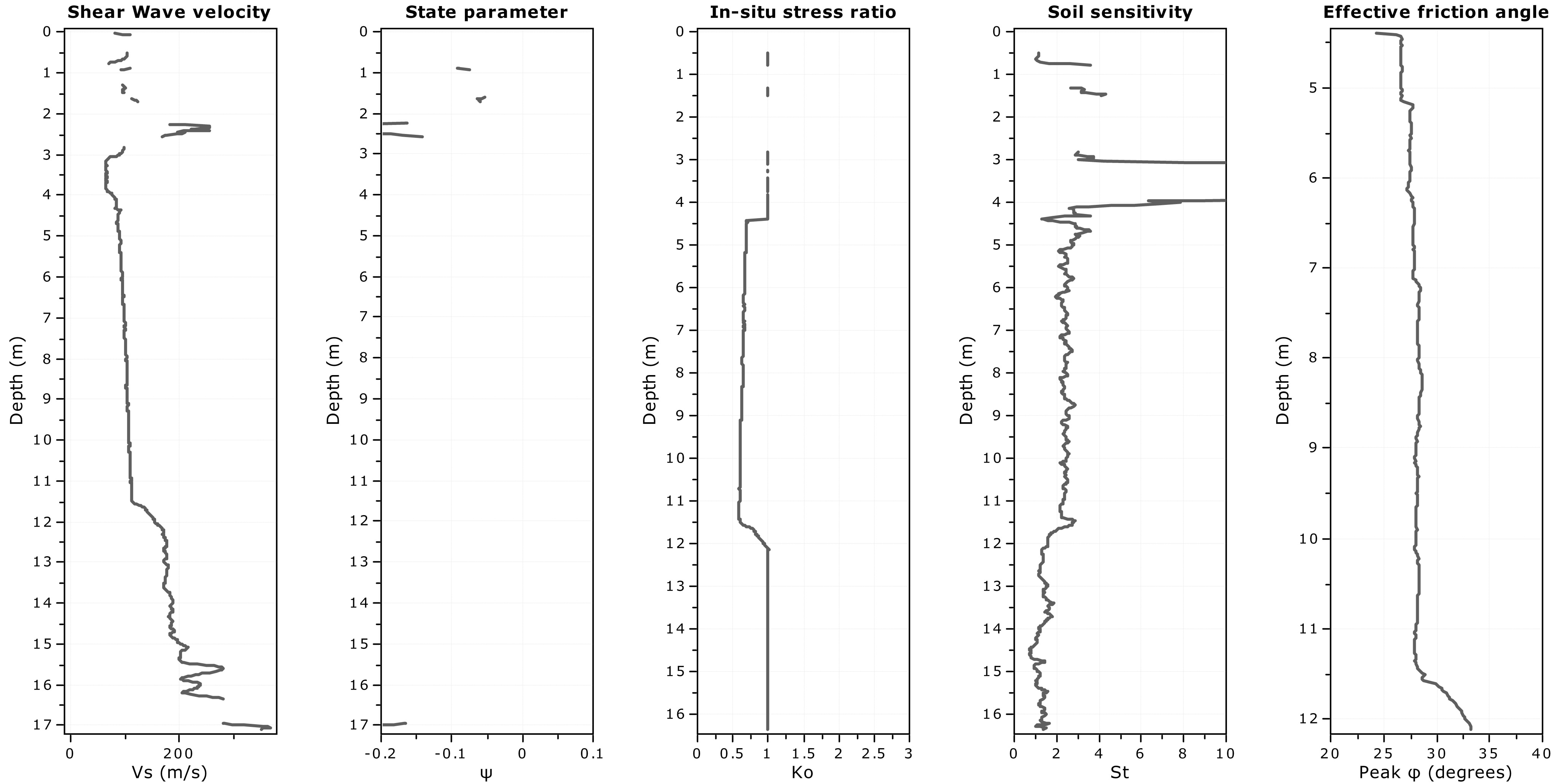
**CPT: CPT05 Corr**
Total depth: 17.10 m, Date: 9/12/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

User defined estimation data

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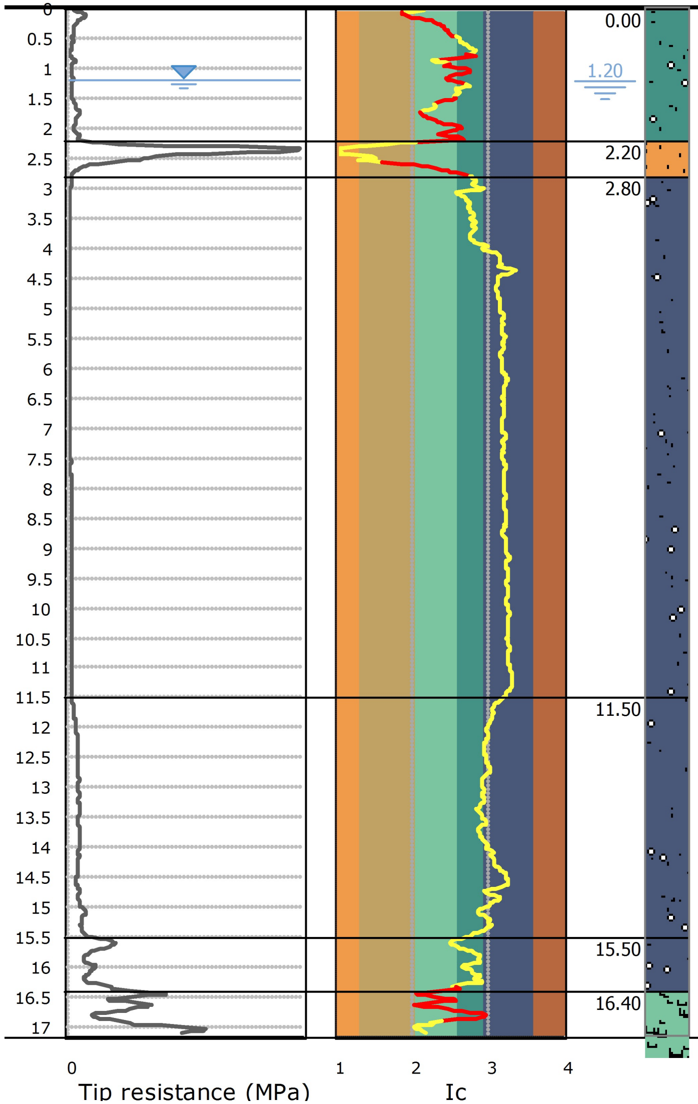
## CPT: CPT05 Corr

Total depth: 17.10 m, Date: 9/12/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**

Depth (m) Elevation: 0.00 (m)




| Depth (m) | Description | qt (MPa) | Ksbt (m/s) | N60 | Es (MPa) | Dr | Phi (°) | M (MPa) | Go (MPa) | Su (kPa) | Su ratio | OCR | Gamma (kN/m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | Clay & silty clay | 0.9 | 1.14E-6 | 3.1 | - | - | - | 11.3 | 16.8 | 41.8 | 3.3 | 13.1 | 16.4 |
| 2.20 | Sand | 21.5 | 1.38E-3 | 33.6 | 39.8 | 82.3 | 43.2 | 86.3 | 86.3 | - | - | - | 18.4 |
| 2.80 | Clay | 0.4 | 4.60E-9 | 2.3 | - | - | - | 1.6 | 14.3 | 20.3 | 0.4 | 1.5 | 14.9 |
| 11.50 | Clay | 1.7 | 8.34E-9 | 8.7 | - | - | - | 20.2 | 58.8 | 105.9 | 1.1 | 4.5 | 18.1 |
| 15.50 | Clay | 4.4 | 6.19E-8 | 18.6 | - | - | - | 57.8 | 114.3 | 295.1 | 2.6 | 10.3 | 19.6 |
| 16.40 | Silty sand & sandy silt | 17.9 | 3.38E-6 | 52.3 | 109.2 | 64.8 | 42.1 | 228.2 | 233.2 | - | - | - | 21.1 |

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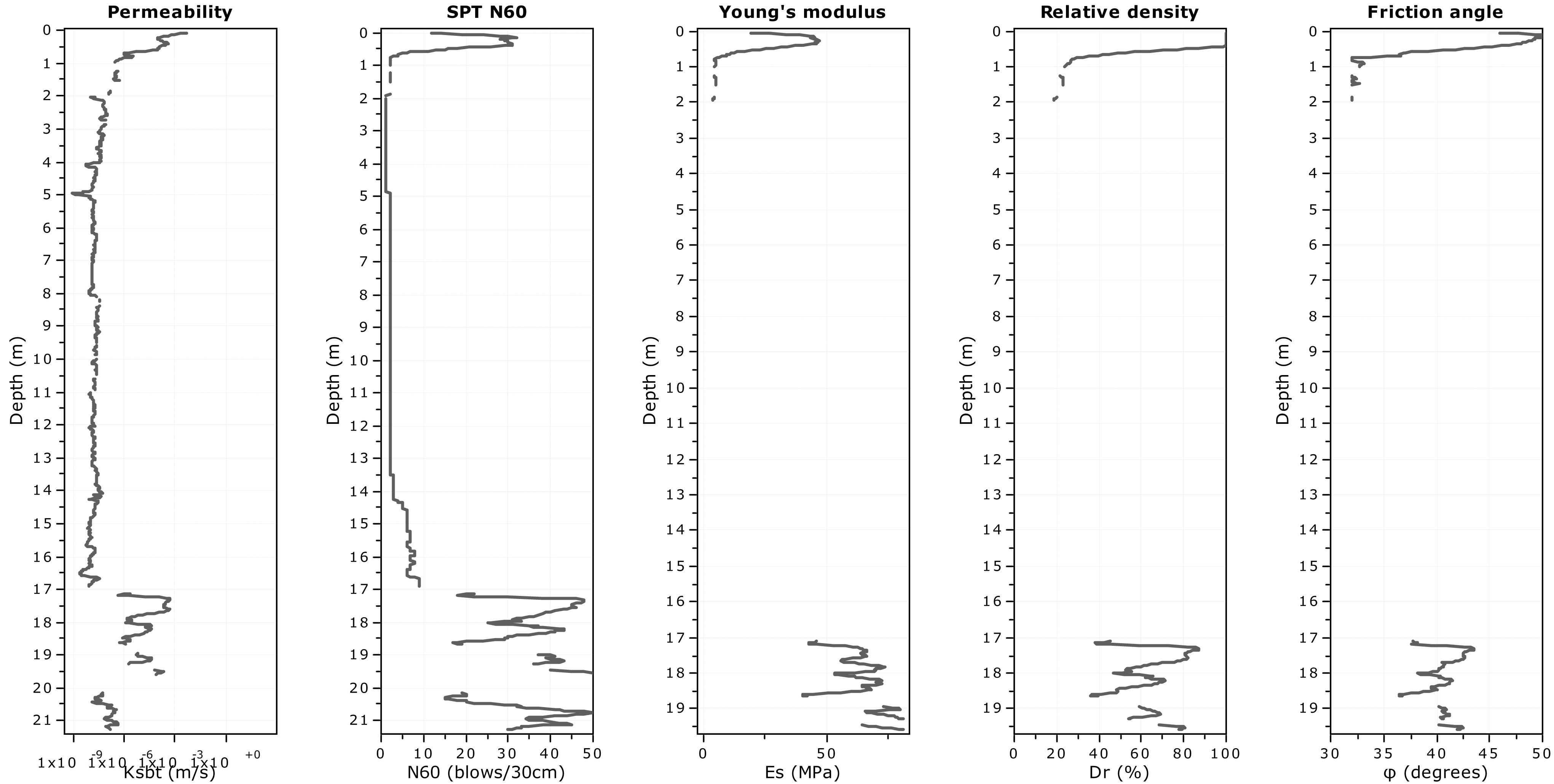
**CPT: CPT06A**
Total depth: 21.34 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

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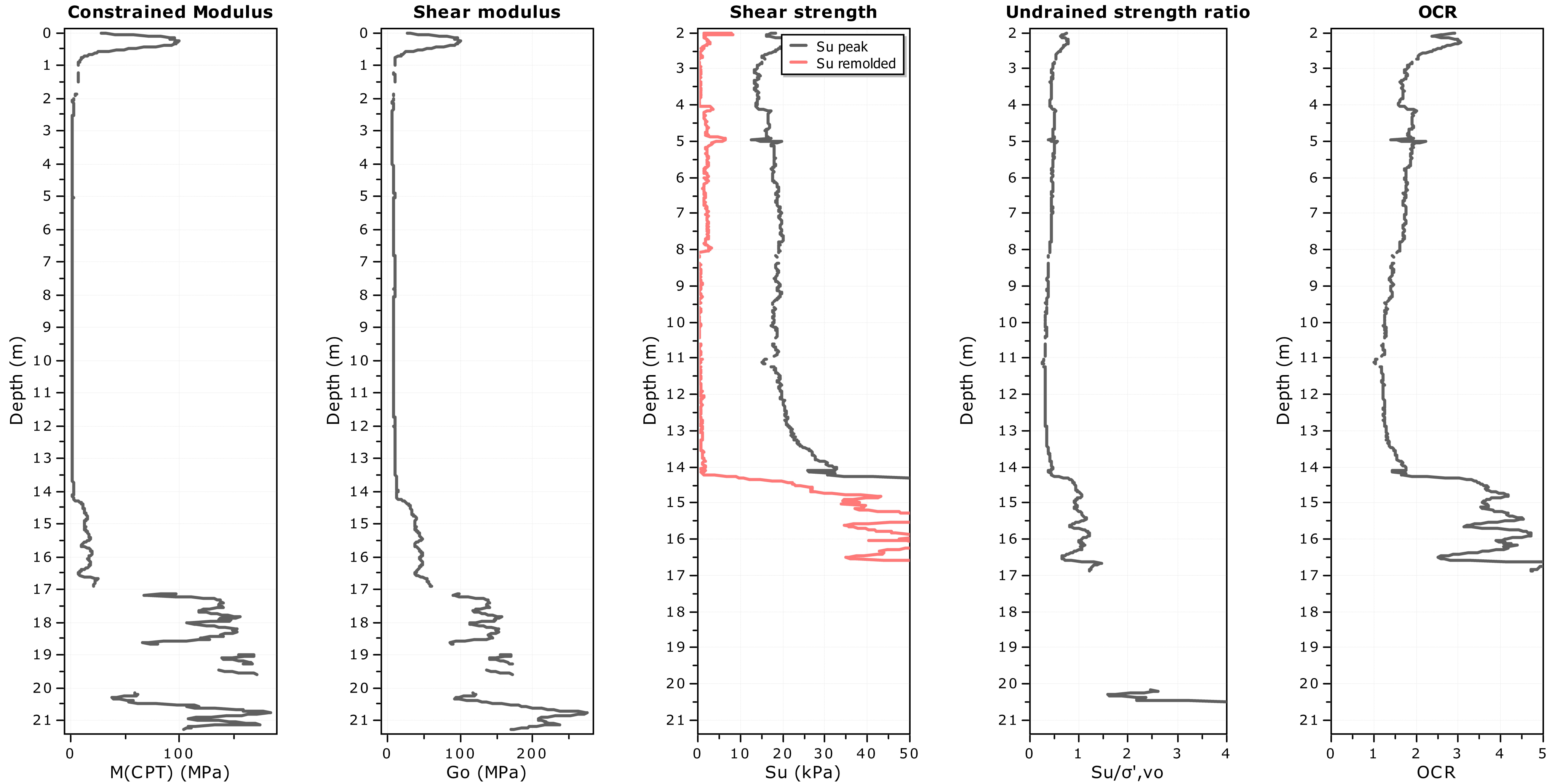
**CPT: CPT06A**
Total depth: 21.34 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14

OCR factor for clays, $N_{kt}$: 0.28
User defined estimation data
Flat Dilatometer Test data

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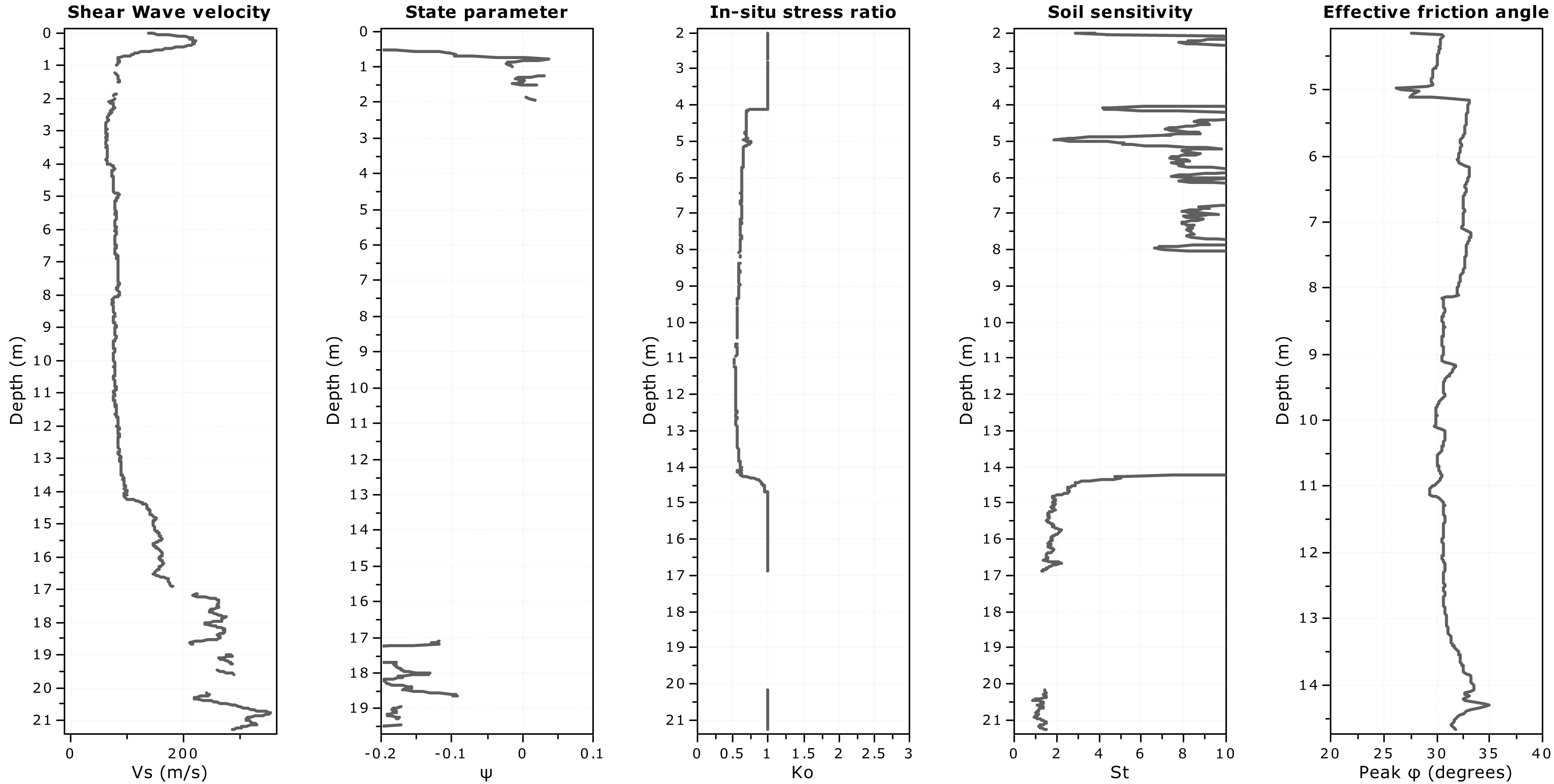
**CPT: CPT06A**
Total depth: 21.34 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

User defined estimation data

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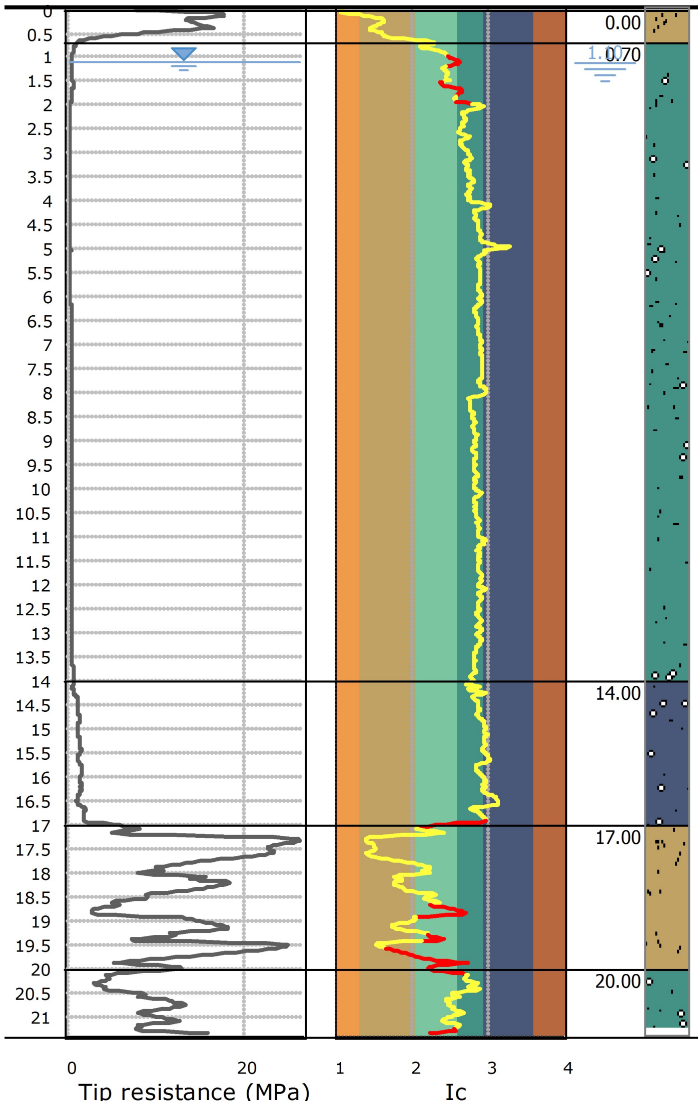
**CPT: CPT06A**
Total depth: 21.34 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**

Depth (m) Elevation: 0.00 (m)




| Depth | Description | qt (MPa) | Ksbt (m/s) | N60 | Es (MPa) | Dr | Phi (°) | M (MPa) | Go (MPa) | Su (kPa) | Su ratio | OCR | Gamma (kN/m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | Sand & silty sand | 10.9 | 4.04E-4 | 20.9 | 31.3 | 84.7 | 44.7 | 64.7 | 64.8 | - | - | - | 18.6 |
| 0.70 | Clay & silty clay | 0.4 | 5.92E-8 | 1.8 | - | - | - | 1.8 | 8.8 | 18.7 | 0.4 | 1.6 | 13.8 |
| 14.00 | Clay | 1.3 | 1.38E-8 | 6.3 | - | - | - | 13.8 | 39.2 | 76.1 | 0.9 | 3.7 | 17.0 |
| 17.00 | Sand & silty sand | 15.7 | 9.54E-5 | 36.9 | 64.3 | 64.1 | 40.6 | 134.9 | 137.4 | - | - | - | 19.9 |
| 20.00 | Clay & silty clay | 8.4 | 1.47E-7 | 32.7 | - | - | - | 113.1 | 188.6 | 576.8 | 4.6 | 17.9 | 20.7 |

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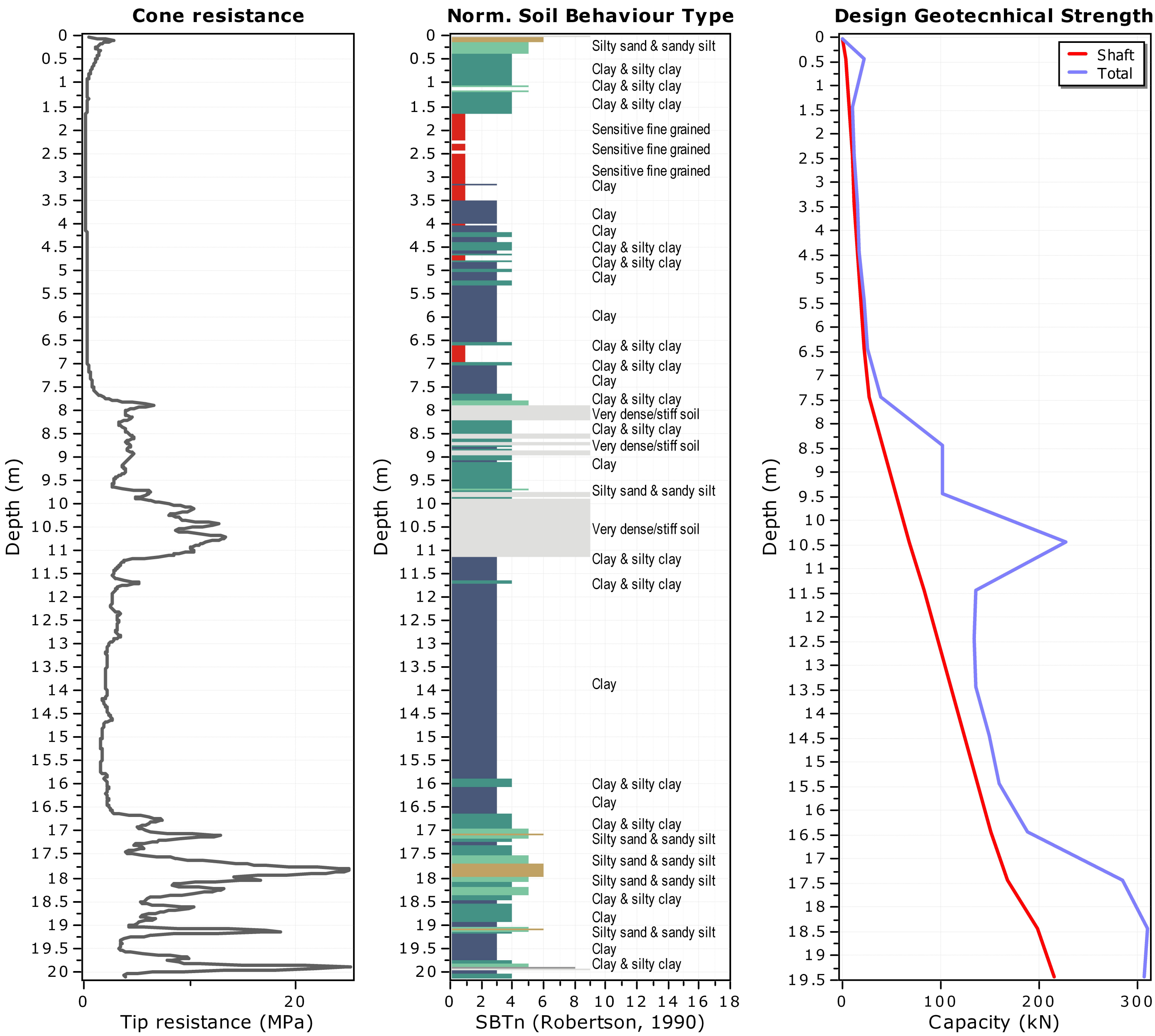
**CPT: CPT03**
Total depth: 20.12 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**

**Pile properties**

| | | | |
|---|---|---|---|
| Shaft diameter: | 0.28 m | Pile shaft Group: | Group IIA |
| Tip diameter: | 0.28 m | Pile tip Group: | Group II |
| Unit friction area: | 0.880 m² | Pile shaft FOS: | 2.22 |
| Tip area: | 0.062 m² | Pile tip FOS: | 2.22 |




**Pile group for bearing capacity factor $k_c$**

- Group I: plain bored piles; mud bored piles; micro piles (grouted under low pressure); cased bored piles; hollow bored piles; piers; barrettes
- Group II: cast screwed piles; driven precast piles; prestressed tubular piles; driven cast piles; jacked metal piles; micropiles (small diameter piles grouted under high pressure with diameter < 250 mm); driven grouted piles (low pressure grouting); driven metal piles; driven rammed piles; jacket concrete piles; high pressure grouted piles of large diameter

**Pile group for friction coefficient alpha**

- Group IA: plain bored piles; mud bored piles; hollow auger bored piles; micro piles (grouted under low pressure); cast screwed piles; piers; barrettes
- Group IB: cased bored piles; driven cast piles
- Group IIA: driven precast piles; prestresses tubular piles; jacket concrete piles
- Group IIB: driven metal piles; jacked metal piles

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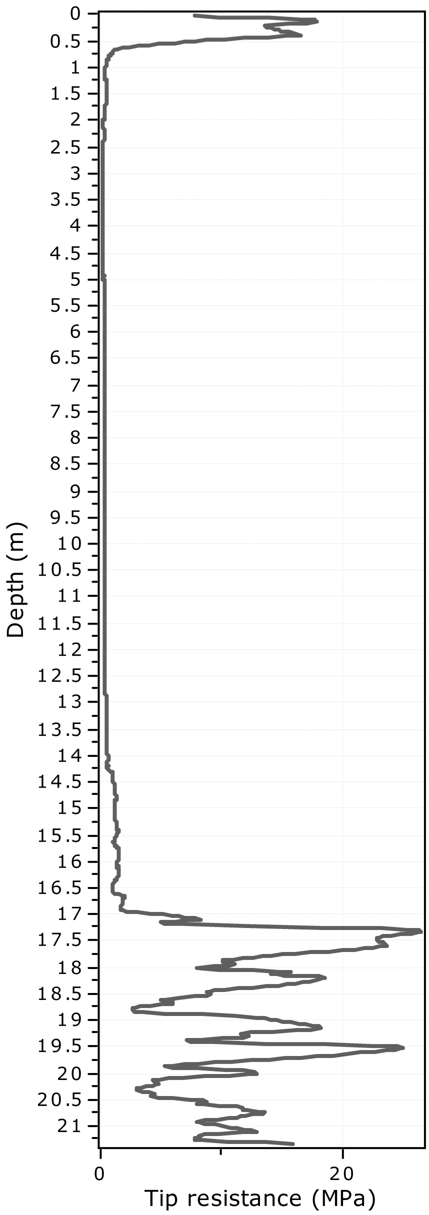
**CPT: CPT06A**
Total depth: 21.34 m, Date: 23/11/2020
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

**Project:**
**Location:**

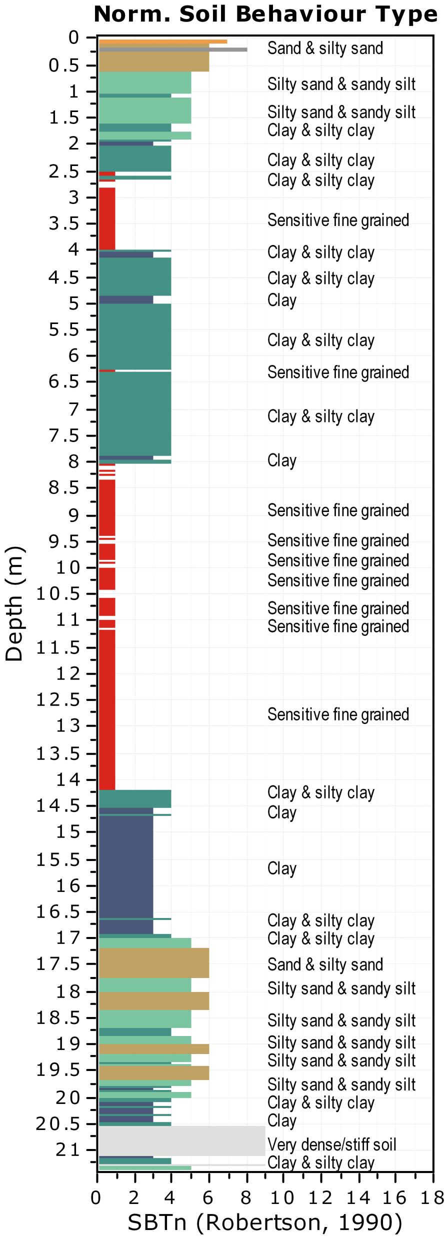
**Pile properties**

| | | | |
|---|---|---|---|
| Shaft diameter: | 0.28 m | Pile shaft Group: | Group IIA |
| Tip diameter: | 0.28 m | Pile tip Group: | Group II |
| Unit friction area: | 0.880 m² | Pile shaft FOS: | 2.22 |
| Tip area: | 0.062 m² | Pile tip FOS: | 2.22 |

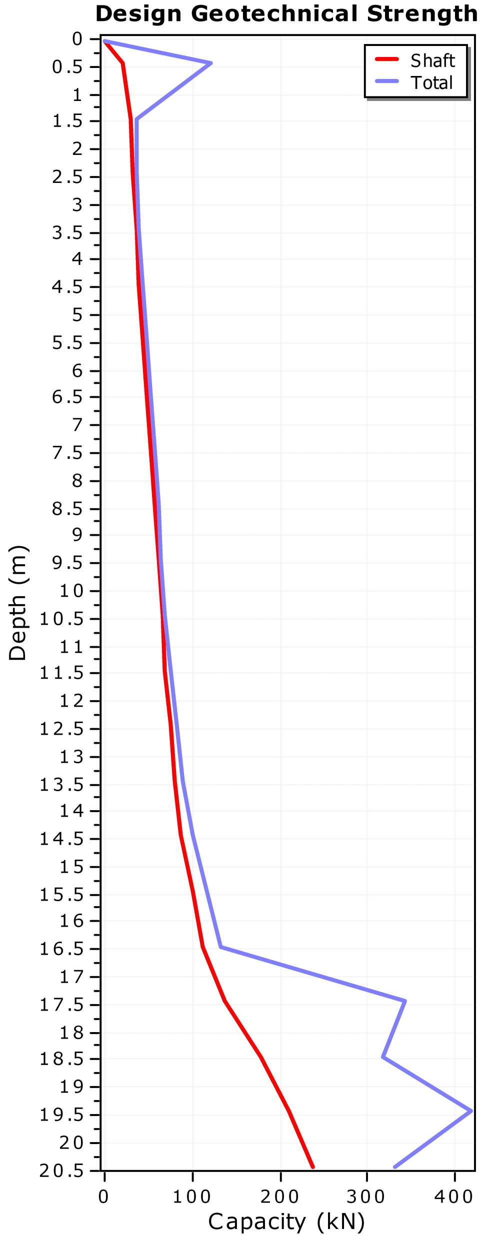
**Cone resistance**




**Norm. Soil Behaviour Type**




**Design Geotechnical Strength**




**Pile group for bearing capacity factor $k_c$**

- Group I: plain bored piles; mud bored piles; micro piles (grouted under low pressure); cased bored piles; hollow bored piles; piers; barrettes
- Group II: cast screwed piles; driven precast piles; prestressed tubular piles; driven cast piles; jacked metal piles; micropiles (small diameter piles grouted under high pressure with diameter < 250 mm); driven grouted piles (low pressure grouting); driven metal piles; driven rammed piles; jacket concrete piles; high pressure grouted piles of large diameter

**Pile group for friction coefficient alpha**

- Group IA: plain bored piles; mud bored piles; hollow auger bored piles; micro piles (grouted under low pressure); cast screwed piles; piers; barrettes
- Group IB: cased bored piles; driven cast piles
- Group IIA: driven precast piles; prestresses tubular piles; jacket concrete piles
- Group IIB: driven metal piles; jacked metal piles

# Appendix D

Drawing 1 - Test Location Plan


Drawing adapted from Google Earth imagery dated 14/12/2017 and drawing by TRG, titled "Proposed Mixed use Development", Drawing No. SK02, Rev P2, dated 17-06-20.

| | | | |
|---|---|---|---|
| **Douglas Partners** Geotechnics / Environment / Groundwater | CLIENT: Maclean Service Centre Pty Ltd | | TITLE: **Test Location Plan** **Proposed Highway Service Centre** **Lot 2 Schwonberg Street, Maclean** |
| | OFFICE: Coffs Harbour | DRAWN BY: Ussher | |
| | SCALE: 1:1000 @ A4 | DATE: 09-12-2020 | |

| | |
|---|---|
| PROJECT No: | 105016.00 |
| DRAWING No: | 1 |
| REVISION: | 0 |

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
18 Lawson Crescent
Coffs Harbour NSW 2450
Phone (02) 6650 3200

# Memorandum

| | | | | |
|---|---|---|---|---|
| **To** | Daniel Hargreaves | Maclean Service Centre Pty Ltd | daniel@hargreavesproperty.com.au | |
| **cc** | Scott McFarlane | Douglas Partners | Scott.McFarlane@douglaspartners.com.au | |
| **From** | John Niland | | **Date** | 26 Mar 2021 |
| **Subject** | Proposed Maclean Highway Service Centre, 2 Schwonberg Street, Townsend | | **Project No.** | 105016.00 |

## 1. Introduction

This memorandum report provides the results of additional geotechnical assessment with reference to Clarence Valley Council (CVC) letter request for information dated 11 September 2020. The CVC letter required additional geotechnical information on earthworks and ground movement causing flooding impacts due to the placement of fill at the site and also the effect on groundwater levels.

Fill of up to 5 m height is anticipated to be placed at the site due to CVC flood requirements.

Douglas Partners Pty Ltd has performed a previous geotechnical investigation report for the site and the results and comments are presented in DP (2020). The previous report and limitation presented therein should be read in conjunction with this memorandum.

## 2. Comments

Information is provided below with reference to CVC letter.

**Earthworks: 1**
It is recommended that construction be phased to minimise impacts to neighbouring properties, ie only adding further preload near site boundaries once sufficient consolidation settlement has occurred and allow a contingency for remediation should surface bulging beyond the site boundary eventuates. Consolidation would be monitored by geotechnical testing / instrumentation eg settlement monitoring plates installed at the time of construction and the on-site settlement data referenced with the predicted settlement prior to increasing preload height. Further discussion on preload construction and monitoring is presented in Section 7.4 of DP(2020).

**Earthworks:3**
DP (2020) indicates excavation of clay / silty clay at the site should be undertaken based on an acid sulfate soil management plan. It is understood that it is proposed to fill the site and therefore it is anticipated that excavation of site soils may not be required.

**Earthworks: 4**
The placement of the fill at the site is anticipated to have a negligible to minor effect on the long-term regional groundwater levels at the site. This is based on the subsurface conditions consisting mainly of a low permeable clay and anticipated relatively flat groundwater levels in the broad area. It is considered

plausible that localised mounding of groundwater could occur within the fill mound during construction ie prior to the surface area being sealed and this mounding would expect to reduce once infiltration of surface water through the surface is minimised by sealing the site. The degree of this localised temporary mounding would depend on the material type used for the proposed earthworks. In this regard, preference would be to provide a clayey material for the upper layers to reduce water infiltration.

We note that DP has not performed a flood study as this is outside our area of expertise and this should be assessed by an appropriately qualified engineer.

**Flood Impacts: 2**
Refer Earthworks 4 above.

**Flood Impacts: 5**
Refer Earthworks 4 above.

## 3. References

Clarence Valley Council, *Planning Proposal (LEP Amendment) to permit a Highway Service Centre at Maclean*, Reference: REZ2020/0004, Dated 11 September 2020.

DP (2020), *Report on Geotechnical Investigation, Proposed Highway Service Centre, 2 Schwonberg Street, Townsend*, Douglas Partners Pty Ltd, Reference 105016.00.R.001.Rev0, dated 21 December 2020.

**Douglas Partners Pty Ltd**

John Niland

**John Niland**
Senior Geotechnical Engineer

Reviewed by

**Scott McFarlane**
Principal

## 4. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 2 Schwonberg Street, Townsend with reference to DP's proposal CFH200151 dated 13 October 2020 and acceptance received from Daniel Hargreaves of Maclean Service Centre Pty Ltd dated 29 October 2020. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Maclean Service Centre Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Attachments: About this Report

# About this Report

Douglas Partners

## Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright



## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# About this Report

## Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

## Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.