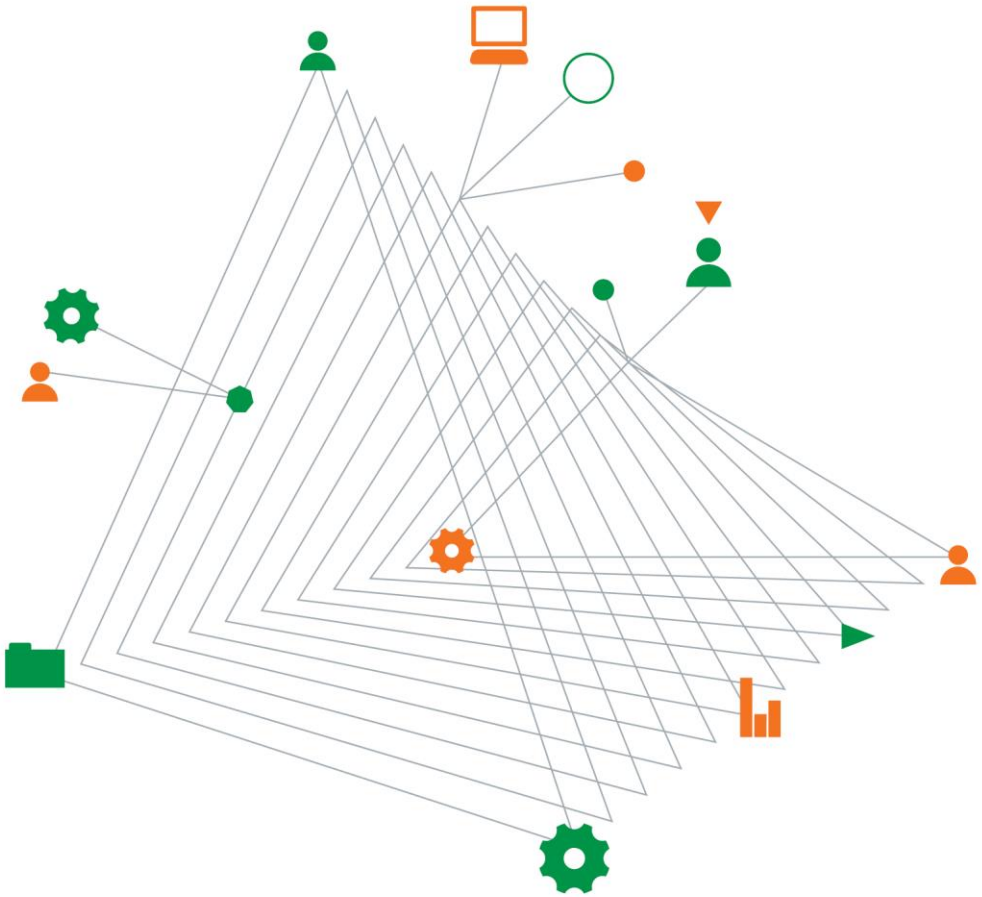
# Karimbla Construction Services (NSW) Pty Ltd

## Initial Geotechnical Site Assessment

2 Macpherson Street, Warriewood, NSW

27 September 2016



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# Initial Geotechnical Site Assessment

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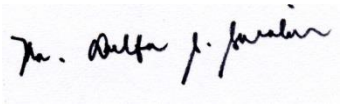
27 September 2016

## Document authorisation

Our ref: GEOTLCOV25237AA-AB Rev1

For and on behalf of Coffey



**Delfa Sarabia**
Senior Geotechnical Engineer

# Quality information

## Revision history

| Revision | Description | Date | Author | Reviewer | Signatory |
|---|---|---|---|---|---|
| 0 | Initial Geotechnical Assessment | 06/11/2014 | Daniel Gorman | Robert Turner | Daniel Gorman |
| 1 | To include updated development plans | 27/9/2016 | Delfa Sarabia | Robert Turner | Delfa Sarabia |

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**Important information about your Coffey Report**


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Appendix A - Preliminary drawing of the proposed development

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# 1. Introduction

This report presents the results of an initial geotechnical site assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) for the proposed redevelopment of 2 Macpherson Street, Warriewood, NSW. The work was commissioned by Mr Tom Hutchison of Karimbla Construction Services and was carried out in general accordance with our proposal (Ref: GEOTLCOV25237AA-AA, dated 9 October 2014). The purpose of the work was to provide geotechnical information to support a Stage 1 Development Application (DA) submission.

Meriton intends to submit a DA to Northern Beaches Council for the construction of 22 townhouses at the site. The objective of this site assessment is to review available sources of information to develop an initial geological model of subsurface conditions. The geological model will be used to identify and discuss the geotechnical issues for the development.

A Phase 1 Preliminary Contamination Assessment was completed by Coffey and issued as a separate report.

This report was revised to include the updated development plans.

# 2. Proposed development

The proposed development will comprise the construction of 22 two-storey townhouses and an access road along the perimeter of the site. No basement levels are proposed. The proposed development will include filling to raise site levels by about 2m.

A preliminary drawing of the proposed development is included as Appendix A.

# 3. Site description

The site is located near the intersection of Macpherson Road and Warriewood Road, Warriewood, NSW. A site location plan is included as Appendix B. The area of land for development is roughly rectangular with an area of approximately two hectares (100m east to west, 200m north to south).

Coffey carried out a site walkover on 29 October 2014. Appendix C presents site photographs taken during our walkover.

The site is currently being used as a plant nursery and mostly comprises sheds and storages areas for plants and equipment. The land is relatively level with concrete and gravel roads for vehicle access, and hardstanding areas for parking.

The nursery is located within flat, low-lying terrain. Flood markers observed on Macpherson Road indicate that the area has a flood risk.

The immediate surrounding areas generally comprise open fields and undeveloped vegetated areas. Macpherson Road runs east to west along the southern site boundary. Narrabeen Creek borders the site along the northern and eastern boundaries. An area of heavily waterlogged ground with standing water was observed along the western site boundary. Warriewood Wastewater Treatment Plant (WWTP) is located about 100m to the south in similar terrain to the site.

To the west of the nursery site there are a number of two to three-storey apartments that appear to have been recently completed. A large area of land approximately 100m west of the site is currently

being developed to expand a local retirement village. These developments are at higher elevation and appear to have different ground conditions to the site.

# 4. Available geotechnical information

## 4.1. Published information

The Sydney 1:100,000 Geological Series Sheet (9130 Edition, 1983) indicates that the site locality is underlain by Quaternary alluvial sediments. The alluvial soils are typically described as silty to peaty quartz sand, silt and clay, with ferruginous and humic cementation in places and common shell layers. The alluvium is underlain by the Newport Formation comprising interbedded laminite, shale and quartz to lithic-quartz sandstone.

The Sydney 1:100,000 Soil Landscape Series Sheet (9130 Edition, 1983) indicates that the site is underlain by level to gently undulating swales, depressions and infilled lagoons on Quaternary sands. Soils are expected to be deep, poorly graded, sandy Humus Podzols and Siliceous Sands. Potential issues for development on this soil are noted as localised flooding and 'run-on', a high water table and highly permeable soil.

The Hornsby/Mona Vale 1:25,000 Acid Sulfate Soil Risk Map (91 30S1 Edition 2 1997) indicates that the site is in an area of high probability for Acid Sulfate Soils. The expected depth to Acid Sulfate Soils is stated to be between 1m and 3m below ground surface level.

A search of groundwater bore licences was undertaken using the NSW Natural Resources Atlas (http://www.nratlas.nsw.gov.au). There are four registered bores (GW110247) located approximately 500 m west of the site; but there was no data on water levels from the bores.

## 4.2. Coffey archives

Coffey has conducted three previous geotechnical investigations for the Warriewood Wastewater Treatment Plant which is located to the south of the site in similar geographical terrain. These investigations indicated a variable thickness of fill (up to 4 m thick in places) overlying deep alluvial soils.

The alluvial soils generally comprised loose sands and soft to firm clays to about 15m depth, becoming dense sands with stiff clay layers to 25m depth.

Sandstone bedrock was encountered beneath the alluvial soils. Groundwater was encountered and monitored on one occasion at relatively shallow depth, about 2m below ground surface level.

# 5. Preliminary site geological model

Our preliminary geological model for the site is presented in Table 1. The model has been developed based on our site observations, available geotechnical information and local experience.

**Table 1: Preliminary Geotechnical Model**

| Soil Unit | Description | Expected Unit Depth |
|---|---|---|
| 1. Fill/Topsoil | Concrete, road base, reworked alluvial sediments and various imported materials and topsoil. | Where not covered by hardstanding the top layer of soil is likely to be disturbed and softened due to the site's current use as a plant nursery.<br>The depth of disturbed soil in garden areas is likely to be shallow (less than about 0.5 m). There could be localised deeper fill from past ground levelling for sheds, etc.<br>The fill may not be a uniform layer, but may occur at discrete locations with different thicknesses. |
| 2. Upper Alluvium | Sand: generally loose, becoming medium dense and dense with depth. Likely to include organic clay lenses.<br>Clay: very soft to firm, underlying the sand strata. | Expected to be encountered to about 15m depth. |
| 3. Lower Alluvium | Predominantly dense sand with some very stiff clay layers. | Expected to be encountered below Unit 2 to about 25m depth. |
| 4. Bedrock | Sandstone with siltstone interbeds. | Top of unit anticipated to be at depths greater than 25m. |

Due to the close proximity to Narrabeen Creek, groundwater is expected to be at shallow depth, about 1m to 2m below ground surface. Groundwater levels are subject to fluctuations due to seasonal effects and water levels may rise above ground level during prolonged wet weather or flood conditions.

# 6. Discussion and recommendations

## 6.1. Geotechnical Issues for Development

The site is expected to contain soil disturbed by agricultural activities and localised fill (Soil Unit 1). Below this, Soil Unit 2 is expected to comprise deep compressible alluvial sediments. A high groundwater table is also expected.

The site in its present state would be considered as Class P with respect to *AS2870-2011 Residential slabs and footings*.

The potential flood risk will require the site levels to be raised by about 2m. The placement of 2m of Engineered Fill will surcharge the compressible alluvium and cause some settlement. If the alluvium is mainly high permeability sands, the settlement should occur relatively quickly. If the alluvium contains mainly low permeability clay, the settlement may take some time, in which case it may be necessary to adopt treatments such as preloading (including wick drains) to speed up settlement, so that development can proceed in a more timely manner.

The 2m thick Engineered Fill embankment will consolidate the compressible alluvium and will form a stiff capping layer at foundation level. This capping layer could then allow the use of concrete stiffened raft footing systems that may otherwise not be feasible for the current site conditions.

In summary, the placement of 2m of Engineered Fill at the site could induce significant total settlements, but would help reduce the post construction differential settlements that would affect housing performance to the extent that shallow footing systems could be feasible.

## 6.2. Ground Preparation Works

Before placing Engineered Fill, disturbed soil and existing fill would need to be treated and compacted to provide a uniform foundation for subsequent fill layers.

Soil Units 1 and 2 are expected to have poor traffickability, particularly when wet. A working platform of coarse-grained material may be needed to support construction plant. Where heavy plant such as piling rigs, or mobile cranes are to traffic the site, specific analysis of working platform requirements may be required to assess working platform thickness.

## 6.3. Foundation options

### 6.3.1. Piled Footings

The anticipated deep profile of soft and loose compressible soils (Soil Unit 2) across the site is expected to be unsuitable as a foundation for residential structures because of the low bearing capacity and high total and differential settlements.

The anticipated depth to a competent stratum for piled foundations (Soil Unit 3) may make piled footings uneconomical solution for the development. In addition, the combination of soft soils and a high water table is likely to preclude the use of bored cast *in-situ* piles, unless supported with temporary casings or bentonite. CFA, screw or driven piles are expected to be feasible options.

The proposed Engineered Fill to raise site levels would likely induce settlement in Soil Unit 2 that may introduce negative friction loads on pile shafts.

### 6.3.2. Shallow Footings

The Engineered Fill embankment that is required to raise the development above flood levels will surcharge Soil Unit 2 and cause it to consolidate and strengthen. The time that this takes to occur will vary depending on the permeability of Soil Unit 2. When consolidation is substantially completed, the residential units could be founded on concrete stiffened raft footing systems as discussed in Section 6.1. The footing system would need to be engineer-designed to consider the anticipated long-term differential settlement and the type of construction proposed (e.g. articulated masonry veneer).

If Soil Unit 2 is not sufficiently permeable to allow consolidation under surcharge in an economic time frame, the consolidation process can be accelerated by increasing the surcharge (adding extra fill and removing it later) and/or installing vertical drains in a close grid pattern.

Other ground improvement methods may also be suitable.

## 6.4. Excavations and acid sulfate soils

As basements are not proposed, excavations are likely to be limited to relatively shallow depths necessary for ground preparation and improvement. Excavations in Soil Units 1 and 2 could be carried out using conventional earth-moving plant such as tracked excavators, but are likely to be

limited by high groundwater levels. Vertical or steeply battered excavations in Soil Units 1 and 2 are unlikely to be stable, even above groundwater.

Testing of soil samples at the WWTP indicated concentrations of chromium reducible sulphur that exceeded the action criteria trigger values published by the Acid Sulfate Soil Management Advisory Committee (ASSMAC). If similar ASS conditions occur at the site, an Acid Sulfate Soil Management Plan would need to be prepared prior to any bulk excavations or spoil generation from piling works.

## 6.5. Adjacent structures and services

Based on the expected limited depth of excavations at the site, and the undeveloped nature of its surroundings, it is unlikely that adjacent structures will fall within influence zones affected by excavation-induced movements.

Should the scope of the development change, or if excavation is proposed near the southern boundary adjacent to Macpherson Road, this should be reassessed. The locations and details of adjacent structures and services should be investigated and the potential impacts assessed prior to excavations commencing.

## 6.6. Further site investigations

We recommend that further geotechnical site investigation is carried out to support post-DA planning and design. For the currently proposed development scheme we expect that geotechnical investigations would comprise a series of cone penetrometer tests and boreholes to investigate the geotechnical issues discussed in this report. The focus of the geotechnical assessment will be the potential total consolidation settlements and how long these will take to occur. The design intention will be to develop a preload strategy if required to accelerate consolidation, and prepare a geotechnical model for assessment and design of shallow footing systems.

Standpipes could also be installed into selected boreholes to assess groundwater levels across the site and to enable water samples to be collected for water quality/chemistry testing if required.

# 7. Conclusions

Based on our site observations, encountered ground conditions and experience on similar projects, the proposed development is considered feasible from a geotechnical perspective. The proposed development is considered to present a low geotechnical risk for the subject and surrounding sites, provided that appropriate design assessments and construction monitoring normally associated with this type of development are carried out.

# 8. Closure

The preliminary geotechnical assessment and recommendations presented in this report are based on a desk study limited to regional information, and subsurface investigation data from outside of the site boundaries. Subsurface conditions can be complex, vary over relatively short distances and over time. Additional, site specific investigations will be required to support detailed design. Detailed design and construction should not proceed on the basis of this desk study report without further advice from Coffey.

The attached document entitled “Important Information about Your Coffey Report” forms an integral part of this report and presents additional information about the uses and limitations of the report.

# Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

## Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

## Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

## Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

## Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

## Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

## Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

# Important information about your **Coffey** Report

## Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

## Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

## Rely on Coffey for additional assistance

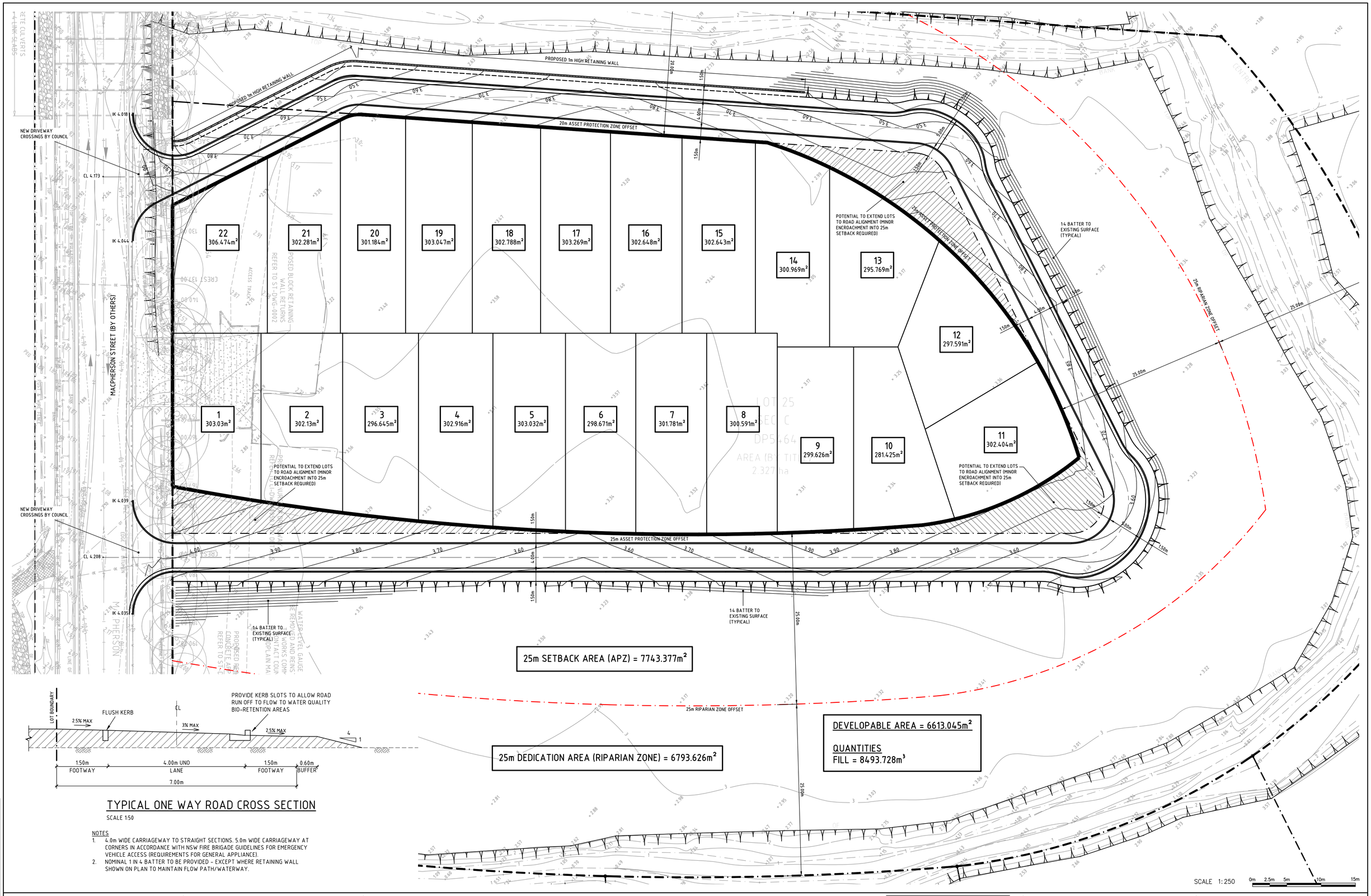
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction,
speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

## Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

# Appendix A - Preliminary drawing of the proposed development







## TYPICAL ONE WAY ROAD CROSS SECTION

SCALE 1:50

NOTES
1. 4.0m WIDE CARRIAGEWAY TO STRAIGHT SECTIONS. 5.0m WIDE CARRIAGEWAY AT CORNERS IN ACCORDANCE WITH NSW FIRE BRIGADE GUIDELINES FOR EMERGENCY VEHICLE ACCESS (REQUIREMENTS FOR GENERAL APPLIANCE).
2. NOMINAL 1 IN 4 BATTER TO BE PROVIDED – EXCEPT WHERE RETAINING WALL SHOWN ON PLAN TO MAINTAIN FLOW PATH/WATERWAY.

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Project Name: 2 MACPHERSON STREET, WARRIEWOOD, NSW 2102

Drawing Title: SITE REDEVELOPMENT CONCEPT PLAN ONE-WAY ROAD

PRELIMINARY

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| Designed | JF |
| Drawn | JF |
| Scale | 1:250 |
| Date | AUG 2016 |
| Sheet | A1 |

Project Director Approved Date

North

Project Ref: 20 21791 01

Drawing No Rev: SK02 P1

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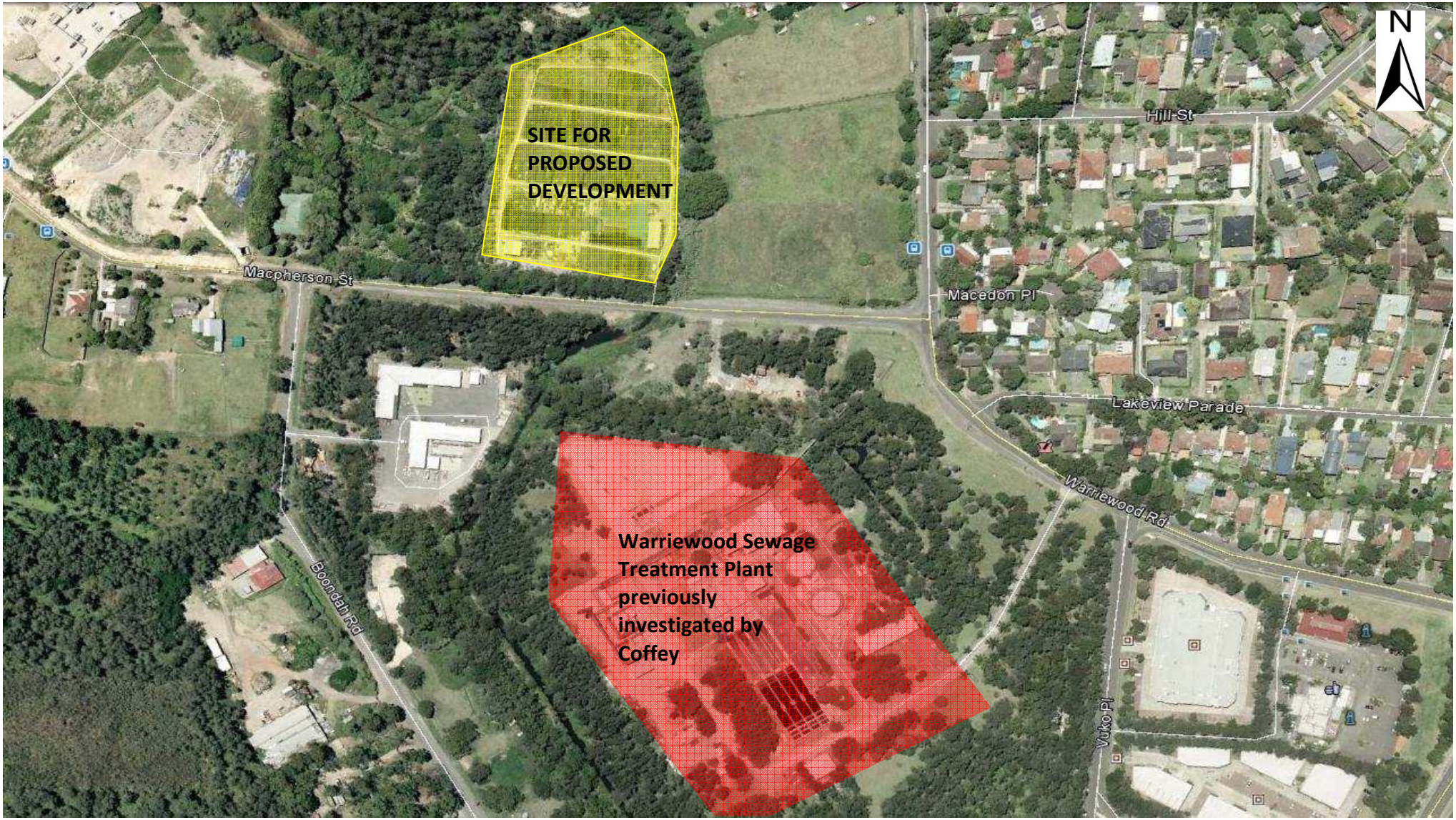
# Appendix B  - Site location plan

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|---|---|---|---|---|
| drawn | DG | coffey | client: | Meriton Group |
| approved | | | project: | 2 Macpherson Street Warriewood<br>Proposed Residential Development |
| date | 31/10/2014 | | title: | Proposed Site Location Plan |
| scale | not to scale | | project no: GEOTLCOV25237AA | figure no: APPENDIX B |
| original size | A4 | | | |

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# Appendix C – Photographs from site walkover

**Plate 1. View of site showing paved access tracks for plant nursery**

**Plate 2. View of Macpherson Road showing flood indicators**

**Plate 3. View of Narrabeen Creek showing flood indicators**

**Plate 4. View of construction site to the west**