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11 November 2019

Our ref: 773-CHCGE231520

Murray Boyes
189 Main South Road
Darfield
Canterbury

Attention: Murray Boyes

Geotechnical report to support a plan change application at Hoskyns Road, Kirwee, Selwyn District

1. Introduction

Baseline Group are currently working on an approved subdivision in Kirwee, Selwyn District. Part of the Baseline Group work is to apply for a plan change for the area covered by the approved subdivision. This is to allow an increase in the density of the existing residential zone.

We understand that the original subdivision was approved based on a geotechnical report completed by Davis Ogilvie (DO) in May 2013; however, this report was focused on the areas which were scheduled for residential development and didn't include testing over the whole area which is being presented as part of the plan change application.

Coffey has been engaged by Murray Boyes to complete additional ground investigations at the site and to provide a report which uses the original DO investigation and reporting supplemented with the additional shallow investigation data to provide a geotechnical report to support the plan change application to Selwyn District Council (SDC), which encompasses the entire site.

2. Scope of work

Based the above information we consider the overarching scope of work to include the following:

- Review of available reporting for the site and for the neighbouring Walter Place Subdivision including:

  Baseline Group plan change submission documents including Appendices 1-11.

  Engeo: Geotechnical and Preliminary Environmental Site Investigation for 88 Courtenay Road, Kirwee, Canterbury dated 11 February 2015 (Walter Place subdivision).

- Review of factual data for the site including:

  New Zealand Geotechnical Database layers.

  Borehole investigation data available from the DO report

- Shallow ground investigation to infill areas which were not investigated by the original DO report.

  5 shallow field tests comprising hand augered boreholes (HA) to 3 mbgl (or refusal) with accompanying dynamic cone penetration testing (DCP) and shear vane testing (SV) where appropriate.

- Provision of a geotechnical report which comments on the items required by Section 106 RMA and is considered suitable to support the plan change application.

The extent of the proposed plan change area is shown in Appendix A.

3. Existing information

3.1. Walter Place Subdivision review

Engeo Limited completed a Geotechnical and Preliminary Environmental Site Investigation for the site at 88 Courtenay Road, Kirwee (now Walter Place) in February 2015. This site is located adjacent to the Hoskyns Road site which is currently under consideration for plan change. A summary of the key information from this report is included below:

- 20 hand auger and Scala penetrometer tests where undertaken across the site.

  All tests reached practical refusal within the upper 0.7 m of the ground profile (inferred to be dense insitu gravel.

- Ground water was estimated as being in excess of 6 mbgl.
- The site was assessed as being geotechnically suitable for subdivision.

3.2. DO Report review

DO completed a geotechnical assessment of the majority of the subject site in May 2013. A summary of the key findings from this report are summarised below:

- 10 machine boreholes (BH) with standard cone penetration tests (SPT) where under taken by DO across the northern portion of the plan change application site.

  These boreholes identified less than 1 m of surficial sand and silt overlying dense to very dense silty / sandy gravel to at least 15 mbgl.

  Ground water was not recorded in the 10 BH at the site.

- Ground water was described based on two publicly available Well Logs (L35/0163 and M35/0921).

  These wells all describe ground water as being deeper than 24 mbgl in all recordings.

- The site was assessed as being categorised equivalent to MBIE Technical Category TC1.
- The site has been considered suitable for subdivision.

4. Site details

4.1. Site description

The site is located within a rural setting on the outskirts (east) of the town of Kirwee in Canterbury.

The site occupies an area of the Canterbury Plains approximately 5 km to the south of the Waimakariri River. Consistent with this geographical setting the site is generally flat with some minor shallow historical channel features consistent with the past migration of the Waimakariri River.

The area under consideration for the plan change application is currently elevated above the Waimakariri River by approximately 15 m.

4.2. Geological setting

The geological map[1] of the area indicates that the site has surface geology consisting of "***Higher elevation, older alluvial gravel, sand and silt"*** of the Springston Formation.

5. Fieldwork summary

5.1. Ground investigation

Coffey performed shallow investigations on 1 November 2019. Our testing consisted of five hand augered boreholes (HA) accompanied by dynamic cone penetrometer (DCP) tests. The hand augered boreholes terminated at depths ranging from 0.3 – 0.7 mbgl. The HA logs are presented in Appendix B of this report.

The HA locations as well as the DO BH locations are shown on Figure 1 below.

[1] Brown, L.J.; Weeber, J.H. 1992: Geology of the Christchurch urban area. Scale 1:25 000 Institute of Geological & Nuclear Sciences geological map 1. 1 sheet + 104 p. Institute of Geological & Nuclear Sciences Limited, Lower Hutt, New Zealand.

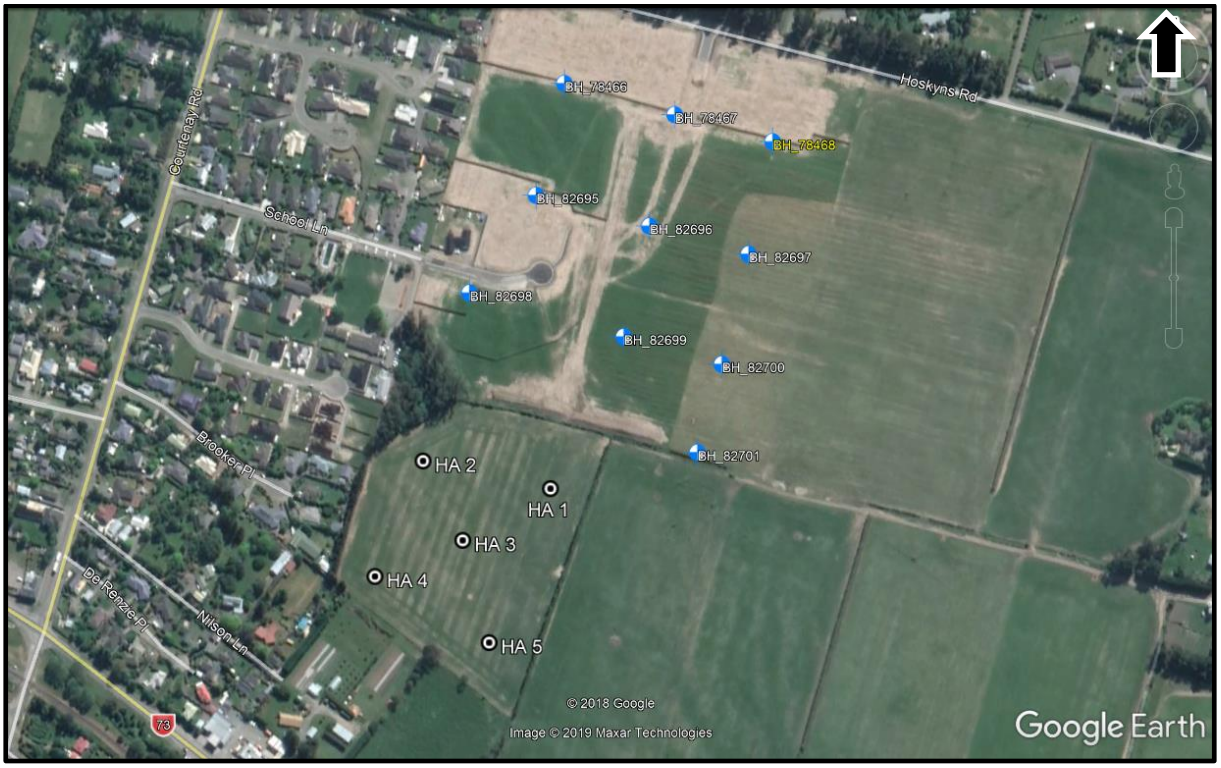


Figure 1: Investigation location plan

5.2. Ground conditions

The ground model for this site was derived based on the ground conditions encountered during our investigations along with data from the DO Report. These other investigations comprise 10 machine boreholes (BH).

The subsurface conditions encountered are generally consistent with the published geological information, and the site stratigraphy has been summarised in Table 1 below.

Table 1: Ground stratigraphy.

Description	Depth to Bottom of Layer (mbgl)	Assessed Relative Density or Consistency
TOPSOIL	0.0 to 0.3	-
Silty SAND / Silty SAND	0.3 to 0.7	Loose to medium dense
Silty GRAVEL	15.0 +	Dense to very dense

5.3. Groundwater regime

As ground water was not encountered in the Engo (neighbouring site), Coffey or DO instigations which extended to a maximum depth of 15.0 mbgl it has been assessed that ground water is in excess of 15.0 mbgl at the site.

5.4. Site subsoil class

In accordance with NZS1170.5, Section 3.1.3, a site subsoil classification of "***Class D – Deep or soft soil sites"*** may be assumed for this site.

6. Geotechnical Assessment

6.1. Natural hazards

6.1.1. Flood hazard

The site is flat and is elevated above the existing Waimakariri River channel by 15 m. Considering this topography, we consider that there is a low risk of inundation of the site in a future flood event.

6.1.2. Erosion

The site is generally flat meaning the potential for fast uncontrolled water flow which could lead to erosion is considered to be low.

6.1.3. Falling debris

The topography of the site and surrounding area are generally flat meaning there is no risk of rockfall or other geological process causing debris to inundate the site.

6.1.4. Subsidence

The ground conditions which are present at the site which include a thick layer of dry dense to very dense sandy gravel are not considered to be prone to either static or liquefaction induced settlement.

The surficial layer of sand / silt is potentially a cause of minor foundation settlement; however, this can be controlled through good earthworks practice.

6.1.5. Lateral spreading

Given the generally flat topography and non-liquefiable nature of the soils at the site it is considered to be at negligible risk of lateral spreading in a future earthquake event.

6.1.6. Slippage

The given the topography of the site the risk of slope failure is considered to be negligible.

7. Suitability of the site for subdivision

Based on our assessment we consider the site is suitable for subdivision, our Statement of Professional Opinion is attached.

We consider that the foundation recommendations outlined in NZS 3604.2011 to be appropriate for the subdivision, provided that lot specific (building consent) geotechnical investigations confirm the ground conditions identified within this report.

8. Limitations

This report has been prepared solely for the use of our client Murray Boyes, his professional advisers and Selwyn District Council (SDC) in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity.

It is recommended that all other parties seek professional geotechnical advice to satisfy themselves as to its on-going suitability for their intended use.

As subsurface information has been obtained solely from discrete investigation locations, which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist, then the matter should be referred back to us immediately.

Please also refer to the enclosed ***Important Information about Your Coffey Report***.

9. Closure

If you have queries or require further clarification regarding aspects of this report, please contact the undersigned.

For and behalf of Coffey

Prepared by

Andrew Jordan
BSc
Senior Engineering Geologist

Reviewed and authorised by

Richmond Beetham
BE (Civil) BSc MSc Eng DIC FEngNZ PEngGeol CPEng
Principal Geotechnical Engineer

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.

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.

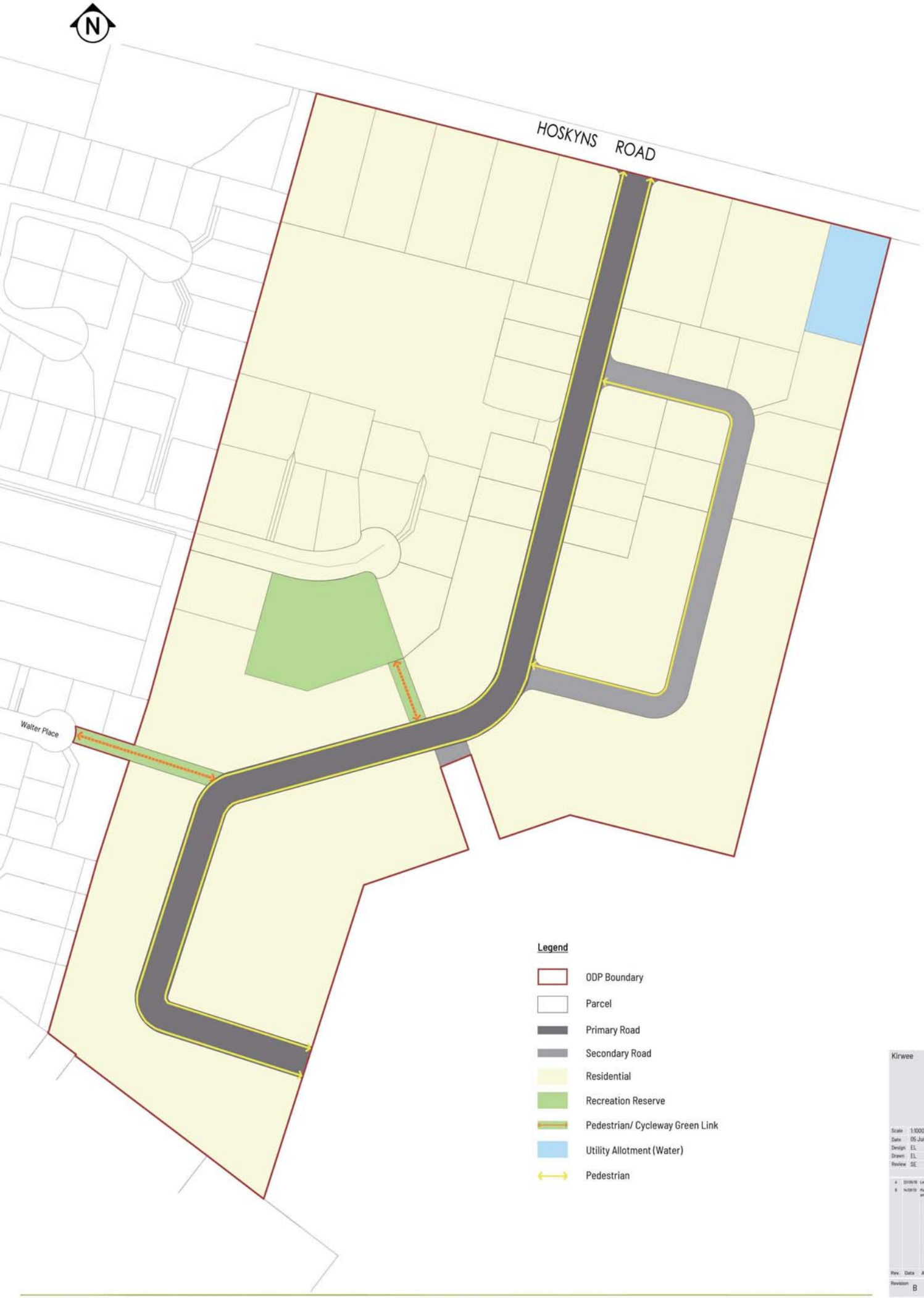
Rely on Coffey for additional assistance

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.

Appendix A - Site plan



BASELINEGROUP

Kirwee

Scale	1:1000 @A1
Date	05 Jun 2019
Design	EL
Drawn	EL
Review	SE

Rev.	Date	Amendment
A	22/06/19	Legend Amendments
B	14/08/19	Match the latest Boundary amendment

Revision B

Sheet 1

Appendix B - Hand auger logs

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Engineering Log - Hand Auger

Borehole ID.	***HA01***
sheet:	1 of 1
project no.	***773-CHCGE231520***
client:	***Murray Boye c/o Baseline Group***
date started:	***01 Nov 2019***
principal:	
date completed:	***01 Nov 2019***
project:	***Kirwee Plan Change***
logged by:	***J. Byron-Joyce***
location:	***Kirwee***
checked by:	***A. Jordan***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N					0.0		OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M				**TOPSOIL**
							ML	**Sandy SILT**: non plastic to low plasticity, pale brown.	M to W	St			**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
					0.5		GW	**SILTY GRAVEL**: fine to medium grained, rounded, pale brown.		MD			
								Hand Auger HA01 terminated at 0.6 m Refusal on gravel					
					1.0								
					1.5								

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V
*
e.g.
B
T

support
M mud
C casing
N nil

penetration
1 2 3

water
bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
V
bit
no resistance ranging to refusal
10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System
U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff
HB

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF BOREHOLE: NON CORED + DCP HAND AUGER LOGS.GPJ <<DrawingFile>> 07/11/2019 12:02

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undisturbed sample ##mm diameter
hand penetrometer (kPa)
standard penetration test (SPT)
SPT sample recovered
SPT with solid cone
vane shear; peak/remoulded (kPa)
refusal
hammer bouncing

moisture
VSt

very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

method & support
penetration 1 2 3
water
RL (m)
depth (m)
graphic log
classification symbol
moisture condition
consistency / relative density
50 100 150 200
2 4 6 8 10

N

1 2 3

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

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Engineering Log - Hand Auger

Borehole ID.	***HA02***
sheet:	1 of 1
project no.	***773-CHCGE231520***
client:	***Murray Boye c/o Baseline Group***
date started:	***01 Nov 2019***
principal:	
date completed:	***01 Nov 2019***
project:	***Kirwee Plan Change***
logged by:	***J. Byron-Joyce***
location:	***Kirwee***
checked by:	***A. Jordan***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA — N							OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M				**TOPSOIL**
					0.5		ML	**Sandy SILT**: non plastic to low plasticity, pale brown. Hand Auger HA02 terminated at 0.3 m Refusal on gravel	M to W	St			**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
					1.0								
					1.5								

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method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V
*
e.g.
B
T

support
M mud
C casing
N nil

penetration
1 2 3

water
bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
V
bit
no resistance ranging to refusal
10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System
U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff
HB

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undisturbed sample ##mm diameter
hand penetrometer (kPa)
standard penetration test (SPT)
SPT sample recovered
SPT with solid cone
vane shear; peak/remouded (kPa)
refusal
hammer bouncing

moisture
VSt

very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

method & support	penetration 1 2 3	water		RL (m)	depth (m)	graphic log	classification symbol		moisture condition	consistency / relative density	50 100 150 200	2 4 6 8 10	
SPT N													

1 2 3

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

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Engineering Log - Hand Auger

Borehole ID.	***HA03***
sheet:	1 of 1
project no.	***773-CHCGE231520***
client:	***Murray Boye c/o Baseline Group***
date started:	***01 Nov 2019***
principal:	
date completed:	***01 Nov 2019***
project:	***Kirwee Plan Change***
logged by:	***J. Byron-Joyce***
location:	***Kirwee***
checked by:	***A. Jordan***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) ⊕ remoulded ⊙ peak (50 100 150 200)	DCP (blows/ 100 mm) (2 4 6 8 10)	structure and additional observations
HA N					0.0		OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M				**TOPSOIL**
								Hand Auger HA03 terminated at 0.25 m Refusal on gravel					
					0.5								
					1.0								
					1.5								

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method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V
*
e.g.
B
T

support
M mud
C casing
N nil

penetration
1 2 3

water
bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
V
bit
no resistance ranging to refusal
10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System
U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff
HB

undisturbed sample ##mm diameter

hand penetrometer (kPa)

standard penetration test (SPT)

SPT - sample recovered

SPT with solid cone

vane shear; peak/remoulded (kPa)

refusal hammer bouncing

moisture

VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

Engineering Log - Hand Auger

Borehole ID. ***HA04***
sheet: 1 of 1
project no. ***773-CHCGE231520***
client: ***Murray Boye c/o Baseline Group*** date started: ***01 Nov 2019***
principal: date completed: ***01 Nov 2019***
project: ***Kirwee Plan Change*** logged by: ***J. Byron-Joyce***
location: ***Kirwee*** checked by: ***A. Jordan***

position: Not Specified surface elevation: Not Specified angle from horizontal: 90° DCP id.:
drill model: drilling fluid: hole diameter : 50 mm vane id.:

drilling information		**material substance**				
samples & field tests		**material description** **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components		vane shear remoulded peak (kPa)	DCP (blows/ 100 mm)	**structure and additional observations**
	OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M			**TOPSOIL**
	ML	**Sandy SILT**: non plastic to low plasticity, pale brown.	M to W	St		**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
		from 0.4m with some gravel				
0.5		Hand Auger HA04 terminated at 0.5 m Refusal on gravel				
1.0						
1.5						

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V

*
e.g.
B
T

support
M mud
C casing
N nil

penetration

water

bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample

V bit
no resistance ranging to refusal

10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System

U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff

HB

undisturbed sample ##mm diameter

hand penetrometer (kPa)

standard penetration test (SPT)

SPT - sample recovered

SPT with solid cone

vane shear; peak/remoulded (kPa)

refusal hammer bouncing

moisture

VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

Engineering Log - Hand Auger

Borehole ID. ***HA05***
sheet: 1 of 1
project no. ***773-CHCGE231520***
client: ***Murray Boye c/o Baseline Group*** date started: ***01 Nov 2019***
principal: date completed: ***01 Nov 2019***
project: ***Kirwee Plan Change*** logged by: ***J. Byron-Joyce***
location: ***Kirwee*** checked by: ***A. Jordan***

position: Not Specified surface elevation: Not Specified angle from horizontal: 90° DCP id.:
drill model: drilling fluid: hole diameter : 50 mm vane id.:

drilling information		material substance				
		material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components		vane shear remoulded peak (kPa)	DCP (blows/ 100 mm)	structure and additional observations
samples & field tests						
	OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M			**TOPSOIL**
	ML	**Sandy SILT**: non plastic to low plasticity, pale brown. Hand Auger HA05 terminated at 0.35 m Refusal on gravel	M to W	St		**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
0.5					20/50 mm	
1.0						
1.5						

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V

*
e.g.
B
T

support
M mud N nil
C casing

penetration

water

bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample

V bit no resistance ranging to refusal

10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System

U## HP N N* Nc VS R

consistency / relative density
VS very soft
S soft
F firm
St stiff

HB

undisturbed sample ##mm diameter

hand penetrometer (kPa)

standard penetration test (SPT)

SPT - sample recovered

SPT with solid cone

vane shear; peak/remoulded (kPa)

refusal hammer bouncing

moisture

VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit