



Douglas Partners
Geotechnics | Environment | Groundwater

Report on
Geotechnical, Hydrogeological & Preliminary
Environmental Study

Phase 1 - Western Geelong Growth Area Project
Fyansford & Batesford

Prepared for
McCann Group, Adelaide Brighton Ltd and Ramsey
Property Group

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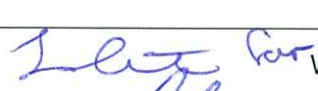
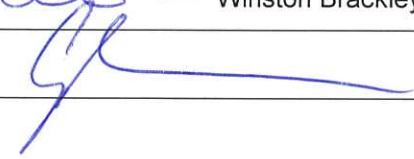
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Executive Summary

This report presents the results of a geotechnical, hydrogeological and preliminary environmental study undertaken for Phase 1 of the Western Geelong Growth Area Project at Fyansford and Batesford in Victoria.

It is understood that the study is to evaluate the feasibility and limitations for the proposed development of the current farming land and quarry to residential, employment, industrial, education and open space uses.

The study area for the combined southern area represented by the McCann Group and Adelaide Brighton Limited covers approximately 2,461 ha as defined by CoGG. The study area for the northern section, represented by the Ramsey Property Group, covers approximately 779 ha as defined by CoGG. Both study areas are dominated by paddocks used for livestock and crop farming.

The Moorabool River runs through the study area and was historically diverted around the northern edge of the Batesford Quarry. Cowies Creek runs along the north east corner of the study area, with the Barwon River running along the southern boundary.

There are overburden stockpiles in the vicinity of the Batesford Quarry.

Large landslips have historically occurred on the banks of the Moorabool River, with smaller slips occurring on the banks of Cowies Creek and the Barwon River.

The study area is underlain by a series of geological units, with Newer Volcanics Basalt and Moorabool Viaduct Sands dominating the near surface materials. Fyansford Formation clay is exposed on the Moorabool River and Cowies Creek banks. This material has historically failed even at relatively shallow slope gradients (1V:3.3H (17°)).

There are 4 geological and geomorphological sites of significance within the study area. These relate to a rotational slump on the bank of the Moorabool River, an exposure of Batesford Limestone, an exposure of Tertiary age deposits and outcrops of granite and epidiorite.

A review of previous geotechnical, hydrogeological, quarry rehabilitation and environmental reports for the study area was undertaken, with comments provided on the findings.

A series of 32 boreholes were drilled over the study area to depths of between 0.35 m and 4.5 m, with three deeper holes in the overburden stockpile areas.

Soil classification geotechnical laboratory testing was undertaken on selected recovered soil samples, in addition to 15 environmental analyses for contamination assessment purposes.

Hydrogeological assessments have been undertaken at the quarry site, with modelling of the existing dewatered conditions and predictions for the final lake level following completion of the quarrying operations and cessation of dewatering. A final lake level of RL 9.6 m AHD has been predicted by Nolan-ITU in their 2002 report.

The lake water quality is likely to be “good” because of the nature of the quarry rock geology as neutral limestone with low metal concentrations, as indicated in the Batesford South, “Summary of Challenges Report for Batesford/Fyansford Further Investigation Area”, 5 April 2013.

The Summary of Challenges document also noted that the flows in “the Moorabool River diversion would be likely to improve following cessation of quarry dewatering. As soon as the lake started to fill then groundwater levels in the immediate vicinity would begin to recover.”

Details of the quarry rehabilitation have been prepared by EarthTech Engineering Pty Ltd in the Rehabilitation Plan for the Batesford Quarry report, updated in 2007. This document has been approved by the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and CoGG. About one third has been completed and it is anticipated that by about the end of 2018 two thirds will have been completed.

Some elevated concentrations of metals above the adopted ecological investigation levels and EPA waste disposal criteria were noted in the environmental laboratory test results. However, these are not considered to represent a risk to current or future uses of the land.

A geotechnical risk mapping exercise was undertaken, and the results are presented graphically in Drawing 102, Appendix B. Similarly, the environmental risks to development are presented in Drawing 102A, Appendix B.

Further discussion on the geotechnical and environmental issues associated with development of the study area are discussed herein.

Further geotechnical, environmental and groundwater field investigation work and risk assessments are recommended to provide site specific information as an input to detailed design in parts of the study area. The further work would specifically target the 3 overburden stockpiles and banks of the Moorabool River, with other investigation works required as per the details shown on Drawing 108 Further Investigation Requirements in Appendix B.

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Appendix B:	Drawing 100 – Site Location Plan Drawing 100A – Site Location Plan with Aerial Background Drawing 101 – Site Investigation Plan Drawing 101A – Classified Site Investigation Plan Drawing 102 – Potential Geotechnical Risks to Development Drawing 102A – Potential Environmental Risks to Development Drawing 103 – Landslide Susceptibility with Geology Drawing 104 – Landslide Susceptibility with Geomorphology Drawing 105 – Potential Moorabool River Crossing Locations with Geotechnical Classification Drawing 105A – Potential Moorabool River Crossing Locations with Shaded Relief Conceptual Road Longitudinal Sections – TGM Drg 15410-99 Sheets 4, 5 and 9 Drawing 106 – Geotechnical Landslide Susceptibility Drawing 107 – Indicative Cross Sections Drawing 108 – Further Investigation Requirements Drawing 109 – Historic Borehole Locations Golder Associates Slope Stability Calculations Drawing 200 – Changes in Dryden Overburden Stockpile Surface Level Relative to Feb 2010 Baseline Levels Drawing 201 – A Line Plasticity Chart Plot Site Photographs
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Report on Geotechnical, Hydrogeological & Preliminary Environmental Study

Phase 1 - Western Geelong Growth Area Project

Fyansford & Batesford

1. Introduction

This report presents the results of a geotechnical, hydrogeological and preliminary environmental study undertaken for Phase 1 of the Western Geelong Growth Area Project at Fyansford and Batesford in Victoria. The study was commissioned in an email dated 14 July 2016 by Michael Gerner of Golder Associates representing the McCann Group, Adelaide Brighton Ltd and Ramsey Property Group and was undertaken in accordance with Douglas Partners' (DP) proposal GGG160023.P.001.Rev1 dated 13 July 2016.

It is understood that the study is to evaluate the feasibility and limitations for the proposed development of the current farming land and quarry to residential, employment, industrial, education and open space uses.

The supplied brief (Northern and Western Geelong Growth Areas Project, Technical Reports – Scopes of Work, May 2016 and File Note, 31 May 2016 both prepared by City of Greater Geelong (CoGG)) indicates that the Phase 1 study should include the following items:

- Current and historical site uses;
- Identification of the existing geomorphology and geology, including soil characteristics and significant geological features;
- Identification of known or potential contaminants, acid sulfate soils, soil aggressivity and salinity;
- Identification of groundwater conditions, existing surface waters and significant hydrogeological features;
- Identification of areas of extensive cut and fill associated with the former quarries;
- Previously identified areas of potential instability, including the overburden spoil heaps, rehabilitation of the Batesford Quarry, dewatering issues associated with the quarry, and geotechnical investigations of the steep slopes on the eastern bank of the Moorabool River and the bank of the Barwon River;
- Previously identified areas of potential instability, including south of Cowies Creek;
- Exploratory drilling at 25 locations in the southern site with an additional five locations added to the northern site; and
- The preparation of a basic landslide susceptibility and hazard zoning map in accordance with the Australian Geomechanics Society document "Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning" Vol 42 No 1 March 2007).

The details of the field work are presented in this report, together with comments and recommendations on the issues listed above.

The study comprised:

- Data review of existing reports and desk top study;
- Review of air photographs and surface topography/geomorphology to assess historical landslides;
- Walkover assessment to view significant geological and environmental features;
- Limited programme of borehole drilling;
- Geotechnical and environmental laboratory testing; and
- Preparation of this report.

2. Site Description

For the purposes of this report, the study area is discussed in two portions designated as the Southern Area and Northern Area as shown on Drawing 100 and 101A in Appendix B.

2.1 Southern Area

The study area for the combined southern area represented by the McCann Group and Adelaide Brighton Limited covers approximately 2,461 ha as defined by CoGG. The area is bounded by the Geelong Ring Road to the east, the Midland Highway to the north, the Merrawarp Road, Friend In Hand Road and Dog Rocks Road to the west, and the Barwon River to the south. See the attached Drawing 100, Site Location Plan in Appendix B. Photographs of some of the site features are also included in Appendix B.

The area is dominated by land used for agricultural purposes that include grazing and growing crops, with associated farms and rural properties. The area also includes two existing quarries, with the largest being the Batesford Quarry in the centre of the study area. Three large overburden stockpiles associated with the quarrying activities are located adjacent to the Batesford Quarry.

The surface elevation varies greatly across the area and ranges between RL 98 m and RL -30 m AHD. The lowest area is the floor of the lake in the eastern section of the Batesford Quarry. The highest area of the area is at the Dog Rocks Flora and Fauna Sanctuary on the western boundary of the area. The natural ground levels typically range between RL 10 m and 80 m AHD.

The Moorabool River meanders in a west to east direction between the Midland Highway and the Batesford Quarry, and then trends in a north to south direction to the east of the quarry. The Moorabool River has been diverted with the construction of the Moorabool River Deviation Channel around the north and east of the main Batesford Quarry. The diversion works were required as the quarry was extended over the past decades.

There is a small basalt quarry towards the Geelong Ring Road near the southern end of the study area. The quarry is up to 25 m deep and has been rehabilitated with vegetation on the northern half by the McCann Group. It is understood that two basalt flows were historically quarried, with a water bearing sandy layer encountered between the flows. There are currently no plans for the McCann Group part of the quarry to be infilled, with the area being set aside as a possible future dump site.

The southern portion of the quarry is currently being infilled by end tipping, with no compaction or dewatering being undertaken.

A former timber treatment yard and current materials recycler with concrete batching plant is located on the southern side of the Hamilton Highway, adjacent to the Geelong Ring Road.

Prior to the field work (Sept 2016), there had been prolonged periods of inclement weather in the wider Geelong area. As a result of the rainfall, there were large areas of saturated ground, particularly on the lower lying areas near the southern end of the site. These were noticeable predominantly in the paddocks to the west and north-west of the former timber yard, where it was only just possible to walk across the saturated ground at the time of the field work.

Overburden Stockpiles

There are three large overburden stockpiles that in addition to other materials contain the excavated spoil from the quarry. Two of the stockpiles are located to the west of the quarry and they are known as the Western and the Balyarta overburden stockpiles. They have approximate footprint areas of 90 and 31 hectares, respectively. The Western stockpile is located directly to the north of the Balyarta stockpile. The top of the Western stockpile is undulating, with the top of the Balyarta stockpile relatively flat and horizontal, both are grass covered. The stockpile side slopes are between 1V:3.1H (18°) and 1V:4.4H (13°).

There is a small worked area in the Western stockpile that is known as the 'dust dump'. This area is to be infilled during the western quarry face rehabilitation works.

The third stockpile is known as the Dryden Stockpile and located to the south of the quarry and has a footprint area of approximately 63 hectares including the side slopes. The approximate heights of the three stockpiles are as follows:

- Western overburden stockpile: between 3 m and possibly 20 m in places due to the undulating natural ground profile beneath the stockpile area;
- Balyarta overburden stockpile: between zero and 20 m, again due to the undulating original ground profile;
- Dryden overburden stockpile: between 15 m and 25 m.

Landslips

A landslide is known to have occurred on the northern bank of the Moorabool River in 1973, near the start of the subsequently constructed Moorabool River Deviation Channel. The slip occurred close to a property that was called Strathire. The slip has subsequently been referred to as the Strathire Slip, although the property has since been demolished. The slip occurred through the Fyansford Clay where the Moorabool River bank had a characteristic slope gradient of 1V:3.3H (17°). Details of the slip are discussed in the Camp Scott Furphy Consulting Engineers 1979 report for the Moorabool River Diversion Reappraisal. The slip is currently visible as hummocky ground in the location shown on Drawing 100, covering an area of approximately 70 m by 40 m in plan.

Another large landslip is known to have occurred in the VicRoads owned land on the eastern bank of the Moorabool River, close to the Geelong Ring Road and near the end of the Moorabool River Deviation Channel. The date of the original failure is unknown and could be pre-1930s, but it is understood that a smaller slip within the large slip area occurred in the 1950's. These slips occurred through Fyansford Clay and have exposed a near vertical escarpment up to 35 m high, with the failures occurring over a plan area of approximately 280 m by 160 m.

The northern and eastern banks of the Moorabool River are dominated by hummocky and undulating slopes, indicating that landslips have historically occurred in these areas. Current river bank slope gradients are between 1V:10H (6°) and typically 1V:4H (14°), with steeper sections of 1V:3.3H (17°) and near vertical in the previous landslip area.

2.2 Northern Area

The study area for the northern section, represented by the Ramsey Property Group, covers approximately 779 ha as defined by CoGG. The area is bounded by the Geelong Ring Road to the east, the railway to the north, the Moorabool River to the west, and the Midland Highway to the south.

The study area, with the exception of roadways and residential areas in the Batesford Township, predominantly comprises paddocks used for livestock and crop farming. Occasional small farms are present, with a winery in the north western corner of the study area. Sparsely spaced large trees were also present with occasional pockets of trees in certain areas.

The Batesford Roadhouse is a fuelling station located on the northern side of the Midland Highway. There is a nursery immediately east of the roadhouse, with a community centre at the junction of the Midland Highway and the Ballan Road.

Covenant College is located on the eastern boundary of the site, with Myers Reserve located to the north. Myers Reserve includes the Bell Post Hill Sport and Recreation Club with a sports oval and netball courts. Myers Reserve is a large and diverse reserve serving the local community. It includes the Bell Post Hill Sport and Recreation Club and has a number of sporting ovals including several soccer facilities, bowling greens, tennis courts, netball court, cricket pitches and a playground.

The Bell Park Sports Club is located at 10 Lynnburn Road, Batesford and provides a purpose built venue for soccer and other recreational activities. The Club has two full size pitches as well as a small sided ground catering for all age groups. The Bell Park Sports Club is also the venue for the Geelong Radio Control Car Club. The Batesford Tennis Courts and community hall are located at 15 Regent Street, Batesford.

Rollins School Batesford campus (primary years 3 and 4) is located at 25 Old Ballarat Road, Batesford.

Cowies Creek meanders along the north eastern edge of the study area, close to the railway line. The creek banks are up to 25 m high with full height gradients of between 1V:7H (8°) and 1V:4H (14°). Localised sections of the lower creek banks have gradients of up to 1H:2.8H (20°). Minor exposure of the underlying soils is evident on the creek banks at tight bends.

The eastern bank of the Moorabool River forms an escarpment along approximately half of the western boundary. The escarpment is up to 45 m high, with slope gradients of up to 1V:3.3H (17°).

3. Geological Setting

The Geological Survey of Victoria 1:63,360 Series Geelong map sheet indicates that the site area is located on a variety of geological units with various aged formations. The Geological units located in the site footprint include:

- **River and Swamp Alluvium Deposits – Quaternary age**
These deposits typically comprise varying combinations of sands, gravels and clays and are predominately located along the Moorabool River;
- **Newer Volcanic Basalts – Quaternary age**
The basalt profile typically comprises high plasticity clay over variably weathered basalt rock. Basalt boulders (floaters) often occur in the clay profile above the rock head. The basaltic plains are located at the northern and southern portions of the study area.
- **Moorabool Viaduct Sands – Tertiary age**
Typically comprise calcareous sand, clayey sand, ferruginous sand and gravel. This unit outcrops in the central portion of the site to the south and west of the Batesford Quarry. Other minor sporadic outcrops are observed over the study area. (Also identified as *Black Rock Sandstone* on some maps).
- **Fyansford Formation / Fyansford Clays – Tertiary age**
The Fyansford Formation typically comprises calcareous sand, sandy clay, silt, marl and sandy limestone. In some instances abundant with bivalve mollusc shells and fragments (brachiopods and pelecypods) may be present. This formation has predominantly been mapped along the northern and eastern sides of the Moorabool river alignment. The geology map also indicates the Fyansford Formation is present in the vicinity of Cowies Creek. (Also identified as *Gellibrand Marl* on some maps).
- **Batesford Limestone – Tertiary age**
The Batesford Limestone has been located at the base of the Batesford Quarry and typically comprises limestone rock, sandy limestone and calcareous sands.
- **Granite – Devonian age**
The “Dog Rocks” granite outcrops to the west of the Batesford Quarry. It is understood the granite extends to the western edge of the active quarry, where it was encountered at the base. This area is now covered with overburden material from the quarrying activities, and the granite is not visible.
- **Greenstone (epidiorite) – Palaeozoic age**
The presence of greenstones in the wider quarry area has been discussed by many parties interested in the history and heritage of the area. Based on anecdotal evidence from the quarry manager, Mark Malone, it is believed the greenstones were historically encountered in the area below the current Western Overburden dump; hence the greenstones are currently not visible. Furthermore, should any greenstones be present on the western edge of the active quarry, they would not be visible, due to placement of overburden in the toe area of the cut face. There is also a possibility that greenstones were encountered in the old quarry on the northern side of the Moorabool River, however, no such stones have been sighted by DP or the quarry manager.

3.1 Geological and Geomorphological Sites of Significance

There are 4 geological and geomorphological sites of significance within the study area. These relate to a rotational slump on the bank of the Moorabool River denoted as Bf3, an exposure of Batesford Limestone denoted as Bf4, an exposure of Tertiary age deposits denoted as Bf5 and outcrops of granite and epidiorite (greenstone) denoted as Bf6. The sites are indicated on Drawing 103 in Appendix B.

As noted above, the greenstones have not been sighted by DP or the Batesford Quarry manager, and their location has only been inferred from the available plans. Furthermore, according to Adelaide Brighton Ltd records, other than in the Dog Rocks area there does not appear to be any evidence of greenstones being found on the quarry site,

4. Hydrogeological Setting

The Department of Primary industries website indicates the study area is underlain by the Western Port basin, near the boundary with the Otway basin.

The underlying aquifers are indicated to be the Quaternary basalt, Tertiary Moorabool Viaduct Sands Tertiary Batesford Limestone and the basement Mesozoic and Palaeozoic Bedrock. The Tertiary age Fyansford Formation is indicated to be an aquitard.

The groundwater table is expected to be in a range between <5 m below ground level (m bgl) and up to >50 mbgl, as indicated on Visualising Victoria's Groundwater website. Groundwater is indicated to be deepest around the edges of the Batesford quarry, mainly beneath the overburden stockpiles.

The surface water bodies are Cowies Creek in the north eastern corner of the study area, and the Moorabool River and Barwon River in the central and southern areas. Regional groundwater flow is anticipated to be towards the south east, although the quarry dewatering works have locally altered the flow direction in the centre of the study area. Subsequently groundwaters are anticipated to flow in the Barwon River to Lake Connemara and then on to the ocean at Barwon Heads.

The Visualising Victoria's Groundwater website lists 34 groundwater monitoring bores within the study area. The bores were drilled to depths of between 7 m and 150 m between 1958 and 2011. No groundwater monitoring results are shown on the website.

5. Review of Previous Geotechnical and Hydrogeological Reports

DP was provided with a variety of previous reports which had been compiled for the land owners for various purposes. A full list of reports is included in the references section of this report.

Several investigations have been completed in, and to the south of the Batesford Quarry. Some of the main issues assessed include the slope stability of the quarry batters and the composition of the overburden mounds located to the west and south of the quarry. Some earlier investigations by Bell Cochrane & Associates (1989-1991) were aimed to assess the feasibility for quarrying basalt to the south of the Batesford Quarry site.

The ground conditions observed in the previous reports are typically consistent with the published geological maps. Investigations to the south and east of the Dryden stockpile found that the soil thickness typically ranged between 1 m and 9 m.

5.1 Quarry Assessment Reports

5.1.1 Slope Stability Analysis

Several assessment reports have been completed for the Batesford Quarry area. The main report for the quarry pit sides is Piper Associates (Piper) 2000 Geotechnical Assessment for Proposed Quarry Face Stabilisation and additional investigation and analysis in 2004. The reports give details of the stability analyses carried out and selection of soil and rock parameters used to generate factors of safety for slope failure. Back analyses were undertaken of the Strathire and 1950's failures, with Piper concluding that the Fyansford Formation clay is highly susceptible to slope failures, even at slope gradients of shallower than 1V:3H. The effective stress parameters used in the back analysis were $c' = 5 \text{ kPa}$ and $\phi' = 20^\circ$ for the lower Fyansford Clay unit. In 2000, Piper suggested slope gradients of 1V:5H should be formed for rehabilitation of the quarry faces formed through Fyansford Formation clay.

Piper also indicated the Fyansford Formation can be divided into 3 separate units, and categorised them as follows:

1. **Upper Unit**

Yellow brown, low plasticity sandy / silty clays, sparsely fossiliferous;

2. **Lower Unit**

Dark grey, high plasticity silty clay with considerable amount of shell fragments; and,

3. **Transition Unit**

Typically comprises interbedded limestone and silty clay bands. This unit is underlain by the Batesford Limestone Formation.

In 2004 Piper conducted an additional geotechnical investigation on the site and reduced the minimum requirements for factors of safety (FOS). They concluded that for rehabilitation of the quarry walls, slopes formed through filling and soil units should be constructed at no steeper than 1V:3H overall slope gradients, for an adopted FOS of 1.2 within the quarry. The minimum FOS of 1.2 had been accepted by the Department of Natural Resources for the quarry walls only. Slopes through limestone could be cut at 1H:1V. A higher FOS of 1.5 was required for river bank slopes.

Piper also concluded that sand drainage layers should be incorporated into remediated quarry walls, to assist with minimising development of pore pressures.

Golder Associates (Golder) undertook an assessment of the stability of the quarry southern escarpment slopes prior to rehabilitation in 2011, with an update in 2012 (Ref Golder report number 097612155-011-R-Rev2). The adopted effective stress parameters were generally higher than those used in the earlier Piper assessments, with the parameters for the lower Fyansford Clay unit at $c' = 9 \text{ kPa}$ and $\phi' = 27^\circ$. The higher parameters were based on statistical analysis of further laboratory tests. Golder discussed a 100 m zone around the perimeter of the quarry in their Summary of Challenges Report for Batesford/Fyansford Further Investigation Area. The 100 m zone was indicated to be the extent of the area beyond the quarry batters where geotechnical consideration for potential impact of development on slope stability is required. The 100 m zone has been included in the red quarry zoning in the potential risks to development plan in Drawing 102, Appendix B.

There have been a variety of values used for the effective stress parameters for the same materials encountered around the quarry. Therefore further work should be undertaken to assess if the materials actually have low effective stress parameters or could there have been other factors contributing to the historical failures through the Fyansford Formation clay material.

A check was carried out by DP using the original March 2000 Piper parameters for the lower Fyansford Clay unit. The check was undertaken on a theoretical 54 m high slope with piezometric surface at both 10 m below the face and at the surface, at a gradient of 1V:3.3H. The slope gradient was based on the fact that the Moorabool River bank failed at this gradient in 1973, near the location of the old Strathire homestead (ref Camp Scott & Furphy 1979 report). The results of the check indicate that further assessment particularly of groundwater should be undertaken, as the FOS is heavily influenced by the piezometric level within the slope. The yearly rainfall for 1973 was the highest ever recorded at the Lovely Banks weather station, at 804.8 mm (ref bom.gov.au historical rainfall). The weather station is located approx. 5 km north of the slip location. Therefore, as previously noted, further work should be undertaken to further investigate the effective stress parameters, groundwater conditions and slope materials of the materials around the banks of the Moorabool River.

A plan showing all of the historical boreholes extracted from the reports listed in Section 15 of this report is presented in Drawing 109, Appendix B.

5.1.2 Batesford Quarry Rehabilitation Plan

EarthTech Engineering Pty Ltd (ET) prepared a Rehabilitation Plan for the Batesford Quarry in 2005 and updated in 2007. This document has been approved by the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and CoGG. The plan states that the pre-1930s quarry should be stripped of overburden and sand up to a maximum depth of 10 m. Subsequently the batter slopes should be cut to 1V:5H through sands and 1V:3H through rock. The remaining quarry walls should be cut so that the overall batter gradients are 1V:3H between the top of the quarry and the quarry floor. Where basalt is present the plan indicates that the batter can be steepened to 1V:1H. The rehabilitation plan requires that a minimum FOS of 1.2 for batter slope stability be achieved for the rehabilitated batters. The slope gradient and FOS recommendations correspond with the 2004 Piper recommendations.

The ET rehabilitation plan indicates erosion management requirements and controls for the quarry side walls during the lake filling process. The erosion management requirements include the use of back slope benches and armoured drainage channels on the batters. Wave action erosion is to be managed through the use of rock rip-rap, gently graded shallow water zones, vegetation and geotextiles.

It is understood that the quarry will not be developed other than flooding for the creation of a lake. However, the areas of land beyond the crest of the quarry walls are planned to be developed and further work needs to be undertaken to establish a suitable offset or buffer zone from the crest for the development to proceed.

Extracts of the factor of safety calculations by Golder Associates from their 2011 report titled Rehabilitation of Southern Escarpment Geotechnical Assessment for the Batesford Quarry are included in Appendix B. These indicate the factor of safety against slope failure for the current lake water level, then at 50% capacity and at the predicted full capacity (RL 9.6 m AHD), at chainage 1600. The Golder analysis reported factors of safety are between 1.3 for the full capacity and 1.8 for the current lake level, above the minimum of 1.2 required in the rehabilitation plan.

The rehabilitation of the quarry faces is proceeding. About one third has been completed and it is anticipated that by about the end of 2018 two thirds will have been completed.

Golder Associates have provided the following comments in relation to the rehabilitation works:

"The batters for the rehabilitated southern and south eastern escarpments are a combination of cut and fill. At the design stage, the stability analysis performed on the proposed batter slopes indicated a factor of safety on stability greater than the required 1.2. Lab testing on undisturbed samples of insitu soil and rock provided design shear strength parameters for use in the stability analysis. Despite lower bound (conservative) parameters being adopted in the analysis, the required factor of safety of 1.2 was comfortably achieved. The fill materials were selected from various in situ sources in and around the edges of quarry. All fill material met the strict selection requirements of the earthworks specification with field test results indicating that the placed fill exceeded the required 95 % compaction rate."

5.1.3 Settlement of Dryden Overburden Stockpile

Survey monitoring by St Quentin Consulting Pty Ltd has been undertaken on the Dryden overburden stockpile, with the results presented in their report titled Dryden Estate Pty Ltd, Ground Settlement Surveillance, Overburden Stockpile, McCanns Lane, Fyansford (2011). Monitoring was based on 20 survey points that were installed over the stockpile and surveyed at varying time intervals over a 6 year period, between 12 February 2010 and 21 January 2016, with the more recent results being supplied in spreadsheet form. The changes in the stockpile surface levels compared to the initial readings on 12 February 2010 are shown in Table 1.

Table 1: Dryden Stockpile Level Changes

Date	Greatest Rise in Surface Level (mm)	Greatest Fall in Surface Level (mm)	Average Change in Surface Level over Whole Stockpile (mm)
11 June 2010	7	2	2 (rise)
10 Nov 2010	8	4	2 (rise)
5 Apr 2011	9	8	1 (fall)
19 Feb 2012	2	12	5 (fall)
27 June 2012	18	11	6 (rise)
20 Dec 2012	4	26	9 (fall)
8 Jan 2014	2 (fall)	26	12 (fall)
12 Jan 2015	4 (fall)	28	14 (fall)
21 Jan 2016	4 (fall)	30	17 (fall)

The greatest rise in the surface level was 18 mm by June 2012 and the greatest fall was 30 mm by Jan 2016. The average Dryden stockpile surface level has fallen 17 mm to date, based on the 20 monitoring point survey results.

The surveyed stockpile level data was plotted by DP. The results do not show any reasonable correlation between the time of year and surface movements. Mean temperature and rainfall data for the Geelong area were also plotted and compared to the stockpile surface level data to assess whether any trends could be observed. Some sections of the compared datasets showed consistencies but the majority of the data did not show any discernible correlation. The Dryden overburden stockpile surface movement relative to the February 2010 baseline readings with mean temperature are shown in Appendix B Drawing 200.

From examination of previous air photos of the area it is understood that the fields over the stockpile have been used to grow crops. It is possible that agricultural plant such as tractors operating in the fields could have disturbed the monitoring points. The movement data was compared to the air photos over the 6 year period in an effort to gauge whether operating plant may have caused diverse surface movements of monitoring points in the paddocks that were being used for cropping during a certain time period, however, no distinct trends were observed.

As the level data was gathered at different times of the year, with the most recent readings at yearly intervals in December or January, it is not possible to correlate the results with the anticipated seasonal shrink-swell movements typical of soils in the area. For a correlation to be established between levels and shrink-swell behaviour, level data would need to be gathered at typically 3 month or more frequent intervals.

5.1.4 Hydrogeological Assessments

Historically, the groundwater in the vicinity of the Batesford Quarry has been lowered by pumping from a series of drives and a well field, as detailed in the Nolan-ITU 2002 Groundwater Level Recovery Investigation report. However, Blake and Associates (Blake) established in the 1980's that recharge to the quarry was primarily from leakage from the Moorabool River, rather than upward leakage from the underlying limestone formation. In 1990 Blake recommended the use of a dewatering sump, which was subsequently adopted and remains in operation today. It is understood the dewatering system discharge approximately 8.5-9 megalitres (ML) of water per day into the Moorabool Deviation channel, maintaining the groundwater level at RL -20 m AHD or deeper in the quarry (ref Dewatering of the Batesford Limestone Quarry, Bell Cochrane and Associates and Roger Blake and Associates, October 2016, Draft report).

Several studies were undertaken by GHD, Pipers, Nolan and others to investigate the feasibility of ceasing dewatering and allowing groundwater to partially fill the quarry, forming a lake in the lower part. Initial assessments indicated the lake would fill to RL 10 m AHD over 13 years (GHD), up to approximately 40 m deep. Subsequently Piper concluded the full supply level would be lower at 7 m AHD. Nolan revised the final lake level to be RL 9.6 m AHD in their 2002 report.

The lake water quality is likely to be "good" because of the nature of the quarry rock geology as neutral limestone with low metal concentrations, as indicated in the Batesford South, "Summary of Challenges Report for Batesford/Fyansford Further Investigation Area", 5 April 2013". Algal blooms are only expected to occur in the early phases of the lake filling, when public access is prohibited as indicated by Nolan-ITS.

The Summary of Challenges document also noted that the flows in "the Moorabool River diversion would be likely to improve following cessation of quarry dewatering. As soon as the lake started to fill then groundwater levels in the immediate vicinity would begin to recover. This recovery would initially be quite rapid in the first few years and would then slow to a more gradual process until the cone of depression dissipates as the lake water level is established (at plus 8 to 9 m AHD), close to the river invert levels." The report continues with "*cessation of dewatering would improve downstream river flow volumes and also would be likely to improve river water quality. Overall the base flows in the Moorabool River would increase and would return to their natural seasonal pattern.*"

Whilst hydrogeological modelling is beyond the scope of this report, it is considered that the previous assessments appear to provide reasonable estimates of the long term lake level. This is based on the Moorabool River bed levels around the quarry being between RL 3 m and RL 5 m AHD, the perched water seepages from parts of the quarry faces at the surface of the Fyansford Formation clayey lower unit, and the anticipated recharge from the underlying confined Batesford Limestone aquifer.

Reference should be made to the flood modelling and assessments being undertaken by Water Technology for parts of the study area that are likely to be susceptible to surface water ponding or shallow perched water.

Infiltration and groundwater recharge was assessed for Barwon Water in the report titled Aquifer Storage and Recovery (ASR), by Sinclair Knight Merz Pty Ltd (SKM) report dated June 2012. Here the Batesford Limestone was assessed through drilling a 150 m deep well in an area between the north east of the current Batesford Quarry and the Moorabool River Deviation Channel. The key findings were as follows:

- The transmissivity and specific yield determined through field investigations were lower than estimated in the SKM Stage 1 desktop investigation.
- The transmissivity identified in the field investigation was between 25 and 75 m²/day compared with 245 m²/day estimated in the desktop investigation.
- The lower than expected parameters could be localised and further field investigations are needed to establish the hydrogeological conditions across the broader site to provide more certainty in the design parameters used for the ASR conceptual design.

Whilst infiltration and groundwater recharge assessment was not undertaken by DP, it is anticipated that the basaltic clay that overlies approximately half of the study area will restrict surface water infiltration to a very low level. The Tertiary age Moorabool Viaduct Sand often contains significant percentages of clay; hence this material is likely to have a similarly low permeability. The underlying basalt rock is often fissured and higher infiltration rates are anticipated where basalt boulders and flows outcrop at ground surface. The Batesford Limestone beneath the majority of the site is anticipated to be suitable for ASR, however, as indicated in the SKM report, further field investigations are needed to confirm this.

5.2 Dust Monitoring

Based on discussions with the quarry manager, Batesford Quarry has a series of dust monitoring stations comprising deposited matter gauges positioned around the perimeter of the site. Site staff also have personal dust monitors. It is understood that no exceedances of personal dust levels have been recorded and whilst occasional high results have been recorded in the perimeter gauges, the dust has not contained calcium carbonate, the main component of the quarried Batesford Limestone.

It is therefore recommended that the current programme of dust monitoring is continued, and records of surrounding farming activities and burning off are kept to allow correlation of possible external dust sources with the exceedances.

5.3 Former Basalt Quarry off Thoona Lane

It is understood that the intent is to completely fill the southern section of the former basalt quarry off Thoona Lane with general spoil. There are no plans for infilling the northern section of the quarry, with the area being set aside as a possible future dump site. The methods and materials used in the filling will influence the potential development options available for the site.

6. Environmental History Investigation

6.1 Site History – Soil Contamination

The agreed scope for the site history investigation comprised:

- Review of available published information on the site, including geological, topographical, soil landscape, flood-levels and acid sulfate soil maps;
- Review of applicable records and documents to assess the potential for contamination at sites within the study area. This comprised a review of aerial photograph records; search of registered groundwater bores in the area; review of dangerous goods and Cathodic protection systems search;
- Review of previous assessments and investigations for the site where available;
- Detailed site inspection to identify areas of potential contamination and assess current site condition and;
- Discussions with personnel familiar with current and previous site activities.

6.1.1 Previous Reports

Most of the previous reports pertained to the southern section of the site and included investigation of site history, hydrogeological conditions, soil contamination and soil vapour issues. The extent of the DP review was intended to provide a high level overview of the site conditions and further review of the reports may be required as future stages of the development progress. The following observations were made from the previous reports as referenced in Section 14 and features are shown on Drawing 100 Site Location Plan:

- The quarry has been in use from 1888 and there are spoil dumps within the quarry land that contain potential waste products at depth. Buried wastes include lime sulphur residue, kiln dust, grease trap waste and scallop shells as discussed in the 2001 Gutteridge Haskins & Davey Pty Ltd (GHD) Quarry Closure Report;
- Some fuel was stored within the quarry site but this is not considered likely to have a regional impact;
- Ongoing dewatering within the pit has resulted in a groundwater drawdown of approximately 27 m in the vicinity of the quarry;
- A former timber treatment yard and current materials recycler is located on Hamilton Highway, Fyansford;
- A small scale sand quarry and backfilling operation is located on the Barwon River in the south eastern corner of the precinct;
- A winery is present immediately off-site to the south west;
- A petrol station and roadhouse is present on the corner of Ross Road and the Midland Highway, Batesford; and
- A winery and grape processing factory known as Littore Winery is present in the north western corner of the study area.

6.1.2 Maps and Registers

Following DP's review of coastal acid sulfate soil risk maps (NRE 2002), DP noted the presence of potential acid sulfate soil along the course of the Moorabool River in the vicinity of the quarry. Further investigation of acid sulfate soils is recommended as part of more detailed studies.

DP made enquires with Energy Safe Victoria, the government body responsible for maintaining a register of cathodic protection systems, which may be used on underground fuel storage tanks (USTs). DP provided the street addresses of individual properties likely to contain tanks including the following sites:

- 200 McCanns Lane, Fyansford (the quarry);
- 315-325 Hamilton Highway, Fyansford (the former timber treatment yard); and
- 495 Ballarat Road, Batesford (the operational Batesford Roadhouse petrol station).

No cathodic protection systems were noted in the database maintained by Energy Safe Victoria. However, notwithstanding the absence of a recorded cathodic protection system, the presence of USTs at the Batesford Roadhouse should be considered highly likely.

6.1.3 Aerial Photographs

DP obtained and reviewed high-level aerial photographs of the precinct from 1947 and from 1990. The selection of these years was made with a view to commenting on the earliest and latest historical aerial images obtainable from the Victorian State Government records (www.landata.vic.gov.au). An additional, more recent aerial image from April 2016 was obtained from Nearmap, and is also referred to in reporting.

In 1947, the site appeared to consist of open grazing land across most of the precinct. Some more intensive agricultural uses are noted in the north western corner, being vineyards associated with the winery which is currently present ("Littore Winery in Figure 100), as well as what appear to be orchards around Bridge Street, Batesford. Some small buildings were noted to be present in the vicinity of the Batesford Roadhouse, but it was not clear if the site was being used for petroleum retailing at this time. The quarry was much smaller in 1947, and was located adjacent to the Moorabool River. In the southern portion of the site, no major buildings were observed immediately south of the Hamilton Highway, indicating that the timber treatment works had not yet commenced operation. The buildings associated with the historic *Frogmore* homestead are noted on the southern fringe of the available aerial photographs.

In 1990, the quarry was noted to have expanded significantly since the earlier photos. The timber treatment yard in Fyansford appears to be operational, with buildings adjacent to the Hamilton Highway and what appear to be large open yards to the south. The sand quarrying adjacent to the Barwon River in the south eastern corner of the precinct is not visible on this aerial photograph. The winery in the north western corner of the precinct is well developed with some evidence of processing facilities being present in their current location. The Roadhouse in Batesford appears to be similar to the present day, but rear yards present in the 2016 Nearmap photograph do not appear to have been constructed at this date.

6.1.4 Site Inspection and Interviews

DP has inspected key areas of the precinct in the presence of Bill McCann and Jim Ramsey who are familiar with the historical uses of the land in the southern and northern areas, respectively. The interviews confirmed the overall findings of the aerial photographs and the previous reports. The following additional areas of potential concern included:

- Fuel storage tanks and maintenance depots within the quarry;
- Fuel storage tanks near a dam adjacent to the quarry manager's residence; and
- Fuel storage tanks in the vicinity of the quarry manager's residence.

None of these areas of potential concern was noted to be of precinct-wide significance for this study.

6.2 Potential for Contamination

Based on review of the available information, the following properties were identified as having a potential for localised contamination:

- Storage and maintenance of heavy machinery along with associated fuels and oils within the quarry site;
- Retailing of fuels at the Batesford Roadhouse;
- Historical timber treatment and current waste recyclers at 315 Hamilton Highway;
- The 3 stockpiles around the quarry: Western, Dryden and Balyarta Overburden Stockpiles. and
- Sand quarry and backfill operation adjacent to Barwon River in the south eastern corner of the precinct.

In addition, it is expected that many of the farming properties and vineyards would have some storage of fuels which may represent localised contamination sources. The same localised potential would also apply to storage and application of agricultural chemicals as well as cattle yards and stock dips. However, these features are not considered to be significant on a precinct-wide level but should be the focus of more targeted investigations in the future.

7. Field Investigation

The field work was performed during the period from 9 to 28 September 2016 and involved the drilling of 31 boreholes (BH01 to BH31). Three of the boreholes (BH07, BH12 and BH13) were completed on the overburden spoil mounds to depths of between 14.3 m and 16.3 m. The other boreholes were drilled to depths of between 0.35 m and 2.7 m.

The test locations are shown on Drawing No. 101 and 101A, Appendix B. The symbols for the boreholes in Drawing 101A have been classified by completed depth.

The positions of the boreholes were selected with the objective of investigating the near surface soils of the geological units indicated to be present within the study area and also to provide preliminary information on the composition of the 3 overburden stockpiles around the Batesford Quarry.

Suggested borehole positions were initially presented in DP's proposal GGG160023 and were subsequently adjusted in consultation with the current main landholders (McCann Group, Adelaide Brighton Ltd and Ramsey Property Group) and CoGG. Adjustments were required due to access issues (mainly boggy ground conditions), lack of individual landowner permissions and presence of underground services. Whilst some boreholes had to be relocated, the original investigation objectives were still met.

During the fieldwork three drilling rigs were used. Borehole BH07 was drilled using a track mounted Comacchio GEO205 drilling rig and was advanced using sonic drilling techniques. Boreholes BH12 and BH13 were drilled using a track mounted GeoProbe drilling rig and were advanced using direct push tube and solid flight auger drilling techniques. The remaining shallow boreholes were completed using a trailer mounted direct push tube drilling rig. Dynamic Cone Penetrometer (DCP) tests were also completed at all of the shallow borehole locations. Both the sonic and direct push tube drilling methods produce continuous soil core sample. Continuous soil core samples from the deep boreholes were boxed / sealed onsite and stored in DP's Geelong office. Disturbed and environmental sub samples were also collected.

The boreholes were backfilled with remaining drill cuttings and surface plugged. Borehole coordinates were recorded with a hand held GPS unit referenced to UTM Zone 55 on the WGS 84 datum. Borehole collar levels were interpolated from available level survey data to an estimated accuracy of +/- 0.5 m.

The field work was supervised by a DP engineer who was responsible for client and individual land owner liaison, field work co-ordination, logging of the strata encountered, sampling and sample handling.

General photographs of the field work are presented in Appendix B.

8. Field Work Results

8.1 Ground Conditions

The subsurface conditions encountered in the boreholes were generally consistent with those expected from published geological data. With the exception of the overburden stockpiles, minor areas of shallow filling were encountered but the majority of the study area surface materials consisted of natural surface soils.

Three overburden stockpiles located to the west and south of the Batesford Quarry are the result of placing quarried spoil and other waste materials, such as lime sulphur residue, kiln dust, grease trap waste and scallop shells (GHD 2001 Quarry Closure Report).

Details of the drilling, sampling and description of the conditions encountered in the boreholes are presented on the borehole logs in Appendix C. The borehole logs should be read in conjunction with the notes 'About this Report' and accompanying explanatory notes contained in Appendix A.

As there are a range of geological units over the study area, the site has been split into three smaller areas in an effort to simplify and group the ground conditions encountered. The Northern area is located to the north of the Midland Highway. The Southern area has been allocated south of the Fyansford – Gheringhap Road and the Hamilton Highway. The Central area is located between the Northern and Southern areas. The inferred stratigraphic sequences, general descriptions and classification of the main units encountered during the site investigation are discussed below in increasing depth order for each of the respective sections.

8.1.1 Northern Area (BH26-30)

In the Northern section a total of 5 boreholes were completed to depths of between 0.6 m and 2.5 m. The materials encountered can be summarised as:

- **Unit 1: Topsoil** – Silty clay, clayey silt, firm to stiff, dark brown, moist;
- **Unit 2: Silty Clay (CH)** – Varies between stiff to hard, grey, red brown and pale grey, high plasticity, occasional basalt cobble or calcareous bands (inferred Basaltic clay); and
- **Unit 3: Silty Clay (CI - CH)** – Very stiff to hard, pale brown, yellow brown, some fissuring observed (inferred Fyansford Formation).

Three of the five boreholes were discontinued when they refused on inferred basalt cobbles or boulders. Weathered basalt gravels (inferred weathered rock head) were observed in borehole BH 29.

8.1.2 Central Area (BH01-BH15, BH17-BH20, BH31-BH32)

In the central section a total of 21 boreholes were completed. Four of the boreholes were completed in overburden stockpile areas (BH07, BH08, BH12 and BH13) and were extended to depths of between 1.45 m and 16.2 m. The remaining boreholes were drilled in areas away from the stockpiles and were drilled to depths between 0.8 m and 4.5 m.

The materials encountered in the non-stockpile boreholes can be summarised as:

- **Unit 1: Filling / Topsoil** – Silty or sandy clays, clayey or silty sands, clayey gravel, typically firm to stiff / medium dense, dark brown, grey, typically damp to moist;
- **Unit 2: Silty Clay (CL – CI), Clayey Sand (SC)** – Firm to stiff, loose to med dense, brown, dark brown, yellow brown, orange brown, grey, typically fine grain sand (inferred alluvium deposits);
- **Unit 3: Silty Clay (CH)** – Varies between firm to very stiff, grey, dark grey, red brown, yellow brown and brown grey, high plasticity (inferred Basaltic clay). At some locations the clays were underlain by clayey gravel (inferred weathered basalt). Six of the twenty one boreholes were discontinued when they refused on inferred basalt cobbles or boulders;
- **Unit 4: Silty Clay (CL - CI), Sand (SW)** – Stiff to very stiff, dense, orange brown, yellow brown, red mottling, sand content was typically fine to medium grained (inferred Moorabool Viaduct Sand); and
- **Unit 5: Silty Clay (CI - CH), Clayey Silt (ML), Clayey Sand (SC)** – Very stiff to hard, medium dense, yellow grey, grey, brown, pale brown, occasional calcareous nodules, some fissuring observed (inferred Fyansford Formation).

The subsurface materials returned from the boreholes completed in the overburden stockpile footprint areas comprised filling that generally consisted of silty clay, with some bands of sandy clays and gravelly clays. Some silty sands zones were also observed within the filling. With the exception of BH08, the clay materials were generally very stiff with occasional firm to stiff and hard zones. The clay filling encountered in BH08 was of firm consistency. Shell fragments were found in the filling in borehole BH13 at 13.5 m depth.

8.1.3 Southern Area (BH16, BH21-BH25)

In the southern section a total of 6 boreholes were completed to depths of between 0.35 m and 2.7 m. The materials encountered can be summarised as:

- **Unit 1: Topsoil** – Clayey silt, silty sand, sandy silt, soft to firm, loose, dark brown, brown, grey, moist to wet;
- **Unit 2: Silty Clay (CL)** – Stiff, dark brown (inferred alluvium deposits); and
- **Unit 3: Silty Clay (CH)** – Varies between stiff to hard, occasional firm areas, yellow grey, grey, brown and orange brown, high plasticity, occasional basalt cobble or calcareous nodules (inferred Basaltic clay).

Two of the six boreholes were discontinued when they refused on inferred basalt cobbles or boulders. Weathered basalt gravels (inferred weathered rock head) were observed in BH16.

8.2 Groundwater

Groundwater was not encountered during the DP investigation. Previous investigations undertaken around the Batesford Quarry area reveal the groundwater has been locally lowered as a result of dewatering the quarry (ref Nolan-ITU 2002 Groundwater Level Recovery Investigation), with levels at between RL -28 m and -31 m AHD. Groundwater monitoring standpipes installed around the quarry were monitored and the results provided to DP. These indicate that the groundwater in the vicinity of the quarry is at an RL of between approximately -20 m and -27 m AHD (Sept 2016).

9. Laboratory Testing

Selected soil samples were submitted to the DP NATA registered soil laboratory for a range of tests, which included the following:

- Moisture Content; and
- Atterberg limits.

Selected samples were also submitted to a third party laboratory, ALS Environmental, for assessment of electrical conductivity and boron content. Results of the ALS laboratory testing are summarised in Table D1, Appendix D. Additional soil contamination testing was also undertaken and results are discussed in Section 10.

Test certificates and a summary table of the results are presented in Appendix D.

The results indicate a wide range of results, with recent alluvium deposits having both low and high plasticity index values. The basaltic clay tests indicate intermediate and high plasticity material, with the Moorabool Viaduct Sands being high plasticity. Two distinct groups of Fyansford Formation clays were identified, with intermediate and high plasticity results. It is likely that the higher plasticity results correspond with the lower unit of the Fyansford Formation clays, however, further detailed testing would have to be undertaken to verify this.

The results have also been plotted on an A line plot, as indicated in Drawing 201 in Appendix B.

10. Preliminary Contamination Investigation

10.1 Environmental Soil Sampling

During the geotechnical investigation, standard environmental sampling procedures, as outlined in DP's 'Field Procedures Manual', were employed and can be summarised as follows:

- Soil samples were collected from the continuous tube samples using disposable gloves (a new pair of gloves was used for each sample collected);
- Labelling of laboratory-prepared glass sample containers with individual and unique identification details including project number, sampling date, borehole number and sample number;
- Placing samples into prepared glass jars and storing in a cooled, insulated and sealed container;
- Transportation of samples to a National Association of Testing Authorities (NATA) registered testing laboratory under chain-of-custody documentation for subsequent testing of selected samples.

Environmental samples were collected from various depths at selected sampling locations as shown on the borehole logs, Appendix C.

10.2 Environmental Laboratory Testing

Fifteen representative soil samples were selected for environmental analysis at ALS Environmental in Scoresby. All analyses were conducted within the holding times recommended by EPA Victoria publication IWRG701, *Sampling and Analysis of Waters, Wastewaters, Soils and Wastes*, June 2009. Table 2 presents the environmental analytical program undertaken. The analysis suite was agreed with the client and was intended to provide a high level overview of potential contaminants of concern.

Table 2: Environmental Analytical Program

Sample ID	Sample Depth (m bgl)	Sample Type	Analysis
BH01-1, 0.3-0.45 m	0.3-0.45 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH03-1, 0.3-0.4 m	0.3-0.4 m	Natural	EPA Screen ²
BH04-1, 0.3-0.4 m	0.3-0.4 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH06-1, 0.2-0.3 m	0.2-0.3 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH07-1, 0.4-0.5 m	0.4-0.5 m	Filling	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH09-1, 0.3-0.4 m	0.3-0.4 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH14-1, 0.5-0.6 m	0.5-0.6 m	Natural	pH, SO ₄ , Cl, EC
BH15-1, 0.4-0.55 m	0.4-0.55 m	Filling	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH16-1, 0.3-0.45 m	0.3-0.45 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH19-1, 0.2-0.3 m	0.2-0.3 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH23-1, 0.35-0.5 m	0.35-0.5 m	Natural	EPA Screen ²
BH24-1, 0.1-0.3 m	0.1-0.3 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH26-1, 0.05-0.2 m	0.05-0.2 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH28-1, 0.1-0.25 m	0.1-0.25 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC
BH29-1, 0.05-0.2 m	0.05-0.2 m	Natural	Metals ¹ , TRH, PAH, pH, SO ₄ , Cl, EC

¹ metals analysis comprised arsenic, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, tin, selenium, silver and zinc

TRH = Total Recoverable Hydrocarbons

PAH = Polycyclic Aromatic Hydrocarbons

EC = Electrical Conductivity

SO₄ = Sulfate

Cl = Chloride

² EPA Screen consists of an IWRG 621 Table 2 Screen which comprises metals (arsenic, cadmium, chromium (VI), copper, iron lead, mercury, molybdenum, nickel, tin, selenium, silver and zinc), total cyanide, total fluoride, speciated phenols (halogenated and non-halogenated), monocyclic aromatic hydrocarbons (including benzene, toluene, ethyl benzene and xylenes known as BTEX), PAH, TRH, polychlorinated biphenyls (PCB), chlorinated hydrocarbons (volatile and semi-volatile) and organochlorine pesticides (OCP).

Tabulated test results are provided in Tables D1 and D2, Appendix D. The NATA endorsed laboratory test certificates and chain of custody documentation are also included in Appendix D.

10.3 Soil Assessment Criteria

To provide a preliminary assessment of the suitability of soils to remain onsite for the proposed mixed land uses, environmental laboratory results were compared to Health Investigation Levels (HILs) presented in the National Environment Protection Council *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as amended 2013 (SCEW 2013). The HILs are scientifically based, generic assessment criteria designed to be used in the first stage of an assessment of potential risks to human health from chronic exposure to contaminants. They are intentionally conservative and are based on a reasonable worst-case scenario for four generic land use scenarios. DP has compared soil data to the most sensitive of the potential uses, standard residential criteria known as HIL-A. Similarly to the health investigation levels, Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) were also selected from the NEPM. For the purposes of this precinct-wide study, added contaminant limits were adopted as the EILs as there were no background samples taken. It is recommended that future smaller scale studies include consideration of background concentrations.

For the assessment of the risk of vapour intrusion from petroleum hydrocarbons, DP adopted the NEPM Health Screening Levels (HSLs) for clayey soil from Table 1A(3) of the NEPM, as well as standard residential land use, and vapour intrusion criteria presented in the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE, 2011) *“Technical Report No. 10 - Heath Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater”*.

If soil is to be removed from a site, it is classified as a waste material in accordance with EPA Publication IWRG621 June 2009, *Soil Hazard Categorisation and Management*, which is the current guideline used to assess soil prior to off-site disposal. Under the IWRG621 guideline, soil can be classified into one of four categories based upon its relative hazard. From least to most contaminated, the categories are:

- Clean Fill Material;
- Category C contaminated soil;
- Category B contaminated soil; and
- Category A contaminated soil.

Further information on each category can be found in the IWRG621 guideline. It is noted that the sampling locations were broadly spaced across a large area and any classifications are indicative only. Further testing is recommended for proposed excavation works including calculation of statistics for the specific domain(s) applicable at the site, rather than the indicative precinct-wide comments provided herein.

In addition to the contamination specific investigation levels, pH, sulfate, chloride and electrical conductivity results were compared to Australian Standard AS2159-2009 *Piling – Design and Installation* as an indicator of soil aggressivity.

10.4 Contamination Assessment Results

10.4.1 Human Health Investigation Levels

All soil laboratory results were below the most sensitive human health investigations for standard residential use. However, it should be noted that none of the identified possible localised contamination sources were targeted for sampling and analysis. Sampling at those locations, such as the Batesford Roadhouse site, may produce results significantly different from what has been identified herein.

10.4.2 Ecological Investigation Levels

Exceedances of the adopted EILs were noted for copper, manganese and nickel in various individual samples:

- Sample BH04-1, 0.3-0.4 m recorded a copper concentration of 360 mg/kg, in excess of the EIL for sensitive residential landuses of 130 mg/kg;
- Sample BH28-1, 0.1-0.25 m recorded manganese at 880 mg/kg, above the default ecological investigation level of 500 mg/kg; and
- Samples BH04-1, 0.3-0.4 m and BH28-1, 0.1-0.25 m recorded nickel concentrations of 120 mg/kg and 98 mg/kg respectively, above the residential level EIL of 86 mg/kg.

All individual exceedances were reported in natural soil and at this stage, it is considered that the range of analytes recorded were within the naturally-occurring range. To provide an indication of the overall variation in results, DP calculated the 95% Upper Confidence Limit of the mean concentration (95% UCL) for these three potential contaminants. The 95% UCL for copper was 147 mg/kg, for manganese 360 mg/kg and for nickel 57 mg/kg. Therefore, on the basis of the statistical analysis, only copper results were above the adopted investigation level.

10.4.3 Waste Disposal Criteria

Comparison of soil laboratory results to EPA Victoria Soil Hazard Categorisation criteria identified the following:

- Samples BH16-1 and BH26-1 recorded arsenic concentrations of 46 mg/kg and 21 mg/kg respectively, above the EPA clean Fill Material limit of 20 mg/kg. The 95% UCL was calculated to be 19 mg/kg and was within the range of clean Fill Material
- Sample BH04-1, 0.3-0.4 m recorded a copper concentration of 360 mg/kg, in excess of the EPA clean fill material limit of 100 mg/kg. The 95% UCL was 147 mg/kg, preliminarily within the range of Category C contaminated soil;
- Sample BH28-1, 0.1-0.25 m recorded manganese at 880 mg/kg, above the default ecological investigation level of 500 mg/kg; and
- Samples BH04-1, 0.3-0.4 m and BH28-1, 0.1-0.25 m recorded nickel concentrations of 120 mg/kg and 98 mg/kg respectively, above clean Fill Material limit of 60 mg/kg. The 95% UCL was 57 mg/kg and within the range of clean Fill Material.

However, DP also notes that the guidelines for waste soil categorisation also make allowance for naturally-occurring elevated concentrations in natural soils, in which case exceedances of the Clean Fill Material limits may not, necessarily, cause waste soils to be classified as Category C contaminated soil.

DP also notes that moderately alkaline pH readings of 9.3 and 9.6 were noted in BH04-1 and BH07-1, which although marginally outside of the acceptable range of 4-9, are not considered to represent contamination. Further investigation of pH values is recommended in the vicinity of these boreholes.

10.4.4 Soil Aggressivity

Results for pH, sulfate and chloride were compared directly to the aggressivity criteria in AS2159-2009 (Standards Australia 2009). All results were within the range of non-aggressive to both concrete and steel. Testing was also undertaken for electrical conductivity and a conversion was applied to estimate the soil resistivity as an additional factor applying to steel piles. Resistivity results for the majority of the samples supported the non-aggressive classification derived from pH, sulfate and chloride results. However, resistivity results for BH24-1 were within the range of mild classification for soils above the groundwater table. Further investigation is suggested in the vicinity of BH24 if steel piles are proposed.

10.5 Preliminary Contamination Investigation Conclusions and Recommendations

Based on the results of the initial testing, no significant soil contamination was detected in the test samples. However, as noted previously, specific sources of potential localised contamination including the Batesford Roadhouse, historical timber treatment works and individual fuel storage facilities could not be targeted in the intrusive investigations. The lack of apparent contamination in soil at the locations investigated should not be interpreted as indicating that the entire investigation area is free of contamination.

Some elevated concentrations of metals above the adopted ecological investigation levels and EPA waste disposal criteria were noted. However these are not considered to represent a risk to current or future uses of the land. Progressive further stages of investigation should be undertaken as proposals for potential redevelopment of the area are considered. Where natural soils have been sampled and analysed, metals concentrations may be considered to potentially represent natural background concentrations.

Based on the existing information as well as collection of additional sources of site history, the properties listed in Table 3 were identified as having a potential for localised contamination:

Table 3: Potential for Contamination

Potential for Contamination	Location
High	Retailing of fuels at the Batesford Roadhouse;
High	Historical timber treatment and current waste recyclers at 315 Hamilton Highway.
Medium	Storage and maintenance of heavy machinery along with associated fuels and oils within the quarry site.
Medium	The 3 stockpiles around the quarry: Western, Dryden and Balyarta Overburden Stockpiles.
Medium	Sand quarry and backfill operation adjacent to Barwon River in the south eastern corner of the precinct.
Low	Remaining sections of the study area.

It is recommended that further investigation of these individual properties should be undertaken at a later date if the sites become rezoned or a change of use is proposed.

DP also advises that under the provisions of Ministerial Direction No 1 (pursuant to s12(2)(a) of the *Planning and Environment Act 1987* the Planning Authority for the area may impose an Environmental Audit Overlay (EAO) to the site or parts of the site, given that they are likely to be considered “potentially contaminated”. The Planning Practice Note (PPN) *Potentially Contaminated Land* (2005) provides guidance on previous site activities to which an EAO may be applied. Included in that category of land uses (listed in Table 1 on the PPN) are “service stations and fuel storage” and “mining and extractive industries”, among others. The site history indicates that these two activities have occurred, and it should be considered that an EAO may be applied to the Batesford Road House site and quarry area.

Redevelopment of the quarries, roadhouse and historical timber treatment yard sites will need to be undertaken following conventional planning, assessment and remediation methods in accordance with EPA and local council guidelines. Along with contaminated soil investigation, potential acid sulfate should also be investigated in the vicinity of the Moorabool River alignment.

11. Proposed Development

It is understood that the following development options are being considered for the proposed precinct:

- Residential housing, both low and high density,
- Employment, business and retail areas,
- Industrial,
- Education precincts including schools and potentially a university,
- Internal roadways with a north-south crossing over the Moorabool River,
- Public areas, reserves, parklands, walking trails, ovals;
- Wetlands and retarding basins, and
- A lake in the current Batesford Quarry, as shown in Drawing 107 Indicative Cross Sections in Appendix B.

12. Geotechnical Comments

12.1 Appreciation of Ground Conditions

The study area is dominated by basalt plains and Tertiary Moorabool Viaduct Sands. These geological units have been widely developed on in the surrounding Geelong and Melbourne suburbs, and the risks associated with their geotechnical performance are well understood by local practitioners.

The exposures of Fyansford Formation clay (Gellibrand Marl) in the Moorabool River escarpment will require careful consideration prior to development in these areas. Landslides have occurred through these materials, and extensive evidence of such failures is visible along the northern and eastern bank of the river as it flows around the Batesford Quarry.

The filling encountered within the overburden stockpiles comprises of a wide range of materials from silts and clays to basalt and limestone, with shells occasionally encountered. Details regarding the fill placement are not known, and given the variability of the stockpile filling, it should be considered as uncontrolled filling. The limited boreholes drilled within the stockpiles indicate the filling to have some degree of compaction. However, there has been some minor settlement of the Dryden overburden stockpile over the 6 year period that detailed surface level monitoring has been undertaken. While there are various methods that are available for building development on the stockpiles, further geotechnical assessment of the stockpiles will need to be undertaken prior to development in these areas.

The river valley materials encountered adjacent to the Barwon and Moorabool rivers are dominated by silty clays and clayey sands. Fyansford Clay (Gellibrand Marl) is indicated on the geology map in the vicinity of Cowies Creek, however, the material may not be as extensive as indicated and further assessment and mapping is required in this area. Such further assessment and mapping should be undertaken for development within 50 m of Cowies Creek. In addition, further assessment and mapping should be undertaken for development within 50 m of any areas indicated to be underlain by Fyansford Clay (Gellibrand Marl), as indicated on Drawing 103 (pink shaded areas with code Ntg).

12.2 Potential Geotechnical and Environmental Risks for Development

Drawings 102 and 102A in Appendix B show a graphical representation of the potential geotechnical and environmental risks respectively identified in the study area. These are defined below.

12.2.1 Geotechnical Risks

Green – no significant geotechnical issues identified for development

These areas are essentially flat and horizontal sections of the study area, and include areas of ground with slope angles of up to 3° (gradients of no steeper than 1V:19H). The underlying ground conditions in these areas are basalt plains, alluvial plains and the Dog Rocks granite dome.

For residential development to proceed in these areas, it is anticipated that the geotechnical risks on individual lots may be assessed using conventional lot classification techniques undertaken in accordance with AS2870-2011.

Geotechnical assessment for other infrastructure should proceed following the guidelines in the Infrastructure Design Manual (IDM), currently up to Version 5, dated Sept 2016 (Ref 4).

Amber – Some geotechnical issues will require further geotechnical investigation

These areas are defined by moderate slope angles of between 3° and 11° (gradients of between 1V:19H and 1V:5H), river valley areas, overburden stockpiles and colluvial slopes. Some minor sections of slopes steeper than 11° may be present in parts of these areas.

For development to proceed in these areas, further geotechnical assessments in addition to complying with AS2870 and the IDM are required. Such assessments could comprise estimating long term settlements of the proposed development through identifying the consistency of the underlying ground conditions, establishing the thickness of alluvial materials, establishing the possible run-out extent from adjacent slope failures in the river banks / escarpments or undertaking landslide risk assessments. The possibility of foundation solutions more complex than conventional slab on ground should also be allowed for. Regrading of steeper slope sections may also be required if the underlying materials are identified as being susceptible to long term movement at current slope angles.

It should be noted that the Western, Balyarta and Dryden overburden stockpiles are currently classified as amber geotechnical risk category. This category has been assigned assuming development of the areas will occur using conventional piled founding solutions. Should the areas be intended for development for primarily residential properties using shallow founding solutions, the three stockpile areas should be reclassified to red, as complex settlement analysis and ground improvement works will be required.

Red – Complex geotechnical issues will require further geotechnical investigation

These areas are dominated by steep slopes with angles greater than 11° (batters steeper than 1V:5H), slopes greater than 5 m in height, escarpments, areas of known landslides and quarries.

For development to proceed in these areas, additional detailed investigation will be required. This could include the drilling of deep geotechnical boreholes, the installation of piezometers to assess pore water pressures, extensive laboratory testing, detailed slope stability analysis and the installation of ground movement monitoring equipment such as inclinometers. It is likely that deep piled solutions, substantial retaining structures and/or significant regrading of slopes to shallower gradients will be required to ensure the long term stability of developments in such areas.

12.2.2 Environmental Risks

Environmental risks are discussed in Section 10.5 of this report.

12.3 Areas of Significant Uncertainty

Drawing 108 in Appendix B indicates the areas of uncertainty and areas where further investigation is required. The areas highlighted in red should be considered as areas of significant uncertainty.

12.4 New Moorabool River Crossing Locations

It is understood that a river crossing from the Midland Highway south over the Moorabool River and into the central portion of the study area is to be constructed. While a wide range of issues will influence the preferred location, the following options are discussed from a strictly geotechnical perspective, with indicative locations presented in Drawings 105 and 105A, Appendix B:

Option 1

Approach road and river crossing south of the existing Moorabool Valley Chocolate Café at 320 Ballarat Rd. Here the topography is relatively shallow, with the steepest slope at about 11° (1V:5H). However, Fyansford Formation clay is present in this area; hence, detailed slope stability analysis would be required to confirm the underlying ground could support an embankment or be stable if a cutting was required.

Option 2

Approach road and river crossing south of the Geelong-Ballan Road, through area of vegetation. The remains of a historical access track to the former Strathire property exist in this area. There is basalt exposed in the upper sections of the slope, however, the thickness is not known. Lower down the slope, Fyansford Formation clay is also present.

Option 3

Approach road and river crossing in area of Pre-1930s quarry. It is understood that the rehabilitation plans for this area involve trimming the current escarpment face back to a stable angle and side casting of the cut material. The trimming would remove the over steepened section of the quarry face such that the overall slope gradient would be at typically 1V:4H, with the toe level at approximately RL 30 m AHD. This would result in a slope face that could be locally cut to provide a flatter gradient for an approach road, however as with Option 1 and 2 there is Fyansford Clay here, so detailed stability analyses would need to be undertaken to confirm the stability of cut slopes.

Option 4

Approach road and river crossing in vicinity of the property at 600 Ballarat Road, Batesford, on shallower gradient land. This option would involve crossing the Moorabool on the shallower gradients of typically 1V:5H in the land west of the Pre-1930s quarry. However, as with the first three options the Fyansford Clay is still present in this location.

Regardless of which location is ultimately chosen, careful consideration will need to be given to the approach road gradients, bridge deck flood level and river bank stability. Detailed geotechnical investigation will be required to assess founding options, which should involve at least one borehole at each abutment and at any pier location.

12.5 Possible Future Uses of Overburden Stockpiles

It is understood that development of the three existing overburden stockpiles (Western, Balyarta and Dryden) is being considered. Based on the findings of the limited investigation undertaken as part of this study, the results indicate that whilst the overburden dumps are not formed of engineered or controlled filling, some degree of compaction the material has occurred. This may have been during placement and/or consolidation under self-weight with time. There is evidence that a variety of materials were dumped in the stockpiles (ref GHD 2001 Quarry Closure Report), and most of these materials have not been identified during the investigations undertaken to date. Therefore, it is suggested that prior to finalising detailed options for development of the overburden stockpiles, further investigation should be undertaken. Such investigations could comprise the use of cone penetration tests (CPTs) with a mechanical cone to measure cone resistance, laid out over a closely spaced grid (say 50 m by 50 m initially). Should weaker areas of filling be identified including evidence of grease trap waste, further CPTs could be undertaken to delineate the extent of the weaker area. Further investigation works using a variety of ground investigation techniques will be required.

Once more information is known about the composition and consistency of the overburden stockpiles, possible development options could include multi-level buildings with piled founding solutions or low rise structures supported on shallow footings following ground improvement works. Heavily loaded structures would need to be supported on deep piles socketed into the natural underlying materials. Some ongoing settlement of roadways and car parking areas founded within the filling should be anticipated. Differential settlement would potentially be noticeable between the piled structures and shallow founded roadways and parking areas in the long term.

For low rise structures, a certain depth of material from the stockpiles could be stripped to unload the surface and lightweight flexible structures, including residential buildings, could be constructed on the overburden stockpiles. The lightweight structures would require an engineer designed founding solution, such as a stiffened raft slab to accommodate differential settlement. The use of impact rolling could assist with compacting the upper 2 m to 3 m of soil to alleviate soft spots and reduce the potential for long term differential settlement. The long term settlement of structures founded on shallow footings would be assessed once the results of further investigation works are known.

DP has provided geotechnical design advice for developments on similar uncontrolled filling sites. These include the development at Victoria Gardens, Richmond that is underlain by up to 16 m of uncontrolled filling. On this site heavy structures were founded on piles and ground improvement was undertaken for at grade car parks. Preloading has been recommended by DP for several other projects, although these have not commenced construction to date.

DP provided geotechnical design advice for the construction of a large warehouse in Box Hill. The structure was founded on pad footings in uncontrolled filling that was compacted using impact rolling. The floor slab was ground bearing and tight differential movement tolerances had to be met.

DP is also aware of several other developments constructed on uncontrolled fill sites around Melbourne:

- The Edgewater estate in Maribyrnong was successfully constructed on up to 14 m of compressible Coode Island Silt. Here initial settlement estimates were prepared by DP and Coffey Geosciences designed and monitored preloading of the compressible material.
- Coffey also provided design and construction advice for a new sporting complex in Port Melbourne that was located on an old industrial landfill. The use of piles was employed for the more heavily loaded structures, while impact rolling was used to densify the upper parts of the filling for lighter structures, pavements and sports fields.
- Golder Associates Pty Ltd has provided geotechnical design services for several residential developments involving the surcharging of areas of uncontrolled fill and measuring settlements. The sites included one in Cheltenham, one in Tooronga and two in Docklands.

12.6 Site Classification to AS 2870-2011

A site classification in accordance with AS2870-2011 provides for the selection of standard footing systems based on the reactivity of the subsurface profile. The site classification for a particular allotment will depend on the presence, thickness and nature of the filling and the reactivity of the natural clays. Different site classifications will apply for similar types of structures depending on the particular subsurface conditions. For this reason, individual allotments should be subject to a specific site investigation to allow classification and assessment based on the actual subsurface conditions.

For the natural ground conditions (i.e. where filling is less than 0.4 m thick or cutting is less than 0.5 m deep) and following Appendix D of Australian Standards AS 2870-2011 (Table D1 and Figure D2), a site classification of Class H2 is considered applicable for preliminary assessment purposes for the basaltic clays >1.5 m thick and Moorabool Viaduct Sands. A characteristic surface movement (y_s) in the range of 60 mm to 75 mm applies to Class H2 sites. A site classification of Class M is considered applicable for preliminary assessment purposes for the shallow soils around the granite dome and where the basalt is shallow (≤ 0.6 m deep). A characteristic surface movement (y_s) in the range of 20 mm to 40 mm applies to Class M sites. Where uncontrolled filling is present (i.e. the overburden stockpiles), a site classification of P would apply.

Site classification also needs to consider the effects of site works in accordance with Section 2.5 of AS 2870-2011. Where cutting is to exceed 0.5 m depth or filling is to exceed 0.4 m thickness, the impact of such works can result in more severe classifications where reactive clay soils are used as engineered filling, which should be assessed based on the particular circumstances.

Where filling comprises low reactive materials, such as clayey sands, weathered siltstone or non-descript crushed rock, the site classification may remain unchanged from the natural classification or a lesser classification can apply if there is a sufficient thickness of low reactive fill overlying the natural clay.

Shrink swell testing should be undertaken to assist in the assessment of characteristic surface movements and individual site classification.

12.7 Excavation Conditions

Predominantly clayey and sandy conditions are anticipated for dry excavations to depths of up to about 3 m over the majority of the study area. Excavation of these materials should be readily achievable using conventional earthmoving equipment, such as backhoes or excavators. Cobble and boulder sized basalt could be encountered within the clay profile above the rock head, requiring either local over-excavation or removal using hydraulic rock breakers, particularly in confined situations, to reduce the amount of over-break.

Shallow rock is likely to be encountered around the Dog Rocks Flora and Fauna Sanctuary and in the northern basaltic plains area. The depth to basalt rock can vary substantially over relatively short distances and it could occur at depths above and below the ranges encountered in the boreholes. An estimate of the areas on site where shallow rock (i.e. less than 2 m below ground level) is likely to be encountered is indicated on Drawing 104 in Appendix B. Where shallow rock is anticipated, higher than normal groundwork costs should be anticipated, due to the potential requirement for rock hammering and reduced productivity for deep excavations. It should be noted that the rock depth assessment is indicative only and is based on the results of the DP boreholes, previous boreholes undertaken by Bell Cochran and Associates, site walkover surveys plus interpretation of air photos. This assessment is preliminary only and shallower or deeper rock may be present in various areas of the site.

The basalt bedrock depth profile can exhibit abrupt variation and it is recommended that allowance be made for the need to excavate strong basalt rock using a dozer mounted ripper (depending on rock strength and the degree of fracturing) or breaking with a boom mounted hydraulic breaker. Also, due allowance should be made for over-excavated volumes of soil in bulk earthworks or trench excavations and the like.

There was standing water over large parts of the southern area of the study area during the field work for the current study; however, this was due to a period of prolonged and heavy rainfall prior to the works. Therefore the possibility of standing water in lower lying areas flooding excavations and the requirement for sump pumping and dewatering should not be ruled out.

12.8 Batter Slopes

Temporary excavations more than 1.5 m deep should be supported or battered back. Through the clay layers, batters should be formed at no steeper than 1H:1V in the short term, for excavations up to 3 m deep.

Permanent batters in these materials except for the Fyansford Formation clays should be formed at 3H:1V to allow vegetation to grow, for stability and subsequent maintenance. As discussed in the 2000 Piper report and originally reported by Scott Camp and Furphy (1979), permanent batters through Fyansford Formation clays have failed at slopes as shallow as 1V:3.3H and 1V:4.6H. Therefore, it is recommended that such slopes are assessed with consideration of the specific circumstances that may apply prior to finalising gradients. As a minimum, it is suggested that Fyansford Formation clay slopes should be formed at no steeper than 1V:5H, however this is subject to detailed understanding of the groundwater conditions. A minimum FOS of 1.5 should be adopted for permanent slopes through such materials and all slopes clear of the quarry pit faces.

Care will be needed as fissures in the clay orientated at angles which dip into the excavation may lead to instability even at the recommended batter angles. Excavation faces should be inspected by a geotechnical engineer to confirm if additional support or treatment is required prior to undertaking work in the excavations.

12.9 Subgrade Preparation

The following subgrade preparation procedures are recommended for construction directly on the natural materials or prior to placing engineered filling;

- Grub out tree stumps and root systems prior to any construction works commencing;
- Remove any topsoil, filling, water softened clays and any deleterious materials, and excavate to the design levels;
- Proof roll the exposed subgrade using a smooth drum roller with a mass of not less than 12 tonne and a load intensity under either the front or rear drum of not less than 6 tonnes per metre width of drum and a minimum of 5 passes to observe the subgrade deflection and detect whether any soft spots exist.
- Soft spots detected should be tined and allowed to dry before being compacted or removed and replaced by suitably compacted material. A geotechnical engineer should observe the proof rolling; and
- Seal the exposed surface using a smooth drum roller to minimise water ingress and possible deterioration.

Excavations to remove soft spots should be backfilled with controlled filling. Where uncontrolled cohesive filling is present, for example in abandoned service trenches, the filling should be excavated back to natural ground and any softened natural soils should also be removed. The excavation then should be backfilled with engineered filling placed in not more than 200 mm thick layers and compacted to at least 95% Standard density ratio and a moisture ratio of between 90% and 115% of optimum.

The onsite clays and granular materials are considered suitable for use beneath flexible pavements, embankments or similar. However, as discussed previously in this report, some of the clays are highly reactive and are susceptible to significant shrink swell movements on changes in moisture content, particularly when placed near to the surface. For this reason, the use of the reactive clay as engineered fill beneath buildings or movement sensitive structures is generally avoided, unless strict control of moisture content is able to be maintained and over compaction is avoided, to prevent excessive post construction swelling.

All clay filling placed beneath residential allotments should be placed in horizontal layers no greater than 200 mm loose thickness and uniformly compacted to a minimum dry density ratio of 95 % standard with a moisture ratio between 90% and 115% of optimum, although it would be preferable to target moisture contents slightly above optimum. Engineered filling beneath pavements should be compacted to a dry density ratio of at least 98% standard within at least 300 mm of the underside of pavement, and 95% standard may be adopted below this depth.

In addition, careful consideration needs to be given to the potential impact the reactive clay fill will have on site classification (refer to Section 12.6 of this report). The reactivity of the subsurface profile could be reduced by limiting the use of the on-site clays to deeper parts of the fill profile and using imported lower reactive materials closer to the surface.

Good site drainage during construction will be important. Any resulting water softened material should be stripped and removed prior to construction.

To ensure that the desired construction standards are achieved it is suggested that the fill placement be tested at the appropriate minimum frequency given in Section 8 Table 8.1 of Australian Standard AS 3798 – 2007 (Ref 2). The geotechnical testing authority should be engaged under Level 1 as defined in the Standard for those areas where the filling is to support buildings, or movement sensitive structures.

If it is elected to import low reactive filling, the following material limits are suggested:

- Maximum liquid limit 50%;
- Plasticity index 6 % to 25%;
- $PI \times \% < 0.425 \text{ mm} < 1000$;
- Potential swell in 4 day soaked CBR test $< 1.5\%$ (4.5 kg surcharge);
- Less than 20% retained on the 37.5 mm sieve (this will allow the implementation of conventional compaction control testing); and
 - o % passing 75 mm sieve: 100%;
 - o % passing 4.75 mm sieve: 40 to 80%;
 - o % passing 0.075 mm sieve: 10 to 40%.

The above limits will ensure a low-reactivity material. Potential sources of select filling should be assessed by an appropriate regime of laboratory tests if potential suppliers do not already have current representative test data.

12.10 Foundations

Buildings may be supported on conventional pad and strip footings or stiffened rafts founded in the natural soils or engineered filling.

The maximum allowable bearing pressures shown in Table 4 are suggested for the design of pad or strip footings.

Table 4: Maximum Allowable Bearing Pressures for Shallow Pad/Strip Foundations

Founding Material	Maximum Allowable Bearing Pressure (kPa)
Engineered filling / stiff to very stiff clays	100 - 150
Very stiff or stronger clays / medium dense or denser sands and gravels / shallow rock	150 – 250
Basalt rock	>500

The above allowable bearing pressures will also apply to thickened edge beams beneath slabs for masonry structures.

Load related settlements for footings founding, designed and constructed in accordance with the parameters shown in Table 4 above, are estimated to be in the range of 0.5% to 1% B, where B is the footing width. However, the structures should be designed to accommodate the impacts of long term seasonal movement (shrink/swell) of the natural clays which may be greater than any settlement arising from the applied loads.

Where the subsurface profile comprises uncontrolled fill to depths that are considered impracticable for spread footings, the use of pile footings will be required. Piles should be founded beneath the fill and within the underlying natural soils or weathered rock.

Various pile types may be considered, including driven piles, galvanised steel screw piles or bored piles. Piles generally derive their capacity from a combination of end bearing and side friction, although given the presence of basalt rock over much of the site, it is expected that pile capacity may be dominated by end bearing for the more lightly loaded structures. Screw piles and driven piles would be expected to experience penetration refusal on the basalt rock and their suitability may be governed by the depth rock. Specific geotechnical advice should be sought regarding suitable pile types once specific details of the development are known.

Preliminary design of bored piles may be based on the allowable unit stresses presented in Table 5.

Table 5 : Preliminary Estimate of Allowable Unit Stresses for Preliminary Pile Design

Founding Material	Allowable Unit Stresses for Piles	
	Skin Friction (kPa)	End Bearing (kPa) ¹
Engineered filling / stiff to very stiff clays	15 - 25	200 - 300
Very stiff or stronger clays / medium dense or denser sands and gravels / shallow rock	20 - 30	300 - 600
Basalt rock	75	>750

Notes

- Assumes that pile penetrates a distance of at least 4 pile diameters into the designated founding material.
The parameters presented Table 5 are preliminary only. Higher parameters within some materials may be available, as pile loads, layouts and settlements are refined during design.

It is noted that the allowable end bearing and shaft resistances presented in Table 5 have been presented in working stress format to allow a relatively quick pricing estimate of piling options. Detailed design should be undertaken in accordance with AS2159-2009 "Piling Design and Installation" (Ref 3), which requires a limit state approach.

The above design parameters are based on standard good construction practice being followed, with the socket walls and base being relatively rough, clean and free of significant debris. Should it not be possible to inspect and suitably clean the socket base, the above end bearing bored pile parameters should be reduced by 50%.

It is recommended that the pile lengths be confirmed by an experienced geotechnical engineer by logging shaft conditions to ensure conditions are consistent with the design assumptions and values given above.

Long term settlements for piles founded at least 4 pile diameters or a minimum of 3 m into the materials listed in Table 5 proportioned on the basis of the above design parameters will generally be 0.5% B, where B is the pile diameter.

12.11 Earthquake Risk Classification to AS 1170.4-2007

Reference to Figure 3.2(A) of AS 1170.4 (Ref 4) indicates a hazard factor (Z) of 0.10 for the Geelong area. Based on the results of the investigation, the study area would also be deemed to have a site subsoil classification of 'Class C_e', shallow soil site.

12.12 Design Subgrade CBR

Laboratory testing was not undertaken as part of this study. However, based on local experience with similar materials, it is recommended that a lower bound CBR of 3% be adopted for the natural materials encountered on site, subject to good compaction and moisture control. This value is based on the assumption that adequate surface and subsurface drainage will be included and maintained.

Once final road alignments are confirmed, detailed investigation and subsequent laboratory testing will be required to confirm the design subgrade CBR and subgrade conditions.

12.13 Light Duty Pavements

For the preparation of a pavement profile design for this project, DP has made reference to the Infrastructure Design Manual (IDM version 5 – Ref 5), which indicates that pavements should be designed in accordance with the Austroads Guidelines "Guide to Pavement Technology." DP has used the latest version of this document for the pavement designs at this site (i.e. Guide to Pavement Technology Part 2: Pavement Structural Design (AGPT02-12)).

Table 12.2 of the Austroads Guide provides typical traffic loadings for various types of roads. A loading condition similar to that defined as "Local Access with no buses" has been adopted (i.e. 400 vehicles per day), for which a design traffic loading of 4×10^4 Equivalent Standard Axles (ESAs) is applicable for the IDM specified 20 year design life. A subgrade CBR value of 3% has also been adopted and expansive subgrade conditions have been assumed.

The assumed traffic loading should be confirmed by the project traffic engineers as appropriate for this development prior to the commencement of construction.

A suggested typical flexible pavement profile for this traffic loading case is presented in Table 6.

Table 6 : Suggested Flexible Pavement Profile – Design Traffic Loading of 4×10^4 ESAs

Asphalt	30 mm thick - Size 10 mm Type N170 asphalt
Prime	Prime Coat
Base Course	100 mm thick - 20 mm Class 2 Crushed Rock
Subbase Course	120 mm thick – 20 mm Class 3 Crushed Rock
Capping Layer	150 mm thick - Vic Roads Type A Fill or lime stabilised clay*
Subgrade	Natural clay or engineered fill (CBR $\geq$ 3%)
Total Pavement Thickness	400 mm**

*Subject to testing to verify that permeability does not exceed 5×10^{-9} m/s.

** VicRoads minimum cover requirement for expansive subgrades.

Further pavement designs will need to be undertaken once specific traffic loadings and locations are chosen, with consideration of the actual subgrade conditions that apply.

12.14 Drainage, Services Installation and Site Maintenance

Careful consideration should be given to site drainage, as poorly detailed or constructed drains can lead to drains holding water, allowing such water to seep into the subgrade with consequential effects. In addition, appropriate road drainage should be installed otherwise movement of the pavement edges will occur, leading to pavement cracking and potentially high ongoing maintenance costs.

Service and drain trenches should be located no closer than 1 m from a foundation except where they have to pass beneath the foundation. In this case, the trenches must be plugged with moist hand tamped clay where the trench meets a footing. Ideally service trenches should be constructed to slope and hence drain away from structures and road pavements.

According to Australian Standard AS 2870-2011 for Class H2 or E sites no trees should be planted closer to a footing than 1 or 1.5 times the mature height of the tree, respectively. However, where rows or groups of trees are present, such a distance should be increased by a further 50% of the mature height. These precautions reduce, but do not eliminate, the risk of excessive damage to the building arising from the tree roots. To reduce the potential for tree related damage, root barriers or alternative foundation designs can be considered.

On-going maintenance of drains and joint seals will be required to ensure satisfactory long term performance of the structures and slabs. Any cracking that occurs in slabs/pavements should be sealed immediately to prevent water ingress to the subgrade.

12.15 Compacted Clay Wetlands Floor Liner

Whilst the basaltic clays encountered on the subject site are of low permeability such that losses are minimised, it is anticipated that some form of erosion protection will be required for water retaining features, as the clays are typically dispersive. Erosion is discussed further in Section 12.17 of this report. The permeability of the remaining materials should be assessed once a wetlands location has been chosen, however, it is anticipated that in addition to the basaltic clays, the Moorabool Viaduct Sands would be a suitable liner material, provided the clay content was sufficiently high.

Due to the likelihood of fissuring in the natural clays, it is suggested that any clays exposed in wetland floors be ripped and re-compacted for at least 450 mm in three 150 mm thick layers. It is recommended that the material should be recompacted to a minimum standard dry density ratio of 95% with a placement moisture of between 95% and 115% of standard optimum moisture content.

12.16 Cut-off Requirements around Pipes

Backfilled pipe trenches are a common leakage pathway in water retention structures. High seepage losses can occur where granular backfilled trenches pass through, under or abut the retarding basin. A combination of appropriately detailed concrete cut-off collars and or compacted clay plugs should be considered to reduce the potential for seepage loss around pipes.

12.17 Water Turbidity and Erosion

The turbidity of water in the wetlands will be affected by the following:

- The turbidity of the water entering it;
- Level of turbulence within the channel due to stormwater inflows and the susceptibility of the channel floor materials to be suspended into solution because of turbulence. Although not quantified or assessed, the natural site clays are typically dispersive and it is likely that direct contact of turbulent flow will cause the clays to be lifted into and remain in suspension;
- The composition and dispersivity of any erosion protection layers placed on the wetland floor liner. Placement of a non-dispersive, non-erosive cover layer will mitigate water turbidity associated with any underlying clay liner material.

The need for erosion protection of a compacted floor liner will depend on the hydraulic conditions. Erosion protection may not be required for low energy flows, however, clays exposed to turbulent flow without protective cover will be susceptible to erosion. Regardless, it is recommended that wetland embankments be protected by a thick vegetative cover or rock beaching. The addition of lime or gypsum to clay can reduce its erosion potential.

Dispersivity can vary with location and depth, and should be verified by Emerson or pinhole laboratory tests.

13. Landslide Assessment

Advice on the development of landslide hazard zoning for planning purposes is given in “Guidelines For Landslide Susceptibility, Hazard And Risk Zoning For Land Use Planning” (AGS 2007). In accordance with these guidelines, a preliminary land slide inventory has been produced and used to guide the development of a landslide susceptibility zoning map. The landslide inventory was developed from a review of aerial photographs and topographic data derived from the supplied 1 m LIDAR data set. The LIDAR data was used to develop derived data sets for elevation and gradient across the site. At this stage, only limited ground-truthing was undertaken and no attempt has been made to date the landslides due to the limited duration and quality of available records. The active quarry faces were not included in this assessment.

Following development of the landslide inventory, the data was combined in a GIS system along with other data including geological unit, ground slope and geomorphology. Inspection of this data indicates two distinct groups of landslides. The first is the numerous small landslides located along the banks of the creeks and rivers across the site (this also includes the former alignment of the Moorabool River prior to diversion). The second group are located along the escarpment below the basalt plain located to the north and east of the Moorabool River, as shown in Drawings 103 and 104 in Appendix B. The geology exposed in the escarpment includes the Newer Volcanics Basalt, Moorabool Viaduct Sands (Black Rock Sandstone) and Fyansford Formation (Gellibrand Marl). The Fyansford Formation is known for instability and is also synonymous with the Balcombe clay, which also is known for instability in relatively gentle slopes.

On this basis, the immediate vicinity of creek and river banks together with the Fyansford Formation exposure in the escarpment should be considered as susceptible to landslides as indicated in Drawing 106 Landslide Susceptibility in Appendix B. The risk along creek and river banks could be addressed by a zone (which may also be required for flood protection). Any development in the vicinity of the escarpment should be subject to a more detailed assessment to develop hazard and risk zoning in accordance with the AGS guidelines.

14. Further Investigation

Further geotechnical, environmental and groundwater field investigation work and risk assessments are required to provide site specific information as an input to the next stages of assessment in parts of the study area. The further work would specifically target the 3 overburden stockpiles and banks of the Moorabool River, with other investigation works required as per the details shown in Drawing 108 Further Investigation Requirements in Appendix B.

The overburden stockpiles would require assessment with a grid of cone penetrometer tests as discussed in Section 12.5 above. Further investigation works using a variety of ground investigation techniques are highly likely to be required, but are primarily expected to comprise additional boreholes, test pits and geological mapping.

15. Third Party Reports

The following reports were provided to DP to assist with preparing this study:

Report No.	Report Title
1	Camp Scott & Furphy Moorabool River Development Reappraisal Report Nov 1979
2	Camp Scott Furphy - Proposed Moorabool River Diversion Environmental Effects Statement March 1980
3	Soilmech Y112 - Report Moorabool River Diversion Batesford 26 Aug 1981
4	Bell Cochrane and Associates, "Results of further conductivity trials at Dryden Estate" July 1989
5	Bell Cochrane & Associates, "Results of percussion drilling at Dryden Estate" May 1990
6	Bell Cochrane & Associates, "Results of diamond drilling of potential basalt area at Dryden Estate" June 1991
7	Gutteridge Haskins & Davey Pty Ltd (GHD) "Groundwater modelling" August 1999
8	GHD: "Quarry closure report on environmental audit" 2000.
9	Piper Associates: "Volume 1 of 2 Geotechnical Assessment for Proposed quarry face stabilisation, Batesford Limestone Quarry", March 2000
10	GHD: "Quarry closure report on environmental audit and soil testing to determine compliance with EPA discharge licence" 2001.
11	Nolan –ITU Pty Ltd, "Batesford Quarry Groundwater Level Recovery Investigation", January 2002
12	Nolan-Itu "Batesford quarry area 2 preliminary contamination assessment" May 2002.
13	Lane consulting "Auditor's review report: waste disposal area Batesford quarry" 2002
14	Piper Associates: "Additional geotechnical investigation of proposed rehabilitation slopes, Batesford Quarry, Fyansford", June 2004
15	Nolan – ITU Pty Ltd, "Batesford Quarry Rehabilitation Water Quality Study", July 2005
16	AS Miner Geotechnical Consulting Engineers, Report to the University of Ballarat, "Landslide and Erosion Susceptibility Mapping in the CCMA Region", 30 June 2006
17	GHD Dryden Overburden Stockpile geotechnical investigation 2008
18	Adelaide Brighton Cement Ltd, "Rehabilitation Plan for Batesford Quarry", 24 November 2009 (last update)
19	NDMP Project Landslide Mapping and Susceptibility Project. Report for industry partners including CCMA, CoGG, COS and NDMP. Prepared by A.S. Miner Geotechnical in association with DPI. Report No 477/02/10. 27 April 2010.
20	Golder Associates, "Initial Assessment of Potential Sources of Contamination" for Batesford South, 15 October 2010
21	Golder Associates, "Preliminary Geotechnical Assessment" for Batesford South, 18 October 2010
22	Golders Rehabilitation of Southern Face Report 097612155 011 R Rev1 and Rev 2
23	St Quentin Dryden Estate Ground Settlement Surveillance Overburden Stockpile, McCanns Lane, Fyansford Feb2010_Apr2011

Report No.	Report Title
24	Barwon Water Aquifer Storage and Recovery (ASR), Sinclair Knight Merz Pty Ltd, June 2012
25	Batesford South, "Summary of Challenges Report for Batesford/Fyansford Further Investigation Area", 5 April 2013
26	Spiire for Ramsey Property Group, "Pre-Feasibility Report on the Potential for Future Residential Development", February 2013
27	Biosis Pty Ltd, "Batesford Quarry Extension CHMP 12499", May 2016
28	Dewatering of the Batesford Limestone Quarry, Bell Cochrane and Associates and Roger Blake and Associates, October 2016

16. References

1. Australian Standard AS2870-2011, "Residential Slabs and Footings", April 2011, Standards Australia
2. Australian Standard AS 3798 – 2007: "Guidelines on Earthworks for Commercial and Residential Developments", Standards Association of Australia.
3. Australian Standard AS2159-2009:"Piling Design and Installation". Standards Australia.
4. Australian Standard AS 1170.4 – 2007: "Structural design actions, Part 4: Earthquake actions in Australia", Standards Australia.
5. Infrastructure Design Manual, Version 5, dated Sept 2016, Local Government Infrastructure Design Association.

17. Limitations

Douglas Partners (DP) has prepared this report for this project at Fyansford & Batesford in accordance with DP's proposal dated 13 July 2016 and acceptance received from Michael Gerner dated 14 July 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of the McCann Group, Adelaide Brighton Ltd and Ramsey Property Group 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.

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.

Asbestos has not been detected by observation or by laboratory analysis, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as brick were, however, located in previous below-ground filling, and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints (as discussed above), or to vegetation preventing visual inspection and reasonable access. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

Douglas Partners Pty Ltd

Appendix A

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

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

Sampling Methods

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.



Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. 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	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

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

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

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	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 - 5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

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;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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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	Solid flight augers
HFA	Hollow 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
▼	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U50/U63	Undisturbed tube sample (50/63 mm)
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
BJ	Bedding joint
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
Fr	Fracture
Frcl	Fracture cleavage
Fgz	Fragmented zone
J	Joint
Jsw	Joint swarm
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

cem	cemented
cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

If not specified, joint is open

Coating Descriptor

brc	breccia
ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
hem	hematite
lim	limonite
mn	manganese
min	mineral (unspecified)
myl	mylonite
sid	siderite
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

Continuity

	continuous unless stated otherwise
discon	Discontinuous, at least 1 termination visible in core
1T	One visible termination
2T	Two visible terminations
En echelon	Joint segments are discontinuous but terminate within a few cm of start of a sub parallel segment, often with overlap

Other

di	probably drilling induced
db	drill break
hb	handling break
fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Douglas Partners



Graphic Symbols for Soil and Rock

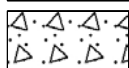
General



Asphalt



Road base



Concrete

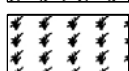


Filling

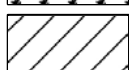
Soils



Topsoil



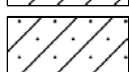
Peat



Clay



Silty clay



Sandy clay



Gravelly clay



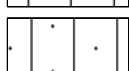
Shaly clay



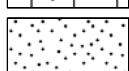
Silt



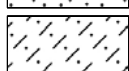
Clayey silt



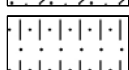
Sandy silt



Sand



Clayey sand



Silty sand



Gravel



Sandy gravel



Cobbles, boulders



Talus

Sedimentary Rocks



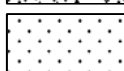
Boulder conglomerate



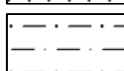
Conglomerate



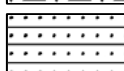
Conglomeratic sandstone



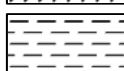
Sandstone



Siltstone



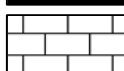
Laminite



Mudstone, claystone, shale

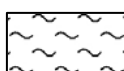


Coal

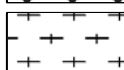


Limestone

Metamorphic Rocks



Slate, phyllite, schist

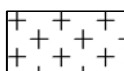


Gneiss

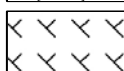


Quartzite

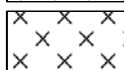
Igneous Rocks



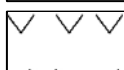
Granite



Dolerite, basalt, andesite



Dacite, epidote



Tuff, breccia



Porphyry



Rock Strength

Rock strength is defined by the Point Load Strength Index ($IS_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $IS_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $IS_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

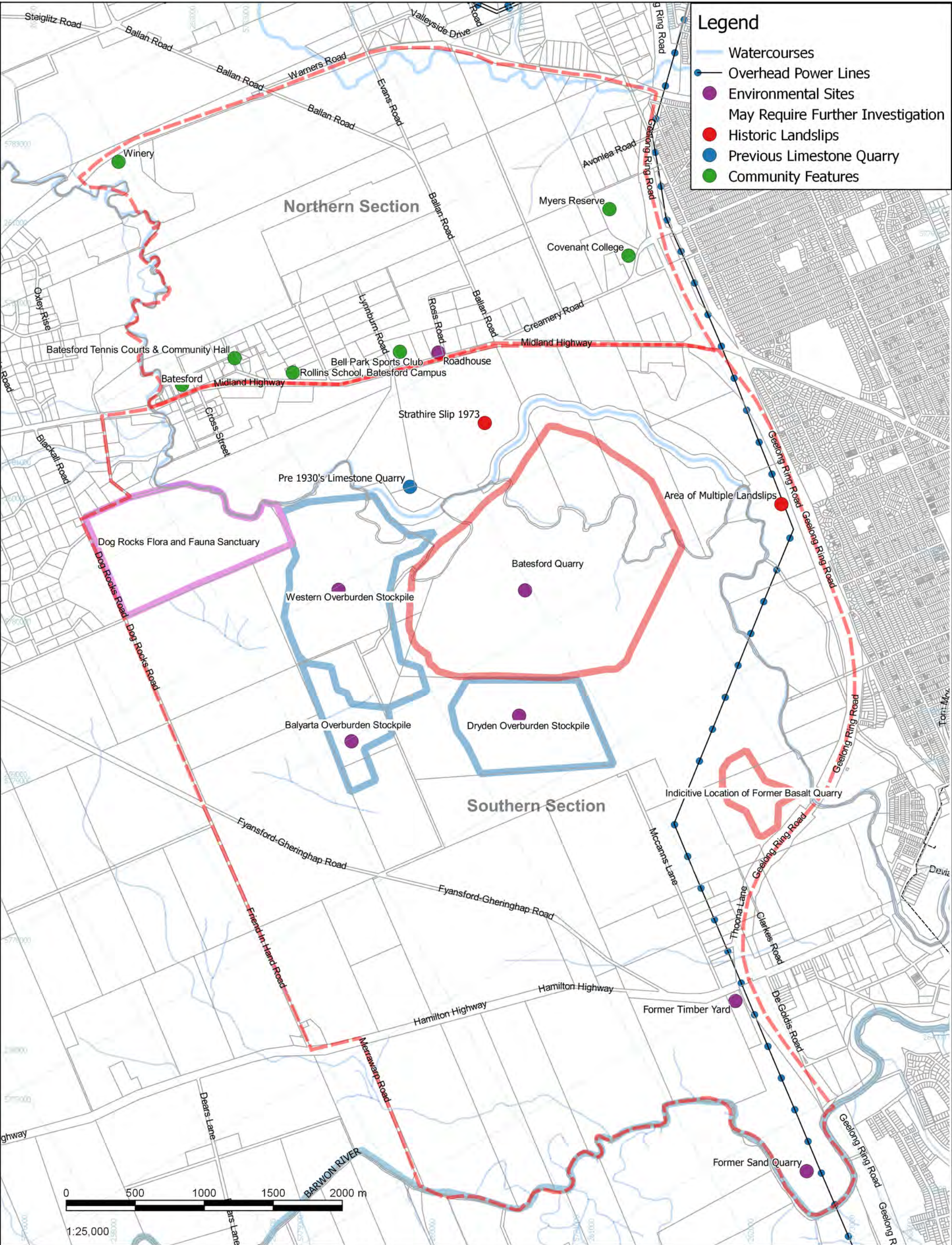
Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Appendix B

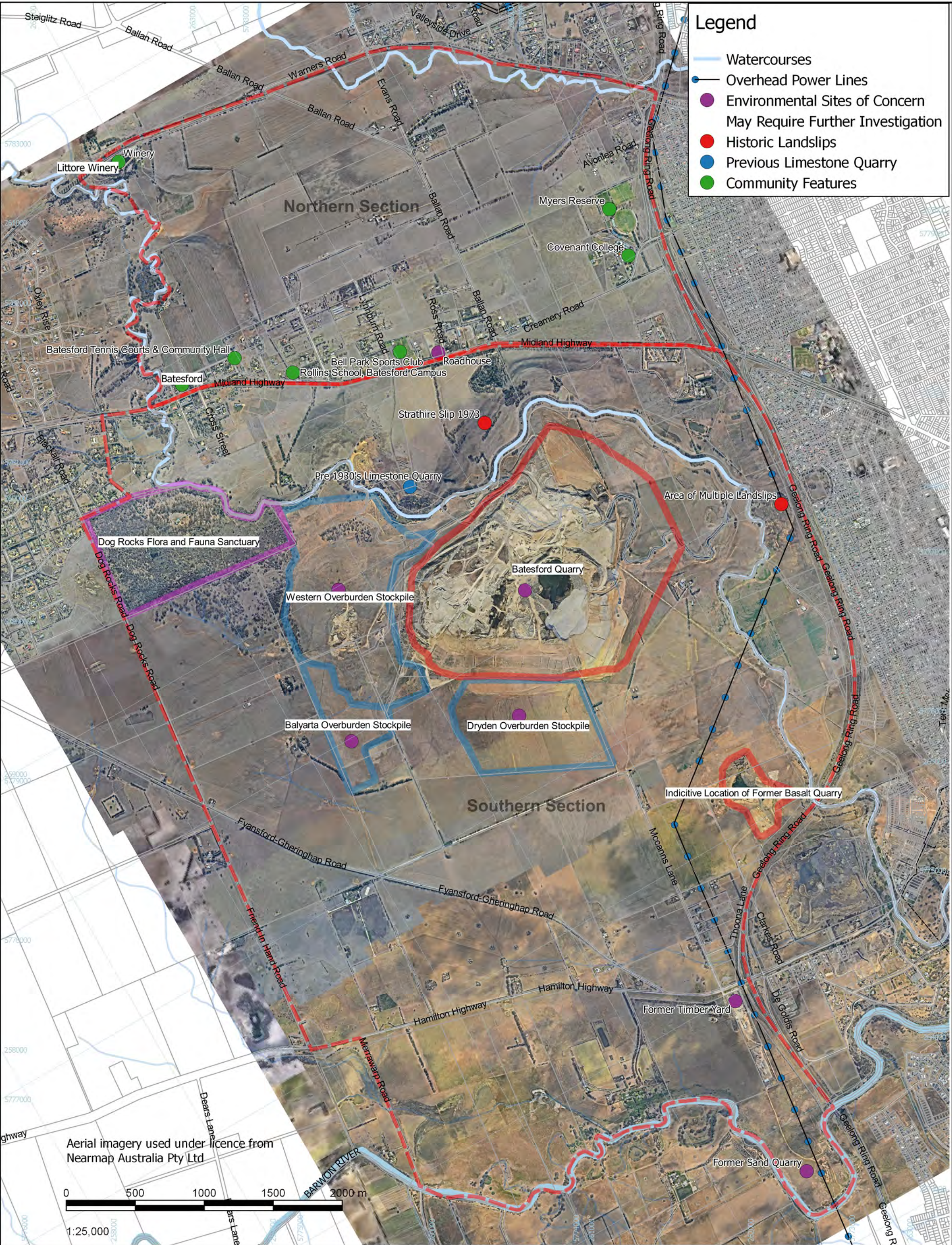
Drawings

Drawing 100 – Site Location Plan
Drawing 100A – Site Location Plan with Aerial Background
Drawing 101 – Site Investigation Plan
Drawing 101A – Classified Site Investigation Plan
Drawing 102 – Potential Geotechnical Risks to Development
Drawing 102A – Potential Environmental Risks to Development
Drawing 103 – Landslide Susceptibility with Geology
Drawing 104 – Landslide Susceptibility with Geomorphology
Drawing 105 – Potential Moorabool River Crossing Locations with
Geotechnical Classification
Drawing 105A – Potential Moorabool River Crossing Locations with
Shaded Relief
Conceptual Road Longitudinal Sections – TGM Drg 15410-99 Sheets 4,
5 and 9
Drawing 106 – Geotechnical Landslide Susceptibility
Drawing 107 – Indicative Cross Sections
Drawing 108 – Further Investigation Requirements
Drawing 109 – Historic Borehole Locations
Golder Associates Slope Stability Calculations
Drawing 200 – Changes in Dryden Overburden Stockpile Surface Level
Relative to Feb 2010 Baseline Levels
Drawing 201 – A Line Plasticity Chart Plot

Site Photographs

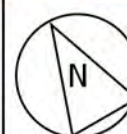
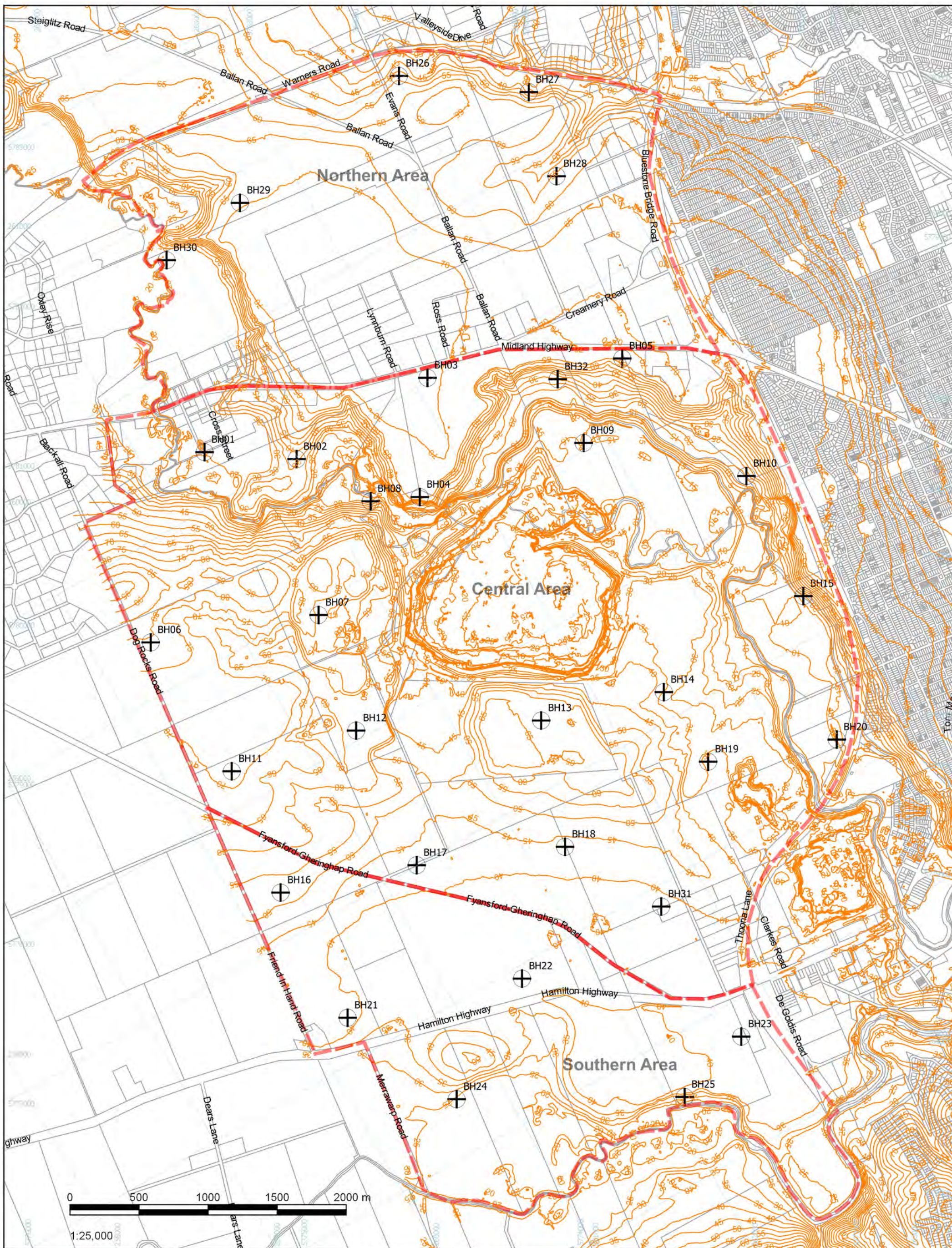


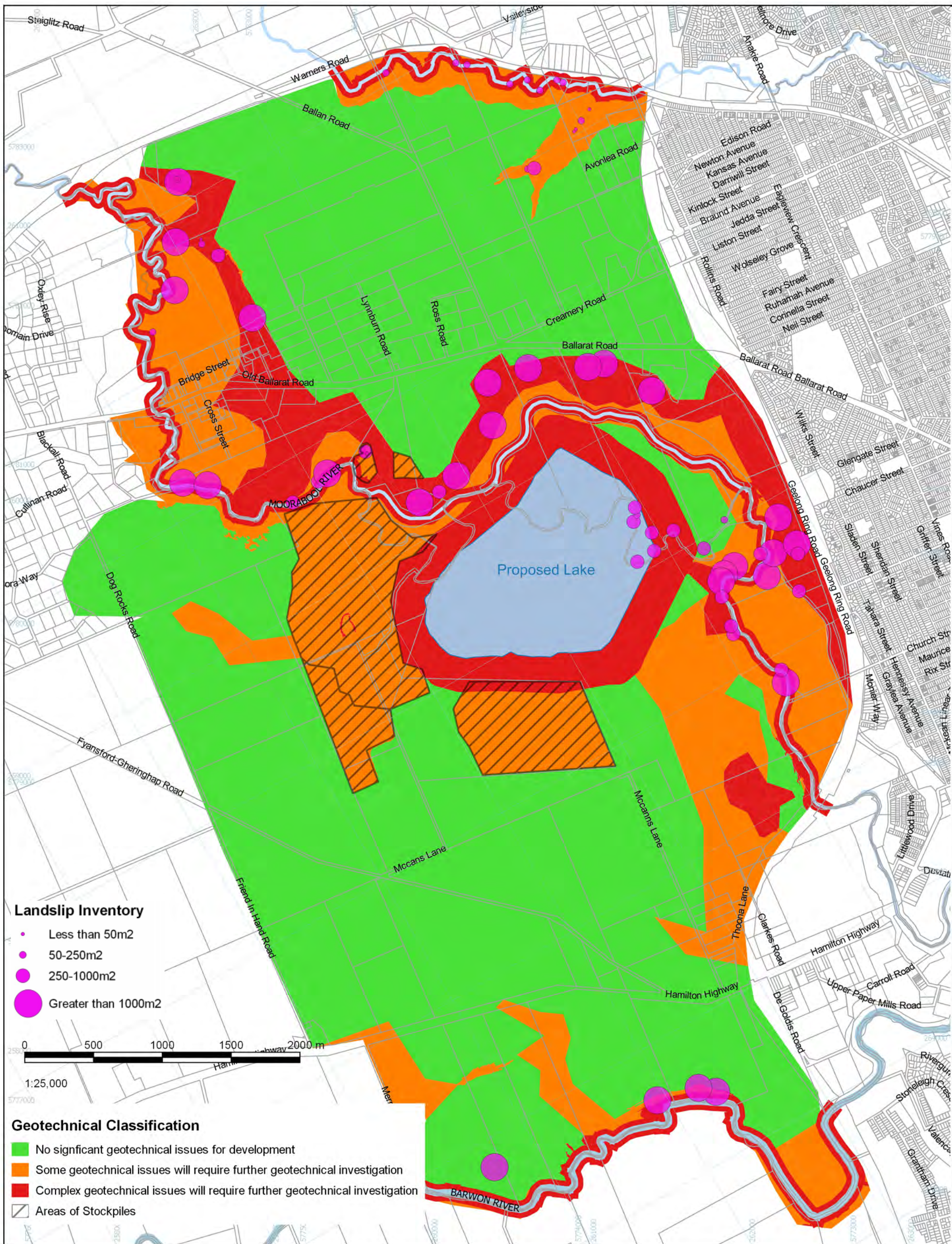
 Douglas Partners <i>Geotechnics Environment Groundwater</i>	TITLE: Site Location Plan Western Geelong Growth Area				OFFICE: Melbourne
					DRAWN BY: WB
					DATE: 31 March 2017
CLIENT: McCann Group, Adelaide Brighton Ltd and Ramsey Property Group	PROJECT No: 87027.00	DRAWING No: 100	REVISION: 4		SCALE: 1:25,000



Legend

- Watercourses
- Overhead Power Lines
- Environmental Sites of Concern
- May Require Further Investigation
- Historic Landslips
- Previous Limestone Quarry
- Community Features





Landslip Inventory

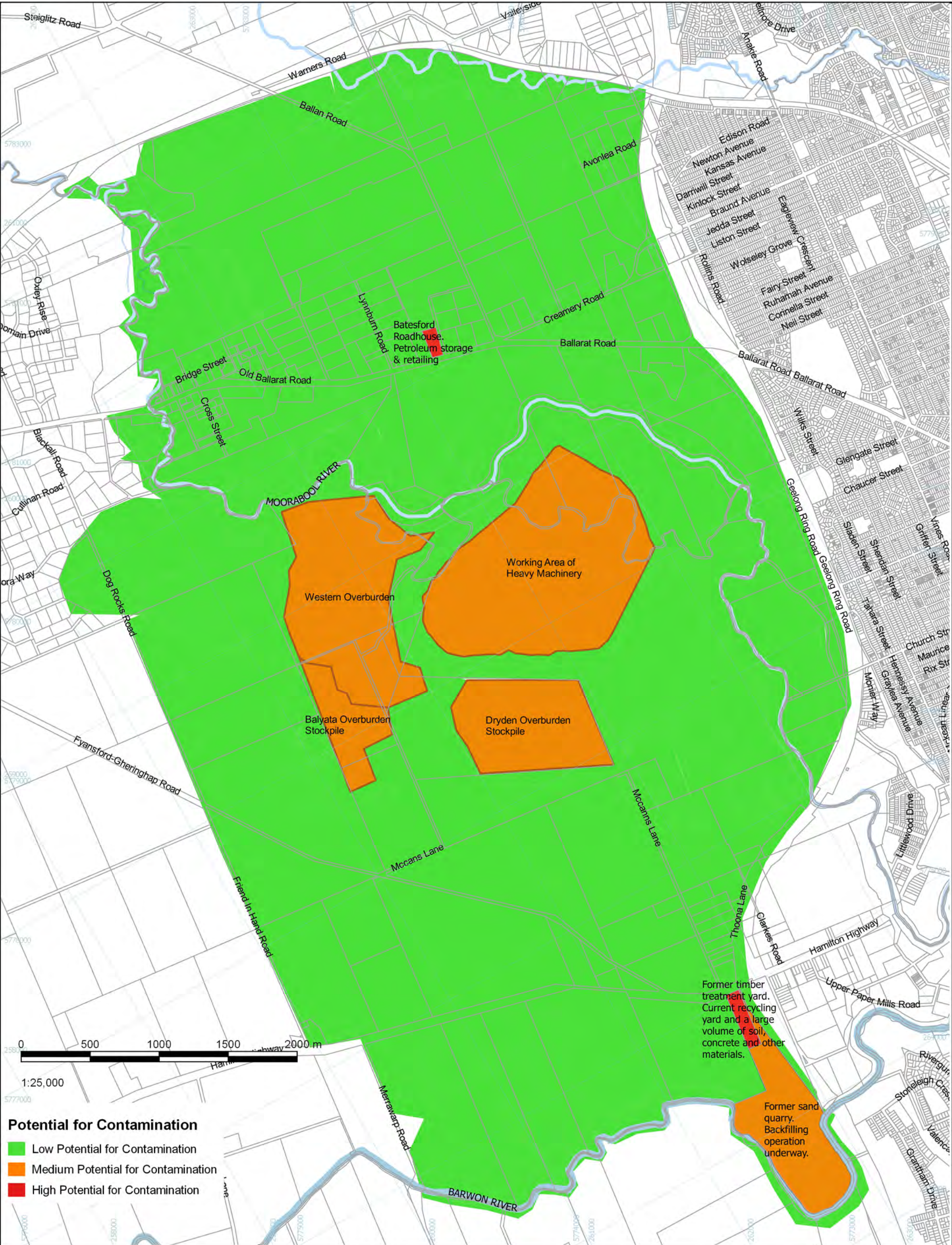
- Less than 50m²
- 50-250m²
- 250-1000m²
- Greater than 1000m²

0 500 1000 1500 2000 m

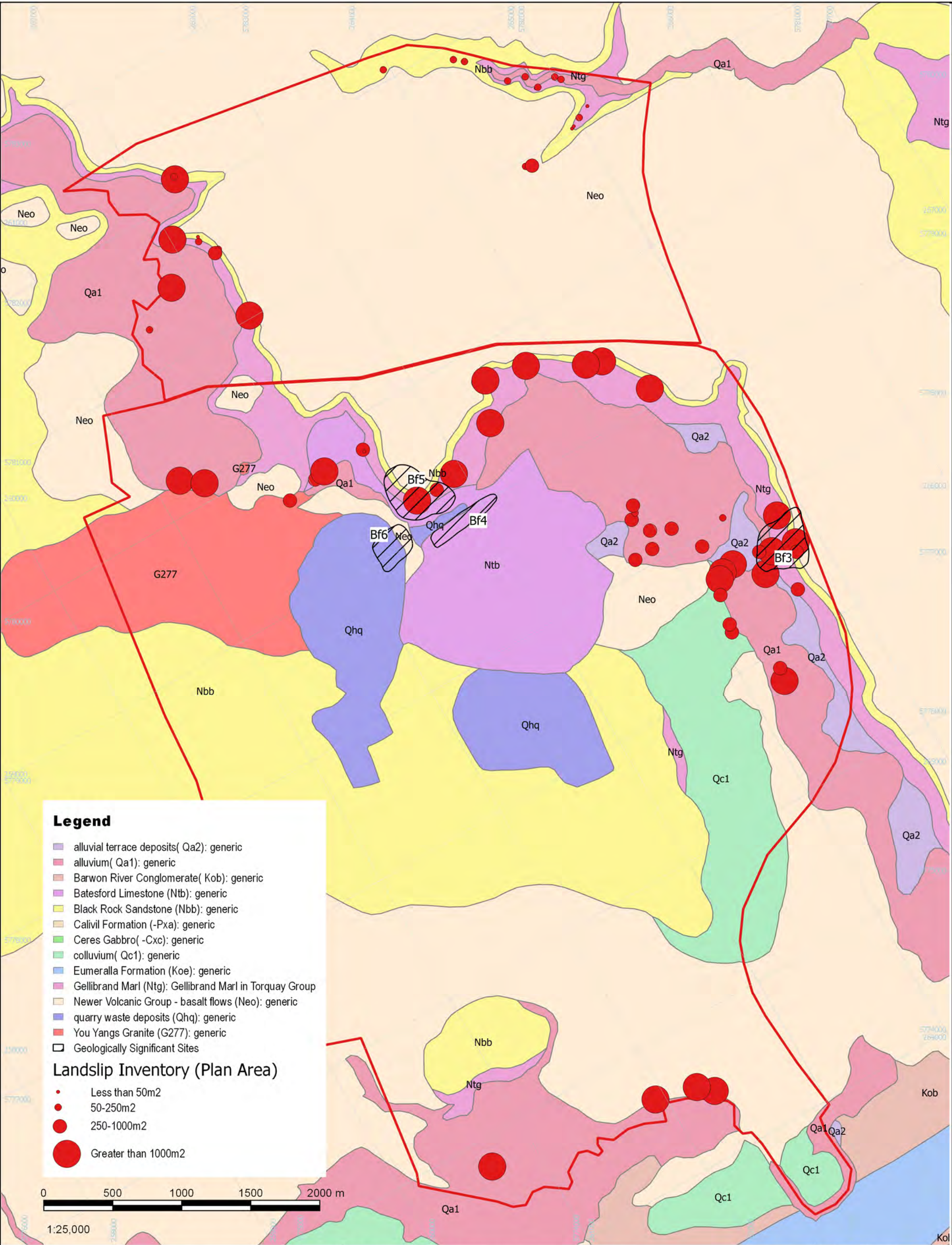
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Geotechnical Classification

- No significant geotechnical issues for development
- Some geotechnical issues will require further geotechnical investigation
- Complex geotechnical issues will require further geotechnical investigation
- Areas of Stockpiles



 Douglas Partners <i>Geotechnics Environment Groundwater</i>	TITLE: Potential Environmental Risks to Development Western Geelong Growth Area				OFFICE: Melbourne
CLIENT: McCann Group, Adelaide Brighton Ltd and Ramsey Property Group		PROJECT No: 87027.00	DRAWING No: 102A		DRAWN BY: WB
			REVISION: 0		DATE: 3 May 2017
					SCALE: 1:25,000



Legend

- alluvial terrace deposits(Qa2): generic
- alluvium(Qa1): generic
- Barwon River Conglomerate(Kob): generic
- Batesford Limestone (Ntb): generic
- Black Rock Sandstone (Nbb): generic
- Calivil Formation (-Pxa): generic
- Ceres Gabbro(-Cxc): generic
- colluvium(Qc1): generic
- Eumeralla Formation (Koe): generic
- Gellibrand Marl (Ntg): Gellibrand Marl in Torquay Group
- Newer Volcanic Group - basalt flows (Neo): generic
- quarry waste deposits (Qhq): generic
- You Yangs Granite (G277): generic
- Geologically Significant Sites

Landslip Inventory (Plan Area)

- Less than 50m2
- 50-250m2
- 250-1000m2
- Greater than 1000m2

0 500 1000 1500 2000 m
1:25,000



TITLE: **Landslide Susceptibility with Geology
Western Geelong Growth Area**



OFFICE: Melbourne

DRAWN BY: CGC

DATE: 14 March 2017

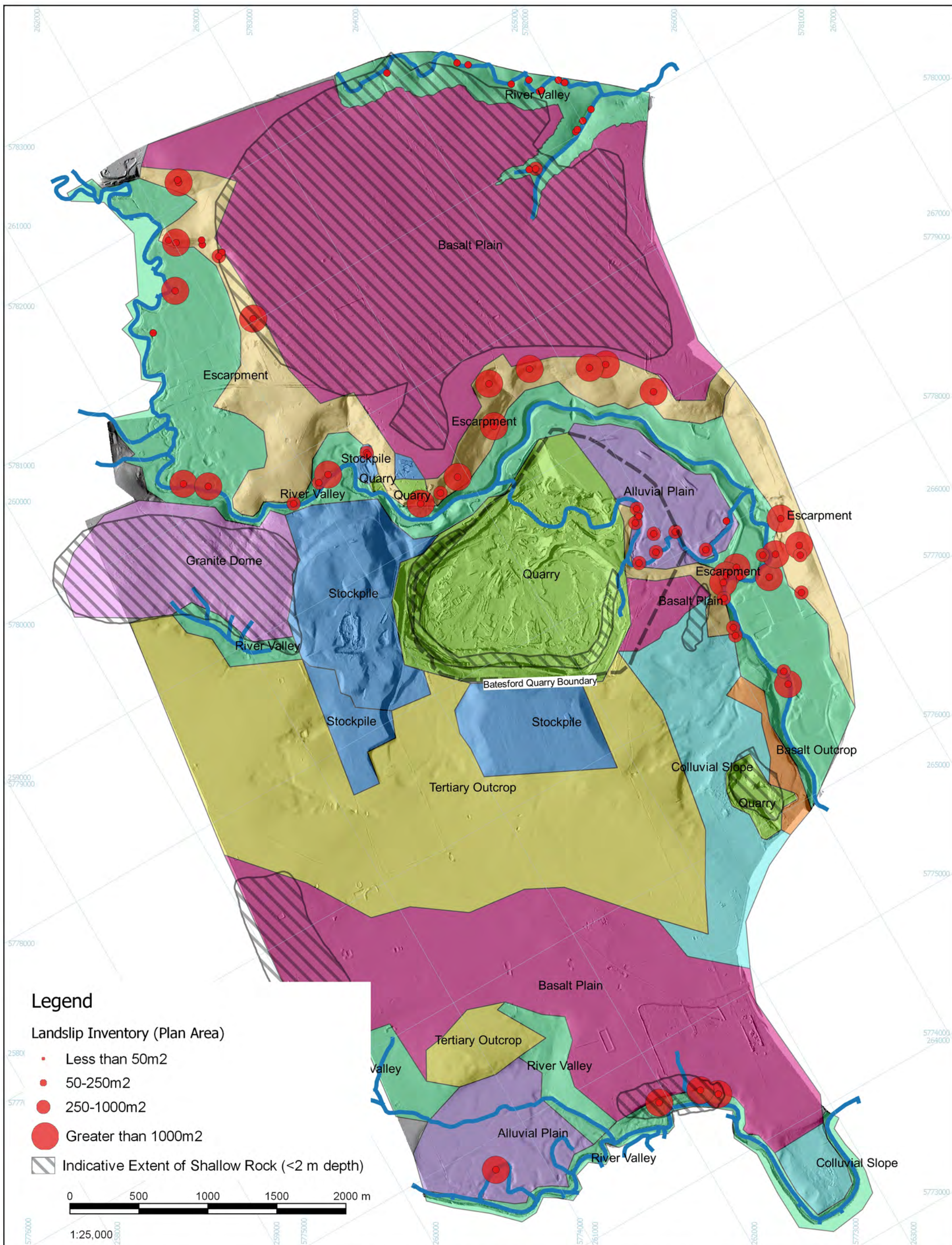
CLIENT: McCann Group, Adelaide Brighton Ltd and Ramsey Property Group

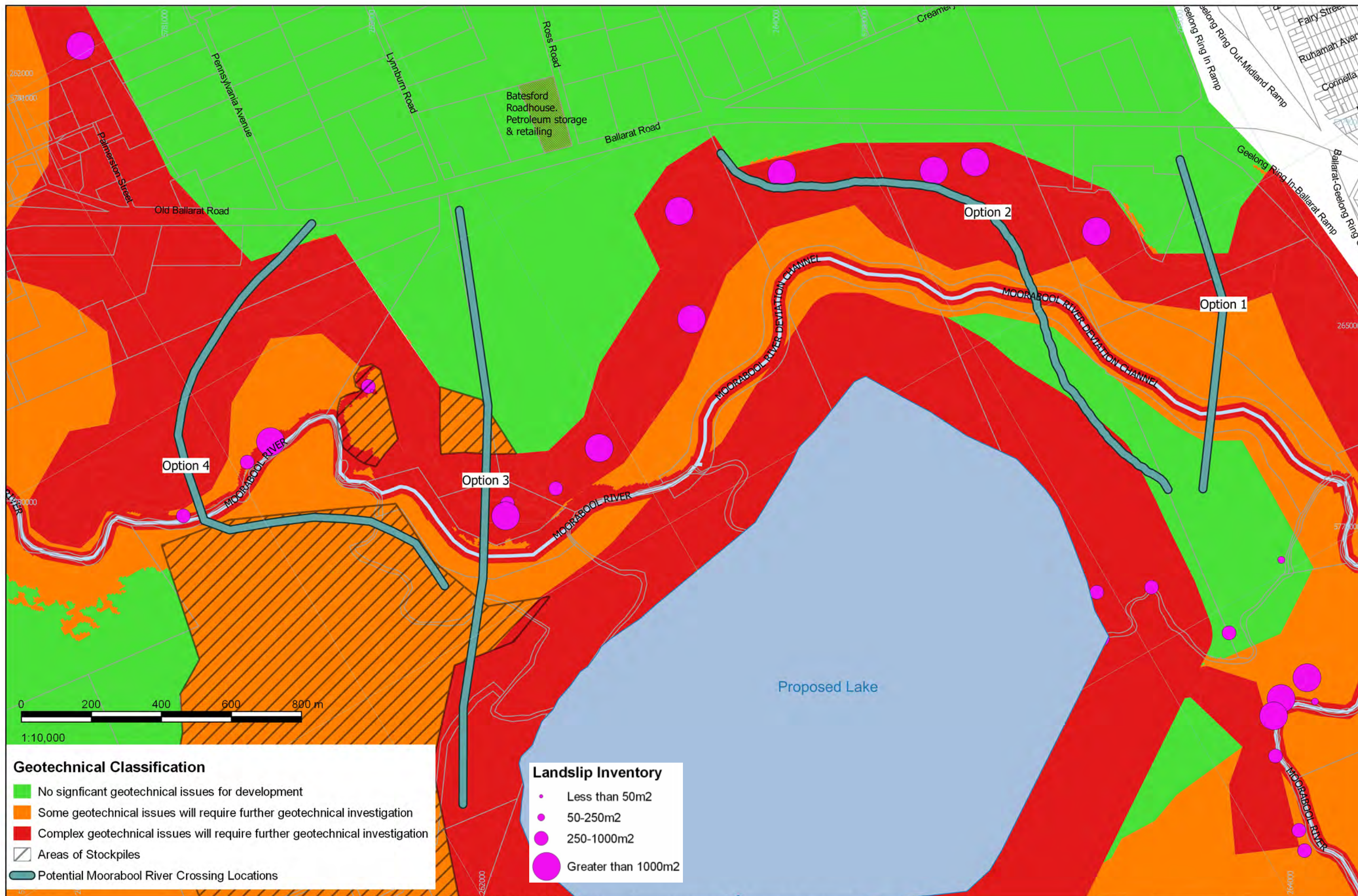
PROJECT No: 87027.00

DRAWING No: 103

REVISION: 3

SCALE: 1:25,000



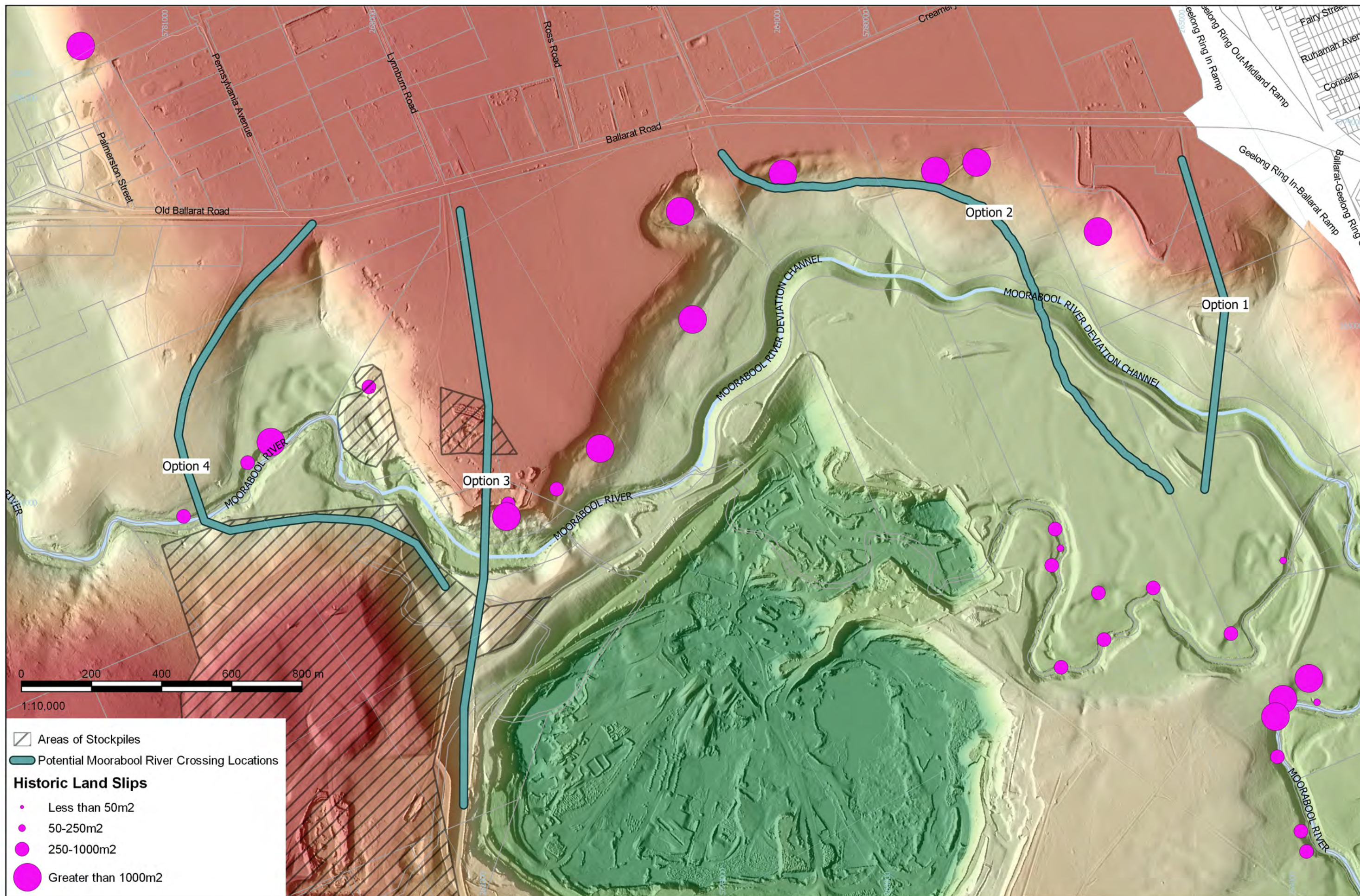


Geotechnical Classification

- No significant geotechnical issues for development
- Some geotechnical issues will require further geotechnical investigation
- Complex geotechnical issues will require further geotechnical investigation
- ▨ Areas of Stockpiles
- Potential Moorabool River Crossing Locations

Landslip Inventory

- Less than 50m²
- 50-250m²
- 250-1000m²
- Greater than 1000m²



Areas of Stockpiles

Potential Moorabool River Crossing Locations

Historic Land Slips

Less than 50m2

50-250m2

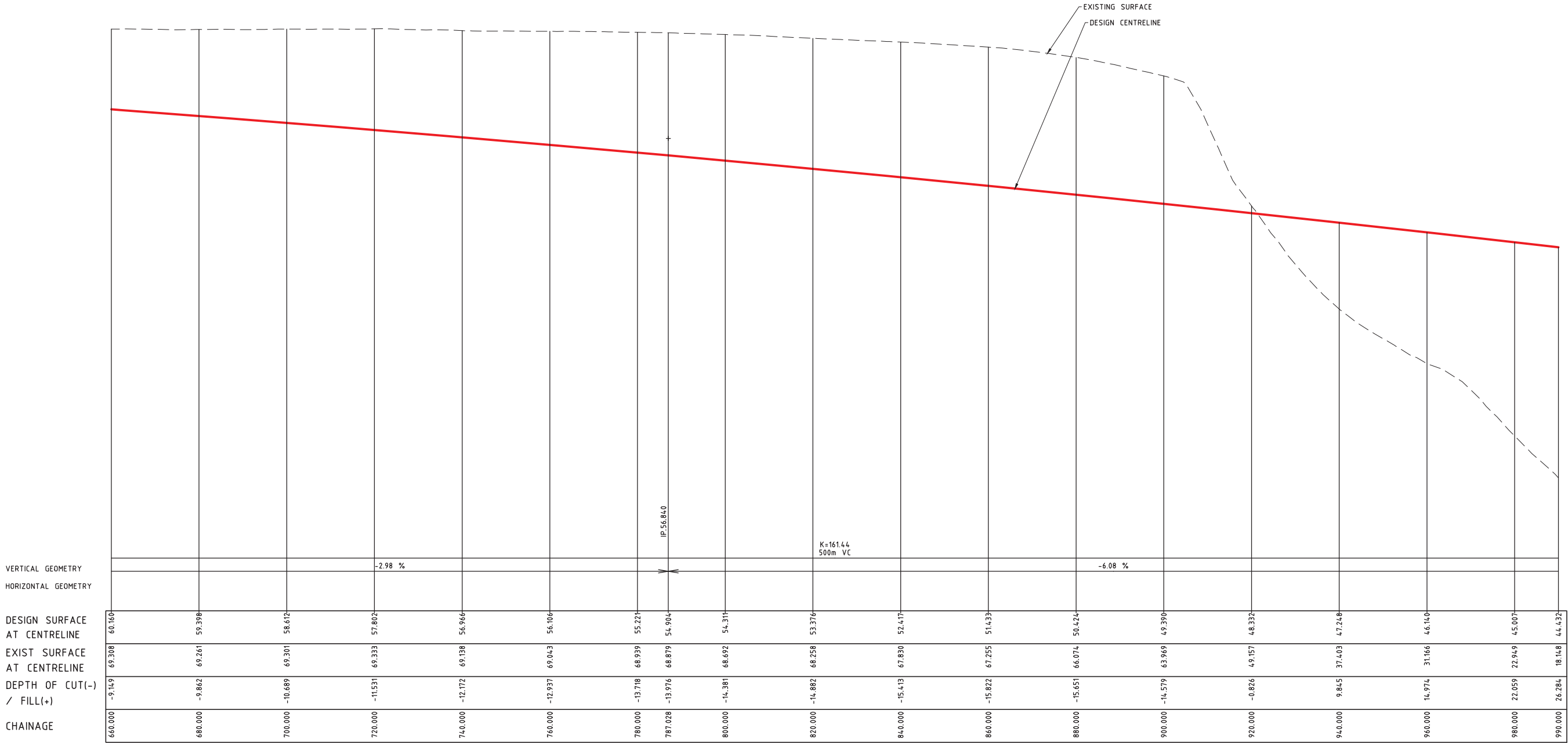
250-1000m2

Greater than 1000m2

- LTP = LEFT TANGENT POINT
RTP = RIGHT TANGENT POINT
TP = TANGENT POINT
CREST = HIGH POINT
SAG = LOW POINT
IP = INTERSECTION POINT

B1

 = TANGENT POINT NUMBER



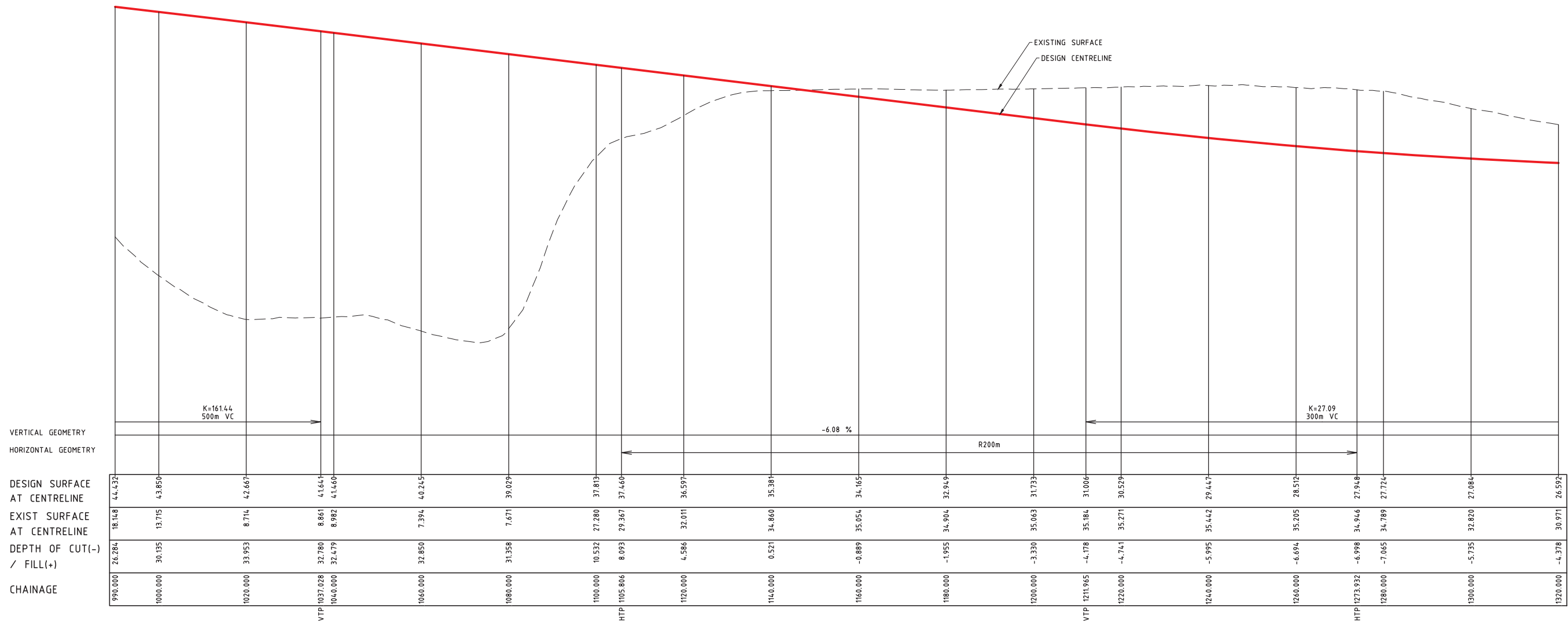
TGM OPTION 1 LONGITUDINAL SECTION

HORZ. SCALE: 1:500
VERT. SCALE: 1:250

Douglas Partners Option 3 Longitudinal Section

ISSUE	ISSUED FOR	DATE	No.	AMENDMENT	DATE	DRAWN	APPROVED	DESIGNED: S.HUNDT	DATE: DEC 2016	TGM Group Geelong 1/27-31 Myers Street (PO Box 1137) Geelong Vic 3220 T 03 5202 4600 F 03 5202 4691 ABN 11 125 568 461 www.tgmgroup.com Melbourne Ballarat Ballina JAS-ANZ Accredited: Quality ISO 9001 - CH&S AS/NZS 4801 - Environment ISO 14001	CLIENT: CERES HOLDINGS PTY LTD PROJECT: NORTHERN CONNECTION ROAD WESTERN GROWTH AREA BATESFORD CITY OF GREATER GEELONG	CIVIL DRAWING DRAWING TITLE: CONCEPTUAL ROAD LONGITUDINAL SECTIONS TGM REF. No.: 15410-99	SHEET: 4 OF 14 REV: 00
00	FOR INFORMATION	21/12/2016					DRAWN: S.HUNDT	SCALE: AS SHOWN					
							SURVEY: TGM GEELONG	SHEET SIZE: A1					
							CHECKED:	APPROVED:					
							POS NO: PS	VERSION:	PERMIT NO:				
WORKS SHALL NOT COMMENCE UNTIL PLANS ARE SIGNED AND APPROVED FOR CONSTRUCTION.													

LTP = LEFT TANGENT POINT
RTP = RIGHT TANGENT POINT
TP = TANGENT POINT
CREST = HIGH POINT
SAG = LOW POINT
IP = INTERSECTION POINT
B1 = TANGENT POINT NUMBER



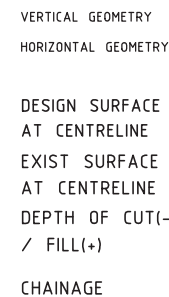
TGM OPTION 1 LONGITUDINAL SECTION

HORZ. SCALE: 1:500
VERT. SCALE: 1:250

Douglas Partners Option 3 Longitudinal Section

ISSUE	ISSUED FOR	DATE	No.	AMENDMENT	DATE	DRAWN	APPROVED	DESIGNED: S.HUNDT	DATE: DEC 2016	TGM Group Geelong	CLIENT:	PROJECT:	CIVIL DRAWING
00	FOR INFORMATION	21/12/2016						DRAWN: S.HUNDT	SCALE: AS SHOWN	1/27-31 Myers Street (PO Box 1137) Geelong Vic 3220 T 03 5202 4600 F 03 5202 4691 ABN 11 125 568 461 www.tgmgroup.com	CERES HOLDINGS PTY LTD	NORTHERN CONNECTION ROAD WESTERN GROWTH AREA BATESFORD	DRAWING TITLE: CONCEPTUAL ROAD LONGITUDINAL SECTIONS
								SURVEY: TGM GEELONG	SHEET SIZE: A1	Geelong Melbourne Ballarat		CITY OF GREATER GEELONG	TGM REF. No.: 15410-99
								CHECKED:	APPROVED:	Melbourne Ballarat Ballina			SHEET: 5 OF 14
								POS. NO: PS	VERSION:	Permit No.			REV: 00
								WORKS SHALL NOT COMMENCE UNTIL PLANS ARE SIGNED AND APPROVED FOR CONSTRUCTION.			THIS ELECTRONIC DRAWING IS PRODUCED BY AUTOCAD (R) SYSTEMS AND REMAINS THE PROPERTY OF TGM GROUP PTY. LTD. IT MAY NOT BE REPRODUCED IN ANY FORMAT WITHOUT WRITTEN PERMISSION.		

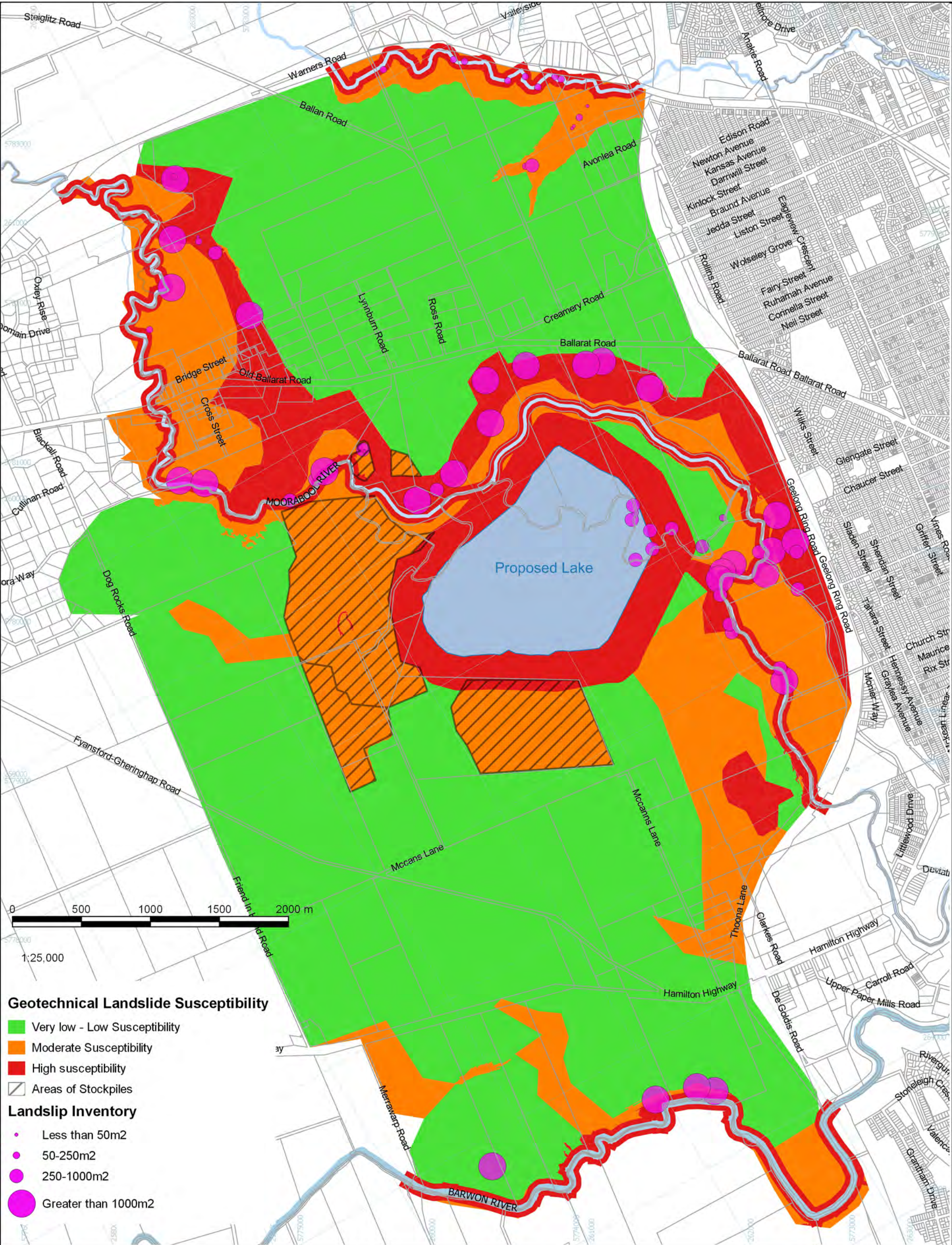
B1 = TANGENT POINT NUMBER



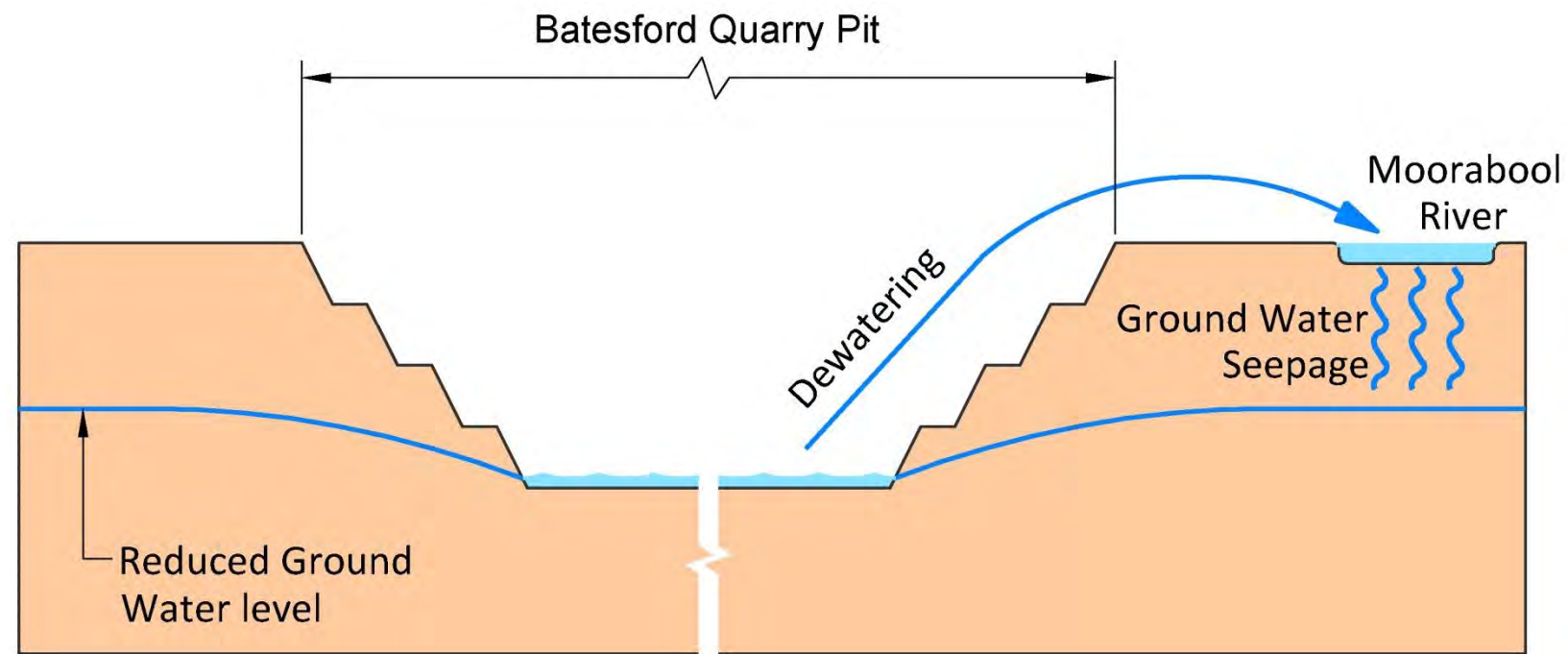
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VERT. SCALE: 1:250

Douglas Partners Option 2 Longitudinal Section

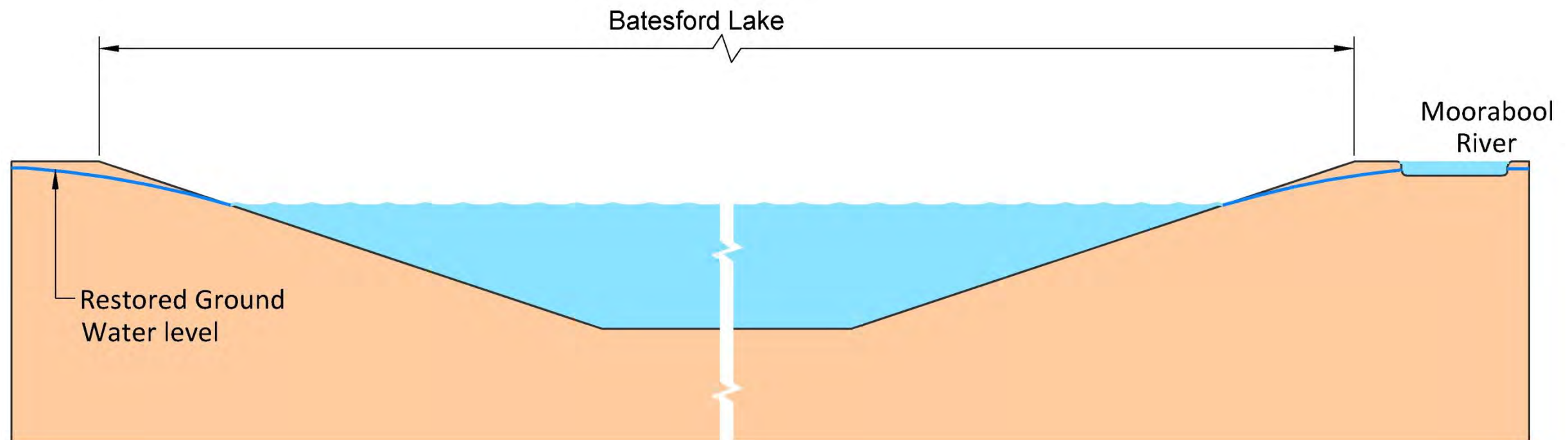
J:\15410 (WESTERN GROWTH AREA, GEELONG)\99 (BUSINESS DEVELOPMENT)\DWG\15410-99 LONGSECTIONS REV 00.DWG



 Douglas Partners <i>Geotechnics Environment Groundwater</i>	TITLE: Geotechnical Landslide Susceptibility Western Geelong Growth Area		OFFICE: Melbourne DRAWN BY: CGC DATE: 3 May 2017
CLIENT: McCann Group, Adelaide Brighton Ltd and Ramsey Property Group	PROJECT No: 87027.00	DRAWING No: 106	REVISION: 3
SCALE: 1:25,000			

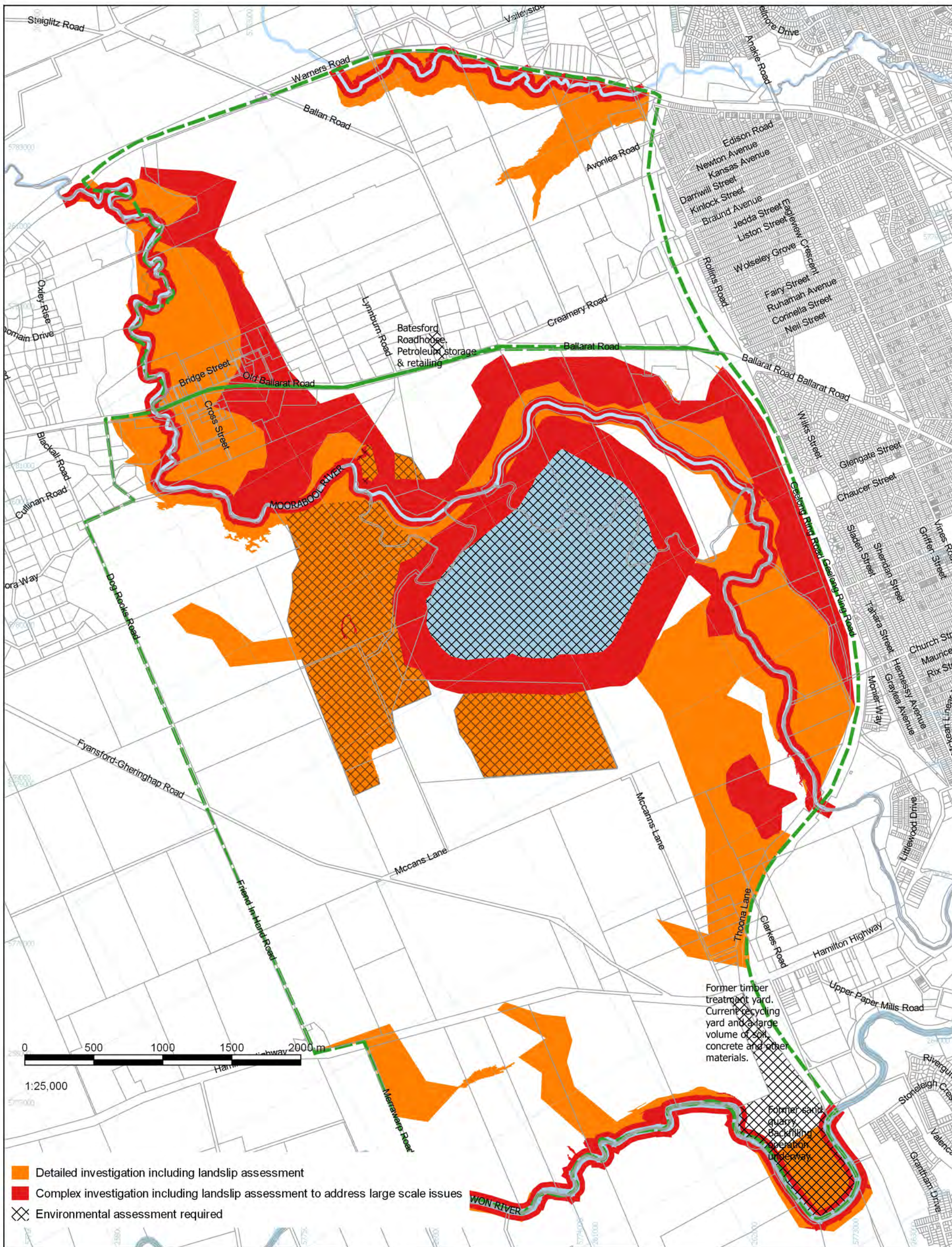


Indicative Cross Section of Existing Quarry Conditions



Indicative Cross Section of Rehabilitated Slope with 1V:3H Batters

Images courtesy of Golder Associates



Douglas Partners
Geotechnics | Environment | Groundwater

TITLE: **Further Investigation Requirements
Western Geelong Growth Area**



OFFICE: Melbourne

DRAWN BY: CGC

DATE: 3 May 2017

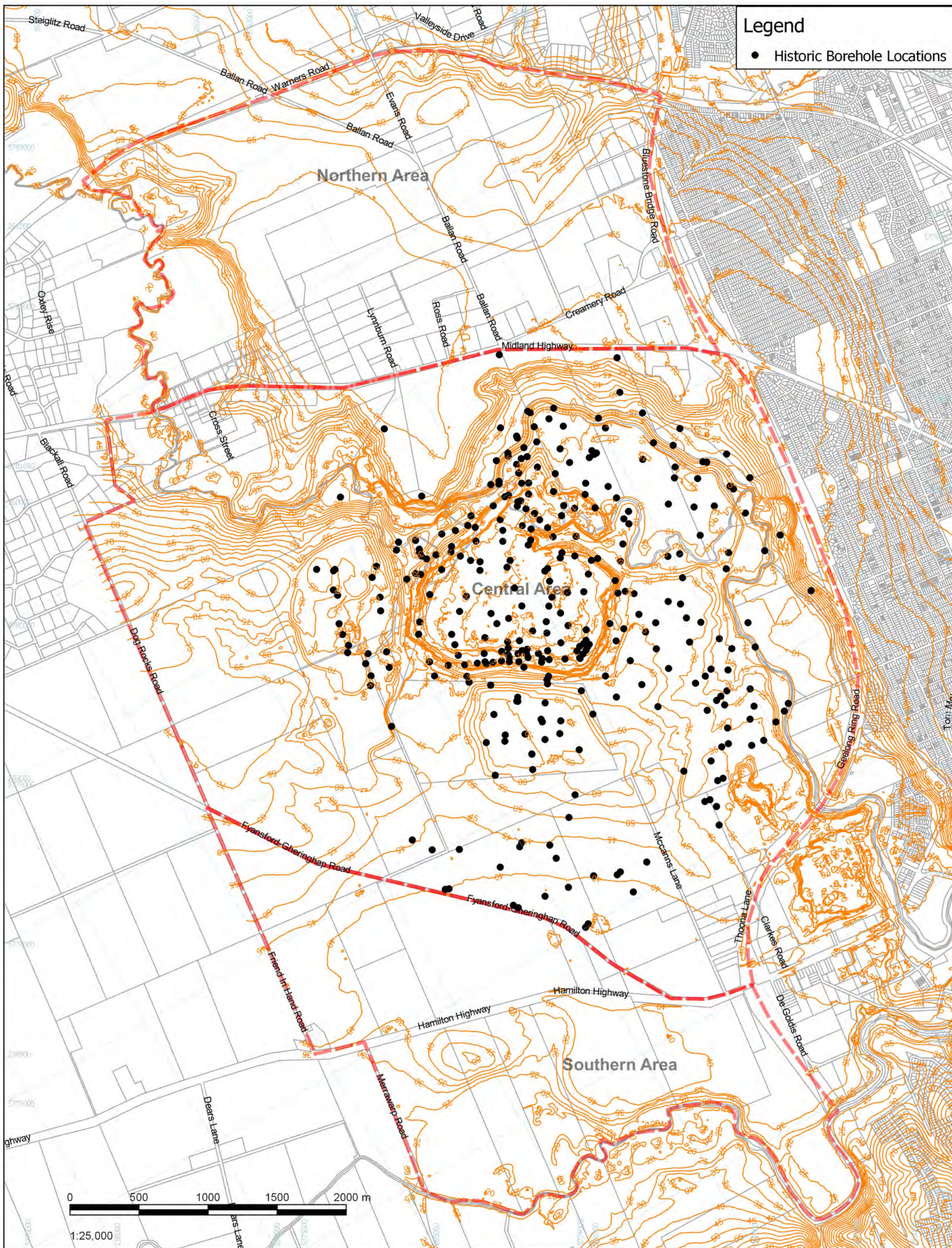
CLIENT: McCann Group, Adelaide Brighton Ltd and Ramsey Property Group

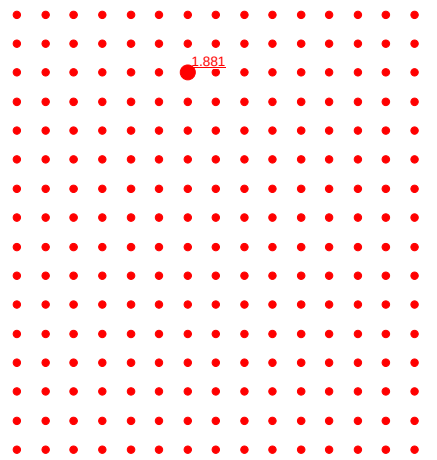
PROJECT No: 87027.00

DRAWING No: 108

REVISION: 2

SCALE: 1:25,000

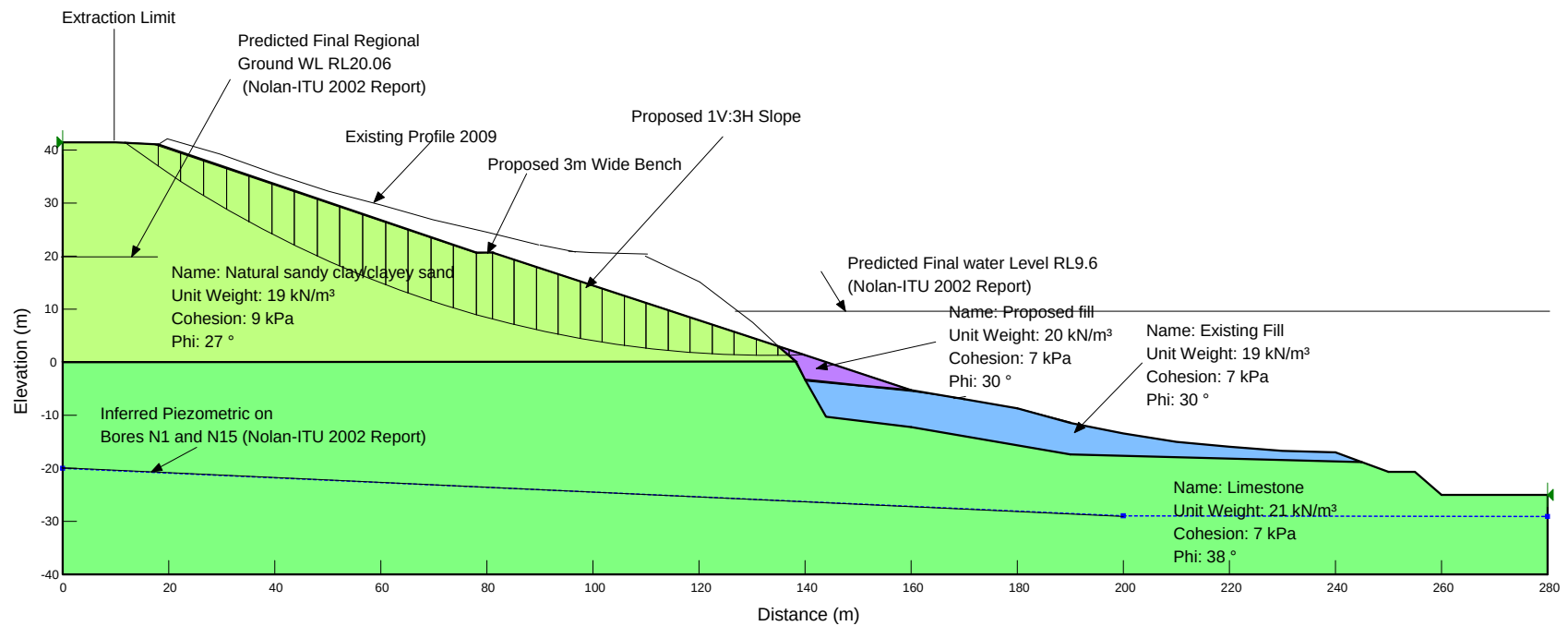


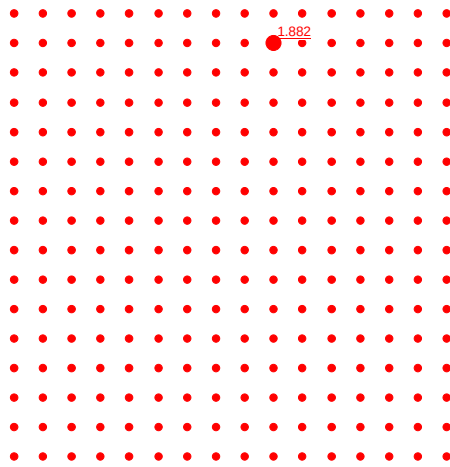


Southern Escarpment Stability - Rehabilitation of Batesford Quarry

File Name: 097612155_CH1600_Proposed_No Water.gsz

Method: Morgenstern-Price Created By: Chen, Kejing Date: 15/12/2010



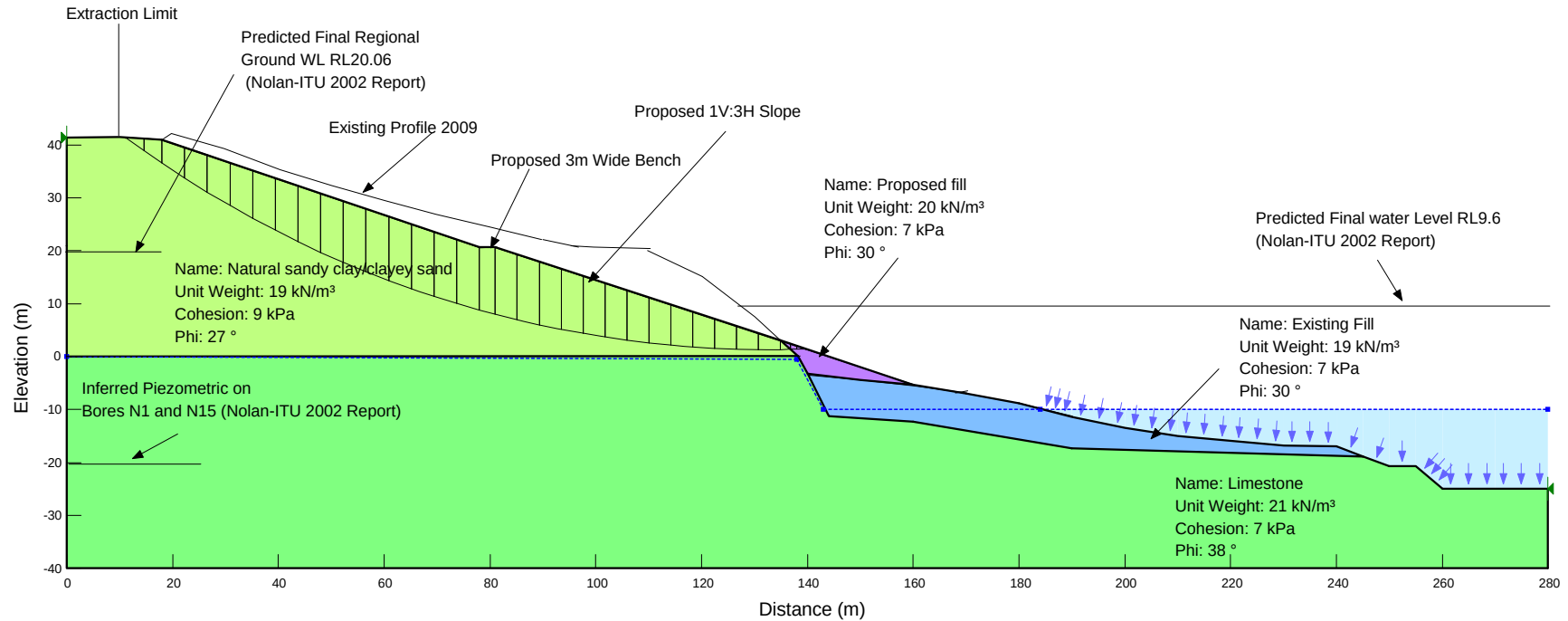


Southern Escarpment Stability - Rehabilitation of Batesford Quarry

File Name: 097612155_CH1600_proposed_50% water_D.gsz

Method: Morgenstern-Price Created By: Chen, Kejing Date: 15/12/2010

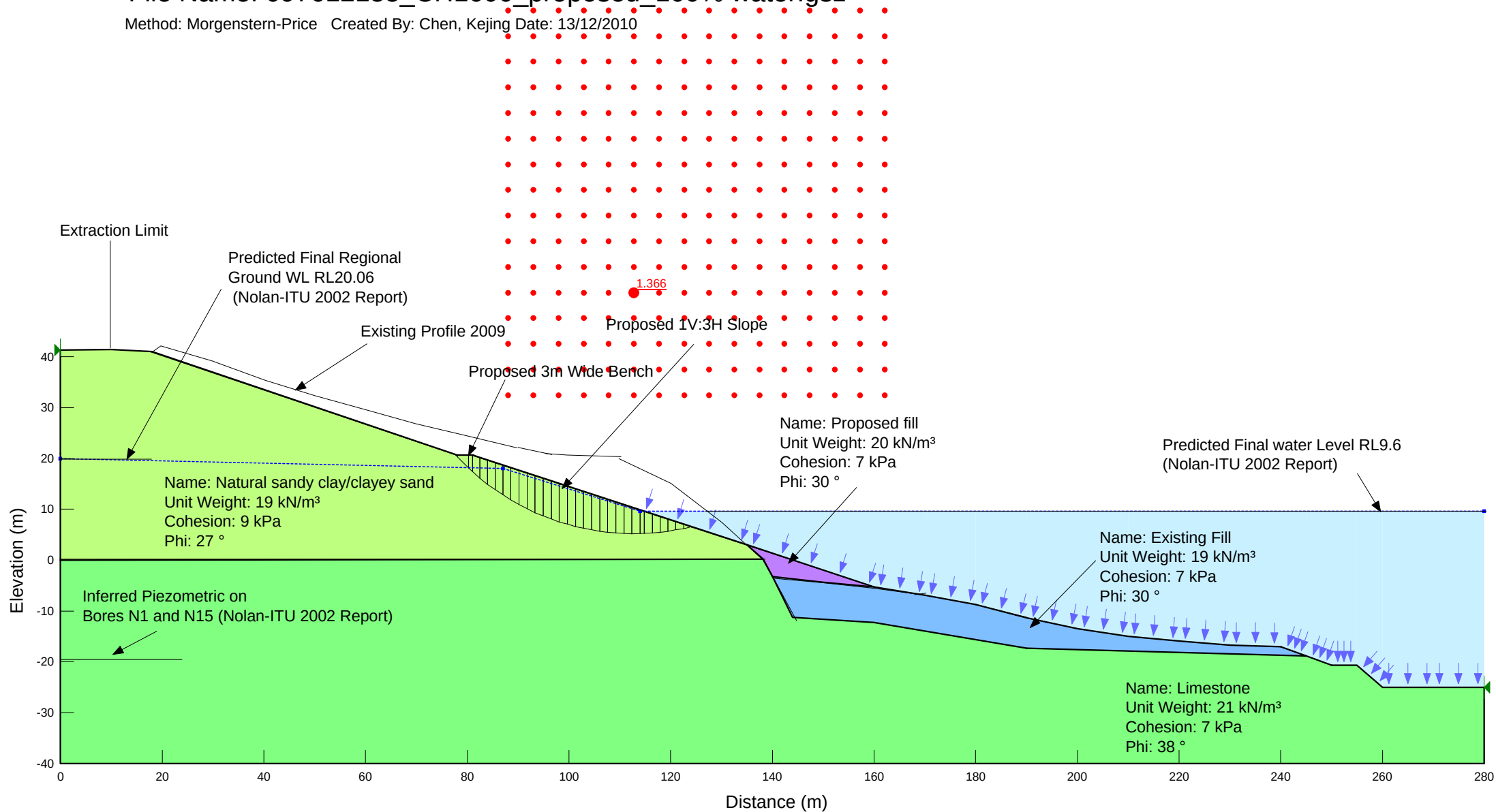
Provision of Drainage



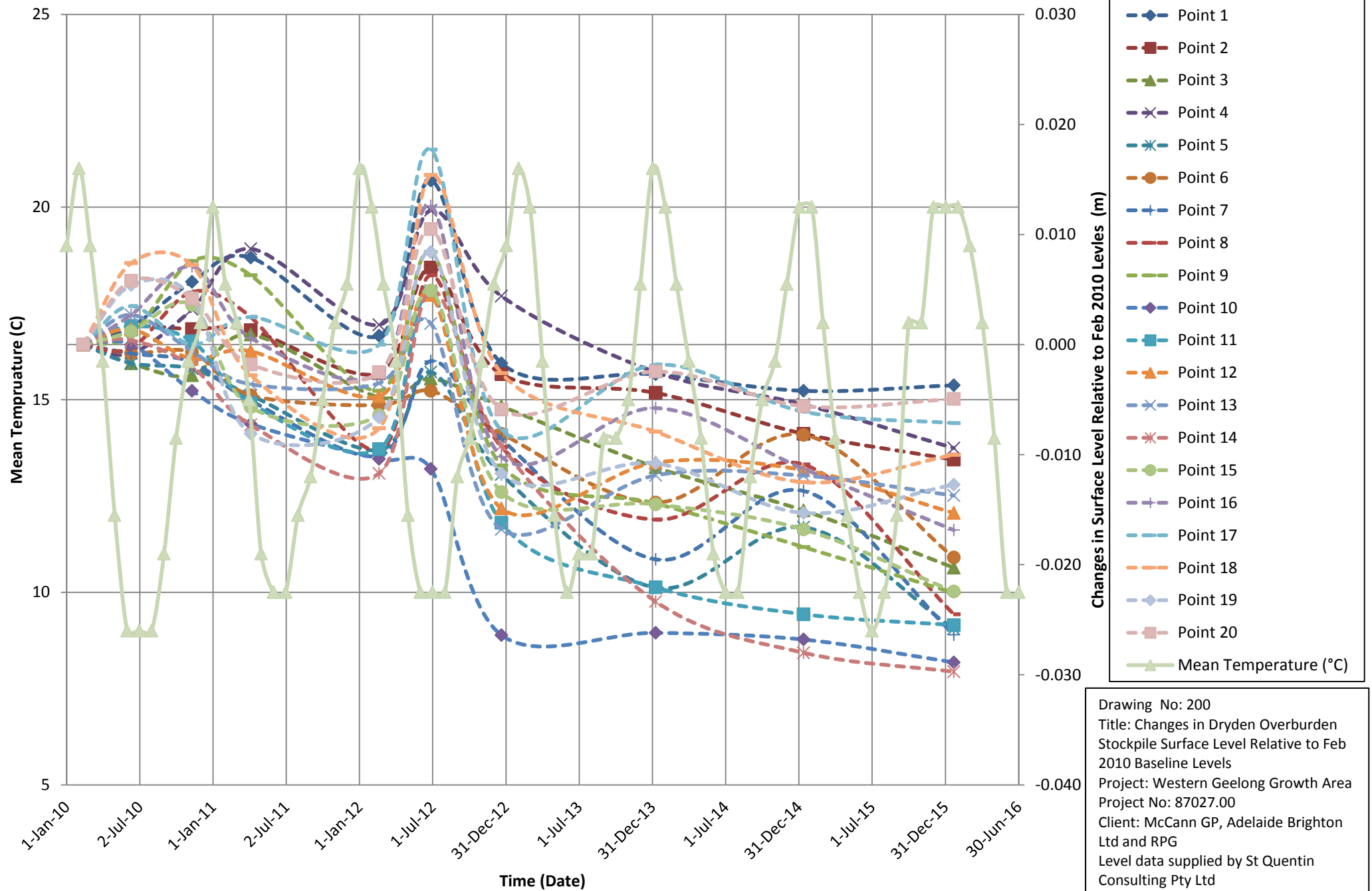
Southern Escarpment Stability - Rehabilitation of Batesford Quarry

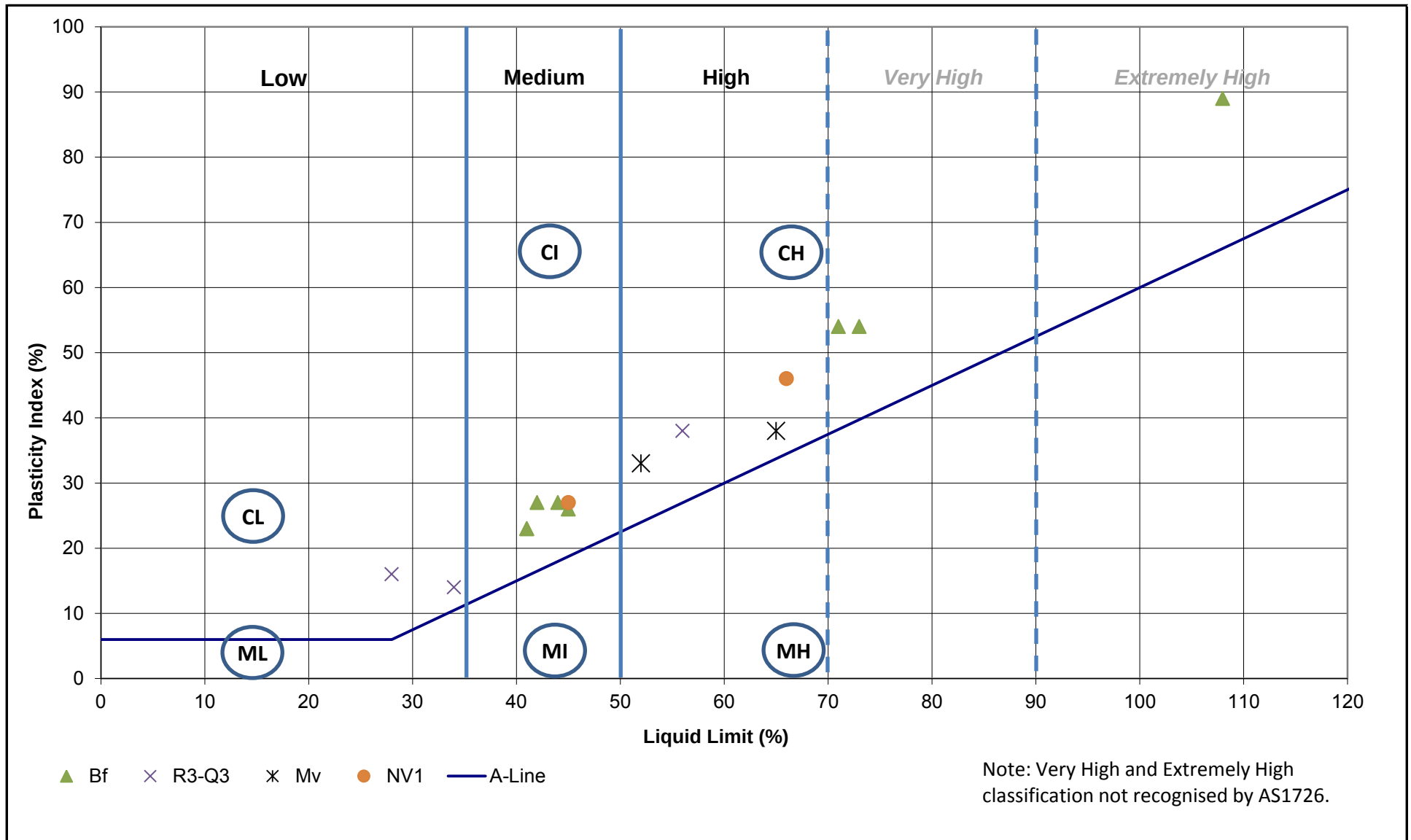
File Name: 097612155_CH1600_proposed_100% water.gsz

Method: Morgenstern-Price Created By: Chen, Kejing Date: 13/12/2010



Changes in Dryden Overburden Stockpile Surface Level Relative to Feb 2010 Baseline Levels





 Douglas Partners Geotechnics Environment Groundwater	CLIENT: McCGP, AB Ltd & RPG	Plasticity Chart Western Geelong Growth Area Project Fyansford & Batesford	PROJECT No: 87027.00
	OFFICE: Geelong		DWG No: 201
	DATE: 14 Oct 2016		REVISION: 0



Photo 1 : BH 1 location trailer mounted push tube rig.

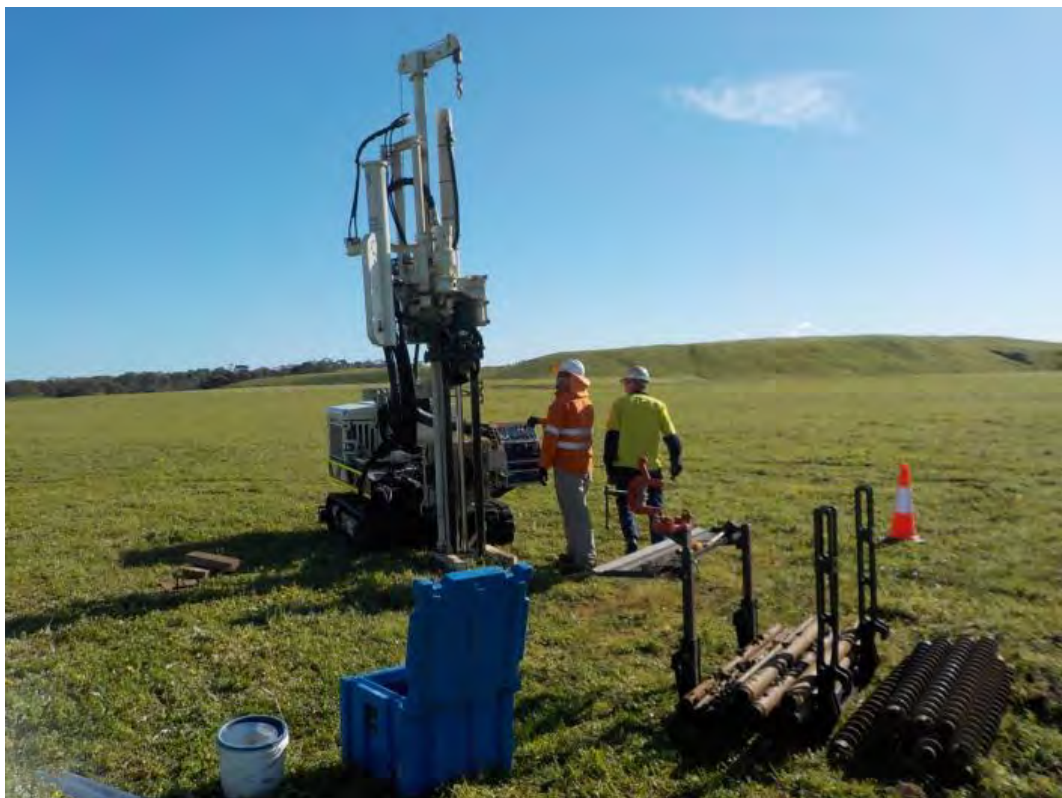


Photo 2 : BH 12 using Geoprobe rig



Photo 3 : Batesford Quarry.



Photo 4 : Location of BH 22



Photo 5 : View of the Batesford Quarry and the Western overburden stockpiles.



Photo 6 : Cowies Creek with exposed soil at tight bends



Site Photographs

Western Geelong Growth Area
Project
Crn Midland Highway and Geelong
Ring Road, Fyansford

CLIENT: McCann GP, Adelaide
Brighton Ltd and RPG

PROJECT: 87027.00

PLATE No: 3

REV: 0

DATE: Nov 2016



Photo 7 : View of the historical landslide at the downstream end of the Moorabool Deviation Channel



Photo 8 : Exposed Fyansford Formation clays and sands adjacent to the historical landslide



Photo 9 : View of the pre-1930s quarry looking from the Western Overburden dump over the Moorabool River



Photo 10 : View of Moorabool River valley (foreground) and escarpment at borehole BH30.

Appendix C

Borehole Logs

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 20 AHD
EASTING: 261434
NORTHING: 5780364
DIP/AZIMUTH: 90°/--

BORE No: BH 01
PROJECT No: 87027.00
DATE: 16/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	0.2	CLAYEY SILT (ML): Firm, dark brown, moist, trace fine grain sand, some rootlets (inferred topsoil).		E								
		SILTY CLAY (CL): Stiff, dark brown, brown, moist, M>Wp, rootlets, trace fine roots, trace fine grain sand.			0.3							
					0.45							
		Becoming yellow brown, damp, M>Wp below 0.8 m.			0.8							
		M~Wp, some fine sand from 1.2 m.			1.4							
1 0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12 -13 -14 -15 -16 -17 -18 -19 -20	1.5	CLAYEY SAND (SC): Medium dense to dense, yellow, orange brown, damp, fine grain sand.		D								
-21 -22 -23 -24 -25 -26 -27 -28 -29 -30 -31 -32 -33 -34 -35 -36 -37 -38 -39 -40	2.2	Bore discontinued at 2.2m										

RIG: Push Tube Rig

DRILLER: GG/WB

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 36.5 AHD
EASTING: 261986
NORTHING: 5779987
DIP/AZIMUTH: 90°/--

BORE No: BH 02
PROJECT No: 87027.00
DATE: 19/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	SILTY CLAY (CL): Firm, dark brown, moist, M>Wp, some rootlets (inferred topsoil).										
		SILTY CLAY (CH): Stiff, red brown, moist, M>Wp, trace rootlets.		E	0.2		BH 2 - 1					
					0.4							
	0.95	SILTY CLAY (CH): Very stiff, yellow grey, minor red brown, damp, M>Wp, fissured, trace rootlets.										
				D	1.2							
					1.5							
		Fine gravel seam at 1.9 m.										
					2.3							
				D	2.5							
	2.7	Bore discontinued at 2.7m										

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 71 AHD
EASTING: 263101
NORTHING: 5780023
DIP/AZIMUTH: 90°/--

BORE No: BH 03
PROJECT No: 87027.00
DATE: 16/9/2016
SHEET 1 OF 1

[illegible]

RIG: Push Tube Rig

DRILLER: GG/WB

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 1.0 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U _s	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W _s	Water seep
E	Environmental sample	W _l	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 66.5 AHD
EASTING: 262621
NORTHING: 5779303
DIP/AZIMUTH: 90°/--

BORE No: BH 04
PROJECT No: 87027.00
DATE: 16/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	FILLING / SANDY CLAY (CL): Stiff, brown, moist, M>Wp, fine to medium grain sand (inferred topsoil).										
		CLAYEY GRAVEL (GC): Medium dense to dense, brown, yellow grey, pale yellow, damp, M<Wp, fine to medium EW basalt fragments, some fine to coarse basalt sand.		E	0.3							
					0.4							
	0.9	CLAYEY SAND (SC): Medium dense, grey, pale grey, damp, fine grain sand.			0.9							
				D								
					1.4							
	2.4	SILTY CLAY (Cl): Inferred very stiff, pale grey, damp, M<Wp.			2.4							
				D								
	2.6	Bore discontinued at 2.6m			2.6							

RIG: Push Tube Rig

DRILLER: DP

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PLD	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 68 AHD
EASTING: 264393
NORTHING: 5779439
DIP/AZIMUTH: 90°/--

BORE No: BH 05
PROJECT No: 87027.00
DATE: 16/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
68	0.1	FILLING / SILTY CLAY (CL): Firm, dark brown, wet, M>>Wp, some fine to medium quartz gravel (inferred topsoil).		E	0.1							
		SILTY CLAY (CH): Stiff, brown, damp, M>Wp.			0.2							
				D	0.4							
	0.5	CLAYEY GRAVEL (GP): Dense, grey, humid, fine to medium basalt fragments (inferred EW Basalt).										
68	0.8	Bore discontinued at 0.8m- Refusal on basalt cobble or boulder.										
67	1											
66	2											

RIG: Push Tube Rig

DRILLER: DP

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 0.6 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 79.5 AHD
EASTING: 260407
NORTHING: 5779365
DIP/AZIMUTH: 90°/--

BORE No: BH 06
PROJECT No: 87027.00
DATE: 16/9/2016
SHEET 1 OF 1

[illegible]

RIG: Push Tube Rig

DRILLER: DP

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
	Core drilling	W	Water sample
C	Disturbed sample	W	Water seep
D	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 78.5 AHD
EASTING: 261559
NORTHING: 5778929
DIP/AZIMUTH: 90°/--

BORE No: BH 07
PROJECT No: 87027.00
DATE: 12 - 13/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
78	0.15	FILLING / SANDY CLAY (CL): Firm, dark brown, damp, with fine to coarse grained sand, trace silt.		E	0.0					
		FILLING / CLAYEY SILT (ML): Firm, orange brown, humid, with some clay and trace fine sand.			0.4	BH07-1				
				C	0.5					
1	1.0	FILLING / GRAVELLY CLAY (GC): Hard, pale grey, dry, desiccated, with some fine to medium basalt and trace sand, fine limestone gravel and brick fragments.			1.4				1	
2	2.0	FILLING / CLAYEY SILT (ML): Hard, dark brown, mottled orange, humid, with some clay and fine sand.		C	2.1		pp = 450		2	
	2.5	FILLING / SILTY CLAY (CL): Stiff, pale grey, dry, with some silt and trace fine limestone gravel.			2.8					
	2.8	FILLING / CLAYEY GRAVEL (GC): Grey brown, fine to coarse basalt with some clay.								
3				C	3.4				3	
				C						
4									4	
	4.3	FILLING / SILTY CLAY (CL): Hard, pale grey, brown, humid, with some silt, sand and fine to medium basalt and limestone gravel.			4.3		pp = 400			
					4.5					
5	5.0	FILLING / SILTY SAND (SM): Dense, orange brown, mottled pale grey, fine to coarse sand with some silt and trace clay.		C					5	
					5.8					
6				C					6	
7	7.0	FILLING / SILTY CLAY (CL): Stiff, pale grey, brown, humid with some silt, sand and fine to medium basalt and limestone gravel.			7.3				7	
				C						
					8.0		pp = 100-150		8	
8					8.3					
		Basalt cobble at 8.5 m depth								
	8.8	FILLING / SANDY CLAY (CL): Firm to stiff, pale brown, wet, with fine to coarse sand and some fine to medium basalt gravel.		C	8.8				9	
9										
	9.5	FILLING / SILTY CLAY (CI): Stiff to very stiff, brown grey, mottled pale brown, damp M > WP, some fine to coarse sand and fine basalt fragments, occasional sandy pockets.			9.8		pp = 200			

RIG: GEO 205

DRILLER: Groundwave

LOGGED: GG/WB

CASING: 2.8

TYPE OF BORING: Sonic

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. Water loss at 14.0 m depth

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	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)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 78.5 AHD
EASTING: 261559
NORTHING: 5778929
DIP/AZIMUTH: 90°/--

BORE No: BH 07
PROJECT No: 87027.00
DATE: 12 - 13/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
68	11	FILLING / SILTY CLAY (CI): Stiff to very stiff, brown grey, mottled pale brown, damp M > WP, some fine to coarse sand and fine basalt fragments, occasional sandy pockets. (continued) Some medium to coarse basalt gravel at 10 m depth.		C	10.1					
					10.8					
				C	11.8					
				C	13.3					
65	13.6	CLAYEY GRAVEL (GP): Inferred dense, grey, damp, medium to coarse basalt gravel.		C	13.8					
14	14.0	BASALT (SW): Very high strength, grey, slightly vesicular.		C	14.3					
14.3	14.3	Bore discontinued at 14.3m								
64	15									
63	16									
62	17									
61	18									
60	19									
59										

RIG: GEO 205

DRILLER: Groundwave

LOGGED: GG/WB

CASING: 2.8

TYPE OF BORING: Sonic

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. Water loss at 14.0 m depth

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 14 AHD
EASTING: 262298
NORTHING: 5779454
DIP/AZIMUTH: 90°/--

BORE No: BH 08
PROJECT No: 87027.00
DATE: 28/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
		FILLING / SANDY CLAY (CL): Firm, dark brown, moist, M>Wp, fine to coarse sand, trace fine gravel, trace shell fragments, trace rootlets.										
		Limestone cobble / gravel band between 0.85 m and 0.95 m. Some fine to medium gravel below 0.95 m.										
	1.45	Bore discontinued at 1.45m- Refusal on cobble or boulder.										
	2											

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 2.2 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 15 AHD
EASTING: 263845
NORTHING: 5779049
DIP/AZIMUTH: 90°/--

BORE No: BH 09
PROJECT No: 87027.00
DATE: 9/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)
				Type	Depth	Sample	Results & Comments		
15.0	0.1	FILLING / TOPSOIL / CLAYEY SAND (SC): Dark brown, moist, fine to coarse grained sand and clay.		E	0.3			1	
		CLAYEY SAND (SP): Medium dense, orange brown, moist, fine to coarse grained sand.			0.4				
		Becoming dense, very clayey below 0.6 m depth.			0.6				
					1.1				
14.0	1.1	LIMESTONE (EW): Extremely low strength, extremely weathered limestone gravel fragments in hard clay matrix, humid.							
13.0	1.3	Bore discontinued at 1.3m- Refusal on limestone cobble or boulder.							
12.0									
11.0									
10.0									
9.0									
8.0									
7.0									
6.0									
5.0									
4.0									
3.0									
2.0									
1.0									
0.0									

RIG: Push Tube Rig

DRILLER: AR

LOGGED: AR

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 1.0 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 16.5 AHD
EASTING: 264746
NORTHING: 5778252
DIP/AZIMUTH: 90°/--

BORE No: BH 10
PROJECT No: 87027.00
DATE: 15/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)
				Type	Depth	Sample	Results & Comments		
		FILLING / SILTY CLAY (CI): Stiff to very stiff, dark brown, brown, humid, M<Wp, rootlets, desiccated (inferred topsoil).							
	0.3	SILTY CLAY (CI): Very stiff, dark brown, humid, M<Wp, some rootlets.							
		Becoming hard below 0.6 m.							
		Brown, pale grey, some fine limestone fragments below 0.9 m.							
	1.4	Bore discontinued at 1.4m							

RIG: Push Tube Rig

DRILLER: GG/WB

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 70.5 AHD
EASTING: 260448
NORTHING: 5778263
DIP/AZIMUTH: 90°/--

BORE No: BH 11
PROJECT No: 87027.00
DATE: 12/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
70	0.1	FILLING / SANDY CLAY (CL): Dark brown, moist, fine to coarse grained sand (inferred topsoil).		D								
		SILTY CLAY (CH): Stiff to very stiff, orange brown, moist, with some silt and fine grained sand pockets.			0.2							
					0.3							
					0.4							
		Becoming mottled red and slightly sandy below 0.5 m depth.										
1	0.8	SAND (SW): Orange brown, mottled red, fine to coarse grained, slightly clayey with some fine quartz gravel.		D	0.8							
	1.3	Bore discontinued at 1.3m- Refusal.			1.3							
2												

RIG: Push Tube Rig

DRILLER: AR

LOGGED: AR

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 0.5 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 60.5 AHD
EASTING: 261376
NORTHING: 5778068
DIP/AZIMUTH: 90°/--

BORE No: BH 12
PROJECT No: 87027.00
DATE: 26/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
		FILLING / SILTY SAND (SM): Inferred medium dense, dark brown, brown grey, moist, fine to coarse sand, trace fine gravel, some rootlets.			0.0					
	0.65	FILLING / SILTY CLAY (CH): Stiff to very stiff, grey, yellow brown, moist, M>Wp, occasional grey, brown grey, fine to medium sand pockets.		C	0.8		pp = 320-380			
	1				1.0		pp = 100-250			1
	1.5	FILLING / GRAVELLY CLAY (GC): Inferred very stiff to hard, brown grey, minor pale grey, moist, M>Wp, fine to coarse basalt gravel / fragments, slightly sandy with medium to coarse basaltic sand.			1.4		pp = 180-300			
	2				1.5					2
	2.3	FILLING / SILTY SAND (SM): Inferred dense, pale yellow, yellow brown, damp, fine to coarse quartz sand, some fine quartz gravel, some clayey pockets.		C						
	3	FILLING / SANDY CLAY (CL): Very stiff, yellow brown, brown, grey, damp to moist, M>Wp, fine to coarse sand, occasional gravel band with fine to coarse basalt fragments, occasional silty / clayey sand pockets.			3.0					3
	4				3.5		pp = 200-350			
	5			C	4.5					4
	6				5.2		pp = 200-400			5
	7				5.7		pp = 250-350			
	8			C	6.0					6
	9				6.2		pp = -300			
	10				6.8		pp = 200-350			7
	11	Inferred basaltic boulder between 7.0 m and 8.0 m.		D	7.0					
	12				7.1					
	13				7.7					8
	14	Becoming inferred stiff to very stiff, grey, brown, moist, M>Wp, fine to coarse basaltic sand, some fine to medium basalt gravel, some calcareous nodules from 8.0 m.		D	7.8					
	15				8.3					
	16				8.4					9
	17				9.6					
	18	Some fine to coarse quartz sand at 9.7 m.		D	9.8					

RIG: Geoprobe

DRILLER: Allura Drilling

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube to 7.0 m, SFA to end.

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 60.5 AHD
EASTING: 261376
NORTHING: 5778068
DIP/AZIMUTH: 90°/--

BORE No: BH 12
PROJECT No: 87027.00
DATE: 26/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
50		FILLING / SANDY CLAY (CL): Very stiff, yellow brown, brown, grey, damp to moist, M>Wp, fine to coarse sand, occasional gravel band with fine to coarse basalt fragments, occasional silty / clayey sand pockets. (continued)								
11					11.2					
10				D	11.4					
12										
12.3		SANDY CLAY (CL): Very stiff, orange brown, minor red, grey, damp, M>Wp, fine sand.		D	12.3		pp = 250-300			
13	13.0	SILTY CLAY (Cl): Very stiff, yellow brown, damp, M>Wp, slightly sandy with fine sand.			12.5					
13		Sandy silt band at 13.5 m.								
14										
15										
16					15.8					
16.2		Bore discontinued at 16.2m		D	16.1					
17										
18										
19										

RIG: Geoprobe

DRILLER: Allura Drilling

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube to 7.0 m, SFA to end.

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 62.5 AHD
EASTING: 262573
NORTHING: 5777461
DIP/AZIMUTH: 90°/-

BORE No: BH 13
PROJECT No: 87027.00
DATE: 23/9/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
	0.25	FILLING / CLAYEY SILT (ML): Dark brown, moist, some fine sand, some rootlets.			0.0					
		FILLING / SILTY CLAY (CI): Stiff, brown, grey, moist, M>Wp, trace fine sand, trace fine to medium gravel, occasional medium dense to dense, grey, brown, silty sand bands.			0.4		pp = 120-200			
		Becoming hard, dark red, brown, damp at 0.7 m.			0.8		pp = 400-550			
		Becoming very stiff at 1.2 m.			1.3		pp = 200-400			
					1.5		pp = 100-220			
		Becoming stiff to very stiff, grey, pale yellow brown, minor orange brown, moist, some fine to medium sand, trace fine to coarse gravel from 1.55 m.			1.6					
		Band of Basalt / Granite gravel between 1.75 m and 1.85 m.			1.95		pp = 180-250			
		Thin seam of limestone fragments at 2.05 m.			2.2		pp = 150-250			
		Becoming very stiff with occasional hard bands, occasional yellow brown below 2.5 m.			2.5		pp = 250-350			
					2.7		pp = 300-350			
					3.0					
					3.3		pp = 200-350			
					4.0		pp = 200-350			
					4.5		pp = 250-350			
					4.6					
					5.1		pp = 200-300			
					5.8		pp = 400-550			
					6.0		pp = 250-350			
					6.2					
					6.8		pp = 200-350			
					7.3		pp = 250-350			
					7.5					
					7.8		pp = 250-350			
					8.2		pp = 150-250			
					8.8		pp = 250-350			
					9.0					
					9.7		pp = 170-230			
					9.8					
					9.9					

RIG: Geoprobe

DRILLER: Allura Drilling

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube to 9.0 m, SFA to end.

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetrometer test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 62.5 AHD
EASTING: 262573
NORTHING: 5777461
DIP/AZIMUTH: 90°/--

BORE No: BH 13
PROJECT No: 87027.00
DATE: 23/9/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
52		FILLING / SILTY CLAY (CI): Stiff, brown, grey, moist, M>Wp, trace fine sand, trace fine to medium gravel, occasional medium dense to dense, grey, brown, silty sand bands. <i>(continued)</i>								
11										
5										
12		Firm to stiff zone at 12.0 m.		D	12.0		pp = 80-100			
50					12.2					
13										
45										
13		Becoming stiff, grey, some shell fragments / shell grit below 13.5 m.		D	13.6		pp = 100-150			
14					13.8					
48										
15		Some Basalt fragments from 15.0 m.		D	14.9					
15.3					15.2					
47		Bore discontinued at 15.3m- Refusal on basalt boulder.								
16										
46										
17										
45										
18										
44										
19										
43										

RIG: Geoprobe

DRILLER: Allura Drilling

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube to 9.0 m, SFA to end.

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 34.5 AHD
EASTING: 263445
NORTHING: 5777195
DIP/AZIMUTH: 90°/--

BORE No: BH 14
PROJECT No: 87027.00
DATE: 9/9/2016
SHEET 1 OF 1

[illegible]

RIG: Push Tube Rig

DRILLER: AR

LOGGED: AR

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 19.5 AHD
EASTING: 264668
NORTHING: 5777292
DIP/AZIMUTH: 90°/--

BORE No: BH 15
PROJECT No: 87027.00
DATE: 15/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)
				Type	Depth	Sample	Results & Comments		
		FILLING / CLAYEY GRAVEL (GP): Inferred dense, dark brown, grey, damp to moist, medium subangular basaltic gravel.							
	0.3	FILLING / CLAYEY SILT (ML): Stiff, dark brown, damp, M < Wp.		E	0.4				
					0.55				
	0.8	SILTY CLAY (CI): Hard, pale brown, brown, humid, M < Wp, desiccated.		D	0.8				
	1.3	CLAYEY SILT (ML): Hard, pale brown, grey, humid, M < Wp.		D	1.3				
	1.5	Bore discontinued at 1.5m			1.5				

RIG: Push Tube Rig

DRILLER: GG/WB

LOGGED: GG/WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 52 AHD
EASTING: 260315
NORTHING: 5777325
DIP/AZIMUTH: 90°/--

BORE No: BH 16
PROJECT No: 87027.00
DATE: 19/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
50-1	0.1	CLAYEY SILT (ML): Firm, dark brown, wet, some rootlets (inferred topsoil).		E	0.3		BH 16 - 1					
		SILTY SAND (SM): Loose, dark brown, grey, wet, medium to coarse sub rounded sand, some fine gravel.										
	0.3	SILTY CLAY (CH): Stiff, brown, yellow grey, moist, M>Wp.										
		Becoming very stiff to hard, M<Wp, some fine grain sand below 0.7 m.										
	0.45											
50-2	0.8			D	1.3							
	1.3	SANDY GRAVEL (GP): Inferred very dense, grey, orange brown, humid, fine to coarse gravel, fine to coarse grain sand (Inferred Highly Weathered Basalt).										
50-2	1.5	Bore discontinued at 1.5m										

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

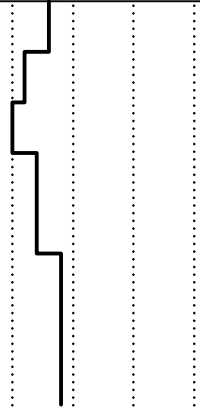
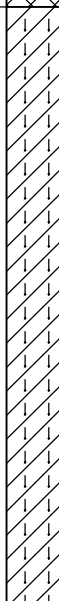
A	Auger sample	G	Gas sample	PLD	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 43 AHD
EASTING: 261268
NORTHING: 5777004
DIP/AZIMUTH: 90°/--

BORE No: BH 17
PROJECT No: 87027.00
DATE: 12/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)				
				Type	Depth	Sample	Results & Comments		5	10	15	20	
43		FILLING / SILTY CLAY (CL): Stiff to very stiff, dark brown, moist, some fine to coarse grained sand.		E	0.4 0.5				1				
0.3	FILLING / CLAYEY SAND (SP): Dense, orange brown, fine to coarse grained sand. (Sub base)												
0.4	SILTY CLAY (CH): Very stiff to hard, orange brown, mottled red, moist.												
				D	1.2				2				
	1.6	Bore discontinued at 1.6m- Refusal.			1.6								
41	2												

RIG: Push Tube Rig

DRILLER: AR

LOGGED: AR

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test (s(50) (MPa)
		PL(D)	Point load diametral test (s(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 43.5 AHD
EASTING: 262265
NORTHING: 5776582
DIP/AZIMUTH: 90°/--

BORE No: BH 18
PROJECT No: 87027.00
DATE: 12/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
		FILLING/TOPSOIL SILTY CLAY (CL): Firm dark brown moist slightly silty with some sand and fine rootlets (inferred topsoil).										
	0.3	SILTY CLAY (CH): Very stiff, orange brown, moist, with some silt.		E	0.3							
					0.4							
	1	Becoming mottled red below 1.0 m depth.										
					1.4							
	1.6	Bore discontinued at 1.6m- Refusal.		D	1.6							
	2											
	4.1											

RIG: Push Tube Rig

DRILLER: GG

LOGGED: AR

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 39 AHD
EASTING: 263471
NORTHING: 5776598
DIP/AZIMUTH: 90°/--

BORE No: BH 19
PROJECT No: 87027.00
DATE: 15/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
39		SILTY SAND (SM): Loose, brown, pale brown, moist, fine to medium grain sand (inferred topsoil).										
	0.2	SILTY CLAY (CH): Very stiff to hard, yellow brown, mottled orange red, humid, M<Wp, some fine grain sand, some rootlets.		E	0.2							
					0.3							
		Becoming yellow brown below 0.7 m.			0.7							
38	1	Becoming very stiff from 1 m.		D				1				
	1.4	Bore discontinued at 1.4m			1.4							
37	2							2				

RIG: Push Tube Rig

DRILLER: GG/WB

LOGGED: GG / WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 10 AHD
EASTING: 264358
NORTHING: 5776271
DIP/AZIMUTH: 90°/--

BORE No: BH 20
PROJECT No: 87027.00
DATE: 15/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
10		SILTY CLAY (CH): Firm, pale grey, brown, moist, M>Wp.										
		Becoming stiff, some stiff clayey silt pockets from 0.2 m.										
				D	0.3							
					0.5							
1	0.8	SILTY CLAY (Cl): Hard, brown, dark brown, damp, M < Wp, some desiccation.										
				E	1.0							
					1.2							
2				D	1.4							
	1.4	Bore discontinued at 1.4m										

RIG: Push Tube Rig

DRILLER: GG/WB

LOGGED: GG / WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 41 AHD
EASTING: 260282
NORTHING: 5776297
DIP/AZIMUTH: 90°/--

BORE No: BH 21
PROJECT No: 87027.00
DATE: 19/9/2016
SHEET 1 OF 1

[illegible]

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. DCP refused (double bouncing) at 0.8 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 38.5 AHD
EASTING: 261518
NORTHING: 5775911
DIP/AZIMUTH: 90°/--

BORE No: BH 22
PROJECT No: 87027.00
DATE: 20/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.1	CLAYEY SILT (ML): Firm, brown, grey, moist, some fine sand, some rootlets (inferred topsoil).			0.1		BH 22 - 1					
		SILTY CLAY (CH): Stiff, grey, brown, damp, M>Wp, trace fine grain sand and some rootlets to 0.5 m.		E	0.25							
		Tree root at 0.5 m.			0.6							
		Becoming pale grey, brown, moist, M>Wp.			1.5							
	1			D								
		Some thin basalt gravel bands / cobbles and occasional thin calcareous bands from 1.8 m.										
	2											
	2.6	Bore discontinued at 2.6m										

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 37 AHD
EASTING: 262683
NORTHING: 5774753
DIP/AZIMUTH: 90°/--

BORE No: BH 23
PROJECT No: 87027.00
DATE: 20/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
37		CLAYEY SILT / SANDY SILT (ML): Inferred firm, grey, brown, moist to wet, some rootlets.					BH 23 - 1			
				E	0.35					
	0.5	SILTY CLAY (CH): Very stiff, brown, minor orange brown, moist, M>Wp.		D	0.5					
	0.6	Bore discontinued at 0.6m			0.6					
36	1									
35	2									

RIG: Hand Auger

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. Saturated ground surface.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 24.5 AHD
EASTING: 260671
NORTHING: 5775391
DIP/AZIMUTH: 90°/--

BORE No: BH 24
PROJECT No: 87027.00
DATE: 19/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
		CLAYEY SILT (ML): Soft, brown, wet, rootlets (inferred topsoil).			0.1		BH 24 - 1					
	0.3	SANDY SILT (ML): Stiff, orange brown, dark brown, moist.		E	0.3							
	0.5	SILTY CLAY (CH): Stiff, brown, orange brown, moist, M>Wp.										
		Becoming hard, grey brown from 0.75 m.			0.7							
	1			D								
		Very stiff from 1.5 m.			1.4							
					1.6		pp = 220					
	2											
					2.5		pp = 250-320					
	2.7	Bore discontinued at 2.7m										

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

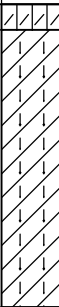
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 27 AHD
EASTING: 262109
NORTHING: 5774579
DIP/AZIMUTH: 90°/--

BORE No: BH 25
PROJECT No: 87027.00
DATE: 20/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
27	0.05	CLAYEY SILT (ML): Inferred firm, dark brown, moist, rootmat (inferred topsoil).		E	0.05		BH 25 - 1			
		SILTY CLAY (CL): Stiff, dark brown, moist, some rootlets.			0.2					
				D	0.3					
					0.4					
	0.6	Bore discontinued at 0.6m								
26	1									
25	2									

RIG: Hand Auger

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 52.5 AHD
EASTING: 264016
NORTHING: 5782021
DIP/AZIMUTH: 90°/--

BORE No: BH 26
PROJECT No: 87027.00
DATE: 14/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)
				Type	Depth	Sample	Results & Comments		
		SILTY CLAY (CH): Stiff red brown, damp, M>Wp, with some rootlets.		E	0.05				
				D	0.2				
					0.4				
		Very stiff, calcareous, pale brown, grey from 0.5 m depth.							
	0.7	Bore discontinued at 0.7m- Refusal on basalt cobble or boulder.							
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								
	26								
	27								
	28								
	29								
	30								

RIG: Push Tube Rig

DRILLER: GG

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 0.7 m depth.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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	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)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 39 AHD
EASTING: 264772
NORTHING: 5781449
DIP/AZIMUTH: 90°/--

BORE No: BH 27
PROJECT No: 87027.00
DATE: 20/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
39		SILTY CLAY (CI): Firm, dark brown, damp, M < Wp, some rootlets, some fine grain sand.			0.2		BH 27 - 1					
				E								
38	0.4	SILTY CLAY (CH): Stiff, red brown, damp, M < Wp, trace rootlets, fissured, basaltic cobble at 0.4 m			0.4							
37		Becoming very stiff to hard from 0.8 m.										
36	1.1	SILTY CLAY (CI): Hard, brown, pale yellow brown, humid, M < Wp, friable.			1.1							
				D								
35					1.5							
				D								
34		Basaltic cobble at 1.8 m.			1.8							
					1.9							
33												
				D								
32												
31	2.5	Bore discontinued at 2.5m			2.5							

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

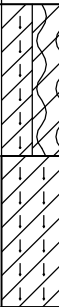
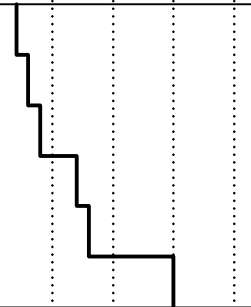
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	>	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 56.5 AHD
EASTING: 264641
NORTHING: 5780821
DIP/AZIMUTH: 90°/--

BORE No: BH 28
PROJECT No: 87027.00
DATE: 14/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)
				Type	Depth	Sample	Results & Comments		
	0.3	SILTY CLAY (CL): Stiff, dark brown, moist, M > Wp, some rootlets (inferred topsoil).		E	0.1				
					0.25				
		SILTY CLAY (CH): Very stiff, grey, dark grey, moist, M>Wp, some fine to medium grained sand, trace fine basalt gravel.		D	0.35				
	0.6	Bore discontinued at 0.6m- Refusal on basalt cobble or boulder.			0.55				
	1								
	2								
	3								
	4								

RIG: Push Tube Rig

DRILLER: GG

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 0.6 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

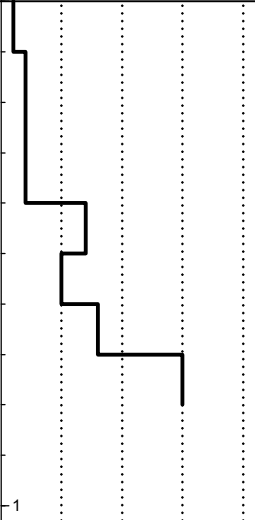
SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	>	Water seep
E	Environmental sample	≡	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 69 AHD
EASTING: 262559
NORTHING: 5781800
DIP/AZIMUTH: 90°/--

BORE No: BH 29
PROJECT No: 87027.00
DATE: 14/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
68		SILTY CLAY (CH): Firm to stiff, dark brown, damp, M» Wp, some rootlets.		E	0.05							
		Very stiff from 0.4 m depth.		D	0.2							
					0.4							
68	0.55	CLAYEY GRAVEL (GP): Dense, pale brown, grey fine to medium gravel of extremely low to very low strength, Extremely to highly weathered basalt.										
	1.05	Bore discontinued at 1.05m- Refusal on basalt cobble or boulder.										
67	2											

RIG: Push Tube Rig

DRILLER: GG

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 0.8 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND			
A	Auger sample	G	Gas sample
B	Bulk sample	P	Piston sample
BLK	Block sample	U	Tube sample (x mm dia.)
C	Core drilling	W	Water sample
D	Disturbed sample	W	Water seep
E	Environmental sample	W	Water level
		PID	Photo ionisation detector (ppm)
		PL(A)	Point load axial test Is(50) (MPa)
		PL(D)	Point load diametral test Is(50) (MPa)
		pp	Pocket penetrometer (kPa)
		S	Standard penetration test
		V	Shear vane (kPa)



BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 24.5 AHD
EASTING: 261937
NORTHING: 5781702
DIP/AZIMUTH: 90°/--

BORE No: BH 30
PROJECT No: 87027.00
DATE: 14/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Dynamic Penetrometer Test (blows per 100mm)			
				Type	Depth	Sample	Results & Comments		5	10	15	20
	0.05	CLAYEY SILT (ML): Dark brown, moist (inferred topsoil).										
		SILTY CLAY (CI): Stiff, red, dark brown damp, M>Wp, some rootlets, trace fine sand.		E	0.1							
					0.3							
					0.8							
		Very stiff, pale brown, humid, desiccated, slightly sandy from 0.8 m depth.		D	1.0							
		Hard from 1.0 m depth.										
	1.6	Bore discontinued at 1.6m										
	2											
	2.2											

RIG: Push Tube Rig

DRILLER: GG

LOGGED: AR

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data. DCP refused (double bouncing) at 1.7 m depth

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

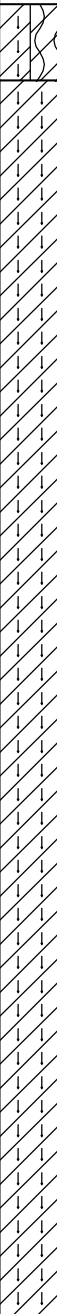
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	>	Water seep	S	Standard penetration test
E	Environmental sample	≡	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 38 AHD
EASTING: 262652
NORTHING: 5775859
DIP/AZIMUTH: 90°/--

BORE No: BH 31
PROJECT No: 87027.00
DATE: 28/9/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
38	0.15	SILTY CLAY (CH): Firm, dark brown, moist, M>Wp, slightly sandy with fine sand, trace fine gravel (inferred topsoil).								
		SILTY CLAY (CH): Stiff, yellow brown, grey, trace fine sand.								
37	1	Becoming stiff to very stiff below 0.9 m.								
		Becoming very stiff, trace fine to medium calcareous gravel from 1.3 m.								
36	2	Becoming slightly gravelly with fine to medium calcareous gravel from 2.4 m.								
	2.6	Bore discontinued at 2.6m								

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 29 AHD
EASTING: 263913
NORTHING: 5779543
DIP/AZIMUTH: 90°/--

BORE No: BH 32
PROJECT No: 87027.00
DATE: 4/10/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
29	0.1	FILLING / SILTY SAND (SM): Dark brown, moist, fine to medium sand, rootmat. Limestone cobble at 0.05 m.								
		FILLING / SILTY CLAY (CH): Stiff, dark brown, moist, M>Wp, some fine sand, trace fine quartz gravel.			0.3		pp = 150-180			
	0.4	SILTY CLAY (CH): Stiff, grey, dark grey, moist, M>Wp.			0.6					
				D	0.8		pp = 180 pp = 180			
		Becoming very stiff below 1.0 m.			1.0				1	
					1.1		pp = 250-300			
	1.5	SILTY CLAY (CL): Hard, dark brown, mottled dark grey, damp, M<Wp, trace fine basalt fragments between 1.5 m and 2.0 m.			1.5					
				D	1.6		pp >600			
					1.8					
					2.0		pp >600		2	
		Becoming grey brown below 2.2 m.			2.4		pp = 450-550			

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)



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BOREHOLE LOG

CLIENT: McCann Gp, Adelaide Brighton Ltd & RPG
PROJECT: Western Geelong Growth Area Project
LOCATION: Fyansford & Batesford

SURFACE LEVEL: 29 AHD
EASTING: 263913
NORTHING: 5779543
DIP/AZIMUTH: 90°/--

BORE No: BH 32
PROJECT No: 87027.00
DATE: 4/10/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing				Water	Well Construction Details	
				Type	Depth	Sample	Results & Comments			
26	3.1	SILTY CLAY (CH): Hard, yellow brown, grey, damp, M> Wp, some calcareous nodules.								
					3.3		pp = 450-550			
					3.4					
				D						
25	4				4.0		pp = 500			
	4.5	Bore discontinued at 4.5m								
24	5									

RIG: Push Tube Rig

DRILLER: WB

LOGGED: WB

CASING: NA

TYPE OF BORING: Push Tube

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in WGS 84 Zone 55 H. Reduced level taken from CoGG lidar data.

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	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	W	Water seep	S	Standard penetration test
E	Environmental sample	W	Water level	V	Shear vane (kPa)

Appendix D

Laboratory Test Results

Results of Moisture Content, Plasticity and Linear Shrinkage Tests

Client: McCann GP, Adelaide Brighton Ltd and RPG		Project No: 87027.00	
Project: Western Geelong Growth Area Project		Report No: M16165001	
Location: Cnr Midland Highway and Geelong Ring Road, Fyansford		Report Date: 14-Oct-2016	
		Date Sampled: -	
		Date of Test: 11-Oct-2016	
		Page: 1 of 1	

Test Location	Depth (m)	Description	Code	W _F %	W _L %	W _P %	PI %	*LS %
BH01	0.8-1.4	Silty CLAY	2,5	14.9	28	12	16	-
BH02	1.2-1.5	Silty CLAY	2,5	32.6	108	19	89	-
BH04	2.4-2.6	Silty CLAY	2,5	17.3	42	15	27	-
BH10	0.9-1.4	Silty CLAY	2,5	12.8	44	17	27	-
BH14	0.9-1.1	Silty CLAY	2,5	25.5	56	18	38	-
BH15	0.81.3	Silty CLAY	2,5	18.4	41	18	23	-

Legend:

W_F Field Moisture Content
 W_L Liquid limit
 W_P Plastic limit
 PI Plasticity index
 LS Linear shrinkage from liquid limit condition (Mould length 254mm)

Test Methods:

Moisture Content: AS 1289 2.1.1
 Liquid Limit: AS 1289 3.1.2
 Plastic Limit: AS 1289 3.2.1
 Plasticity Index: AS 1289 3.3.1
 Linear Shrinkage: AS 1289 3.4.1

Code:

Sample history for plasticity tests

1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Methods: Sampled by Engineering Department

Remarks:



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested: MS
 Checked: AG



Arveendra Gounder
Laboratory Manager

Results of Moisture Content, Plasticity and Linear Shrinkage Tests

Client:	McCann GP, Adelaide Brighton Ltd and RPG	Project No:	87027.00
Project:	Western Geelong Growth Area Project	Report No:	M16165002
Location:	Cnr Midland Highway and Geelong Ring Road, Fyansford	Report Date:	14-Oct-2016
		Date Sampled:	-
		Date of Test:	12-Oct-2016
		Page:	1 of 1

Test Location	Depth (m)	Description	Code	W _F %	W _L %	W _P %	PI %	*LS %
BH17	1.2-1.6	Silty CLAY	2,5	32.5	65	27	38	-
BH18	1.4-1.6	Silty CLAY	2,5	24.3	52	19	33	-
BH19	0.7-1.4	Silty CLAY	2,5	22.3	71	17	54	-
BH20	1.2-1.4	Silty CLAY	2,5	28.5	41	18	23	-
BH24	0.7-1.4	Silty CLAY	2,5	28.4	66	20	46	-
BH25	0.3-0.4	Silty CLAY	2,5	25.5	34	20	14	-

Legend:

W_F Field Moisture Content
 W_L Liquid limit
 W_P Plastic limit
 PI Plasticity index
 LS Linear shrinkage from liquid limit condition (Mould length 254mm)

Test Methods:

Moisture Content: AS 1289 2.1.1
 Liquid Limit: AS 1289 3.1.2
 Plastic Limit: AS 1289 3.2.1
 Plasticity Index: AS 1289 3.3.1
 Linear Shrinkage: AS 1289 3.4.1

Code:

Sample history for plasticity tests

1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Methods: Sampled by Engineering Department

Remarks:

Results of Moisture Content, Plasticity and Linear Shrinkage Tests

Client:	McCann GP, Adelaide Brighton Ltd and RPG			Project No:	87027.00			
Project:	Western Geelong Growth Area Project			Report No:	M16165003			
Location:	Cnr Midland Highway and Geelong Ring Road, Fyansford			Report Date:	14-Oct-2016			
				Date Sampled:	-			
				Date of Test:	12-Oct-2016			
				Page:	1 of 1			

Test Location	Depth (m)	Description	Code	W _F %	W _L %	W _P %	PI %	*LS %
BH27	1.9-2.5	Silty CLAY	2,5	16.3	45	18	27	-
BH30	0.8--1.0	Silty CLAY	2,5	24.0	45	19	26	-
BH32	3.4-4.0	Silty CLAY	2,5	22.1	73	19	54	-

Legend:

W_F Field Moisture Content
 W_L Liquid limit
 W_P Plastic limit
 PI Plasticity index
 LS Linear shrinkage from liquid limit condition (Mould length 254mm)

Test Methods:

Moisture Content: AS 1289 2.1.1
 Liquid Limit: AS 1289 3.1.2
 Plastic Limit: AS 1289 3.2.1
 Plasticity Index: AS 1289 3.3.1
 Linear Shrinkage: AS 1289 3.4.1

Code:

Sample history for plasticity tests

1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Methods: Sampled by Engineering Department

Remarks:



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested: MS
 Checked: AG


 Arveendra Gounder
 Laboratory Manager

Results of Moisture Content Test

Client:	McCann GP, Adelaide Brighton Ltd and RPG	Project No:	87027.00
Project:	Western Geelong Growth Area Project	Report No:	M16165004
		Report Date:	14-Oct-2016
Location:	Cnr Midland Highway and Geelong Ring Road, Fyansford	Date Sampled:	-
		Date of Test:	06-Oct-2016
		Page:	1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	MOISTURE CONTENT (%)
BH01	0.8-1.4	Silty CLAY	14.9
BH02	1.2-1.5	Silty CLAY	32.6
BH04	2.4-2.6	Silty CLAY	17.3
BH10	0.9-1.4	Silty CLAY	12.8
BH14	0.9-1.1	Silty CLAY	25.5
BH15	0.8-1.3	Silty CLAY	18.4
BH17	1.2-1.6	Silty CLAY	32.5
BH18	1.4-1.6	Silty CLAY	24.3
BH19	0.7-1.4	Silty CLAY	22.3
BH20	1.2-1.4	Silty CLAY	28.5
BH24	0.7-1.4	Silty CLAY	28.4
BH25	0.3-0.4	Silty CLAY	25.5
BH27	1.9-2.5	Silty CLAY	16.3
BH30	0.8-1.0	Silty CLAY	24.0
BH32	3.4-4.0	Silty CLAY	22.1

Test Method(s): AS1289.2.1.1

Sampling Method(s): Sampled by Engineering Department

Remarks:



NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested: SP
Checked: AG


 Arveendra Gounder
 Laboratory Manager

Table D1
Comparison of Soil Laboratory Results to
Ecological and Health Criteria

Sample No		Strata	Sample Depth	Sample Date	Metals										Monocyclic Aromatic Hydrocarbons (MAH)				Total Recoverable Hydrocarbons (TRH)				Cyanide	Organochlorine pesticides								Phenols			Polycyclic Aromatic Hydrocarbons (PAH)						
					Arsenic	Cadmium	Chromium		Copper	Lead	Manganese	Mercury	Nickel	Selenium	Zinc	Benzene	Toluene	Ethyl Benzene	Total Xylenes	TRH C6-C10	TRH >C10-C16	TRH >C16-C34		TRH >C34-C40	DDT + DDD + DDE	Aldrin + Dieldrin	Chlordane	Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Polychlorinated Biphenyls	Phenol	Pentachlorophenol	Cresols	Naphthalene	Benzo(a)Pyrene (BaP)	BaP TEQ	Total PAH	
							Total Chromium III	Total Chromium VI																																	
							(mg/kg)	(mg/kg)																																	(mg/kg)
NEPM EIL & ESL CRITERIA (Residential & Open Space) ¹					100	3 ^a	606		130	1,114		1 ^a	86		297	50	85	70	45	180	120	1,300 ^b	5,600 ^b		180											170	0.7				
NEPM EIL and ESL CRITERIA (Commercial and Industrial) ¹					160	3 ^a	866		175	1,814	500 ^a	1 ^a	111		427	75	135	165	95	215	170	2,500 ^b	6,600 ^b		640											370	1.4				
NEPM HIL-A CRITERIA (Residential with soil access) ¹					100	20		100	6,000	300	3,800	40	400	200	7,400										250	240	6	50	270	10	6	10	300	1	3,000	100	400			3	300
NEPM HIL-A Vapour Intrusion (Residential) ^{1, B}																0.5	160	55	40	45 ^c	110 ^d																				
CRC CARE HSL-A Direct Contact (Low-density Residential) ²															100	14,000	4,500	12,000	4,400	3,300	4,500	6,300														1,400					
CRC CARE HSL-C Direct Contact (Recreational/Open Space) ²															120	18,000	5,300	15,000	5,100	3,800	5,300	7,400														1,900					
NEPM HIL-B CRITERIA (Residential with minimal soil access) ¹					500	150		500	30,000	1,200		120	1,200	1,400	60,000									300	600	10	90	400	20	10	15	500	1	45,000	130	4,700			4	400	
CRC CARE HSL-B Direct Contact (High-density Residential) ²															140	21,000	5,900	17,000	5,600	4,200	5,800	8,100														2,200					
NEPM HIL-D CRITERIA (Commercial and Industrial) ¹					3000	900		3600	240,000	1,500		730	6,000	10,000	400,000								1,500	3,600	45	530	2,000	100	50	80	2,500	7	240,000	660	25,000			40	4,000		
CRC CARE HSL-D Direct Contact (Commercial and Industrial) ²															430	99,000	27,000	81,000	26,000	20,000	27,000	38,000														11,000					
NEPM HSL-D Vapour Intrusion (Commercial and Industrial) ¹															5	6,500	1,800	1,200	1,000 ^c	800 ^d																	4				
BH01-1	Silty CLAY	0.3-0.45m	16/09/2016	5	<0.2	50		17	10	210	<0.05	40	<3	35					<20	<20	<50	<50													<0.1	<0.1	<0.1	<0.1			
BH03-1	Silty CLAY	0.3-0.4m	16/09/2016	<5	<0.2		<1	6	8	300	<0.05	49	<3	18	<0.5	<0.5	<0.5	<1	<20	<20	<50	<50	<5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.5	<0.5	<1	<0.1	<0.1	<0.1	<0.1		
BH04-1	Clayey GRAVEL	0.3-0.4m	16/09/2016	<5	<0.2	110		360	<5	47	<0.05	120	<3	60					<20	<20	<50	<50													<0.1	<0.1	<0.1	<0.1			
BH06-1	Silty CLAY	0.2-0.3m	16/09/2016	16	<0.2	50		<5	17	17	0.07	11	<3	9					<20	<20	<50	<50													<0.1	<0.1	<0.1	<0.1			
BH07-1	Filling (SILT)	0.4-0.5m	12/09/2016	19	<0.2	21		7	7	190	<0.05	37	<3	25					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH09-1	Clayey SAND	0.3-0.4m	9/09/2016	<5	<0.2	8		<5	<5	39	<0.05	<5	<3	7					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH14-1	Silty CLAY	0.5-0.6m	9/09/2016																																						
BH15-1	Filling (SILT)	0.4-0.55m	15/09/2016	12	<0.2	32		8	9	300	<0.05	21	<3	26					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH16-1	Silty CLAY	0.3-0.45m	19/09/2016	46	<0.2	200		<5	28	55	<0.05	14	<3	7					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH19-1	Silty CLAY	0.2-0.3m	15/09/2016	<5	<0.2	36		<5	9	16	<0.05	10	<3	9					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH23-1	SILT	0.35-0.5m	20/09/2016	<5	<0.2		<1	<5	<5	25	<0.05	<5	<3	<5	<0.5	<0.5	<0.5	<1	<20	<20	<50	<50	<5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.5	<0.5	<1	<0.1	<0.1	<0.1	<0.1		
BH24-1	SILT	0.1-0.3m	19/09/2016	19	<0.2	43		6	12	81	<0.05	22	<3	20					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH26-1	Silty CLAY	0.05-0.2m	14/09/2016	21	<0.2	75		17	7	320	<0.05	70	<3	44					<20	<20	<50	<50												<0.1	<0.1	<0.1	<0.1				
BH28-1	Silty CLAY	0.1-0.25m	14/09/2016	7	<0.2	120		37	28	880	0.07	98	<3	71					<20	<20	340	110											<0.1	<0.1	<0.1	<0.1					
BH29-1	Silty CLAY	0.05-0.2m	14/09/2016	<5	<0.2	52		11	10	310	<0.05	35	<3	23					<20	<20	<50	<50											<0.1	<0.1	<0.1	<0.1					

Notes	
	A blank space indicates no test performed, or no criteria available
LORR	Limit of reporting has been raised due to high moisture content, insufficient sample or matrix interference
5	Represents exceedance of the ecological assessment criteria
5	Represents exceedance of the HIL/HSL-A residential/recreational assessment criteria
5	Represents exceedance of the HIL/HSL-B residential assessment criteria
6	Represents exceedance of the industrial/commercial criteria

¹ Schedule B1 - Guideline on Investigation Levels for Soil and Groundwater, of the National Environmental Protection Measure (NEPM) for Assessment of Site Contamination, December 1999 (amendment 2013).
²CRC CARE, "Technical Report no. 10, Health screening levels for petroleum hydrocarbons in soil and groundwater", September 2011, Table B4: Soil Health Screening Levels for Direct Contact.

^A EILs sourced from Oliszowy et al. (1995), referenced in section 2.5.7 of Schedule B1 - Guideline on Investigation Levels for Soil and Groundwater, of the National Environmental Protection Measure (NEPM) for Assessment of Site Contamination, December 1999 (amendment 2013).

^B ESL for fine textured soils, from table 1B(6).

^C HSL for F1 (C₈ -C₁₀ minus BTEX).

^D HSL for F2 (C₁₀ -C₁₆ minus naphthalene).

Table D2
Comparison of Soil Laboratory Results to
Waste Categorisation Criteria

[illegible]

Notes	
	A blank space indicates no test performed, or no criteria available
LORR	Limit of reporting has been raised due to high moisture content, insufficient sample or matrix interference
ASLP	Australian Standard Leaching Procedure - Leachable Concentration
27	Represents exceedance of the EPA Fill Material criteria and sample tested classifications as Category C Contaminated Soil

References for Upper Limits

1) Environment Protection Authority of Victoria (EPA), June 2009: EPA Publication IWRG621 "Soil Hazard Categorisation & Management".

CERTIFICATE OF ANALYSIS

Batch No: 16-43570
Final Report 582342

Client: Douglas Partners Pty Ltd
Contact: Arthur Rowling
Address: 231 Normanby Road
 SOUTH MELBOURNE VIC 3205

Client Program Ref: 87027.00 Western Geelong
ALS Program Ref: DOUGLAS
PO No: 124986

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Laboratory Scoresby Laboratory
Address Caribbean Business Park, 22 Dalmore Drive, Scoresby, VIC 3179
Phone 03 8756 8000
Fax 03 9763 1862
Contact: Tuyen Nguyen
 Client Manager
 Tuyen.Nguyen@alsglobal.com

Date Sampled: 09-Sep-2016 - 20-Sep-2016
Date Samples Received: 22-Sep-2016
Date Issued: 28-Sep-2016

The sample(s) referred to in this report were analysed by the following method(s) under NATA Accreditation No. 992.

The hash (#) below indicates methods not covered by NATA accreditation in the performance of this service.

Analysis	Method	Laboratory	Analysis	Method	Laboratory	Analysis	Method	Laboratory
BTEXN	CM047	Scoresby	CHC	CM045	Scoresby	Chloride	CM031	Scoresby
Cyanide	EK026SF	Scoresby	EC	CM060 C	Scoresby	Total Fluoride	EK040TSC	Scoresby
HVOL	CM047	Scoresby	MAH	CM051 & CM047	Scoresby	Moisture	CM041	Scoresby
MS Total Metals	CM050 C	Scoresby	OCP	CM048	Scoresby	PAH	CM043	Scoresby
PCB	CM048	Scoresby	pH	EA002	Scoresby	Phenols(Halo)	CM056	Scoresby
Phenols(NonHalo)	CM056	Scoresby	SO4	ED041GWRG	Scoresby	Total Cr 6+ DA	EG048G	Scoresby
TRH F2	# EP071WRG	Scoresby	TRH & TPH (>C10)	EP071WRG	Scoresby	TRH (C6-C10) & F1	CM047 (F1 not NATA)	Scoresby

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Analysis conducted outside holding time due to late arrival or delayed extraction/analysis. Based on APHA, VICEPA, AS & NEPM

Late Sample Arrival - EC[4927912,4927913,4927914,4927920,4927921,4927922] pH[4927912,4927913,4927914,4927920,4927921,4927922] TRH F2[4927912,4927913,4927920,4927921,4927922] TRH & TPH (>C10)

Late Analysis - EC[4927915,4927917] pH[4927915,4927917]



NATA Accredited
Laboratory No. 992

Accredited for compliance
with ISO/IEC 17025
- Testing

Signatories
These results have been electronically signed by the authorised signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11

<i>Name</i>	<i>Title</i>	<i>Name</i>	<i>Title</i>
Chatura Perera	Team Leader Nutrients	Hoa Nguyen	Analyst
Hao Zhang	Team Leader Organics	Joseph De Alwis	Analyst
John Earl	Team Leader Metals	John Levvey	Principal Trace Metals Chemist
Kosta Christopoulos	Deputy Team Leader Organics		



LOR = Limit of reporting. When a reported LOR is higher than the standard LOR, this may be due to high moisture content, insufficient sample or matrix interference.

CAS Number = Chemistry Abstract Services Number. The analytical procedures in this report (including in house methods) are developed from internationally recognised procedures such as those published by USEPA, APHA and NEPM.

					Sample No.						
					Client Sample ID						
					Sample Date						
					Sample Type						
Analysis	Analyte	CAS #	LOR			4927908	4927909	4927910	4927911	4927912	4927913
BTEXN	Benzene	71-43-2	<0.5	mg/kg		BH01-1,0.3-0.45m	BH03-1,0.3-0.4m	BH04-1,0.3-0.4m	BH06-1,0.2-0.3m	BH07-1,0.4-0.5m	BH09-1,0.3-0.4m
BTEXN	Toluene	108-88-3	<0.5	mg/kg		16/09/16	16/09/16	16/09/16	16/09/16	12/09/16	09/09/16
BTEXN	Ethyl Benzene	100-41-4	<0.5	mg/kg		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
BTEXN	Xylene - m&p	108-38-3 /	<1	mg/kg							
BTEXN	Xylene - O	95-47-6	<0.5	mg/kg							
BTEXN	Naphthalene	91-20-3	<0.5	mg/kg							
BTEXN	Total Xylenes	1330-20-7	<1	mg/kg							
BTEXN	BTEX (Sum)	BTEX	<1	mg/kg							
Analysis	Analyte	CAS #	LOR								
CHC	1,2,3,4-Tetrachlorobenzene	634-66-2	<0.1	mg/kg							
CHC	1,2,3,5-Tetrachlorobenzene	634-90-2	<0.1	mg/kg							
CHC	1,2,3-Trichlorobenzene	87-61-6	<0.1	mg/kg							
CHC	1,2,4,5-Tetrachlorobenzene	95-94-3	<0.1	mg/kg							
CHC	1,2,4-Trichlorobenzene	120-82-1	<0.1	mg/kg							
CHC	1,2-Dichlorobenzene	95-50-1	<0.1	mg/kg							
CHC	1,3,5-Trichlorobenzene	108-70-3	<0.1	mg/kg							
CHC	1,3-Dichlorobenzene	541-73-1	<0.1	mg/kg							
CHC	1,4-Dichlorobenzene	106-46-7	<0.1	mg/kg							
CHC	2-Chloronaphthalene	91-58-7	<0.1	mg/kg							
CHC	Benzal Chloride	98-87-3	<0.1	mg/kg							
CHC	Benzotrichloride	98-07-7	<0.1	mg/kg							
CHC	Benzylchloride	100-44-7	<0.1	mg/kg							
CHC	Hexachloroethane	67-72-1	<0.1	mg/kg							
CHC	Hexachlorobutadiene	87-68-3	<0.1	mg/kg							
CHC	Hexachlorocyclopentadiene	77-47-4	<0.1	mg/kg							
CHC	Pentachlorobenzene	608-93-5	<0.1	mg/kg							
Analysis	Analyte	CAS #	LOR								
HVOL	1,1,1,2-Tetrachloroethane	630-20-6	<0.5	mg/kg							
HVOL	1,1,2,2-Tetrachloroethane	79-34-5	<0.5	mg/kg							

Samples not collected by ALS and are tested as received.

A blank space indicates no test performed. Soil results expressed in mg/kg dry weight unless specified otherwise. Microbiological testing was commenced on the day of receipt and within 24 hours of sampling unless otherwise stated. MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate. MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate. Calculated results are based on raw data.



				Sample No.	4927908	4927909	4927910	4927911	4927912	4927913
				Client Sample ID	BH01-1,0.3-0.45m	BH03-1,0.3-0.4m	BH04-1,0.3-0.4m	BH06-1,0.2-0.3m	BH07-1,0.4-0.5m	BH09-1,0.3-0.4m
				Sample Date	16/09/16	16/09/16	16/09/16	16/09/16	12/09/16	09/09/16
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
HVOL	1,1- Dichloroethane	75-34-3	<0.5	mg/kg		<0.5				
HVOL	1,1-Dichloroethene	75-35-4	<0.5	mg/kg		<0.5				
HVOL	1,1-Dichloropropene	563-58-6	<0.5	mg/kg		<0.5				
HVOL	1,2,3-Trichloropropane	96-18-4	<0.5	mg/kg		<0.5				
HVOL	1,2-Dibromo-3-Chloropropane	96-12-8	<0.5	mg/kg		<0.5				
HVOL	1,2-Dichloroethene [cis]	540-59-0(cis)	<0.5	mg/kg		<0.5				
HVOL	1,2-Dichloroethene [trans]	540-59-0(trans)	<0.5	mg/kg		<0.5				
HVOL	1,2-Dichloroethane	107-06-2	<0.5	mg/kg		<0.5				
HVOL	1,2-Dichloropropane	78-87-5	<0.5	mg/kg		<0.5				
HVOL	1,3-Dichloropropane	142-28-9	<0.5	mg/kg		<0.5				
HVOL	1,3-Dichloropropene [cis]	10061-01-5	<0.5	mg/kg		<0.5				
HVOL	1,3-Dichloropropene [trans]	10061-02-6	<0.5	mg/kg		<0.5				
HVOL	2,2-Dichloropropane	594-20-7	<0.5	mg/kg		<0.5				
HVOL	2-Chlorotoluene	95-49-8	<0.5	mg/kg		<0.5				
HVOL	4-Chlorotoluene	106-43-4	<0.5	mg/kg		<0.5				
HVOL	Bromochloromethane	74-97-5	<0.5	mg/kg		<0.5				
HVOL	Bromodichloromethane	75-27-4	<0.5	mg/kg		<0.5				
HVOL	Bromobenzene	108-86-1	<0.5	mg/kg		<0.5				
HVOL	Bromoform (Tribromomethane)	75-25-2	<0.5	mg/kg		<0.5				
HVOL	Carbon Tetrachloride	56-23-5	<0.5	mg/kg		<0.5				
HVOL	Chloroform (Trichloromethane)	67-66-3	<0.5	mg/kg		<0.5				
HVOL	Chlorobenzene	108-90-7	<0.5	mg/kg		<0.5				
HVOL	Dibromochloromethane	124-48-1	<0.5	mg/kg		<0.5				
HVOL	Dibromomethane	74-95-3	<0.5	mg/kg		<0.5				
HVOL	1,2-Dibromoethane	106-93-4	<0.5	mg/kg		<0.5				
HVOL	Dichloromethane	75-09-2	<1	mg/kg		<1				
HVOL	Trichlorofluoromethane (CFC11)	75-69-4	<2	mg/kg		<2				
HVOL	Tetrachloroethene	127-18-4	<0.5	mg/kg		<0.5				
HVOL	Vinyl Chloride (Monomer)	75-01-4	<1	mg/kg		<1				
HVOL	1,1,1-Trichloroethane	71-55-6	<0.5	mg/kg		<0.5				
HVOL	1,1,2-Trichloroethane	79-00-5	<0.5	mg/kg		<0.5				
HVOL	Trichloroethene	79-01-6	<0.5	mg/kg		<0.5				

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					Sample No.	4927908	4927909	4927910	4927911	4927912	4927913
					Client Sample ID	BH01-1,0.3-0.45m	BH03-1,0.3-0.4m	BH04-1,0.3-0.4m	BH06-1,0.2-0.3m	BH07-1,0.4-0.5m	BH09-1,0.3-0.4m
					Sample Date	16/09/16	16/09/16	16/09/16	16/09/16	12/09/16	09/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Analysis	Analyte	CAS #	LOR								
MAH	Styrene	100-42-5	<0.5	mg/kg			<0.5				
Analysis	Analyte	CAS #	LOR								
OCP	BHC (alpha isomer)	319-84-6	<0.05	mg/kg			<0.05				
OCP	a-Endosulphan	959-98-8	<0.05	mg/kg			<0.05				
OCP	Aldrin	309-00-2	<0.05	mg/kg			<0.05				
OCP	BHC (beta isomer)	319-85-7	<0.05	mg/kg			<0.05				
OCP	b-Endosulphan	33213-65-9	<0.05	mg/kg			<0.05				
OCP	Chlordane	57-74-9	<0.05	mg/kg			<0.05				
OCP	cis-Chlordane	5103-71-9	<0.05	mg/kg			<0.05				
OCP	trans-Chlordane	5103-74-2	<0.05	mg/kg			<0.05				
OCP	BHC (delta isomer)	319-86-8	<0.05	mg/kg			<0.05				
OCP	DDD	72-54-8	<0.05	mg/kg			<0.05				
OCP	DDE	72-55-9	<0.05	mg/kg			<0.05				
OCP	DDT	50-29-3	<0.05	mg/kg			<0.05				
OCP	Dieldrin	60-57-1	<0.05	mg/kg			<0.05				
OCP	Sum of alpha-, beta- and Endosulphan	115-29-7	<0.05	mg/kg			<0.05				
OCP	Endosulfan Sulfate	1031-07-8	<0.05	mg/kg			<0.05				
OCP	Endrin	72-20-8	<0.05	mg/kg			<0.05				
OCP	Endrin Aldehyde	7421-93-4	<0.05	mg/kg			<0.05				
OCP	Endrin Ketone	53494-70-5	<0.05	mg/kg			<0.05				
OCP	Hexachlorobenzene	118-74-1	<0.05	mg/kg			<0.05				
OCP	Heptachlor Epoxide	1024-57-3	<0.05	mg/kg			<0.05				
OCP	Heptachlor	76-44-8	<0.05	mg/kg			<0.05				
OCP	BHC (gamma isomer) [Lindane]	58-89-9	<0.05	mg/kg			<0.05				
OCP	Methoxychlor	72-43-5	<0.05	mg/kg			<0.05				
OCP	Oxychlordane	27304-13-8	<0.05	mg/kg			<0.05				
OCP	Sum of DDD, DDE and DDT	DDT+DDE+DD	<0.05	mg/kg			<0.05				
OCP	Sum of Aldrin and Dieldrin	309-00-2 +	<0.05	mg/kg			<0.05				
Analysis	Analyte	CAS #	LOR								
PAH	Acenaphthene	83-32-9	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Acenaphthylene	208-96-8	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Anthracene	120-12-7	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

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					Sample No.	4927908	4927909	4927910	4927911	4927912	4927913
					Client Sample ID	BH01-1,0.3-0.45m	BH03-1,0.3-0.4m	BH04-1,0.3-0.4m	BH06-1,0.2-0.3m	BH07-1,0.4-0.5m	BH09-1,0.3-0.4m
					Sample Date	16/09/16	16/09/16	16/09/16	16/09/16	12/09/16	09/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
PAH	Benz(a)anthracene	56-55-3	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(a)pyrene	50-32-8	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(b)fluoranthene	205-99-2	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(g,h,i)perylene	191-24-2	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(k)fluoranthene	207-08-9	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Chrysene	218-01-9	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Dibenz(a,h)anthracene	53-70-3	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Fluoranthene	206-44-0	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Fluorene	86-73-7	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Indeno(1,2,3-cd)pyrene	193-39-5	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Naphthalene	91-20-3	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Phenanthrene	85-01-8	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Pyrene	129-00-0	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Total PAH	TOTALPAH	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	BaP TEQ (zero)	BaP_TEQ_0xE	<0.1	mg/kg		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PAH	BaP TEQ (half LOR)	BaP_TEQ_0.5x	<0.1	mg/kg		0.1	0.1	0.1	0.1	0.1	0.1
PAH	BaP TEQ (LOR)	BaP_TEQ_1.0x	0.2	mg/kg		0.2	0.2	0.2	0.2	0.2	0.2
Analysis	Analyte	CAS #	LOR								
PCB	Aroclor 1016	12674-11-2	<0.1	mg/kg			<0.1				
PCB	Aroclor 1221	11104-28-2	<0.1	mg/kg			<0.1				
PCB	Aroclor 1232	11141-16-5	<0.1	mg/kg			<0.1				
PCB	Aroclor 1242	53469-21-9	<0.1	mg/kg			<0.1				
PCB	Aroclor 1248	12672-29-6	<0.1	mg/kg			<0.1				
PCB	Aroclor 1254	11097-69-1	<0.1	mg/kg			<0.1				
PCB	Aroclor 1260	11096-82-5	<0.1	mg/kg			<0.1				
PCB	Total PCBs	1336-36-3	<0.1	mg/kg			<0.1				
Analysis	Analyte	CAS #	LOR								
Phenols(Halo)	4-Chloro-3-Methylphenol	59-50-7	<0.5	mg/kg			<0.5				
Phenols(Halo)	2-Chlorophenol	95-57-8	<0.5	mg/kg			<0.5				
Phenols(Halo)	2,4-Dichlorophenol	120-83-2	<0.5	mg/kg			<0.5				
Phenols(Halo)	2,6-Dichlorophenol	87-65-0	<0.5	mg/kg			<0.5				
Phenols(Halo)	Pentachlorophenol	87-86-5	<0.5	mg/kg			<0.5				

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					Sample No.	4927908	4927909	4927910	4927911	4927912	4927913
					Client Sample ID	BH01-1,0.3-0.45m	BH03-1,0.3-0.4m	BH04-1,0.3-0.4m	BH06-1,0.2-0.3m	BH07-1,0.4-0.5m	BH09-1,0.3-0.4m
					Sample Date	16/09/16	16/09/16	16/09/16	16/09/16	12/09/16	09/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Phenols(Halo)	2,3,4,5-Tetrachlorophenol	4901-51-3	<0.5	mg/kg			<0.5				
Phenols(Halo)	2,3,4,6-Tetrachlorophenol	58-90-2	<0.5	mg/kg			<0.5				
Phenols(Halo)	2,3,5,6-Tetrachlorophenol	935-95-5	<0.5	mg/kg			<0.5				
Phenols(Halo)	2,4,5-Trichlorophenol	95-95-4	<0.5	mg/kg			<0.5				
Phenols(Halo)	2,4,6-Trichlorophenol	88-06-2	<0.5	mg/kg			<0.5				
Phenols(Halo)	Total Phenols (Halogenated)	64743-03-9(Hal	<0.5	mg/kg			<0.5				
Analysis	Analyte	CAS #	LOR								
Phenols(NonHalo)	Phenol	108-95-2	<0.5	mg/kg			<0.5				
Phenols(NonHalo)	Total Cresols	1319-77-3	<1	mg/kg			<1				
Phenols(NonHalo)	2,4-Dimethylphenol	105-67-9	<0.5	mg/kg			<0.5				
Phenols(NonHalo)	2,4-Dinitrophenol	51-28-5	<30	mg/kg			<30				
Phenols(NonHalo)	2-Methyl-4,6-Dinitrophenol	534-52-1	<10	mg/kg			<10				
Phenols(NonHalo)	2-Nitrophenol	88-75-5	<0.5	mg/kg			<0.5				
Phenols(NonHalo)	4-Nitrophenol	100-02-7	<0.5	mg/kg			<0.5				
Phenols(NonHalo)	2-Cyclohexyl-4,6-Dinitrophenol	131-89-5	<30	mg/kg			<30				
Phenols(NonHalo)	Dinoseb	88-85-7	<10	mg/kg			<10				
Phenols(NonHalo)	Total Phenols (non Halogenated)	64743-03-9(Non	<30	mg/kg			<30				
Analysis	Analyte	CAS #	LOR								
Moisture	Moisture %	MOISTCONTE	<2	% w/wet w			26				
pH	pH, units	pH_Lab	<0.1	Units		7.0	8.8	9.3	7.0	9.6	6.9
EC	EC, uS/cm @ 25C	E.CONDUCTIVI	<2	uS/cm		76		180	100	290	31
Total Fluoride	Total Fluoride, as F	16984-48-8	<100	mg/kg			350				
Cyanide	Cyanide, as CN	57-12-5	<5	mg/kg			<5				
Chloride	Chloride, as Cl	16887-00-6	<5	mg/kg		11		81	47	81	<5
SO4	Sulfate	14808-79-8	<10	mg/kg		<25 LINT		280	<250 LINT	<100 LINT	<25 LINT
Total Cr 6+ DA	Hexavalent Chromium (Total) Soil DA	18540-29-9	<1	mg/kg			<1				
Analysis	Analyte	CAS #	LOR								
MS Total Metals	Arsenic	7440-38-2	<5	mg/kg		5	<5	<5	16	19	<5
MS Total Metals	Cadmium	7440-43-9	<0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MS Total Metals	Chromium	7440-47-3	<5	mg/kg		50		110	50	21	8
MS Total Metals	Copper	7440-50-8	<5	mg/kg		17	6	360	<5	7	<5
MS Total Metals	Iron	7439-89-6	<10	mg/kg		29000	24000	59000	38000	17000	4300
MS Total Metals	Lead	7439-92-1	<5	mg/kg		10	8	<5	17	7	<5

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					Sample No.	4927908	4927909	4927910	4927911	4927912	4927913
					Client Sample ID	BH01-1,0.3-0.45m	BH03-1,0.3-0.4m	BH04-1,0.3-0.4m	BH06-1,0.2-0.3m	BH07-1,0.4-0.5m	BH09-1,0.3-0.4m
					Sample Date	16/09/16	16/09/16	16/09/16	16/09/16	12/09/16	09/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
MS Total Metals	Manganese	7439-96-5	<5	mg/kg		210	300	47	17	190	39
MS Total Metals	Mercury	7439-97-6	<0.05	mg/kg		<0.05	<0.05	<0.05	0.07	<0.05	<0.05
MS Total Metals	Molybdenum	7439-98-7	<5	mg/kg		<5	<5	<5	<5	<5	<5
MS Total Metals	Nickel	7440-02-0	<5	mg/kg		40	49	120	11	37	<5
MS Total Metals	Selenium	7782-49-2	<3	mg/kg		<3	<3	<3	<3	<3	<3
MS Total Metals	Silver	7440-22-4	<5	mg/kg		<5	<5	<5	<5	<5	<5
MS Total Metals	Tin	7440-31-5	<5	mg/kg		<5	<5	<5	<5	<5	<5
MS Total Metals	Zinc	7440-66-6	<5	mg/kg		35	18	60	9	25	7
Analysis	Analyte	CAS #	LOR								
TRH (C6-C10) &	TPHC6-C9	C6-C9	<20	mg/kg		<20	<20	<20	<20	<20	<20
TRH (C6-C10) &	TRHC6-C10	C6-C10	<20	mg/kg		<20	<20	<20	<20	<20	<20
TRH (C6-C10) &	TRHC6-C10 minus BTEX	F1-BTEX	<20	mg/kg		<20	<20	<20	<20	<20	<20
Analysis	Analyte	CAS #	LOR								
TRH F2	TRH>C10-C16 minus Naphthalene	F2-NAPHTHAL	<20	mg/kg		<20	<20	<20	<20	<20	<20
TRH & TPH	TPH C10-C14	C10-C14	<20	mg/kg		<20	<20	<20	<20	<20	<20
TRH & TPH	TPH C15-C28	C15-C28	<50	mg/kg		<50	<50	<50	<50	<50	<50
TRH & TPH	TPH C29-C36	C29-C36	<50	mg/kg		<50	<50	<50	<50	<50	<50
TRH & TPH	TRH>C10-C16	C10-C16	<20	mg/kg		<20	<20	<20	<20	<20	<20
TRH & TPH	TRH>C16-C34	C16-C34	<50	mg/kg		<50	<50	<50	<50	<50	<50
TRH & TPH	TRH>C34-C40	C34-C40	<50	mg/kg		<50	<50	<50	<50	<50	<50
TRH & TPH	Sum of TRH>C10-C40	C10-C40	<50	mg/kg		<50	<50	<50	<50	<50	<50

LINT Level of Reporting raised due to interferences in the sample matrix

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LOR = Limit of reporting. When a reported LOR is higher than the standard LOR, this may be due to high moisture content, insufficient sample or matrix interference.

CAS Number = Chemistry Abstract Services Number. The analytical procedures in this report (including in house methods) are developed from internationally recognised procedures such as those published by USEPA, APHA and NEPM.

					Sample No.	4927914	4927915	4927916	4927917	4927918	4927919
					Client Sample ID	BH14-1,0.5-0.6m	BH15-1,0.4-0.55m	BH16-1,0.3-0.45m	BH19-1,0.2-0.3m	BH23-1,0.35-0.5m	BH24-1,0.1-0.3m
					Sample Date	09/09/16	15/09/16	19/09/16	15/09/16	20/09/16	19/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Analysis	Analyte	CAS #	LOR								
BTEXN	Benzene	71-43-2	<0.5	mg/kg						<0.5	
BTEXN	Toluene	108-88-3	<0.5	mg/kg						<0.5	
BTEXN	Ethyl Benzene	100-41-4	<0.5	mg/kg						<0.5	
BTEXN	Xylene - m&p	108-38-3 /	<1	mg/kg						<1	
BTEXN	Xylene - O	95-47-6	<0.5	mg/kg						<0.5	
BTEXN	Naphthalene	91-20-3	<0.5	mg/kg						<0.5	
BTEXN	Total Xylenes	1330-20-7	<1	mg/kg						<1	
BTEXN	BTEX (Sum)	BTEX	<1	mg/kg						<1	
Analysis	Analyte	CAS #	LOR								
CHC	1,2,3,4-Tetrachlorobenzene	634-66-2	<0.1	mg/kg						<0.1	
CHC	1,2,3,5-Tetrachlorobenzene	634-90-2	<0.1	mg/kg						<0.1	
CHC	1,2,3-Trichlorobenzene	87-61-6	<0.1	mg/kg						<0.1	
CHC	1,2,4,5-Tetrachlorobenzene	95-94-3	<0.1	mg/kg						<0.1	
CHC	1,2,4-Trichlorobenzene	120-82-1	<0.1	mg/kg						<0.1	
CHC	1,2-Dichlorobenzene	95-50-1	<0.1	mg/kg						<0.1	
CHC	1,3,5-Trichlorobenzene	108-70-3	<0.1	mg/kg						<0.1	
CHC	1,3-Dichlorobenzene	541-73-1	<0.1	mg/kg						<0.1	
CHC	1,4-Dichlorobenzene	106-46-7	<0.1	mg/kg						<0.1	
CHC	2-Chloronaphthalene	91-58-7	<0.1	mg/kg						<0.1	
CHC	Benzal Chloride	98-87-3	<0.1	mg/kg						<0.1	
CHC	Benzotrichloride	98-07-7	<0.1	mg/kg						<0.1	
CHC	Benzylchloride	100-44-7	<0.1	mg/kg						<0.1	
CHC	Hexachloroethane	67-72-1	<0.1	mg/kg						<0.1	
CHC	Hexachlorobutadiene	87-68-3	<0.1	mg/kg						<0.1	
CHC	Hexachlorocyclopentadiene	77-47-4	<0.1	mg/kg						<0.1	
CHC	Pentachlorobenzene	608-93-5	<0.1	mg/kg						<0.1	
Analysis	Analyte	CAS #	LOR								
HVOL	1,1,1,2-Tetrachloroethane	630-20-6	<0.5	mg/kg						<0.5	
HVOL	1,1,2,2-Tetrachloroethane	79-34-5	<0.5	mg/kg						<0.5	

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				Sample No.	4927914	4927915	4927916	4927917	4927918	4927919
				Client Sample ID	BH14-1,0.5-0.6m	BH15-1,0.4-0.55m	BH16-1,0.3-0.45m	BH19-1,0.2-0.3m	BH23-1,0.35-0.5m	BH24-1,0.1-0.3m
				Sample Date	09/09/16	15/09/16	19/09/16	15/09/16	20/09/16	19/09/16
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
HVOL	1,1- Dichloroethane	75-34-3	<0.5	mg/kg					<0.5	
HVOL	1,1-Dichloroethene	75-35-4	<0.5	mg/kg					<0.5	
HVOL	1,1-Dichloropropene	563-58-6	<0.5	mg/kg					<0.5	
HVOL	1,2,3-Trichloropropane	96-18-4	<0.5	mg/kg					<0.5	
HVOL	1,2-Dibromo-3-Chloropropane	96-12-8	<0.5	mg/kg					<0.5	
HVOL	1,2-Dichloroethene [cis]	540-59-0(cis)	<0.5	mg/kg					<0.5	
HVOL	1,2-Dichloroethene [trans]	540-59-0(trans)	<0.5	mg/kg					<0.5	
HVOL	1,2-Dichloroethane	107-06-2	<0.5	mg/kg					<0.5	
HVOL	1,2-Dichloropropane	78-87-5	<0.5	mg/kg					<0.5	
HVOL	1,3-Dichloropropane	142-28-9	<0.5	mg/kg					<0.5	
HVOL	1,3-Dichloropropene [cis]	10061-01-5	<0.5	mg/kg					<0.5	
HVOL	1,3-Dichloropropene [trans]	10061-02-6	<0.5	mg/kg					<0.5	
HVOL	2,2-Dichloropropane	594-20-7	<0.5	mg/kg					<0.5	
HVOL	2-Chlorotoluene	95-49-8	<0.5	mg/kg					<0.5	
HVOL	4-Chlorotoluene	106-43-4	<0.5	mg/kg					<0.5	
HVOL	Bromochloromethane	74-97-5	<0.5	mg/kg					<0.5	
HVOL	Bromodichloromethane	75-27-4	<0.5	mg/kg					<0.5	
HVOL	Bromobenzene	108-86-1	<0.5	mg/kg					<0.5	
HVOL	Bromoform (Tribromomethane)	75-25-2	<0.5	mg/kg					<0.5	
HVOL	Carbon Tetrachloride	56-23-5	<0.5	mg/kg					<0.5	
HVOL	Chloroform (Trichloromethane)	67-66-3	<0.5	mg/kg					<0.5	
HVOL	Chlorobenzene	108-90-7	<0.5	mg/kg					<0.5	
HVOL	Dibromochloromethane	124-48-1	<0.5	mg/kg					<0.5	
HVOL	Dibromomethane	74-95-3	<0.5	mg/kg					<0.5	
HVOL	1,2-Dibromoethane	106-93-4	<0.5	mg/kg					<0.5	
HVOL	Dichloromethane	75-09-2	<1	mg/kg					<1	
HVOL	Trichlorofluoromethane (CFC11)	75-69-4	<2	mg/kg					<2	
HVOL	Tetrachloroethene	127-18-4	<0.5	mg/kg					<0.5	
HVOL	Vinyl Chloride (Monomer)	75-01-4	<1	mg/kg					<1	
HVOL	1,1,1-Trichloroethane	71-55-6	<0.5	mg/kg					<0.5	
HVOL	1,1,2-Trichloroethane	79-00-5	<0.5	mg/kg					<0.5	
HVOL	Trichloroethene	79-01-6	<0.5	mg/kg					<0.5	

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					Sample No.	4927914	4927915	4927916	4927917	4927918	4927919
					Client Sample ID	BH14-1,0.5-0.6m	BH15-1,0.4-0.55m	BH16-1,0.3-0.45m	BH19-1,0.2-0.3m	BH23-1,0.35-0.5m	BH24-1,0.1-0.3m
					Sample Date	09/09/16	15/09/16	19/09/16	15/09/16	20/09/16	19/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Analysis	Analyte	CAS #	LOR								
MAH	Styrene	100-42-5	<0.5	mg/kg						<0.5	
Analysis	Analyte	CAS #	LOR								
OCP	BHC (alpha isomer)	319-84-6	<0.05	mg/kg						<0.05	
OCP	a-Endosulphan	959-98-8	<0.05	mg/kg						<0.05	
OCP	Aldrin	309-00-2	<0.05	mg/kg						<0.05	
OCP	BHC (beta isomer)	319-85-7	<0.05	mg/kg						<0.05	
OCP	b-Endosulphan	33213-65-9	<0.05	mg/kg						<0.05	
OCP	Chlordane	57-74-9	<0.05	mg/kg						<0.05	
OCP	cis-Chlordane	5103-71-9	<0.05	mg/kg						<0.05	
OCP	trans-Chlordane	5103-74-2	<0.05	mg/kg						<0.05	
OCP	BHC (delta isomer)	319-86-8	<0.05	mg/kg						<0.05	
OCP	DDD	72-54-8	<0.05	mg/kg						<0.05	
OCP	DDE	72-55-9	<0.05	mg/kg						<0.05	
OCP	DDT	50-29-3	<0.05	mg/kg						<0.05	
OCP	Dieldrin	60-57-1	<0.05	mg/kg						<0.05	
OCP	Sum of alpha-, beta- and Endosulphan	115-29-7	<0.05	mg/kg						<0.05	
OCP	Endosulfan Sulfate	1031-07-8	<0.05	mg/kg						<0.05	
OCP	Endrin	72-20-8	<0.05	mg/kg						<0.05	
OCP	Endrin Aldehyde	7421-93-4	<0.05	mg/kg						<0.05	
OCP	Endrin Ketone	53494-70-5	<0.05	mg/kg						<0.05	
OCP	Hexachlorobenzene	118-74-1	<0.05	mg/kg						<0.05	
OCP	Heptachlor Epoxide	1024-57-3	<0.05	mg/kg						<0.05	
OCP	Heptachlor	76-44-8	<0.05	mg/kg						<0.05	
OCP	BHC (gamma isomer) [Lindane]	58-89-9	<0.05	mg/kg						<0.05	
OCP	Methoxychlor	72-43-5	<0.05	mg/kg						<0.05	
OCP	Oxychlordane	27304-13-8	<0.05	mg/kg						<0.05	
OCP	Sum of DDD, DDE and DDT	DDT+DDE+DD	<0.05	mg/kg						<0.05	
OCP	Sum of Aldrin and Dieldrin	309-00-2 +	<0.05	mg/kg						<0.05	
Analysis	Analyte	CAS #	LOR								
PAH	Acenaphthene	83-32-9	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Acenaphthylene	208-96-8	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Anthracene	120-12-7	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1

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					Sample No.	4927914	4927915	4927916	4927917	4927918	4927919
					Client Sample ID	BH14-1,0.5-0.6m	BH15-1,0.4-0.55m	BH16-1,0.3-0.45m	BH19-1,0.2-0.3m	BH23-1,0.35-0.5m	BH24-1,0.1-0.3m
					Sample Date	09/09/16	15/09/16	19/09/16	15/09/16	20/09/16	19/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
PAH	Benz(a)anthracene	56-55-3	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(a)pyrene	50-32-8	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(b)fluoranthene	205-99-2	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(g,h,i)perylene	191-24-2	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(k)fluoranthene	207-08-9	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Chrysene	218-01-9	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Dibenz(a,h)anthracene	53-70-3	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Fluoranthene	206-44-0	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Fluorene	86-73-7	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Indeno(1,2,3-cd)pyrene	193-39-5	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Naphthalene	91-20-3	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Phenanthrene	85-01-8	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Pyrene	129-00-0	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	Total PAH	TOTALPAH	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	BaP TEQ (zero)	BaP_TEQ_0xE	<0.1	mg/kg			<0.1	<0.1	<0.1	<0.1	<0.1
PAH	BaP TEQ (half LOR)	BaP_TEQ_0.5x	<0.1	mg/kg			0.1	0.1	0.1	0.1	0.1
PAH	BaP TEQ (LOR)	BaP_TEQ_1.0x	0.2	mg/kg			0.2	0.2	0.2	0.2	0.2
Analysis	Analyte	CAS #	LOR								
PCB	Aroclor 1016	12674-11-2	<0.1	mg/kg						<0.1	
PCB	Aroclor 1221	11104-28-2	<0.1	mg/kg						<0.1	
PCB	Aroclor 1232	11141-16-5	<0.1	mg/kg						<0.1	
PCB	Aroclor 1242	53469-21-9	<0.1	mg/kg						<0.1	
PCB	Aroclor 1248	12672-29-6	<0.1	mg/kg						<0.1	
PCB	Aroclor 1254	11097-69-1	<0.1	mg/kg						<0.1	
PCB	Aroclor 1260	11096-82-5	<0.1	mg/kg						<0.1	
PCB	Total PCBs	1336-36-3	<0.1	mg/kg						<0.1	
Analysis	Analyte	CAS #	LOR								
Phenols(Halo)	4-Chloro-3-Methylphenol	59-50-7	<0.5	mg/kg						<0.5	
Phenols(Halo)	2-Chlorophenol	95-57-8	<0.5	mg/kg						<0.5	
Phenols(Halo)	2,4-Dichlorophenol	120-83-2	<0.5	mg/kg						<0.5	
Phenols(Halo)	2,6-Dichlorophenol	87-65-0	<0.5	mg/kg						<0.5	
Phenols(Halo)	Pentachlorophenol	87-86-5	<0.5	mg/kg						<0.5	

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					Sample No.	4927914	4927915	4927916	4927917	4927918	4927919
					Client Sample ID	BH14-1,0.5-0.6m	BH15-1,0.4-0.55m	BH16-1,0.3-0.45m	BH19-1,0.2-0.3m	BH23-1,0.35-0.5m	BH24-1,0.1-0.3m
					Sample Date	09/09/16	15/09/16	19/09/16	15/09/16	20/09/16	19/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Phenols(Halo)	2,3,4,5-Tetrachlorophenol	4901-51-3	<0.5	mg/kg						<0.5	
Phenols(Halo)	2,3,4,6-Tetrachlorophenol	58-90-2	<0.5	mg/kg						<0.5	
Phenols(Halo)	2,3,5,6-Tetrachlorophenol	935-95-5	<0.5	mg/kg						<0.5	
Phenols(Halo)	2,4,5-Trichlorophenol	95-95-4	<0.5	mg/kg						<0.5	
Phenols(Halo)	2,4,6-Trichlorophenol	88-06-2	<0.5	mg/kg						<0.5	
Phenols(Halo)	Total Phenols (Halogenated)	64743-03-9(Hal	<0.5	mg/kg						<0.5	
Analysis	Analyte	CAS #	LOR								
Phenols(NonHalo)	Phenol	108-95-2	<0.5	mg/kg						<0.5	
Phenols(NonHalo)	Total Cresols	1319-77-3	<1	mg/kg						<1	
Phenols(NonHalo)	2,4-Dimethylphenol	105-67-9	<0.5	mg/kg						<0.5	
Phenols(NonHalo)	2,4-Dinitrophenol	51-28-5	<30	mg/kg						<30	
Phenols(NonHalo)	2-Methyl-4,6-Dinitrophenol	534-52-1	<10	mg/kg						<10	
Phenols(NonHalo)	2-Nitrophenol	88-75-5	<0.5	mg/kg						<0.5	
Phenols(NonHalo)	4-Nitrophenol	100-02-7	<0.5	mg/kg						<0.5	
Phenols(NonHalo)	2-Cyclohexyl-4,6-Dinitrophenol	131-89-5	<30	mg/kg						<30	
Phenols(NonHalo)	Dinoseb	88-85-7	<10	mg/kg						<10	
Phenols(NonHalo)	Total Phenols (non Halogenated)	64743-03-9(Non	<30	mg/kg						<30	
Analysis	Analyte	CAS #	LOR								
Moisture	Moisture %	MOISTCONTE	<2	% w/wet w						14	
pH	pH, units	pH_Lab	<0.1	Units		7.9	8.6	6.9	5.6	7.4	8.9
EC	EC, uS/cm @ 25C	E.CONDUCTIVI	<2	uS/cm		97	120	100	250		600
Total Fluoride	Total Fluoride, as F	16984-48-8	<100	mg/kg						120	
Cyanide	Cyanide, as CN	57-12-5	<5	mg/kg						<5	
Chloride	Chloride, as Cl	16887-00-6	<5	mg/kg		25	10	23	330		410
SO4	Sulfate	14808-79-8	<10	mg/kg		<25 LINT	<25 LINT	<50 LINT	350		<100 LINT
Total Cr 6+ DA	Hexavalent Chromium (Total) Soil DA	18540-29-9	<1	mg/kg						<1	
Analysis	Analyte	CAS #	LOR								
MS Total Metals	Arsenic	7440-38-2	<5	mg/kg			12	46	<5	<5	19
MS Total Metals	Cadmium	7440-43-9	<0.2	mg/kg			<0.2	<0.2	<0.2	<0.2	<0.2
MS Total Metals	Chromium	7440-47-3	<5	mg/kg			32	200	36		43
MS Total Metals	Copper	7440-50-8	<5	mg/kg			8	<5	<5	<5	6
MS Total Metals	Iron	7439-89-6	<10	mg/kg			20000	170000	11000	10000	28000
MS Total Metals	Lead	7439-92-1	<5	mg/kg			9	28	9	<5	12

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					Sample No.	4927914	4927915	4927916	4927917	4927918	4927919
					Client Sample ID	BH14-1,0.5-0.6m	BH15-1,0.4-0.55m	BH16-1,0.3-0.45m	BH19-1,0.2-0.3m	BH23-1,0.35-0.5m	BH24-1,0.1-0.3m
					Sample Date	09/09/16	15/09/16	19/09/16	15/09/16	20/09/16	19/09/16
					Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
MS Total Metals	Manganese	7439-96-5	<5	mg/kg			300	55	16	25	81
MS Total Metals	Mercury	7439-97-6	<0.05	mg/kg			<0.05	<0.05	<0.05	<0.05	<0.05
MS Total Metals	Molybdenum	7439-98-7	<5	mg/kg			<5	<5	<5	<5	<5
MS Total Metals	Nickel	7440-02-0	<5	mg/kg			21	14	10	<5	22
MS Total Metals	Selenium	7782-49-2	<3	mg/kg			<3	<3	<3	<3	<3
MS Total Metals	Silver	7440-22-4	<5	mg/kg			<5	<5	<5	<5	<5
MS Total Metals	Tin	7440-31-5	<5	mg/kg			<5	<5	<5	<5	<5
MS Total Metals	Zinc	7440-66-6	<5	mg/kg			26	7	9	<5	20
Analysis	Analyte	CAS #	LOR								
TRH (C6-C10) &	TPHC6-C9	C6-C9	<20	mg/kg			<20	<20	<20	<20	<20
TRH (C6-C10) &	TRHC6-C10	C6-C10	<20	mg/kg			<20	<20	<20	<20	<20
TRH (C6-C10) &	TRHC6-C10 minus BTEX	F1-BTEX	<20	mg/kg			<20	<20	<20	<20	<20
Analysis	Analyte	CAS #	LOR								
TRH F2	TRH>C10-C16 minus Naphthalene	F2-NAPHTHAL	<20	mg/kg			<20	<20	<20	<20	<20
TRH & TPH	TPH C10-C14	C10-C14	<20	mg/kg			<20	<20	<20	<20	<20
TRH & TPH	TPH C15-C28	C15-C28	<50	mg/kg			<50	<50	<50	<50	<50
TRH & TPH	TPH C29-C36	C29-C36	<50	mg/kg			<50	<50	<50	<50	<50
TRH & TPH	TRH>C10-C16	C10-C16	<20	mg/kg			<20	<20	<20	<20	<20
TRH & TPH	TRH>C16-C34	C16-C34	<50	mg/kg			<50	<50	<50	<50	<50
TRH & TPH	TRH>C34-C40	C34-C40	<50	mg/kg			<50	<50	<50	<50	<50
TRH & TPH	Sum of TRH>C10-C40	C10-C40	<50	mg/kg			<50	<50	<50	<50	<50

LINT Level of Reporting raised due to interferences in the sample matrix

Samples not collected by ALS and are tested as received.

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LOR = Limit of reporting. When a reported LOR is higher than the standard LOR, this may be due to high moisture content, insufficient sample or matrix interference.

CAS Number = Chemistry Abstract Services Number. The analytical procedures in this report (including in house methods) are developed from internationally recognised procedures such as those published by USEPA, APHA and NEPM.

					Sample No.	4927920	4927921	4927922
					Client Sample ID	BH26-1,0.05-0.2m	BH28-1,0.1-0.25m	BH29-1,0.05-0.2m
					Sample Date	14/09/16	14/09/16	14/09/16
					Sample Type	SOIL	SOIL	SOIL
Analysis	Analyte	CAS #	LOR					
PAH	Acenaphthene	83-32-9	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Acenaphthylene	208-96-8	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Anthracene	120-12-7	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Benz(a)anthracene	56-55-3	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(a)pyrene	50-32-8	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(b)fluoranthene	205-99-2	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(g,h,i)perylene	191-24-2	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Benzo(k)fluoranthene	207-08-9	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Chrysene	218-01-9	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Dibenz(a,h)anthracene	53-70-3	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Fluoranthene	206-44-0	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Fluorene	86-73-7	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Indeno(1,2,3-cd)pyrene	193-39-5	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Naphthalene	91-20-3	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Phenanthrene	85-01-8	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Pyrene	129-00-0	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	Total PAH	TOTALPAH	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	BaP TEQ (zero)	BaP_TEQ_0xE	<0.1	mg/kg	<0.1	<0.1	<0.1	<0.1
PAH	BaP TEQ (half LOR)	BaP_TEQ_0.5x	<0.1	mg/kg	0.1	0.1	0.1	0.1
PAH	BaP TEQ (LOR)	BaP_TEQ_1.0x	0.2	mg/kg	0.2	0.2	0.2	0.2
Analysis	Analyte	CAS #	LOR					
pH	pH, units	pH_Lab	<0.1	Units	6.6	6.1	6.9	
EC	EC, uS/cm @ 25C	E.CONDUCTIVI	<2	uS/cm	150	74	140	
Chloride	Chloride, as Cl	16887-00-6	<5	mg/kg	14	60	36	
SO4	Sulfate	14808-79-8	<10	mg/kg	<25 LINT	<100 LINT	<50 LINT	
Analysis	Analyte	CAS #	LOR					
MS Total Metals	Arsenic	7440-38-2	<5	mg/kg	21	7	<5	
MS Total Metals	Cadmium	7440-43-9	<0.2	mg/kg	<0.2	<0.2	<0.2	
MS Total Metals	Chromium	7440-47-3	<5	mg/kg	75	120	52	

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					Sample No.	4927920	4927921	4927922
					Client Sample ID	BH26-1,0.05-0.2m	BH28-1,0.1-0.25m	BH29-1,0.05-0.2m
					Sample Date	14/09/16	14/09/16	14/09/16
					Sample Type	SOIL	SOIL	SOIL
MS Total Metals	Copper	7440-50-8	<5	mg/kg		17	37	11
MS Total Metals	Iron	7439-89-6	<10	mg/kg		38000	52000	24000
MS Total Metals	Lead	7439-92-1	<5	mg/kg		7	28	10
MS Total Metals	Manganese	7439-96-5	<5	mg/kg		320	880	310
MS Total Metals	Mercury	7439-97-6	<0.05	mg/kg		<0.05	0.07	<0.05
MS Total Metals	Molybdenum	7439-98-7	<5	mg/kg		<5	<5	<5
MS Total Metals	Nickel	7440-02-0	<5	mg/kg		70	98	35
MS Total Metals	Selenium	7782-49-2	<3	mg/kg		<3	<3	<3
MS Total Metals	Silver	7440-22-4	<5	mg/kg		<5	<5	<5
MS Total Metals	Tin	7440-31-5	<5	mg/kg		<5	<5	<5
MS Total Metals	Zinc	7440-66-6	<5	mg/kg		44	71	23
Analysis	Analyte	CAS #	LOR					
TRH (C6-C10) &	TPHC6-C9	C6-C9	<20	mg/kg		<20	<20	<20
TRH (C6-C10) &	TRHC6-C10	C6-C10	<20	mg/kg		<20	<20	<20
TRH (C6-C10) &	TRHC6-C10 minus BTEX	F1-BTEX	<20	mg/kg		<20	<20	<20
Analysis	Analyte	CAS #	LOR					
TRH F2	TRH>C10-C16 minus Naphthalene	F2-NAPHTHAL	<20	mg/kg		<20	<20	<20
TRH & TPH	TPH C10-C14	C10-C14	<20	mg/kg		<20	<20	<20
TRH & TPH	TPH C15-C28	C15-C28	<50	mg/kg		<50	230	<50
TRH & TPH	TPH C29-C36	C29-C36	<50	mg/kg		<50	180	<50
TRH & TPH	TRH>C10-C16	C10-C16	<20	mg/kg		<20	<20	<20
TRH & TPH	TRH>C16-C34	C16-C34	<50	mg/kg		<50	340	<50
TRH & TPH	TRH>C34-C40	C34-C40	<50	mg/kg		<50	110	<50
TRH & TPH	Sum of TRH>C10-C40	C10-C40	<50	mg/kg		<50	450	<50

LINT Level of Reporting raised due to interferences in the sample matrix

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QUALITY CONTROL - BLANKS

QC Blanks are an 'analyte free' matrix in which all applicable reagents have been added in the same proportion as in standard samples and are an internal monitor for laboratory contamination.

				Value
Lab Sample ID	Client Sample ID	Analysis	Analyte	
4929305	QC - Blank	pH	pH, units	5.9
4929305	QC - Blank	EC	EC, uS/cm @ 25C	<2
4930284	QC - Blank	Total Fluoride	Total Fluoride, as F	<100
Lab Sample ID	Client Sample ID	Analysis	Analyte	
4930852	QC - Blank	MS Total Metals	Arsenic	<5
4930852	QC - Blank	MS Total Metals	Cadmium	<0.2
4930852	QC - Blank	MS Total Metals	Chromium	<5
4930852	QC - Blank	MS Total Metals	Copper	<5
4930852	QC - Blank	MS Total Metals	Iron	<10
4930852	QC - Blank	MS Total Metals	Lead	<5
4930852	QC - Blank	MS Total Metals	Manganese	<5
4930852	QC - Blank	MS Total Metals	Mercury	<0.05
4930852	QC - Blank	MS Total Metals	Molybdenum	<5
4930852	QC - Blank	MS Total Metals	Nickel	<5
4930852	QC - Blank	MS Total Metals	Selenium	<3
4930852	QC - Blank	MS Total Metals	Silver	<5
4930852	QC - Blank	MS Total Metals	Tin	<5
4930852	QC - Blank	MS Total Metals	Zinc	<5
4932042	QC - Blank	MS Total Metals	Arsenic	<5
4932042	QC - Blank	MS Total Metals	Cadmium	<0.2
4932042	QC - Blank	MS Total Metals	Chromium	<5
4932042	QC - Blank	MS Total Metals	Copper	<5
4932042	QC - Blank	MS Total Metals	Iron	<10
4932042	QC - Blank	MS Total Metals	Lead	<5
4932042	QC - Blank	MS Total Metals	Manganese	<5
4932042	QC - Blank	MS Total Metals	Mercury	<0.05
4932042	QC - Blank	MS Total Metals	Molybdenum	<5
4932042	QC - Blank	MS Total Metals	Nickel	<5
4932042	QC - Blank	MS Total Metals	Selenium	<3

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					Value
4932042	QC - Blank	MS Total Metals	Silver	mg/kg	<5
4932042	QC - Blank	MS Total Metals	Tin	mg/kg	<5
4932042	QC - Blank	MS Total Metals	Zinc	mg/kg	<5
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4931045	QC - Blank	MAH	Styrene	mg/kg	<0.5
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4931033	QC - Blank	BTEXN	Benzene	mg/kg	<0.5
4931033	QC - Blank	BTEXN	Toluene	mg/kg	<0.5
4931033	QC - Blank	BTEXN	Ethyl Benzene	mg/kg	<0.5
4931033	QC - Blank	BTEXN	Xylene - m&p	mg/kg	<1
4931033	QC - Blank	BTEXN	Xylene - O	mg/kg	<0.5
4931033	QC - Blank	BTEXN	Naphthalene	mg/kg	<0.5
4931033	QC - Blank	BTEXN	Total Xylenes	mg/kg	<1
4931033	QC - Blank	BTEXN	BTEX (Sum)	mg/kg	<1
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4931118	QC - Blank	TRH (C6-C10) & F1	TPHC6-C9	mg/kg	<20
4931118	QC - Blank	TRH (C6-C10) & F1	TRHC6-C10	mg/kg	<20
4931118	QC - Blank	TRH (C6-C10) & F1	TRHC6-C10 minus BTEX	mg/kg	<20
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4931541	QC - Blank	TRH & TPH (>C10)	TPH C10-C14	mg/kg	<20
4931541	QC - Blank	TRH & TPH (>C10)	TPH C15-C28	mg/kg	<50
4931541	QC - Blank	TRH & TPH (>C10)	TPH C29-C36	mg/kg	<50
4931541	QC - Blank	TRH & TPH (>C10)	TRH>C10-C16	mg/kg	<20
4931541	QC - Blank	TRH & TPH (>C10)	TRH>C16-C34	mg/kg	<50
4931541	QC - Blank	TRH & TPH (>C10)	TRH>C34-C40	mg/kg	<50
4931541	QC - Blank	TRH & TPH (>C10)	Sum of TRH>C10-C40	mg/kg	<50
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4930763	QC - Blank	PAH	Acenaphthene	mg/kg	<0.1
4930763	QC - Blank	PAH	Acenaphthylene	mg/kg	<0.1
4930763	QC - Blank	PAH	Anthracene	mg/kg	<0.1
4930763	QC - Blank	PAH	Benz(a)anthracene	mg/kg	<0.1
4930763	QC - Blank	PAH	Benzo(a)pyrene	mg/kg	<0.1
4930763	QC - Blank	PAH	Benzo(b)fluoranthene	mg/kg	<0.1
4930763	QC - Blank	PAH	Benzo(g,h,i)perylene	mg/kg	<0.1
4930763	QC - Blank	PAH	Benzo(k)fluoranthene	mg/kg	<0.1

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					Value
4930763	QC - Blank	PAH	Chrysene	mg/kg	<0.1
4930763	QC - Blank	PAH	Dibenz(a,h)anthracene	mg/kg	<0.1
4930763	QC - Blank	PAH	Fluoranthene	mg/kg	<0.1
4930763	QC - Blank	PAH	Fluorene	mg/kg	<0.1
4930763	QC - Blank	PAH	Indeno(1,2,3-cd)pyrene	mg/kg	<0.1
4930763	QC - Blank	PAH	Naphthalene	mg/kg	<0.1
4930763	QC - Blank	PAH	Phenanthrene	mg/kg	<0.1
4930763	QC - Blank	PAH	Pyrene	mg/kg	<0.1
4930763	QC - Blank	PAH	Total PAH	mg/kg	<0.1
4930763	QC - Blank	PAH	BaP TEQ (zero)	mg/kg	<0.1
4930763	QC - Blank	PAH	BaP TEQ (half LOR)	mg/kg	0.1
4930763	QC - Blank	PAH	BaP TEQ (LOR)	mg/kg	0.2
4930766	QC - Blank	PAH	Acenaphthene	mg/kg	<0.1
4930766	QC - Blank	PAH	Acenaphthylene	mg/kg	<0.1
4930766	QC - Blank	PAH	Anthracene	mg/kg	<0.1
4930766	QC - Blank	PAH	Benz(a)anthracene	mg/kg	<0.1
4930766	QC - Blank	PAH	Benzo(a)pyrene	mg/kg	<0.1
4930766	QC - Blank	PAH	Benzo(b)fluoranthene	mg/kg	<0.1
4930766	QC - Blank	PAH	Benzo(g,h,i)perylene	mg/kg	<0.1
4930766	QC - Blank	PAH	Benzo(k)fluoranthene	mg/kg	<0.1
4930766	QC - Blank	PAH	Chrysene	mg/kg	<0.1
4930766	QC - Blank	PAH	Dibenz(a,h)anthracene	mg/kg	<0.1
4930766	QC - Blank	PAH	Fluoranthene	mg/kg	<0.1
4930766	QC - Blank	PAH	Fluorene	mg/kg	<0.1
4930766	QC - Blank	PAH	Indeno(1,2,3-cd)pyrene	mg/kg	<0.1
4930766	QC - Blank	PAH	Naphthalene	mg/kg	<0.1
4930766	QC - Blank	PAH	Phenanthrene	mg/kg	<0.1
4930766	QC - Blank	PAH	Pyrene	mg/kg	<0.1
4930766	QC - Blank	PAH	Total PAH	mg/kg	<0.1
4930766	QC - Blank	PAH	BaP TEQ (zero)	mg/kg	<0.1
4930766	QC - Blank	PAH	BaP TEQ (half LOR)	mg/kg	0.1
4930766	QC - Blank	PAH	BaP TEQ (LOR)	mg/kg	0.2
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4930769	QC - Blank	OCP	BHC (alpha isomer)	mg/kg	<0.05
4930769	QC - Blank	OCP	a-Endosulphan	mg/kg	<0.05

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					Value
4930769	QC - Blank	OCP	Aldrin	mg/kg	<0.05
4930769	QC - Blank	OCP	BHC (beta isomer)	mg/kg	<0.05
4930769	QC - Blank	OCP	b-Endosulphan	mg/kg	<0.05
4930769	QC - Blank	OCP	Chlordane	mg/kg	<0.05
4930769	QC - Blank	OCP	cis-Chlordane	mg/kg	<0.05
4930769	QC - Blank	OCP	trans-Chlordane	mg/kg	<0.05
4930769	QC - Blank	OCP	BHC (delta isomer)	mg/kg	<0.05
4930769	QC - Blank	OCP	DDD	mg/kg	<0.05
4930769	QC - Blank	OCP	DDE	mg/kg	<0.05
4930769	QC - Blank	OCP	DDT	mg/kg	<0.05
4930769	QC - Blank	OCP	Dieldrin	mg/kg	<0.05
4930769	QC - Blank	OCP	Sum of alpha-, beta- and Endosulphan	mg/kg	<0.05
4930769	QC - Blank	OCP	Endosulfan Sulfate	mg/kg	<0.05
4930769	QC - Blank	OCP	Endrin	mg/kg	<0.05
4930769	QC - Blank	OCP	Endrin Aldehyde	mg/kg	<0.05
4930769	QC - Blank	OCP	Endrin Ketone	mg/kg	<0.05
4930769	QC - Blank	OCP	Hexachlorobenzene	mg/kg	<0.05
4930769	QC - Blank	OCP	Heptachlor Epoxide	mg/kg	<0.05
4930769	QC - Blank	OCP	Heptachlor	mg/kg	<0.05
4930769	QC - Blank	OCP	BHC (gamma isomer) [Lindane]	mg/kg	<0.05
4930769	QC - Blank	OCP	Methoxychlor	mg/kg	<0.05
4930769	QC - Blank	OCP	Oxychlordane	mg/kg	<0.05
4930769	QC - Blank	OCP	Sum of DDD, DDE and DDT	mg/kg	<0.05
4930769	QC - Blank	OCP	Sum of Aldrin and Dieldrin	mg/kg	<0.05
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4930772	QC - Blank	PCB	Aroclor 1016	mg/kg	<0.1
4930772	QC - Blank	PCB	Aroclor 1221	mg/kg	<0.1
4930772	QC - Blank	PCB	Aroclor 1232	mg/kg	<0.1
4930772	QC - Blank	PCB	Aroclor 1242	mg/kg	<0.1
4930772	QC - Blank	PCB	Aroclor 1248	mg/kg	<0.1
4930772	QC - Blank	PCB	Aroclor 1254	mg/kg	<0.1
4930772	QC - Blank	PCB	Aroclor 1260	mg/kg	<0.1
4930772	QC - Blank	PCB	Total PCBs	mg/kg	<0.1
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4930754	QC - Blank	CHC	1,2,3,4-Tetrachlorobenzene	mg/kg	<0.1

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					Value
4930754	QC - Blank	CHC	1,2,3,5-Tetrachlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,2,3-Trichlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,2,4,5-Tetrachlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,2,4-Trichlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,2-Dichlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,3,5-Trichlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,3-Dichlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	1,4-Dichlorobenzene	mg/kg	<0.1
4930754	QC - Blank	CHC	2-Chloronaphthalene	mg/kg	<0.1
4930754	QC - Blank	CHC	Benzal Chloride	mg/kg	<0.1
4930754	QC - Blank	CHC	Benzotrichloride	mg/kg	<0.1
4930754	QC - Blank	CHC	Benzylchloride	mg/kg	<0.1
4930754	QC - Blank	CHC	Hexachloroethane	mg/kg	<0.1
4930754	QC - Blank	CHC	Hexachlorobutadiene	mg/kg	<0.1
4930754	QC - Blank	CHC	Hexachlorocyclopentadiene	mg/kg	<0.1
4930754	QC - Blank	CHC	Pentachlorobenzene	mg/kg	<0.1
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4930760	QC - Blank	Phenols(Halo)	4-Chloro-3-Methylphenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2-Chlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,4-Dichlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,6-Dichlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	Pentachlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,3,4,5-Tetrachlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,3,4,6-Tetrachlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,3,5,6-Tetrachlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,4,5-Trichlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	2,4,6-Trichlorophenol	mg/kg	<0.5
4930760	QC - Blank	Phenols(Halo)	Total Phenols (Halogenated)	mg/kg	<0.5
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4930757	QC - Blank	Phenols(NonHalo)	Phenol	mg/kg	<0.5
4930757	QC - Blank	Phenols(NonHalo)	Total Cresols	mg/kg	<1
4930757	QC - Blank	Phenols(NonHalo)	2,4-Dimethylphenol	mg/kg	<0.5
4930757	QC - Blank	Phenols(NonHalo)	2,4-Dinitrophenol	mg/kg	<30
4930757	QC - Blank	Phenols(NonHalo)	2-Methyl-4,6-Dinitrophenol	mg/kg	<10
4930757	QC - Blank	Phenols(NonHalo)	2-Nitrophenol	mg/kg	<0.5

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					Value
4930757	QC - Blank	Phenols(NonHalo)	4-Nitrophenol	mg/kg	<0.5
4930757	QC - Blank	Phenols(NonHalo)	2-Cyclohexyl-4,6-Dinitrophenol	mg/kg	<30
4930757	QC - Blank	Phenols(NonHalo)	Dinoseb	mg/kg	<10
4930757	QC - Blank	Phenols(NonHalo)	Total Phenols (non Halogenated)	mg/kg	<30
Lab Sample ID	Client Sample ID	Analysis	Analyte		
4931043	QC - Blank	HVOL	1,1,1,2-Tetrachloroethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,1,2,2-Tetrachloroethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,1- Dichloroethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,1-Dichloroethene	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,1-Dichloropropene	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2,3-Trichloropropane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2-Dibromo-3-Chloropropane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2-Dichloroethene [cis]	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2-Dichloroethene [trans]	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2-Dichloroethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2-Dichloropropane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,3-Dichloropropane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,3-Dichloropropene [cis]	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,3-Dichloropropene [trans]	mg/kg	<0.5
4931043	QC - Blank	HVOL	2,2-Dichloropropane	mg/kg	<0.5
4931043	QC - Blank	HVOL	2-Chlorotoluene	mg/kg	<0.5
4931043	QC - Blank	HVOL	4-Chlorotoluene	mg/kg	<0.5
4931043	QC - Blank	HVOL	Bromochloromethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	Bromodichloromethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	Bromobenzene	mg/kg	<0.5
4931043	QC - Blank	HVOL	Bromoform (Tribromomethane)	mg/kg	<0.5
4931043	QC - Blank	HVOL	Carbon Tetrachloride	mg/kg	<0.5
4931043	QC - Blank	HVOL	Chloroform (Trichloromethane)	mg/kg	<0.5
4931043	QC - Blank	HVOL	Chlorobenzene	mg/kg	<0.5
4931043	QC - Blank	HVOL	Dibromochloromethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	Dibromomethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,2-Dibromoethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	Dichloromethane	mg/kg	<1
4931043	QC - Blank	HVOL	Trichlorofluoromethane (CFC11)	mg/kg	<2
4931043	QC - Blank	HVOL	Tetrachloroethene	mg/kg	<0.5

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					Value
4931043	QC - Blank	HVOL	Vinyl Chloride (Monomer)	mg/kg	<1
4931043	QC - Blank	HVOL	1,1,1-Trichloroethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	1,1,2-Trichloroethane	mg/kg	<0.5
4931043	QC - Blank	HVOL	Trichloroethene	mg/kg	<0.5

QUALITY CONTROL - DUPLICATES

QC Data for duplicates is calculated on raw 'unrounded' values. Laboratory duplicates are randomly selected samples tested by the laboratory to maintain method precision and provide information on sample homogeneity.

RPD = Relative Percentage Difference for duplicate determinations. RPD's that fall outside the general acceptance criteria will be attributed to non-homogeneity of samples or results of low magnitudes.

Lab Sample ID	Client Sample ID	Analysis	Analyte		Sample Value	Duplicate Value	% RPD
4930807	BH03-1,0.3-0.4m	Moisture	Moisture %	% w/wet w	26	26	1.0
4932019	BH19-1,0.2-0.3m	pH	pH, units	Units	5.6	5.6	1.6
4932019	BH19-1,0.2-0.3m	EC	EC, uS/cm @ 25C	uS/cm	250	320	25.9
4934155	NCP	Cyanide	Cyanide, as CN	mg/kg	<5	<5	0
4934857	BH29-1,0.05-0.2m	SO4	Sulfate	mg/kg	<50	<50	0
4934858	NCP	Total Cr 6+ DA	Hexavalent Chromium (Total) Soil DA	mg/kg	<1	<1	0
4934859	NCP	Chloride	Chloride, as Cl	mg/kg	10	10	6.9
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930858	BH01-1,0.3-0.45m	MS Total Metals	Arsenic	mg/kg	5	5	0.1
4930858	BH01-1,0.3-0.45m	MS Total Metals	Cadmium	mg/kg	<0.2	<0.2	0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Chromium	mg/kg	50	51	3.7
4930858	BH01-1,0.3-0.45m	MS Total Metals	Copper	mg/kg	17	18	5.5
4930858	BH01-1,0.3-0.45m	MS Total Metals	Iron	mg/kg	29000	30000	1.9
4930858	BH01-1,0.3-0.45m	MS Total Metals	Lead	mg/kg	10	10	1.8
4930858	BH01-1,0.3-0.45m	MS Total Metals	Manganese	mg/kg	210	170	18.0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Mercury	mg/kg	<0.05	<0.05	0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Molybdenum	mg/kg	<5	<5	0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Nickel	mg/kg	40	41	1.2
4930858	BH01-1,0.3-0.45m	MS Total Metals	Selenium	mg/kg	<3	<3	0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Silver	mg/kg	<5	<5	0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Tin	mg/kg	<5	<5	0
4930858	BH01-1,0.3-0.45m	MS Total Metals	Zinc	mg/kg	35	35	1.0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Arsenic	mg/kg	19	18	3.8

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					Sample Value	Duplicate Value	% RPD
4930860	BH24-1,0.1-0.3m	MS Total Metals	Cadmium	mg/kg	<0.2	<0.2	0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Chromium	mg/kg	43	41	5.3
4930860	BH24-1,0.1-0.3m	MS Total Metals	Copper	mg/kg	6	<5	NA
4930860	BH24-1,0.1-0.3m	MS Total Metals	Iron	mg/kg	28000	26000	5.6
4930860	BH24-1,0.1-0.3m	MS Total Metals	Lead	mg/kg	12	12	5.6
4930860	BH24-1,0.1-0.3m	MS Total Metals	Mercury	mg/kg	<0.05	<0.05	0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Molybdenum	mg/kg	<5	<5	0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Nickel	mg/kg	22	19	11.6
4930860	BH24-1,0.1-0.3m	MS Total Metals	Selenium	mg/kg	<3	<3	0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Silver	mg/kg	<5	<5	0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Tin	mg/kg	<5	<5	0
4930860	BH24-1,0.1-0.3m	MS Total Metals	Zinc	mg/kg	20	20	0.2
4932044	NCP	MS Total Metals	Arsenic	mg/kg	<5	<5	0
4932044	NCP	MS Total Metals	Cadmium	mg/kg	<0.2	<0.2	0
4932044	NCP	MS Total Metals	Chromium	mg/kg	37	33	10.5
4932044	NCP	MS Total Metals	Copper	mg/kg	26	25	3.8
4932044	NCP	MS Total Metals	Iron	mg/kg	41000	38000	8.2
4932044	NCP	MS Total Metals	Lead	mg/kg	7	6	7.5
4932044	NCP	MS Total Metals	Manganese	mg/kg	590	550	6.8
4932044	NCP	MS Total Metals	Mercury	mg/kg	<0.05	<0.05	0
4932044	NCP	MS Total Metals	Molybdenum	mg/kg	<5	<5	0
4932044	NCP	MS Total Metals	Nickel	mg/kg	120	110	13.4
4932044	NCP	MS Total Metals	Selenium	mg/kg	<3	<3	0
4932044	NCP	MS Total Metals	Silver	mg/kg	<5	<5	0
4932044	NCP	MS Total Metals	Tin	mg/kg	<5	<5	0
4932044	NCP	MS Total Metals	Zinc	mg/kg	68	62	9.5
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4931115	BH01-1,0.3-0.45m	TRH (C6-C10) & F1	TPHC6-C9	mg/kg	<20	<20	0
4931115	BH01-1,0.3-0.45m	TRH (C6-C10) & F1	TRHC6-C10	mg/kg	<20	<20	0
4931115	BH01-1,0.3-0.45m	TRH (C6-C10) & F1	TRHC6-C10 minus BTEX	mg/kg	<20	<20	0
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	TPH C10-C14	mg/kg	<20	<20	0
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	TPH C15-C28	mg/kg	<50	<50	0
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	TPH C29-C36	mg/kg	<50	<50	0
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	TRH>C10-C16	mg/kg	<20	<20	0

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					Sample Value	Duplicate Value	% RPD
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	TRH>C16-C34	mg/kg	<50	<50	0
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	TRH>C34-C40	mg/kg	<50	<50	0
4931538	BH09-1,0.3-0.4m	TRH & TPH (>C10)	Sum of TRH>C10-C40	mg/kg	<50	<50	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TPH C10-C14	mg/kg	<20	<20	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TPH C15-C28	mg/kg	<50	<50	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TPH C29-C36	mg/kg	<50	<50	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TRH>C10-C16	mg/kg	<20	<20	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TRH>C16-C34	mg/kg	<50	<50	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TRH>C34-C40	mg/kg	<50	<50	0
4931539	BH23-1,0.35-0.5m	TRH & TPH (>C10)	Sum of TRH>C10-C40	mg/kg	<50	<50	0
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930761	BH09-1,0.3-0.4m	PAH	Acenaphthene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Acenaphthylene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Anthracene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Benz(a)anthracene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Benzo(a)pyrene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Benzo(b)fluoranthene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Benzo(k)fluoranthene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Chrysene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Fluoranthene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Fluorene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Naphthalene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Phenanthrene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Pyrene	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	Total PAH	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	BaP TEQ (zero)	mg/kg	<0.1	<0.1	0
4930761	BH09-1,0.3-0.4m	PAH	BaP TEQ (half LOR)	mg/kg	0.1	0.1	0.0
4930761	BH09-1,0.3-0.4m	PAH	BaP TEQ (LOR)	mg/kg	0.2	0.2	0.0
4930764	BH23-1,0.35-0.5m	PAH	Acenaphthene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Acenaphthylene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Anthracene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Benz(a)anthracene	mg/kg	<0.1	<0.1	0

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					Sample Value	Duplicate Value	% RPD
4930764	BH23-1,0.35-0.5m	PAH	Benzo(a)pyrene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Benzo(b)fluoranthene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Benzo(k)fluoranthene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Chrysene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Fluoranthene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Fluorene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Naphthalene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Phenanthrene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Pyrene	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	Total PAH	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	BaP TEQ (zero)	mg/kg	<0.1	<0.1	0
4930764	BH23-1,0.35-0.5m	PAH	BaP TEQ (half LOR)	mg/kg	0.1	0.1	0.0
4930764	BH23-1,0.35-0.5m	PAH	BaP TEQ (LOR)	mg/kg	0.2	0.2	0.0
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930767	BH23-1,0.35-0.5m	OCP	BHC (alpha isomer)	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	a-Endosulphan	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Aldrin	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	BHC (beta isomer)	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	b-Endosulphan	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Chlordane	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	cis-Chlordane	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	trans-Chlordane	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	BHC (delta isomer)	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	DDD	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	DDE	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	DDT	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Dieldrin	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Sum of alpha-, beta- and Endosulphan	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Endosulfan Sulfate	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Endrin	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Endrin Aldehyde	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Endrin Ketone	mg/kg	<0.05	<0.05	0

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					Sample Value	Duplicate Value	% RPD
4930767	BH23-1,0.35-0.5m	OCP	Hexachlorobenzene	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Heptachlor Epoxide	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Heptachlor	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	BHC (gamma isomer) [Lindane]	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Methoxychlor	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Oxychlorane	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Sum of DDD, DDE and DDT	mg/kg	<0.05	<0.05	0
4930767	BH23-1,0.35-0.5m	OCP	Sum of Aldrin and Dieldrin	mg/kg	<0.05	<0.05	0
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1016	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1221	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1232	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1242	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1248	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1254	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Aroclor 1260	mg/kg	<0.1	<0.1	0
4930770	BH23-1,0.35-0.5m	PCB	Total PCBs	mg/kg	<0.1	<0.1	0
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930752	BH23-1,0.35-0.5m	CHC	1,2,3,4-Tetrachlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,2,3,5-Tetrachlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,2,3-Trichlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,2,4,5-Tetrachlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,2,4-Trichlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,2-Dichlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,3,5-Trichlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,3-Dichlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	1,4-Dichlorobenzene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	2-Chloronaphthalene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Benzal Chloride	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Benzotrifluoride	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Benzylchloride	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Hexachloroethane	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Hexachlorobutadiene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Hexachlorocyclopentadiene	mg/kg	<0.1	<0.1	0
4930752	BH23-1,0.35-0.5m	CHC	Pentachlorobenzene	mg/kg	<0.1	<0.1	0

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					Sample Value	Duplicate Value	% RPD
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	4-Chloro-3-Methylphenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2-Chlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,4-Dichlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,6-Dichlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	Pentachlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,3,4,5-Tetrachlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,3,4,6-Tetrachlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,3,5,6-Tetrachlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,4,5-Trichlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	2,4,6-Trichlorophenol	mg/kg	<0.5	<0.5	0
4930758	BH23-1,0.35-0.5m	Phenols(Halo)	Total Phenols (Halogenated)	mg/kg	<0.5	<0.5	0
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	Phenol	mg/kg	<0.5	<0.5	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	Total Cresols	mg/kg	<1	<1	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	2,4-Dimethylphenol	mg/kg	<0.5	<0.5	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	2,4-Dinitrophenol	mg/kg	<30	<30	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	2-Methyl-4,6-Dinitrophenol	mg/kg	<10	<10	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	2-Nitrophenol	mg/kg	<0.5	<0.5	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	4-Nitrophenol	mg/kg	<0.5	<0.5	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	2-Cyclohexyl-4,6-Dinitrophenol	mg/kg	<30	<30	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	Dinoseb	mg/kg	<10	<10	0
4930755	BH23-1,0.35-0.5m	Phenols(NonHalo)	Total Phenols (non Halogenated)	mg/kg	<30	<30	0

QUALITY CONTROL - SPIKES

QC Data for spikes is calculated on raw 'unrounded' values. Laboratory spikes are randomly selected samples in which the analytes in question have been artificially introduced and recovered via standard analysis and are used to provide information on potential matrix effects on analyte recoveries.

Spike recoveries that fall outside the general acceptance criteria will be attributed to sample matrix interference or results of high magnitudes.

NCP: Non-Customer Parent (sample quality is representative of the analytical batch but the sample that was QC tested belongs to a customer not pertaining to the report.)

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Lab Sample ID	Client Sample ID	Analysis	Analyte	mg/kg	Sample Value	Expected Value	% Recovery
4934148	NCP	Cyanide	Cyanide, as CN	mg/kg	<5	20	102
4934851	BH19-1,0.2-0.3m	SO4	Sulfate	mg/kg	350	1300	110
4934853	NCP	Total Cr 6+ DA	Hexavalent Chromium (Total) Soil DA	mg/kg	<1	0.50	108
4934854	NCP	Chloride	Chloride, as Cl	mg/kg	10	1000	109
Lab Sample ID	Client Sample ID	Analysis	Analyte	mg/kg	Sample Value	Expected Value	% Recovery
4930859	BH01-1,0.3-0.45m	MS Total Metals	Cadmium	mg/kg	<0.2	100	106
4930859	BH01-1,0.3-0.45m	MS Total Metals	Chromium	mg/kg	50	140	92.8
4930859	BH01-1,0.3-0.45m	MS Total Metals	Copper	mg/kg	17	110	85.2
4930859	BH01-1,0.3-0.45m	MS Total Metals	Iron	mg/kg	29000	26000	89.0
4930859	BH01-1,0.3-0.45m	MS Total Metals	Lead	mg/kg	10	110	107
4930859	BH01-1,0.3-0.45m	MS Total Metals	Mercury	mg/kg	<0.05	1.0	115
4930859	BH01-1,0.3-0.45m	MS Total Metals	Molybdenum	mg/kg	<5	100	90.9
4930859	BH01-1,0.3-0.45m	MS Total Metals	Nickel	mg/kg	40	130	84.2
4930859	BH01-1,0.3-0.45m	MS Total Metals	Tin	mg/kg	<5	100	103
4930859	BH01-1,0.3-0.45m	MS Total Metals	Zinc	mg/kg	35	130	87.7
4930861	BH24-1,0.1-0.3m	MS Total Metals	Arsenic	mg/kg	19	110	85.6
4930861	BH24-1,0.1-0.3m	MS Total Metals	Cadmium	mg/kg	<0.2	100	106
4930861	BH24-1,0.1-0.3m	MS Total Metals	Chromium	mg/kg	43	130	91.2
4930861	BH24-1,0.1-0.3m	MS Total Metals	Copper	mg/kg	6	100	86.2
4930861	BH24-1,0.1-0.3m	MS Total Metals	Lead	mg/kg	12	110	105
4930861	BH24-1,0.1-0.3m	MS Total Metals	Mercury	mg/kg	<0.05	1.0	113
4930861	BH24-1,0.1-0.3m	MS Total Metals	Molybdenum	mg/kg	<5	100	95.9
4930861	BH24-1,0.1-0.3m	MS Total Metals	Nickel	mg/kg	22	120	84.1
4930861	BH24-1,0.1-0.3m	MS Total Metals	Selenium	mg/kg	<3	100	88.3
4930861	BH24-1,0.1-0.3m	MS Total Metals	Tin	mg/kg	<5	100	103
4930861	BH24-1,0.1-0.3m	MS Total Metals	Zinc	mg/kg	20	120	89.2
4932047	NCP	MS Total Metals	Cadmium	mg/kg	<0.2	100	111
4932047	NCP	MS Total Metals	Chromium	mg/kg	37	130	95.9
4932047	NCP	MS Total Metals	Copper	mg/kg	26	120	83.2
4932047	NCP	MS Total Metals	Lead	mg/kg	7	110	103
4932047	NCP	MS Total Metals	Mercury	mg/kg	<0.05	1.0	117
4932047	NCP	MS Total Metals	Molybdenum	mg/kg	<5	100	98.8
4932047	NCP	MS Total Metals	Tin	mg/kg	<5	100	109
4932047	NCP	MS Total Metals	Zinc	mg/kg	68	160	83.3

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Lab Sample ID	Client Sample ID	Analysis	Analyte	mg/kg	Sample Value	Expected Value	% Recovery
4931044	BH23-1,0.35-0.5m	MAH	Styrene	mg/kg	<0.5	4.6	76.5
4931031	BH23-1,0.35-0.5m	BTEXN	Benzene	mg/kg	<0.5	4.6	83.1
4931031	BH23-1,0.35-0.5m	BTEXN	Toluene	mg/kg	<0.5	4.6	92.2
4931031	BH23-1,0.35-0.5m	BTEXN	Ethyl Benzene	mg/kg	<0.5	4.6	79.1
4931031	BH23-1,0.35-0.5m	BTEXN	Xylene - m&p	mg/kg	<1	9.2	88.2
4931031	BH23-1,0.35-0.5m	BTEXN	Xylene - O	mg/kg	<0.5	4.6	90.3
4931116	BH07-1,0.4-0.5m	TRH (C6-C10) & F1	TPHC6-C9	mg/kg	<20	120	93.1
4931116	BH07-1,0.4-0.5m	TRH (C6-C10) & F1	TRHC6-C10	mg/kg	<20	120	92.3
4931540	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TPH C15-C28	mg/kg	<50	870	74.4
4931540	BH23-1,0.35-0.5m	TRH & TPH (>C10)	TRH>C16-C34	mg/kg	<50	880	74.9
4930762	BH09-1,0.3-0.4m	PAH	Acenaphthene	mg/kg	<0.1	1.3	95.4
4930762	BH09-1,0.3-0.4m	PAH	Acenaphthylene	mg/kg	<0.1	1.3	83.8
4930762	BH09-1,0.3-0.4m	PAH	Anthracene	mg/kg	<0.1	1.3	89.2
4930762	BH09-1,0.3-0.4m	PAH	Benz(a)anthracene	mg/kg	<0.1	1.3	89.2
4930762	BH09-1,0.3-0.4m	PAH	Benzo(a)pyrene	mg/kg	<0.1	1.3	82.4
4930762	BH09-1,0.3-0.4m	PAH	Benzo(b)fluoranthene	mg/kg	<0.1	1.3	79.0
4930762	BH09-1,0.3-0.4m	PAH	Benzo(g,h,i)perylene	mg/kg	<0.1	1.3	106
4930762	BH09-1,0.3-0.4m	PAH	Benzo(k)fluoranthene	mg/kg	<0.1	1.3	88.8
4930762	BH09-1,0.3-0.4m	PAH	Chrysene	mg/kg	<0.1	1.3	91.8
4930762	BH09-1,0.3-0.4m	PAH	Dibenz(a,h)anthracene	mg/kg	<0.1	1.3	77.2
4930762	BH09-1,0.3-0.4m	PAH	Fluoranthene	mg/kg	<0.1	1.3	91.4
4930762	BH09-1,0.3-0.4m	PAH	Fluorene	mg/kg	<0.1	1.3	89.6
4930762	BH09-1,0.3-0.4m	PAH	Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	1.3	91.2
4930762	BH09-1,0.3-0.4m	PAH	Naphthalene	mg/kg	<0.1	1.3	86.8
4930762	BH09-1,0.3-0.4m	PAH	Phenanthrene	mg/kg	<0.1	1.3	91.0
4930762	BH09-1,0.3-0.4m	PAH	Pyrene	mg/kg	<0.1	1.3	92.6
4930765	BH23-1,0.35-0.5m	PAH	Acenaphthene	mg/kg	<0.1	1.4	91.6
4930765	BH23-1,0.35-0.5m	PAH	Acenaphthylene	mg/kg	<0.1	1.4	83.6
4930765	BH23-1,0.35-0.5m	PAH	Anthracene	mg/kg	<0.1	1.4	87.2
4930765	BH23-1,0.35-0.5m	PAH	Benz(a)anthracene	mg/kg	<0.1	1.4	94.4

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					Sample Value	Expected Value	% Recovery
4930765	BH23-1,0.35-0.5m	PAH	Benzo(a)pyrene	mg/kg	<0.1	1.4	85.6
4930765	BH23-1,0.35-0.5m	PAH	Benzo(b)fluoranthene	mg/kg	<0.1	1.4	73.8
4930765	BH23-1,0.35-0.5m	PAH	Benzo(g,h,i)perylene	mg/kg	<0.1	1.4	104
4930765	BH23-1,0.35-0.5m	PAH	Benzo(k)fluoranthene	mg/kg	<0.1	1.4	83.8
4930765	BH23-1,0.35-0.5m	PAH	Chrysene	mg/kg	<0.1	1.4	87.8
4930765	BH23-1,0.35-0.5m	PAH	Dibenz(a,h)anthracene	mg/kg	<0.1	1.4	76.8
4930765	BH23-1,0.35-0.5m	PAH	Fluoranthene	mg/kg	<0.1	1.4	91.6
4930765	BH23-1,0.35-0.5m	PAH	Fluorene	mg/kg	<0.1	1.4	87.8
4930765	BH23-1,0.35-0.5m	PAH	Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	1.4	100
4930765	BH23-1,0.35-0.5m	PAH	Naphthalene	mg/kg	<0.1	1.4	81.2
4930765	BH23-1,0.35-0.5m	PAH	Phenanthrene	mg/kg	<0.1	1.4	87.4
4930765	BH23-1,0.35-0.5m	PAH	Pyrene	mg/kg	<0.1	1.4	92.2
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930768	BH23-1,0.35-0.5m	OCP	BHC (alpha isomer)	mg/kg	<0.05	2.9	90.7
4930768	BH23-1,0.35-0.5m	OCP	a-Endosulphan	mg/kg	<0.05	1.4	91.6
4930768	BH23-1,0.35-0.5m	OCP	Aldrin	mg/kg	<0.05	1.4	90.8
4930768	BH23-1,0.35-0.5m	OCP	BHC (beta isomer)	mg/kg	<0.05	2.3	92.6
4930768	BH23-1,0.35-0.5m	OCP	b-Endosulphan	mg/kg	<0.05	1.4	96.4
4930768	BH23-1,0.35-0.5m	OCP	Chlordane	mg/kg	<0.05	2.9	109
4930768	BH23-1,0.35-0.5m	OCP	cis-Chlordane	mg/kg	<0.05	1.4	109
4930768	BH23-1,0.35-0.5m	OCP	trans-Chlordane	mg/kg	<0.05	1.4	109
4930768	BH23-1,0.35-0.5m	OCP	BHC (delta isomer)	mg/kg	<0.05	2.9	97.5
4930768	BH23-1,0.35-0.5m	OCP	DDD	mg/kg	<0.05	1.4	96.4
4930768	BH23-1,0.35-0.5m	OCP	DDE	mg/kg	<0.05	1.4	94.4
4930768	BH23-1,0.35-0.5m	OCP	DDT	mg/kg	<0.05	1.4	93.6
4930768	BH23-1,0.35-0.5m	OCP	Dieldrin	mg/kg	<0.05	1.4	95.8
4930768	BH23-1,0.35-0.5m	OCP	Endosulfan Sulfate	mg/kg	<0.05	1.4	86.2
4930768	BH23-1,0.35-0.5m	OCP	Endrin	mg/kg	<0.05	1.4	94.0
4930768	BH23-1,0.35-0.5m	OCP	Endrin Aldehyde	mg/kg	<0.05	1.4	83.4
4930768	BH23-1,0.35-0.5m	OCP	Endrin Ketone	mg/kg	<0.05	1.4	102
4930768	BH23-1,0.35-0.5m	OCP	Hexachlorobenzene	mg/kg	<0.05	2.6	90.1
4930768	BH23-1,0.35-0.5m	OCP	Heptachlor Epoxide	mg/kg	<0.05	1.4	98.8
4930768	BH23-1,0.35-0.5m	OCP	Heptachlor	mg/kg	<0.05	1.4	106
4930768	BH23-1,0.35-0.5m	OCP	BHC (gamma isomer) [Lindane]	mg/kg	<0.05	2.9	90.5
4930768	BH23-1,0.35-0.5m	OCP	Methoxychlor	mg/kg	<0.05	1.4	84.0

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					Sample Value	Expected Value	% Recovery
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930771	BH23-1,0.35-0.5m	PCB	Aroclor 1016	mg/kg	<0.1	2.4	88.7
4930771	BH23-1,0.35-0.5m	PCB	Aroclor 1260	mg/kg	<0.1	2.7	96.7
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930753	BH23-1,0.35-0.5m	CHC	1,2,3,4-Tetrachlorobenzene	mg/kg	<0.1	1.4	81.0
4930753	BH23-1,0.35-0.5m	CHC	1,2,3-Trichlorobenzene	mg/kg	<0.1	1.4	86.8
4930753	BH23-1,0.35-0.5m	CHC	1,2,4,5-Tetrachlorobenzene	mg/kg	<0.1	2.9	81.3
4930753	BH23-1,0.35-0.5m	CHC	1,2,4-Trichlorobenzene	mg/kg	<0.1	1.4	86.6
4930753	BH23-1,0.35-0.5m	CHC	1,2-Dichlorobenzene	mg/kg	<0.1	1.4	99.8
4930753	BH23-1,0.35-0.5m	CHC	1,3,5-Trichlorobenzene	mg/kg	<0.1	1.4	94.4
4930753	BH23-1,0.35-0.5m	CHC	1,3-Dichlorobenzene	mg/kg	<0.1	1.4	88.4
4930753	BH23-1,0.35-0.5m	CHC	1,4-Dichlorobenzene	mg/kg	<0.1	1.4	94.8
4930753	BH23-1,0.35-0.5m	CHC	2-Chloronaphthalene	mg/kg	<0.1	1.4	93.2
4930753	BH23-1,0.35-0.5m	CHC	Benzal Chloride	mg/kg	<0.1	1.4	89.4
4930753	BH23-1,0.35-0.5m	CHC	Benzotrichloride	mg/kg	<0.1	1.4	85.8
4930753	BH23-1,0.35-0.5m	CHC	Benzylchloride	mg/kg	<0.1	1.4	118
4930753	BH23-1,0.35-0.5m	CHC	Hexachloroethane	mg/kg	<0.1	1.4	93.0
4930753	BH23-1,0.35-0.5m	CHC	Hexachlorobutadiene	mg/kg	<0.1	1.4	78.4
4930753	BH23-1,0.35-0.5m	CHC	Hexachlorocyclopentadiene	mg/kg	<0.1	1.4	93.0
4930753	BH23-1,0.35-0.5m	CHC	Pentachlorobenzene	mg/kg	<0.1	1.4	80.2
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	4-Chloro-3-Methylphenol	mg/kg	<0.5	1.4	86.0
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2-Chlorophenol	mg/kg	<0.5	1.4	86.4
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2,4-Dichlorophenol	mg/kg	<0.5	1.4	83.4
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2,6-Dichlorophenol	mg/kg	<0.5	1.4	78.6
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	Pentachlorophenol	mg/kg	<0.5	1.4	86.2
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2,3,4,6-Tetrachlorophenol	mg/kg	<0.5	2.9	79.6
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2,3,5,6-Tetrachlorophenol	mg/kg	<0.5	1.4	74.2
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2,4,5-Trichlorophenol	mg/kg	<0.5	1.4	76.8
4930759	BH23-1,0.35-0.5m	Phenols(Halo)	2,4,6-Trichlorophenol	mg/kg	<0.5	1.4	71.8
Lab Sample ID	Client Sample ID	Analysis	Analyte				
4930756	BH23-1,0.35-0.5m	Phenols(NonHalo)	Phenol	mg/kg	<0.5	1.4	107
4930756	BH23-1,0.35-0.5m	Phenols(NonHalo)	Total Cresols	mg/kg	<1	4.3	98.3
4930756	BH23-1,0.35-0.5m	Phenols(NonHalo)	2,4-Dimethylphenol	mg/kg	<0.5	1.4	98.4
4930756	BH23-1,0.35-0.5m	Phenols(NonHalo)	2-Nitrophenol	mg/kg	<0.5	1.4	82.0

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Lab Sample ID	Client Sample ID	Analysis	Analyte	mg/kg	Sample Value	Expected Value	% Recovery
4930756	BH23-1,0.35-0.5m	Phenols(NonHalo)	4-Nitrophenol	mg/kg	<0.5	1.4	71.8
4931042	BH23-1,0.35-0.5m	HVOL	1,1,1,2-Tetrachloroethane	mg/kg	<0.5	4.6	77.2
4931042	BH23-1,0.35-0.5m	HVOL	1,1,2,2-Tetrachloroethane	mg/kg	<0.5	4.6	97.4
4931042	BH23-1,0.35-0.5m	HVOL	1,1- Dichloroethane	mg/kg	<0.5	4.6	72.6
4931042	BH23-1,0.35-0.5m	HVOL	1,1-Dichloroethene	mg/kg	<0.5	4.6	88.9
4931042	BH23-1,0.35-0.5m	HVOL	1,2,3-Trichloropropane	mg/kg	<0.5	4.6	98.7
4931042	BH23-1,0.35-0.5m	HVOL	1,2-Dibromo-3-Chloropropane	mg/kg	<0.5	4.6	73.2
4931042	BH23-1,0.35-0.5m	HVOL	1,2-Dichloroethane	mg/kg	<0.5	4.6	91.2
4931042	BH23-1,0.35-0.5m	HVOL	1,2-Dichloropropane	mg/kg	<0.5	4.6	78.1
4931042	BH23-1,0.35-0.5m	HVOL	1,3-Dichloropropane	mg/kg	<0.5	4.6	96.3
4931042	BH23-1,0.35-0.5m	HVOL	2-Chlorotoluene	mg/kg	<0.5	4.6	85.0
4931042	BH23-1,0.35-0.5m	HVOL	4-Chlorotoluene	mg/kg	<0.5	4.6	82.6
4931042	BH23-1,0.35-0.5m	HVOL	Bromochloromethane	mg/kg	<0.5	4.6	79.4
4931042	BH23-1,0.35-0.5m	HVOL	Bromodichloromethane	mg/kg	<0.5	4.6	74.7
4931042	BH23-1,0.35-0.5m	HVOL	Bromobenzene	mg/kg	<0.5	4.6	81.9
4931042	BH23-1,0.35-0.5m	HVOL	Chloroform (Trichloromethane)	mg/kg	<0.5	4.6	82.0
4931042	BH23-1,0.35-0.5m	HVOL	Chlorobenzene	mg/kg	<0.5	4.6	88.9
4931042	BH23-1,0.35-0.5m	HVOL	Dibromomethane	mg/kg	<0.5	4.6	82.0
4931042	BH23-1,0.35-0.5m	HVOL	1,2-Dibromoethane	mg/kg	<0.5	4.6	86.3
4931042	BH23-1,0.35-0.5m	HVOL	Dichloromethane	mg/kg	<1	4.6	101
4931042	BH23-1,0.35-0.5m	HVOL	Trichlorofluoromethane (CFC11)	mg/kg	<2	4.6	80.1
4931042	BH23-1,0.35-0.5m	HVOL	Tetrachloroethene	mg/kg	<0.5	4.6	82.2
4931042	BH23-1,0.35-0.5m	HVOL	Vinyl Chloride (Monomer)	mg/kg	<1	4.6	75.3
4931042	BH23-1,0.35-0.5m	HVOL	1,1,1-Trichloroethane	mg/kg	<0.5	4.6	74.5
4931042	BH23-1,0.35-0.5m	HVOL	1,1,2-Trichloroethane	mg/kg	<0.5	4.6	90.5
4931042	BH23-1,0.35-0.5m	HVOL	Trichloroethene	mg/kg	<0.5	4.6	78.6

Samples not collected by ALS and are tested as received.

A blank space indicates no test performed. Soil results expressed in mg/kg dry weight unless specified otherwise. Microbiological testing was commenced on the day of receipt and within 24 hours of sampling unless otherwise stated. MM524: Plate count results <10 per mL and >300 per mL are deemed as approximate. MM526: Plate count results <2,500 per mL and >250,000 per mL are deemed as approximate. Calculated results are based on raw data.

16-43870

CHAIN OF CUSTODY DESPATCH SHEET

Project Name: Western Geelong Growth Area
 Project Number: 87027.00
 DP Contact Person: Arthur Rowling
 Prior storage: Esky / Fridge

To: ALS
 22 Dalmore Drive
 Scoresby
 Ph:
 Attn: Tuyen Nguyen
 15 samples

Date relinquished: 22/09/2016
 Results required by: 29/09/2016 PM
 Turnaround requirements: standard

Sample Receipt:
 Signed: *[Signature]*
 Date: 22/09/16

ALS Water Resources Group
 Received By: *[Signature]*
 Date: 22/09/16 Time: 3:00 PM
 ALS WRG Bottles: Yes / No
 Sample Intact: Yes / No
 Chain of Custody: Yes / No
 Comments:

Laboratory Sample Receipt Stamp

LAB REFERENCE: _____

Sample ID	Sample Type	Sample Date	Lab ID	EPA Screen *	Metals**, TRH & PAH	pH Sulfate	Chloride	EC			Notes
BH01-1, 0.3-0.45 m	Soil	16/09/2016			✓	✓	✓	✓			* IWRG 621 Table 2 Clean Fill Screen (inc. Mn and Fe) **As, Cd, Cr, Cu, Pb, Hg, Mn, Mo, Ni, Sn, Se, Ag, Zn, Fe
BH03-1, 0.3-0.4 m	Soil	16/09/2016		✓							
BH04-1, 0.3-0.4 m	Soil	16/09/2016			✓	✓	✓	✓			
BH06-1, 0.2-0.3 m	Soil	16/09/2016			✓	✓	✓	✓			
BH07-1, 0.4-0.5 m	Soil	12/09/2016			✓	✓	✓	✓			
BH09-1, 0.3-0.4 m	Soil	9/09/2016			✓	✓	✓	✓			
BH14-1, 0.5-0.6 m	Soil	9/09/2016				✓	✓	✓			
BH15-1, 0.4-0.55 m	Soil	15/09/2016			✓	✓	✓	✓			
BH16-1, 0.3-0.45 m	Soil	19/09/2016			✓	✓	✓	✓			
BH19-1, 0.2-0.3 m	Soil	15/09/2016			✓	✓	✓	✓			
BH23-1, 0.35-0.5 m	Soil	20/09/2016		✓							
BH24-1, 0.1-0.3 m	Soil	19/09/2016			✓	✓	✓	✓			
BH26-1, 0.05-0.2 m	Soil	14/09/2016			✓	✓	✓	✓			
BH28-1, 0.1-0.25 m	Soil	14/09/2016			✓	✓	✓	✓			
BH29-1, 0.05-0.2 m	Soil	14/09/2016			✓	✓	✓	✓			

Count	2	12	13	13	13
Allowance	2	12	13	13	13



Sample Receipt Advice (SRA)

Client:

Douglas Partners Pty Ltd
231 Normanby Road
SOUTH MELBOURNE VIC 3205

Client Contact: Arthur Rowling

Phone : 5221 0711
Mobile : 0414 716 907
Fax : 5221 0799
Email : arthur.rowling@douglaspartners.com.au

Batch Summary:

ALS Water Resources Group Batch No : 16-43570

Date Received : September 22, 2016 3:18 pm
Scheduled Reporting Date : 29-Sep-2016
Client Job Ref : 87027.00 Western Geelong
No. of Sample(s) : 15
Program : Misc.
Purchase Order : 124986
NATA report : Reqd.
Lab. Contact : Tuyen Nguyen
Phone: (03) 8756 8116
Email: Tuyen.Nguyen@alsglobal.com

Delivery Details:

COC Received :

YES

COC is complete, correct and unambiguous:

YES

- ☒ Samples are Chilled.
- ☒ All samples have been received as described in the COC.
- ☒ Samples have been received in appropriate containers with correct preservatives.
- ☒ All samples were received in good condition.
- ☒ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

Comments: