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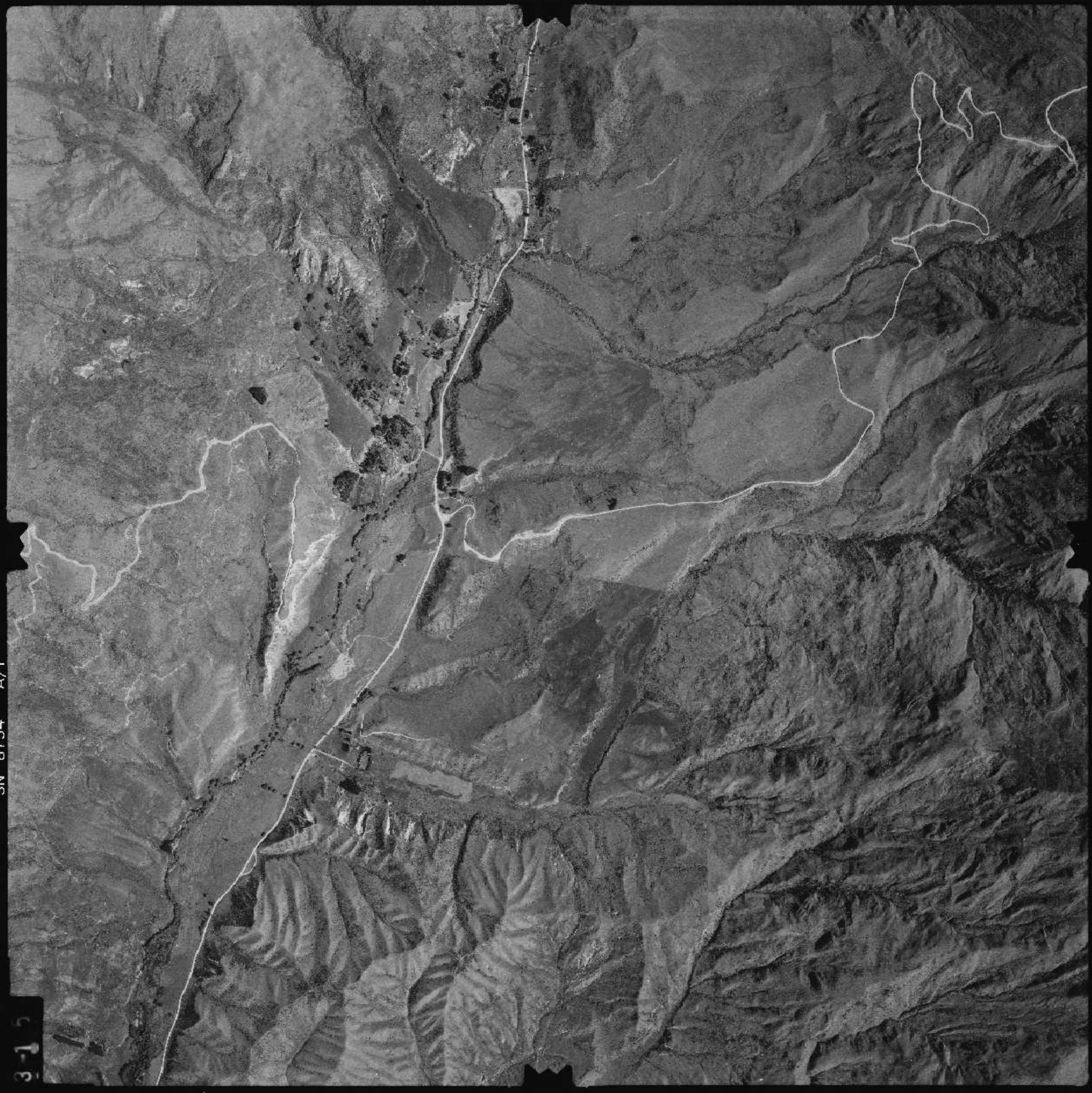


Appendix D:

Regional Council Supporting Information

10 June 2019

Dear Jodi Halleux,

Thank you for your enquiry regarding information that the Otago Regional Council may hold regarding potential soil contamination at the properties indicated below:

Address	Valuation Number / Legal Description
N/A	Lot 1 DP 4525263
N/A	Lot 1 DP 4333836
N/A	Lot 6 DP 344432

The Otago Regional Council maintains a database of properties where information is held regarding current or past land-uses that have the potential to contaminated land. Land-uses that have the potential to contaminate land are outlined in the Ministry for the Environment's Hazardous Activities and Industries List (HAIL).

Where investigation has been completed, results have been compared to relevant soil guideline values. The database is continually under development, and should not be regarded as a complete record of all properties in Otago. The absence of available information does not necessarily mean that the property is uncontaminated; rather no information exists on the database. You may also wish to examine the property file at the relevant City or District Council to check if there is any evidence that activities occurring on the HAIL have taken place.

I can confirm that:

The above land does not currently appear on the database.

If your enquiry relates to a rural property, please note that many current and past activities undertaken on farms may not be listed on the database, as they can be more difficult to identify. Activities such as use, storage, formulation, and disposal of pesticides, offal pits, landfills, animal dips, and fuel tanks have the potential to contaminated land.

Similarly, the long-term use of lead-based paints on buildings can, in some cases, cases cause soil contamination. The use of lead-based paint is generally not recorded on the database.

Please feel free to contact me if you have any other enquires, or you would like to discuss the matter further,

Regards,

Joanne Taylor
Environmental Officer

The enclosed/attached information is derived from the Otago Regional contaminated land register and is being disclosed to you pursuant to the Local Government Official Information and Meetings Act 1987. This information reflects the Otago Regional Council's current understanding of this site, which is based solely on the information obtained by the Council and held on record. It is disclosed only as a copy of those records and is not intended to provide a full, complete or entirely accurate assessment of the site. Accordingly, the Otago Regional Council is not in a position to warrant that the information is complete or without error and accepts no liability for any inaccuracy in, or omission from, this information. Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

HAIL Status	
Verified HAIL	Information has been provided confirming, more likely than not, that an activity or industry described in the HAIL is being or has been undertaken on the site.
Unverified HAIL	Information has been provided that suggests an activity or industry described in the HAIL is or has been undertaken on the site; however, this information has not been verified.
Verified non-HAIL – more likely than not	It has been established, more likely than not, that an activity or industry described in the HAIL has not been undertaken on the site at the time of listing.

Contamination Status	
Contaminated for <Context>	The site has been investigated and results demonstrate that there are hazardous substances in or on the land at the site that have, or are reasonably likely to have significant adverse effects on the environment. <Context> refers to the current or proposed site use and/or on/off-site ecological receptors.
Managed for <Context>	The site has been investigated and results demonstrate that there are hazardous substances present at the site that have the potential to pose risks to human health or the environment. However, those risks are considered managed for <context> because - The nature of the use of the site prevents human and/or ecological exposure to the hazard; and/or - The land has been altered in some way and/or restrictions have been placed on the way it used to prevent human and/or ecological exposure to the hazard.
Acceptable for <Context>	The site has been investigated and results demonstrate that there are hazardous substances present at the site, but assessment indicates that any adverse effects or risks to human health are considered to be so low as to be acceptable for <context>.
At or Below Background Concentrations	The site has been investigated or remediated. The investigation or post-remediation validation results confirm that there are no hazardous substances above local background concentrations. Local background concentrations are those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterize the site.
Partially investigated	The site has been partially investigated. Investigations have been conducted that – - Demonstrate there are hazardous substances present; however, there is insufficient information to quantify any adverse effects or risks to human health or the environment; or, - Do not adequately verify the presence or absence of contamination associated with all HAIL activities that have been undertaken on the site.
Not Investigated	The soils at the site have not been subject to investigation. Contamination may have occurred but should not be assumed to have occurred.
New Information	New information has been received. This information is currently being assessed prior to assigning a site status.

CATEGORY: Consents | LAST UPDATED DATE: 25/06/2019 | VIEWS: 2571

Consent Details: Bores

Specific information about Bore consents, such as Bore Tag Number, Maximum Rate, Depth, Diameter, Aquifer Source, etc.

Related Links

Current Bore Consents

What are you searching for?

Build your query

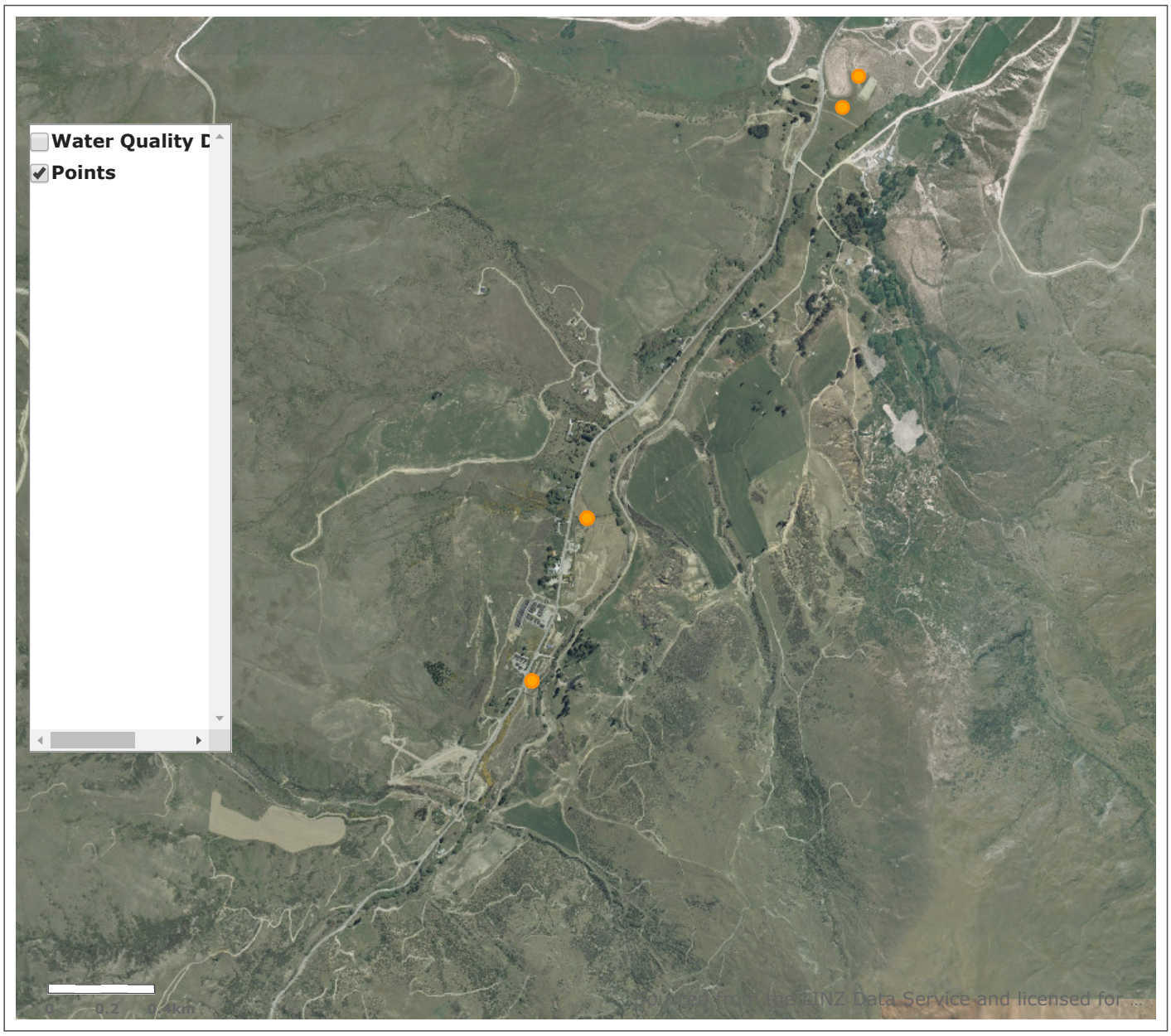
ConsentStatus (String) ▾ | is equal to ▾ | Current | AND ▾

Which columns do you want to see?

ALL SELECT

Results

The maximum download limit for CSV files is 20000. Please use the full query url in the data view below if results above this limit are found.



Geotechnical Report for Resource Consent

McDougall's Block

Lot 6 DP 344432 and Lot 1 DP 425263,
Curtis Road, Cardrona Valley

Report prepared for:

Roberts Family Trust

Report prepared by:

GeoSolve Ltd

Distribution:

Roberts Family Trust

Maestro Projects Ltd

GeoSolve Limited (File)

January 2020

GeoSolve Ref: 190098- Rev3

GEOTECHNICAL WATER RESOURCES PAVEMENTS

Table of Contents

1 Introduction

1.1 General

This report presents the results of a geotechnical investigation carried out by GeoSolve Ltd in order to assess natural hazard risk and provide geotechnical inputs for a proposed subdivision, McDougall's Block, consisting of 15 additional lots within Lot 6 DP 344432 and Lot 1 DP 425263, Cardrona Valley. An existing dwelling is present within Lot 6 DP 344432 and a previously consented building platform is present within Lot 1 DP 425263, which is labelled Lot 16 as part of this investigation.

This report is intended to supplement a resource consent application with the local council authority. A plan showing the proposed subdivision is detailed in Appendix A and photographs of the general areas where building platforms are proposed are shown below in photograph 1 and 2.

Photo 1. Site photo looking southwest across Lot 1 (building platform indicated by red arrow).

Photo 2. Site photo looking west across the main development area (Lots 2-15).

The geotechnical investigation was carried out for the Roberts Family Trust in accordance with GeoSolve Ltd.'s proposal dated 6 March 2019, which outlines the scope of work and conditions of engagement.

1.2 Proposed Development

It is proposed to create an additional 15 lots within the subject property (Lots 1 to 15 inclusive). Allocated building platforms within the lot boundaries have been provided in the scheme plan by GeoSolve.

Earthworks plans have yet to be provided to GeoSolve at this time, however it is expected that cut and fill earthworks will be required to establish the proposed accessways to the proposed building platforms, underground services trenches and cut-off diversion drains. Conceptual scheme plans have been supplied by Baxter Designs.

It should be noted that Lot 16 and the associated building platform on the proposed scheme plan has already been consented and therefore has not been assessed as part of this investigation.

The position of the proposed lots are outlined in Appendix A, Figures 1a and 1b.

2 Site Description

2.1 General

The subject property which the proposed lots are located on is legally described as Lot 6 DP 344432 and Lot 1 DP 425263, Curtis Road.

The sites are located within the Cardrona Valley approximately 500 m northwest of the Cardrona Township, as shown in Figure 1 below.

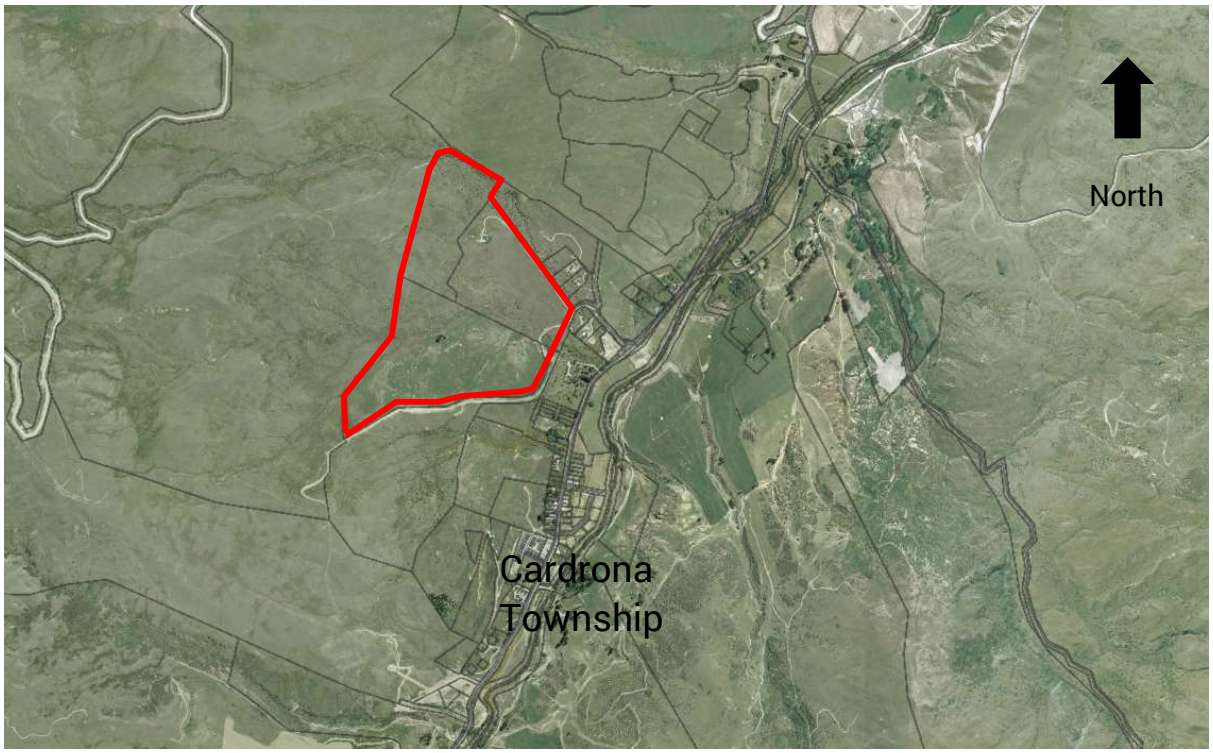


Figure 1. Site location (indicated by red outline) in relation to the Cardrona Township (Source: http://maps.qldc.govt.nz/qldcviewer/).

The subject property is bounded by farmland to the west, north and south, with residential properties bounding the property to the east and northeast.

Pringles Creek runs through the northern boundary of the site with Pongs Creek running through the centre of the site. An un-named creek runs in close proximity to the southern boundary of the site.

The areas of the proposed new building platforms are currently unused with ground cover across all sites comprising grass and tussock.

2.2 Topography and Surface Drainage

2.2.1 Lot 1

The Lot 1 building platform is located adjacent to the banks of Pongs Creek and comprises a central spur with surrounding undulating terrain. The building platform is offset approximately 2 m from the crest of the 20-25° south facing slope. The slope extends for approximately 5 m above the creek.

An overland flow path runs to the north of the building platform with Pongs Creek directly to the south.

No surface water or seepages were observed within the building platform area during site investigations.

2.2.2 Lots 2-15

Lots 2-15 occupy generally undulating and hummocky terrain that trends downslope towards the east at approximately 5 to 20°.

Lots 2-12 occupy an undulating fan surface. Lots 13-15 occupy a hummocky fan surface.

Pongs Creek runs directly to the north of Lots 7-11, 13 and 15 and is moderately incised adjacent to Lots 7-9 and 15, the creek is only shallowly incised adjacent to Lots 13 and 11.

Seepage was regularly observed across the area within the surficial topsoil, underlying softened fan alluvium, and within the more permeable (across the site) layers of the fan alluvium. Seepages/surface flows were observed in rapid response to rainfall following preferential paths on the undulating and hummocky fan surface.

3 Geotechnical Investigations

An engineering geological site inspection has been undertaken with confirmatory subsurface investigations including geomorphic mapping of the proposed building platforms and surrounding area. The following geotechnical investigations were completed on site between the 28th of May and the 7th of June 2019 for the purposes of this report:

- 16 test pits (TP1-16) which were advanced to a maximum depth of 3.5 m below ground level (bgl) to produce geological logs of the subsoils;
- 5 soakage tests (SP1-5) to assess suitability for stormwater and wastewater disposal to ground at the site, and;
- Geomorphological mapping of the proposed building platforms and surrounding area was undertaken by an engineering geologist to assess the landforms and natural hazards at the subject site.
- Aerial photography analysis (including stereoscopic pairs) to assess the natural hazards at the subject site.

Test pit and Scala Penetrometer locations and logs are contained in Appendix A and B respectively.

Soak pit locations and logs are contained in Appendix A and B respectively.

4 Subsurface Conditions

4.1 Geological Setting

The Cardrona Valley is underlain by regionally extensive Otago Schist bedrock which lies at depth beneath the valley floor. Over consolidated Manuherikia Group lake sediments overlie the schist and are overlain by Early Quaternary outwash gravels which outcrop extensively throughout the valley. Extensive post glacial alluvial fan deposits have developed off the bounding range fronts and overlie the older outwash gravels.

Debris landslides developed on the steep schist mountain slopes above the base of the valley. During post-glacial times the Cardrona River has entrenched into the valley floor.

Two trace paths of the active NW Cardrona Fault are inferred, from QLDC hazard maps, to pass through the site, or in close proximity to the site. Due to the long (est. 5,000-10,000 year) average return period for earthquakes on this fault, the seismic risk posed by this geological structure is considered relatively low.

The Alpine Fault, located approximately 80 km to the northwest, runs along the western foothills of the Southern Alps, and is likely to present a more significant seismic risk. There is a high probability that a major earthquake of Magnitude 8 or more will occur along the Alpine Fault within the next 50 years and such a rupture is likely to result in strong and prolonged ground shaking in the vicinity of Cardrona Valley.

A detailed fault hazard assessment for the subject site is described in Section 5.5 of this report.

4.2 Stratigraphy

Results from the test pitting indicate the sub-surface stratigraphy beneath the proposed lots varies across the site. The observed stratigraphy is summarised below:

- 0.15-0.4 m of **topsoil**, overlying;
- 0.2-0.55 m of **softened fan alluvium**, overlying;
- 0.6-2.9 m+ of **fan alluvium.**

Topsoil was observed at the surface of all TPs to a depth of between 0.15 and 0.4 m bgl. Topsoil comprises dark brown, organic SILT with rootlets.

Softened fan alluvium was observed to underlie topsoil in TPs 1-7, 10 ,12-14, 16 and SPs 1-4 and was observed to extend to between 0.4 and 0.8 m bgl. Softened fan alluvium was observed to comprise grey mottled orange/grey/brown soft to firm/loose silty SAND with trace rootlets, SILT with minor sand and trace rootlets, SILT and silty SAND with some gravel and boulders. The softened fan alluvium was regularly observed as moist to wet in condition, with the upper surface below the topsoil horizon often being wet.

Fan alluvium was observed to underlie the topsoil or softened fan alluvium in all TPs completed across the proposed development. Fan alluvium was observed to underlie the topsoil and softened fan alluvium at 0.15 to 0.8 m bgl. Fan alluvium comprises greyish brown to brownish grey/grey/light brown, loose to medium dense/firm to very stiff variable compositions of SILT, SAND and GRAVEL (see the geotechnical descriptions in Appendix B). Some to trace cobbles and boulders were observed throughout the fan alluvium unit.

Fan alluvium was observed to extend to the base of all test pits completed for the development.

4.3 Groundwater

Seepage was observed within TPs 4-8, 10, 11, 14 and 16 and within SPs 1 and 3 between the surface and 1.8 m bgl. Seepages were observed as very minor to moderate within the above test pits.

The surface of the site was generally wet underfoot and overland flow paths began running in quick response to rain indicating infiltration rates of the underlying soils are likely to be low.

Perched water tables may occur at the contact of the silty fan alluvium with overlying soils at times of sustained rainfall.

A spring flow (as marked on Figure 1b, Appendix A) was observed directly to the east of Lot 13 while onsite, the flow was aided by an overland flow path that intercepted Lot 14. The spring is inferred to occur where an impermeable fan alluvium horizon daylights at the ground surface.

The spring flow and overland flow path resultantly flowed directly through the proposed Lot 11 building platform as shown below in Figure 2.

Figure 2: Site view looking northeast across the southern extent of the Lot 11 proposed building platform. Spring/overland flow combined to pass through approximately the southeast corner of the platform.

The permanent groundwater table is expected to lie at moderate depth however spring flows and overland flow paths show moderate subterranean flows across the majority of Lots 2-15.

Two historic water races, the Cardrona Company water race and Walter Littles's water race, are located at the subject site and are understood to have been used for historic mining.

The locations of the water races are shown on Figure 1b, Appendix A. It is understood that these water races are not currently in use. If any water is being transported into the site

through the existing water races it is recommended that these are cut-off to inhibit additional water entering the site.

5 Hazard Assessment

5.1 Landslide

5.1.1 General

An area of inferred landslide activity, which is shown on the QLDC hazard maps, lies within the site boundary. This landslide is classed by QLDC as "areas of fine-grained soils susceptible to sliding". This is sourced from IGNS QMAP 1:50,000 Compilation Sheets. This landslide feature is shown to affect Lots 2 to 16 inclusive, as shown on Figure 1b, Appendix A.

We understand from GNS that the mapping of the landslide feature at the site is based on aerial photography assessment and is a "broad-brush interpretation which can be improved upon by site specific investigation".

GNS indicated that Royden Thomson (Geologist) conducted the mapping works.
Mr Thomson commented that this mapping was a broad-brush assessment using 1;50,000 aerial photography and not verified from field checking.

As mentioned above, Lot 16 and the associated building platform on the proposed scheme plan have already been granted resource consent. The geological appraisal of the proposed building platform was conducted by Royden Thompson, report dated 29 October 2009 (attached in Appendix E).

Mr Thompson identified that the Lot 16 building platform was located on a spur feature likely to comprise highly weathered schist at shallow depths.

Mr Thompson also provided refinement to the extent of the landslide feature (originally identified using aerial mapping), shown on the October 2009 geological appraisal report appended site plan (Appendix E), which includes Lots 13-15 and no other lots. We understand this refinement was assessed by the extent of hummocky terrain identified during his visual appraisal of the building platform for Lot 16. It should be noted that no subsurface investigations were undertaken to further verify this refinement or determine the nature and extent of the landslide feature.

5.1.2 Geomorphological Observations

Detailed geomorphological field mapping and an aerial photography analysis (including stereoscopic pairs) has been conducted as part of the hazard assessment for the subject site.

The subject site is generally sited on a historical alluvial fan feature that has since been incised by Little Meg, Pongs and Pringles Creeks.

Lots 2 to 16 inclusive are locally located on a fan surface that has been incised by an unknown creek to the south and Pongs Creek to the north, within the historical fan feature.

The ground surface on the fan surface is typically undulating with isolated areas of hummocky terrain on the upslope (western) part of the fan. We understand that the ground surface is likely to have been modified by historic farming practices. The hummocky terrain, as shown in Figure 1b, Appendix A, is shown to affect the building platforms of

proposed Lots 13-15. These findings are generally in agreement with the visual appraisal conducted by Royden Thompson for the October 2009 report.

It should be noted that significant hummocky terrain, seepages and landslide scraps (fresh and historical) are present within the catchment associated with Pongs Creek, indicating deep seated movement and instability located upslope (west) of the subject site.

A spur feature is located adjacent to the western site boundary. The spur feature is understood to comprise highly weathered schist at shallow depths. The approximate location and extent of the spur feature is shown on Figure 1b, Appendix A.

It is inferred that the spur feature separates the subject site from the deep-seated movement observed in the upslope catchment of Pongs Creek. The observed hummocky terrain in the southern part of the site is understood to be the result of confined shallow seated slope movement/instability of the slopes within the site boundary.

Additionally, isolated small volume shallow seated slope failures were also identified on steep slopes within the site, as shown in Figure 1b, Appendix A. One of these features is located in close proximity to the building platform of Lot 1 and further information regarding the slope stability of Lot 1 is discussed in Section 6.8 of this report.

A plan showing the main geomorphological observations is attached in Figure 1b, Appendix A.

5.1.3 Geotechnical Investigation

Subsurface investigations have been undertaken to determine the nature and extent of the inferred landslide feature at the site, which is shown on the QLDC hazard maps.

As discussed in Section 5.1.2 of this report, hummocky ground, inferred to be a potential landslide landform was observed to affect the building platforms of Lots 13-15.

The results of the geotechnical investigation concluded that softened topsoil and fan alluvium was observed across the site (0-0.8 m bgl) and that this softened material is susceptible to shallow seated movement when saturated.

The softened fan alluvium was regularly observed as moist to wet in condition. It is understood that saturation of this material could trigger shallow seated movement, due to a reduction in effective stress of the material caused by excess porewater pressure. It is likely that this may have occurred in areas of observed hummocky landforms, particularly at locations with steeper slope profiles.

The softened fan alluvium soils were observed to a maximum depth of 0.8 m (bgl) and were not differentiated by the presence of significantly hummocky ground on the ground surface at the subject site.

It is inferred that slope movement is more pronounced on steeper slopes, areas with the underlying presence of impermeable fan alluvium and at locations of higher seepage.

5.2 Alluvial Fan

5.2.1 Debris Flow

According to QLDC hazard mapping, Lots 1, 7, 8, 9 and 11 are mapped as an active fan in the ORC alluvial fan mapping, as shown on Figure 1b, Appendix A.

The building platforms were generally lacking any features that would suggest recent alluvial fan activity. In general, significant topsoil development indicated a substantial passage of time since alluvial activity. This suggests the fan deposits are historic and their accumulation is not an active or recent process.

It should be noted that the building platforms located on Lots 7, 8, 9 and 11 are elevated above the mapped alluvial fan hazard and appear to be sufficiently elevated from the valley floor to mitigate any potential alluvial fan hazard.

It should be noted that the building platform for Lot 1 is located adjacent to the incised river channel of Pongs Creek. The building platform appear to be sufficiently elevated from the river channel to mitigate any potential debris flow alluvial fan hazard.

Based on the above, the risk of alluvial fan activity affecting Lots 1, 7, 8, 9 and 11 are considered to be very low and unlikely to affect a future development and no mitigation measures or further assessment is required for the proposed development with respect to this hazard.

5.2.2 Flooding

There is a potential risk for Pongs Creek to avulse upslope of Lot 11 and 13. In order to mitigate the resulting flood hazard, minimum floor levels will be established for buildings on these lots. It is expected that finished floor levels above the proposed ground surface by up to 750mm should provide adequate protection.

It is understood that the existing ground surface will be modified in the course of proposed landscaping earthworks, stormwater and roading works at the site. Proposed landscape bunds may have a secondary effect of providing additional comfort to the flood protection of these lots.

A flood risk assessment report to confirm the recommended minimum floor levels should be conducted by a suitable qualified professional for the affected lots (Lot 13 and 11) with respect to flood hazard, during the detailed design stage of the project and following finalisation of the proposed earthworks.

5.3 Liquefaction

The location of the building platform for Lot 1 is identified as being in an area which is 'Possibly Susceptible' to liquefaction (Opus 2002 report). This assessment is based on a broad scale review of the geology and geomorphology and is not based on a specific site assessment.

It is understood that Lot 1 has been identified within the above liquefaction classification due to the sites proximal distance to the river channels at the site. It is assumed that subsurface conditions comprising fine grained sandy/silty soils with a shallow groundwater table have been inferred for the QLDC liquefaction hazard assessment.

A site wide liquefaction risk review has been conducted for the purposes of this report.

The following comments are provided with respect to liquefaction.

- Discrete perched seepages were encountered in TP 4, however all other test pits in close proximity to the Lot 1 building platform were dry. The regional groundwater table was not intercepted.
- Lot 1 is elevated above the incised channel of Pringles Creek.
- Pongs Creek comprises low flow volumes and a perched water table which does not extend laterally in to the proposed building platforms.
- Minor seepages have been recorded across the site, however, are generally confined to the overland flow paths and surface softened fan alluvium soils and was not observed to penetrate the underlying alluvial fan soil.
- The regional groundwater level is anticipated to lie at moderate depth below the site, below the extent of the test pit investigations, exceeding 3.5 m below the existing ground surface.
- Saturation of the alluvial fan unit is therefore considered unlikely.
- Medium dense/stiff to very stiff soils were intercepted in the test pit locations and the building platform locations below 0.8 m depth and are generally elevated from the perched watercourses at the site.
- A non-liquefiable crust is present below the proposed building platforms.

Based on the above observations the risk of liquefaction is considered low at the site. The low liquefaction risk is due to the combination of a static water table located at depth and medium dense/stiff to very stiff deposits associated with the alluvial fan deposits. No special provisions are considered necessary with respect to this hazard and building design, however foundation bearing capacity will be assessed for all building platforms at detailed design stage.

5.4 Fault Hazard

5.4.1 General

Two trace paths of the active NW Cardrona Fault are inferred, from QLDC hazard maps, to pass through the site, or in close proximity to the site.

For the purposes of this report the two fault traces have been labelled western fault trace and eastern fault trace.

The western fault trace runs south to north, adjacent to the western boundary of the site and the trace is mapped to terminate soon after entering the site in the north western part of the site.

The eastern fault trace runs south to north approximately through the middle of the subject site. The fault trace continues beyond the southern and northern site boundaries.

The approximate location of the NW Cardrona Fault system (including the western and eastern fault traces, named for the purposes of this report) is shown on Figure 1b, Appendix A.

5.4.2 Western Fault Trace

The western trace of the NW Cardrona Fault is described as “accurate” on the QLDC hazard maps and the inferred fault trace can be seen adjacent to the Cardrona Skifield access

road, as shown in Figure 3 below, located approximately 400 m to the north of the site boundary.

The fault trace is inferred to continue in a southerly direction and enters the site approximately 280 m south of the northwest corner boundary. The fault trace can be faintly observed on the elevated fan terrace at this location.

The fault trace is not observed within the floor of Pringles Creek and is projected between the fault trace in Figure 3 and the elevated fan terrace at the subject site.

Examination of aerial photography shows the fault trace to terminate within the south facing landslide area located to the north of Pongs Creek. This is in agreement with the location of the mapped feature on the QLDC planning maps.

Figure 3. "View towards the west Cardrona Valley. The Cardrona Skifield access road runs lower right to upper left across the ridge. A visible, active trace of the NW Cardrona Fault is highlighted between the two arrows" (Source: Seismic Hazard in the Queenstown Lakes District, August 2015).

Geosolve have completed an assessment of the risk posed by the western fault trace of NW Cardona Fault using guidelines provided by the Ministry of Environment for developing land close to active faults. For the assessment the western fault trace of the NW Cardrona Fault has been categorised with a return period of 5,000 to 10,000 years (GNS Science website, Active Faults Database), and the location is assessed as **well defined**, as indicated on published geological mapping.

Following the Ministry of the Environment guidelines provided in Section 11 "Taking a Risk-Based Approach to Resource Consents", building importance category structures 1, 2a and 2b, are a permitted activity. NZS 3604 dwelling structures fall under category 2a and are therefore considered to be a permitted activity in close proximity to the western fault trace of the NW Cardrona Fault System.

The mapped western fault trace is in excess of 400 m from any proposed building platform. This set back from the western fault trace is considered appropriate to mitigate the risk of any surface fault rupture expressed by this fault trace. The set back is in accordance with the recommended minimum buffer (fault avoidance zone) of 20 metres either side of a known fault trace (well defined fault), as outlined in the Ministry of the Environment guidelines.

5.4.3 Eastern Fault Trace

The eastern trace of the NW Cardrona Fault is described as "concealed" on the QLDC hazard maps. The location of the eastern fault trace was not identified during the examination of aerial photography, detailed field mapping and test pitting at the subject site. The eastern fault trace is inferred to be concealed by overlying fan alluvium. The fan alluvium at the subject site is understood to be early to middle Quaternary age.

For the assessment the eastern fault trace of the NW Cardrona Fault has been categorised with a return period of 5,000 to 10,000 years (GNS Science website, Active Faults Database), and the location is assessed as **uncertain**, as indicated on published geological mapping and determined from the works conducted herein.

Following the Ministry of the Environment guidelines provided in Section 11 "Taking a Risk-Based Approach to Resource Consents", building importance category structures 1, 2a and 2b are a permitted activity. NZS 3604 dwelling structures fall under category 2a and are therefore considered to be a permitted activity in close proximity to the eastern fault trace of the NW Cardrona Fault System.

It should be noted that the eastern fault trace of the NW Cardrona Fault system continues north from the subject site into Mt Cardrona Station, located adjacent to the northern boundary of the subject site. No evidence of an active fault trace was identified from this fault trace that could be used to project the location of this fault to the subject site and the fault trace is also understood to be concealed by the fan alluvium material at this location.

It is our opinion that the location of the eastern fault trace is uncertain and no accurate fault avoidance zone can be provided for this fault trace. The lack of surficial expression of this feature on the overlying Quaternary fan alluvium material at the subject site illustrates the long return period on this fault trace.

A more significant seismic risk exists in this district from potentially strong ground shaking, likely to be associated with a rupture of the Alpine Fault, located along the West Coast of the South Island. There is a high probability that an earthquake with an expected magnitude of over 8 will occur along the Alpine Fault within the next 50 years, which will subject the site area to strong, prolonged ground shaking.

6 Engineering Considerations

6.1 General

The recommendations and opinions contained in this report are based upon ground investigation data and mapping obtained at discrete locations on site and historical information held on the GeoSolve database. The nature and continuity of subsoil conditions away from the investigation locations is inferred and cannot be guaranteed.

6.2 Geotechnical Parameters

Table 1 provides a summary of the recommended geotechnical design parameters for the soils expected to be encountered during construction of the proposed new building platforms.

Table 1 - Recommended Geotechnical Design Parameters

Unit	Thickness (m)	Bulk Density γ (kN/m^3)	Effective Cohesion c´ (kPa)	Effective Friction ϕ´ (deg)	Elastic Modulus E (kPa)	Poissons Ratio ν
Topsoil (organic SILT)	0.15-0.4	To be removed beneath building footprints and the crest of cut slopes				
Softened Fan Alluvium (soft to firm/loose, silty SAND and SILT with minor sand and trace rootlets)	0.0-0.55	To be removed beneath building footprints and the crest of cut slopes				
Fan Alluvium (loose to medium dense/firm to very stiff, SILT, SAND and GRAVEL compositions – see descriptions in Appendix B)	0.15-2.9+	18	0	Sandy GRAVEL to gravelly SAND 33-35 SILT 30-31 SAND 31-32	5,000 - 20,000	0.3

6.3 Site Preparation

During earthworks operations all topsoil, softened fan alluvium, organic matter, and other unsuitable soils should be removed from the construction areas in accordance with the recommendations of NZS 4431:1989.

Robust, shallow graded sediment control measures should be instigated during construction where rainwater and drainage run-off across exposed soils is anticipated. If slope gradients in excess of 4% are proposed in erosive soils then the construction and lining of drainage channels is recommended, e.g. with geotextile and suitably graded rock, or similarly effective armouring.

Exposure to the elements should be limited for all soils and covering the soils with polythene sheeting will reduce degradation due to wind, rain and surface run-off. Excavations in soils should be left proud of the finished subgrade level by 200 to 300 mm if

a delay prior to construction is expected. The final cut to grade should be performed immediately prior to foundation construction.

Water should not be allowed to pond or collect near or under a foundation slab. Positive grading of the subgrade should be undertaken to prevent water ingress or ponding.

All fill that is utilised as bearing for foundations should be placed and compacted in accordance with the recommendations of NZS 4431:1989 and certification provided to that effect.

We recommend topsoil stripping and subsequent earthworks be undertaken only when a suitable interval of fair weather is expected, or during the earthworks construction season.

6.4 Excavations

Excavations are expected to be undertaken within topsoil, softened fan alluvium and fan alluvium.

Recommendations for temporary and permanent batter slope angles are described below in Table 2. Slopes that are required to be steeper than those described below should be structurally retained or subject to specific geotechnical design.

All slopes should be periodically monitored during construction for signs of instability and excessive erosion, and, where necessary, corrective measures should be implemented to the satisfaction of a suitably qualified Chartered Professional Engineer.

Minor seepages and overland flows were observed across the site during investigations. Batters excavated within wet soils should be cut as per the recommendations of Table 2, it is also recommended that a geotechnical engineer or engineering geologist should inspect any seepage, spring flow or under-runners where encountered during construction.

6.4.1 Cut Slopes in Soil Materials

Table 2 summarises the recommended batter angles for temporary and permanent slopes up to 3 m high, which are formed in the soil materials identified at the site.

Table 2 Recommended maximum batter angles for cut slopes up to 3 m high in site soils.

Material Type	Recommended Maximum Batter Angles for Temporary Cut Slopes Formed in Soil (horizontal to vertical)		Recommended Maximum Batter Angles for Permanent Cut Slopes Formed in Soil – dry ground only (horizontal to vertical)
	Dry Ground	Wet Ground	
Topsoil and Softened Fan Alluvium	2H: 1V	3H: 1V	3H: 1V
Fan Alluvium	1.5H: 1V	3H: 1V	2.5H: 1V

The temporary batter slopes in wet soils are provisional only and should be inspected on a case by case basis. **Note permanent cut slopes are in dry soils only.**

6.5 Engineered Fill and Engineered Fill Slopes

All fill should be placed and compacted in accordance with the recommendations of NZS4431: 1989 and Queenstown Lakes District Council Standards. All cut and fill earthworks should be inspected and tested as appropriate during construction and certified by a Chartered Professional Engineer.

The fan alluvium could be used as engineered fill on site. The topsoil and softened fan alluvium are not suitable for reuse as a fill source, however can be used for re-topsoiling and in landscaping areas. Due to the changeable grain size of the natural soil materials on site, a range of compaction reference tests will be required. Maximum density and optimum moisture content will vary. Additionally, due to the high proportion of fine-grained soil material observed within the site there should be a contingency in the earthworks programme and budget to strip wet and weaving layers and allow drying time following rainfall. Compaction of the fill sources at lab tested optimum moisture content is critical for these soil types. Cobbles and boulders over 100 mm in size will need to be screened from fill sources. Boulders up to 1.1 m in diameter were observed during the site investigations. Due to the fine-grained soil materials it is recommended that earthfills are completed during warmer months.

All un-retained fill slopes which are less than 3 m high should be constructed with a batter slope angle of 2.0H: 1.0V (horizontal to vertical) or flatter and be benched into sloping ground.

Reinforced earth slopes can be considered if batters need to be steeper than 2H:1V.

6.6 Ground Retention

Earthworks plans are yet to finalised for the site and therefore the use of retaining as part of the subdivision construction is yet to be confirmed. All retaining walls should be designed by a Chartered Professional Engineer using the geotechnical parameters recommended in Table 1 of this report. Due allowance should be made during the detailed design of all retaining walls for forces such as surcharge due to the sloping ground surface behind the retaining walls, groundwater, seismic and traffic loads.

All temporary slopes for retaining wall construction should be battered in accordance with the recommendations outlined in Table 2 of this report. Where these batter slopes cannot be achieved temporary retaining will be required.

Groundwater seepage was regularly observed during investigations, infiltration of surface water behind retention structures, in particular as a result of heavy or prolonged rainfall, can occur. To ensure potential water seepage or flows are properly controlled behind retaining walls, the following recommendations are provided:

- A minimum 0.3 m width of durable free draining granular material should be placed behind all retaining structures;
- A heavy duty non-woven geotextile cloth, such as Bidim A14, should be installed between the natural ground surface and the free draining granular material to prevent siltation and blockage of the drainage media;
- A heavy-duty (TNZ F/2 Class 500) perforated pipe should be installed within the drainage material at the base of all retaining structures to minimise the risk of

excessive groundwater pressures developing. This drainage pipe should be connected to the permanent piped storm water system, and;

- Comprehensive waterproofing measures should be provided to the back face of all retaining walls forming changes in floor level within the dwelling to remove groundwater seepage into the finished buildings.

It is recommended that the retaining wall excavation batters are inspected by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist.

6.7 Groundwater Issues

Minor groundwater and surficial seepages were regularly observed across the proposed subdivision during investigations, it is recommended that these are diverted away from each of the building platforms with a set of cut-off diversion drains. The cut-off drains will be located and designed at the detailed design stage.

The permanent groundwater table is expected to lie at depth below the site however a moderate to strong seepage was observed in TP10 (Lot 13) at 1.1 m depth, the building platform has been moved away from this area, so excavations are unlikely here.

It is important that GeoSolve be contacted should there be any seepage, spring flow or underrunners encountered during construction.

6.8 Slope Stability

The proposed building platform within Lot 1 occupies a ridge that slopes moderately towards Pongs Creek. The slope is approximately 5 m high with a current angle of between 20 and 25 degrees. The stability of the slope has been analysed using the software programme Slope/W and the impact on the building platform assessed. The following slope stability cases have been analysed:

- Static Case – No Seismic Loading
- Serviceability Limit State (SLS) – significant earthquake generally expected to occur during the lifetime of the building (equivalent to a 1 in 25 year event). The building should be designed such that there is no structural damage during a seismic event of this magnitude, and;
- Ultimate Limit State (ULS) – Major regional earthquake (equivalent to a 1 in 500 year event). The building should be designed to remain standing and prevent loss of life following an event of this magnitude.

Seismic loading for analysis purposes has been estimated in accordance with the NZTA Bridge Manual. The Slope/W analysis results are provided in Table 3 below.

Table 3: Slope/W analysis results for the proposed Lot 1 building platform

Stability Case	Target Factors of Safety	Result
Static	> 1.5	1.56
SLS	> 1.2	1.24
ULS	No Target. Magnitude of ground displacements to be estimated.	5-15 mm

The results indicate the stability of the slope only marginally meets the requirements of the building code with respect to the static and SLS cases.

It is recommended that the slope stability of the proposed building platform is reassessed at detailed design stage following final building footprint positioning to confirm if specific design or setback from the crest is required. It is also recommended that a specific survey is undertaken to confirm the existing ground profile with more accuracy as compared to the LiDar data currently used for the assessment.

6.9 Shallow Foundations

6.9.1 General

Topsoil and softened fan alluvium observed to extend to between 0.15 and 0.8 m bgl will not provide adequate support for future building foundations and will need to be removed from the entire building footprint.

Footings or waffle raft foundations are expected to upon predominately mixed sand, silt and gravel fan alluvium for all building platforms. As the upper fan alluvium varies in thickness, composition and relative density it is considered available bearing capacity within the unit is likely to be in the order of half to two thirds of NZS 3604 “ground ground” bearing capacity.

Greater bearing capacity may be available within the predominate gravel subsoil however this is expected only over a minority of the proposed building platforms and was typically observed in thin layers or at a depth below likely foundation levels based on existing ground levels. Granular engineered fill, overlying fan alluvium can be used to re-achieve ground levels following removal of topsoil and softened fan alluvium. The engineered fill gravel raft can include a drainage blanket if required.

To minimise the effects of freeze-thaw cycles, all shallow foundations in soils should be founded a minimum of 0.4 m below the adjacent finished ground surface or placed on a gravel raft of a minimum of 400 mm thickness.

It is recommended that foundation bearing capacity, the recommended gravel raft and subsoil drainage should be specifically designed on each building platform at detailed design stage when plans for each dwelling are developed.

6.9.2 Additional Testing at Detailed Design

It is recommended that a site-specific investigation is undertaken at the building consent stage for each of the proposed dwellings, once plans are developed, to confirm applicable soil bearing capacities and geotechnical soil parameters. Investigations should comprise a minimum of four test pits at the four corners of the proposed building platform.

6.9.3 Foundation Inspections During Construction

It is recommended the foundation subgrade be inspected during construction/platform earthworks by a suitably qualified and experienced geotechnical practitioner to confirm the conditions are in accordance with the assumptions and recommendations provided in this report and future detailed foundation investigation and design.

6.10 Stormwater & Overland Flow Paths

Numerous small gully overland flow path features (shown on Figures 1b, Appendix A) are present within, or adjacent to, the proposed lot areas. These small gullies will act as overland flow paths for surface storm water runoff.

Sufficient stormwater drainage of the site is required before construction can begin in any areas in close proximity to the indicative overland flow paths.

A stormwater drainage design is recommended at detailed design stage.

All sources of slope saturation should be eliminated by cut-off drains, swale drains and bunds and redirected around building platforms and access roads.

Lot 14 has been relocated away from an overland flow path (see Figure 1a and 1b, Appendix A).

6.11 Recommended Landslide Hazard Mitigation

6.11.1 General

An area of inferred landslide activity, which is shown on the QLDC hazard maps, lies within the site boundary. Lots 2-15 are within the landslide area defined as an area of fine-grained soils susceptible to sliding.

As discussed in Section 5.1 of this report, the results of the geotechnical investigation concluded that softened fan alluvium was observed across the site and that this softened material is susceptible to shallow seated movement when saturated.

Development of the site will require effective drainage of the slopes. This remediation can be achieved using conventional engineering techniques comprising slope runoff diversion drains and counterfort drains. It is recommended that a set of cut-off diversion drains are constructed upslope of each set of proposed building platforms.

No storm or waste water discharge is recommended upslope of the hydraulic gradient of any proposed building platform.

The extent of the deep-seated landslide features appears to be limited to the upslope catchment of Pongs Creek and are unlikely to encroach into the area proposed for development reported herein.

In order to further mitigate the surficial soils, it is recommended to construct foundations below the softened/wet topsoil and fan alluvium material and on the competent underlying fan alluvium material, up to approximately 0.8 m below the existing ground surface.

The finished subgrade should be inspected by a geotechnical practitioner to ensure that no unstable features are exposed.

6.11.2 Lot 13

It should be noted that significant seepage of the surficial soils was identified at the location of Lot 13, increasing the potential for slippage of the surficial soils at this location. Remedial drainage solutions are available to reduce this risk for development at this location, comprising slope runoff diversion drains and counterfort drains. To provide a more robust

solution to the potential for slippage of the surficial soils, and avulsion of Pongs Creek, it is recommended that the building platform of Lot 13 is relocated upslope (to the northwest). This building platform shift is now reflected on Figure 1a and 1b, Appendix A.

6.11.3 Lots 13-15

As discussed in Section 5.1.2 of this report, hummocky ground, inferred to be a potential landslide landform was observed to affect the building platforms of Lots 13-15.

The softened fan alluvium was regularly observed as moist to wet in condition. Saturation of this material could trigger shallow seated movement.

To mitigate any potential slope movement for the proposed building platforms at Lots 13-15, it is recommended that an engineered fill gravel raft, with in-built drainage, can be constructed to re-achieve site levels following the removal of unsuitable soils (topsoil and softened fan alluvium).

For further shallow foundations recommendations refer to Section 6.9 of this report.

6.12 Site Subsoil Category

For detailed design purposes, it is recommended the magnitude of seismic acceleration be estimated in accordance with the recommendations provided in NZS 1170.5:2004.

The building platform sites are Class D (deep soil site) in accordance with NZS 1170.5:2004 seismic provisions.

6.13 QLDC Land Development and Subdivision Code of Practice

Section 2.4.4 of the QLDC Land Development and Subdivision Code of Practice (QLDC CoP) requires the developer of any subdivision to appoint a geo-professional to carry out the following functions from the planning to construction phases of the subdivision:

a) Check regional and district plans, records, and requirements prior to commencement of geotechnical assessment;

b) Prior to the detailed planning of any development, to undertake a site inspection and such investigations of subsurface conditions as may be required, and to identify geotechnical hazards affecting the land, including any special conditions that may affect the design of any pipelines, underground structures, or other utility services;

c) Before construction commences, to review the drawings and specifications defining any earthworks or other construction and to submit a written report to the TA on the foundation and stability aspects of the project (if required);

d) Before and during construction, to determine the extent of further geo-professional services required (including geological investigation);

e) Any work necessary to manage the risk of geotechnical instability during the construction process;

f) Before and during construction, to determine the methods, location, and frequency of construction control tests to be carried out, determine the reliability of the

testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work;

g) During construction, to undertake regular inspection consistent with the extent and geotechnical issues associated with the project;

h) On completion, to submit a written report (i.e. Geotechnical Completion Report) to the Territorial Authority (TA) attesting to the compliance of the earthworks with the specifications and to the suitability of the development for its proposed use including natural ground within the development area. Where NZS 4431 is applicable, the reporting requirements of that Standard shall be used as a minimum requirement.

This resource consent level report can be considered to have completed items a) and b) from the above list. Once resource consent for the subdivision has been granted a geo-professional will need to be appointed by the developer to review the earthworks drawings and specifications prior to finalising the documentation for tendering and/or construction, and to oversee the construction phase of the project including certification of fill and provide a Geotechnical Completion Report (GCR) and Schedule 2A in accordance with the QLDC CoP.

The GCR and Schedule 2A should detail the results of site observations, testing and monitoring during earthworks construction, confirm the stability of the finished earthworks, and identify any specific geotechnical design requirements that must be addressed in order to construct a building on site. Any identified specific design requirements will then be registered on the subject lots' 'certificate of title' and will need to be addressed during the building consent process.

The geo-professional completing the GCR and Schedule 2A which includes the certification of fill should in all cases be engaged by the developer not the contractor. It is also advisable that the geo-professional review the earthworks contract to assist in managing the developer's risk and ensuring that the contract is clear with respect to geotechnical risks and responsibilities during construction.

The use of this report and any of its findings or recommendations as part of the GCR and Schedule 2A may only be used with our prior review and written agreement.

7 Stormwater and Wastewater Infiltration

7.1 General

It is understood stormwater and wastewater disposal is proposed to be targeted within each individual lot within the proposed subdivision.

The sites geology consists of topsoil overlying fan alluvium to the depth of all completed test pits. The fan alluvium is of a varying composition of sand, silt and gravel however generally includes silt as part of each unit and therefore is of relatively low permeability.

No areas were identified as part of investigations that would be significantly more permeable than the areas tested onsite.

7.2 Infiltration Testing

Soakage pit permeability testing was carried out within the observed site soils (fan alluvium) at five field locations - see Figure 1a, Appendix A for test locations.

Soakage testing was undertaken at between 1.1 and 2.0 m bgl in soak pit test pits (SPs) 1-5. This was performed by introducing water from a water container until the soak pit reached a set depth. The inflow was then ceased and the time it took for the water level to drop was recorded (falling-head test). Soak pits were typically excavated by shovel at the bottom of the machine excavated pit to create a small soak pit. Soakage testing was unable to be completed on a larger scale (ie. with water introduced from a water cart) as no access to each of the sites was available for a truck.

The results were then analysed to determine indicative soakage and infiltration rates, which are presented in Appendix C and summarised in Figure 4 and Table 4 below.

Note that seepages which developed during the test duration exceeded soakage in SPs 1 and 3, and a negative net soakage was observed.

Table 4: Hydraulic Conductivity Values from onsite soakage testing.

Location		Test method	Infiltration rate (m/s)**	Soakage Rate (L/m2/min)**
Lots 10-15	SP1	Open pit soakage test	-*	-*
Lots 7-9	SP2		3×10^{-6}	0.3
Lots 2-6	SP3		-*	-*
Lot 1	SP4		2.5×10^{-6}	0.15
Northern Area	SP5		1.5×10^{-5}	0.9
Preliminary Long-Term Design Values (not including 0.5 reduction factor)			**1.7×10^{-6}**	**0.1**
*Negative net infiltration observed within SPs 1 and 3 during testing **All values presented in the table are preliminary and unfactored				

As soakage tests were undertaken as small hand dug pits within machine excavated pits of maximum dimensions of 0.4x0.35 m (length by width) it is recommended that additional testing is completed. Tests were not able to be completed at a larger scale at this time as access was not available to the test locations with a water cart. It is recommended that

soakage rates should be assessed with larger scale longer duration tests to confirm soakage rates when access is available with a water cart at the site.

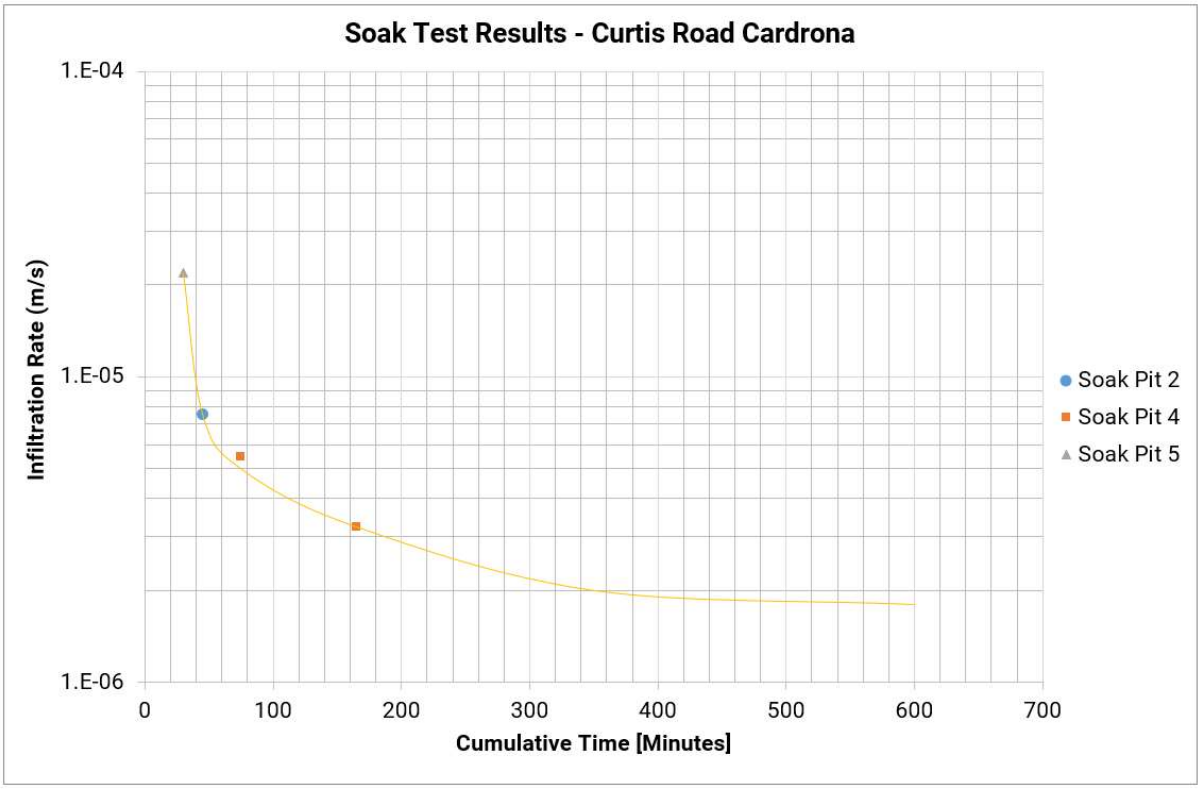


Figure 4. Measured vertical infiltration rate graphed against test duration with the estimated long-term trend shown in yellow.

7.3 Infiltration design

Representative soakage testing was undertaken within each area of the proposed subdivision and recorded generally lower than desirable soakage results. Soakage testing was targeted into the most suitable layer identified in surrounding TPs as detailed below in Table 5.

Table 5: Targeted infiltration material and overlying stratigraphy for completed soakage testing

Location		Infiltration Material	Test Depth (m)	Overlying materials
Lots 10-15	SP1	SILT with trace fine gravel	1.1	0-0.2 Topsoil 0.2-0.5 silty SAND 0.5-0.9 silty sandy GRAVEL 0.9-1.1 SILT with trace fine gravel
Lots 7-9	SP2	SAND with some silt	2	0-0.2 Topsoil 0.2-0.7 SILT 0.7-1.6 SILT with minor sand 1.6-1.8 silty SAND with some gravel 1.8-2.0 SAND with some silt

Lots 2-6	SP3	SILT with trace fine gravel	1.3	0-0.25 Topsoil 0.25-0.6 SILT 0.6-0.9 SILT with minor sand 0.9-1.1 silty gravelly SAND 1.1-1.3 SILT with trace fine gravel
Lot 1	SP4	Silty GRAVEL with minor sand, cobbles and boulders	1.4	0-0.2 Topsoil 0.2-0.5 SILT 0.5-1.35 SILT with minor sand 1.35-1.4 silty GRAVEL with minor sand, cobbles and boulders
Northern Area	SP5	Silty gravelly SAND with some cobbles and boulders	1.3	0-0.2 Topsoil 0.2-0.7 silty SAND with some gravel and boulders 0.7-1.1 silty SAND with some boulders 1.1-2.1 silty gravelly SAND with some cobbles and boulders

Preliminary infiltration rates are provided above in Table 4 within the tested substrate. Testing indicates a relatively consistent trendline across SPs 2, 4 and 5, with an estimated long-term infiltration rate of $1.7x10^{-6}$ (which equates to a soakage rate of 0.1 L/m^2/min). It is recommended a 0.5 reduction factor should be applied to the above value to account for potential loss of soakage performance over time. The infiltration rates are less than desirable, suggesting that any on-site stormwater/wastewater systems should be designed to favour storage-based solutions rather than high soakage to ground.

We recommend provision for routine inspection and maintenance be included in each systems design, and a safe overland flowpath be identified for the stormwater system to outlet in a super design storm.

Consideration of three-dimensional groundwater effects are recommended for large stormwater volumes disposed over large areas, which may be the case here. Further detailed modelling using finite-element or finite-difference methods could assist in this regard and should enable an optimised stormwater disposal system to be developed.

As discussed in Section 6.11, it is concluded that surficial sluffing at the site has been caused by regular minor seepages, saturating and softening the predominately fine-grained upper site soils. Due to the regular surficial sluffing of the topsoil and fan alluvium (observed to a max depth of 0.8 m bgl), it is recommended that soakage is targeted below at least 1.0 m below the existing surface to ensure the surficial soils aren't further saturated and softened. Note that more permeable soils were typically observed to underlie the soils within the upper 1 m within test pits. Saturation of upper soils should not be increased by stormwater/wastewater infiltration above the proposed building platforms, it is recommended that soakage is targeted downslope of each building platform and channelled away using a diversion drain (if required) to ensure further saturation of soils underlying any building platform does not occur.

It is further recommended that any infiltration storm or waste water design be reviewed by a Geotechnical Engineer or Engineering Geologist to assess any slope stability implications, associated with the existing landslide risk potential at the subject site.

8 Hazards/Neighbouring Structures

Natural Hazards: Known seismic hazards affecting the development are detailed in Section 4.1 and appropriate allowance should be made for seismic loading during detailed design of any proposed building, retaining walls and foundations.

The QLDC Hazards Database indicates that the proposed Lots 2-15 are within a landslide area defined an area of fine-grained soils susceptible to sliding. The results of the geotechnical investigation concluded that softened topsoil and fan alluvium (between 0-0.8 m bgl) was observed across the site and that this softened material is susceptible to shallow seated movement if saturated. It is recommended that a set of cut-off diversion drains are designed as part of the stormwater detailed design and constructed upslope of each set of proposed building platforms and foundations are constructed below any topsoil and softened fan alluvium to mitigate this hazard.

Alluvial fan hazard present on the QLDC hazard mapping is considered in Section 5.2.

There is a potential risk for Pongs Creek to avulse upslope of Lot 11 and 13. In order to mitigate the resulting flood hazard, minimum floor levels will be established for buildings on these lots. It is expected that finished floor levels above the proposed ground surface by up to 750mm should provide adequate protection. A flood risk assessment report to confirm the recommended minimum floor levels should be conducted by a suitable qualified professional for the affected lots (Lot 13 and 11) with respect to flood hazard, during the detailed design stage of the project and following finalisation of the proposed earthworks, as discussed in Section 5.2.2.

The regional groundwater level is anticipated to lie at moderate depth below the site and therefore the liquefaction risk is considered to be low for the proposed building platforms.

Distances to adjoining structures: The proposed building platforms are situated within a rural area with the closest existing building more than 80 m away from the proposed Lot 1 building platform. Distances to neighbouring structures for the remainder of lots exceed 300 m. No adverse geotechnical implications apply for neighbouring properties during construction of the proposed building platforms provided appropriate measures are taken during construction.

Aquifers: No aquifer resource will be adversely affected by the proposed development.

Erosion and Sediment Control: The sites present some potential to generate silt runoff during heavy rainfall events and this would naturally drain downslope towards Pongs Creek (for Lots 1-15). Effective systems for erosion control are runoff diversion drains and contour drains, while for sediment control, options are earth bunds, silt fences, vegetation buffer strips and sediment ponds. Only the least amount of subsoil should be exposed at any stage and surfacing established as soon as practical. Details for implementation are given within the following link: http://esccanterbury.co.nz/. Run-off towards Pongs Creek will have to be controlled during earthworks and construction for Lots 1-15.

Noise: It is expected that conventional earthmoving equipment, such as excavators, trucks and compactors will be required during construction. The earthworks contractor should take appropriate measures to control the construction noise and ensure QLDC requirements are met in regard to this issue.

Dust: Regular dampening of soil materials with sprinklers should be effective if required.

Vibration: Neighbouring structures are too distant from the proposed building platforms to be affected by vibrations generated from engineered fill placement and compaction.

9 Conclusions and Recommendations

- The stratigraphy beneath the proposed building platforms comprise surficial layers of topsoil and softened fan alluvium, overlying fan alluvium;
- Groundwater seepage was observed within TPs 4-8, 10, 11, 14, 16 and SPs 1 and 3 between the surface and 1.8 m bgl. Seepages were observed as very minor to moderate. The surface of the site was generally wet underfoot during investigations;
- The permanent groundwater table is expected to be at moderate depth below the site;
- The results of the geotechnical investigation concluded that softened topsoil and fan alluvium was observed across the site (0-0.8 m bgl) and that this softened material is susceptible to shallow seated movement when saturated;
- The risk of debris flow activity affecting Lot 1 is considered to be very low and unlikely to affect a future development and no mitigation measures or further assessment is required for the proposed development with respect to this hazard;
- There is a potential risk for Pongs Creek to avulse upslope of Lot 11 and 13. In order to mitigate the resulting flood hazard, minimum floor levels will be established for buildings on these lots. It is expected that finished floor levels above the proposed ground surface by up to 750mm should provide adequate protection;
- A flood risk assessment report to confirm the recommended minimum floor levels should be conducted by a suitable qualified professional for the affected lots (Lot 13 and Lot 11) with respect to flood hazard, during the detailed design stage of the project and following finalisation of the proposed earthworks;
- The inferred depth to regional groundwater and medium dense/stiff to very stiff, unsaturated soils present across the site confirm the liquefaction risk is low. No further investigation or assessment is considered necessary with respect to liquefaction, however foundation bearing capacity will be assessed for all building platforms at detailed design stage;
- The NW Cardrona Fault System has an inferred trace within the proposed development area. A detailed fault hazard assessment for the subject site is described in Section 5.5 of this report;
- Temporary and permanent batters within the observed site soils are provided in Table 2, Section 6.4.1. Earthworks plans have yet to be developed for the site;
- Fan alluvium could be used as engineered fill however only during warmer months. The implications and considerations of using fan alluvium as engineered fill is discussed in Section 6.5;
- Due allowance should be made during the detailed design of all retaining walls for forces such as surcharge due to the sloping ground surface behind the retaining walls, groundwater, seismic and traffic loads;
- Minor groundwater and surficial seepages were regularly observed across the proposed subdivision during investigations, it is recommended that these are diverted away from each of the building platforms with a set of cut-off diversion drains. The cut-off drains will be located and designed at the detailed design stage;
- A slope stability analysis for the proposed Lot 1 building platform indicates the southern edge of the building platform only marginally meets the required factor of safety guidelines. It is recommended that the slope stability of the proposed

building platform is reassessed at detailed design stage following final building footprint positioning to confirm if specific design or setback from the crest is required;

- Topsoil and softened fan alluvium observed to extend to between 0.15 and 0.8 m bgl will not provide adequate support for future building foundations and will need to be removed from the entire building footprint. Any fill that is utilised as bearing for foundations should be placed and compacted in accordance with NZS 4431:1989 and certification provided to that effect;
- Footings or waffle raft foundations are expected to bear upon predominately mixed sand, silt and gravel fan alluvium for all building platforms. As the upper fan alluvium varies in thickness, composition and relative density it is considered available bearing capacity within the unit is likely to be in the order of half to two thirds of NZS 3604 “good ground” bearing capacity;
- Granular engineered fill, overlying fan alluvium can be used to re-achieve ground levels following removal of topsoil and softened fan alluvium. The engineered fill gravel raft can include a drainage blanket if required.
- It is recommended that foundation bearing capacity, the recommended gravel raft and subsoil drainage should be specifically designed on each building platform at detailed design stage when plans for each dwelling are developed;
- It is recommended that a site-specific investigation is undertaken at the building consent stage for each of the proposed dwellings, once plans are developed, to confirm applicable soil bearing capacities and geotechnical soil parameters. Investigations should comprise a minimum of four test pits at the four corners of the proposed building platform;
- It is recommended the foundation subgrade be inspected during construction/platform earthworks by a suitably qualified and experienced geotechnical practitioner to confirm the conditions are in accordance with the assumptions and recommendations provided in this report and future detailed foundation investigation and design;
- Additionally, a geotechnical practitioner should inspect any seepage, spring flow or under-runners that may be encountered during construction of the proposed new building platforms.
- Stormwater drainage design is recommended at detailed design stage;
- To mitigate any potential slope movement for the proposed building platforms at Lots 13-15, it is recommended that an engineered fill gravel raft, with in-built drainage, can be constructed to re-achieve site levels following the removal of unsuitable soils (topsoil and softened fan alluvium);
- The finished subgrade should be inspected by a geotechnical practitioner to ensure that no unstable features are exposed;
- For detailed design purposes, it is recommended that all building platforms are classified “Class D – deep soil sites” in accordance with NZS 1170.5:2004 seismic provisions;
- Stormwater and wastewater soakage are considered suitable across the site within more permeable layers of the fan alluvium however note that infiltration/soakage rates are less than typically desirable and a design that favours storage as opposed to soakage to ground will be required;
- It is recommended that soakage is targeted below at least 1.0 m below the existing surface to ensure the surficial soils aren’t further saturated and softened;

- It is recommended that soakage is targeted downslope of each building platform and channelled away using a diversion drain (if required) to ensure further saturation of soils underlying any building platform does not occur;
- It is further recommended that any infiltration storm or waste water design be reviewed by a Geotechnical Engineer or Engineering Geologist to assess any slope stability implications, associated with the existing landslide risk potential at the subject site. For further infiltration recommendations refer to Section 7.0 of this report;

10 Applicability

This report has been prepared for the benefit of Roberts Family Trust with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

It is important that we be contacted if there is any variation in subsoil conditions from those described in this report.

Please do not hesitate to contact the undersigned if we can provide any further assistance with this project.

Report prepared by:

.....

Mike Plunket

Geotechnical Engineer

Report prepared by:

.....

Simon Reeves

Engineering Geologist

Reviewed for GeoSolve Ltd by:

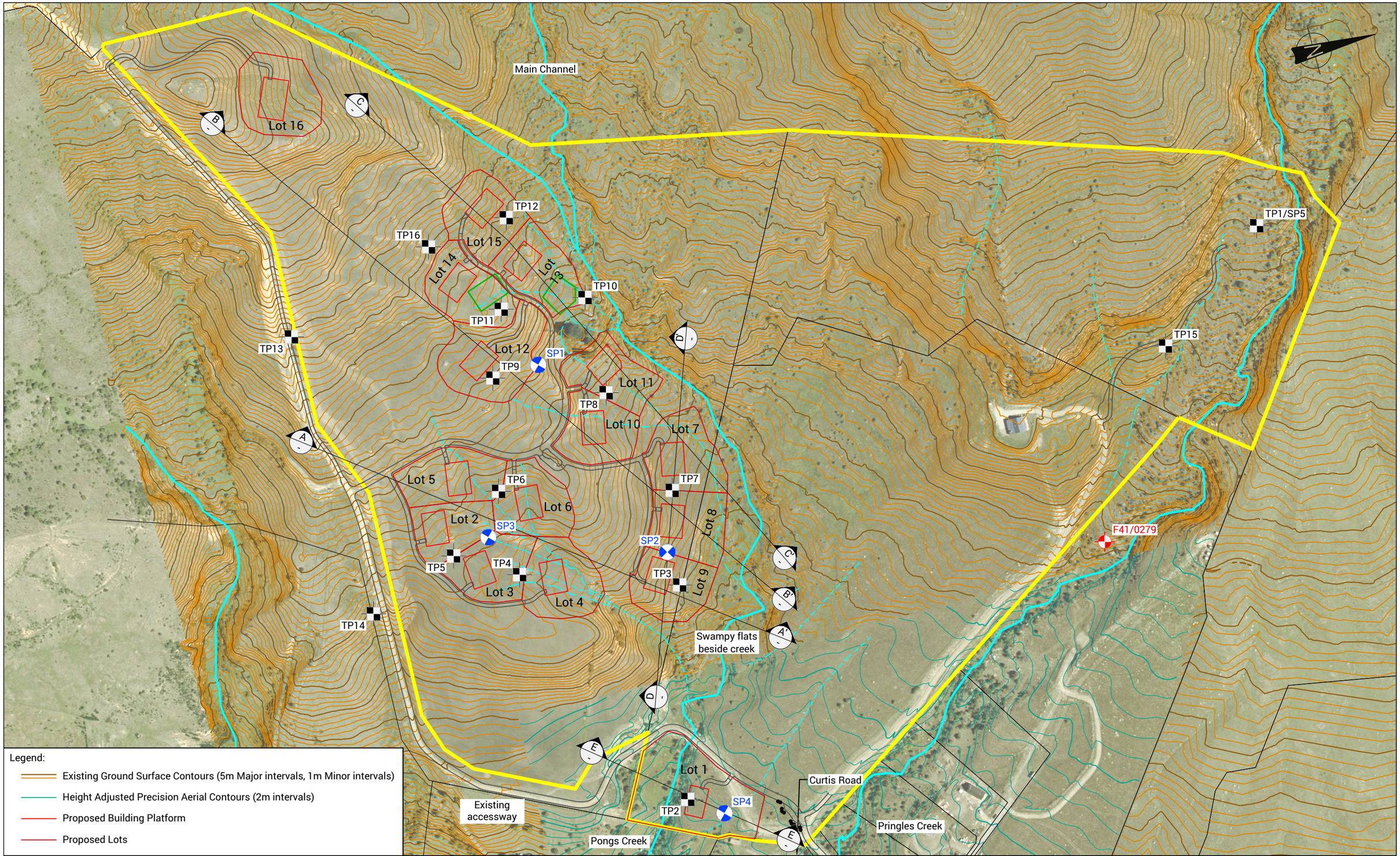
.....

Hank Stocker
Senior Engineer Water

.....

Fraser Wilson
Senior Engineering Geologist

Appendix A: Site Investigation Plans and Cross-Sections



Legend:

- Existing Ground Surface Contours (5m Major intervals, 1m Minor intervals)
- Height Adjusted Precision Aerial Contours (2m intervals)
- Proposed Building Platform
- Proposed Lots

Notes:
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SCALE 1:3500

0 35 70 105 140 175 (m)

GEOSOLVE
Level 1, 70 Macandrew Road, South Dunedin
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DRAWN	WCG	Jan.20
DRAFTING CHECKED	SR	Dec.19
APPROVED	PGF	Dec.19
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:3500		
PROJECT No: 190098		

Roberts Family Trust

Curtis Road, Cardrona

Geotechnical Investigations

Site Plan

FIG No: Figure 1a

REV. 3

Main Channel

Landslide area with hummocky topography, numerous seepages in the region with shallow failures of surfical soils likely on steep slopes. Recent scarps present upslope of the site

Incised channel beyond boundary

Spur feature

Lot 16

Potential for the creek to avulse potentially affecting lot 13 & 11

Small 0.5m bund feature, inferred alluvial overflow protection

Change in slope profile at top of steep contours adjacent/ part of edge or spur

Mobilised debris material located in overland flow path

TP12

TP16

Lot 15

Lot 14

Lot 13

TP1/SP5

Fan terrace with more recent alluvium deposition, including large boulders

TP10

Creek gradient steepens and is confined by historical lobe features and ongoing incision

Occasional hummocky terrain

TP11

Fence

Cardrona Company Water Race, to be cut-off to inhibit additional water entering site

TP13

Lot 12

SP1

TP9

Undulating alluvial fan surface

Creek shallower downslope with shallow fan angle and meandering creek on fan feature within valley

TP15

Numerous Boulders on surface. Boulders have been collated into piles present across the site; inferred to be fan alluvium deposits.

Lot 11

TP8

Lot 10

Lot 7

Numerous Boulders on surface

Unnamed creek

Littles Water Race, to be cut-off to inhibit additional water entering site

Fan alluvium terrace, gently sloping

Lot 5

TP6

TP7

Lot 6

Lot 2

SP3

Lot 8

Significant hummocky terrain

Existing Dwelling

F41/0279

SP2

TP4

TP5

TP3

Lot 9

Lot 3

Lot 4

Undulating alluvial fan surface

Fan Alluvium Terrace

Swampy flats beside creek

Gravel quarry in Fan Alluvium

Lot 1

Curtis Road

Existing accessway

TP2

SP4

Pringles Creek

Pongs Creek

Legend:

- Alluvial Fan (ORC) - Active
- Alluvial Fan (ORC) - Less Recently Active
- Landslide - Areas of Fine Grained Soils Susceptible to Sliding
- Mapped Fault - Cardrona Fault System (well defined)
- Mapped Fault - Cardrona Fault System (uncertain)
- Existing Ground Surface Contours (5m Major intervals, 1m Minor intervals)
- Height Adjusted Precision Aerial Contours (2m intervals)
- Proposed Building Platform
- Original Proposed Building Platform
- Proposed Lots
- Water Race
- Change in slope profile
- Overland flow paths
- Historical scarp (approximate location)
- Spring flow
- Area of swampy ground
- Area of Hummocky Ground

Notes:
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SCALE 1:3500

0 35 70 105 140 175 (m)

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CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:3500		
PROJECT No: 190098		

Roberts Family Trust

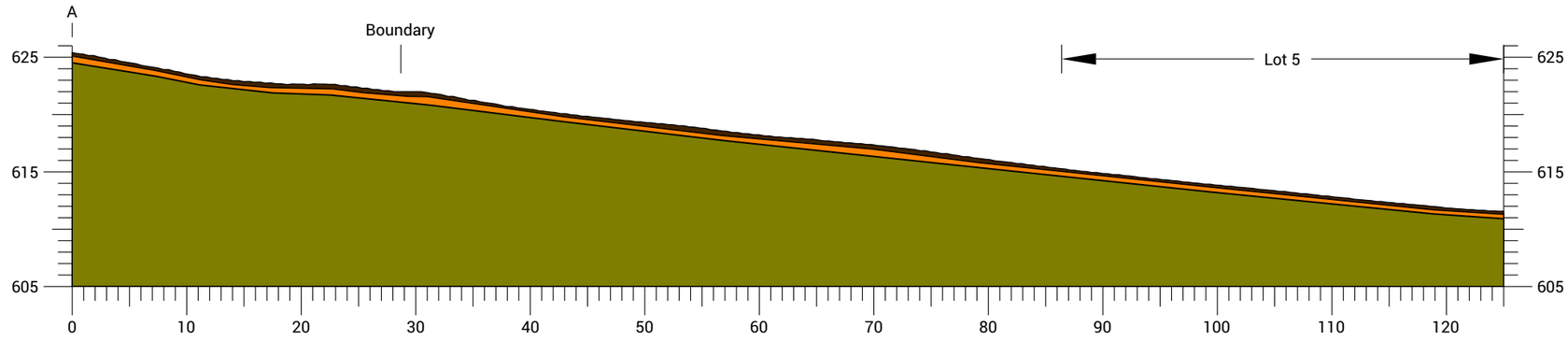
Curtis Road, Cardrona

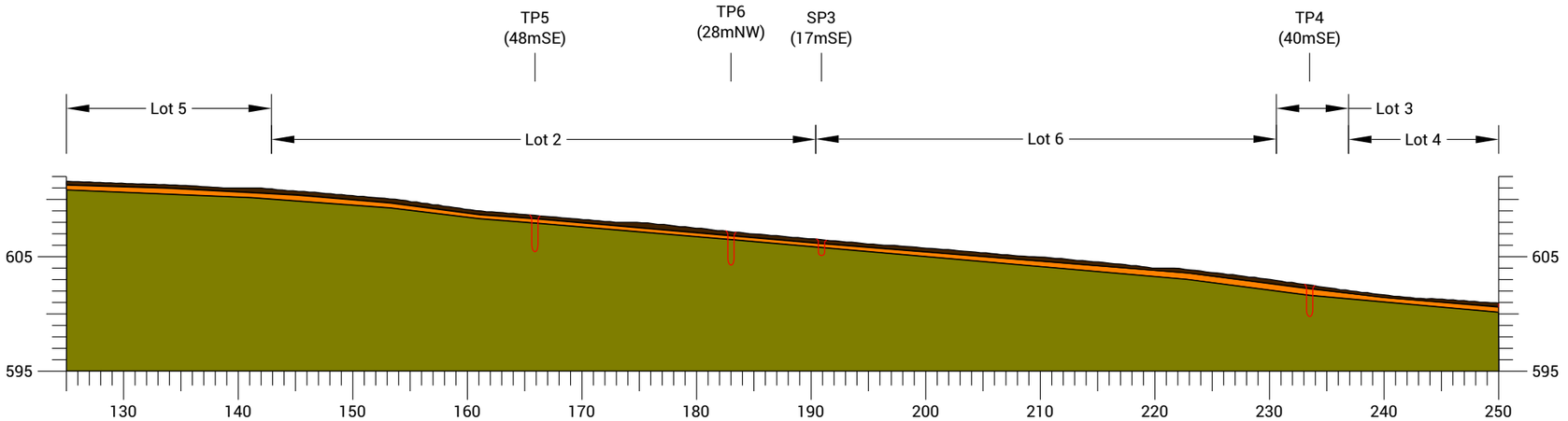
Geotechnical Investigations

Geomorphology Plan

FIG No: Figure 1b

REV. 3





= TOPSOIL

= SOFTENED FAN ALLUVIUM

= FAN ALLUVIUM

Notes:

1. These drawings have been prepared for the benefit of Maestro Projects with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Legend:

Location of Proposed Building Platform

SCALE 1:500

0 5 10 15 20 25 (m)

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DRAWN	WCG	Jul.19
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APPROVED	PGF	Jul.19

CADFILE: 190098.dwg

SCALES (AT A3 SIZE): 1:500

PROJECT No: 190098

FIG No: Figure 2a

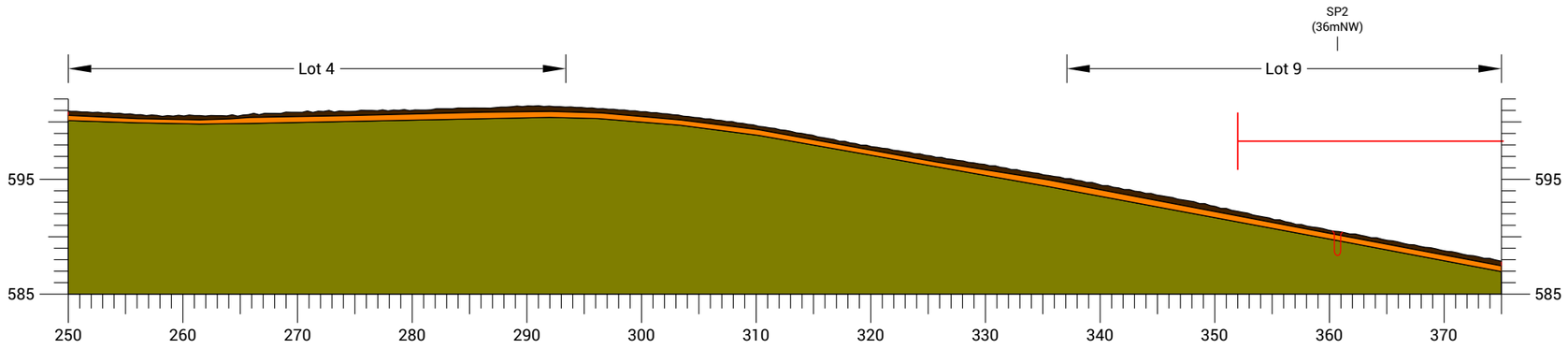
REV. 0

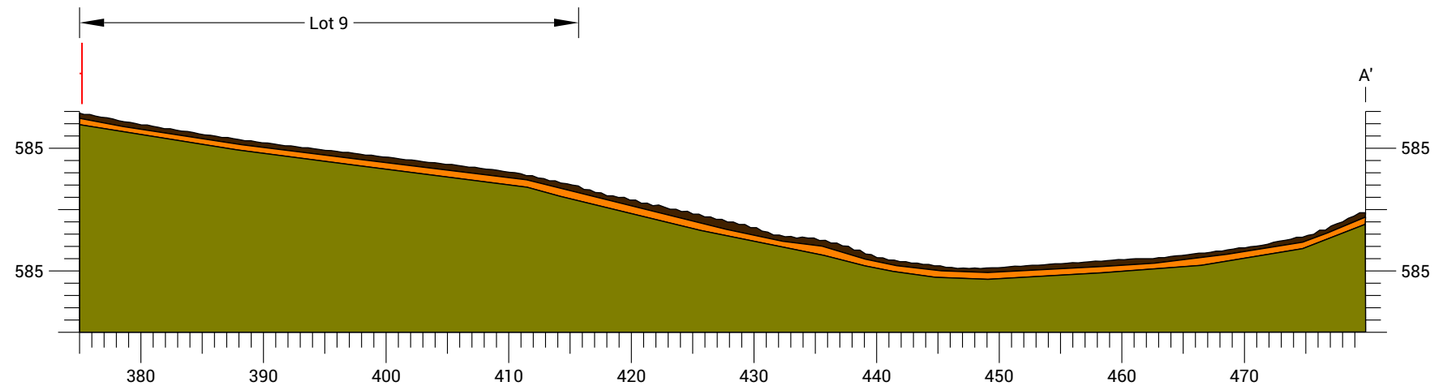
Roberts Family Trust

Curtis Road, Cardrona

Geotechnical Investigations

Cross Section A 1/2





= TOPSOIL

= SOFTENED FAN ALLUVIUM

= FAN ALLUVIUM

Notes:

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Legend:

Location of Proposed Building Platform

SCALE 1:500

0 5 10 15 20 25 (m)

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CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098		

Roberts Family Trust

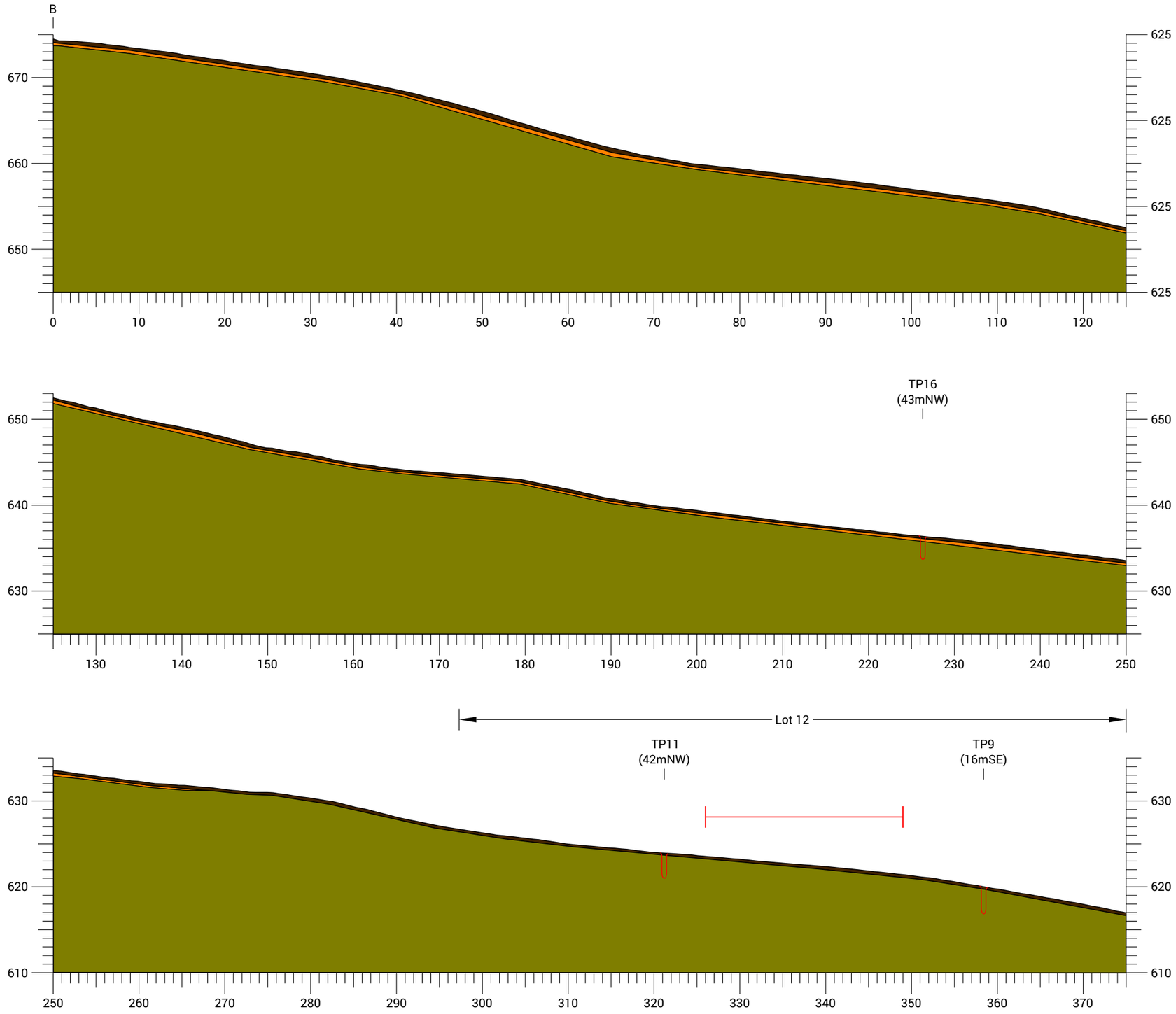
Curtis Road, Cardrona

Geotechnical Investigations

Cross Section A 2/2

FIG No: Figure 2b

REV. 0



Notes:
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Legend:

Location of Proposed Building Platform

SCALE 1:500

0 5 10 15 20 25 (m)

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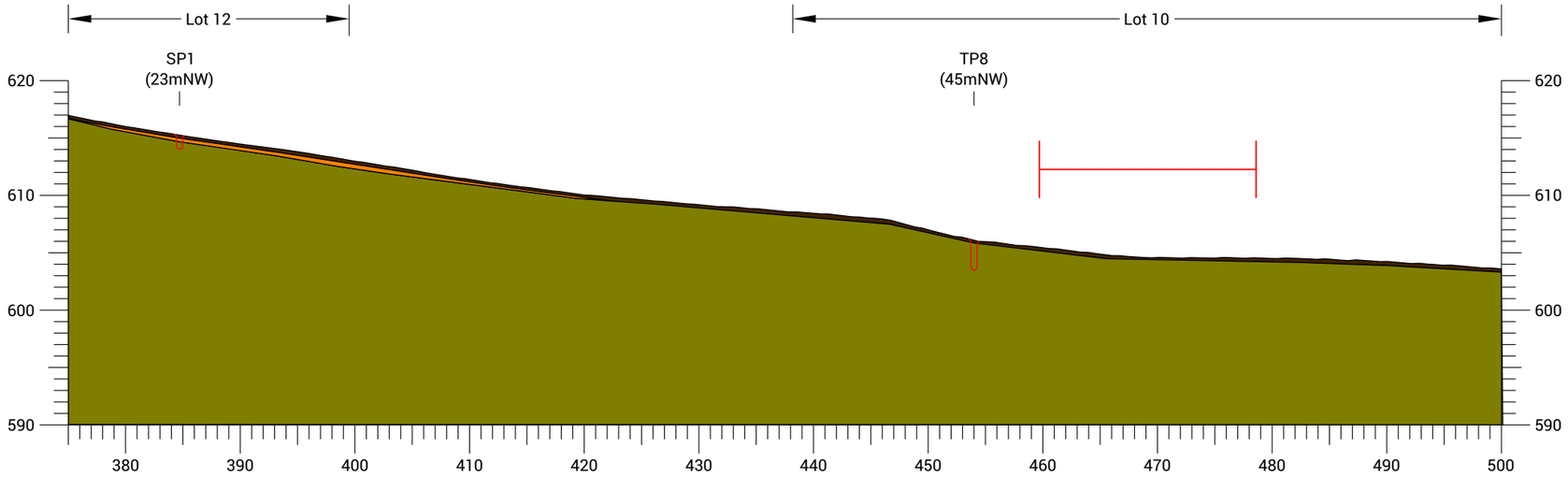
APPROVED	PGF	Jul.19
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098	FIG No: Figure 2c	REV. 0

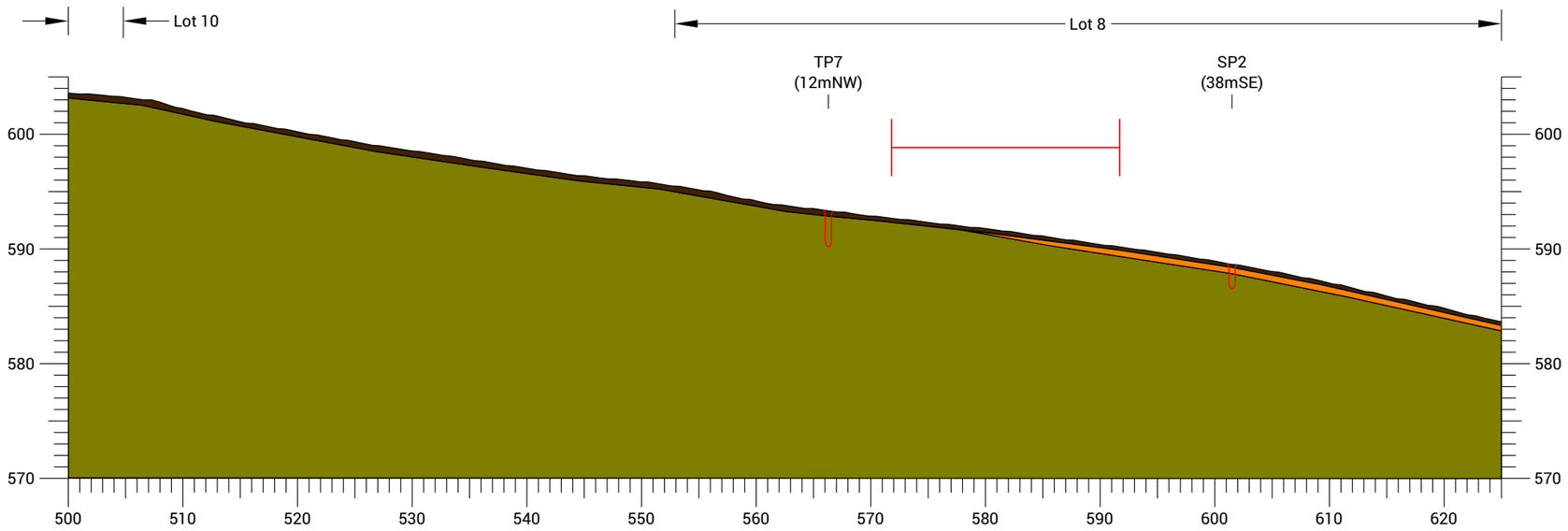
Roberts Family Trust

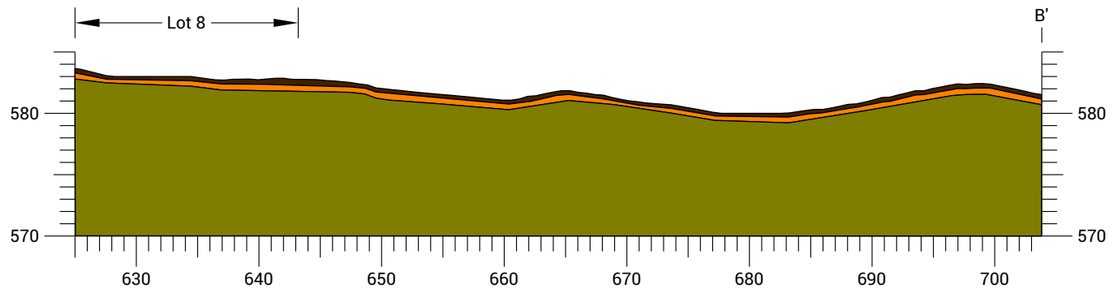
Curtis Road, Cardrona

Geotechnical Investigations

Cross Section B 1/2







= TOPSOIL
= SOFTENED FAN ALLUVIUM
= FAN ALLUVIUM

Notes:
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Legend:
Location of Proposed Building Platform

SCALE 1:500
0 5 10 15 20 25 (m)

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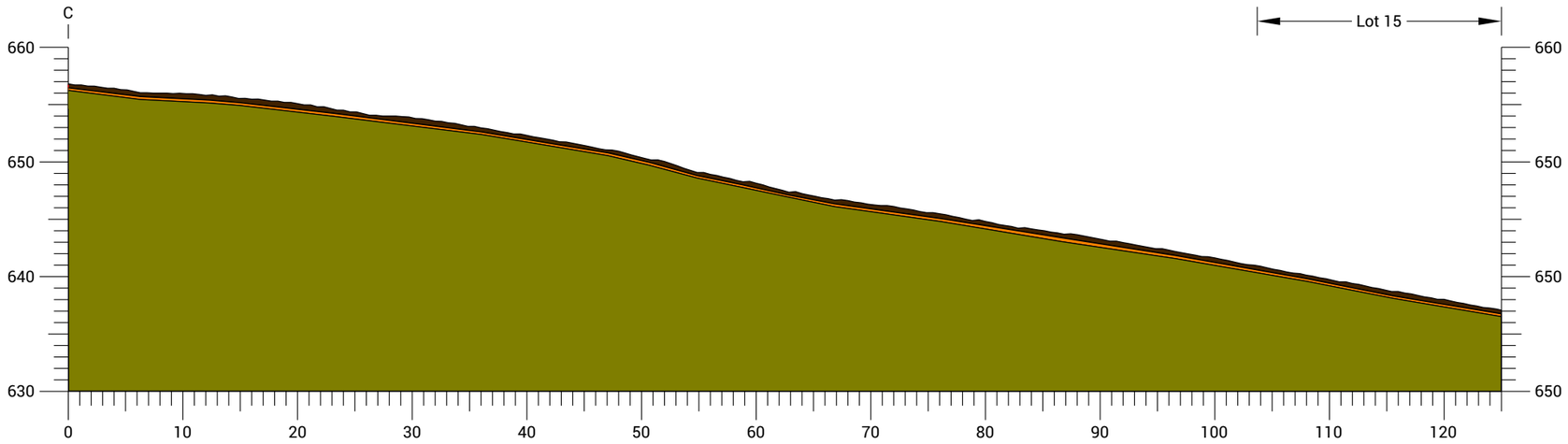
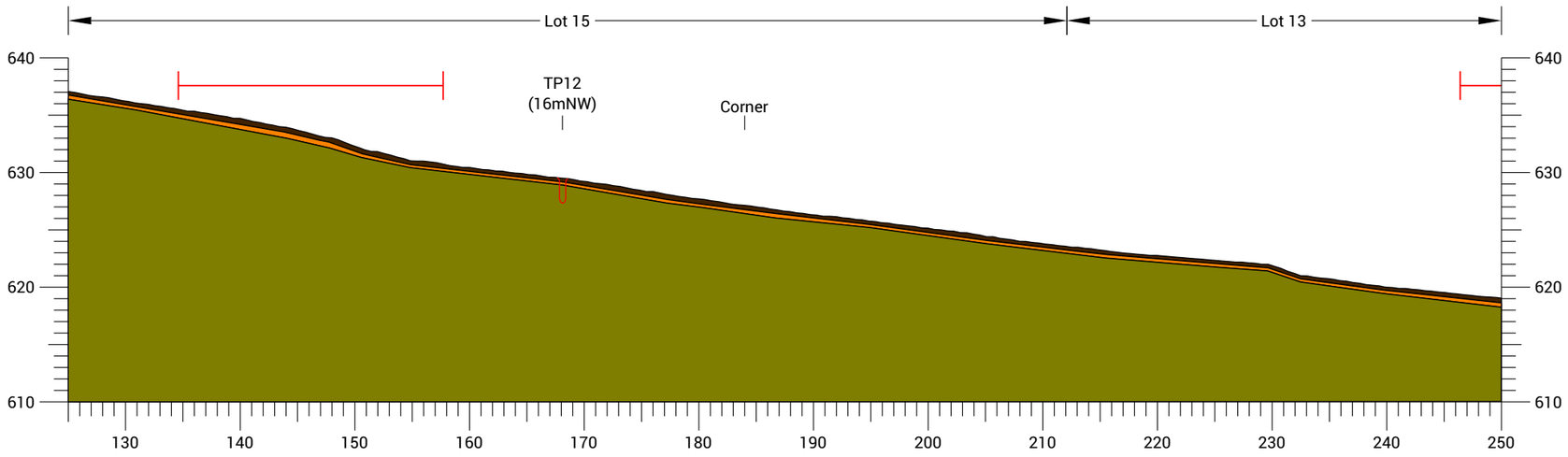
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098		

Roberts Family Trust
Curtis Road, Cardrona
Geotechnical Investigations
Cross Section B 2/2

FIG No: Figure 2d
REV. 0





= TOPSOIL

= SOFTENED FAN ALLUVIUM

= FAN ALLUVIUM

Notes:

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Legend:

Location of Proposed Building Platform

SCALE 1:500

0 5 10 15 20 25 (m)

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APPROVED	PGF	Jul.19
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098		

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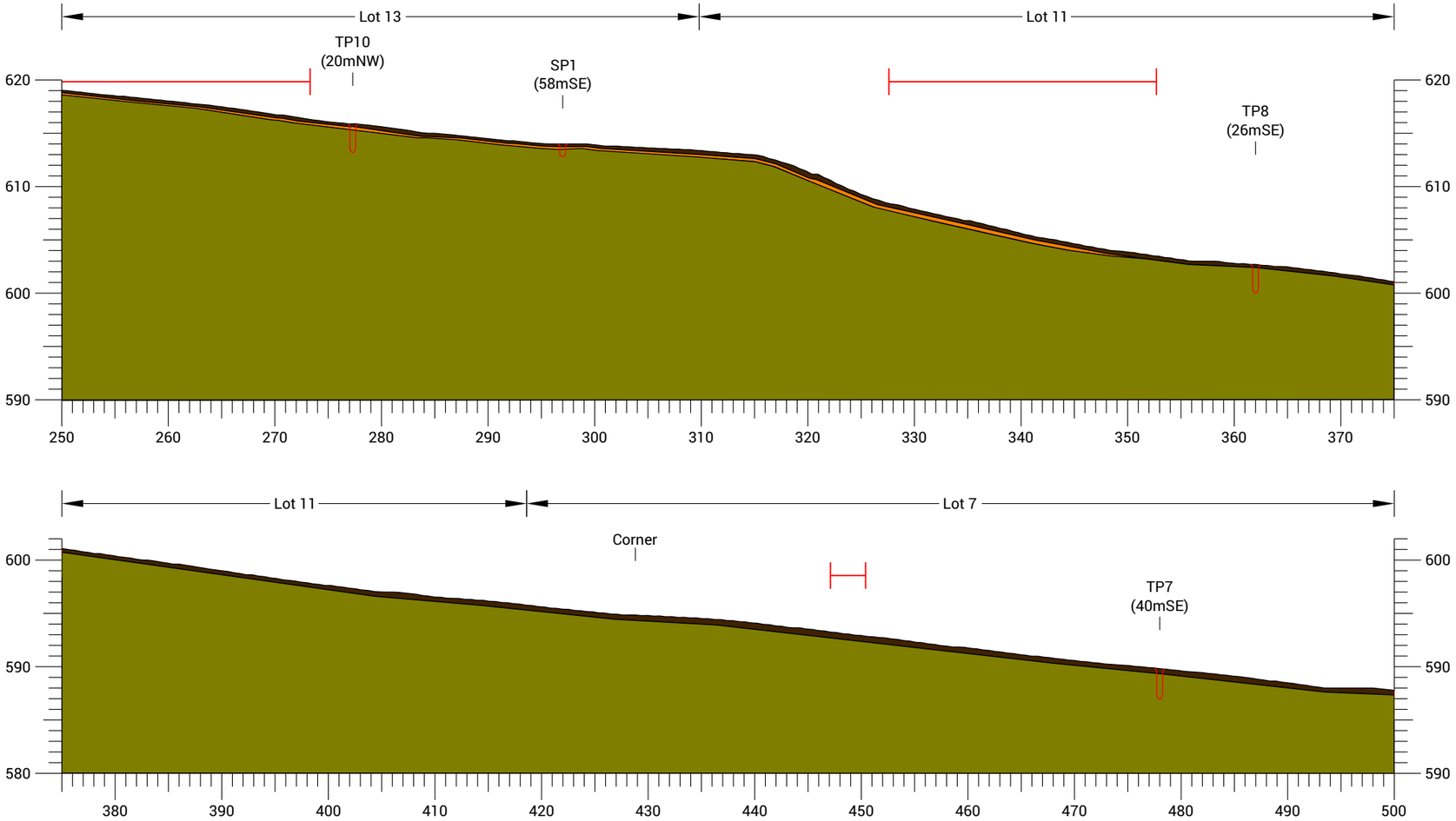
Curtis Road, Cardrona

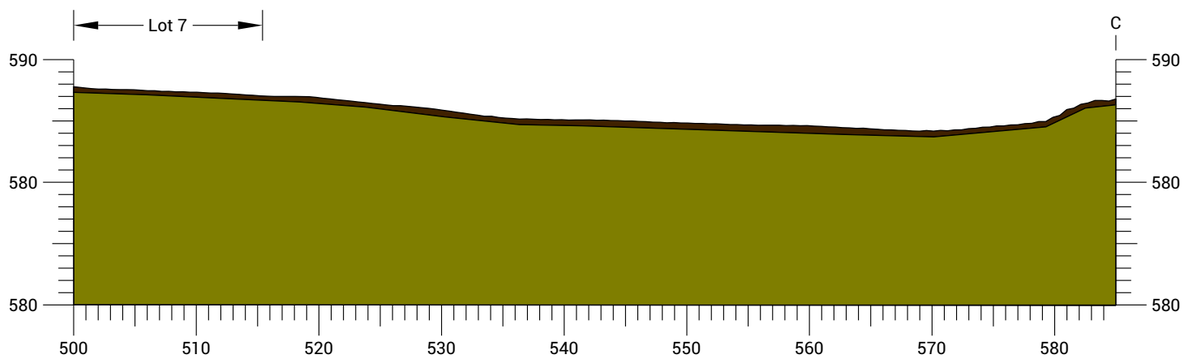
Geotechnical Investigations

Cross Section C 1/2

FIG No: Figure 2e

REV. 0





= TOPSOIL

= SOFTENED FAN ALLUVIUM

= FAN ALLUVIUM

Notes:

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Legend:

Location of Proposed Building Platform

SCALE 1:500

0 5 10 15 20 25 (m)

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DRAWN	WCG	Jul.19
DRAFTING CHECKED	SR	Jul.19
APPROVED	PGF	Jul.19
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098		

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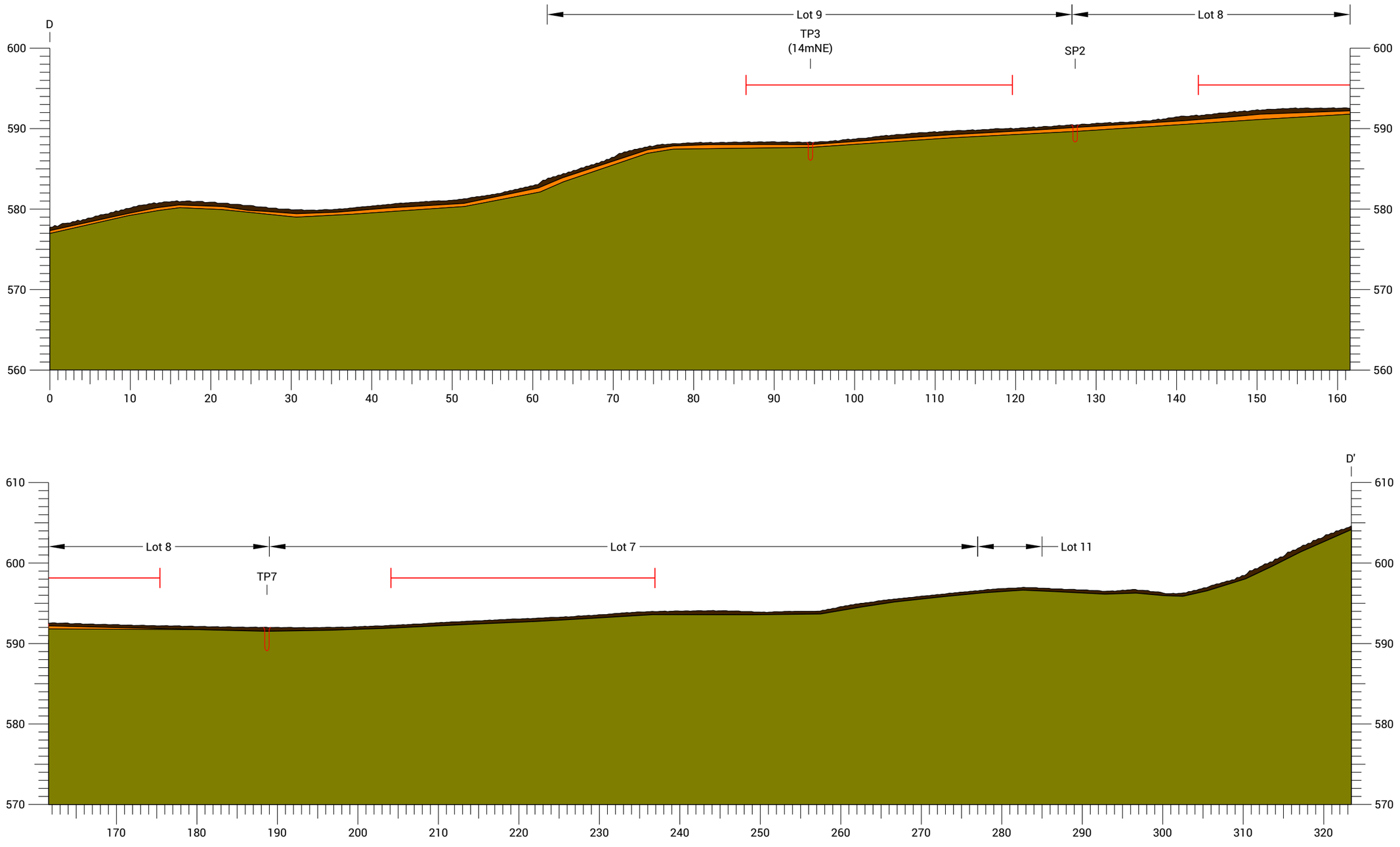
Curtis Road, Cardrona

Geotechnical Investigations

Cross Section C 2/2

FIG No: Figure 2f

REV. 0



Notes:
1. These drawings have been prepared for the benefit of Maestro Projects with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Legend:
Location of Proposed Building Platform

SCALE 1:500
0 5 10 15 20 25 (m)

GEOSOLVE
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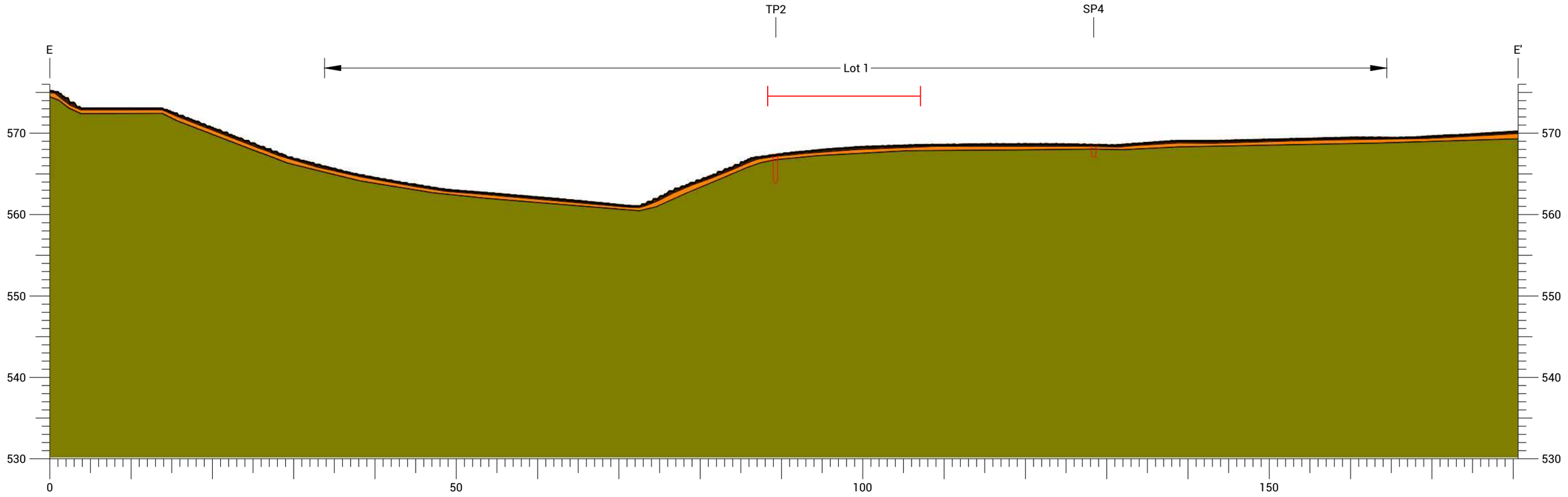
DRAWN	WCG	Jul.19
DRAFTING CHECKED	SR	Jul.19
APPROVED	PGF	Jul.19
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098		

Roberts Family Trust
Curtis Road, Cardrona
Geotechnical Investigations
Cross Section D

FIG No: Figure 2g
REV. 0



Notes:
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SCALE 1:500
0 5 10 15 20 25 (m)

Legend:
- Location of Proposed Building Platform
- Topsoil
- Softened Fan Alluvium
- Fan Alluvium

GEOSOLVE
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APPROVED	PGF	Dec.19
CADFILE: 190098.dwg		
SCALES (AT A3 SIZE): 1:500		
PROJECT No: 190098		

Roberts Family Trust
Curtis Road, Cardrona
Geotechnical Investigations
Cross Section E

FIG No: Figure 2h
REV. 3

Appendix B: Investigation Data

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 1/SP 5**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan — INCLINATION: Vertical		

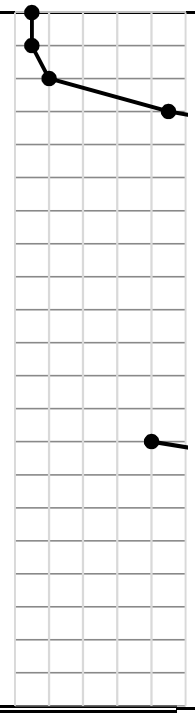
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist. Sluffed.		
0.7	SOFTENED FAN ALLUVIUM		Greyish brown, silty SAND with some gravel & boulders. Sand is fine to medium. Boulders up to 600mm diameter. Silt is nonplastic. Loose. Moist to wet. Sluffed.		
1.1	FAN ALLUVIUM		Grey, silty SAND with some boulders. Sand is fine to medium. Boulders up to 700mm diameter. Silt is non-plastic. Loose to medium dense. Massive. Dry to moist.		
2.1	FAN ALLUVIUM		Greyish brown, silty gravelly SAND with cobbles & some boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular. Boulders up to 900mm diameter. Silt is non-plastic. Medium dense. Massive. Dry to moist.		NO SEEPAGE

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 2.1 m

COMMENT: Hole obstructed by boulders. Soak test completed at 1.3 m bgl

Logged By: MDP

Checked Date:

Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 2**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

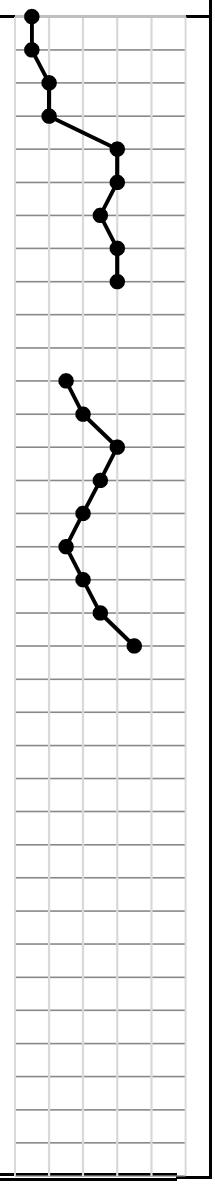
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	7-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	7-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Moist. Sluffed.		
0.6	SOFTENED FAN ALLUVIUM		Grey, SILT with trace rootlets. Silt is non-plastic. Soft. Moist to wet. Sluffed.		
1.9	FAN ALLUVIUM		Grey, SILT with minor sand. Silt is non-plastic. Firm. Dry to moist.		
2.6	FAN ALLUVIUM		Grey, silty gravelly SAND with some cobbles and minor boulders. Sand is fine to coarse. Gravel is fine to coarse and sub-angular. Silt is non-plastic. Medium dense. Loose bedding. Dry to moist.		
3.5	FAN ALLUVIUM		Orange/light brown, SILT. Silt is non-plastic. Stiff. Chaotic structure. Dry to moist.		NO SEEPAGE

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 3.5 m

COMMENT:

Logged By: MDP

Checked Date:

Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 3**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

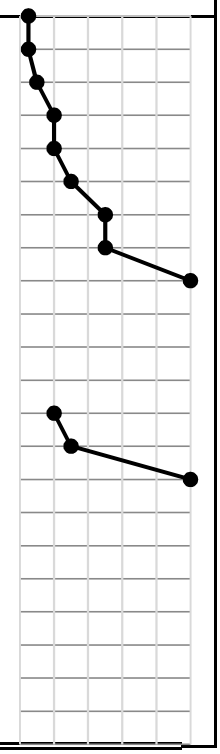
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.25	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non plastic. Moist. Sluffed.		
0.6	SOFTENED FAN ALLUVIUM		Brownish grey & grey, SILT with minor sand & rootlets. Silt is non plastic. Soft. Moist to wet. Sluffed.		
1.4	FAN ALLUVIUM		Brownish grey & grey, SILT with some sand. Sand is fine to medium. Silt is non plastic. Firm to stiff. Moist.		
2.2	FAN ALLUVIUM		Brownish grey, silty gravelly SAND with some cobbles & minor boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non plastic. Medium dense. Loose bedding structure. Dry to moist.		NO SEEPAGE

Total Depth = 2.2 m

SCALA PENETROMETER

Blows per 100mm



COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 4**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

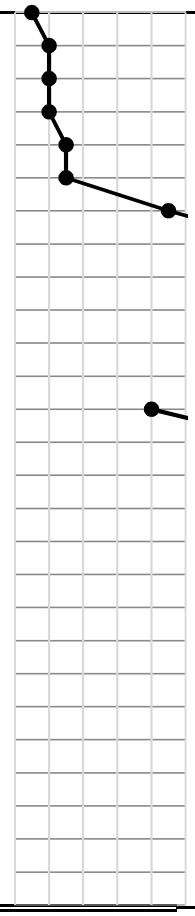
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.25	TOPSOIL		Dark brown, organic SILT with rootlets. Moist.		
0.8	SOFTENED FAN ALLUVIUM		Light grey/brown, SILT with minor sand & rootlets. Silt is nonplastic. Soft. Moist to wet. Sluffed.		Minor Seepage @ 0.25 m
1.0	FAN ALLUVIUM		Grey, silty sandy GRAVEL with trace rootlets, cobbles & boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Boulders up to 500mm diameter. Silt is non-plastic. Medium dense. Moist.		
2.7	FAN ALLUVIUM		Brown, silty GRAVEL with some sand, minor cobbles & boulders. Gravel is fine to coarse. Gravel is sub-angular. Boulders up to 300mm diameter. Silt is non-plastic. Medium dense. Bedded. Moist.		

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 2.7 m

COMMENT:

Logged By: MDP

Checked Date:

Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 5**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm (0 2 4 6 8 10)
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Wet to moist. Sluffed.			
0.6	SOFTENED FAN ALLUVIUM		Grey, SILT with minor rootlets & sandy SILT. Silt is nonplastic. Soft. Moist to wet. Sluffed.			
0.9	FAN ALLUVIUM		Grey, SILT with minor sand. Silt is non-plastic. Firm. Moist to wet.			
1.3	FAN ALLUVIUM		Grey, sandy silty GRAVEL with minor cobbles & trace boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Mediium dense. Moist to wet.		Minor Seepage at 0.3 and 0.9 m	
1.9	FAN ALLUVIUM		Brown/light brown, sandy silty GRAVEL with minor cobbles & trace boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Mediium dense. Loose bedding. Moist.			
2.6	FAN ALLUVIUM		Light grey & orange mottled, SILT. Silt is non-plastic. Stiff. Chaotic structure. Dry to moist.			
3.1	FAN ALLUVIUM		Light brown/light grey, sandy SILT interbedded with SILT. Sand is fine to medium. Silt is non-plastic. Stiff. Chaotic structure. Dry to moist.			

Total Depth = 3.1 m

COMMENT:

Logged By: MDP
Checked Date:
Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 6**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

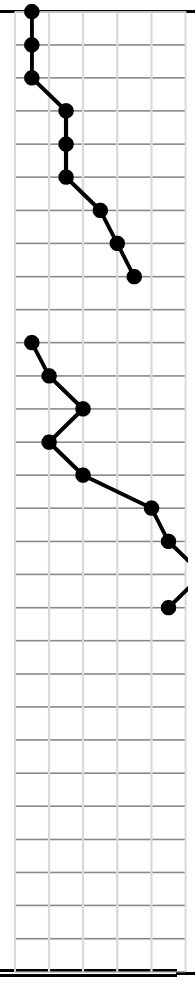
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.25	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Wet. Sluffed.		Surficial Seepage
0.6	SOFTENED FAN ALLUVIUM		Light brown/grey, SILT with minor sand & rootlets. Silt is nonplastic. Firm. Moist to wet. Sluffed.		
0.9	FAN ALLUVIUM		Grey, sandy SILT with trace fine gravel. Sand is fine to medium. Silt is non-plastic. Firm to stiff. Moist.		
1.6	FAN ALLUVIUM		Light brown/brown, silty GRAVEL with minor sand & cobbles & trace boulders. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Medium dense. Moist.		
2.9	FAN ALLUVIUM		Light brown/brown, sandy GRAVEL with minor silt & cobbles & trace boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Medium dense. Moist.		

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 2.9 m

COMMENT:

Logged By: MDP

Checked Date:

Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 7**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan — INCLINATION: Vertical		

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

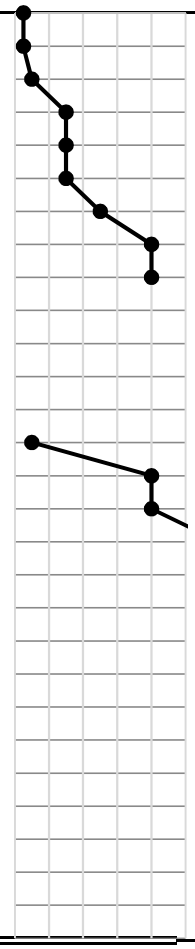
DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.15	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist.		
0.4	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist to wet.		
0.6	FAN ALLUVIUM		Brownish grey, SILT with some sand & trace rootlets. Sand is fine to medium. Silt is non-plastic. Stiff. Massive. Moist.		Seepage @ 0.4 m
2.2	FAN ALLUVIUM		Brownish grey, SILT with some sand & minor cobbles & trace boulders. Sand is fine to medium. Boulders up to 1100mm diameter. Silt is non-plastic. Stiff. Massive. Moist.		
2.8	FAN ALLUVIUM		Grey, SAND interbedded with minor lenses of silt. Sand is fine to medium. Boulders up to 600mm diameter. Medium dense. Chaotic structure. Moist.		

Total Depth = 2.8 m

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 8**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

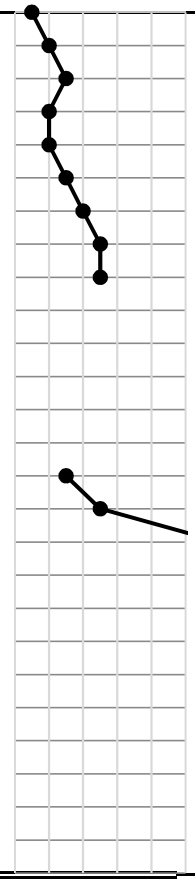
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist.		
0.6	FAN ALLUVIUM		Greyish brown, silty SAND with trace rootlets. Sand is fine to medium. Silt is non-plastic. Loose. Dry to moist.		
1.4	FAN ALLUVIUM		Brownish grey, silty sandy GRAVEL with some cobbles & minor boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Medium dense. Loose bedding. Moist becoming wet at interface of silt.		Minor seepage @ 1.3 m
1.6	FAN ALLUVIUM		Orange, SILT with some sand. Sand is fine to medium. Silt is non-plastic. Stiff. Moist.		
2.6	FAN ALLUVIUM		Brownish grey, silty sandy GRAVEL with some cobbles & minor boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Medium dense. Loose bedding. Moist.		

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 2.6 m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 9**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan INCLINATION: Vertical		

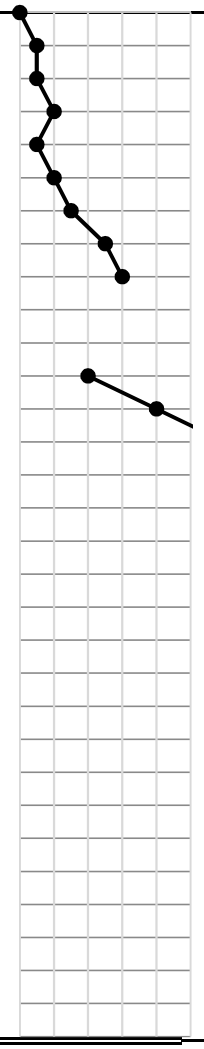
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Moist.		
0.5	FAN ALLUVIUM		Grey/mottled orange, SILT with minor sand. Silt is non-plastic. Firm. Moist.		
1.0	FAN ALLUVIUM		Grey, silty GRAVEL with minor sand, cobbles & boulders. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Medium dense. Moist.		
1.5	FAN ALLUVIUM		Light brown/orange, gravelly sandy SILT with minor cobbles & boulders. Sand is fine to medium. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Stiff to very stiff. Dry to moist.		
3.1	FAN ALLUVIUM		Mottled grey, SILT. Silt is non-plastic. Very stiff. Dry to moist.		NO SEEPAGE

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 3.1 m

COMMENT:

Logged By: MDP

Checked Date:

Sheet: 1 of 1

EXCAVATION LOG

EXCAVATION NUMBER: **TP 10**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan — INCLINATION: Vertical		

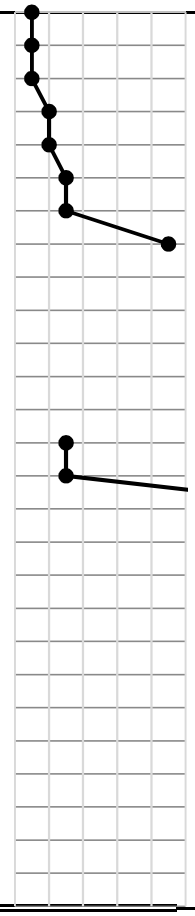
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist.		
0.55	SOFTENED FAN ALLUVIUM		Mottled orange/grey, silty SAND with trace rootlets. Sand is fine to medium. Silt is non-plastic. Loose. Massive. Moist to wet. Sluffed.		
1.1	FAN ALLUVIUM		Grey, SILT with minor sand. Silt is non-plastic. Firm to stiff. Massive. Moist.		
2.7	FAN ALLUVIUM		Grey, silty GRAVEL with minor sand, cobbles & boulders. Boulders up to 500mm. Silt is non-plastic. Medium dense. Loose bedding. Wet to saturated.		Moderate to strong seepage

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



Total Depth = 2.7 m

COMMENT: Perched groundwater. Sides collapsing below seepage.

Logged By: MDP

Checked Date:

Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 11**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

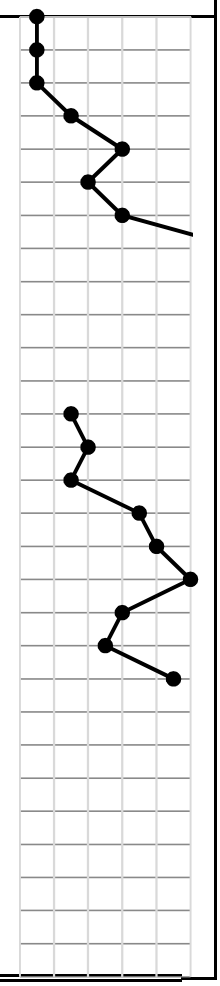
DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.15	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist.		
1.1	FAN ALLUVIUM		Brown, silty GRAVEL with minor sand, cobbles & boulders. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Boulders are up to 600mm. Silt is non-plastic. Medium dense. Massive. Moist.		
1.8	FAN ALLUVIUM		Light brown, SILT with minor sand. Silt is non-plastic. Stiff to very stiff. Massive. Moist.		Very minor seepage
2.9	FAN ALLUVIUM		Light brown/grey, SILT with trace fine gravel & cobbles. Cobbles up to 150mm. Silt is non-plastic. Very stiff. Chaotic. Wet at interface from seepage then moist.		

Total Depth = 2.9 m

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 12**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

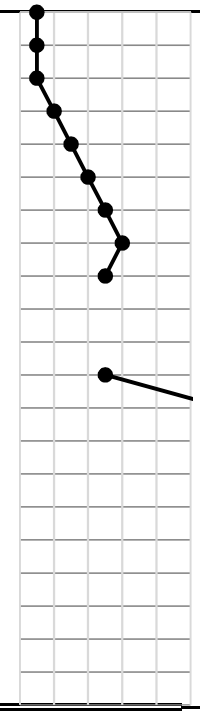
DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.25	TOPSOIL		Dark brown, organic SILT with rootlets. Silt is non-plastic. Moist.		
0.5	SOFTENED FAN ALLUVIUM		Light grey/brownish grey, silty SAND with trace boulders & rootlets. Sand is fine to medium. Boulders up to 500mm diameter. Silt is non-plastic. Loose to medium dense. Moist to wet. Sluffed.		
1.0	FAN ALLUVIUM		Brownish grey, SILT with some sand & trace boulders. Sand is fine to medium. Boulders up to 600mm diameter. Silt is non-plastic. Stiff. Moist.		
2.1	FAN ALLUVIUM		Light brown to brown, silty GRAVEL with some sand, minor cobbles & trace boulders. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Boulders up to 500mm diameter. Silt is non-plastic. Medium dense. Loose bedding. Moist.		NO SEEPAGE

Total Depth = 2.1 m

SCALA PENETROMETER

Blows per 100mm

0 2 4 6 8 10



COMMENT: Refusing on boulders at base of excavation.	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

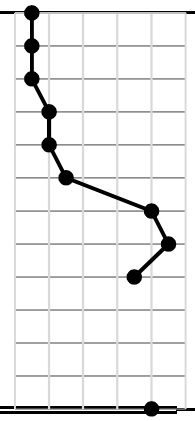
EXCAVATION NUMBER: **TP 13**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm
0.25	TOPSOIL		Dark brown, organic SILT. Sluffed. Moist.		NO SEEPAGE	0 2 4 6 8 10
0.5	SOFTENED FAN ALLUVIUM		Grey, SILT with trace rootlets. Silt is non-plastic. Firm. Moist to wet. Sluffed.			
1.2	FAN ALLUVIUM		Grey/brown, sandy SILT with trace cobbles. Sand is fine to medium. Cobbles up to 150mm diameter. Silt is non-plastic. Stiff. Moist.			

Total Depth = 1.2 m



COMMENT:

Logged By: MDP
Checked Date:
Sheet: 1 of 1

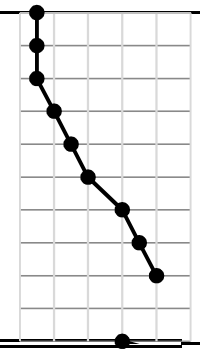
EXCAVATION LOG

EXCAVATION NUMBER: **TP 14**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan — INCLINATION: Vertical		

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER Blows per 100mm (0 2 4 6 8 10)
0.2	TOPSOIL		Dark brown, organic SILT. Sluffed. Moist.			
0.4	SOFTENED FAN ALLUVIUM		Grey, SILT with trace rootlets. Silt is non-plastic. Soft to firm. Moist to wet. Sluffed.			
1.0	FAN ALLUVIUM		Grey, SILT with some cobbles & minor boulders. Boulders up to 400mm diameter. Stiff. Moist.		Minor to mod. seepage	



Total Depth = 1 m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

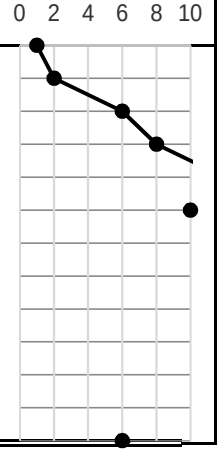
EXCAVATION NUMBER: **TP 15**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan — INCLINATION: Vertical		

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE
0.15	TOPSOIL		Dark brown, organic SILT with rootlets, some gravel & minor boulders. Boulders up to 800mm diameter. Moist.		NO SEEPAGE
0.3	FAN ALLUVIUM		Brown, silty SAND with some gravel & boulders. Boulders up to 800mm diameter. Loose. Massive. Moist.		
1.2	FAN ALLUVIUM		Brown, silty sandy GRAVEL with some cobbles & boulders. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Boulders up to 900mm diameter. Medium dense. Massive. Moist.		

SCALA PENETROMETER



Total Depth = 1.2 m

COMMENT:

Logged By: MDP
Checked Date:
Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **TP 16**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan INCLINATION: Vertical		

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Sluffed. Silt is non-plastic. Moist.			
0.5	SOFTENED FAN ALLUVIUM		Light brown/grey, SILT with minor sand & trace rootlets. Silt is nonplastic. Firm. Massive. Moist to wet. Sluffed		Minor Seepage	
0.8	FAN ALLUVIUM		Light brown/grey, SILT with some gravel & minor sand. Silt is non-plastic. Stiff. Massive. Dry to moist.			
2.1	FAN ALLUVIUM		Light brown/grey mottled, SILT with trace fine gravel. Silt is non-plastic. Stiff to very stiff. Chaotic structure. Dry to moist.			
2.9	FAN ALLUVIUM		SILT with some gravel & trace cobbles. Cobbles up to 150mm diameter. Stiff to very stiff. Chaotic structure. Dry to moist.			

Total Depth = 2.9 m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: SP 1

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan INCLINATION: Vertical		

EASTING:		mE	EQUIPMENT:	5.5t excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Sluffed. Moist to wet.		NO SEEPAGE	
0.5	SOFTENED FAN ALLUVIUM		Grey, silty SAND with trace rootlets. Loose. Moist to wet. Sluffed.			
0.9	FAN ALLUVIUM		Grey, silty sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Loose to medium dense. Moist to wet.			
1.1	FAN ALLUVIUM		Orange/light brown, SILT with fine gravel. Silt is non-plastic. Stiff. Moist to dry.			

Total Depth = m

COMMENT: Soakage test at 1.1 m bgl

Logged By: MDP
Checked Date:
Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: SP 2

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan	INCLINATION: Vertical	

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Sluffed. Silt is non-plastic. Moist.		NO SEEPAGE	
0.7	SOFTENED FAN ALLUVIUM		Grey, SILT with trace rootlets. Silt is non-plastic. Soft to firm. Moist to wet. Sluffed.			
1.6	FAN ALLUVIUM		Brownish grey, SILT with minor sand. Silt is non-plastic. Stiff. Moist.			
1.8	FAN ALLUVIUM		Brownish grey, silty SAND with some gravel. Sand is fine to coarse. Gravel is fine to medium. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Medium dense. Dry to moist.			
2.0	FAN ALLUVIUM		Light brown, SAND with some silt. Medium dense. Dry to moist.			

Total Depth = 2 m

COMMENT: Soak pit test at 2 m bgl.

Logged By: MDP
Checked Date:
Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: **SP 3**

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan — INCLINATION: Vertical		

EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.25	TOPSOIL		Dark brown, organic SILT with rootlets. Sluffed. Silt is non-plastic. Moist.		Very minor	
0.6	SOFTENED FAN ALLUVIUM		Grey, SILT with trace rootlets. Silt is non-plastic. Soft to firm. Moist to wet. Sluffed.			
0.9	FAN ALLUVIUM		Grey, SILT with minor sand. Silt is non-plastic. Stiff. Moist.		Very minor	
1.1	FAN ALLUVIUM		Greyish brown, silty gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse. Gravel is sub-angular to sub-rounded. Silt is non-plastic. Medium dense. Loose bedding. Dry to moist.			
1.3	FAN ALLUVIUM		Orange/light brown, SILT with trace fine gravel. Silt is non-plastic. Stiff to very stiff. Chaotic structure. Dry to moist.			

Total Depth = 1.3 m

COMMENT: Soakage test at 1.3 m bgl	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

GEOSOLVE

EXCAVATION LOG

EXCAVATION NUMBER: SP 4

PROJECT:	Curtis Rd	JOB NUMBER:	190098
LOCATION:	See Site Plan INCLINATION: Vertical		

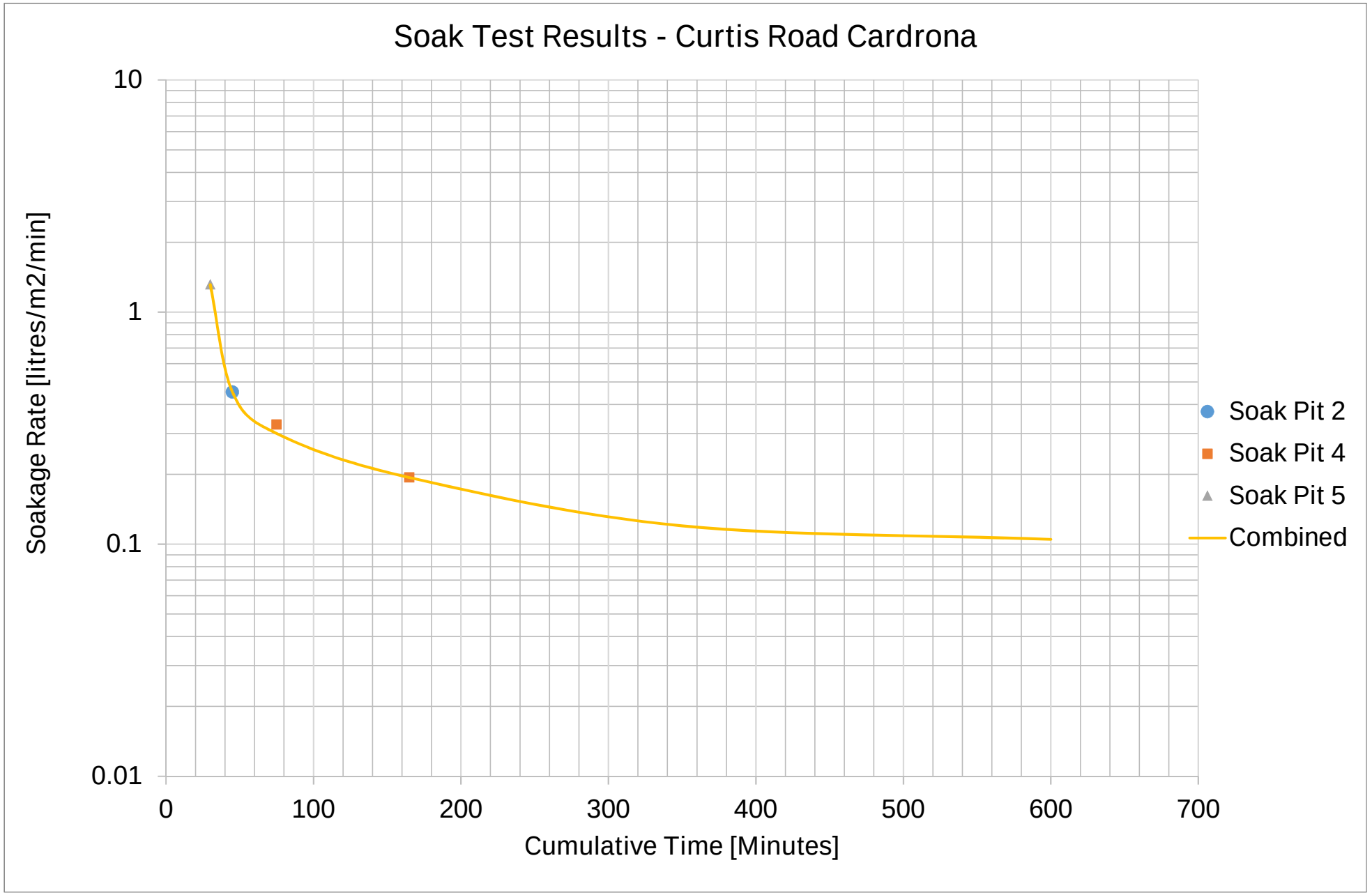
EASTING:		mE	EQUIPMENT:	5.5 T Excavator	OPERATOR:	Mat
NORTHING:		mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:		m	DIMENSIONS:		HOLE STARTED:	5-Jun-19
METHOD:			EXCAV. DATUM:		HOLE FINISHED:	5-Jun-19

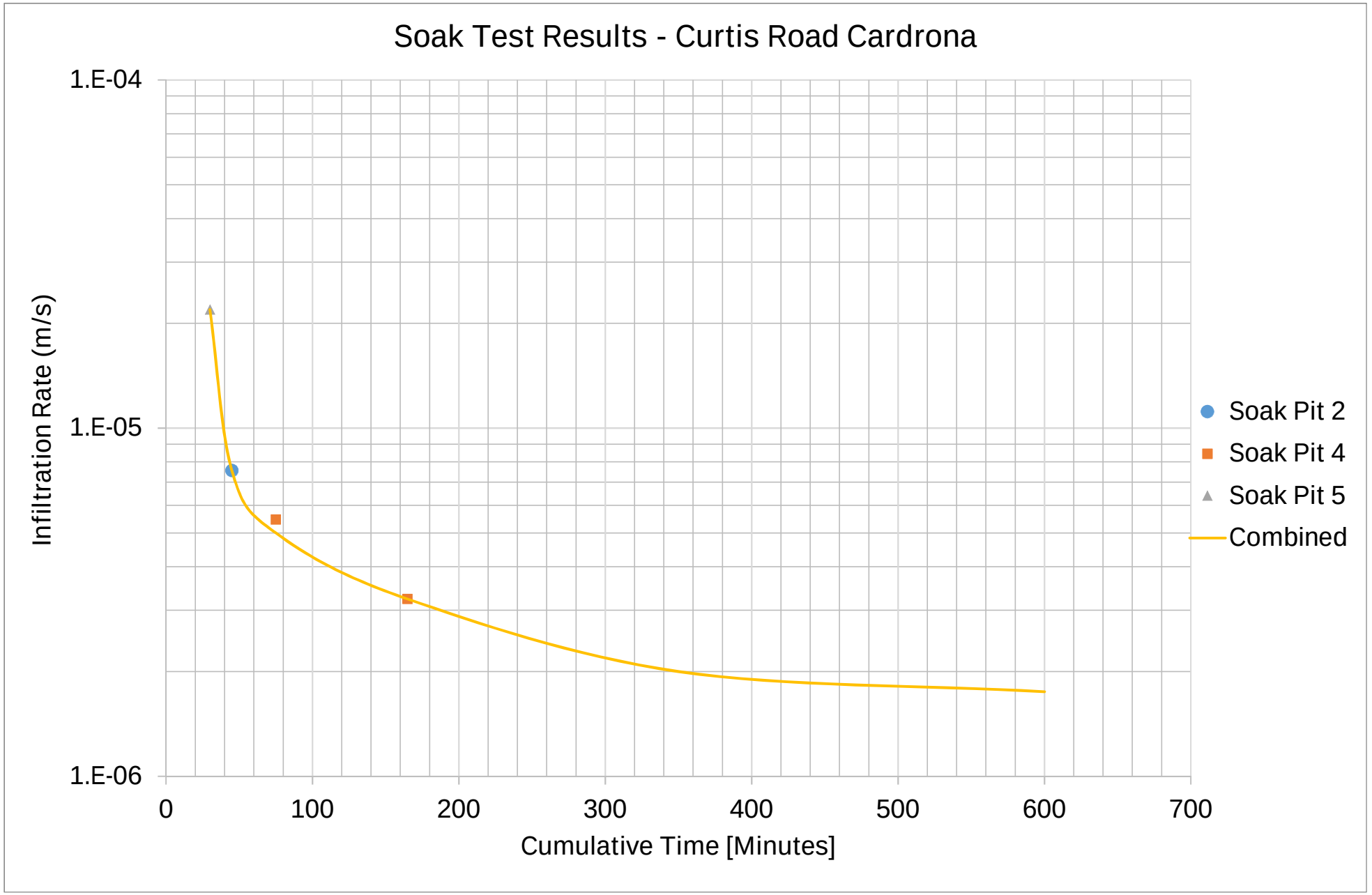
DEPTH (m)	SOIL / ROCK TYPE	GRAPHIC LOG	DESCRIPTION	USCS GROUP	GROUNDWATER / SEEPAGE	SCALA PENETROMETER
0.2	TOPSOIL		Dark brown, organic SILT with rootlets. Moist. Sluffed.			
0.5	SOFTENED FAN ALLUVIUM		Brownish grey, SILT with trace rootlets. Soft. Moist to wet. Sluffed.			
1.35	FAN ALLUVIUM		Brownish grey, SILT with minor sand. Silt is non-plastic. Stiff. Dry to moist.			
1.4	FAN ALLUVIUM		Brownish grey, silty GRAVEL with minor sand, cobbles & boulders. Gravel is fine to coarse. Gravel is sub-angular. Silt is non-plastic. Medium dense. Loose bedding. Dry to moist.		NO SEEPAGE	

Total Depth = m

COMMENT:	Logged By: MDP
	Checked Date:
	Sheet: 1 of 1

Appendix C: Soakage Results





Document Set ID: 6467044
Version: 1, Version Date: 20/03/2020

Appendix D: QLDC Wastewater Resource Consent Form

Onsite Wastewater Disposal Site & Soils Assessment

QUEENSTOWN LAKES DISTRICT COUNCIL

Use for Subdivision or Land Use Resource Consent

The design standard for waste water treatment and effluent disposal systems is AS/NZS 1547:2012. All references in this form relate to this standard.

Applications should provide sufficient information to demonstrate that all lots will be capable of accommodating an on-site system.

Site Description

Property Owner: Roberts Family Trust

Location Address: 10 Curtis Road
Cardrona 9381

Lot 6 DP344432 and Lot 1 425263

Legal Description (eg Lot3 DP1234) :

List any existing consents related to waste disposal on the site: BC 021461 - Existing dwelling - 10 Curtis Road

General description of development / source of waste water: Site Proposed to be Subdivided. Existing Lots to be Subdivided into 16 lots total (1 lot - lot 16 - has resource consent)

The number and size of the lots being created: 16 lots ~5000m²

Site Assessment (refer to Tables R1 & R2 for setback distances to site features)

Land use: Rural General

Topography: Undulating, ~~West~~ East facing

Slope angle: 0~20° approx.

Aspect: Eastery

Vegetation cover: Grass / Tussocks

Areas of potential ponding: n/a - slopes east

Ephemeral streams: See Site Plan

Drainage patterns and overland paths: Regular overland flow paths, see site plan

Flood potential (show with return period on site plan): no identified flood potential, with Return period.

Distance to nearest water body: ~15m

Water bores with 50m (reference ORC Maps): F41/0279 within 50m boundary (large distance 200+ from building platforms)

Other Site Features: Pougs Creek runs through site. Pringles Creek located adjacent to eastern site boundary

Slope stability assessment details – summarise any areas unsuitable for waste water irrigation.
(Attach report if applicable): Slope Stability attached. Wastewater Soakage Should be targeted below 1mbgl

(Highest potential) Depth to ground water:

Summer ~ 3.6m

Winter ~ 3.6m

Information Source Based on not encountering at max depth of test pits - (regional GW depth unknown)

What is the potential for waste water to short circuit through permeable soils to surface and / or ground water?
Unlikely - if targeted below 1m from the Surface - or very low design infiltration rate.

Soil Investigation (Appendix C)

Field investigation date: 5-7/6/19

Number of test pit bores (C3.5.4): 20

Soil investigation addendum to be attached that includes a plan showing test pit or bore location, log results and photos of the site profile.

If fill material was encountered during the soil investigation state how this will impact on the waste water system: No fill encountered

Average depth of topsoil: 0.2 - 0.25

Indicative permeability (Appendix G) : 0.14 m/d (1.7×10^{-6} m/s)

Percolation test method (refer to B6 for applicability) : Open Soak pit Test.
(attach report if applicable)

Soil Category *(Table 5.1)*	Soil Texture *(Appendix E)*	Drainage	Tick One
1	Gravel and sands	Rapid	
2	Sandy loams	Free	
3	Loams	Good	
4	Clay loams	Moderate	
5	Light clays	Moderate to slow	✓
6	Medium to heavy clays	Slow	

Reasons for placing in stated category:

Feild testing & Site observations.

Loading rate, DLR (Table L1):

Explanation for proposed loading rate:

Recommendations from site and soils assessment

Specify any design constraints
Specify any areas unsuitable for location of the disposal field
Specify any unsuitable treatment and/or disposal systems
Propose suitable mitigation to enable successful effluent treatment

Soakage targeted at depth <1m below grounds surface (to reduce further saturation and softening of the upper soil units).

Attachments Checklist

- [x] Copy of existing consents
- [x] Soil investigation addendum
- [x] To scale site plan, the following must be included on the plan:
  - Buildings
  - Boundaries
  - Retaining Walls
  - Embankments
  - Water bodies
  - Flood potential
  - Other septic tanks / treatment systems
  - Water bores
  - Existing and proposed trees and shrubs
  - Direction of ground water flow
  - North arrow

Note that an Otago Regional Council (ORC) consent may also be required to discharge domestic waste water to land if any of the following apply:

- Daily discharge volume exceeds 2,000 litres per day
- Discharge will occur in a groundwater protection zone
- Discharge will occur within 50 metres of a surface water body (natural or manmade)
- Discharge will occur within 50 metres of an existing bore/well
- Discharge will result in a direct discharge into a drain/water ace/ground water
- Discharge may runoff onto another persons' property

If any of these apply then we recommend that you correspond with the ORC;

Otago Regional Council
"The Station" (upstairs)
Cnr. Camp and Shotover Streets
P O Box 958
Queenstown 9300

Tel: 03 442 5681

I believe to the best of my knowledge that the information provided in this assessment is true and complete. I have the necessary experience and qualifications as defined in Section 3.3 AS/NZS 1547:2012 to undertake this assessment in accordance with the requirements of AS/NZS 1547:2012:

Company: Geosolve

Email: sreeves@geosolve.co.nz

Phone number: 027245 7470

Name: Simon Reeves

Signature:

Date: 16/01/2020

Queenstown Lakes District Council
Private Bag 50072
10 Gorge Road
QUEENSTOWN 9348

Phone: 03 441 0499
Fax: 03 442 4778
Email: services@qldc.govt.nz
Website: www.qldc.govt.nz

Consent Details

CHAS & JENNY ROBERTS	No.	**021461**
C/- SALMOND ARCHITECTURE	Issue date	10/12/02
PO BOX 470	Application date	26/11/02
WANAKA		

Project

DESCRIPTION	NEW CONSTRUCTION BEING STAGE 1 OF AN INTENDED 1 STAGES ERECT NEW DWELLING
INTENDED LIFE	INDEFINITE, BUT NOT LESS THAN 50 YEARS
INTENDED USE	RESIDENTIAL
ESTIMATED VALUE	$270,000
LOCATION	CARDRONA VALLEY ROAD, CARDRONA
LEGAL DESCRIPTION	LOT 10 DP 304819 - SUBJ TO ROW -
VALUATION NO.	2906125500

	DATE/INITIALS			Satisfactory			Unsatisfactory		
1. Foundations	22-5-03 CO			✓					
2. Floor – concrete	"			✓					
3. Walls – concrete									
4. Walls – timber (pre-line)	2.10.03			✓					
5. Floors – timber (pre-line)	"			✓					
6. Roof – timber (pre-line)	"			✓					
7. Drainage	12-11-03			✓					
8. Plumbing									
9. Water heater cylinder									
10. Surface water	16-4-04			✓					
11. External wall coverings	2.10.03			✓					
12. Internal wall/floor	16-4-04			✓					
13. Insulation	2-10-03			✓					
14. Fire Safety									
15. Access – stairs, ramps	16-4-04 HA			✓					
16. Ventilation									
17. Fire Appliance	16-4-04 HA			✓					
FINAL	16-4-04	10-9-04		X	✓				

22-5-03 FOOTING & SLAB - STEEL GOOD, SLAB NOT COMPLETED BUT LOOKS OK. G.C.

2.10.03 Pre-line insp. Framing ok. Bolting, tieing and strapping ok including exterior flashings

QUEENSTOWN LAKES DISTRICT COUNCIL

Building Consent

Section 35, Building Act 1991

Application

CHAS & JENNY ROBERTS	No.	**021461**
C/- SALMOND ARCHITECTURE	Issue date	10/12/02
PO BOX 470	Application date	26/11/02
WANAKA		

Project

DESCRIPTION	NEW CONSTRUCTION
	BEING STAGE 1 OF AN INTENDED 1 STAGES
	ERECT NEW DWELLING
INTENDED LIFE	INDEFINITE, BUT NOT LESS THAN 50 YEARS
INTENDED USE	RESIDENTIAL
ESTIMATED VALUE	$270,000
LOCATION	CARDRONA VALLEY ROAD, CARDRONA
LEGAL DESCRIPTION	LOT 10 DP 304819 - SUBJ TO ROW -
VALUATION NO.	2906125500

Contractor: TBA

Charges

The Council's charges paid on this Building Consent, in accordance with the attached details are:

	$	1,783.00
Building Research Levy	$	270.00
Building Industry Authority Levy	$	175.50
Total	$	2,228.50

This building consent is a consent under the Building Act 1991 to undertake building work in accordance with the attached plans and specifications so as to comply with the provisions of the building code. It is not a consent under the Resource Management Act and does not affect any duty or responsibility under any other Act nor permit any breach of any other Act.

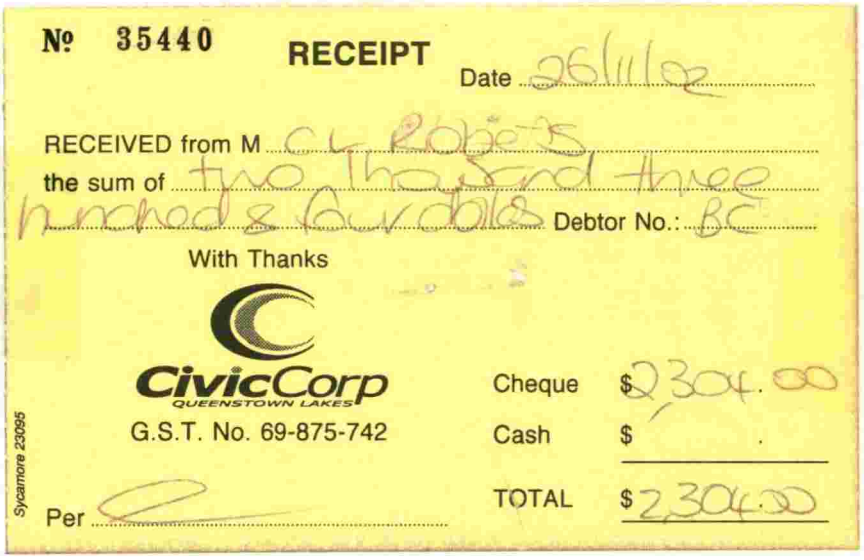
This building consent is issued subject to the conditions specified in the attached page(s) headed Conditions of Building Consent 021461.

Signed for and on behalf of the Council:

Name: [signature] **Date:** 10-12-02

1. The Owner or his authorised agent are reminded of their responsibilities to ensure that any conditions detailed are conveyed to the appropriate parties engaged to carry out works associated with this consent.
2. The owner or person undertaking building work to which this consent relates shall notify CivicCorp at least one working day prior to the covering up or closing in (as applicable) of any drainage, plumbing, foundation excavation, foundation reinforcing, fitting of insulation and closing in of any timber required to have a specified moisture content.
3. Subject to all construction not specifically detailed or specified being in strict accordance with the relevant clauses of the New Zealand Building Code.
4. Building materials, components and construction methods shall be sufficiently durable to ensure that the building, without reconstruction or major renovation, satisfies the other functional requirements of the NZBC throughout the life of the building.
5. Slab on ground floors are to be set at least 225mm above finished unprotected ground level, or 150mm above finished paved level. Where masonry veneer is installed dimensions can be reduced to 150mm and 100mm respectively.
6. Subject to the installation of all flashings necessary to ensure that the building is impervious to external moisture.
7. Wall and floor surfaces adjacent to sanitary fixtures and/or sanitary appliances shall be impervious and easily cleaned.
8. Glazing subject to human impact shall comply with the code of practice for Glazing in Buildings NZS 4223: Part 3: 1999.
9. Fixed appliances and fireplaces using the controlled combustion of solid, liquid or gaseous fuels are to be installed or erected in strict accordance with the provisions of:
10. - NZBC Clause B1 "Structure" - Acceptable Solution B1/AS3 - NZBC Clause 1 "Outbreak of Fire" - Acceptable Solution C1/AS1
11. One working days notice is to be given to facilitate inspection of the flue and liner penetration through concealed parts of the building structure such as floors, ceilings, roof spaces etc.
12. Subject to all proprietary products and systems being installed according to the manufacturers technical instructions and recommendations.
13. Barrier heights and construction are to comply with the provisions of the New Zealand Building Code, clause F4 "Safety from Falling and B1 "Structure".
14. Where the floor level is in excess of 1.0 metres above the adjacent finished ground level and the window sill height is less than 760mm above the floor level, barriers complying with NZBC clause F4 "Safety from falling" shall be provided or restrictor stays fitted to limit sash opening dimensions to 100mm for residential buildings and 460mm for other buildings unlikely to be frequented by children under the age of 6 years.
15. To enable a Code Compliance Certificate to be issued please complete "Advice of Completion" form which is attached to this consent and return to this office.
16. This consent has been processed and issued based on the information submitted. Issuing of this consent will not preclude Council from taking enforcement actions if field inspections demonstrate that the material submitted for the consent is inaccurate or incorrect.
17. Names and registration numbers of the craftsman registered plumber doing plumbing work and registered drainlayer doing drainage work to be submitted prior to work commencing.
18. Plumbing & drainage installation is to comply with N.Z.B.C Clauses E1, G12 and G13 or AS/NZS 3500.2.2 1996.
19. Plumbing installation must be carried out by a registered craftsman plumber.
20. Drainage work must be carried out by a registered drainlayer.

21. Water supply pipework to be pressure tested to 1500 KPA.
22. Drainage work to be tested.
23. On completion of drainage and water supply installation, an as laid site and services plan (Foul & Stormwater Drainage and Water Supply) must be submitted to CivicCorp before a Code Compliance Certificate can be issued.
24. Subject to the Producer Statement issued by Adam William Thornton (October 2002) for structural design.
25. Provide mechanical ventilation to the laundry cupboard, to comply with New Zealand Building Code, G4.
26. If more than two 45kg gas bottles are to be used, a Dangerous Goods Licence will be required.
27. Septic tank effluent disposal system to be installed and maintained as per Engineer's (John Hesseling) Design and Report.
28. Soil stack to be taken up above roof as open vent.
29. Sub soil drains to discharge via sump to stormwater system. Waste pipes over 3.5 metres in length to have trap water seal protection.



№ 35440 **RECEIPT** Date 26/11/02

RECEIVED from M C.L. Robertson

the sum of two thousand three hundred & four dollars Debtor No.: BC

With Thanks

CivicCorp QUEENSTOWN LAKES

G.S.T. No. 69-875-742

Cheque $2304.00

Cash $.

TOTAL $2304.00

Per

Sycamore 23095

n duplicate.

ildings. (Site Plan

lippage, alluvion,

in close proximity

dust, suppression

r it is on a marae,

, and Driveway.

structed to comply

Address: P.O. Box 710, Warkworth

Phone Number: ..... Fax Number: .....

BUILDER

Name: .....

Address: .....

Phone Number: ..... Fax Number: .....

DRAINLAYER

Name: ..... Reg. No. .....

Address: .....

Phone Number: ..... Fax Number: .....

PLUMBER

Name: ..... Reg. No. .....

Address: .....

Phone Number: ..... Fax Number: .....

GASFITTER

Name: ..... Reg. No. .....

Address: .....

Phone Number: ..... Fax Number: .....

NOMINATION OF THE GASFITTER AND ELECTRICIAN IS OPTIONAL UNDER THE BUILDING ACT EXCEPT WHERE THE BUILDING CONTAINS A COMPLIANCE SCHEDULE ITEM.

ELECTRICIAN

Name: ..... Reg. No. .....

Address: .....

Phone Number: ..... Fax Number: .....

CERTIFIERS

Name: ..... Reg. No. .....

Address: .....

Phone Number: ..... Fax Number: .....

Certifying .....

The building will con
procedures):

- ☐ Automatic
- ☐ Automatic
- ☐ Emergenc
- ☐ Emergenc
- ☐ Escape ro
- ☐ Riser mai
- ☐ Any autom
- ☐ Lifts, esca
- ☐ Mechanica
- ☐ Any other
  the buildin
- ☐ Building m
- ☐ Such signs
- ☑ None of th

15.

E2 : OTHER SY

Complete

The building will co
procedures):

- ☐ Means of
- ☐ Safety ba
- ☐ Means of
  Persons C

Electric

Gas

Solid Fuel

Floor electrical

Ceiling electrical

Storage electrical

ing

Electric

Gas

Solid fuel

$270,000

CIVICCORP FEES AND CHARGES

	$	c
Project Information Mem.	187	00
Building	1,596	00
BRANZ Levy	270	00
B.I.A. Levy	175	50
Connections Water		
Sewer		
Stormwater		
Photocopying		
Footpath/Street Bond		
FEE PAYABLE UPON APPLICATION $	2228	50

INFORMATION FOR APPLICANT

Fees are payable on application.

Additional charges may be incurred over and above this amount in accordance with council's current schedule of building control charges.

In making this application I agree to pay all costs of collection, including agency fees, court costs and disbursements made in the collection of any debt and reasonable solicitors' fees regardless of judgement.

Prepared by Anslie

Checked by

CONSENT No.: 021461

RECEIPT DETAILS

Debtor No.:

Receipt No.: 35440.

Date: 26/11/02

Plans ☐ Species ☐ Bracing ☐ Producer Certificate ☐

$75.50 difference

1. OWNER

Name: Chas

Postal Address: Wadesh

Phone Number: (H

Fax Number: (H

3. ADDRESS F

4. PROJECT L

Street Address:

LEGAL DESCRIPT

Lot(s):
(Section)

5. PROJECT

5.1 New Building

Alteration

Relocation

Demolition

☑ Application Bu

☐ Application fo

Signed by or for ap

APPROVED	✓	COMMENTS
FOUNDATIONS		
Footing	✓	
Wall	—	
FLOORS - Ground		
Slab	✓	
Timber	—	
Piles	—	
Bearers	—	
Floor Joists	—	
Flooring	—	
WALL		
Framing	✓	
Lintels	✓	
FLOOR - Upper		
Concrete	—	
Floor Joists	✓	
Flooring	✓	
WALL		
Framing	✓	
Lintels	✓	
ROOF		
Truss	✓	ENG.
Ceiling joists	—	
Ceiling runners	—	
Rafters	✓	
Under purlins	—	
Strutting beams	—	
Purlins	✓	
Ridge	—	
Roof covering	✓	
GENERAL		
Insulation	✓	
Bracing calculation	✓	
Design Certificate	✓	
Exterior Cladding	✓	

SUMMARY OF ITEMS NON-COMPLYING OR FURTHER INFORMATION REQUIRED

1. 2 × GAS BOTTLES ✓
2. VENT LAUNDARY CUPBOARDS
3. ~~[illegible]~~ BATHROOM & LOO.
4.
5.
6.
7.
8.
9.
10.

BUILDING		✓	COMMENTS
STABILITY			
B1	Structure	✓	
B2	Durability	✓	
FIRE SAFETY			
C1	Outbreak of fire (fire appliance)	✓	
C2	Means of escape		
C3	Spread of fire		
C4	Structural stability during fire		
ACCESS			
D1	Access routes		
D2	Mechanical installation for access		
MOISTURE			
E1	Surface water	✓	
E2	External moisture	✓	
E3	Internal moisture	✓	
SAFETY OF USERS			
F1	Hazardous agents on site		
F2	Hazardous building materials		
F3	Hazardous substances and processes		
F4	Safety from falling		
F5	Construction and demolition hazards		
F6	Lighting for emergency		
F7	Warning systems		
F8	Signs		
SERVICES AND FACILITIES			
G1	Personal hygiene		
G2	Laundering		
G3	Food preparation and prevention of contamination		
G4	Ventilation	✓	
G5	Interior environment		
G6	Airborne impact sound		
G7	Natural light	✓	
G8	Artificial light		
G9	Electricity		
G10	Pipes services		
G11	Gas as an energy source		
G12	Water supplies		
G13	Foul water		
G14	Industrial liquid waste		
G15	Solid waste		
ENERGY EFFICIENCY			
H1	Energy efficiency	✓	

021461

ISSUE OF CONSENT SUBJECT TO FOLLOWING CONDITIONS:

R.M. Certificate Required Y / N

1-5a-6-7-2d-34-7b-14-2-2a-26-33-15-22a-19-44.

SUBJECT TO THE PRODUCER STATEMENT ISSUED BY. ADAM WILLIAM THORNTON (OCT 2002) FOR STRUCTURAL DESIGN.

PROVIDE MECHANICAL VENTILATION TO THE LAUNDRY CUPBOARD, TO COMPLY WITH NZBC G4.

IF MORE THAN 2 45kg GAS BOTTLES ARE TO BE USED A DANGEROUS GOODS LICENCE WILL BE REQUIRED.

Prod SEPTIC TANK EFFLUENT DISPOSAL SYSTEM TO BE INSTALLED AND MAINTAINED AS PER ENGINEERS [JOHN HESSELING] DESIGN AND REPORT. SOIL STACK TO BE TAKEN UP ABOVE ROOF AS OPEN VENT. SUB SOIL DRAINS TO DISCHARGE VIA SUMP TO STORM WATER SYSTEM. WASTES PIPES OVER 3.5 METRES IN LENGTH TO HAVE TRAP WATER SEAL PROTECTION. 10- 45- 46- 47- 49- 50- 51.

P & D Inspector: _____ **Date:** 9.12.02

Building Inspector: _____ **Date:** 9-12-02

QUEENSTOWN LAKES DISTRICT COUNCIL

Code Compliance Certificate

Section 43(3), Building Act 1991

Application

CHAS & JENNY ROBERTS	No.	021461
C/- SALMOND ARCHITECTURE	Issue date	13/09/04
PO BOX 470		
WANAKA		

Project

Description	New (& prebuilt) House, Unit, Bach, Crib, Town House etc.
	Being Stage 1 of an intended 1 Stages
	ERECT NEW DWELLING
Intended Life	Indefinite, but not less than 50 years
Intended Use	RESIDENTIAL
Estimated Value	$270,000
Location	CARDRONA VALLEY ROAD, CARDRONA
Legal Description	LOT 10 DP 304819 - SUBJ TO ROW -
Valuation No.	2906125500 11

This is a final Code Compliance Certificate issued in respect of all the building work under the above building consent.

Signed for and on behalf of the Council:

Name: [signature] **Date:** 13-9-04

CivicCorp, Private Bag 50077, Queenstown, Tel 03-442 4777, Fax 03-442 4778.

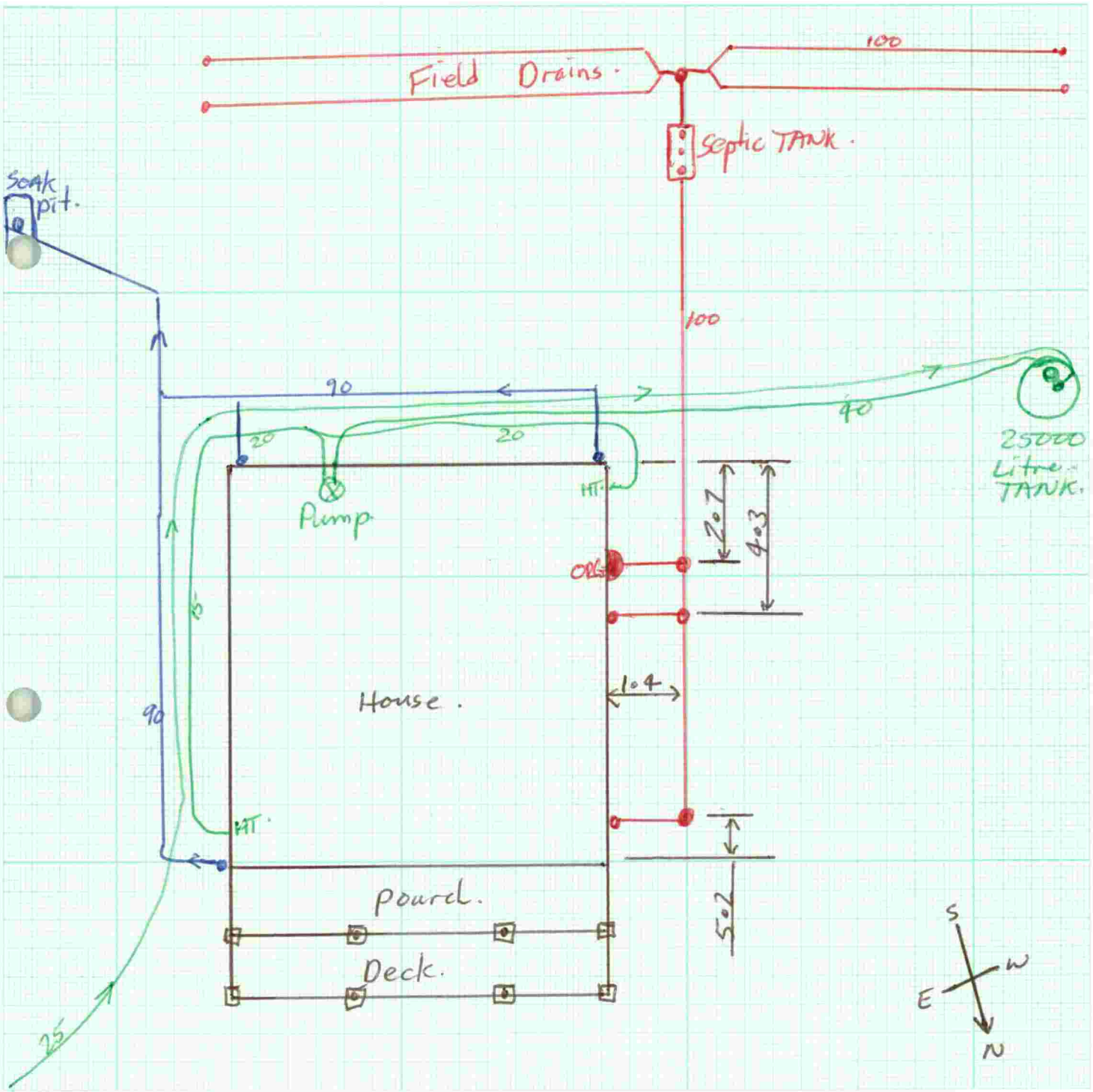
QUEENSTOWN LAKES DISTRICT COUNCIL

DRAINAGE BLOCK PLAN

KEY:

AP	-	Access Points	FAI	-	Fresh Air Inlet
RP	-	Rodding Points	TV	-	Terminal Vent
IP	-	Inspection Points	IC	-	Inspection Chamber
YP	-	Junction Pipe	AC	-	Acess Chamber
GT	-	Gully Trap	ORG	-	Over Flow Relief Gully

SCALE:
TO BE SUBMITTED PRIOR TO, OR AT TIME OF INSPECTION



NOTE: PLEASE ALSO SHOW POSITIONS OF WATER TOBY ON THIS PLAN!

VALUATION NUMBER 29061/255 **BC NUMBER** 021461

LOT ..... **DP** ..... **OWNER** Roberts. **DATE** .....

Signature Mawer plumbers Reg. Number 054451

OFFICE MEMO

FILE REF: 29061/255

TO: ALEX

FROM: HANS ARNESTEDT

DATE: 16/04/04

SUBJECT: **ROBERTS HOUSE**

The following matters requires attention prior to the CCC can be issued:

1. Complete the installation of the ridge flashing and the felt edge flashing into the bottom of the corrugations.
2. It appeared that the top of the verandah roof iron sheets have not been nailed down.
3. The spoutings and down pipes had not been installed at the time of the inspection.
4. Has the effluent system been designed for a garbage grinder in the sink?
5. The laundry tub shall be fixed to the wall or the floor.
6. I could not find the 2 inlet vents for the Jetmaster Fire. The two outlet vents shall be provided with bird netting.
7. The bedroom window on the 1st floor shall be provided with a restriction stay.
8. The chimney for the free standing fire place shall be provided with an approved roof flashing.

Regards
Hans Arnestedt

FINAL INSPECTION CHECK LIST

Inspector: _____ *Date:* 16.4.04 *BC:* 021461

EXTERIOR		
Consent conditions		
Ground heights		
Sub-floor ventilation		
Cladding		
Flashings		
Roofing		Ridging to be completed - Nail top of verandah roof (East Northern)
Spouting		Missing at the rear ✓
Gullytraps		
Terminal vents		
As-built drainage plan		
Durability		
		Kitchen waste disposal units ? ✓
INTERIOR		
Consent conditions	✓	
Floor plan	✓	
Floor coverings	✓	
Wall linings	✓	
Bathroom fittings		Laundry tub to be fixed ✓
Ventilation	✓	
Fire appliance	✓	Mapua Flueing WEE RAD 190mm ✓ Vents to Jetmaster ✓ Bird-guard
Insulation	✓	
Stairs	✓	
Hand rails	✓	
Barriers		Window to floor ✓
HWC restraints		gas ✓
HWC valves		
Water temperature		gas ✓
Producer statements		
Electrical certificate		
Gas certificate		
COMMERCIAL		
Fire requirements		
Fire alarm, certificate		
Disabled access		
Disabled facilities		
Signage		
Compliance Schedule		

Appendix E: Lot 16 Geotechnical Report

ROYDEN THOMSON, GEOLOGIST

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29 October 2009

Andrew Morris
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QUEENSTOWN

Dear Andrew

PROPOSED ROBERTS PLATFORM, CARDRONA:
GEOTECHNICAL APPRAISAL OF THE SITE

Please find below a discussion on the site geology and perceived prospective issues that could arise during the construction phase. Mapping was essentially constrained to the platform vicinity, but supplementary information has been derived from aerial photos and I have some background knowledge of the geology from previous work on Mt Cardrona Station.

Geological Setting

(a) Physiography

As indicated by Figure 1, and attached photos, the proposed site lies on the west flank of a very minor ridge in a stream-dissected, moderate relief area. The latter is flanked to the south and west by scarps, beyond which are older, high-level, fan remnants.

At a site-specific scale, the platform would occupy a shallow basin, which faces to the north-west (Fig. 2a, Photo 3). Slope gradients in the interest area are low to moderate.

(b) Rock Types and Distribution

There are few obvious outcrops in the area, and I haven't attempted to resolve the lithological configuration, but a tentative model follows.

i Schist appears to form the minor, host ridge. It is likely to be strongly weathered.

Schist may well form the effective basement elsewhere in the Pongs Creek subcatchment (Fig. 1), but I suspect the presence of weak, Tertiary-age, lake sediments in the area as a hummocky terrain is a prominent, local characteristic. This aspect not resolved.

ii Fans, of different ages and with differing elevations, have been constructed by the various tributaries draining off the Mt Cardrona ridge. Several can be viewed on Photo 1; the most prominent are the high level surface(s) to the south of the site and a younger surface adjoining lower Pringles Creek (lower right in photo), but there are intermediate surfaces, such as the remnants in Pongs Creek. Without attempting some stream and fan profiling, I interpret the residual deposits near the site as one of the latter.

iii Landslides are ubiquitous in the lower relief regions flanking the site, where hummocky terrain clearly indicates mass movement at unknown rates of creep (Photo 2).

(c) Tectonic Structure

The site is generally in the vicinity of the NW Cardrona Fault Zone, and may lie within it. Exact positions of surface traces of the strands are largely unknown near the site, hence future surface rupture localities remain enigmatic.

I have not attempted to assess the seismotectonic risks to the site but note that:

- there are no obvious recent scarps near the platform, nor are they present on the fan surface to the south.
- as the proposal develops one, or more, territorial authority may request a site-specific assessment of the faulting hazard, so an additional item of geological work may be required as part of the consent process.

(d) Surface Flows and Groundwater

East-trending streams are closely-spaced in the area (Fig. 1). At the time of our visit all were actively flowing but most are likely to be ephemeral. Streams are, in part, spring fed.

Site Geology

(a) Physiography

The dominant feature is a slightly arcuate, NE-SW-trending ridge which tends asymmetric in section (Figs. 2a, b). On the north flank there is a shallow gully (Photos 3, 4), the axis of which trends north-west, also in arcuate manner. Slope angles for both the platform and access road regions are low to moderate (Photos 4, 5).

(b) Rock Types and Distribution

i The effective basement appears to be schist, on the basis of several small outcrops along the cut batter above the road to the south-east of the site.

Such a projection leads to a speculative determination of the subfoundation lithology at the platform. If correct, the schist is likely to be moderately to highly weathered, and soft.

ii Alluvial fan remnants cap the ridge at two localities (Fig. 2a). Surface debris and stacked stone heaps indicate a coarse, bouldery alluvium is present but the basal elevation cannot be determined at either of the remnants. It is unlikely this lithology will impact on any construction activities.

iii Mass movement deposits clearly flank the ridge on its eastern side (Fig. 2a), nominal directions of creep being illustrated.

To the west there are no obvious landslide features originating on the ridge. However, the shallow gully hosting the platform, while not now containing obviously hummocky relief elements (Photo 4), may have been a site of former landsliding. Again, this is a speculative interpretation.

(c) Groundwater and Surface Flows

There are no indications of erosion gutters within the gully so overland flows must be minor, as would be expected in such a small catchment. This has to be qualified in that much of the area

has been recently ploughed - green area on Photo 4 - perhaps obliterating some erosion features in lower reaches of the gully.

A minor spring had caused ground saturation within the gully, outside of the platform footprint (Fig. 2a; Photos 3, 4). This can only be sourced within the super-adjacent gully and is assumed to be ephemeral. Why groundwater should daylight here is conjectural, but it is probably where a low permeability geological unit intersects the surficial deposits.

Perceived Geotechnical Issues

(a) Roading

The existing road, south-east of the site, appears to traverse soft materials that do not inherently provide a good surface. While accepting it is largely on landslide deposits, there is an inference that locally-derived, disturbed schist is weak.

The proposed access road, however, appears to be on an in situ terrain, which is probably weathered schist that will have a minimal moisture content. Construction and maintenance problems are unlikely, but adverse conditions cannot be ruled out until affected lithologies are determined.

(b) Platform Excavations

At the south end of the platform cuts to about 5m in depth are proposed but batter angles, at 2:1, should be stable, unless anomalously weak materials - assumed schist - are encountered. Bearing strengths should be adequate, even in weathered schist, but there could be locally moist materials at final floor levels, so some mitigative works could be required.

(c) Platform Fill Zone

As indicated by Figures 2a and 2b, about one third of the platform is on fill, the toe of which extends to beyond the spring. Of prospective concern are:

- the characteristics of the cut material when reworked. Should it be soft, highly weathered schist, there could be compaction problems - a speculative item.
- the nature and extent of drainage mitigation works.
- stripping volumes in the fill footprint. At present, the thicknesses of surficial deposits (soil, loess) are unknown.
- the integrity of the nominal basement lithology.

Conclusions

(a) The proposed site lies in a minor embayment on the west flank of a minor ridge. Surrounding areas have moderate relief and there are numerous, east-draining streams which bracket the host ridge.

(b) Very limited outcrop information indicates the ridge is composed of weathered schist. A residual stream fan caps the crest and there is landsliding along the eastern flank.

(c) The position of the site with respect to the NW Cardrona Fault Zone is uncertain; no specific work has been undertaken to assess seismotectonic risks. However, there are no obvious fault traces in proximity to the site, suggesting the risk of direct tectonic displacement is extremely low in the dwelling's lifetime

(d) Assuming the subfoundation lithology at the platform is weathered schist, there is unlikely to be adverse effects on proposed cuts (2:1 batters) or within the cut section of the dwelling footprint.

(e) Part of the platform is to be constructed on fill. Potential concerns in this segment include:

- the characteristics of the (assumed) weathered schist when compacted.
- the amount of stripping required to remove surficial deposits.
- the influence of groundwater, a probable seasonal occurrence, and the drainage works required to mitigate its influence.

Recommendations

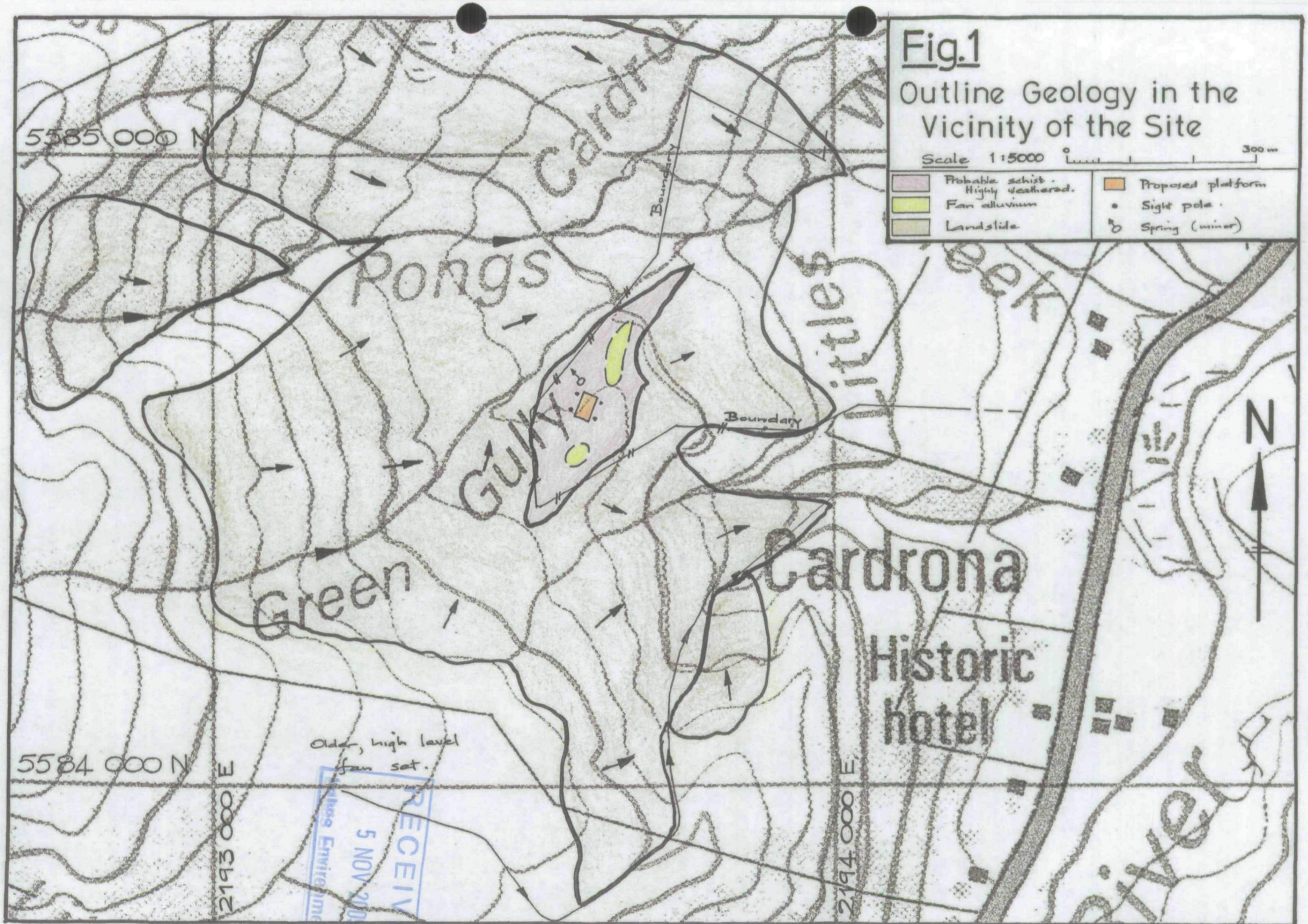
(a) Test pit in the platform vicinity to assess the subfoundation lithologies and their characteristics relative to both fill construction and stripping requirements.

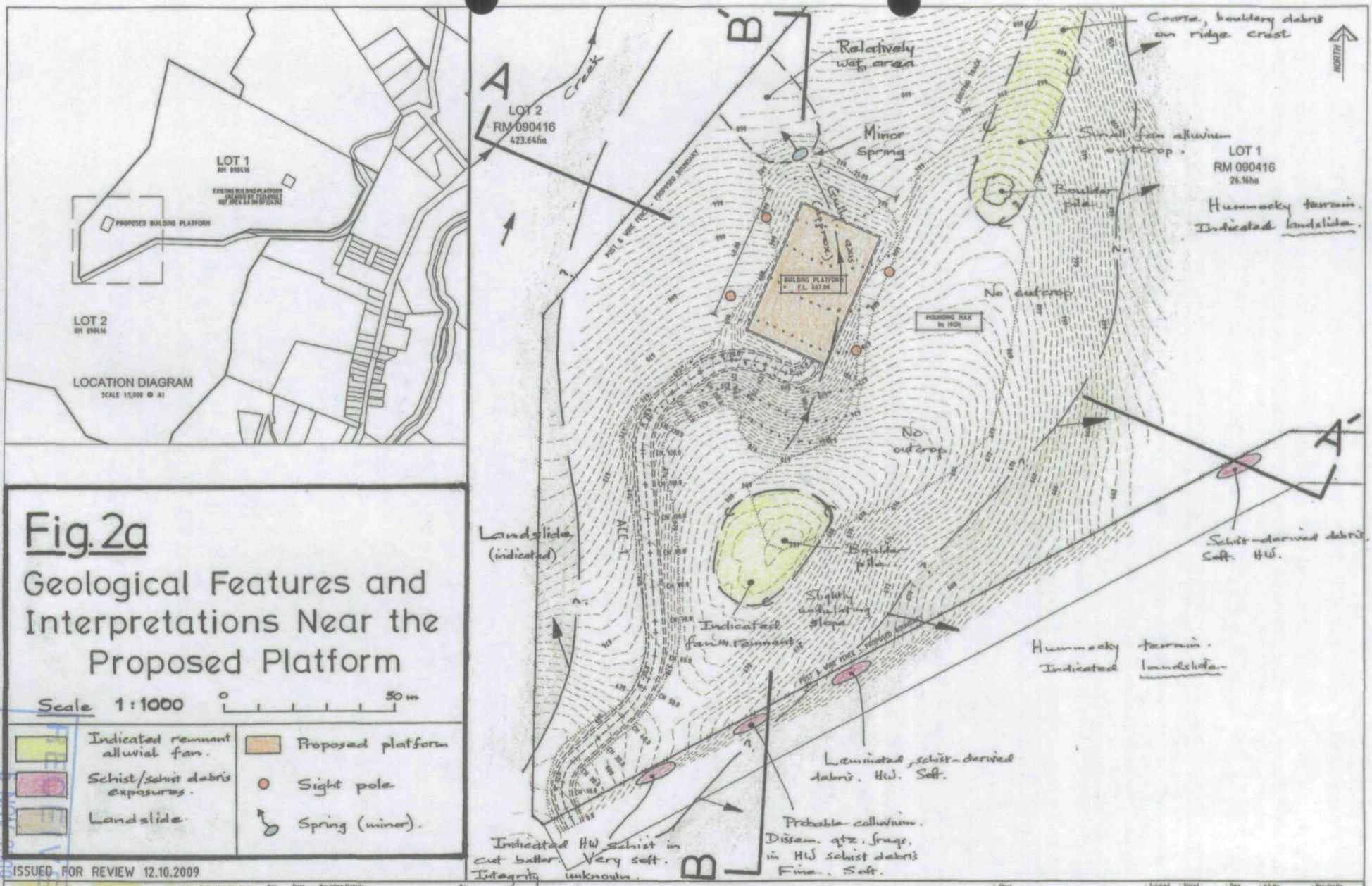
(b) Attempt to rationalise the spring source, and its potential impact on the foundation area.

(c) Depending on material properties determined in (a), above, a test pit in the fan alluvium remnant to the north-east of the site may be beneficial in the definition of prospective fill sources.

There remain some uncertainties with the site, such as subfoundation lithologies and the seismotectonic issues, but I don't perceive any geotechnical factors that would render it as being untenable. Really a matter of applying "engineering solutions", in my view.

Regards,





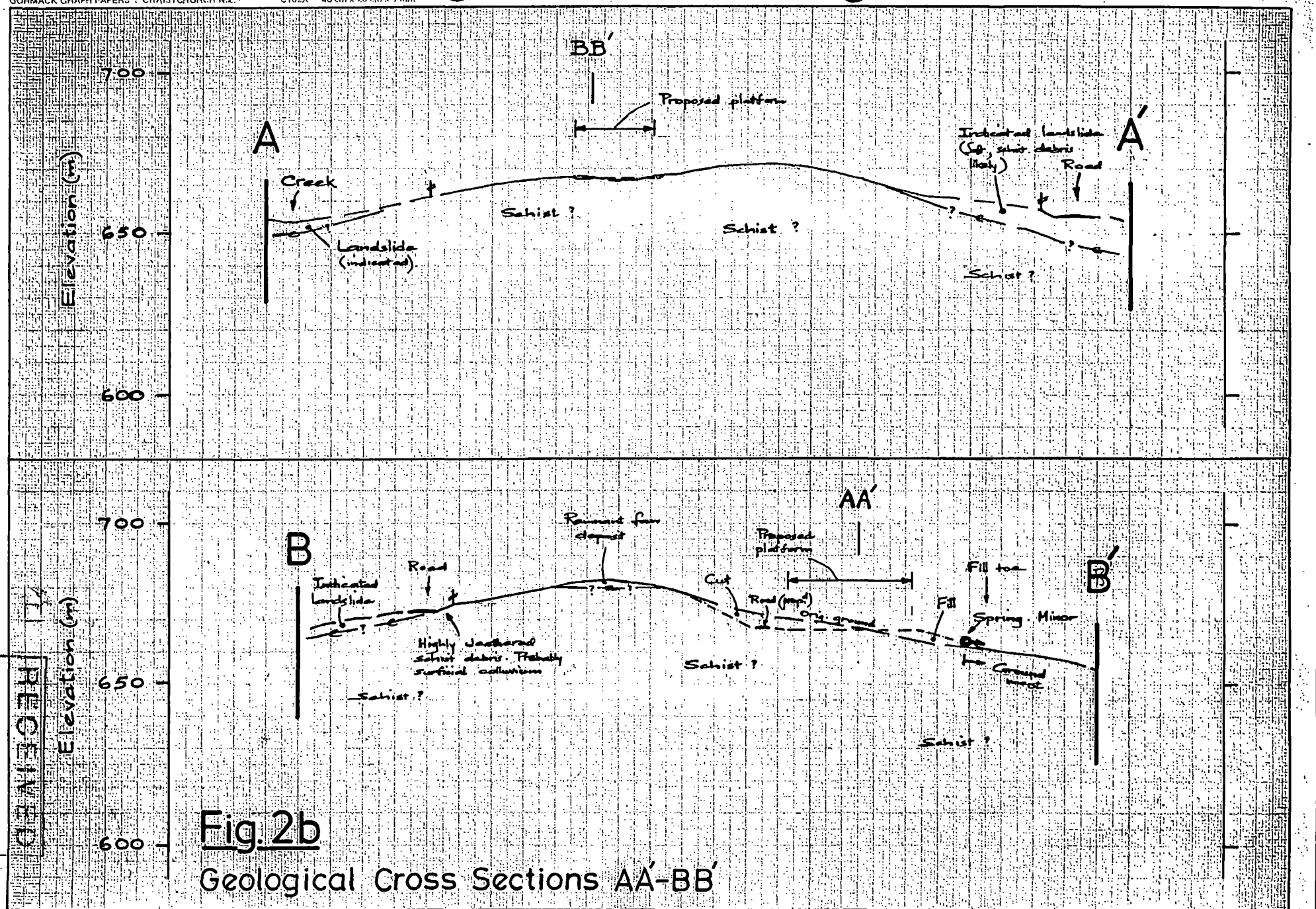


Fig. 2b

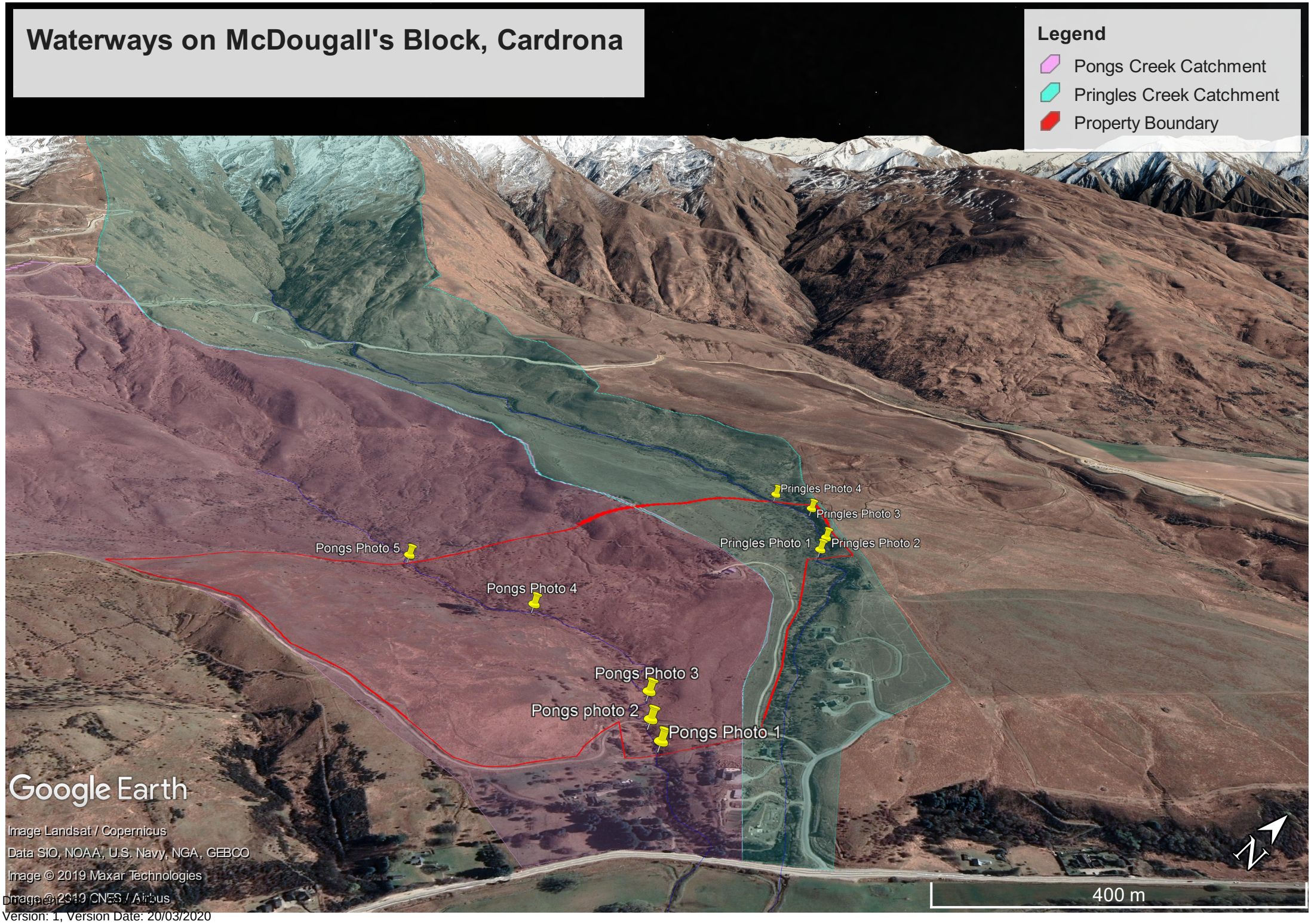
Geological Cross Sections AA'-BB'

Attachment

Captions for photos of the site and surrounds

Photo	Description
1	Looking SW to the hill slopes generally west of Cardrona Township. Note: • The proposed Roberts platform lies just behind the crest of the green patch, just below photo centre. • Stream fans, at various elevations, are prominent geomorphic features. • Hummocky terrains, reflecting landslide masses, are obvious in the central region of the photo.
2	Looking SSE to the site and surrounds. Note: • The proposed platform lies on the near side of the minor ridge at photo centre. • Extensive landslide (hummocky) terrain in foreground and mid distance areas.
3	Central section of Photo 2. The site for the proposed platform lies within the shallow basin at photo centre. Note a minor dark patch below photo centre; the position of a small spring.
4	Close view of the site, looking SE. Note: • A small spring beneath photo centre. • Indicated fan alluvium remnants at far left and at the hill crest, right of centre. • Lack of outcrop, in general. • Four sight poles, defining a previous platform position which presumably had a centroid common with the current design.
5	Looking SW to the proposed site. The centroid of the platform would be approximately at photo centre.

Waterways on McDougall's Block, Cardrona



Version: 1, Version Date: 20/03/2020

Pongs Creek

Photo 1. Pongs Creek at lower property boundary. Width 2.8

Photo 2. Pongs Creek. Typical lower section. Well contained. Width 1.6

Photo 3. Pongs Creek. Very slow flowing through some parts of central section

Photo 4. Pongs Creek. Typical upper section. Swifter flowing, well contained Width 1.7

Photo 5. Pongs Creek at upper property boundary. Width 2.3

Pringles Creek

Pringles Photo 1. Pringles Creek at lower property boundary. Width 1.7

Pringles Photo 2. Pringles Creek. Typical swift flowing mid section. Width 2.1

Pringles Photo 3. Pringle Creeks. Swift flowing midsection. Well contained within defined river banks. Width 1.6

Pringles Photo 4. Pringles Creek at Upper property boundary. Width 2.4

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CSNZ THE CONSULTING SURVEYORS OF NEW ZEALAND
A DIVISION OF THE NEW ZEALAND INSTITUTE OF SURVEYORS

21 October 2019

Leon West
Project Manager
Maestro Projects Ltd
PO Box 1625
QUEENSTOWN

Waterways on McDougall's Block, Cardrona – Inspection Report

On Friday 18 October 2019, I, Matthew John Suddaby, Licenced Cadastral Surveyor with 25 years of experience undertook an inspection of waterways on the McDougall's Block, Cardrona Valley, to determine stream widths.

The weather was overcast. There had been significant spring rainfall the previous week. The streams were running high but generally clear within their normal flood banks. There were some sections where the water was running over green grass and reeds indicating to me that the streams were running higher than normal.

Methodology of Investigation

The streams were visually inspected to ascertain typical sections of stream over which to make the measurements. Both streams were walked from lower boundary to upper boundary and measurements were made and photos taken at intervals of approximately 30-40m.

Photos were taken of each stream and waypoints taken as a reference for the photos. The photos include a 3m staff placed across the stream to give scale to the stream.

The measurements were tallied, and an average width derived.

The Waterways

Pongs Creek
Pongs Creek is a small waterway with a catchment of approximately 160ha on the western flanks of the Cardona Range. Pongs Creek has a relatively flat catchment which drains to the Cardona River.

The banks of the stream have differing characteristics. In the lower sections the water is contained within deep grass banks, while higher up there are sections where the banks are much less defined and flow meanders through wet farmland.

There are occasional sections, particularly in the lower reaches where there is evidence of flow approaching 3.0m. These sections were isolated, and atypical. For the most part the stream has a width of around 1.8-2.4m.

Pringles Creek
Pringles creek is a small steep waterway with a catchment of approximately 400 hectares. This catchment extends to the summit of the Cardrona Range and drains a large part of the Cardrona Ski Field into the Cardrona River.

This is a large catchment, and there was a significant flow at the time of inspection. The banks of the stream are clearly defined and although the stream was running full, there was no sign of recent flooding.

The section of stream inspected was bordered by scrub and bush along each bank.

Measurements taken along the length of Pringles Stream through the property have an average width of between 2.0 and 2.5m.

Historical Survey Data

As topographical features, DP 304819 records the position of Pongs Creek at 1.5m wide, and Pringles Creek at 2.5m wide. No Marginal Strips or Esplanade Strips have been registered on the certificate of titles either upstream or downstream of the inspected sections.

Summary

Neither Pongs Creek or Pringles Creek are qualifying rivers in terms of Section 230(4) of the Resource Management Act as they do not have an average width of 3.0m or more where they flow though the property.

Yours faithfully

Matthew Suddaby
Registered Professional Surveyor/ Licensed Cadastral Surveyor.

Attachments:

Plan showing catchment extents and photo locations
Photo Supplement