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GEOTECHNICAL

WATER RESOURCES

PAVEMENTS

NB. This is the developers development geotech report
Please use this report as a general guide.
It is not Site Specific. You may still be required to obtain your own site specific geotech report for building consent?

Geotechnical Report

11 Centre Road Subdivision

Ocean Grove, Dunedin

NB. This is the developers pre earthworks development geotech report. Please use this report as a very general guide only!.
*It is **not** Site Specific. You may still be required you to obtain your own site specific geotech report for building consent?*
More relevant will be the earthworks completion report when available closer title

Report prepared for:

Willowridge Developments Limited

Report prepared by:

GeoSolve Limited

Distribution:

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Paterson Pitts Group

GeoSolve Limited (File)

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GEOTECHNICAL WATER RESOURCES PAVEMENTS

Table of Contents

1 Executive Summary

- We are in receipt of a subdivision scheme plan from Paterson Pitts Group (reference 17023, dated 13 December 2021) which indicates the proposed development is for a 52-lot subdivision and associated accessways.
- An engineering geological site appraisal has been undertaken with confirmatory subsurface investigations. GeoSolve Ltd visited the subject property undertaking geotechnical investigations between May and November 2021comprising 33 machine excavated tests pits and associated Scala penetrometer testing.
- Apart from a surficial layer of topsoil (or topsoil mixed with fill), the site is underlain by extensive dune sand deposits, which overlie colluvium then weathered Dunedin volcanic rock. The dune sands are generally absent or thinner within the sloping north-eastern lots.
- Geosolve are supervising the construction of earthworks at the site and will provide a completion report once that work is completed.
- We recommend that any subsequent excavations within lots should be subject to the advice in Table 6.2 and inspected by a geotechnical practitioner during earthworks construction.
- There are standard foundation solutions available across all the lots within the subdivision. Further comment is provided in Section 6.8 of this report.
- Further geotechnical investigations in accordance with NZS3604:2011 are the minimum requirement at the building consent stage for individual lots. The recommendations in this section are suitable for subdivision consent purposes only.
- Locations where erosion could present a future risk should be treated with erosion protection measures such as various matting products and/or plantings.
- There are no geotechnical constraints or hazards that would preclude residential development of the site.

2 Introduction

2.1 General

This report presents the results of geotechnical investigations carried out by GeoSolve Ltd in order to determine subsoil conditions and provide geotechnical inputs for a proposed subdivision at 11 Centre Road, Ocean Grove, Dunedin.

The report is designed to provide information to enable assessment of geotechnical considerations and hazards for the proposed subdivision and does not provide full geotechnical advice for development of individual lots, as plans for structures are not yet available.

Photo 1.1 – Proposed subdivision scheme plan, 11 Centre Road.

The investigations were carried out for Willowridge Developments Ltd in accordance with GeoSolve Ltd's proposal and agreement dated 12 November 2021, which outlines the scope of work and conditions of engagement.

This is GeoSolve Ltd's third stage of involvement in this project; initial inputs were provided at feasibility stages, followed by advice for the earthworks and roading construction stage and now the subdivision assessment stage.

2.2 Development

We have reviewed the proposed subdivision scheme plan from Paterson Pitts Group (reference 17023, dated 13 December 2021) which indicates the proposed development is for a 52-lot subdivision with associated accessways.

The proposed subdivision layout is shown in Figure 1, Appendix A. Main access will be off Tomahawk Road and Centre Road.

Relatively significant earthworks are proposed as shown in Figure 2.1, with localised cuts of up to 6 m and fills of up to 4 m. The largest cuts are localised to areas where sand dunes are to be levelled. No earthworks are proposed on the sloping north-eastern lots, which naturally slope at up to 20 degrees.

Figure 2.1: Preliminary Earthworks Plans (Reference Paterson Pitts, D17023-02, Dated August 2021)

All final lot profiles appear to generally slope less than 20 degrees and often much gentler. Some localised areas of modified land, associated with road cuts slope up to 30 degrees locally but in isolated areas only.

This report advises on general hazard considerations, slope stability, general requirements for earthworks batters, slope retention, drainage measures, foundation considerations and further work that may be required as part of the final development.

3 Site Description

3.1 General

The subject property is located in the suburb of Ocean Grove, which is situated approximately 5 km southeast of central Dunedin, as shown in Figure 3.1 below.

Figure 3.1 – Site location plan

The site has been surveyed by Patterson Pitts Group (reference 17023, dated December 2021) and the site topography is shown in Figure 1, Appendix A and the appended cross sections. The existing slopes on site are highly variable as a result of the sand dunes present, with some steep ground over localised areas up to 30 degrees.

The difference in elevation between the highest and lowest surveyed parts of the site is approximately 50 m.

At the time of the investigations, the site was partially developed with main accessways as well as a large pond having been partially constructed. It is understood some existing structures were demolished in early stages. The site is generally vegetated with grasses, shrubs and some small to medium sized trees.

The site is bounded to the east by Centre Road and developed and undeveloped residential properties bound the site to all other sides. Main access to the site is from either Tomahawk or Centre Roads via a partially constructed (at the time of the investigations) roadway within the proposed subdivision.

The site is naturally free draining, and no spring flows are evident on the slopes, though some perched water was observed near the base of sand dune deposits.

4 Geotechnical Investigations

An engineering geological site appraisal has been undertaken with confirmatory subsurface investigations. GeoSolve Ltd visited the subject property undertaking geotechnical investigations between May and November 2021comprising:

- 33 machine excavated tests pits which were advanced to a maximum depth of 3.7 m;
- Dynamic cone (Scala) penetrometer tests were undertaken at most test pit locations advancing to 2.4 m or refusal;

Test pit and Scala penetrometer locations and logs are contained in Appendices A and B respectively.

5 Subsurface Conditions

5.1 Geological Setting

5.1.1 Regional Geology

The geology of the Dunedin area is dominated by volcanic rock types of basaltic to andesitic composition that were intruded through pre-existing marine sediments during Miocene times. Extensive volcanism at that time produced lava flows and bedded volcanoclastic materials were widely distributed by eruptions. The generalised stratigraphic profile comprises schist at depth, overlain by a Cretaceous to Tertiary-age sequence; initially by thin non-marine sediments and then a thick accumulation of marine sediments including sandstones and mudstones. The volcanic rock types cross cut these sediments where vents were present and extensively mantle them where lava flows or volcanic ejecta were deposited.

More recently (Pleistocene times), the hills of Dunedin have been extensively mantled by windblown loess and localised sands deposits to depths of up to several metres. Watercourses and tidal embayments such as Otago Harbour have locally deposited alluvial, estuarine and marine deposits and generally modified the volcanic landscape by deep incision and sedimentation. Fill and refuse has been placed locally during post-settlement times. Landslips have occurred on steeper hillsides particularly where springs emerge or where fills have been placed.

The lower half of the site is mapped by GNS Science to contain Holocene shoreline deposits containing loose well sorted sand deposited predominantly by marine and lesser aeolian processes minor gravel and silt. The upper half of the site is mapped to contain rock of the Dunedin Volcanic Group which are also expected to underlie the deeper sand deposits.

5.1.2 Seismicity

Dunedin has traditionally been considered to have lower than average seismic activity when compared to other areas in New Zealand, however nearby active faults are known and strong shaking is certain to occur periodically.

Cook et al[1] states that the earthquake hazard in Dunedin is dominated by relatively infrequent moderate to large earthquakes (magnitude up to M_w 7.5) in eastern Otago, and large to very large earthquakes in the much more seismically active Fiordland and Westland regions.

The nearest active faults with demonstrated Late Quaternary movement history are the Green Island Fault and the Akatore Fault. The Green Island Fault is currently considered to be the cause of the 1974 earthquake that caused damage in Dunedin. It is mapped approximately 12 km to the southwest of the subject site, but its general projections could continue through South Dunedin and may run northeast up the harbour in which case it would pass within about 4 km of the site.

The nearest mapped trace of the Kaikorai Fault also passes within about 4 km of the site and this is potentially active.

[1] Cook, DRL, McCahon, IF and Yetton, MD (1993). The Earthquake Hazard in Dunedin. Study funded by EQC, Research Project 91/56.

The Akatore Fault is expected to have a recurrence interval of 2-3,000 years[2]; however a recent paleoseismic study of the Akatore fault[3] found that three recent ruptures of this fault which occurred in the past 15,000 years (two of which occurred in the past 1,300 years) were preceded by a minimum 110,000 year period of quiescence, suggesting this fault exhibits strong aperiodicity of earthquake occurrence. The authors suggest it is prudent to assume that the relatively high rates of recent fault activity will continue, with an estimated recurrence interval of 450-5110 years.

These faults are likely to be capable of generating magnitude 7.5 earthquakes in Dunedin.

There are a number of other faults not mapped by GNS Science as "active" that lie within 5 km of the site, with the nearest fault mapped approximately 3 km to the east of the site. The recent Canterbury earthquakes have highlighted the issue that previously unidentified faults or presumed activity status may be very significant factors in the actual future risk applying to any particular site.

It should be noted the fault terminations shown on fault trace maps are often approximations (owing to lack of data) and the presence of other active faults may be unknown because they may be obscured by overburden soils.

Other known faults that have some potential to cause strong shaking in Dunedin are the Titri Fault and the North Taieri Fault, located roughly 13 km and 19 km west/northwest of the site, respectively.

The above discussed faults are not included in Table 3.6 of NZS 1170.5:2004 as major faults requiring near fault factors when assessing structural design actions.

Strong ground shaking throughout the South Island is likely to be associated with a rupture of the Alpine Fault, located along the West Coast of South Island. Recent research[4] suggests there is a 75% probability of an Alpine Fault earthquake occurring within the next 50 years and an 82% probability that the next earthquake on the Alpine Fault will be of magnitude 8 or greater.

Average return periods for shaking intensity are: MM 7 = 100 years, MM 8 = 450 years and MM 9 = >2,500 years. The most recent major earthquake to affect Dunedin occurred in 1974 and produced damage consistent with MM 7 intensity.

5.2 Stratigraphy

The engineering geological model for the site is summarised in Figures 1-4, Appendix A. More detailed geotechnical description of soils is provided in the test pit logs contained in Appendix B, with a brief description provided below.

Apart from the thin layer of surficial topsoil, the southern part of the site is predominantly underlain by varying depths of dune sand which overlie weathered Dunedin volcanics. Isolated deposits of colluvium, alluvium and uncontrolled fill were also noted.

The northern slopes of the site are underlain by colluvium and weathered volcanic rock.

[2] Otago Regional Council (2005). Seismic Risk in the Otago Region. Report No SPT: 2004 / 23. Wellington, NZ: Opus International Consultants.

[3] Taylor-Silva, B.I., Stirling, M.W., Litchfield, N.J., Griffin, J.D., van den Berg, N.J., Wang, N. (2019). Paleoseismology of the Akatore Fault, Otago, New Zealand. New Zealand Journal of Geology and Geophysics, 63(2): 151-167; doi: 10.1080/00288306.2019.1645706

[4] Howarth, J.D., *et al.* (2021). Spatiotemporal clustering of great earthquakes on a transform fault controlled by geometry. Nature Geoscience; doi: 10.1038/s41561-021-00721-4

Topsoil consisting of sandy organic SILT covers the surface of most of the site to depths of 0.2 – 0.7 m below ground level (BGL). This layer appeared as a buried topsoil in some areas below fill or windblown dune sand deposits.

Uncontrolled Fill was encountered in isolated parts of the subdivision, the most notable being at TP19 where the fill persisted to 3 m BGL. The fill consisted of SILT with variable sand, gravel, rubbish, cobbles and boulders. Based on site topography and investigation data it is considered likely that lots 1 – 3 will have significant depths of fill present. It is inferred this fill was placed to form a level yard for the recently demolished dwelling that occupied the area. Minor fill was also noted in other isolated areas with thicknesses of less than 500 mm.

Dune Sand was observed across much of the site with variable thickness. This layer is a loose to medium dense SAND and was observed to be > 3 m thick in some areas. This layer is absent in the northern lots, with the approximate extent of this unit indicated on Figure 1 in Appendix A.

Colluvium was observed in the upper northern and eastern slopes of the site. The colluvium generally appeared as SILT with trace sand and clay in stiff to very stiff condition.

Weathered Volcanic Basalt was seen in some test pits, generally on steeper sloping sites, comprising silts with trace sand, clay and gravel which transitioned to moderately weathered rock.

Bedrock (moderately weathered volcanics) was encountered in some tests and is expected lie at shallow to moderate depth below the entirety of the site, comprising moderately weathered grading to unweathered Dunedin Volcanic bedrock which is expected to extend to great depth.

5.3 Groundwater

No groundwater table was observed in any of the test pits during investigations. The soils observed were predominantly moist in condition.

Perched groundwater and seepages were not logged but some wet soils (e.g. alluvium) have been noted on the contact between units with permeability contrasts (e.g. basalt bedrock and overlying dune sands, or the contact between the dune sand and underlying colluvium). This has been noted during times of high rainfall, where these contacts are exposed in some of the road cuttings that have been excavated within the site.

5.4 Slope Stability

The area has been mapped by Benson[5] as being underlain by Second phase Dunedin Volcanic Group rock types, generally comprising strong flow rock types with little documented susceptibility to land instability.

The subdivision not within any area mapped in the most recent 2017 GNS Science report[6] as being landslide terrain.

No slope instability was identified on the site at the time of the test pitting investigations.

[5] Benson, W.N. (1968). Dunedin District, 1:50,000. NZGS Miscellaneous Series Map 1. Department of Scientific and Industrial Research.

[6] Barrell D.J.A., Smith Lyttle B., Glassey P.J. (2017). Revised landslide database for the coastal sector of the Dunedin City district. Lower Hutt (NZ): GNS Science. 29 p. (GNS Science consultancy report; 2017/41).

As noted above there is a risk that perched groundwater may be transiently present and if these seepages are intersected by cuts, then localised instability could result. These seepages have resulted in localised failures on over-steepened temporary slopes during bulk earthworks construction. Controlling these groundwater seepages will be important to ensure overall stability of earthworks as part of the subdivision development. This is discussed further in Section 6.3 below.

The risk of global slope instability is interpreted to be low based on the shallow to moderate site gradient, the generally competent underlying soils present below sands and the lack of a shallow global groundwater table.

Wind erosion of the sandy soils could potentially be an issue in the future, depending on specific locations and proposed developments.

6 Engineering Considerations

6.1 General

The recommendations and opinions contained in this report are based upon ground investigation data obtained at discrete locations 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 6.1 provides a summary of the recommended geotechnical design parameters for the soil materials expected to be encountered during construction of the proposed dwelling.

Table 6.1 – 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 (soft-firm organic SILT)	0.05-0.3	16	N/A	N/A	N/A	N/A
Uncontrolled Fill (firm to stiff SILT with variable sand, gravel, rubbish, boulders and cobbles)	0.0 – 3.0 (where observed)	N/A	N/A	N/A	N/A	N/A
Dune Sand (loose to medium dense SAND)	Varies	18	0	30-34	5,000-10,000	0.3
Colluvium (stiff to very stiff SILT with trace sand)	Varies	19	2	32	8,500	0.3
Completely weathered volcanics (very stiff SILT with a trace of sand, clay and gravel)	Not proven	20	2	32	20,000+	0.3

6.3 Groundwater Issues

Numerous perched seepages were identified during roadway construction, predominantly identified in the Dune Sands. These seepages have resulted in localised failures on over steepened temporary slopes during bulk earthworks construction.

Within the lots, the proposed earthworks for the subdivision stage are not anticipated to intercept any groundwater seepages

GeoSolve Ltd should be contacted for further advice if seepages or wet soils are identified. However, in general, if seepages are identified during construction within lots, cut-off drains or counterfort drainage should be installed to capture and appropriately divert seepage

runoff. These drains should be connected to Dunedin City Council approved stormwater infrastructure and no water should be discharged onto ground on these sites.

It is essential that any groundwater seepages are appropriately addressed to mitigate slope instability risk within the sloping ground present.

6.4 Slope Stability

No slope instability was identified during the time of inspection.

Owing to the evidence of landslide activity on adjacent hillsides, care will be required to ensure that the development does not promote slope instability on the steeper areas of site. Placement of uncontrolled side-cast fill should be avoided on the slopes. All sources of slope saturation should be captured upslope of the cuts and no stormwater or wastewater should be discharged to these slopes.

All cuts within individual lots should be subject to inspection during construction and if higher than outlined in Table 6.2 should be subject to specific design.

Wind and rainfall erosion of the sandy soils could potentially be an issue in future, depending on specific locations and proposed developments. Locations where this could present a future risk should be treated with erosion protection measures such as various matting products and/or topsoiling/plantings.

6.5 Excavations

Most major earthworks will have been completed as part of the subdivision engineering works, however some levelling of building platforms will likely be required. All cut batters have been assessed and cut back to suitable angles based on inspection and assessment by a geotechnical engineer.

We recommend that any subsequent excavations within lots should be subject to the advice in Table 6.2 and inspected by a geotechnical practitioner during earthworks construction.

No seepage was encountered during test pitting and hence groundwater is unlikely to be encountered during excavations, apart from localised perched seepage at the base of the dune sand. However, a geotechnical practitioner should inspect any seepage, spring flow or under-runners that may be encountered during construction.

Recommendations for permanent batters within lots are as follows.

Table 6.2 – Recommended batters for permanent cuts up to 2 m in height

Material type	Recommended maximum batter for permanent cuts less than 2 m high (horizontal to vertical)	
	Dry ground	Wet ground
Fill, Topsoil	2 : 1	3 : 1
Dune Sand	2 : 1	3 : 1
Colluvium / Weathered Volcanics	1.5 : 1	3 : 1

Higher cuts should be subject to specific advice by a geotechnical specialist.

Temporary cuts may be formed at steeper angles subject to geotechnical advice. However, this may require specific design depending upon the soil types encountered.

In addition to the recommended batter angles of Dune Sand noted in Table 6.2 above, we recommend that any permanent cut within this unit type be immediately either topsoiled and vegetated or treated with permanent erosion protection products to minimise sand migration during wind and rainfall which is typical in these settings.

The subsurface materials will be relatively easy to excavate by conventional methods. Basaltic bedrock is expected to be at shallow to moderate depth it is possible that excavations will encounter this in isolated areas, in particular in the northern lots and slopes.

6.6 Engineered Fill

6.6.1 Subdivision Filling

As noted in Figure 2.1, some filling of lots is required to meet final design levels.

Subdivision earthworks have been completed under Geosolve supervision, where site won dune sand, colluvium or weathered bedrock have been used as fill. Any fill placed has met the requirements of NZS4431:1989 and certification will be provided to that effect.

6.6.2 Additional Filling Within Lots

All additional fill that is placed within lots and 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.

All fill slopes less than 2 m in height should be constructed with a maximum batter of 2:1 (horizontal to vertical) or flatter, if well drained. To minimise erosion, effective vegetation cover or erosion protection should be established on fill batters and no water flows should be directed to these slopes. Thicker or steeper fills will require specific engineering assessment and design.

The subgrade of any proposed fills will need to be sub-horizontal (with benching of slopes as required) to promote stability.

Maintaining the moisture content of any cohesive fill soils to achieve the required compaction will need to be addressed by the contractor. It is recommended that cut to fill soils be placed and compacted immediately as they are excavated, as stockpiling and reworking is highly likely to degrade the compaction properties of the soils.

Earthworks should only be carried out in the summer or during a period of forecast, prolonged dry weather.

6.7 Ground Retention

It would be feasible to construct retaining walls within some of the sloping lots to assist with the creation of flatter building platforms if required. Any retaining wall proposed should be designed by a chartered professional engineer.

Pole type walls (timber or steel) are likely to be most suitable option for sloping sites, although providing sufficient embedment into the weathered rock may be problematic if this is encountered.

All retaining walls should be designed using the general geotechnical parameters recommended in Table 6.1 of this report and we also recommend additional site-specific testing to confirm local conditions. Due allowance should be made during the detailed design of all retaining walls for any additional loads upslope of the wall (i.e. surcharge due to backslope).

All temporary slopes for retaining wall construction should be battered in accordance with advice from a geotechnical specialist.

Groundwater was not identified in the test pits but has the potential to develop following completion of the earthworks, in particular as a result of heavy or prolonged rainfall as observed. To ensure potential groundwater seeps and flows are properly controlled behind the 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; and
- 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.

The safety implications of working under temporary cuts will need to be adequately addressed.

Additional investigations should be undertaken along wall alignments to assist with wall design and to select the most appropriate retention option.

6.8 Settlement and Foundations

It is expected the building foundations will comprise either piles (driven or augered), shallow footings / foundations walls or raft style foundations depending on ground conditions and gradients at each lot.

Geotechnical investigations in accordance with NZS3604:2011 are the minimum requirement at the building consent stage for individual lots. The recommendations in this section are suitable for subdivision consent purposes only.

Moderate bearing is available on the dune sands with moderate to good bearing available on stiff colluvium or weathered rock

Piled foundations will likely need to be used on lots with extensive fill or loose dune sand deposits, as well as on moderate to steeply sloping sites. It is expected the piles be taken to underlying Colluvium or Weathered volcanics in most cases, though consideration of driven piles may be economical in areas of very deep sand deposits.

Shallow foundations may be suitable on lots with relatively shallow colluvium or weathered rock deposits, or in flat areas containing sand deposits where raft style foundations could be considered. Foundation walls would be on option where suitable bearing is at moderate depths.

In all cases, all unsuitable materials identified in foundation excavations, particularly those softened by exposure to water, should be undercut and replaced with engineered fill during construction or fully penetrated by piles.

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.

It is recommended the foundation excavations be inspected by a suitably qualified and experienced geotechnical specialist to confirm the conditions are in accordance with the assumptions and recommendations provided in this report. So that the subgrade is protected, the foundation excavations should be covered in a minimum 50 mm layer of site concrete or a 100 mm layer of compacted granular hardfill following the recommended inspections.

Table 6.3 provides indicative foundation options for the various lots.

Table 6.3 – Indicative foundation options.

Lots	Indicative Ground conditions[1]	Preliminary Foundation Options[2]
1,2,3	Uncontrolled fill (containing boulders), potentially > 3m deep, underlain by; Medium dense dune sand	Driven or bored piles founding in the dune sands or the underlying colluvium or weathered rock. Boulders are present within the fill which may cause issues with pile driving or boring
10,11,12,13,14,15,16,30,31,32,33,51	Either relatively thin (<2 m) dune sands overlying colluvium or weathered rock OR Shallow colluvium or weathered rock Moderate to good bearing available	For sloping sections timber pole foundations socketed into the colluvium or weathered rock For flatter sections or if localised earthworks are carried out then raft or standard NZ3604 foundations are options subject to site specific investigation of bearing capacity.
Other sections	Loose to medium dense dune sand at shallow depth underlain by colluvium at shallow (>2m) to moderate depth	For sloping sections timber pole foundations driven or bored into the colluvium or medium dense dune sand For flatter sections or if localised earthworks are carried out then raft foundation designed for site specific bearing capacity.

Table notes:

1) Ground conditions have been inferred from available ground investigation data. Site specific investigations required for each lot at detailed design stage;
2) For concept design purposes 200 kPa ultimate geotechnical bearing capacity likely to be available for all lots (excluding 1-3) with 300 kPa ultimate geotechnical bearing capacity likely to be available locally

6.9 Site Preparation

During any earthworks operations all topsoil, organic matter, uncontrolled fill and other unsuitable materials should be removed from the construction areas in accordance with the recommendations of NZS 4431:1989, unless specific foundation design involves piling through these soils.

Owing to the erodible nature of some of the soils present across the site, sediment control measures should be instigated during earthworks 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.

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.

6.10 Accessway & Pavements

Accessway and pavement geotechnical considerations have been undertaken by GeoSolve Ltd previously, and are outlined in GeoSolve Ltd's report reference 190782.01, dated September 2021.

6.11 Surface Runoff and Drainage

The control of surface water should be considered for each lot as part of the detailed design. It is important stormwater and overland flows are considered and capture to prevent any instability.

6.12 Site Subsoil Category

The following geotechnical information has been used to characterise the site subsoil class in respect of NZS 1170.5:2004 Structural Design Actions:

Based on the best available information, we consider the site subsoil class in terms of NZS 1170.5:2004 Clause 3.1.3 to be **Class C (Shallow Soil Sites)**.

7 Additional Geotechnical Works Required

Within individual lots additional ground investigations should be carried out to inform the design of foundations and retaining walls.

Investigations are likely to comprise hand augering and Scala penetrometer testing within proposed building platforms and along the alignment of any retaining walls.

For some lots, where larger excavation are proposed or where there are uncontrolled fills investigations with an excavator or deep penetrometer testing may be required to assist with design.

8 Neighbouring Structures/Hazards

8.1 Other Hazards

Natural Hazards: A risk of seismic activity has been identified for the region as a whole and appropriate allowance should be made for seismic loading during detailed design of the proposed development, but there are no site-specific constraints.

A review of The Otago Regional Council's Natural Hazards Database and GeoSolve's archives did not find any records of mapped slope instability or landslide features in the vicinity of the subject site. The recommendations discussed in Sections 5.4, 6.4 and 6.8 of this report should be followed in order to mitigate the risk associated with landslip and erosion.

The site has been mapped in a 2014 liquefaction hazard assessment[7] as belonging to Domain A, which is predominantly underlain by rock or firm sediments; in this domain there is little or no likelihood of damaging liquefaction occurring. The lack of groundwater and relatively shallow depth of stiff, plastic soils indicate the likelihood of damaging liquefaction occurring on site to be very low.

A risk of seismic activity has been identified for the region as a whole and appropriate allowance should be made for seismic loading during detailed design of the proposed development, but there are no site-specific constraints.

Flood hazard has not been assessed in this study but is unlikely in this hillslope setting, provided that upslope flow paths are well controlled.

Distances to adjoining structures: No adverse geotechnical implications apply for neighbouring properties during construction of dwellings provided the above excavation considerations are noted.

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

Erosion and Sediment Control: The site presents some potential to generate silt runoff, and this would naturally drain downslope. Only the least amount of subsoil should be exposed at any stage and surfacing established as soon as practical. Silt runoff should not be permitted to enter any watercourse.

Due to the sandy nature of the soils observed during investigations, it is likely that surface runoff will result in erosion, and some erosion control will likely be required.

We recommend advice be sought from a qualified specialist where compliance with local and regional erosion and sediment control regulations is uncertain.

Noise: Rock-breaking and/or blasting is unlikely to be required.

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

Vibration: No vibration induced settlement is expected in these soil types; however, any works that create vibrations should be subject to geotechnical advice. Any neighbouring

[7] Barrell, D.J.A., Glassey, P.J., Cox, S.C., Smith Lyttle, B. (2014). Assessment of liquefaction hazards in the Dunedin City district. GNS Science Consultancy Report 2014/068. 68p.

structures should be considered by the contractor with respect to vibration effects and further advice sought if there is any uncertainty.

9 Applicability

This report has been prepared for the sole use of our client, Willowridge Developments Limited, with respect to the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose or in any other contexts, without our prior review and written agreement.

Investigations have been undertaken at discrete locations in accordance with the brief provided. It must be appreciated that the nature and continuity of subsoil conditions away from the investigation locations cannot be guaranteed.

During construction, foundation excavations should be examined by an inspector or engineer competent to confirm that subsurface conditions encountered throughout are compatible with the findings of this report. It is important that we be contacted if there is any variation in subsoil conditions from those described in this report.

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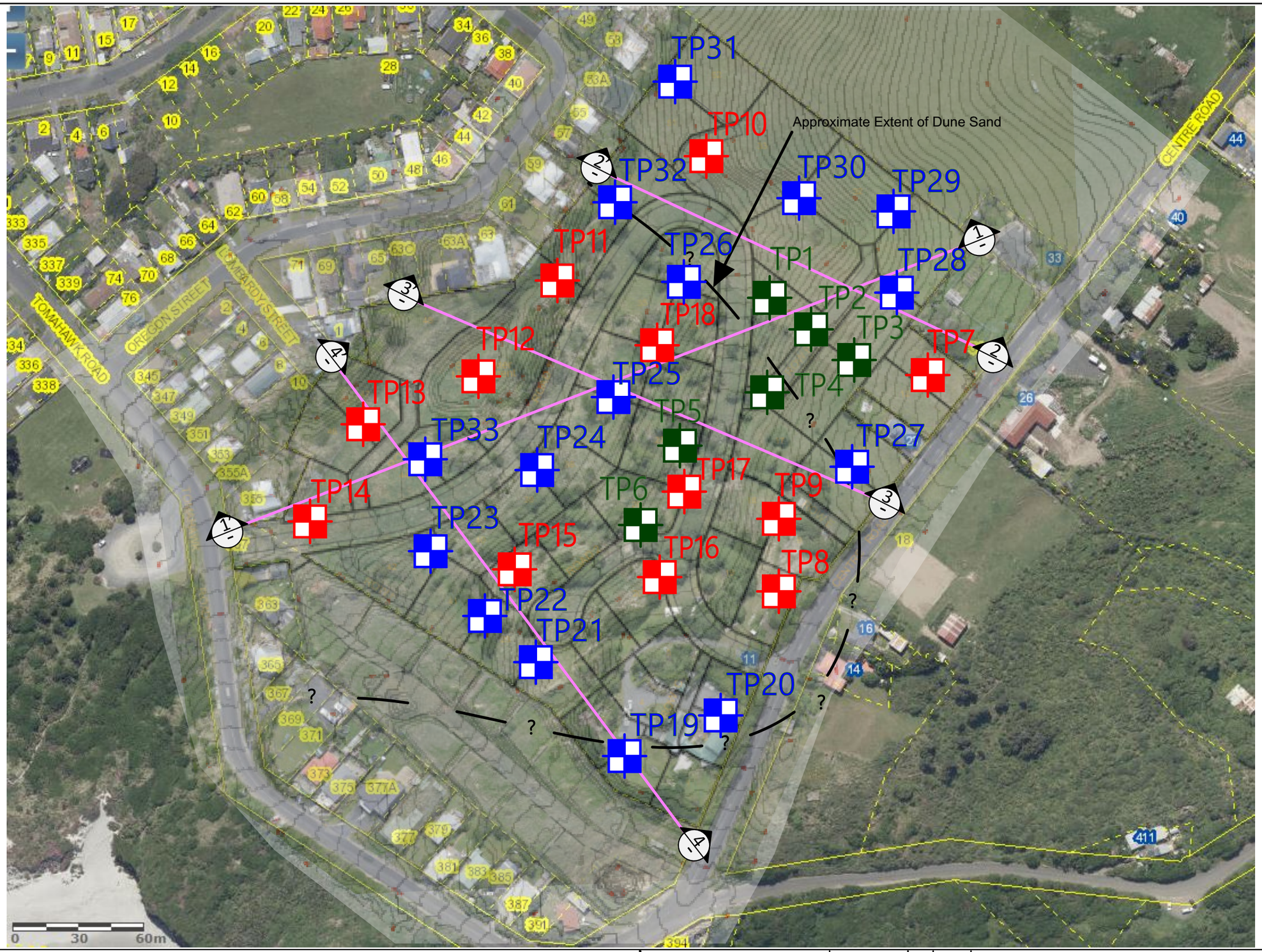
Appendices: Appendix A – Site Plan & Cross-section - Figures 1-5 [5p]
Appendix B – Investigation Data - TP1-TP33 [3p]

Appendix A: Site Plan & Cross-sections



Key

- Test pit and Scala penetrometer test locations (Pre-lim stage, completed)
- Test pit and Scala penetrometer test locations (Stage 1, Completed)
- Test pit and Scala penetrometer test locations (Stage 2, To be Completed)

CADFILE:	Site Plan.xar	DRAWN	NT	04/2022
SCALE:	As shown	DRAFTING CHECKED	NT	04/2022
PROJECT No.:	190782.02	APPROVED	CEM	04/2022

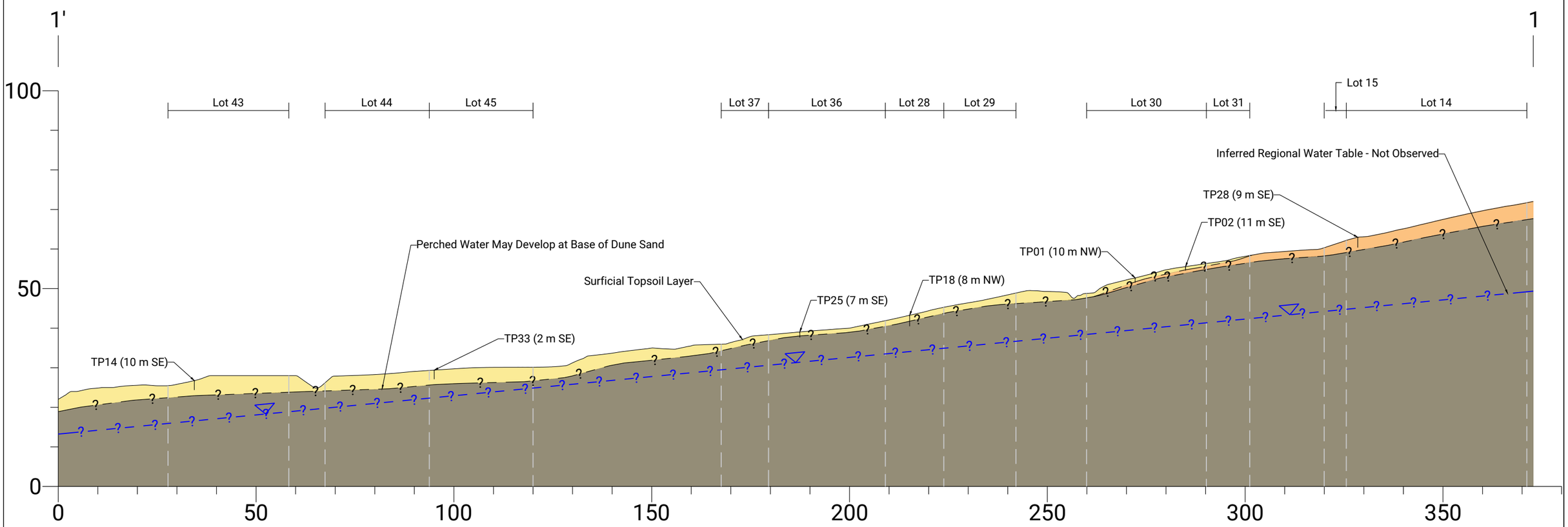
GEOSOLVE
ENGINEERING CONSULTANTS
GEOTECHNICAL
WATER RESOURCES
PAVEMENTS

Willowridge Developments Ltd
Geotechnical Investigation
11 Centre Rd, Ocean Grove, Dunedin
Site Plan

FIG No: FIGURE 1 REV. 1

Legend:

- Dune Sand
- Colluvium
- Basaltic Bedrock (Minor Near-Surface Weathering)



Notes:
1. These drawings have been prepared for the benefit of Willowridge Developments Ltd 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.
2. Elevations shown are based off survey data supplied by the Paterson Pitts Group on the 19th of January, 2022.
3. Investigations have been carried out after the majority of bulk earthworks were completed on site.

SCALE 1:1000

0 10 20 30 40 50 (m)

GEOSOLVE

Level 1, 70 MacAndrew Road, South Dunedin
www.geosolve.co.nz

DRAWN	ETC	Feb.22
DRAFTING CHECKED	NT	Jan.22
APPROVED	CEM	Jan.22
CADFILE: 190782.02 Sections.dwg		
SCALES (AT A3 SIZE): 1:1000		
PROJECT No: 190782.02	FIG No: 2b	REV. 0

Willowridge Developments Ltd

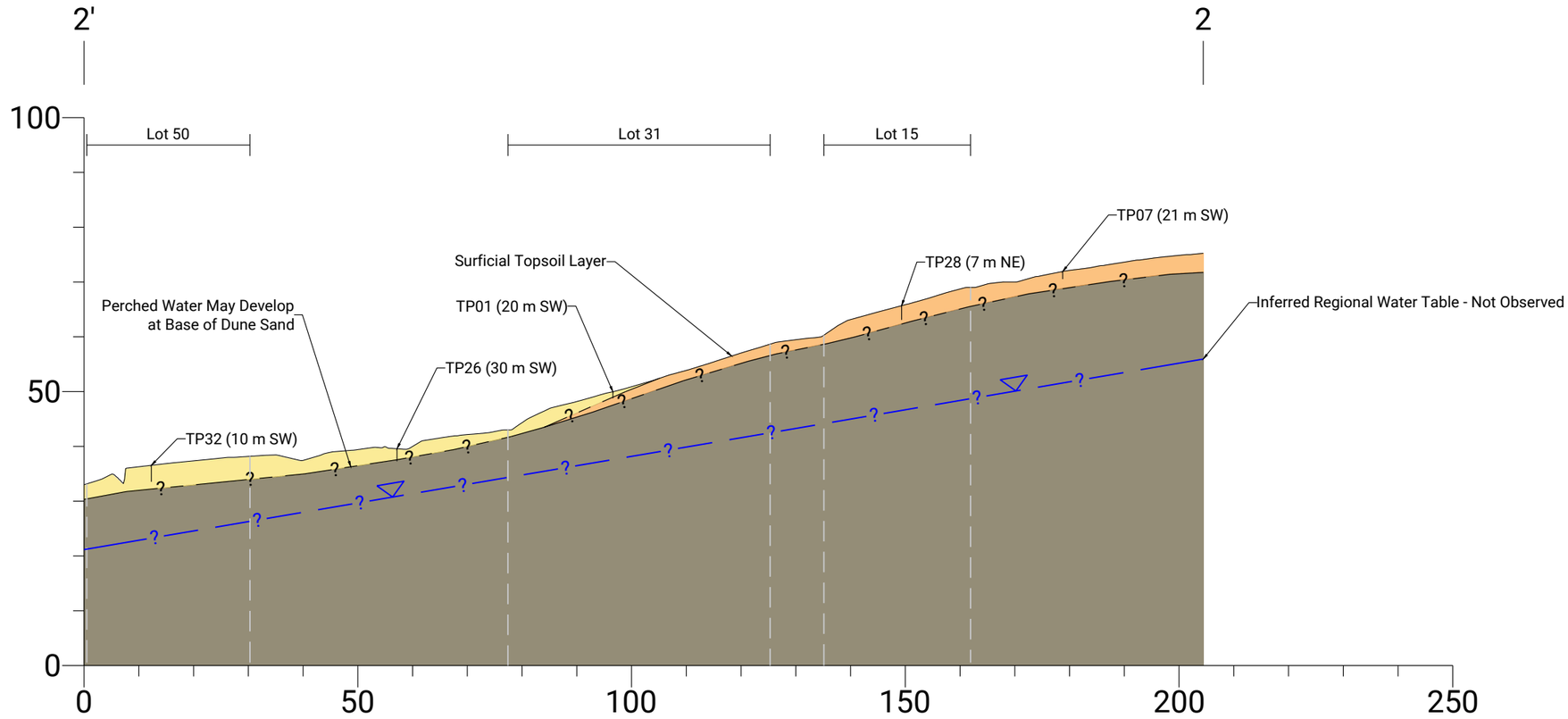
Geotechnical Assessment

11 Centre Road, Dunedin

Section 1' - 1

Legend:

- Dune Sand
- Colluvium
- Basaltic Bedrock (Minor Near-Surface Weathering)



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2. Elevations shown are based off survey data supplied by the Paterson Pitts Group on the 19th of January, 2022.
3. Investigations have been carried out after the majority of bulk earthworks were completed on site.

SCALE 1:1000
0 10 20 30 40 50 (m)

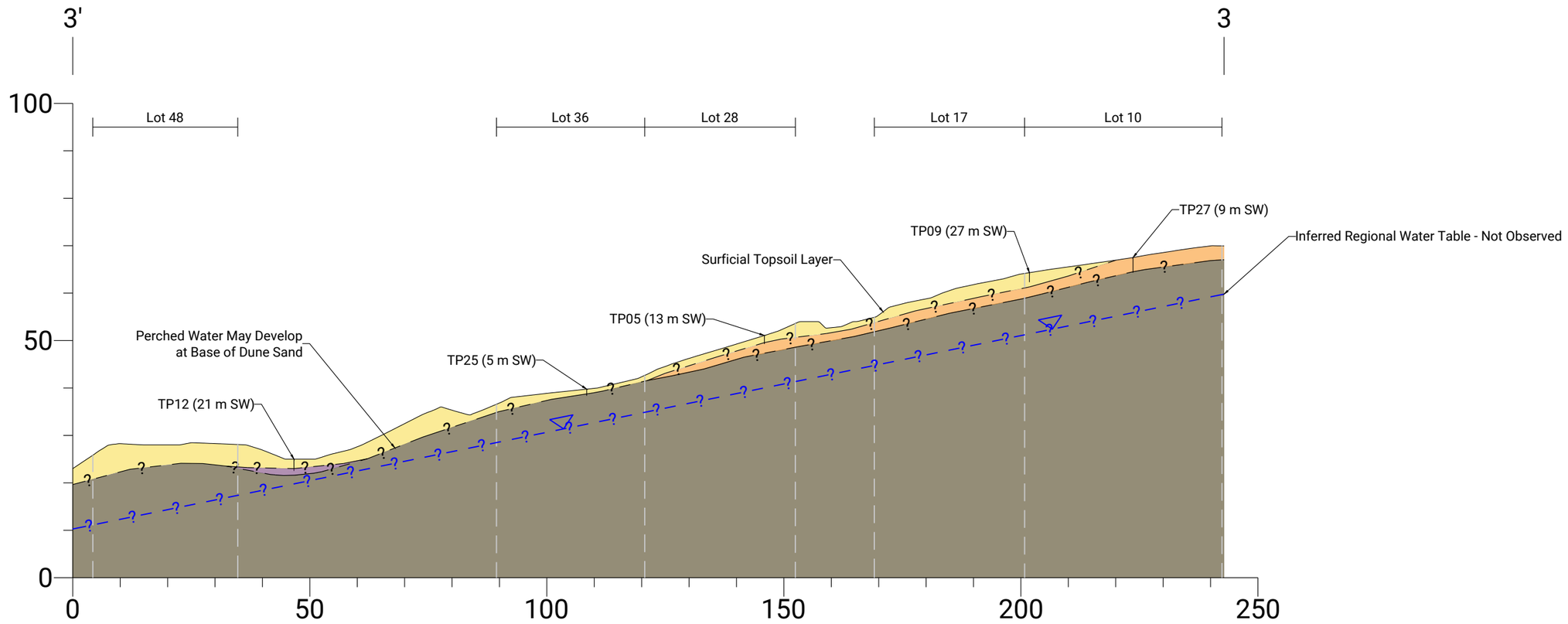
GEOSOLVE
Level 1, 70 MacAndrew Road, South Dunedin
www.geosolve.co.nz

DRAWN	ETC	Feb.22
DRAFTING CHECKED	NT	Jan.22
APPROVED	CEM	Jan.22
CADFILE: 190782.02 Sections.dwg		
SCALES (AT A3 SIZE): 1:1000		
PROJECT No: 190782.02	FIG No: 2a	REV. 0

Willowridge Developments Ltd
Geotechnical Assessment
11 Centre Road, Dunedin
Section 2' - 2

Legend:

- Dune Sand
- Colluvium
- Back Beach Deposits
- Basaltic Bedrock (Minor Near-Surface Weathering)



Notes:
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2. Elevations shown are based off survey data supplied by the Paterson Pitts Group on the 19th of January, 2022.
3. Investigations have been carried out after the majority of bulk earthworks were completed on site.

SCALE 1:1000
0 10 20 30 40 50 (m)

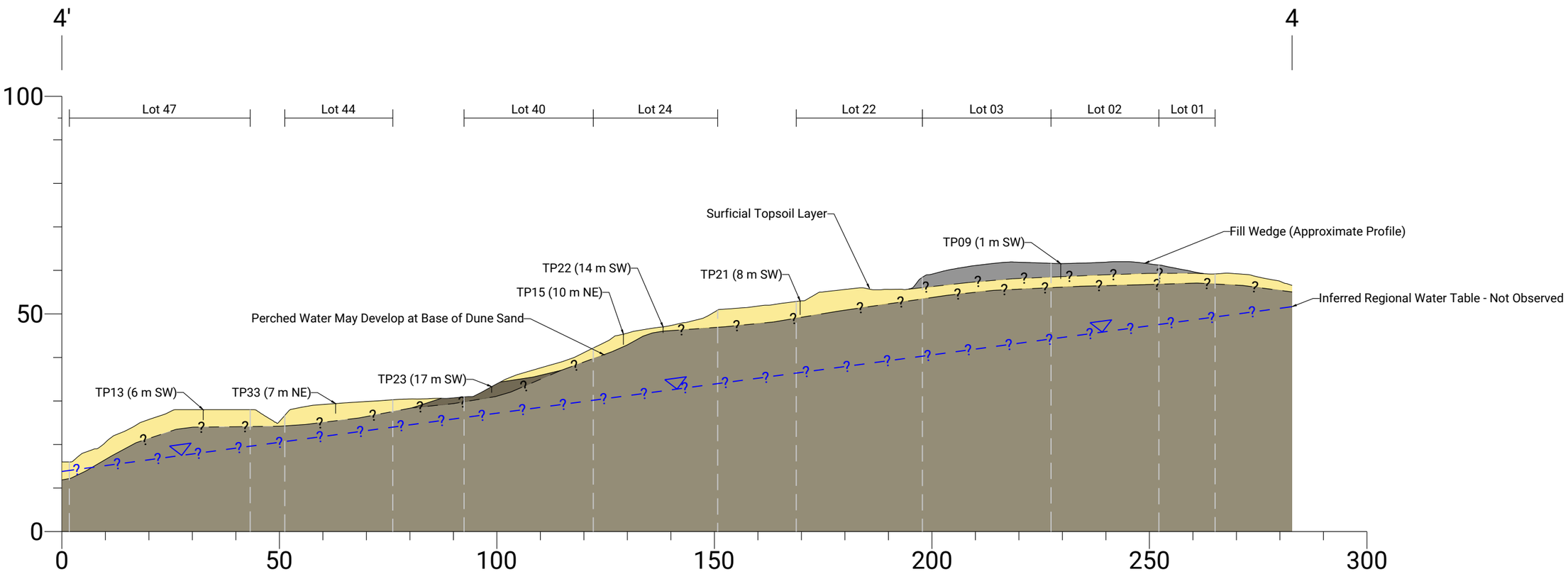
GEOSOLVE
Level 1, 70 MacAndrew Road, South Dunedin
www.geosolve.co.nz

DRAWN	ETC	Feb.22
DRAFTING CHECKED	NT	Jan.22
APPROVED	CEM	Jan.22
CADFILE: 190782.02 Sections.dwg		
SCALES (AT A3 SIZE): 1:1000		
PROJECT No: 190782.02	FIG No: 2c	REV. 0

Willowridge Developments Ltd
Geotechnical Assessment
11 Centre Road, Dunedin
Section 3' - 3

Legend:

- Fill
- Dune Sand
- Completely Weathered Volcanics
- Basaltic Bedrock (Minor Near-Surface Weathering)



Notes:
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2. Elevations shown are based off survey data supplied by the Paterson Pitts Group on the 19th of January, 2022.
3. Investigations have been carried out after the majority of bulk earthworks were completed on site.

SCALE 1:1000
0 10 20 30 40 50 (m)

GEOSOLVE
Level 1, 70 MacAndrew Road, South Dunedin
www.geosolve.co.nz

DRAWN	ETC	Feb.22
DRAFTING CHECKED	NT	Jan.22
APPROVED	CEM	Jan.22
CADFILE: 190782.02 Sections.dwg		
SCALES (AT A3 SIZE): 1:1000		
PROJECT No: 190782.02	FIG No: 2d	REV. 0

Willowridge Developments Ltd
Geotechnical Assessment
11 Centre Road, Dunedin
Section 4' - 4

Appendix B: Investigation Data

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 1

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	05/05/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	05/05/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm) 0 5 10 15
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.3m		0.0, 0.1, 0.2, 0.3	NO SEEPAGE	
DUNE SAND	Fine to medium SAND with a trace of silt and rare organics; brown. Loose to medium dense; moist; gap graded. 0.3m – 1m		0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0		
COLLUVIUM	SILT with a trace of sand and clay; grey brown and orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse. 1m – 1.2m		1.1, 1.2		

Total Excavation Depth = 1.2 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 2

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	05/05/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	05/05/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm) 0 5 10 15
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.4m		0.0 – 0.4	NO SEEPAGE	
DUNE SAND	Fine to medium SAND with a trace of silt and rare organics; brown. Loose to medium dense; moist; gap graded. 0.4m – 0.5m		0.4 – 0.5		
DUNE SAND	Fine to medium SAND with a trace of silt; light brown trace orange, minor oxidation staining. Medium dense; moist; gap graded. 0.5m – 0.8m		0.5 – 0.8		
COLLUVIUM	SILT with a trace of sand and clay; grey brown and orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse. 0.8m – 1m		0.8 – 1.0		

Total Excavation Depth = 1.0 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 3**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	05/05/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	05/05/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm) 0 5 10 15
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.3m		0.0 – 0.3		
DUNE SAND	Fine to medium SAND with a trace of silt; light brown trace orange, minor oxidation staining. Medium dense; moist; gap graded. 0.3m – 0.9m		0.3 – 0.9		
COLLUVIUM	SILT with a trace of sand and clay; grey brown and orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse. 0.9m – 1.4m		0.9 – 1.4	NO SEEPAGE	

Total Excavation Depth = 1.4 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 4

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	05/05/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	05/05/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm) 0 5 10 15
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.3m		0.0 – 0.3		
DUNE SAND	Fine to medium SAND with a trace of silt and rare organics; brown. Loose to medium dense; moist; gap graded.		0.3 – 0.8		
DUNE SAND	Fine to medium SAND with a trace of silt; light brown trace orange, minor oxidation staining. Medium dense; moist; gap graded. 0.8m		0.8 – 1.3		
COLLUVIUM	SILT with a trace of sand and clay; grey brown and orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse. 1.3m – 1.7m		1.3 – 1.7	NO SEEPAGE	

Total Excavation Depth = 1.7 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 5

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	05/05/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	05/05/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm) 0 5 10 15
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.3m		0.0 – 0.3		
DUNE SAND	Fine to medium SAND with a trace of silt and rare organics; brown. Loose to medium dense; moist; gap graded. 0.3m – 1.5m		0.3 – 1.5	NO SEEPAGE	
COLLUVIUM	SILT with a trace of sand and clay; grey brown and orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse. 1.5m – 1.8m		1.5 – 1.8		

Total Excavation Depth = 1.8 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 6

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	05/05/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	05/05/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm) 0 5 10 15
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.3m		0.0 – 0.3		
DUNE SAND	Fine to medium SAND with a trace of silt and rare organics; brown. Loose to medium dense; moist; gap graded. 0.3m – 4m		0.3 – 4.0	NO SEEPAGE	

Total Excavation Depth = 4.0 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 7**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

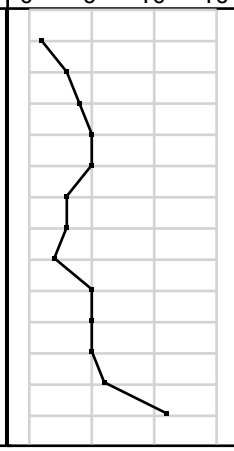
Soil / Rock Type	Description	Depth
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m – 0.2m
COLLUVIUM	Sandy SILT with a trace of gravel; light brown trace orange, minor oxidation staining. Firm to stiff; dry; non plastic; sand, fine to coarse; gravel, fine, subrounded, weathered volcanics.	0.2m – 0.7m
COLLUVIUM	SILT with minor sand, gravel and clay; grey with orange mottle. Stiff to very stiff; dry to moist > 0.85 m; non plastic; sand, fine to coarse; gravel, fine to medium, subrounded to subangular, weathered volcanics.	0.7m – 1.4m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 1.4 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 8**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
FILL	Sandy organic SILT with some mottled silt inclusions; brown. Soft; moist to dry; non plastic; sand, fine to medium; trace rootlets. 0m – 0.25m		0.0 – 0.25		
DUNE SAND	Fine to medium SAND; brown. Loose to medium dense; dry to moist; gap graded. 0.25m – 1.8m		0.25 – 1.8		
DUNE SAND	Fine to medium SAND with minor silt and trace organics; grey with reddish brown mottle. Medium dense; wet to saturated > 2.0 m; dilatant; organics roots & rootlets. 1.8m – 2.3m		1.8 – 2.3	NO SEEPAGE	
-	- 2.3m – 2.4m		2.3 – 2.4		

0 5 10 15

Total Excavation Depth = 2.3 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 9**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.25m		0.0 – 0.1 – 0.2		0 5 10 15
DUNE SAND	Fine to medium SAND; brown. Loose to medium dense; dry to moist; gap graded. 0.25m – 2m		0.3 – 2.0	NO SEEPAGE	
-	- 2m – 2.4m	? ? ? ? ?	2.1 – 2.3 – 2.4		

Total Excavation Depth = 2.0 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 10

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description		Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Sandy organic SILT; light brown. Soft; moist; non plastic; sand, fine to medium; trace rootlets.	0m		0.0		0 5 10 15
COLLUVIUM	SILT with some sand and a trace of gravel; orange / brown / grey. Firm; moist; non plastic; sand, fine to coarse; gravel, fine, subrounded, volcanics.	0.2m		0.1 0.2 0.3 0.4 0.5		
COLLUVIUM	SILT with trace sand and gravel; orange / brown / grey. Stiff; moist; non plastic; sand, fine to medium; gravel, fine, subrounded volcanics.	0.6m		0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5		
COLLUVIUM	SILT with minor sand and gravel; orange / brown with dark red mottle. Very stiff; dry; non plastic; sand, fine to coarse; gravel, fine, subrounded, volcanics.	1.6m		1.6 1.7 1.8	NO SEEPAGE	
BEDROCK	BASALT; brown. Weak; dry; massive; highly weathered.	1.9m 2.2m		1.9 2.0 2.1 2.2		

Total Excavation Depth = 2.2 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 11**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
FILL	Fine to medium SAND with minor to some organic silt inclusions and trace boulders; brown. Loose; moist; gap graded; trace timber, brick, steel and glass.	0m – 0.7m	0.0 – 0.7		0 5 10 15
BURIED TOPSOIL	Organic SILT; dark brown. Soft; moist; non plastic.	0.7m – 1m	0.7 – 1.0		
DUNE SAND	Fine to medium SAND with rare organics; light yellowy brown, more grey > 1.7 m. Medium dense; moist becoming saturated at 1.8 m; gap graded; sand, fine to medium.	1m – 2m	1.0 – 2.0		
ALLUVIUM	SILT with some sand and a trace of gravel; grey with orange mottle. Stiff; wet; non plastic; sand, fine to coarse; gravel, fine, subrounded.	2m – 2.3m	2.0 – 2.3	NO SEEPAGE	
-	-	2.3m – 2.4m	2.3 – 2.4		

Total Excavation Depth = 2.3 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 12**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

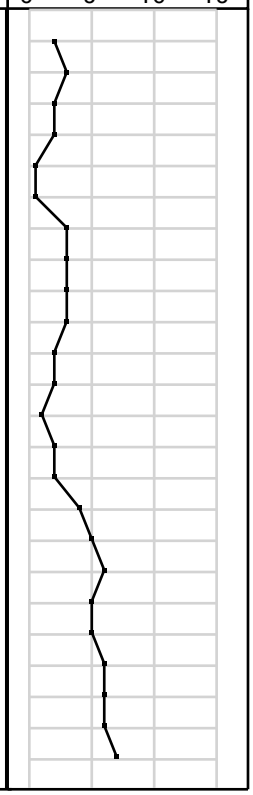
Soil / Rock Type	Description	
TOPSOIL	Sandy organic SILT; dark brown. Soft; moist; non plastic; sand, fine to medium; trace rootlets.	0m
DUNE SAND	Fine to medium SAND; orangey brown, grey mottle from 0.6 m. Loose to medium dense; moist; gap graded; trace rootlets.	0.1m
HARD PAN	Cemented fine to medium SAND with some silt; dark orange, seepage at 1.6 m. Dense; moist; gap graded.	1.6m
DUNE SAND	Fine to medium SAND with minor silt; purple / grey with dark brown mottle, slow dilatancy. Medium dense; wet to saturated; gap graded.	1.65m
BACK BEACH DEPOSITS	Sandy SILT with minor organics; dark grey. Stiff; wet; non plastic to low plasticity > 2.3 m; sand, fine to medium; organics, amorphous and rootlets.	2m
		2.5m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 2.5 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER: **TP 13**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

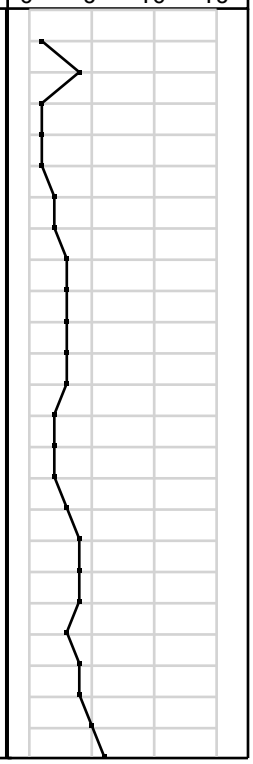
Soil / Rock Type	Description
TOPSOIL	0m — Sandy organic SILT; dark brown. Soft; moist; non plastic; trace rootlets.
DUNE SAND	0.1m — Fine to medium SAND with rare organics; light yellowy brown. Medium dense; dry to moist; gap graded.
	2.4m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 2.4 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 14**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Sandy organic SILT; dark brown. Soft; moist; non plastic; sand, fine to medium; trace rootlets. (0m – 0.1m)		0.0 – 0.1		
FILL	Fine to medium SAND with trace bricks; light yellowy grey. Loose; dry to moist; gap graded. (0.1m – 0.4m)		0.1 – 0.4		
BURIED TOPSOIL	Fine to medium SAND with a trace of silt and organics; brown / grey. Loose; moist; gap graded; trace rootlets. (0.4m – 0.6m)		0.4 – 0.6		
DUNE SAND	Fine to medium SAND; light grey. Medium dense; moist; gap graded. (0.6m – 2.4m)		0.6 – 2.4	NO SEEPAGE	0 5 10 15

Total Excavation Depth = 2.4 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 15**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Sandy organic SILT; dark brown. Soft; moist; non plastic; sand, fine to medium; trace rootlets. 0m		0.0		0 5 10 15
DUNE SAND	Fine to medium SAND with rare organics; light yellowy brown. Medium dense; dry to moist; gap graded. 0.2m		0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4	NO SEEPAGE	
	2.45m				

Total Excavation Depth = 2.45 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 16**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Sandy organic SILT; dark brown. Soft; moist; non plastic; sand, fine to medium; trace rootlets. 0m – 0.35m		0.0		0 5 10 15
DUNE SAND	Fine to medium SAND; light yellowy grey. Loose; dry; gap graded; trace rootlets > 0.55 m.		0.1 – 0.9		
DUNE SAND	Fine to medium SAND; brown / grey. Medium dense; moist; gap graded. 1m – 2.8m		1.0 – 2.8	NO SEEPAGE	

Total Excavation Depth = 2.8 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 17**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Sandy organic SILT; dark brown. Soft; moist; non plastic; sand, fine to medium; trace rootlets. (0m)		0.0		0 5 10 15
DUNE SAND	SAND with rare organics; light yellowy brown. Medium dense; dry to moist; gap graded; sand, fine to medium. (0.2m)		0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3	NO SEEPAGE	
-	- (2.35m)		2.4		

Total Excavation Depth = 2.35 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 18

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	16/12/2019
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	16/12/2019

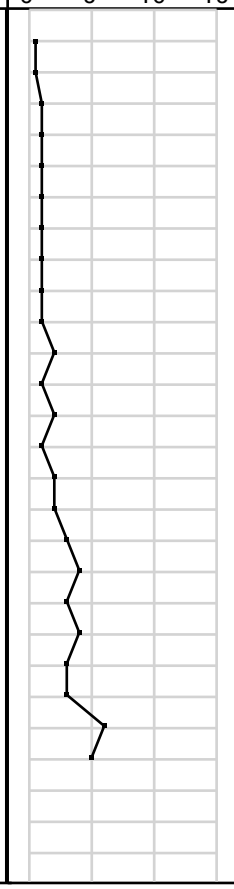
Soil / Rock Type	Description	Depth
RECENT WINDBLOWN SAND	Fine to coarse SAND with some organic silt; grey / brown. Loose; moist; well graded.	0m
BURIED TOPSOIL	Sandy organic SILT; dark brown. Loose; moist; gap graded; trace rootlets.	0.2m
DUNE SAND	Fine to medium SAND with rare organics; light yellowy brown. Medium dense; dry to moist; gap graded.	0.4m
SLOPEWASH	Fine to coarse SAND with minor silt and a trace of gravel; grey with orange mottle. Medium dense; moist; well graded; gravel, fine to medium, surrounded, weathered volcanics.	1.5m
ALLUVIUM	SILT with minor sand and gravel; grey with orange mottle. Stiff; moist to wet; non plastic; gravel, fine to coarse, surrounded, weathered volcanics.	2m
		2.8m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 2.8 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 19**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

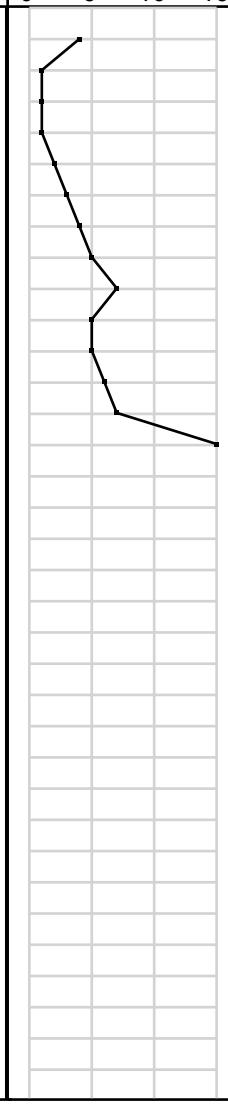
EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Depth (m)
FILL	Sandy SILT with some organics and a trace of gravel and rubbish; brown. Firm; moist; non plastic; sand, fine to coarse; gravel, fine to coarse, angular to rounded; rubbish includes bricks and concrete.	0m
FILL	SILT with some sand and a trace of gravel, cobbles, boulders and rubbish; brown / grey. Firm to stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse, angular to rounded; rubbish includes bricks, glass and concrete; boulders > 0.7 m.	0.2m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	3m
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	3.3m
		3.5m

Graphic Log

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 3.5 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 20**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

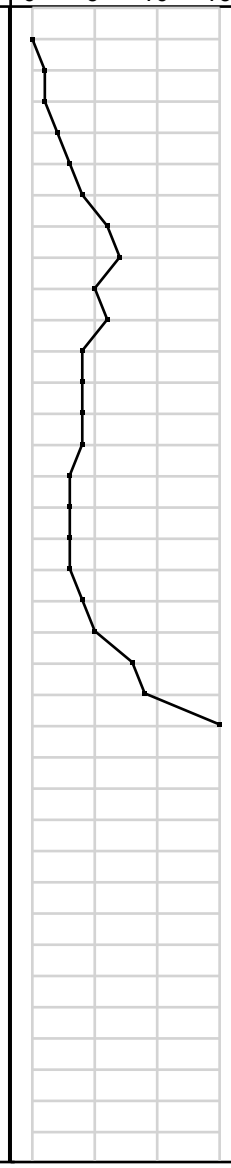
EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Depth (m)
FILL	Sandy SILT with some organics and a trace of gravel and rubbish; brown. Firm; moist; non plastic; sand, fine to coarse; gravel, fine to coarse, angular to rounded; rubbish includes bricks and concrete.	0m – 0.4m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.4m – 0.6m
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	0.6m – 2.7m
ALLUVIUM	SILT with some clay and a trace of sand and organics; bluey grey. Firm to stiff; wet; low plasticity; sand, fine to coarse.	2.7m – 3.2m
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics.	3.2m – 3.7m

Graphic Log

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 3.7 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 21**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

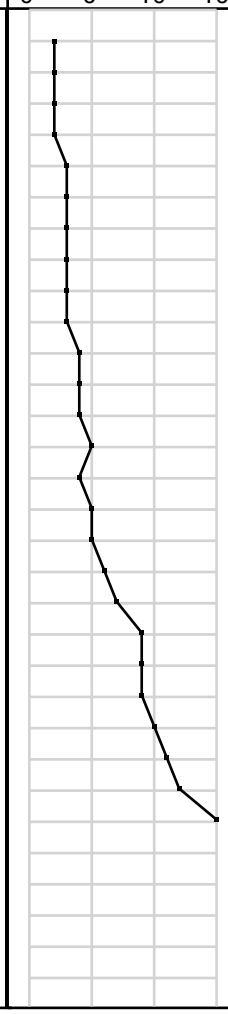
Soil / Rock Type	Description	
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.2m
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	0.4m
		3.2m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 3.2 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 22

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. (0m – 0.4m)	0.0 – 0.4	NO SEEPAGE	0 5 10 15
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded. (0.4m – 1m)	0.4 – 1.0		
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics. (1m – 1.2m)	1.0 – 1.2		
BEDROCK	BASALT; grey. Weak; non plastic; moderately weathered. (1.2m – 1.4m)	1.2 – 1.4		

Total Excavation Depth = 1.4 m

COMMENT:	Unable to penetrate rock.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 23

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. (0m)		0.0		0 5 10 15
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown, depth of layer varies across pit from 0.2 - 1.0 m. Medium dense; moist; gap graded. (0.2m)		0.1 0.2 0.3 0.4 0.5 0.6 0.7		
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics. (0.7m)		0.8 0.9 1.0 1.1 1.2 1.3 1.4	NO SEEPAGE	

Total Excavation Depth = 1.4 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 24

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

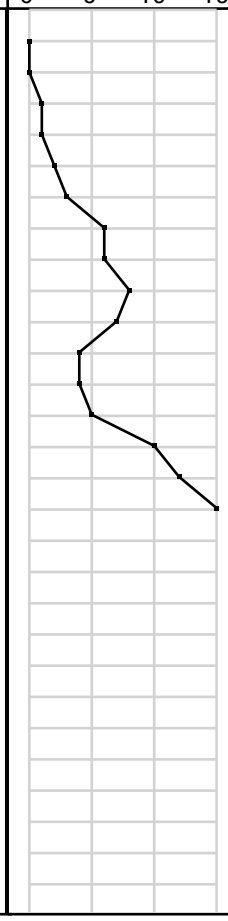
Soil / Rock Type	Description	
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m – 0.3m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.3m – 0.7m
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	0.7m – 2.9m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 2.9 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 25

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. (0m – 0.2m)		0.0 – 0.2	NO SEEPAGE	0 5 10 15
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded. (0.2m – 1m)		0.2 – 1.0		
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics. (1m – 1.2m)		1.0 – 1.2		
BEDROCK	BASALT; grey. Weak; non plastic; moderately weathered. (1.2m – 1.4m)		1.2 – 1.4		
-	- (1.4m – 1.6m)		1.4 – 1.6		

Total Excavation Depth = 1.4 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

GEOSOLVE
ENGINEERING CONSULTANTS

TEST PIT LOG

EXCAVATION NUMBER:
TP 26

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description		Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m		0.0		0 5 10 15
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.2m		0.2		
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	0.4m		0.4		
				0.5		
				0.6		
				0.7		
				0.8		
				0.9		
				1.0		
				1.1		
				1.2		
				1.3		
				1.4		
				1.5		
				1.6		
				1.7		
				1.8		
		2m		1.9		
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics.			2.0	NO SEEPAGE	
				2.1		
		2.3m		2.2		
-	-			2.3		
		2.4m		2.4		

Total Excavation Depth = 2.3 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 27

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

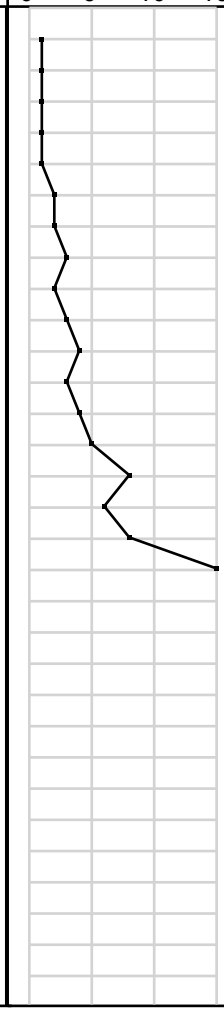
Soil / Rock Type	Description	Depth (m)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m – 0.3m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.3m – 0.8m
COLLUVIUM	SILT with a trace of sand, clay and rare organics; grey / brown / orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse; organics, fibrous.	0.8m – 3m
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics.	3m – 3.2m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 3.2 m

COMMENT:	Target depth achieved.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 28

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. (0m)		0.0		0 5 10 15
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded. (0.35m)		0.4		
COLLUVIUM	SILT with a trace of sand, clay and rare organics; grey / brown / orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse; organics, fibrous. (0.5m)		0.5		
	(2.6m)		2.6	NO SEEPAGE	

Total Excavation Depth = 2.6 m

COMMENT:	Target depth & very difficult penetration.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 29

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.5m		0.0 – 0.5		
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded. 0.8m		0.5 – 0.8		
COLLUVIUM	SILT with a trace of sand, clay and rare organics; grey / brown / orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse; organics, fibrous. 2.4m		0.8 – 2.4	NO SEEPAGE	

Total Excavation Depth = 2.4 m

COMMENT:	Target depth & very difficult penetration.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 30

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description	Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded. 0m – 0.3m		0.0 – 0.3	NO SEEPAGE	0 5 10 15
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded. 0.3m – 0.6m		0.3 – 0.6		
COMPLETELY WEATHERED VOLCANICS	SILT with a trace of sand, clay and gravel; grey / orange / brown. Very stiff; moist; non plastic; sand, fine to coarse; gravel, fine to coarse subrounded to subangular, weathered volcanics. 0.6m – 1.3m		0.6 – 1.3		
BEDROCK	BASALT; grey. Weak; non plastic; moderately weathered. 1.3m – 1.6m		1.3 – 1.6		

Total Excavation Depth = 1.6 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER: **TP 31**

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

Soil / Rock Type	Description		Graphic Log	Depth (m)	Groundwater / Seepage	Scala Penetrometer (Blows per 100mm)
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m		0.0		0 5 10 15
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.2m		0.1 0.2 0.3 0.4		
COLLUVIUM	SILT with a trace of sand, clay and rare organics; grey / brown / orange. Stiff to very stiff; moist; non plastic; sand, fine to coarse; organics, fibrous.	0.4m		0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2	NO SEEPAGE	
		2.3m		2.3		

Total Excavation Depth = 2.3 m

COMMENT:	Target depth & very difficult penetration.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 32

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

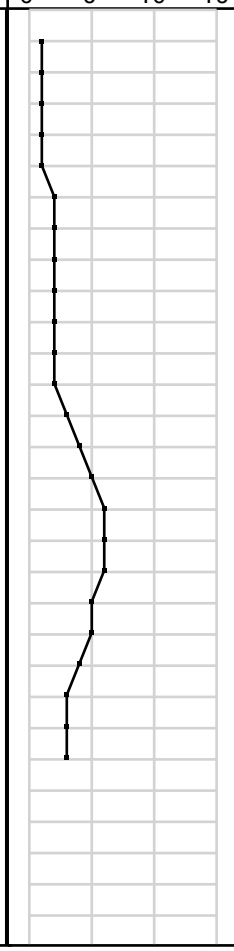
Soil / Rock Type	Description	
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.15m
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	0.3m
		3m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 3.0 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1

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TEST PIT LOG

EXCAVATION NUMBER:
TP 33

PROJECT:	CENTRE11_SUBDIVISON			JOB NUMBER:	190782.02
LOCATION:	See Site Plan	INCLINATION:	Vertical		

EASTING:		EQUIPMENT:	20t excavator / Scala	OPERATOR:	NT / MB / MTW / A. Hollands
NORTHING:		COORD. SYSTEM:		COMPANY:	GeoSolve / A. Hollands
ELEVATION:		EXCAV. DATUM:	GL	HOLE STARTED:	19/11/2021
METHOD:	Aerial Photography	ACCURACY:	± 4 Metres	HOLE FINISHED:	19/11/2021

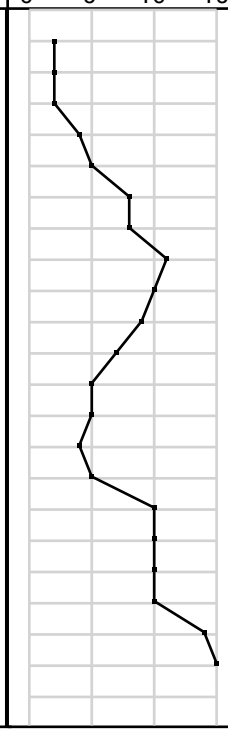
Soil / Rock Type	Description	
TOPSOIL	Fine to medium SAND with some organics and silt; brown. Loose; moist; gap graded.	0m
BURIED TOPSOIL	Fine to medium SAND with trace silt and organics; brown. Medium dense; moist; gap graded.	0.15m
ALLUVIUM	SILT with some sand and a trace of organics and clay; grey / brown. Firm to stiff; moist; non plastic; sand, fine to medium; organics, fibrous.	0.6m
DUNE SAND	Fine to medium SAND with rare silt; light brown. Medium dense; moist; gap graded.	0.9m
		2.3m

Graphic Log

Depth (m): 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3

Groundwater / Seepage: NO SEEPAGE

Scala Penetrometer (Blows per 100mm)



Total Excavation Depth = 2.3 m

COMMENT:	Test pit collapsing.	LOGGED BY:	NT / MB / MTW
		CHECKED DATE:	20/01/2022
		SHEET:	1 of 1