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WATER RESOURCES

PAVEMENTS

Geotechnical Report for Plan Change

Corbridge Estate, Wanaka

Report prepared for:

SIO No 12 Limited

Report prepared by:

GeoSolve Limited

Distribution:

SIO No 12 Limited

GeoSolve Limited (File)

June 2026

GeoSolve Ref: 250417

Revision	Issue Date	Purpose	Author	Reviewed
1	22/05/2026	Client issue for plan change application	JMJ	FAW
2	03/06/2026	Client issue for plan change application	JMJ	FAW

GEOTECHNICAL WATER RESOURCES PAVEMENTS

Table of Contents

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1 Introduction

1.1 General

This report presents the results of a geotechnical assessment carried out by GeoSolve Limited (GeoSolve) in order to determine subsoil conditions and provide geotechnical inputs for a proposed plan change at 707 Wanaka-Luggate Highway (RD2), Wanaka.

Photo 1.1 – Looking southeast over a section of the proposed plan change area.

Photo 1.2 – Looking northwest over a section of the proposed plan change area.

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Photo 1.3 – Looking southeast over a section of the proposed plan change area.

Test pit investigations were undertaken by Tonkin & Taylor within the property for a previously proposed development in 2012. The investigation data has been reviewed for the purposes of this report.

The compilation of this report was carried out for SIO No 12 Limited in accordance with GeoSolve Ltd's proposal dated 10 March 2026, which outlines the scope of work and conditions of engagement.

1.2 Development

We understand that the development comprises the construction of a golf resort. The indicative masterplans provided depict two 18-hole golf courses with an additional 12-hole public short course.

No earthworks plans are available at this stage. It is understood that the development will utilise the natural topography as much as possible. However, some cut and fill earthworks are expected to be required.

A large man-made lake is proposed in the natural central depression in the approximate centre of the site.

The resort buildings are shown to comprise a hotel precinct, a restaurant, a clubhouse precinct, a private driving range, a public driving range, a public precinct, workers accommodation and a maintenance compound. Numerous freehold apartments are proposed on the southern side of the proposed lake. Residential lots are also proposed across the entire development to fit between the golf holes.

The proposed areas are shown on Figures 1b and 2, Appendix A.

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2 Site Description

2.1 General

The subject property, legally described as Part Sections 64-67, Block IV, Lower Wanaka Survey District held on Record of Title OT14C/457 and Section 1, Block II Lower Wanaka Survey District held on Record of Title OT17A/336, is located approximately 6.5 km east of the Wanaka Township, as shown below in Figure 2.1

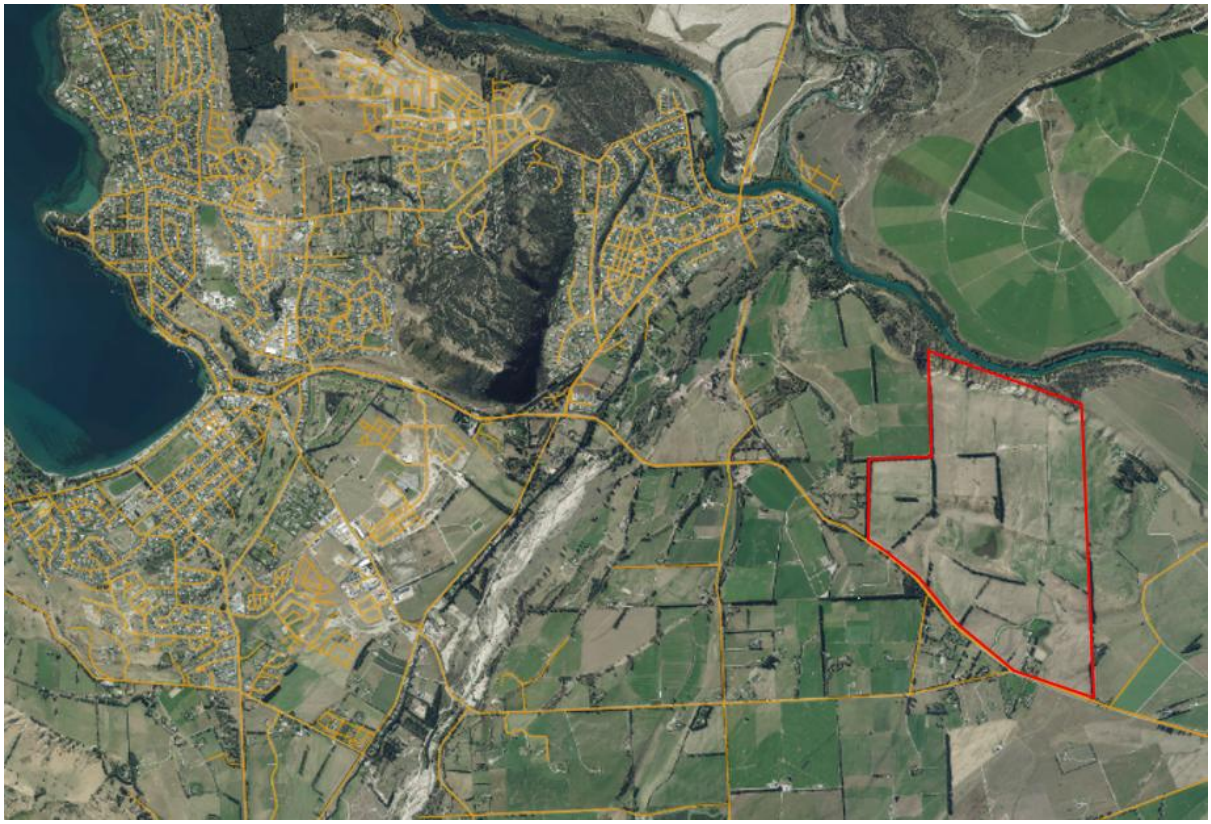

Figure 2.1- Site location (outlined in red) in relation to Wanaka Township

The site is bounded by the Clutha River/Mata-au to the north, farmland to the east and west and the Wanaka-Luggate Highway to the south/southwest. The site is currently being used as farmland.

2.2 Topography and Surface Drainage

The development area has been surveyed, and the site topography is shown in Figures 1A & 1B, Appendix A.

The site topography consists of typical undulating glacial moraine topography, apart from a major (approximately 300 x 400 m) depression in the centre of the proposed development area. A gully extends from the western end of the central depression.

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The majority of the site is used for crop farming. Several water races are present in the southern half of the site. The overland flow paths, as mapped by GeoSolve, are shown on Figures 1A & 1B, Appendix A.

3 Geotechnical Investigations

Tonkin and Taylor previously undertook test pits within the site in February 2012. A total of ten test pits were advanced to a maximum depth of 4.5 m. The test pit data has been reviewed for the purposes of this report.

The test pit data has been supplemented by geomorphological mapping, completed by GeoSolve in May 2026.

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

4 Subsurface Conditions

4.1 Geological Setting

The site is located in the Wanaka Basin, a feature formed predominantly by glacial advances. The schist bedrock within the basin has been extensively scoured by ice and lies at considerable depth below this site. Overburden material above the schist in this region includes glacial till, alluvial outwash sediments and glacially deposited fluvial/lake sediments. Tertiary sediments underlie the site at depth and can be seen outcropping in the Clutha River embankments to the north.

Active fault traces were not observed at the site and have not been reported the vicinity. However, significant seismic risk exists in this region 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.

4.2 Stratigraphy

The subsurface soils observed during the site investigations typically comprise:

- 0.3 m of **topsoil**, overlying;
- 0.4-1.5 m of **loess/colluvium**, overlying;
- 3-3.7 m+ of **outwash gravel**, overlying;
- 0.3-3.5 m+ of **fluvial sediments**, overlying;
- 0.3-3.2 m+ of **glacial till**.

Topsoil was observed at the surface of all test pits to a depth of 0.3 m. Topsoil was observed to comprise grey, SILT.

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Loess/colluvium was observed to underlie the topsoil in TPs 1-5 and extends to between 0.7 and 1.8 m below ground level (bgl). Loess/colluvium was observed to comprise light brown/grey, loose/firm, gravelly silty SAND, gravelly sandy SILT and sandy SILT.

Outwash gravel was observed to underlie the topsoil and glacial till in TPs 5-7 to 4 m bgl. Outwash gravel was observed to comprise grey, loose to medium dense sandy GRAVEL with some cobbles and minor boulders and sandy GRAVEL. Thin lenses (0.2-0.3 m thick) of SILT and SAND were observed within the outwash gravel in TPs 5 and 7 at 2.2 to 2.5 m bgl. Outwash gravel was observed to extend to the base of TPs 5 and 7.

Fluvial sediments were observed to underlie the loess/colluvium and outwash gravel in TPs 1, 3 and 6 and extends to between 4.3 and 4.5 m bgl. Fluvial sediments were observed to comprise grey, medium dense/firm interbedded SAND, SILT and sandy SILT. Fluvial sediments were observed to extend to the base of all test pits where observed.

Glacial till was observed to underlie the loess in TPs 2, 4 and 5 and extended to between 1 and 4 m bgl. Glacial till was observed to comprise grey, firm/medium dense silty sandy GRAVEL with some cobbles, gravelly silty SAND, gravelly sandy SILT, bouldery GRAVEL with some silt and sand and silty SAND with minor to some gravel. Glacial till was observed to extend to the base of TPs 2 and 4.

Full details of the observed subsurface stratigraphy can be found within the test pit logs contained in Appendix B.

4.3 Groundwater

No groundwater seepage was observed during test pit investigations. Soils were observed as dry to moist with the exception of TP7 where a lens of SILT within the outwash gravel was observed to be wet. Based on nearby borehole data (G40/0194) the regional water level is expected to lie greater than 40 m below the base of the existing lake level.

5 Preliminary Natural Hazard Assessment

In accordance with the National Policy Statement for Natural Hazards 2025 (NPSNH)[1], we have undertaken a preliminary natural hazard risk assessment to people and property associated with the development.

NPSNH specifies that the risk must be assessed using:

a. The likelihood of a natural hazard event occurring; and,
b. The consequence of a natural hazard event for life and property.

Figure 5.1, Figure 5.2 and Figure 5.3 below have been extracted from the NPSNH document for the “likelihood” and “consequence” definitions, as well as the risk matrix classification table, respectively.

[1] National Policy Statement for Natural Hazards 2025 (December 2025). New Zealand Government.

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Likelihood level	Annual exceedance probability (AEP)	Average recurrence interval (ARI) or 'return period'
Almost certain	10% or more	Up to and including 10 years
Very likely	10% to 5%	Over 10 and up to and including 20 years
Likely	5% to 2%	Over 20 and up to and including 50 years
Possible	2% to 1%	Over 50 and up to and including 100 years
Unlikely	1% to 0.2%	Over 100 and up to and including 500 years
Rare	0.2% to 0.02%	Over 500 and up to and including 5,000 years
Very rare	Less than 0.02%	More than 5,000 years

Figure 5.1 – Likelihood table (extracted from NPSNH 2025).

Consequence level	Damage to property	Potential for injury or fatalities
Catastrophic	Severe damage to land and building(s), potential for collapse or total destruction of structures. Building(s) need to be demolished, rebuilt or relocated.	High threat to life safety, with probable fatalities and/or critical injuries.
Major	Major damage to land and building(s), including structural damage. Loss of use and substantial repair required.	Unsafe for people, with potential for many injuries, or critical injuries and/or fatalities.
Moderate	Some damage to land and non-structural damage to building(s). Limited loss of use, repairs required.	Unsafe for people, with potential for injuries, although expected to be minor.
Minor	Minor damage to land and building(s). No loss of use, minimal repairs required.	Isolated minor injuries possible.
Negligible	No loss of use, no building repairs required.	No injuries.

Figure 5.2 – Consequence table (extracted from NPSNH 2025).

Consequence Level	Likelihood Level						
	Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
ARI (years)	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
Major	Very High	Very High	High	High	Medium	Medium	Medium
Moderate	High	High	High	Medium	Medium	Low	Low
Minor	Medium	Medium	Medium	Medium	Low	Low	Low
Negligible	Low	Low	Low	Low	Low	Low	Low

Figure 5.3 – Risk matrix classification table (extracted from NPSNH 2025).

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A risk matrix summarising our preliminary assessment for this development is provided in Table 5.1 below.

Table 5.1 – Preliminary NPS-NH risk matrix summary table for the proposed plan change.

Natural Hazard	Natural Hazard Risk Level	Preliminary Mitigated Natural Hazard Risk Level	Justification of Assigned Risk Level
Flooding	Low	Low	ORC hazard mapping does not show an alluvial fan or flooding hazard at the site, and the landform is generally well elevated. It is understood that the overland flow paths and stormwater will be managed as part of the earthworks design and be directed away from the proposed structures and lots from the development to an appropriate outlet/disposal location. It is assumed that the level of the man-made lake will be controlled via an outlet pipe.
Landslips	High	Low	The slope stability risk to the proposed development is discussed in Section 5.1 below.
Coastal Erosion	Low	Low	Site is not near coast.
Coastal Inundation	Low	Low	Site is not near coast.
Active Faults	Low	Low	No site-specific active faults have been identified. A regional seismic risk is present as discussed in Section 4.1 and appropriate allowance should be made for seismic loading during detailed design of any proposed buildings, foundations and retaining walls, however this is addressed by the building code, and is not specifically covered by the NPSNH.
Liquefaction	Low	Low	Due to the predominantly medium dense relative density of the outwash gravel, fluvial sediments and glacial till and the depth to groundwater, there is no liquefaction risk at the proposed development area. This is consistent with the ORC Domain A[2] classification for the site, which is defined as *'the ground is predominantly underlain by rock or firm sediments. There is little or no likelihood of damaging liquefaction occurring. In MBIE (2017) terms liquefaction damage is unlikely.'* It is important that the construction of the man-made lake is undertaken with an impermeable liner, so the lake does not introduce groundwater under the proposed building areas.

[2] Assessment of Liquefaction hazard in the Queenstown Lakes, Central Otago, Clutha and Waitaki districts of the Otago Region, GNS Science Consultancy Report 2018/67, June 2019.

Natural Hazard	Natural Hazard Risk Level	Preliminary Mitigated Natural Hazard Risk Level	Justification of Assigned Risk Level
Tsunami	Low	Low	Site is not near coast or any major water body.

5.1 Slope Stability

5.1.1 Northern Site Boundary

Existing slope instability was identified and observed along the northern site boundary on the steep slopes above the Clutha River/Mata-au.

A representative ground model, based on the test pit investigations and a review of the geomorphology, have been analysed using the software programme Slide 2.

The following slope stability cases have been analysed:

- **Static Case** – No seismic loading;
- **Serviceability Limit State (SLS)** – (equivalent to a 1 in 25-year event).
- **Ultimate Limit State (ULS)** – major regional earthquake (equivalent to a 1 in 500-year event). Stability should be sufficient to prevent loss of life following an event of this magnitude.

Peak horizontal ground accelerations and effective magnitudes were calculated using the procedure from Module 1 of the Earthquake Geotechnical Engineering Practice in New Zealand[3].

The analysis assumes dry conditions. It should be noted that the ground model was based on test pits which achieved a maximum depth of 4 m. The steep slopes along the northern site boundary are approximately 100 m high, and due to the lack of deep investigations the slope was conservatively modelled.

The target Factors of Safety used for the analysis are shown in Table 5.2 below.

Table 5.2 - Target Factors of Safety

Stability Case	Target Factor of Safety
Static	>1.5
Seismic SLS	>1.2
Seismic ULS	No target, magnitude of ground displacements to be estimated using method by Bray and Macedo (2019)[4]. Ground displacements at building platforms are typically targeted to be <25 mm.

[3] NZGS and MBIE (2021) Earthquake Geotechnical Engineering Practice, Module 1

[4] Jonothan D. Bray and Jorge Macedo, *Procedure for Estimating Shear Induced Seismic Slope Displacement for Shallow Crustal Earthquakes*, (2019)

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The analysis results show that building setbacks will be required to achieve the required factors of safety.

Table 5.3– Slope Stability Analysis Results

Stability Case	Preliminary required setback from crest of slope (m)
Static	58
Seismic SLS	59
Seismic ULS	110-130

The preliminary analysis indicates that a 58-59 m setback from the crest of the northern slopes will provide a suitable building setback with regards to the static and seismic SLS cases however lateral seismic slope displacements have been predicted to exceed typical building tolerances to between 110 and 130 m back from the crest.

Any building between the static/seismic SLS set back and the seismic ULS setback will require specific design by a suitably qualified and experienced structural engineer and geotechnical engineer to accommodate for the potential for lateral stretch greater than 25 mm.

The preliminary setbacks have been shown on Figures 1b and 2, Appendix A. As can be seen on the drawings, the proposed hospitality area (H on the drawings) and two of the proposed visitor accommodation/residential areas (VAR1 and 2) as well as areas of the proposed golf course.

As discussed above, the ground model was based on shallow investigations only. It is recommended that further investigations including deep boreholes are completed to further identify the ground conditions at depth, which may reduce the setbacks required. This should be completed as part of the Resource Consent works.

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5.1.2 Internal Slope Stability

Aside from the proposed works along the northern site boundary, several of the proposed residential lots and structures are on or adjacent to sloping ground. The locations are considered preliminarily acceptable; however, the slope stability will require assessment as part of the Resource Consent works. We consider that the extent and degree of any slope instability will be minor, such that they can be readily mitigated by standard planning and engineering measures. Erosion scouring was observed within the channel of the water race along the southern side of the central depression. In one location the water race had collapse causing considerable scouring of the slopes below. Armouring/lining of the water race channel is recommended where slope gradients exceed 4% in fine grained soils if the water race is to remain.

Photo 5.1 – Photo showing the erosion scouring below the water race on the southern side of the central depression.

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.

Further geotechnical investigations will be required at detailed design as per the recommendations of Section 6.10.

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6.2 Site Preparation

During the 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 4431:2022. These soils can be re-used for landscaping purposes away from the proposed structures and residential lots.

Owing to the moderately erodible nature of some of the soils present across the site, sediment control measures should be instigated during earthworks construction. Robust, shallow graded sediment control measures should be instigated during construction where rainwater and drainage run-off over exposed soils is anticipated.

Exposure to the elements should be limited for all soils, where practically feasible, to reduce degradation due to wind, rain and surface run-off.

Water should not be allowed to pond or collect near or under a foundation slab or footing. Positive grading of the subgrade should be undertaken to prevent water ingress or ponding. Covering footing alignments with site concrete or engineered fill is recommended following footing excavations.

6.3 Engineered Fill

All fill that is utilised as bearing for foundations and to form the proposed residential lots and other buildings should be placed and compacted in accordance with the recommendations of NZS 4431:2022 and Queenstown Lakes District Council standards.

The glacial till and outwash soils can be used as engineered fill on site (during good weather and in accordance with an earthfill specification). The topsoil is not suitable as a fill source. To use the loess/colluvium and fluvial sediment material as a fill source, it is recommended to be blended with a more granular site won material to be satisfactory.

All un-retained fill slopes should be constructed with a batter slope angle of 3H:1V (horizontal to vertical) or flatter and be benched into sloping ground. Specific analysis or geogrid reinforced slopes can be considered if engineered fill batters need to be steeper.

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. 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. In areas where significant amounts of cobbles over 100 mm are observed, the material should be blended with fine grain materials to create a well graded fill. If the cobble and boulder content is high, clasts over 100 mm in size should be screened from the fill source or crushed. An earthfill specification can be provided by GeoSolve.

We recommend topsoil and unsuitable soil stripping and subsequent earthworks be undertaken only when a suitable interval of fair weather is expected.

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6.3.1 Settlement of Engineered Fill over Natural Soils

Where engineered fill is proposed to be placed upon loose/firm colluvium or fluvial sediment soils, a settlement analysis should be completed. It is recommended that the settlement analysis is completed at earthworks design/detailed design following the additional proposed investigations as recommended within Section 6.10.

6.4 Excavations

Recommendations for temporary and permanent batter slope angles are described below in Table 6.1. 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 geotechnical engineer or engineering geologist.

The soils are anticipated to be excavated by conventional methods, however boulders are likely to be encountered within the glacial till and outwash gravels.

Based on plans provided by Tilt Architecture, the existing water race channel (as shown on Appendix A, Figures 1A and B) intersects one of the proposed building precinct areas. It is anticipated that the water race will need to be realigned as part of the earthworks.

No groundwater seepages were encountered within test pit excavations during site investigations; however, they may be encountered during construction on site. A geotechnical practitioner should inspect any seepage, spring flow or under-runners that may be encountered during construction.

6.4.1 Cut Slopes in Soils

Table 6.1 summarises the recommended batter angles for temporary and permanent soil slopes, which are formed in the soils identified at the site.

Table 6.1 – Recommended cut batter slopes for cut slopes for dry soils only

Material Type	Recommended Maximum Batter Angles for Temporary Cut Slopes Formed in dry Soil (horizontal to vertical)	Recommended Maximum Batter Angles for Permanent Cut Slopes Formed in dry Soil (horizontal to vertical)
Topsoil	2.0H: 1.0V	3.0H: 1.0V
Loess/Colluvium/Fluvial Sediments	1.5H: 1.0V	3.0H: 1.0V
Glacial Till/Outwash Gravel	1.0H: 1.0V	2.5H: 1.0V

If wet slopes are encountered, they should be inspected on a case-by-case basis by a geotechnical engineer/engineering geologist to confirm any specific recommendations e.g. drainage installation, regrading or temporary retaining.

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6.5 Groundwater Issues

The regional water table is expected to lie well below the development. Dewatering or other groundwater-related construction issues are therefore unlikely to be required. It is important that GeoSolve be contacted should there be any seepage, spring flow or under-runners encountered during construction.

The proposed earthworks and foundation construction methodology will need to consider the formation of the proposed lakes.

6.6 Formation of Man-Made Lakes

Several man-made lakes are proposed across the development area. As several proposed structures are directly adjacent to the man-made lakes, the lake will need to hold a constant level without drifting up and down. To ensure the lakes hold at a consistent level, lining of the lake base with an impermeable liner is recommended. It is understood that the northern most freehold apartment and a portion of the hotel building will be partially constructed upon the proposed lakes. Foundation solutions and construction methodology and staging will need to consider the raising of the lake.

It is important that the construction of the man-made lake is undertaken with an impermeable liner, so the lake does not introduce groundwater under the proposed building areas and create a liquefaction hazard.

6.7 Wave Action

Erosion effects from wave action will need to be considered for structures proposed adjacent to the man-made lakes. Standard mitigation options include the installation of riprap or sheet piles to deflect wave energy. However, depending on the foundation solution for each of the proposed building precincts, mitigation of erosion from wave action may be able to be incorporated into the building design. It is recommended that the final solution is confirmed at detailed design, following confirmation of the preferred foundation types for each area of the development.

6.8 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 assuming Class D subsoil conditions exist across the site.

A borehole in the east of the proposed site extends to 84 m depth, predominantly in gravel soils with no contact to rock.

6.9 Stormwater Disposal to Ground

Disposal of stormwater via soakage to ground is expect the be generally feasible across the site. The outwash gravels are expected to provide moderate to high infiltration rates, while the glacial till and fluvial sediments are expected to provide relatively low infiltration rates.

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On site soakage testing at the proposed disposal locations should be completed as part of the detailed design stage.

6.10 Additional Geotechnical Investigations

It is anticipated the following investigations will be required as part of the detailed design stage:

- Additional test pit investigations to define the geological model in more detail surrounding each of the proposed building areas.
- Deep site investigations comprising sonic boreholes/SPT and cone penetrometer testing to confirm the soil profile at depth below the site if/where significant cuts are proposed. Similar deep site investigations could be considered along the crest of the slopes above the Clutha River/Mata-au to better define the setback requirements from the crest.
- Geotechnical cross sections through structures and proposed residential lots on sloping ground.
- Soakage testing to assess infiltration design values for stormwater design, following confirmation of the site stormwater management plan.

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7 Conclusions and Recommendations

- Based on the site investigations and natural hazard assessment discussed above, the proposed development areas are considered to be at low risk for geotechnical hazards. A minor level of geotechnical hazard may be present at isolated locations within the proposed development area, and site-specific investigation and assessment will be required to assess building platform and structure locations. However, we consider that the extent and degree of any such hazards will be minor, such that they can be readily mitigated by standard planning and engineering measures.
- The stratigraphy at the site typically comprises topsoil overlying loess/colluvium overlying outwash gravel, fluvial sediments and glacial till.
- No groundwater seepage was observed during site investigations.
- No evidence of existing slope instability has been identified on site. However, evidence was observed on the slope crest and slope above the Clutha River/Mata-au during the site inspection. Minor scouring of the terrace slope on the alignment of the water race was also observed during a site walkover inspection.
- Recommendations for temporary and permanent batter slope angles are described in Section 6.4. Slopes that are required to be steeper than those described should be structurally retained or subject to specific geotechnical design.
- The colluvium, glacial till, outwash and fluvial sediments are considered suitable for use as engineered fill (during earthworks season and in accordance with an earthfill specification).
- All unsuitable soils identified in foundation excavations, particularly those softened by exposure to water, should be undercut and replaced with engineered fill during construction.
- Any fill that is utilised as bearing for foundations or to form building platforms/residential lots should be placed and compacted in accordance with NZS 4431:2022 and certification provided to that effect.
- For detailed design purposes it is recommended that the site is classified “Class D – Deep subsoil” in accordance with NZS 1170.5:2004 seismic provisions.
- Additional investigations will be required at detailed design stage. Recommendations for geotechnical investigations are detailed within Section 6.10.

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8 Applicability

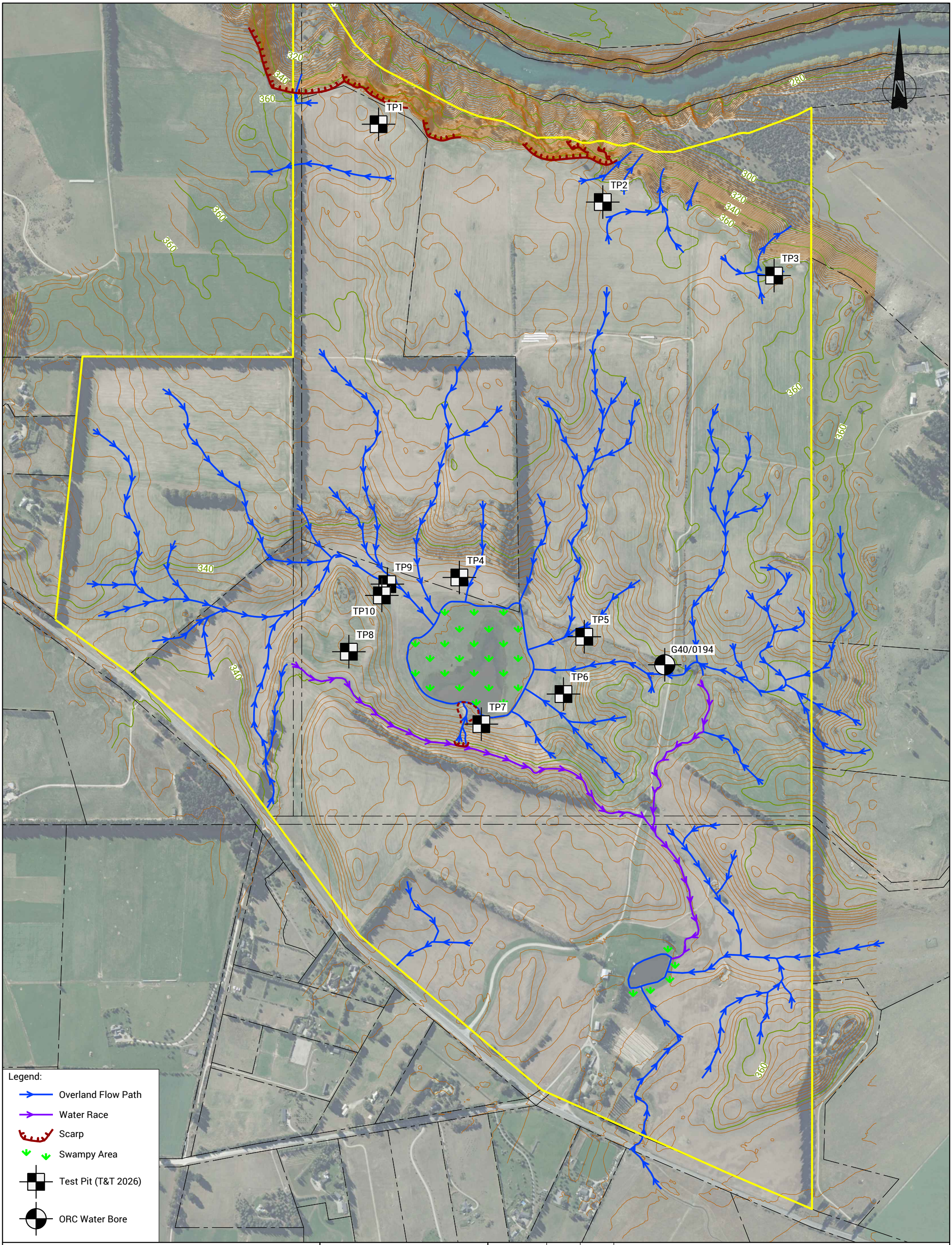
This report has been prepared for the sole use of our client, SIO No 12 Limited, with respect to the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose or in any other contexts, without our 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. Further investigations should be completed as part of the detailed design stage.

Report prepared by:	Reviewed for GeoSolve Ltd by:
	
.....	.....
Jack Mynett-Johnson	Fraser Wilson
Engineering Geologist	Senior Engineering Geologist

Appendices: **Appendix A – Site Investigation Plans**
Appendix B – Investigation Data

Appendix A: Site Investigation Plans



Notes:
1. These drawings have been prepared for the benefit of SIO No 12 Limited 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.

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SIO No 12 Limited

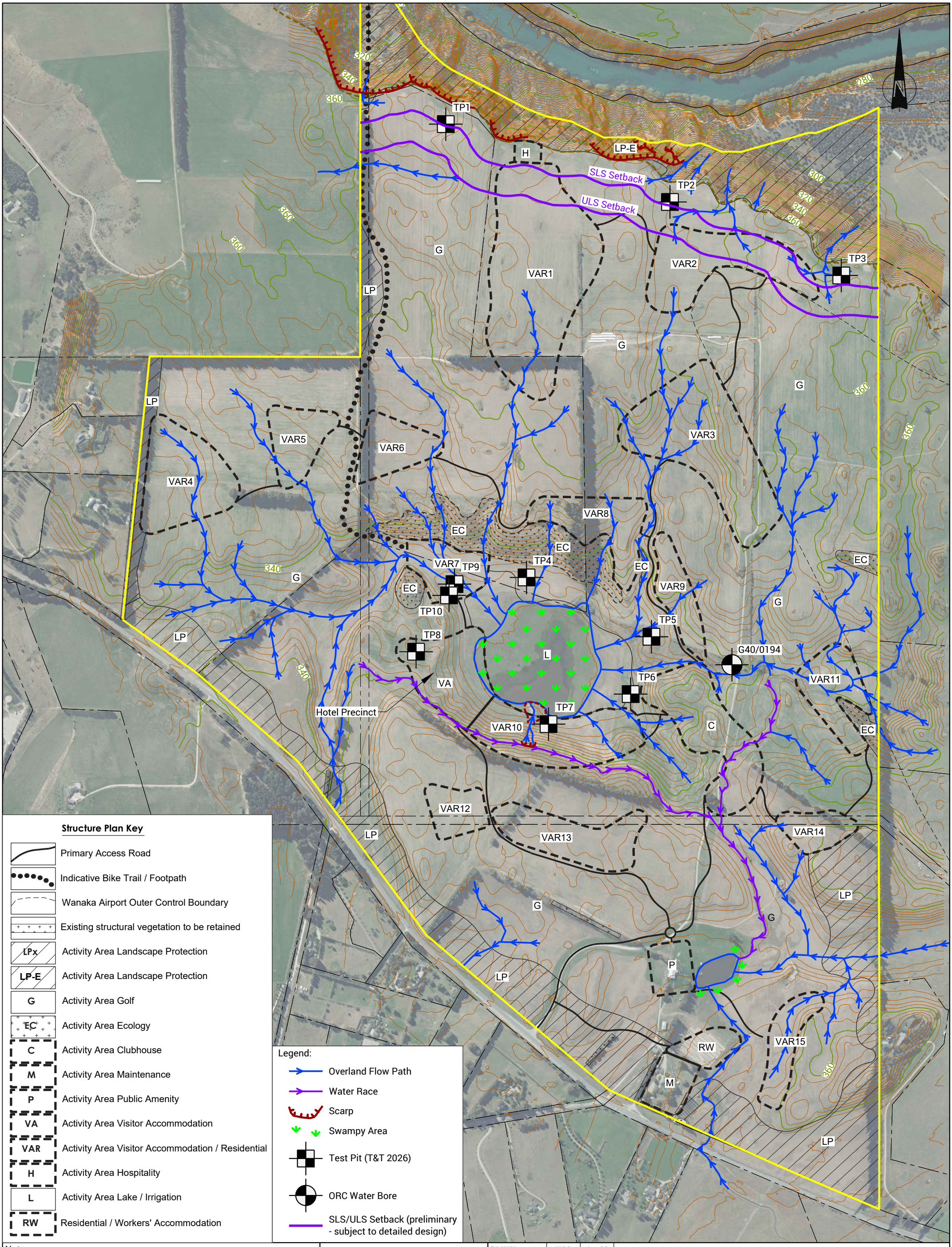
Corbridge Estate, Wanaka

Geotechnical Assessment

Geomorphological Plan

Figure No.: Appendix A, Figure 1a

Revision: 0



Structure Plan Key

- Primary Access Road
- Indicative Bike Trail / Footpath
- Wanaka Airport Outer Control Boundary
- Existing structural vegetation to be retained
- LPx — Activity Area Landscape Protection
- LP-E — Activity Area Landscape Protection
- G — Activity Area Golf
- EC — Activity Area Ecology
- C — Activity Area Clubhouse
- M — Activity Area Maintenance
- P — Activity Area Public Amenity
- VA — Activity Area Visitor Accommodation
- VAR — Activity Area Visitor Accommodation / Residential
- H — Activity Area Hospitality
- L — Activity Area Lake / Irrigation
- RW — Residential / Workers' Accommodation

Legend:

- Overland Flow Path
- Water Race
- Scarp
- Swampy Area
- Test Pit (T&T 2026)
- ORC Water Bore
- SLS/ULS Setback (preliminary - subject to detailed design)

Notes:
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SIO No 12 Limited

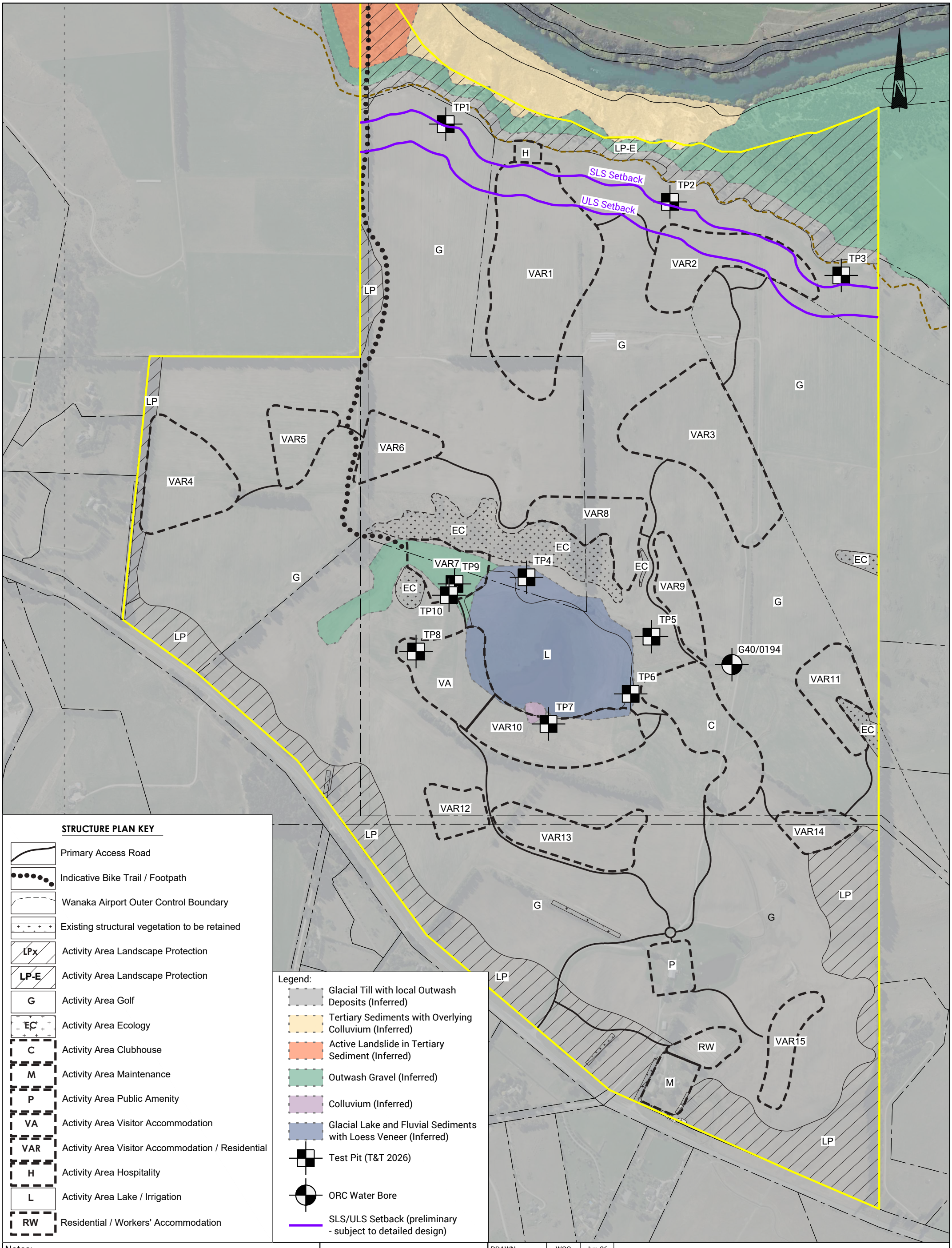
Corbridge Estate, Wanaka

Geotechnical Assessment

Geomorphological Plan with Proposed Development

Figure No. Appendix A, Figure 1b

Revision 0



STRUCTURE PLAN KEY

- Primary Access Road
- Indicative Bike Trail / Footpath
- Wanaka Airport Outer Control Boundary
- Existing structural vegetation to be retained
- LPx — Activity Area Landscape Protection
- LP-E — Activity Area Landscape Protection
- G — Activity Area Golf
- EC — Activity Area Ecology
- C — Activity Area Clubhouse
- M — Activity Area Maintenance
- P — Activity Area Public Amenity
- VA — Activity Area Visitor Accommodation
- VAR — Activity Area Visitor Accommodation / Residential
- H — Activity Area Hospitality
- L — Activity Area Lake / Irrigation
- RW — Residential / Workers' Accommodation

Legend:

- Glacial Till with local Outwash Deposits (Inferred)
- Tertiary Sediments with Overlying Colluvium (Inferred)
- Active Landslide in Tertiary Sediment (Inferred)
- Outwash Gravel (Inferred)
- Colluvium (Inferred)
- Glacial Lake and Fluvial Sediments with Loess Veneer (Inferred)
- Test Pit (T&T 2026)
- ORC Water Bore
- SLS/ULS Setback (preliminary - subject to detailed design)

Notes:
1. These drawings have been prepared for the benefit of SIO No 12 Limited 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.

SCALE 1:8,000
0 80 160 240 320 400 (m)

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www.geosolve.co.nz

DRAWN	WCG	Jun.26
CHECKED		
APPROVED		
CAD File: 250417.dwg		
Scale (at A3): 1:8000		
Project No.: 250417		

SIO No 12 Limited
Corbridge Estate, Wanaka
Geotechnical Assessment
Inferred Geological Plan

Figure No.: Appendix A, Figure 2
Revision: 0

Appendix B: Investigation Data

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 1**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.5		Grey, SILT.	Dry	TOPSOIL
	NO SEEPAGE	3.5		Grey, silty SAND with some gravel and minor boulders. Sand is fine to coarse. Gravel is fine to coarse. Boulders max size 0.4m. Massive. Medium dense.	Moist	TILL

Total Depth = 3.5 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 2**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Grey, SILT.	Dry	TOPSOIL
		0.4				
	NO SEEPAGE			Grey, sandy SILT to SILT with minor boulders. Gravel is fine to coarse. Boulders max size 0.3m. Massive. Firm.	Moist	TILL
		4.0				

Total Depth = 4 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 3**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
	NO SEEPAGE	4.0		Brownish grey, gravelly sandy SILT to SILT with minor boulders. Gravel is fine to coarse. Boulders max size 0.5m. Silt is non-plastic. Firm.	Dry to moist	TILL

Total Depth = 4 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 4**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING: mE	EQUIPMENT: 12T excavator	OPERATOR:	
NORTHING: mN	INFOMAP NO.	COMPANY: Diverse Works	
ELEVATION: m	DIMENSIONS:	HOLE STARTED: 15-Feb-12	
METHOD:	EXCAV. DATUM:	HOLE FINISHED: 15-Feb-12	

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		1.0		Light brown, gravelly silty SAND. Gravel is fine to medium. Sand is fine to coarse. Loose.	Moist	LOESS/COLLUVIUM
		3.0		Grey, SAND. Interbedded layers of fine sand and sand (fine to medium) with some gravel. Gravel is fine. Medium dense. Horizontally bedded.	Moist	FLUVIAL SEDIMENTS
	NO SEEPAGE	4.5		Grey, SAND with some horizons of laminated silt (20mm thick). Sand is fine. Silt is non-plastic. Medium dense. Horizontally bedded.	Moist	FLUVIAL SEDIMENTS

Total Depth = 4.5 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 5**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING: mE	EQUIPMENT: 12T excavator	OPERATOR:	
NORTHING: mN	INFOMAP NO.	COMPANY:	Diverse Works
ELEVATION: m	DIMENSIONS:	HOLE STARTED:	15-Feb-12
METHOD:	EXCAV. DATUM:	HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		0.8		Grey, sandy SILT. Silt is non-plastic. Loose. Massive.	Moist	LOESS
		1.8		Grey, silty sandy GRAVEL. Silt is non-plastic. Medium dense. Massive.	Moist	TILL
		2.3		Grey, bouldery GRAVEL with some silt and sand. Gravel is fine to coarse, schist clasts, angular to sub-angular. Boulders maz size 0.4m. Medium dense. Massive.	Moist	TILL
	NO SEEPAGE	4.0		Grey, silty SAND with minor/some gravel. Gravel is fine to coarse. Sand is fine. Silt is non-plastic. Medium dense. Massive.	Moist	TILL

Total Depth = 4.5 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 6**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		0.8		Grey, sandy SILT. Sand is fine. Silt is non-plastic. Loose. Massive.	Moist	LOESS
		1.8		Grey, gravelly sandy SILT. Gravel is fine. Sand is fine to coarse. Silt is non-plastic. Loose. Massive.	Moist	LOESS/COLLUVIUM
	NO SEEPAGE	4.5		Grey, SAND. Interbedded layer of fine sand and sand (fine to medium) with some gravel. Gravel is fine to medium. Medium dense. Bedded.	Moist	FLUVIAL DEPOSITS

Total Depth = 4.5 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 7**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		1.0		Light brown, sandy SILT. Sand is fine. Silt is non-plastic. Loose.	Moist	LOESS
		1.4		Grey, silty sandy GRAVEL with some cobbles. Gravel is fine to coarse. Cobbles maz size 200mm. Silt is non-plastic. Medium dense.	Moist	TILL
	NO SEEPAGE	3.8		Grey, gravelly silty SAND. Sand is fine to coarse. Gravel is fine to coarse. Silt is non-plastic. Medium dense.	Moist	TILL

Total Depth = 3.8 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 8**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING: mE	EQUIPMENT: 12T excavator	OPERATOR:	
NORTHING: mN	INFOMAP NO.	COMPANY:	Diverse Works
ELEVATION: m	DIMENSIONS:	HOLE STARTED:	15-Feb-12
METHOD:	EXCAV. DATUM:	HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		0.7		Grey, sandy SILT. Sand is fine. Silt is non-plastic. Loose.	Moist	LOESS
		1.0		Grey, gravelly sandy SILT. Sand is fine. Gravel is fine to medium. Silt is non-plastic. Firm.	Moist	TILL
		2.2		Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded. Loose to medium dense. Pit walls collapsing.	Moist	OUTWASH GRAVEL
		2.5		Yellow-grey, SAND. Sand is fine to medium. Medium dense.	Moist	OUTWASH GRAVEL
	NO SEEPAGE	4.0		Grey, sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Loose to medium dense. Pit wall collapsing.	Moist	OUTWASH GRAVEL

Total Depth = 4 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 9**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		4.0		Grey, sandy GRAVEL with some cobbles and minor boulders. Occasional sand lenses. Gravel is fine to coarse. Sand is fine to coarse. Cobbles are schist/quartz. Boulders max size 0.4m. Medium dense. Horizontally bedded. Free draining (visually).	Moist	OUTWASH GRAVEL
	NO SEEPAGE	4.3		Sandy SILT. Interbedded layers of SAND and laminated SILT. Sand is fine. Medium dense and firm. Horizontally bedded. Low-moderate permeability.	Moist	FLUVIAL DEPOSITS

Total Depth = 4.3 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 10**

PROJECT: Corbridge Downs			Job Number: 892491
LOCATION: See Site Plan	Inclination:	Vertical	Direction:

EASTING:	mE	EQUIPMENT: 12T excavator		OPERATOR:	
NORTHING:	mN	INFOMAP NO.		COMPANY:	Diverse Works
ELEVATION:	m	DIMENSIONS:		HOLE STARTED:	15-Feb-12
METHOD:		EXCAV. DATUM:		HOLE FINISHED:	15-Feb-12

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.3		Grey, SILT.	Dry	TOPSOIL
		2.5		Grey, sandy GRAVEL with some cobbles and minor boulders. Occasional sand lense. Gravel is fine to coarse. Sand is fine to coarse. Boulders max size 0.4m. Medium dense. Free draining (visually).	Moist	OUTWASH GRAVEL
		2.8		Grey, SILT. Non-plastic. Soft to firm. Low permeability.	Wet	OUTWASH
	NO SEEPAGE	4.0		Grey, sandy GRAVEL with some cobbles and minor boulders. Occasional sand lense. Gravel is fine to coarse. Sand is fine to coarse. Boulders max size 0.4m. Medium dense. Free draining (visually).	Wet	OUTWASH GRAVEL

Total Depth = 4 m

COMMENT:	Logged By: GSH
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

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