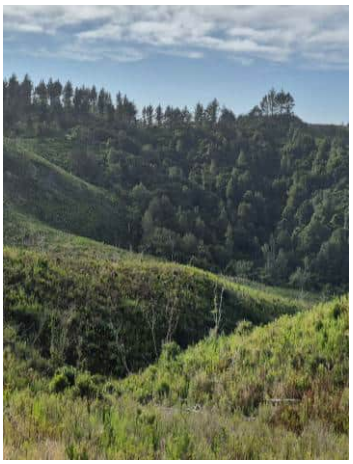
Clevedon Quarry Extension

Geotechnical Assessment Report
Proposed overburden disposal area







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1 Introduction

Stevenson Aggregates Limited (SAL) is proposing to expand its operations at Clevedon Quarry, located in Clevedon in the Auckland Region.

Clevedon Quarry is a regionally significant quarry, operating in the area since the 1970s (initially operated by Warren Shaw Limited). Clevedon Quarry is a greywacke hard rock quarry supplying aggregate to the Auckland market.

The existing Clevedon Quarry is located entirely within 546 McNicol Road, Clevedon. It is positioned within a wider area owned by SAL, encompassing approximately 544.32 hectares (ha). Existing land types/uses within the SAL landholdings include quarrying, plantation forestry (recently harvested and replanted), and pockets of native vegetation.

To enable the expansion of Clevedon Quarry, and support the extraction of aggregate, the project will also include the construction of internal haul roads, overburden removal and the establishment of an overburden disposal area (OBDA) to the east of the proposed quarry.

We understand that consenting for the proposed Clevedon Quarry expansion is likely to proceed under the Fast Track Approvals Act (2024). We understand that our report will be provided as a supporting document for the substantive application under the FTAA.

A key component of the project is the creation of a new Overburden Disposal Area (OBDA) located in a gully head to the east of the existing quarry which will support the early stages of overburden stripping from the proposed Quarry expansion. This report provides a geotechnical assessment of the proposed OBDA design.

Our scope of works was set out in our offer of service dated 30 January 2026.

2 Proposed OBDA

A design has been prepared by SAL for the placement of overburden (refer Appendix A and Figure 2-1). The design incorporates a series of batter faces separated by small surface water drainage benches between a toe elevation of approximately RL 210 m and a crest elevation up to RL 300 m.

The nature of the existing topography is such that a small spur ridge separates an east gully and a west gully and will remain proud of the final OBDA surface. Most of the fill will be established in the east of the footprint with a smaller area of fill in the west. Both west and east fills will be supported by the same toe buttress located downgradient of the confluence of the east and west gullies.

Batter slopes are typically 10 m in height and separated by 3 m wide benches. The batter slopes become gentler with increasing elevation as follows:

- RL 210 m to RL 220 m: 1V:1.5H (approx. 30° from horizontal).
- RL 220 m to RL 250 m: 1V:2H (approx. 26°).
- RL 250 m to RL 270 m: 1V:2.5H (approx. 22°).
- RL 270 m to RL 290 m: 1V:3H (approx. 18°).
- RL 290 m to RL 300 m: 1V:3.5H (approx. 16°).

The maximum fill thickness is expected to be approximately 40 m. Overburden materials will be sourced from the quarry excavation and are expected to comprise residual greywacke soils, minor alluvium, colluvium and unsaleable highly to moderately weathered greywacke rock (brown rock[1]).

We understand that the OBDA is proposed to be planted upon completion as part of the wider terrestrial offset package.



Figure 2-1: Location of Proposed OBDA (source Steveson Propeller Portal 04/02/2026).

3 Background information

3.1 Site description

The current Clevedon Quarry is orientated east-west along the lower slopes of the north to south trending Hunua Ranges and is bounded to the west by the Wairoa River (Figure 3-1). The extraction area is accessed from McNicol Road via the site office area.

The current Clevedon Quarry does not extend below McNicol Road as it has been developed by pushing back into the flanks of the hillside to the east. Presently, extraction is concentrated on upper benches and is removing weathered rock to expose unweathered greywacke resource. This excavation is broadly following topography eastwards with a series of staggered benches and batters that provide a final approximate slope height of 175 m.

The site office area is at an approximate elevation of RL 21 m, with the current extraction areas at RL 140 m, RL 160 m (Shot Floor), and RL 200 m (Overburden Stripping).

[1] Brown rock is technically a low value, saleable product. However, it is often designated as waste material if there is insufficient space to stockpile it and it needs to be stripped to access higher value unweathered resource.

Land to the south and east of the quarry, within which the wider quarry expansion is proposed, is also within the wider SAL land holding. This area was formerly in forestry, which has been progressively harvested since 2020. It currently has limited vegetation cover as replanted pines reestablish. Areas of forestry slash are apparent throughout the site.



Figure 3-1: Annotated current quarry overview (Propeller 18 December 2025).

3.2 Historical aerial photographs

Historical aerial imagery sourced from Auckland Council GeoMaps dated between the 1940s and 2024, were reviewed to understand the site history and previous land-use. An overview of the historical images reviewed are presented in Appendix C. Our observations are set out in Table 3-1.

Table 3-1: Summary of historical aerial imagery of the site

Date	Observation
1966-1972 & 1972-1973	Prior to the development and operation of the quarry, the property and surrounding hill sides were undeveloped rural land, populated with dense vegetation. A single small structure was located at the base of the ridge spur. The ridge spur is characterized with several gullies draining into streams situated to the north and south.
1980-1981	Majority of the vegetation was removed, and earthworks have begun at the foot of the ridge spur (i.e. inferred beginning of quarry operations in the late 1970's).
2006-2009	The spur outside of the quarry operation is repopulated with early growth pine plantation. Quarry operations are limited to within 400m of McNicol Road with several benches formed within the quarry.

4 Published geology

Published geological maps (Figure 4-1) indicate that the site is underlain by Waipapa Group. The Waipapa Group is described as a massive to thinly bedded volcaniclastic sandstone and siltstone of Late Triassic to Jurassic age. There are localised deposits of Tauranga Group river and hill slope deposits, East Coast Bays Formation (ECBF) sandstone and siltstone, and Holocene river deposits to the north and west of the site.

The Wairoa North Fault is inferred to be positioned within the western portion of the site and is considered active (downthrown to the southwest). An unnamed secondary fault extends to the west of the Wairoa North Fault, with inferred downthrow to the southeast.

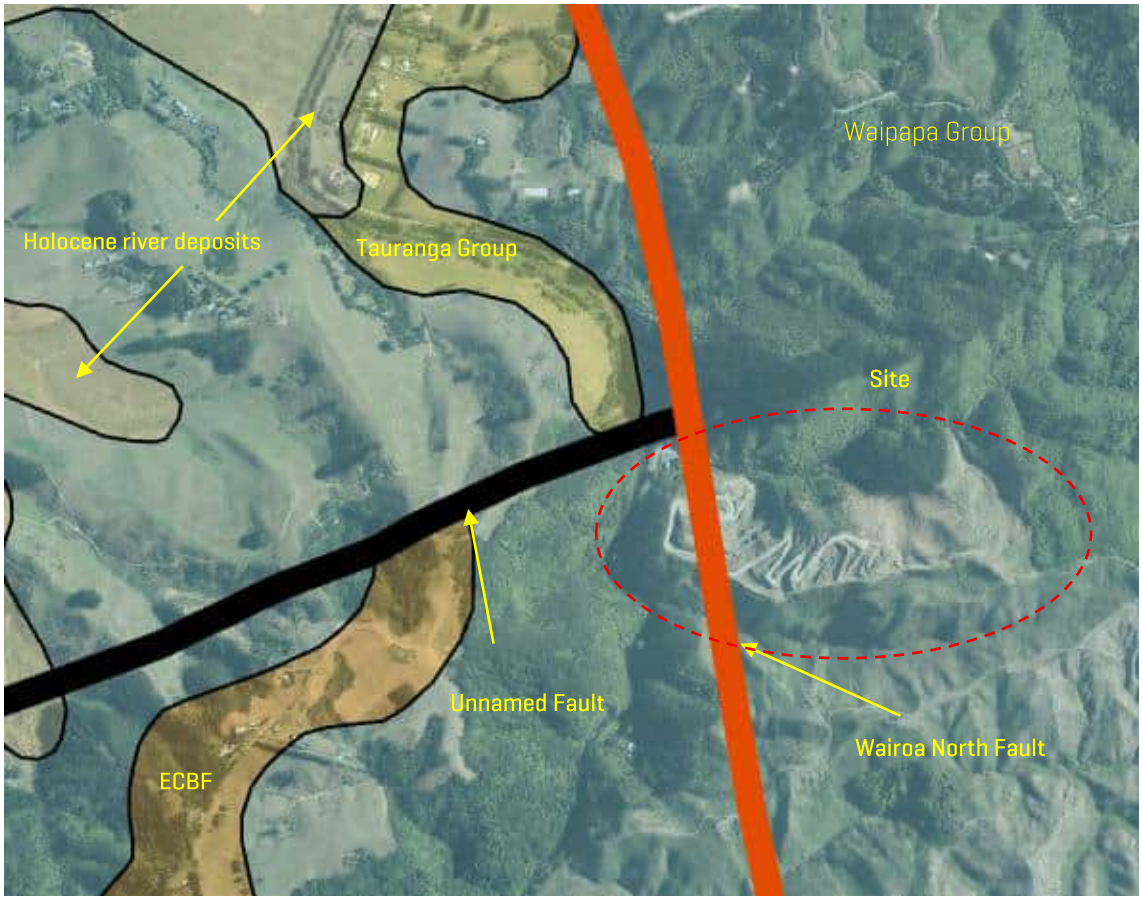


Figure 4-1: Published geological map illustrating the site (red) and the surrounding geological units. (retrieved from GNS[2])

5 Field observations

BGL visited the site on 11 December, 15-16 December 2025 and 9 February 2026. Field visits were undertaken to map rock exposure and geomorphology of the wider site and the OBDA foundation.

[2] Retrieved from https://data.gns.cri.nz/geology/ on 16/01/2026.

Field observations set out in this report relate specifically to the OBDA foundation, while other observations are described in the quarry extension geotechnical assessment report[3].

The points of interest and photograph locations are annotated onto a plan presented in Appendix B. Annotated photographs are presented in Appendix C.

In summary, field mapping identified the following:

- Slightly to moderately weathered greywacke rock outcrops in the base of the gully system, at the confluence of the east and werst gullies.
- In upper parts of the gully system the gully invert is obscured by local areas of alluvium and colluvium soils comprising light brown silts and clays.
- Some areas of the gully floor were inaccessible due to an accumulation of forestry slash.
- Surface water flows were evident in the stream channel at the confluence of the east and west gullies. Flows were estimated at 10 l/min.
- Surface water flows appear to be groundwater derived (our site visit took place after three days of fine weather). Groundwater seepage appears to be occurring at or near to the soil/rock contact at or around RL 256 m as the eastern stream channel was dry above this.
- Small scale, localised areas of soil instability are apparent in the steep side slopes of the gully system.

6 Conceptual ground and groundwater model

6.1 Geology

Based on the field observations and the existing sub-surface information, the broad geology across the site includes a typical weathering profile of greywacke ranging from residual soil through to unweathered rock, locally overlain by alluvial deposits and colluvial deposits in parts of the gully floors.

Since deposition of the Waipapa Group greywacke, these materials have undergone regional scale tectonic faulting and uplift.

While the published geological maps show that the Wairoa North Fault passes through the quarry, a structure of this size is not apparent in quarry batters, and we infer that the Wairoa River is likely to be defined by the northwest-southeast strike of this major regional scale fault.

Both second order northeast to southwest striking fault structures illustrated in the geological maps, as well as smaller scale northeast to southwest striking faults observed in the existing quarry slopes suggest that the major northeast to southwest trending gully systems within the extension land are likely to be controlled by this faulting.

[3] Baseline Geotechnical 2026, Clevedon Quarry Extension. Geotechnical Assessment Report Quarry Extension. Dated 22 October 2026, BGL000206A v1.2.

Based on observed weathering depths in the quarry walls and a nearby borehole[3] we anticipate a depth of 40-45 m to slightly weathered greywacke beneath ridge crests. Gully inverts are incised down into moderately to slightly weathered greywacke.

Localised shallow soil instability features exist across the very steep side slopes of the proposed OBDA footprint.

Localised gravel, sand and silt in the floor of the gully is considered to be locally sourced colluvium, or alluvial deposits reworked from the colluvium debris. These materials range from very soft to firm clayey silts with moderately weathered weak greywacke gravel size clasts.

We interpret greywacke rock to be present within a few metres of ground surface in the toe area of the proposed OBDA. This interpretation is based on observed exposures of moderately weathered to slightly weathered greywacke rock in the stream channel during mapping.

Interpreted ground conditions are illustrated in Appendix B.

6.2 Groundwater

Based on the seepage observations at the head of each gully and surface water flow at the base of the gullies (refer to Section 5), we interpret a perched piezometric surface along the gully invert increasing in elevation towards the head of the gully where water seepage was observed.

7 Assessment of Natural Hazards – Geotechnical

7.1 Landslide hazard assessment (PC120)

BGL have reviewed publicly available Auckland Council natural hazard maps at the site. Shallow and large-scale landslide susceptibility are identified in Auckland Council Technical Report TR2025/7, and this information is available in Auckland Council's public Geomaps portal. These susceptibility assessments were completed at a regional scale which provides guidance around the need for site-specific assessment.

For the proposed OBDA site, shallow landslide susceptibility is identified by Auckland Council as 'very high', whilst large scale slope instability was identified to be 'low'. Therefore amendments in Proposed Plan Change 120 (PC120) to Chapter 36 of the Auckland Unitary Plan – Operative in Part (AUP) apply.

The purpose of this project is to construct an OBDA which is designed to achieve commonly accepted levels of slope stability. The OBDA is expected to buttress any shallow slope instability within the catchment, fundamentally improving slope stability within the OBDA footprint.

This report provides a site-specific assessment based on our site observations, and a series of construction recommendations to promote improved slope stability and supersedes the regional scale assessment outlined in Auckland Council Technical Report TR2025/7. Appendix D presents a separate geotechnical report addendum which has been prepared to address the risk classification in accordance with Chapter M, Appendix 24 of the AUP.

7.2 Liquefaction

Liquefaction vulnerability is defined in Auckland Council technical report TR2021/19. It identifies the wider site at Clevedon Quarry as having a categorisation of "very low liquefaction vulnerability".

Liquefaction requires a large magnitude earthquake and saturated silts and sands. These are not present within the OBDA footprint. The foundation material is greywacke rock, which is non-liquefiable. Liquefaction is therefore not a natural hazard that will affect the proposed OBDA.

8 Seismicity

A key consideration for developing seismic loadings is the selection of importance level (IL) in accordance with NZS1170:0. We understand that once the fill placement is complete, the surface will not have buildings placed on the final surface and on this basis, we have not adopted the recently published technical standard (SNZ TS 1170.5:2025) when considering seismic loading. Rather we have adopted a combination of NZS1170:0, MBIE Module 1[4], and the NZTA Bridge Manual[5] when developing seismic loadings as set out in Table 8-1 below. However, we note that the resulting horizontal seismic loads are consistent with, or slightly below, those generated from SNZ TS1170:5:2025.

Table 8-1 Derivation of seismic loads

Parameter	Value Adopted	Comment
Importance Level	IL1	NZS 1170:0 2002 Table 3.2
Design Life	>100 years	NZS 1170:0 2002 Table 3.3
Recurrence interval	1:250	NZS 1170:0 2002 Table 3.3
ULS Seismic Load (PGA)	0.14g	MBIE Module 1 Table A1
Earthquake Magnitude	5.9	MBIE Module 1 Table A1
Maximum Considered Earthquake (MCE = 1.5 x ULS PGA)	0.21g	NZTA Bridge Manual

9 Slope stability assessment

9.1 General

Our stability assessment has been undertaken using Slide2, a limit equilibrium software package that compares driving forces and resisting forces as a ratio, called a Factor of Safety (FoS). Where driving forces exceed resisting forces a factor of safety below 1 is calculated, indicating a slope failure condition.

The most recent topography for the existing ground is based on photogrammetry undertaken by SAL. Proposed design contours and cross sections are illustrated in Appendix B.

[4] MBIE and NZGS (November 2021) Earthquake Geotechnical Engineering Practice: Module 1 Overview of the guidelines, Appendix A.
[5] NZTA (May 2013). Bridge manual (SP/M/022), version 3.

A single cross section has been selected to use as the basis of our slope stability assessment (Appendix B). Because of the nature of the geometry of the gully alignment and the OBDA face, this section has had to be cut slightly obliquely through part of the OBDA to follow the underlying gully alignment.

9.2 Material parameters

We have based the overburden fill material parameters on the observed performance of other OBDA fill sites with similar greywacke derived overburden.

The parameters adopted in this assessment are considered to broadly represent average conditions, based on our observations, but we recognise that some uncertainty remains with respect to the variability of the toe bund and general fill materials. Our adopted material parameters are presented in Table 9-1 below.

Table 9-1: Soil parameters for design

Material	Density [kN/m^3]	Effective Cohesion [c' – kPa]	Effective Friction Angle [ϕ' – degrees]
Zone 1 - Brown Rock Fill	19	0	40
Zone 2 – Improved Clay Fill	18	5	33
Zone 3 - Mixed Clay Fill	17	3	28
Residual & completely weathered greywacke	18	7	32

Table 9-2: Rock parameters for design

Material	Type	Density [kN/m^3]	UCS [MPa]	GSI	mi	D
HW Rock [Greywacke]	Generalized Hoek Brown	18	5	30	11	0
MW Rock [Greywacke]		22	40	40	11	0
SW-UW Rock [Greywacke]		25	100	50	11	0

9.3 Groundwater conditions for design

For the purposes of the slope stability assessment and based on the information presented in Section 6.2 we have conservatively adopted a single piezometric surface for the natural soil and rock. This piezometric surface has been applied at or close to the pre-development ground surface.

For the purposes of design under static and seismic conditions, the Overburden Fill material has been modelled with an Ru[6] of 0.10 [representing ~20% saturation of any analysed slip circle].

[6] Ru is defined as a ratio of normal stress to pore water pressure.

The Ru values adopted are broadly consistent with long term measured pore water pressures in an instrumented overburden disposal site at a quarry in Auckland.

To model elevated groundwater conditions, the Overburden Fill material has been modelled with an Ru of 0.25 (representing ~50% saturation of any slip circle). This is to account for a potential build up in pore pressure during prolonged high intensity rainfall events or partial sub-soil drainage failure.

Separation of groundwater pressures in overburden materials and in-situ soil and rock is considered reasonable, provided that a sub-soil drainage network is constructed in the former gully system to pick up and discharge groundwater seepages (refer Section 10.2).

9.4 Design criteria

We have adopted typical stability design criteria for a low importance site that will not support development on completion and that has a low risk of instability extending beyond site boundaries.

Proposed design criteria are:

- Static Case FoS ≥ 1.3
- Elevated Groundwater Case FoS ≥ 1.1
- ULS Seismic Case FoS ≥ 1.0 or displacement analysis <1.0 m.

These criteria are broadly consistent with published regulatory recommendations for parks and bush land, with limited risk of off-site effects[7]. This site will be planted on completion and will essentially revert to bush land on completion of works.

9.5 Results

We have completed slope stability calculations for the proposed OBDA design. The results are summarised in Table 9-3 and analysis outputs are presented in Appendix E.

Table 9-3: Proposed OBDA design slope stability analysis results.

Section Reference	Design Case	Factor of Safety (FoS)	Comment
Section 1	Static	1.50	20% saturation
	Elevated Groundwater	1.34	50% saturation
	Seismic ULS	1.0	1:250 AEP – PGA 0.14g
	Seismic MCE	0.87	PGA 0.21g

9.6 Displacement analysis

Seismic cases for the proposed design indicate that acceptable levels of stability can be achieved for the ULS design case, however, displacements can be expected for the MCE case considered. For

[7] The Auckland Code of Practice for Land Development and Subdivision Chapter 2: Earthworks and Geotechnical. July 2022, Version 2.0. Auckland Council.

guidance we have assessed displacements in the MCE case in accordance with Jibson 2007[8] and Macedo et al 2023[9]. These return results of between 5 mm and 40 mm of displacement (depending on the method adopted). This level of displacement is considered acceptable for a landform of this nature.

9.7 Discussion

We have reviewed the concept OBDA landform prepared by SAL and adopted the general shape of the landform in our assessment.

Our analysis results demonstrate that acceptable levels of stability can be achieved provided that:

- The OBDA toe geometry includes a toe buttress of Zone 1 free draining weathered rock fill constructed as follows:
  - All fill below RL 220 m.
  - Minimum 20 m horizontal width between RL 220 and RL 230 m
  - Minimum 15 m horizontal width between RL 230 and RL 240 m.
- Zone 2 Improved Clay Fill should be used as follows:
  - All remaining fill that is not Zone 1 up to RL 230 m.
  - A minimum horizontal width of 12 m between RL 240m and RL 300 m.
- Above RL 230 m, remaining fill, behind Zone 1 & Zone 2, may comprise Zone 3 mixed clay fill materials.
- Foundation stripping is undertaken to remove soft soils from the toe of the OBDA, with brown rock fill placed as a shear key to build up undercut areas.
- Sub soil drainage is provided along the gully axes, including sidling gullies and any identified groundwater seepages.
- A 1m thick layer of Zone 1 weathered rock fill should be placed as an informal drainage blanket across the OBDA at RL 250 m, RL 270 m and RL 290 m.

10 Construction recommendations

Key construction recommendations are set out in the following sections. These recommendations are designed to manage slope instability risks. We anticipate that these would be included in an OBDA Construction Management Plan (CMP) (or equivalent) along with other civil construction related items (such as surface water management).

[8] Jibson RW. Regression models for estimating coseismic landslide displacement. Eng Geo 2007;91(2–4):209–18.

[9] Macedo J, Bray JD, Liu C. Seismic slope displacement procedure for interface and intraslab subduction zone earthquakes. Journal of Geotechnical and Geoenvironmental Engineering 2023 ASCE

10.1 Foundation preparation

We anticipate that foundation stripping will be required to remove soft and unsuitable soils within the axis of the gullies.

The gullies are narrow, so the width and depth of soft/wet soils that will need to be undercut is expected to be limited.

Foundation stripping should extend down into the underlying completely weathered, hard greywacke soils at a minimum. Foundation stripping should extend up gully a minimum of 100 m from the toe of the OBDA.

Soils stripped during foundation preparation may be incorporated into the Zone 3 mixed clay fill part of the developing OBDA.

Stripping of topsoil and vegetation should be undertaken from the entire footprint of the OBDA. These materials may be stockpiled for final rehabilitation of the OBDA.

10.2 Sub-surface drainage

Formal underfill drainage will be required to manage groundwater pressures at the contact between the current ground surface and the overburden fill.

Conceptually sub-soil drainage will include 110 mm or 170 mm diameter Nexus Hiway perforated pipe, in a filter sock, surrounded by drainage aggregate, wrapped in a geofabric. Concept designs are illustrated in Appendix B.

Sub-surface drainage design should be finalised prior to commencing gully infilling.

10.3 Zoned Fill Placement

10.3.1 Zone 1 – Brown Rock Fill

A key part of the geotechnical design is constructing the Zone 1 weathered rock embankment and achieving an appropriate thickness or Zone 1 for the lower OBDA front face, which will essentially buttress the poorer quality (Zone 3) mixed clay fill behind it.

Brown rock fill may include minor fines, but must be free draining, with clast to clast contact between greywacke cobbles and gravels providing a high level of frictional strength.

From time to time, excess weathered rock may be sent to the OBDA. This material would normally be placed in lifts up to 0.50 m to 1.0 m thick, due to the variability in block size. The surfaces are then track rolled by bulldozer. We anticipate that layers of brown rock may also be used to intermittently cap to the OBDA if trafficking becomes an issue for the overburden fleet.

Section 9.7 sets out the design geometry of the Zone 1 Fill Brown Rock, this is also set out schematically in Appendix B.

Guidance on placement requirements and compaction control is set out in Table 10-1 below.

10.3.2 Zone 2 – Improved Clay Fill

Depending on the volume of brown rock available during stripping from the quarry, there may be a need to utilise greywacke soils as structural fill for the upper part of the outer face of the OBDA site.

A zone of improved clay fill, with more rigorous placement controls, is proposed to be used as required for the upper portion of the OBDA. Material placed in this zone will need to comprise moist residual greywacke clay soils, placed in thin lifts and rolled with a sheep's foot roller. We note that Zone 1 materials may be utilised in construction of any proposed Zone 2 area.

Overly soft, organic rich or wet soils are to be excluded from source materials for this zone.

Guidance on placement requirements and compaction control is set out in Table 10-1 below.

10.3.3 Zone 3 – Mixed Clay Fill

Our understanding is that typical mixed clay fill placement would include separation of residual soils depending on moisture content.

Drier soils may be bladed out and placed in lift thicknesses up to 1 m, while wetter soils may need to be bladed out in thinner layers (300-400 mm) due to difficulty in working and trafficking this material when placed in thicker lifts. The surfaces would normally be track rolled by bulldozer.

In general, poorer quality soils (wet/soft) should be separated and placed at the rear of the OBDA away from the front face.

The placement methodology will result in significant air voids within the placed fill and potential for softening of the fill post placement; however, this is not expected to have a significant effect on stability over the expected life of the OBDA.

Overall, the methodology is expected to be able to achieve the modelled material strengths used in our stability assessment for this unit.

Table 10-1: Summary of fill placement requirements

Material Type	Loose Layer Thickness (max)	Max Particle Size	Placement requirements	Testing & construction observation
Zone 1 – Weathered Greywacke Rock Fill	0.5 m	250 mm	Bladed out into lifts by Dozer. Track rolling by Dozer. Cycling of laden haul truck fleet	Single Test Minimum Clegg Impact Value (CIV) = 10 Average Clegg Impact Value (CIV) = 12 No warping or weaving evident under passage of laden haul trucks.
Zone 2 – Improved Clay Fill	0.4 m	200 mm	Bladed out into lifts by Dozer. Track rolling by Dozer. Rolling with CAT 825 G or equivalent (minimum 3 passes). Cycling of laden haul truck fleet.	Single Test Minimum Corrected Shear Vane = 100 kPa Single Test Minimum Corrected Shear Vane = 120 kPa No warping or weaving evident under passage of laden haul trucks.

Zone 3 – Mixed Clay Fill	1.0 m	NA	Bladed out into lifts by Dozer. Track rolling by Dozer.	No specific testing requirements

10.4 Construction inspections

We anticipate that geotechnical inspections/assessment will be required intermittently during construction. This is expected to include:

1. Inspection of undercuts to verify foundation conditions in the gully floors.
2. Inspection of first stages of sub-soil drainage construction.
3. In-situ strength testing of early lifts of Zone 1 & Zone 2 fills to verify that assumed strengths are being achieved by the placement methodology.

The purpose of inspection and testing is to verify ground conditions and placed fill strengths. The frequency of testing is expected to be substantially reduced from what may be normally expected for a civil earthworks project as long-term settlement is not a design consideration for this site (refer Section 10.6).

10.5 Surface water drainage

Both interim and final surfaces should be gently graded so that surface water is unable to pond on the OBDA during rainfall events.

Specific surface water drainage channels have been developed to manage surface water flows on the front face for the ODBA. However, it is likely that discharge points at either edge of the OBDA (where the drainage benches discharge) may need to be stabilised in the final design to limit erosion at the contact point between the OBDA front face and the steeper natural slopes where surface water flows are expected to concentrate.

The OBDA surface should be rehabilitated as soon as practicable after individual stages of construction are completed to limit the volume of sediment laden water runoff during rainfall events.

10.6 Final surface settlement

The nature of the fill placement and overall height of the fill mean that long term settlements are expected to be significant (in the order of hundreds of millimetres) and will be ongoing for a significant period post completion. The site is not expected to be suitable for the development of structures in the future.

11 Review of environmental effects

Environmental effects have been considered in relation to the geotechnical performance of the proposed OBDA.

The key area of potential environmental effects relates to the short and long term stability of the OBDA. In general, for environmental effects to be considered significant, there would need to be a risk of slope instability that could:

- Result in instability extending beyond the applicants' property boundaries.
- Result in debris from instability coming into contact with areas of native vegetation.
- Result in debris from instability coming into contact with streams and watercourses.

Based on the stability assessments undertaken, we consider that the risk of instability at the site is low based on the conservative design criteria adopted, the analysis results and the location of the adjacent property boundaries. In our opinion the potential for environmental effects related to geotechnical performance of the OBDA is therefore negligible.

12 Summary and recommendations

Our geotechnical assessment of the proposed OBDA at Clevedon Quarry has identified that the proposed footprint lies within a gully head to the east of the current quarry.

The gully floor is obscured in places by alluvium and forestry slash. However, the presence of rock outcropping near the toe of the proposed OBDA, at the confluence of the east and west gullies, indicates that a greywacke rock or hard soil foundation will be available for the OBDA, with only typical foundation preparation (undercutting of local soft alluvium) required.

Our analyses indicate acceptable levels of slope stability under static, elevated groundwater and design seismic conditions.

Construction recommendations include the need for foundation undercuts, stripping of topsoil, construction of sub-soil drainage and zoned fill placement as set out in Section 9.7.

The OBDA fill surfaces should be graded so that surface water is unable to pond, and rehabilitation should be undertaken soon after final slopes are developed.

Our assessment has included an assessment of potential environmental effects based on slope instability that could either extend off site, affect streams, or affect areas of high value ecology. In our opinion the potential for environmental effects relating to geotechnical performance of the OBDA is negligeable.

Our opinion is subject to the construction recommendations set out above, which play a critical role in achieving the level of stability predicted. For that reason, we consider that the construction recommendations should be formalised into a OBDA Construction Management Plan, which could in turn be integrated into the suite of resource consent conditions.

We have reviewed the consent conditions drafted by SAL. We are satisfied that the conditions proposed adequately address the recommendations set out in this report.

13 Applicability

This report has been prepared for the exclusive use our client Stevenson Aggregates Limited, and the Fast Track Expert Panel in their capacity as decision makers for an Application for consent for the Clevedon Quarry Extension project. The recommendations and opinions in this report are limited to the purpose stated within the report. It may not be relied upon in other contexts or for any other purpose, or by any person other than those nominated above, without our prior written agreement.

We trust that this report meets your present requirements. If you have any queries or wish to discuss any aspect, please contact the undersigned.

For and on behalf of Baseline Geotechnical Limited:

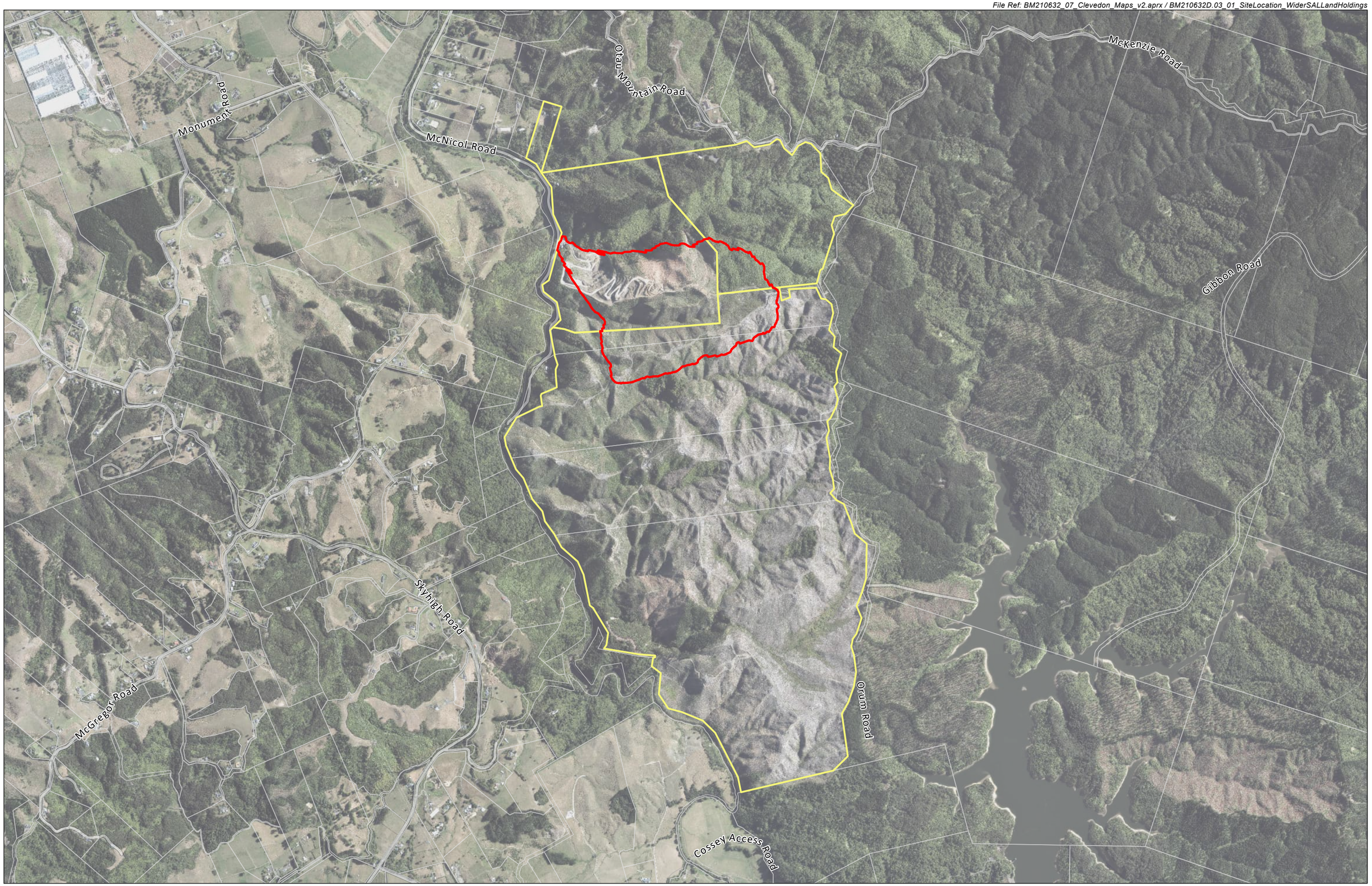


.....

Cameron Lines

Director

Appendix A – Proposed OBDA design



STEVENSON
Boffa Miskell

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.

0 400 800 m
1:20,000 @ A3

DRAFT

Data Sources: LINZ (Aerials), Stevenson Aggregates, BML

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND
- Proposed Pit Extent (LOQ)
- SAL Land Holdings
- Land Parcels

CLEVEDON QUARRY

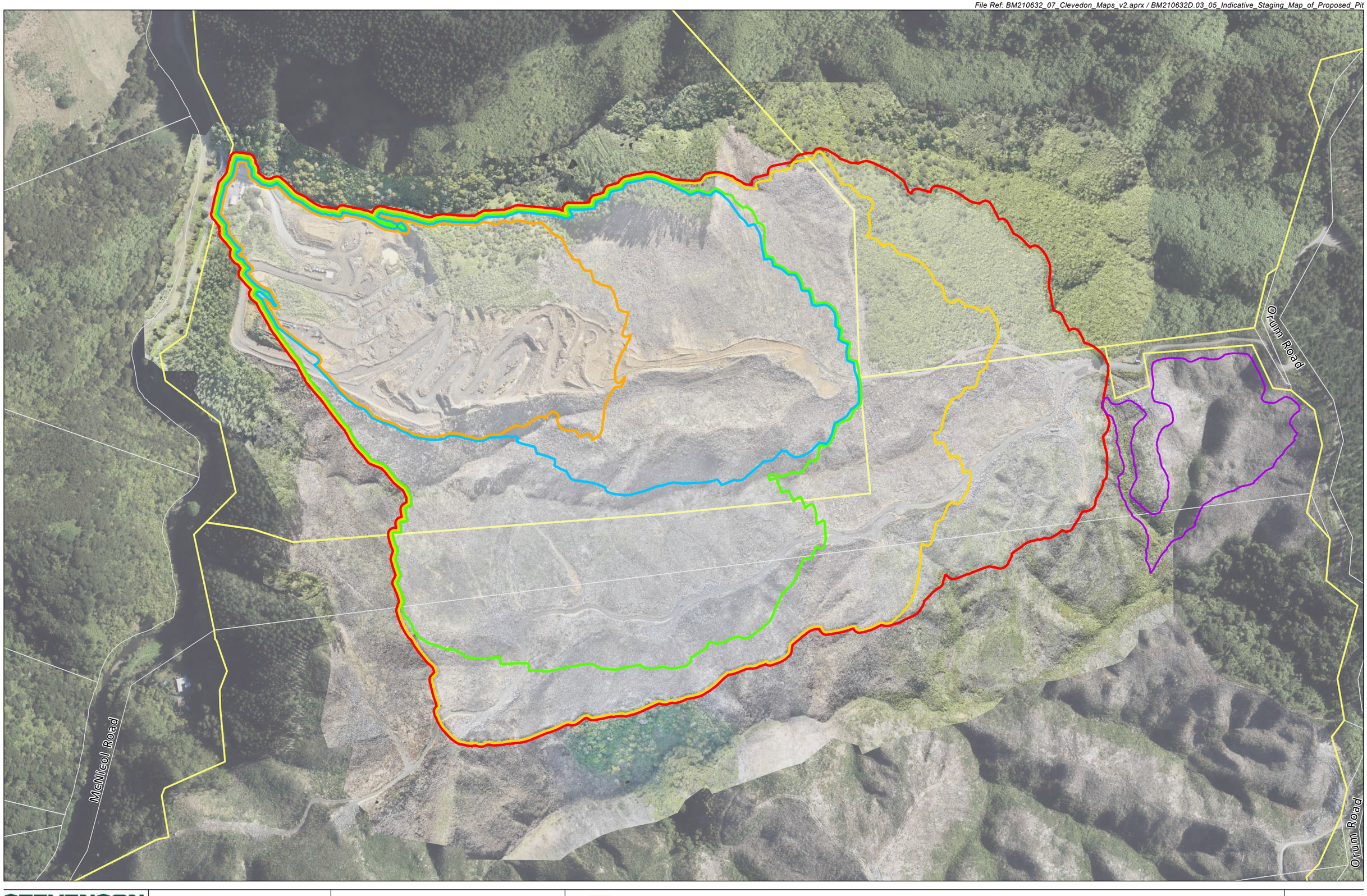
Site Location - Wider SAL Land Holdings

Date: 29 January 2026 | Revision: B

Plan prepared by Boffa Miskell Limited

Project Manager: Sandeep.Gangar@boffamiskell.co.nz | Drawn: SGa | Checked: JUr

Figure 1



STEVENSON
Boffa Miskell

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.

0 100 200 m
1:5,000 @ A3

DRAFT

Data Sources: LINZ (Aerial), Stevenson Aggregates, BML

Projection: NZGD 2000 Mount Eden Circuit

LEGEND

- Indicative Stage 1: 10 years
- Indicative Stage 2: 20 years
- Indicative Stage 3: 30 years
- Indicative Stage 4: 40 years
- Indicative Stage 5: 50 years
- SAL Land Holdings
- Overburden Disposal Area
- Land Parcels

CLEVEDON QUARRY

Indicative Staging Map of Proposed Pit

Date: 03 February 2026 | Revision: B

Plan prepared by Boffa Miskell Limited

Project Manager: Sandeep.Gangar@boffamiskell.co.nz | Drawn: SGa | Checked: JUr

Figure 5



STEVENSON
Boffa Miskell

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that they arise from inaccurate information provided by the Client or any external source.

0 25 50 m
1:2,000 @ A3

Data Sources: LINZ (Aerial), Stevenson Aggregates, BML

Projection: NZGD 2000 Mount Eden Circuit

DRAFT

LEGEND
- Overburden Disposal Area
- Proposed Pit Extent (Life of Quarry)
- SAL Land Holdings
- Land Parcels

CLEVEDON QUARRY

OBDA Map

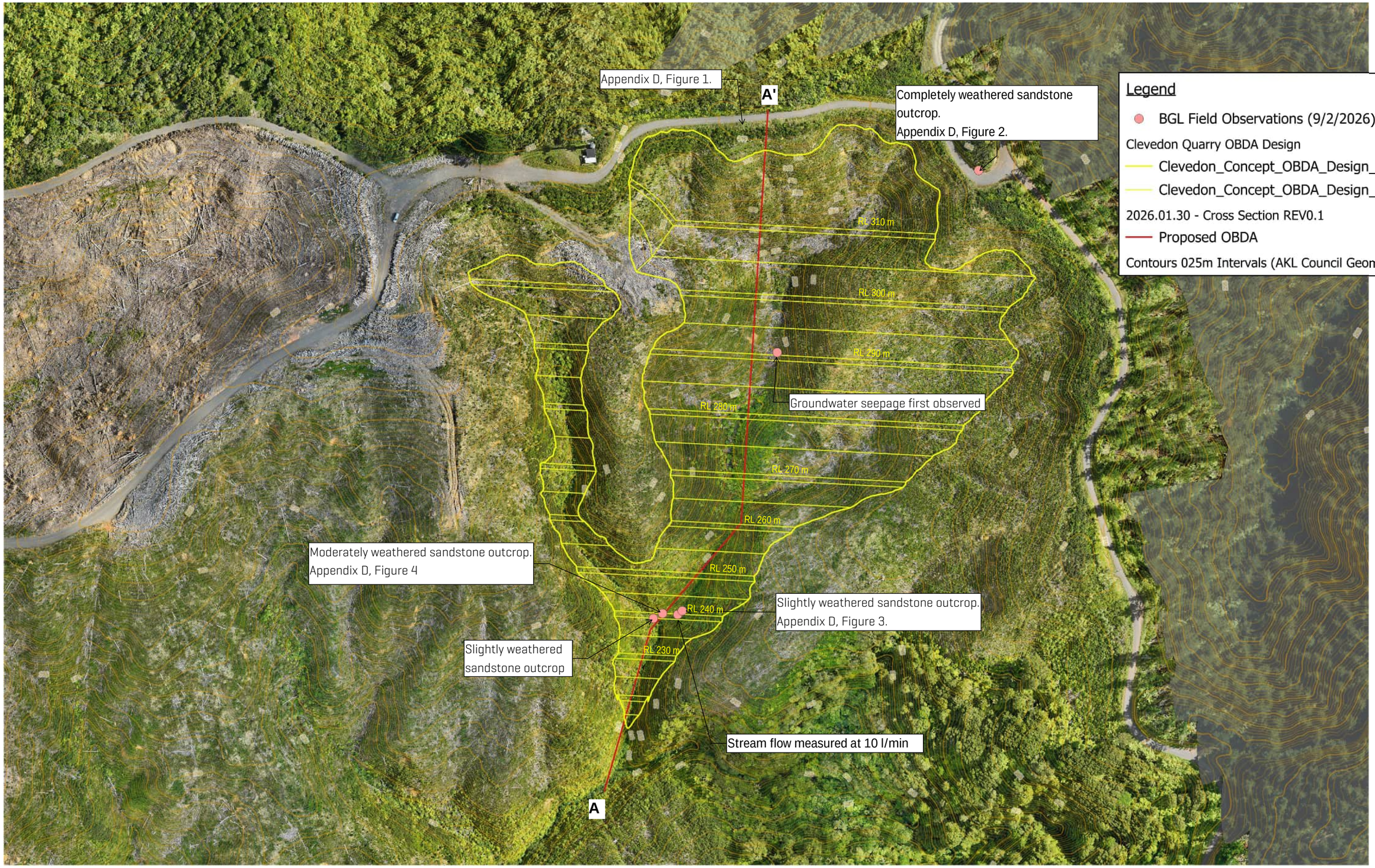
Date: 03 February 2026 | Revision: B

Plan prepared by Boffa Miskell Limited

Project Manager: Sandeep.Gangar@boffamiskell.co.nz | Drawn: SGa | Checked: JUr

Figure 13

Appendix B – Figures



1. Quarry aerial sourced from Propeller dated 28 January 2026.
2. Basemap sourced from Auckland Council Geomaps, dated 2024.
3. Proposed OBDA design is up to date as of January 2026.
4. Contours sourced from Auckland Council Geomaps.

Drawn	ASW	10/02/25
Checked	CJL	10/02/25

Project No. BGL000206B

Scale: 1:2000 Original Size: A3

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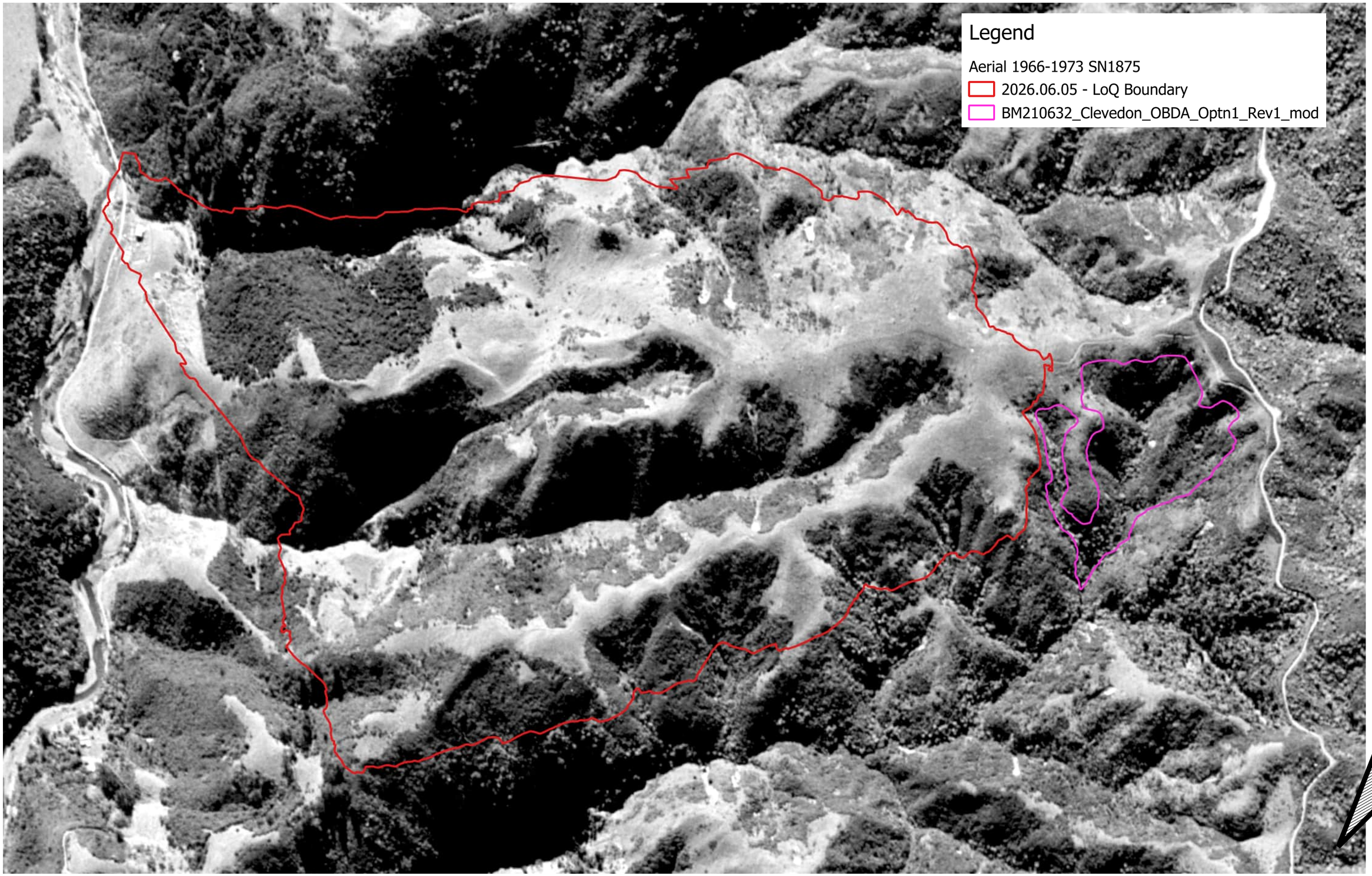
Clevedon Quarry- Site Plan and Cross Section

Clevedon Quarry Extension

Overburden Disposal Area

Figure Number: Appendix B - Figure 1

Rev 1



1. Historic aerial image sourced from Auckland Council geomaps.
2. Proposed OBDA and quarry extension design are up to date as of 29 May 2026.

Drawn	ASW	05/06/2026
Checked	CJL	05/06/2026

Project No. BGL000206B

Scale: 15000 Original Size: A3

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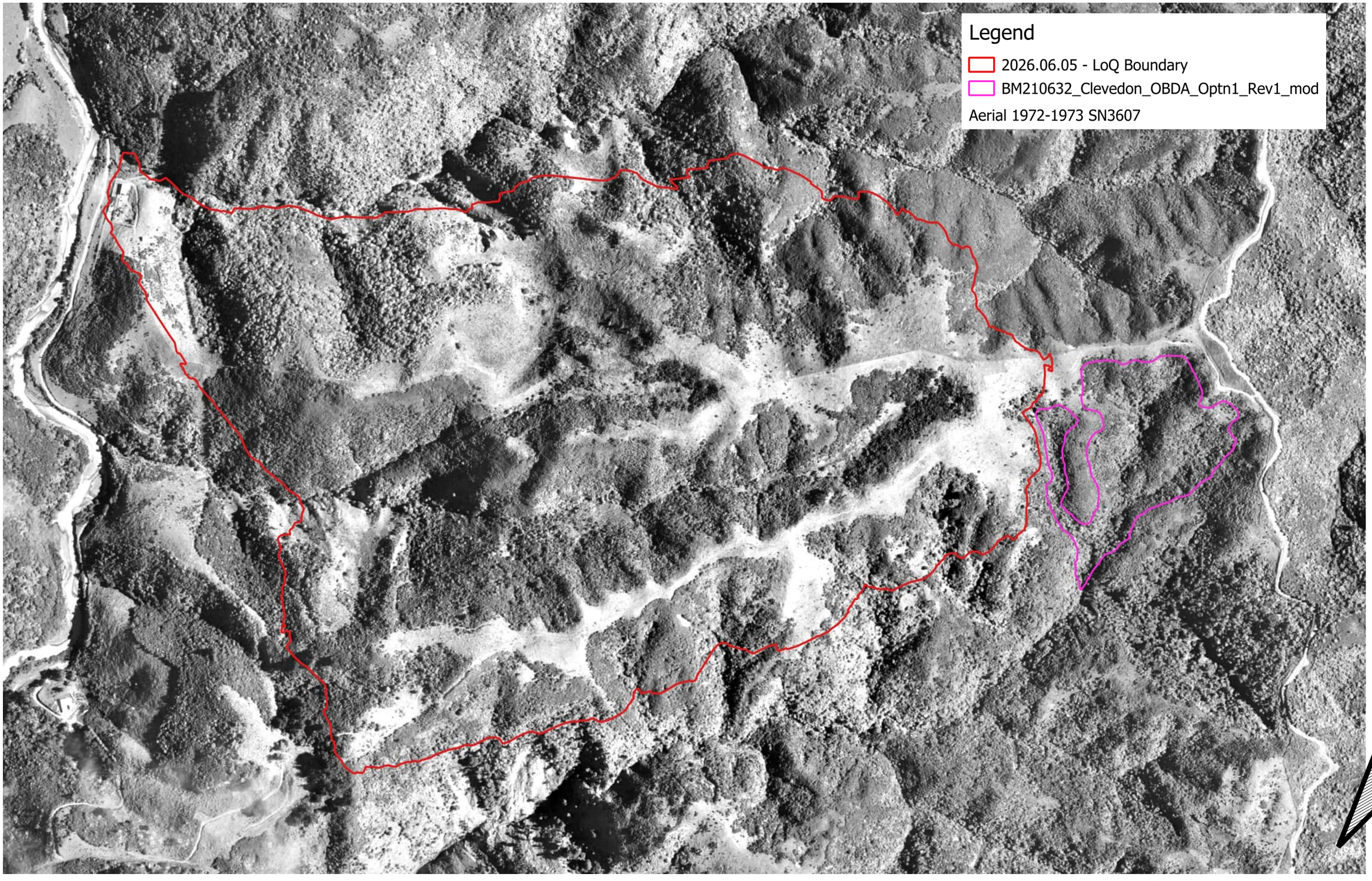
STEVENSON

Clevedon Quarry - Historic Aerial (1966-1973)

Clevedon Quarry Extension
Overburden Disposal Area

Figure Number: Appendix B - Figure 2

Rev 1.0



1. Historic aerial image sourced from Auckland Council geomaps.
2. Proposed OBDA and quarry extension design are up to date as of 29 May 2026.

Drawn	ASW	05/06/2026
Checked	CJL	05/06/2026

Project No. BGL000206B

Scale: 15000.005427 Original Size: A3

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Clevedon Quarry - Historic Aerial (1972-1973)

Clevedon Quarry Extension
Overburden Disposal Area

Figure Number: Appendix B - Figure 3

Rev 1.0



1. Historic aerial image sourced from Auckland Council geomaps.
2. Proposed OBDA and quarry extension design are up to date as of 29 May 2026.

Drawn	ASW	05/06/2026
Checked	CJL	05/06/2026

Project No. BGL000206B

Scale: 15000.005427 Original Size: A3

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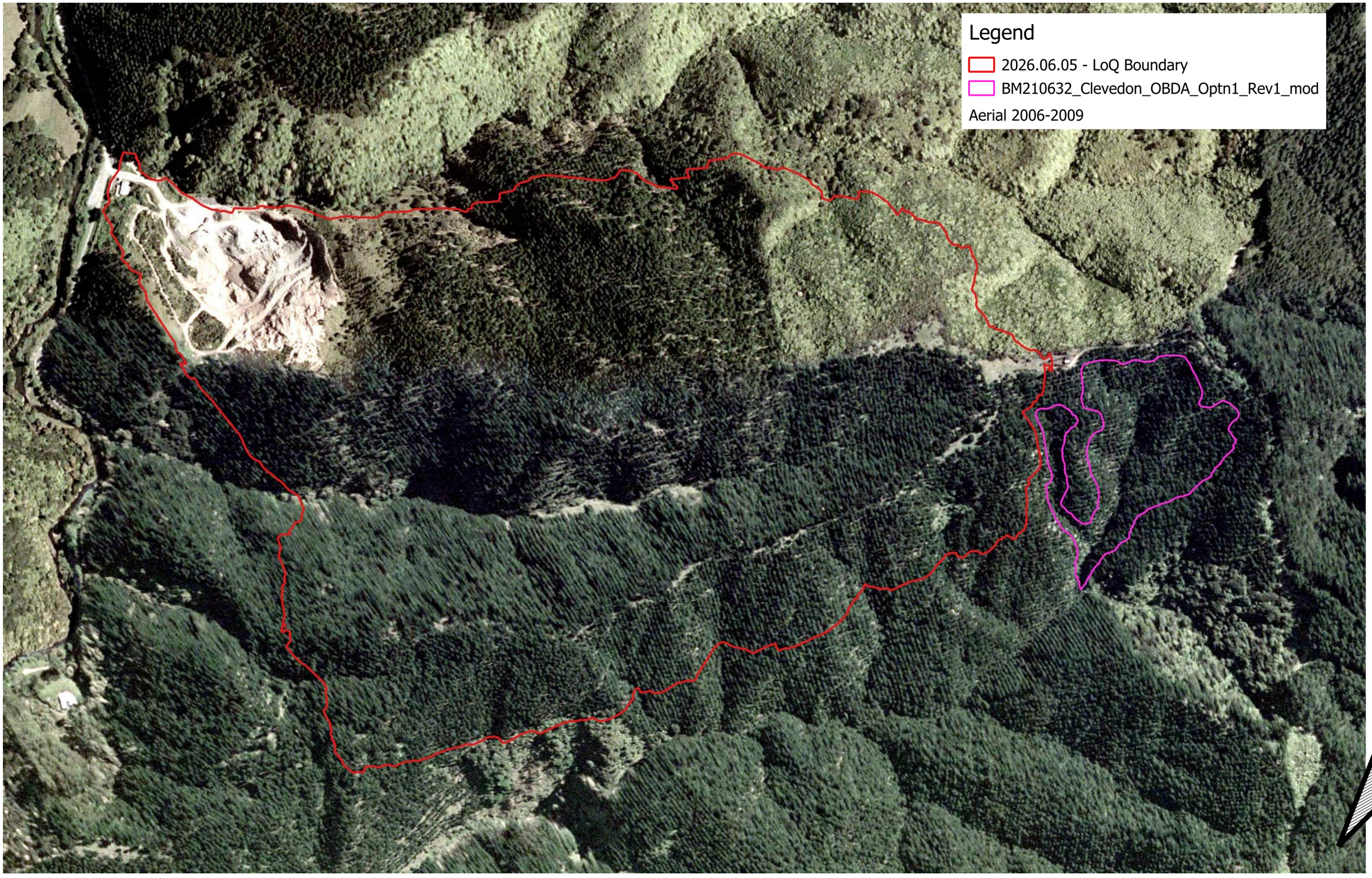
STEVENSON

Clevedon Quarry - Historic Aerial (1980-81)

Clevedon Quarry Extension
Overburden Disposal Area

Figure Number: Appendix B - Figure 4

Rev 1.0



1. Historic aerial image sourced from Auckland Council geomaps.
2. Proposed OBDA and quarry extension design are up to date as of 29 May 2026.

Drawn	ASW	05/06/2026
Checked	CJL	05/06/2026

Project No. BGL000206B

Scale: 15000.005427 Original Size: A3

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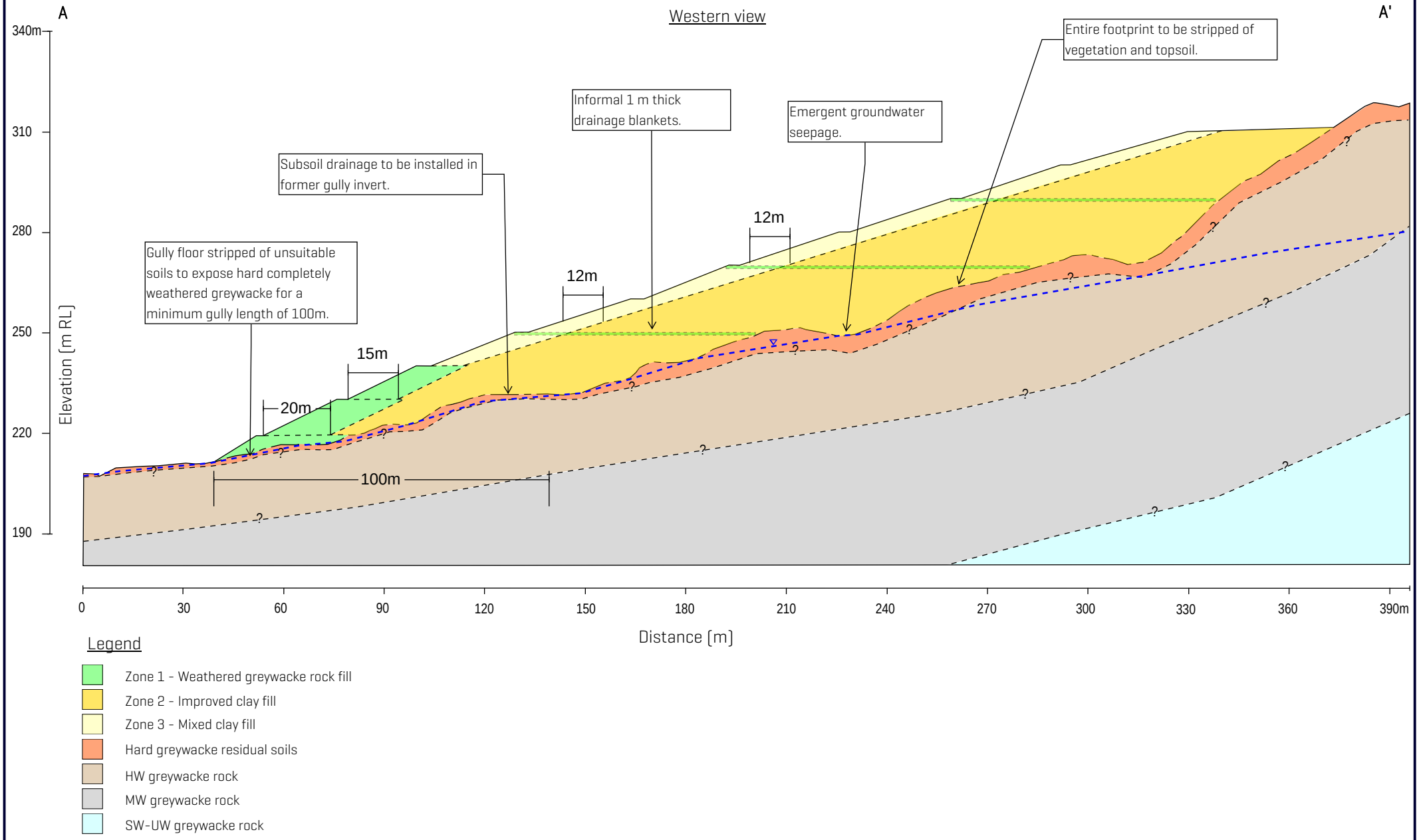
STEVENSON

Clevedon Quarry - Historic Aerial (2006-2009)

Clevedon Quarry Extension
Overburden Disposal Area

Figure Number: Appendix B - Figure 5

Rev 1.0



1. Topography sourced from photogrammetry through the Stevenson Propeller Portal.
2. Design topography Clevedon_Concept_OBDA_Design_Surface Optn1_Rev1_29Aug25.dxf sourced from Stevenson Propeller Portal.

BASELINE GEOTECHNICAL

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DRAWN	CJL	09/02/25
DRAFTING CHECKED	CLi	12/02/25

APPROX. SCALE (AT A4 SIZE) 1:1,500 1H:1V

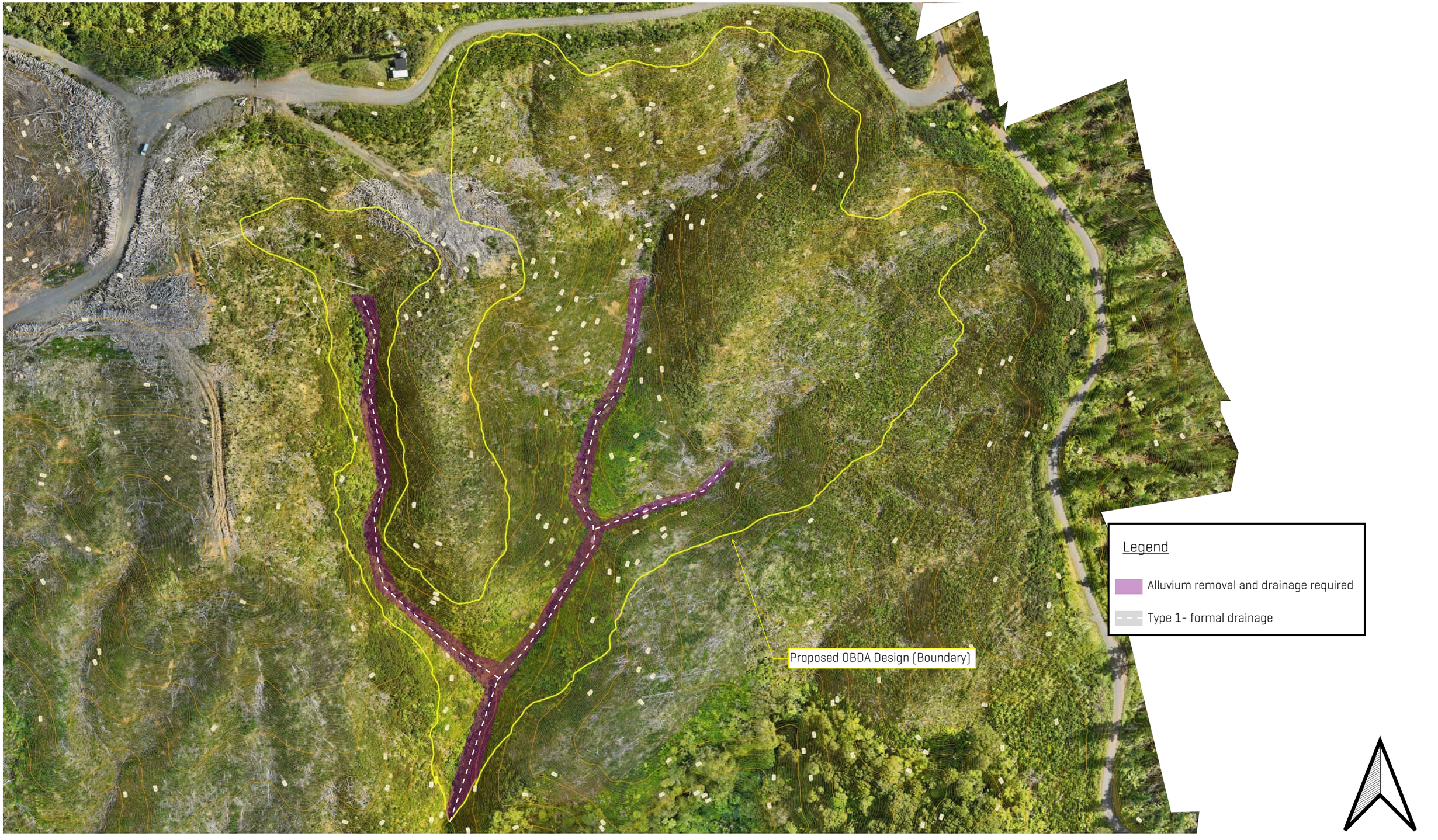
PROJECT No. BGL000206B

Cross Section

Clevedon Quarry Extension
Overburden Disposal Area

FIG. No. Appendix B - Figure 6

REV. 1



1. Quarry aerial sourced from Propeller dated 28 January 2026.
2. Contours sourced from Auckland Council Geomaps.
3. Proposed OBDA design is up to date as of January 2026.

Drawn	ASW	10/02/25
Checked	CJL	10/02/25

Project No. BGL000206B

Scale: 1:1500 Original Size: A3

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STEVENSON

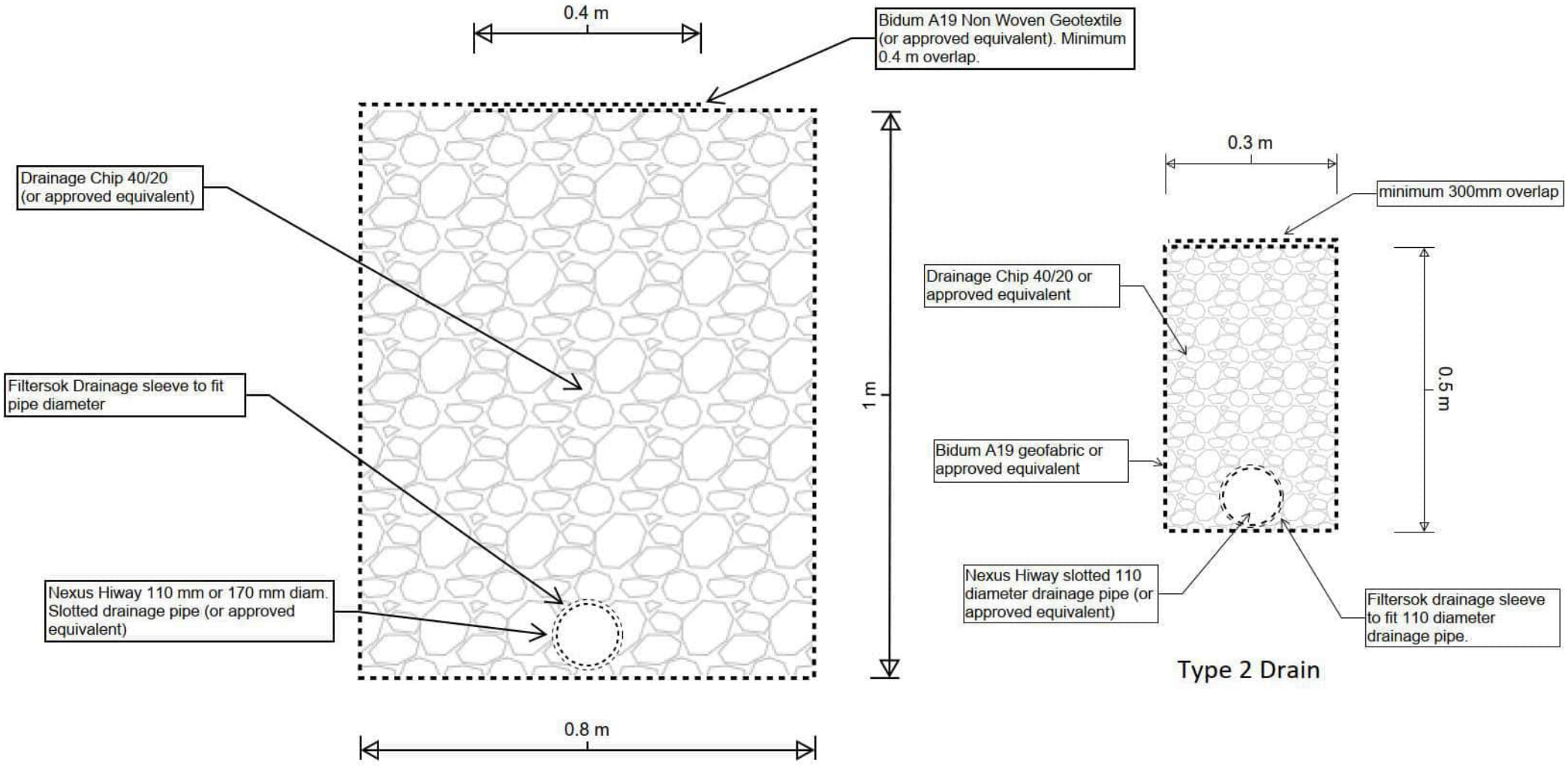
Clevedon Quarry- Indicative Drainage Plan

Clevedon Quarry Extension

Overburden Disposal Area

Figure Number: Appendix B - Figure 7

Rev 1



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DRAWN	CJL	09/02/25
DRAFTING CHECKED	CLi	12/02/25

APPROX. SCALE (AT A4 SIZE)
1:1,500 1H:1V

PROJECT No.
BGL000206B

Drainage Detail

Clevedon Quarry Extension

Overburden Disposal Area

FIG. No. Appendix B - Figure 8

REV. 1

Appendix C – Annotated Photographs

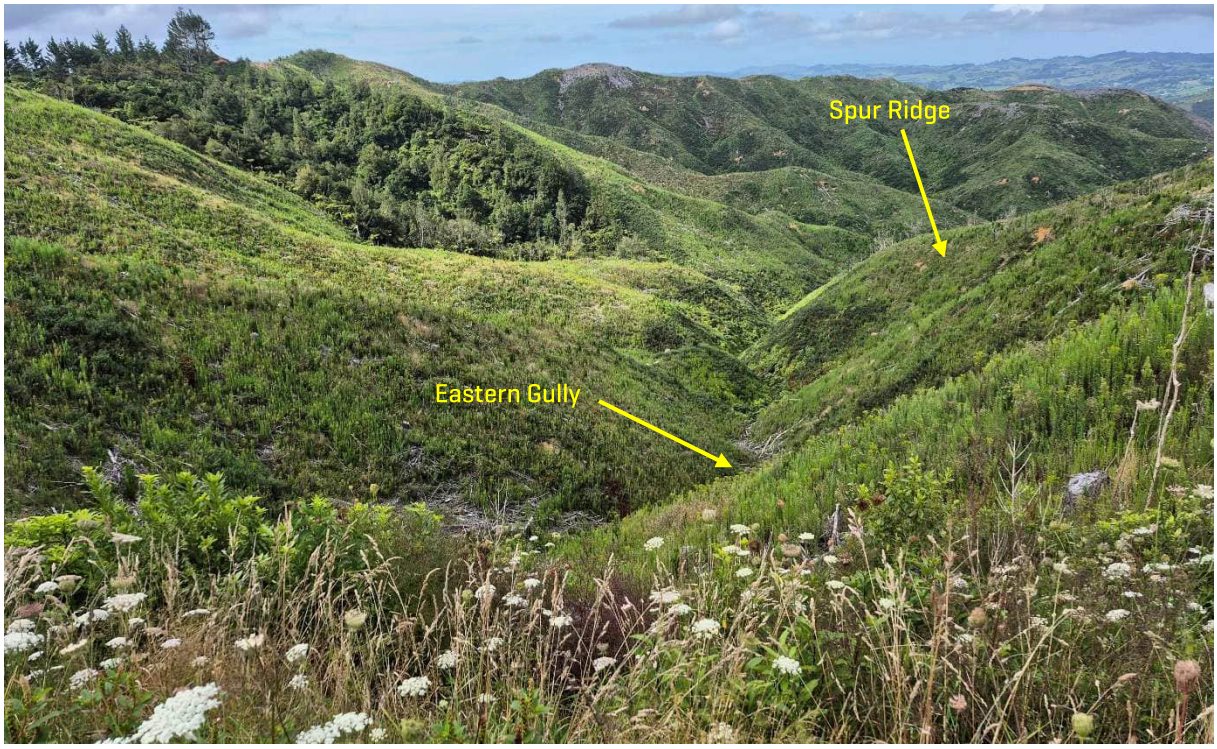


Figure 1: General view of the eastern gully, showing the relative steepness of the site. Photo taken facing south.



Figure 2: Completely weathered sandstone outcrop observed within the road cutting on Orum Road. Photo taken facing north.



Figure 3: Example of slightly weathered sandstone outcrop within the eastern gully. Photo taken facing northwest.



Figure 4: Moderately weathered sandstone outcrop. Photo taken facing north.

Appendix D: PC120 Addendum Report

Project Reference: BGL000206B

22 October 2026

Stevenson Aggregates Limited
Private Bag 94000,
Manukau City,
Auckland 2241

Attention: Bryn Llewellyn

Clevedon Quarry OBDA – PC120 Slope Stability Addendum Report

1 Introduction

Stevenson Aggregates Limited (SAL - the Client) are looking to expand their quarry operations at Clevedon Quarry, which includes the establishment of an Overburden Disposal Area (OBDA), located in a gully head to the east of the existing quarry.

Baseline Geotechnical Limited (BGL) was engaged to prepare a geotechnical assessment report[1] to support consenting for the proposed OBDA design, which is expected to proceed under the Fast-Track Approvals Act 2024 (FFTA).

We understand that the proposed OBDA falls within areas of very high susceptibility to shallow instability and low susceptibility for large-scale landslides as outlined in Auckland Council Geomaps and therefore the amendments in Proposed Plan Change 120 (PC120) to Chapter 36 of the Auckland Unitary Plan – Operative in Part (AUP) may apply.

This addendum report follows a step-by-step process of the proportional, risk-based framework required under policy (E36.3[2]) and the methodology set out in Appendix 24 (Chapter M[3]) of PC120.

2 Stage 1 – Desk study hazard assessment

Stage 1 comprises a desktop study to identify if there is a landslide hazard that could affect the site, or the location in which the activity is proposed. The area for the proposed OBDA is mapped as being highly to very

[1] Baseline Geotechnical Limited (14 October 2026), Clevedon Quarry Extension: OBDA Geotechnical Assessment Report. Job ref: BGL000206B v1.2. Report prepared for Stevenson Aggregates Limited.
[2] Auckland Council, Auckland Unitary Plan Operative in part – E36 Natural Hazards and Flooding – E36.3 Policies
[3] Auckland Council (November 2025), Auckland Unitary Plan Operative in part – Proposed Plan Change 120 (PC120) – Housing Intensification and Resilience. Chapter M Appendices, Appendix 24.

highly susceptible to shallow landslides with a low susceptibility to large-scale landslides in Auckland Council Geomaps. However, as noted on the Geomaps website, the maps are intended as a regional overview and do not replace site-specific assessments. A site-specific quantitative slope stability assessment was undertaken as part of our Geotechnical Assessment report.

3 Stage 2 – Risk assessment method selection

Stage 2 uses the findings of the desk study to determine the appropriate landslide risk assessment method to apply. As discussed in our geotechnical assessment report[1], we have adopted a return period of 1 in 250 years for our seismic scenario which is the critical stability case.

The landslide (slope instability) can achieve an acceptable level of stability in line with the minimum factor of safety (FoS) adopted in the Auckland Council Code of Practice[4] and the associated risk is therefore considered as 'low'. The risk of slope instability can be managed and mitigated by the recommended conditions of consent in Section 10 of our report[1].

As the slope instability risk is low, Appendix 24 Methodology 1 (semi-quantitative risk assessment) has therefore been adopted.

4 Stage 3 – Risk assessment

Method 1 uses the engineering geological model for the site, as discussed in our report[1], to identify three landslide hazard scenarios and then determine the landslide risk classification for each scenario by combining likelihood and consequence. The following three scenarios are evaluated: (a) shallow failure within the front facing of the OBDA; (b) complete failure and evacuation of the OBDA fill material along topography; and (c) deep seated landslide within the OBDA material and the underlying foundation material, comprise of weathered greywacke sandstone.

The landslide scenarios and semi quantitative landslide risk assessment following mitigation is presented in Table 4-1 below.

Table 4-1: Landslide semi-quantitative risk assessment in accordance with Appendix 24 (Chapter M)

Scenario		Likelihood	Consequence	Risk Classification
High Likelihood	Shallow failure within the front face of the OBDA	Possible	Insignificant	Low (acceptable)
Median Likelihood	Complete failure of the OBDA fill material and evacuated down the catchment.	Unlikely	Minor	Low (acceptable)
Maximum Credible	Deep seated landslide of the OBDA along with the underlying foundation material	Rare	Medium	Low (acceptable)

[4] The Auckland Code of Practice for Land Development and Subdivision Chapter 2: Earthworks and Geotechnical. July 2022, Version 2.0. Auckland Council.

5 Stage 4 – Conclusion

Based on the assessment above, it is considered that the proposed OBDA at Clevedon Quarry has a Low (acceptable) slope instability risk for all three landslide scenarios. The areas classified as being highly and very highly susceptible to landslides do not reflect the actual level of risk on site when considering the proposed site modifications, existing operations, and the engineering contingency measures proposed[1]. On the basis of the assessment above, the proposed extension is consistent with the PC120 E36 objectives and policies and with Appendix 24.

6 Applicability

This report has been prepared for the exclusive use of our client Stevenson Aggregates 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, or by any person other than our client, without our prior written agreement.

We trust that this letter report meets your present requirements. If you have any queries or wish to discuss any aspect, please contact the undersigned.

For and on behalf of Baseline Geotechnical Limited



.....

Charles Li

Engineering Geologist

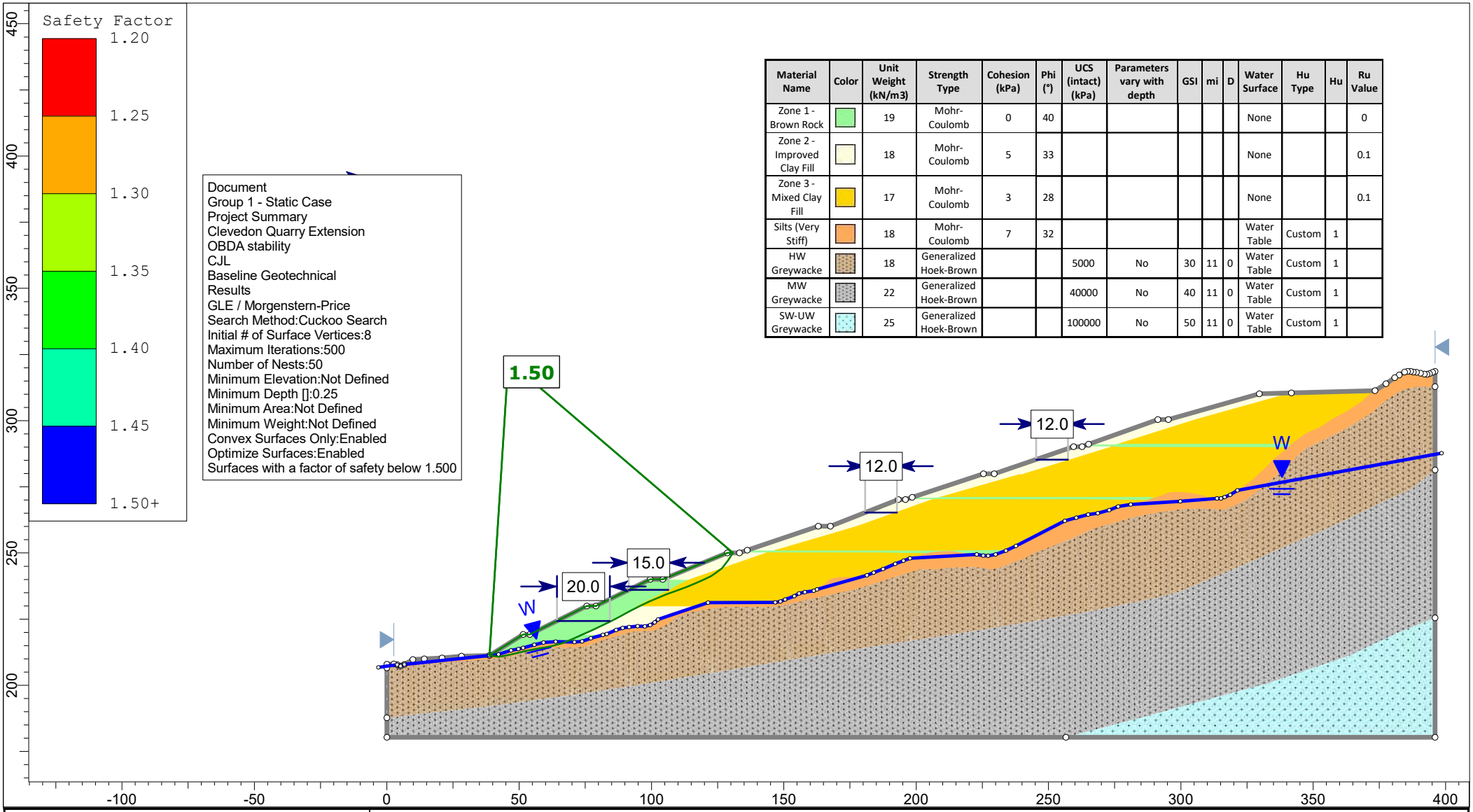


.....

Cameron Lines

Director

Appendix E: Slope Stability Analysis outputs

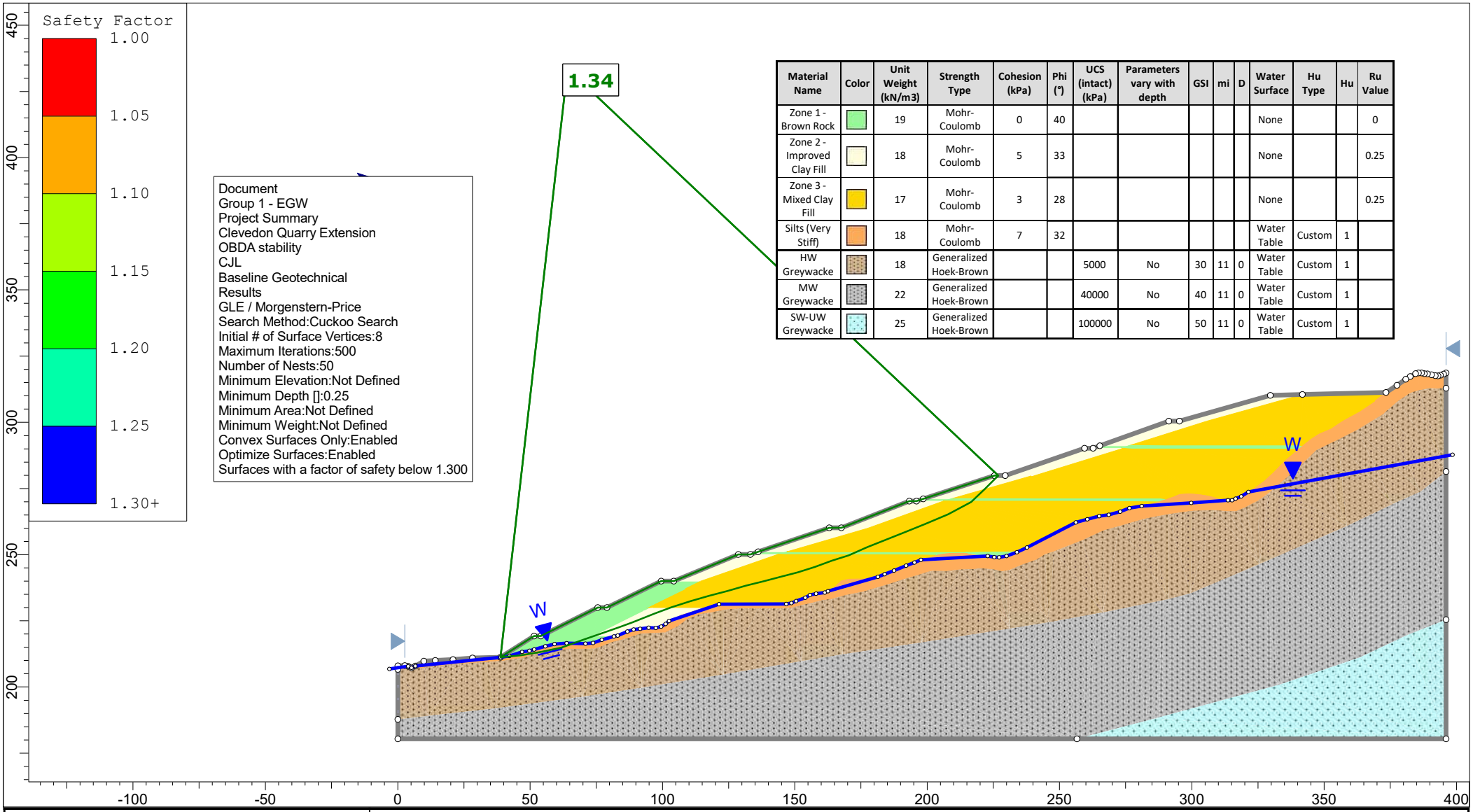


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu	Ru Value
Zone 1 - Brown Rock		19	Mohr-Coulomb	0	40						None			0
Zone 2 - Improved Clay Fill		18	Mohr-Coulomb	5	33						None			0.1
Zone 3 - Mixed Clay Fill		17	Mohr-Coulomb	3	28						None			0.1
Silts (Very Stiff)		18	Mohr-Coulomb	7	32						Water Table	Custom	1	
HW Greywacke		18	Generalized Hoek-Brown			5000	No	30	11	0	Water Table	Custom	1	
MW Greywacke		22	Generalized Hoek-Brown			40000	No	40	11	0	Water Table	Custom	1	
SW-UW Greywacke		25	Generalized Hoek-Brown			100000	No	50	11	0	Water Table	Custom	1	

BASELINE GEOTECHNICAL

SLIDEINTERPRET 9.041

Project	Clevedon Quarry Extension		
Analysis Description	OBDA stability, Static Case		
Drawn By	CJL	*Scale* 1:2000	*Company* Baseline Geotechnical
Date	9/02/2026		*File Name* OBDA Section 1.slmd

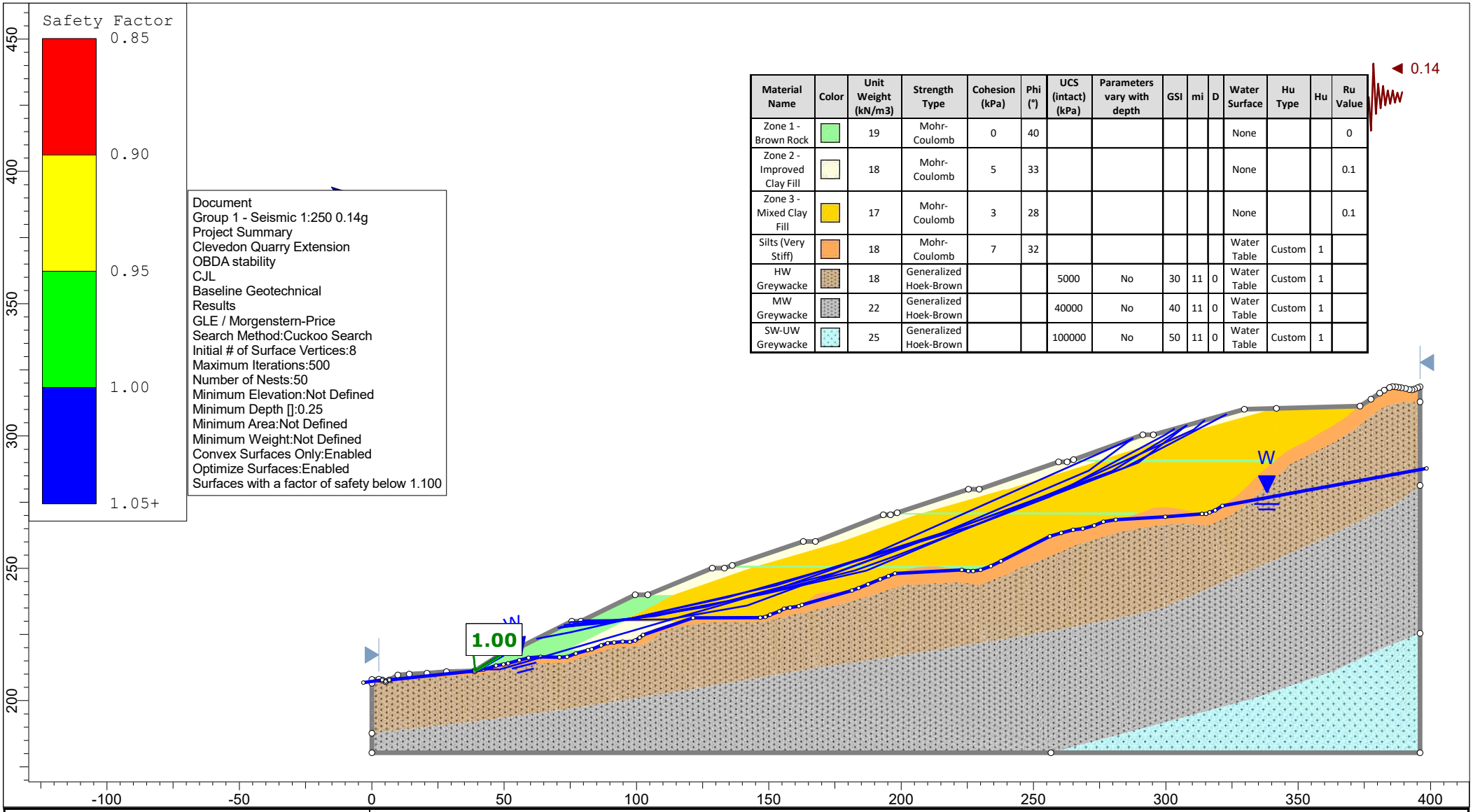


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu	Ru Value
Zone 1 - Brown Rock		19	Mohr-Coulomb	0	40						None			0
Zone 2 - Improved Clay Fill		18	Mohr-Coulomb	5	33						None			0.25
Zone 3 - Mixed Clay Fill		17	Mohr-Coulomb	3	28						None			0.25
Silts (Very Stiff)		18	Mohr-Coulomb	7	32						Water Table	Custom	1	
HW Greywacke		18	Generalized Hoek-Brown			5000	No	30	11	0	Water Table	Custom	1	
MW Greywacke		22	Generalized Hoek-Brown			40000	No	40	11	0	Water Table	Custom	1	
SW-UW Greywacke		25	Generalized Hoek-Brown			100000	No	50	11	0	Water Table	Custom	1	

BASELINE GEOTECHNICAL

SLIDEINTERPRET 9.041

Project	Clevedon Quarry Extension		
Analysis Description	OBDA stability, Elevated Groundwater Case		
Drawn By	CJL	*Scale* 1:2000	*Company* Baseline Geotechnical
Date	9/02/2026		*File Name* OBDA Section 1.slmd

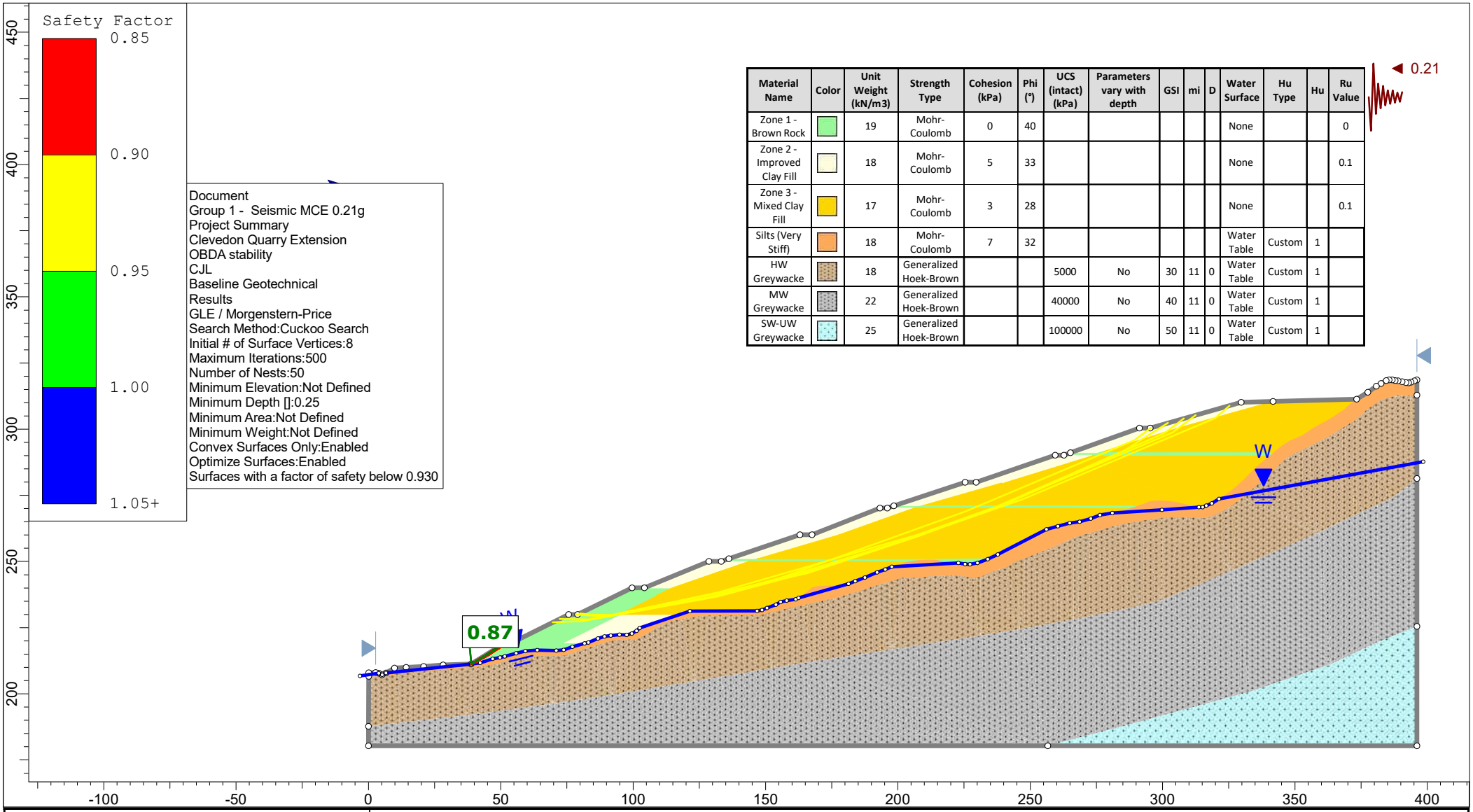


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu	Ru Value
Zone 1 - Brown Rock		19	Mohr-Coulomb	0	40						None			0
Zone 2 - Improved Clay Fill		18	Mohr-Coulomb	5	33						None			0.1
Zone 3 - Mixed Clay Fill		17	Mohr-Coulomb	3	28						None			0.1
Silts (Very Stiff)		18	Mohr-Coulomb	7	32						Water Table	Custom	1	
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MW Greywacke		22	Generalized Hoek-Brown			40000	No	40	11	0	Water Table	Custom	1	
SW-UW Greywacke		25	Generalized Hoek-Brown			100000	No	50	11	0	Water Table	Custom	1	

BASELINE GEOTECHNICAL

SLIDEINTERPRET 9.041

Project	Clevedon Quarry Extension		
Analysis Description	OBDA stability, Seismic Case ULS		
Drawn By	CJL	*Scale* 1:2000	*Company* Baseline Geotechnical
Date	9/02/2026		*File Name* OBDA Section 1.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	UCS (intact) (kPa)	Parameters vary with depth	GSI	mi	D	Water Surface	Hu Type	Hu	Ru Value
Zone 1 - Brown Rock		19	Mohr-Coulomb	0	40						None			0
Zone 2 - Improved Clay Fill		18	Mohr-Coulomb	5	33						None			0.1
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MW Greywacke		22	Generalized Hoek-Brown			40000	No	40	11	0	Water Table	Custom	1	
SW-UW Greywacke		25	Generalized Hoek-Brown			100000	No	50	11	0	Water Table	Custom	1	

BASELINE GEOTECHNICAL

SLIDEINTERPRET 9.041

Project	Clevedon Quarry Extension			
Analysis Description	OBDA stability, Seismic Case MCE			
Drawn By	CJL	*Scale*	1:2000	*Company* Baseline Geotechnical
Date	9/02/2026			*File Name* OBDA Section 1.slmd