

16 November 2016

Our ref: GENZSILV17153AC-AA

Orewa Developments Ltd
49 Sir William Avenue
East Tamaki
Auckland 20136

Attention: Mr Li Liangren

Dear Mr Li

Preliminary Geotechnical Appraisal of the revised plan for Subdivision and Land Resource Consent, Stage 2, Halls Farm Development, Orewa

1. Introduction

Coffey Services (NZ) Limited (Coffey) has received a revised scheme plan and a revised landform design for Stage 2 of the Subdivision at Halls Farm from CKL Surveyors Ltd (CKL). This letter presents the results of our preliminary geotechnical appraisal of the revised scheme plan and landform design for Stage 2 of the Subdivision. This letter also presents our recommendations for supplementary geotechnical investigation and instrumentation for detailed design of the Stage 2 Subdivision.

Coffey Services (NZ) Limited (Coffey) has received the revised scheme plan and revised landform design for Stage 2 of the Halls Farm Development from CKL, including stormwater catchment plans¹. The plans for Halls Farm – North Park, Orewa, referenced S3278 include:

- Stage 2 and 4 Geotech Long Sections, Original Contours, CKL Ref. S3278-000-00
- Stage 2 and 4 Geotech Long Sections, Proposed Contours, CKL Ref. S3278-000-00
- Stage 2 and 4 Geotech Long Sections, Cut and Fill, CKL Ref. S3278-000-00

¹ CKL (26 October @11:17am) FW: ODL – Stage 2 Resource Consent Variation. Email from Richard Hunt to Vincent Blanchet.

- Wetland A Catchment Plan, CKL Ref. S3278-700-E3
- Stage 2 & 4 Geotechnical Long Sections AA-AA', QQ-QQ', SS-SS', S2-1-S2-1', S2-2-S2-2', S3-1-S3-1', VV-VV', WW-WW', XX-XX', and YY-YY'

It is understood that this revised scheme plan and revised landform will form part of a variation to a Resource Consent application to be submitted to Auckland Council.

A Geotechnical Investigation and Design report GENZSILV17153AA-AB dated 16 December 2013, has previously been issued encompassing Stages 1 to 5. This included initial geotechnical analyses for Stage 2, including preliminary ground remediation recommendations. The scope of this particular letter is limited to preliminary geotechnical appraisal of the proposed revised landform design change from the GENZSILV17153AA-AB design report. A future detailed design phase supplemented by extensive geotechnical investigation and instrumentation to design the geotechnical treatment is strongly recommended.

2. Development Proposals

The revised scheme plans and revised landform design provided by CKL reference S3278, presented in Attachment A, shows the Revised Subdivision Stage 2 development. The revision mainly involves a revision of the design finished surfaces associated with the previous design by Harrison Grierson, the creation of an additional 10 new/revised lots across the south west portion of the subdivision, and new retaining walls (up to 3.5m high) and in-ground walls also in this south west corner of Stage 2.

The remainder of the South West portion of this Stage 2 subdivision will be finalised as part of the detailed design stage and will be supplemented by extensive geotechnical investigation.

3. Related Reports

The following relevant reports, prepared by Coffey, have been reviewed in preparation of this document:

1. GENZSILV17153AA-AB, Geotechnical Investigation and Design Report on Residential Subdivision at Hall Farm North Orewa, dated 16th December 2013. This report provided information and design geotechnical treatment for Stage 1 to 5 and is based on Harrison Grierson's (HG) landform design (now superseded);
2. GENZSILV17153AA-AD, Hall Farm, Stage 1 Palisade Wall Design Report, dated 10th February 2014. This design report provided detail design of the Palisade walls A and B at the proposed wetland, as per HG's landform design;
3. GENZSILV17153AB-AA, Halls Farm, Stage 1 – Geotechnical review of the updated landform" referenced, dated 1 December 2015. The report was prepared in support of the revised design landform by CKL Ltd;
4. GENZSILV17153AB-AC, Halls Farm Stage 1 – Review of landform for Wall, Stage 1, dated 11th April 2016. The report was prepared in support of the revised design landform in collaboration with CKL and Coffey.

4. Geology

Our ground model is being continuously updated as more ground is uncovered by the Stage 1 earthworks and it is observed by Coffey. Our ground model is summarised as follows and should be read in conjunction with our site investigation location plan, geomorphological and geological plans which are presented in Attachment B; see Drawings AC-AA-001 through AC-AA-003.

- The underlying bedrock in this area is of sedimentary origin and part of the Miocene aged East Coast Bays Formation of the Waitemata Group. The rock of the Waitemata Group typically consists of extremely weak to weak interbedded siltstones and sandstones with near horizontal bedding. Un-cemented dense sand layers are common in the upper layers of the rock mass. The strength and condition of the rock materials varies highly with depth and location.
- This rock has generally weathered to a residual soil profile between 5m to greater than 10m depth along ridges. The residual soil often comprising interbedded, grey to pale brown, moist, firm to very stiff sandy, silty clays and clayey silts;
- Upper layers largely consist of brown and orange, soft to hard, moist to wet, plastic silty clays and clay colluvium, with residual strength, slickensided shear surfaces associated with large scale land movement. These surfaces have been frequently observed in the overburden soil adjacent, and generally parallel, to bedrock as discrete shear planes, with excess pore seepage and discolouration evident;
- Geological structure (such as faults and rock mass defects) within the underling rock heavily influences the surface topography and on-going geological processes (such as slope instability and erosion) in this terrain. Stepping of former ridgelines are anticipated to reflect structure (such as faults or joints) in the underlying rock mass;
- Slope instability mechanisms exist within the overburden soils. These materials have been subject to movement processes and shear contact surfaces are present throughout the entire overburden profile. The potential mechanism for deeper seated ground movement within the rock mass includes shallow contact bedding shear surfaces beneath the residual soil and on top of the underlying rock mass or wider scale tectonic derived bedding shears.
- For Stage 2, as indicated in the geomorphological plan (Attachment B), there was a major historical landslide. See the scarp of this landslide located to the north of the Stage 2 boundary and extending along the northeastern side of Stage 2. A second landslide scarp is also present behind this major scarp.
- The colluvial material ranges in strength and stiffness and was observed generally more disturbed material towards the toe of the slope and just below historic scarp (known as graben). The site investigation indicates the presence of colluvium (landslide debris) and shear zone or wet, soft zone within the colluvium. Within Stage 2, colluvium and shear zones were found at the following locations:
 - Boreholes M1 and M2 (2005): landslide debris to depths of up to 11 and 4.5m respectively.
 - TP3 (2005): landslide debris to depths of up to 4m, and possible shear zone at 4-5m depth.
 - TP7 (2005): landslide debris to depths of up to 3m, and possible shear zone at 3-5m depth.
 - TP8 (2005): landslide debris to depths of up to 3.8m.
 - At approximately 2.0m deep within: TP1, TP2, TP5, TP6, TP7, TP8.
 - At approximately 4.5m deep within: TP1, TP2, TP3, TP4, TP5, TP6, TP9.
- Site groundwater model is highly responsive to rainfall events (rising and falling several metres over the seasons) within the overburden soils. Near surface water levels have been observed during winter in many areas. A delayed, more muted, response is observed in the bedrock, with significant variation due to faulting and joint structures.

Additional information about the ground model developed to-date includes:

- The adopted depth of residual soil/ colluvium to bedrock for the slope stability analyses performed to-date was based on the review of the available site investigation data together with the bulk earthworks construction observations;
- Several shear planes or shear zones were considered in the ground model. A shear plane inclination of 4 to 7 degrees was adopted in the model, with an effective friction angle of 17degrees. Sensitivity in terms of shear plane material properties were carried out as part of the analysis in report GENZSILV17153AB-AA, dated 1st December 2015; and
- The geological and geomorphological plans, developed and refined as work has progressed through investigation and construction during the previous stages of the Halls Farm development, are presented in Attachment B.

5. Geotechnical Appraisal / Project Evaluation

We have carried out a preliminary review of CKL earthworks plan and updated cross sections. The scheme plans indicate that the proposed development will provide in most places for significant easing of the steeper contours from the natural ground surface.

Based on our experience in this geology and site observations from bulk earthworks operations undertaken during the earlier works (Stage 1), we consider the proposed development and the proposed remediation options for Stage 2, as contained in our report GENZSILV17153AA-AB dated 16 December 2013, are feasible from a geotechnical perspective. The proposed remediation measure, presented in this earlier report included:

Counterfort Drains: An extensive network of counterfort drains installed to provide control over groundwater levels and pore water pressures and to assist consolidation of the fills; see Drawing AC-AA-005 in Appendix B.

Pre-fill Gully Preparation: Muck out of any soft alluvial soils will be required in the gully formations. Anticipated extents and typical details are presented as GU2 on Drawing AC-AA-005.

Subsoil drainage required within the gully muck out areas: Tributary (counterfort) drains will be tapped into the main subsoil drains. Anticipated locations and drainage details are provided on Drawing AC-AA-005.

Palisade Walls: Our initial stability analyses have confirmed the need to provide support lots along the flanks of the central gully system (Gully 2). Due to the depth of the underlying bedrock, the piles likely do not need to be keyed into the underlying bedrock² but the embedment must ensure the upslope development is protected against future soil creep or instability on the lower portions of the slopes. The remediation plan in Drawing AC-AA-004 in Attachment B shows the anticipated extents of the palisade walls/retaining walls based on the current (October 2016) earthworks design. These walls will require specific design. This is further discussed in Section 6 below.

6. Supplementary Geotechnical Investigation

Little investigation (one test pit) was undertaken to date within the southwestern portion of the subdivision. The detailed design of the geotechnical treatment will need to be supplemented by an

² This depends on the nature and strength of materials beneath the potential failure surface at the wall locations; the proposed supplementary investigation will provide this information.

extensive geotechnical investigation and instrumentation programme. Previous slope stability analyses will need to be updated for the revised landform and finished surface elevations presented by CKL.

The additional information will be used to:

- Refine and increase confidence in the ground model in this area (southwestern corner)
- Perform revised and additional slope stability analysis
- Support the design of geotechnical treatment along the southern and western boundary of Stage 2 (in-ground pile and retaining walls) where required.

The outcome of the testing will be presented in our geotechnical report for Stage 2.

6.1. Design of geotechnical treatment along the western and southern boundary

Following the landform design change, we have allowed for the design of geotechnical treatments along the southern and western boundary of Stage 2. The geotechnical treatments may take the form of an in-ground pile wall (southern boundary) and retaining wall (western boundary). We recommend allowing for the design of in-ground pile/retaining walls and preparation of a design report to support a building consent application. The location of the in-ground/retaining walls is shown on Drawing AC-AA-004 in Attachment B.

7. Closure

Thank you for the opportunity for Coffey to provide you with our recommended supplementary geotechnical investigation, earthworks and geotechnical treatment designs for Stage 2 of Halls Farm development. We look forward to undertaking the work described herein.

For and on behalf of Coffey

Prepared By:



Dante Legaspi
Associate Geotechnical Engineer

Reviewed and Authorised By:



Peter Marchant
Principal Geotechnical Engineer

Additional review provided by Vincent Blanchet, Associate Geotechnical Engineer

Attachments - Attachment A: CKL Scheme Plans and Sections
Attachment B: Coffey Site Investigation, Geomorphological and Geologic Plans, Preliminary Remediation Design (2013), and Conceptual Geotechnical Treatment Plan/Retaining Walls (2016)

Appendix A - CKL Drawings

LEGEND

STAGE BOUNDARY

EARTH WORKS BOUNDARY

EXTENT OF GULLY MUCK OUT

UNDERFILL DRAINS INSTALLED

UNDERFILL DRAINS TO BE FINISHED

GEOTECH LONG SECTION

CONTOUR MAJOR (5.0m)

CONTOUR MINOR (1.0m)

CKL

Planning | Surveying | Engineering | Environmental

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A: 25 Broadway, Newmarket

P: 09 524 7029

Hamilton Office:

A: 58 Church Road, Hamilton

P: 07 849 9921

Te Awamutu Office:

A: 103 Market Street, Te Awamutu

P: 07 871 6144

HALLS FARM

OREWA DEVELOPMENTS LTD

264 WEST HOE HEIGHTS, OREWA

STAGE 2 AND 4 GEOTECH

LONG SECTIONS

ORIGINAL CONTOURS

Issue Description		Checked	Date	Date		Scale:
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Drawn: ABC				00.00.00		
Checked:						
Job No:		Dwg No:		Rev:		
S3278		000		00		

LEGEND

STAGE BOUNDARY

EARTH WORKS BOUNDARY

EXTENT OF GULLY MUCK OUT

UNDERFILL DRAINS INSTALLED

UNDERFILL DRAINS TO BE FINISHED

GEOTECH LONG SECTION

CONTOUR MAJOR (5.0m)

CONTOUR MINOR (1.0m)

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HALLS FARM

OREWA DEVELOPMENTS LTD

264 WEST HOE HEIGHTS, OREWA

STAGE 2 AND 4 GEOTECH

LONG SECTIONS

PROPOSED CONTOURS

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S3278		000		00			

LEGEND

STAGE BOUNDARY

EARTH WORKS BOUNDARY

EXTENT OF GULLY MUCK OUT

UNDERFILL DRAINS INSTALLED

UNDERFILL DRAINS TO BE FINISHED

GEOTECH LONG SECTION

CUT CONTOUR (0.5m)

FULL CONTOUR (0.5m)

FOR INFORMATION

CKL

Planning | Surveying | Engineering | Environmental

Auckland Office:

A: 25 Broadway, Newmarket

P: 09 524 7029

Hamilton Office:

A: 58 Church Road, Hamilton

P: 07 849 9921

Te Awamutu Office:

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HALLS FARM

OREWA DEVELOPMENTS LTD

264 WEST HOE HEIGHTS, OREWA

STAGE 2 AND 4 GEOTECH

LONG SECTIONS

CUT AND FILL

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				S3278		000	00

LEGEND:

STAGE BOUNDARY:

PIPED STORMWATER NETWORK:

OVERLAND FLOWPATH



STAGE 2 & 4
CATCHMENTS /
FLOWPATH



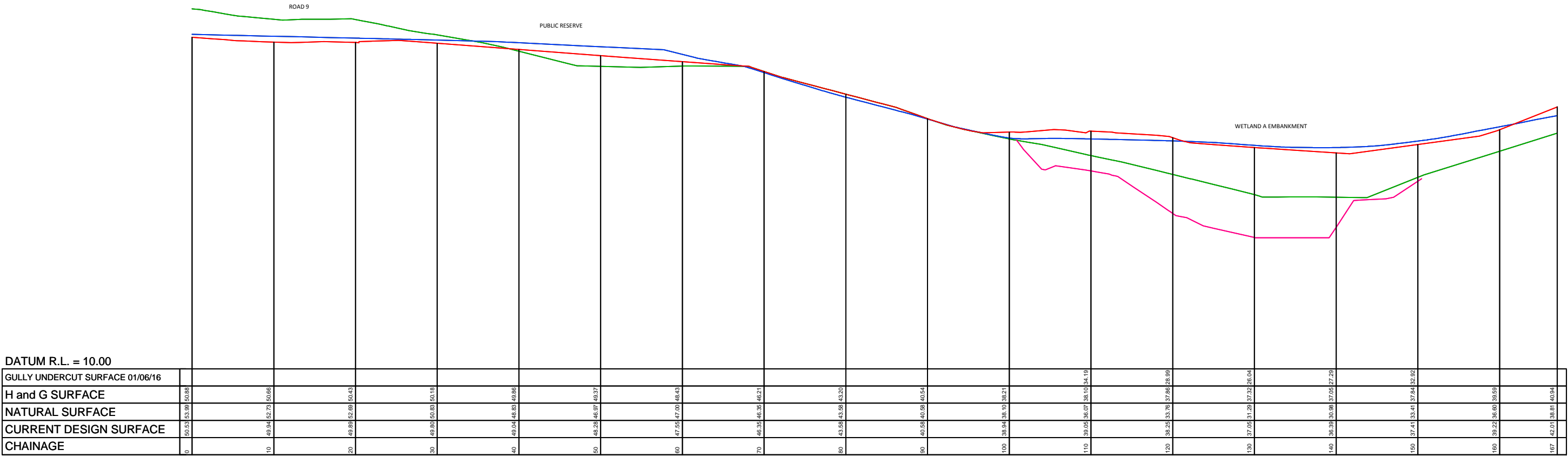
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CKL FINISHED SURFACE

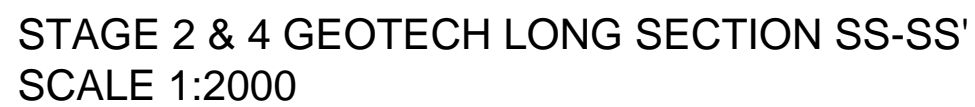
H & G PREVIOUS FINISHED SURFACE

NATURAL SURFACE

GU 2 UNDERCUT



STAGE 2 & 4 GEOTECH LONG SECTION QQ-QQ'
SCALE 1:500





LEGEND:

CKL FINISHED SURFACE

H & G PREVIOUS FINISHED SURFACE

NATURAL SURFACE

GU 2 UNDERCUT

ROAD 9

DATUM R.L. = 10.00

H and G SURFACE	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
NATURAL SURFACE	53.79	28.88	27.67	29.81	32.72	35.71	38.80	41.78	44.43	45.49	46.65	47.79	48.03	50.64	50.63	51.04
CURRENT DESIGN SURFACE	53.79	28.88	27.67	29.81	32.72	35.71	38.80	41.78	44.43	45.49	46.65	47.79	48.03	50.64	50.63	51.04
CHAINAGE	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

STAGE 2 & 4 GEOTECH LONG SECTION S2-2 - S2-2'
SCALE 1:500



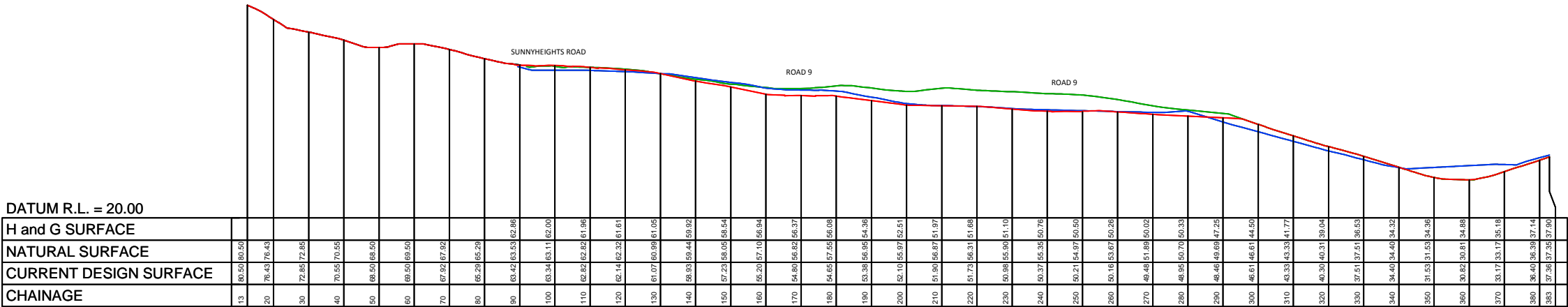
LEGEND:

CKL FINISHED SURFACE

H & G PREVIOUS FINISHED SURFACE

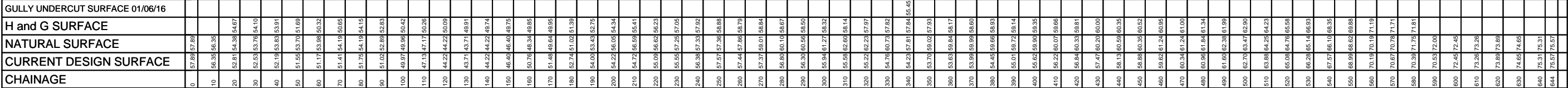
NATURAL SURFACE

GU 2 UNDERCUT



STAGE 2 & 4 GEOTECH LONG SECTION VV-VV'
SCALE 1:1500

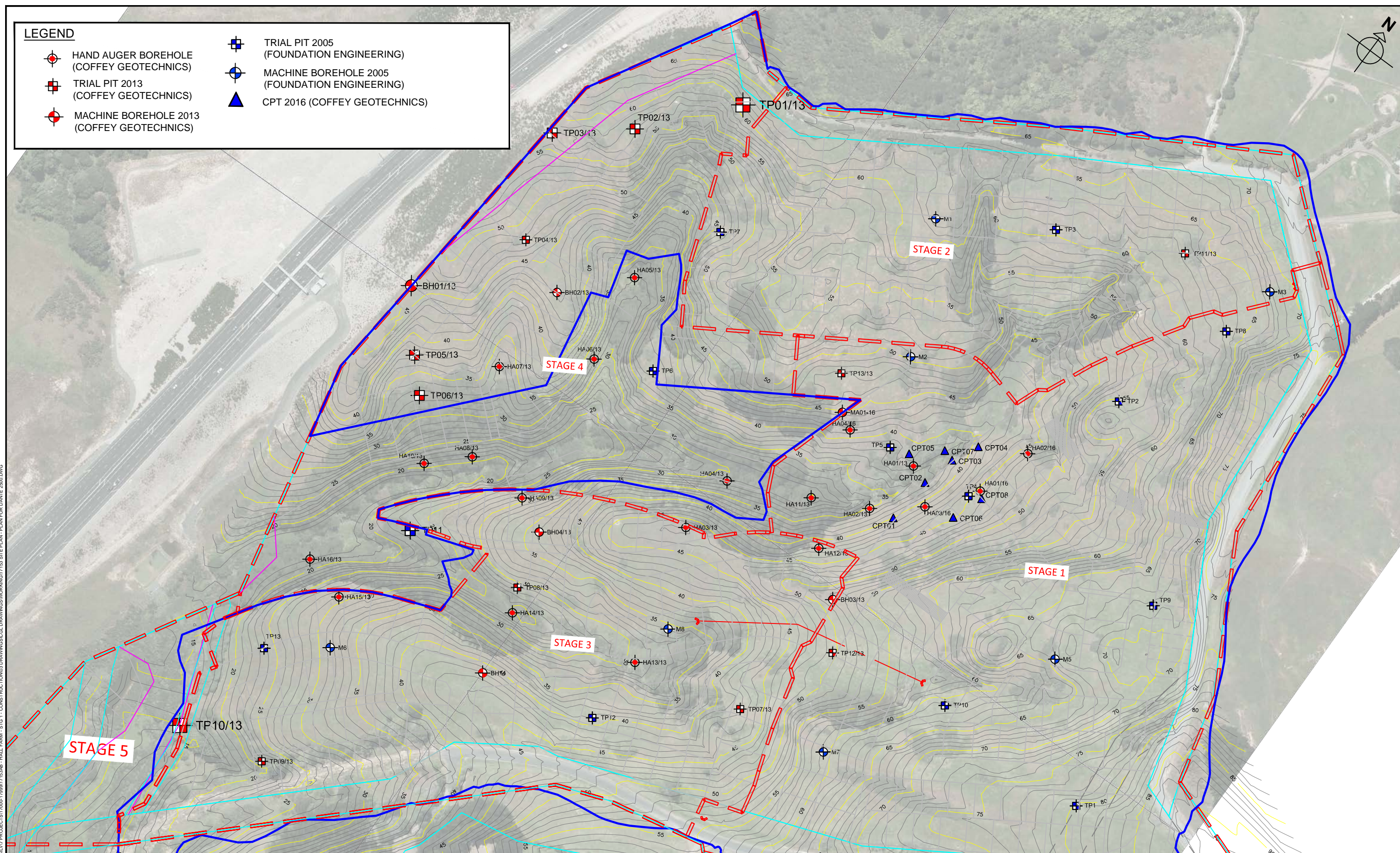
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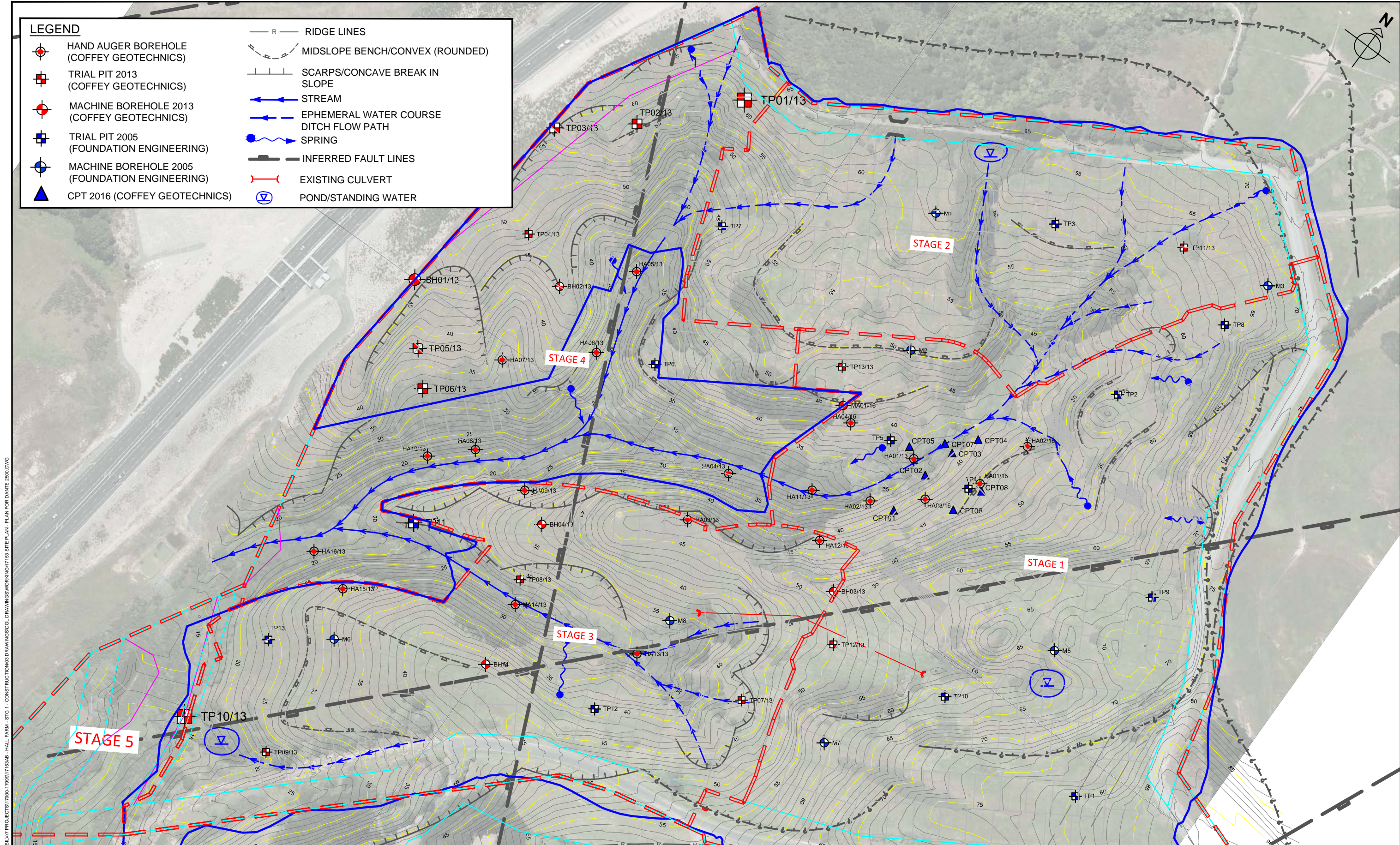
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Appendix B - Coffey Drawings

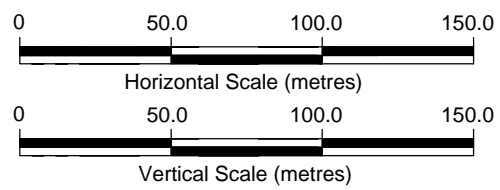


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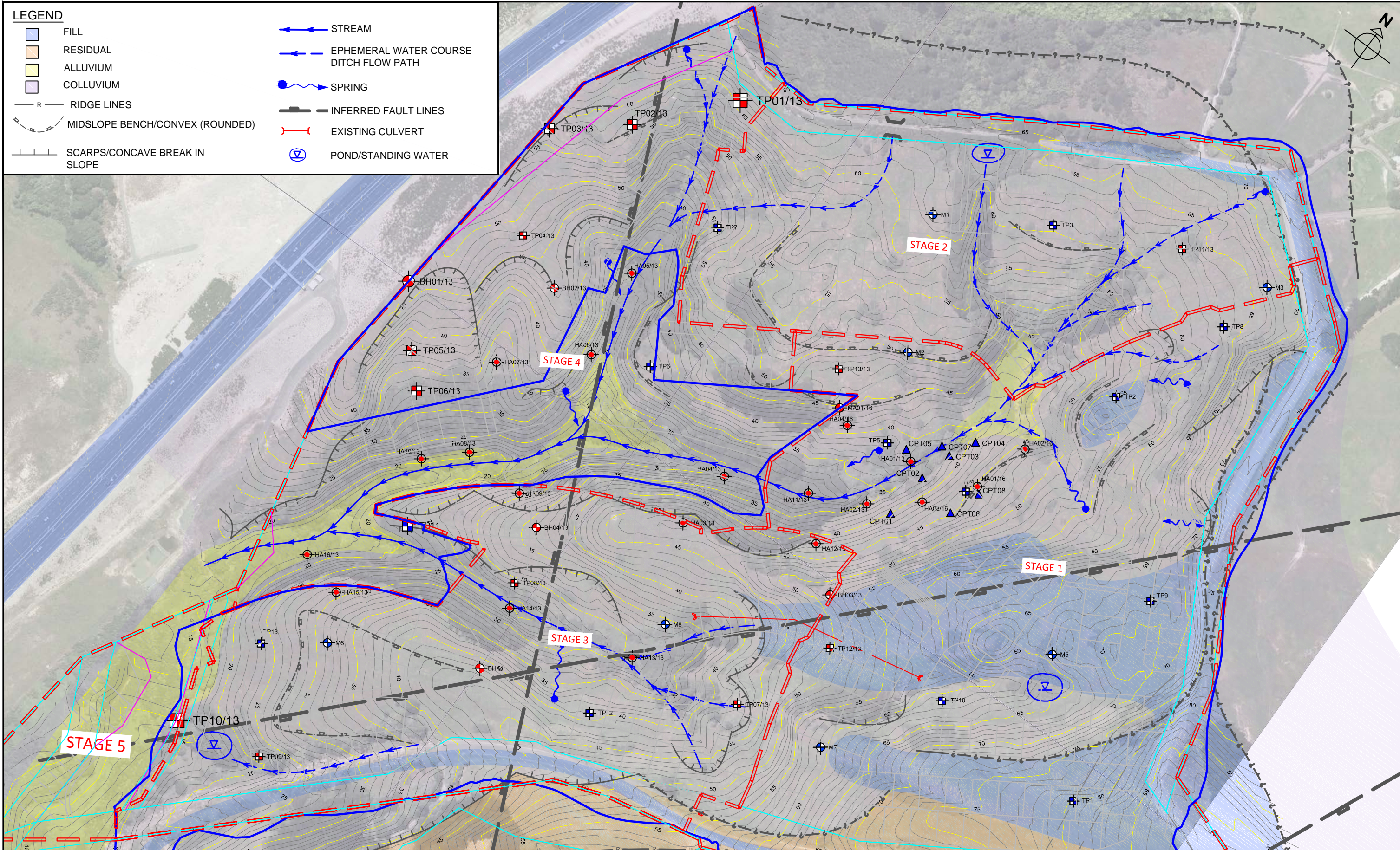
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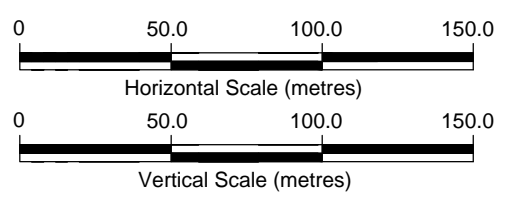


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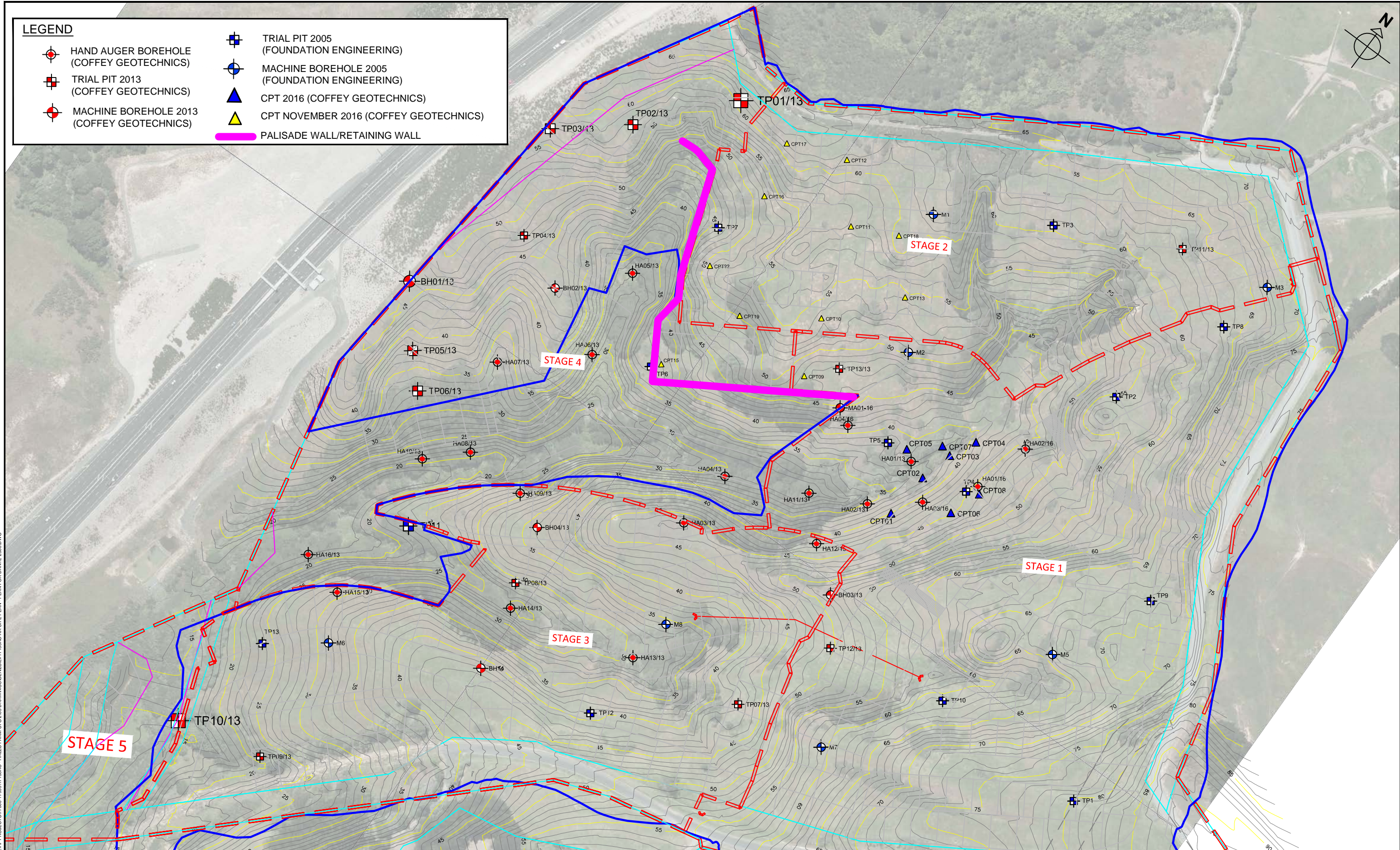
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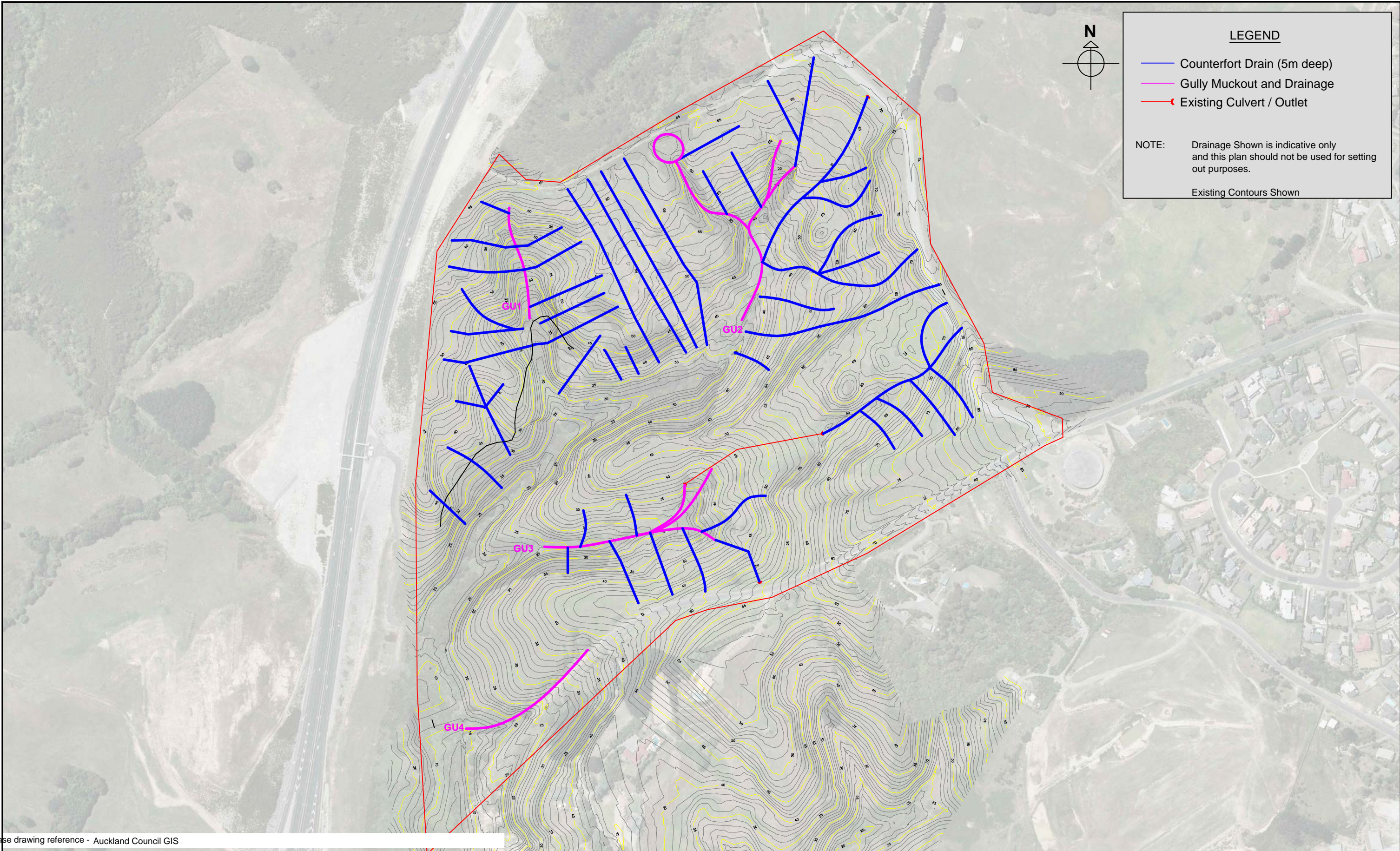
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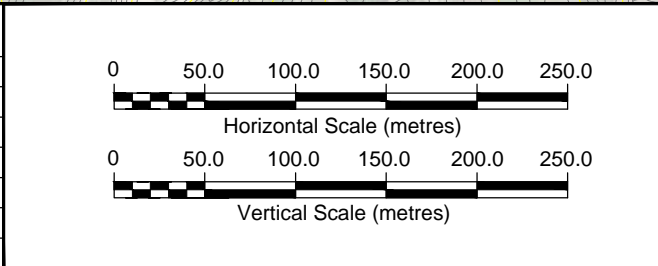
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Base drawing reference - Auckland Council GIS



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approved	DL
date	31/10/2016
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