



DRAFT STORMWATER MANAGEMENT PLAN (SMP)

610, 614, 670, 697 & 451
Muriwai Road, Muriwai

FEBRUARY 2022

Client: The Bears Home Project
Management Ltd



MCKENZIE & CO.

DOCUMENT CONTROL RECORD

PROJECT: Muriwai Golf Course Development

CLIENT: The Bears Home Project Management Ltd.

PROJECT LOCATION: 610, 614, 670, 697, 451 Muriwai Road, Muriwai, Auckland

LOCAL AUTHORITY: Auckland Council, Healthy Waters

FILE PATH: *Synergy12d://MCKSQL01/1976 610 Muriwai Road/Documents and Communications/Reports*

Revision	Date	Originator	Checker	Approver	Description
A	29/09/2021	RC	SM	JD	DRAFT
B	18/05/2022	CGH	SM	JD	ISSUE

Table of Contents

Table of Contents	1
1.0 Executive Summary.....	2
2.0 Existing Site Appraisal	3
3.0 Proposed Development.....	13
4.0 Planning Context.....	16
5.0 Mana Whenua.....	18
6.0 Stakeholders	18
7.0 Stormwater Management	18
8.0 Departures from Regulatory or Design Codes	29
9.0 Conclusions and Recommendations for Future Work.....	29
APPENDIX A – STORMWATER DRAWINGS.....	31
APPENDIX B – STORMWATER CALCULATIONS	32
APPENDIX C – GEOTECHNICAL PARAMETERS FOR ONSITE WASTEWATER AND STORMWATER DISPOSAL	33

List of Acronyms

Acronym	Description
AEP	Annual Exceedance Probability
ARI	Annual Recurrence Interval
AUP: OiP	Auckland Unitary Plan: Operative in Part
BMP	Best Management Practice
BPO	Best Practicable Option
CMA	Coastal Marine Area
DE	Development Engineer (Auckland Council)
DSI	Detailed Site Investigation
EPA	Engineering Plan Approval
GD	Guideline Document
GIR	Geotechnical Investigation Report
GPT	Gross Pollutant Traps
HCGA	High Contaminant Generating Activity
HW	Healthy Waters (Auckland Council Stormwater Unit)
ITA	Integrated Transport Assessment
MCCL	Mckenzie and Co Consultants Limited
MCI	Macroinvertebrate Community Index
MPD	Maximum Probable Development
NDC	Network Discharge Consent
NES	National Environmental Standard
NZBC	New Zealand Building Code
OLFP	Overland Flow Path
SEA	Significant Ecological Area
SEV	Stream Ecological Valuation
SMAF	Stormwater Management Area – Flow 1 and Flow 2
SMP	Stormwater Management Plan
SWCOP	The Stormwater Code of Practice
UP	Unitary Plan
WQ	Water Quality
WSD	Water Sensitive Design

1.0 Executive Summary

McKenzie and Co. Consultants Ltd (MCCL) have been engaged by The Bears Home Project Management Ltd (Applicant) to provide a Stormwater Management Plan (SMP) in support of the resource consent for the proposed Muriwai Golf Course and Resort development located at 610, 614, 670, 697, 451 Muriwai Road, Muriwai, Auckland, ('site').

This SMP sets out good management practices and identifies the mechanisms to be utilised to avoid or mitigate potential adverse effects on the receiving environment associated with the discharge of stormwater. It outlines appropriate stormwater control measures to support the development of the site, meeting the standards set out in the Auckland Unitary Plan, and GD04 on Water Sensitive Design for Stormwater.

This SMP provides a strategic framework for sustainable stormwater design in order to reduce the impacts of the proposed development on the receiving environment. It will utilise at-source control and treatment train system for stormwater management. It will also provide a toolbox for best practicable option (BPO) approach for water quality, and stormwater management practices for flood mitigation.

The purpose of this SMP is to set out how stormwater will be managed within the site. To demonstrate that the proposed stormwater management is the BPO, consideration of the existing site features, hydrology, and the future land use is necessary. The stormwater management framework used to develop this SMP meets the conditions of Auckland Unitary Plan, Operative in Part (AUP: OiP). This will support the Resource Consent application and future Building Consents and Engineering Plan Approvals for the development of the site. The SMP also sets out guidelines to enhance and manage stormwater runoff, respect natural processes, minimise flood risk and implement water sensitive design, protect ecological corridors, and natural linkages throughout the wider landscape. It includes linkages with riparian planting along waterways which maintain and enhance water quality and aquatic habitats; enhance existing native vegetation within the wider catchment; and reduce stream bank erosion. Furthermore, it maintains the existing catchment hydrology through management of stormwater on-site, employing water sensitive design principles prior to discharge. It also integrates the stormwater management network within the surrounding development and provide for other values such as movement, amenity, open space, wetlands, and ecological values.

2.0 Existing Site Appraisal

The property is located on Muriwai Road approximately 1.5km northwest of the settlement of Muriwai. The property is made up of several rural properties (see identification and description in Section 1.1, Table 1) all accessible from Muriwai Road. The property zoning and land use is rural production and has an aggregate land area of 504ha. It is bounded by a permanent stream to the north known as the Ōkiritoto Stream and similar rural properties along the east, west and south boundaries.

The rural property is interspersed with gullies and stream features that ultimately drain to Muriwai Beach west of the site. AUP: OiP management layers / overlays show significant ecological areas and quality-sensitive aquifer management areas within the site.



Figure1 – Property Location (Source: Auckland Council GeoMaps)

2.1 Summary of Data Sources

Table 1 – Summary of Data Source

Existing Site Appraisal Item	Source and date of data used
Topography	<ul style="list-style-type: none"> • Auckland Councils LIDAR data (GeoMaps 2016) • Topographical and UAV survey gathered by MCCL (2021)
Geotechnical/soil conditions	<ul style="list-style-type: none"> • NZS Geological Maps–Auckland Region • Landers /Riley Consultants and LDE

Existing Site Appraisal Item	Source and date of data used
Existing Stormwater Network	<ul style="list-style-type: none"> • Auckland Council GeoMaps • Survey information gathered by MCCL
Existing Hydrological Features	<ul style="list-style-type: none"> • Auckland Council GeoMaps
Stream, River, and Coastal Erosion	<ul style="list-style-type: none"> • Auckland Council GeoMaps
Flooding and Flow Paths	<ul style="list-style-type: none"> • Auckland Council GeoMaps
Ecological/ Environmental area	<ul style="list-style-type: none"> • Auckland Council GeoMaps and AUP Overlay
Cultural and Heritage sites	<ul style="list-style-type: none"> • Tbc – Nga Maunga Whakahii o Kaipara
Contaminated Land	<ul style="list-style-type: none"> • PSI and DSI carried out by Pattle Delamore Partners Ltd

2.2 Location and General Property Information

Table 2 – Summary of Property Information

EXISTING SITE SUMMARY INFORMATION	
Site Address	<ul style="list-style-type: none"> • 451 Muriwai Road, Muriwai Valley • 610 Muriwai Road, Muriwai Valley • 614 Muriwai Road, Muriwai Valley • 670 Muriwai Road, Muriwai Valley • 680 Muriwai Road, Muriwai Valley • 697 Muriwai Road, Muriwai Valley
Legal Description	<ul style="list-style-type: none"> • Lot 4 DP 187060, Lot 3 DP 196479, Sec 3 SO 41485 (112.6571ha) • Lot 2 DP 196478 (Area = 140.8011ha) • Lot 1 DP 196478 (Area = 5.4989ha) • Lot 1 DP 187057 (Area = 143.9175ha) • Lot 1 DP 163736 (Area = 1.8781ha) • Lot 5 DP 187061 (Area = 101.4371ha)
Current Land Use	<ul style="list-style-type: none"> • Site predominantly utilised as pastoral land use with residential dwellings and sheds located on site.
Zone	<ul style="list-style-type: none"> • Rural – Rural Production Zone
Current Building Coverage	<ul style="list-style-type: none"> • N / A
Historical Land Use	<ul style="list-style-type: none"> • Rural
Overlays	<ul style="list-style-type: none"> • Natural Resources: Significant Ecological Area • Quality-Sensitive Aquifer Management Areas – Kaipara Sand Aquifer (rp) • Natural Resources: Lake Management Areas Overlay (Natural and Urban Lake) [rp] – Lake Ōkaihou, Natural • Natural Heritage: Outstanding Natural Features – Toroanui and Ōkiritoto Falls (within 610 Muriwai Road) • Natural Heritage: Outstanding Natural Features Overlay [rcp/dp] – ID 225, Toroanui and Ōkiritoto Falls

EXISTING SITE SUMMARY INFORMATION

- Natural Heritage: Outstanding Natural Features Overlay [rcp/dp] – ID 72, Lake Ōkaihau

2.3 Land-Use and Topography

The property consists of two main land areas separated by Muriwai Road. The property area located on the northern side of Muriwai Road can generally be characterised by rolling terrain dipping in elevation from the elevated land along Muriwai Road, towards the lower lying terrain in the north, where a main dividing gully system defines the northern boundary (Ōkiritoto Stream). Several incising features form tributaries to the main dividing gully, with these features being far more significant and pronounced over the western half of this portion of the site.

The combined property area to the south of Muriwai Road comprises also of rolling terrain which falls from the Muriwai Road boundary towards a couple of prominent gully features. The western gully feature traverses in north-east direction past the existing quarry site and under Muriwai Road forming a tributary into the Ōkiritoto Stream. Similarly, the eastern gully feature known as the Raurataua Stream traverses in a north-east to north direction under Muriwai Road to also tribute in the Ōkiritoto Stream. See Figure 2 below.

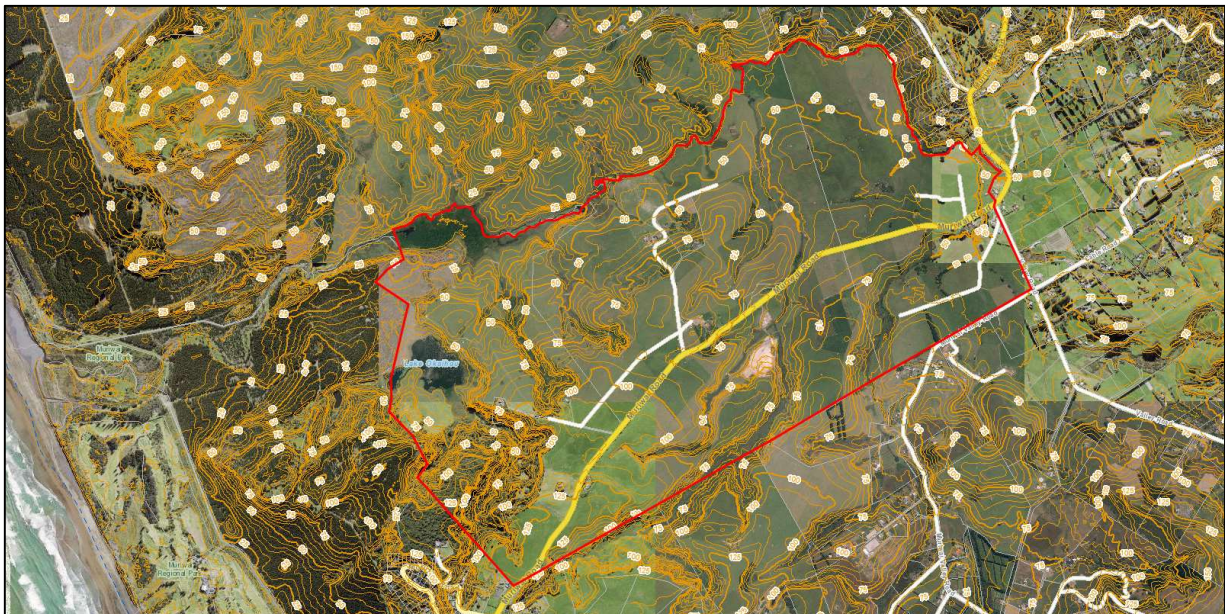


Figure 2 - Topography (Source: Auckland Council GeoMaps)

2.4 Geotechnical

Reference to NZ Geological Mapping: 1:250,000 Map of Auckland Area (GNS), refer to Figure 3 (below), indicates that the property is primarily, underlain with cemented dune sands and associated facies (i.e., Awhitu Group).

Across the northern and southern portions of the site there are small areas of volcaniclastic sandstone and siltstone (i.e., Nihotupu Formation). Towards the western portion of the site there

is evidence of mobile sand dunes (i.e., Kariotahi Group).

Across the eastern portion of the site, there is evidence of alluvial deposits (Tauranga Group) and a small area located across the central portion to the site that will be underlain with basalt flow and pillow lavas (i.e., Waiatarua Formation).

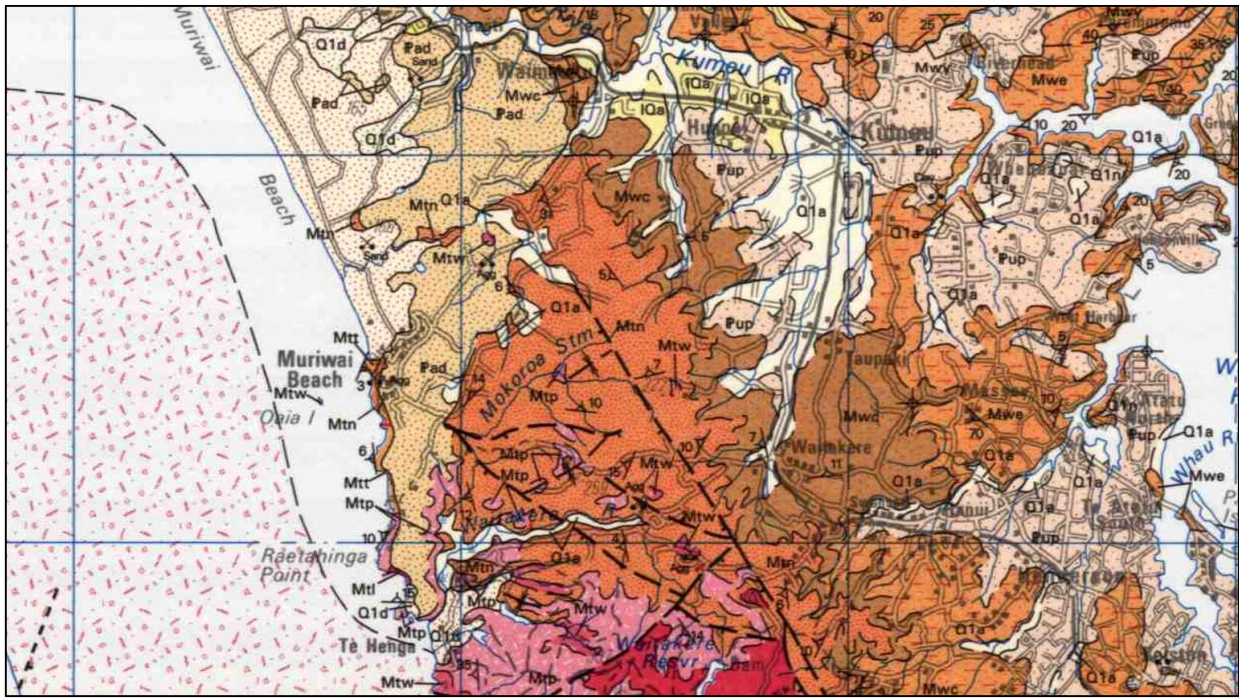


Figure 3 – Geology Map Auckland 1:250,000 (Courtesy of GNS)

Based on the Landers Geotechnical Investigation Report – October 2021 (see Appendix 4 of the AEE), the following results were observed with recommendations following a geomorphic assessment, site walkover, subsoil hand auger and machine bore investigations and stability assessment – refer Figure 4 below for field investigation locations:

- The geomorphology of the site can be categorised by rolling terrain dipping in elevation from the elevated southern terrain near Muriwai Road towards the lower elevated land in the north where a main gully feature defines the northern boundary to the site. There are a number of steeply incised gully features between wide flat ridgelines which form tributaries to the main dividing gully (Ōkiritoto Stream). These gully features tend to be more significant and pronounced across the western half of the site where there is evidence of gentle and shallowly incised overland flow channels present across the wide ridgelines before they drop sharply to intersect with the main gullies.
- Geometric slope stability assessment carried out indicates slip failure zones encroached into some parts of the proposed building areas hence not meeting minimum factors of safety. The recommendation is to implement a safe building line restriction. Any building encroaching this setback line towards the slope of the gully will require specific design and engineering mitigation (e.g. engineered palisade walls) to meet minimum acceptable factors of safety.

- The central and eastern portions of the site are gentler and do not appear to present the any inherent slope stability risks. The proposed Golf & Property Maintenance Complex (GPMC) is located outside any building restriction line.
- Topsoil was encountered at all test locations ranging up to 0.7m depth but generally averaging 0.3m depth.
- Groundwater was encountered at the time of the investigation within the piezometers installed on the machine boreholes at depths ranging from 2.6m – 15.6m which is below the depths of any anticipated cut level for the development.
- Control of stormwater discharge is essential to minimise slope failure and/ or erosional scour. Discharge from any impervious source should not be concentrated or uncontrolled and the use of engineered diversion channels and energy dissipating outlets are recommended.

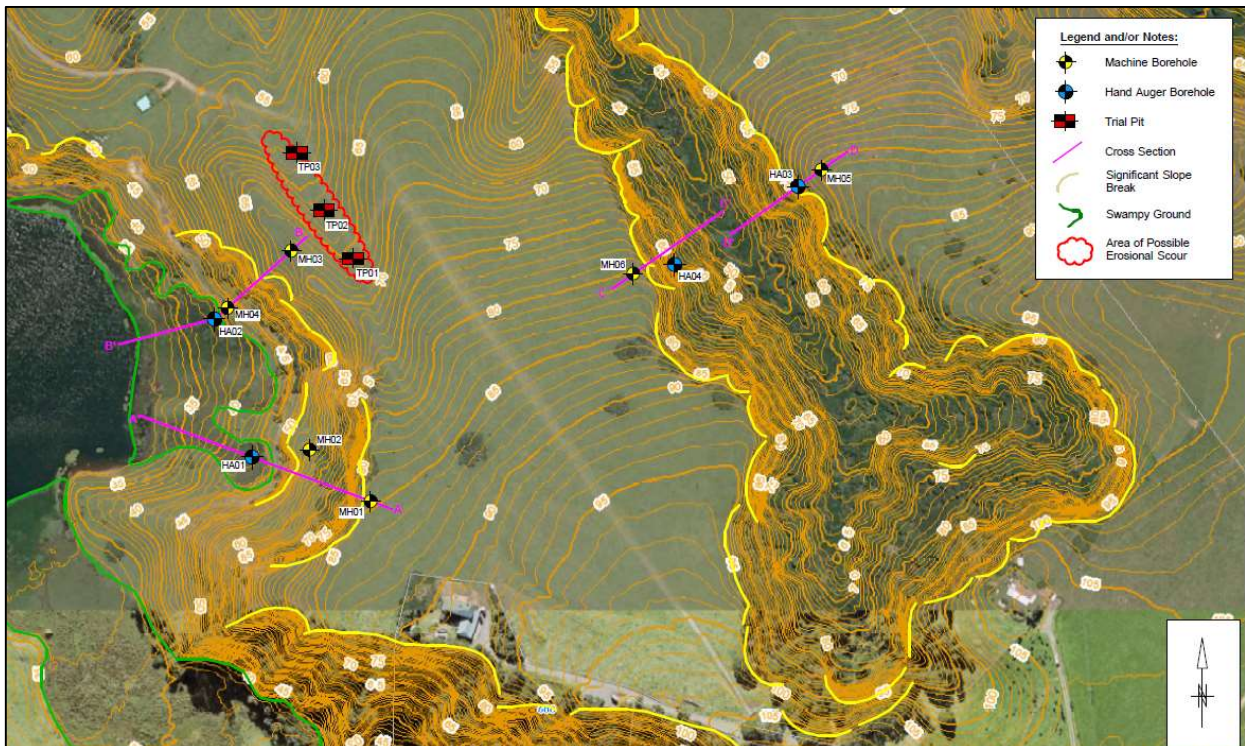


Figure 4 – Site investigation plan (Source: Landers Geotechnical GIR)

2.5 Soakage

Land Development and Engineering (LDE) conducted field testing (March 2022) to provide information in relation to onsite stormwater disposal concepts. Findings from the laboratory testing and percolation test results indicated the subsoils (up to 2.0m depth) to comprise of natural Awhitu Dune Deposits tending to fall into the Heavy Clay category with in-situ percolation to be considered poor (0.006 – 0.61L/m²/min). Monitoring of piezometers also indicated no further encounter of groundwater in any of the boreholes (i.e., drilled 1.0m–2.0m).

To aid in the mitigation of downstream flooding an at-source soakage system can be incorporated into the management of stormwater discharge from the various individual site

amenities (i.e., external lodge buildings). This would be achieved by way of soak pits or trenches collecting roof water and discharging runoff into the sandy subsoil layers below. Based on the soil conditions discussed above, to successfully carry this out, we recommend soakage to following either of the concepts below to ensure penetration through the heavy clay layer to the underlying sand layers:

- In areas where there is no cut or areas in fill, provided deepened boreholes (e.g., typically 600mmØ) down to the sandy layer (approx. 2–3m depths) filled with free draining material and geofabrics: or
- In areas where there is minimal or no overlying heavy clay, provide shallower trenches or boreholes filled with free draining material and geofabrics (i.e., direct to underlying sand stratum).

We note that disposal into soakage devices should be avoided within the building restriction zone which would be designated a specific design zone as recommended in the Landers GIR – October 2021 (refer – Appendix 4 AEE). We note further detailed geotechnical information will also need to be obtained at the building consent stage to support soakage use in the proposed individual development areas.

2.6 Existing Drainage Features & Stormwater Infrastructure

Auckland Council (AUP) viewer indicates the site is not located within a SMAF zone and Auckland Council GeoMaps information indicates that there is no public stormwater network available for the development to divert or direct stormwater discharge into.

On land stormwater soaks to groundwater or discharges to intermittent tributary streams (i.e., incised gullies) across the west and southeast portion of the site which all connect into the Ōkiritoto Stream. These intermittent tributary streams have various riparian vegetated featured areas associated with them (Refer Ecology Report Appendix 11 of the AEE).

Similarly for the portion of the site to the south of Muriwai Road, on land discharge enters the two main gully features. Stormwater flows through the western tributary gully, passes under Muriwai Road via a 1500Ø culvert and the Raurataua Stream passes under Muriwai Road via an existing bridge culvert crossing near the eastern boundary.

The portion of Muriwai Road through the site has existing roadside drains which are connected by several downstream piped culverts under the road formation. These roadside drains generally discharge into the two intermittent streams which cross Muriwai Road.

2.7 Receiving Environment

The receiving environment for the proposed development is local unconfined groundwater, the tributary gully features / wetland areas and ultimately the Ōkiritoto Stream. In the absence of a catchment wide stormwater management system, the requirement for development is to:

- Treat stormwater discharge in accordance with Auckland Councils Guideline Document (2017/001) - GD01.
- Minimise changes to the pre-development hydrological regime (i.e., attenuating stormwater flows for neutrality discharge).
- Consider low impact design (i.e., water sensitive design).

Complying with the above requirements can deliver much of the intent of the AUP: OiP.

2.8 Existing Hydrological Features (Streams, Rivers, and Coast)

Auckland Council GeoMaps indicate intermittent streams within the site connecting with the Ōkiritoto Stream, which in turn discharges into the Tasman Sea at Muriwai Beach (approximately 1.5km downstream of the site).

The site is also located within Waitemata Aquifer groups. See Figure's 5–7 below.



Figure 5 – Existing Rivers and Streams (Source: Auckland Council GeoMaps)

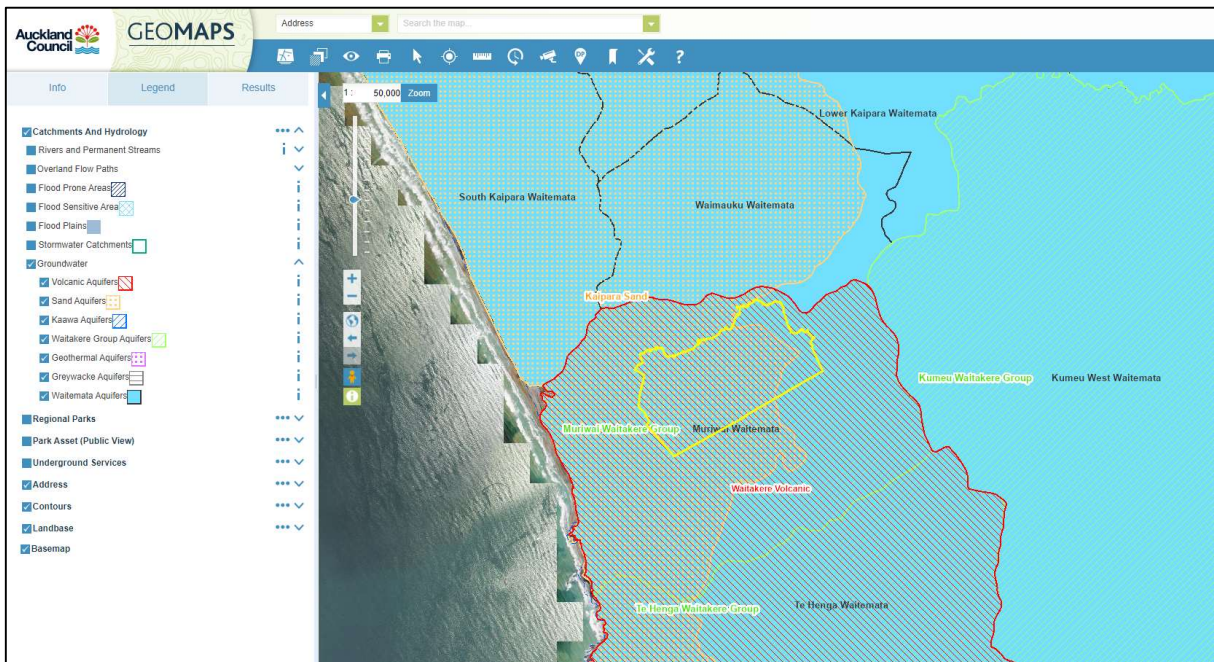


Figure 6 – Ground Water Aquifers (Source: Auckland Council GeoMaps)

2.9 Flooding & Flow Paths

Auckland Council GeoMaps show potential overland flow paths and flood plains within the property. See light blue hatched areas in Figure 7 below.

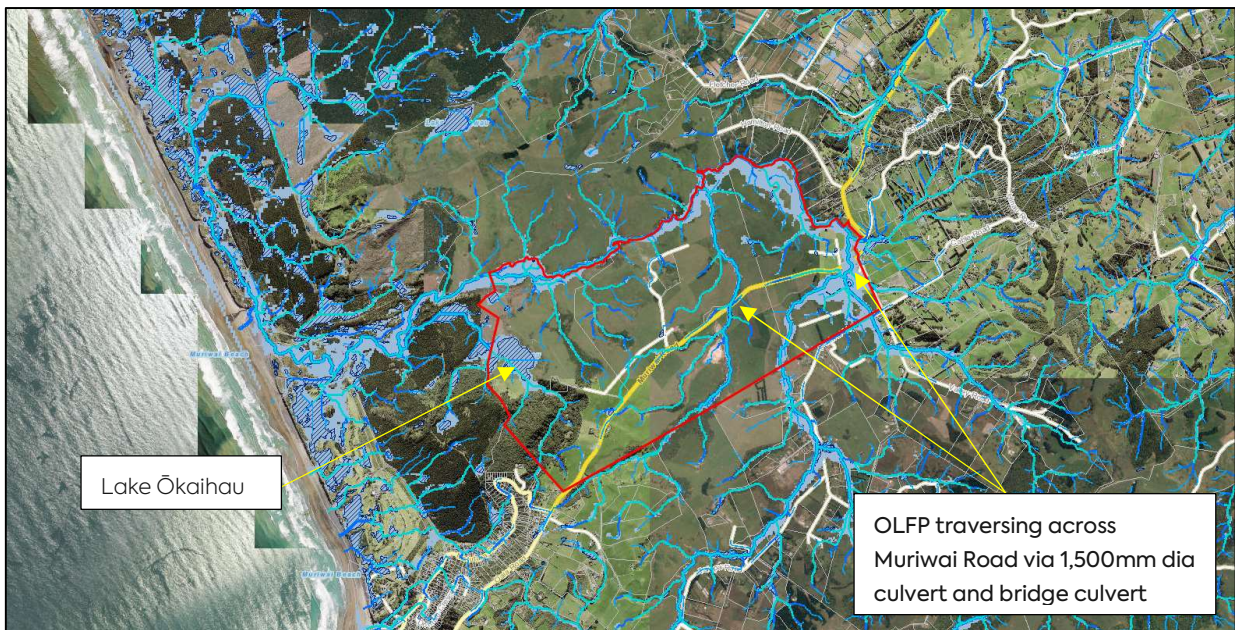


Figure 7 – Catchment and Hydrological Map (Source: Auckland Council GeoMaps)

Flood inundation is generally contained within the lower lying gully features and online wetlands across the site. These all contribute into the Ōkiritoto Stream along the northern boundary. There is an area which is prone to flooding for example the area at the upstream inlet to 1500Ø culvert crossing under Muriwai Road as well as the significant depression that forms Lake Ōkaihou.

2.10 Biodiversity / Ecological and Environmental Areas

The AUP: OiP Unitary Plan GeoMaps management layers / overlays show significant ecological areas (SEA) and quality-sensitive aquifer management areas within the site.

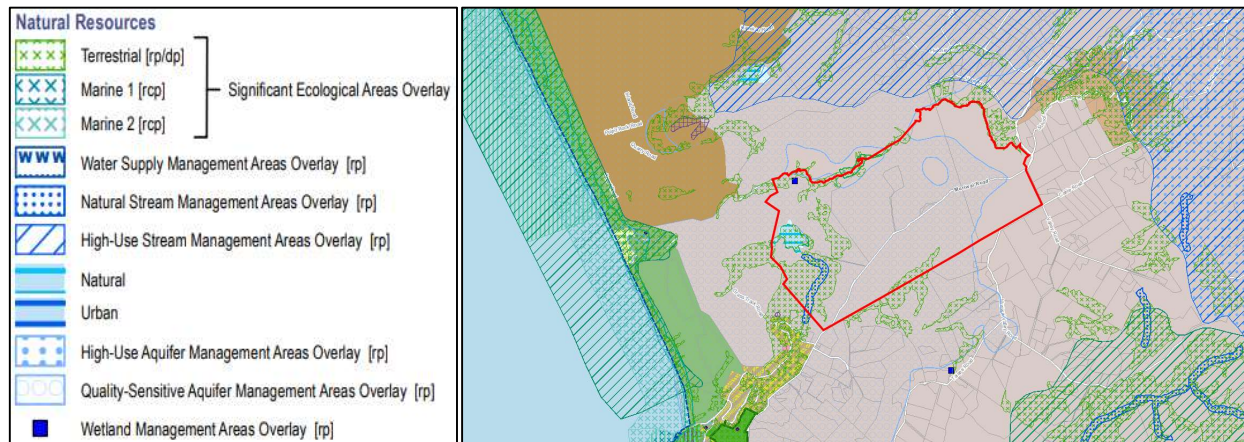


Figure 8 – Unitary Plan Overlays (Source: Auckland Council Unitary Plan GeoMaps)

2.11 Cultural and Heritage Sites

Based on the information provided on the AUP Planning layers in Auckland Council GeoMaps, there are no known natural heritage, historic heritage or places of significance to Mana Whenua within the site.

2.12 Contaminated Land

A Detailed Site Investigation (DSI) has been prepared by Pattle Delamore Partners Ltd (PDP) which supplements further detail to the previous Preliminary Site Investigation (PSI) – see Appendix 6A of the AEE. Various areas across the site which were categorised under the Hazardous Activity and Industry List. These areas identified were further investigated with soil sample retrieved for testing to determine the likelihood of human health and environmental risk.

The areas identified in the PSI are shown in Figure 10 below:

- Historical Kumara Crop located in the centre of the site near Muriwai Road.
- A sheep spray shower and Woolshed area located in the central north portion of site.
- Storage area for treated timber.
- Historical boarding house located in the northwest corner of site.

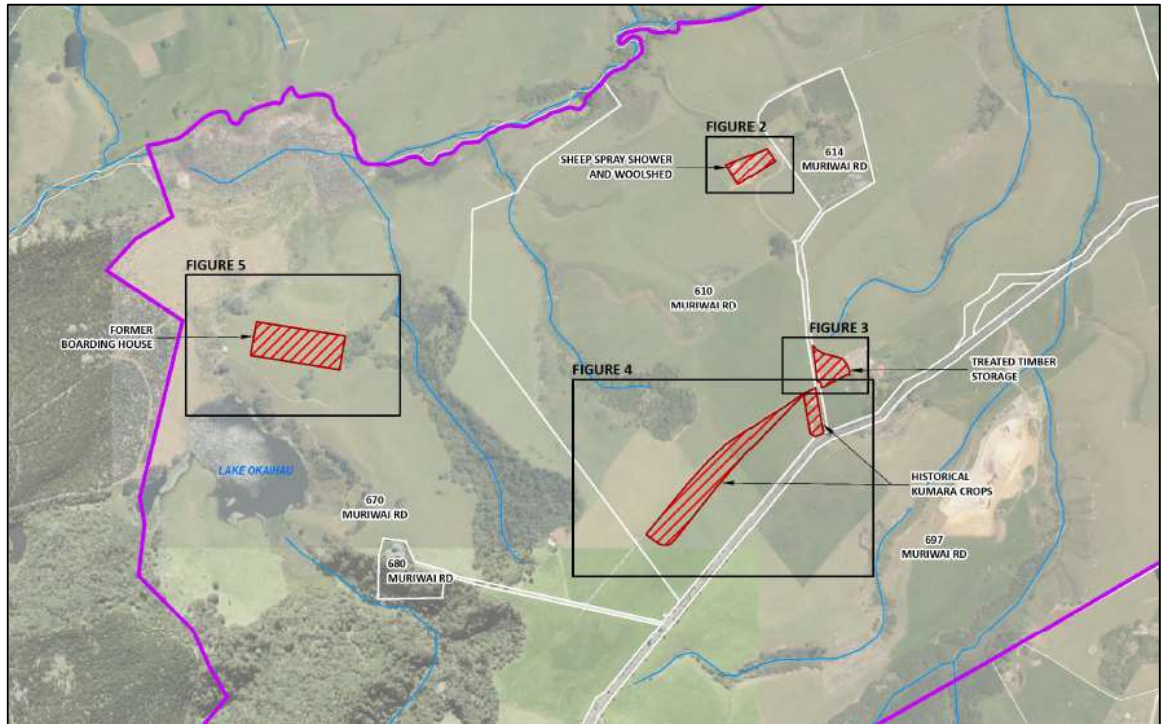


Figure 9 – Location of Sampling areas (Source: DSI prepared by PDPO)

The DSI set out remediation protocols for the future Contractor to follow prior to issuing of the Site Validation Report (SVR). Stormwater contamination risk will be appropriately addressed in accordance with the Contaminated Land Management Plan.

3.0 Proposed Development

3.1 Location and Area

Refer to Figure 11 and the MCCL engineering drawings for the proposed development layout.



Figure 10 – Proposed Master Plan Layout (Source Kyle Phillips Golf Course Design)

3.2 Site Layout

The development proposal will involve a marquee 19-hole golf course to be constructed across the north-west and central portion of the property. The proposal will also include the construction of a short stay accommodation resort and retreat to be constructed on the upper western portion of the property along the existing flat wide ridge between the two western gully features.

Toward the central portion of the site, it is proposed to construct a Clubhouse building with practice facility for the golf course. Further amenities within the property will include a Golf Academy, small 9-hole practice course and Golf & Property Maintenance Complex which will be constructed further to the east of the Clubhouse location.

A private sealed roading network will provide connection to the various site amenities as well as access onto Muriwai Road. The Lodge facility will generally be serviced by golf carts for the movement of guests and staff onsite and all visiting vehicles will be parked in the carparking facility provided to the south of the Lodge.

As part of the development proposal, the existing dairy farming operations and residences (i.e., 451, 610 & 614 Muriwai Road) will cease on the golf course development but will continue across the eastern portion of the property with the exception of dairy farming activities. Onsite amenities (e.g., stormwater, wastewater and water supply) for these properties will remain unchanged. It is understood that these existing devices are working efficiently with no known issues and hence no upgrades or replacement is required.

Refer to Figure 11 above, and the MCCL engineering drawings for the proposed development layout.

3.3 Site Coverage

Future impervious coverage for the development comprises the following estimated areas based on the current master plan:

Resort Lodge

Total Roof Coverage:	9,000m ² – (Lodge, accom & retreat units, and wellness centre)
Concrete & Asphalt Road:	6,850m ² – (Roads 1, 2, 8 incl. local connecting roads)
Sealed Carparking:	3,600m ² – (Carparking & individual carpark, accom & retreat units)
Pedestrian paths and cart paths:	2,640m ²

Clubhouse

Total Roof Coverage:	1,125m ²
Road Asphalt:	6,250m ² – (Road, incl. road widening Muriwai Road)
Carparking & Access:	7,210m ² – (Roads 1 & 7, incl. cart access to clubhouse & helicopter pads)

Sports Academy & GPMC

Total Roof Coverage:	6,080m ²
Road Asphalt:	4,380m ² – (Road, inc. road widening Muriwai Road)
Carpark	9,550m ²
Tennis Courts:	1,762m ²
Pedestrian Paths:	650m ²

Golf Course

Total Cart Pathways:	9,510m ² – (incl. bridge crossings over SEA areas)
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The total impervious coverage associated with the proposed development is estimated at approximately 68,600m² (6.9ha) across the entire 504 Ha property which is in the order of 1.4% coverage.

3.4 Hydrological Mitigation

The key concept is to maintain the existing hydrology on site e.g. post development the runoff from the site will remain largely unchanged from the predevelopment levels. The discharge off the site will be managed and attenuated through both retention (retaining of flows on site) and Detention (collecting and managing of flows to the rate of discharge from the site to predevelopment or similar levels) to achieve hydraulic neutrality for the site as practically achievable.

As with all hydraulic mitigation the site must be looked at ‘in a whole’ rather than analysing small individual catchments. The objectives are to manage ultimate runoff to the Ōkiritoto Stream.

Retention will be provided through two primary methods and 2 secondary methods.

- Soakage to the natural Awhitu sand geology present on site via the use of soakage pits, bio-retention swales and raingardens (to be confirmed at Building Consent stage). This approach will see stormwater management devices retaining surface water runoff flows for controlled soakage into the ground.
- Reuse of roof runoff using rainwater harvesting tanks (e.g. at the operations & maintenance facility). Runoff is retained in tanks then reused in operations and potable water uses at these locations resulting in a reduction of runoff to the site.
- Retention is also achieved through the additional planting proposed which will reduce the runoff coefficients and therefore volume and rate of flows for areas of pasture converted to planting.
- In addition to the two primary methods and secondary planting mitigation outlined above for retention a selected number of buildings will look to utilise green roof solutions which will replicate and likely improve over natural conditions with the use of green roof materials providing greater retention than pasture would typically provide

Attenuation to maintain pre-development flows will be provided by detaining flows over 24-hour period and slow release into the wetlands and streams. This approach will achieve hydraulic neutrality and soil erosion protection. This will primarily be achieved via the same four methods as outlined for retention.

3.5 Earthworks

Refer to the section 4 of the Engineering Infrastructure Report prepared by MCCL (see Appendix 5 of the AEE) for information pertaining to the proposed earthworks requirements and environmental management of sediment and erosion discharge.

4.0 Planning Context

Policy directives generally focus on maintaining the productive capacity of the land, its natural and amenity values and a rural character.

4.1 Regulatory & Design Requirements

Based on the review of Auckland Council’s regulatory and stormwater guidelines the site-specific stormwater management requirements have been identified. The relevant regulatory guidelines are listed in Table 3 below, and a summary of the requirements is presented in the sections following.

Table 3 – Summary of Regulatory and Design Requirements

Requirement	Relevant regulatory / design to follow
SMAF Hydrology Mitigation	• Not within SMAF zone
High Contaminant Generating Areas	• AUP Chapter E9
Natural Hazards	• AUP Chapter E36
Natural Resources of the Regional Policy Statement	• AUP Chapter B7
Discharge and Diversion	• AUP Chapter E8
Stormwater Management Devices Design	• GD01
Application of Principles of Water Sensitive Design	• GD04
Hydrology in Auckland Region	• Guidelines for Stormwater Runoff Modelling in the Auckland Region – Technical Publication 108 (1999). Former Auckland Regional Council.
Stormwater Management approach	• Auckland Unitary Plan stormwater management provisions: technical basis of contaminant and volume management requirements– Technical Report 2013/035 (2013). Auckland Council.
Design and Construction of Stormwater systems for Land development and Subdivision	• Auckland Code of Practice: For Land Development and Subdivision (Chapter 4 – Stormwater) – November (2015). Auckland Council.
Detail on Stormwater Management including WSD, Flood Risk Management, Freeboard allowance etc.	• NZS4404 – Land development and Subdivision infrastructure.
Rural Coastal Zones	• AUP Rule H19
Coastal Environment	• AUP Rule B8
Significant Ecological Areas Overlay	• AUP Rule D9

4.2 Natural Hazards and Flooding

Chapter E36 of the AUP sets out the policies relating to the management of natural hazards and flooding.

Under Table E36.4.1 Activity table specifies the activity status of land use and development activities pursuant to section 9(3) of the Resource Management Act 1991. The piping of the overland flow path under A33 and A36 is classified as a “Restricted Discretionary” Activity.

Table 4 - Table E36.4.1 – Activity table

Activities in the 1 per cent annual exceedance probability (AEP) floodplain		
(A33)	Construction of other land drainage works; stormwater management devices or flood mitigation works in the 1 per cent annual exceedance probability (AEP) flood plain	RD
Activities in Overland flow paths		
(A41)	Diverting the entry and exit point, piping or reducing the capacity of any part of an overland flow path.	RD

The identified 1% AEP flooding will not pose any significant impacts to the development as these flow paths and flood plains are largely contained within the lower lying gully features. All buildings and amenities for the development have been located well clear of these identified flood hazard areas.

We note that any secondary flow path features (minor) that will be in proximity to any internal private roading infrastructure are only gentle depressions across the terrain and are likely to be non-concentrated flows. These secondary flow paths will be maintained and managed with the use of formed swales and culverts across road alignments to maintain their natural flow patterns.

We note that part of the golf course design will require filling of two existing flow paths which provide conveyance to separate wetland features and ultimately into the Ōkiritoto Stream. These are both located in the north-east portion of the golf course crossing the proposed holes 14 and 16 also through holes 11 and 17. The proposal is to provide engineered culverts with stabilised outlets to maintain the natural flow pattern up to the 1% AEP storm event ultimately discharging into the Ōkiritoto Stream. These culverts will also be designed to ensure ecological habitats are preserved (e.g. fish passages for the culvert beneath holes 14 and 16) – refer to MCCL Drawings 1976-1-430-432 & 435- Appendix A.

The proposed development results in inconsequential changes to the existing natural flow pattern of stormwater and no conceivable impact on flood plain functions. There is also suitable space available for the proposed buildings and service amenity provisions including effluent disposal outside land at risk to inundation. All buildings/structures will be designed and constructed in accordance with the New Zealand Building Codes.

5.0 Mana Whenua

The resource consent process has involved consultation with Mana Whenua which will continue. Water is a very important natural resource to Māori and the proposed collection, conveyance and treatment of water will be undertaken with their guidance to ensure this valuable and important resource is appropriately managed.

6.0 Stakeholders

Similar to Mana Whenua, various stakeholder such as Auckland Transport and neighbouring landowners will be consulted with if required during the resource consent process.

7.0 Stormwater Management

7.1 Key Principles

This section sets out the stormwater management approach for the post-development operation of the site. It is consistent with AUP provisions. This approach is intended for the sustainable stormwater management and land development within the site. It is also geared towards the protection, restoration, and enhancement of the receiving environment (e.g. watercourse / wetlands)

The following standards and guidelines were adopted for the proposed stormwater management approach:

- Stormwater Management Devices in the Auckland Region, Guideline Document 2107/001 Version 1 (GD01) Dec 2017.
- Water Sensitive Design for Stormwater, March 2015, Guideline Document 2015/004 (GD04).
- The Auckland Council Code of Practice for Land Development and Subdivision, Stormwater (SWCoP).
- Guidelines for Stormwater Runoff Modelling in the Auckland Region, ARC Technical Publication No. 108 (ARC TP108), 1999.
- NZS3725: Loads on Buried Concrete Pipes, 1989.

The assessment of stormwater runoff volumes and peak flows were determined using Auckland Councils ARC TP108 methods and encompasses the following areas included for stormwater treatment:

- Existing pervious and impervious surfaces,
- Proposed new private roads, carparking and driveway areas,
- All other new impervious areas (e.g. new roof areas and hardstanding areas).

Permanent treatment devices will be designed in accordance with the guideline document *“Stormwater Management Devices in the Auckland Region, Guideline Document 2107/001 Version 1 (GD01) Dec 2017”*, using the BPO approach. All the devices proposed in this design will provide

water quality treatment to 75% removal of Total Suspended Solids (TSS) efficiency. The designs will provide flow attenuation and extended detention.

The guiding water sensitive design principles as outlined in GD04 and the performance outcomes and standards have been adopted and incorporated in the stormwater management approach for the development of the site. See key points and guiding principles below. Table 5 also shows the expected outcomes and performance standards consistent with the objectives and policies AUP:(OiP).

Table 5 – Application of Water Sensitive Design Principles

Water Sensitive Design Principles	Applications
Protect and enhance the values and functions of the natural ecosystem	<ul style="list-style-type: none"> ● Adoption of the WSD Blue–Green infrastructure, and green corridor network. ● Riparian stream edge planting, and riprap have been proposed where practicable, to minimise impact of stormwater runoff and overland flow on the receiving downstream environment. ● Bio-retention devices have been proposed for water quality and hydrological mitigation within the site to mitigate effects on receiving environments (streams).
Address stormwater effects as close to the source point as possible	<ul style="list-style-type: none"> ● Generation of contaminants will be prevented as far as practicable using inert building materials. ● Where contaminants are generated, i.e., road and car parks, green infrastructure will be provided to mimic natural physical, biological, and physical treatment processes as close to the source as practicable (e.g., swales).
Mimic natural systems and processes for stormwater management	<ul style="list-style-type: none"> ● Green infrastructure such as vegetated bio-retention devices, filter strips and green outfalls have been proposed for use within the site. ● Riparian stream edge planting, esplanade revegetation planting, and riprap to protect the stream networks within the site. ● Discharge of stormwater to the stream environment will be retarded and dispersed to maintain the stream flow regime within the site

7.2 Variation or Additional Principles

We envisage no updated principles for stormwater management and the development proposal will adopt the standards and principles in line with the Auckland Council regulatory and New Zealand Building Code requirements as discussed above.

7.3 Stormwater Management Proposal

The proposed development will result in the increase to impervious coverage which will generate stormwater runoff (i.e., volume and peak flow rate) that will need to be controlled with appropriate mitigation.

A stormwater management network of swales, raingardens, tanks and pipes (i.e., private) will be utilised to convey the flows from the various site amenity buildings and roading infrastructure in a treatment train approach.

Due to the size of the site, site features and contours, the site consists of various catchments. The stormwater concept will be designed to maintain these catchments as best as practical in the post development scenario. This will enable the management of stormwater to maintain the natural hydraulic and hydrological patterns of discharge and hence provide a close to neutral outcome for the receiving environment. The stormwater management system (pipes, treatment devices and outfalls) will be designed to ensure discharges into the receiving land, streams and wetland features resemble pre-development flows and water quality. To calculate the pipe size to convey the post development 10% AEP flows, TP108 is used for the catchment areas directly servicing the piped network – Refer calculations provide in Appendix A.

7.4 Water Quality

The development includes building amenities, vehicular access, and carpark. These have the potential to inhibit reduced stormwater quality.

The water quality management approach seeks to:

- Eliminate, and if not possible minimise the generation and discharge of contaminants.
- Design a stormwater management system that provides for a high level of water quality to protect the receiving environment.
- Preserve, protect, and enhance streams and floodplains in the Blue-Green network, which can also provide amenity and connectivity with communities.
- Provide at-source water quality treatment of runoff for all contaminant generating impervious surfaces to target sediment, metals and gross pollutants. Provide treatment devices (raingardens and or swales) in the high-use zones, to target treatment efficiency of at least 75% TSS. Green infrastructure is preferred.

These objectives will generally be achieved through the following measures and stormwater management devices:

7.5 Site wide buildings

- Using inert building materials to prevent the generation of contaminant-laden runoff from the site, i.e., avoiding use of high contaminant yielding building products.
- Designing the Clubrooms and Lodge buildings to include green roof systems.

7.6 Roads, carpark, hardstand areas

- Treating runoff from all contaminant generating impervious areas where practical (i.e., parking areas and areas of high vehicle manoeuvring, accessways, and roads regardless of traffic volumes) with at-source green infrastructure treatment devices to be located upstream of the catchment discharge points. All treatment devices will be designed to GD01 standards.
- Where applicable, install grated catchpits and inlets to the stormwater network for capturing gross contaminants, solids, sediment, and gravels.
- Near-to-source devices such as vegetated swales, rain gardens, filter strips, and tree pits, will be included where effective.

7.7 Water Sensitive Design Development Concepts

For proposed concepts of WSD for the development, refer to MCCL Drawings 400 series and Table 6 for summary below:

Table 6 – WSD Concepts for Development Proposal

Land Use Catchment	Treatment Train Concept
Lodge	
<u>Roading Infrastructure</u>	
Road 2 (Ch0–Ch590)	- Sealed, 3% cross-fall, edge beam for non-concentrated flow to roadside treatment swale.
Road 8 (Ch0–Ch340)	- Sealed, 3% cross-fall, edge beam for non-concentrated flow to roadside treatment swale.
Carpark (Zone A & B)	- Sealed, single 3% cross-fall, edge beam for non-concentrated flow to raingarden (RG-1).
Carpark (Staff)	- Sealed, single 3% cross-fall, edge beam for non-concentrated flow to raingarden (RG-2).
<u>Lodge Buildings</u>	
Main Lodge	- Proposed Green Living Roof and inert building materials.
External buildings	- Roof water to independent soakage devices, overflow to primary reticulation.
Club House	
<u>Roading Infrastructure</u>	
Road 1 (Ch0–Ch780)	- Sealed, 3% cross-fall, edge beam for non-concentrated flow to roadside existing pasture and treatment swale.
Road 4 (Ch0–Ch20)	- Sealed, 3% cross-fall, edge beam for non-concentrated flow to roadside treatment swale.
Road 7 (Ch0 – Ch6)	- Helicopter Pad – Sealed, 3% cross-fall for non-concentrated flow to existing pasture.
Carpark (Clubhouse#1)	- Sealed, single 3% cross-fall, edge beam for non-concentrated flow to raingarden (RG-3).
Carpark (Clubhouse#2)	- Sealed, single 3% cross-fall, edge beam for non-concentrated flow to

Land Use Catchment	Treatment Train Concept
	treatment swale.
<u>Clubhouse Buildings</u>	
Main Lodge	- Proposed Green Living Roof and inert building materials with collection to reticulation network.
Sports Academy	
<u>Roading Infrastructure</u>	
Road 5 (Ch0–Ch110)	- Sealed, 3% cross-fall, edge beam for non-concentrated flow to roadside existing pasture and treatment swale.
Carpark (Academy)	- Sealed, single 3% cross-fall, edge beam for non-concentrated flow to treatment swale.
<u>Academy Buildings</u>	
Main Building & Tennis	- Inert building materials and roof water collection into rainwater harvesting tanks with overflow to reticulation network.
Golf Property & Maintenance Complex	
<u>Roading Infrastructure</u>	
Road 5 (Ch110–Ch580)	- Sealed, 3% cross-fall, edge beam for non-concentrated flow to roadside treatment swale.
Carpark (Staff)	- Sealed, single 3% cross-fall, edge beam for non-concentrated flow to treatment swale for discharge into raingarden (RG-4).
GPMC yard (north)	- Sealed with cross-fall to catchpits for discharge into raingarden (RG-4).
GPMC yard (south)	- Sealed with cross-fall to catchpits for discharge into raingarden (RG-5).
<u>GPMC Buildings</u>	
Bulk, Operation, Equipment Store, GMC Office, Materials Bay	- Inert building materials and roof water collection into rainwater harvesting tanks with overflow to reticulation network.
Golf Course	
<u>Golf Course Pedestrian & Cart pathways.</u>	- Sealed (concrete/timber), single cross-fall, for non-concentrated flow on-land to pastural and or natural vegetation. We note all paths are predominately restricted to electric carts only with low-traffic volume.

7.8 Water Quantity

The development will increase the impervious area, which will result in an increase in stormwater runoff (peak flow and volume). It is noted that the proposed overall impervious percentage for the site is in the order of 1.4% of the total property land area and as such its impact is regarded as minimal to the overall catchment. The impervious areas are widespread across multiple catchments rather than being concentrated in a single area which further reduces its impact in any one particular area.

Also considered is the potential to utilise the relatively high permeability sand layers below the upper clay layers (i.e., Awhitu Group sands) and the proposal to utilise this existing natural function as part of the stormwater management outcomes for the site (e.g. onsite soakage).

7.9 Hydraulic Mitigation

This section considers the mitigation of smaller but more frequent storm events to offset the effects of development. These smaller storm events also strongly influence the geomorphology of receiving streams and therefore the effects on downstream erosion risk are also considered in Section 6.2.5 below. The hydrological mitigation measures identified here will be most effective during smaller events (e.g., up to the 10% AEP event) but will mitigate runoff in all storm events.

Retention is the process of providing baseflow management in streams and recharge of groundwater. This can be achieved by storing and retaining stormwater runoff onsite to reduce the volume of stormwater discharged to the receiving environment. Detention is the temporary storage and slower release of runoff, which effectively reduces peak flows and protects the downstream receiving environment from scour and erosion.

Reduction in peak flows and management of increased runoff flow volumes is important but not at the detriment to existing base line flow that discharge to the wetlands and streams.

Detailed design of the retention and detention devices will be in accordance with GD01 (TP10). To meet the hydrological mitigation objectives, the following management options are proposed:

7.10 For Retention

- The primary method of retention will be at source soakage/infiltration, via soakage, infiltration systems and bioretention devices. The site largely falls within the Awhitu Group geological area which comprises primarily of underlying sands and cemented sands. These soil types will present the potential opportunity for onsite infiltration (soakage) and hence the opportunity for disposal of roof water into the subsoil ground water table (i.e. recharge).
- Construction of soakage devices in locations suitable to cater for each individual unit. These proposed soakage pits will be designed in accordance with Auckland Council and NZBC standards and will typically be filled with an approved drainage scoria (i.e. ±50% void area) and wrapped in a geofabric material (e.g. Biddim A14 or similar approved) for filtration. For areas within the fill or no cut areas we recommend deep borehole soak holes to competent draining subsoil layers (e.g sands) and for areas in cut, shallower aggregate filled bore hole or trenched soakage pits. Further geotechnical investigations specifically for soil infiltration rates, will need to be determined to adequately size each device. These will be further detailed at the Building Consent stage.
- We note that Landers Geotechnics have recommended that any soakage devices shall be avoided within the building limit line (i.e. in proximity to steep slopes) as described in their Geotechnical Investigation Report.

- For some buildings (e.g. sports academy and operation & maintenance facility) the use of rainwater tanks for re-use will also be utilised which will provide a retention element.

7.11 For Detention

- For roads and other paved impervious areas, raingardens and soakage will be utilised to manage stormwater flows. Raingardens, filter strips or soakage devices will be provisionally sized to accommodate the necessary level of hydrological mitigation for each catchment up to the 10% AEP event.
- Raingardens, vegetated swales and soakage devices are bio-retention devices which can be designed to also provide detention while adding to the landscape value of the site.
- Rainwater harvesting tanks will be provided within the site to store rainwater for re-use for the operations and maintenance facilities and sports academy and will incorporate a separate detention volume or soakage from overflows with controlled discharge to mimic pre-development flows.
- Some areas of the site are impractical to achieve full hydraulic neutrality via retention and detention such as steeper sections of roads where either residency time or collection methods preclude detention. This accounts for a smaller proportion of the of the overall percentage if impervious area at an estimated <15% of the total impervious or 0.15% of the site area.

Refer to stormwater drawings 1976-1-400-491 (Appendix A) and stormwater calculations (Appendix B) for further details.

7.12 Erosion Management

Unless carefully managed, additional impervious areas from the proposed development can lead to adverse stream bank erosion effects due to the increased runoff rate and volume. Additional measures (such as increased detention, flood plain management or in-stream works) may be required to manage erosion effects when there are already bank erosion and stream stability issues in the receiving environments. Planting programmes are planned for the watercourses/wetland extremities (i.e. riparian) which will assist in improving bank erosion and stability while also providing and improved ecological outcome.

Riparian margins have the added benefit of:

- improving the ecological values and function of the Blue-Green Network within the site.
- minimising and mitigate the effects on temperature in the freshwater systems.
- providing a green barrier between impervious areas and the receiving environments providing additional erosion protection.

Further erosion protection provisions at stormwater outfalls into streams/wetlands will be in accordance with Auckland Council Technical Report 2013/018 – Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices (TR18).

7.13 Flooding

The general flood management approach is to maintain the function of overland flow paths to convey stormwater runoff safely from a site to the receiving environment. Generally, all flood inundation risk associated with overland flow on the property is restricted to the main gully features or intermittent tributaries into the Ōkiritoto Stream. We consider there will be no risk resulting from these identified areas of inundation as there is no development proposed within these areas.

Any changes to overland flow paths (i.e., piped) are to retain their capacity to pass stormwater flows safely without causing any safety issues to the public or damage to property or the environment upstream and downstream.

The overland flow paths will be assessed in detail in the detailed design phase of the project to ensure these criteria are adhered to. Any minor changes to flow paths will be minimal and will be contained within the site and external boundaries will be maintained.

To ensure that there are no adverse flooding effects within the site itself, the following are proposed to manage flood risk:

- All building platforms to be located outside of and set away from natural overland flow pathways and above the 1% AEP flood plain, with a suitable allowance for freeboard in accordance with the NZBC.
- Infrastructure to be located outside the 1% AEP flood plain, unless designed to be flood resilient.
- For events greater than a 10% AEP storm event and up to a 1% AEP storm event, secondary flows will be formed to convey the flows away from critical elements of high-risk erosion areas of the site whilst mimicking natural conditions.

7.14 Asset Ownership

The private stormwater infrastructure requirements (i.e. conveyance and treatment) to service the development will be installed by the developer, at their cost. These will be installed in accordance with regulatory standards and CEMP to ensure there is no increased effects on the downstream environment during the building construction stage and the future of the development. The cost of maintenance and upkeep of the assets will also be at the property owner's responsibility and cost.

7.15 Maintenance Requirements

All private stormwater devices (e.g. green roofs, raingardens and swales) must be managed and maintained in accordance with Auckland Council's Stormwater Bylaw. Stormwater infrastructure and treatments devices ultimately established on this site will be the sole responsibility of the development owner as these will be private assets.

The private treatment devices should be monitored, inspected and maintained regularly to ensure that, the depth of stored sediment does not cause sediment to migrate out of the devices into the downstream environment.

Maintenance will take the form of removing the sediment from the treatment devices and monitoring the vegetation cover on a regular basis. When sediments are to be removed, vegetation and soil conditions should be restored to their originally constructed condition. Regular inspections must be done to ensure that the desired vegetation remains and is not overtaken by invasive undesirable plants. General maintenance to remove coarse debris and rubbish should routinely be undertaken. We recommend the development owner prepare and implement an operational and maintenance programme to manage all stormwater systems which will be further detailed at the detailed design stage (i.e. Building Consent).

7.16 Implementation of Stormwater Network

The stormwater network has been conceptually designed to manage both the quantity and quality of the stormwater run-off from the contributing development catchments. The stormwater system and devices have been designed in accordance with the Auckland Council's regulatory standards (i.e. SWCoP, GD01 & GD01). All stormwater conveyance and treatment devices will be determined as part of the Building Consent stage. Once approved the works will be installed and, monitored before being inspected by Council for signoff. As the site amenities and golf course is constructed, staged stabilisation of completed areas will occur thus no extra sedimentation of the stormwater network will occur.

Operations, maintenance, and monitoring of the proposed stormwater system will be critical in ensuring that the short and long-term performance of the system is maintained. Maintenance and monitoring will focus on preventing sedimentation entering the system and ultimately the receiving environment.

Monitoring will be carried out during the construction stages and on completion will continue throughout the life-cycle of the system. This will be the responsibility of the development owner. Continual monitoring will identify any need for maintenance requirements as these arise.

7.17 Dependencies

All the stormwater conveyance, treatment and detention works will be completed within the development and will become private assets. These works will be completed under the Building Consent stage. The only stormwater works required outside the development will involve realigning of the roadside drains to facilitate the upgrading of Muriwai Road at the proposed two

access locations. These works will be carried out under Engineering Plan applications if required which will be separate to the internal private building consent works.

7.18 Risk Register

Proposed Risk to Stormwater Management	Mitigation / Management	Further mitigation/management to be used	When do risks need to be addressed	What is the Resultant level of Risk?
Soil Erosion	To reduce the risk of erosion of temporary batter faces, due care to overland/ stormwater flows should be made to ensure surface water does not flow over formed batters, i.e., forming diversion bunds at the crest of batters.	To reduce the risk of erosion of temporary batter faces, due care to overland/ stormwater flows should be made to ensure surface water does not flow over formed batters, i.e., forming diversion bunds at the crest of batters.	During the Resource Consent phase (i.e earthworks stage)	Moderate
Slope Stability	Slope stability analyses undertaken on the western boundary of the site considered the current site is not at risk of large-scale land instability. However, it was recommended that more detailed analysis of land stability is carried out on the final earthworks design.	N/A	During the Resource Consent phase	Moderate
Overland Flows	Overland Flow velocity & depth assessment	The development will be designed to incorporate OLFP's within the road reserves and green spaces. Freeboard of 150mm (minimum) above the top water levels for 1% AEP OLFP will be provided to vulnerable areas, such as habitable floor levels, for flows less than 2m ³ /s, as per current Auckland Council Code of Practice.	During Resource Consent Stage	Moderate
Reduced capacity of natural conveyance routes	Provide onsite mitigation to manage peak flows up to the 1% AEP event to maintain natural flow patterns as per pre-development scenario.	N/A	During Resource Consent stage	Low

8.0 Departures from Regulatory or Design Codes

The stormwater management approach for development meets the minimum regulatory or design codes standards and is considered the BPO approach.

9.0 Conclusions and Recommendations for Future Work

This SMP has been developed for the specific development of the site into a marque golf course and resort. An integrated stormwater management approach will be adopted across site. It has been developed based on AUP:OiP regulatory policies, Auckland Council and New Zealand Building Code stormwater-specific guidelines. The overarching principle of the SMP is to implement an integrated stormwater management approach for the site, which includes:

- Eliminate and if not possible, minimise the impacts on the receiving environment.
- Emphasise a water sensitive design approach that:
 - manages the impact of land use change from rural to a golf course and resort facility.
 - minimises or mitigates the adverse effects on water quality, freshwater systems, stream health and ecological values of the receiving environment through the implementation of stormwater management devices; this includes tributaries of the permanent stream to the north of the site.
 - protects and enhances stream systems and riparian margins.
- Minimise the generation and discharge of contaminants/sediments into the sensitive receiving environment of the Ōkiritoto stream, Lake Ōkaihau and ultimately Muriwai Beach.
- Recognise a Blue-Green network approach with the stormwater management system to integrate “blue” aspects of the site (the streams and flood plains) and the “green” aspects of the environment (indigenous biodiversity and ecological significance such as SEAs).
- Protect key infrastructure, people, and the environment from significant flooding events.

The proposed approach, based on water sensitive design to deliver water quality, conveyance, hydrological and flood mitigation outcomes, comprises to:

- Preserve, protect, and enhance streams and floodplains in the Blue-Green network, which can also provide amenity and connectivity with the end using community.
- Eliminate and if not possible minimise the generation of contaminants with the provisions of near-source water quality treatment of runoff for all contaminant generating impervious surfaces. Water quality treatment to target sediment, metals and gross pollutants should be provided. Green infrastructure is preferred.

Detailed design of the proposed stormwater management approach, including device selection, sizing and location will be addressed at detailed design stage of development and approved through the engineering plan approval and the building consent processes.

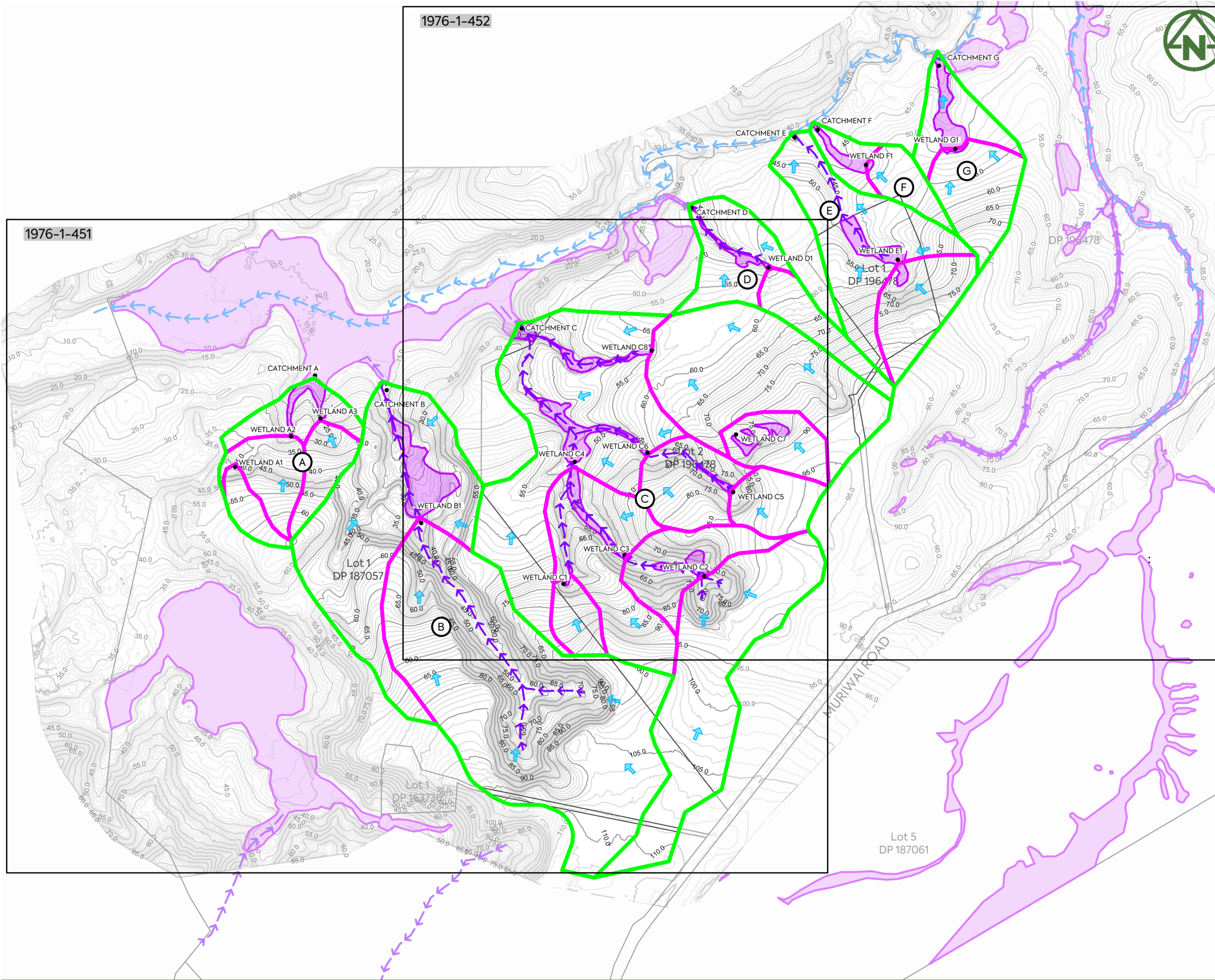
Based on the investigations that have been completed at this stage, it is expected that stormwater effects from the site can be managed safely and without damage to the receiving environment. The development of the site can, therefore, proceed without any major concerns relating to stormwater management

APPENDIX A – STORMWATER DRAWINGS

STORMWATER DRAWINGS 1976-1-450, 453, 455, 459, 460 & 486

1976-1-452

1976-1-451



NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING INFRASTRUCTURE AND SERVICING REPORT.
2. REFER TO DRAWING 455-457 FOR Q100 POST-DEVELOPMENT CATCHMENTS.

LEGEND:

- EXTENT OF EARTHWORKS -----
- CATCHMENT BOUNDARY (PRE DEVELOPMENT) -----
- SUB-CATCHMENT BOUNDARY (PRE DEVELOPMENT) -----
- OVERLAND FLOW PATH → →
- CATCHMENT NAME B
- OVERLAND FLOW DESIGN POINT
- EXISTING (5m) MAJOR CONTOUR -----
- EXISTING (1m) MINOR CONTOUR
- PERMANENT STREAM - - - - -
- INTERMITTENT STREAM - - - - -
- EXISTING WETLANDS (TO BE PROTECTED)

CLIENT:

THE BEARS HOME PROJECT MANAGEMENT LTD

PROJECT:

MURIWAI DOWNS GOLF PROJECT
610 & 697 MURIWAI ROAD
MURIWAI VALLEY

TITLE:

PROPOSED DRAINAGE
Q100 PRE DEVELOPMENT
STORMWATER CATCHMENT
OVERALL PLAN

PURPOSE OF ISSUE:

FOR CONSENT

SCALE:
1:7500

DO NOT SCALE

DRAWING NO:

1976-1-450

REV:

C



MCKENZIE & CO.

REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
C	ISSUED FOR CONSENT	MO	CIM	JSD	26/11/21
B	SECOND ISSUE	MO	CIM	JSD	05/11/21
A	FIRST ISSUE	MO	CIM	JSD	24/08/21

PRE DEVELOPMENT CATCHMENT INFO

24-hour rainfall	Imperviousness	SCS Curve No.														
Depth (mm)	(%)	(mm)														
175	0%	74														
Description	Catchment Area	Contributing Catchments	Total Catchment Area	Catchment Slope	Catchment Length	Channelisation	Imperviousness	q*	Weighted curve number	Storage	la weighted	$c^*=(P24-2la)/(P24-2la+2S)$	tc	Peak Q100 Flow	Q24	V24
	(ha)		(ha)	(m/m)	(km)	C	(%)	Approx.		(S)	(mm)			(m3/s)	(mm)	(m3)
Wetland A1	0.90	A1	0.90	0.128	0.21	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.19	111.5	1003.30
Wetland A2	1.88	A1+A2	2.78	0.116	0.34	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.59	111.5	3099.10
Wetland A3	1.43	A3	1.43	0.168	0.27	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.30	111.5	1594.14
Catchment A	1.77	A1+A2+A3+A	5.98	0.113	0.47	1.00	0%	0.120	74.0	89.2	5.00	0.48	0.18	1.26	111.5	6666.40
Wetland B1	19.57	B1	19.57	0.105	0.82	1.00	0%	0.107	74.0	89.2	5.00	0.48	0.27	3.66	111.5	21816.31
Catchment B	10.44	B1+B	30.01	0.090	1.09	1.00	0%	0.098	74.0	89.2	5.00	0.48	0.34	5.15	111.5	33454.64
Wetland C1	1.20	C1	1.20	0.204	0.17	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.25	111.5	1337.74
Wetland C2	9.05	C2	9.05	0.073	0.67	1.00	0%	0.109	74.0	89.2	5.00	0.48	0.26	1.73	111.5	10088.79
Wetland C3	2.83	C2+C3	11.88	0.069	0.83	1.00	0%	0.102	74.0	89.2	5.00	0.48	0.31	2.12	111.5	13246.97
Wetland C4	5.30	C1+C2+C3+C4	18.38	0.063	1.04	1.00	0%	0.095	74.0	89.2	5.00	0.48	0.37	3.06	111.5	20493.06
Wetland C5	1.83	C5	1.83	0.129	0.20	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.39	111.5	2040.05
Wetland C6	2.80	C5+C6	4.63	0.106	0.39	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.98	111.5	5156.99
Wetland C7	2.06	C7	2.06	0.111	0.24	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.44	111.5	2296.45
Wetland C8	8.88	C7+C8	10.94	0.092	0.48	1.00	0%	0.118	74.0	89.2	5.00	0.48	0.20	2.26	111.5	12195.73
Catchment C	12.27	C4+C6+C8+C	46.22	0.072	1.37	1.00	0%	0.090	74.0	89.2	5.00	0.48	0.42	7.28	111.5	51524.16
Wetland D1	1.72	D1	1.72	0.098	0.46	1.00	0%	0.119	74.0	89.2	5.00	0.48	0.19	0.36	111.5	1917.43
Catchment D	2.88	D1+D	4.60	0.089	0.66	1.00	0%	0.110	74.0	89.2	5.00	0.48	0.25	0.89	111.5	5128.00
Wetland E1	2.85	E1	2.85	0.167	0.24	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.60	111.5	3177.13
Catchment E	5.92	E1+E	8.77	0.091	0.57	1.00	0%	0.117	74.0	89.2	5.00	0.48	0.22	1.80	111.5	9781.11
Wetland F1	1.29	F1	1.29	0.108	0.23	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.27	111.5	1432.50
Catchment F	0.94	F1+F	2.23	0.087	0.35	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.47	111.5	2480.39
Wetland G1	2.89	G1	2.89	0.127	0.21	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	0.61	111.5	3221.72
Catchment G	2.04	G1+G	4.93	0.094	0.38	1.00	0%	0.121	74.0	89.2	5.00	0.48	0.17	1.04	111.5	5495.88



CLIENT: THE BEARS HOME PROJECT MANAGEMENT LTD

PROJECT: MURIWAI DOWNS GOLF PROJECT
610 & 697 MURIWAI ROAD
MURIWAI VALLEY

TITLE: PROPOSED DRAINAGE Q100 PRE DEVELOPMENT CALCULATION DATA TABLE

PURPOSE OF ISSUE: FOR CONSENT

SCALE: NTS @ A3
DO NOT SCALE

DRAWING NO: 1976-1-453 REV: A

1976-1-457

1976-1-456

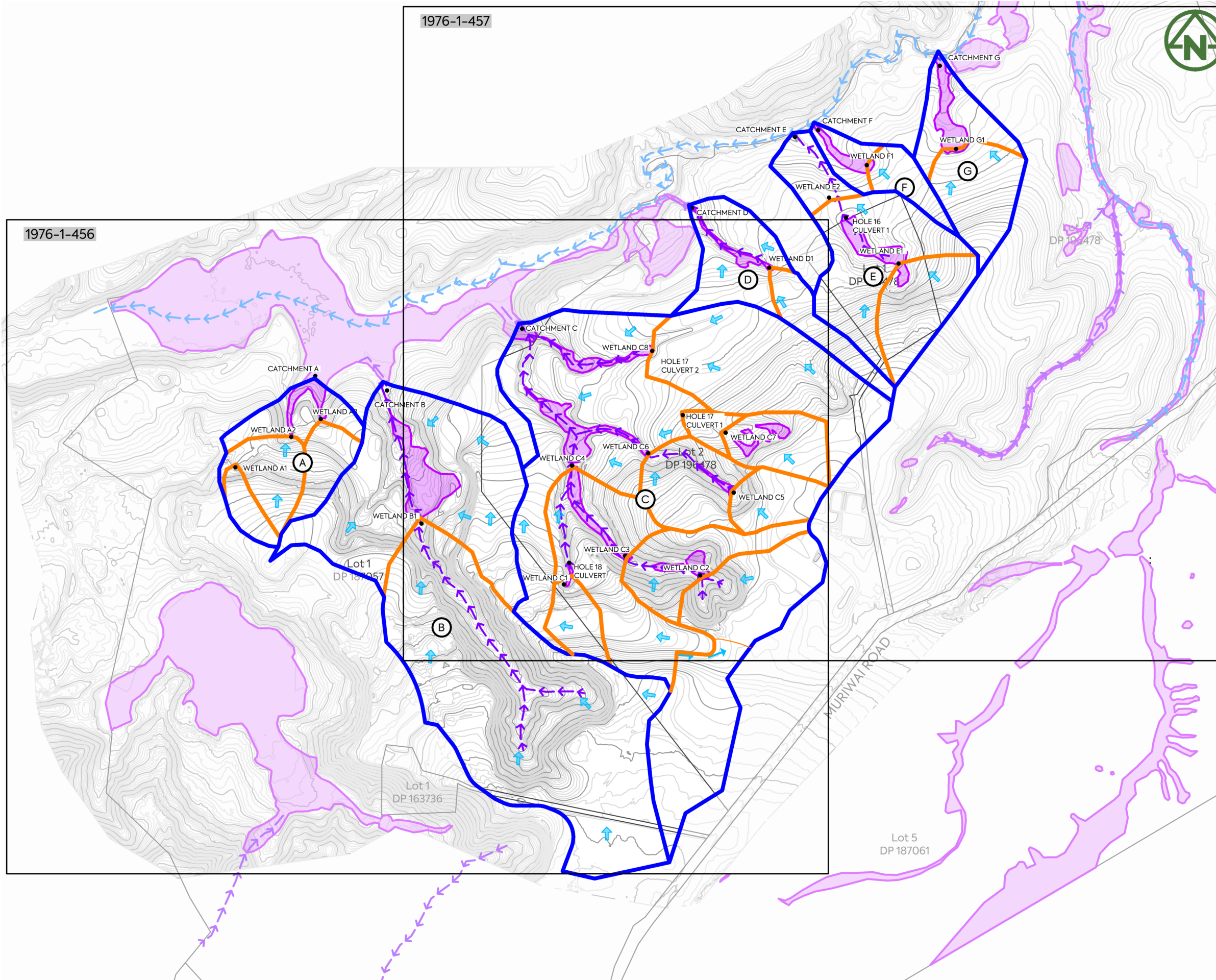


NOTES:

- 1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING INFRASTRUCTURE AND SERVICING REPORT.
- 2. REFER TO DRAWING 450-452 FOR Q100 PRE-DEVELOPMENT CATCHMENTS.

LEGEND:

- EXTENT OF EARTHWORKS
- CATCHMENT BOUNDARY (POST DEVELOPMENT)
- SUB-CATCHMENT BOUNDARY (POST DEVELOPMENT)
- OVERLAND FLOW PATH
- CATCHMENT NAME
- OVERLAND FLOW DESIGN POINT
- FINISHED (5m) MAJOR CONTOUR
- FINISHED (1m) MINOR CONTOUR
- PERMANENT STREAM
- INTERMITTENT STREAM
- EXISTING WETLANDS (TO BE PROTECTED)



REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE
C	ISSUED FOR CONSENT	MO	CIM	JSD	26/11/21
B	SECOND ISSUE	MO	CIM	JSD	05/11/21
A	FIRST ISSUE	MO	CIM	JSD	24/08/21



CLIENT:
THE BEARS HOME PROJECT MANAGEMENT LTD

PROJECT:
**MURIWAI DOWNS GOLF PROJECT
 610 & 697 MURIWAI ROAD
 MURIWAI VALLEY**

TITLE:
**PROPOSED DRAINAGE
 Q100 POST DEVELOPMENT
 STORMWATER CATCHMENT
 OVERALL PLAN**

PURPOSE OF ISSUE:
FOR CONSENT

SCALE:
1:7500
 DO NOT SCALE

DRAWING NO.: **1976-1-455** REV: **C**

PRE DEVELOPMENT				POST DEVELOPMENT						
Description	Contributing	Total Catchment	Peak Q100 Flow	Description	Contributing	Total Catchment	Peak Q100 Flow	Change in Impervious area	Change in Flow	Change in area
	Catchments	Area (ha)	(m3/s)		Catchments	Area (ha)	(m3/s)	(m)	(m3/s)	(%)
Wetland A1	A1	0.90	0.19	Wetland A1	A1	0.87	0.19	0	0.00	-3%
Wetland A2	A1+A2	2.78	0.59	Wetland A2	A1+A2	2.74	0.58	0	0.00	-1%
Wetland A3	A3	1.43	0.30	Wetland A3	A3	1.40	0.30	0	0.00	-2%
Catchment A	A1+A2+A3+A	5.98	1.26	Catchment A	A1+A2+A3+A	5.91	1.22	0	-0.04	-1%
Wetland B1	B1	19.57	3.66	Wetland B1	B1	19.35	3.66	13700	-0.01	-1%
Catchment B	B1+B	30.01	5.15	Catchment B	B1+B	30.44	5.22	0	0.07	1%
Wetland C1	C1	1.20	0.25	Wetland C1	C1	1.25	0.27	2500	0.01	4%
Wetland C2	C2	9.05	1.73	Wetland C2	C2	8.57	1.63	1500	-0.09	-5%
Wetland C3	C2+C3	11.88	2.12	Wetland C3	C2+C3	11.52	2.04	1600	-0.08	-3%
Wetland C4	C1+C2+C3+C4	18.38	3.06	Wetland C4	C1+C2+C3+C4	18.65	3.17	0	0.11	1%
Wetland C5	C5	1.83	0.39	Wetland C5	C5	1.73	0.37	0	-0.02	-5%
Wetland C6	C5+C6	4.63	0.98	Wetland C6	C5+C6	4.56	0.97	0	-0.01	-1%
Wetland C7	C7	2.06	0.44	Wetland C7	C7	2.16	0.46	0	0.02	5%
Wetland C8	C7+C8	10.94	2.26	Wetland C8	C7+C8	10.44	2.01	0	-0.25	-5%
Catchment C	C4+C6+C8+C	46.22	7.28	Catchment C	C4+C6+C8+C	44.59	7.10	1500	-0.18	-4%
Wetland D1	D1	1.72	0.36	Wetland D1	D1	1.65	0.35	0	-0.01	-4%
Catchment D	D1+D	4.60	0.89	Catchment D	D1+D	4.69	1.00	500	0.12	2%
Wetland E1	E1	2.85	0.60	Wetland E1	E1	2.86	0.61	0	0.01	0%
Catchment E	E1+E	8.77	1.80	Catchment E	E+E1+E2	9.13	1.88	0	0.09	4%
Wetland F1	F1	1.29	0.27	Wetland F1	F1	1.25	0.27	0	-0.01	-3%
Catchment F	F1+F	2.23	0.47	Catchment F	F1+F	2.21	0.43	0	-0.04	-1%
Wetland G1	G1	2.89	0.61	Wetland G1	G1	2.89	0.62	0	0.01	0%
Catchment G	G1+G	4.93	1.04	Catchment G	G1+G	4.93	1.05	0	0.01	0%



CLIENT:
THE BEARS HOME
PROJECT MANAGEMENT LTD

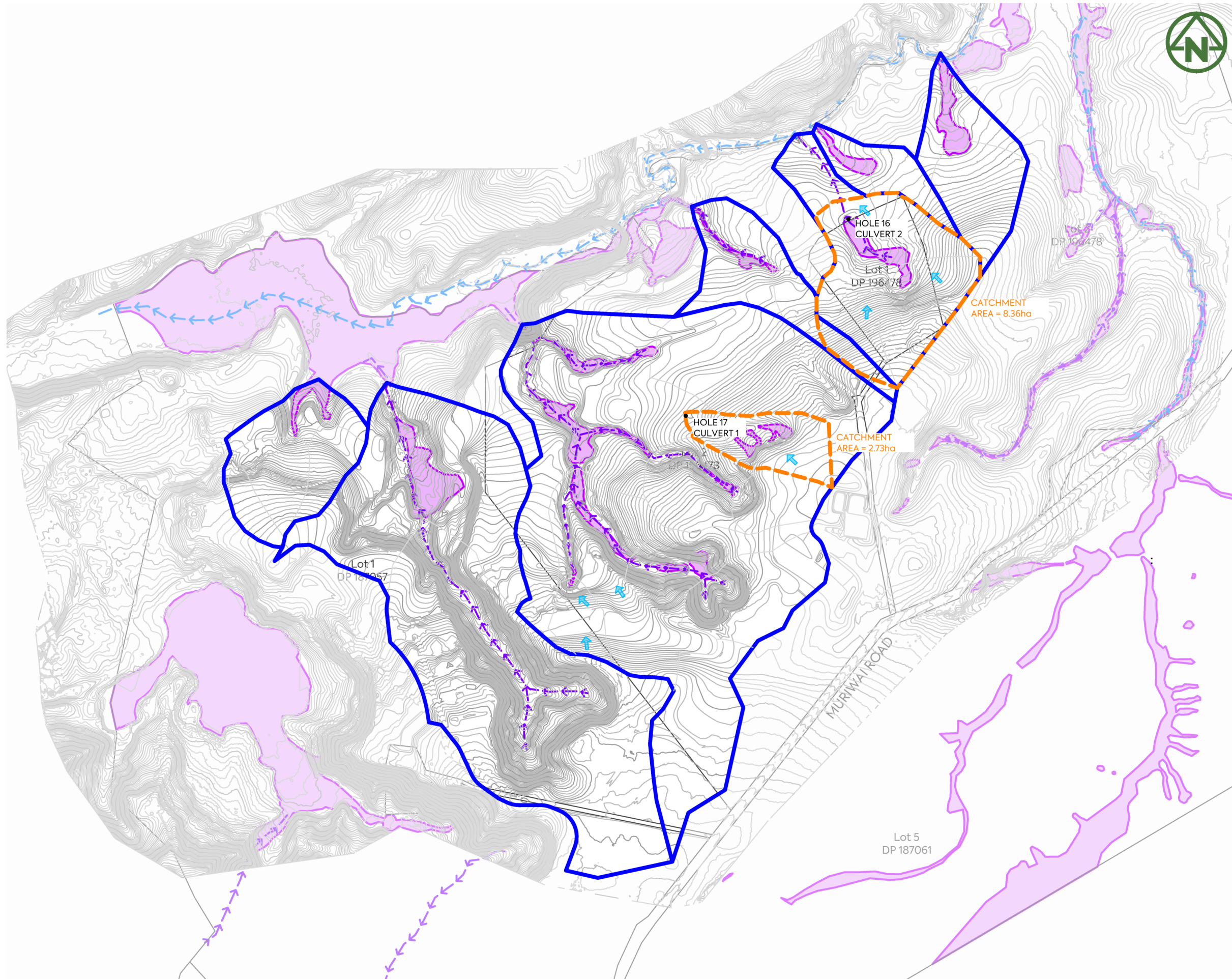
PROJECT:
MURIWAI DOWNS GOLF PROJECT
610 & 697 MURIWAI ROAD
MURIWAI VALLEY

TITLE:
PROPOSED DRAINAGE
Q100 PRE VS POST DEVELOPMENT
CALCULATION DATA TABLE

PURPOSE OF ISSUE:
FOR CONSENT

SCALE:
NTS @ A3
DO NOT SCALE

DRAWING NO:
1976-1-459
REV:
A



NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ENGINEERING INFRASTRUCTURE AND SERVICING REPORT.
2. REFER TO DRAWING 431-433 FOR CULVERT DETAILS.
3. REFER TO DRAWING 435 FOR OUTLET PROTECTION DETAILS.
4. REFER TO DRAWING 450-457 FOR OVERLAND FLOW DETAILS.

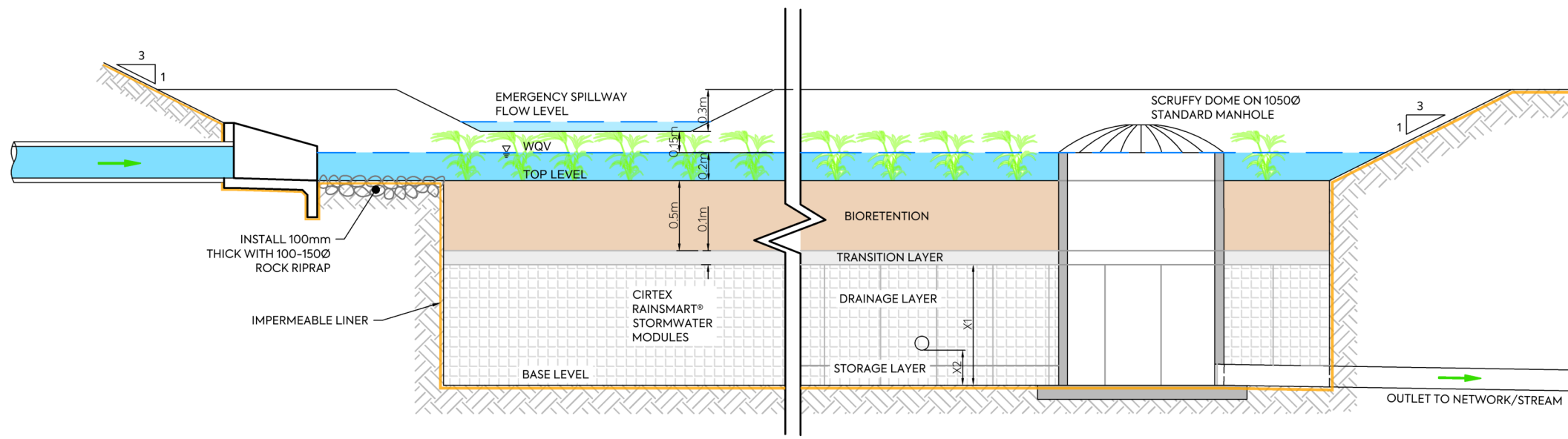
LEGEND:

CATCHMENT BOUNDARY	
PROPOSED CULVERT	
OVERLAND FLOW PATH	
FINISHED (5m) MAJOR CONTOUR	
FINISHED (1m) MINOR CONTOUR	
PERMANENT STREAM	
INTERMITTENT STREAM	
EXISTING WETLANDS	

CLIENT:	PROJECT:	TITLE:	PURPOSE OF ISSUE:
THE BEARS HOME PROJECT MANAGEMENT LTD	MURIWAI DOWNS GOLF PROJECT 610 & 697 MURIWAI ROAD MURIWAI VALLEY	PROPOSED DRAINAGE Q100 POST DEVELOPMENT CULVERT CATCHMENT OVERALL PLAN	FOR CONSENT
			SCALE: 1:7500 DO NOT SCALE
			DRAWING NO. REV:
			1976-1-460 C

C	ISSUED FOR CONSENT	MO	CIM	JSD	26/11/21
B	SECOND ISSUE	MO	CIM	JSD	05/11/21
A	FIRST ISSUE	MO	CIM	JSD	24/08/21
REV	DESCRIPTION	DRN BY	CHK BY	APP BY	DATE



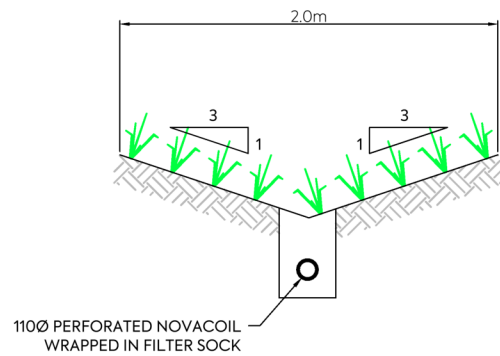


PONDING LAYER: 200 mm
 MULCH LAYER: 50-75 mm MEDIA AS PER TABLE 51 (GD01)
 BIORETENTION MEDIA: 500 mm
 TRANSITION LAYER: 100 mm CLEAN 2 - 7 mm GRAVEL
 DRAINAGE LAYER: CIRTEX RAINSMART® STORMWATER MODULES
 STORAGE LAYER: CIRTEX RAINSMART® STORMWATER MODULES

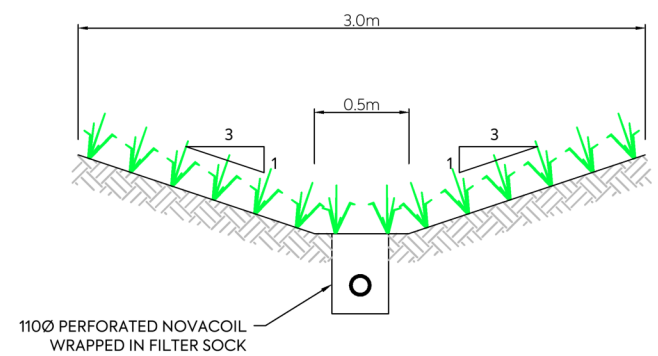
RAINGARDEN NAME	Cirtex RAINSMART® stormwater			Minimum pipe depth (X2)
	Width	Length	Height (X1)	
RG 1	0.400	0.715	0.44	0.09
RG 2	0.400	0.715	0.44	0.05
RG 3	0.400	0.715	0.44	0.16
RG 4	0.400	0.715	0.44	0.17
RG 5	0.400	0.715	0.44	0.14

A TYPICAL SECTION - RAINGARDEN PROFILE
 SCALE: 1:20 @ A1
 1:40 @ A3

RAINGARDEN NAME	Cirtex RAINSMART® stormwater modules		RAINGARDEN DESIGN				
	W	L	Area	RG Top	WQV Level	RG Base	
	m	m	m ²	RL	RL	RL	
RG 1	width: 0.400 length: 0.715	1.80	41.70	88.00	87.75	87.95	86.71
RG 2	width: 0.400 length: 0.715	1.80	43.60	78.00	95.77	95.97	94.73
RG 3	width: 0.400 length: 0.715	IRREGULAR SHAPE		77.00	77.88	78.08	76.84
RG 4	width: 0.400 length: 0.715	IRREGULAR SHAPE		185.00	88.00	88.20	86.96
RG 5	width: 0.400 length: 0.715	IRREGULAR SHAPE		126.00	90.70	90.90	89.66



B TYPICAL SECTION - LINEAR CONVEYANCE SWALE
 SCALE: 1:20 @ A1
 1:40 @ A3



C TYPICAL SECTION - LINEAR TREATMENT SWALE
 SCALE: 1:20 @ A1
 1:40 @ A3

APPENDIX A – STORMWATER DRAWINGS

STORMWATER DRAWINGS 1976-1-450, 453, 455, 459, 460 & 486

RAINGARDEN DESIGN								
RAINGARDEN NAME	Cirtex RAINSMART® stormwater modules		W	L	Area	RG Top	WQV Level	RG Base
			m	m	m ²	RL	RL	RL
RG 1	width:	0.400	1.80	41.70	88.00	87.75	87.95	86.71
	length:	0.715						
RG 2	width:	0.400	1.80	43.60	78.00	95.77	95.97	94.73
	length:	0.715						
RG 3	width:	0.400	IRREGULAR SHAPE		77.00	77.88	78.08	76.84
	length:	0.715						
RG 4	width:	0.400	IRREGULAR SHAPE		185.00	88.00	88.20	86.96
	length:	0.715						
RG 5	width:	0.400	IRREGULAR SHAPE		126.00	90.70	90.90	89.66
	length:	0.715						

Cirtex				
RAINGARDEN NAME	Cirtex RAINSMART® stormwater			Minimum pipe depth (X2)
	Width	Length	Height (X1)	
RG 1	0.400	0.715	0.44	0.09
RG 2	0.400	0.715	0.44	0.05
RG 3	0.400	0.715	0.44	0.16
RG 4	0.400	0.715	0.44	0.17
RG 5	0.400	0.715	0.44	0.14

RAIN GARDEN					
	RG 1	RG 2	RG 3	RG 4	RG 5
The total area required for the quality treatment:	32.12 m ²	15.54 m ²	49.00 m ²	124.50 m ²	72.90 m ²
Provided area:	88.00 m ²	78.00 m ²	77.00 m ²	185.00 m ²	126.00 m ²
The total required retention volume:	8.03 m ³	3.89 m ³	12.25 m ³	31.13 m ³	18.23 m ³
Provided retention volume:	8.03 m ³	3.89 m ³	12.25 m ³	31.13 m ³	18.23 m ³
The total required detention volume:	28.81 m ³	13.94 m ³	43.95 m ³	111.68 m ³	65.39 m ³
Provided detention volume:	61.42 m ³	57.67 m ³	48.52 m ³	114.88 m ³	81.21 m ³
Difference between the provided and the required volume:	32.61 m ³	43.73 m ³	4.57 m ³	3.20 m ³	15.82 m ³
Deduct volume of the 4 manholes within RGs	1.44 m ³	1.44 m ³	1.44 m ³	1.44 m ³	1.44 m ³
Excess of RGs volume:	76.59 m ³				

APPENDIX C – GEOTECHNICAL PARAMETERS FOR ONSITE WASTEWATER AND STORMWATER DISPOSAL

PREPARED BY LAND DEVELOPMENT AND ENGINEERING - LDE



Project Reference: J01662

31/03/2022

The Bears Home Project Management Limited
60 Clearwater Avenue
Waimauku

C/- McKenzie and Co Consultants Limited

Attention: S. McIntyre

Dear Scott

Geotechnical Parameters for On-Site Wastewater and Stormwater Disposal at Muriwai Downs Golf Course, Muriwai,

1 INTRODUCTION AND SCOPE

LDE have been asked to undertake a field and laboratory testing in order to inform on-site stormwater and wastewater disposal design at the Muriwai Downs Golf Course, Muriwai. Our scope of work has included:

Stormwater Soakage Testing:

- Drill a 2m deep, 100mm diameter hand auger borehole in each of the four stormwater soakage locations indicated by McKenzie and Co and undertake falling head soakage tests as appropriate as outlined in TR2013/040, Appendix A, Annexure C, Worksheets W1.

Wastewater Disposal Field Testing:

- Drill a 2m deep, 50mm diameter hand auger borehole at each of six locations as indicated by McKenzie and Co and install a piezometer within each 2m deep borehole (allowance for 1500mm minimum depth to groundwater as outlined by TP58; Onsite Wastewater Systems, Table 5.2) and subsequent groundwater monitoring round not less than 1 week following installation and;
- Undertake Atterberg Limits and Particle Size Distribution laboratory testing on each of four representative soil samples retrieved from the hand auger boreholes.

Our fieldwork was undertaken on the 23rd and 24th of February 2022.

2 FINDINGS

2.1 Topsoil

Topsoil was present in each hand auger and percolation borehole between 0.2m and 0.5m depth.

2.2 Existing Fill

Existing fill was found to be present in HA105 to a depth of 1.2m deep. This comprised very stiff silty clay, however, as we are not aware of any certification or controls on this material, we assume it is non engineered.

2.3 Awhitu Group Fixed Dunes

The natural soils encountered in each of our test locations comprised Awhitu Group Fixed Dune deposits, which consisted generally of stiff to hard clays and silts. These comprised the cohesive mantle soils which tend to be found on this site in less steep areas and are generally between around 2m to 5m deep where present. Several of our boreholes (HA101, 102 and 104) terminated prior to target depth. This may be a result of a hard layer of consolidated sands in the area of these boreholes, which were also found in some instances in boreholes in our previous tranche of work undertaken in September 2021.

2.4 Groundwater

No groundwater was encountered in any of our boreholes over the depths drilled (1m to 2m deep) at the time of drilling (end of summer). Our groundwater monitoring of the piezometers installed in HA101 to 106, undertaken on 29 March 2022 found no groundwater over the depth of the piezometer (1.0m to 2.0m).

Test Name	Surface Level in m RL	Groundwater Level as measured 29 March 2022	
		Depth Below Existing Groundwater Level	Depth in m RL
HA101	110	1.45m	108.55m RL
HA102	110	0.9m	109.1m RL
HA103	110	1.43m	108.6m RL
HA104	109	NE* (borehole depth 1.0m)	NE* (borehole invert 108m RL)
HA105	26	1.55m	24.45m RL
HA106	51	1.4m	49.6m RL

*NE = groundwater not encountered over the depths drilled at the time of measuring groundwater.

Our deep tests undertaken in September 2021 found the groundwater levels were typically deep at this site (between approximately 10m and 20m deep, except where boreholes were placed close to lake/ stream surface level, and therefore the above results are not unexpected.

2.5 Percolation Test Results

Five percolation tests, Perc01 to Perc05, were undertaken in the locations indicated on the site plan, Figure 01. Tests were undertaken in accordance with TR 2013/040, Appendix A, Annexure C, Worksheet W1 – Falling Head Percolation Test. Percolation rates are as indicated on the table below:

Table 1: Percolation Test Summary

Test	Minimum Percolation Rate	Test Depth	Soil Materials Summary	Pre-Soak Conditions	Preceding Weather Conditions
Perc01	0.0059 L/m ² /min	2.0m	Clayey silt and silty clay, hard, moist, low to medium plasticity	20 Hrs	Dry
Perc02	0.0117 L/m ² /min	2.0m	Clayey silt, hard, moist, low plasticity	20 Hrs	Dry
Perc03	0.0472 L/m ² /min	2.0m	Clayey silt, hard, moist, low plasticity	20 Hrs	Dry
Perc04	0.0149 L/m ² /min	2.0m	Clayey silt and silty clay, hard, moist, low to medium plasticity	20 Hrs	Dry
Perc05	0.0609 L/m ² /min	2.0m	Clayey silt, hard, moist, low plasticity	20 Hrs	Dry

2.6 Laboratory Test Results

Laboratory testing was undertaken to determine particle size distributions and Atterberg Index properties for the determination of likely soakage properties. All results are IANZ (International Accreditation New Zealand) endorsed and full details are appended.

Table 1: Laboratory Testing Results Summary

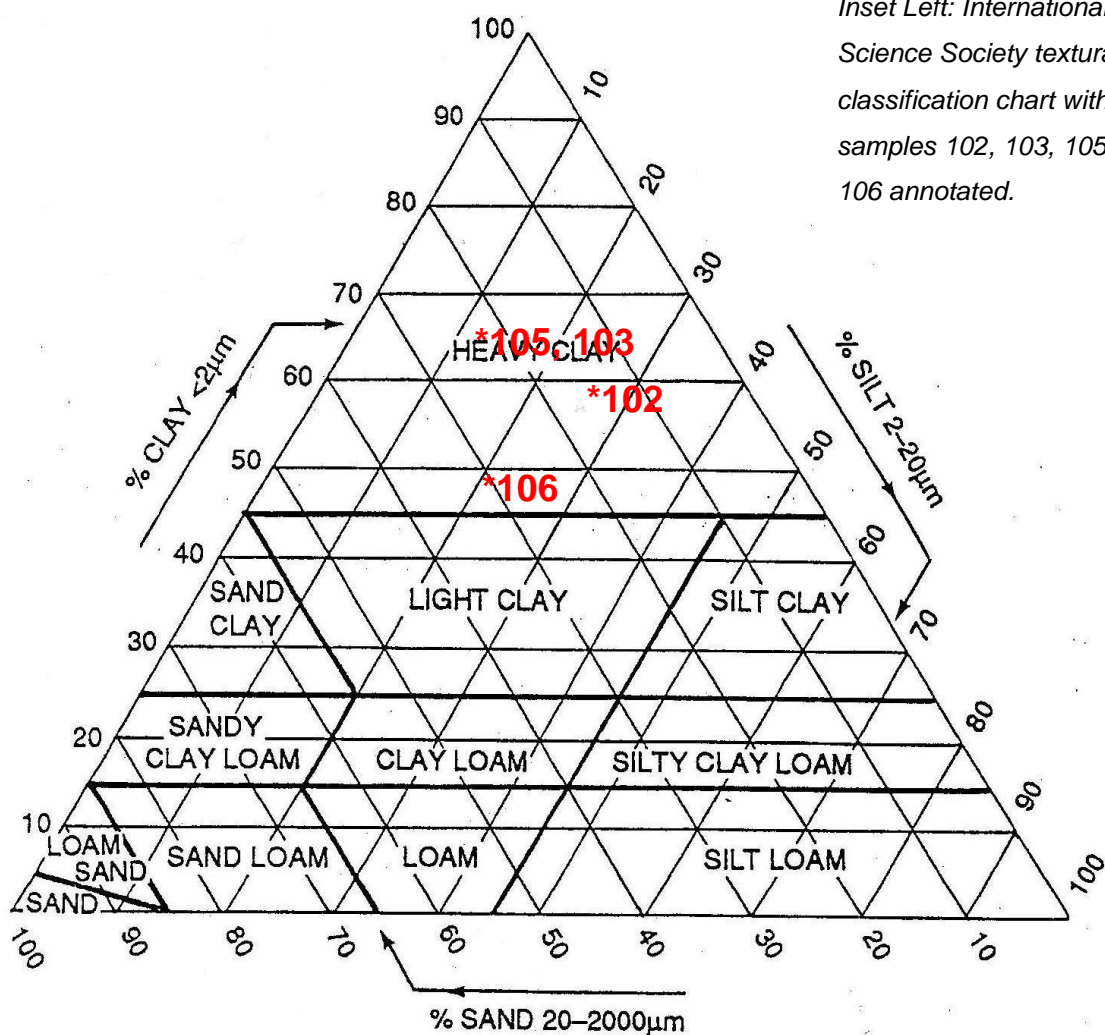
Sample	Particle Size Distribution			D30	Plasticity Index	Liquid Limit	Plastic Limit
	Clay	Silt	Sand				
HA102 (0.2-1.0m)	59%	27%	14%	<1.3µm	40	86	46
HA103 (0.3-1.5m)	63%	15%	22%	<1.3µm	67	94	27
HA105 (0.5-2.0m)	64%	14%	22%	<1.3µm	71	111	40
MH106 (0.3-1.2m)	49%	21%	30%	<1.3µm	51	76	25

3 ON-SITE STORMWATER ATTENUATION

Minimum percolation rates from our tests (up to 2.0m deep) ranged from 0.0059 L/m²/min to 0.0609 L/m²/min. Based on these results we consider that in-situ percolation will be likely be poor.

Further, based on laboratory testing, the soils samples recovered fall into the Heavy Clay category according to the International Soil Science Society textural classification chart as shown the inset below with each of samples 102, 103, 105 and 106 annotated.

The Auckland Regional Council TR2009/0072¹ (Review of Hydrologic Properties of Soils in the Auckland Region) defines clay soils as having a coefficient of permeability of between 1 and 5 mm per hour (Table 7, Section 3.3 of TR2009/0072).



Inset Left: International Soil Science Society textural classification chart with samples 102, 103, 105 and 106 annotated.

¹ Burford, P. (2008). Review of Hydrologic Properties of Soils in the Auckland Region. Prepared by URS for Auckland Regional Council. Auckland Regional Council, Technical Report No. 2009/072, December 2009.

4 ON-SITE EFFLUENT DISPOSAL

Based on visual-tactile observation of the soil types and the laboratory testing results (refer Section 3), we have classified the soils on this site as being soil category 6 (Table 5.1, TP58). Each on-site effluent disposal should be specifically designed at building consent stage using an aerial loading rate 3mm per day, given in TP58. We consider that there is suitable land on this site in relatively proximity to the nominated platforms to locate primary and secondary fields in this regard.

Due regard should be made to any overland flow paths and stormwater soakage in locating effluent fields.

Based on the groundwater depths observed in the boreholes, groundwater marginally met the 900mm to 600mm separation distance for groundwater for category 6 soils as per Table 5.2 of TP58.

The proposed effluent fields are set back from the steep slopes present on this site and we infer from the geomorphology that the proposed effluent field locations should be generally stable.

5 LIMITATIONS

This letter has been prepared exclusively for The Bears Home Project Management Limited with respect to the brief given to us. Information, opinions, and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

This report was prepared in general accordance with current standards, codes, and practice at the time of this report. These may be subject to change.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

For and on Behalf of Land Development and Engineering Ltd

Report prepared by:





Jasmine Lam
Engineering Geologist
MEngNZ

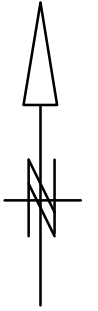
Report reviewed by:



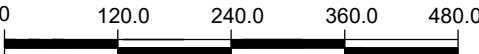
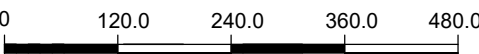

Shane Lander
Principal Geotechnical Engineer
CMEngNZ, CPEng, IntPENZ

Legend and/or Notes:

-  Hand Auger (2m)
-  Hand Auger + Percolation Test (2m)



Base Plan from Auckland Council GIS. Retrieved on 04.03.22

revision	description	drawn	approved	date	 <p>Horizontal Scale (metres)</p>  <p>Vertical Scale (metres)</p>	drawn	AT		client:	THE BEARS HOME PROJECT MANAGEMENT LTD	
						approved	AH		project:	MURIWAI DOWNS GOLF PROJECT	
						date	04.03.2022		title:	SITE INVESTIGATION PLAN	
						scale	1:8000		project no:	J 01662	figure no:
						original size	A3				



Hand Auger Borehole Log

Test ID: **HA102**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924908mN, 1729305mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: RZ

Checked By: AT

Vane ID: 307

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.1	TS	TOPSOIL								
0.1 - 1.0	Orange cross-hatch	Clayey SILT; orange brown. Hard; dry to moist; low plasticity. 0.7m: becoming moist	Awhitu Group						201+	-0.5
1.0 - 1.1				▼					201+	-1.0
1.1 - 1.2									▶ 20	-1.0
1.2 - 1.3										-1.0
1.3 - 1.4										-1.0
1.4 - 1.5										-1.5
1.5 - 1.6										-1.5
1.6 - 1.7										-1.5
1.7 - 1.8										-1.5
1.8 - 1.9										-1.5
1.9 - 2.0										-2.0
2.0 - 2.1										-2.0
2.1 - 2.2										-2.0
2.2 - 2.3										-2.0
2.3 - 2.4										-2.5
2.4 - 2.5										-2.5
2.5 - 2.6										-2.5
2.6 - 2.7										-2.5
2.7 - 2.8										-2.5
2.8 - 2.9										-3.0
2.9 - 3.0										-3.0
3.0 - 3.1										-3.0
3.1 - 3.2										-3.0
3.2 - 3.3										-3.5
3.3 - 3.4										-3.5
3.4 - 3.5										-3.5
3.5 - 3.6										-3.5
3.6 - 3.7										-3.5
3.7 - 3.8										-4.0
3.8 - 3.9										-4.0
3.9 - 4.0										-4.0
4.0 - 4.1										-4.0
4.1 - 4.2										-4.5
4.2 - 4.3										-4.5
4.3 - 4.4										-4.5
4.4 - 4.5										-4.5
4.5 - 4.6										-4.5
4.6 - 4.7										-5.0
4.7 - 4.8										-5.0
4.8 - 4.9										-5.0
4.9 - 5.0										-5.0
5.0 - 5.1										-5.5
5.1 - 5.2										-5.5
5.2 - 5.3										-5.5
5.3 - 5.4										-5.5
5.4 - 5.5										-5.5

Hole Depth: 1.00m **Termination:** Reached target depth

Remarks: End of Borehole at 1.0m. DCP found effective refusal at 1.1m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow
 UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HA/TP Log v7 - 31/03/2022 7:58:41 pm



Hand Auger Borehole Log

Test ID: **HA103**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924808mN, 1729211mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: MB

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.4	TS	TOPSOIL								
0.4 - 0.7	TS	silty CLAY, orange and grey mottled brown. Very stiff, moist, medium plasticity, moderately sensitive, with topsoil intermixed to 0.4m	Awhitu Group						139 / 62 (2.2)	-0.5
0.7 - 1.0	TS	0.7m: becoming moist to wet								
1.0 - 1.2	TS	1.0m: becoming insensitive							108 / 58 (1.9)	-1.0
1.2 - 1.5	TS	1.2m: becoming orange mottled light yellow/grey								
1.5 - 1.8	TS	1.5m: becoming stiff, high plasticity, with trace fine to medium sand							85 / 46 (1.8)	-1.5
1.8 - 2.0	TS	clayey SILT, orange streaked grey. Hard, moist, low plasticity								
2.0	TS								UTP	-2.0
2.0 - 2.5										-2.5
2.5 - 3.0										-3.0
3.0 - 3.5										-3.5
3.5 - 4.0										-4.0
4.0 - 4.5										-4.5
4.5 - 5.0										-5.0
5.0 - 5.5										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak ▼ Standing water level
- Vane residual ◁ Groundwater inflow
- ◆ Vane UTP ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **HA104**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924847mN, 1729126mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: MB

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.0 - 0.5		TOPSOIL		Groundwater Not Encountered							
0.5 - 1.0		clayey SILT, orange streaked brown/grey. Very stiff, dry to moist, low plasticity, sensitive	Awhitu Group							169 / 39 (4.3)	-0.5
1.0 - 1.1		clayey SILT, brown/red. Hard, dry to moist, low to no plasticity								UTP	-1.0
1.1 - 1.15									▶ 20	-1.1	
1.15 - 1.2										-1.2	
1.2 - 1.3										-1.3	
1.3 - 1.4										-1.4	
1.4 - 1.5										-1.5	
1.5 - 1.6										-1.6	
1.6 - 1.7										-1.7	
1.7 - 1.8										-1.8	
1.8 - 1.9										-1.9	
1.9 - 2.0										-2.0	
2.0 - 2.1										-2.1	
2.1 - 2.2										-2.2	
2.2 - 2.3										-2.3	
2.3 - 2.4										-2.4	
2.4 - 2.5										-2.5	
2.5 - 2.6										-2.6	
2.6 - 2.7										-2.7	
2.7 - 2.8										-2.8	
2.8 - 2.9										-2.9	
2.9 - 3.0										-3.0	
3.0 - 3.1										-3.1	
3.1 - 3.2										-3.2	
3.2 - 3.3										-3.3	
3.3 - 3.4										-3.4	
3.4 - 3.5										-3.5	
3.5 - 3.6										-3.6	
3.6 - 3.7										-3.7	
3.7 - 3.8										-3.8	
3.8 - 3.9										-3.9	
3.9 - 4.0										-4.0	
4.0 - 4.1										-4.1	
4.1 - 4.2										-4.2	
4.2 - 4.3										-4.3	
4.3 - 4.4										-4.4	
4.4 - 4.5										-4.5	
4.5 - 4.6										-4.6	
4.6 - 4.7										-4.7	
4.7 - 4.8										-4.8	
4.8 - 4.9										-4.9	
4.9 - 5.0										-5.0	
5.0 - 5.1										-5.1	
5.1 - 5.2										-5.2	
5.2 - 5.3										-5.3	
5.3 - 5.4										-5.4	
5.4 - 5.5										-5.5	

Hole Depth: 1.00m **Termination:** Reached target depth

Remarks: End of Borehole at 1.0m. DCP found effective refusal at 1.1m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
 - Vane residual
 - ◆ Vane UTP
 - ▼ Standing water level
 - ◁ Groundwater inflow
 - ▷ Groundwater outflow
- UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **HA105**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925879mN, 1728572mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.5	TS	TOPSOIL								
0.5 - 1.0	TS	silty CLAY, red streaked orange/brown. Very stiff, moist, medium plasticity	FILL		○	●			131 / 19 (6.9)	-0.5
1.0 - 1.5	TS	clayey SILT, orange/brown. Very stiff, moist, low to medium plasticity	Awhitu Group		○	●			123 / 39 (3.2)	-1.0
1.5 - 2.0	TS	1.6m: with trace fine to medium sand		▼	○	●			212 / 112 (1.9)	-1.5
2.0 - 2.5					○	●			196 / 92 (2.1)	-2.0
2.5 - 3.0										-2.5
3.0 - 3.5										-3.0
3.5 - 4.0										-3.5
4.0 - 4.5										-4.0
4.5 - 5.0										-4.5
5.0 - 5.5										-5.0
5.5 - 6.0										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow
 UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **HA106**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5926255mN, 1729911mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: RZ

Checked By: AT

Vane ID: 307

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
		TOPSOIL			2	4	6	8		
0.5		Silty CLAY; brown orange. Very stiff; moist; high plasticity.	Awhitu Group						201+	-0.5
1.0		1.2m: becoming orange brown							201+	-1.0
1.5									201+	-1.5
2.0		Silty CLAY, with trace gravel; orange mottled light grey. Hard; moist; low plasticity; gravel, fine, Pumiceous.							201+	-2.0
2.5										-2.5
3.0										-3.0
3.5										-3.5
4.0										-4.0
4.5										-4.5
5.0										-5.0
5.5										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ↙ Groundwater inflow
- ↘ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **Perc01**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925136mN, 1728913mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.1	TS	TOPSOIL								
0.1 - 0.6	XX	clayey SILT with trace fine sand, light brown. Hard, dry to moist, low plasticity	Awhitu Group	Groundwater Not Encountered					UTP	-0.5
0.6 - 0.8	XX	0.6m: with trace fine to medium gravel inclusions								
0.8 - 1.0	XX	0.8m: becoming orange mottled brown							270+	-1.0
1.0 - 1.5	XX	silty CLAY with trace fine sand, red streaked brown/orange. Hard, moist, medium plasticity, insensitive							220 / 135 (1.6)	-1.5
1.5 - 2.0	XX	clayey SILT, dark brown/orange. Hard, moist, low plasticity						UTP	-2.0	
2.0 - 2.5										
2.5 - 3.0										
3.0 - 3.5										
3.5 - 4.0										
4.0 - 4.5										
4.5 - 5.0										
5.0 - 5.5										

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **Perc02**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925418mN, 1728665mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.5	TOPSOIL									
0.5 - 0.7	clayey SILT with trace fine sand, brown. Hard, dry to moist, low plasticity, with trace basalt gravel inclusions		Awhitu Group	Groundwater Not Encountered					UTP	-0.5
0.7 - 1.0	0.7m: becoming brown/red streaked orange/brown, low to medium plasticity								UTP	-1.0
1.0 - 1.5	1.0m: becoming red streaked light grey mottled dark brown/orange, with trace medium sand								UTP	-1.5
1.5 - 1.8	1.5m: becoming brown/orange, dry to moist, no plasticity, with trace medium to coarse sand, with hardened silt clasts								UTP	-2.0
1.8 - 2.0	1.8m: becoming moist, low to medium plasticity								UTP	-2.0
2.0 - 2.5										-2.5
2.5 - 3.0										-3.0
3.0 - 3.5										-3.5
3.5 - 4.0										-4.0
4.0 - 4.5										-4.5
4.5 - 5.0										-5.0
5.0 - 5.5										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **Perc03**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925383mN, 1729122mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.0 - 0.5	TOPSOIL										
0.5 - 0.7	clayey SILT, brown. Hard, moist, low plasticity		Awhitu Group	Groundwater Not Encountered					UTP	-0.5	
0.7 - 0.8	0.7m: becoming medium plasticity										
0.8 - 1.0	0.8m: becoming orange mottled brown									270+	-1.0
1.0 - 1.3	1.3m: becoming brown/orange, with trace medium sand										
1.3 - 1.6	1.6m: becoming dry to moist, no plasticity								UTP	-1.5	
1.6 - 2.0	2.0m: becoming insensitive								239 / 158 (1.5)	-2.0	
2.0 - 2.5										-2.5	
2.5 - 3.0										-3.0	
3.0 - 3.5										-3.5	
3.5 - 4.0										-4.0	
4.0 - 4.5										-4.5	
4.5 - 5.0										-5.0	
5.0 - 5.5										-5.5	

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **Perc04**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925523mN, 1729615mE

System: NZTM

Elevation: Ground

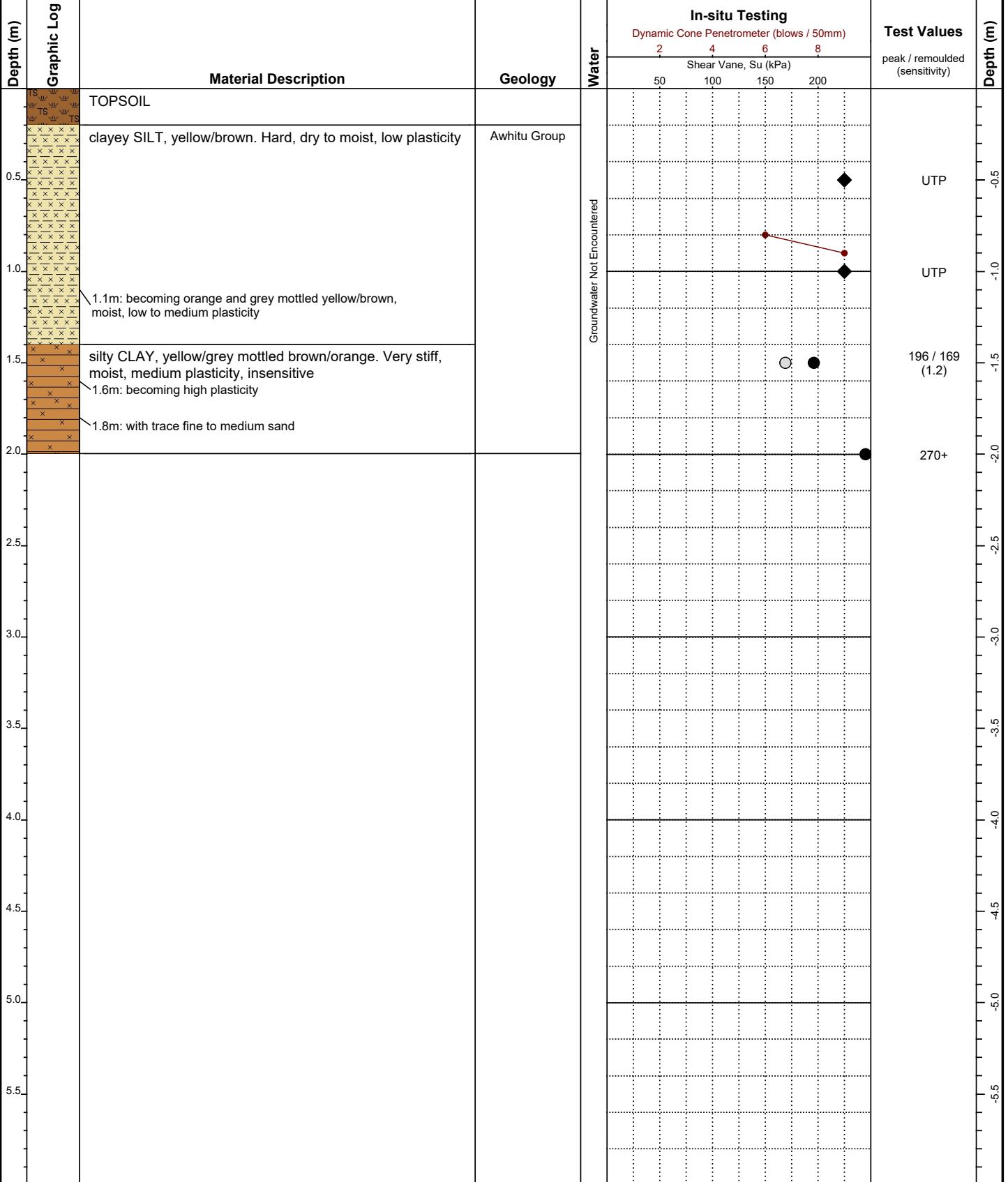
Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750



Hole Depth: 2.00m Termination: Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **Perc05**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925781mN, 1729785mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0	TS	TOPSOIL								
0.5		clayey SILT, brown/orange. Hard, dry to moist, low plasticity	Awhitu Group	Groundwater Not Encountered					UTP	-0.5
0.5		0.5m: becoming orange								
0.7		0.7m: becoming low to no plasticity								
1.0									UTP	-1.0
1.4		1.4m: becoming yellow, with trace medium sand								
1.5									UTP	-1.5
1.7		1.7m: with minor medium sand								
2.0		2.0m: becoming moderately sensitive							204 / 58 (3.5)	-2.0
2.5										-2.5
3.0										-3.0
3.5										-3.5
4.0										-4.0
4.5										-4.5
5.0										-5.0
5.5										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate

STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Limited	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
		Page	1 of 2

Hole No:	Perc 01	Diameter:	0.1 (m)
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Location:		Depth:	2 (m)
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Weather conditions preceding test:	Dry
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Details of presoaking:	20 Hrs
------------------------	--------

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
10:24	-	0.00	2.00	0
10:25	1	0.03	1.97	1
10:26	1	0.05	1.95	2
10:29	3	0.10	1.90	5
10:34	5	0.15	1.85	10
10:39	5	0.20	1.80	15
10:54	15	0.27	1.73	30
11:24	30	0.38	1.62	60
11:54	30	0.45	1.55	90
12:24	30	0.49	1.51	120
12:54	30	0.53	1.47	150
13:24	30	0.57	1.43	180
13:54	30	0.58	1.42	210
14:24	30	0.59	1.41	240

Test	Perc 01	
Gradient	0.0003	m/min
Percolation	0.0059	L/m ² /min



LDE Limited
 320 Ti Rakau Dr, Burswood, Auckland 2013
 Phone: 09 262 1528
 Email: shane@landergeotechnical.co.nz

Operator:	MB
Checked:	JL

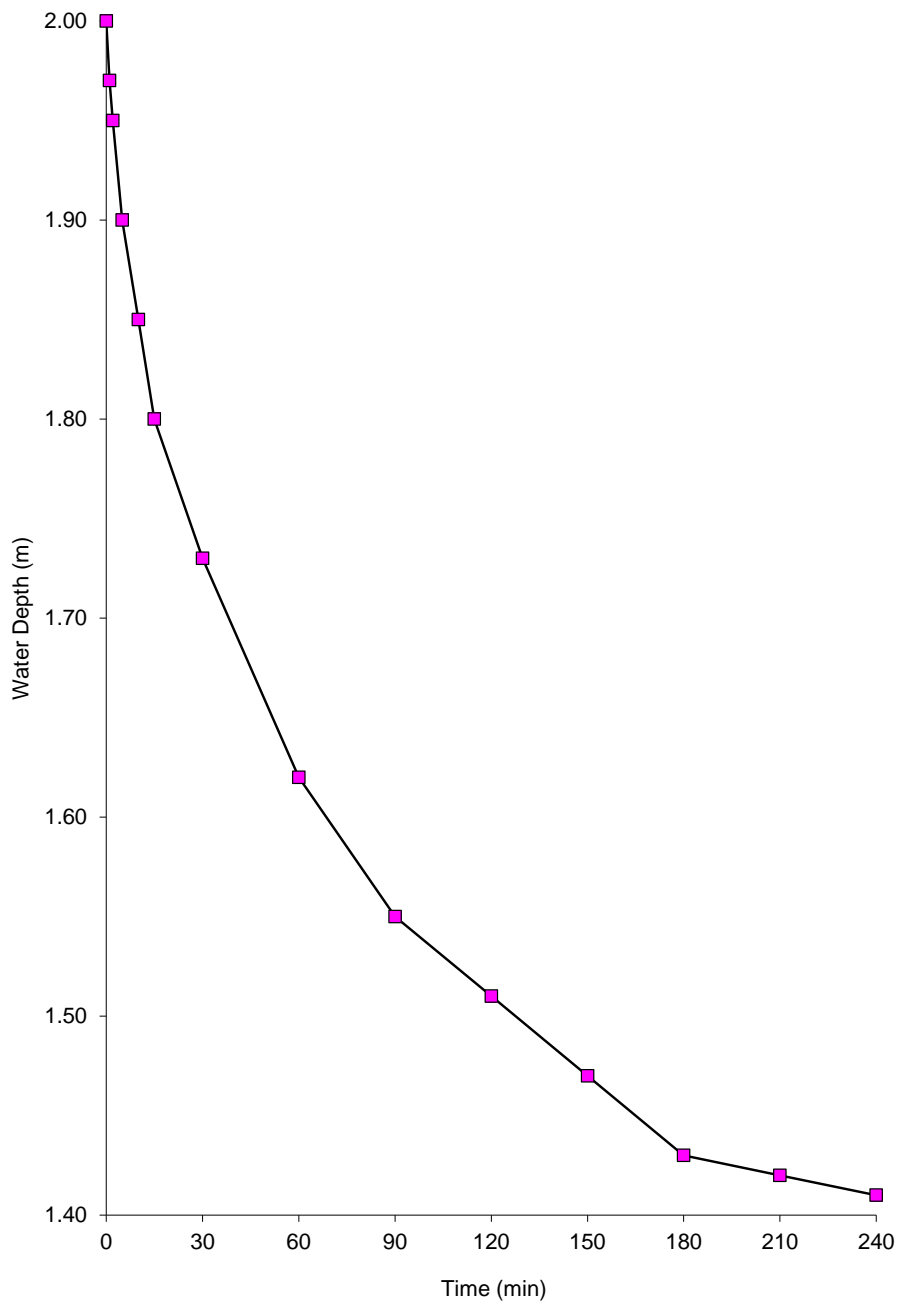
STORMWATER PERCOLATION TEST

Client: The Bears Home Project Management Lirr Job No: J01662
Location: Muriwai Downs Golf Project Date: 24.02.22
Page 2 of 2

Hole No: Perc 01 Diameter: 0.1 (m)

Location: Depth: 2.0 (m)

Water Depth vs Time



LDE Limited
320 Ti Rakau Dr, Burswood, Auckland 2013
Phone: 09 262 1528
Email: shane@landergetechnical.co.nz

Operator: MB
Checked: JL

STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Limited	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
		Page	1 of 2

Hole No:	Perc 02	Diameter:	0.1 (m)
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Location:		Depth:	2 (m)
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Weather conditions preceding test:	Dry
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Details of presoaking:	20 Hrs
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Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
10:57	-	0.00	2.00	0
10:59	2	0.08	1.92	2
11:02	3	0.12	1.88	5
11:07	5	0.16	1.84	10
11:11	4	0.19	1.81	14
11:27	16	0.28	1.72	30
11:57	30	0.37	1.63	60
12:27	30	0.42	1.58	90
12:57	30	0.46	1.54	120
13:27	30	0.50	1.50	150
13:57	30	0.54	1.46	180
14:27	30	0.56	1.44	210
14:57	30	0.58	1.42	240

Test	Perc 02	
Gradient	0.0007	m/min
Percolation	0.0117	L/m ² /min



LDE Limited
 320 Ti Rakau Dr, Burswood, Auckland 2013
 Phone: 09 262 1528
 Email: shane@landergeotechnical.co.nz

Operator:	MB
Checked:	JL

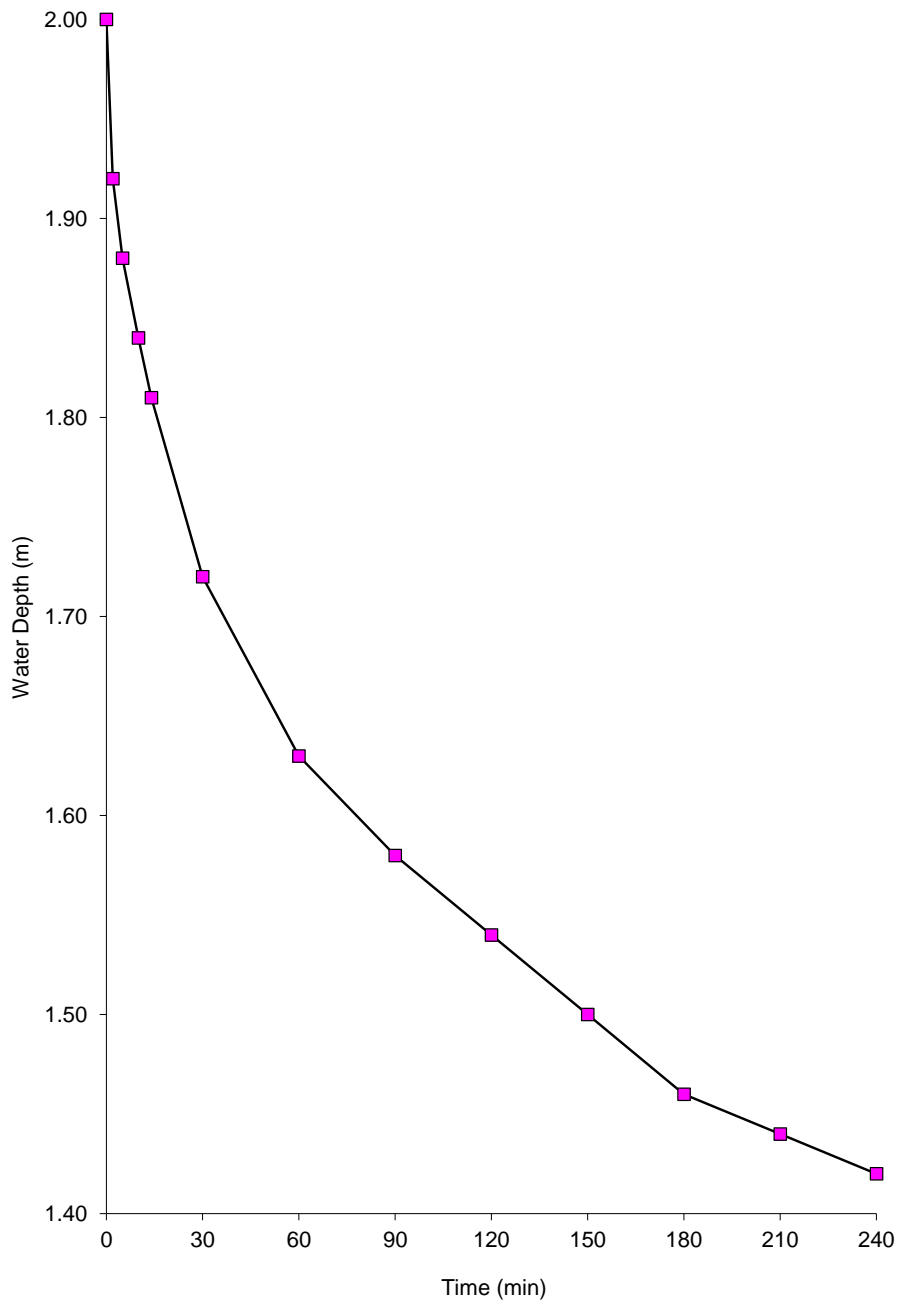
STORMWATER PERCOLATION TEST

Client: The Bears Home Project Management Lirr Job No: J01662
Location: Muriwai Downs Golf Project Date: 24.02.22
Page 2 of 2

Hole No: Perc 02 Diameter: 0.1 (m)

Location: Depth: 2.0 (m)

Water Depth vs Time



LDE Limited
320 Ti Rakau Dr, Burswood, Auckland 2013
Phone: 09 262 1528
Email: shane@landergeotechnical.co.nz

Operator: MB
Checked: JL

STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Limited	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
		Page	1 of 2

Hole No:	Perc 03	Diameter:	0.1 (m)
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Location:		Depth:	2 (m)
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Weather conditions preceding test:	Dry
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Details of presoaking:	20 Hrs
------------------------	--------

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
9:47	-	0.00	2.00	0
9:48	1	0.06	1.94	1
9:50	2	0.14	1.86	3
9:52	2	0.20	1.80	5
9:57	5	0.29	1.71	10
10:02	5	0.34	1.66	15
10:17	15	0.45	1.55	30
10:47	30	0.59	1.41	60
11:17	30	0.69	1.31	90
11:47	30	0.72	1.28	120
12:17	30	0.79	1.21	150
12:47	30	0.85	1.15	180
13:17	30	0.91	1.09	210
13:47	30	0.97	1.03	240

Test	Perc 03
Gradient	0.0020 m/min
Percolation	0.0472 L/m ² /min



LDE Limited
 320 Ti Rakau Dr, Burswood, Auckland 2013
 Phone: 09 262 1528
 Email: shane@landergeotechnical.co.nz

Operator:	MB
Checked:	JL

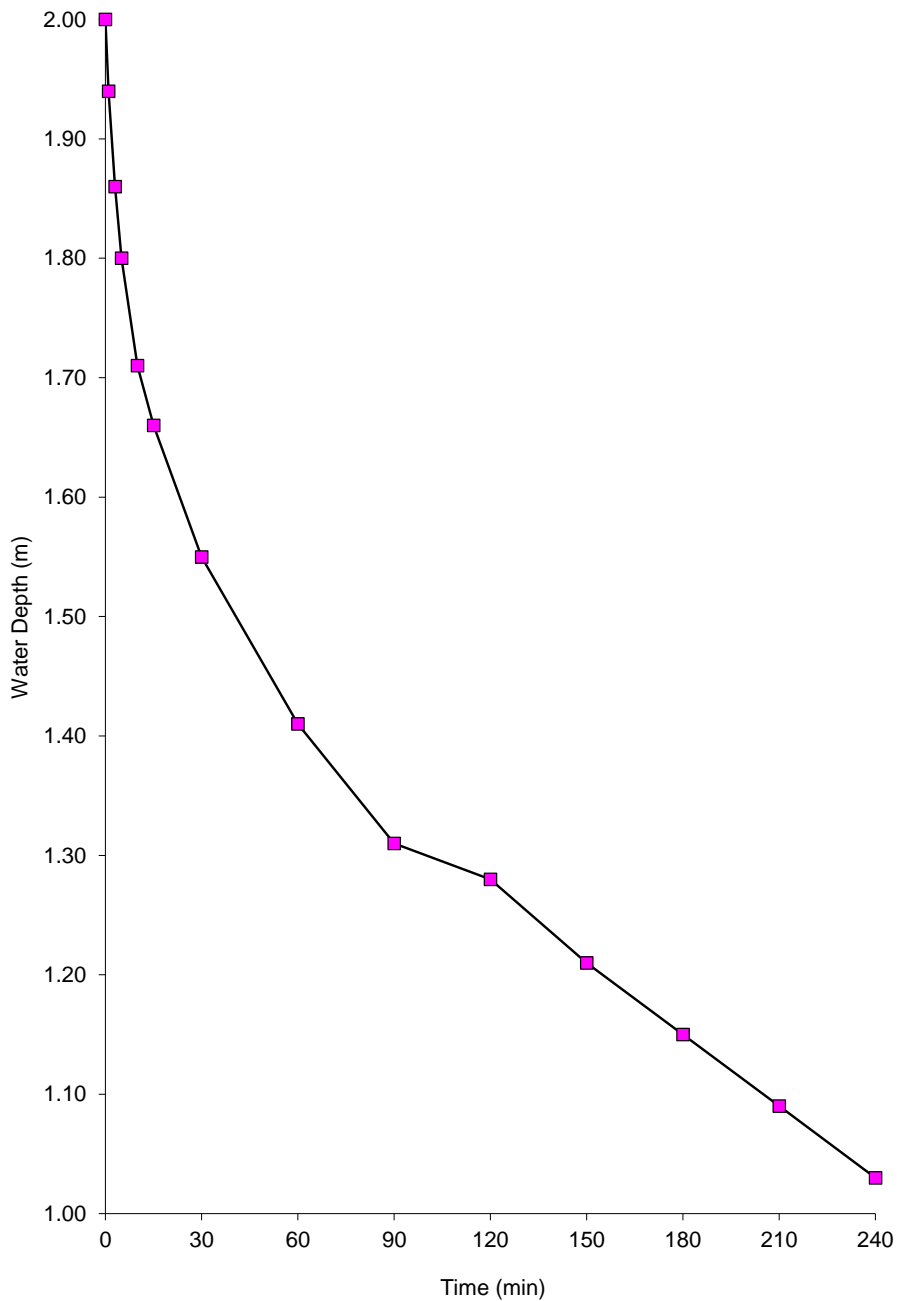
STORMWATER PERCOLATION TEST

Client: The Bears Home Project Management Lir Job No: J01662
Location: Muriwai Downs Golf Project Date: 24.02.22
Page 2 of 2

Hole No: Perc 03 Diameter: 0.1 (m)

Location: Depth: 2.0 (m)

Water Depth vs Time



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STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Limited	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
		Page	1 of 2

Hole No:	Perc 04	Diameter:	0.1 (m)
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Location:		Depth:	2 (m)
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Weather conditions preceding test:	Dry
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Details of presoaking:	20 Hrs
------------------------	--------

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
10:58	-	0.00	2.00	0
11:00	2	0.38	1.62	2
11:02	2	0.45	1.55	4
11:07	5	0.58	1.42	9
11:12	5	0.65	1.35	14
11:17	5	0.70	1.30	19
11:42	25	0.84	1.16	44
12:00	18	0.88	1.12	62
12:28	28	0.94	1.06	90
12:58	30	0.99	1.01	120
13:22	24	1.02	0.98	144
13:52	30	1.04	0.96	174
14:22	30	1.06	0.94	204
14:58	36	1.08	0.92	240

Test	Perc 04
Gradient	0.0006 m/min
Percolation	0.0149 L/m ² /min



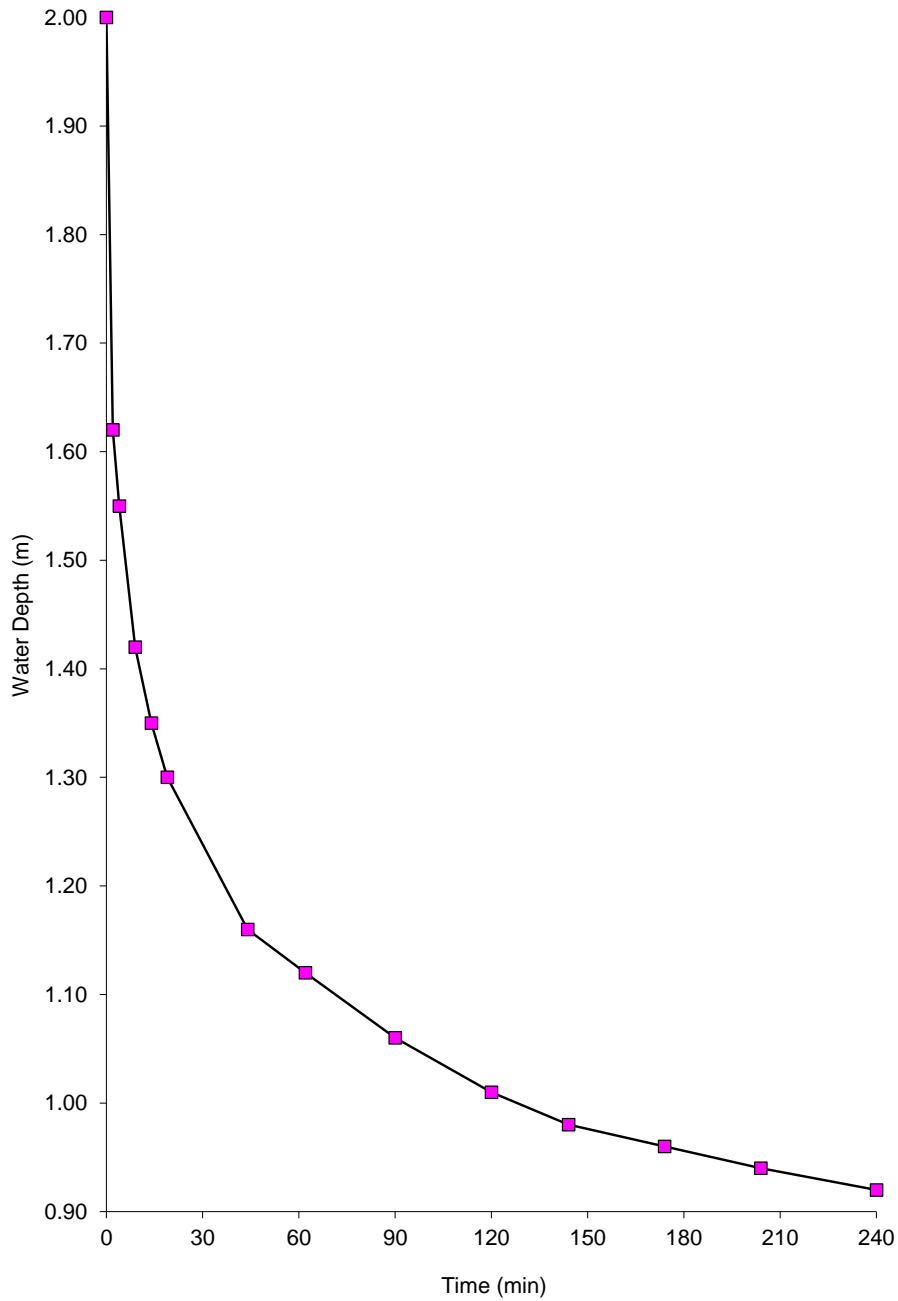
LDE Limited
 320 Ti Rakau Dr, Burswood, Auckland 2013
 Phone: 09 262 1528
 Email: shane@landergeotechnical.co.nz

Operator:	MB
Checked:	JL

STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Lirr	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
	0	Page:	2 of 2
Hole No:	Perc 04	Diameter:	0.1 (m)
Location:	0	Depth:	2.0 (m)

Water Depth vs Time



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Phone: 09 262 1528
Email: shane@landergeotechnical.co.nz

Operator: MB
Checked: JL

STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Limited	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
		Page	1 of 2

Hole No:	Perc 04	Diameter:	0.1 (m)
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Location:		Depth:	2 (m)
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Weather conditions preceding test:	Dry	
------------------------------------	-----	--

Details of presoaking:	20 Hrs	
------------------------	--------	--

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
10:58	-	0.00	2.00	0
11:00	2	0.38	1.62	2
11:02	2	0.45	1.55	4
11:07	5	0.58	1.42	9
11:12	5	0.65	1.35	14
11:17	5	0.70	1.30	19
11:42	25	0.84	1.16	44
12:00	18	0.88	1.12	62
12:28	28	0.94	1.06	90
12:58	30	0.99	1.01	120
13:22	24	1.02	0.98	144
13:52	30	1.04	0.96	174
14:22	30	1.06	0.94	204
14:58	36	1.08	0.92	240

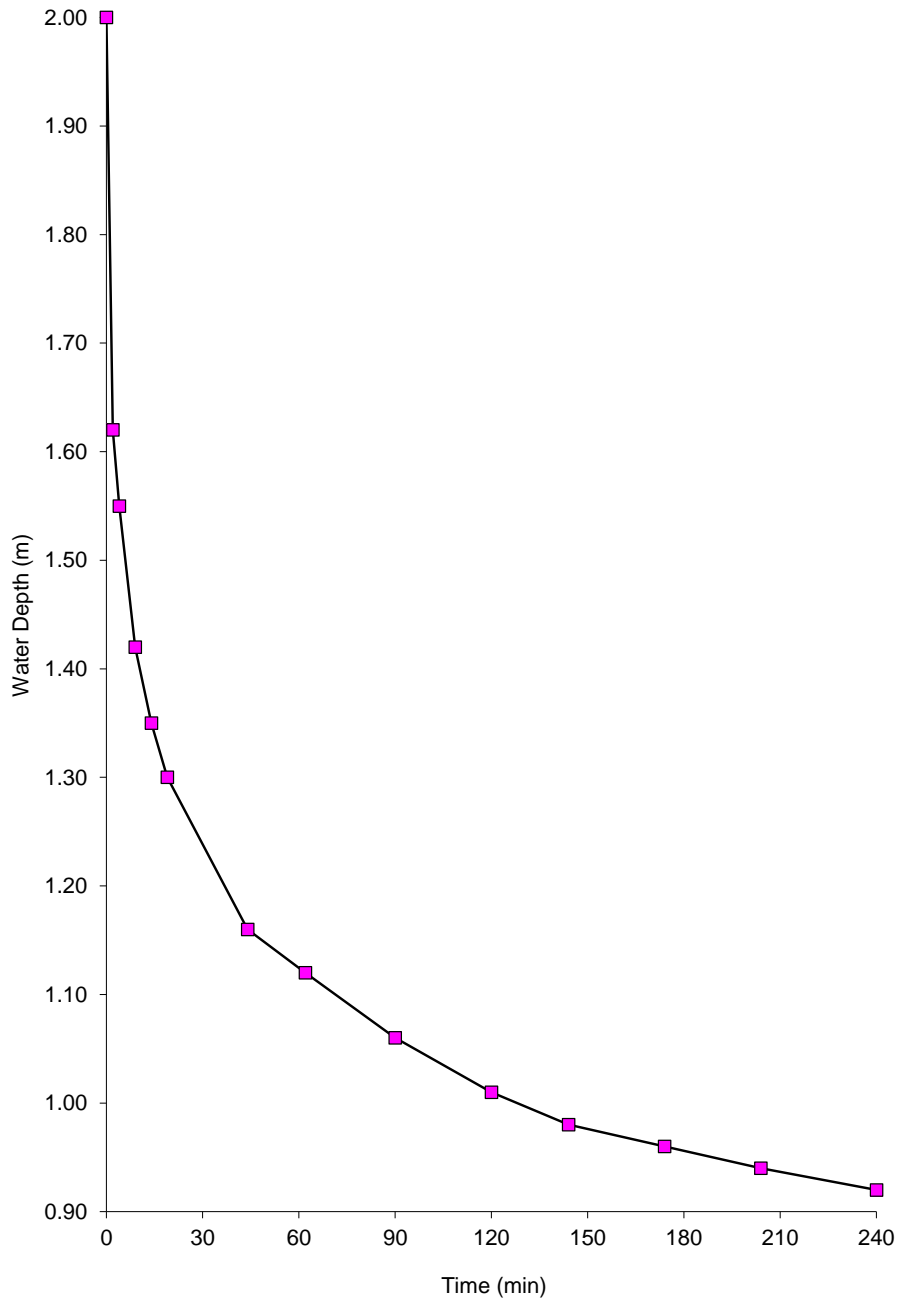
	Test	Perc 04
	Gradient	0.0006 m/min
	Percolation	0.0149 L/m ² /min

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STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Lirr	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
	0	Page:	2 of 2
Hole No:	Perc 04	Diameter:	0.1 (m)
Location:	0	Depth:	2.0 (m)

Water Depth vs Time



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Phone: 09 262 1528
Email: shane@landergeotechnical.co.nz

Operator: MB
Checked: JL

STORMWATER PERCOLATION TEST

Client:	The Bears Home Project Management Limited	Job No:	J01662
Location:	Muriwai Downs Golf Project	Date:	24.02.22
		Page	1 of 2

Hole No:	Perc 05	Diameter:	0.1 (m)
----------	---------	-----------	---------


Location:		Depth:	2 (m)
-----------	--	--------	-------

Weather conditions preceding test:	Dry
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Details of presoaking:	20 Hrs
------------------------	--------

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
10:30	-	0.10	1.90	0
10:32	2	0.14	1.86	2
10:38	6	0.34	1.66	8
10:42	4	0.42	1.58	12
10:52	10	0.52	1.48	22
11:22	30	0.75	1.25	52
11:52	30	1.02	0.98	82
12:22	30	1.12	0.88	112
12:52	30	1.21	0.79	142
13:22	30	1.29	0.71	172
13:52	30	1.34	0.66	202
14:22	30	1.43	0.57	232
14:30	8	1.46	0.54	240

	Test Perc 05
	Gradient 0.0017 m/min
	Percolation 0.0608 L/m ² /min

	LDE Limited 320 Ti Rakau Dr, Burswood, Auckland 2013 Phone: 09 262 1528 Email: shane@landergeotechnical.co.nz	Operator: MB Checked:
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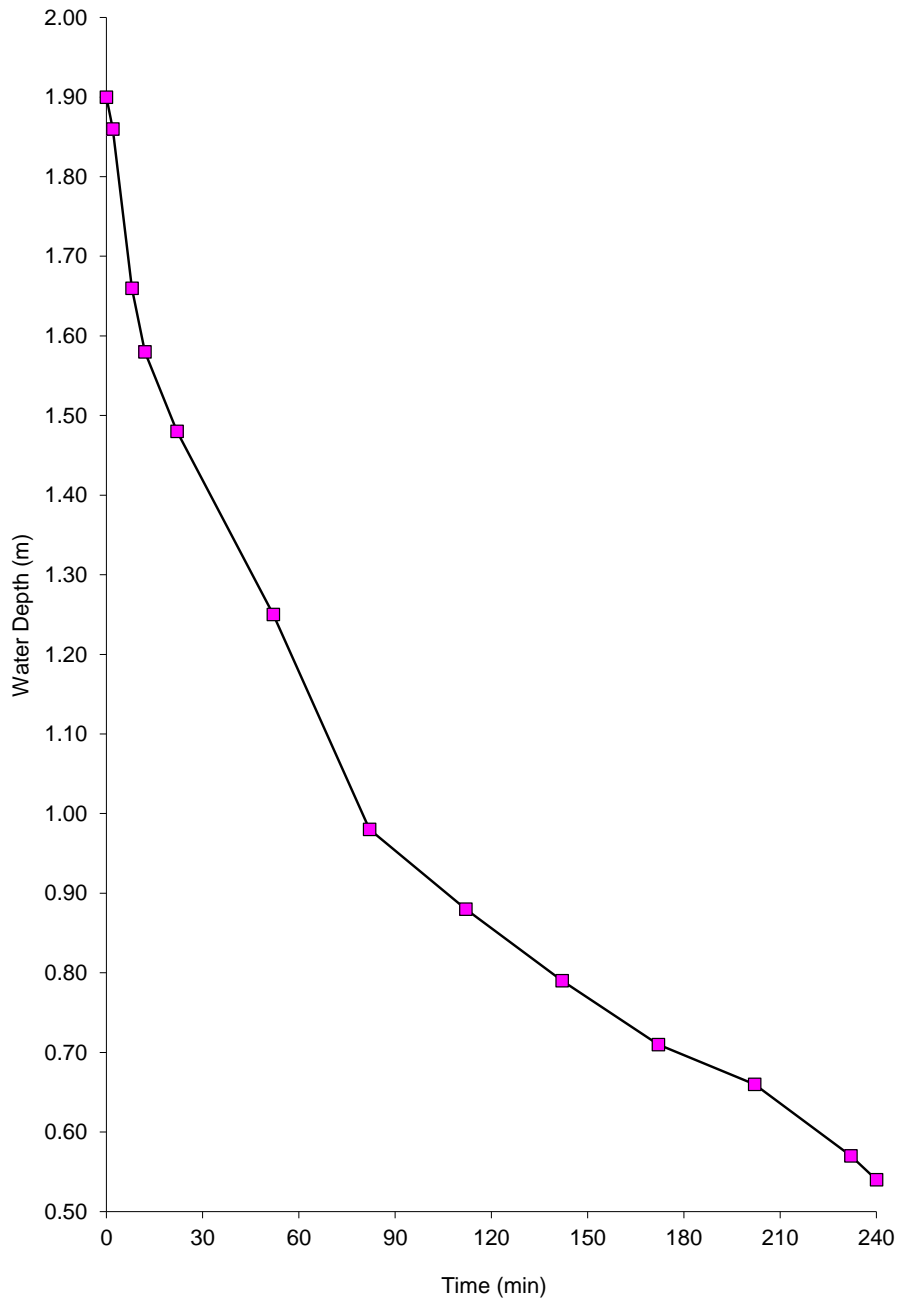
STORMWATER PERCOLATION TEST

Client: The Bears Home Project Management Lirr Job No: J01662
Location: Muriwai Downs Golf Project Date: 24.02.22
Page 2 of 2

Hole No: Perc 05 Diameter: 0.1 (m)

Location: Depth: 2.0 (m)

Water Depth vs Time



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Email: shane@landergetechnical.co.nz

Operator: MB

Checked:



Hand Auger Borehole Log

Test ID: **HA101**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924959mN, 1729234mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: RZ

Checked By: AT

Vane ID: 307

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.2	TS	TOPSOIL								
0.2 - 1.0	x	Silty CLAY; orange brown. Hard; moist; high plasticity.	ASH						201+	-0.5
1.0 - 1.5	x	Clayey SILT, with trace sand; orange grey. Very stiff; moist; low plasticity; sand, medium.							201+	-1.0
1.4 - 1.5		1.4m: becoming yellow mottled orange 1.5m: with trace limonite stained fine gravel							▶ 20	-1.5
1.5 - 5.5				Groundwater Not Encountered						-2.0 to -5.5

Hole Depth: 1.50m **Termination:** Reached target depth

Remarks: End of Borehole at 1.5m. DCP found effective refusal at 1.6m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow
 UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **HA102**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924908mN, 1729305mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: RZ

Checked By: AT

Vane ID: 307

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0	TS	TOPSOIL								
0.0	TS	Clayey SILT; orange brown. Hard; dry to moist; low plasticity. 0.7m: becoming moist	ASH	Groundwater Not Encountered					201+	-0.5
0.5										
1.0									▶ 20	
1.5										
2.0										
2.5										
3.0										
3.5										
4.0										
4.5										
5.0										
5.5										

Hole Depth: 1.00m **Termination:** Reached target depth

Remarks: End of Borehole at 1.0m. DCP found effective refusal at 1.1m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow
 UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HA/TP Log v7 - 4/03/2022 1:48:56 pm



Hand Auger Borehole Log

Test ID: **HA103**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924808mN, 1729211mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: MB

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing		Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)	Shear Vane, Su (kPa)		
0.0 - 0.4	TS	TOPSOIL						
0.4 - 0.7	x	silty CLAY, orange and grey mottled brown. Very stiff, moist, medium plasticity, moderately sensitive, with topsoil intermixed to 0.4m	ASH				139 / 62 (2.2)	-0.5
0.7 - 1.0	x	0.7m: becoming moist to wet						
1.0 - 1.2	x	1.0m: becoming insensitive					108 / 58 (1.9)	-1.0
1.2 - 1.5	x	1.2m: becoming orange mottled light yellow/grey						
1.5 - 2.0	x	1.5m: becoming stiff, high plasticity, with trace fine to medium sand					85 / 46 (1.8)	-1.5
2.0 - 2.0	x	clayey SILT, orange streaked grey. Hard, moist, low plasticity					UTP	-2.0
2.0 - 5.5				Groundwater Not Encountered				-2.5 -3.0 -3.5 -4.0 -4.5 -5.0 -5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
 ○ Vane residual ◁ Groundwater inflow
 ◆ Vane UTP ▷ Groundwater outflow

UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HA/TP Log v7 - 4/03/2022 1:48:56 pm



Hand Auger Borehole Log

Test ID: **HA104**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5924847mN, 1729126mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: MB

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.0 - 0.5	TOPSOIL			Groundwater Not Encountered					169 / 39 (4.3)	-0.5	
0.5 - 1.0	clayey SILT, orange streaked brown/grey. Very stiff, dry to moist, low plasticity, sensitive		ASH								-1.0
1.0 - 1.1	clayey SILT, brown/red. Hard, dry to moist, low to no plasticity									UTP ▶20	-1.1
1.1 - 1.5										-1.5	
1.5 - 2.0										-2.0	
2.0 - 2.5										-2.5	
2.5 - 3.0										-3.0	
3.0 - 3.5										-3.5	
3.5 - 4.0										-4.0	
4.0 - 4.5										-4.5	
4.5 - 5.0										-5.0	
5.0 - 5.5										-5.5	

Hole Depth: 1.00m **Termination:** Reached target depth

Remarks: End of Borehole at 1.0m. DCP found effective refusal at 1.1m.

- Vane peak ▼ Standing water level
- Vane residual ◁ Groundwater inflow
- ◆ Vane UTP ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **HA105**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925879mN, 1728572mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.5	TOPSOIL									
0.5 - 1.0	silty CLAY, red streaked orange/brown. Very stiff, moist, medium plasticity		FILL	Groundwater Not Encountered	○		●		131 / 19 (6.9)	-0.5
1.0 - 1.5	clayey SILT, orange/brown. Very stiff, moist, low to medium plasticity		ASH		○		●		123 / 39 (3.2)	-1.0
1.5 - 2.0	1.6m: with trace fine to medium sand					○		●	212 / 112 (1.9)	-1.5
2.0 - 2.5						○		●	196 / 92 (2.1)	-2.0
2.5 - 3.0										-2.5
3.0 - 3.5										-3.0
3.5 - 4.0										-3.5
4.0 - 4.5										-4.0
4.5 - 5.0										-4.5
5.0 - 5.5										-5.0
5.5 - 6.0										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak ▼ Standing water level
- Vane residual ◁ Groundwater inflow
- ◆ Vane UTP ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **HA106**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5926255mN, 1729911mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 24/02/2022

Logged By: RZ

Checked By: AT

Vane ID: 307

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)
					Dynamic Cone Penetrometer (blows / 50mm)					
					Shear Vane, Su (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0 - 0.5	TS	TOPSOIL								
0.5 - 1.2	x	Silty CLAY; brown orange. Very stiff; moist; high plasticity.	ASH						201+	-0.5
1.2 - 1.8	x	1.2m: becoming orange brown							201+	-1.0
1.8 - 2.0	x	Silty CLAY, with trace gravel; orange mottled light grey. Hard; moist; low plasticity; gravel, fine, Pumiceous.							201+	-1.5
2.0 - 2.2	x								201+	-2.0
2.2 - 2.5										-2.5
2.5 - 3.0										-3.0
3.0 - 3.5										-3.5
3.5 - 4.0										-4.0
4.0 - 4.5										-4.5
4.5 - 5.0										-5.0
5.0 - 5.5										-5.5

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **Perc01**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925136mN, 1728913mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.0 - 0.5	TS	clayey SILT with trace fine sand, light brown. Hard, dry to moist, low plasticity	ASH	Groundwater Not Encountered					UTP	-0.5	
0.5 - 0.6		0.6m: with trace fine to medium gravel inclusions									
0.6 - 0.8		0.8m: becoming orange mottled brown									
0.8 - 1.5		silty CLAY with trace fine sand, red streaked brown/orange. Hard, moist, medium plasticity, insensitive								270+	-1.0
1.5 - 2.0		clayey SILT, dark brown/orange. Hard, moist, low plasticity								220 / 135 (1.6)	-1.5
2.0 - 2.0										UTP	-2.0
2.0 - 2.5											-2.5
2.5 - 3.0											-3.0
3.0 - 3.5											-3.5
3.5 - 4.0											-4.0
4.0 - 4.5										-4.5	
4.5 - 5.0										-5.0	
5.0 - 5.5										-5.5	

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak ▼ Standing water level
- Vane residual ◁ Groundwater inflow
- ◆ Vane UTP ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **Perc02**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925418mN, 1728665mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.5		clayey SILT with trace fine sand, brown. Hard, dry to moist, low plasticity, with trace basalt gravel inclusions	ASH	Groundwater Not Encountered					◆	UTP	
0.7		0.7m: becoming brown/red streaked orange/brown, low to medium plasticity									
1.0		1.0m: becoming red streaked light grey mottled dark brown/orange, with trace medium sand								◆	UTP
1.5		1.5m: becoming brown/orange, dry to moist, no plasticity, with trace medium to coarse sand, with hardened silt clasts									◆
2.0		1.8m: becoming moist, low to medium plasticity								◆	UTP
2.5											
3.0											
3.5											
4.0											
4.5											
5.0											
5.5											

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak ▼ Standing water level
- Vane residual ◁ Groundwater inflow
- ◆ Vane UTP ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID: **Perc03**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925383mN, 1729122mE

System: NZTM

Elevation: Ground

Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750

Depth (m)	Graphic Log	Material Description	Geology	Water	In-situ Testing				Test Values peak / remoulded (sensitivity)	Depth (m)	
					Dynamic Cone Penetrometer (blows / 50mm)						
					Shear Vane, Su (kPa)						
					2	4	6	8			
					50	100	150	200			
0.5		clayey SILT, brown. Hard, moist, low plasticity	ASH	Groundwater Not Encountered					UTP	-0.5	
0.7m:		becoming medium plasticity									
0.8m:		becoming orange mottled brown									
1.3m:		becoming brown/orange, with trace medium sand									
1.6m:	becoming dry to moist, no plasticity							UTP	-1.5		
2.0m:	becoming insensitive							239 / 158 (1.5)	-2.0		
2.5										-2.5	
3.0										-3.0	
3.5										-3.5	
4.0										-4.0	
4.5										-4.5	
5.0										-5.0	
5.5										-5.5	

Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak
- Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Hand Auger Borehole Log

Test ID: **Perc04**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925523mN, 1729615mE

System: NZTM

Elevation: Ground

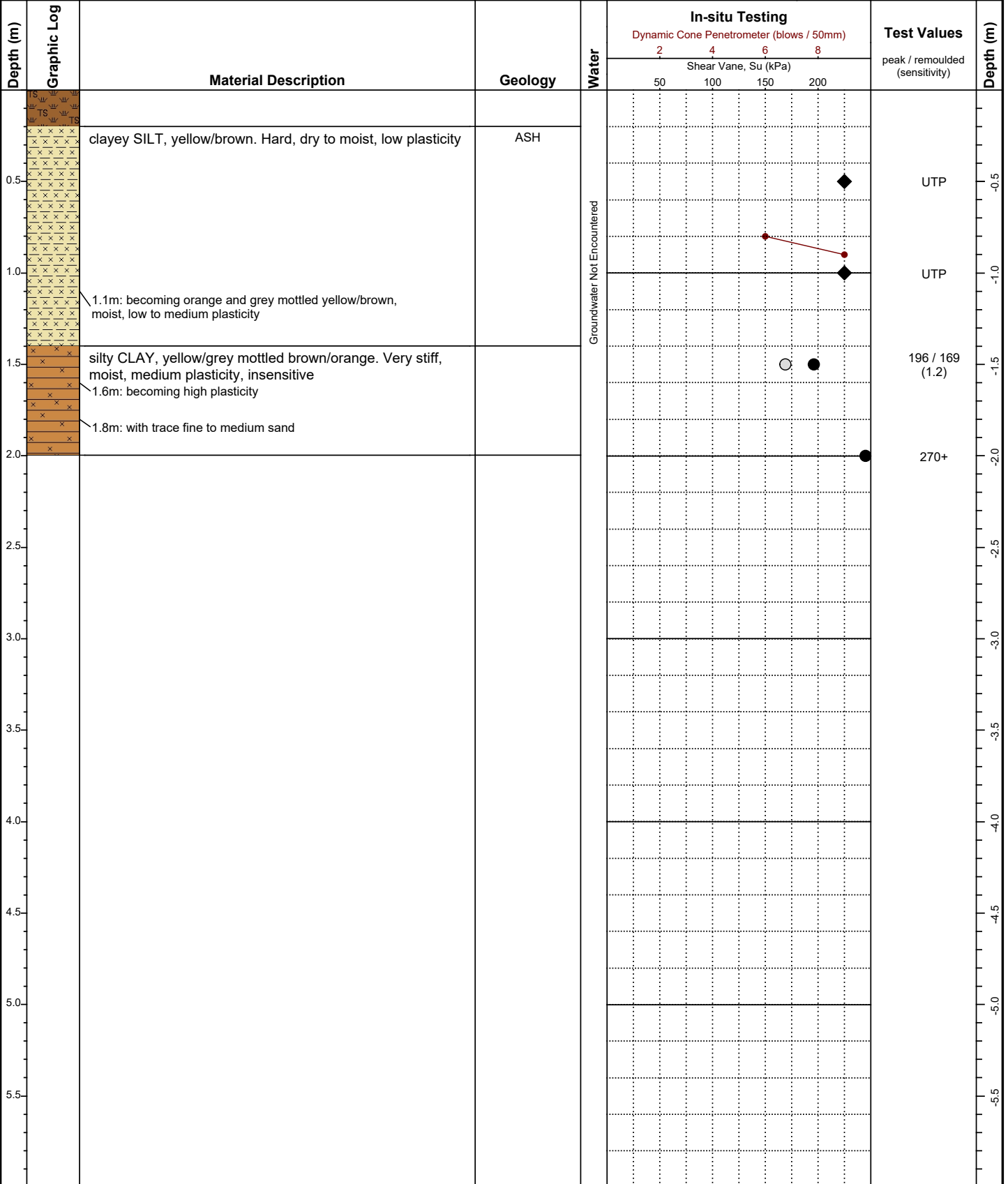
Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750



Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak
 - Vane residual
 - ◆ Vane UTP
 - ▼ Standing water level
 - ◁ Groundwater inflow
 - ▷ Groundwater outflow
- UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.



Hand Auger Borehole Log

Test ID: **Perc05**

Project ID: J01662

Sheet: 1 of 1

Method:

Client: The Bears Home Project Management Limited

Project: Muriwai Downs Golf Project

Location: Muriwai Downs Golf Project

Test Site: Refer to site plan

Coordinates: 5925781mN, 1729785mE

System: NZTM

Elevation: Ground

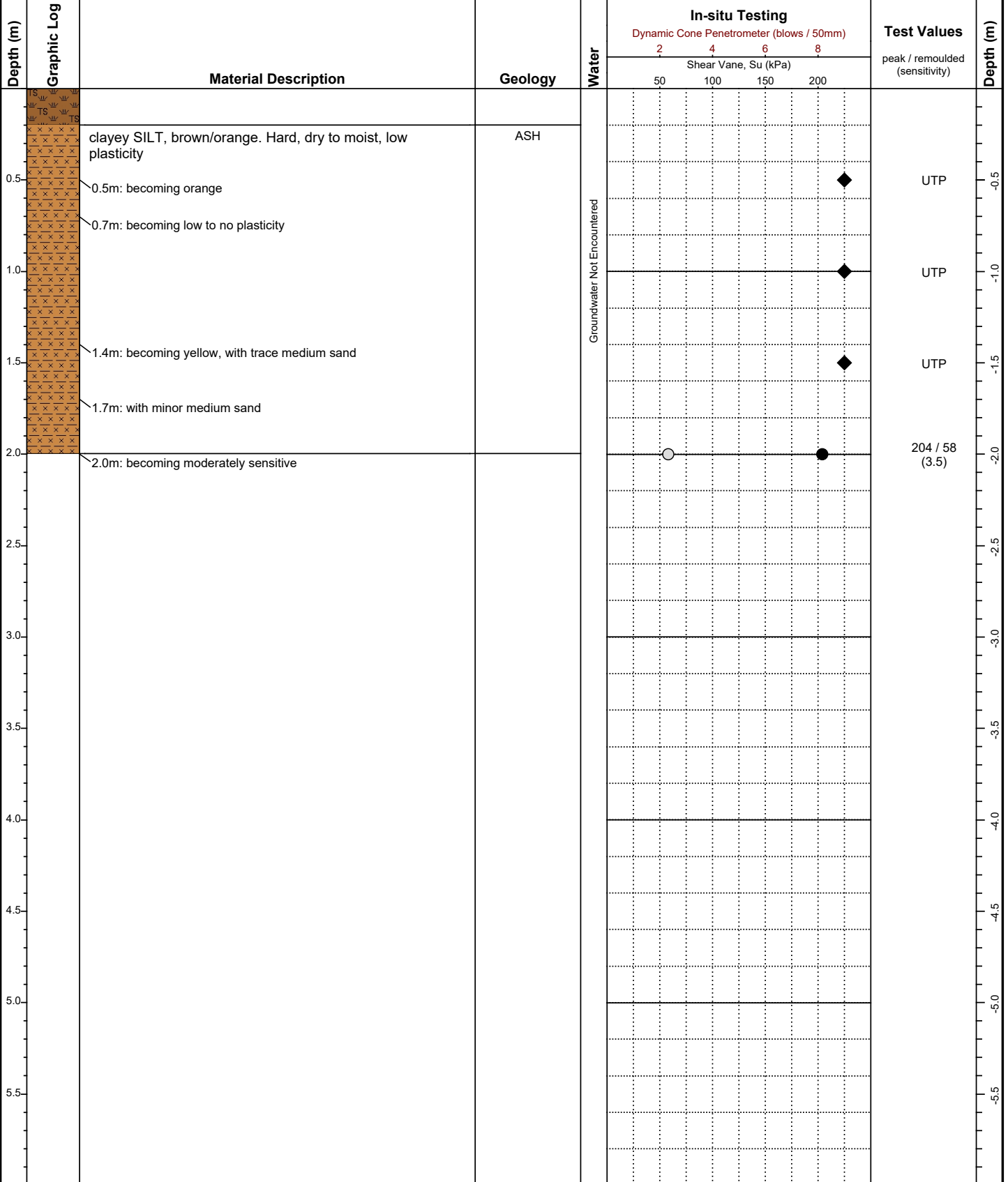
Located By:

Test Date: 23/02/2022

Logged By: MB/RZ

Checked By: AT

Vane ID: 1750



Hole Depth: 2.00m **Termination:** Reached target depth

Remarks: End of Borehole at 2.0m.

- Vane peak ▼ Standing water level
- Vane residual ◁ Groundwater inflow
- ◆ Vane UTP ▷ Groundwater outflow

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate



Our Ref: 2021000.0565R/LabRep1
18 March 2022

Land Development & Engineering Ltd
LDE Ltd
320 Ti Rakau Drive
Burswood
Auckland 2013

Attention: Jasmine Lam

Dear Jasmine

Muriwai Downs – Hydrometer PSD and Liquid & Plastic Limit, Plasticity Index Laboratory Test Report

Customer's Instructions

We were instructed to complete the Determination of the Particle Size Distribution - Hydrometer Method and the Determination of the Liquid & Plastic Limit, Plasticity Index on cohesive material.

Sampling Procedure

Samples have been tested as received from the customer on the 28th February 2022.

Test Methods

NZS 4402:1986 Test 2.2 – Liquid limit

NZS 4402:1986 Test 2.3 – Plastic limit

NZS 4402:1986 Test 2.4 – Plasticity index

NZS 4402:1986 Test 2.8.4 – Particle size distribution (Hydrometer)

Test Results

Test results are attached.

General Remarks

Samples not destroyed during testing, will be retained for one month from the date of this report before being discarded.

Descriptions are enclosed for your information, but are not covered under the IANZ endorsement of this report.

This report has been prepared for the benefit of Land Development & Engineering Ltd, with respect to the particular brief given to us and it cannot be relied upon in other contexts or for any other purpose without our prior review and agreement.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to get in touch. Contact details are provided at the bottom of the letterhead page.

GEOTECHNICS LTD

Report prepared by:



.....
Caitlyn Gillard
Laboratory Technician

Authorised for Geotechnics by:

.....
Anthony Gilliland
Project Director
Approved Signatory

Report checked by:



.....
Fergus Goldie
Laboratory Technician



All tests reported herein
have been performed in
accordance with the
laboratory's scope of
accreditation

18-Mar-22

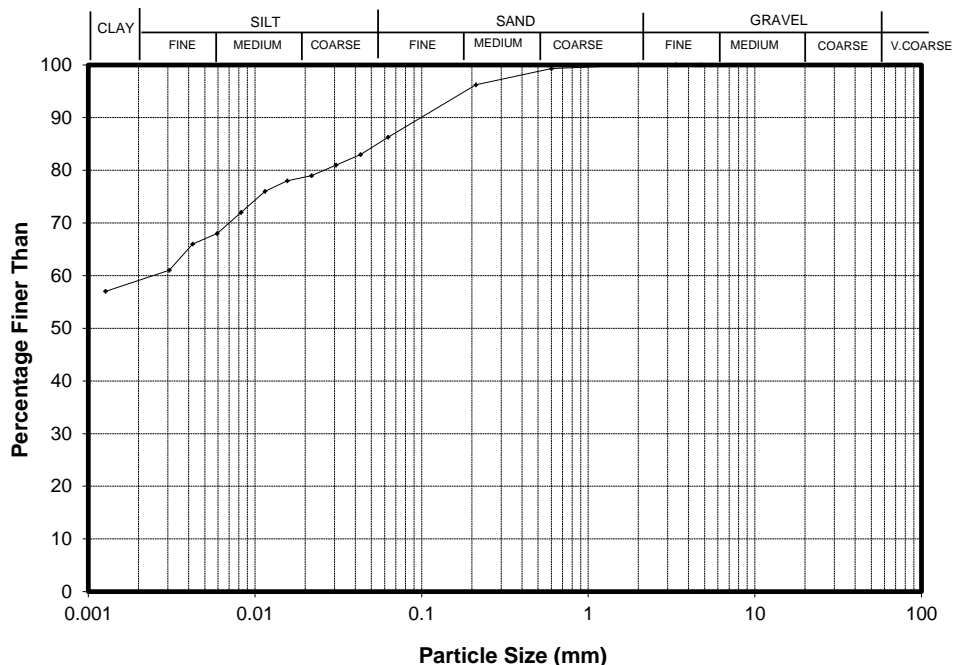
t:\geotechnicsgroup\projects\2021000\2021000.0565 - Ide muriwai downs - lab testing\issueddocuments\ LabRep1



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Site: **Muriwai Downs** Your Job No.: **JO1662**
BH No.: **HA102** Sample ID.: **AKL45.1** Our Job No.: **2021000.0565**
Test Method Used : NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer) Depth: **0.2-1 m**

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
4.75	-		
3.35	-		
2.00	100		
0.600	99		
0.212	96		
0.063	86		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0430	83
0.0307	81
0.0219	79
0.0156	78
0.0115	76
0.0083	72
0.0059	68
0.0042	66
0.0031	61
0.0013	57

Sample history : Tested as recived
Description: Silty CLAY with some sand, brownish orange, high plasticity

Remarks : A sub sample was split from the original sample for hydrometer analysis. This sample was soaked with a dispersing agent (~2 hrs), then the mechanical shaker was used, until the material was brought into suspension, before proceeding with the test.
Suspension pH 8.0
The classification of gravel-sand-silt-clay components were described on the basis of particle size analysis.
Sample description is not IANZ accredited.
Results was obtained in accordance with NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer)

Entered by : GEGO Date : 18/03/2022 Checked by : CAGI Date : 18/03/2022



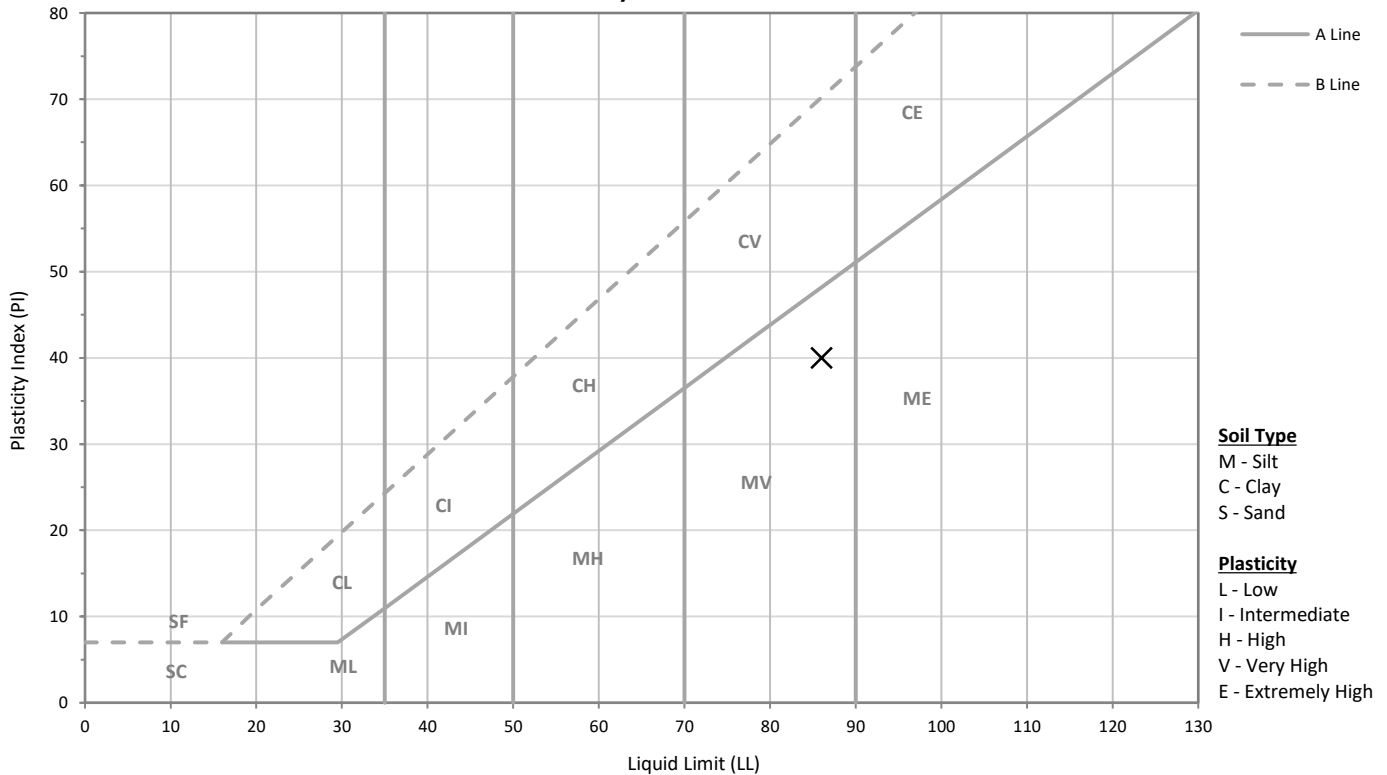
DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - NZS 4402: 1986 Tests 2.2 (4 Point), 2.3 & 2.4

TEST DETAILS			
LOCATION	ID	HA102	
	Description	N/A	
	Data	Level: 0.2- 1.0 m	
SAMPLE	Geotechnics ID	AKL_202203010	Date Received 1/03/2022
	Reference	Sample 1	Depth 0.20m - 1.00m
	Description	N/A	
SPECIMEN	Reference	3	Depth -
	Description	Silty CLAY with some sand, brownish orange; high plasticity	

TEST RESULTS

Liquid Limit 86
Plastic Limit 46
Plasticity Index 40

Plasticity Chart - BS 5930:1999



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS

- The material used for testing was natural, fraction passing a 425um sieve.

This test result is IANZ accredited.

Approved By AJFG

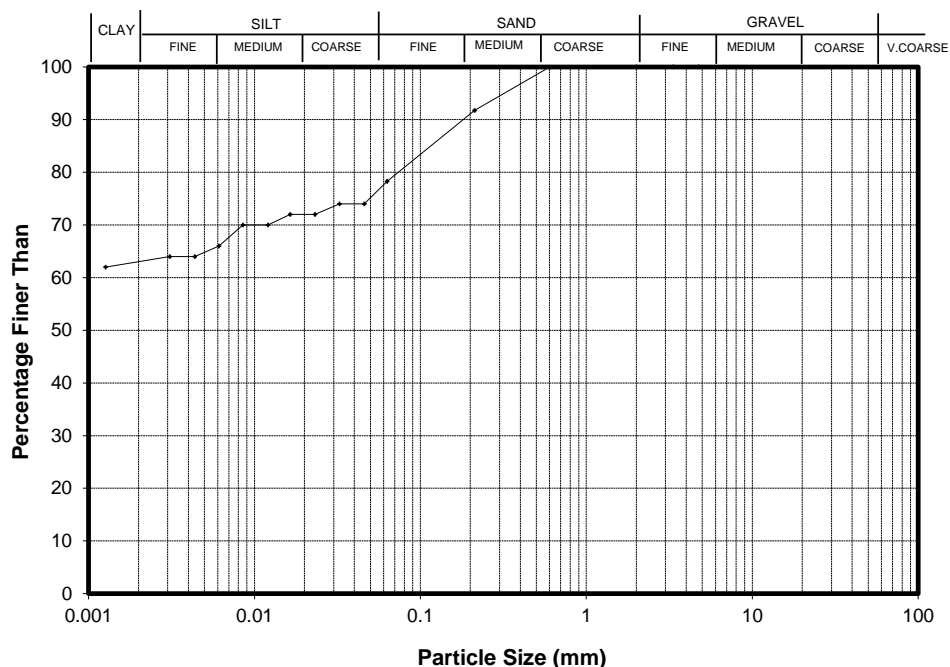
Date 21/03/2022



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Site: **Muriwai Downs** Your Job N **JO1662**
BH No.: **HA103** Our Job Nc **2021000.0565**
Sample ID.: **AKL45.2** Depth: **0.3-1.5 m**
Test Method Used : NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer)

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
4.75	-		
3.35	-		
2.00	-		
0.600	100		
0.212	92		
0.063	78		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0460	74
0.0325	74
0.0232	72
0.0164	72
0.0121	70
0.0085	70
0.0061	66
0.0044	64
0.0031	64
0.0013	62

Sample history : Tested as recived
Description: sandy CLAY, brownish grey, high plasticity

Remarks : A sub sample was split from the original sample for hydrometer analysis. This sample was soaked with a dispersing agent (~2 hrs), then the mechanical shaker was used, until the material was brought into suspension, before proceeding with the test.
Suspension pH 8.1
The classification of gravel-sand-silt-clay components were described on the basis of particle size analysis.
Sample description is not IANZ accredited.
Results was obtained in accordance with NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer)

Entered by : GEGO

Date : 18/03/2021 Checked by : CAGI

Date : 18/03/2022



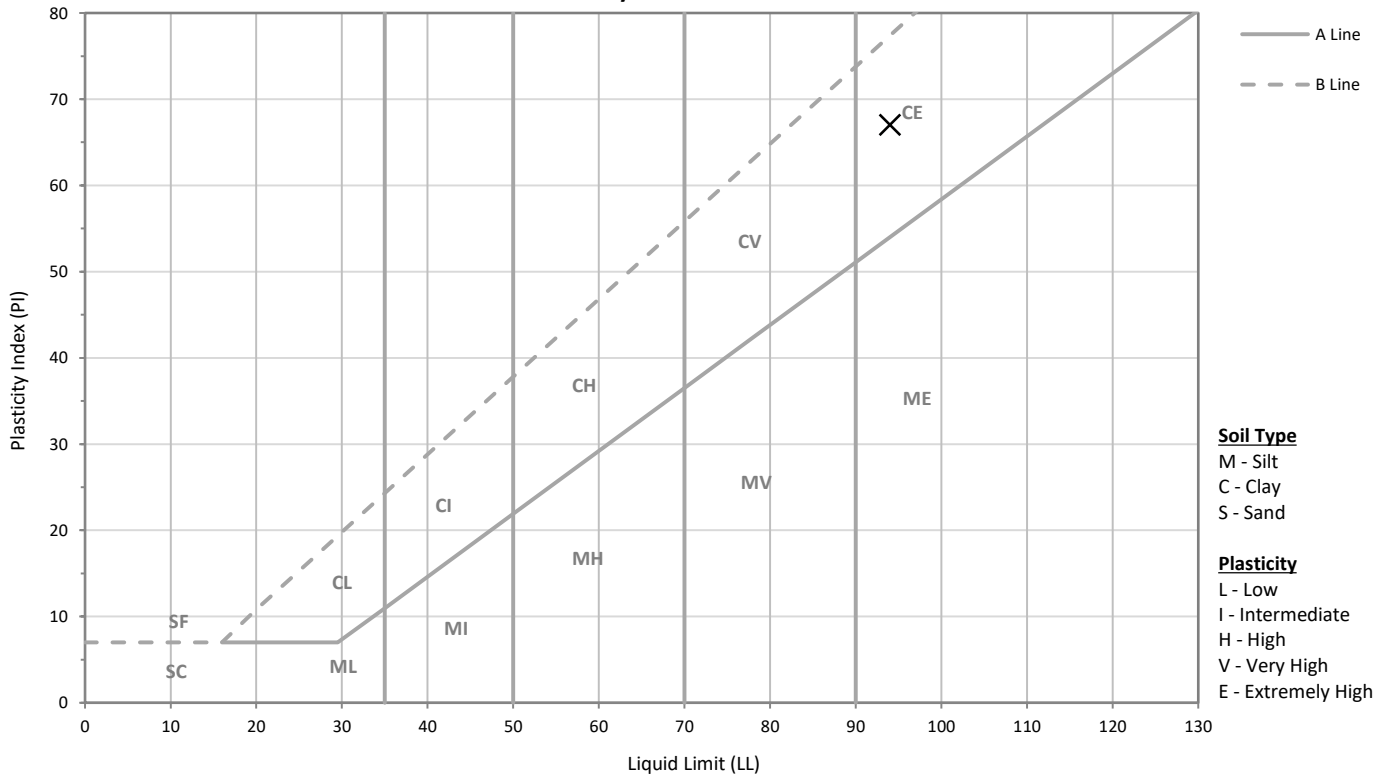
DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - NZS 4402: 1986 Tests 2.2 (4 Point), 2.3 & 2.4

TEST DETAILS			
LOCATION	ID	HA103	
	Description	N/A	
	Data	Level: 0.3-1.5 m	
SAMPLE	Geotechnics ID	AKL_202203070	Date Received 1/03/2022
	Reference	Sample 2	Depth 0.30m - 1.50m
	Description	N/A	
SPECIMEN	Reference	2	Depth -
	Description	Sandy CLAY, brownish grey, high plasticity	

TEST RESULTS

Liquid Limit 94
Plastic Limit 27
Plasticity Index 67

Plasticity Chart - BS 5930:1999



Soil Type
M - Silt
C - Clay
S - Sand

Plasticity
L - Low
I - Intermediate
H - High
V - Very High
E - Extremely High

The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS

- The material used for testing was natural, fraction passing a 425um sieve.

This test result is IANZ accredited.

Approved By AJFG

Date 21/03/2022



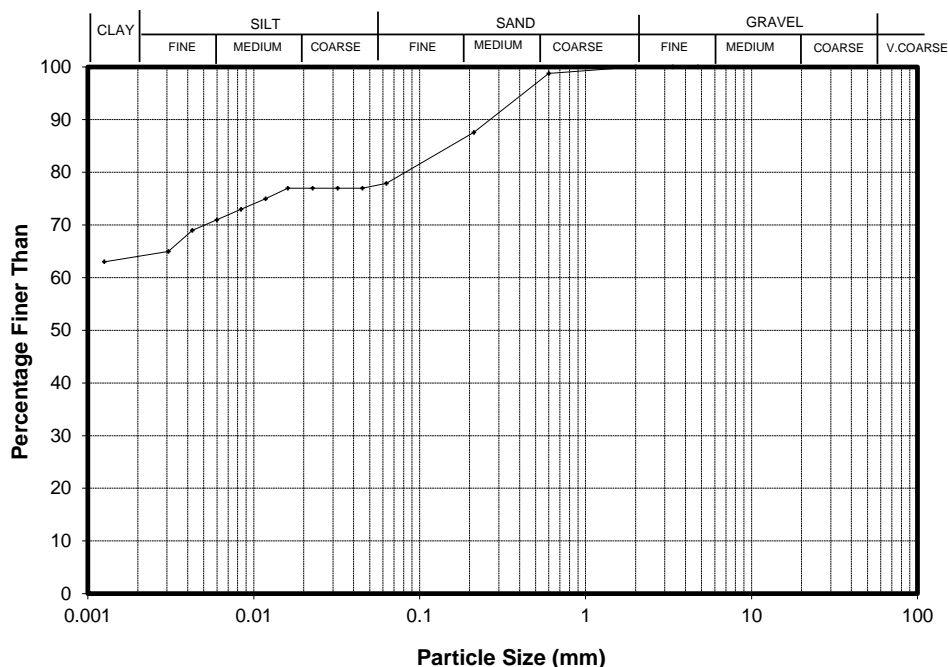
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Site: **Muriwai Downs**BH No.: **HA105**Sample ID.: **AKL45.3**

Test Method Used : NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer)

Your Job No.: **JO1662**Our Job No.: **2021000.0565**Depth: **0.5-2 m**

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
4.75	-		
3.35	-		
2.00	100		
0.600	99		
0.212	88		
0.063	78		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0452	77
0.0320	77
0.0226	77
0.0160	77
0.0118	75
0.0084	73
0.0060	71
0.0043	69
0.0031	65
0.0013	63

Sample history : Tested as recived
Description: sandy CLAY with some silt, dark brown orange with light brownish orange, high plasticity

Remarks : A sub sample was split from the original sample for hydrometer analysis. This sample was soaked with a dispersing agent (~2 hrs), then the mechanical shaker was used, until the material was brought into suspension, before proceeding with the test.
Suspension pH 8.98
The classification of gravel-sand-silt-clay components were described on the basis of particle size analysis.
Sample description is not IANZ accredited.
Results was obtained in accordance with NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer)

Entered by : GEGO

Date : 18/03/2022 Checked by : CAGI

Date : 18/03/2022

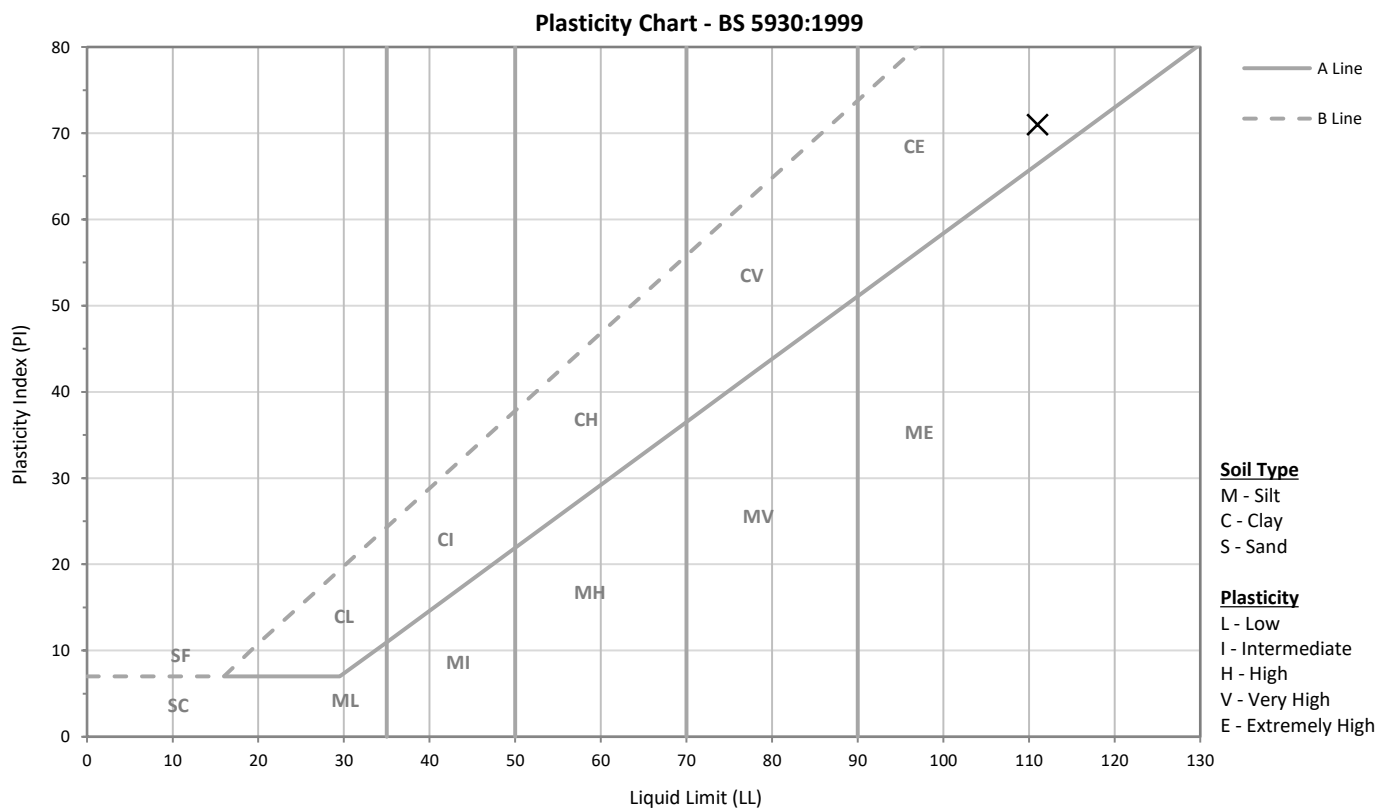


DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - NZS 4402: 1986 Tests 2.2 (4 Point), 2.3 & 2.4

TEST DETAILS			
LOCATION	ID	HA105	
	Description	N/A	
	Data	Level: 0.5-2.0 m	
SAMPLE	Geotechnics ID	AKL_202203071	Date Received 1/03/2022
	Reference	Sample 3	Depth 0.50m - 2.00m
	Description	N/A	
SPECIMEN	Reference	3	Depth -
	Description	sandy CLAY with some silt, dark brownish orange with light brownish orange, high plasticity	

TEST RESULTS

Liquid Limit 111
Plastic Limit 40
Plasticity Index 71



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS

- The material used for testing was natural, fraction passing a 425um sieve.

This test result is IANZ accredited.

Approved By AJFG

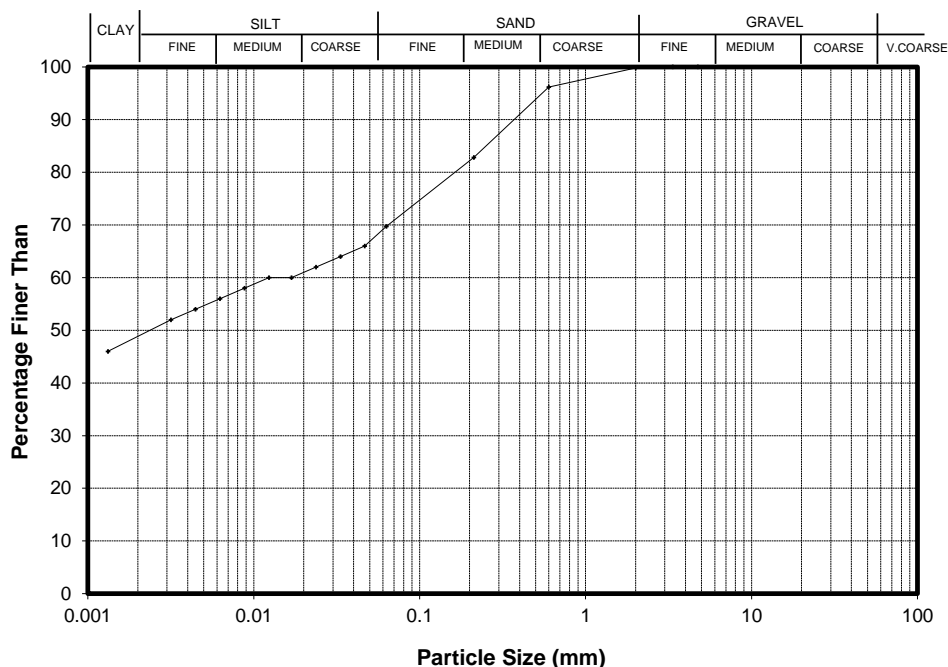
Date 21/03/2022



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Site: **Muriwai Downs** Your Job No.: **JO1662**
BH No.: **HA106** Sample ID.: **AKL45.4** Our Job No.: **20212000.0565**
Test Method Used : NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer) Depth: **0.3-1.2 m**

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing	Sieve (mm)	Total % Passing
4.75	100		
3.35	100		
2.00	100		
0.600	96		
0.212	83		
0.063	70		

Equivalent Particle Diameter D (mm)	% of Particles Finer than D
0.0467	66
0.0333	64
0.0237	62
0.0169	60
0.0123	60
0.0088	58
0.0063	56
0.0045	54
0.0032	52
0.0013	46

Sample history : Tested as recived
Description: sandy CLAY with silt, dark brown, high plasticity

Remarks : A sub sample was split from the original sample for hydrometer analysis. This sample was soaked with a dispersing agent (~2 hrs), then the mechanical shaker was used, until the material was brought into suspension, before proceeding with the test.
Suspension pH 8.0
The classification of gravel-sand-silt-clay components were described on the basis of particle size analysis.
Sample description is not IANZ accredited.
Results was obtained in accordance with NZS 4402:1986 Test 2.8.4 Subsidiary method for fine soils (Hydrometer)

Entered by : GEGO

Date : 18/03/2022 Checked by : CAGI

Date : 18/03/2022



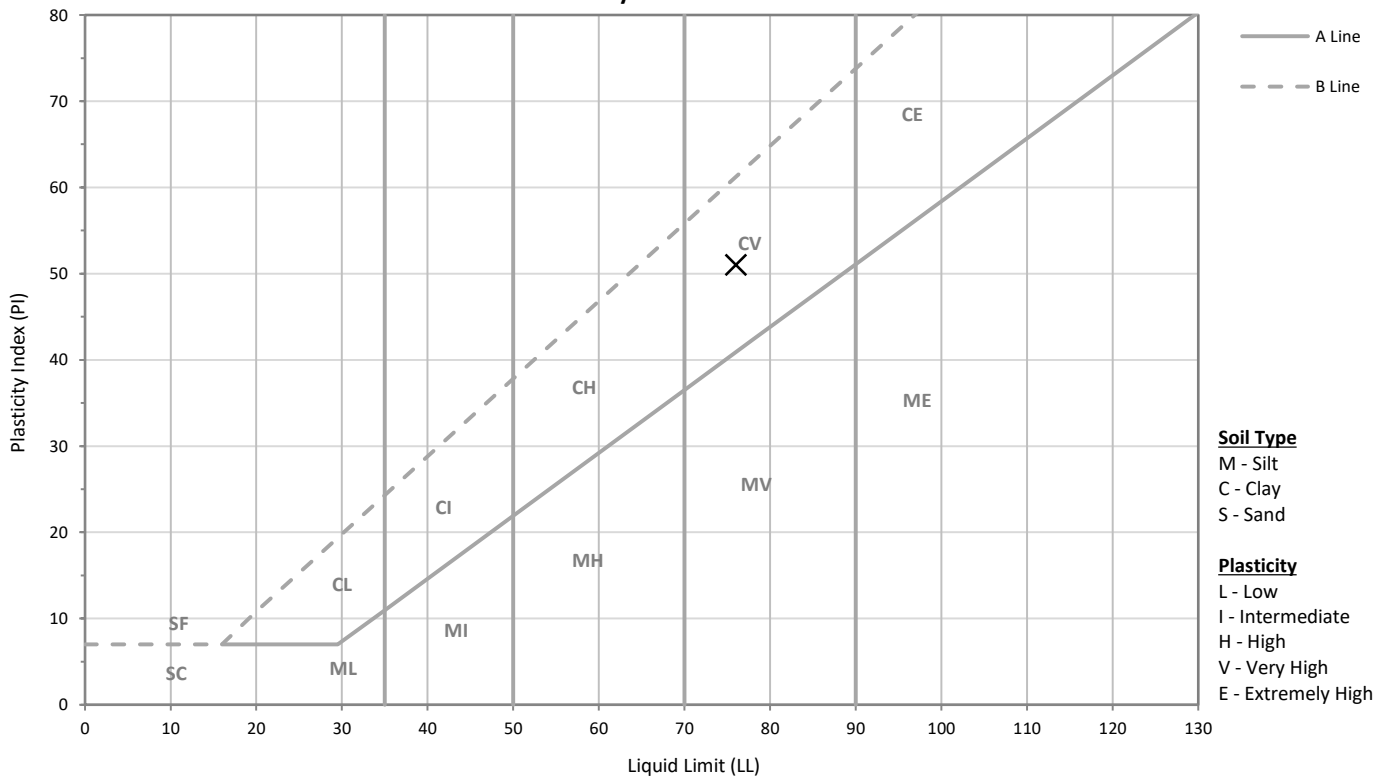
DETERMINATION OF LIQUID & PLASTIC LIMIT, PLASTICITY INDEX - NZS 4402: 1986 Tests 2.2 (4 Point), 2.3 & 2.4

TEST DETAILS			
LOCATION	ID	HA106	
	Description	N/A	
	Data	Level: 0.3-1.2 m	
SAMPLE	Geotechnics ID	AKL_202203072	Date Received 1/03/2022
	Reference	Sample 4	Depth 0.30m - 1.20m
	Description	N/A	
SPECIMEN	Reference	4	Depth N/A
	Description	sandy CLAY with silt, dark brown, high plasticity	

TEST RESULTS

Liquid Limit 76
Plastic Limit 25
Plasticity Index 51

Plasticity Chart - BS 5930:1999



The plasticity chart is provided for your inference only and is not covered under our scope of IANZ accreditation. Due to the nature of classifications it is possible to have discrepancies between observational behaviour descriptions and measured parameters

TEST REMARKS

- The material used for testing was natural, whole soil.

This test result is IANZ accredited.

Approved By AJFG

Date 21/03/2022