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24 September 2025

JP Neethling
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Kia Ora JP,

PŌRANGAHAU STOPBANK BORROW AREA 3 MATERIAL INVESTIGATION ADDENDUM TO PORANGAHAU STOPBANK BORROW AREA MATERIAL INVESTIGATION REF HB01041700R007

1.0 Introduction

Hawke's Bay Regional Council (HBRC) appointed Pattle Delamore Partners Limited (PDP) to carry out the geotechnical investigation and design of a stopbank protecting Pōrangahau Town from future significant flood events.

Typical wetland vegetation was identified in Borrow Area 1, resulting in portions of the area being designated as a wetland. Borrow Area 2 is bisected by the rising wastewater main, restricting the available material. Therefore, to satisfy the overall material volume requirements for construction of the proposed stopbank, additional borrow material was needed.

This letter reports the assessment of the material of the site "Borrow Area 3", situated north of Beach Road, as shown in Figure 1.

2.0 Scope of Work

The scope of work for material assessment comprised invasive material investigation of this additional potential borrow site (Borrow Area 3), identified by HBRC.

HBRC provided a specification, including a preferred grading envelope, against which to evaluate the source material (HBRC, 2021).

Figure 1: Site Layout, Borrow Area 3 Investigation Test Locations

3.0 Site Investigation

3.1 Test Pits and Laboratory Testing

Test pitting was carried out in the Borrow Area 3, as identified by HBRC, north of Beach Road in Pōrangahau (Figure 1 above). Three test pits were excavated using a Volvo 16T excavator with a straight-edged bucket. The test pits were inspected, profiled and selectively sampled by an engineering geologist according to NZGS (2005). The details of the sampling and results are summarised in Table 1 below, and the test pit soil profile logs are included in Appendix A.

Samples were gathered from TP07 and TP08 and analysed by the WSP Laboratory in Napier for Compaction, Full Particle Size Distribution (PSD), including Hydrometer Testing, California Bearing Ratio (CBR) and Atterberg Limits.

Laboratory test results are included in Appendix B.

Table 1: Laboratory Test Summary

Position	Depth (m)	Compaction Effort	Max Dry Density & OMC (t/m³)	CBR			% Passing				Atterberg Limits		
				CBR (%)	Penetration (mm)	Swell (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
TP07	0.30-1.50	100% NZ Heavy	1.56 @ 26.4%	2.5	2.5/5	2	39	59	97	0	63	29	34
TP07	1.50-2.70	100% NZ Heavy	1.57 @ 24.4%	2.5	2.5	1.5	36	57	97	0	67	30	37
TP08	0.30-1.35	100% NZ Heavy	1.39 @ 32.3%	1.5	2.5/5	1.5	36	61	99	0	68	34	34
TP08	1.35-2.60	100% NZ Heavy	1.46 @ 29.2%	1	2.5/5	2	38	66	99	0	70	33	37

Notes:

1. *N/T: Not tested*
2. *No hydrometer test performed*

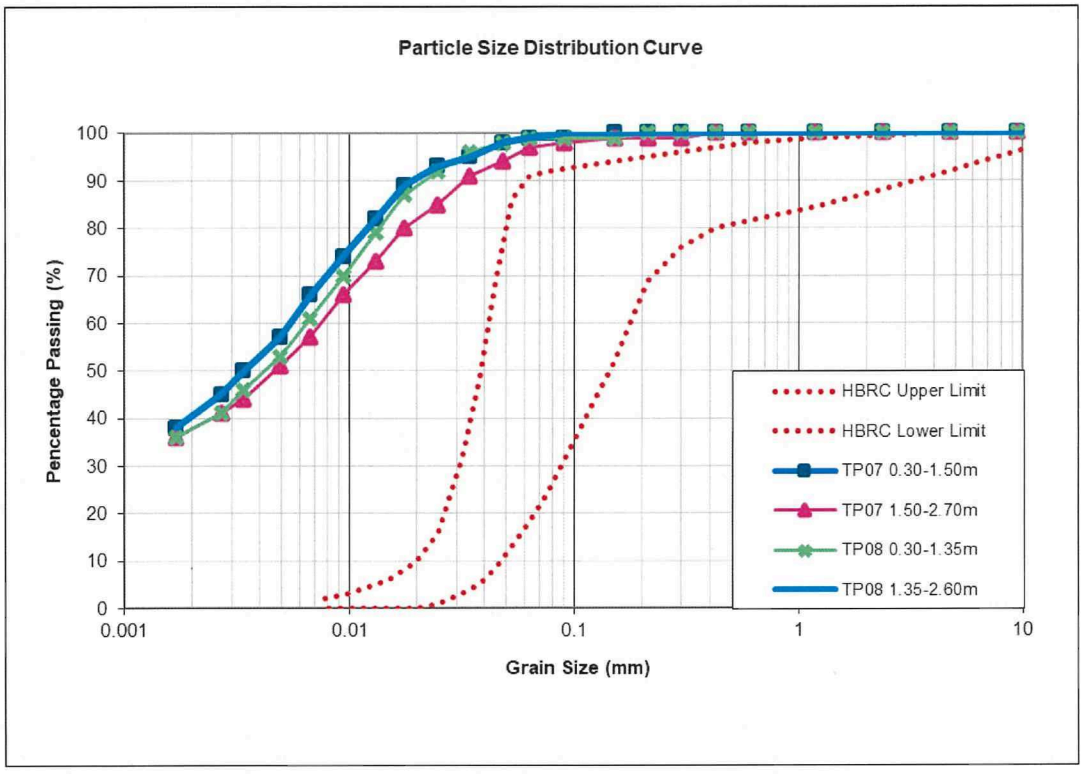

Figure 2: HBRC Stopbank Borrow Material Grading Curves vs. Site Test Pit Material from Proposed Borrow Area 3

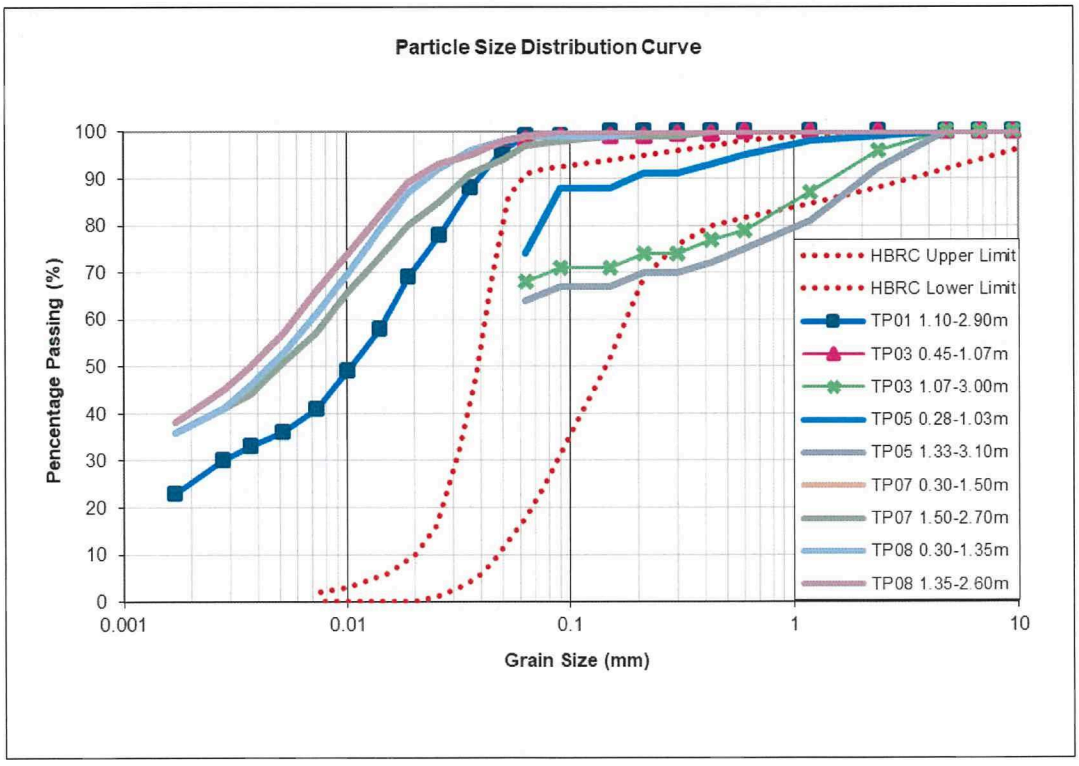

Figure 3: HBRC Stopbank Borrow Material Grading Curves vs. Combined Site Test Pit Material from all proposed Borrow Areas

4.0 Borrow Area Assessments

4.1 Material Assessment

The Borrow Area 3 and test pit locations are shown in Figure 1. The materials in the test pits were generally consistent across the borrow area and comprised recent topsoil overlying Holocene-aged alluvial deposits, occurring in bedded layers and are not uniform in vertical or horizontal distribution across the site. Test pits were excavated down to 3m below ground level or to where groundwater was encountered. The test pits had the following general horizons:

4.1.1 Soil Units Encountered:

- Unit 1 – Topsoil – Silt/sandy silt: The six test pits contained a shallow horizon of silt or sandy silt with a dark brown colour. Vertical thicknesses of this horizon were consistent in the three test pits at 0.3 m. This material was not sampled, as it is considered topsoil and was not targeted for use as a construction material.
- Unit 2 - Clayey silt: The three test pits contained a shallow horizon of silty clay or clayey silt with a light grey mottled orange-brown colour and an inferred soft to firm consistency. The horizon also contained wood debris fragments. Vertical thicknesses of this horizon ranges from 1.05 to 1.35 m. This material was sampled in TP07 and TP08.
- Unit 3 – Silty clay: This unit occurs in all test pits and has a light grey mottled light yellowish orange to orange, streaked light grey. Inferred material consistencies were soft to firm with high plasticity. The vertical thickness of this horizon ranges from 1.1 m to 1.25 m. This horizon was sampled in TP07 and TP08.
- Unit 4 – Silty Sand. This horizon was present in all test pits and is bluish grey in colour. The inferred material consistency was loose with low plasticity. The vertical thickness of this horizon ranges from 0.50 m to 0.60 m. This horizon was not sampled.

4.1.2 Material Laboratory Test Results:

Indicative samples were taken from TP07 and TP08. Material particle size distribution testing showed that the material from the proposed Borrow Area 3 falls outside the HBRC grading envelope (Figure 2), with the bulk of the material being silt or clay. Additionally, California Bearing Ratio (CBR) testing was carried out on all the samples from TP07 and TP08 with results ranging from 1 to 2.5 % (with NZ standard compaction). Maximum Dry Densities ranged from 1.39 t/m^3 and 1.57 t/m^3.

Atterberg Limits were also determined, resulting in a Liquid Limits ranging from 63 to 70 %, and Plasticity Indexes ranging from 34 to 37 %. Both parameters rank the material quality as "high to very high", according to HBRC (2021) fine soil shrinkage and swelling classification. Figure 3 has been included and shows the combined particle size distributions from Borrow Area 2 compared to the HBRC grading envelope.

4.2 Groundwater Conditions

Construction restrictions limit the excavation of construction material to above the groundwater level, limiting the extent of the vertical soil profile that can be used. Groundwater levels were recorded during the test pit investigation and are summarised in Table 2.

Groundwater was encountered in two of the test pits at depths of 2.4 m to 3.15 m below ground level (mbgl). The groundwater seepage from the test pit sidewalls was slow.

Table 2: Summary of Groundwater Conditions		
Test Pit	**Depth of Groundwater (mbgl)**	**Comment**
TP07	Not encountered	N/A
TP08	2.4	Minimal seepage from sidewall
TP09	3.15	Slow seepage from sidewall

Seasonal fluctuations in groundwater levels are expected, and the site investigation was carried out towards the end of the wet season.

4.3 Material Volume

Borrow Area 3 was identified as a potential source for stop bank construction material (as shown in Figure 1) and measures approximately 3.4 ha in area. The topsoil thickness is consistent at 0.3 m thick. This topsoil material will need to be removed and stockpiled to expose the underlying borrow material, to be used for stopbank construction, then placed back into the reshaped borrow pits once the construction material has been removed to reinstate the areas.

The vertical thickness of the borrow material is approximately 2.3 m thick in Borrow Area 3. The base of the borrow pits will be approximately 2.7 mbgl deep (i.e. 5.2 mRL).

The estimated borrow material volumes in this area is based on the test pit data and includes consideration of the groundwater restrictions. This is summarised in Table 3, considering a 20 % bulking factor for stockpiling. The final volume of construction material (after construction) will depend on the extent of compaction (i.e., volume reduction) during construction.

Table 3: Material Volume Summary (Total Area 1.58 ha)		
Borrow Area	**Overburden (Topsoil) (m^3)**	**Construction Material (m^3)**
3	10,200	91,900
Total (Incl. Bulking factor of 20%)	**12,240**	**110,280**

The extraction of the material from the borrow area will begin in the north with the excavation of the initial cut of borrow material following the stripping and stockpiling of topsoil. A portion of this rae excavated will be utilised as a sump area for the duration of the operation, allowing any stormwater to be directed to the low point. This will allow any sediment to settle out before being drained into the drain along the northern border of the Borrow Area 3.

The borrow area will also have silt fences places along the lowest boundary as a further erosion and sediment control measure.

4.4 Borrow Area Sidewalls

The proposed borrow area is large, but relatively shallow due to the material distribution in the soil profile and the limitation imposed by the groundwater levels. As a result, the deepest anticipated sidewall is expected to be approximately 2.7 m. It is proposed that these sidewalls be battered to a short-term slope of 1 (V): 2 (H).

4.5 Borrow Area Rehabilitation

Rehabilitation of the borrow areas will be affected by the final detailed design for the stopbank project. Rehabilitation will include the grading of the borrow area towards the north where the sump area will be rehabilitated and shaped to allow drainage into the drain running along the northern edge of the borrow area. Following the regrading of the area the stockpiled topsoil will be placed across the site. The following is recommended for closure:

- All sides and embankments of the borrow area are to be battered to a final slope of 1 (V): 3 (H).
- Topsoil material stockpiled prior to material extraction to be placed across the borrow area and shaped to leave a uniform, even base and shaped sides.
- If required, the base of the shaped floor needs to be revegetated by seeding or alternative suitable methods.

4.6 Risks

The use of these borrow areas has certain risks associated with it, which must be considered by HBRC before deciding whether to use the material. These risks are:

- Groundwater: The possibility of seasonal fluctuations in groundwater levels may impose restrictions on the depth to which materials can be excavated, and thus, the available volume of construction material may be restricted. In the absence of regional groundwater monitoring data, the volume estimates given in this report are based on groundwater conditions as encountered during the site investigation only with no seasonal variations taken into consideration.
- Material Distribution: The soil profiles on this site are depositional and may vary over short distances, both vertically and horizontally. A degree of uniformity is inferred based on the test pit data. It will, however, be essential that material excavated be closely monitored to ensure that any unsuitable material is not excavated or used as fill for the stop banks.
- Material Properties: The target material at this site does not comply with HBRC's (2021) particle size distribution grading specification. Other stop banks in the Hawke's Bay region appear to have been constructed using similar materials and these have performed acceptably during Cyclone Gabrielle.
- Flood Modelling: Following rehabilitation of the borrow areas, there will be surface depressions, estimated to be less than 1m deep compared with current ground levels. The deepest parts of the borrow areas will be filled first to leave an evenly graded floor level. Regardless of the closure method, the effects of the surface depression on future floods should be considered:
  - It is suggested that the borrow area should start at the lowest point which could become the settlement pond area as the material excavation progresses.
  - The flow direction of surface water may be dictated by these low-lying areas.
  - The remaining depressions could act as a sediment trap for any sediment contained in floodwater.
  - The depressions will form a potential point of groundwater ingress. Given the size of the area, it is expected that the effects on groundwater will be minimal.

5.0 Conclusions

Potential material sources for the construction of the proposed Pōrangahau Stopbank were identified by HBRC. However, the material sources have practical limitations and risks associated with them, which need to be taken into consideration.

The total volume of usable material from Borrow Area 3 (Approximately 110,280 m^3(bulked)) exceeds what is required for the proposed stopbank embankments and floodwall foundations (estimated at approximately 47,000 m^3 including a 20 % bulking factor).

6.0 References

HBRC: Hawke's Bay Regional Council, (2021). *IRG Level of Service Upgrade Project Consultation Briefing Document for Stopbank NG3827R Raupare Upper (V2.3).*

NZGS: New Zealand Geotechnical Society, 2005. *Field Description of Soil and Rock for Engineering Purposes*.

7.0 Limitations

This document has been prepared based on geotechnical material test results provided by WSP and field test logs captured by PDP. The site conditions as described in this document have been interpreted from, and are subject to, this information and its limitations and accordingly PDP does not represent that its interpretation accurately represents the full site conditions.

The advice and opinions expressed in this document are based on the observation and sampling of a series of test pits at the site. The geological and associated environmental conditions interpolated between the test pits are not guaranteed to be accurate.

This assessment is limited to collection and analysis of soil and/or groundwater samples from discrete sampling locations. Interpretations of subsurface conditions, including contaminant concentrations, are not guaranteed at distance away from the specific points of sampling.

This report has been prepared by PDP on the specific instructions of Hawke's Bay Regional Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by

Paul Lombard

Service Leader - Geotechnics

Reviewed and approved by

Gerald Strayton

Technical Director – Geotechnics

Appendix A: Test Pit Logs

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INVESTIGATION LOG

Job No.: HB01041700
Test No.: TP07
Sheet: 1 of 1
Date: 27/08/25
Ground Level mRL: 7.9m (NZVD 2016)

Client: Hawke's Bay Regional Council
Project: Porangahau Stop Banks
Site Address: Porangahau
Coordinates: 1907240mE, 5532094mN (NZTM)

Interpretation	Geological Description (Soil and Rock logged in accordance with New Zealand Geotechnical Society field description of soil and rock (2005).)	Depth (m)	RL (m)
Topsoil	Sandy, SILT; dark brownish grey. Soft - firm; moist; sand, fine; Abundant rootlets.	0.5	7.5
Holocene River Deposits	Clayey, SILT; light grey mottled orange. Soft - firm; dry to moist; high plasticity; minor rootlets.	1.0	7.0
	Silty, CLAY; light grey mottled light yellowish orange. Soft - firm; dry to moist; high plasticity; Abundant wood fragments.	1.5	6.5
		2.0	6.0
	Silty, fine to medium SAND, with some clay; bluish grey. Loosely packed; moist; low plasticity; Abundant shell fragments.	2.5	5.5
	EOH: 3.20m Target Depth Achieved	3.0	5.0
		3.5	4.5
			4.0

Graphic Log: TS

Squeeze Zone

Samples: TP07/ 0.30 - 1.50m, TP07/ 1.50 - 2.70m,

Scala Penetrometer (Blows / 100 mm): 2 4 6 8 10 12 14 16 18

Vane Shear Strength (kPa) Vane: 50 100 150 200 Values

Water: Groundwater not encountered

Remarks
1. No groundwater encountered.
2. Backfilled with arising and track rolled at surface.
3. Bulk samples collected between 0.3-1.5 and 1.5-2.7 m bgl.

Investigation Type
- ☐ Hand Auger
- ☑ Test Pit

Water
- Standing Water Level
- In flow
- Out flow

Contractor:	Rig/Plant Used:	Logged By:	Checked By:	Hole Depth:
Galbraiths	16 Tonne Volvo EC140DL	PL	S McV	3.20 m

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INVESTIGATION LOG

Job No.: HB01041700
Test No.: TP08
Sheet: 1 of 1
Date: 27/08/25
Ground Level mRL: 7.9m (NZVD 2016)

Client: Hawke's Bay Regional Council
Project: Porangahau Stop Banks
Site Address: Porangahau
Coordinates: 1907309mE, 5532107mN (NZTM)

Interpretation	Geological Description (Soil and Rock logged in accordance with New Zealand Geotechnical Society field description of soil and rock (2005).)	Depth (m)	RL (m)
Topsoil	Sandy, SILT; dark brownish grey. Soft - firm; moist; sand, fine; Abundant rootlets.	0.0	7.9
Holocene River Deposits	Clayey, SILT; light grey mottled orange. Soft - firm; dry to moist; high plasticity; minor rootlets.	0.5	7.5
	Silty, CLAY; orange streaked light grey. Soft - firm; dry to moist; high plasticity; Abundant wood fragments.	1.0	7.0
		1.5	6.5
		2.0	6.0
		2.5	5.5
	Silty, fine to medium SAND, with some clay; bluish grey. Loosely packed; moist to wet; low plasticity; Abundant shell fragments.	3.0	5.0
	EOH: 3.20m Target Depth Achieved	3.5	4.5
		4.0	

Graphic Log: TS

Squeeze Zone

Samples: TP08/ 0.30 - 1.35m, TP08/ 1.35 - 2.60m,

Scala Penetrometer (Blows / 100 mm): 2 4 6 8 10 12 14 16 18

Vane Shear Strength (kPa) Vane: 50 100 150 200 Values

Water

Remarks

1. Seepage at 2.4 m bgl.
2. Backfilled with arising and track rolled at surface.
3. Bulk samples collected between 0.3-1.35 and 1.35-2.6 m bgl.

Investigation Type

- ☐ Hand Auger
- ☑ Test Pit

Water

- Standing Water Level
- In flow
- Out flow

Contractor:	Rig/Plant Used:	Logged By:	Checked By:	Hole Depth:
Galbraiths	16 Tonne Volvo EC140DL	PL	S McV	3.20 m

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INVESTIGATION LOG

Job No.: HB01041700
Test No.: TP09
Sheet: 1 of 1
Date: 27/08/25
Ground Level mRL: 8.2m (NZVD 2016)

Client: Hawke's Bay Regional Council
Project: Porangahau Stop Banks
Site Address: Porangahau
Coordinates: 1907255mE, 5532174mN (NZTM)

Interpretation	Geological Description (Soil and Rock logged in accordance with New Zealand Geotechnical Society field description of soil and rock (2005).)	Depth (m)	RL (m)
Topsoil	Sandy, SILT; dark brownish grey. Soft - firm; moist; sand, fine; Abundant rootlets.	0.0	8.2
Holocene River Deposits	Clayey, SILT; light grey mottled orange. Soft - firm; dry to moist; high plasticity; minor rootlets.	0.5	7.5
		1.0	7.0
		1.5	6.5
	Silty, CLAY; light grey mottled light yellowish orange. Soft - firm; dry to moist; high plasticity; Abundant wood fragments.	2.0	6.0
		2.5	5.5
	Silty, fine to medium SAND, with some clay; bluish grey. Medium dense; moist; low plasticity; Abundant shell fragments.	3.0	5.0
	EOH: 3.30m Target Depth Achieved	3.5	4.5

Graphic Log | Squeeze Zone | Samples | Scala Penetrometer (Blows / 100 mm): 2 4 6 8 10 12 14 16 18 | Vane Shear Strength (kPa) Vane: 50 100 150 200 Values | Water

Remarks

1. Seepage at 3.15 m bgl.
2. Backfilled with arising and track rolled at surface.
3. No bulk samples collected.

Investigation Type

- ☐ Hand Auger
- ☑ Test Pit

Water

- Standing Water Level
- In flow
- Out flow

Contractor:	Rig/Plant Used:	Logged By:	Checked By:	Hole Depth:
Galbraiths	16 Tonne Volvo EC140DL	PL	S McV	3.30 m

TP07: 0.0-3.2 m bgl

TP08: 0.0-3.2 m bgl

TP09: 0.0-3.3 m bgl

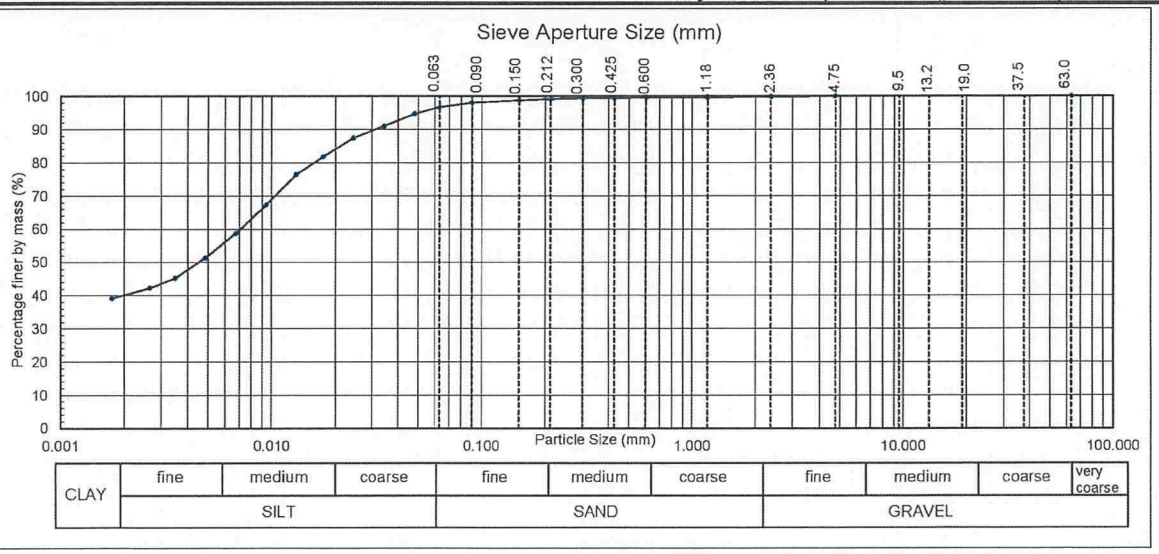
Appendix B: Laboratory Test Results

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT

Project :	**Porangahau Laboratory Testing**
Location :	**Porangahau**
Client :	**Pattle Delamore Partners Ltd**
Client/Sample Ref :	**Test Pits 07 and 08**
Consultant :	**WSP Napier Laboratory**
Test Pit No:	**7** Depth: **0.3-1.5 metres**
Sampled by :	**Client**
Date sampled :	**27/08/25**
Sampling method :	**Not stated, Test pit samples**
Sample condition :	**As received, sealed, moist**
Sample description :	**Clayey SILT, trace of sand; grey, mottled orange.**
Solid Particle Density (t/m^3):	**2.65** **Assumed**
Water Content (as received):	**29.1** **%**

Project No:	**2-L0728.25**
Lab Ref No:	**NA9670_WA1**
Client Ref:	**1,2 TP07/0.3-1.5 m**

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	0.0481	95	0.0068	59
37.5	--	2.36	100	0.212	99	0.0343	91	0.0049	51
19.0	--	1.18	100	0.150	99	0.0245	87	0.0035	45
13.2	--	0.600	100	0.090	98	0.0175	82	0.0027	42
9.5	--	0.425	100	0.063	97	0.0130	76	0.0018	39
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0094	67		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	pH of suspension : 9.5 (Macherey Nagel 0-14 pH Indicator strip)
	All information supplied by Client

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 05-15/09/2025

Date Reported: 16/09/25

Approved Signatory R Jones

Designation : *Laboratory Manager*

Date : 18/09/25

ACCREDITED IANZ TESTING LABORATORY

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

WSP
Whanganui (Rakau Road)
Quality Management Systems Certified to ISO 9001

Unit 1, 18 Rakau Road, Castlecliff
PO Box 654, 4541, Whanganui, New Zealand

Telephone 03 349 6640
Website www.wsp.com/nz

DRY DENSITY / WATER CONTENT RELATIONSHIP
HEAVY COMPACTION

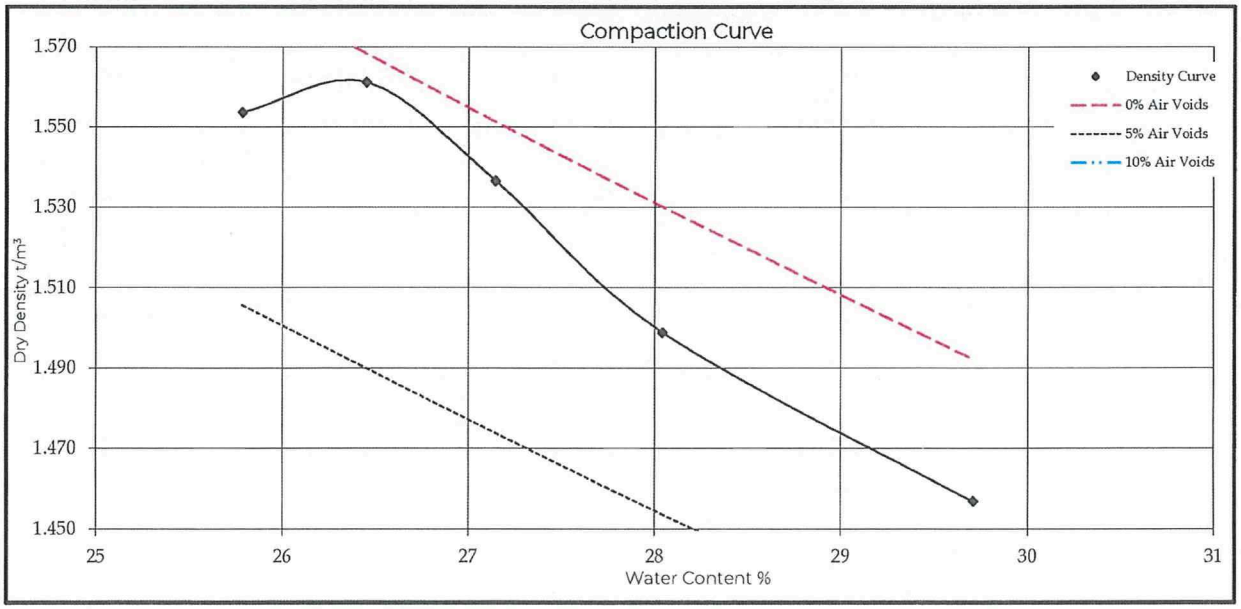
Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand. grey, mottled orange
Sample condition :	As Received
Solid density :	2.68 t/m³ (Assumed)
Source :	TP07 (0.3m - 1.5m)

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Maximum dry density	1.56	t/m³	Natural water content	26.4 %
Optimum water content	26.4	%	Fraction tested	Whole

Sample ID		-1	Nat	1	2	3		
Bulk density	t/m³	1.954	1.974	1.954	1.919	1.890		
Water content	%	25.8	26.4	27.1	28.0	29.7		
Dry density	t/m³	1.554	1.561	1.537	1.499	1.457		
Sample condition		Moist	Moist	Moist	Wet	Wet		



Test Methods		Notes
Compaction	NZS 4402 : 1986 Test 4.1.2 (Heavy)	

Date tested : 04/09/25
Date reported : 19/09/25

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

ACCREDITED IANZ TESTING LABORATORY

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

WSP
Napier (Cadbury Rd)
Quality Management Systems Certified to ISO 9001
10 Cadbury Rd
Private Bag 6019 , Hawkes Bay Mail Centre, 4142, Napier, New Zealand
Telephone 06 833 5590
Website www.wsp.com/nz

PLASTICITY INDEX FOR SOILS
TEST REPORT

Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand, grey, mottled orange
Sample condition :	As Received
Sample reference:	TP07
Sample depth:	0.3m - 1.5m

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results		
Liquid Limit :	63	
Plastic Limit :	29	
Plasticity Index :	34	
Natural Water Content :	24.8	%
Linear Shrinkage:	14	%

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Fraction passing 425µm test sieve
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	
Water Content	NZS 4402 : 1986, Test 2.1	
Linear Shrinkage	NZS 4402: 1986 Test 2.6	

Date tested : 04/09/25
Date reported : 19/09/25

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

ACCREDITED IANZ TESTING LABORATORY

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

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Private Bag 6019 , Hawkes Bay Mail Centre, 4142, Napier, New Zealand

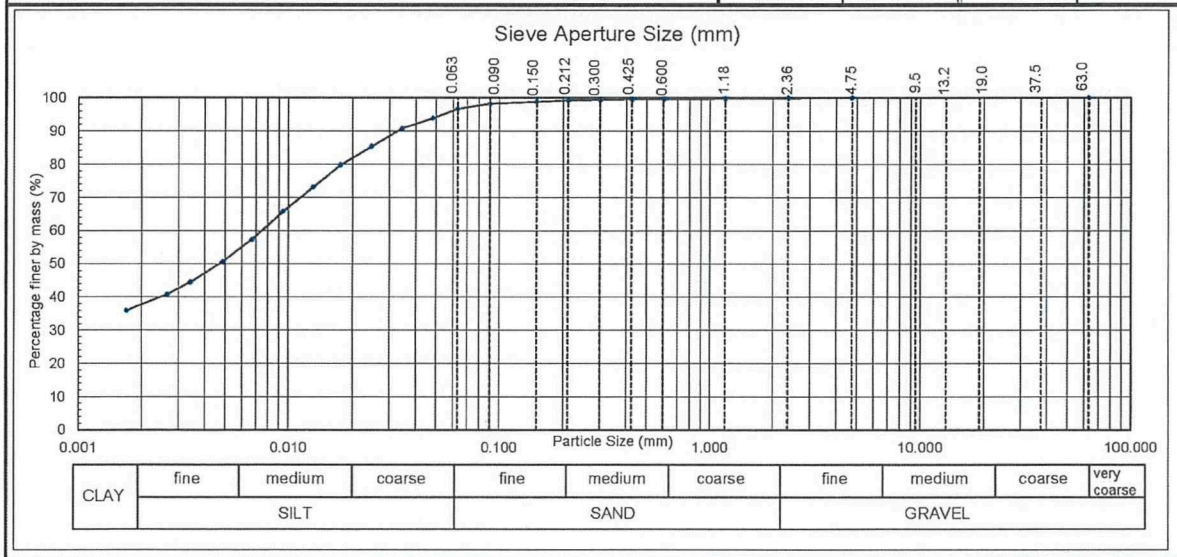
Telephone 06 833 5590
Website www.wsp.com/nz

PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT

Project :	**Porangahau Laboratory Testing**
Location :	**Porangahau**
Client :	**Pattle Delamore Partners Ltd**
Client/Sample Ref :	**Test Pits 07 and 08**
Consultant :	**WSP Napier Laboratory**
Test Pit No:	**7** Depth: **1.5-2.7 metres**
Sampled by :	**Client**
Date sampled :	**27/08/25**
Sampling method :	**Not stated, Test pit samples**
Sample condition :	**As received, sealed, moist**
Sample description :	**Clayey SILT, trace of sand; grey, mottled orange.**
Solid Particle Density (t/m^3):	**2.65** **Assumed**
Water Content (as received):	**28.6** **%**

Project No:	2-L0728.25
Lab Ref No:	NA9670_WA2
Client Ref:	3,4 TP07/1.5-2.7 m

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	0.0483	94	0.0067	57
37.5	--	2.36	100	0.212	99	0.0344	91	0.0049	51
19.0	--	1.18	100	0.150	99	0.0246	85	0.0034	44
13.2	--	0.600	100	0.090	98	0.0176	80	0.0027	41
9.5	--	0.425	100	0.063	97	0.0131	73	0.0017	36
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0094	66		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	pH of suspension : 9.5 (Macherey Nagel 0-14 pH Indicator strip) All information supplied by Client

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 05-15/09/2025

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Date Reported: 16/09/25

Approved Signatory R Jones

Designation : *Laboratory Manager*

Date : 18/09/25

ACCREDITED IANZ TESTING LABORATORY

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DRY DENSITY / WATER CONTENT RELATIONSHIP
HEAVY COMPACTION

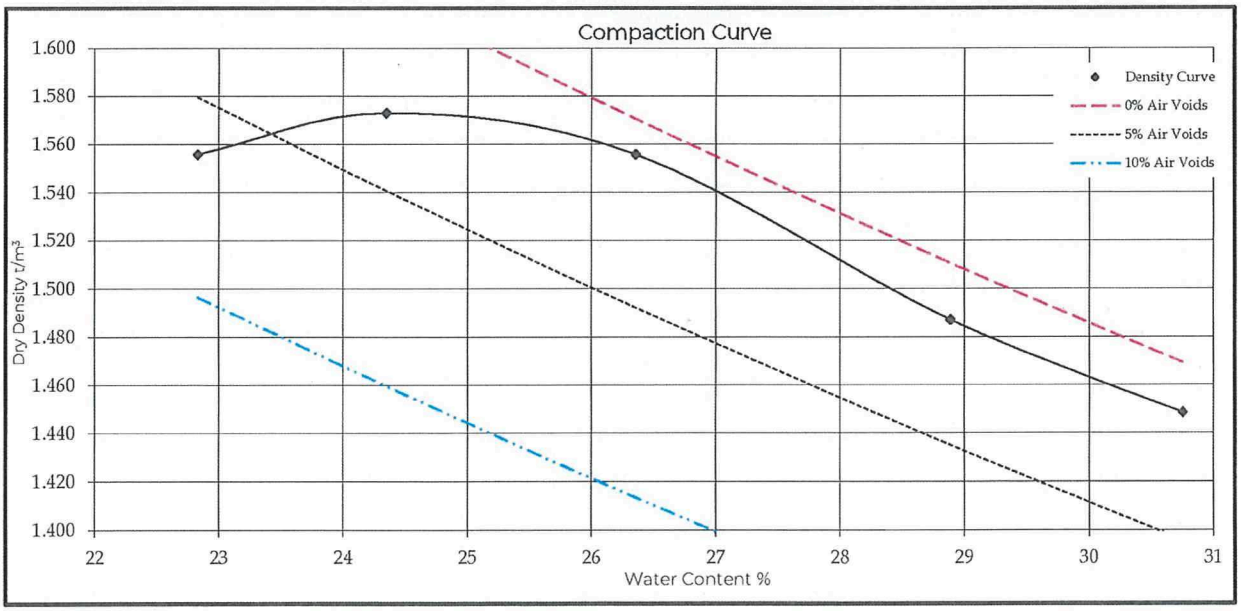
Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand. grey, mottled orange
Sample condition :	As Received
Solid density :	2.68 t/m³ (Assumed)
Source :	TP07 (1.5m - 2.7m)

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Maximum dry density	1.57	t/m³	Natural water content	28.9 %
Optimum water content	24.4	%	Fraction tested	Whole

Sample ID		-3	-2	-1	Nat	1		
Bulk density	t/m³	1.911	1.956	1.966	1.917	1.894		
Water content	%	22.8	24.3	26.4	28.9	30.8		
Dry density	t/m³	1.556	1.573	1.556	1.487	1.449		
Sample condition		Moist	Moist	Moist	Wet	Wet		



Test Methods		Notes
Compaction	NZS 4402 : 1986 Test 4.1.2 (Heavy)	

Date tested : 04/09/25
Date reported : 19/09/25

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

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PLASTICITY INDEX FOR SOILS
TEST REPORT

Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand, grey, mottled orange
Sample condition :	As Received
Sample reference:	TP07
Sample depth:	1.5m - 2.7m

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Liquid Limit :	67	
Plastic Limit :	30	
Plasticity Index :	37	
Natural Water Content :	25.3	%
Linear Shrinkage:	16	%

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Fraction passing 425µm test sieve
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	
Water Content	NZS 4402 : 1986, Test 2.1	
Linear Shrinkage	NZS 4402: 1986 Test 2.6	

Date tested : 04/09/25
Date reported : 19/09/25

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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

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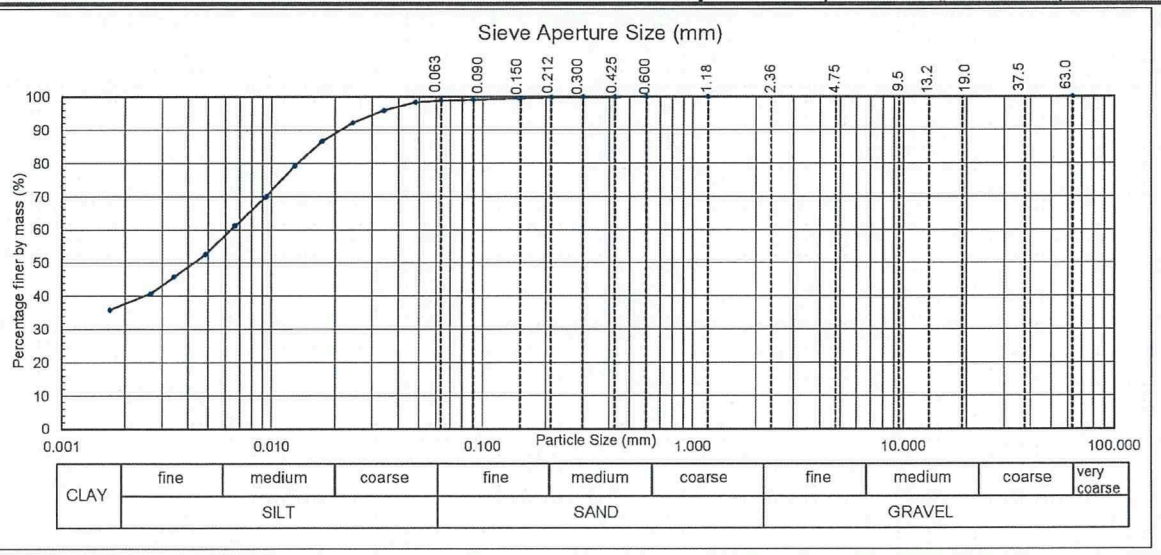
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT

Project :	**Porangahau Laboratory Testing**
Location :	**Porangahau**
Client :	**Pattle Delamore Partners Ltd**
Client/Sample Ref :	**Test Pits 07 and 08**
Consultant :	**WSP Napier Laboratory**
Test Pit No:	**8** Depth: **0.3-1.35 metres**
Sampled by :	**Client**
Date sampled :	**27/08/25**
Sampling method :	**Not stated, Test pit samples**
Sample condition :	**As received, sealed, moist**
Sample description :	**Clayey SILT, trace of sand; grey, mottled orange.**
Solid Particle Density (t/m^3):	**2.65** **Assumed**
Water Content (as received):	**39.2** **%**

Project No:	2-L0728.25
Lab Ref No:	NA9670_WA3
Client Ref:	5,6 TP08/0.3-1.35 m

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	100	0.0479	98	0.0067	61
37.5	--	2.36	--	0.212	100	0.0341	96	0.0048	53
19.0	--	1.18	100	0.150	99	0.0243	92	0.0034	46
13.2	--	0.600	100	0.090	99	0.0174	87	0.0027	41
9.5	--	0.425	100	0.063	99	0.0129	79	0.0017	36
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0093	70		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	pH of suspension : 9.5 (Macherey Nagel 0-14 pH Indicator strip) All information supplied by Client

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 05-15/09/2025

This report may only be reproduced in full.

Date Reported: 16/09/25

Approved Signatory R Jones

Designation : *Laboratory Manager*

Date : 18/09/25

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DRY DENSITY / WATER CONTENT RELATIONSHIP
HEAVY COMPACTION

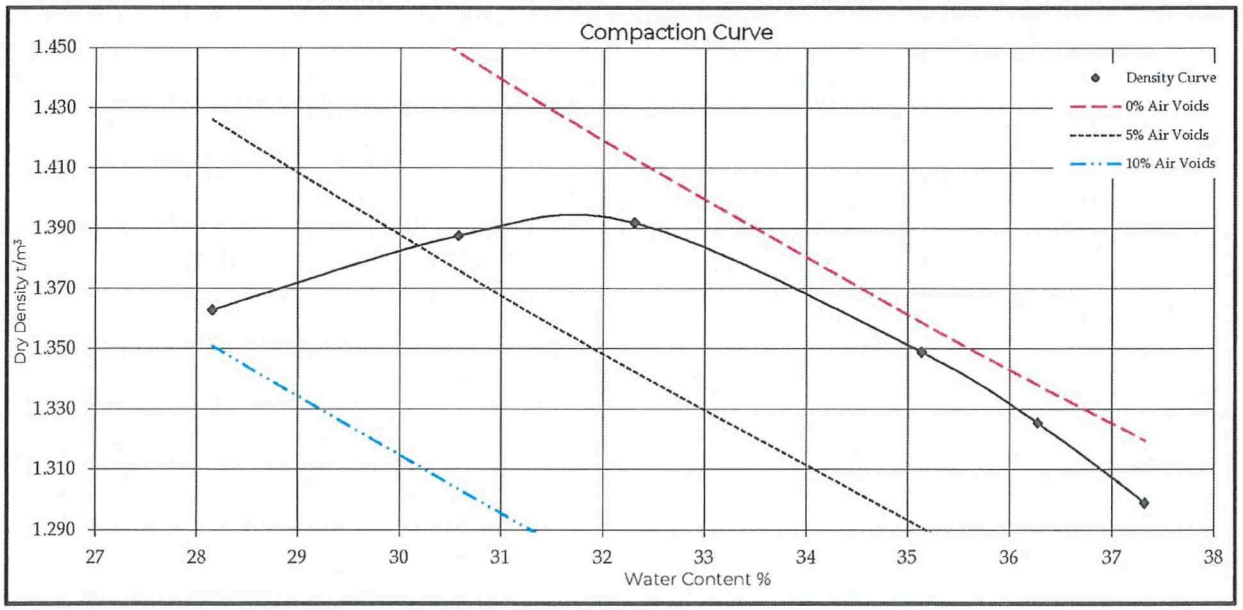
Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand. grey, mottled orange
Sample condition :	As Received
Solid density :	2.60 t/m³ (Assumed)
Source :	TP08 (0.3m - 1.35m)

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Maximum dry density	1.39 t/m³	Natural water content	35.1 %
Optimum water content	32.3 %	Fraction tested	Whole

Sample ID		-6	-4	-2	Nat	1	2	
Bulk density	t/m³	1.747	1.812	1.841	1.823	1.806	1.784	
Water content	%	28.2	30.6	32.3	35.1	36.3	37.3	
Dry density	t/m³	1.363	1.387	1.392	1.349	1.325	1.299	
Sample condition		Moist	Moist	Moist	Wet	Wet	Wet	



Test Methods		Notes
Compaction	NZS 4402 : 1986 Test 4.1.2 (Heavy)	

Date tested : 04/09/25
Date reported : 19/09/25

Approved J. Crichton

Designation : *Laboratory Manager*
Date : 19/09/25

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PLASTICITY INDEX FOR SOILS
TEST REPORT

Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand, grey, mottled orange
Sample condition :	As Received
Sample reference:	TP08
Sample depth:	0.3m - 1.35m

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results		
Liquid Limit :	68	
Plastic Limit :	34	
Plasticity Index :	34	
Natural Water Content :	37	%
Linear Shrinkage:	16	%

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Fraction passing 425µm test sieve
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	
Water Content	NZS 4402 : 1986, Test 2.1	
Linear Shrinkage	NZS 4402: 1986 Test 2.6	

Date tested : 04/09/25
Date reported : 19/09/25

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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

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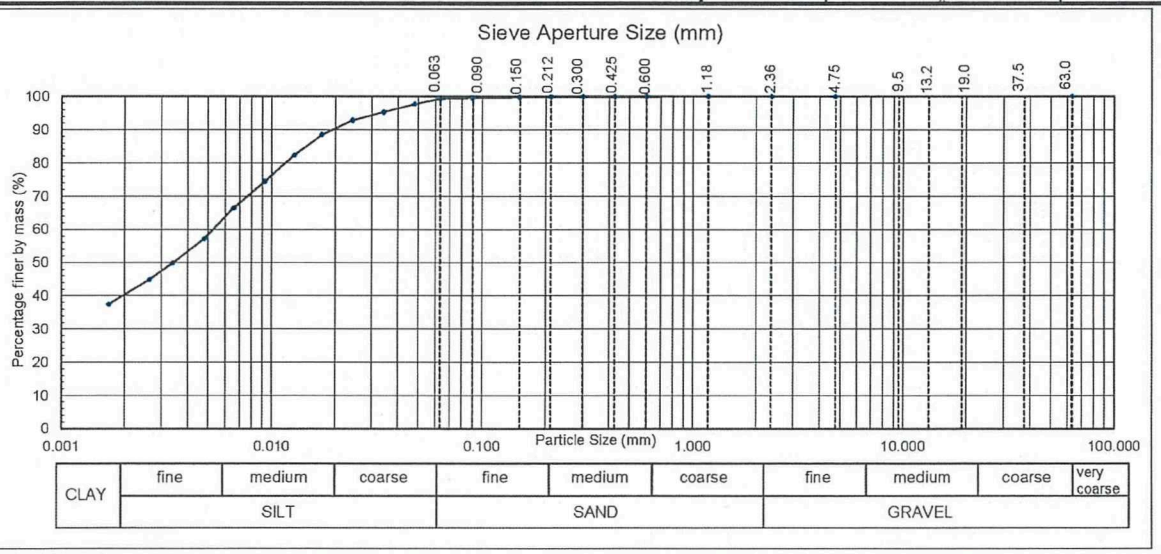
PARTICLE SIZE ANALYSIS (HYDROMETER METHOD)
TEST REPORT

Project :	**Porangahau Laboratory Testing**
Location :	**Porangahau**
Client :	**Pattle Delamore Partners Ltd**
Client/Sample Ref :	**Test Pits 07 and 08**
Consultant :	**WSP Napier Laboratory**
Test Pit No:	**8** Depth: **1.35-2.60 metres**
Sampled by :	**Client**
Date sampled :	**27/08/25**
Sampling method :	**Not stated, Test pit samples**
Sample condition :	**As received, sealed, moist**
Sample description :	**Clayey SILT, trace of sand; grey, mottled orange.**
Solid Particle Density (t/m^3):	**2.65** **Assumed**
Water Content (as received):	**45.2** **%**

Project No:	2-L0728.25
Lab Ref No:	NA9670_WA4
Client Ref:	7,8 TP08/1.35-2.60 m

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	0.0479	98	0.0066	66
37.5	--	2.36	100	0.212	100	0.0341	95	0.0048	57
19.0	--	1.18	100	0.150	100	0.0242	93	0.0034	50
13.2	--	0.600	100	0.090	100	0.0173	89	0.0026	45
9.5	--	0.425	100	0.063	99	0.0128	82	0.0017	38
Note:	"--" denotes sieve not used and/or hydrometer analysis not tested					0.0092	74		



Test Methods	Notes
Particle Size Analysis: NZS 4402:1986: Test 2.8.4 (Washed Grading & Hydrometer Method)	pH of suspension : 9.5 (Macherey Nagel 0-14 pH Indicator strip) All information supplied by Client

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

Date Tested: 05-15/09/2025

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Date Reported: 16/09/25

Approved Signatory R Jones

Designation : *Laboratory Manager*

Date : 18/09/25

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DRY DENSITY / WATER CONTENT RELATIONSHIP
HEAVY COMPACTION

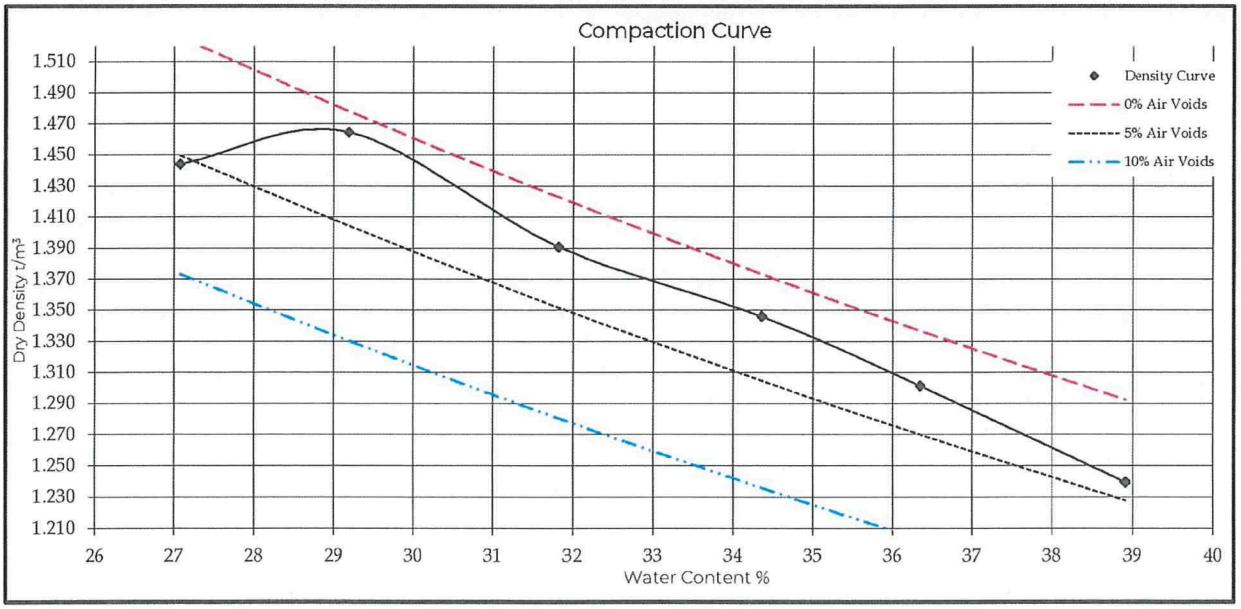
Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand. grey, mottled orange
Sample condition :	As Received
Solid density :	2.60 t/m³ (Assumed)
Source :	TP08 (1.35m - 2.60m)

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Maximum dry density	1.46 t/m³	Natural water content	38.9 %
Optimum water content	29.2 %	Fraction tested	Whole

Sample ID		-10	-8	-6	-4	-2	Nat	
Bulk density	t/m³	1.835	1.892	1.833	1.808	1.774	1.722	
Water content	%	27.1	29.2	31.8	34.4	36.3	38.9	
Dry density	t/m³	1.444	1.465	1.391	1.346	1.301	1.239	
Sample condition		Moist	Moist	Moist	Wet	Wet	Wet	



Test Methods		Notes
Compaction	NZS 4402 : 1986 Test 4.1.2 (Heavy)	

Date tested : 04/09/25
Date reported : 19/09/25

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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

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PLASTICITY INDEX FOR SOILS
TEST REPORT

Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand, grey, mottled orange
Sample condition :	As Received
Sample reference:	TP08
Sample depth:	1.35m - 2.60m

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Liquid Limit :	70	
Plastic Limit :	33	
Plasticity Index :	37	
Natural Water Content :	44.2	%
Linear Shrinkage:	16	%

Test Methods		Notes
Liquid Limit	NZS 4402 : 1986, Test 2.2	Materials used: Passing 425um sieve
Plastic Limit	NZS 4402 : 1986, Test 2.3	
Plasticity Index	NZS 4402 : 1986, Test 2.4	
Water Content	NZS 4402 : 1986, Test 2.1	
Linear Shrinkage	NZS 4402: 1986 Test 2.6	

Date tested : 04/09/25
Date reported : 19/09/25

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Approved Signatory
J. Crichton
Designation : *Laboratory Manager*
Date : 19/09/25

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CALIFORNIA BEARING RATIO (REMOULDED) TEST REPORT

Project :	Porangahau Laboratory Testing
Location :	Porangahau
Client :	P. Lombard
Contractor :	Pattle Delamore Partners Ltd
Sampled by :	Client
Date sampled :	29/08/25
Sampling method :	Unknown
Sample description :	Clayey SILT, trace of sand, grey, mottled orange
Sample condition :	As Received

Project No :	2-L0728.25
Lab Ref No :	NA9670
Client Ref No :	

Test Results

Sample ID		TP07	TP07	TP08	TP08
Location		0.3m-1.5m	1.5m-2.7	0.3m-1.35m	1.35m-2.6
Sample condition at compaction		Moist	Moist	Moist	Moist
Sample condition at test		Soaked	Soaked	Soaked	Soaked
Sample description		Clayey SILT, trace of sand, grey. mottled orange			
Curing time	days	0	0	0	0
Soaking time	days	4	4	4	4
Passing 19mm	%	100	100	100	100
Surcharge mass	kg	4.0	4.0	4.0	4.0
Lime additive	%	0	0	0	0
Cement additive	%	0	0	0	0
Swell	%	2	1.5	1.5	2
Penetration	mm	2.5 / 5	2.5	2.5 / 5	2.5/5.0
Water content as received	%	24.8	25.3	37.0	44.2
Water content as compacted	%	26.9	28.6	36.2	43.8
Water content after testing	%	32.0	36.0	42.4	50.5
Dry density	t/m³	1.52	1.49	1.33	1.18
CBR value	%	**2.5**	**2.5**	**1.5**	**1**

Test Methods		Notes	
CBR	NZS : 4402 : 1986 : 6.1.1	Material Used	Whole Soil
Water Content	NZS : 4402 : 1986 : 2.1	Rate of penetration	1mm/min
Compaction	NZS : 4402 : 1986 : 4.1.1 (Standard)		

Date tested : 08/09/25
Date reported : 19/09/25

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J. Crichton
Designation : *Laboratory Manager*
Date : 22/09/25

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