



Rangitikei District Council

**GEOTECHNICAL ASSESSMENT REPORT
FOR RESIDENTIAL LAND-USE CHANGES**

Bulls, Marton & Mangaweka High Level Planning

DOCUMENT CONTROL

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EXECUTIVE SUMMARY

LDE Ltd was engaged by the Rangitikei District Council (RDC) to undertake a geotechnical review and assessment for potential future residential development areas (land-use change to residential) within the townships of Bulls, Marton, and Mangaweka.

Based on the assessment and appraisal of the sites reported herein, the proposed development areas have generally been assessed at a regional scale as suitable for land-use change / future residential development and are expected to be suitable for conventional construction in accordance with the relevant codes of practice.

The areas are summarised as below:

Bulls:

- Late Pleistocene alluvial deposits deposited on elevated marine terrace deposits. Moderate to high strength alluvial SILTs underlain by alluvial gravel at shallow depths.
- Generally level areas with minor stormwater channels / overland flow paths & minor alluvial undulations / terraces.
- No mapped active faults within the assessment areas.
- Unlikely / low liquefaction potential.
- Expected high strength soils allowing TC1 / NZS3604 foundations.
- Consideration for stormwater management / designs for new developments, may include earthworks and FFL requirements.
- Generally low instability risk.

Marton:

- Middle to Late Pleistocene alluvial deposits on elevated marine terrace deposits. Moderate to high strength alluvial and marine SILTs, expected to be underlain by gravel at greater depths.

- Generally level areas with minor to moderate stormwater channels / overland flow paths & minor alluvial undulations / terraces. Areas include existing stormwater management comprising of earth-dams with culverts maintained by Horizons Regional Council (HRC).
- A mapped active fault (a part of the Marton Fault Zone) is located within the Mar02 area. Our initial assessment concludes the likely presence of this fault and building restrictions within Fault Avoidance Area apply unless supported by detailed fault investigations.
- Unlikely / low liquefaction potential.
- Expected high strength soils allowing TC1 / NZS3604 foundations.
- Consideration for stormwater management / designs for new developments, may include earthworks and FFL requirements.
- Generally low instability risk. Consideration on / adjacent to moderate slopes unless mitigated by earthworks designs or planning designs (larger minimum lot sizes).

Mangaweka:

- Late Pleistocene alluvial deposits at the surface. Moderate to high strength alluvial SILTs and SANDs with gravel underlain by high strength sedimentary rock units at shallow depths.
- Generally level areas with minor stormwater channels / overland flow paths. Very steep and deep (10m+) alluvial channel which leads down to the incised Rangitikei River channel.
- Very steep, 60m high alluvial cut cliffs below Mangaweka leading down to the Rangitikei River.
- Negligible / low liquefaction potential.
- Expected high strength soils allowing TC1 / NZS3604 foundations.
- Consideration for stormwater management / designs for new developments, may include earthworks and FFL requirements. Area Mang01 lower than and constrained by both SH1 and the railway and therefore may be more prominent to flooding.
- Instability risk within Mang02 along deep channel and alluvial cliffs. Minimum setbacks distances behind a 45° line from the base is recommended unless supported by detailed stability assessments. A conservative set back distance as noted in the Slope Instability Section 5.3 can be adopted if determining the 45° line proves challenging.

A detailed walkover assessment and desktop review complimented with several verification tests were undertaken at a regional scale for information to provide RDC. All other geotechnical hazards within the site have been highlighted and generally assessed as either not present or of acceptable risk for future residential development. Specific assessments and designs can be undertaken at resource consent and the design phase for future developments. The recommendations are provided based on a regional scale walkover assessment to inform likely conditions and possible restraints for the proposed land-use changes.

This executive summary must not be taken out of context with the balance of this report, which should be read in full. Additional recommendations and considerations are made in the body of the report which provide the context for the above key findings relating to the development under consideration.

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1 INTRODUCTION

LDE Ltd was engaged by the Rangitikei District Council (RDC) to undertake a geotechnical review and assessment for potential future residential development areas within the townships of Bulls, Marton, and Mangaweka (Figure 1). The proposed areas provided by the RDC comprise several land parcels which are considered as potential future 'growth' areas (Figures 2 – 4) and are under consideration to have the land-use changed to residential.

The purpose of the review and assessment, including a small number of initial investigation confirmation testing, was to characterise the engineering geology of the sites, assess the potential risk of ground deformation affecting them, and to provide geotechnical opinions and recommendations for the sites. It is intended to provide an in depth review of the area and provide geotechnical information for RDC's planning purposes. Subsequent further detailed testing may be undertaken upon consideration of this information and 'refining' of the proposed 'best' areas for such land-use changes.

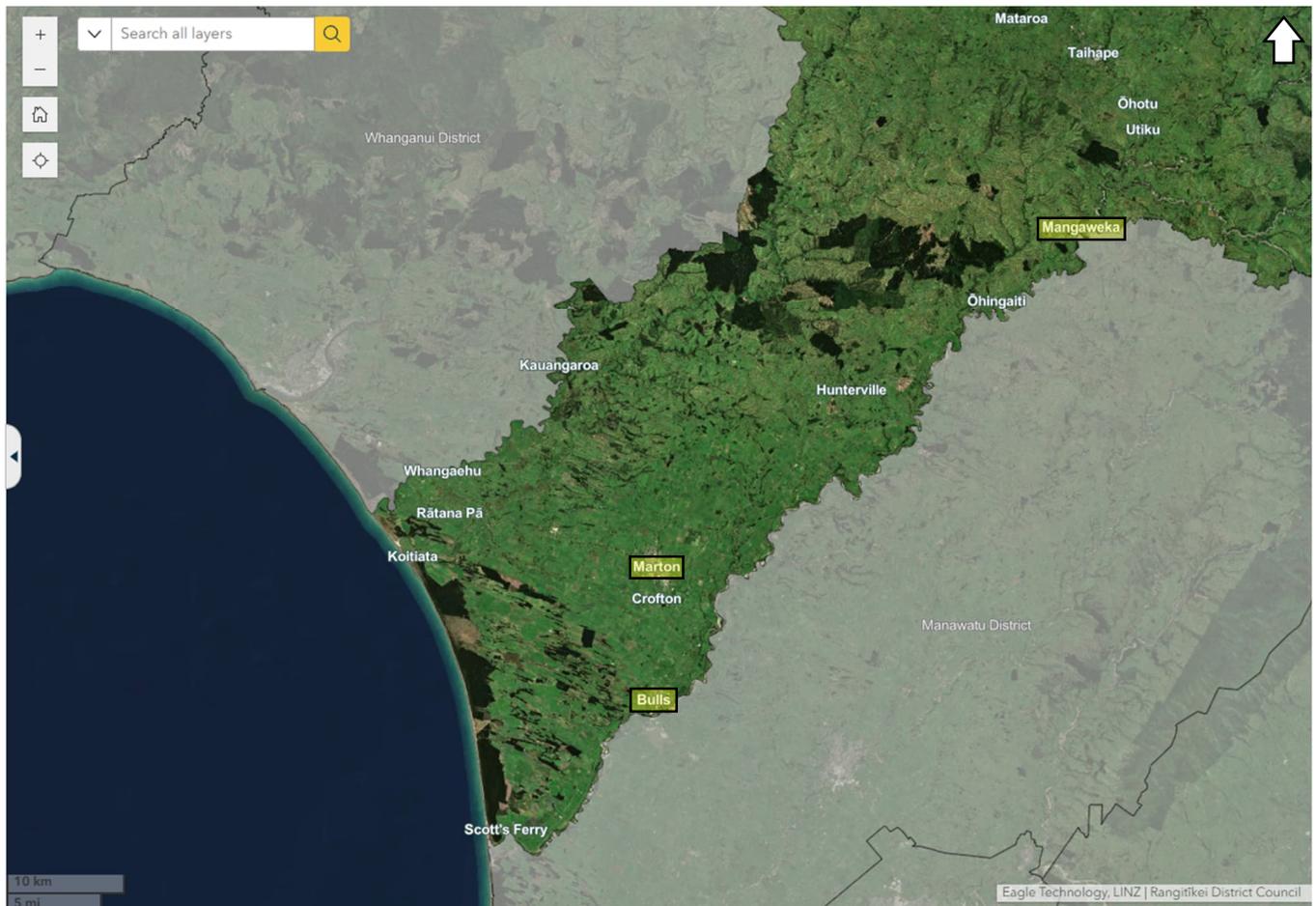


Figure 1: Location of Bulls, Marton and Mangaweka within the Rangitikei District (Source: RDC Online Maps).



Figure 2: Annotated image showing the assessment areas within Bulls as provided by RDC (Source: RDC Online Maps).

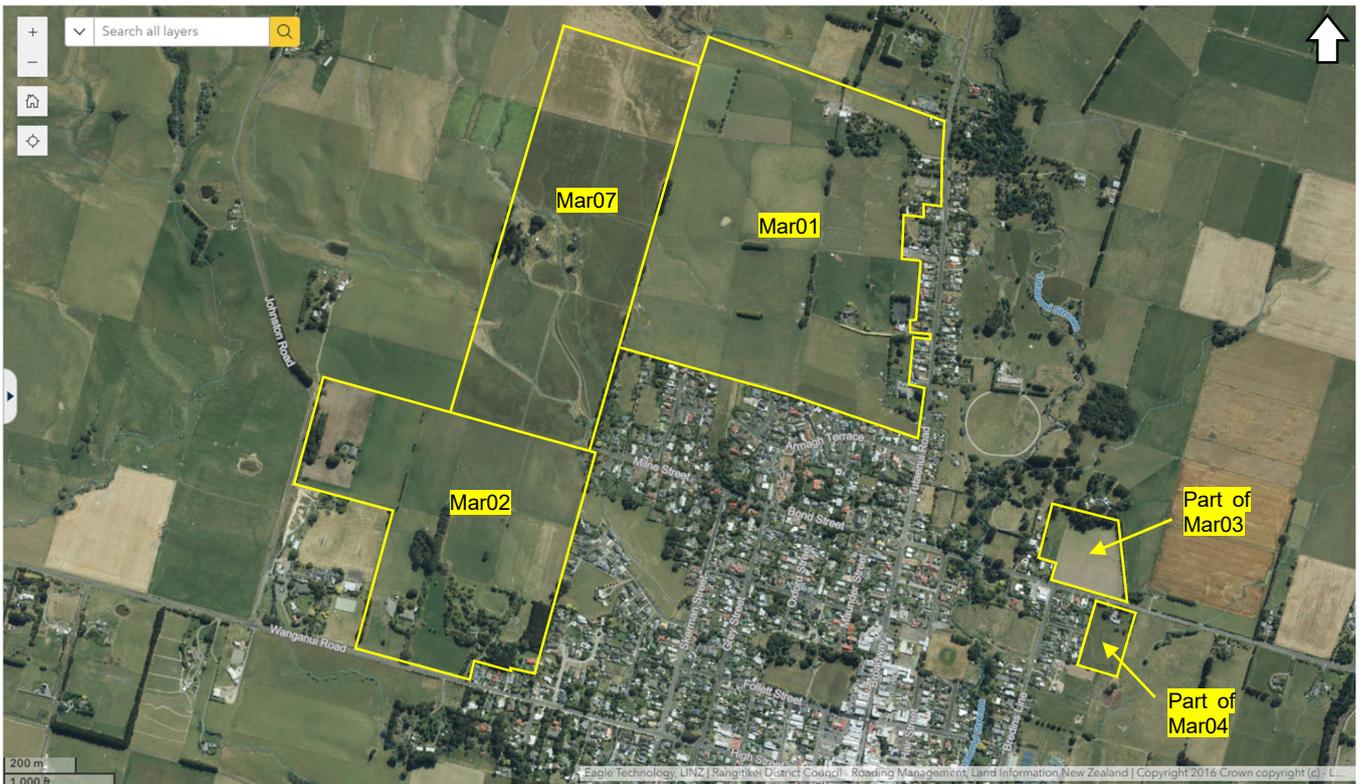


Figure 3: Annotated image showing the assessment areas within Marton as provided by RDC (Source: RDC Online Maps).

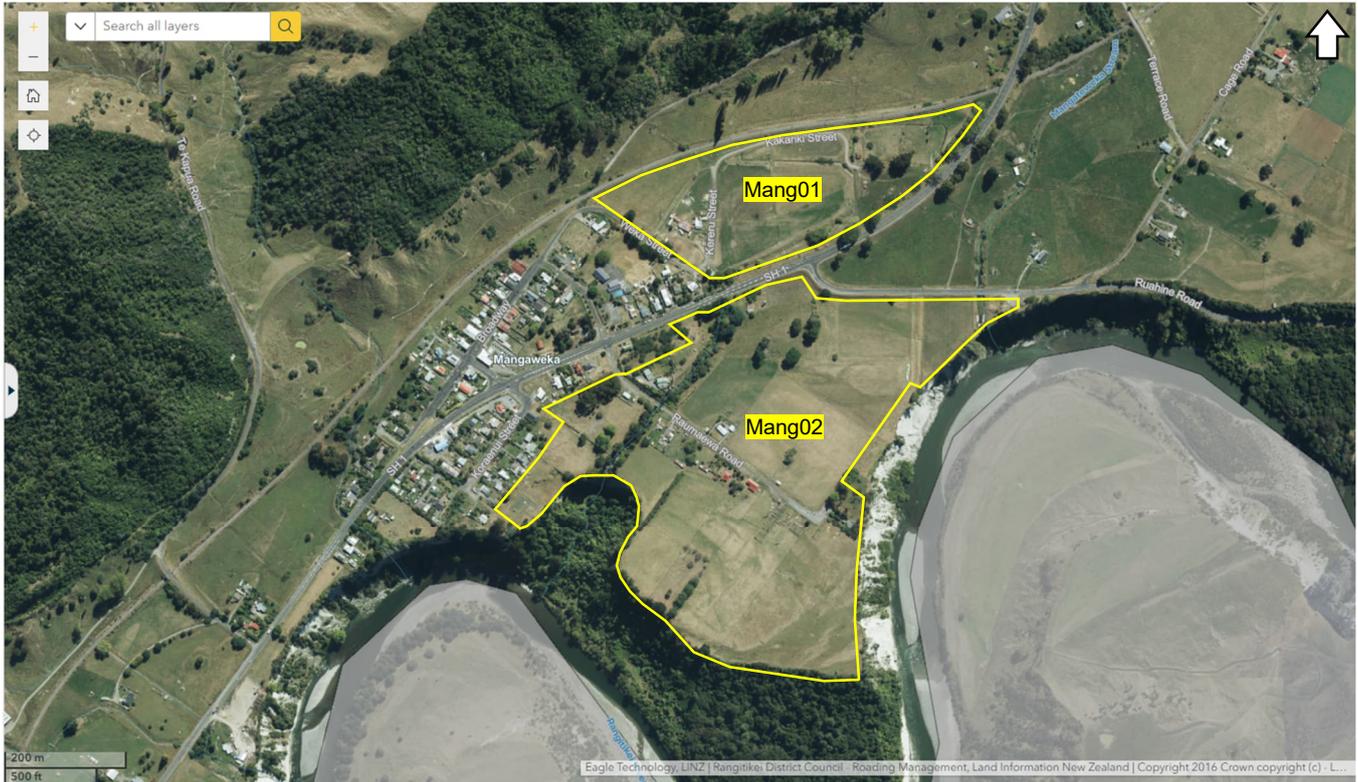


Figure 4: Annotated image showing the assessment areas within Mangaweka as provided by RDC (Source: RDC Online Maps).

2 GENERAL GEOTECHNICAL SUMMARY

The following summarises the assessment of the general expected geotechnical conditions of the regions. An in-depth assessment for each area is presented further within the report which highlights specific site details.

2.1.1 Bulls

- Late Pleistocene alluvial deposits located on (elevated) marine terrace deposits. Moderate to high strength alluvial SILTs underlain by alluvial gravel at shallow depths.
- Generally level areas with minor stormwater channels / overland flow paths & minor alluvial undulations / terraces.
- No mapped active faults within the assessment areas.
- Unlikely / low liquefaction potential.

2.1.2 Marton

- Middle to Late Pleistocene alluvial deposits located on (elevated) marine terrace deposits. Moderate to high strength alluvial and marine SILTs – likely to be underlain by gravel at greater depths.
- Generally level areas with minor to moderate stormwater channels / overland flow paths & minor alluvial undulations / terraces. Areas include existing stormwater management comprising of earth-dams with culverts.

- A mapped active fault (a part of the Marton Fault Zone) is located within the Mar02 area. Our initial assessment concludes the likely presence of this fault.
- Unlikely / low liquefaction potential.

2.1.3 Mangaweka

- Late Pleistocene alluvial deposits located on (elevated) marine terrace deposits. Moderate to high strength alluvial SILTs and SANDs with gravel underlain by high strength marine terrace deposits (sedimentary rock deposits) at shallow depths.
- Generally level areas with minor stormwater channels / overland flow paths. Very steep and deep (10m+) alluvial channel which leads down to the Rangitikei River.
- Very steep, 60m high alluvial cut cliffs below Mangaweka leading down to the Rangitikei River.
- Negligible / low liquefaction potential.

3 SITE SETTING

3.1 Desktop Review

Google Earth¹, the Rangitikei District Council Online Maps², Horizons Regional Council (HRC) Natural Hazard Viewer³, the GNS Active Faults Database⁴, GNS Online Geological Map⁵, NZ Geotechnical Database (NZGD)⁶, Listed Land Use Register (LLUR)⁷, and Land Information NZ (LINZ)⁸ were reviewed as a part of this desktop study and indicated the following:

3.1.1 Bulls

- The high-level LiDAR contour information (0.5-1.0m contours) available on the LINZ database for the Bulls area which covers the assessment areas returned data errors and therefore the contour data has not been reproduced.
- 8.0m contour data is available however the resolution quality does not highlight the minor / moderate features such as site undulations and drainage channels within the areas.
- The sites are situated outside of the mapped liquefaction susceptibility areas mapped within the Manawatu District (HRC Natural Hazard Viewer), with the “moderate” zone mapped to the immediate east of the Bul02 parcel. We note that this map is presented at a regional scale and is derived from the

¹ Google Earth Pro (Google Earth)

² RDC Online Maps (<https://experience.arcgis.com/experience/2051b410ad46457c91107167208ff238/page/Map-Views/?views=Property-View>)

³ HRC Natural Hazard Viewer (<https://experience.arcgis.com/experience/3f7b4ec2f6f14503af1146ce412de39e/page/Home>)

⁴ GNS Online Active Fault Database (<http://data.gns.cri.nz/af/>)

⁵ GNS Online Geological Map of New Zealand (<http://data.gns.cri.nz/geology/>)

⁶ NZ Geotechnical Database (<https://nzgd.org.nz/tenant/295/hierarchy/3563/level/1823/tag/Map0>)

⁷ Listed Land Use Register (LLUR) (<https://llur.ecan.govt.nz/home>)

⁸ Land Information NZ (LINZ Data) (<https://data.linz.govt.nz/>)

GNS Science Consultancy Report 2016/40⁹, with the “moderate” zone comprising the lower terrace levels adjacent to the Rangitikei River flowing to the southeast of the Bulls township (Figure 5 below). We further note that some of the mapped ‘low’ zones in the greater region (particularly the Horowhenua region & coast) have since been / had sites assessed and proven to be susceptible to liquefaction while conversely areas in the ‘moderate’ have been found to be underlain by thick expanses of gravels not susceptible to liquefaction. Therefore this map should be considered for guidance as a potential liquefaction susceptibility map and not solely relied upon even at a regional scale.

- The sites are not crossed by any active or in-active fault traces or Fault Avoidance Zones (FAZ) / Fault Awareness Areas (FAA).
- A machine borehole was undertaken in February 2020 on Walton Street, Bulls (to the south of Bul01 & Bul02, refer Figure 5). The geological logs (appended) are available on the NZGD (ID 150006) and show at least 15m of dense to very dense alluvial gravel deposits with a silt and sand matrix from beneath the 100mm topsoil layer.
- Bul01 and Bul02 are generally shown to have minimal ‘modelled wet extents’ as mapped under the HRC Flood Hazard 200yr (Bul02 includes an area not modelled). Bul03 is shown to be predominately mapped within a modelled wet extent (Figure 6 below).
- The sites have been predominately used for pastoral land. The former horse racing track is situated within the Bul02 area.
- The Listed Land Use Register (LLUR) does not currently have any information about a Hazardous Activities and Industries List (HAIL) site on / within the selected land parcels.

⁹ Dellow, G.D.; Abbott, E.R.; Heron, D.W.; Scott, B.J.; Ries, W.F.; Lukovic, B. 2016. Update of hazard Information for 2015 Lifelines Risk & Responsibilities Report, GNS Science Consultancy Report 2016/40. 33 p

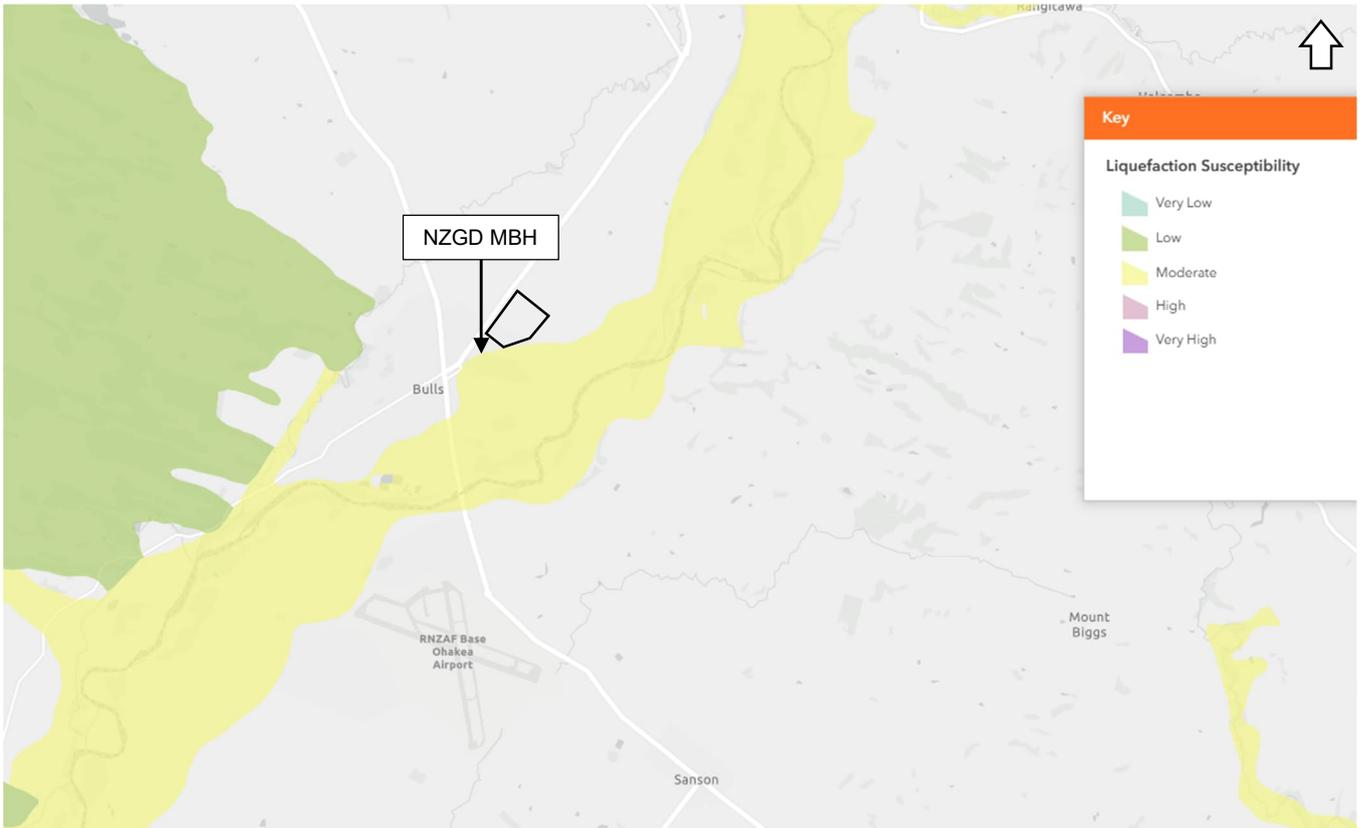


Figure 5: Horizons regional liquefaction map showing 'moderate' susceptibility within the lower alluvial terrace / channel of the Rangitikei River, and 'low' susceptibility to the west of Bulls (Source: HRC Natural Hazard Viewer). Annotated Bul02 area approximately shown.

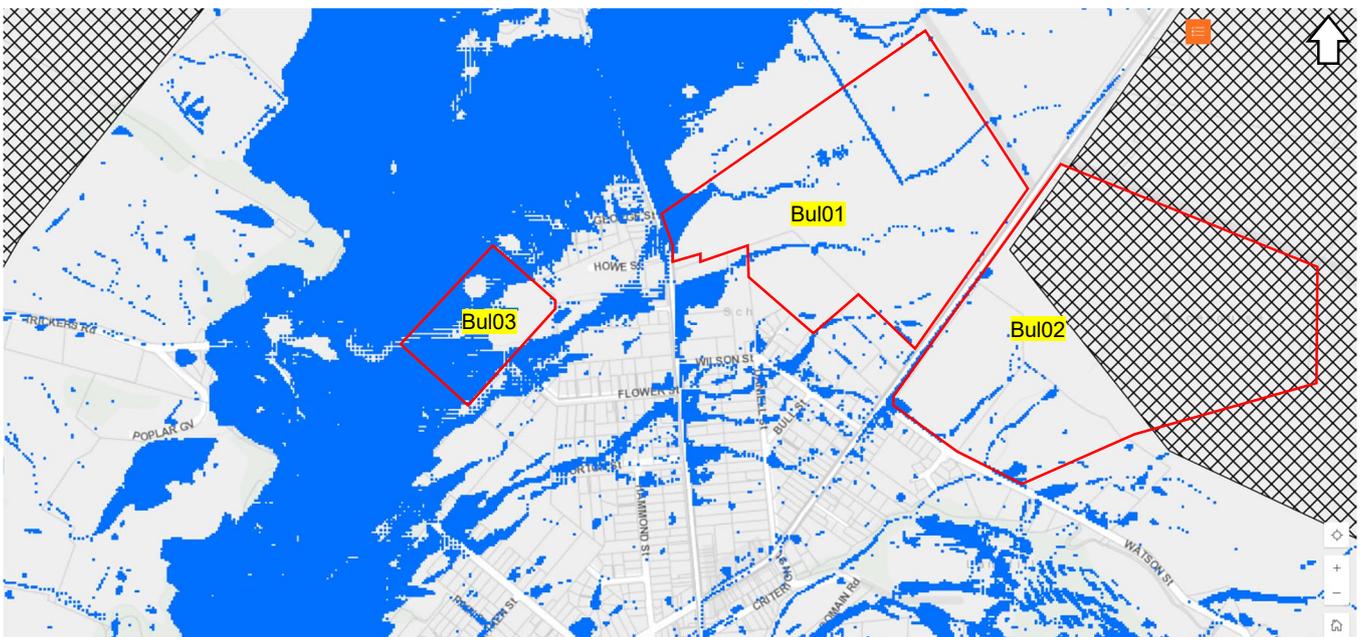


Figure 6: Mapped modelled wet extents for 200yr event for Bulls (Source: HRC Natural Hazard Viewer).

3.1.1.1 Published Geology

The 1:250,000 geological map of the region¹⁰ shows the sites as being underlain by Late Pleistocene aged river deposits. The deposits are described as consisting of 'poorly to moderately sorted gravel with minor sand and silt underlying terraces; includes minor fan deposits and loess' (Figure 7). It should be noted that more recently laid river deposits are likely present within and adjacent to watercourses due to ongoing erosion and redeposition.

The Leedstown active fault is mapped approximately 500m to the west of the western extent of Bul03. No Fault Avoidance Zone (FAZ) / Fault Awareness Area (FAA) associated with this fault are mapped across any of the sites³ (Figure 8).



Figure 7: Mapped geological units near Bulls (Source: GNS Geological Map).



Figure 8: Mapped Leedstown Fault to the west of Bulls (Source: GNS Active Fault Database).

¹⁰ Townsend, D.; Vonk, A.; Kamp, P.J.J. (compilers) 2008: Geology of the Taranaki area: scale 1:250,000. Lower Hutt: Institute of Geological & Nuclear Sciences Limited. Institute of Geological & Nuclear Sciences 1:250,000 geological map 7. 77 p. + 1 folded map.

3.1.1.2 Site Characteristics

The subject areas are generally located within the rural area to the northwest and northeast of Bulls.

Bul01 is generally level with a minor alluvial terrace / slope trending west to east within the southern half of the area. The land 'steps down' towards the south.

Bul02 is also generally level with several minor natural and formed stormwater channels within the site. The continuation of the alluvial terrace / slope trending west to east is situated within the northern corner of the area.

Bul03 is generally level with slight undulations. The continuation of the alluvial terrace / slope trending west to east is also situated within the southern corner of the area. A stormwater channel is present along the northeastern corner below the alluvial terrace / slope which then trends towards the west and cuts through the lower level of the area.

A series of representative photographs of the areas are presented in Appendix A.

3.1.2 Marton

- The high-level LiDAR contour information (0.5-1.0m contours) available on the LINZ database for the Marton area does not cover a majority of the assessment areas and therefore the contour data has not been reproduced.
- 8.0m contour data is available however the resolution quality does not highlight the minor / moderate features such as site undulations and drainage channels within the areas.
- The Marton sites are situated outside of the mapped liquefaction susceptibility areas mapped within the Manawatu District (HRC Natural Hazard Viewer).
- The majority of the sites are not crossed by any active or in-active fault traces or Fault Avoidance Zones (FAZ) / Fault Awareness Areas (FAA). However, a fault trace comprising a part of the Marton Fault Zone is mapped within the southern area of Mar02 as shown in Figure 10 below.
- A machine borehole was undertaken in March 2022 at 25 Milne Street, Marton (between areas Mar01, Mar02 & Mar07). The geological logs are available on the NZGD (ID 192993) and show approximately 5.2m of moderate to high strength surface soils (sands to clayey silts) underlain by dense to very dense alluvial gravel deposits with a sand matrix from 5.2m to the borehole depth of 10.65m. Groundwater was recorded at 8.6m depth.
- Mar01, Mar02, Mar07 and Part of Mar03 and Mar04 are generally shown to have minimal 'modelled wet extents' as mapped under the HRC Flood Hazard 200yr. However, the western and eastern extents beyond Marton include areas not modelled (Figure 9). Existing stormwater management and stormwater dam structures have been constructed and are present within / near areas Mar 01, Mar02 and Mar 07. The dams are managed and maintain by Horizons Regional Council (HRC) and are shown on the Marton Site Plan appended.
- The sites have been predominately used for pastoral land.

- The Listed Land Use Register (LLUR) does not currently have any information about a Hazardous Activities and Industries List (HAIL) site on / within the selected land parcels.

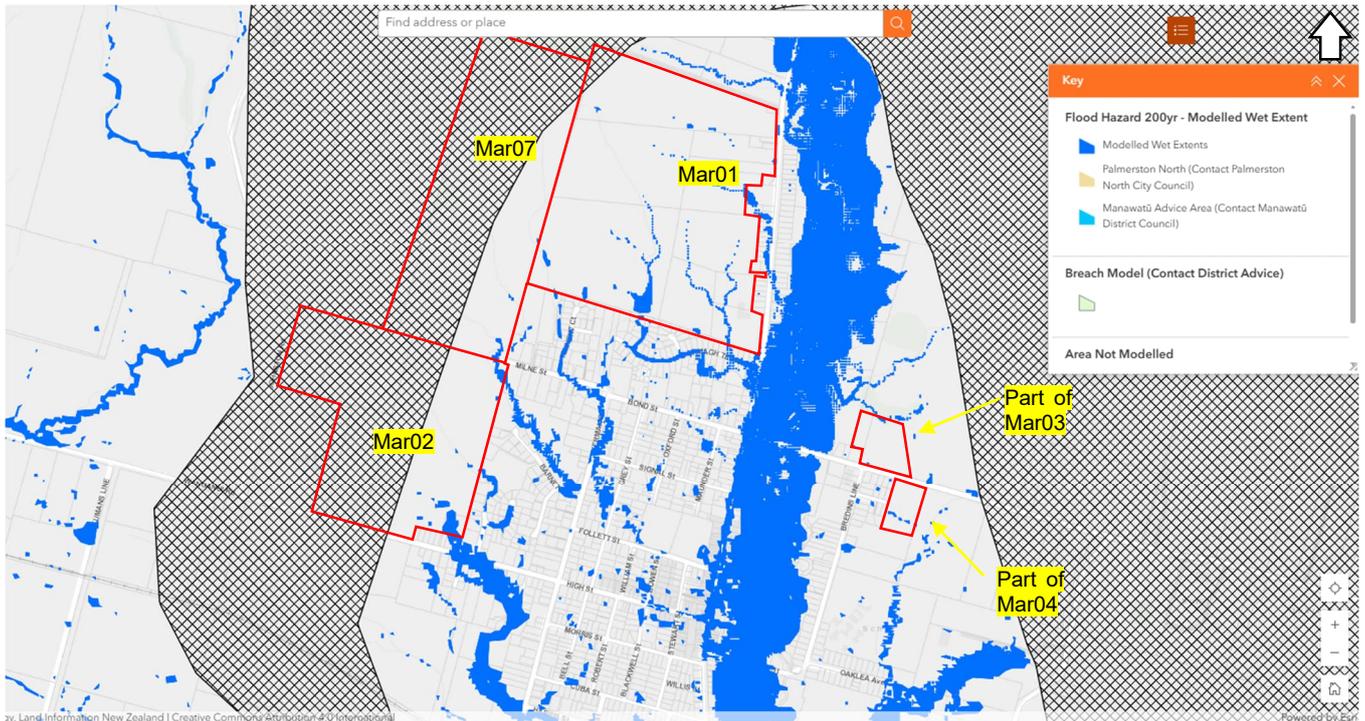


Figure 9: Mapped modelled wet extents for 200yr event for north Marton (Source: HRC Natural Hazard Viewer).

3.1.2.1 Published Geology

The 1:250,000 geological map of the region¹¹ shows the sites as being underlain by Middle & Late Pleistocene aged river deposits and Middle Pleistocene aged shoreline deposits (Figure 10). The alluvial deposits are described as consisting of 'weathered, poorly to moderately sorted gravel with minor sand and silt underlying terraces; includes minor fan deposits and loess'. The north-western areas (MAR02, MAR07 and MAR01) of Marton are mapped as Middle Pleistocene shoreline deposits described as 'Ngarino terrace coverbeds comprising shallow marine conglomerate, shellbeds, dune sands and peat'. It should be noted that more recently laid river deposits are likely present within and adjacent to watercourses due to ongoing erosion and redeposition.

The active Leedstown Fault is mapped to the east of Marton, and the Marton Fault Zone is located to the west / southwest of Marton (Figure 11). A Fault Avoidance Zone (FAZ) associated with the Marton Fault Zone is situated to the south of Mar02 with the fault trace mapped parallel to Wanganui Road³.

¹¹ Townsend, D.; Vonk, A.; Kamp, P.J.J. (compilers) 2008: Geology of the Taranaki area: scale 1:250,000. Lower Hutt: Institute of Geological & Nuclear Sciences Limited. Institute of Geological & Nuclear Sciences 1:250,000 geological map 7. 77 p. + 1 folded map.

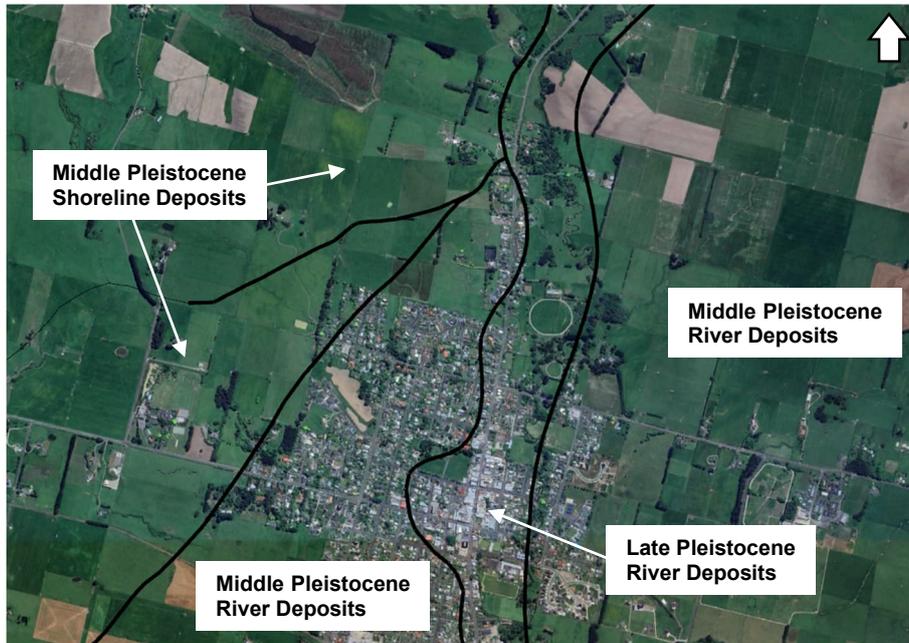


Figure 10: Mapped geological units near Marton (Source: GNS Geological Map).



Figure 11: Mapped Faults located near Marton as a part of the Marton Fault Zone (Source: GNS Active Fault Database).

3.1.2.2 Site Characteristics

The subject areas are generally located within the rural area to the northwest and northeast of Marton.

Mar01 and Mar 07 comprise of level ground with minor to moderate undulations / slopes. The low-lying undulations have been formed by natural drainage / overland flow paths which are typically dry. Along the northern boundary of these areas, the land slopes down moderately to steeply towards the north. An existing stormwater management dam is located along the western boundary of Mar07, and along the southern boundary of Mar01.

Mar02 is generally level with minor to slight undulations / slopes forming dry drainage channels. A minor terrace slope is present along the mapped fault trace to the south of Mar02 indicating the presence of the fault. An existing stormwater management dam is located within Mar02.

Part of Mar03 and Mar04 are both essentially level with slight undulations.

A series of photographs of the areas are appended in Appendix A.

3.1.3 Mangaweka

- No high-level LiDAR contour information (0.5-1.0m contours) for the Mangaweka area are available on the LINZ database and therefore the contour data has not been reproduced.
- 8.0m contour data is available however the resolution quality does not highlight the minor / moderate features such as site undulations and drainage channels within the areas.
- The sites are situated outside of the mapped liquefaction susceptibility areas mapped within the Rangitikei District (HRC Natural Hazard Viewer).
- The sites are not crossed by any active or in-active fault traces or Fault Avoidance Zones (FAZ) / Fault Awareness Areas (FAA).
- Mang01 and Mang02 are generally level areas with minor stormwater channels / overland flow paths. A very steep and deep (10m+) alluvial channel crosses through Mang02 and leads down to the incised Rangitikei River channel.
- Very steep, 60m high alluvial cut cliffs are present below Mangaweka (Mang02) which lead down to the Rangitikei River. Google earth and the limited contour data indicate the cliff heights are approximately 60m. Three machine boreholes were undertaken in 1973 towards the northeast of Mangaweka. The geological logs are available on the NZGD and show approximately 5.65m to 7.3m of moderate to high strength surface soils (sands / silts and alluvial gravels) underlain by high strength siltstone deposits which were encountered to at least the deepest borehole depth of 18.4m. Groundwater was not recorded.
- Mangaweka is not within a mapped 'modelled wet extent'.
- The sites have been predominately used for pastoral land.
- The Listed Land Use Register (LLUR) does not currently have any information about a Hazardous Activities and Industries List (HAIL) site on / within the selected land parcels.

3.1.3.1 Published Geology

The 1:250,000 geological map of the region¹² shows the sites as being underlain by Late Pleistocene river deposits. The alluvial deposits are described as consisting of 'poorly to moderately sorted gravel with minor sand and silt underlying terraces; includes minor fan deposits and loess' (Figure 12). The alluvial deposits are shown to overlie Neogene sedimentary rock deposits (Rangitikei Supergroup; Paparangi Group) described as comprising 'massive

¹² Townsend, D.; Vonk, A.; Kamp, P.J.J. (compilers) 2008: Geology of the Taranaki area: scale 1:250,000. Lower Hutt: Institute of Geological & Nuclear Sciences Limited. Institute of Geological & Nuclear Sciences 1:250,000 geological map 7. 77 p. + 1 folded map.

mudstone, concretionary sandstone; limestone and conglomerate in the east'. It should be noted that more recently laid river deposits are likely present within and adjacent to watercourses due to ongoing erosion and redeposition.

No active faults are mapped near Mangaweka. The inactive Rangitikei Fault is mapped approximately 4km to the west, and the inactive Rauoterangi Fault is mapped approximately 5.2km to the southwest. No Fault Avoidance Zone (FAZ) / Fault Awareness Area (FAA) associated with this fault are mapped across any of the sites³.

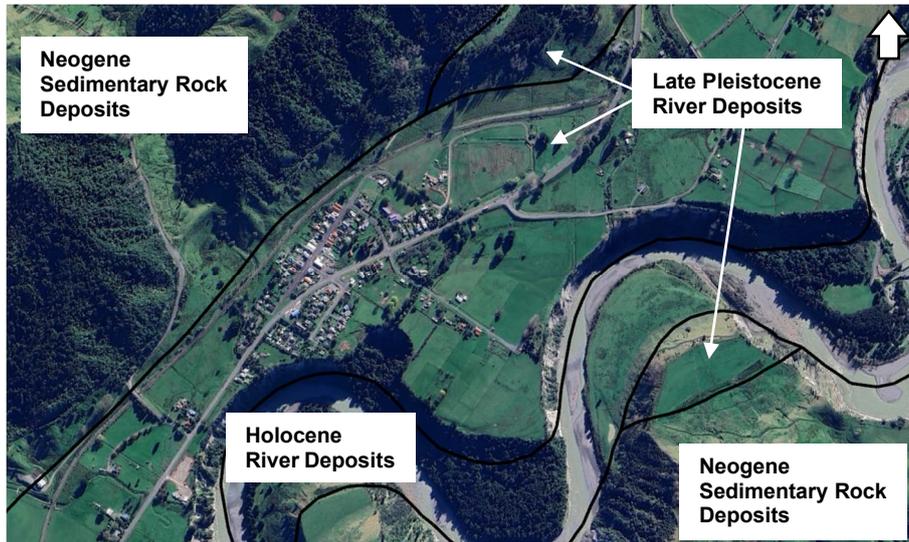


Figure 12: Mapped geological units near Mangaweka (Source: GNS Geological Map).

3.1.3.2 Site Characteristics

The subject areas are generally located within the rural area to the north and east of Mangaweka.

Mang01 is generally level. The ground level is lower than both SH1 bounding the area to the south and the railway line bounding the area to the north. The area comprises several minor to moderate stormwater channels which lead to the SH1 culvert at the southern-most corner of the area.

Mang02 also comprises level ground with a minor rise (alluvial terrace) towards SH1 bounding the northwestern boundaries. The eastern and southern boundaries are also bound by very steep (>70°) alluvial cut cliffs / terraces which exposes the thin alluvial soils underlain by massive siltstone deposits. The cliffs are shown to be in the order of 60m in height. The culvert beneath SH1 flows out towards the southwest within a deep channel approximately 5m near SH1 to >10m where it discharges over the alluvial cliff into the Rangitikei River along the southwestern boundary. The Rangitikei River comprises a shallow gravel bed.

A series of photographs of the areas are appended in Appendix A.

4 GROUND CONDITIONS

4.1 General

The nature of the ground beneath the sites are summarised below and in the appended logs. It is based on an integration of published and unpublished data, the geomorphology of the site, and subsurface investigations carried out at discrete locations. The nature of the ground between the investigation points is inferred and may vary from that described. For details of the materials encountered and measurements of their respective strengths please review the appended investigation logs.

4.2 Subsurface Investigations

Our investigation of the sites included the following ground investigation work:

- A detailed walk over assessment of the areas. Some properties within the areas were not available for access.
- A series of initial investigation tests to correlate / confirm expected ground conditions.
- 50mm hand augered boreholes were put down to a target depth of 2m to 4m or refusal. Undrained shear strength measurements were recorded within cohesive soils at 200mm intervals using a calibrated shear vane.
- Dynamic penetrometer tests were put down alongside the hand augered boreholes, to a target depth of 2m to 4m or refusal with measurements taken in 50mm increments, each forming a Test Site with the borehole.

The locations of the subsurface investigations are shown in Figures 13 to 15 below and on the Geotechnical Investigation Plan in Appendix B. Logs of the boreholes and penetrometer tests are presented in Appendix C. The field work was completed over 12-14/02/2025.

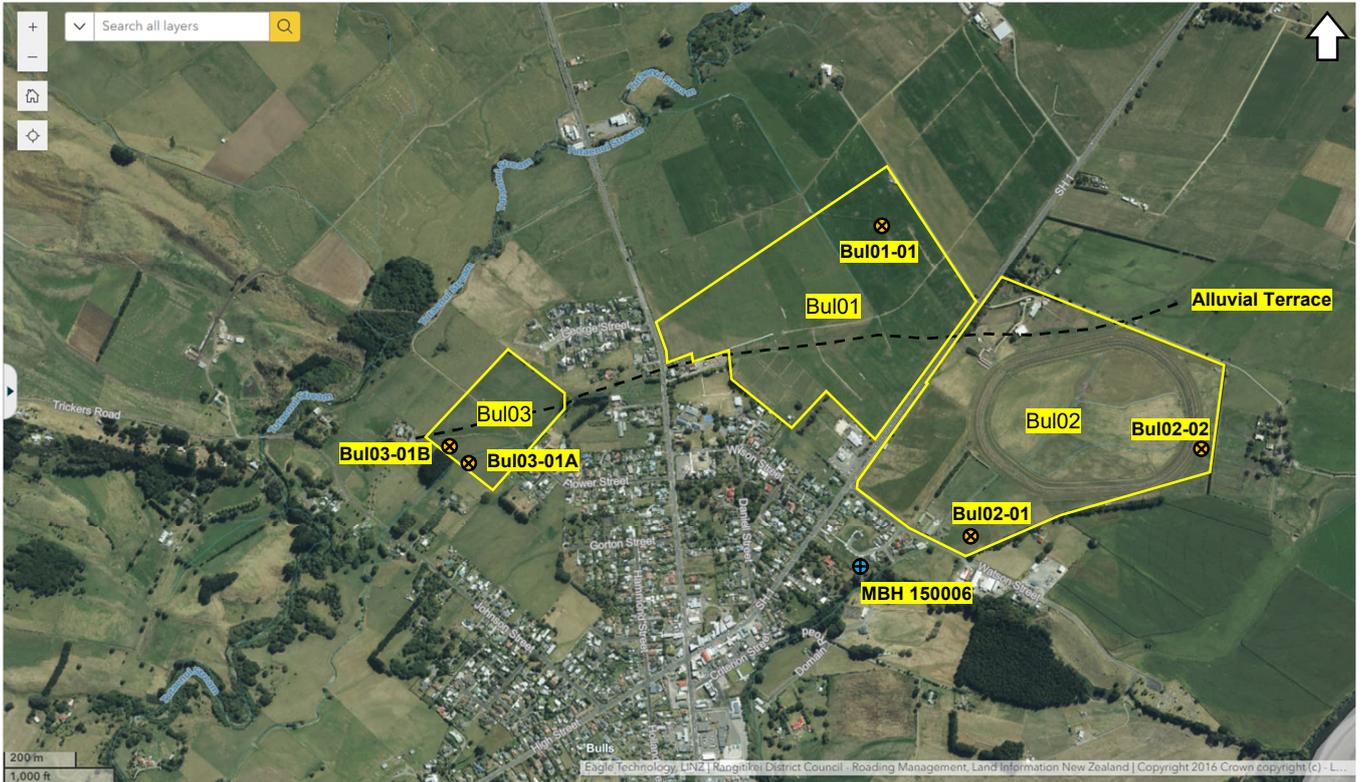


Figure 13: Geotechnical annotated site plan for Bulls (Image Source: RDC Online Maps).

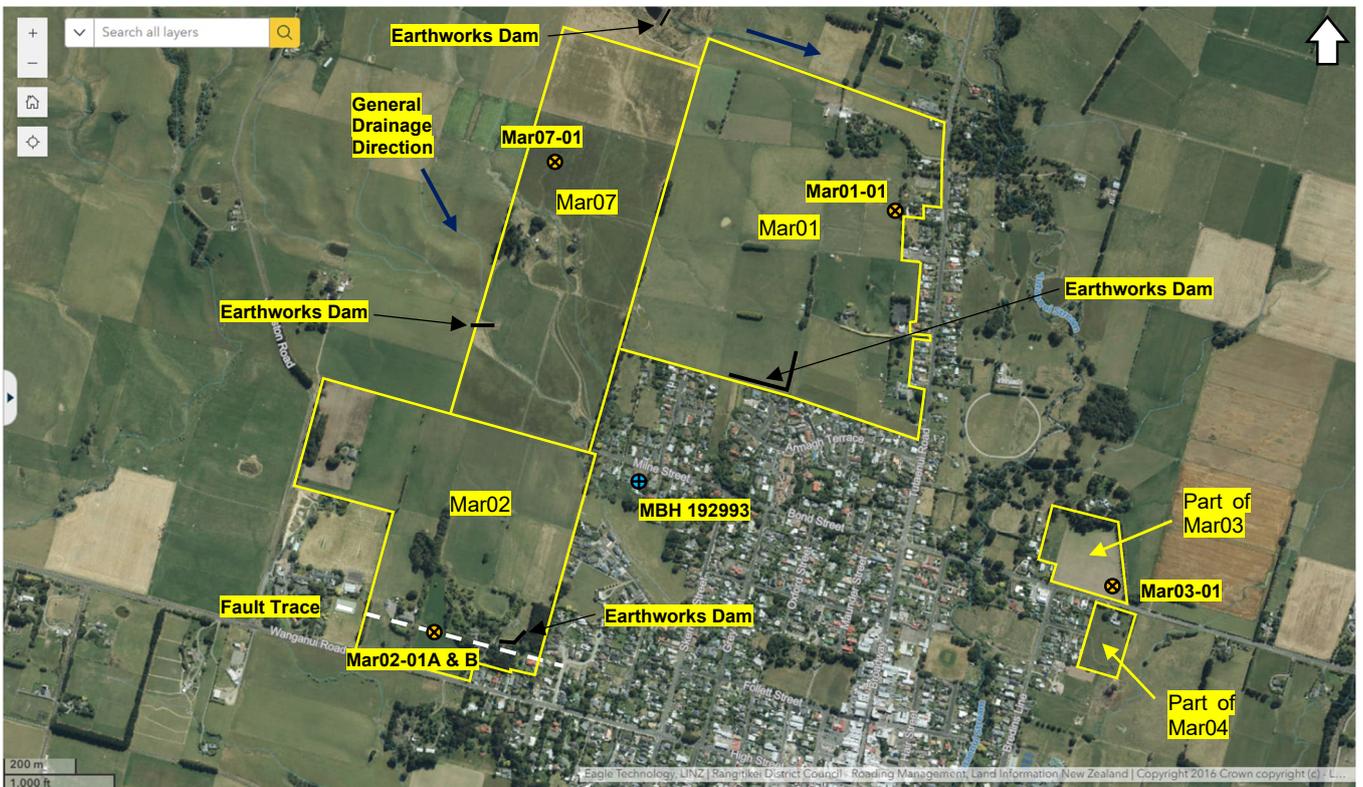


Figure 14: Geotechnical annotated site plan for Marton (Image Source: RDC Online Maps).

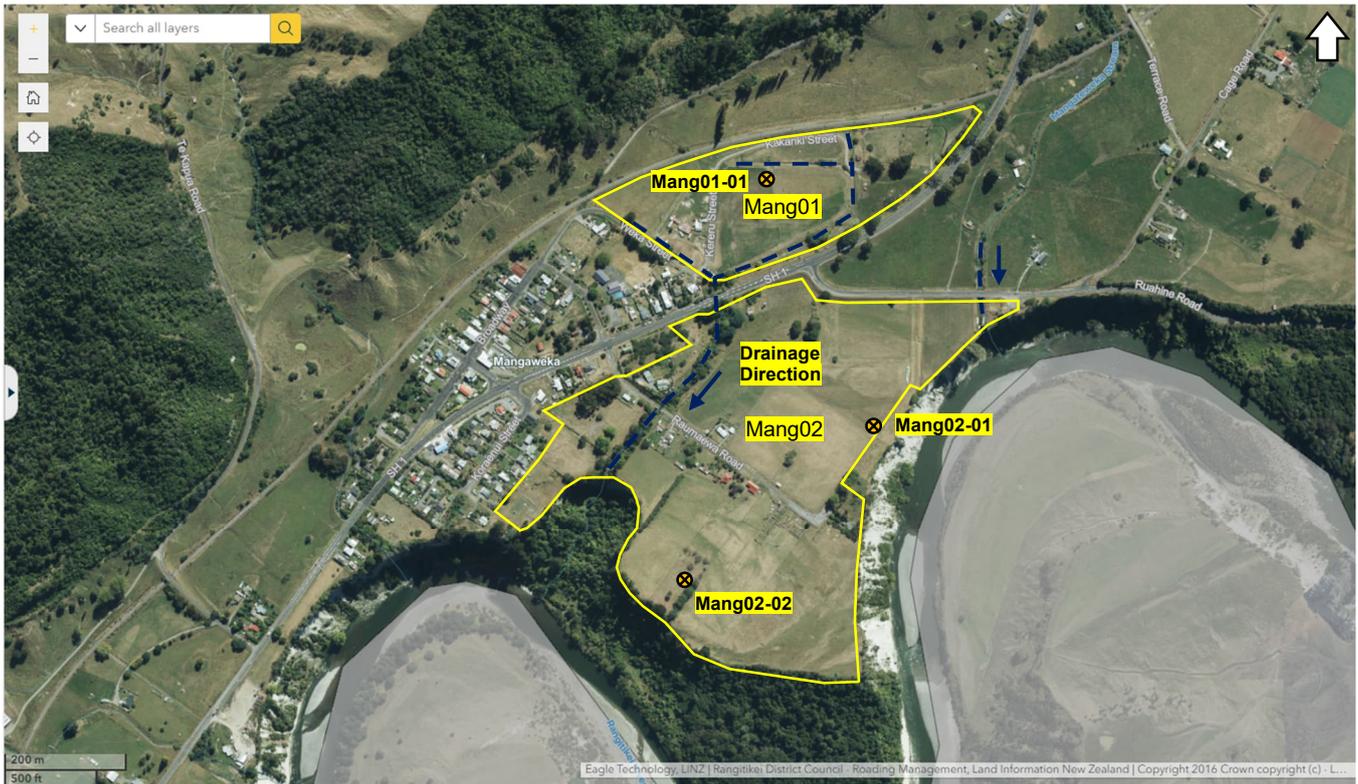


Figure 15: Geotechnical annotated site plan for Mangaweka (Image Source: RDC Online Maps).

4.3 Subsurface Conditions

In summary, our investigations generally encountered alluvial river deposits and marine shoreline deposits consistent with the mapped geology for the sites.

Specifically, the investigations indicate that the sites are underlain by a surface layer of organic SILT (**Topsoil**) typically encountered down to 0.2m to 0.3m.

Underlying the topsoil layer, the investigations typically encountered high strength, cohesive soils (**Alluvium / Shoreline Terrace Deposits**). The boreholes typically refused at shallow depths due alluvial gravel (Bulls & Mangaweka) and due to very high strength deposits (Marton). The penetrometer tests also refused upon encountering either the alluvial gravel deposits or very high strength materials. For site specific geotechnical details see the attached logs and NZGD borehole logs in Appendix C.

A representation of the subsoil profile is depicted in Tables 1 to 3 below.

The material strength parameters given have been used in our analyses of the site. These were generally derived from published and unpublished correlation charts and tables for the particular materials encountered in the investigation. Results from laboratory testing of similar materials were also taken into consideration, as were results from numerical back analyses. Consideration has been given to the behaviour of the materials with long term loading, and also their strength under likely worst-case moisture content levels. The assigned geotechnical

parameters should be considered to be provisional and are provided for indicative considerations only, and should not be used for geotechnical design without further investigation and appraisal by geotechnical specialists.

Table 1: Simplified stratigraphic profile beneath Bulls and provisional geotechnical parameters to subsoil layers.

Graphic Log	Unit Simple Description	Depth to Base of Unit (m)	Unit Thickness (m)	Typical Test Results	Provisional Geotechnical Parameters
	Topsoil	0.3m	0.3m	N/A	N/A
	Alluvial Soils SILT to SAND	Varies	Varies	DCP = 2-6 blow / 50mm) SV = 140+	C = 0-6 kPa $\phi = 30^\circ$ $\gamma = 18 \text{ kN/m}^3$ GUBC = 300kPa
	High Strength Alluvial Gravel Deposits GRAVEL	Unknown (>15.5m)	Unknown	DCP = >10 blow / 50mm) SV = UTP	C = 2 kPa $\phi = 34^\circ$ $\gamma = 18 \text{ kN/m}^3$ GUBC = >300kPa

Table 2: Simplified stratigraphic profile beneath Marton and provisional geotechnical parameters to subsoil layers.

Graphic Log	Unit Simple Description	Depth to Base of Unit (m)	Unit Thickness (m)	Typical Test Results	Provisional Geotechnical Parameters
	Topsoil	0.3m	0.3m	N/A	N/A
	Alluvial & Shoreline Soils SILT	Varies	Varies	DCP = 2-6 blow / 50mm) SV = 140+	C = 0-6 kPa $\phi = 30^\circ$ $\gamma = 18 \text{ kN/m}^3$ GUBC = 300kPa
	High Strength Alluvial Gravel Deposits GRAVEL	Unknown (>10.65m)	Unknown	DCP = >10 blow / 50mm) SV = UTP	C = 2 kPa $\phi = 34^\circ$ $\gamma = 18 \text{ kN/m}^3$ GUBC = >300kPa

Table 3: Simplified stratigraphic profile beneath Mangaweka and provisional geotechnical parameters to subsoil layers.

Graphic Log	Unit Simple Description	Depth to Base of Unit (m)	Unit Thickness (m)	Typical Test Results	Provisional Geotechnical Parameters
	Topsoil	0.3m	0.3m	N/A	N/A
	Alluvial Soils Silty & Sandy GRAVEL	Varies	Varies	DCP = 2-10 blow / 50mm) SV = 140+	C = 4 kPa $\phi = 32^\circ$ $\gamma = 18 \text{ kN/m}^3$ GUBC = >300kPa
	Sedimentary Rock Deposits SILTSTONE	Unknown (>60m)	Unknown	DCP = >10 blow / 50mm) SV = UTP	C = 10 kPa $\phi = 36^\circ$ $\gamma = 18 \text{ kN/m}^3$ GUBC = >500kPa

4.4 Soil Moisture Profile and Groundwater Conditions

The hand augered boreholes indicated that the soils beneath the building site were generally dry to moist.

Groundwater was not encountered in any of the boreholes, however we expect the permanent groundwater table to lie several metres below the surface of the subject sites based on the elevation of the site to the surrounding watercourses.

The moisture content of the near surface soils is expected to be higher during the winter months or extended periods of wet weather resulting in their saturation at times. The extent of the wetting front will be dependent on the duration of the period of rainfall. Similarly, the groundwater table is expected to rise during extended periods of wet weather. Complete saturation of the ground / soil profile is unlikely to occur, however due to the typically low permeability of the surface soils surface pooling is likely with overland flow paths / channels likely to drain flowing water during rainfall events.

4.5 Seismic Subsoil Category

Based on the information available we consider that Bulls and Marton are most appropriately designated as a Class D 'Deep or Soft' soil site, and Mangaweka can be most appropriately designated as a Class B 'rock' or Class C 'shallow soil site' as defined by NZS 1170.5 (2004) "Structural Design Actions: Part 5: Earthquake actions – New Zealand". This is considered to be sufficient for a regional scale.

5 NATURAL HAZARDS & GROUND DEFORMATION

5.1 General

This section summarises our assessment of the natural hazards within the regions as generally defined in Section 106 of the Resource Management Act (1991 and subsequent amendments) and the Building Act (2004) and the potential risk that these present to the areas in terms of vertical and lateral ground deformation. This section also includes our assessment of the expected ground conditions beneath the areas which is outside the definition of "Good Ground" as defined by the Compliance Document for the NZ Building Code, NZS3604 (2011) "Timber Framed Buildings" and NZS4229 (2013) "Concrete Masonry Buildings Not Requiring Specific Engineering Design". This is any ground which could foreseeably experience movement of 25mm or greater for any reason including one or a combination of compressible ground, land instability, ground creep, subsidence, liquefaction, seasonal swelling and shrinking, frost heave, changing groundwater level, erosion, dissolution of soil in water, and the effect of tree roots.

5.2 Earthquake Hazards

5.2.1 Earthquake Shaking

The Ministry of Business Innovation & Employment (MBIE) have released guidelines for Earthquake Geotechnical Engineering Practice in New Zealand. Module 1 of the current version, dated 29 November 2021, provides guidance on estimating magnitudes and peak ground acceleration (PGA) in accordance with Section 175 of the Building Act.

Method 1 from MBIE Module 1 was adopted which recommends the use of estimated parameters that can be used Independently of Site Soil Class from the National Seismic Hazard Model (NZHM), which is based on the publication titled "Re-Evaluation of New Zealand Seismic Hazard for Geotechnical Assessment and Design" (Cubrinovski et al.,

2021). Current best practice in geotechnical seismic design and ground performance is to adopt this methodology over NZS1170.5 (2004), whilst noting that NZS1170 (2004) remains the current codified document for the structural design of building elements, bracing, etc.

The ground motion values adopted are provided in Table 4 and are based on the return periods provided in Table 3.3 of 1170.0:2002 assuming an Importance Level 2 (IL2) structure with a 50-year design life.

Table 4: Adopted Ground Motion Parameters.

Limit State	Return Period	Peak Ground Acceleration (PGA)	Magnitude
Serviceability Limit State 1 (SLS)	1/25 year	0.09g	6.3
Intermediate Limit State (ILS)	1/100 year	0.18g	6.3
Ultimate Limit State (ULS)	1/500 year	0.36g	6.3

5.2.2 Fault Line Surface Rupture

The GNS NZ Geology Webmap and Active Faults Database¹³ do not show any faults passing beneath the majority of the sites with the exception of the mapped fault trace within Mar02. There also does not appear to be any surface expressions which would indicate the presence of an active fault line beneath or within close proximity to the sites. We therefore consider that the surface fault line rupture risk to be low for the general development areas for a majority of the areas.

A surface terrace expression and Fault Avoidance Area are present for the mapped active fault trace within Mar02. The fault is noted as a normal fault, recurrence interval class IV (>5,000 to ≤10,000 years) and with a net slip rate of <0.04mm/yr and net single event displacement of <1m. Building within the avoidance zone is likely to be permitted for normal residential structures depending on the fault complexity and Building Importance level (BI1 and BI2)¹⁴, although high significance structures e.g. post-disaster emergency facilities (BI4), school halls (BI3) etc should be avoided. However at a regional scale, building is typically best suitable outside the avoidance zone in the first instance, with roading possible to cross the fault or the zones designated for parks, fields, etc.

The Ministry for the Environment (MFE) report for planning for development of land on or close to active faults¹⁵ recommends a minimum buffer zone of 20m either side of known fault traces or likely surface fault rupture zones. The MFE report also states that the fault avoidance zone can be reduced if a detailed fault study shows that the zone of intense deformation and secondary rupture is less than 20m from the likely fault rupture zone.

Therefore, the current FAZ width of approximately 200m can be refined upon further investigation and analysis such as detailed fault mapping, trenching, and geophysics following due consideration of the density of any proposed

¹³ <http://data.gns.cri.nz/geology/>

¹⁴ Kerr et al., (2023). A guideline to assist resource management planners in New Zealand. Institute of Geological & Nuclear Sciences client report 2002/124.

¹⁵ Kerr, J et al. (2003) "Planning for Development of Land on or Close to Active Faults; A guideline to assist resource management planners in New Zealand": Ministry for the Environment report ME 483.

development. The mapped FAZ can be adopted as a simple trigger for specialist geotechnical assessment prior to any future subdivision.

Table 5: Re-Produced GNS 2019/168 Table A2.1 - Examples, based on MfE Active Fault Guidelines, of Resource Consent Category for both developed and/or already subdivided sites, and Greenfield sites along RI Class IV faults. Categories account for various combinations of Building Importance and Fault Complexity (Source GNS Science Consultancy Report 2013/151¹⁶). The * indicates “the activity is permitted but could be controlled or discretionary given that the fault is well defined.”

Example Resource Consent Categories for Class IV Faults (>5000 to ≤10,000 Years) e.g. Rauoterangi, Himatangi and Mt Stewart-Halcombe Faults (Rangitikei)					
Developed and/or Already Subdivided Sites					
Building Importance Category	1	2a	2b	3	4
Fault Complexity	Resource Consent Category				
Well-defined	Permitted	Permitted*	Permitted*	Permitted*	Non-complying
Distributed	Permitted	Permitted	Permitted	Permitted	Non-complying
Uncertain	Permitted	Permitted	Permitted	Permitted	Non-complying
Greenfield Sites					
Building Importance Category	1	2a	2b	3	4
Fault Complexity	Resource Consent Category				
Well-defined	Permitted	Permitted*	Permitted*	<i>Non-complying</i>	Non-complying
Distributed	Permitted	Permitted	Permitted	<i>Discretionary</i>	Non-complying
Uncertain	Permitted	Permitted	Permitted	<i>Discretionary</i>	Non-complying

* Indicates that the Resource Consent Category is permitted but could be 'Controlled' or 'Discretionary', given that the fault location is well-defined.

Italics: The use of italics indicates that the Resource Consent Category activity status of these categories is more flexible. For example, where 'Discretionary' is indicated, 'Controlled' may be considered more suitable by the Council, or vice versa.

5.3 Slope Instability

The areas in Bulls are generally considered stable with smooth minor undulations with shallow to moderate slopes. The instability risk is expected to be low and can be assessed at resource / building consent level if required. This may include suitable set back distances from channels determined / set at resource & consent or building consent. From a geotechnical land stability perspective, a minimum dwelling set back distance of 5m from the channel would be considered suitable for planning purposes. A greater set back distance may be set for planning purposes (protecting waterways / flooding risk).

The areas in Marton are also generally considered stable with larger smooth hills and minor to moderate undulations with moderate slopes. The instability risk is expected to be low and can be assessed at resource / building consent level if required. This may include suitable set back distances from channels as above, and set back distances from

¹⁶ Langridge, R.M.; Morgenstern, R. (2020). Active Fault Mapping and Fault Avoidance Zones for Rangitikei District. *GNS Science Consultancy Report 2019/168, April 2020. Appendix 2.*

slopes or foundation modifications / retaining on sloping ground. We do not consider that the sloping ground would restrict development, but some specific retaining may be required and determined at resource / building consent.

Mang02 in Mangaweka is bound by the alluvial cut cliffs which are typically very steep ($>70^\circ$) and approximately 60m in height. The cliffs lead down to the Rangitikei River below and show inundated slip debris at the toe of the cliffs. Although the deposits appear very high strength, future instability regression as well as river erosion regression of the cliffs is considered possible, with the movements likely to be episodic in nature rather than lineal progression. In the absence of a detailed assessment and machine borehole testing of the sedimentary rock deposits it is generally considered that building development should be restricted to behind a 45° line from the base of the cliffs. This 45° set back line should also apply to the base of the deep channel to the southwest and northeast of the bridge along Raumaewa Road.

As the 45° line / set back line may be difficult to confirm, a conservative distance of 85m (60m + 25m buffer) from the cliffs can be adopted. A conservative set back distance of 30m (20m + 10m buffer) from the channel to the southwest of the bridge, and a distance of 20m (10m + 10m buffer) from the channel to the northeast of the bridge can also be adopted. This is a generally conservative approach, and we note that if further assessment / investigation is undertaken then a reduced setback may be determined and subsequently adopted.

5.4 Liquefaction

The sites are outside of the liquefaction vulnerability zones mapped within the Rangitikei Region.

As the subject sites are generally located on an elevated landform (alluvial and shoreline deposits on elevated marine deposits) that are underlain by unsaturated and typically non-liquefiable cohesive silts and dense gravel deposits, as well as bedrock deposits beneath Mangaweka, the geomorphic and engineering setting of the sites does not meet the criteria for the build-up of pore water pressures and the development of potential liquefaction conditions. Therefore, the sites are not considered to be at risk of liquefaction settlement or lateral spreading in response to earthquake shaking.

We therefore considered that an unlikely / low liquefaction potential (TC1-like ground performance) is expected within the sites within Bulls and Marton, and a negligible liquefaction potential is present within Mangaweka.

The foregoing does not preclude re-assessment by geotechnical professionals on a site-specific basis in the (unlikely) event that saturated liquefiable sand and silt soils are encountered during geotechnical investigations.

5.5 Compressible Ground and Consolidation Settlement

The organic topsoil encountered to approximately 0.2m to 0.3m depth is expected to be subject to consolidation due to loading. Apart from this surficial layer, there does not appear to be any compressible ground beneath the building site as defined by NZS3604 (2011).

5.6 Ground Shrinkage and Swelling Potential

Plastic soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by shrinkage and swelling from variations in soil moisture content which can result in apparent heaving and settlement of buildings, particularly between seasons. This is referred to as soil reactivity or shrink-swell behaviour and termed expansive soils. NZS3604 (2011) defines expansive soils as having a liquid limit above 50% and a linear shrinkage value above 15%.

No laboratory testing of the soil properties was completed. Field tests indicate the materials within the near surface demonstrate low plasticity silts with minimal clay properties and are unlikely to be within the laboratory criteria and are therefore best regarded as being non-reactive. In addition, the majority of the sites are underlain by shallow gravel deposits, and in the in instance of Mangaweka, by shallow bedrock. These high strength deposits effectively limit the depth of any swell-shrink potential.

Based on the low plasticity of the soils, the foundation conditions are generally not considered to be expansive and therefore no modifications to the foundation designs given in NZS3604 (2011) are required for residential structures, particularly where the soil column is less than approximately 1.5m.

However, we note that an area of Mar02 was investigated for a potential subdivision by WSP Ltd (report reference 5-WT686.00, dated 04/12/2020), with the report made available for this review. The investigations toward the centre of Mar02 encountered deeper soils with higher clay content than that reported herein, with laboratory testing indicating values above the NZS3604(2011) limiting criteria. On that basis a Class S reactive site was designated.

Where expansive soils are considered to be present, the guidance within NZS3604 (2011), AS27870 (2011), and Amendment 19 (November 2019) of B1/AS1 of the NZ Building Code can be adopted.

5.7 Tree Root Deformation

Trees within close proximity to buildings can result in potentially significant building damage due to heaving as a result of tree root growth, and also settlement due to soil shrinkage from the moisture uptake of the roots.

5.8 Conclusions

From our assessment of the natural hazard and ground deformation risks presented to the areas we consider that residential development buildings can be safely located within the identified areas. We provide regional scale conclusions and recommendations in Section 6.

6 EXPECTED ENGINEERING CONDITIONS & RECOMMENDATIONS

6.1 General

It should be appreciated that the high-level conclusions and recommendations noted below are based on the surface and subsurface conditions encountered at the time of the investigation. In addition to the possible variations in the subsurface conditions away from the investigation points within and around the site, changes to the site levels can have a dramatic effect on the recommendations given.

6.2 Bulls

- Expected high strength soils allowing TC1 / NZS3604 foundations.
- Unlikely / low liquefaction potential.
- Consideration for stormwater management / designs for new developments, may include earthworks and FFL requirements.
- Generally low slope instability risk.

6.3 Marton

- Expected high strength soils allowing TC1 / NZS3604 foundations.
- Unlikely / low liquefaction potential.
- Consideration for stormwater management / designs for new developments, may include earthworks and FFL requirements.
- The HRC earthwork dams located within / near areas Mar01, Mar02 and Mar07 should be considered during development of nearby areas.
- Generally low slope instability risk. Consideration on / adjacent to moderate slopes.
- Building exclusion within Fault Avoidance Area for Marton Fault trace within Mar02 unless supported by detailed fault investigations.

6.4 Mangaweka

- Expected high strength soils allowing TC1 / NZS3604 foundations.
- Negligible / low liquefaction potential.
- Consideration for stormwater management / designs for new developments, may include earthworks and FFL requirements. Area Mang01 lower than and constrained by both SH1 and the railway and therefore may be more prominent to flooding.
- Instability risk within Mang02 along deep channel and alluvial cliffs. Minimum setbacks distances behind a 45° line from the base of the cliffs and channel is recommended unless supported by detailed stability

assessments. A conservative set back distance as noted in the Slope Instability Section 5.3 above can be adopted if determining the 45° line proves challenging.

7 LIMITATIONS

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

This report has been prepared exclusively for Rangitikei District Council in accordance with the brief given to us or the agreed scope and they will be deemed the exclusive owner on full and final payment of the invoice. Information, opinions, and recommendations contained within this report can only be used for the purposes with which it was intended. LDE accepts no liability or responsibility whatsoever for any use or reliance on the report by any party other than the owner or parties working for or on behalf of the owner, such as local authorities, and for purposes beyond those for which it was intended.

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

Opinions given in this report are based on visual methods and subsurface investigations at discrete locations designed to the constraints of the project scope to provide the best assessment of the environment. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from those described in this report.

Geotechnical hazards relevant to development and construction works should be assessed by professionals who can make their own interpretation of the data and high-level interpretation provided within this report. They should perform any additional testing and investigation as necessary for their own purposes, and this report should not be used as a replacement for site-specific assessments.

APPENDIX A

SITE PHOTOGRAPHS

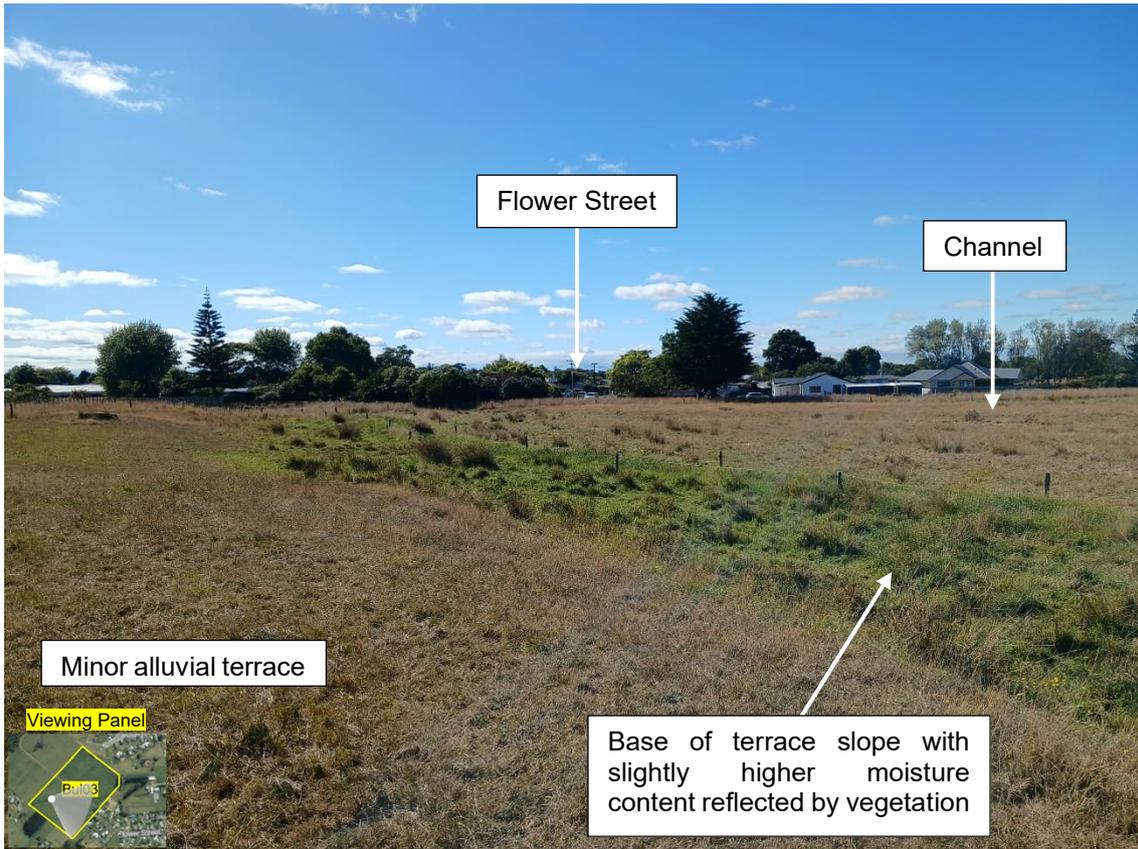
PHOTOGRAPHS: BULLS



Photograph 1: Area Bul03 viewed from the end of Flower Street, viewed towards the northwest.



Photograph 2: Channel trending west through the lower area of Bul03, viewed towards the west.



Photograph 3: Bul03: View from on minor alluvial terrace looking back towards Flower Street, viewed towards the southeast.



Photograph 4: Bul03: View of the generally level upper terrace, viewed to the northeast towards George Street.



Photograph 5: View of the generally level ground of Bul02, viewed to the northeast from the southwestern corner of Bul02.



Photograph 6: View of the generally level ground of Bul02 and drainage channel through the site, viewed to the northeast from within the lower properties of Bul02.



Photograph 7: View of the horse racetrack within Bul02, viewed to the west from within the east most boundary / edge of track within Bul02.



Photograph 8: View of the minor alluvial terrace (trending west to east) to the north of the racetrack to the north of Bul02, viewed towards west.



Photograph 9: View of the generally level upper alluvial terrace within the northern area of Bul01, viewed towards south from outside the northern corner of Bul01.



Figure 10: View of the alluvial terrace (trending west to east) within the southern half of Bul01, viewed towards the west.

PHOTOGRAPHS: MARTON



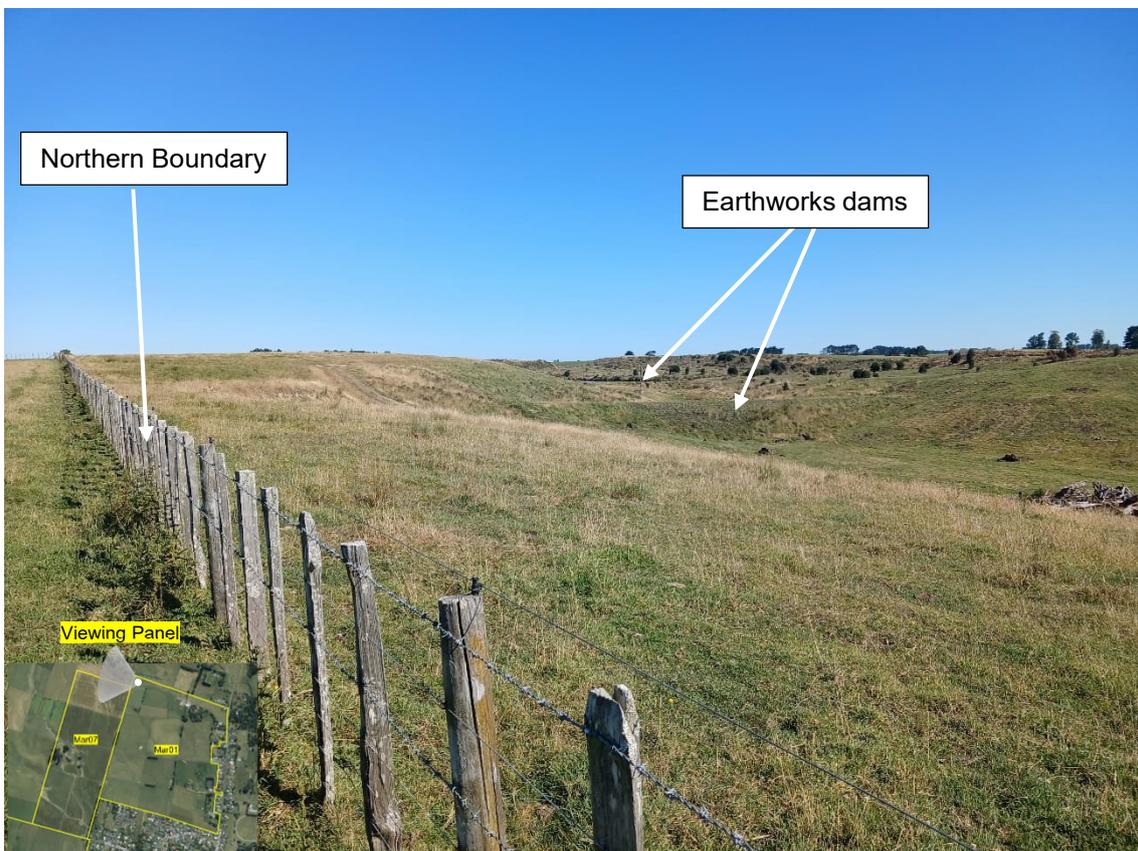
Photograph 11: Generally level topography with minor undulations within Mar01, viewed towards the southeast.



Photograph 12: Generally level topography with minor undulations within Mar01, viewed towards the northwest.



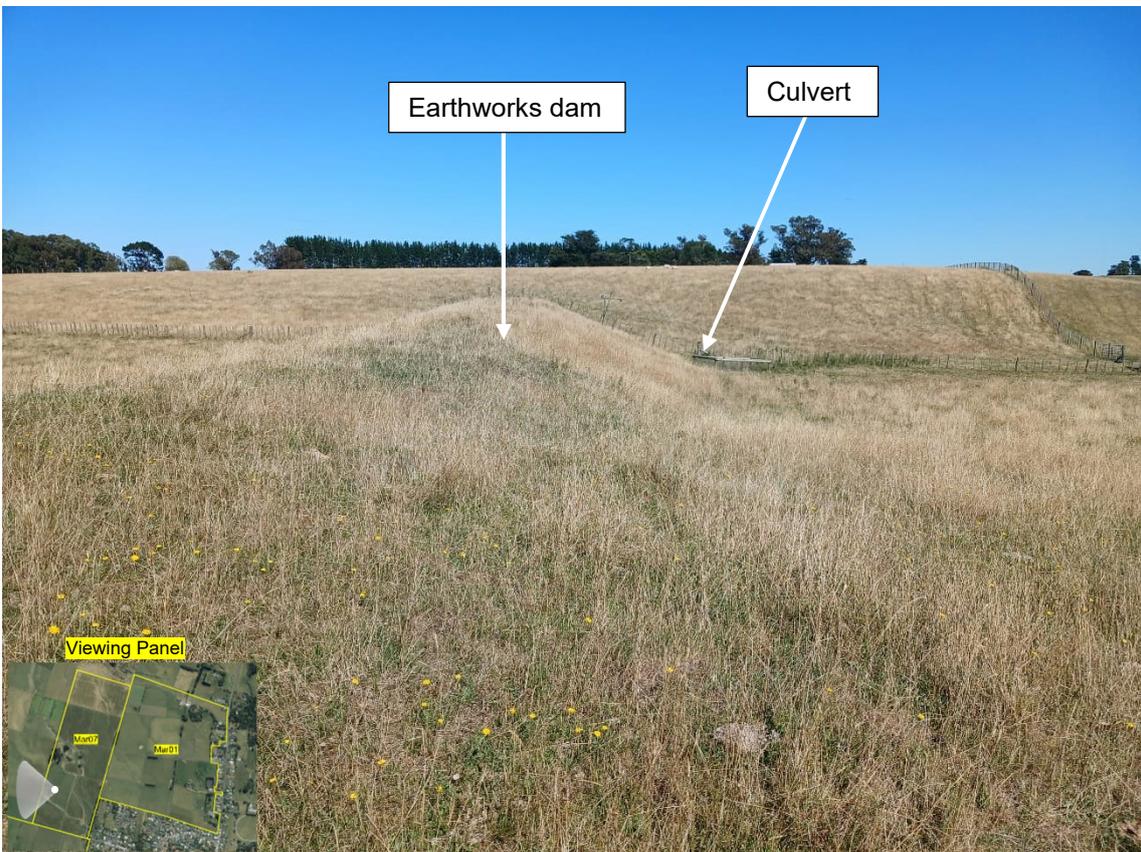
Photograph 13: View of the southern earthworks dam along the southern boundary of Mar01, viewed towards the southwest.



Photograph 14: View of the northern boundary of Mar01 and Mar07 with a moderate slope north of the site boundary. Also 2 earthworks dams are located within the deep alluvial channel to the north / northwest of Mar07, viewed towards the northwest.



Photograph 15: Generally level topography with larger minor to moderate undulations within Mar07, viewed towards the south.



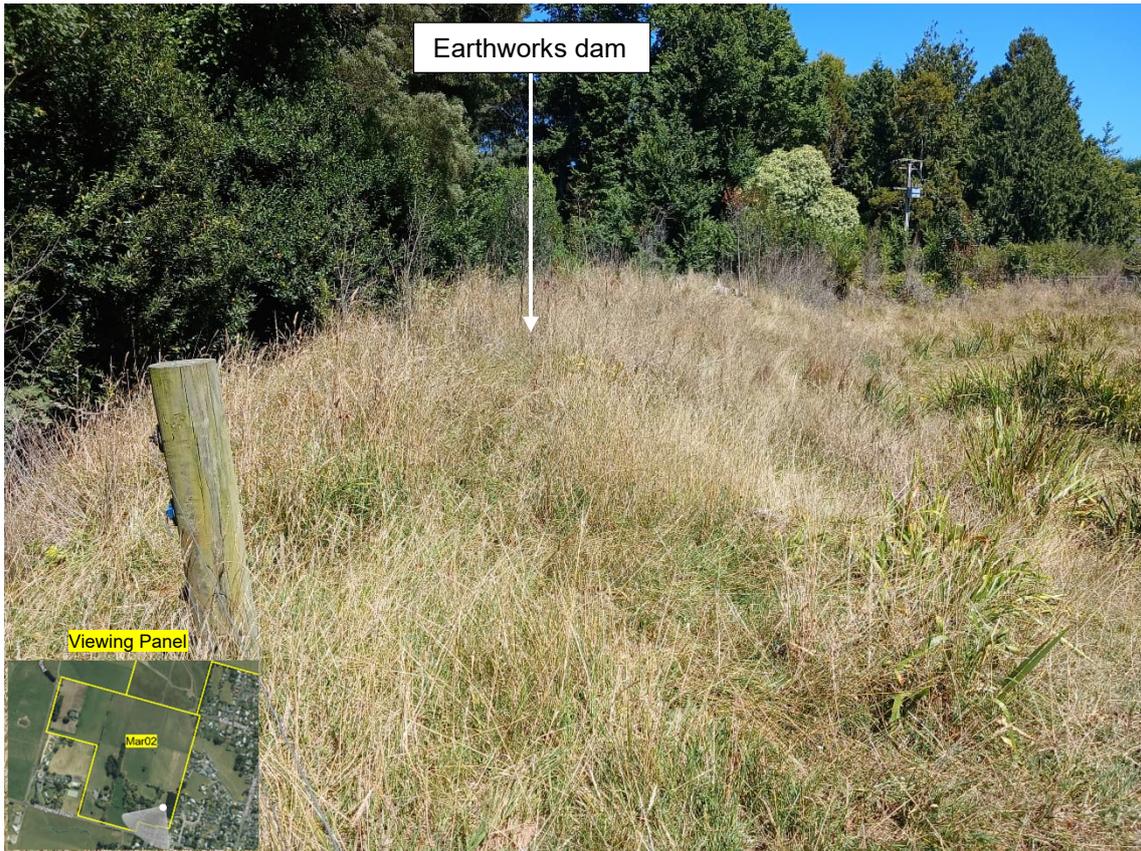
Photograph 16: View of the western earthworks dam along western boundary within the southern half of Mar07, viewed towards the west.



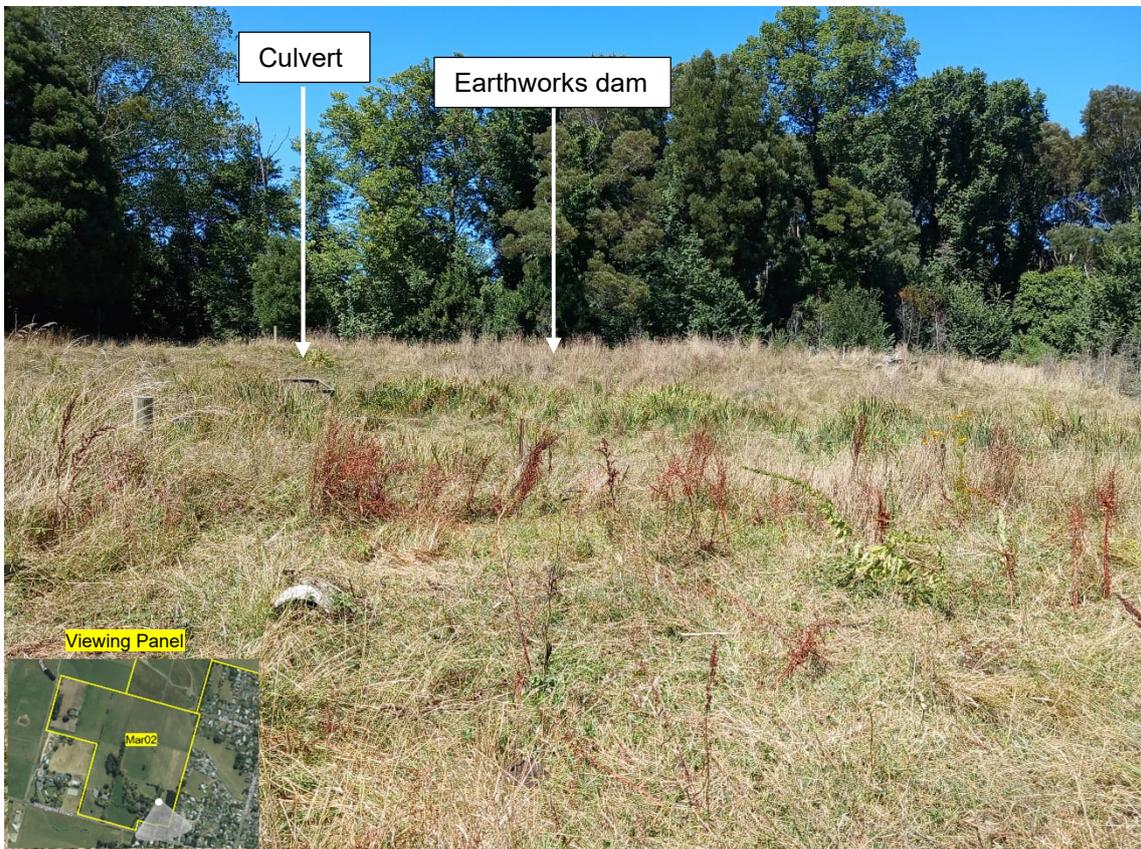
Photograph 17: Generally level topography within Mar02, viewed towards the south from the northern boundary of Mar02.



Photograph 18: View of the mapped fault trace with the south of Mar02 as evident by minor terrace (trending west to east), viewed towards the east.



Photograph 19: View of the southern earthworks dam near the southern boundary of Mar02, viewed towards the southwest.



Photograph 20: View of the southern earthworks dam near the southern boundary of Mar02, viewed towards the south.

PHOTOGRAPHS: MANGAWEKA



Photograph 21: View of the generally level area within Mang02, viewed towards the north from Raumaewa Road.



Photograph 22: View of the generally level area within Mang02, viewed towards the sedimentary bedrock cliffs which bound the eastern and southern boundaries of Mang02. Viewed towards the southeast from the end of Raumaewa Road.



Photograph 23: View of the eastern boundary of Mang02 showing the alluvial cut bedrock cliffs which bound the eastern and southern boundaries of Mang02. Viewed towards the northeast from the eastern edge of Mang02.



Photograph 24: Alluvial cut sedimentary bedrock cliffs below Mang02, viewed towards the northeast.



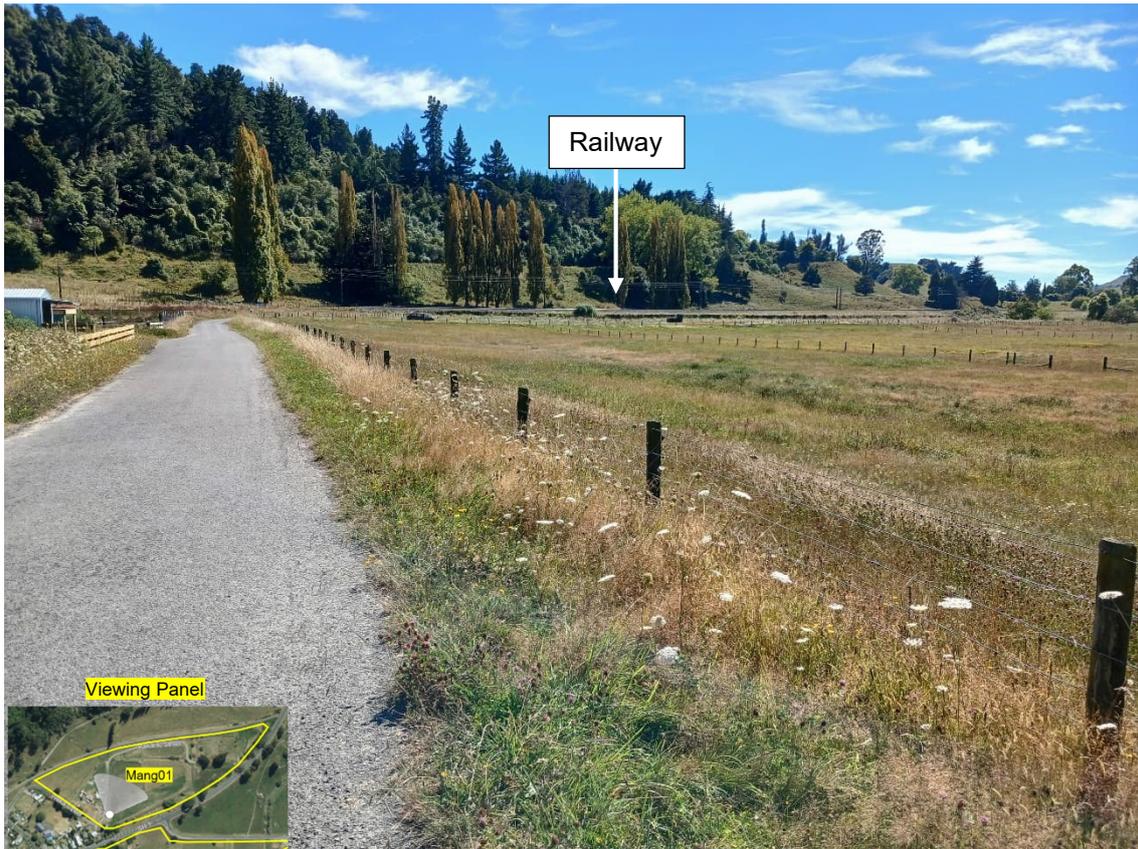
Photograph 25: Outflow of deep channel through the alluvial cliffs down to the Rangitikei River below, viewed the northwest from the southern edge of Mang02.



Photograph 26: View of the deep drainage channel (>10m deep) which flows towards the southwest to the outflow shown in Photograph 25 above. Viewed towards the north from the eastern side of the channel within Mang02.



Photograph 27: View of the generally level area within Mang01, viewed towards the east from the eastern corner along Weka Street.



Photograph 28: View of the generally level area within Mang01, viewed towards the north from the southern corner. Note the ground is generally lower than the railway along the northern boundary (in the background).



Photograph 29: View of the generally level area within Mang01, viewed towards the south from the northern boundary. Note the ground is generally lower than SH1 along the southern boundary (in the background).



Photograph 30: View of one of the stormwater channels along the eastern boundary of Mang01 / SH1 which flows beneath the SH1 culvert and through the channel within Mang02 shown in Photographs 25 & 26 above. Viewed towards the northeast from the southern corner.

APPENDIX B

REFERENCE SITE MAPS



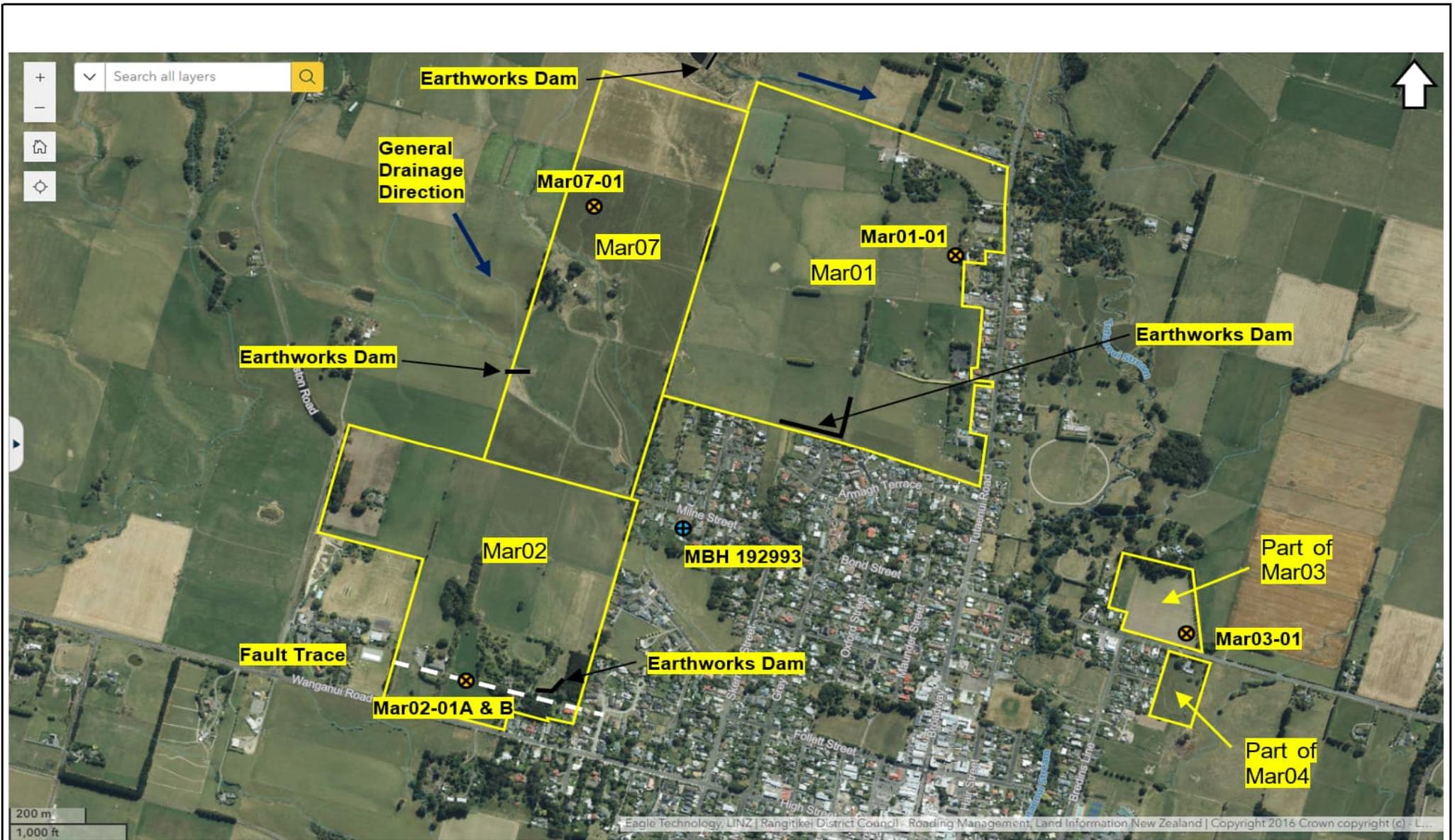
1. Image Source: RDC Online Maps

NOT FOR CONSTRUCTION



**Annotated Geotechnical Site Plan: BULLS
Geotechnical Investigation Plan**

DRAWN	MD
CHECKED	DD
DATE	20-Mar-25
PROJECT	27641



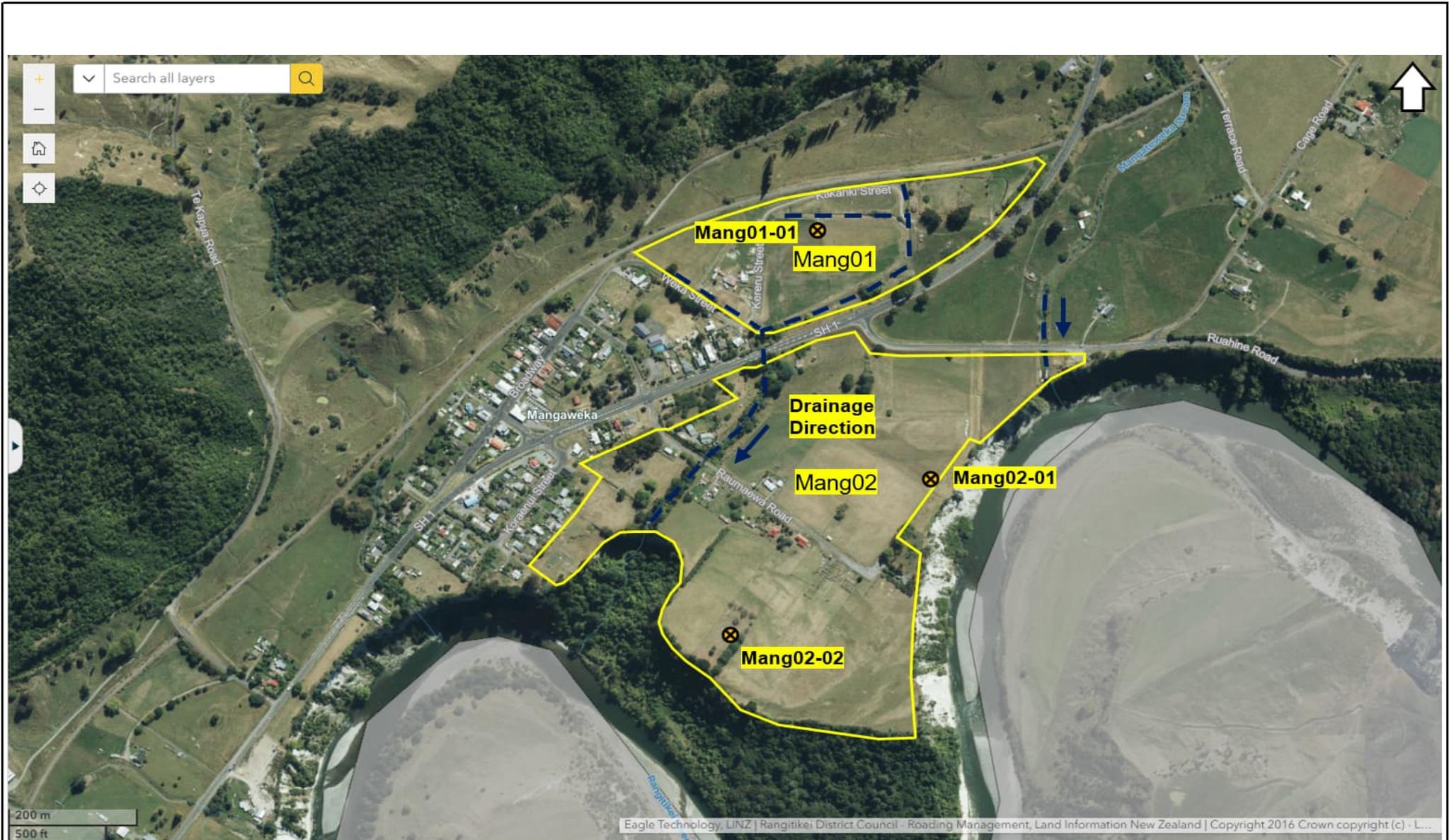
1. Image Source: RDC Online Maps

NOT FOR CONSTRUCTION



**Annotated Geotechnical Site Plan: MARTON
Geotechnical Investigation Plan**

DRAWN	MD
CHECKED	DD
DATE	20-Mar-25
PROJECT	27641



1. Image Source: RDC Online Maps

NOT FOR CONSTRUCTION



**Annotated Geotechnical Site Plan: MANGAWEKA
Geotechnical Investigation Plan**

DRAWN	MD
CHECKED	DD
DATE	20-Mar-25
PROJECT	27641

APPENDIX C

SUBSURFACE INVESTIGATION DATA

Hand Auger Borehole Log

Test ID: Bul01-01

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5551406mN, 1803561mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 12/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)		Vane undrained shear strength, s_u (kPa)			
0.0 - 0.2	Topsoil		SILT, with minor sand; dark brown; dry; sand, fine; organic, rootlets.	Groundwater not encountered	2	4	6	8		
0.2 - 0.5	Alluvium		SILT, with minor sand, with trace carbonaceous / silt clasts; orangish brown with grey & brown mottles. Very stiff to hard; dry to moist; low plasticity; sand, fine. 0.50m: Clasts absent.		50	100	150	200	223 / 20 (11.2)	
0.5 - 0.6									233+	-0.5
0.6 - 0.8									233+	
0.8 - 1.0									UTP	-1.0
1.0 - 1.1								15		
1.1 - 1.2										
1.2 - 1.3										
1.3 - 1.4										
1.4 - 1.5										
1.5 - 1.6										
1.6 - 1.7										
1.7 - 1.8										
1.8 - 1.9										
1.9 - 2.0										
2.0 - 2.1										
2.1 - 2.2										
2.2 - 2.3										
2.3 - 2.4										
2.4 - 2.5										
2.5 - 2.6										
2.6 - 2.7										
2.7 - 2.8										
2.8 - 2.9										
2.9 - 3.0										

Hole Depth: 0.90m **Termination:** Due to Gravel.

Remarks:

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

Generated with CORE-GS by Geroc - HAXTP Log v9 - 3/03/2025 3:18:55 pm

Hand Auger Borehole Log

Test ID: Bul02-01

Project ID: 27641

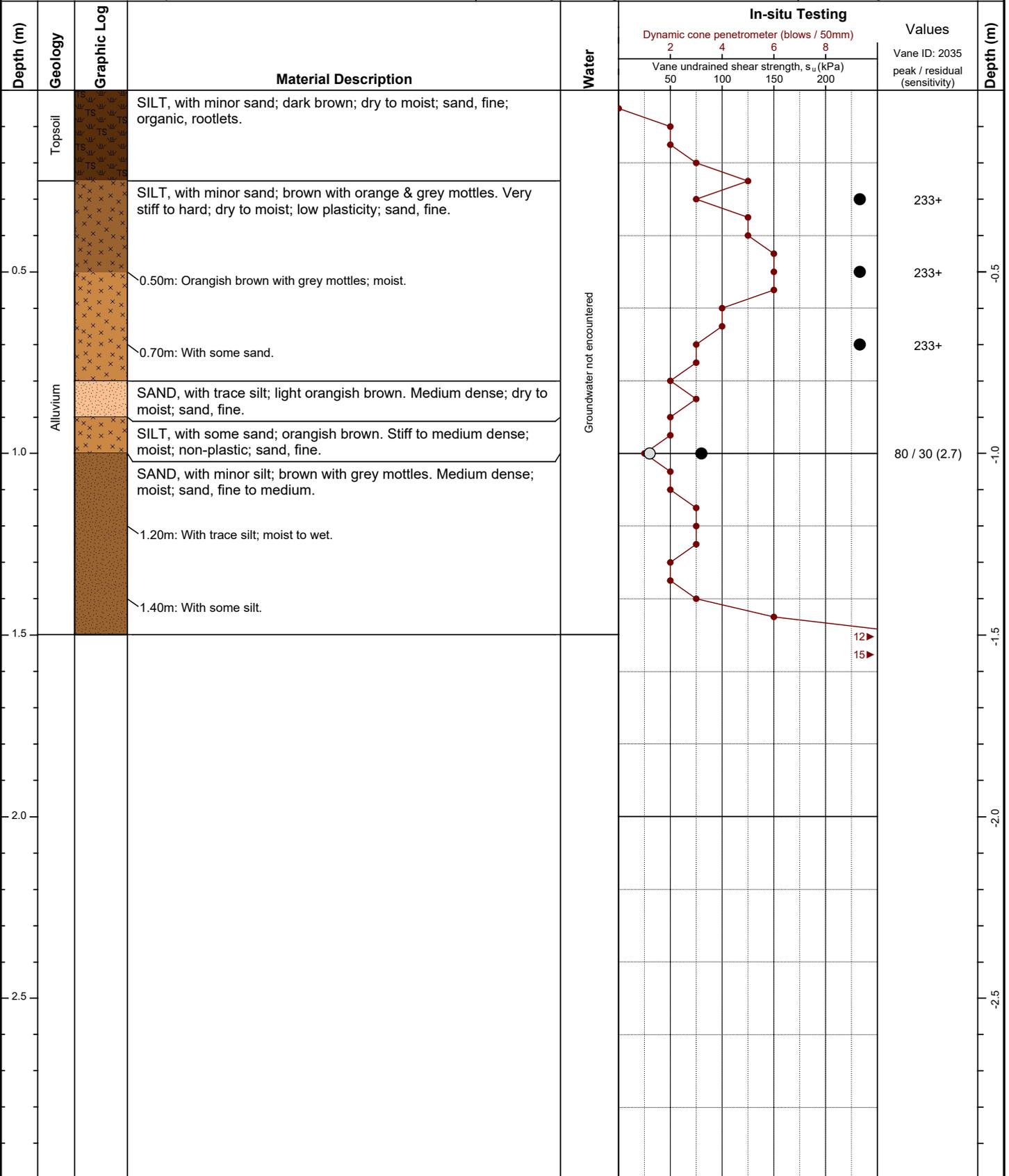
Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5550469mN, 1803828mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 12/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD



Hole Depth: 1.50m

Termination: Due to Gravel.

Remarks:

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: **Bul02-02**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5550725mN, 1804457mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 12/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing		Values	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)	Vane undrained shear strength, s_u (kPa)		
0.0 - 0.2	Topsoil		SILT, with some sand; dark brown; dry; sand, fine; organic, rootlets.	Groundwater not encountered	2	50	Vane ID: 2035 peak / residual (sensitivity)	0.0
0.2 - 0.5	Alluvium		Sandy SILT; brown with orange & grey mottles. Very stiff; dry; non-plastic; sand, fine.		4	100		0.2
0.5 - 0.6					6	150	0.4	0.5
0.6 - 0.7					8	200	0.5	0.6
0.7 - 0.8							UTP	0.7
0.8 - 0.9							15	0.8
0.9 - 1.0							15	0.9
1.0 - 1.1								1.0
1.1 - 1.2								1.1
1.2 - 1.3								1.2
1.3 - 1.4								1.3
1.4 - 1.5								1.4
1.5 - 1.6								1.5
1.6 - 1.7								1.6
1.7 - 1.8								1.7
1.8 - 1.9								1.8
1.9 - 2.0								1.9
2.0 - 2.1								2.0
2.1 - 2.2								2.1
2.2 - 2.3								2.2
2.3 - 2.4								2.3
2.4 - 2.5								2.4
2.5 - 2.6								2.5

Hole Depth: 0.40m **Termination:** Due to Gravel.

Remarks:

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

Generated with CORE-GS by Geroc - HAXTP Log v9 - 3/03/2025 3:19:00 pm



Hand Auger Borehole Log

Test ID: **Bul03-01A**

Project ID: 27641

Sheet: 1 of 1

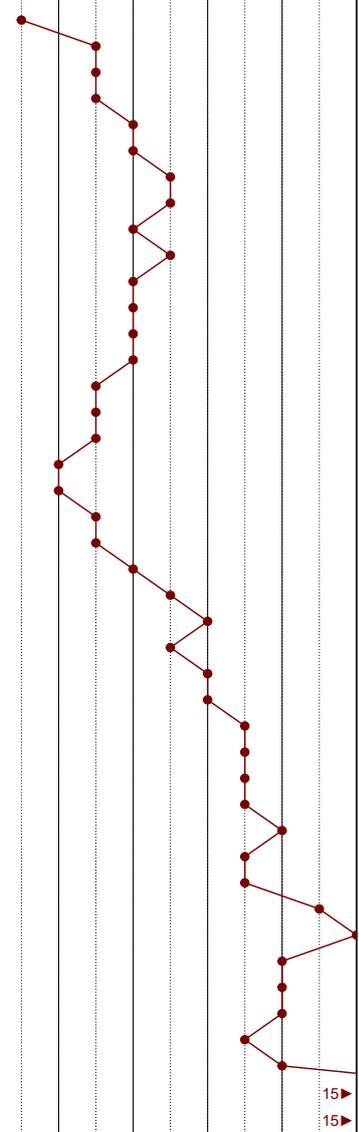
Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5550677mN, 1802437mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 12/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values Vane ID: N/A peak / residual (sensitivity)	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)					
					Vane undrained shear strength, s_u (kPa)					
					2	4	6	8		
					50	100	150	200		



Hole Depth: 0.00m	Termination: Reached target depth	● Vane peak	▼ Standing water level
Remarks: 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 residual	◁ Groundwater inflow
		◆ Vane UTP	▷ Groundwater outflow
		UTP = Unable to Penetrate	

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Hand Auger Borehole Log

Test ID: **Bul03-01B**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5550717mN, 1802391mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 12/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values Vane ID: 2035 peak / residual (sensitivity)	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)					
					Vane undrained shear strength, s_u (kPa)					
	Topsoil		SILT, with minor sand; dark brown; dry to moist; sand, fine; organic, rootlets.	Groundwater not encountered						
0.5	Alluvium		SILT, with minor sand; brown with orange & grey mottles. Very stiff to hard; dry to moist; low plasticity; sand, fine.						●	233+
									●	233+
1.0									●	233+
1.5										
2.0										
2.5										

Hole Depth: 0.95m **Termination:** Due to Hard / Spinning.

Remarks:
 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: **Mang01-01**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5590035mN, 1839188mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 14/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)					
					Vane undrained shear strength, s_u (kPa)					
					2	4	6	8		
					50	100	150	200		
0.0	Topsoil		SILT, with trace sand; dark brown; moist; sand, fine; organic, rootlets.	Groundwater not encountered						
0.0	U vi U		SILT, with trace sand and gravel; greyish brown. Very stiff; moist; low plasticity; sand, fine, gravel, fine to medium, subrounded.							
0.5										
1.0										
1.5										
2.0										
2.5										

Hole Depth: 0.25m **Termination:** Due to Gravel.

Remarks:
 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: **Mang02-01**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5589609mN, 1839321mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 14/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)		Vane undrained shear strength, s_u (kPa)			
					2	4	6	8		
					50	100	150	200		
0.0 - 0.2	Topsoil		SILT, with some sand; dark brown; dry; sand, fine; organic, rootlets.	Groundwater not encountered						0.0
0.2 - 0.35	Alluvium		SILT, with minor sand and gravel; brown. Medium dense; dry to moist; sand, fine, gravel, fine to medium, subrounded to subangular.							0.35

Hole Depth: 0.35m **Termination:** Due to Gravel.

Remarks:

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: **Mar01-01**

Project ID: 27641

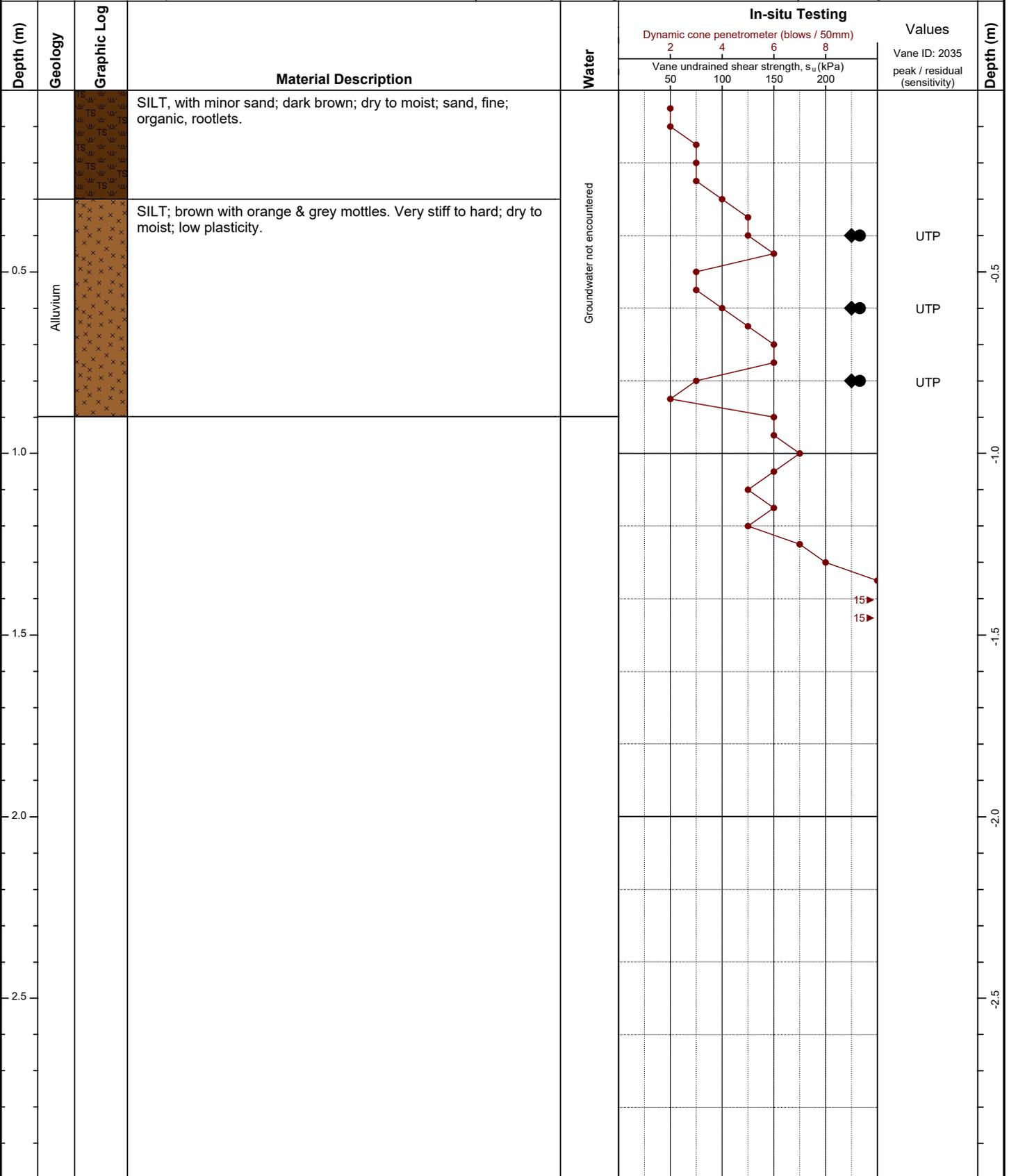
Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5563453mN, 1802956mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 13/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD



Hole Depth: 0.90m **Termination:** Due to Hard / Spinning.

Remarks:

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



Hand Auger Borehole Log

Test ID: **Mar02-01A**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5562292mN, 1801678mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 13/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)					
					2	4	6	8		
					Vane undrained shear strength, s_u (kPa)					
					50	100	150	200		
0.0 - 0.2	Topsoil		SILT, with minor sand; dark brown; dry to moist; sand, fine; organic, rootlets.	Groundwater not encountered	~1	~2	~3	~4	UTP	0.0
0.2 - 0.5	Marine Terrace Deposits		SILT, with minor f-m carbonaceous fragments / clasts and sand; brown with orange & grey mottles - highly mottled. Very stiff to hard; dry to moist; sand, fine.		~12	~12	~12	~12		UTP
0.5 - 1.0										1.0
1.0 - 1.5										1.5
1.5 - 2.0										2.0
2.0 - 2.5										2.5

Hole Depth: 0.40m **Termination:** Due to Hard / Spinning - Possible Gravel / Crushed zone.

Remarks:

- 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.

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Hand Auger Borehole Log

Test ID: **Mar02-01E**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5562305mN, 1801681mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 13/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values Vane ID: N/A peak / residual (sensitivity)	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)		Vane undrained shear strength, s_u (kPa)			
					2	4	6	8		
					50	100	150	200		

Hole Depth: 0.00m	Termination: Reached target depth	● Vane peak	▼ Standing water level
Remarks: 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 residual	◁ Groundwater inflow
		◆ Vane UTP	▷ Groundwater outflow
		UTP = Unable to Penetrate	

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Hand Auger Borehole Log

Test ID: **Mar03-01**

Project ID: 27641

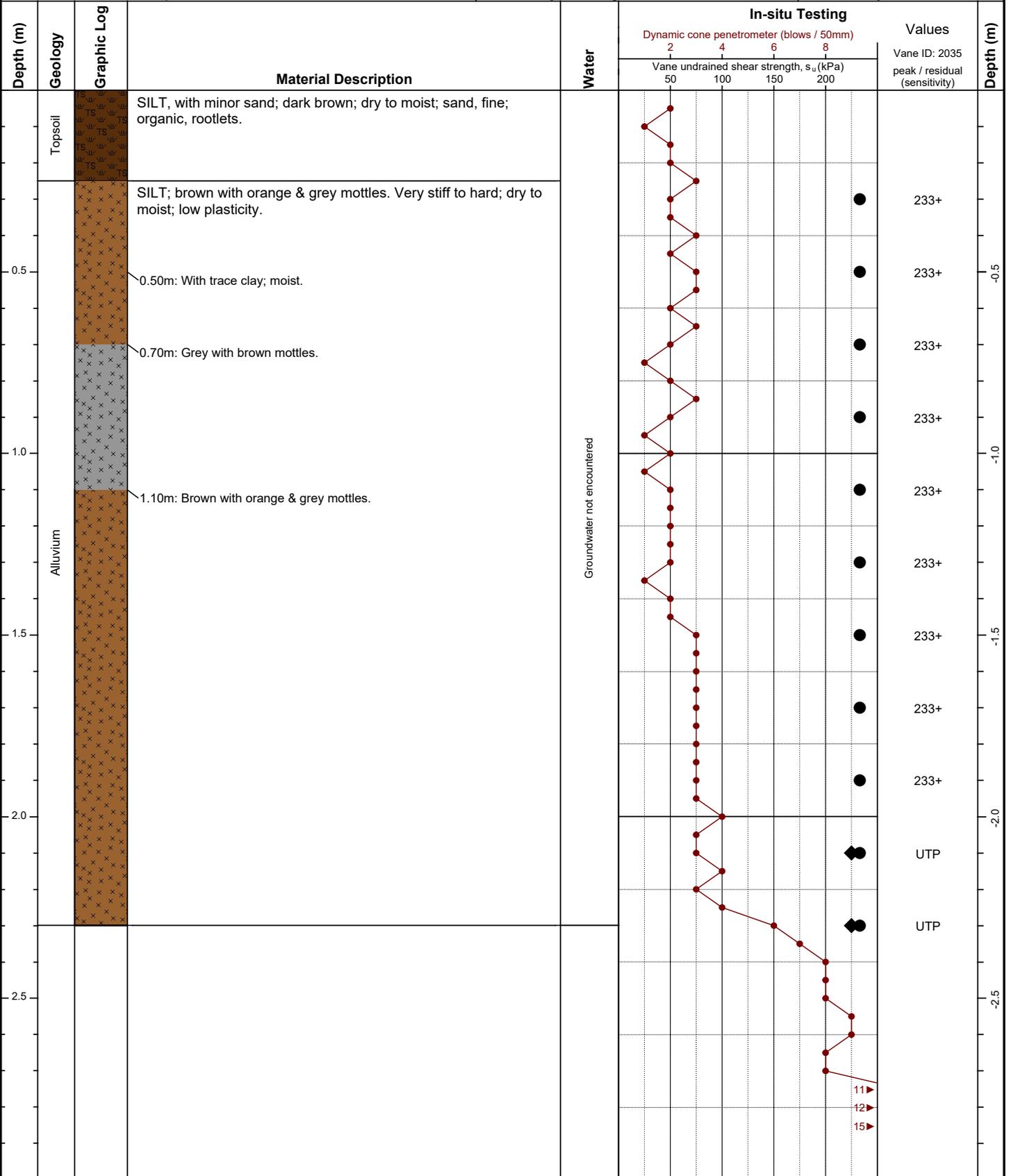
Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5562402mN, 1803545mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 13/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD



Hole Depth: 2.30m **Termination:** Due to Hard / Spinning.

Remarks:

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

Hand Auger Borehole Log

Test ID: **Mar07-01**

Project ID: 27641

Sheet: 1 of 1

Method: HA+DCP

Client: Rangitikei District Council
Project: Geotechnical Assessment
Location: Bulls, Marton, Mangaweka
Test Site: Refer to site plan

Coordinates: 5563582mN, 1801994mE
System: NZTM
Elevation: Ground
Located By: Google Earth

Test Date: 13/02/2025
Logged By: MD
Prepared By: MD
Checked By: DD

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing				Values	Depth (m)
					Dynamic cone penetrometer (blows / 50mm)					
					Vane undrained shear strength, s_u (kPa)					
					50	100	150	200		
0.0 - 0.4	Topsoil		SILT, with minor sand; dark brown; dry to moist; sand, fine; organic, rootlets.	Groundwater not encountered	~2	~3	~4	~5		
0.4 - 0.5	Marine Terrace Deposits		SILT, with minor silt/ carbonaceous clasts and sand; brown with orange & grey mottles. Very stiff to hard; dry; low plasticity; sand, fine.		~100	~120	~140	~160	UTP	
0.5 - 0.6					~100	~120	~140	~160	UTP	
0.6 - 0.7					~100	~120	~140	~160	UTP	
0.7 - 2.5										

Hole Depth: 0.70m **Termination:** Due to Hard / Spinning.

Remarks: 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



SOIL LOG

BH01

SHEET 1 OF 5

CLIENT: Keith Hay Homes	PROJECTION: NZTM2000	LOCATION:
PROJECT: 198120602	EASTING: 1803537.00	STARTED: 03/02/2020
LOCATION: Walton St, Bulls	NORTHING: 5550401.00	FINISHED: 03/02/2020
OFFICE: RDCL - WGTN	DATUM: -	LOGGED BY: RD DATE: 03/02/2020
ENGINEER: EAC	ELEVATION: -	CHECKED BY: DATE:
	AZUMITH: - PLUNGE: 90°	STATUS: Draft data

CONTRACTOR: Geotech Drilling RIG: OPERATOR:

DEPTH (m)	MATERIAL DESCRIPTION	METHOD	TCR (%)	GRAPHIC LOG	SPT BLOW COUNT	SAMPLES & TESTS	GRADING	WATER	BACKFILL	RL (m)
0.0 - 1.0	Silty TOPSOIL; dark brown. Wet; rootlets. Silty GRAVEL; brown; blocky. Hard and medium dense; dry; gravel, fine to coarse, round to subround, some flattened.		100%							-1.0
1.0 - 2.0			100%							
2.0 - 3.0	Gravelly COBBLES, with some clay, with minor silt; brown. Dense; high plasticity; wet; cobbles, subround to subangular, up to 100mm, greywacke; gravel, fine to coarse, subround to subangular; moisture content inferred to be from wash fluid.		100%							-2.0
3.0 - 3.3	SPT: no recovery.			N/R PC N/R						-3.0
3.3 - 3.5	Silty GRAVEL, with some cobbles, with trace sand; brown. Very dense; wet to moist; gravel, fine to coarse, round to angular,		100%							

N = 14 (C)
1.50m
3, 5 / 5, 4, 2, 3
450mm penetration

N = 50 (C)
3.00m
21, 29
220mm penetration

METHOD	WATER	REMARKS
	<ul style="list-style-type: none"> ▼ SWL ◁ Out flow ▷ In flow 	Logged in accordance with NZGS 2005 - Field Description of Soil and Rock



SOIL LOG

BH01

SHEET 2 OF 5

CLIENT: Keith Hay Homes	PROJECTION: NZTM2000	LOCATION:
PROJECT: 198120602	EASTING: 1803537.00	STARTED: 03/02/2020
LOCATION: Walton St, Bulls	NORTHING: 5550401.00	FINISHED: 03/02/2020
OFFICE: RDCL - WGTN	DATUM: -	LOGGED BY: RD DATE: 03/02/2020
ENGINEER: EAC	ELEVATION: -	CHECKED BY: DATE:
	AZUMITH: - PLUNGE: 90°	STATUS: Draft data

CONTRACTOR: Geotech Drilling RIG: OPERATOR:

DEPTH (m)	MATERIAL DESCRIPTION	METHOD	TCR (%)	GRAPHIC LOG	SPT BLOW COUNT	SAMPLES & TESTS	GRADING	WATER	BACKFILL	RL (m)
4.0	greywacke; cobbles, round to angular, up to 70mm; sand, fine to coarse.		100%							-4.0
4.3 - 4.4	Gravelly COBBLES, with some sand, with trace silt; reddish brown. Very dense; moist; cobbles, round to subangular, up to 100mm, greywacke; gravel, fine to coarse, round to subangular; at 4.3 - 4.4m bgl, heavy iron stain and mostly comprising pea gravels.		100%		N = 50 (C) 4.50m 13, 15 / 20, 19, 11 405mm penetration					-4.5
5.0	Gravelly COBBLES, with some clay, with trace silt; greyish brown. Very dense; moderate plasticity; moist and dry; cobbles, subround to subangular, up to 130mm, greywacke; gravel, fine to coarse, subround to subangular, (pea gravels); becoming reddish brown from 6.45m bgl.		100%							-5.0
6.0			100%		N = 50 (C) 6.00m 23, 27 220mm penetration					-6.0

METHOD	WATER ▼ SWL ◁ Out flow ▷ In flow	REMARKS Logged in accordance with NZGS 2005 - Field Description of Soil and Rock
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SOIL LOG

BH01

SHEET 3 OF 5

CLIENT: Keith Hay Homes	PROJECTION: NZTM2000	LOCATION:
PROJECT: 198120602	EASTING: 1803537.00	STARTED: 03/02/2020
LOCATION: Walton St, Bulls	NORTHING: 5550401.00	FINISHED: 03/02/2020
OFFICE: RDCL - WGTN	DATUM: -	LOGGED BY: RD DATE: 03/02/2020
ENGINEER: EAC	ELEVATION: -	CHECKED BY: DATE:
	AZUMITH: - PLUNGE: 90°	STATUS: Draft data

CONTRACTOR: Geotech Drilling RIG: OPERATOR:

DEPTH (m)	MATERIAL DESCRIPTION	METHOD	TCR (%)	GRAPHIC LOG	SPT BLOW COUNT	SAMPLES & TESTS	GRADING	WATER	BACKFILL	RL (m)
8.0	[CONT] Gravelly COBBLES, with some clay, with trace silt; greyish brown. Very dense; moderate plasticity; moist and dry; cobbles, subround to subangular, up to 130mm, greywacke; gravel, fine to coarse, subround to subangular, (pea gravels); becoming reddish brown from 6.45m bgl.		100%		N = 50 (C) 7.50m 9, 20 / 28, 22 350mm penetration					-8.0
9.0	Silty GRAVEL, with some clay; dark brown to brown. Very dense; moderate plasticity; moist; gravel, fine to coarse, round to subround, greywacke, some flattened; becoming siltier from 10.95m bgl.		100%		N = 50 (C) 9.00m 13, 26 / 20 230mm penetration					-9.0
10.0			100%							-10.0

METHOD	WATER	REMARKS
	<ul style="list-style-type: none"> ▼ SWL ◁ Out flow ▷ In flow 	Logged in accordance with NZGS 2005 - Field Description of Soil and Rock



SOIL LOG

BH01

SHEET 4 OF 5

CLIENT: Keith Hay Homes	PROJECTION: NZTM2000	LOCATION:
PROJECT: 198120602	EASTING: 1803537.00	STARTED: 03/02/2020
LOCATION: Walton St, Bulls	NORTHING: 5550401.00	FINISHED: 03/02/2020
OFFICE: RDCL - WGTN	DATUM: -	LOGGED BY: RD DATE: 03/02/2020
ENGINEER: EAC	ELEVATION: -	CHECKED BY: DATE:
	AZUMITH: - PLUNGE: 90°	STATUS: Draft data

CONTRACTOR: Geotech Drilling RIG: OPERATOR:

DEPTH (m)	MATERIAL DESCRIPTION	METHOD	TCR (%)	GRAPHIC LOG	SPT BLOW COUNT	SAMPLES & TESTS	GRADING	WATER	BACKFILL	RL (m)
11.0	[CONT] Silty GRAVEL, with some clay; dark brown to brown. Very dense; moderate plasticity; moist; gravel, fine to coarse, round to subround, greywacke, some flattened; becoming siltier from 10.95m bgl.		100%		N = 50 (C) 10.50m 13, 37 210mm penetration					-11.0
12.0	Silty GRAVEL, with some cobbles; dark brown. Very dense; moist; gravel, fine to coarse, round to subangular, greywacke, some flattened; cobbles, round to subangular, up to 70mm. 12.1m - 12.3m: SAND; reddish brown. Medium dense; moist to wet; sand, fine to medium; 150mm lens thickness. 12.5m - 12.6m: SAND, with minor gravel. Sand, fine; gravel, fine. 50mm lens thickness.		100%		N = 50 (C) 12.00m 1, 8 / 7, 17, 20, 6 395mm penetration					-12.0
13.0	Sandy GRAVEL, with trace silt; reddish brown. Very dense; wet to moist; gravel, fine to coarse, round to subangular; sand, fine. Silty GRAVEL, with some cobbles, with trace sand; brown. Very dense; moist; gravel, fine to coarse, round to subround, greywacke; cobbles, round to subround, up to 70mm.		100%		N = 50 (C) 13.50m 24, 26 210mm penetration					-13.0

METHOD	WATER ▼ SWL ◁ Out flow ▷ In flow	REMARKS Logged in accordance with NZGS 2005 - Field Description of Soil and Rock
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SOIL LOG

BH01

SHEET 5 OF 5

CLIENT: Keith Hay Homes	PROJECTION: NZTM2000	LOCATION:
PROJECT: 198120602	EASTING: 1803537.00	STARTED: 03/02/2020
LOCATION: Walton St, Bulls	NORTHING: 5550401.00	FINISHED: 03/02/2020
OFFICE: RDCL - WGTN	DATUM: -	LOGGED BY: RD DATE: 03/02/2020
ENGINEER: EAC	ELEVATION: -	CHECKED BY: DATE:
	AZUMITH: - PLUNGE: 90°	STATUS: Draft data

CONTRACTOR: Geotech Drilling RIG: OPERATOR:

DEPTH (m)	MATERIAL DESCRIPTION	METHOD	TCR (%)	GRAPHIC LOG	SPT BLOW COUNT	SAMPLES & TESTS	GRADING	WATER	BACKFILL	RL (m)
15.0	[CONT] Silty GRAVEL, with some cobbles, with trace sand; brown. Very dense; moist; gravel, fine to coarse, round to subround, greywacke; cobbles, round to subround, up to 70mm.		100%		N = 50 (C) 15.00m 16, 21 / 29, 21 340mm penetration					-15.0
	EOH: 15.50m		100%							-16.0
17.0										-17.0

METHOD	<p>WATER</p> <p>▼ SWL</p> <p>◁ Out flow</p> <p>▷ In flow</p>	<p>REMARKS</p> <p>Logged in accordance with NZGS 2005 - Field Description of Soil and Rock</p>
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	BOREHOLE LOG		HOLE NO.: BH1
	CLIENT: Pak Design Ltd PROJECT: Geotechnical Investigation		JOB NO.: 13808
	SITE ADDRESS: 25 Milne Street, Marton LOCATION: DRILL TYPE/METHOD: Sonic Core MACHINE:		START DATE: 11/03/2022 END DATE: 11/03/2022 LOGGED BY: RD OPERATOR: Griffiths Drilling

DESCRIPTION	METHOD	DEPTH	GRAPHIC	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	SAMPLES	WATER
SILT with trace Clay and Organics; light brown. Very stiff; low plasticity.		1.0	x	11	N = 11 (S) 0.50m 1/2, 2, 3, 3, 3 450mm penetration	0.50 - 0.95m, S1	
Clayey SILT/ Silty CLAY; light grey with mottled brown staining. Very stiff; low plasticity.		2.0	x	13	N = 13 (S) 1.50m 2/4, 3, 3, 2, 4 450mm penetration	0.95 - 1.50m, C1 1.50 - 1.95m, S2	
SILT; light grey with mottled orange brown staining. Very stiff.		3.0	x	21	N = 21 (S) 3.00m 1/2, 3, 5, 6, 7 450mm penetration	1.95 - 3.00m, C2 3.00 - 3.45m, S3	
SAND (fine); brown/ dark brown. Medium dense.			.			3.45 - 4.50m, C3	

REMARKS

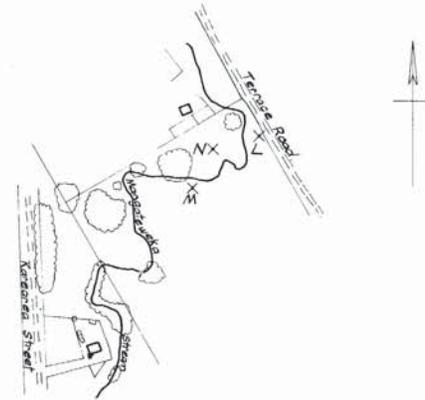
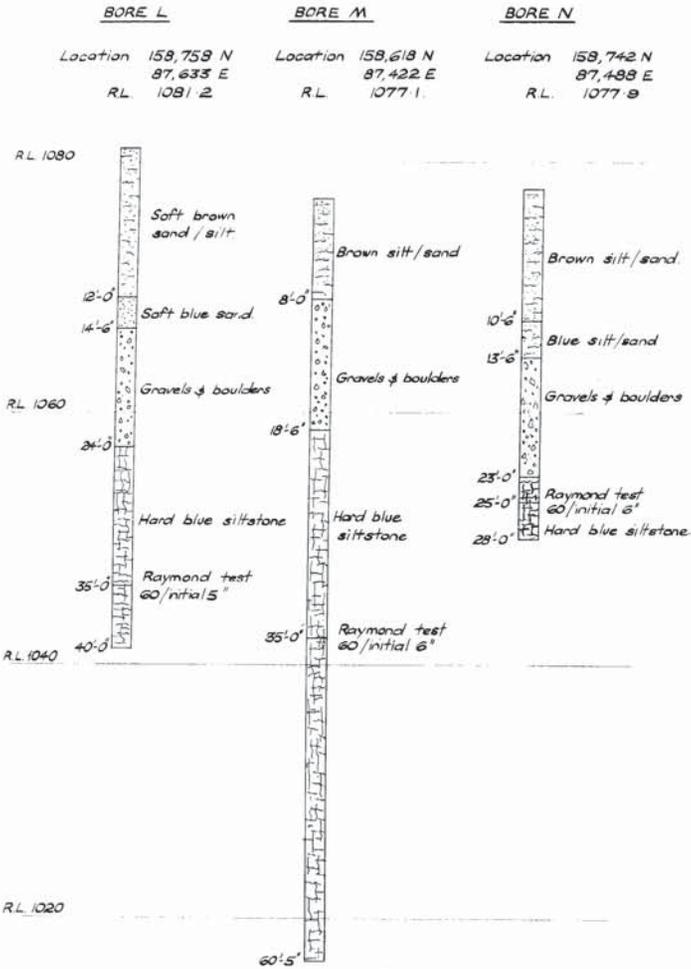
PO Box 13-273
Johnsonville
WELLINGTON 6440
 Ph:(04) 478-3929
 Email: abuild@abuild.co.nz
HOLE DEPTH: 10.65m

 ABUILD™ Consulting Engineers Ltd <i>Geotechnical and Civil Engineers</i>	BOREHOLE LOG		HOLE NO.:	BH1
	CLIENT: Pak Design Ltd PROJECT: Geotechnical Investigation		JOB NO.:	13808
	SITE ADDRESS: 25 Milne Street, Marton LOCATION: DRILL TYPE/METHOD: Sonic Core MACHINE:		START DATE: 11/03/2022 END DATE: 11/03/2022 LOGGED BY: RD OPERATOR: Griffiths Drilling	

DESCRIPTION	METHOD	DEPTH	GRAPHIC	SPT N-VALUE (Uncorrected)	SPT DATA (Uncorrected)	SAMPLES	WATER
grades slightly Gravelly SAND (fine). SAND (fine) with a trace of silt; weakly cemented. Dense.		5.0	[Dotted pattern]	10 20 30 40	N = 45 (S) 4.50m 15/16, 15, 15, 10, 5 450mm penetration	4.50 - 4.95m, S4 4.95 - 6.00m, C4	
GRAVEL (fine to medium); brown. Dense to very dense. Gravel, fine to medium with some coarse. grades to slightly Sandy GRAVEL.		6.0	[Cross-hatched pattern]		N = 50 (S) 6.00m 6/11, 40, 10 300mm penetration	6.00 - 6.30m, S5 6.30 - 7.50m, C5	
Sandy GRAVEL; brown. Dense to very dense. Gravel, fine to medium with some coarse.		7.0	[Cross-hatched pattern]		N = 50 (S) 7.50m 10/20, 50 225mm penetration	7.50 - 7.73m, S6 7.73 - 9.00m, C6	

REMARKS

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HOLE DEPTH: 10.65m



LOCATION BORE L-M-N Scale: 200ft = 1"

TEST BORE INFORMATION Scale: 5'-0" = 1"

NB For detailed bore-log data refer DE. 21519 (may be sighted at the DE's office.)

NOTE: The department does not warrant that this site investigation information is correct or truly representative of the actual site conditions. The Department assumes no responsibility for the accuracy or completeness of this information and the contractor must exercise his own judgement in the use he makes of it.

Note For information only
This sheet will not form part
of the contract documents.

AMENDMENTS	BY	APP'D	DATE	CALCULATIONS	CHKD	DATE	RECOMMENDED	SCALE	DE
				CALCS CHKD	✓	5.73	RECOMMENDED	As Shown	21939
				DRAWN	✓	7.73	APPROVED	DE FILE: 235 49 12	SHEET
				TRACED	✓	7.73		CCE FILE:	90569
				DRAW CHKD	✓	7.73			
				TOTAL CHECK	✓				